Proposal for

Engineering Services

Return Flow Pump Station and Advanced Phosphorus Treatment with Facilities Enhancement for Clean Water Plant

Submitted to:

City of Waukesha
Department of Public Works

Submitted by:

JACOBS

September 2018

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September 28, 2018

Mr. Jeff Harenda
Plant Manager, City of Waukesha Department of Public Works—Clean Water Plant
600 Sentry Dr.
Waukesha, WI 53186

Subject: Engineering Services for Return Flow Pump Station and Advanced Phosphorus Treatment with Facilities Enhancement for Clean Water Plant

Dear Mr. Harenda:

As part of the Great Water Alliance (GWA) Program, the City of Waukesha (City) will obtain drinking water from the City of Milwaukee and will provide return flow of treated wastewater to the Root River in accordance with the diversion approval granted by the Great Lakes Compact Council. This project includes critical infrastructure to continue implementation of the 2011 Facility Plan and to meet the diversion approval and WPDES permit requirements for the split effluent discharge to the Fox and Root Rivers.

In 2017, the City's Final Phosphorus Compliance Alternatives Plan was completed, developing a plan for how the Clean Water Plant (CWP) will meet stringent phosphorus effluent limits for the Fox River discharge. Through work with the GWA, a facility plan amendment was developed to meet even stricter requirements for the Root River discharge – the lowest river effluent limits in the State. Treated effluent that is discharged to the Root and Fox Rivers must soon meet these limits. This project will build on the compliance alternatives plan, finalize evaluation and selection of the phosphorus treatment method(s), and complete final design documents for the phosphorus treatment facilities.

This project will build on previously completed designs for the Return Flow Pump Station. Our goal would be to provide a pump station design that balances cost, operations and maintenance pipeline hydraulics, and management of the return flow that meets the WPDES and diversion permits requirements.

We have assembled a local team supported by top global experts that will design facilities to reliably and cost effectively meet the WDNR effluent permit requirements as well as the diversion approval. Our team offers the following important attributes for the successful completion the project:

- Key members of our team have, for the past 18 years, been working with the City to address water supply issues, gain approval of the Great Lakes Compact, address wastewater permitting issues, and amend the CWP Facility Plan. We will use the experience and knowledge gained through that work to help ensure that facilities design will meet the effluent permit and requirements of the Great Lakes Compact. Our key members have a proven record of working together with the GWA, the CWP, and the Department of Public works to ensure coordination, cooperation, and beneficial strategies across the City.
- We have a proven track record of designing wastewater facilities that meet phosphorus effluent limits as low or lower than the CWP's likely limit of 0.06 mg/L. Our team includes globally recognized experts in phosphorus treatment who hold multiple patents for phosphorus treatment innovations and have designed and operated plants with some of the lowest phosphorus effluent limits in North America. This experience will help ensure that systems designed will consistently meet permit limits and will minimize O&M costs. For example, appropriate designs for chemical mixing and feed systems could save up to $2 million over 20 years.
- We bring you experts in pump design and hydraulics that will oversee the design of the pump station and who will help ensure the pump station is reliable, functions properly, and saves energy. Our initial estimates show that an energy efficient design could save up to $1 million over 20 years. The GWA will be completing a

hydraulic transient analysis to determine if there is a need for surge protection. Our hydraulics experts, who have extensive experience in surge protection, will consider how that analysis may affect the pump station design to help minimize the risk of pumping equipment being damaged from surge.

- We are a team with no subcontractors, offering the City a single source of responsibility, with control over all aspects of the project. Most work will be executed by staff from our Milwaukee office, located within a 15-minute drive to the CWP, which will save travel costs and make our team available to the City on short notice. The local team will be supported by the firm's top global experts in phosphorus treatment and pump station design.

We value our longstanding partnership with the City, and as such we have brought forth our best staff to work with you on this challenging project. The high standard of quality, service, and the professional staff we have committed will result in cost-effective and reliable facilities that will consistently meet effluent permit limits and the requirements of the diversion approval. Should you have any questions regarding our proposal, please do not hesitate to contact Bill Desing at 414-847-0313 or at bill.desing@jacobs.com.

Sincerely,

Jacobs Engineering Group Inc.

Bill Desing, PE
Project Manager

AJ Catalanotte, PE
Vice President

SECTION 01

Project Approach

Introduction, Background and Approach Summary

As part of Waukesha's Clean Water Plant (CWP) 20-year facility plan, the first phase of the plan's recommended improvements has been completed including a significant upgrade to solids processing and significant improvements to mechanical and process facilities. In 2017 the Final Phosphorus Compliance Alternatives Plan was completed that developed a plan for how the Clean Water Plant will meet Wisconsin's new, more stringent phosphorus effluent limits. Part of the purpose of this project will be to build on the compliance alternatives plan, finalize evaluation and selection of the phosphorus treatment method(s) and complete the final design documents for the phosphorus treatment facilities.

Waukesha is in the process of changing drinking water supplies from the current well systems to Lake Michigan water provided through the City of Milwaukee. The Great Lakes Compact allowed that switch to occur and the pipelines and facilities for changing supplies are being constructed as part of the Great Water Alliance (GWA). The Great Lakes Compact requires that treated wastewater effluent be returned to Lake Michigan through a pipeline that will discharge to the Root River. We will design a pump station to meet these requirements as part of this project.

Key members of our team have for the past 18 years been working with the City on water supply issues, approval of the Great Lakes Compact, addressing wastewater permitting issues and amending the Clean Water Plant Facility Plan. We will use the experience and knowledge gained through that work to help ensure that facilities design will meet the effluent permit and requirements of the Great Lakes Compact.

Existing Tertiary Treatment Process

The existing tertiary process consists of ferric chloride chemical feed, chemical mixing through aerated influent channels, tertiary settling (using the existing "Coagulation Basins"), and effluent sand filtration. During dry, low flow years, by using high chemical doses, the existing system can achieve effluent phosphorus concentrations close to the likely future limit of 0.06 mg/L. However, there are concerns regarding the ability of the system to perform at that level reliably during high flow rates.

The existing "Coagulation Basins" are essentially tertiary clarifiers and City staff have noted that the basins remove little to no phosphorus. The could be due several things including poor floc development in the aerated channels, floc shear in the center well feed of the clarifiers, resuspension of settled solids due to local velocity currents or rake mechanism operation, or high overflow rates.

Using WDNR 5 gallons per minute per square foot (gpm/sqft) maximum overflow rate for sand filters, with one filter out of service, the filters have a capacity of 31.5 mgd. However, filter performance has been shown to deteriorate at about 13 mgd and at 20 mgd they are hydraulically limited because flow backups through the backwash troughs which bypasses the filters. This could be due to hydraulic bottlenecks caused the filter effluent piping and conduit, particle build up due to poor backwashing, limitations of the underdrain system, or a combination. A detailed evaluation of the hydraulic limitations could be completed if rehabilitating the existing sand filters is determined to be viable.

Comparison of Phosphorus Treatment Technologies

There are several different treatment methods that could be used to achieve the require phosphorus effluent limits. The Final Phosphorus Compliance Alternatives Plan developed budgetary present worth costs that were later adjusted in a Facility Plan for the following alternatives:

- Blue PRO reactive filtration

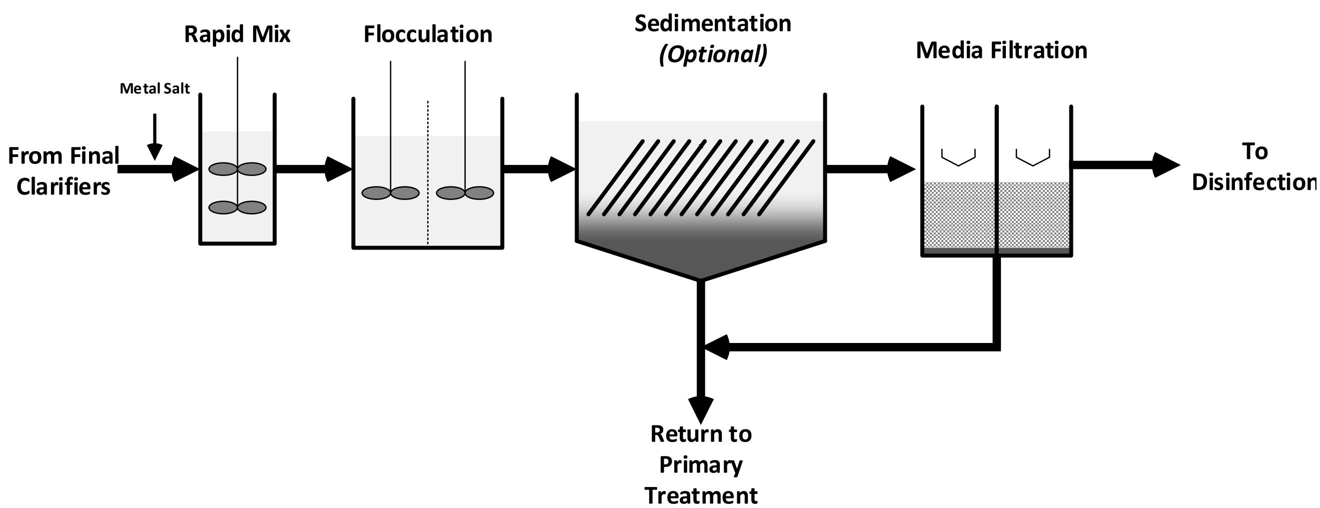
- ACTIFLO® ballasted sedimentation
- CoMag® ballasted sedimentation
- Rapid Mix, flocculation, disc (aka cloth) filtration

As part of the project at hand, we will refine and expand upon the previous evaluation of treatment options that was done and evaluate other low phosphorus treatment options that may be viable including any new or emerging technologies. Our team will provide the City with a thorough and comprehensive evaluation of the alternatives and the information needed to help the City determine which alternative is the most cost-effective solution that meets the specific needs and goals of the City. While finding a solution with a low life cycle (capital and O & M) cost will be critical, it will also be important to consider non-monetary factors such as reliability, ability to consistently achieve effluent limits, and maintenance requirements.

Sand Filtration

Granular media filtration, commonly referred to as sand filtration, is the most common and well-proven form of filtration used in water and wastewater treatment (Exhibit 1-1). The type of granular media chosen is often based on pilot testing and is typically either single media with sand or dual media with sand and anthracite coal. In tertiary applications, often rapid mix, coagulation and flocculation precede filtration to increase the efficiency of particle removal. In some applications, a tertiary sedimentation step is included between flocculation and filtration to settle solids, reduce solids loading on the filters and increase performance. Tertiary sedimentation can also use recycling of settled chemical solids to overall chemical dosing – a recent innovation that our team has implemented. In some applications, the tertiary sedimentation step utilizes Lamella Plate Settlers to allow a higher loading rate and a smaller footprint.

EXHIBIT 1-1
Typical Granular Media Filtration



Over their lifetime, most media filtration systems will undergo rehabilitation to extend their life. The rehabilitations typically include replacing underdrains, filter face piping replacement, improving backwash efficiency, and replacing filter media. A rehabilitation brings the performance of an aging filter back to the original design criteria. With proper media selection, filter performance can often be actually made better than the original design performance. The City has completed improvements to the existing filtration system; including face piping replacements, valve modifications, automation, and improvements to backwash water supply storage and any project to improve filter performance should build on the City's work. The enhancements would likely include replacement of the underdrain system, replacement of the filter media, replacement of the backwash troughs, and the incorporation of air:water backwash with new backwash blowers. The project would also likely include modifications to the existing coagulation basins to improve mixing and chemical floc development. Improvements to the existing tertiary clarifiers (Coagulation Basins) could improve performance and decrease solids loading to the media filters.

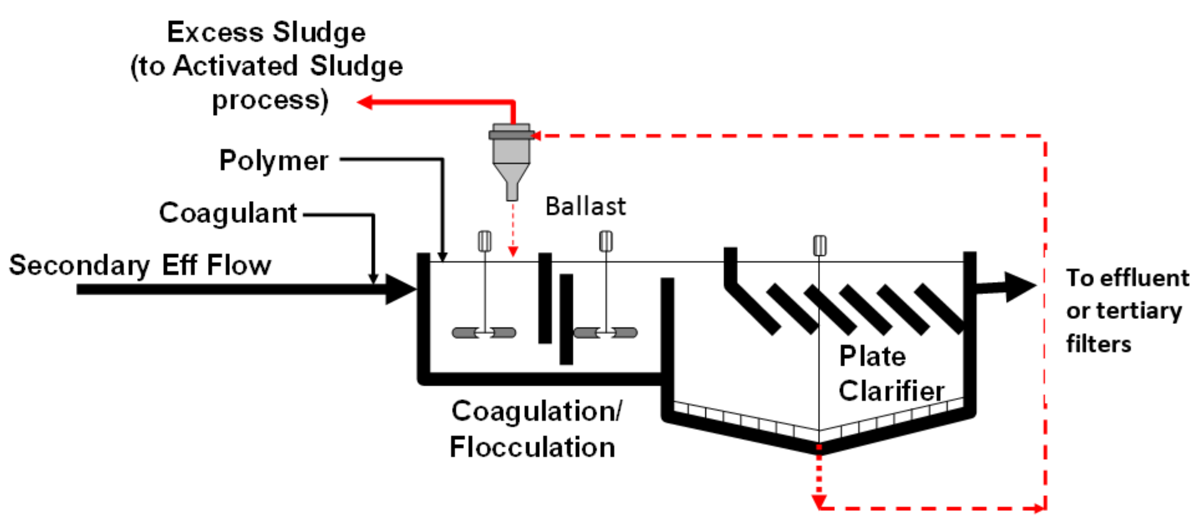
Ballasted Flocculation

The ballasted flocculation process is a compact clarification system that uses a ballast to accelerate flocculation and settling that is widely used for the treatment of drinking water. Application of ballasted flocculation for wastewater is relatively recent for and is used for removal of TSS, BOD, and phosphorus.

The ballasted flocculation system typically includes a mixer, an injection tank, a maturation (flocculation) tank, and a settling tank. A coagulant is added upstream of the influent pipe mixer and the flow enters the coagulation tank, followed by the injection tank where the ballast and polymer are added and the particles agglomerate and grow into high-density flocs that settle quickly in the settling tank. Lamella plates enhance settling and allow the surface overflow rate to be increased significantly. The settled sludge and ballast are collected in the settling tank and pumped to separation units to recover the ballast, which is recycled back to the injection tank while the sludge is discharged to the headworks, or solids treatment system.

Two common ballasted flocculation processes are ACTIFLO®, which is a proprietary technology developed by Krüger, Inc., and CoMag® by Evoqua. The ballast in ACTIFLO® is microsand, which is recovered using a hydrocyclone. The ballast in CoMag® is magnetite, which is recovered a rotating magnetic recovery drum. Exhibit 1-2 shows a general process configuration for ballasted flocculation.

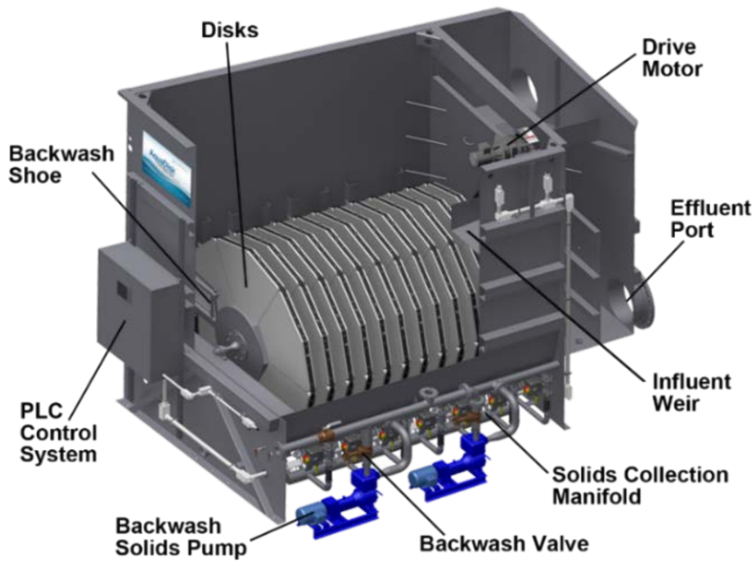
EXHIBIT 1-2
Coagulation/ followed by Ballasted Sedimentation Process Flow Diagram



Ballasted flocculation has been demonstrated at pilot scale at the CWP by both ACTIFLO® and CoMag®. The pilots met the 0.06 mg/L phosphorus effluent limit and established approximate chemical doses and showed the ability to handle secondary treatment upsets. A disadvantage of ballasted flocculation is that if performance upsets are not caught quickly, the system can potentially quickly have a complete failure much faster than lower rate two-stage (sedimentation followed by filtration) systems. This is because ballasted flocculation is a high rate rate system therefore moves much faster to failure when conditions change whereas a two-stage system uses tertiary sedimentation as second stage polishing stage that can treat first stage upsets.

Cloth Media Filtration

EXHIBIT 1-3



For cloth media filtration, (also known as disk filtration or fabric filtration) water flows through woven fabric media that is mounted on a series of disks or on a drum. Flow through the cloth media can either be inside-out or outside-in. The buildup of solids on the cloth media causes the headloss across the filter to increase and when the headloss reaches a set point, a backwash sequence is initiated. Unlike sand media filtration, backwashes in cloth media can occur while the filter is in operation which means less filters are required. Cloth media filters have backwash rates that are as much as 90 percent less than sand filters.

However, the footprint required for cloth filters is significantly less than an equivalent capacity granular media filters due to the vertical configuration of the filter disks (Exhibit 1-3) that provides a large filtration surface area in a small footprint. Cloth media filters is that they can be retrofitted inside existing sand filter which avoids the significant cost of constructing new concrete walls and a building.

For most “inside out” filters, the cloth disk is a flat polyester sheet with a 10-micron pore size and backwash uses a high pressure/low volume wash that with filtered effluent. Kruger is one of the most well-established manufacturer of this filter type and they do not recommend filters where phosphorus limits are less than 0.075 mg/L unless long term testing is completed. The media for the “outside in" cloth filter type is usually a cloth pile similar in appearance to shag carpeting with pore sizes of 5 to 10 micron.

The effective pore size is reduced by the filter fibers and deposited solids to as low as 2 to 4 microns. Aqua Aerobics (Aqua) is the most well-known manufacturer of this category of cloth filter. Aqua has performed phosphorus speciation and are optimistic their filter could meet a 0.06 mg/L phosphorus limit, but a pilot test would likely be required for Aqua to guarantee performance. At least 7 filters would be needed for a 32 mgd capacity system for the CWP.

Comparison of Tertiary Treatment Technologies

The advantages and disadvantages for the commonly used tertiary treatment technologies for low phosphorus limits discussed above are briefly described on the next page in Exhibit 1-4.

EXHIBIT 1-4
Advantages and Disadvantages of Common Tertiary Treatment Technologies

Technology	Advantages	Disadvantages
Granular (sand) media filtration	Small effective filter pore size of 1 µm Can be rehabilitated to achieve original performance Maximizes use of existing infrastructure to potentially reduce cost	Large backwash volumes and long backwash durations increase energy costs Lower surface overflow rate (~ 5gpm/SF) requires large footprint High solids loading can reduce performance Can result in high building humidity and filter flies
Cloth media filtration	Compact footprint Low backwash volumes Low energy consumption Can be enclosed to mitigate building humidity and filter flies	Larger effective filter pore size: 3 to 10 µm Disks require periodic replacement and are costly May require upstream flocculation to achieve performance similar to granular filters High solids loading can reduce performance
Ballasted flocculation	Higher surface overflow rate (>25 gpm/SF) results in compact foot print High peak load capacity Demonstrated performance at the Waukesha CWP through pilot testing	Highest chemical use Relatively complex mechanically Sand (ACTIFLO®) may is abrasive and could cause wear of pumps and pipes No full scale permitted installations achieved the Waukesha effluent limit

Other Tertiary Treatment Technologies

In addition to those described above there are other tertiary filtration technologies including tertiary membrane filtration, reactive filtration (e.g Blue PRO), algae-based system (e.g. CLEARAS). Based on our team's experience evaluating these for other similar situations, for Waukesha, these technologies would likely have a significantly higher lifecycle cost compared to the other alternatives. However, they could be reviewed and considered if the City desires.

Tertiary Treatment Configurations Specific to the Waukesha CWP

There are several ways that the tertiary treatment technologies described above can be configured to be integrated into the site-specific conditions at the Waukesha CWP. We will work with City staff to develop and review potential configurations in a brainstorming-type workshop to make sure that the many potential options are considered to help ensure that ultimately the one best for the CWP is selected.

The CWP has a significant amount of existing tertiary treatment infrastructure that has the potential to be reused and reconfigured to form a phosphorus treatment system and doing so has the potential to save significant capital costs. However, the condition of the existing infrastructure must be assessed to determine rehabilitation needs and costs and the ability to reliably and cost effectively meet effluent limits must be carefully determined.

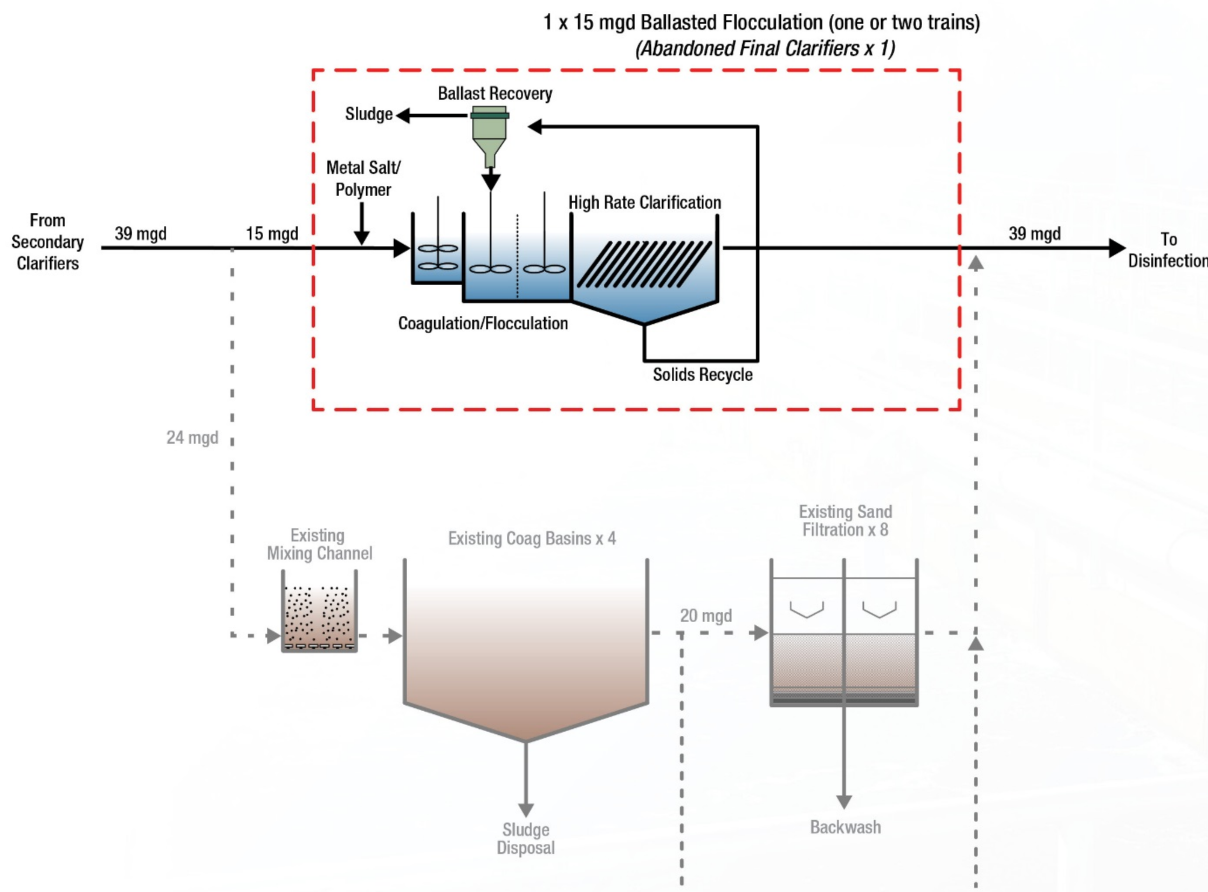
Exhibit 1-5 shows process flow diagrams and a discussion of some non-monetary attributes that could be considered to help select the best alternative. Exhibits 1-6, 1-7, and 1-8 show preliminary site layouts for some of these alternatives. In a workshop, we would present and discuss these and other alternatives with City staff to help select a smaller number of alternatives that are the most viable that would be evaluated in more detail.

On the following pages is a discussion of some key considerations that would be documented and evaluated during phosphorus treatment selection.

EXHIBIT 1-5
Preliminary Potential Concepts for Phosphorus Treatment

Alternative 1A – 15 mgd Ballasted Flocculation

Ability to Meet 0.06 mg/L Phosphorus Limit
Actiflo and CoMag systems both piloted and demonstrated ability to meet limit. However, no full scale facility installations at the city's permit limit. Relies on sand filters for flows >15 mgd.



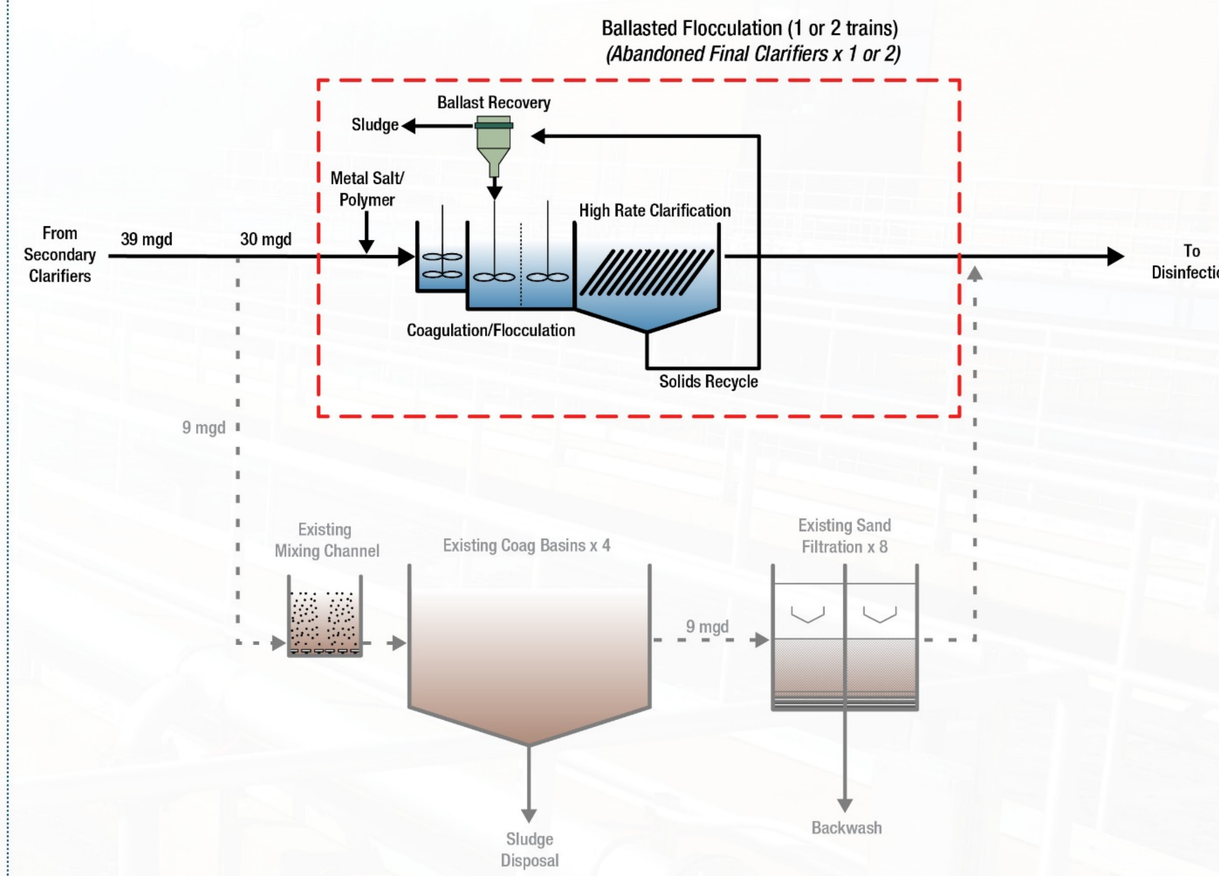
Redundancy
Sand filters serve as redundant system. Filter performance decreases above 13 mgd. Without filter improvements firm capacity of system is 13 mgd. Sand filters will require rehabilitation in the future to maintain reliability.

Maintenance
Additional maintenance will be required for maintaining mixers, clarifier, recirculation pumps, and ballast separation. Maintenance for coagulation basins and sand filters will be similar to current levels but less frequent.

Chemicals and Consumables
High ferric chloride and polymer consumption. Ballast addition also required. Increase in electricity use for ballasted flocculation and ballast pumping.

Alternative 1B – 30 mgd Ballasted Flocculation

Ability to Meet 0.06 mg/L Phosphorus Limit
Actiflo and CoMag systems both piloted and demonstrated ability to meet limit. However, no full scale facility installations at the city's permit limit. Relies on sand filters for flows >15 mgd, but may be able to bypass sand filters since >30 mgd infrequent.



Redundancy
Ballasted settling train and sand filters serve as redundant system. Sand filters will required rehabilitation in future to maintain reliability. Pilot tests have shown system (if 2 trains provided) can perform to meet limits at a 2 peaking factor (30 mgd) with a small marginal increase in capital cost. System is fully redundant with high chemical dosing rate.

Maintenance
Additional maintenance will be required for maintaining mixers, clarifiers, recirculation pumps, and ballast separation. Maintenance for coagulation basins and sand filters will be similar to current levels but less frequent.

Chemicals and Consumables
High ferric chloride and polymer consumption. Ballast addition also required. Increase in electricity use for ballasted flocculation and ballast pumping.

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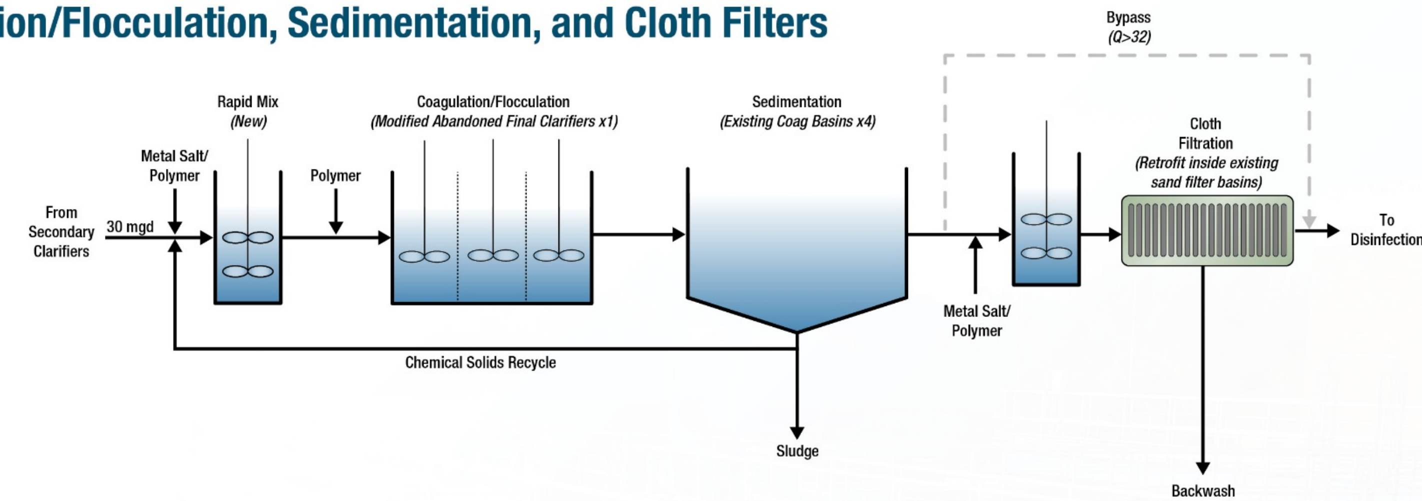
EXHIBIT 1-5
Preliminary Potential Concepts for Phosphorus Treatment

Alternative 2 – Coagulation/Flocculation, Sedimentation, and Cloth Filters

Ability to Meet 0.06 mg/L Phosphorus Limit
Aqua Aerobics completed P specialization testing and believe system will meet permit limit. Pilot testing required to confirm performance prior to committing to a performance guarantee. However, no full scale facility installations at the city's permit limit.



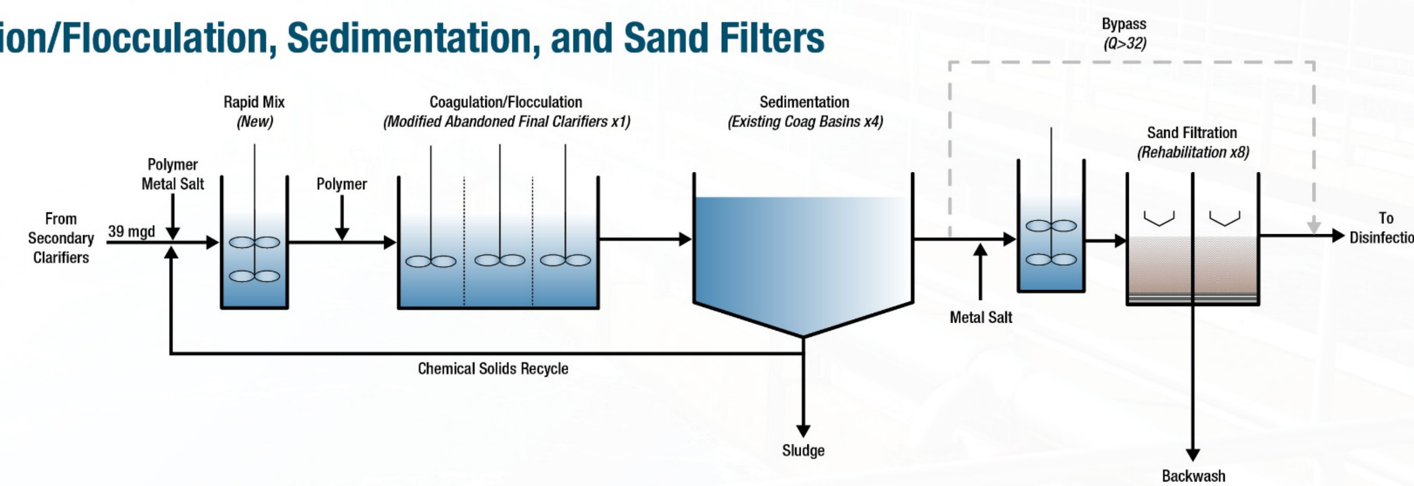
Redundancy
Coagulation and flocculation system is fully redundant. One Coagulation System clarifier can be removed from service without affecting effluent quality due to fully redundant cloth filters.

Maintenance
Maintenance of mixers for coagulation and flocculation will be required. Backwash supply pumping reduced. Surface wash no longer required. Backwash waste basin and return pumping no longer required. Cloth disks replaced every 7 to 10 years. Cloth cleaning every 2 years.

Chemicals and Consumables
Ferric chloride and polymer consumption lower than Alternative 1A and 1B. Disk replacement every 7-10 years. Increase in electricity use for coagulation/flocculation. Electricity use for cloth filters lower than sand filters.

Alternative 3 – Coagulation/Flocculation, Sedimentation, and Sand Filters

Ability to Meet 0.06 mg/L Phosphorus Limit
Full size systems are in operation and have demonstrated ability to meet permit limit. Performance guarantee can be provided by Jacobs.



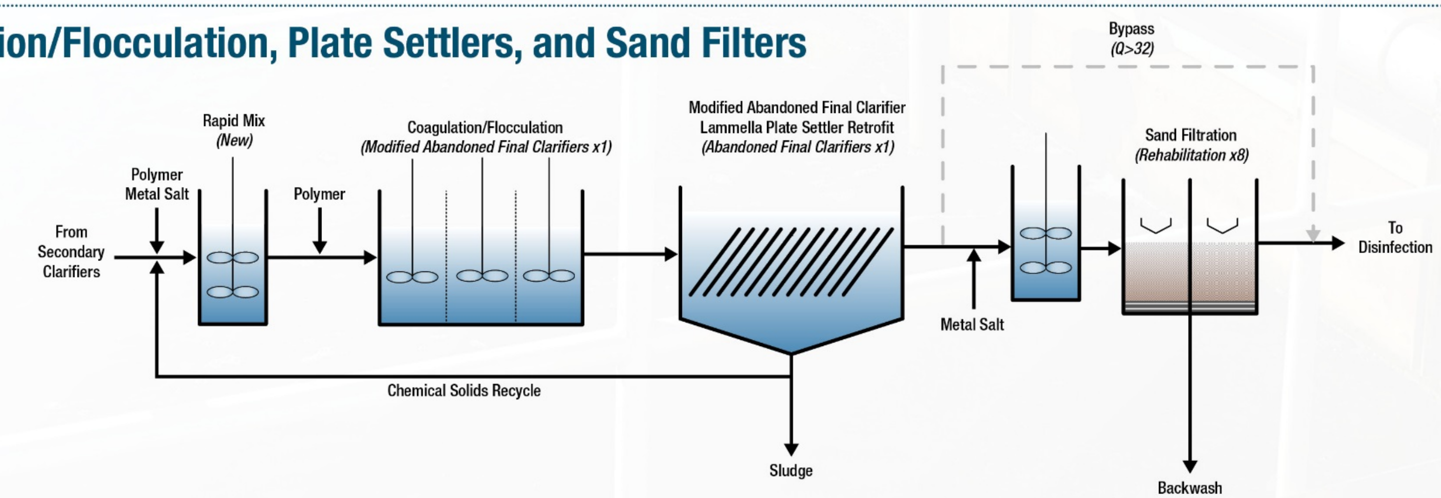
Redundancy
Coagulation and flocculation system is fully redundant. One Coagulation System clarifier can be removed from service without affecting effluent quality due to fully redundant filters.

Maintenance
Maintenance of mixers for coagulation and flocculation will be required. Maintenance for coagulation basins and sand filters will be similar to current levels.

Chemicals and Consumables
Lower ferric chloride consumption than for Alternative 1A and 1B. Polymer may be required under peak flow conditions. Media replacement every 15-20 years. Increase in electricity use for coagulation and flocculation. Filter surface replaced by backwash pumping and air wash.

Alternative 4 – Coagulation/Flocculation, Plate Settlers, and Sand Filters

Ability to Meet 0.06 mg/L Phosphorus Limit
Full size systems are in operation and have demonstrated ability to meet permit limit. Performance guarantee can be provided by Jacobs. Lamellas reduce surface area needed and number of basins.



Redundancy
Coagulation and flocculation system is fully redundant. One Coagulation System clarifier can be removed from service without affecting effluent quality due to fully redundant filters.

Maintenance
Maintenance of mixers for coagulation and flocculation will be required. Maintenance for coagulation basins and sand filters will be similar to current levels. Fewer sedimentation mechanisms to maintain. Filter surface replaced by backwash pumping and air wash.

Chemicals and Consumables
Lower ferric chloride consumption compared to Alternative 1A and 1B. Polymer may not be required. Media replacement every 15-20 years. Increase in electricity use for coagulation and flocculation.

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EXHIBIT 1-6

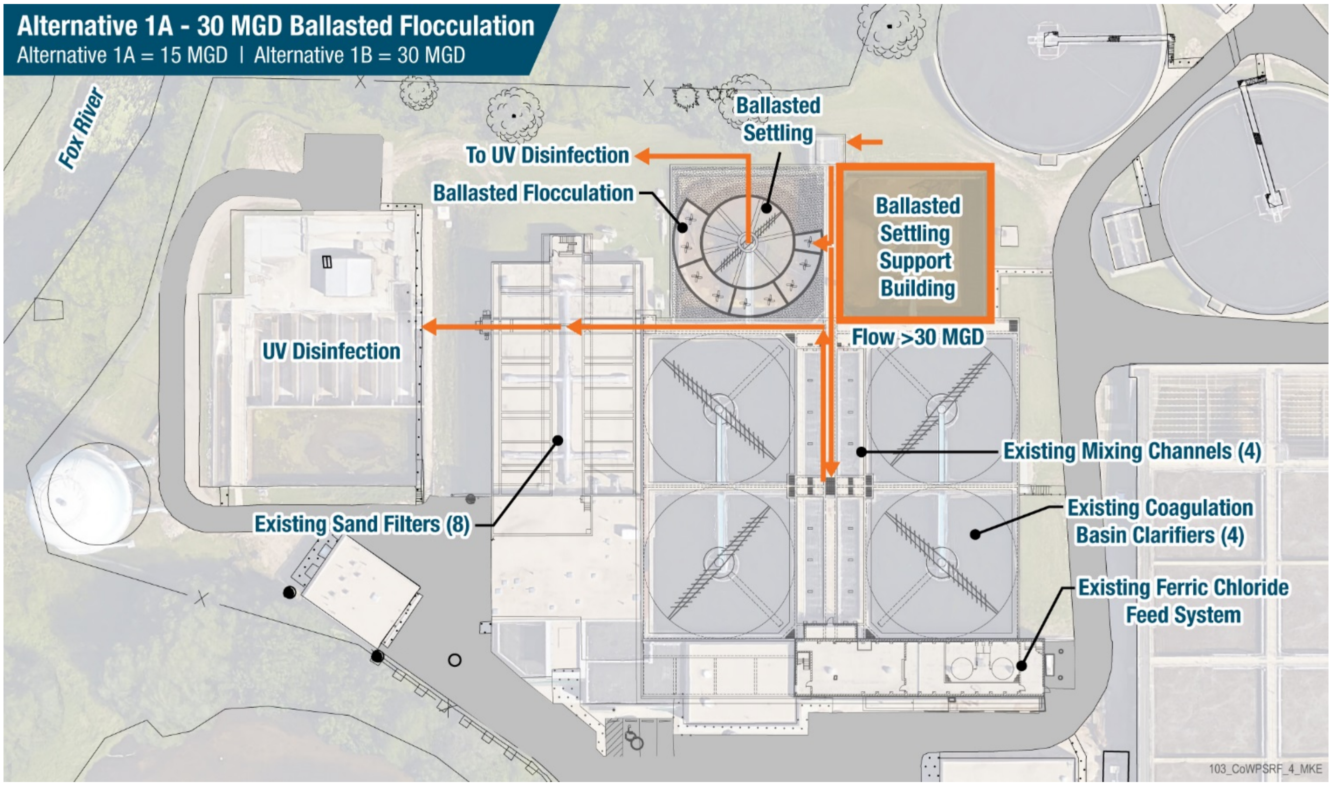


EXHIBIT 1-7

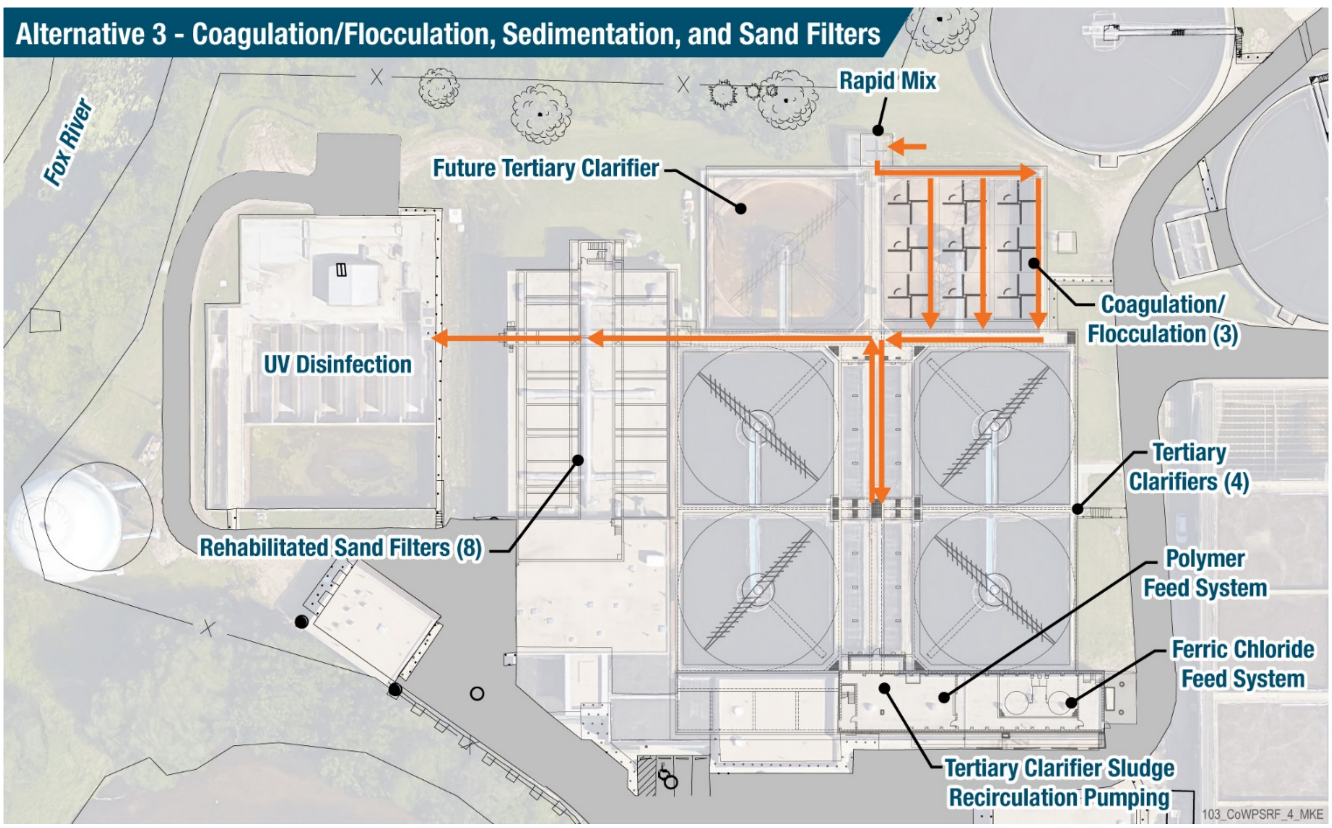
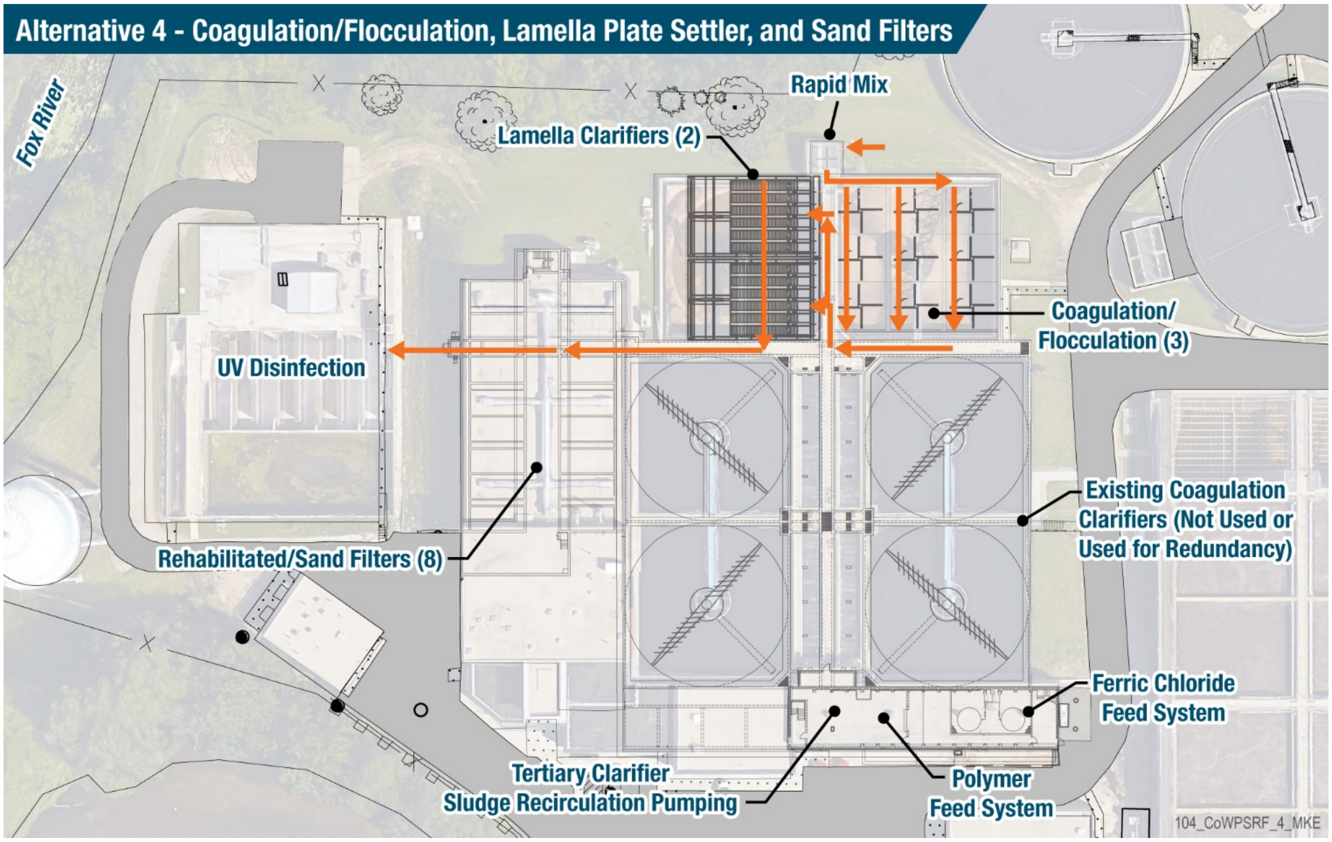


EXHIBIT 1-8



Redundancy and Reliability

Key non-monetary criteria for selecting a treatment technology are reliability and redundancy. The system and equipment should be reliable so that it is seldom out of service to ensure permit compliance and to avoid excessive maintenance and repair costs. In addition to drawing on our experience and the City's experience to specify reliable and proven equipment, redundant equipment can be provided to help address system reliability, so that good treatment can still occur when pieces of equipment are out of services for maintenance.

Redundancy can be addressed in part if the systems are designed to handle peak flows. For example, ballasted flocculation system with a manufacturer's capacity rating of 15 mgd (Alternative 1A) was proposed in the Final Phosphorus Compliance Alternatives Plan. For a relatively small additional cost, that alternative could treat about double that flow if the system hydraulics are properly designed (Alternative 1B). This would provide flexibility for the plant to treat peak wet weather events using only ballasted flocculation. rather than relying frequently on the sand filters to treat peaks. Another important consideration is whether to install a single train or two parallel trains sized for half the flow. Two trains would of course increase the capital costs but would mitigate the risk of permit violations should a train be out of service for an extended time.

Ballasted flocculation could be done by installing it into one of the original final clarifiers (Exhibit 1-6 shows a CoMag® configuration). It has been proposed to use the existing sand filters in parallel for treatment of flows above 15 mgd. An alternative would be to use ballasted flocculation for all flows – up to 30 mgd or more. While marginally more costly, this could allow for the existing sand filters to be used in series downstream of ballasted flocculation, rather than in parallel, which would aid in effluent polishing. However, a concern with filtration following ballasted flocculation is excessive polymer carryover from the ballasted flocculation process, which can result in excessive headloss due to blinding of the sand filters.

Jacobs Engineering Process Guarantee: Two-stage Tertiary Treatment with Sedimentation and Filtration Rehabilitation

As discussed in a subsequent section, we understand that it will be critical to receive comprehensive effluent performance guarantees from equipment vendors that give the City confidence that effluent permit limits will be consistently met. As an alternative to vendor guarantees, Jacobs Engineering routinely gives our clients performance guarantees for processes that we design that do not rely on vendor package systems and we could discuss doing that for this project. Potential concepts for a system that Jacobs would design and potentially guarantee is described below and represented in Exhibits 1-7, and 1-8.

The existing tertiary clarifiers do not provide any significant removal of phosphorus likely as a result of poor floc formation due to inadequate chemical mixing, and floc shear from the center feed configuration. Floc development can be improved by installing a better mixing system in one of the abandoned clarifiers and the installation of a rapid mix chamber. Exhibit 1-9 shows preliminary design criteria for this concept.

Improvements to the existing clarifiers would also be recommended to improve performance including modifications to reduce floc shear, relocate the clarifier feed, baffling to reduce short circuiting changes in sludge scraper operation (intermittent instead of continuous) launder covers to prevent algae and sludge pumping changes to recycle solids. Generally, tertiary clarifiers perform well without polymer addition if the surface overflow rate can be maintained below 1,150 gallons per day per square foot (gpd/sqft). As shown in Exhibit 1-9, for all conditions except peak hour, the overflow rate is below the target. For flows above 32 mgd, the remaining final clarifier that is not in use could be rehabilitated to provide increased surface area, or polymer could be added to increase settling velocities, though the need to treat a peak that occurs very rarely should be carefully evaluated.

EXHIBIT 1-9
Design Criteria for Flocculation Tertiary Clarification

	Peak Hour	Peak Day	Average
Influent Flow, mgd	32	27	15
Solids Recycle Rate, gpm	100	70	50
Coagulation/Flocculation			
Stage Hydraulic Retention Time, min	8.5	10.0	18.1
Total Hydraulic Retention Time, min	25.4	30.1	54.2
Clarifiers (squirqle)			
No. In service	4	4	4
Surface overflow rate gpd/sqft	1,256	1,059	589

This configuration would likely provide better treatment reliability because unlike some other alternatives, it provides two-stages where performance upsets of the tertiary clarification would be polished using rehabilitated sand filters or cloth filters retrofitted into the sand filter structure. Also, a significant potential advantage of this system is that it would use much less chemical than CoMag®or ACTIFLO®. The capital cost of this alternative may be comparable to other options and the lower chemical cost could result in a lower life cycle cost although the costs must be carefully estimated.

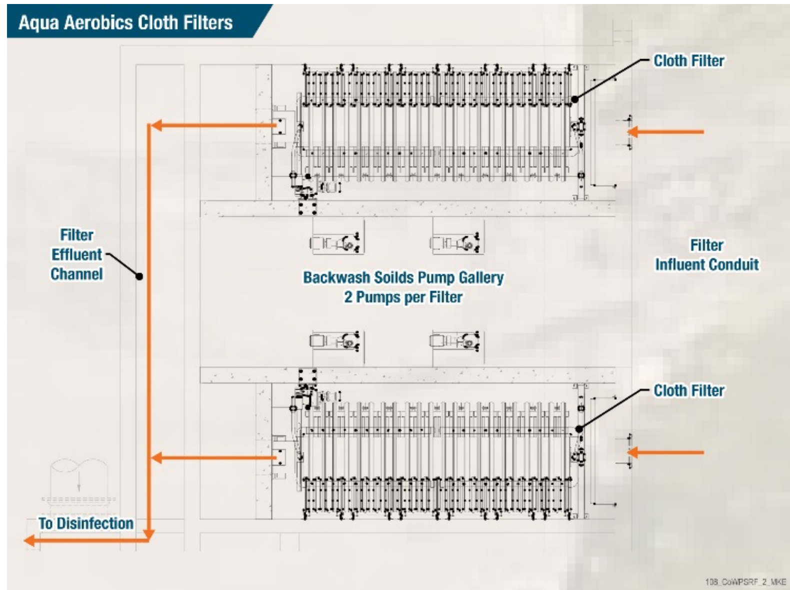
Two-Stage Tertiary Treatment with Lamella Plate Settler Retrofit and Filtration Rehabilitation

Similar to the previous alternative, this alternative (Exhibit 1-8) incorporates a two-stage system, with the only difference is that settling is accomplished using lamella plate settlers rather than the existing final clarifiers. Lamella plate settlers would significantly reduce the amount of surface area needed for settling.

Retrofitting Cloth Filters into Sand Filter Infrastructure

Exhibit 1-10 shows how 2 filters could be installed into the existing sand filters. A cloth filter could be placed in each filter and the center gullet removed for installing backwash solids pumps with a new wall at each filter to enclose the filter tank. The washwater drain conduit would be used for the filter effluent channel and would connect to the filter effluent conduit which routes to UV disinfection. This would require locating the cloth filters in the west half of the building.

EXHIBIT 1-10



Approach to Competitive Phosphorus Treatment Vendor Bids

It could be found that two similar phosphorus treatment technologies are both viable parts of a treatment configuration. A likely example of this is ACTIFLO®and CoMag® ballasted flocculation systems. To help ensure the City receives the equipment price possible, competitive bids could be received from each vendor. Our goal would be to have the bids be equitable, comparable and structured such that there would be no question as to what system provides the best value to the City. To do this, we would recommend, the bid structure:

- Require a comprehensive breakdown of lifecycle costs including chemical doses, consumable quantities (e.g. sand), and electrical power.
- The life cycle cost items above should include a penalty equal to the City's additional lifecycle costs if the vendor does not meet the bid quantities during performance testing.
- All bidding requirements should be clear and unambiguous to help ensure that the City is receiving comparable costs.

Phosphorus Treatment Guarantees

Most of the tertiary treatment equipment being considered only have met effluent phosphorus concentrations as low as Waukesha's proposed limits using pilot scale, but not full-scale installations and this means getting firm vendor performance guarantees critical.

A comparison of vendor process guarantees shows considerable differences between in language regarding the definition regarding what satisfies the guarantee, financial liability, and the general clarity of the guarantee.

EXHIBIT 1-11
Vendor Process Guarantee Example

KRÜGER

PROCESS PERFORMANCE GUARANTEE
ACTIFLO® (Tertiary Clarification)
Wilson Creek WWTP Expansion and Advanced Treatment Improvements

Wilson Creek, TX
High Rate Treatment System

GENERAL

This process Performance Guarantee is made to North Texas Municipal Water District ("Owner") by Kruger Inc. in connection with the subject High Rate Treatment System (ACTIFLO®) provided for the Wilson Creek, TX High Rate Treatment System project.

PERFORMANCE GUARANTEE

Subject to the provisions contained herein, Kruger Inc. hereby guarantees that the ACTIFLO System in

Ambiguous requirements and unreasonable requirements regarding secondary effluent quality that feeds the tertiary treatment process could be used to circumvent the intent of the guarantee. Process guarantees provided by vendors are usually not intended to be warranty against a permit violation but rather serve as guarantees that a performance test can be passed under a given set of conditions that may vary between vendors. For example, the duration of performance tests are often different ranging from 5 to 30 days. The maximum financial liability offered by vendors for failing the performance guarantee varies from 50 to 100 percent of the value of the equipment.

Any warranty must be written with the City's interest in mind to help ensure that the systems meet the phosphorus effluent permit requirements. However, if the requirements are overly burdensome and favorable to the City, the vendors could increase their price to unreasonable levels cover the added risk or decide not to bid. In order to get multiple bids, protect the City's interests while still providing a system that will achieve permit limits at a reasonable cost, a balance must be struck and equitable guarantee language should be developed. To help do that, we will work closely with CWP and City legal council to develop a detailed process guarantee.

Impacts of Transitioning from Waukesha Well Water to Milwaukee Water

As the City transitions its water supply from the current groundwater wells to water supplied by primarily by Milwaukee Water, there will be changes in water quality that will result in changes to influent wastewater characteristics. Milwaukee Water uses utilizes Lake Michigan surface water, which has different water quality characteristics and requires a higher level of treatment compared to Waukesha's current water supply. Also, the large size of Milwaukee's water distribution system requires the use of chloramines. Chloramines are formed from chlorine and ammonia and are used as a distribution system residual disinfectant rather than the chlorine residual used by Waukesha. Using chloramines results in a small increase in nitrogen loading to the Clean Water Plant. Milwaukee Water has approximately 0.1 to 0.3 mg-N/L more ammonia compared to Waukesha well water. Milwaukee Water also uses phosphates as corrosion inhibitors to reduce corrosion of lead and copper pipes in the distribution system, which is a practice not employed by Waukesha. As a result, influent phosphate loads to the Clean Water Plant will increase once the transition to Milwaukee Water occurs. This increase could affect the Clean Water Plant phosphorus treatment; for example, it could increase the required ferric dose.

The parameters with the highest potential to impact operations at the Clean Water plant are shown in Exhibit 1-12 along with the differences in estimated values for both water supplies. include temperature, pH, alkalinity, hardness, and influent phosphate loading.

EXHIBIT 1-12

Estimated Drinking Water Supply Quality Changes

Parameter	Waukesha Well Water[1]		Milwaukee Lake Michigan Water[4]	
	Average[2]	Range[3]	Average	Range
Temperature, °C	11.4	10 - 12.8	12.0	2.9 - 21.8
pH, s.u.	7.3	6.8 - 8	7.7	7.4 - 7.9
Alkalinity, mg $CaCO_3$/L	240	210 - 340	105	90 - 130
Hardness, mg $CaCO_3$/L	320	260 - 490	133	110 - 150
PO_4, mg-P/L	ND	ND	0.5	0.3 - 1

[1]Data from 1993 to 2012 IOCs

[2]Assumes 20% Well No. 12 and 80% Well No. 10

[3]Indivdual well observations, not blended distribution system water quality

[4]Data from 2017 Distribution System Water Quality Report

Exhibit 1-13 demonstrates changes in these key water quality constituents.

EXHIBIT 1-13
Impacts of Transitioning from Waukesha Well Water to Lake Michigan Water

Parameter	Potential Impact
Temperature	Averages are similar, but range of Milwaukee Water temperatures is much wider than the existing ground water wells. Temperature changes will be dampened in the wastewater collection system but in the future the CWP will experience slightly lower influent temperatures in the winter and warmer temperatures in summer months. Much lower temperatures could result in reduced nitrification efficiency, increased ferric dose, or reduced process stability.
pH/Alkalinity, Hardness	The average pH produced by both water supplies are similar but there are substantial differences in hardness and alkalinity. The lower hardness of Milwaukee Water could reduce the scaling potential on in-plant service water systems and reduce calcium phosphate-based precipitates (i.e. brushite) that form in digestion. Lower Milwaukee Water alkalinity is a potential concern because nitrification and ferric chloride addition result in alkalinity depletion. Nitrification reduces alkalinity by approximately 7 mg of calcium carbonate for every milligram of ammonia that is nitrified. Ferric chloride results in alkalinity loss of 2.7 mg calcium carbonate per mg of iron (Fe). If enough alkalinity is lost, pH will decrease, and nitrification will be inhibited. Alkalinity can be recovered by denitrification or increased through alkalinity addition using carbonate or hydroxide. Impacts of changing drinking water supplies on secondary and tertiary chemical addition will be evaluated and if needed methods to mitigate the potential adverse impacts will be considered.
Phosphate Loading	At current dosing rates, Milwaukee Water phosphate-based corrosion inhibitors result in an increase of phosphate loading of near 0.5 mg-P/L. In the future, drinking water regulatory changes could result the need to increase phosphate doses for corrosion control potentially requiring a dose as high as 1 mg-P/L. This higher phosphorus influent could be addressed by adding more ferric to secondary treatment. There is an opportunity to optimize the split of ferric between secondary and tertiary to reduce chemical costs.

Chemical Dosing and Mixing

Low level phosphorus treatment requires high chemical doses and, it has been shown that the proper design of chemical feed and mixing systems has the potential to minimize effluent phosphorus and reduce chemical usage costs. Chemical use and cost can be reduced significantly by good mixing system design and through the use of online analyzers to optimized dosing. This will be important since chemical use was estimated to cost on the order of $500,000 per year and an optimized mixing and dosing system could save up to perhaps 20 percent or $100,000 per year which would be $2 million dollars over a system's 20-year life.

Chemical use was estimated to cost on the order of $500,000 per year and an optimized mixing and dosing system could save up to perhaps 20 percent or $100,000 per year—$2M over a system's 20-year life.

Chemical Feed and Mixing Systems

As metal salts (e.g. ferric chloride) are added, they create hydrous metal oxides which have capacity to adsorb orthophosphate. To reduce chemical doses and costs our design would focus on optimizing rapid mix, which allows for quick interaction of metal salts with phosphate, and flocculation, which develops larger chemical flocs for improved settling and more time for adsorption of orthophosphate. Chemical dose and settleability can be improved further by recycling of chemical solids from the settled sludge line, which contains residual chemicals that remain active and it creates a denser, more settlable floc. This is similar to the Densadeg process and We have used this approach successfully on other similar recent projects.

The dose needed for tertiary treatment is highly dependent on the solids separation process (i.e. filtration, sedimentation, etc.), the intensity of rapid mixing, the duration of flocculation, the incorporation of solids recycle, and other factors. A tertiary system with properly designed rapid mix and flocculation that incorporates solids recycle can achieve doses between 3 and 5 mol Fe/mol P but without proper mixing systems, this dose can be as high 10 to 30 mol Fe/mol P. The Facility Plan estimated a high dose ferric chloride which indicated that there may a significant opportunity to reduce chemical costs through proper mixing design.

Exhibits 1-14 shows data (Szabo et al. (2008) and Smith et al. (2008)) on the impact of rapid mixing intensity and flocculation time on phosphorus removal showing that mixing intensity (G value) is key to achieving low phosphorus effluent. Exhibit 1-15 demonstrates the impact of flocculation time on P removal. Generally, rapid mix intensity should be between a G value of 300 and 400 s^{-1}, and the flocculation time should be greater than 20 minutes.

Ballasted flocculation (CoMag®, ACTIFLO®) require only about 5 minutes of flocculation, but chemical use is much higher than other tertiary processes.

EXHIBIT 1-14
Impact of mixing energy on effluent phosphorus

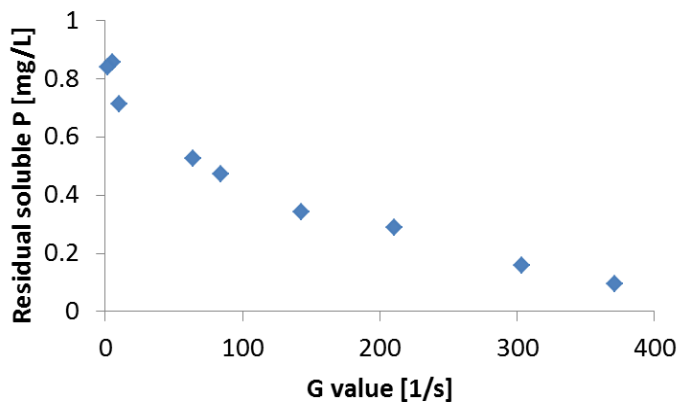
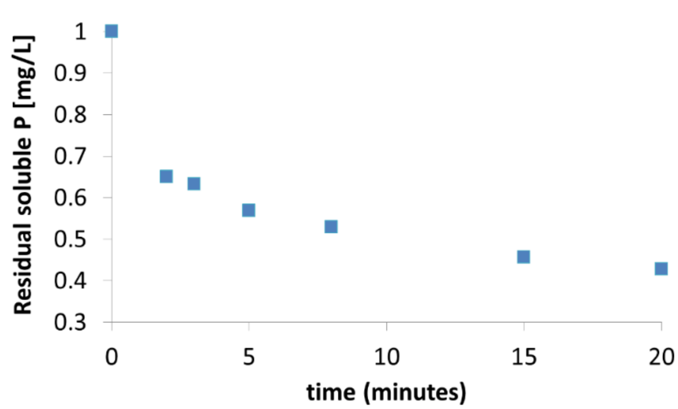


EXHIBIT 1-15
Impact of mixing time on effluent phosphorus



Online Analyzers to Reduce Chemical Costs

Using online analyzers (Exhibit 1-16) is another way to significantly reduce chemical costs. Our team has installed analyzers and achieved low phosphorus effluent limits that could have not been meet without them. Online analyzer control exactly matches the required dose to adjust to continuously changing conditions.

EXHIBIT 1-16
Example online phosphorus analyzer

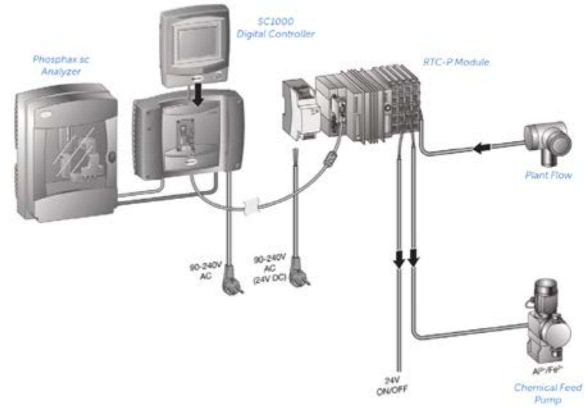


Image courtesy of Hach

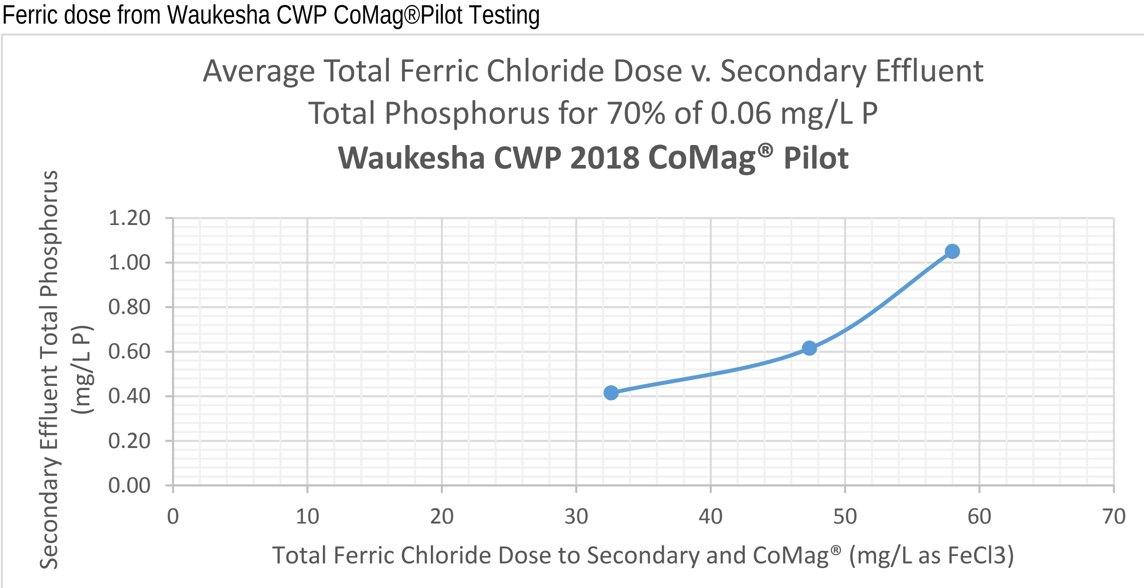
Optimize Dose Between Secondary and Tertiary Treatment

Dosing at two locations instead of one can reduce chemical total dose and cost. Waukesha currently doses ferric chloride at two locations: secondary treatment and the coagulation basins. Going forward, our team will help find the optimum split between dosing to secondary treatment and tertiary treatment to minimize cost and comply with permit limits. During the CoMag®pilot, it was shown the the total ferric chloride dose increased dramatically as secondary effluent phosphorus (influent to CoMag®) increased. The data (partially shown in Exhibit 1-17) indicates that total ferric chloride (tertiary and aeration dosing points) cost would be $437,000 per year less if secondary effluent were controlled to about 0.4 mg/L total phosphorus instead of about 1 mg/L.

Data indicates that total ferric chloride (tertiary and aeration dosing points) cost would be $437,000 per year less if secondary effluent were controlled to about 0.4 mg/L total phosphorus instead of about 1 mg/L.

The data trend indicates that total chemical cost can be further reduced by increasing the ferric chloride dose to secondary treatment and reducing the ferric chloride dose to tertiary treatment. However, ballasted flocculation will not function if all ferric chloride was dosed only to secondary treatment. Based on initial estimates of chemical doses, we estimate the two existing 10,000-gallon ferric chloride tanks will provide about 1 month of storage and it appears that no additional storage is required. However, that will be reviewed during an early workshop.

EXHIBIT 1-17
Ferric dose from Waukesha CWP CoMag®Pilot Testing



Permitting Issues

DPW and WWU Memorandum of Understanding (MOU)

An early action item will convene a meeting between DPW, CWP, and the WWU to identify specific involvement and coordination on return flow design elements. This will ensure there is a clear roadmap for coordination and allow the design teams to be efficient with time and budget to meet the project schedule.

An MOU has been developed between the DPW and WWU that establishes schedule, coordination needs, and leadership roles for several elements of the Great Water Alliance program. This includes topics such as the coordination with contract packages for return flow pipeline and discharge site infrastructure. Elements included in the MOU are evolving, such as should contract packages that may be bid and designed together instead of issuing separate contract packages. Through our involvement on the program, we will keep DPW/CWP informed of program changes and when beneficial to DPW/CWP, the DPW/CWP will be included in discussions that affect the CWP. We will do this through our involvement in Great Water Alliance program meetings, and workshops and meetings with the DPW project team. This will ensure that the expectations of DPW and WWU are understood and that efficient and cost-effective implementation of the design and construction of the return flow infrastructure is completed.

Return Flow Management Plan

Over the past two years, we have led the coordination between the WWU, Great Water Alliance, and DPW for return flow management. Our goal in doing this has been to provide the City the maximum flexibility possible in how they meet the diversion approval return flow requirements. Because the CWP will be operating the RFPS under the WWU's Diversion Permit, ensuring that both entities are integrated into the permitting, reporting, and operation of the return flow is critical to balance the diversion permit requirements while incorporating CWP operational, maintenance and infrastructure needs.

Over a dozen return flow management plan scenarios have been modeled and discussed with the City to evaluate the impacts of the scenarios on criteria such as minimizing pump size, reducing energy usage and operations cost, minimizing operational complexity, ensuring compliance with diversion approval requirements, and integrate return flow into the overall CWP operations.

Pump Station Design

Our team's approach to the design of the Return Flow Pump Station (RFPS) is to focus on activities that will cost-effectively achieve maximum operational flexibility given the required return flow capacity range and optimize the pump selection to achieve the highest pump efficiency and overall "wire-to-water" pumping system efficiency. The efficiency will be key because the operating pumps could have a combined motor rating of nearly 1 megawatt and the goal should be to minimize the electrical power costs. Included in our level of effort will be taking the City's preferred attributes from the pump station design and study efforts that were previously completed. We will utilize our firm's extensive experience with designing pump stations to recommend enhancements to the previous work. Our team will:

- Successfully integrate the pumping station and pipeline design and operating criteria based on the system head conditions of the pipeline.
- Select pumps that achieve operation within the candidate pumps' preferred operating range (POR) to achieve the highest operating efficiency and longest service life considering the entire envelop of design flow and head conditions.

- Ensure pump intake hydraulics at the pump suctions at a minimum meet the recommendations and best practices of the Hydraulics Institute Standards to ensure highly efficient pump operation free of potentially costly pump cavitation damage.
- Configure a pumping station and wet well arrangement that is easy to maintain and achieves the highest levels of reliability and redundancy and operational flexibility.
- Develop a control strategy for the pumping system that achieves the highly accurate flow control associated with required return flow requirements.

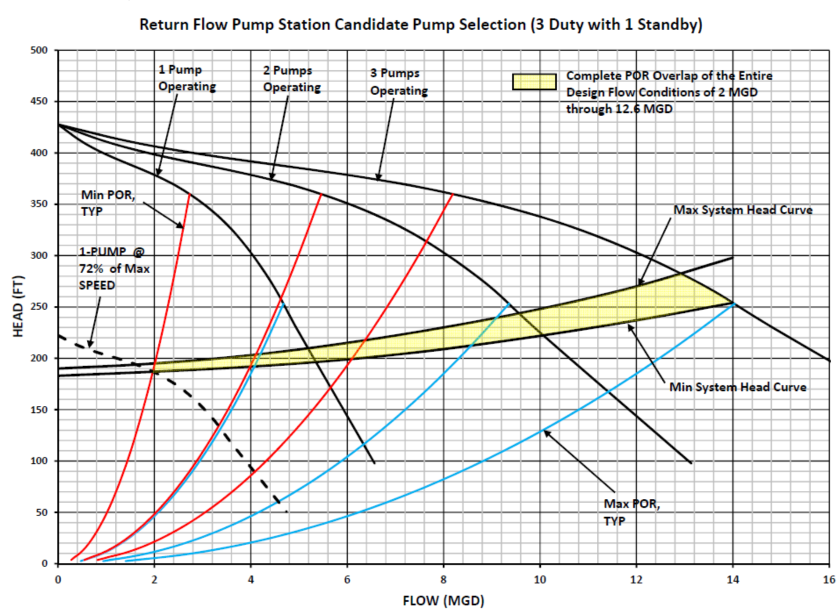
Pump Selection

Our approach to pump selection is rooted in our unsurpassed expertise in large pumping equipment and their application. Our standard approach includes early involvement with the candidate pump manufacturers. We will couple system head curves coupled with a statistical analysis of the flow range and flow frequencies to pinpoint the optimum pump performance range and best efficiency performance conditions that will result in a long pump life the high pump operating efficiencies to minimize power costs.

Selection of the size and number of pumps depends on many factors. To ensure the longest performance life of the pump, the majority of the pump operation should be within its POR, which is based on each pump's specific speed. We will confirm all selected pumps operate within their preferred POR as defined by Hydraulics Institute standards. When operated within the POR, flow through the pump remains well controlled and the pump service life is not significantly affected by hydraulic loads, vibration, or flow recirculation within impeller.

To achieve optimal performance, pumps will be selected so that the POR overlaps for all pumps operating throughout the entire design flow and head service range enveloped between the preliminary defined flows of 12.6 mgd maximum to the minimum dry weather capacity of 2 mgd. Exhibit 1-18 shows an example preliminary pump selection for this project for identically sized vertical turbine pumps (3 duty with 1 standby). The POR affinity curves for one pump through three pumps in operation are plotted across the pump performance and system head curves (shown as red and blue curves). Exhibit 1-18 shows the minimum and maximum flow POR curves overlap and provides complete operation within the POR of each pump combination throughout the entire design flow range of 2 mgd to 12.6 mgd as shown by the shaded yellow region. For the project, we will perform a more detailed specific speed and suction specific speed analysis for pump impeller sizing. This will be done to tailor the pumps' best efficiency point and corresponding POR to our actual operating conditions as well as establishing wet well submergence requirements for pump operation free of damaging cavitation. We will include strict vibration limits in the specifications for the pumps and motors, including comprehensive lateral and torsional vibration interference analysis requirements to ensure no shaft vibration critical speeds occur and to eliminate pump/motor shaft and coupling fatigue failures. We will also include comprehensive factory performance validation testing requirements to ensure that pumps perform as intended and are reliable.

EXHIBIT 1-18



Pumping Station and Wet Well Configuration

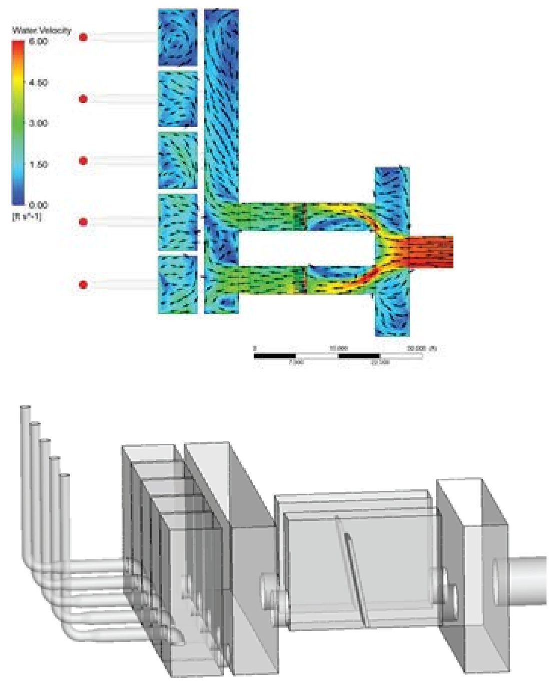
We have the ability to provide CFD modeling during evaluation of pump station layout to help select the optimum configuration that will prevent cavitation, loss of pump capacity, and premature wear of pumps, impellers and bearings. We have used CFD modelling to evaluate numerous pump station designs up to 1,000 MGD to improve the wetwell configuration and pumping efficiencies, which ultimately results in optimized flow conditions and improved pump performance. As can be seen in Exhibit 1-19, velocity distribution across the pump bays is not even and symmetrical. These undesirable approach flow patterns create vortices and poor velocity distribution at the pump intake, leading to poor pump performance and excessive maintenance. This example demonstrates the benefits of CFD modeling during conceptual and preliminary design to evaluate the effects of potential layouts on the hydraulics.

The previous pump station design work incorporated vertical turbine pumps suspended over a wet well.

A second option could be evaluated: horizontal, split-case centrifugal pumps housed in dry-pit configuration adjacent to the wet well. Each configuration has both cost and non-monetary advantages and disadvantages that could be evaluated to determine the optimum configuration that balances life-cycle-cost and operations and maintenance advantages.

EXHIBIT 1-19

CFD modeling can be used to design wet wells and optimize pump performance



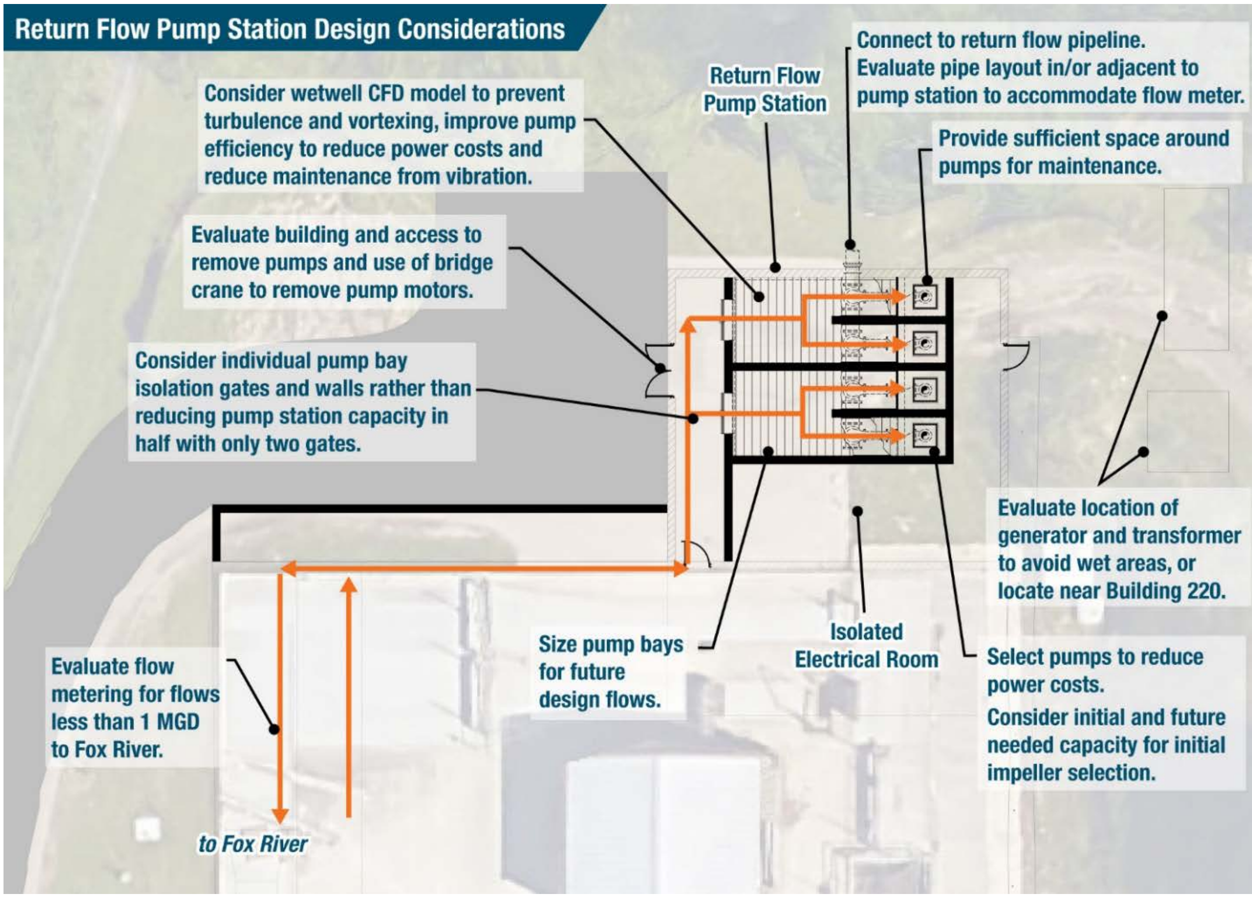
Our focused approach can greatly reduce the risk of pumping equipment performance problems, such as pumps developing damaging cavitation within their operating range, pumps not achieving rated flow and head conditions at expected efficiency, and pumps not operating within the specified vibration limits, which could void the pump manufacturer’s warranty.

The wet well must provide reliable yet flexible system operation while complying with the recommendations of the Hydraulic Institute Standards at the intake to each pump. Design development of the wet well and pump intake conditions will take into account hydraulic suction conditions such as turbulence at each pump suction bell, submergence for vortex suppression and appropriate net positive suction head available versus net positive suction head required for each pump. Our design development of will focus first on the preliminary design to validate required improvements needed in the flow spaces within the wet well. For vertical turbine pump applications, wet well features such as open top pump cans which we have successfully utilized in wet well facilities allows for optimization of wet well dimensions including operating depths while still maintaining compliance with the Hydraulics Institute Standards.

Our focused approach can greatly reduce the risk of pumping equipment performance problems, such as pumps developing damaging cavitation within their operating range, pumps not achieving rated flow and head conditions at expected efficiency, and pumps not operating within the specified vibration limits, which could void the pump manufacturer’s warranty. Wet well configurations will be confirmed for sequencing pumps on and off, single and parallel pumps in operation, and for variable speed pump control. The wet well water levels associated with pump operation will be established by each wet well geometry, the maximum rate of inflow, the time required to start and stop pumps, the acceleration rate of variable speed pumps (ramping rate of variable speed drives), and the minimum incremental change in water level that the level instruments can accurately measure.

Exhibit 1-20 shows just a few of the Return Flow Pump Station Design Considerations.

EXHIBIT 1-20



Return Flow Pipeline Hydraulics

The return flow pipeline to the point of discharge at the Root River will be designed by others. We understand that the preliminary pipeline profile identifies a high-point located approximately 8 miles downstream of the RFPS that can be used to establish gravity flow from the high-point to the pipeline's point of discharge at Root River. We also understand that other pipeline concepts included consideration of pressure sustaining valves located at the pipeline discharge which would essentially allow the pipeline to operate as a complete force main.

Our approach would include early involvement with the pipeline designer and the City to evaluate and confirm the pipeline size, alignment and profile, and also the pipeline operating strategy (i.e., partial force main and gravity flow pipeline versus pipeline operating as a complete force main) so the pumps are properly sized for the static and total dynamic head conditions associated with the selected pipeline operating criteria. We will also coordinate results of the pump station hydraulic transient-surge evaluation and corresponding pipeline protection recommendations.

Energy Management

This project requires initial pumping at an average of 6 to 8 mgd against a significant discharge head, which will significantly increase energy consumption at the CWP. Energy efficiency can not only be gained through careful pump bay design and pump selection, but also through motor design, programming logic for pump speed and number of pumps in service, building layout and envelope, and building services. We propose to leverage our experience designing LEED certified wastewater and water facilities to implement energy efficiency into the design of lighting and HVAC, considering room designs and ventilation requirements, and heat recovery. High efficiency TEWAC motors using cooling by heat exchange within the pumped medium could be considered. And we can simulate strategies to minimize pumping costs by optimizing duty point operation around pump best efficiency point and targeted pump efficiency envelope.

Electrical Power

As discussed, the return flow pump station will require a significant increase in plant power consumption. And the pump station must operate continuously to meet regulatory requirements. The electrical power supply to the pump station must be highly reliable to address this. Based on discussions with plant staff and our experience with designing other critical pump stations, a back-up power supply will be key – likely utilizing a natural gas generator. We will coordinate closely with We Energies the CWP regarding current and potential future electrical supplies, substations and power reliability issues.

Facility Plan 5 to 10 Year Upgrades

In addition to the phosphorus treatment system and Return Flow Pump that will be design as part of this project, there are several other items that will be included in the design. For each of the following items, we will meet with CWP staff in a workshop to review the items, clearly define the needs and develop design criteria:

- Replacement of the PVC aeration piping and membrane diffusers in three aeration bays
- Replacement of Building 110 Primary Influent pumps, motors, motor control centers (MCCs) and associated cabling
- Replacement of Building 140 Primary Effluent pumps, motors, MCCs and associated cabling
- Replacement of Building 150 (primary sludge pumps and primary scum pumps) MCCs and associated cabling
- Replacement of about 10 overhead doors
- Replacement/repair of about 8 manual slide gates
- Select area painting (Building 400 pumps and piping, Building 240 pumps and piping, Facility 230 clarifier baffles)

City of Waukesha Application for a Lake Michigan Diversion with Return Flow (2009 – 2016)

For several years, CH2M (now Jacobs) managed the following separately funded project activities on the same project: Water Supply Alternatives Planning, Water Conservation Program Implementation, Return Flow Management Studies, and Environmental Impact Assessments. The primary reasons for tracking and monthly reporting on these efforts separately was in preparation for the multiple funding sources to be ultimately integrated in the GWA Program. Another reason relates to regulation by the Wisconsin Public Service Commission and costs that can be covered in water utility rates.

Knowledge of Split Funded Projects

We understand the importance of delivering engineering design and construction services in strict conformance with the financial accounting requirements of the funding project funding entities. We use very detailed project delivery workplans, aligned with our project accounting system, to ensure our delivery team charges time and expenses appropriately. It is our standard project set-up practice to have a unique project number for each scope task to track and manage work progress. We also commonly assign separate project numbers for separate facilities on the same project.

To successfully manage a project in which team members charge the correct task or split their time on a general task (i.e., developing front end bidding and general requirements specifications) requires detailed project instructions and timely review of work progress and project charges. Project instructions set forth at the beginning of the project the specific time charging expectations for each team member. This guidance, along with weekly work progress updates and project accounting reports ensures work effort is being split as intended. These practices result in accurate project accounting that withstands audits commonly performed on federally funded projects.

SECTION 02

Qualifications of Firm

About Jacobs

Our firm has long been a global leader in full-service consulting, design, design-build, operations and program management services for government, civil, industrial and energy clients. Established in 1946 by three engineers and a professor, CH2M operated from the beginning on four values: take care of clients, deliver great work, do right by employees, and stay true to our integrity and honesty.

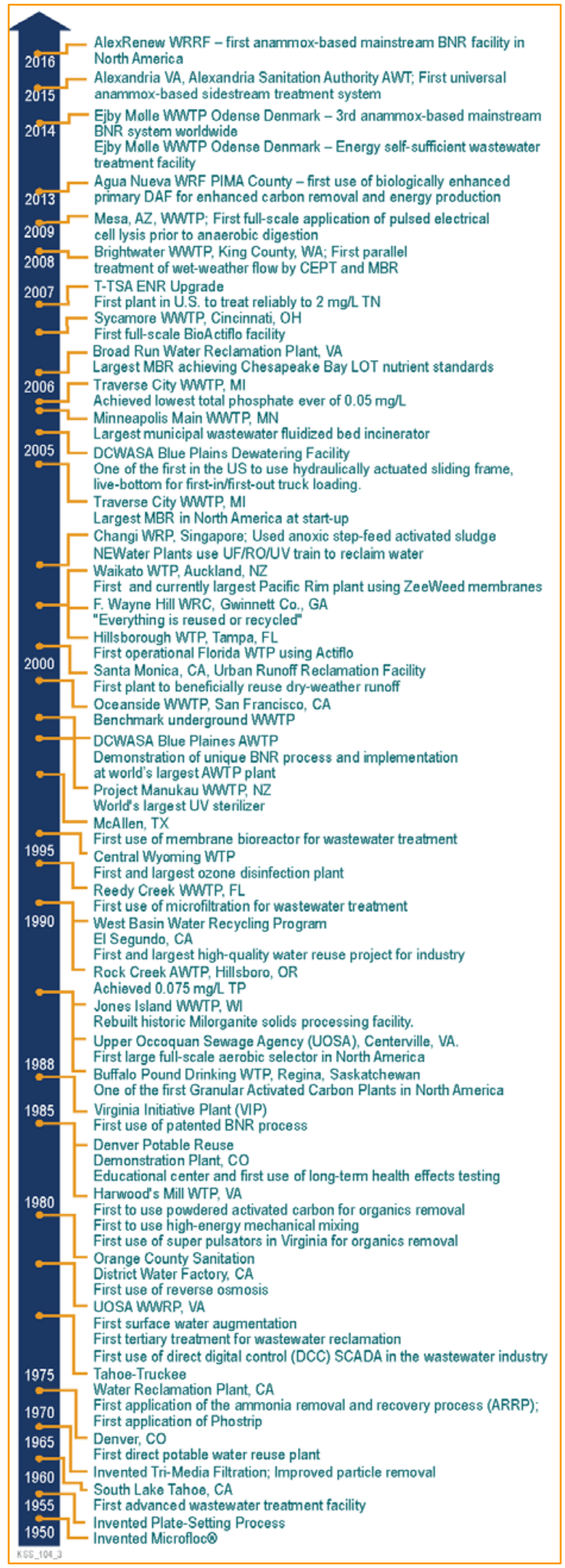
On December 15, 2017, Jacobs Engineering Group (Jacobs) acquired CH2M, resulting in a new company that has never existed before in our industry. Jacobs is one of the world's largest and most diverse providers of full-spectrum technical, professional and construction services for industrial, commercial and government organizations globally. The combined company employs more than 74,000 people and operates in more than 40 countries around the world and every state in the union including Wisconsin where more than 300 Jacobs staff are located. Most of the project will be delivered by staff from our 160 person Milwaukee office which is located just 15 minutes from the Waukesha Clean Water Plant.

Wastewater Treatment Qualifications

As the industry's top-rated wastewater treatment firm, our locally based team supported by globally recognized experts in phosphorus treatment and pump station design will deliver high-quality services required to evaluate and design improvements. With our unparalleled expertise, we help take projects from early planning stages to detailed design, through construction to full operation. Since 1946 we have completed more than 7,000 water and wastewater projects and have maintained a leadership position in the industry based on the innovation and quality of our services.

We have established an international reputation in developing and applying innovative treatment technologies for municipal wastewater. For example, we are the only firm in North America to have designed virtually every type of phosphorus removal process being used at wastewater treatment facilities today. We have been at the forefront of wastewater treatment innovation for more than 60 years and we continue to be leader. We have been the first firm to apply several technologies and processes as shown in Exhibit 2-1.

EXHIBIT 2-1
Our History of Wastewater Innovation



Low Effluent Phosphorus Treatment Experience

Our firm has designed more than 200 wastewater treatment plants that include phosphorus removal processes. We have designed, constructed and operated plants that have achieve phosphorus effluent concentrations close to or lower than Waukesha's likely 0.06 mg/L limit (Exhibit 2-2). This limit will be the lowest in Wisconsin and close to the lowest in the United States and our team brings the needed, proven experience with these low level proceses.

Nutrient removal, including phosphorus removal, is one of the biggest challenges facing our wastewater clients throughout the United States. Our record of innovation and implementation in nutrient removal includes research, development, application of nutrient removal processes, pilot testing, implementation, and continued support of operations for advanced phosphorus and nitrogen removal facilities. Our innovation and leadership in nutrient removal is exemplified by the number of patentable nutrient removal technologies we have developed and pioneered. Our firm has been involved in patenting phosphorus treatment processes since 1989. We have since received a patent in 1996 for step-feed Bio-P (#5,480,548), another in 2003 for the use of moving bed reactors (MBRs) for nutrient removal (#6,517,723), one in 2004 for the application of MBRs to second-stage nitrification (#6,723,244), and two in 2005 for very low phosphorus removal using MBRs and a novel method of combining chemical and biological phosphorus removal steps that enables plants with low biochemical oxygen demand/phosphorus (BOD/P) ratios to economically achieve very low effluent phosphorus levels.

EXHIBIT 2-2
Example CH2M/Jacobs Low Phosphorus Limit Designs

Utility	Flow Rate	Phosphorus Effluent Level
West Camden Sewage Treatment Plant, New South Wales, Australia	6 mgd	**Target of 0.04 mg/L**
Regional WRF Design-Build -Operate Project, Spokane, WA	8 mgd	**Consistently achieves <0.05 mg/L**
Woonsocket, Rhode Island WWTP	16 mgd	**0.1 mg/L limit. Has achieved < 0.05 mg/L**
Metro Denver - Northern Treatment Plant	24 mgd	**Originally permitted for 0.1 mg/L; demonstrated less than 0.07 mg/L**
Rock Creek Advanced WWTP, Clean Water Services, Washington County, OR	23 mgd	**Permit limit of 0.07 mg/L; consistently less than 0.05 mg/L**
Blue Plains Advanced WWTP, DC Water, Washington DC	300 mgd	**Consistently achieved well below permit limit of 0.1 mg/L**
Skway WWTP Burlington, Ontario, CA	80 mgd	**Consistently achieves less than 0.1 mg/L**
Broad Run WRF, Loudoun County, VA	14 mgd	**Permit limit of 0.1 mg/L; has achieved 0.02 mg/L**
Alexandria VA WWTP	54 mgd	**Max month = 0.18 mg/L; has achieve less than 0.08 mg/L**

Our team includes Dr. Glen Daigger, who was involved in the development of most of these patented processes. Dr. Daigger will lead our senior review, where he will identify innovations that may be applied to help the District achieve its goals.

Wisconsin Phosphorus Compliance

Our firm offers comprehensive services in using innovative strategies for water quality compliance, including optimizing treatment processes for phosphorus and other pollutants, watershed assessments and credit trading. The project at hand will be the key to the City's phosphorus compliance plan and understanding how this project may impact that plan will be important. We have been a leader in assisting multiple Wisconsin wastewater utilities in complying with WDNR phosphorus regulations including NEW Water (Green Bay MSD), Appleton, Oshkosh, and Fond du Lac, in addition to our significant work in assisting Waukesha with compliance.

Our staff were heavily involved in the development of the Wisconsin phosphorus regulations and we continue to be involved in developing WDNR regulatory guidance. This involvement provides us the insights that may be needed to interpret the regulations to help achieve phosphorus compliance. In addition to our Wisconsin experience, our team brings national expertise in working with several other states and the U.S. EPA in development of water quality regulations which provides a broader perspective that can be brought to Waukesha.

Our core Wisconsin-based team has access to the firm's technical resources needed to address all aspects of this project. This includes the experts who have designed and operated municipal wastewater treatment plants that are achieving some of the lowest level phosphorus concentrations in the world. This experience will provide the depth and breadth of skills to efficiently determine the most beneficial and cost-effective path for phosphorus treatment that will meet the permitting requirements.

Tertiary Filtration

Our firm is a global leader in evaluating and designing tertiary treatment systems and the more than 200 tertiary systems that we have designed include those that have met some of the lowest phosphorus limits that exist. We have designed all of the commonly used and emerging types of tertiary treatment systems that are available and have had a key role in working with multiple equipment vendors to help make innovations in the tertiary treatment systems. In addition, we have provided performance guarantees for very low phosphorus tertiary treatment systems that we have designed rather than relying soley upon vendor guarantees that may be more limited and restrictive. We will bring the knowledge gained through this experience to Waukesha to help determine the best tertiary treatment system.

Pump Station Experience

Our firm has served in major design and construction roles for more than 200 pumping stations over the past 5 years with capacities up to 1,000 mgd and pumps as large as 66,000 hp. Our team is made up of highly experienced delivery leads who have the expertise and understanding required for designing and building large, complex pump stations, having successfully delivered similar projects around the world. Our technical experts bring years of extensive experience in design, cost estimating, construction management, and commissioning of large and high head pump stations, including resilience and recovery from power outages. We present to you a team who is expert in the configuration of pumping systems, mechanical equipment selection, layout of piping and valves, and analysis of pumping equipment and control valves. We examine innovative energy efficiency solutions that extending the equipment service life, run more quietly and require less cooling within the pump station space representing potential substantial energy savings.

Our pump station team is a blend of local and global technical experts, providing valuable insight into the City's facilities and staff, backed by a proven history of developing innovative solutions for pump stations to successfully deliver projects for our clients. The project matrix featured in Exhibit 2-3 shows some of our pump station experience.

Lake Michigan Water Supply Permitting Experience for Waukesha

Our team has led the technical development of the permitting strategy for the first-ever test of the Great Lakes—St. Lawrence River Basin Water Resources Compact. The City of Waukesha, located in the Mississippi drainage basin, was granted approval in 2016 to divert Lake Michigan water with return flow to the Lake Michigan basin through the Root River. We led the technical negotiations for the state and local permits and Compact approval conditions, gaining approvals from eight Great Lakes states, federal agencies and the two Great Lakes Provinces of Canada. This included working directly with City of Waukesha and outside legal counsel, and leading the coordination of those efforts with the City's 2012 WPDES permit renewal to ensure that the WPDES permitting strategy was aligned between City departments and consistent with the water supply permit. The permitting strategy was developed with the future in mind, to ensure that the ongoing 2017 WPDES permit application was also consistent with the 2016 diversion approval and compliments the City's infrastructure plans for a Root River discharge.

EXHIBIT 2-3
Pump Station Experience

Project Qualifications, Experience, and References

Jacobs' project portfolio showcases more than 200 pump stations around the world in the last 5 years with capacities up to 1000 MGD and pumps as large as 66,000 hp. The project matrix below offers more detail on selected projects that are similar to the Sioux Falls Main Lift Station project.

JACOBS

Project Name, Client and Location	Pump Size (MGD)	CFD Modeling/Hydraulics Evaluation	Pump Station Configuration Evaluation	Planning and Design	Services During Construction	Permitting	Energy Efficiency	Cost Estimating	Standby Generator Design
Lakeview Pump Station Pump Replacement Project, Sanitation District 1, Fort Wright, KY	25		•	•	•		•		•
Narrows Road Diversion New Pump Station, Sanitation District 1, Fort Wright, KY	17		•	•	•		•		•
Primary Effluent Pumping Station (PEPS), Sacramento Regional County Sanitation District (SRCSD), CA	480	•	•	•	•	•	•		
OSIS Augmentation and Relief Sewer (OARS) Diversion Structure (Pump Station), Columbus, Ohio	75	•	•	•	•		•		
Skyway WWTP Tertiary Lift Station Expansion, Burlington, Ontario, Canada	132	•	•	•	•	•	•		
Cedar Creek Pump Station Project, Tarrant Regional Water District, Fort Worth, TX	250	•	•	•	•		•	•	•
Wet Weather Pump Stations, Passaic Valley Sewerage Commission, Newark, NJ	50,40,40,26	•	•	•	•		•		•
Wastewater Pump Station Design, North Hudson Sewerage Authority, Hoboken, NJ	250	•	•	•	•		•		•
Hudson County Wastewater Pump Stations Upgrades, North Hudson Sewerage Authority, Hoboken, NJ	100,80,80,52	•	•	•	•	•	•		•
East Hartford WPCF Influent Pump Station Replacement, Hartford Metropolitan District, CT	250	•	•	•	•	•	•		•
Derek Guthrie Pump Station, Louisville MSD, KY	250	•	•	•	•	•	•		•
Flat Branch Pump Station, Upper Occoquan Service Authority, Centreville, VA	105		•	•			•		•
ASA Advanced WTF Influent Pump Station, Alexandria Sanitation Authority, VA	72	•	•	•	•		•	•	
Norman Cole Jr. PCP, Fairfax County, VA	67	•	•	•	•	•	•	•	•
Atherton WWTP Influent Pump Station, Independence, MO	52	•	•	•	•	•	•		•
Columbia Boulevard WWTP Influent Pump Station, Portland, OR	100	•	•	•	•	•	•	•	•
Green Bay WWTP Influent Pump Station, Green Bay, WI	49	•	•	•	•	•	•	•	
Jones Island WWTP Influent Pump Station, Milwaukee, WI	120	•	•	•	•	•	•	•	
Morris Forman WWTP Primary Effluent Pump Station, Louisville, KY	105	•	•	•	•	•	•	•	
West Point WWTP Influent Pump Station, King County DNRP, Seattle, WA	120	•		•	•		•	•	
Cottonwood Creek Lift Station, North Texas Municipal Water District, Wylie, TX	56	•	•	•	•	•	•	•	•
Southerly WWTP, Columbus, Ohio	210	•	•	•	•	•	•	•	•
Changi WRP Influent Pump Station, Republic of Singapore	1057	•	•	•	•	•	•	•	•
Hyperion WWTP, Los Angeles County Sanitation District, CA	400	•	•	•	•		•	•	•
Blue Plains WWTP, DCWASA, Washington, DC	890	•	•	•	•		•	•	
Thames Tideway Lee Tunnel Pump Station, London, UK	400	•	•	•	•	•	•	•	•
J Avenue Water Plant, Cedar Rapids, IA	42	•	•	•	•	•	•	•	•
WTF, Filter to Pump Station, Appleton, WI	3	•	•	•	•	•		•	
WFP Intermediate and High Lift Pump Stations, Oshkosh, WI	16	•	•	•	•	•	•	•	•
North Shore Water Commission, WTP, Intermediate PS Modifications WT, Milwaukee, WI	18		•	•	•	•	•	•	•
McCarrons WTP, St Paul, MN		•		•	•	•		•	
Low Lift & Highlift PS, Jefferson County, MO	3		•	•	•	•		•	•
WTP BWs PS, Weymouth, MA	15		•	•	•	•		•	
WTP High view PS, St Joseph, MI	15	•	•	•	•	•	•	•	
Oak Creek WTP, Oak Creek, WI	30	•	•	•		•	•	•	•

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Relevant Projects

Treatment Plant Upgrade, West Camden Sewage Treatment Plant, New South Wales, Australia

Project Description

The West Camden Sewage Treatment Plant, located in New South Wales, Australia, required upgrading for both increased capacity and to achieve new stricter nitrogen and phosphorus limits. The project was awarded to the CHBM Water Joint Venture (a joint venture between CH2M and Barclay Mowlem) late 2004 with the goal of increasing plant capacity from 2.6 mgd to 6.0 mgd on an average day basis. Additionally, full nutrient removal was implemented with a target effluent TN value of 7.5 mg/L (median) and ***a target effluent total phosphorus concentration average of 0.04 mg/L*** .

The West Camden STP Advanced System Design Achieves Total Phosphorus less than 0.04 mg/L

The scope of the upgrade included modifying the existing aerobic activated sludge system to a MLE process with a capacity of 1.8 mgd, adding two new continuous feed sequencing batch reactors (IDALs) at 4.2 mgd with biological phosphorus removal capabilities, tertiary clarifiers for phosphorus removal with alum and polymer dosing, doubling the tertiary filter capacity, new chlorine contact tank with hypochlorite dosing, new centrifuge thickening and dewatering with associated centrate holding and balance tanks, anaerobic digestion, digested sludge holding tanks and dewatered cake loading facility.

The upgrade has achieved its objectives of catering for future population growth in the wider Camden area and is providing improved water quality in the Hawkesbury-Nepean River and is able to provide up to 1.3 mgd of high quality recycled water to the Elizabeth Macarthur Agricultural Institute.

Phosphorus Removal Design

The phosphorus removal system is staged to achieve the lowest feasible chemical usage. The IDALs are not specifically designed to accomplish biological phosphorus removal, but do show 2 mg/L of excess biological phosphorus removal attributable to the anaerobic conditions present during the decant step. The MLE system relies entirely upon chemicals for its phosphorus removal. During the period of testing, all the flow was directed to the IDAL's system. The first stage is therefore biological phosphorus removal, augmented with both SPL addition and with the recycled alum sludge. After late August, the SPL dosage was 18 mg Fe/L and kept at that point for the remainder of the operating period.

Services Performed

Head contractor (JV partner), design management, project management, multidiscipline design and construction, functional and process commissioning, multidiscipline project incorporating civil, mechanical and electrical trades

Contract Duration

2004 – 2010

Client Reference

John Butow, Project Manager, (02) 9795-4300

Key Staff

Bruce Johnson

Spokane County Regional Water Reclamation Facility Design-Build-Operate Project, Spokane County Division of Utilities, Spokane, WA

Project Description

To meet future population growth, eliminate septic tank service, and reduce phosphorous discharge to the Spokane River, the Spokane County Board of Commissioners awarded our firm a $132M design-build-operate contract for a new greenfield 8-mgd water reclamation facility.

The state-of-the-art membrane bioreactor and nutrient removal systems ***achieves some of the lowest phosphorus effluent levels in North America, at 0.050 mg/L*** and 0.25 mg/L ammonia. The other notable aspect of the facility is the use of post-aerobic digestion (aerobic digestion after anaerobic) to greatly reduce nitrogen loads on the facility and improve volatile suspended solids destruction in the biosolids train.

The scope of work for the facility encompassed the design, permitting, construction, commissioning, and long-term operations of the new treatment facility. Construction was completed 7 months ahead of schedule and nearly $1M under budget, at which point we began a 20-year facility operation and maintenance period that includes administration of the County's Industrial Pretreatment Program.

The plant's sustainable design allows energy recovered through digester gas production, process heating, and cogeneration systems to produce electricity to help run the facility. Using this renewable energy will help the environment and reduce electrical costs for the County, and were designed to meet LEED™ Silver criteria. Our team self-performed all design disciplines including mechanical, electrical, structural, civil, instrumentation and controls, heating, ventilation and air conditioning, architectural, geotechnical, and process. We also led permitting, construction management, yard piping, equipment installation, process mechanical, concrete/civil work, SCADA and I&C installation, and long term O&M operations and planning.

The plant serves as a catalyst for revitalization of the area, while being a good neighbor to existing developments. An advanced SCADA system that can allow unattended operations was implemented and integrated with maintenance management and operations optimization programs to minimize operation and maintenance costs.

Our staff developed a proactive and aggressive approach for addressing the permitting, and received permits ahead of schedule due to a long history of collaboration with regulatory agencies, including the Department of Ecology, Environmental Protection Agency, Spokane Regional Clean Air Agency, City of Spokane, and the Washington Department of Transportation.

Services Performed

Prime designer, builder, and operator

Contract Duration

2009 – 2011 (O&M end date 2031, Design-build final acceptance December 2013)

Client Reference

Rob Lindsey, Water Programs Manager, 509-477-7576

Key Staff

Glen Daigger, Bruce Johnson

Regional Wastewater Treatment Plant Nutrient Removal Upgrades, Operate-Design-Build-Operate Contract, City of Woonsocket, RI

Built in the early 1930s with subsequent upgrades in the 1960s, 1970s and 1990s, the Woonsocket WWTF is burdened with aging equipment and faces increasingly stringent regulatory requirements from the Rhode Island Department of Environmental Management. The City of Woonsocket selected our firm to assume operations of the existing facility, perform design-build upgrades, followed by long-term operations of the improved wastewater treatment facility. A key objective was to reduce nitrogen and phosphorus loads to the Blackstone River and thereby make a positive impact on water quality.

Our team was responsible for permit compliance with the facility's RIPDES permit. Under this new permit, the facility must meet a seasonal total effluent nitrogen concentration of 3.0 mg/L between May 1 and October 31, and a total effluent phosphorus concentration of 0.1 mg/L in summer months. **The plant has achieved less than 0.05 mg/L total phosphorus.** Nutrient removal upgrades were complete by May 2017.

We designed an innovative and cost effective process to achieve the state-of-the-art limits for the nutrient removal upgrades at the treatment plant. The process is termed the "AB process," and is being constructed within the existing aeration basins. The AB process consists of three "A" process trains followed by two "B" process trains, followed by secondary clarification and sand filtration.

One advantage of the AB process is that the multiple zones are being constructed within the existing aeration basins and the traveling bridge sand filters are being retained. Another advantage is that during wet weather flows, there is the ability to replenish the nitrifiers in the "A" trains from the "B" trains to maintain high levels of performance for nitrogen removal. These features have provided a very robust multi-barrier and cost-effective solution.

Services Performed

Prime designer, builder, and operator

Contract Duration

2012 – 2017

Client Reference

Alan Brodd, Director of Public Works, 401-767-9209

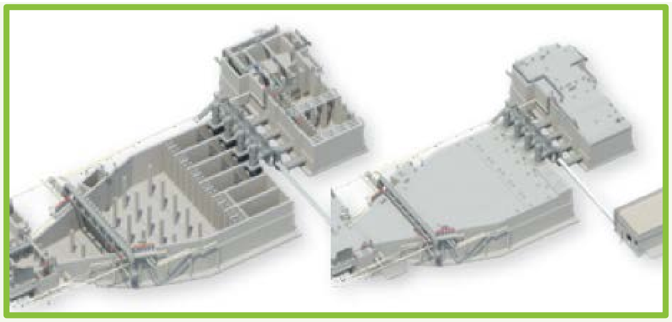
Key Staff

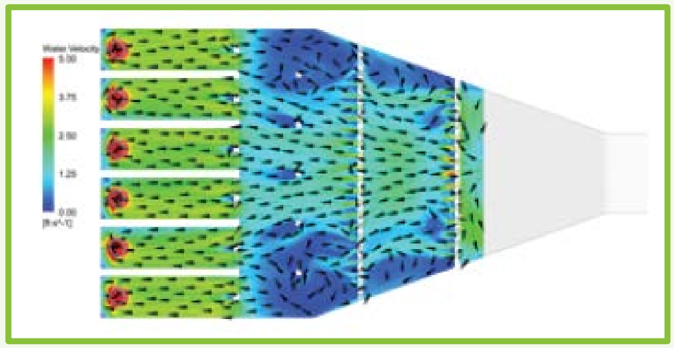
Bruce Johnson, Colin Fitzgerald

Primary Effluent Pumping Station, Sacramento Regional County Sanitation District, CA

The Primary Effluent Pumping Station (PEPS) Project provided a new influent lift station to allow a new biological nutrient removal (BNR) process to be added into the existing treatment train at the Sacramento Wastewater Treatment Plant.

The work included the preliminary and final design of an 800-foot extension of a 400-mgd capacity primary effluent channel, a large self-cleaning wet well structure sized for flow up to 720 mgd (initially fitted for 480 mgd, plus future expansion capacity), distribution structure to feed primary effluent to the BNR process, a variety of diversion structures, extensive site development, and related work. The pump station includes six 120-mgd pumps (4 initial, 6 total), each fitted with a 450 hp induction motor controlled using a variable speed drive. The design was supported by a combination of CFD and physical hydraulic modeling to verify the configuration while minimizing project schedule risks. Hydraulic Institute standards would have required an enormous wet well for a pumping system of this capacity. Our team was able to design a compact fan-style wet well by using CFD modeling analysis to support the design and still achieve full HI compliance while reducing the site footprint and construction cost.


3D design renderings of wet well and discharge structure


CFD Analysis of the PEPS wet well allowed a cost-effective and hydraulically efficient design

The project also included a biofilter to treat foul air from the pumping plant, and extensive site development. Energy efficiency through proper pump sizing and variable speed drive operations was confirmed using REPLICA™ for the simulation of the full range of operations conditions.

Services Performed

Preliminary and final design

Contract Duration

2013 – 2016

Client Reference

Graham Calciano, Sacramento Regional Co Sanitation District PMO, 916-875-9456 / calcianog@sacsewer.com

Key Staff

Kevin Nielsen, Tony Naimey

Raw Water Intake Pump No. 2 and Lake Mead Intake No. 2 and 3
Southern Nevada Water Authority, Las Vegas, NV

The multi-year, multi-component program was designed to provide a deeper water intake to maintain water supply to Las Vegas if drought conditions continue and lake levels drop to forecast lows. It involved major intake tunnels, integrated pump stations, other infrastructure, and was delivered under separate contracts and delivery methods to meet schedule.

Intake No. 2: Involved project management and design for a 1,600-foot intake tunnel constructed by drill and blast and a 600-mgd pump station with deep rock chamber; and a 20-foot internal diameter surge shaft, 300-feet deep with surge chamber constructed in rock. The team developed/executed a geotechnical program, analyzed geotechnical data and engineering computations, prepared GBR, prepared plans and specifications, and conducted geotechnical observations during construction. Complex hydraulic, compatibility, and O&M issues were resolved to integrate existing and new facilities.

Intake No. 3, Contract 1: CH2M and a joint venture partner provided design and construction support of Intake No. 3. The tunneling portions of the project involved three contracts: an approximately $489M intake tunnel and riser assembly, using design-build (DB) delivery; a $30M gate shaft and partial connecting tunnel to Intake No. 2; and a $45M surge shaft and IPS-2 connecting tunnel (nearing construction).

Our team was responsible for project management and was lead designer for planning, preliminary engineering, preparation of design-build tender documents including a GBR for DB, owner's engineer review of design-builder submittals and engineering services during construction for the new deep lake intake. The project involved tunneling approximately 3 miles of 20-foot internal diameter tunnel to an intake riser located at a water depth of approximately 300 feet. The tunnel was bored using a dualmode tunnel boring machine (TBM) (slurry mix-shield for closed mode and EPB-like screw conveyor for open mode) through highly faulted hard Precambrian rock, variable weak to strong Tertiary mudstone-siltstone, and sandstone and conglomerate ending in layered basalt and mudflow rock. Tunnel depths ranged from 387 to 606 feet with groundwater heads between 10 and 15 bar. The final lining is primarily a one-pass, backfill grouted, precast concrete segmental lining installed during tunnelling.

Intake No. 3, Contract 2: Involved construction of a 490-foot-deep, 28-foot internal diameter surge shaft; approximately 328 feet of 22-foot-internal diameter horseshoe tunnel; a tunnel bulkhead; and approximately 2,585 feet of 17-foot internal diameter horseshoe tunnel within variably faulted and sheared amphibolite gneiss. Tunnel depths range from 410 to 490 feet with groundwater heads in the range of 9 to 10 bar. Initial support consists of rock bolts and dowels. The final lining consists of rock bolts and steel fiber shotcrete.

Services Performed

Project management, design and services during construction; for DB project, preliminary engineering, preparation of design-build tender documents, and GBR

Contract Duration

2000 – 2014

Client Reference

Erika Moonin, Project Manager, 702-822-3342

Key Staff

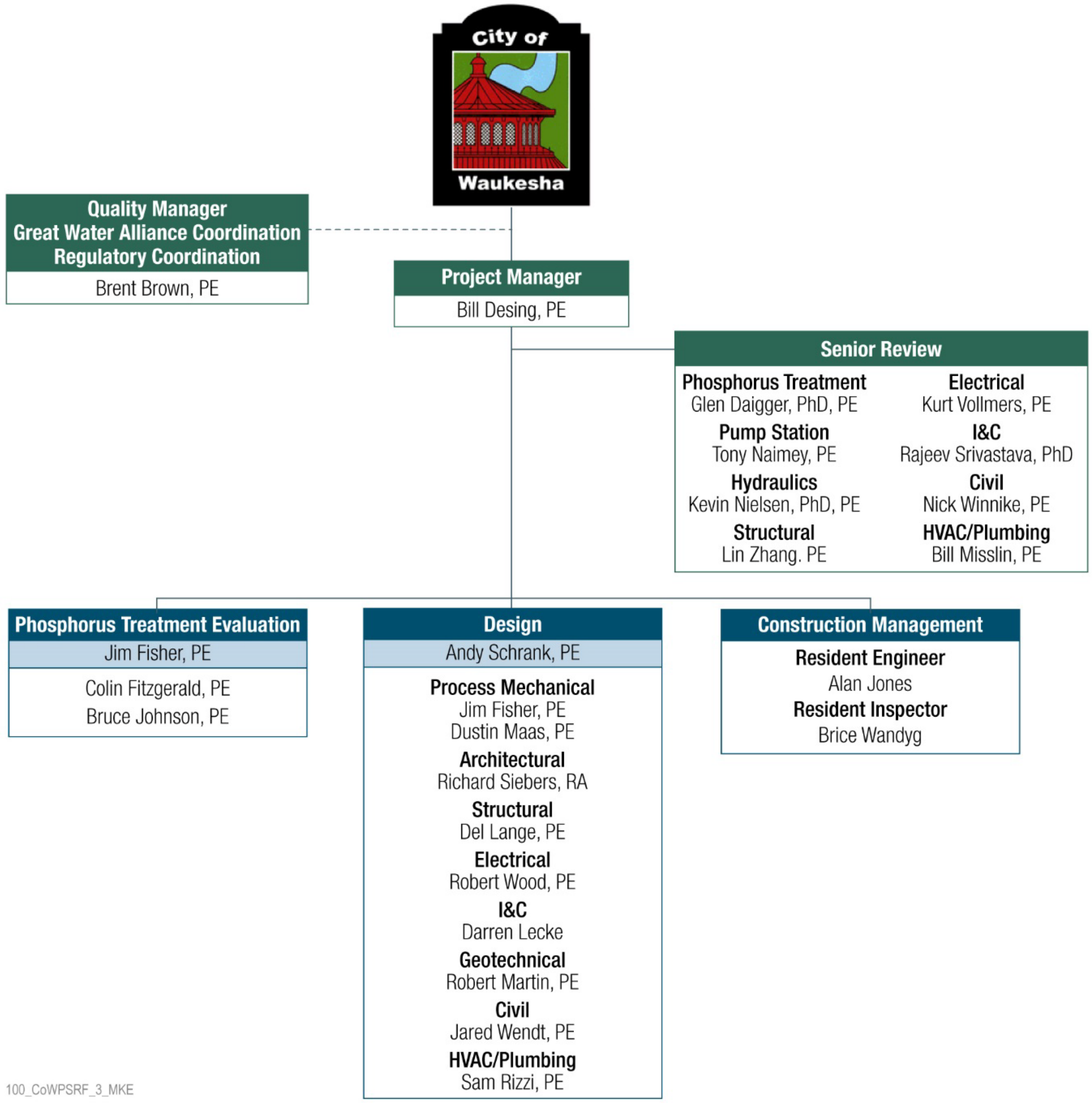
Tony Naimey

Section 03—Qualifications of Individuals Assigned

SECTION 03

Qualifications of Individuals Assigned

EXHIBIT 3-1
Organization Chart



Team Overview

We are a locally based team supported by top global experts that will design facilities to reliably and cost effectively meet the WDNR effluent permit requirements as well as the conditions of the Great Lakes Compact. Our team offers the following important attributes for the successful completion of the project.

- Key members of our team have been working with the City for more than 18 years on water supply issues, approval of the Great Lakes Compact, addressing wastewater permitting issues and amendment of the Clean Water Plant Facility Plan. We will use the experience and knowledge gained through that work to help ensure that facilities design will meet the effluent permit and requirements of the Great Lakes Compact.

- Members of our team have a proven track record of designing wastewater facilities that meet phosphorus effluent limits as low or lower than Waukesha's likely limit of 0.06 mg/L. Our team includes globally recognized experts in phosphorus treatment who hold multiple patents for innovations in phosphorus treatment who have designed and operated plants with some of the lowest phosphorus effluent limits in North America.
- We bring you experts in pump design and hydraulics that will oversee the design of the pump station who will help ensure the pump station is reliable, functions properly and saves energy. The Water Utility will be completing a hydraulic transient analysis to determine if there is a need for surge protection and our hydraulics experts, who have extensive experience in surge protection, will consider how that analysis may affect the pump station design.
- We are a team with no subcontractors, giving the City a single source of responsibility who will manage all project aspects. Most work will be executed by staff from our Milwaukee office, located within a 15-minute drive from the plant, which will save travel costs and make our team available on short notice for meetings and site visits.

Key Personnel

Bill Desing, PE, Project Manager

Bill has more than 30 years of experience in wastewater treatment planning, design, construction and operations for plants ranging from 5 to 300 mgd. He has assisted Wisconsin wastewater utilities including NEW Water (Green Bay), Oshkosh, Appleton, Waukesha, and Madison in evaluating tertiary treatment alternatives for phosphorus. He is currently serving as the project manager for NEW Water's Final Phosphorus Compliance Plan. Part of that plan involves evaluating tertiary treatment options for phosphorus for NEW Water's 12-mgd De Pere Plant that currently uses sand filter for tertiary treatment. Conceptual designs are being completed for rehabilitating the sand filters, coagulation flocculation improvements, cloth filters, and ballasted sedimentation.

Bill served as the project manager for NEW Water's Biosolids Facility Plan that evaluated biosolids handling options. That project defined plans for NEW Water's new biosolids facilities that later became known as R2E2. Bill managed the basis of design for that $169M project that includes centrifuge thickening, digestion, drying, engine generators, co-digestion facilities, and incineration. In addition, he served as project manager for the design and construction services for the $28M upgrade project for Grand Chute Menasha—West that included phosphorus treatment facilities, digestion and numerous other plant upgrades. For the Milwaukee Metropolitan Sewerage District, he served as project manager to develop a comprehensive energy management plan for both of their plants and the collection system. The plan identified and evaluated the numerous energy generation and conservation projects that would be needed to achieve the District's goal of generating 100 percent of their energy from renewable sources by 2035. He has been involved in several projects that incorporated pump stations including serving as the design manager for the Northeast Ohio Regional Sewerage District's Westerly Plant CSO treatment facility that could treat up to 900 mgd.

Brent Brown, PE, Permitting and Great Water Alliance Issues

Brent is a water resources engineer with expertise in watershed assessment and management, nutrient management, water quality modeling and monitoring, and water quality permitting strategies. For the past 18 years, Brent has worked with the City of Waukesha beginning with assisting with development of the Great Lakes Compact. Most recently he has assisted the City with planning and permitting the return flow to the Root River as part of the Great Water Alliance. This permitting included working with the City and the WDNR to establish the phosphorus effluent limits and conditions. Brent also helped develop the Clean Water Plant Facility Plan Amendment that included planning for phosphorus compliance and return flow. He has assisted several Wisconsin wastewater utilities in complying with WNDR phosphorus regulations including NEW Water, Appleton, Oshkosh, Grand Chute Menasha-West, and Fond du Lac. He also had significant involvement in working with the WDNR in developing the relatively recent phosphorus regulations.

Brent will review the phosphorus treatment and return flow pump station design concepts to help ensure that they will meet the permitting requirements that he has been involved in. For example, he will help evaluate how a change in the effluent phosphorus averaging period could impact the ability of different treatment processes to meet permit limits.

Jim Fisher, PE, Phosphorus Treatment Evaluation and Design

Jim is a senior wastewater treatment technologist with 28 years of experience in wastewater process planning, design, and operation, including significant experience in phosphorus treatment. He recently assisted the Waukesha Clean Water Plant in preparing a facility plan amendment to address phosphorus treatment alternatives and return flow pumping. He was the lead process engineer for the Madison, Wisconsin Nine Springs Wastewater Treatment Plant project, which evaluated treatment processes and costs for nine potential combinations of effluent phosphorus and nitrogen limits to comply with WDNR phosphorus regulations. He developed conceptual designs and cost estimates for NEW Water to achieve compliance with WDNR’s phosphorus rules. Jim served as project manager for the evaluation of phosphorus treatment options for Appleton Wisconsin where multiple treatment methods were evaluated for achieving compliance with their new lower limits. He served as instructor for a continuing education course titled “Theory and Practice of Phosphorus Removal” that presented alternatives for meeting very low effluent phosphorus concentrations to meet new Wisconsin regulatory requirements. He conducted research at the University of Wisconsin—Madison on factors important to design and operation of phosphorus removal using iron and aluminum salts.

Jim’s experience includes process selection; capacity evaluation and design using steady state and dynamic modeling, stress testing, and bench-scale testing; detail process and mechanical design; and facility startup and operation. Jim is presently supporting the City of Waukesha Clean Water Plant on return flow including required pumping rate, phosphorus compliance, and chloride compliance.

Glen Daigger, PhD, PE, BCEE, Senior Review—Phosphorus Treatment

With 40 years of experience in his field, Glen is an internationally recognized expert in wastewater treatment technologies and one the world’s top experts in phosphorus and tertiary treatment. Through his project work, and as past president of IWA, he has also advanced the concept of addressing water quality issues through holistic solutions that involve the entire water cycle including the watershed, treatment, and drinking water. He is the recipient of awards from the American Consulting Engineering Council for innovative biological phosphorus and nitrogen removal processes, the American Academy of Environmental Engineers, and *Engineering-News Record,* and holds two U.S. patents for low phosphorus removal processes. He is the coauthor of *Phosphorus and Nitrogen Removal from Municipal Wastewater—Principles and Practice* (Lewis Publishers). Glen has served as senior reviewer for several projects that are meeting or exceeding the likely 0.06 mg/L phosphorus limit that the Waukesha Clean Water Plant will have and has led the process design for plants that have some of the lowest phosphorus effluent limits in the world. Glen will attend workshops to help select the phosphorus treatment alternative for the City.

Tony Naimey, PE, Senior Review—Return Flow Pump Station

Tony is our firm’s foremost expert in the design and construction of large-scale, high pressure pump stations. He has more than 30 years of experience in the design of pump stations, flow control facilities, pressure-reducing facilities, large-diameter pipelines, and wastewater and water treatment facilities. Tony has developed and implemented cutting-edge variable-speed pumping controls that maximize pump performance and operating efficiencies. He is also responsible for firmwide technology leadership in mechanical engineering best practices and design processes and tools. Tony regularly serves as a design reviewer on projects involving process mechanical and pump station design and brings a long resume of experience to this role on WWU’s project.

Kevin Nielsen, PhD, PE, Senior Review—Hydraulics

Kevin specializes in fluid mechanics, hydraulic design, hydrology studies, and environmental water resources project planning related to conveyance and collection. He is the company's top expert in hydraulics for pump stations and treatment plants and has led pump station hydraulics for stations with capacities approaching 800 mgd. He has led the design or review of numerous hydraulic designs for large pump station including innovative wet well designs and evaluation of and design of surge protection systems. He participates in value engineering studies to review designs associated with pipeline and pump station systems, river protection and control structures, energy dissipation, and several other associated hydraulic components. Kevin currently serves as the firm's global hydraulics leader for hydraulic transient analysis, application of computational fluid dynamics, and advanced hydraulic modeling, evaluation and design.

Bruce Johnson, PE, BCEE, Phosphorus Treatment Evaluation

Bruce has more than 30 years of experience in operating, troubleshooting, and designing water and wastewater treatment plants and equipment. He is a Technology Fellow and process engineer in Jacobs Buildings, Infrastructure and Advanced Facilities Group. He formerly held the role of Global Technology Leader for Municipal Wastewater Treatment within our firm and currently serves as the Global Practice Leader for Wastewater Simulation and is the Technical Process Design Lead for our Design-Build program. With 30 years of experience in the design, operation, and startup of water and wastewater treatment equipment, he is an international expert in the design of low-level phosphorus and nitrogen removal systems using biological, chemical, and physical separation technologies. Bruce served as lead process engineer or senior reviewer for several projects that are meeting or exceeding the 0.06 mg/L phosphorus limit that the Waukesha Clean Water Plant will likely be expected to meet.

Andy Schrank, PE, Design Lead

Andy has 34 years of water engineering experience for major municipal water, wastewater collection and treatment, and industrial projects, on which he regularly serves as design manager, project manager or resident engineer. He has experience with a broad range of biological and physical/chemical wastewater treatment processes. He also has experience with various project delivery approaches, including engineer-procure-construct, design-build, and traditional design-bid-build approaches. He recently served as project manager for the design of multiple pump stations on a water infrastructure capital program that included approximately 100 miles of mainline pipeline consisting of 30-inch and 36-inch HDPE pipe with eight main line pump stations. Most recently, he assisted in the design and construction of NEW Water's $169M R2E2 project which included the improvements needed to comply with their new lower WDNR phosphorus effluent limits.

Colin Fitzgerald, PE, Phosphorus Treatment Evaluation

Colin is a process engineer with broad experiences in wastewater treatment. He is well-versed in wastewater treatment plant process engineering, detailed design, and wastewater treatment modeling. He has led the process engineering for evaluation of phosphorus treatment options for several Wisconsin wastewater facilities including NEW Water and Oshkosh, WI. For NEW Water he is leading the evaluation of upgrading their tertiary sand filters to comply with phosphorus regulations at their De Pere Plant that includes a comparison of ballasted flocculation, sand filters, Lamella separators and cloth filters. Colin has performed wastewater treatment plant process modeling and uncertainty analyses for projects ranging in size from 1 mgd to 405 mgd.

Dustin Maas, PE, Design—Process Mechanical

Dustin Maas has 11 years of experience in wastewater and water facility planning and design. He has served as the process mechanical designer for a variety of wastewater projects for plants with capacities ranging from 3 to more than 100 mgd. Dustin is currently assisting with the preparation of NEW Water's Final Phosphorus and TSS Compliance Plan, which addresses options to reduce phosphorus and TSS in the DPF effluent. He also is assisting the City of Oshkosh with conceptual designs of alternative for complying with WDNR phosphorus regulations.

Alan Jones, PE, Construction Management—Resident Engineer

Alan has more than 35 years of experience in the execution and coordination of planning, design, and construction phase activities. He has developed and implemented construction program organizations, delivery processes, and start-up activities on major wastewater programs in the U.S. and internationally. He has served as resident engineer on a wide range of wastewater and water project including serving as a resident engineer for the Milwaukee MSD's South Shore Plant ($100M+ construction) and the Grand Chute Menasha-West, WI wastewater plant upgrade ($28M construction). Currently, Alan is the construction manager for the multi-disciplinary team delivering the $169M Resource Recovery Electrical Energy construction project for NEW Water in Green Bay, that includes new thickening, digestion, engine generators, drying, centrifuge dewatering and incineration.

Brice Wandyg, Construction Management—Resident Inspector

Brice has more than 12 years of experience in field inspection and contract management of heavy civil projects including several water supply and wastewater systems. He is currently serving as the lead inspector for NEW Water's R2E2 project, responsible for field inspection of a new solids processing building, including the construction of cast-in-place reinforced concrete, precast concrete panels, and all other structural elements, working under the guidance of construction manager Alan Jones. Bryce served as a construction inspector for the $2.3B project to upgrade to the City of Chicago's drinking water systems that included upgrading multiple pump stations and replacing 880 miles of water pipelines.

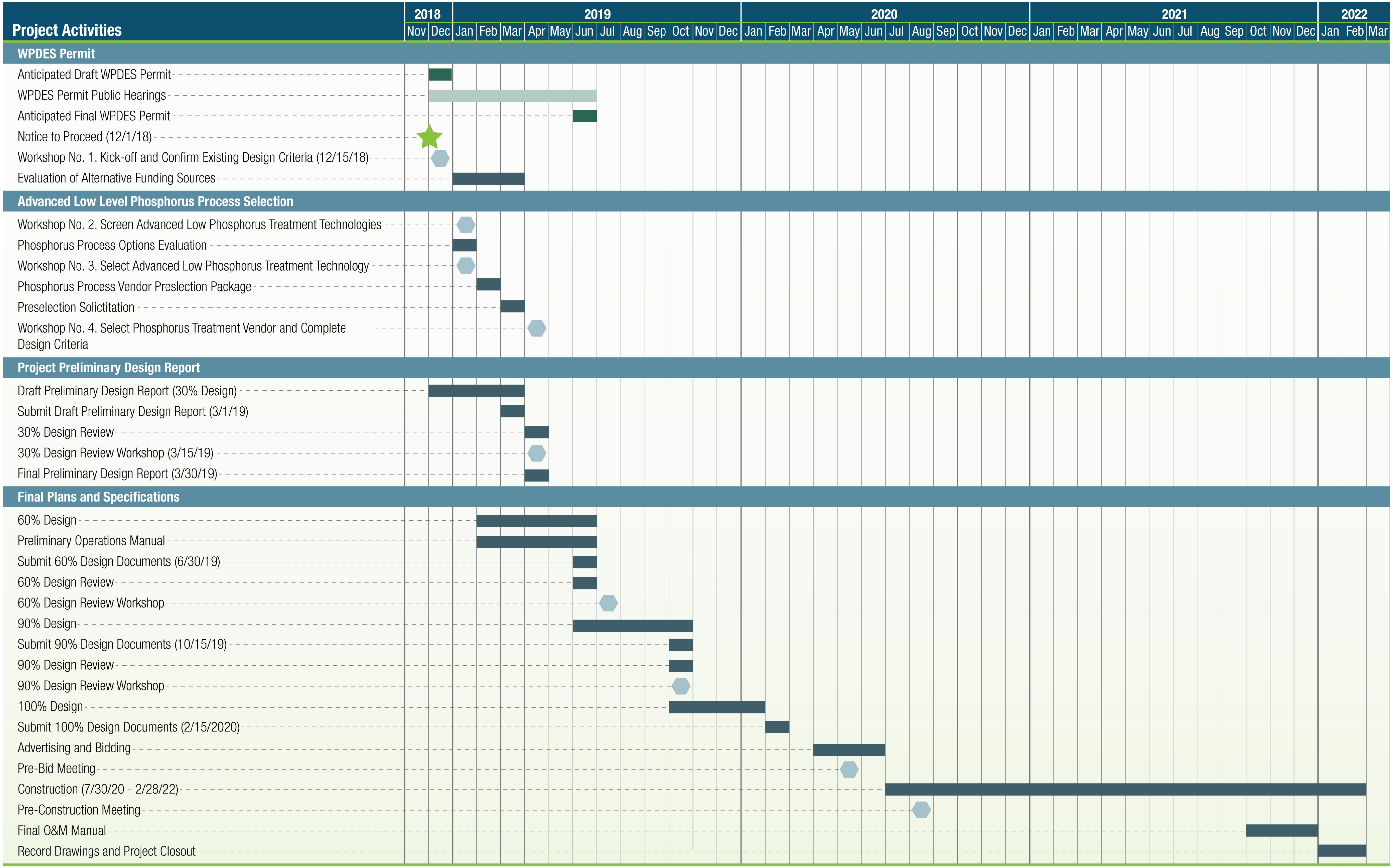
Section 04—Ability to Meet Schedule

SECTION 04

Ability to Meet Schedule

Through our involvement with the City on the Great Water Alliance Program, the WPDES permit, return flow, phosphorus improvements studies, and the Diversion Permit, we are uniquely qualified to provide seamless coordination between those activities and the project at hand. We have a thorough understanding of the needs of the Program, and the experience of working with the CWP and DPW on planning related to return flow and phosphorus treatment infrastructure for the CWP. This experience will benefit the CWP and DPW by leveraging our knowledge of the past work to efficiently meet the Program schedule requirements outlined in the Water Utility and DPW memorandum of understanding. Our team will use our background knowledge to hit the ground running and avoid a learning curve for permitting issues that could otherwise consume valuable schedule time.

The ability to meet the interim and final completion milestones are highly dependent on ongoing work being coordinated through the Program, including the approval of the 2018 Facility Plan Amendment, obtaining a draft and final WPDES permit, and WDNR approval of the return flow management plan criteria that will be authorized through the Diversion Permit. Our proposed schedule leverages past studies and incorporates new and updated evaluations, to achieve the overall required project schedule. Our proposed schedule allows for time for new process technology evaluations and a thorough pump station design that will ultimately reduce the City’s project costs and risks.


Project Activities
2018
2019
2020
2021
2022
Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar
WPDES Permit
Anticipated Draft WPDES Permit
WPDES Permit Public Hearings
Anticipated Final WPDES Permit
Notice to Proceed (12/1/18)
Workshop No. 1. Kick-off and Confirm Existing Design Criteria (12/15/18)
Evaluation of Alternative Funding Sources
Advanced Low Level Phosphorus Process Selection
Workshop No. 2. Screen Advanced Low Phosphorus Treatment Technologies
Phosphorus Process Options Evaluation
Workshop No. 3. Select Advanced Low Phosphorus Treatment Technology
Phosphorus Process Vendor Preslection Package
Preselection Solictitation
Workshop No. 4. Select Phosphorus Treatment Vendor and Complete Design Criteria
Project Preliminary Design Report
Draft Preliminary Design Report (30% Design)
Submit Draft Preliminary Design Report (3/1/19)
30% Design Review
30% Design Review Workshop (3/15/19)
Final Preliminary Design Report (3/30/19)
Final Plans and Specifications
60% Design
Preliminary Operations Manual
Submit 60% Design Documents (6/30/19)
60% Design Review
60% Design Review Workshop
90% Design
Submit 90% Design Documents (10/15/19)
90% Design Review
90% Design Review Workshop
100% Design
Submit 100% Design Documents (2/15/2020)
Advertising and Bidding
Pre-Bid Meeting
Construction (7/30/20 - 2/28/22)
Pre-Construction Meeting
Final O&M Manual
Record Drawings and Project Closout
106_CoWPSRF_2_MKE

Appendix A—Resumes

APPENDIX

Resumes

Bill Desing, PE, Project Manager

Education and Professional Registrations

MS, Science, Environmental Engineering, Marquette University

BS, Science, Civil Engineering, Marquette University

Professional Engineer: Illinois, Wisconsin

Distinguishing Qualifications

- 32 years of experience in wastewater project management, planning, design, and operations, with significant, recent experience in managing phosphorus removal projects
- Has served as project manager, senior technologist, or process design manager on numerous wastewater treatment facility plans and design projects for plants ranging in size from 5 mgd to more than 200 mgd
- Has worked with several Wisconsin wastewater utilities to comply with WDNR phosphorus
- Has been involved with projects that included design of pump stations ranging from 5 to 900 mgd

Relevant Experience

Project Manager and Compliance Alternatives Analysis Lead, Preliminary Compliance Alternatives Plan, NEW Water, Green Bay, WI. NEW Water needed to evaluate alternatives to comply with regulatory requirements for phosphorus and TSS as required in the December 2015 Wisconsin Pollutant Discharge Elimination System (WPDES) permit. Bill led a team that provided a thorough and comprehensive evaluation of each compliance option or combination of options, resulting in a compliance plan that is most advantageous to NEW Water. Our team helped NEW Water to reduce compliance costs through application of the latest innovative and novel treatment technologies and watershed-based compliance approaches.

Project Manager and Compliance Alternatives Analysis Lead, Final Compliance Alternatives Plan, NEW Water, Green Bay, WI. The final plan built upon the work done in the Preliminary Plan. The plan included evaluating tertiary treatment options for their 18 mgd De Pere Plant that considered rehabilitating the existing sand filters, replacing the sand filters with cloth filters, and replacing the sand filters with ballasted flocculation and sedimentation (e.g. CoMag and Actiflo).

Principal-in-Charge, Appleton Wastewater Treatment Plant Compliance Plan. Served as principal-in-charge for the preparation of Appleton's phosphorus and TSS compliance plan. The project included extensive process modeling and full-scale pilot testing.

Task Manager, Oshkosh Wastewater Plant Phosphorus Compliance Plan. Currently serving as task manager for preparation of Oshkosh's phosphorus compliance plan which includes Monte Carlo uncertainty analysis, process modeling and evaluation of tertiary treatment alternatives.

Project Manager, Carol Stream Wastewater Treatment Facility Phosphorus Optimization and Feasibility Study, Carol Stream, IL. Managed a team that evaluated the feasibility of achieving phosphorus effluent concentrations of 1.0, 0.5 and 0.1 mg/l. A process model was developed, and Monte Carlo uncertainty analysis was used to estimate the achievable effluent phosphorus concentrations under a wide range of influent wastewater characteristics to determine the probability of meeting the limits for varying permit averaging periods. The study also included identifying and controlling sources and influent phosphorus. Industrial and commercial sources of phosphorus were quantified by sampling and analyzing numerous samples for phosphorus. Recommendations were made to reduce phosphorus effluent through changes in plant operations and process control.

Project Manager, Facility Plan and Design, Grand Chute-Menasha West Wastewater Treatment Plant, Grand Chute, WI. Project manager for the development of a 20-year facility plan and design for the Grand Chute-Menasha West Wastewater Treatment plant. The project included evaluating several alternatives for liquid treatment, wet weather flows and solids handling and disposal. The design and construction included a $27-million-dollar expansion of plant capacity, biological phosphorus removal, nitrification capabilities and rehabilitation and replacement. The design was executed on a 5-month fast track schedule to make the deadline to receive a $14M U.S. Federal stimulus grant.

Task Manager, Basis of Design Resource Recovery and Electrical Generation Facility (R2E2), NEW Water, Green Bay, WI. Led a team in the basis of design for a $169 million biosolids processing facility to reduce fossil fuel use by 75 percent. The facilities designed included new silo-shaped digesters, co-digestion waste receiving facilities, dewatering centrifuges, centrifuge thickening, odor control, drying, fluid bed incineration, internal combustion engines, nutrient recovery including phosphorus release tanks and fluid bed struvite formation, and a thermal oil heat recover system.

Project Manager, Solids Management Facility Plan, NEW Water, Green Bay, WI. The facility plan initially evaluated 17 solids processing alternatives to replace NEW Water's aging dewatering and incineration system. Ultimately, the alternative that used digestion, incineration with advanced air pollution control, power generation, and heat recovery was selected for what was later referred to as the Resource Recovery and Electrical Energy Project, or R2E2. Our team was selected to design the R2E2 project facilities – a project with an estimated $169M capital cost.

Lead Engineer, CSO Treatment and Conveyance Facility Plan, City of Fort Wayne, Fort Wayne, IN.
Led facility planning for design of improvements to Fort Wayne's 350 mgd CSO treatment and conveyance system. Facilities included a 350 mgd pump station, solids removal and handling and three CSO storage ponds with a storage capacity of 400 million gallons. Prepared conceptual design of odor control alternatives for the treatment systems.

Design Manager, 900-mgd Combined Sewer Overflow Facility, Northeast Ohio Sewer District, Cleveland, OH. Lead process engineer for the design of improvements to a 900 mgd CSO treatment system. The system included a pump station, screening and primary treatment. In addition, an evaluation of methods to disinfect the CSO treatment system effluent was completed. Methods for disinfection that were considered included ozone, sodium hypochlorite, and ultraviolet light.

Project Manager, Energy Plan Milwaukee Metropolitan Sewerage District, Milwaukee, WI. Evaluated and documented more than 100 alternatives as part of a long-term plan to help MMSD achieve its' goal of achieving 100 percent renewable energy use.

Project Manager, Greenhouse Gas Inventory and Energy Footprint, Milwaukee Metropolitan Sewerage District, Milwaukee, WI. Project manager for an inventory of greenhouse gas emissions for the District's operations and facilities, including the Jones Island and South Shore Water Reclamation Facilities, the Headquarters Central Lab Building, the Metropolitan Interceptor Sewer System, the Inline Storage and Pumping System, and utility-owned vehicles. Performed the inventory that estimated emissions from each source of the six gases covered by the Kyoto Protocol.

Brent Brown, PE, Quality Manager, Great Water Alliance Coordination, and Regulatory Coordination

Education and Professional Registrations

MS, Environmental Engineering, University of Illinois at Urbana–Champaign

BS, Civil Engineering, University of Wisconsin at Platteville

Professional Engineer: Wisconsin, Ohio

Distinguishing Qualifications

- 18 years of experience developing and implementing permitting strategies for public and private water and wastewater clients
- Proven track record of coordinating various departments within the City of Waukesha as part of the Lake Michigan water application, and as the current Great Water Alliance
- Extensive knowledge of site-specific permitting needs for the City of Waukesha Diversion and WPDES permits
- Extensive experience negotiating permit conditions with Wisconsin DNR, including with senior management and legal teams to develop site-specific agreements
- Manage diverse teams of engineers, scientists and client legal counsel for planning and implementing nutrient, hydraulic, and hydrologic-based programs

Relevant Experience

Task Leader, City of Waukesha Application for Lake Michigan Water Supply, Waukesha, WI. Supported the City with water supply planning in 2001 through developing their application for Lake Michigan water in 2013, with approval in 2016. Facilitated discussions with regulatory officials to reach consensus on the analyses and documentation within the application and supporting documents. Developed an innovative return flow management plan that meet state and international requirements for the Lake Michigan diversion. Completed multiple assessments to evaluate multiple return flow alternatives, including assessments of water quality, stream geomorphology, land use impacts, constructability, flooding, flashiness, diurnal flow variations, fisheries and macroinvertebrate impacts, and wetlands. Developed an exhaustive environmental report for the water supply and return flow alternatives that is supportive of a NEPA process and EIS.

Task Leader, Waukesha Water and Wastewater Return Flow Permitting and Facility Planning, Waukesha, WI. Leading a team of engineers, scientists and legal counsel to obtain the first-ever permit for obtaining Lake Michigan water for a community outside the Great Lakes Basin. Lead the consultant support of WPDES permit application and renewal, including technical works and coordination between the water and wastewater utilities to support the permitting for two discharge locations from the wastewater treatment plant.

Project Manager, Adaptive Management Program, NEW Water, Green Bay, WI. Leading the development of Adaptive Management Plan that balances improvements at the WWTP with watershed works within the 38,000 acres watersheds of Ashwaubenon and Dutchman Creeks. This plan integrates permit compliance strategies consistent with numerous Phosphorus Compliance Alternatives Plan evaluations and a memorandum of understanding (MOU) between NEW Water and the WDNR that was developed for the site-specific conditions that allowed Adaptive Management to be advantageous for permit compliance. The MOU was closely coordinated with the client legal counsel, and the Adaptive Management Plan includes the most comprehensive water quality and biological monitoring plan in the State, to allow NEW Water strategic options for meeting permit conditions.

Project Manager, Adaptive Management Pilot Project, Silver Creek Watershed, NEW Water, Green Bay, WI. Leading a team of engineers, scientists, agricultural crop consultants, and supporting dozens of stakeholders and partners in designing and implementing an agricultural based adaptive management project to reduce nutrient and sediment runoff to achieve in-stream water quality standards.

Project Engineer, Phosphorus Optimization and Permitting Strategies, NEW Water, Green Bay, WI. Supported team in developing permitting strategies for permit renewal, WWTP optimization for phosphorus removal, and bench testing and process modeling to comply with permit and TMDL limits. Process modeling included evaluating operational scenarios of the two WWTPs to allow the District to develop a comprehensive operational strategy for meeting permit and TMDL limits. Leading WPDES permit renewal for both Green Bay and De Pere facilities.

Project Manager and Technical Lead, Phosphorus Compliance Strategies, Permitting Assistance and TMDL Technical Support, Oshkosh, WI. Assisting the City and their legal counsel in technical planning and permitting compliance support for the City's WWTP permit that includes very low effluent limits for phosphorus (0.04 mg/L). Providing technical TMDL services including planning materials modeling review, participating in meetings with DNR and EPA TMDL teams, and submitting documented input. Leading a team providing technical advice and recommendations with consideration of the wide-ranging options for compliance with WQBELs, including wastewater treatment optimization, water quality trading, and watershed adaptive management, or a combination of these measures.

Task Leader, Phosphorus Compliance Alternatives Planning, Oshkosh, WI. Leading a team of engineers and scientists to evaluate the treatment, watershed and variance options for phosphorus and sediment permit compliance planning. Closely coordinating with WDNR and EPA TMDL teams to ensure planning considers all options of TMDL allocations.

Project Engineer and Co-Project Manager, Evaluation of Phosphorus Treatment Optimization and TMDL Compliance, City of Appleton Department of Utilities Wastewater Division, Appleton, WI. Provided technical support in developing and analyzing scenarios for complying with strict phosphorus effluent limits. Supported development of bench and pilot testing programs, influent wastewater characterization sampling, and process modeling. Supported development of future treatment scenarios that included varying treatment levels with offsets created through water quality credit trading and watershed improvements through the state's Adaptive Management option for phosphorus compliance.

Task Leader, Phosphorus Reduction Master Planning, Wastewater Treatment and Resource Recovery Facility, Fond du Lac, WI. Providing technical support for evaluating phosphorus treatment and watershed reduction projects to meet strict effluent phosphorus limits of 0.04 mg/L. Providing technical guidance and strategies between the City and WDNR for coordination with the development of the Lake Winnebago TMDL. Meeting with various stakeholders and customers to review compliance options and developing monetary and non-monetary comparisons to support Master Planning efforts.

Project Engineer, Nine Springs WWTP Nutrient Removal, Madison MSD, WI. Provided technical support developing and analyzing scenarios for complying with strict phosphorus effluent limits, including varying treatment levels with offsets created through water quality credit trading and watershed improvements through the state's adaptive management option for phosphorus compliance.

Project Engineer, Facility Planning and Outfall Design, Grand Chute-Menasha West Sewerage Commission, Neenah, WI. Lead engineer for planning, permitting and design of a new plant outfall to facilitate facility planning conducted by the project team. Lead permitting strategy with Wisconsin DNR and coordinated multiple stakeholder response to proposed DNR effluent limits. Coordinated outfall design and permitting with partnered consultant.

Jim Fisher, PE, Phosphorus Treatment Evaluation and Design

Education and Professional Registrations

MS, Environmental Engineering, University of Wisconsin—Madison

BS, Civil/Environmental Engineering, University of Illinois, Champaign—Urbana

Professional Engineer: Wisconsin, Virginia

Distinguishing Qualifications

- Senior wastewater treatment technologist with 29 years of experience
- Project manager and lead process engineer for both the Madison and Appleton WI phosphorus compliance projects
- Conducted his graduate studies and wrote his master's thesis on factors important to the design and operation of phosphorus removal using iron and aluminum salts
- Instructor at University of Wisconsin Continuing Education courses including process modeling and alternatives for meeting very low effluent phosphorus concentrations
- Repeat presenter at Central States Water Environment Association Annual Conference on achieving low effluent phosphorus
- As an undergraduate, worked in the environmental engineering lab operating a bench scale biological phosphorus removal and denitrification bioreactor fed with synthetic wastewater
- Significant experience with process selection; capacity evaluation and design using steady state and dynamic modeling, stress testing, and bench scale testing; detail process and mechanical design; construction inspection; and facility startup and operation
- Supporting the City of Waukesha Clean Water Plant on return flow including required pumping rate, phosphorus compliance, and chloride compliance

Relevant Experience

Lead Process Engineer for Phosphorus Compliance, Chloride Compliance, and Pump Station Sizing, Great Lakes Water Supply Program, Waukesha, WI Clean Water Plant. Supporting the City of Waukesha on Clean Water Plant (CWP) return flow including required flow rates affecting the return flow pump station sizing, the softener optimization program for chloride compliance, and compliance with phosphorus limits associated with the Root River discharge. Early phosphorus involvement included consultation with the program attorney and permit negotiation team suggesting and providing technically achievable justification for proposing the limit not be less than 0.06 mg/L in response to a regulatory commentary seeking a limit "well below" the 0.075 mg/L stream water quality-based limit. Analyzed the extra life cycle cost associated with a 0.06 and 0.044 mg/L limit compared to the 0.075 mg/L limit applicable to the Fox River discharge for cost to benefit analysis in conjunction with anticipated water quality differences. The evaluation demonstrated very little water quality benefit at exponentially increasing life cycle cost. Also provided comments to the City on several iterations of their consultant's phosphorus compliance plan. Provided input on the CoMag pilot plan including proposing operating at significantly higher overflow rates than Evoqua's standard overflow rates to verify the potential to design the system for a significant peaking factor above design average flow which can be done at minimal increased capital cost. Provided review and comments on the Co-Mag pilot study report.

Project Manager and Lead Process Engineer, Treatment Process and Optimization Study, Appleton Wastewater Treatment Plant, Appleton, WI. Project manager and lead process in a study for the Appleton Wastewater Treatment Plant (AWWTP) evaluating optimization, chemical dosing, biological phosphorus removal, tertiary treatment, adaptive management, and trading for compliance with their TMDL. The Appleton TMDL translates into an approximate 0.23 mg/L effluent limit at current annual average flow. The study included jar testing comparing chemicals, a 5-month full scale test with the selected chemical and an online analyzer, and polymer testing to one secondary clarifier. Tertiary treatment was narrowed down to ballasted flocculation and settling, and disk filtration and cost estimates and site plans were developed for each. The study concluded that the low-cost alternative was chemical dosing with online analyzer control and that compliance with the phosphorus TMDL is achievable without any tertiary treatment. Promising optimization approaches were also identified to minimize chemical cost and improve reliability. The study provides the AWWTP with a roadmap for TMDL compliance for now and the future while considering TSS TMDL limits, the possibility of future nitrogen limits, and the uncertainties affecting cost of trading and adaptive management as implementation of those programs continue to develop.

Project Manager and Lead Process Engineer, Nine Springs Wastewater Treatment Plant Preliminary Nutrient Removal Cost Estimates, Madison Metropolitan Sewerage District, Madison, WI. The Madison Metropolitan Sewerage District (MMSD) commissioned the Preliminary Nutrient Removal Cost Estimates Study to establish an understanding of the economic impacts at the Nine Springs Wastewater Treatment Plant (NSWWTP) to meet potential new nutrient limits. A total of nine different scenarios covering a range of potential effluent total phosphorus and total nitrogen effluent limits were evaluated in this study. Treatment technologies were identified and the top three treatment schemes for each scenario were ranked based on applicability to the Nine Springs WWTP, reliability to meet each scenario of phosphorus and nitrogen limits, complexity, and relative cost. A client workshop was conducted to discuss all the treatment alternatives identified and to adjust the preliminary top three ranked treatment schemes for each scenario. The top alternative for each scenario was then modeled using our patented PRO2D process model to size facilities and determine operating requirements, including chemicals, to meet the nutrient limits. Once sized, the capital, operation and maintenance, and life cycle costs were determined using our cost estimating software to estimate costs. The process model and costing tool were also used to estimate greenhouse gas emissions for each scenario. The final report included an overview of the project, treatment alternatives evaluated, capital, operation and maintenance, life-cycle costs, and GHG impacts. Jim served as project manager and lead process on the project. The Madison Metropolitan Sewerage District continues to use these costs for comparison to watershed-based approaches to TMDL compliance.

Resource Recovery and Electrical Energy (R2E2), NEW Water, Green Bay, WI. During the Facility Plan, Jim developed cost estimates and provided triple bottom line analysis of solids processing alternatives. The selected R2E2 alternative incorporates anaerobic digestion which will increase ammonia and phosphorus loading on the aeration basins from dewatering. Jim used process modeling to evaluate the impacts. Jim evaluated alternatives for phosphorus compliance including primary sludge fermentation, chemical phosphorus removal, chemical phosphorus removal in conjunction with biological phosphorus removal, and struvite recovery in conjunction with biological phosphorus removal. The latter was determined to be the most cost effective alternative and it provided environmental benefits. Jim was a lead process engineer for developing bid documents to solicit competitive bids from two leading struvite recovery manufacturers.

Glen Daigger, PhD, PE, BCEE, Senior Review—Phosphorus Treatment

Education and Professional Registrations

PhD, Environmental Engineering, Purdue University

MS, Civil Engineering, Purdue University

BS, Civil Engineering, Purdue University

Professional Engineer: Indiana and Arizona

Board Certified Environmental Engineer, American Academy of Environmental Engineers

Distinguishing Qualifications

- 36 years of experience in wastewater treatment plant evaluation, troubleshooting, and process design
- Internationally recognized expert in wastewater treatment process design and evaluation
- Past President of the International Water Association; Member of the U.S. National Academy of Engineering
- Authored numerous publications and co-wrote several manuals frequently used within the wastewater industry, including, Phosphorous and Nitrogen Removal for Municipal Wastewater- Principles and Practice; Manual on the Causes and Control of Activated Sludge Bulking, Foaming, and Other Solids Separation Problems, and Biological Wastewater Treatment, 2nd and 3rd Editions

Relevant Experience

Technical Advisor, Liquid Processes, R2E2 Project, NEW Water, Green Bay, WI. Technical advisor for this project consisting of digesting waste activated and primary sludges, followed by dewatering and incineration. These processes will generate and recover significant energy. Engines powered by biogas from the digesters will generate electricity, and heat recovered from the engines and incineration will be used for power generation, plant building heating, and digester heating. As the technical advisor for liquid processes, assisted with the analysis of the existing system, development of alternatives to be evaluated, and evaluation criteria. Senior technical advisor for the conceptual design of the R2E2 nutrient recovery system and aeration basin improvement–two key parts of NEW Water's plan to reduce phosphorus effluent.

Senior Technical Advisor, Preliminary Compliance Alternatives Plan, NEW Water, Green Bay, WI. Senior advisor for this project to evaluate alternatives to comply with regulatory requirements for phosphorus and TSS as required in the December 2015 WPDES permit.

Senior Reviewer, Spokane County Regional Water Reclamation Facility Tertiary Phosphorus Removal Pilot Plant, Spokane, WA. Large-scale pilot plant to evaluate a wide variety of tertiary treatment technologies to upgrade the 40 mgd Spokane facility to meet extremely stringent effluent phosphorus limits, approaching 0.01 mg-P/L. Served as member of peer review committee charged with overview and oversight of pilot plant program and review of final technology assessment.

Senior Consultant, Blue Plains Advanced WWTP, DC Water and Sewage Authority (DCWASA), Washington, D.C. Consulted on demonstration of novel biological nitrogen removal process using half of 380-mgd Blue Plains Advanced WWTP in Washington, DC. Operation of demonstration plant alone resulted in significant reductions in nitrogen discharge to Chesapeake Bay. Extensive public outreach was critical component of demonstration project, which resulted in public support to extend process to entire facility.

Senior Consultant/Peer Reviewer, Blue Plains Advanced WWTP, DCWASA, Washington, D.C. Addition and subsequent upgrade of nitrogen removal for this the largest advanced wastewater treatment plant in the world. Projects have included a full-scale test using half of the plant of innovative nitrogen removal option which was subsequently implemented, and the following upgrade of this facility to meet more stringent (3 mg- N/L) effluent total nitrogen limits.

Strategic Advisor, ARenew, Alexandria, VA. Strategic advisor to Alexandria Renew (ARenew) since 1992, This 72 mgd Water Resource Recovery Facility (WRRF) has been rehabilitated and sequentially upgraded to meet stringent Chesapeake Bay discharge standards of 8 mg/L Total Nitrogen (TN) and then 3 mg/L TN while maintaining consistent compliance with stringent effluent Total Phosphorus (TP) requirement of 0.18 mg/L. A building block approach, similar to that used with the Clean Water Services facilities, facilitated sequential upgrade of the facility which is located on a highly constrained site in downtown Alexandria, VA. More recently, a Master Plan for further improvement to the facility anticipated potentially more restrictive future effluent standards while achieving increased sustainability. This Master Plan identified a side-stream partial nitritation/Anammox facility which is currently in start-up (first purpose-built facility in North America), resulting in substantial energy and supplemental carbon addition savings. Further application of partial nitritation/Anammox to the mainstream process is being implemented. In all, more than $500M in capital improvements have been successfully implemented. Most recently served as Technical Advisor for update of the existing long-range plan to anticipate future more restrictive regional biosolids management options.

Senior Consultant, Regional Municipalities of Durham and York, Ontario, Canada. Senior consultant for an evaluation of the phosphorus removal capability of the existing 166 mgd Duffin Creek Water Pollution Control Plant (WPCP), along with options to increase phosphorus removal capability either through minor improvements and optimization of the existing facility or through the addition of tertiary treatment facilities. The existing primary and secondary (activated sludge) treatment facility meets its existing effluent total phosphorus (TP) discharge limits of 0.8 mg-P/L monthly and 0.5 mg-P/L annual average. Monte Carlo analysis was used to assess the reliability of continued compliance with current consent limits, and what the limits of increased reliable performance with modifications such as dual point addition of ferric chloride and polymer addition. Tertiary treatment options evaluated included tertiary granular media filtration, ballasted flocculation, and tertiary membrane treatment.

Senior Consultant, Loudoun Water, Leesburg, VA. Senior consultant for planning, process development, design, start-up, and optimization of the Broad Run Water Resource Facility (WRF). This 12 mgd (expandable to 24 mgd) WRF is designed to produce near potable quality reclaimed water and also to comply with stringent Chesapeake Bay discharge requirements. Effluent discharge requirements include nutrient limits of 3 mg/L total nitrogen (TN) and 0.1 mg/L total phosphorus (TP) and 10 mg/L of chemical oxygen demand (COD) and non-detectable fecal coliforms. The facility pioneered the use of membrane bioreactor (MBR) technology for nutrient removal and includes upflow-downflow activated carbon contactors for water reclamation. A nine-month pilot study demonstrated the nutrient removal capability of MBR technology and its contribution to effluent COD and pathogen control for more effective water reclamation. More recently served as member of a Technical Advisory Panel assisting with the development of a long-range master plan (through 2070) for the Broad Run WRF, considering evolving treatment requirements, water reuse and resource recovery opportunities, evolving and emerging technologies, and other factors that could affect treatment facilities and practices.

Senior Consultant, Tahoe-Truckee Sanitary District, CA. Constructed initially as a high purity oxygen (HPO) activated sludge plant, this 9.6 mgd facility has been upgraded to provide biological phosphorus and nitrogen removal. This facility faces a number of challenges, including significant seasonal variations in plant loadings and adverse operating conditions due to its location in a widely known and attractive winter sports area. Phosphorus removal was first required, and the facility was converted to the Phostrip™ process and has become one of the most successful applications of this technology. Upgrade to meet stringent effluent total nitrogen (TN) requirements (2 mg/L TN) was accomplished by adding nitrifying aerated filters followed by denitrifying filters. Final polishing in a leach field receiving plant effluent provides a further compliance margin of safety. On-line now for several years, the plant has demonstrated an outstanding record of compliance with discharge requirements.

Tony Naimey, PE, Senior Review—Phosphorus Treatment

Education and Professional Registrations

BS, Mechanical Engineering, Southern Illinois University

Professional Engineer: Nevada and California

Distinguishing Qualifications

- 30 years of experience in the planning, design, and construction of pumping plants and water conveyance facilities
- Globally renowned expert in the configuration and design of large, complex pumping systems, mechanical equipment selection, layouts of piping and valves, and hydraulic and cavitation analysis of pumping equipment and control valves, demonstrating highly sustainable, cutting edge pumping plant system designs that deliver the highest wire to water pumping efficiencies resulting in lower overall operating power costs
- Developed and implemented cutting edge, variable speed pumping controls that maximize the pump performance envelope and operating efficiencies on some of the most complex pumping plants in the world
- Has managed the design of 20 pumping plants with a total combined value of nearly 1 billion, including some of the world's largest and most complex
- Experience in all phases of quality management, including QA/QC review of design and construction documents using PMI approaches
- Proven manager with expertise with large, complex, and deep pumping plants, offering innovation in pumping equipment sizing and selection and flexible solutions to deliver designs on time and on budget

Relevant Experience

Project Manager, Evaluation for Staged Implementation, California Water Fix, Metropolitan Water District of Southern California. Recently led a hydraulic and pumping equipment selection analysis of a staged implementation plan. Project involved analyzing a single tunnel and single pumping plant up to a firm capacity of 6,000 cfs in a short timeframe (3 weeks). This thorough evaluation assisted DWR to confirm feasibility of staged implementation.

Senior Mechanical Technical Consultant, Lee Tunnel Deep Shaft Pumping Plant, Thames Water Utilities, UK. Responsible for the detailed technical review and development of the reference design and design-build contract documents for the 641-cfs, 285-foot-deep Tideway Pumping Plant, screen shaft, and pumping plant flow distribution structure. Consulted during the preliminary and final selections of the main pumps, valves, and major ancillary equipment; facility layout; equipment redundancy evaluation; materials of construction of piping, valves, and pumps; and during the complete hydraulic evaluation of the screen shaft facilities, pump suction intake chamber and piping, and discharge flow distribution structure, which included review of the system's transient analysis and CFD analysis of the pump intake piping and structure, and overall system controls. Witnessed physical model testing, participated in preliminary and final reference design drawings and specifications, and witnessed factory performance testing. Delivered the operable pumping plant on time. The state-of-the-art integrated feed-forward controls operate the main pumps. The controlled variable speed algorithms incorporated within the pumping plant's main PLC maintained pump operation within the preferred operating range of the pump between the maximum and minimum tunnel water surface elevations. Robust design and facility that has a long, dependable service life. Successful completion of integral piece of flood control infrastructure to reduce overflows. Respondent Contract Value: $220M (Lee Tunnel and Pumping Plant). Overall Program Value: $8.7B (Lee Pumping Plant—~$150M). Number of Staff Managed: 35.

Pumping Plant Design Manager, Low Lake Level Pumping Station, Southern Nevada Water Authority (SNWA), Las Vegas, NV. Responsible for the detailed design of an 1,856-cfs raw water pumping plant that withdraws water from Lake Mead via the new Intake No. 3 tunnel system and delivers it into two treatment facilities (within different pressure zones). The initial pumping plant includes a deep underground cavern forebay and 490-foot-deep well shafts, each 72 inches in diameter, that house a total of 22, 3,218 hp, 46 cfs submersible vertical pumps, and up to 22, 4,700 hp, 46 cfs submersible vertical pumps for a combined maximum connected power of up to 158,220 hp. Facilities also include individual energy dissipater devices for each submersible vertical pump to allow startup, commissioning, and operation of the pumping plant at any Lake Mead water surface elevation; 205-ton rail-mounted gantry crane; one open top surge tank; two steel hydro pneumatic surge tanks; and two 144-inch-diameter discharge aqueducts with isolation valve vault structures connecting to each existing water treatment facility. Contracted with three of the world's top submersible pump suppliers for test pump procurement, including endurance testing, which became the basis for SNWA's owner-furnished selection of the pumps. As a critical facility, this pumping plant is required to be in operation when the existing intake's pumping plants are not capable of operation, and therefore serves as the sole water supply. Use of pumps allowed for aboveground exposed well head configuration—saving millions of dollars in building construction—that is easily accessible, provides a less complex vertical pump, allows for accelerated construction, and is equipped with energy dissipation devises so that pumps can be operated with lake levels outside of the pump's allowable operating range.

Lead Mechanical Engineer, Raw Water Pumping Station, Southern Nevada Water Authority, Las Vegas, NV. Lead mechanical engineer for preliminary and final design of a raw water pumping system designed to convey about 1,100 ML/d of water from Lake Mead to the new Southern Nevada Water Authority River Mountains Water Treatment Facility in the Las Vegas Valley. The system included three large complex pumping stations with large forebays, a large flow control facility with a capacity of 235 mgd, about 7 km of 144-inch to 72-inch-diameter welded steel pipelines, and a variety of significant and complex appurtenant facilities.

Lead Mechanical Engineer/Pumping Plant Lead, Intake Pumping Station No. 2 Expansion, Southern Nevada Water Authority, Las Vegas, NV. Lead mechanical engineer for the design and construction support of a 66,000-hp, 600-mgd (1,114 cfs) raw water intake pump station. This project included 19 constant-speed 3,000-hp deep set vertical turbine pumps and three variable-frequency drive 3,000-hp vertical turbine pumps, hydraulically actuated pump control cone valves, high pressure hydraulic pump control valve power system, two 108,000-gallon cylindrical hydropneumatic surge tanks, and overhead crane system.

Lead Mechanical Engineer, Southern Delivery Raw Water Conveyance System, Colorado Springs Utilities, Colorado Springs, CO. Lead mechanical engineer responsible for the design of a 42,000-hp, 300 ML/d raw water conveyance system. This project included three in-series booster pumping stations equipped with a total of 21 2,000-hp pumps (7 vertical turbine pumps and 14 horizontal split case centrifugal pumps). Each booster pumping station facility is equipped with three variable frequency driven units and four constant speed units, hydraulically actuated pump control cone valves, individual high pressure hydraulic pump control cone valve power systems, a detached prestressed-concrete forebay, housed cylindrical hydropneumatic surge tanks, an overhead bridge crane system, and a flow metering station.

Senior Consultant/Design Reviewer, Freeport Intake Pump Station, Freeport Regional Water Authority (East Bay Municipal Utility District and County of Sacramento), Sacramento, CA. This project involved the design of a 185-mgd (286-cfs) pumping plant located on the Sacramento River bank. The pump station was designed for a turndown from full flow to 15 mgd (23 cfs), which is accomplished using four 2,000-hp, 4.16-kV adjustable frequency drives with synchronous transfer capability. This facility simultaneously serves two pressure zones and involves a pressure sustaining/rate of flow control station, metering station, and surge tank system.

Kevin Nielsen, PhD, PE, Senior Review—Hydraulics

Education and Professional Registrations

PhD, Civil and Environmental Engineering, University of Iowa

MS, BS, Civil and Environmental Engineering, Utah State University

Special Studies: Instream Flow Methodologies, USFWS; River Mechanics Short Course, IDWR; Applied Fluvial Geomorphology Short Course

Professional Engineer: Idaho, Montana

Distinguishing Qualifications

- Over 33 years of experience in fluid mechanics, hydraulic design, hydrology studies, and environmental water resources project planning related to wastewater and water conveyance and collection
- Extensive experience conducting hydraulic and hydrological analyses for water supply, hydraulic structures, and wastewater
- Expert in the detailed analysis of surge transients associated with pump stations
- Exert in the application of computational fluid dynamics (CFD) for evaluating complex hydraulics
- Has provided quality assurance/quality control (QA/QC) and senior review for numerous water hammer evaluations all over the world, including pump stations, wellfields, hydropower plants, and valve operating conditions, as well as several different mitigation alternatives such as surge tanks, surge chambers, bladder surge chambers, air valves, relief valves, and numerous operational transient control methods

Relevant Experience

CFD Modeling Lead; Activated Sludge Effluent Pump Station, Fairfax County Department of Public Works and Environmental Services, Fairfax County, VA. Led the CFD analysis for the ASE pump station (67 mgd) to evaluate the existing wet well and pumping system approach conditions to improve reliability of the pumping system. Since the original construction of the pump station, Fairfax County staff have reportedly experienced several problems with the pumps including pump failure due to cavitation. The CFD models were used to evaluate the efficiency of various pump station configurations. Proposed modifications included changes to the wet well such as guide walls and baffles along with pump bell intake improvements such as strainers, cones, and guide vanes. A variety of floor vane configuration were investigated to minimize the potential for clogging. CFD provided valuable insight in developing a cone and floor vane system that would improve the pump approach conditions while minimizing the potential for clogging.

Hydraulics Task Leader, Spring Hill Water Treatment Plant Intake Pump Station, Joint Water Commission, Portland, OR. The pump station was performing below capacity, CFD was used to investigate the existing facility and evaluate proposed solutions to fix the pump capacity concerns. The JWC portion of the WTP has four vertical intake pumps capable of a maximum station flow rate of 85 mgd. The model consisted of the river backwater pond, intake screens, a common bay, traveling screens, intake bays, and JWC pumps. The main parameters that were investigated were approach velocity patterns, pump intake velocity distribution, pump swirl angle, and vortex potential. CFD was successfully used to show the effective use of several proposed solutions, as well as help eliminate several solutions that would not produce desired results.

CFD Hydraulics Model/Physical Model Task Leader, Primary Effluent Pumping Station (PEPS), Sacramento Regional County Sanitation District, CA. Our team performed a CFD simulation study along with leading the physical model study for Sacramento Regional County Sanitation District's PEPS. The PEPS facility, proposed as part of the EchoWater Project, will convey and lift primary effluent from the existing primary sedimentation tanks to a new biological nutrient removal (BNR) facility. We modeled the full buildout facility as the baseline alternative with all six pumps operating at 130 mgd for a pump station total flow of 780 mgd. Led the CFD analysis and physical modeling effort for this pump station evaluation. The CFD analysis evaluated pumping performance for several different pump and wetwell configurations. The analysis compared general approach flow conditions, swirl angle, and velocity distribution criteria to acceptance criteria established in the American National Standards Institute (ANSI) Hydraulic Institute (HI) Standards. The analysis included CFD evaluation of 25 alternatives with different pump modifications and wetwell configurations to help select a configuration that met HI criteria under different flow conditions. The alternatives included different configurations of layouts, baffle walls, splitter plates, floor cones, fillets, and bay entrance arrangements. The final alternative based on the CFD modeling was then evaluated with a physical model. The physical model confirmed that the selected alternative would meet HI standards and provided some additional refinements to the final design.

CFD Hydraulics Model Task Leader, Integrated Pipeline (IPL) Pump Stations Project, Tarrant Regional Water District (TRWD), TX. Led the CFD analysis effort for the three large raw water pump stations associated with the IPL project. The IPL project is a raw water supply program that integrates the TRWD and Dallas Water Utilities (DWU) water supplies from Lake Palestine, Cedar Creek Reservoir, and Richland Chambers Reservoir with intake pump peak flows of 150 mgd, 277 mgd, and 250 mgd, respectively. The IPL will be developed over the next 20 years and will provide raw water to both TRWD and DWU. The program includes raw water pipelines, raw water intakes and pumping stations, booster pumping stations, and storage reservoirs. Each pump station consists of several can pumps sharing a single wet well connected to t-screen filter intakes in the reservoir. Conducted a CFD analysis of the raw water intakes, wet wells, and pump can hydraulics. Performed CFD modeling to evaluate the proposed wet well configurations prior to the physical model testing of the pump intake and wet well designs. Compared results against the HI acceptance criteria to identify undesirable pump approach flow conditions.

CFD Hydraulics Model Task Leader, Ute Reservoir Intake Pump Station, Eastern New Mexico Rural Water System (ENMRWS), NM. Led the CFD analysis effort for the Ute Reservoir Intake Pump Station. The pump station will deliver raw water to a 1-MG storage tank located at the high point of the raw water conveyance system. The source water for the raw water conveyance system is Ute Reservoir by means of a new raw water intake structure. The ENMRWS raw water conveyance system will be capable of delivering a minimum of about 5 mgd to a maximum of about 28.1 mgd of raw water from the Ute Reservoir intake structure to the ENMRWS WTP, with an average flow rate of about 15 mgd. Facility spacing for pumping equipment, piping, and typical appurtenances associated with a maximum design flow capacity of up to 13 mgd have been incorporated into the intake structure and the Ute Reservoir intake pump station. Used the CFD model to investigate the general approach flow patterns of the proposed pump station wet well layout. This information was compared against the HI acceptance criteria to identify undesirable pump approach flow conditions. Several improvement modifications such as splitter walls between pump intakes, flow alignment cross vanes in the pump intake bells, and various fillets and wedges to better align flow into the pump intakes were evaluated to identify methods to reduce swirl angles, improve velocity distribution, and provide better approach flow characteristics to meet HI criteria.

CFD Modeling Lead, Kitchener WWTP Plant 2 and Ultraviolet (UV) Disinfection Upgrade Project, Regional Municipality of Waterloo. Senior CFD analysis and lead for development of CFD models for new pump station attached to UV immediately downstream as part of expansion to the 100 (400 peak) ML/d facility. The pump wet well consisted of a north wet well and south wet well with three pump locations in each wet well. The approach conditions were strongly driven by the existing facility creating very complex and undesirable approach flow conditions. Several flow scenarios were evaluated to determine the necessary improvements. Used CFD modeling to effectively evaluate several flow enhancements alternatives to bring the pump flow conditions into compliance with the HI standards for pump suction flow. The CFD modeling provided a cost-effective solution to maintain appropriate flow conditions while staying within restrictive site constraints.

Lin Zhang, PE, Senior Review—Structural

Education and Professional Registrations

MCE Civil Engineering, University of Delaware

BS, Civil Engineering, Tsinghua University, Beijing, China

Professional Engineer: Connecticut, Maryland, Pennsylvania, Virginia

Distinguishing Qualifications

- 18 years of experience in the design and modification of water and wastewater treatment plants
- Experience in the design and modification of additional heavy industrial facilities including, mass transit maintenance facilities, nuclear and fossil power plants, and miscellaneous government and military facilities
- Served as Structural Engineer of Record for various construction projects at water and wastewater treatment plants in Mid-Atlantic States

Relevant Experience

Lead Structural Engineer, North Hudson H5 Wet Weather Pump Station, Hoboken, NJ. Design and construction of three underground structures, including an electrical building, a pump station and a transition vault.

Lead Structural Engineer, Rocky Hill Waste Pollution Control Facility Plant Upgrade, Hartford, CT. Lead structural engineer for design and construction of a primary effluent pump station, new electrical building, and modification to existing headworks structure.

Lead Structural Engineer, City of Suffolk Water Treatment Plant Upgrade, Suffolk, VA. Lead structural engineer for the phase IIIA upgrade including design of two new gravity thickeners, a new sludge dewatering building and a new waste pump station. Served as structural engineer of record during construction of the facilities.

Structural Engineer, Wet Weather Pump Station, North Hudson Sewerage Authority, Hoboken, NJ. Designed underground pump stations. Originated project specifications and drawings.

Structural Engineer, Corbalis Water Treatment Plant Electrical System Improvements, Fairfax Water, Fairfax County, VA. Provided structural evaluation of existing facility for the installation of new equipment. Designed new access platform at existing basin. Designed extension to existing mezzanine floor. Provided design criteria for new building components added to existing facility. Provided foundation design for new transformers and generator.

Structural Reviewer, State-of-the-Art Nitrogen Upgrade (SANUP), Alexandria Renew Enterprises (AlexRenew), Alexandria, VA. Reviewed construction documents for this 400-foot-long by 250-foot-wide nutrient management facility. Reviewed shop drawings and responded to contractor questions and change orders.

Structural Engineer, Fairfax County Noman Cole Pollution Control Plant, Solids Upgrade Project—Contract 2, Fairfax County, VA. Originated contract documents including specifications and drawings for solids upgrade of existing facilities at Noman Cole Pollution Control Plant.

Structural Engineer, WSSC Piscataway Secondary Clarifier and Polymer Feed System Upgrade, Accokeek, MD. Provided structural design of modification to the foundation of four existing clarifiers to support new rotating scum skimmer center column. Designed a new 200-ft diameter secondary clarifier.

Design and Structural Engineer, 37th Street Water Treatment Plant Phase III Upgrade Project, Norfolk, VA. Performed design of a new UV disinfection building and modification to existing clear well and flocculation basin. Structural Engineer of Record during construction phase including coordination with general contractor and vendors, reviewed shop drawings and special inspection reports, performed structural inspection of existing clear well and flocculation basin during dewatering.

Kurt Vollmers, PE, Senior Review—Electrical

Education and Professional Registrations

BS, Electrical and Electronic Engineering, California State University at Chico

Registered Electrical Engineer: Arizona, California, Nevada

Distinguishing Qualifications

- 24 years of experience performing electrical design for water and wastewater infrastructure projects
- Specializes in design, construction, and application of power distribution and motor control systems for pumping and irrigation projects
- Leads electrical design for numerous conveyance systems
- In addition to design, he provides services during the construction phase of large water projects, including shop drawing review, responding to questions from the contractor, and site inspections

Relevant Experience

Lead Electrical Engineer, Lane City Reservoir and Dam Improvements, Lower Colorado River Authority, Lane City, TX. Provided design services and ongoing services during construction for the pumping plants. Project involves a canal inlet/outlet structure, 700 cfs relift pumping plant with four operation modes, 750 cfs river outfall structure, and 40,000-acre foot off channel reservoir with a 5.2-mile, 35 to 40-foot high embankment.

Electrical Engineer, Oceanside Water Pollution Control Plant, City and County of San Francisco, San Francisco, CA. Lead electrical designer during implementation of this $225M award-winning project including the design of four new anaerobic digesters, using custom-designed pump mix systems. Foam and grit management were significant issues during design, facility startup provided an opportunity to optimize the performance of these systems.

Electrical Engineer, Tisdale Positive Barrier Fish Screen and Pumping Plant, Sutter Mutual Water Company, CA. Provided electrical design and construction services for this concrete structure, with a 150-hp pump-driven sediment removal system and computer control and SCADA system.

Lead Electrical Engineer, Sankey Diversion, Natomas Mutual Water Company, CA. Project involved a $25M, 434-cfs river intake, fish screen, and pumping plant with conveyance pipeline beneath/through the Garden highway and levee to an outfall structure and canal interface. The screens include five vertical turbine pumps. Provided electrical design, distribution, motor controls, and facility electrical for the pumping plant.

Lead Electrical Engineer, Combined Pumping Plant and Fish Screen Project, Reclamation District 108, CA. This design and construction for a fish screen and pumping plant. Provided electrical design and services during construction. Electrical features included primary metering, transformation facilities, distribution, and control for the combined pumping plant and fish screen.

Electrical and Construction Design Engineer, Sacramento River Replacement Intake Pump Station, City of Sacramento, CA. Provided electrical design and construction services for an architecturally unique, screened 160-mgd pump station, located 250 feet into the Sacramento River.

Electrical QC Reviewer, Tinker Road Storage Tank and Pump Station, Placer County Water Agency, Roseville, CA. Electrical QC for facilities including a 3.3-mgd and 7-mgd pump station and support systems for a 120-foot by 40-foot building and 10-MG aboveground prestressed concrete storage tank.

Well 16 Pump Station Design, City of Vacaville, CA. Provided electrical engineering services for a well pump station with fluoride and chlorine chemical feed systems to meet future water supply needs. The well building allows for chemical rooms and potential building expansion to meet future regulatory requirements.

Rajeev Srivastava, PhD, Senior Review—I&C

Education and Professional Registrations

PhD, Chemical Engineering, Michigan Technological University

MS, Chemical Engineering, Michigan Technological University

B Tech, Chemical Engineering, Benaras Hindu University, India

Distinguishing Qualifications

- 30 years of experience as an I&C engineer
- Brings expertise in designing control systems for pump stations, water, and wastewater treatment plants for both municipal and industrial projects
- Actively involved with the implementation phase of the projects, including startup, system testing and checkout, operator training, and plant operation
- Experienced in developing computer simulations for industrial processes. He has conducted stability analyses of closed-loop systems for designing improved operation and control strategies

Relevant Experience

Lead I&C Engineer, Pump Station Modifications, Flat Branch Pump Station Upper Occoquan Sewage Authority, Centerville, VA. This 60-mgd pump station conveys sewage to the Upper Occoquan Sewage Authority Regional Water Reclamation Plant. The pump station is equipped with four adjustable speed raw sewage pumps, two emergency generators, a hydrogen peroxide storage and feed system, and an activated carbon odor-control system. The upgrade work included replacing an existing electro-mechanical control system with a Programmable Logic Controller based system. The control system consisted of two identical 984-785EQ Modicon controllers in hot standby configuration, and personal computer-based control stations with Wonderware operator interface software. Developed new startup sequence and PID control strategies for the raw sewage pumps. Implementing these control schemes eliminated some of the operational problems that often were encountered in the past. The new pump sequencing logic also reduced energy consumption by operating the pumps in their high efficiency range and reducing the number of automatic pump starts in a typical day.

Lead I&C Engineer, WWTP Expansion, Cub Run Pump Station, Upper Occoquan Sewage Authority, Centerville, VA. Lead I&C engineer for the expansion and improvement of existing wastewater delivery facilities at the Upper Occoquan Sewage Authority's Cub Run Pump Station Site in Centerville. The control system design included Modicon Quantum Programmable Logic Controllers for pump station control and a spread-spectrum radio link to the treatment plant.

Lead I&C Engineer, Resource Recovery and Electrical Energy (R2E2) Project, NEW Water, Green Bay, WI. The project involves installation of an incinerator and peripheral equipment. In addition to the traditional I&C design, the project entails development of a plan for a comprehensive power monitoring system that will track and report electricity, natural gas and biogas usage and generation and energy recovery throughout the plant in real time and allow operating staff to make informed decisions on electrical, natural gas and biogas usage for operation of equipment.

Lead I&C Engineer, De Pere & Green Bay Facility Upgrades, NEW Water, Green Bay, WI. The design services included the preparation of bid and construction documents and bidding for one general construction project that included work at the De Pere Facility and the Green Bay Facility. Equipment and processes at the De Pere Facility were automated to allow remote monitoring and control from the Green Bay Facility. A new UPS infrastructure was provided to allow continuous monitoring of the process and video systems in the event of a complete power outage. The UPS infrastructure was designed to support a runtime of at least 30 minutes for

PLCs, HMI computers, network infrastructure and video monitoring systems (including cameras). A new fiber network infrastructure was provided to connect the PLCs, video cameras, HMI computers at the De Pere facility to the Green Bay facility. Existing PLC systems at the De Pere facility were upgraded to Ethernet-capable processors. Existing PLC system logic was reviewed and revised to allow remote monitoring and control and to ensure that it will function adequately when inter-plant communications are down.

Project Manager, Conveyance SCADA System Risk/Reliability Assessment, MMSD, Milwaukee, WI. MMSD's Conveyance SCADA System monitors and controls approximately 300 remote facilities. This serial-based radio system utilizes UHF frequencies to cover an area of approximately 400 square miles. The system was experiencing periodic downtimes of several minutes or more since startup. The City made several modifications to enhance the system performance but felt that there was further potential for improving the system reliability and performance. They retained our firm to evaluate their system and propose modifications that could increase the reliability of the data communication. Our team conducted a thorough investigation of the system and proposed that system reliability can be improved by installing a backup communication system between the critical remote sites and the master control station at the Jones Island.

Project Manager, Engineering Services for Backup Communication System for Conveyance SCADA System, MMSD, Milwaukee, WI. Following the successful assessment, MMSD hired our firm to evaluate backup communication alternatives and to design the system for the 50 most critical sites. Several alternatives were evaluated and serial communication over telephone lines as the backup communication alternative was selected by the City. To demonstrate the viability of the selected alternative, our team designed and implemented the backup communication link for four critical remote sites. The demonstration project proved successful in increasing system reliability by seamlessly switching to the backup communication mode upon loss of radio communication between the remote site and the master station. The full-scale implementation of backup communication is in progress, but may not be completed because a new, more comprehensive project will be implemented that includes replacement of the entire serial communication network with Internet Protocol radios and cellular modems.

Design Manager, Control System Upgrades, MMSD, Milwaukee, WI. The project goal was to remove obsolete control system equipment and to take advantage of the current technology for improved operational reliability at the Jones Island and South Shore Wastewater WRFs. The existing Bailey Distributed Control Systems were replaced with PLC-based systems. The project provided a staged and planned execution to ensure continued operation of the treatment processes during control system upgrade. Scope of work included system design and engineering services during construction.

Lead I&C Engineer, Remedial Design, Greenwood Chemical Site, Newtown, VA. The work was performed under the ARCS III program. The project included extraction and treatment of contaminated groundwater and lagoon water with discharge to a nearby stream. The extraction system consisted of five wells with submersible well pumps. The treatment processes included equalization, rapid mixing, flocculation, clarification, filtration, pH adjustment, ultraviolet (UV)/Peroxide oxidation, and granular activated carbon (GAC) adsorption. A Programmable Logic Controller (PLC) based system with personal computer (PC) type operator interface was installed to control the plant operation. The plant PLC interfaced with several package control PLCs for an integrated control system. An automatic alarm dialer system was also installed for remote notification of process alarms. Responsibilities included definition of control strategies for the plant PLC as well as package system PLCs, preparation of contract documents and drawings, and review of vendor submittals.

Nick Winnike, PE, Senior Review—Civil

Education and Professional Registrations

BS, Civil Engineering, University of Notre Dame

MS, Environmental Engineering, University of California, Davis

Professional Engineer: Indiana, Kentucky, Missouri, Ohio, Wisconsin

Distinguishing Qualifications

- 35 years of experience providing a wide range of environmental services to a variety of municipal and industrial clients in the wastewater and water fields
- The services include facilities condition and performance assessments, flow and odor monitoring, facilities and master planning, pilot testing, preparation of permit applications, hydraulic modeling of pipelines and treatment facilities, preliminary and final design of conveyance and treatment facilities, construction inspection, contractor submittal review, operations manual preparation, and startup assistance

Relevant Experience

Project Manager, Advanced Treatment at Fort Thomas and Memorial Parkway Treatment Plants, NKWD, Fort Thomas, KY. Responsible for plant upgrades to the Fort Thomas and Memorial Parkway Treatment Plants to include post-filtration GAC contactors and UV disinfection. Work included preliminary engineering; detailed design, regulatory interface, bidding, and construction support services. The facility additions include low-lift pumping, GAC adsorption contactor beds, backwash pumping and air scout systems, and medium pressure UV.

Project Manager, Socialville-Fosters Pump Station, Greater Cincinnati Water Works, Cincinnati, OH. Design efforts included pump selection and coordination with City of Mason and Warren County staff and GCWW staff to provide for control system connectivity that met the needs of all the parties. Additionally, the reservoir mixing and sampling systems and the flow metering system design required coordination with multiple GCWW divisions to ensure that the facilities conformed to standards for customer billing, operations, and water quality. The pump station is rated at 5 mgd with three vertical turbine pumps each rated at 2.5 mgd.

Project Manager, Various Planning, Design, and Construction Projects, Northern Kentucky Water District: Provided project management for 18 task orders ranging from plant automation and treatment facilities to pump station upgrades. The initial projects involved services for new chemical building designs and construction services at the Fort Thomas and Taylor Mill plants and for the Waterworks Road Pump Station at the Memorial Parkway plant. He directed remote design teams while coordinating local activities to incorporate geotechnical, surveying, and traffic flow data and to gain regulatory approval. Two significant Kentucky regulatory firsts occurred at Taylor Mill with the use of sodium hypochlorite for disinfection and automation of chemical feed facilities. Under his direction, the design teams succeeded in completing connections to existing facilities while maintaining plant operations, adding new buildings connected to existing structures, and blending architecture with current plant aesthetics.

Engineering Manager, Wastewater and Water Utilities, U.S. Army Post, Fort Campbell, KY. CH2M assumed utility ownership in 2003 and Nick was responsible for directing engineering teams completing engineering studies resulting in the development of a 5-year $44M capital improvements plan. During each of the first 2 years of the program, no fewer than 8 separate studies of components of the utility treatment and conveyance systems were being conducted concurrently. Teams completing the studies under his direction included staff from 5 different offices with specialties ranging from source water supply to GIS to pipe condition assessment to treatment process optimization. After these System Characterization Studies were completed, coordinated the initial slate of design projects including designs at the water and wastewater treatment plants, the raw water pump station, and at multiple points in the wastewater collection system.

Bill Misslin, PE, Senior Review—HVAC/Plumbing

Education and Professional Registrations

BS, Mechanical Engineering, Arizona State University

Mechanical Engineer: California, Nevada, Washington

Distinguishing Qualifications

- 34 years of experience includes process facility design, pump station hydraulics, gas-handling systems, piping systems, HVAC systems, SCADA implementation, and energy conservation
- Serves as project manager, design manager, quality control reviewer, and lead engineer for pump station and conveyance systems, water and wastewater treatment plants, and industrial processing plants

Relevant Experience

Project Manager, Pumping Plants, City of Santa Rosa, CA. Project manager for the design of 26 irrigation booster pumping plants. The pumping plants boost water pressure for sprinkler irrigation and effluent disposal. The plants were designed with hydraulic controls to maximize control of the treated effluent. Project included preparation of construction bid documents, including drawings and specifications on this multidiscipline design project.

Lead Mechanical Engineer, Pumping Plants, City of Tracy, CA. Project involved the design of major process pumping plants at the City's wastewater treatment facility. Project included preparation of construction bid documents, including drawings and specifications.

Lead Mechanical Engineer, East Roseville Raw Sewage Pumping Plant, City of Roseville, CA. This pumping plant replacement project included preparation of construction bid documents, including drawings and specifications.

Project Design Manager, CAP Distribution System Project, Salt River Pima-Maricopa Indian Community, AZ. The project consists of a 3,400-hp pump station and 2.5 miles of pipeline. The pump station consists of three 700-hp, three 400-hp, and two 200-hp vertical turbine pumps that will supply irrigation water for agriculture.

Assistant Project Manager and Lead Mechanical Engineer, Laguna WWTP Upgrade, City of Santa Rosa, CA. Designed a new reclaimed water pump station as part of the project and led various project teams in completion of the final design for the $15M construction project. The pump station consists of four 75-hp vertical turbine pumps that provide reclaimed water for use throughout the facility.

Project Manager, Design of 26 Irrigation Booster Pump Stations, City of Santa Rosa, CA. The pump stations boost water pressure for sprinkler irrigation and effluent disposal. The stations were designed with hydraulic controls to maximize control of the treated effluent.

Project Manager, Pump Station No. 5 Booster Pump Station, City of Redding, CA. The project included a 6,000-gpm pump station with variable-speed pump control and 1,000 feet of supply pipeline. The pump station replaced an existing 2,000-gpm pump station.

Lead Mechanical Engineer, Lift Station Design, Eagle Point, OR. Served as lead mechanical engineer and coordinated design services for the Eagle Point dewer tie-in lift station. The lift station consists of two 75-hp solids handling pumps, a 150-kW emergency generator and a control building.

Lead Mechanical Engineer, Incline Village General Improvement District Burnt Cedar Water Disinfection Plant, Incline Village, NV. Development/evaluation of treatment alternatives, preliminary engineering, final design, major equipment procurement assistance, and services during construction for this 8.5-mgd plant that includes ozone and UV disinfection treatment to meet the Long Term 2 Enhanced Surface Water Treatment Rule. Coordinated design of all mechanical systems including the treated water pump station, ozone generation facility, UV facility, and ozone destruct building.

Colin Fitzgerald, PE, Phosphorus Treatment Evaluation

Education and Professional Registrations

MS, Environmental Engineering, University of Wisconsin–Madison

BS, Civil and Environmental Engineering, University of Wisconsin–Madison

BS, Physics, University of Wisconsin–Eau Claire

Professional Engineer: Illinois, Minnesota

Distinguishing Qualifications

- Well-versed in biological nutrient removal, phosphorus treatment technologies, and sidestream nutrient management
- Experienced in the application of wastewater process modelling, working on 10+ process modeling projects in the last 2 years
- Expertise in incorporating Monte Carlo based statistical approaches into wastewater process modeling and process evaluations

Relevant Experience

Project Engineer, Preliminary Compliance Alternatives Plan, NEW Water, Green Bay, WI. The project involved development of the preliminary phosphorus compliance plan required by the WWTP's WPDES Permit. Included the evaluation of tertiary treatment and watershed-based approaches required for phosphorus reduction. Monte Carlo Based uncertainty analysis was used to establish a band of likely plant performance which was projected over 100 dynamic years. The projections allowed for a range of likely effluent phosphorus loads to be established. By understanding the range of likely effluent loads, the sizing of tertiary treatment processes and watershed-based approaches can be refined to provide the highest likelihood of future compliance while minimizing life cycle costs. Responsible for the uncertainty analysis and was involved in the capital and life cycle cost assessments.

Process Engineer, R2E2 Commissioning, NEW Water, Green Bay, WI. The Resource Recover and Electrical Energy (R2E2) project includes the construction of a 180 million-dollar solids processing system upgrade. The solids process improvements the addition of anaerobic digestion, primary sludge thickening upgrades, dewatering centrifuges, nutrient recovery (through struvite precipitation), biogas utilization for energy production, biosolids drying, and a new fluidized bed thermal oxidizer. Assisted with commissioning of the anaerobic digestion process, phosphorus release, and nutrient recovery. Also responsible for process modeling surrounding the period of startup, focusing on interim mitigation of struvite and conservation of effluent performance throughout startup.

Process Engineer, Phosphorus Compliance Plan, West Chicago, IL. The project included the evaluation of phosphorus treatment strategies with as required by the Illinois Environmental Protection Agency, including chemical treatment and various biological phosphorus removal modifications. Also assessed the hydraulic impacts of proposed modifications. Involved in WWTP process modeling and responsible for hydraulic evaluation using visual hydraulics. Also assisted with capital and life cycle cost assessments for the proposed alternatives.

Process Engineer, Preliminary Compliance Alternatives Plan, Oshkosh, WI. The project involved development of the preliminary phosphorus compliance plan required by the WWTP's Wisconsin Pollutant Discharge Elimination System (WPDES) Permit. The project included evaluations of the existing chemical phosphorus removal system, WWTP modifications required for biological phosphorus removal, and the evaluation of watershed-based approaches (i.e., adaptive management). Involved in treatment plant process modeling using Sumo, hydraulic modeling using Visual Hydraulics, and responsible for the uncertainty analysis. Hydraulic modeling was used to analyze the impacts of that potential basin modifications would have on the WWTP's ability to process peak wet weather flows. The project utilized Monte Carlo based uncertainty analysis to assess the reliability chemical and biological phosphorus removal.

Project Engineer, Wastewater System, Asset Management, Oshkosh, WI. Involved in the development of an asset management plan for the City of Oshkosh's wastewater treatment plant and collection system. The project aimed to identify a plan to replace or mitigate high risk assets in to improve treatment plant performance and reliability. I was responsible for wastewater treatment plant evaluations and overall report preparation.

Process Engineer, Northern Treatment Plant Commissioning, Metro Wastewater Reclamation District Denver, CO. The Northern Treatment Plant (NTP) is a newly constructed facility owned by Metro Wastewater Reclamation District. NTP is an advanced biological nutrient removal facility with tertiary treatment and expansive solids treatment processes. Colin was involved in unit process evaluations throughout startup, assisted with preparation of the final startup report, and has also been involved in ongoing optimization through the application of Monte Carlo based process modeling.

Process Engineer, MK Nelson Complex Facility and Collection System Long Term Plan, Johnson County, KS. Process engineer for the ongoing wastewater treatment facility long-term planning for the MK Nelson Complex. The complex consists of two independent multi-stage trickling filter facilities, with combined solids processing and disinfection. The trickling filters are nearing their useful life and changing regulations have reduced their suitability as a long-term treatment strategy. The long-range planning effort will consider optimum strategies for wet and dry weather treatment, the impact of future nutrient regulations, and evaluate phasing of improvements to maintain compliance through conversion to an activated sludge process. The evaluation utilizes process modeling to evaluate alternatives and identify phasing strategies that allow compliance through the extensive facility upgrade.

Project Engineer, Master Plan, Trinity River Authority, TX. The master plan update included the calibration of new WWTP process model. The process model was used to optimized WWTP performance, identify process components restricting performance, evaluate alternate operational strategies, operations, and evaluate alternative improvements to meet long term performance goals. Colin was involved as a project engineer assisting with these process evaluations.

Project Engineer, Savage WTP No. 2 Rehabilitation, Savage, MN. Involved in rehabilitation design of the existing water treatment plant No. 2 owned by the City of Savage. Responsible for the process design, and preparation of the plans and specifications. The project involved a complete renovation of the existing water treatment plant, which included new steel gravity filters, aeration processes, backwash reclamation, inclined plate settlers, chemical feed systems and upgrades to the instrumentation and control system.

Project Engineer, WTP No. 7 Expansion, Elk River, MN. Project engineer involved in the design of the expansion of the existing water treatment plant No. 7 owned by the City of Elk River. Responsible for the process design, and preparation of the plans and specifications. The project involved doubling the capacity of the pressure filter plant, upgrades to the chemical feed systems, and upgrades to the instrumentation and control system.

Project Engineer, Eau Claire WTP Filter Rehabilitation Project, Eau Claire, WI. Project engineer involved in the design of the rehabilitation of the existing gravity filter system at the Eau Claire Water Treatment Plant. Colin was responsible for the process design, preparation of the plans and specifications, and construction administration. The project involved placement of the filter face piping, replacement of the original 1952 underdrains and the installation of an air-wash process.

Bruce Johnson, PE, BCEE, Phosphorus Treatment Evaluation

Education and Professional Registrations

MS, in Environmental Systems Engineering, Clemson University, SC

BS, Chemical Engineering, University of Wyoming, Laramie, WY

Professional Engineer: Idaho

American Academy Environmental Engineers Board Certified Environmental Engineer

International Water Association Fellow

Distinguishing Qualifications

- Over 30 years of experience in the design, operation, and troubleshooting of water and wastewater treatment equipment
- Expert in wastewater treatment modeling
- Expert in biological and chemical nutrient removal
- Expert in biological sludge reduction
- Expert in modeling wastewater plant performance

Relevant Experience

Senior Technologist, Woonsocket WWTP Operate Design Build Operate Project, Woonsocket, RI. Our team was selected to operate, then design/build and operate a nutrient removal expansion to the 9-mgd average flow Woonsocket WWTP targeting 0.1 mg/L TP and 3 mg/L TN. Developed an innovative two stage activated sludge system design that maximizes the use of existing infrastructure and plant capacity while improving overall plant reliability to achieve these very low nutrient limits and lowering power usage.

Senior Technologist, Spokane County Regional Water Reclamation Facility, Spokane County, WA. Spokane County selected our team to design/build/operate (DBO) their new 8-mgd water reclamation facility. Served as senior technologist and was responsible for an innovative design that includes chemically enhanced primary treatment and an MBR secondary process to produce effluent with less than 0.05 mg/L total phosphorus. In addition, the plant's solids handling system includes a first of its kind anaerobic/aerobic digestion system that removes nitrogen to very low levels in the dewatering filtrate and significantly improves digester VSS destruction. Also supported the startup team on understanding and optimizing both the bioreactor system and post aerobic digestion process.

Lead Process Designer, Kaiser Aluminum in Spokane, WA. Our team was selected to develop, pilot, and design a system to reduce their effluent phosphorus levels to less than 0.01 mg/L. Served as the lead process designer for this first of its kind system.

Senior Technologist, Parker Water and Sanitation District North Water Reclamation Facility Master Plan and Design Project, Parke, CO. Our team was selected to provide planning and engineering services for the capacity upgrade at Parker's North WRF. This project involved expanding the existing North WRF from approximately 2 mgd capacity to 6 mgd capacity while maintaining its ability to achieve effluents total phosphorus of 0.1 mg P/L and nitrogen levels of 10 mg TIN/L.

Senior Technologist; Northern Treatment Plant, Metro Sanitation District, Denver, CO. Jacobs was selected to deliver this 24-mgd Greenfield wastewater treatment plant on the progressive Design-Build-Deliver platform. Serving as lead technologist on this project and working with the District to design and build the new plant to achieve less than 0.1 mg/L TP and less than 6 mg/L total nitrogen and includes one of the first post aerobic digesters in North America.

Senior Process Advisor, Lander Street Filtration Project, Boise, ID. Senior process advisor on this project evaluating filtration approaches for a new filter system at the City of Boise's Lander Street WWTP. The City of Boise, Idaho needed to meet new total phosphorus (TP) limits at their Water Renewal Facilities (WRF). The City's Lander Street WRF has an existing capacity of 15 mgd on an average day maximum month (ADMM) basis. The Phase 1 Improvements project at the Lander Street WRF will provide new preliminary treatment, tertiary treatment, disinfection, and associated site work. The tertiary treatment system is designed for the WRF to meet the monthly average TP limit of 300 micrograms per liter (µg/L). A detailed evaluation of tertiary treatment technologies was completed to determine the appropriate system for the WRF. A key item was to ensure that the tertiary treatment technology did not adversely impact the existing EBPR system. Deep-bed mono media (sand) filtration was selected for implementation at the WRF. Features included with the deep-bed sand filter include a tertiary pump station, four-cell filter layout, backwash system with air scour, and rapid-mixing system for chemical feed. The system is designed for expansion up 25.5-mgd peak hour conditions. In addition, the system is design for the potential incorporation of tertiary clarification to meet more stringent effluent TP limits in the future. The project is currently in detailed design, with construction anticipated for 2019.

Project Manager and Process Lead, Phosphorus Removal Evaluations at the West Boise Wastewater Treatment Facility (WWTF), Boise, ID. Led a project to help the City of Boise identify various options to meet the upcoming phosphorus limits. This project investigated a range of chemical and/or biological options to meet the new permit levels.

Senior Process Designer, The West Camden Sewage Treatment Plant, New South Wales, Australia. The West Camden plant required upgrading for both increased capacity and to achieve new stricter nitrogen and phosphorus limits. Served as senior process designer for this upgrade. The plant capacity was increased from 2.6 mgd to 6.0 mgd on an average day basis. Additionally, full nutrient removal was implemented with a target effluent TN value of 7.5 mg/L (median) and a target effluent total phosphorus of 0.04 mg/L (median). The system uses a combination of biological phosphorus removal with multipoint chemical addition and metal salt recycle to achieve these goals at the lowest feasible chemical dosage. Data indicates that that the metal salt usage is approximately half that would normally be expected for these effluent goals. A key innovation in this design was the recycle of tertiary metal salts sludge to the head of the plant to promote further absorption of phosphorus by the tertiary sludge in the secondary system in combination with the high shear alum addition system.

Senior Process Technologist and Process Lead, Clean Water Services Durham AWTF Facility Plan, Portland, OR. Clean Water Services enlisted our team to develop the new facility plan for the Durham AWTF. The Durham plant is an industry leading facility with biological phosphorus removal, primary sludge fermentation, and tertiary clarification and filtration to achieve very low levels of phosphorus removal.

Lead Designer, Alexandria Sanitation Authority's Advanced Waste Treatment Facility Upgrade, Alexandria, VA. Served as the lead designer for an upgrade of the Alexandria Sanitation Authority's Advanced Waste Treatment Facility. This project involved retrofitting a 120-mgd tertiary settling and filtration facility with a new inclined plate setting system, upgrading the existing filters, and adding 10 new filters to achieve an effluent total phosphorus level of less than 0.18 mg/L.

Andy Schrank, PE, Design Lead

Education and Professional Registrations

BS, Civil and Environmental Engineering, University of Wisconsin—Madison

BS, Industrial Technology, University of Wisconsin—Stout

Professional Registrations Professional Engineer: Wisconsin

Distinguishing Qualifications

- 34 years of water engineering and construction management experience
- Project manager for 100-mile-long pipeline project
- Resident engineer for numerous municipal wastewater projects
- Experience with a broad range of biological and physical/chemical wastewater treatment processes

Relevant Experience

Project Manager, Multiple Pump Station Designs, Water Infrastructure Capital Program, Confidential Client. Major components of the program included approximately 100 miles of mainline pipeline consisting of 30-inch and 36-inch HDPE pipe with eight main line pump stations. Each station covers approximately 20 acres and includes a 20-million-gallon, double-lined pond and wet well sized to pump 21 mgd utilizing five vertical turbine pumps (3,000 gpm). Approximately 25 subsystems were developed to connect the mainline to the frac ponds. Subsystem piping consists of approximately 300 miles of pipelines ranging from 16-inch to 30-inch HDPE pipe connecting to approximately 150 frac ponds. Multiple trenchless crossings using horizontally directional drilling (HDD) of drainage ways, wetlands, and highways were designed and range from 200 linear feet to 400 linear feet. HDD crossings ranged in diameter from 16-inch to 36-inch for the HDPE carrier pipe and 24-inch to 54-inch for the steel casing pipe.

Resident Engineer, R2E2 Project, NEW Water, Green Bay, WI. Construction of the $170 million R2E2 project includes three construction packages and multiple equipment purchase packages. Construction has been performed by 15 contractors and subcontractors. At the peak of construction, more than 150 trades construction staff were on site. Andy was responsible for managing construction of an 85,000-square-foot solids facility building containing various sludge handling and heat recovery systems.

Assistant Project Manager, R2E2, NEW Water, Green Bay, WI. The $170 million R2E2 is the single largest water/wastewater project constructed in Wisconsin in more than 25 years. The project consists of new biosolids processing facilities that include thickening, digestion, dewatering, drying, incineration, nutrient recovery, and a 4-MW biogas engine system. The project's energy systems will provide 75 percent of the plant's energy needs through renewable sources, which will save more than $50 million in fossil fuel costs over 20 years. Andy's responsibilities included coordinating the Basis of Design Report, preparation of Division 1 specifications and procurement documents, owner review coordination, and involvement with LEED document preparation.

Assistant Manager, Metropolitan Water Reclamation District of Greater Chicago, Chicago, IL. Responsible for multi-discipline and multi-subconsultant design coordination and bidding services. Project included $200 million in sludge thickening facilities at the Stickney Water Reclamation Plant. Construction included eight 80-foot-diameter gravity thickeners and associated pumps, wet well pump stations, and an effluent pump station in the sludge concentration tank complex.

Assistant Project Manager, WWTP Design and Construction Services, Metropolitan Government of Nashville and Davidson County, TN. Responsible for the coordination of design and services during construction (RFIs, shop drawings, change order requests) activities for this $117 million design-build project for a new 137-dry-tpd biosolids facility and associated improvements.

Project Manager, Wastewater Treatment Facilities Expansion, Cannon Falls, MN. Responsible for client management, design, budget and schedule coordination. Project included design of wastewater treatment plant expansion including preliminary treatment, oxidation ditch, clarification, RAS/WAS pumping, sludge storage tanks and administration building.

Project Manager, Daniels Island Wastewater Treatment Plant Expansion, Charleston Commissioners of Public Works, North Charleston, SC. Responsible for client, design, budget and schedule coordination. The project included design of a 4-mgd expansion of the wastewater treatment facilities including preliminary treatment, oxidation basin, clarification, RAS/WAS pumping, filtration, flow monitoring, effluent storage and chlorination/dechlorination. Effluent from this facility normally is reused for watering local golf courses.

Project Engineer, Phase 1 Camp and Infrastructure Suncor, Fort Hills, Alberta, Canada. Project included design, expediting and construction coordination between disciplines and various engineering firms. Also responsible for leading the development and issuing over 70 Engineering Work Packages (EWP). The project included engineering, procurement and construction related services to support 500 – 2,500 person construction camp. Project included HDD raw water intake, influent transfer pumps, potable water treatment and distribution, wastewater collection and treatment, fire water distribution system, gas distribution, temporary power system and communications systems.

Design Manager, Apogee Coal Company, Logan, WV. Responsible for discipline coordination and preparation of plans and specifications. The projector was a design/build Selenium treatment plant. The process included three pond pumping systems, blend tank, fluidized bed reactors, sand ballasted clarifiers and filter presses along with associated pumps and chemical feed systems.

Project Manager, Bottling Plant Neutralization System, Cott Beverages, Fort Worth, TX. In charge of all aspects of design and construction related services. Managing shop drawing review, onsite construction observation, and preparation of the pretreatment permit application. This design/build project included a neutralization system and secondary containment, fiberglass neutralization tank, associated piping and valves, acid and caustic chemical metering pumps, recirculation pumps and pH probes, a mixer, a control panel, and indoor secondary containment area for bulk chemical storage and metering pumps.

Dustin Maas, PE, Design—Process Mechanical

Education and Professional Registrations

BS, Environmental Engineering, University of Wisconsin—Platteville

BS, Reclamation, Environment, and Conservation, University of Wisconsin—Platteville

Professional Engineer: Wisconsin, Minnesota

Distinguishing Qualifications

- 10 years of experience in water and wastewater treatment planning, design, and construction administration involving both liquids and solids treatment
- Process mechanical engineer experienced in hydraulic modeling of gravity and pumped flow systems and modeling of low and high-pressure digester gas systems.
- Knowledgeable in application of wastewater treatment codes and design standards including WI NR110, EPA 40 CFR 503, Recommended Standards for Wastewater Facilities, Hydraulic Standards Institute, and NFPA 820

Relevant Experience

Process Mechanical Engineer, Backwash Waste Pump Replacement Study, F. Wayne Hills Water Resource Center, Gwinnett County, GA. Process engineer responsible for the evaluation of the backwash waste pumps that return backwash from the sand filters to the liquids treatment train. Capacity of the pumps decreased after a new discharge point was placed into service. A new system curve was established and a three-pump system to restore pumping capacity was selected to ensure the pumps continuously operate in the Preferred Operating Range.

Project Engineer, Wastewater Treatment Facility Expansion, City of Princeton, Princeton, MN. Project involved the expansion of the existing oxidation ditch wastewater treatment with biological phosphorus removal and tertiary filtration. The project included expanded fine screening, oxidation ditches, final sedimentation, secondary scum pumping, tertiary filtration, ultraviolet light disinfection, post aeration, effluent pumping, aerobic sludge stabilization, pumping and reed beds. Tertiary filtration options were evaluated during design that were capable of meeting the 0.3 mg/L phosphorus limit. Filtration options evaluated included sand filters, cloth filters by Aqua Aerobics, and cloth filters by Kruger. Kruger filters were selected and installed.

Project Engineer, Hydraulic Profile Review, City of Oshkosh, Oshkosh, WI. Created a hydraulic model of the Oshkosh WWTF from the aerated grit chamber splitter box thru the discharge at the Fox River using WinHydro modeling software. An Average Day 12-mgd and Peak Secondary Capacity 65-mgd scenario were created to verify the accuracy of the existing hydraulic profile. The model was used to evaluate the hydraulic impacts of two alternatives identified in the Phosphorus Preliminary Compliance Alternatives Plan for dividing flow to all four final clarifiers while using half of the aeration basin capacity.

Project Engineer, Mercury Removal Treatment Project, City of Hibbing, Hibbing, MN. Project involved improvements to meet a new low-level mercury limit. The project included a new advanced filtration system to provide low-level mercury removal treatment at the existing south wastewater treatment plant. The project included the addition of a new filter building with five sand and anthracite dual media filters incorporating air and water backwash operation. A vertical turbine pump station was designed to Hydraulic Institute Standards to increase head from the final clarifiers to the filters.

Project Engineer, Resource Recovery and Electrical Energy Design, NEW Water, Green Bay, WI. Project engineer responsible for the design of primary sludge pumping facilities, thickened sludge pumping, and improvements to the cake storage building to handle solids while the incinerator is removed from service including a new high-pressure cake feed pipe. Primary digester solids improvements included addition of automated to recirculate contents of scum box to break up scum mat prior to pumping to scum concentrator.

Richard Siebers, RA, Design—Architectural

Education and Professional Registrations

BS, Architecture, University of Wisconsin at Milwaukee

Registered Architect: Wisconsin

Distinguishing Qualifications

- 29 years of architectural and design management experience in studies, designs, and construction support for industrial, utility and military projects
- Building condition and space utilization assessments for numerous projects
- Water and wastewater system vulnerability assessment experience
- Security system and target hardening design experience
- Design manager and architectural task leader on numerous DoD projects involving AT/FP design criteria

Relevant Experience

Lead Architect, Control System, Influent Pumping and Aeration Blowers Update, Oshkosh WWTP Oshkosh, WI. Lead architect for upgrades to the influent pump station motor room and chemical building electrical room.

Lead Architect, De Pere and Green Bay Facility Upgrades, NEW Water, Green Bay, WI. Lead architectural designer on all phases of design and construction for the De Pere and Green Bay Facility Upgrades project. The project included security upgrades to all the existing exterior doors at the De Pere Facility, including a new gate with brick and concrete gate enclosures. The project also included modifications and addition to existing Influent Pump Station, a new 2 story grit building, new chemical storage areas and modification to the existing Service Building, an addition to an electrical building, along with other modifications to De Pere and Green Bay Facilities.

Lead Architect, Water Filtration Plant Modifications and Demolition Project, Oshkosh, WI. Lead architectural designer on all phases of design and construction. The project included demolition of previously decommissioned treatment plant facilities. A new basin was designed to provide backup disinfection contact time and filter backwash supply storage. The basin was constructed concrete form liner and staining to look like stone. A new low lift pump station was constructed on the top of the existing concrete pump station foundation, which was part of the treatment facility being demolished. The existing high lift pump station was removed from the top of existing reservoir, and the new pump station was built. Both new pumps stations have a higher floor elevation and new pumps and equipment. Skylights are installed over the pumps in both new pump stations to allow for future removal of pumps and motors.

Lead Architect, Water Treatment Plant Upgrade, Township of North Brunswick, NJ. Lead architect on all phases of design and construction for the Water Treatment Plant Upgrade project. The project included a new 2 story Filter Building with pump room, office area and laboratory. The building included solar collector panels on the roof. The project also contained modifications to existing facilities, including renovating 2 existing steel backwash thickening tanks, new backwash equalization tanks, and a new stair for the precipitators. The treatment plant is next to a nature trail, so the new work used colors to blend in with the existing trees and site. Because the new work would be visible from neighbors, so the Filter Building was designed to be aesthetically pleasing.

Lead Architect, Water Plant Disinfection System Improvements, City of Cedar Rapids, IA. 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 connect by above ground walkway to the J Ave. UV disinfection building. The new J Ave. buildings were to match the existing historic brick and stone buildings.

Lead Architect, Cleveland Security System Project, Cleveland, OH. Worked with the Cleveland Public Utilities to set a standard for target hardening of their critical facilities. Lead Architect for the design of security improvements for four water plants, maintenance and administration facilities, over 50 water towers, pump stations, power substation, water pollution control and emergency radio facilities. The design included security assessment and recommendation for improvements, surveillance and intrusion detection systems, target hardening of critical assets and remote sites, and facility and site access monitoring and control.

Architectural Task Leader, Cedar Rapids Wastewater Treatment Plant, Cedar Rapids, IA. Architectural designer and architectural task leader on all phases of design and construction for the Anaerobic Treatment Facilities. The project included adding 3 new buildings; the Chemical Building, Process Building and Biogas Building. The Chemical Building was for process chemical storage and pumps. The Process Building included a large room for process equipment, a laboratory, toilet, and control room. The Biogas Building had a biogas processing room, gas handling room and a chemical room.

Architectural Task Leader, Sludge Dewatering and Fine Screen projects for Freeport Water and Sewage Commission, Freeport, IL. Architectural designer and architectural task leader on all phases of design and construction for Sludge Dewatering and Fine Screen projects. The Sludge Dewatering added a new building for centrifuge, pumps and polymer systems. The Fine Screen project replaced an existing bar screener with a new screening press.

Architectural Task Leader, Disinfection System Design and Health Office Relocation Projects, NEW Water, Green Bay, WI. Architectural designer on all phases of design and construction for Disinfection System Design and Health Office Relocation Projects. The Disinfection System Design project renovated an existing unused process space into a new Sodium Hypochlorite storage and pumping room. The Office Relocation project renovated an existing space into two rooms and a bathroom

Architectural task leader for the Atherton WWTP Improvements, Little Blue Valley Sewer District, Independence, KS. Architectural designer and architectural task leader on all phases of design and construction for upgrade of this wastewater treatment plant. The treatment plant upgrades included a new raw wastewater pump station, headworks facility, primary pump station, and ferric and polymer building. To meet the deadline for state revolving fund loans, the facilities plan was completed in 100 days. The preliminary and final design was completed in 9 months and submitted to the state for review.

Architect, Fridley Ammonia Building Design Project, Minneapolis, MN. Worked with the Division of Water Treatment and Distribution Services (DWTDS) to design an anhydrous ammonia storage and feed facility for the Fridley Filter Plant (FFP). The FFP had previously used an exterior storage tank, interior day tank and local feed rate control via rotometers. The new facility, which is currently being constructed, consists of three 2,000-gallon pressurized storage tanks, five ammonia gas feeders, and emergency wet scrubber, all contained within an aesthetically pleasing explosion proof building. A bioretention pond to minimize the release of stormwater to the Mississippi River was also incorporated into the design.

Del Lange, PE, Design—Structural

Education and Professional Registrations

Graduate Studies in Structural Engineering, University of Maryland, University of Kansas

BS, Civil Engineering, University of Wisconsin

Professional Engineer: Wisconsin, District of Columbia, Florida, Indiana, Iowa, Louisiana, Minnesota, New Jersey, Rhode Island, South Carolina, Tennessee, Virginia, West Virginia,

Distinguishing Qualifications

- Over 30 years of experience serving as a structural lead on a wide variety of projects including numerous water and wastewater treatment plant designs and upgrades
- Structural expertise on large, multi-disciplined wastewater projects, including the Green Bay, Manatee County, Fairfax County, and City of Crestview wastewater projects in the past 5 years
- Subject matter expert on welding and a Certified Weld Inspector (American Welding Society)

Relevant Experience

Lead Structural Engineer, 2016 Water Treatment Plant Improvements Project, Oak Creek Water and Sewer Utility, Oak Creek, WI. Responsible for design of the pretreatment building and filter building expansion. The project included a 2-million-gallon storage tank, intermediate pump station, UV disinfection, new high-lift pump station, emergency generator, and rehabilitation of the old high-lift pump station to an electrical room. Del worked closely with geotechnical and architectural disciplines to provide facilities that were functional, structurally sound, and accommodated site-specific soil conditions. He also critically reviewed the pre-stressed concrete storage tank and made suggestions to the tank manufacturers that improved the tank.

Senior Reviewer, Crestview Wastewater Treatment Facility Expansion, City of Crestview, FL. Provided senior review during design of chlorine contact basins, effluent vault, and splitter box as well as a timber framed hypochlorite pump building and adjacent concrete masonry chemical building. Also performed submittal review during construction. Construction Cost: $6.5M (Phase 4 only). Year Completed: 2014 (Phase 4 only).

Lead Structural Engineer, Southwest Water Reclamation Facility (WRF) Nitrogen Removal and Digester Modifications, Manatee County Utilities, FL. Designed and constructed new splitter boxes, modified existing anoxic basins to accommodate new mixers, modified existing aeration basins to accept new air piping and pumps. Construction Cost: $16.1M. Year Completed: 2017 (estimated).

Provided Civil and Structural Designs, Water Pump Station Expansion, Fairfax County Water Authority, Fairfax, VA. Provided designs to accommodate the expansion of a water pumping station, which was required to maintain service throughout the expansion activities. He provided site design, rerouted a pipeline through the site, and wrote demolition plans for the existing building. Also wrote specifications and secured building permits. In addition to construction administration responsibilities, presided over monthly construction meetings.

Lead Structural Engineer, Water Filtration Plant Modifications and Demolition Project, Oshkosh, WI. Responsible for design of baffled, cast-in-place Chlorine Contact/Backwash Water Supply Basin, High Lift Pump Station 6/7, and backup Low Lift Pump Station.

Macon Municipal Utilities Water Treatment Plant Improvements, Macon, MO. Structural design consisted of the addition of a dry pit pump room within an existing clearwell.

Lead Structural Engineer, Pump Station Projects, City of Fort Wayne, IN. Lead structural engineer for the design and construction of the Plant 3 North Sludge Pump Station, Plant 3 Winterization and Sludge Facilities Planning Study Projects at the Three Rivers Filtration Plant.

Lead Structural Engineer, J Avenue Water Plant Disinfection System Improvements Project, City of Cedar Rapids, IA. The project consisted of the addition of a UV reactor building and a reservoir and pump station. The UV reactor building will be constructed immediately adjacent to and between two existing buildings. Dewatering during construction and the fact that the foundation of the UV building is below the adjacent structures required the implementation of a support of excavation system that will not undermine the existing structures foundations and will minimize the potential for construction dewatering related settlement.

Structural Engineer, Dublin Road Water Purification Plant, Nitrate Removal Facility, Columbus, OH. The upgrade/expansion increased the lime softening plant's capacity from 65-mgd to 80 mgd using advanced treatment processes. Optimized the existing lime softening and filtration processes. The existing filters were approved at a higher rate, with new underdrains and biological GAC media, saving millions of dollars over expansion of the filter facility. Can incorporate UV and GAC contactors into future expansion.

Lead Structural Engineer, Resource Recovery and Electrical Energy (R2E2) Project, Digestion and Solids Facilities Contract No. 34, NEW Water, Green Bay, WI. Performed design of solids processing building (100 feet by 300 feet, three story) and ash dewatering basins. Coordinated with multiple offices, disciplines, and design firms. Conducted weekly site visits to inspect construction and help direct field staff. Coordinated submittal review with multiple engineers/offices. Construction Cost: $135M. Year Completed: Ongoing.

Lead Structural Engineer, Ohio River Intake Project, Cincinnati Water Works, Cincinnati, OH. Responsible for the structural design of a $14-million water intake structure.

Lead Structural Engineer, Pretreatment Building Design, Water Treatment Plant, Oak Creek, WI. Responsible for the design of the pretreatment building and filter building expansion.

Lead Structural Engineer, Steel Tank Foundation Design, Water Pollution Control Facility, City of Cedar Rapids, IA. Responsible for the design of numerous steel tank foundations, pre-engineered steel building foundation, and miscellaneous structures.

Lead Structural Engineer, Condition Assessment, Fridley Water Treatment Plant, MN. Provided inspection of all water holding reservoirs and conduits and a report documenting inspection, summarizing condition of assets, and recommendations for future repairs.

Robert Wood, PE, Design—Electrical

Education and Professional Registrations

MS, Engineering (Electrical Specialty), Colorado School of Mines

BS, Electrical Engineering, University of Wisconsin—Milwaukee

BS, Secondary Education, Mathematics, University of Wisconsin—Milwaukee

Professional Engineer: Colorado, Florida

Distinguishing Qualifications

- 19 years as an electrical engineer designing and implementing water and wastewater plant, power plant, and refinery electrical upgrades
- Specified, designed, and implemented power distribution equipment from 6.9kV switchgear through 480-volt motor control centers and, including interface of this equipment with SCADA systems
- Directs electrical contractors during plant startup at multiple pump stations, water, and wastewater treatment plants
- Added backup generation capabilities to multiple water and wastewater treatment plants
- Specified, designed interface with, and started up variable frequency drives throughout career
- Designed electrical interface with PLCs, DCSs, radio, and SCADA systems from multiple vendors

Relevant Experience

Lead Electrical Engineer, 2018 Strategic Capital Improvements Project (SCIP), Water Treatment Plant Phase 1 Project, City of St. Joseph, MI. Designed electrical portion of new high lift pump station, including motor control center and all distribution and control wiring. Designed power distribution modifications to accommodate future Phase 2 and Phase 3. Replaced existing motor control center in main plant and designed new MCC to accommodate new chemical feed systems and refeed existing plant loads.

Lead Electrical Engineer, Dry Creek Wastewater Treatment Plant UV Cogeneration and UV Disinfection Project, Nashville, TN. Designed electrical distribution and control wiring including new motor control center with backup generator and transfer switch for new three channel UV system with future fourth channel. Six banks of 20 lamps per channel. Designed around Trojan UV Signa system and allowed provisions for other vendors. Located control panels and gate controls and instrumentation. Designed cable trenches for power, control, and UV system cables.

Lead Electrical Engineer, Clearwells Replacement Project, Oshkosh Water Filtration Plant, Oshkosh, WI. Designed expansion of existing 480 V power distribution system to accommodate addition of clearwells at the Oshkosh Water Filtration Plant. Design included replacing separate generator switchgear and manual transfer switch arrangement with state of the art generator paralleling switchgear, with automatic startup and drop out of generators. New 5000 A switchgear, and two 1 MW generators. Designed connection of new distribution system to existing plant and new intermediate and high-lift pump stations. Worked with generator switchgear vendor to design switchgear relay interlocking system.

Lead Electrical Engineer, Water Pollution Control Facility Odor Control Upgrades Project, Cedar Rapids Utilities Department, Cedar Rapids, IA. Completed electrical design and specifications for addition of two biotrickling filters and modifications to two gravity thickeners. Design included Class I, Division 1 and Division 2 hazardous areas, and modifications of existing plant distribution equipment.

Lead Electrical Engineer, 2016 Water Treatment Plant Improvements, Oak Creek, WI. Designed upgrade and expansion of 2.4 kV main electrical distribution equipment, along with distribution, controls, and duct bank system required for two new 30-mgd pump stations and new UV treatment facility. Designed layout and cable routing through new and existing pump station. Added a second engine-generator and transfer switch to existing emergency power system. Provided electrical sequence of construction so that plant would remain operational while new equipment is installed.

Lead Electrical Engineer, Wastewater Treatment Plant Control System, Influent Pumping and Aeration Blowers Upgrade, City of Oshkosh, WI. Modified design to match equipment provided, including five large 480 V VFDs. Configured construction sequence to minimize times of reduced pumping capacity.

Lead Electrical Engineer, 13.8kV and 2.4kV Switchgear Replacement Conceptual Design, Saint Paul Regional Water Services, St. Paul, MN. Provided description of existing medium voltage (MV) distribution system, and four alternatives for upgrading their 40-year-old switchgear to modern standards and controls. Alternatives ranged from replace in place to complete redesign of system to accommodate all future loads and replace 2.4kV with 4.16kV. Produced single line diagrams, load flow and short circuit studies, and layouts for all four alternatives. Worked with client to provide a recommended alternative, and provided conceptual design, detailed analysis and sequence of construction for selected alternative.

Electrical Engineer, Tuas TDP3 Desalination Plant Conceptual Design, Singapore, SG. Produced conceptual design for a 30 MGD desalination plant while on assignment in Singapore for six weeks. Produced single line diagrams from 66kV incoming power down to 440-volt loads. Provided load flow and short circuit data using SKM Systems Analysis. Provided preliminary plant layout for this two-story facility, which included low and medium voltage switchgear, transformers, and control equipment. Electrical and physical design completed in international units.

Lead Electrical Engineer, Primary Treatment Improvements, Metro Wastewater Reclamation District, Denver, CO. Performed majority of electrical design and sealed all electrical drawings for $22 million Primary Treatment Improvements. Project included rehabilitation of fourteen primary clarifiers, addition of four gravity thickeners, and retrofit of headworks building. Electrical controls and distribution including motor control centers were replaced under this project. Coordinated electrical design with other disciplines, and incorporated client preferences into design. Specified equipment suitable for hazardous locations. Discussed equipment operation and design with vendors. Reviewed vendor drawings. Visited project site in all phases of the project, from pre-design through start-up. Assisted electrical contractor with field wiring, programming, and start-up of low voltage switchgear, motor control centers, pump motors, valves, HVAC equipment, and programmable logic controllers.

Lead Electrical Engineer, Santan Expansion Project, Salt River Project, Gilbert, AZ. Performed electrical design for water purification facility for large power plant. Completed electrical design for four separate bid packages for design-build construction. Designed wiring and controls for separately provided pump motors, packaged pumping systems, and pre-packaged chemical feed systems. Designed and implemented 480V, 3-phase backup diesel generator with automatic transfer switch and performed startup services at new Berthoud, CO, Wastewater Treatment Plant. Designed wastewater treatment plant upgrades at Pueblo, CO and Broomfield, CO. Project engineer for City of Idaho Falls, ID electrical and mechanical upgrades at several well sites. Retrofitted valve motors and controls at Eleven Mile Dam near Lake George, CO. Designed upgrades to SCADA systems. Programmed PLC in ladder logic and designed control panel displays.

Darren Lecke, Design—I&C

Education and Professional Registrations

BS, Electrical Engineering Technology, MSOE, Milwaukee, WI

Distinguishing Qualifications

- I&C engineer with 14 years of experience and a strong background in programmable logic controller (PLC) design/programming, human machine interface (HMI) design/programming, and system integration
- Expertise includes system design and layout, programming of PLCs and HMIs, interfacing PLC to PLC, interfacing PLC to PC, drive setup and interfacing, interfacing databases to systems, interfacing with communication networks, and knowledge of hydraulics
- Knowledge and experience building systems to comply with National Fire Protection Association (NFPA) 70, NFPA 79, UL 508A, and NFPA 496

Relevant Experience

I&C Engineer, R2E2 Solids Facilities Design Project, NEW Water, Green Bay, WI. The R2E2 project is projected to reduce energy costs by $75 million over 20 years and reduce the energy required for power and heat at the Green Bay Plant by 75 percent through use of renewable biogas and waste heat. Our team developed concepts for reducing energy usage beyond facility plan concepts that evaluated during project predesign. Additionally, the team is evaluating the viability of recovering low grade waste heat for polymer make-up water and sludge heating to reduce polymer usage and increase cake solids. As a design lead, Darren was to write the I&C specifications, fiber specifications, component specifications, create a network block diagram, and fiber routing. He assisted in the first phase SCADA application software development, installation, start-up, and training of plant staff for the new primary switchgear. He will additionally assist in the second phase SCADA application software development, installation, start-up, and training of plant staff for the new solids facility.

I&C Engineer, 2016 Water Treatment Plant Improvements Project, Oak Creek Water and Sewer Utility, Oak Creek, WI. Darren coordinated I&C on the Oak Creek project, which included a 2-MG storage tank, intermediate pump station, UV disinfection, new high-lift pump station, emergency generator, and rehabilitation of the old high lift pump station to an electrical room. Darren worked closely with electrical and process engineers, along with Jack Knight, to provide an operator friendly facility that integrated with the existing SCADA system.

I&C Engineer, Wastewater Treatment Plant Control System, Influent Pumping, and Aeration Upgrades, City of Oshkosh, WI. The purpose of the project was to upgrade and replace the existing PLC hardware and to upgrade the influent pumping and aeration basins for more energy efficient operation. The system required interfacing to packaged systems, which include the upgraded centrifuges and new aeration blowers provided. A new single-mode fiber backbone will be installed as part of the project. As a design lead, Darren was to write the I&C specifications, fiber specifications, component specifications, generate a PLC input/output (I/O) list, create piping and instrumentation diagrams (P&IDs), create a network block diagram, and fiber routing. He is currently assisting in the SCADA application software development and will in the future assist in the installation, start-up, and training of plant staff.

I&C Engineer, Conveyance SCADA Backup Communications, Milwaukee Metropolitan Sewerage District, Milwaukee, WI. The current sites provide weather and storm sewer data that is sent over radio to a central location. The radio communication network is not always reliable during heavy storms, and a backup phone line and modem are being installed. He reviewed the existing controls and sites and compiled installation documentation for contractors to bid on and use for installation.

I&C Engineer, Water Pollution Control Facility Odor Control Upgrades Project, Cedar Rapids Utilities Department, Cedar Rapids, IA. I&C engineer for the addition of two biotrickling filters and modifications to two gravity thickeners. Design included Class I, Division 1 and Division 2 hazardous areas, and modifications of existing plant distribution equipment.

I&C Engineer, Marion Road Water Tower Replacement Project, City of Oshkosh, WI. Project includes aesthetic features to meet community goals, including a decorative fence, pre-fabricated equipment enclosures of a view screen for telecommunications antennas.

I&C Engineer, Fridley Filter Plant Ammonia System Replacement, Minneapolis Water Works, Minneapolis, MN. The purpose of the project was to replace the existing ammonia system. This project required interfacing to existing plant facilities such the plant SCADA, security systems, CCTV systems, and fiber network. Additionally, a new PLC was added to monitor and automate filling of the ammonia storage tanks and pacing the ammonia feed systems. Darren's role as a design lead was to write the I&C specifications, component specifications, generate an access control schedule, generate and CCTV system schedule, generate a PLC I/O list, and create P&IDs.

I&C Engineer, Fridley Filter Plant Control Chamber and Chemical Feed System Upgrades, Minneapolis Water Works, Minneapolis, MN. The purpose of the project was to upgrade the existing control chambers to allow for easier maintenance and add some additional chemical treatment feeds. This project required interfacing to existing plant facilities, such the plant SCADA and security systems. As a design lead, Darren wrote the I&C specifications, component specifications, generated an access control schedule, generated a PLC I/O list, and created P&IDs.

Instrument & Controls Engineer, Aquifer Storage and Recovery (ASR) Facility, New Jersey American Water, Aberdeen, NJ. The purpose of the system is to store treated potable water in and an aquifer and recovery the treated potable water for use in the distribution system. This is an unmanned facility that will use a PLC for automating the recharge of the aquifer and recovery of the potable water for the distribution system. The site will be remotely monitored using an existing SCADA network at another plant. As the design lead, Darren wrote the I&C specifications, component specifications, loop specifications, generated a PLC I/O list, and created P&IDs.

I&C Engineer, Groundwater Extraction System, Dow Chemical Co, Ludington, MI. The purpose of the site is to extract groundwater from ten wells and monitor the amount of ground water extracted. Secondary systems not part of this project process the extracted water. Darren was responsible for programming and configuring the control system, HMI, instruments, and variable frequency drives. This included automating the facility, loop tuning of proportional-integral-derivatives (PIDs), alarm monitoring, logging data, generating reports, remote access, and status emails.

I&C Engineer, Groundwater Containment System, USEPA, Washington, NJ. The purpose of the system is to treat contaminated groundwater from ten extraction wells and then send the treated water to two injection wells. This is an unmanned facility that will use a PLC for automating the extraction of the groundwater treating the contaminated water with by separating the volatile organic compounds (VOCs) using an air stripper, vapor, and liquid granular activated carbon (GAC) filters. The site will be remotely monitored using a web-based interface and email status alarms. Darren's role as a design lead was to write the I&C specifications, component specifications, loop specifications, generate a PLC I/O list, and create P&IDs.

Robert Martin, PE, Design—Geotechnical

Education and Professional Registrations

BS, Civil Engineering, University of Minnesota

Professional Engineer: Wisconsin, Minnesota, Nebraska, Ohio, Texas

Distinguishing Qualifications

- Nearly 20 years of tunneling and underground construction experience
- Provides analysis of soft ground and rock tunneling, rock slope protection design, tunnel inspection and rehabilitation design, and preparation of baseline reports for underground construction
- Member of ASCE's Committee developing Auger Boring Manual of Practice (MOP)

Relevant Experience

Tunnel Project Manager, Inner Doha Resewerage Implementation Strategy (IDRIS); Public Works Authority (ASHGHAL), Doha, Qatar. The IDRIS Program includes a conveyance system consisting of 40 km of deep main trunk sewer and over 70 km of lateral interceptor sewers, a 70-m deep large terminal pump station, an advanced sewage treatment works, and more than 70 km of treated sewage effluent return mains and pump station. Duties include coordination and preparation of the design build technical specifications and drawings for the main trunk sewer and the lateral interceptor sewers.

Project Engineer, Stave Lake Intake and Pump Station, Mission, British Columbia, Canada. To meet rapid growth in the region, Abbotsford Mission Water & Sewer Services (AMWSC) embarked on a program to expand the drinking water system. This included developing Stave Lake as a major supply source with the implementation of the raw water intake and pump station in rock consisting of a blocky granodiorite. Duties included a detailed alternatives analysis, preliminary site investigation, and preliminary design report.

Project Engineer, New Mexico Rural Water System, NM. The ENMRWS Project was developed to address the municipal and industrial water shortage, resulting from the declining and deteriorating groundwater resources. The ENMRWS Project consists of the following elements: Raw water intake structure and pump station located at the south shore of Ute Reservoir, with a flow rate of 28.1 million gallons per day (mgd), A 28.1 mgd raw water booster pump station at the base of the Caprock area and a 1 mgd storage tank at the top of the Caprock area in Quay County, A 28.1 mgd water treatment plant in Curry County with a finished water booster pump station to service downstream municipalities, A 28.1 mgd finished water booster pump station in Roosevelt County to convey finished water to Elida, New Mexico, Lateral pipelines to service Cannon Air Force Base, Clovis, Elida, Grady, Melrose, Portales, and Texico, Approximately 150 miles of buried raw and finished water conveyance pipelines, made of steel, ductile iron, and polyvinyl chloride (PVC), ranging in size from 4 inches to 48 inches in diameter, Pipelines conveying raw water from Ute Reservoir to the water treatment plant will consist of 42- to 48-inch diameter steel pipes. Finished water from the plant will be conveyed to major distribution laterals using 24- to 42-inch diameter steel and ductile iron pipes. Distribution system from the laterals to end users will generally consist of 4- to 24-inch diameter ductile iron and PVC pipes. Duties include the review of site investigation data, recommendation for supplemental investigation, 30 percent design of the raw water intake and pumping station, 15 trenchless crossing, preliminary specification, and cost estimate.

Project Engineer, Lake Mead Intake #3, Southern Nevada Water Authority, Lake Mead, NV. The project scope of new facilities for Lake Mead Intake No. 3 consists of a submerged intake shaft and structure, a tunnel beneath Lake Mead, Intake Pumping Station No. 3 (IPS-3), a discharge pipeline from the pumping station connecting with an existing water treatment facility, a tunnel connecting Intake No. 3 to the existing Intake No. 2, modifications to the IPS-2 intake structure, and necessary infrastructure and electrical supply works on Saddle Island. Structures included a 26-foot-inside-diameter 350 foot deep Surge Shaft and Surge Chamber, forebay will be approximately 36 feet high by 33 feet wide by 232 feet long, with an arched crown, and the IPS-3 Connector Tunnel will be a 20-foot-by-20-foot-wide modified horseshoe tunnel with a flow capacity of 1,200 mgd, and will be about 400 feet long. Duties included the evaluation of the rock quality, preliminary excavation support requirements, liner support initial design, modeling of the support concepts, and design report findings and recommendations, and construction observation.

Project Engineer, Lake Lanier Raw Water Intake, Forsyth County, GA. The proposed raw water pump station is subterranean, circular structure that will be constructed in the overburden. A 25-foot diameter shaft that receives raw water from the proposed 2,000-foot intake tunnel with an invert elevation of approximately 230 below ground surface will be constructed in a Powers Ferry Formation consisting of gneiss, amphibolite and schist. Duties included the review of existing boring data, concept feasibility, future site investigation requirements and design recommendations based on available data.

Condition Assessment, Lake Whatcom Water Supply Tunnel Inspection, Bellingham, WA. The Lake Whatcom Water Supply Tunnel is located in Bellingham, Washington, conveying raw water from Lake Whatcom to the City's Screen House. The tunnel is horseshoe-shaped constructed in 1939 using drill and blast methods with a length of 7,560 linear feet and a diameter of 6.5-feet and is lined with a cast-in-place concrete. Procedures defined by the National Association of Sewer Service Companies (NASSCO) Pipe Assessment Condition Program (PACP), were modified for manned entry inspection, to document liner defects as part of the condition assessment and data was collected electronically in the decrease inspection time in the field and processing of the data in the office. Duties included developing an electronic data collection system for use in the field, inspection and mapping of over 7,560 feet of the tunnel to determine the current and long-term stability of the liner. Completed a condition assessment report with recommendations for future maintenance, monitoring and repairs.

Condition Assessment, Homestake Raw Water Tunnel Inspection, Eagle County, CO. The Homestake Raw Water Tunnel, located in Pitkin and Lake County, and was inspected to assess the current condition of the tunnel and to determine if corrective action is required to maintain the integrity of the tunnel. The tunnel is approximately 28,600 feet long and constructed through Pre-Cambrian crystalline metamorphic that is Horseshoe in shape and is 9.5 feet wide and 11 feet tall. Procedures defined by the National Association of Sewer Service Companies (NASSCO) Pipe Assessment Condition Program (PACP), were modified for manned entry inspection, to document liner defects as part of the condition assessment and data was collected electronically in the decrease inspection time in the field and processing of the data in the office. Duties included developing an electronic data collection system for use in the field, inspection and mapping of over 28,600 feet of the tunnel to determine the current and long-term stability of the liner. Complete a condition assessment report, design of repairs for collapsed tunnel liner discovered during the inspection, services during construction of the repair and recommendations for future maintenance and repairs.

Jared Wendt, PE

Education

BS, Civil Engineering, University of Wisconsin-Platteville

Professional Registrations

Professional Engineer: Wisconsin

Distinguishing Qualifications

- 11 years of experience developing simple and complex staging plans, utility coordination, agency coordination, preparation of specifications and estimates for civil engineering projects
- Expert-level proficiency in Autodesk Civil 3D design software
- Expert-level proficiency in Bentley InRoads design software
- STEM Forward Young Engineer of the Year 2016
- President of American Society of Civil Engineers Wisconsin Section Southeast Branch, 2015-2016
- President of American Society of Civil Engineers Wisconsin Section, 2018-2019
- Received “Excellence in Highway Design” award from the Wisconsin Department of Transportation for “Consultant Rural Design” for the USH 41/45 Interchange in Oshkosh, WI in 2013
- Received “Excellence in Highway Design” award from the Wisconsin Department of Transportation for “Consultant Rural Design” for the USH 41/STH 51 Interchange & Lake Butte des Morts Causeway in Oshkosh, WI in 2014

Relevant Experience

Site Civil Engineer, F-35 Simulator Site Design, Truax Field, Madison, WI. Site civil engineer for the F-35 Simulator Site design for the Wisconsin Air National Guard. The project includes conceptual layout of the proposed 19,000-sf facility, grading plans including relocation of the existing site access, utility coordination and relocation, demolition plans for the existing building, and permit compliance.

Lead Engineer, STH 15 Reconstruction, STH 76 to New London, Outagamie County, WI. Lead engineer for the STH 15 reconstruction project. Our team led the design of the 10.5-mile project corridor through preliminary design and is continuing with the final design of the 3.5-mile east segment. The STH 15 project is a highway reconstruction project converting an existing undivided 2-lane roadway to a 4-lane divided roadway including a bypass of the Village of Hortonville. Access revisions were included where the proposed route is on existing alignment. Roundabouts are proposed at both ends of the bypass at the WIS 15 intersection with County T and County JJ. The project includes both a rural and urban section, an at-grade railroad crossing, and the design of multiple detention ponds. We are also performing utility coordination and preparing permit applications for the entire corridor. These tasks along with matching staging from the adjacent project require the project team to coordinate with the design teams from the Northeast Region working on the other segments to ensure a consistent approach is utilized throughout the corridor during final design.

Lead Engineer, USH 41 Reconstruction, STH 21 Interchange and Lake Butte des Morts Crossing, Winnebago County, WI. Lead engineer on this 4-mile stretch of USH 41 from Witzel Avenue to Fountain Avenue in Oshkosh, including the replacement of two interchanges and the expansion of the bridges/causeways over Lake Butte des Morts. This freeway expansion project included the reconstruction and reconfiguration of an interchange, expansion of the freeway from 4 to 6 lanes, and the expansion of the bridges and causeway over Lake Butte des Morts. The USH 41 profile was modified at both the STH 21 and USH 45 interchanges to pass under STH 21 and USH 45 rather than over them, described as a “flip-flop” of the profiles in the interchange areas. In addition, the USH 45 interchange was reconfigured into a partial system interchange by providing free flow movements from northbound USH 41 to northbound USH 45 (curved steel flyover bridge) and from southbound USH 45 to southbound USH 41. Both interchanges were reconstructed while maintaining 2-lanes of traffic in each direction on USH 41 through the construction of a temporary bypass of USH 41. Roundabouts were constructed at eight intersection locations throughout this section including at the 3 ramp terminal locations. The work includes survey, right-of-way plat preparation, drainage/stormwater management design, erosion control design, preliminary and final roadway design, structure design and PS&E preparation for Project ID's listed above.

Lead Engineer, USH 41 Reconstruction, Lake Butte des Morts Causeway Landscaping and Trail Enhancement Plans, Winnebago County, WI. Lead engineer on this project, which added many Community Design and aesthetic elements to the USH 41 Lake Butte des Morts causeway crossing. The design team worked closely with the neighboring communities and various state agencies to include unique features into the design of the path. The path included 12 points overlooking Lake Butte des Morts, with each location featuring a history of a Native American tribe. The trail also featured approximately 1,700 feet of aluminum railing to protect against a steep slope at the edge of the trail leading into the bridge crossings. Jared was involved in the coordination with the landscape architect on the aesthetic elements and was responsible for the preparation of the contract documents, specifications, and estimate for this project.

Sam Rizzi, PE, Design—HVAC/Plumbing

Education and Professional Registrations

BS, Civil Engineering, Youngstown State University

Distinguishing Qualifications

- 28 years of experience in providing consulting engineering design and construction phase services
- Specializes in providing civil, process and mechanical engineering design, construction phase engineering and project management services for wastewater and water treatment facilities
- Experience with concept/design/construction phase engineering on medium to large scale wastewater treatment plant projects

Relevant Experience

Project Engineer/Design Manager/QA/QC Reviewer/SDC Manager, Noman M Cole Jr Pollution Control Plant (NMCPCP) Fairfax County, VA. Rehabilitation of the Building S Polymer System. Responsible for the design management for this 50-contract drawing, $1M construction cost upgrades project which includes replacement of the dry polymer system and polymer feed pumps. Will also serve as the QA/QC manager through bid phase and as the design manager for services during construction work including submittals and shop drawings review, requests for information responses, project changes and revisions and the engineer's role in commissioning services for the project which runs until 2019.

Design Engineer, Disinfection Chemical Handling Facility Improvements, Jackson Pike Wastewater Treatment Plant, Division of Sewerage and Drainage City of Columbus, OH. Responsible for preparing portions of the technical proposal, power-point presentation and subsequent kick-off meeting agenda for the proposed new sodium hypochlorite and sodium bisulfite chlorination and dechlorination chemical handling systems. Responsible for reviewing technical portions of the Detailed Design Memorandum. Responsible for the process drawings and specifications involving upgrades at the flushing water pump station for this 260+ drawings $22M project. Process design responsibilities included replacement of the flushing water vertical turbine pumps and seal water system, replacement of self-cleaning strainers and replacement of all system piping, valves, air releases, flowmeter and appurtenances to increase capacity by 25 percent. Also responsible for managing, coordinating and reviewing the work of the subconsultant for the plumbing and HVAC design contract drawings and specifications

Design Engineer, Effluent Pump Station Conduit, Southerly Wastewater Treatment Plant, Division of Sewerage and Drainage, City of Columbus, OH. Responsible for the HVAC and plumbing Detailed Design Memorandum (DDM), contract drawings and specifications for this 350+ drawing $16M project. Provided mechanical design for control building, electrical building, sampling building and metering chamber building. HVAC consisted of custom air filtration deep bed carbon scrubbers, custom air handling units, control room air filtration unit and air handling unit, ventilation fans, electric unit heaters and motorized louvers/dampers. Plumbing design consisted of floor, roof and equipment drainage systems, sump pump discharge system and potable water system.

Design Engineer, Hap Cremean Water Plan Sludge Pump Station Renovations and Electrical Upgrades, Division of Water, City of Columbus, OH. Responsible for managing the preparation and production and for the QA/QC and technical review of contract drawings and specifications for the civil, process and mechanical design disciplines for this 400 drawing $30M project. Responsible for the detailed design of the Coagulation Sludge Control House and Waste Sludge Control Houses 1 and 2.

Design Engineer, Additional Chemical Systems and Transmission Improvements, Phase 1 - Metal Salts, Blue Plains AWTP, District of Columbia Water and Sewer Authority, Washington, D.C. Responsible for civil, mechanical/ process and plumbing drawings and specifications for this 400 drawing $30M project involving renovation of the existing Chemical Building and related new facilities. Mechanical/process design responsibilities included the chemical building and chemical receiving station; tunnels, pipe chases, and galleries piping; the rehabilitation of the reclaimed secondary effluent pumps, the low-pressure final effluent booster pumps. Civil site and utility design responsibilities included site development, new roadways, chemical unloading/spill containment areas; sanitary and storm sewer piping; relocation of buried plant process utilities and electrical ductbanks; and Site Runoff Pump Station-5, which included collection and conveyance of storm runoff and sanitary flow to a combination vertical lift and submersible propeller pumping station and transmission back to the front of the plant for treatment through a buried force system. Also responsible for managing, coordinating and reviewing the design work of the subconsultants for the demolition, plumbing and HVAC design. Subsequent to design, served as the Construction Phase Engineer responsible for mechanical and process equipment submittal review and approval, request for information responses, construction contract change order preparation, and general construction management tasks including field inspection, final walkthrough and punch list.

Design Engineer, Additional Chemical Systems and Transmission Improvements, Phase 2 - Polymer, Blue Plains AWTP, District of Columbia Water and Sewer Authority, Washington, D.C. Responsible for the process, mechanical and civil contract drawings and specifications for this 260 drawing $25M project involving renovation of the Solids Processing Building (a once hollow portion) to provide a seven-story home for the largest dry polymer system in the world. Responsible for the process/mechanical detailed design and layout of the Polymer Area which included dry polymer dehumidified pneumatic unloading; dry polymer silo storage and conveyance; dry polymer batching and wetting; liquid polymer mixing and storage; and final polymer solution pumping and transmission subsystems. Responsible for the civil site and utility design for the Polymer Unloading Area, which included collection and conveyance of chemical containment, storm runoff and sanitary flow to a Site Runoff Pump Station. Also responsible for managing, coordinating and reviewing the design work of the subconsultants for the demolition, plumbing and HVAC design. Subsequent to design, served as the Construction Phase Engineer responsible for mechanical and process equipment submittal review and approval, request for information responses, construction contract change order drawing preparation, and general project management.

Design Engineer, Rehabilitation of Primary Sedimentation Tanks Nos. 1 and 2, Blue Plains AWTP, District of Columbia Water and Sewer Authority, Washington, D.C. Responsible for the civil and mechanical/process design, drawings and specifications for various upgrades at the plant for this 300 drawing $15M project, including service tunnel and site improvements, sludge blending and transmission improvements, and a new trucked sludge receiving station. Design responsibilities included site and utility work; interprocess piping and tunnel piping layout; and pumps, flow meters, related equipment.

Design Engineer, Direct Sludge Loading Station, Blue Plains AWTP, District of Columbia Water and Sewer Authority, Washington, D.C. Civil site and utility design responsibilities included a Site Runoff Pump Station 1, which included collection and conveyance of storm runoff and sanitary flow to a submersible chopper pumping station and transmission back to the front of the plant for treatment through a buried force system. Also participated in the preparation of the operation and maintenance manual for the new facility.

Alan Jones, PE, Construction Management—Resident Engineer

Education and Professional Registrations

BS, Architectural Engineering, Milwaukee School of Engineering

Professional Engineer: Wisconsin, Minnesota

Distinguishing Qualifications

- Over 38 years project/program management experience in project/program start up, execution and coordination between planning, design and construction phase activities.
- Served as Northeast Regional Quality Manager for the CCI Environmental Services Business Group and assisted in development of the project quality management plan and standard operating procedures used by project managers and ensure implementation of the quality program within the region
- Served as Director of the firm's North America Region Communications Design Center located in Chicago, IL. Develop the Design Delivery Plan outlining processes for successful production, quality assurance and performance objectives and goals for communications design work.
- Audits client design and construction programs to identify areas for improvement. Develop programs to optimize production performance and reporting (three major communications programs in the U.S.)
- Developed and implemented construction program organization, project delivery processes, procedures and start-up activities on two major international communications programs
- Experienced in managing hard dollar construction projects from bid phase through project close out.

Relevant Experience

Principal Project Manager, Resource Recovery and Electrical Energy (R2E2) Project, NEW Water, Green Bay, WI. Serving as Construction Manager for the R2E2 Project. Managing a multi-firm CM team and working closely with Owner personnel to successfully deliver the project. The project is currently in unit process startup phase. Scope of work includes solids processing facility building (approximately 90,000 sf.) including building services and bio-air system, personnel offices, control room, training room, kitchen/break area, locker and bathrooms, process solids dewatering and drying equipment, incineration system, co-gen engine generation systems. Scope also includes two 2.2-million-gallon silo type digesters and associated mixing and pumping, facility interconnecting tunnels, biogas storage and associated compression equipment, gas treatment equipment, and flare and bio-air processing equipment. Other facilities included in the R2E2 scope is septage receiving screening building and ancillary equipment and offloading stations. High strength waste (HSW) receiving stations and associated modifications to existing indoor tankage for HSW storage and associated pumping equipment. New aeration basin equipment and mixers, two ash dewatering basins and associated site modifications.

Principal Project Manager – CH2M GE Aviation, Cincinnati, OH. Short term assignment to step in as project manager to schedule and manage an accelerated electrical 138 kv substation project, including yard tower structures, breakers and transformers and site utilities. The project included construction of a 5000 square foot substation facility, including switchgear to provide service to new structures. Project Management services included bidding, contracting, purchasing and managing delivery of this four-phase project with demanding deadlines. The schedule required acceleration of the project to attain a GE temporary power milestone. In parallel, managed construction of a smaller substation project also within the GE existing facilities.

Principal Project Manager/Construction Manager Water Pollution Control Plant Combined Sewage Pump Station and Screenings Building Improvements, Contract A & B, and the CSPS Electrical Substation Improvements, Fort Wayne, IN. Serve as Construction Manager and Owner's representative during construction. The three projects totaling $23.4M SRF funded projects that began in October 2011 and under terms of the U.S. District Court Consent Decree required completion no later than December 2013. The scope of work included demolition and removal of existing building, structures, equipment and other facilities and upgrading the capacity of the existing pump station from 360 mgd to 530 mgd while maintaining operation for plant use. Installation of two new 1000 hp vertical mixed flow pumps, rebuild and re-installation of existing 1500 hp vertical mixed flow pumps. Providing modifications to existing discharge structure to include screening facilities. Construction of a new electrical building with 4160 V switchgear, removal of existing substation equipment, structures and foundations and installation of two (2) new 34.5kV Power Transformers, 69kV Circuit Switchers, concrete foundations, 5kV underground duct banks, control conduits and grounding. The complexity of work sequence and coordination of trades required weekly schedule update meetings during the height of construction. The CSPS projects were selected as one of the top water and wastewater projects of 2013 by Water &Wastes Digest, December 2013.

Principal Project Manager/Resident Engineer, Grand Chute Menasha West WWTF Expansion and Rehabilitation Project, Neenah, WI. Serve as Resident Engineer and Owner's representative during construction of the Grand Chute Menasha West WWTF Expansion and Rehabilitation Project, a $24M stimulus funded project (Federal American Recovery and Reinvestment Act of 2009 (ARRA)), that began in October 2009 and was scheduled for completion in December 2011. The scope of work included construction of new primary and secondary clarifiers, integrated fixed-film activated solids (IFAS) aeration basins, a Therm AER™ Auto-Thermal Thermophilic Aerobic Digestion (ATAD) facility, bio-filter facility, tunnel modifications, installation of plant wide data and power duct banks, new plant fiber network, installation of new PLC panels and programs for updating plant control systems and new motor control centers.

Northeast Regional Construction Quality Manager, CH2M/CCI Environmental Services Business Group. Milwaukee, WI. As Regional Construction Quality Manager (RCQM), responsibilities include continuing development of quality procedures, processes and the Project Quality Management Plan (PQMP) and ensuring implementation of the quality program within the region. This responsibility includes oversight of quality performance, training personnel on the processes of the quality program, performing project audits of the processes being implemented on projects, and implementing continuous improvement initiatives of the quality program. The RCQM is responsible for assisting the Project Quality Manager in establishing and overseeing the implementation of the quality system for each program, project, and task.

Brice Wandyg, Construction Management—Resident Inspector

Education and Professional Registrations

BS, Civil Engineering Western Michigan University

Distinguishing Qualifications

- 10 years of experience in field inspection and contract management of heavy civil projects including water supply systems, stormwater management, bridges, and roadways
- Extensive contract administration experience, including construction management, project scheduling and budgeting, documentation and reporting, and stakeholder/contractor coordination
- Surveying experience includes GPS Data Collection and Processing and site grading
- Extensive safety training

Relevant Experience

Construction Engineer III, Resource Recovery and Electrical Energy (R2E2), NEW Water, Green Bay, WI. Responsible for field inspection of new solids processing building. This includes the construction of cast-in-place reinforced concrete, precast concrete panels, and all other structural elements of the building under the supervision of the resident engineer. Upon completion of the building, field inspection of all the piping and various equipment installed. The client is kept up-to-date on all progress via reporting and weekly meetings held will all the contractors present on the project. When complete the new facility will produce substantial energy savings to the client and bring the facility in-line with current EPA emissions regulations.

Construction Engineer III, CTR-Chicago, IL Department of Water Program Management. Responsible for field management and project inspection including project supervision, quality control, record drawing preparation, payment recommendations and daily report creation. Attends weekly Alderman and bi-weekly contractor meetings to discuss project progress. Additionally, regular coordination between City and Contractor personnel is required to perform various tasks on project sites. Responsible for training new field employees; this process lasts several weeks, and each field engineer learns project specifications, expectations, and reporting requirements.

Construction Engineer, Ashland Boulevard Water Main Replacement, Chicago, IL. Located between W. Irving Park and W. Lawrence, the two new water mains were installed (8 inches and 16 inches), with a total project length of 8700 LF. Work involved replacement of all house drains per IEPA Specifications, and reconnection of existing water services to new water main.

Construction Engineer, Roscoe Village Water Main Replacement, Chicago, IL. Located on both N. Leavitt and N. Hamilton between W. Addison and W. Belmont, an 8-inch Watermain installed on both streets, with a total project length of 5200 linear feet. Work involved coordination with business district to minimize water supply disruptions during business hours, regular meetings with business representatives to mitigate impact of construction activities, and coordination with the construction manager on client project directives.

Construction Engineer, Roadway Reconstruction, City of Three Rivers, MI. Work involved the installation of new 8-Inch watermain, 12-inch sanitary, and 24-inch storm sewers, with a total project length of 5,000 linear feet. The project included complete reconstruction of the existing road including subbase, asphalt pavement, curb and gutter, and landscaping.

Construction Engineer, Transportation Improvements, Western Michigan University, Kalamazoo, MI.
The project involved complete reconstruction of approximately one-half mile of existing roadway to include new curb and gutter, new storm sewer, replacement of defective base material, ADA ramp installations, and new asphalt pavement.

Appendix B—Detailed Scope of Services

APPENDIX B

Detailed Scope of Work

Section 1 of our proposal describes how we intend to approach completing the project including a detailed discussion of how we will propose to address several key technical project issues. This section describes in detail the scope of our work and assumptions that would be intended to form the basis for a contract between the City and Jacobs. Jacobs prepared the level of effort and fee estimate for the design and construction services based on the following detailed description of tasks, assumptions, and preliminary construction drawing list.

The Project will be delivered through completion of the following tasks:

Task 1 – Preliminary Design

Task 2 – Final Design and Permitting

Task 3 – Bid Phase Services

Task 4 – Construction Phase Services

Task 5 – Project and Quality Management

Jacobs staff will charge their time and expenses for each task described below separately for the Return Flow Pump Station.

Task 1—Preliminary Design

The City has already completed a preliminary design of the Return Flow Pump Station and its Final Phosphorus Compliance Alternatives Plan. The purpose of Task 1 is to conduct the technical evaluations, workshops and design work necessary to develop the 30 percent complete Preliminary Design Report that will serve as the basis of final design. The City can incur significant unbudgeted cost, schedule delay, or both if the design team revisits design decisions finalized in the Preliminary Design Report. The project team will revisit decisions only if there is a fatal flaw in design or if the City directs a change.

1.1 Preliminary Design Workshops

Workshops and evaluations will be conducted to confirm preliminary design criteria including new facility layout, process monitoring and control, hydraulics (working within existing head conditions), and equipment and instrumentation preferences. While the City's previous engineering work will be reviewed and utilized to meet the City's project objectives, some major decisions remain to be made by the City such as selection of the advanced low phosphorus treatment technology and facilities. It is anticipated that some design criteria such as the return flow control strategy for regulatory compliance will also be refined during preliminary design. To help make those decisions with the City and other stakeholders, Jacobs will lead four workshops. Attendees will include City personnel from the Waukesha Sewer Utility, the Waukesha Water Utility, the Waukesha Department of Public Works, GWA representatives, and other stakeholders the City identifies to participate in the preliminary design process.

The workshops will be structured to separate Return Flow Pump Station discussion and stakeholder attendance from discussion related to the other project improvements.

Preliminary Design Workshop No. 1. Kick-off and Confirm Existing Design Criteria

Project Kickoff Meeting

In preparation for Workshop No. 1, Jacobs will submit a request a data and information needs request.

Jacobs shall conduct a kick-off meeting with City to include, including review of the following items:

- Project objectives
- City expectations

- Factors critical to project success
- Roles and responsibilities of City and Jacobs project team members
- Project schedule/key milestones/construction sequence constraints
- Supplemental data and information needs
- Alternative project funding sources

Confirm Major Design Criteria

During Workshop No. 1, established major design criteria will be confirmed; i.e., Return Flow Pump Station location, design flow and required discharge head. City preferences for emergency generator location, electrical room features, access for operations and maintenance, and facility automation will be discussed.

Further, it is anticipated that design criteria for the other plant improvements, described in the RFP and listed below, will also be confirmed:

- Replacement of the PVC aeration piping and membrane diffusers in three aeration bays
- Replacement of Building 110 Primary Influent pumps, motors, motor control centers (MCCs) and associated cabling
- Replacement of Building 140 Primary Effluent pumps, motors, MCCs and associated cabling
- Replacement of Building 150 ~~(primary sludge pumps and primary scum pumps)~~ MCC~~s~~ and associated cabling
- Replacement of approximately 10 overhead doors
- Replacement/repair of approximately 8 manual slide gates
- Select area painting (Building 400 pumps and piping, Building 240 pumps and piping, Facility 230 clarifier baffles)

Jacobs will begin to solicit the City’s input on the proposed alternatives evaluation to select the Advanced Low Phosphorus Treatment technology.

Preliminary Design Workshop No. 2. Screen Advanced Low Phosphorus Treatment Technologies

In this workshop, alternatives for phosphorus treatment, including those previously evaluated in the Facility Plan Amendment and piloting and other concepts presented in our proposal, will be discussed. Through this process, the City will determine which alternatives are the most viable and up to three alternatives will be evaluated in more detail.

Preliminary Design Workshop No. 3. Select Advanced Low Phosphorus Treatment Technology

Jacobs will prepare the following information and analysis for the selected alternatives:

- Detailed process flow diagrams
- Conceptual site plan layouts
- Design criteria
- A summary of vendor information such as catalog cuts
- Conceptual life cycle cost estimates including capital and O & M costs
- A comparison of non-monetary criteria for each alternative such as reliability, redundancy, maintenance requirements, and ability to meet effluent permit limits

Jacobs will conduct a workshop to discuss the alternatives and assist the City in selecting the process and facilities that will be advanced to final design. During this workshop, Jacobs will also present a draft table of contents for the phosphorus treatment preselection package and an overview of the vendor proposal evaluation and selection process.

Preliminary Design Workshop No. 4. Select Phosphorus Treatment Vendor and Complete Design Criteria

In Workshop No. 4, Jacobs will facilitate discussion, evaluation, and selection of the phosphorus treatment technology proposals received by the City

In addition, Jacobs will provide presentation of all the project final design criteria and a thorough preview of the Preliminary Design Report. The agenda will include discussion of facility operations and maintenance considerations for the project improvements, coordination with existing CWP facilities and systems, coordination with GWA program requirements, coordination with WE Energies, and review of constructability and sequence-of-construction constraints.

In preparation for Workshop No. 4, Jacobs will investigate ways to maximize operational energy efficiency in the design of the design of the new facilities. The evaluation will include consideration pump selection for efficient operation over the required flow range, premium efficiency pump motors and adjustable frequency drives. The investigation will also include consideration of alternative operating scenarios to optimize energy use and the project's ability to meet Focus on Energy eligibility requirements for energy efficiency financial incentives.

Task 1.1 Deliverables

Workshop agendas, presentation materials, and meeting summaries including discussion, decisions, treatment technology evaluation and design criteria.

1.2 Preliminary Design Report

Using Task 1.1 findings, Jacobs will develop the Preliminary Design Report, comprised of design criteria and preliminary drawings for the Return Flow Pump Station, Advanced Low Phosphorus Treatment Facility, and the other plant improvements identified in the RFP. Jacobs will submit a draft report for City review and conduct a report review meeting. It is anticipated the City and Jacobs will review the draft Preliminary Design Report with the Wisconsin Department of Natural Resources. City input on the draft report will be incorporated in the final report. The Report and drawings will represent a 30-percent complete design and address the following aspects of the project:

General

- Regulatory agencies with jurisdiction for the Project. List contact people at the agencies with jurisdiction.
- List known permits required for construction and operation.
- Applicable codes and versions of those applicable codes.
- Utilities from which service will be required. List contact people at the utilities. Detail requirements for obtaining service from each utility.

Geotechnical

- Geotechnical recommendations for new structures
- Construction issues (shoring, bracing, and dewatering requirements)

Structural

- Required modifications to existing structures concepts
- Corrosion control requirements

Architectural

- Return Flow Pump Station and Advanced Low Phosphorus Treatment Facility layout and egress requirements

Civil

- Project base map
- Civil site layout for proposed improvements
- Erosion control and stormwater management plan concepts

Process Mechanical

- Design criteria for process and pumping equipment
- Equipment sizing and selection for energy efficiency
- Pumping and process systems' layout
- Pumping system hydraulic transient analysis

Building Mechanical

- Heating, ventilating, air conditioning requirements

Instrumentation and Control

- Preliminary process and instrumentation diagrams (P&IDs).
- Equipment tag numbering, naming and abbreviation conventions.
- Overall control philosophy including local control approach, control system, level of automation
- Alarm and communication needs

Electrical

- One-line diagram modifications for the proposed facilities
- Recommendations for backup power
- Preliminary load calculations
- Electrical room sizing review
- Preliminary location of power feed
- Preferred voltages for power distribution and utilization equipment.

Project Implementation

- Construction Schedule
- Constructability and sequence of construction constraints
- Updated opinion of project cost
- Project funding alternatives

Task 1.2 Deliverables

Draft and final Preliminary Design Reports in electronic format and 6 paper copies.

Task 2—Final Design and Permitting

Jacobs will complete final design of the Project based on the Preliminary Design Report.

2.1 Bid Documents (Drawings and Specifications)

Jacobs will prepare the bidding and legal specifications, technical specifications, and drawings needed to support the improvements project. Table 1 lists the anticipated final design drawings to be prepared along with specifications to comprise the Bid Documents. In addition to bi-weekly conference calls with the City during design, Jacobs will meet with City personnel in person at the 60 and 90 percent complete milestones to review design progress, make decisions and discuss the City's input. During the development of Bid Documents, Jacobs will conduct weekly design team coordination meetings. The City is welcome to join in these routine design development meetings. An update to the construction cost estimate and a proposed construction schedule will be prepared at the 90 percent milestone.

The front-end bidding, legal, and general requirements will be based both of City of Waukesha standard requirements and Jacobs standard Engineers' Joint Contract Document Committee documents. Jacobs will customize the front-end bidding and legal specifications to conform to City's standard requirements. City officials will review the documents to confirm compliance with current City standards and practices. Technical specifications will be prepared using the Jacobs standard specifications. Drawings will be prepared using the Jacobs standard format, standard size (22- by 34-inch full-size drawing), CAD software, and legends. CAD submittals to the City will be in the latest version of AutoCAD.

Task 2 Deliverables

Final design document submissions to City include the following:

- 6 copies of 60 percent complete drawings, specifications, and construction cost estimate
- 6 copies of 90 percent complete drawings, specifications, and construction cost estimate
- Evaluation of other project funding sources, as directed by the City
- 6 half-size copies and 1 full-size copy of sealed 100 percent complete drawings and specifications
- 1 PDF file of the 100 percent complete drawings
- 1 PDF and 1 Word copy of 100 percent complete specifications
- One complete schedule of prices for the project, using the City's standard format with the Return Flow Pump Station prices separate from the rest of the project

Task 2.2 Permitting

Jacobs will prepare the following project permit applications and supporting technical materials:

- Wisconsin Department of Natural Resources wastewater construction approval permit including three copies of half-size drawings and specifications and three copies of the final *Preliminary Design Report.*
- Wisconsin Department of Natural Resources Construction Site Storm Water Permit (Notice of Intent)
- WE Energies application for new electrical service
- City of Waukesha building and electrical permit applications
- City of Waukesha Financial Department Clean Water Fund Program Loan Application

Task 3—Bid Phase Services

Jacobs will prepare a draft of the Advertisement for Bid for City review, respond to bidder's questions, prepare appropriate addenda, and facilitate a pre-bid meeting. Jacobs will provide a log of Contractor questions to City for distribution in an addendum. Jacobs will assist the City in the identification of appropriately qualified construction contractors and review of pre-qualification documentation.

City will advertise the bid, post the bid documents and addendums, and conduct the bid opening. Jacobs will assist the City with the bid evaluation and recommendation for award.

Task 3 Deliverables

Draft Advertisement for Bid, bid phase addendum, and award recommendation.

Task 4—Construction Phase Services

Jacobs will provide the following professional engineering services during construction. All construction phase office and field services will be managed and implemented in a manner that separates work related to the Return Flow Pump Station from the remainder of the Project.

Task 4.1 Office Engineering Services

Jacobs will provide the following office engineering services during the construction of the project:

Construction Meetings

Jacobs will participate in the following meetings:

Preconstruction meeting. Jacobs will conduct a pre-construction conference with City, Contractor, and other key stakeholders. Meeting minutes will be prepared.

Monthly construction progress meetings. Jacobs will attend 19 monthly construction progress meetings facilitated by the Contractor.

Weekly coordination meetings. Jacobs construction manager or construction inspector will attend up to 80 meetings facilitated by contractor to coordinate site construction issues.

Permitting agency coordination. Jacobs will coordinate communication with permitting agencies including the Wisconsin Department of Natural Resources and the City of Waukesha. Jacobs will provide Contractor permit application information of City permits.

Shop Drawings, Samples and Submittals

Jacobs will log, track, and review the construction contractor's shop drawings, samples, test results, and other data the Contractor is required to submit. Jacobs will review shop drawings, samples, and submittals for conformance with the design and compliance with the requirements of the contract for construction.

On select submittals, Jacobs will coordinate, compile, and submit to contractor submittal review comments from Jacobs and City. To help minimize the number of shop drawing resubmittals, Jacobs will facilitate conference calls with the contractor and design engineers to discuss and resolve review comments on shop drawings with greater than 25 review comments.

Jacobs will maintain hard copy records of relevant documentation and will turn over one complete set of project-approved submittals to City.

Requests for Information

Jacobs will provide technical interpretations of the contract documents and provide written responses to the contractor's Requests For Information (RFIs), and interpretation or clarification of the contract documents. We will evaluate requested deviations from the approved design or specifications.

Change Orders, Field Orders, Disputes

Jacobs will coordinate the issuance of change orders; review and evaluate proposed changes; and make recommendations regarding the acceptability, including cost and/or schedule impacts. We will assist in drafting proposed Change Orders, Work Change Directives, and Field Orders, obtain backup material from Contractor as appropriate. Jacobs will consult with City and lead all negotiations related to contract modifications. Upon approval of City, we will issue contract modification documents for execution by City and Contractor.

Jacobs will receive, log, and notify City and Jacobs about all notices from the contractor concerning claims or disputes between the contractor and City pertaining to the acceptability of the work or the interpretation of the requirements of the contract for construction. We will assist City in discussions with the contractor to facilitate discussions and resolution of contractor claims and disputes, when necessary. Jacobs will provide recommendations for contractor claims or disputes.

As-Built Record Drawings

Jacobs will revise the original design drawings to reflect available record information provided by the contractor. Jacobs is not responsible for any errors or omissions in the information provided by others and incorporated in the drawings. As-built drawings will be provided to City in paper (4 copies), PDF, and AutoCAD format.

O&M Manuals

Jacobs will prepare Operations and Maintenance (O&M) Manuals for the Return Flow Pump Station and the new phosphorus treatment facilities. Jacobs will prepare updates for the City's existing O&M documentation and information management systems to incorporate design and construction phase documentation for the new facilities and other project improvements.

Task 4.2 Field Engineering Services During Construction

Jacobs will provide the following field engineering services during construction including providing the equivalent of 1 full-time field representative through part-time field services of one construction manager and one construction inspector, both licensed engineers, for 19 months.

Jacobs will provide overall administration of the construction contract and observation of the contractor's work. Jacobs will consult with and advise City and act as City's representative as provided in the General Conditions of the Construction Contract. The extent and limitations of the duties, responsibilities and authority of Jacobs field staff as assigned in said General Conditions shall not be modified unless provided specifically in a Contract Amendment. Jacobs will have authority to act on behalf of City in dealings with the Contractor, to the extent specifically provided in this Contract and said General Conditions, except as otherwise provided in writing.

Construction Management and Contract Administration

Communication. Jacobs will serve as City's primary point of contact for day-to-day communication during the construction phase of the project. Jacobs will perform the following: Communicate and report progress to City; implement and maintain regular communications with the Contractor during the construction; receive and log communications from the contractor and coordinate communications between City, Jacobs and contractor; deliver written responses to contractor's Requests for Information; consult with City in advance of scheduled major tests, inspections or start of important phases of the Work.

Documentation. Maintain project files for correspondence, conference records, submittals including shop drawings and samples, certifications, reproductions of original Contract Documents including all Addenda, signed Agreement, Work Change Directives, Change Orders, Field Orders, additional Drawings issued after the Effective Date of the Agreement, Jacobs's written clarifications and interpretations, progress reports, and other Project related documents.

Review for completeness contractor's redlined drawings which will be the basis of the record drawings.

Keep a diary or log book recording pertinent site conditions, activities, decisions and events. The construction log book shall be updated at least weekly to the project team SharePoint site and include descriptions of daily activities, conditions and decisions.

Project Schedule. Review and monitor the Progress Schedule, Schedule of Submittals, and Schedule of Values prepared by contractor and verify that it is consistent with the requirements of the contract for construction. The periodic review shall not be considered as a guarantee or confirmation that the contractor will complete the work in accordance with the contract for construction. Provide comments to City to assist in approving, accepting or taking other action on the contractor's schedule, in accordance with the contract for construction.

Payments to Contractor. Receive and review the contractor's requests for payment. Determine whether the amount requested reasonably reflects the progress of the contractor's work and is in accordance with the construction contract. Provide recommendations to City as to the acceptability of the requests and advise City as to the status of the total amounts requested, paid, and remaining to be paid under the terms of the contract for construction.

Recommendations by Jacobs to City for payment will be based upon Jacobs knowledge, information and belief from its observations of the work on site and selected sampling that the work has progressed to the point indicated. Such recommendations do not represent that continuous or detailed examinations have been made by Jacobs to ascertain that the contractor has completed the work in exact accordance with the contract for construction; that Jacobs has made an examination to ascertain how or for what purpose the contractor has used the moneys paid; that title to any of the work, materials or equipment has passed to City free and clear of liens, claims, security interests, or encumbrances.

Safety. Manage the health, safety and environmental activities of Jacobs staff to achieve compliance with the project Health and Safety Plan applicable health and safety laws and regulations. Coordinate with responsible parties to correct conditions that do not meet applicable federal, state and local occupational safety and health laws and regulations, when such conditions expose Jacobs staff to unsafe conditions.

Notify affected personnel of observed site conditions posing an imminent danger.

Jacobs will not responsible for health or safety precautions of construction contractor or City personnel or conformance by these parties to federal, state, and local occupational safety and health laws and regulations.

Manufacturers' Training: Observe manufacturers' training sessions so that the training sessions are scheduled and conducted in accordance with the requirements of the construction contract documents.

Inspection Services

Conduct on-site observations of the contractor's work for the purposes of determining if the work conforms to the contract for construction and that the integrity of the design concept has been implemented and preserved by the contractor. Should work by the Contractor be found to not conform to the contract for construction, Jacobs will inform City and contractor and monitor the contractor's corrective actions.

Monitor that tests are conducted in the presence of appropriate personnel, and that the contractor maintains adequate records thereof. Observe, record, and report to City appropriate details relative to test procedures and startups.

Observation of work is not an exhaustive observation or inspection of all work performed by the contractor. Jacobs does not guarantee the performance of the contractor. Jacobs observations shall not relieve the contractor from responsibility for performing the work in accordance with the contract for construction, and Jacobs shall not assume liability in any respect for construction of the project. Jacobs shall, with the assistance of City, obtain written plans from the contractor for quality control of its work, and will monitor the contractor's compliance with its plan.

Start-up Services and Milestone Punchlists

Jacobs will provide technical start-up assistance to City staff. Start-up assistance activities will include reviewing draft O&M manual information with CWP staff and incorporating City input in final O&M materials.

In addition, Jacobs will facilitate one operations training session for the new Return Flow Pump Station and one for the Advanced Phosphorus Treatment Facility. The training session agendas will include an overview of the facility performance objectives, normal operations, handling unusual operating conditions, and operators' SCADA system interface (i.e., monitoring and control setpoints).

Jacobs will facilitate punchlist inspections by lead design engineers in the company of City and the construction contractor and prepare a list of items to be completed or corrected at the substantial and final completion project milestones. To the extent possible, trips to provide start-up assistance and review for substantial and final completion will be coordinated with City and the contractor to coincide with performance acceptance testing or other scheduled coordination meetings.

Task 5—Project and Quality Management

5.1 Project Management

Jacobs will manage the delivery of the project technical services and work products to meet City's schedule and budget. Jacobs will update its project instructions for the project delivery team to reflect revisions to the project schedule and scope. Project instructions addressed include the following:

- Detailed scope of services and project deliverables
- Task assignments
- Project schedule
- Project budget by task
- Time and expense charging to separately track Return Flow Pump Station costs
- Health and safety considerations
- Communication procedures within the team, the City and other stakeholders

5.2 Project Communication

Communication Plan

Jacobs will develop a project Communication Plan to provide the team guidance of formal and informal project communication. The Communication Plan will be included in the Project Instructions and will address the following:

- Communication in formal workshops and design milestone meetings
- Expectations for weekly design team coordination meetings
- Informal communication in regular project progress meetings, telephone calls, and e-mail
- Coordination with permitting agencies
- Collaboration with stakeholders, including GWA, and their service providers
- Monthly invoices and progress reports to City. Jacobs monthly invoices will be itemized by task and indicate individuals' hours performed during the billing period. The progress reports will be in letter format and summarize activities completed to date, financial and schedule status, and identify any potential problems, critical issues, and planned corrective actions. City's and Jacobs's project managers will review the progress reports and invoices on a monthly basis.

Change Management Plan

Jacobs will develop a project Change Management Plan to provide the team guidance on the process for communicating and managing potential project changes. The identification of scope change is the responsibility of all project team members and is particularly critical on fast-track design work. Potential changes could involve one or more of the following: design scope, cost, quality or design schedule, construction cost, construction schedule or operability. The Change Management Plan will include provisions for gaining endorsement from key stakeholders prior to implementing the change.

Health and Safety Plan

Safety is of a primary concern to City and Jacobs. Jacobs will prepare a Health and Safety Plan for both the design and construction phases of the project. During construction, when at the project site, Jacobs personnel will comply with the construction contractor's project health and safety plan.

5.3 Quality Management

Jacobs will develop a Quality Management Plan to help the design team accomplish the following objectives:

- Take responsibility for the quality of our design and deliverables
- Conform to best practices and meet Jacobs standards in completing calculations, delivering work products, completing quality assurance/quality control (QA/QC) reviews, and documenting and adjudicating review comments
- Conduct continuous QC review through the design and construction phases of the project

Design Assumptions

The following assumptions were used to estimate the proposed level of effort.

1. The Project will be designed in a single set of bid documents (drawings and specifications) with Return Flow Pump Station design costs tracked and managed separately.
2. The City will provide all available CAD and PDF files for facilities to be modified as part of the Project as well as any drawings developed for the Return Flow Pump Station. The existing CAD files will be used as base files for the design drawings. Jacobs will reasonably rely on the accuracy of the drawing files. Existing files will be revised to reflect Project improvements to meet the City's requirement of maintaining a single set of current CWP drawings.
3. Engineering services will be performed on the schedule outlined in the RFP and shown in Section 4.
4. The hydraulic model for the return flow conveyance system, including the return flow pipeline alignment beyond the CWP boundary, will be developed by others. Model output will be used to confirm final design flows for the Return Flow Pump Station.
5. The need for Return Flow conveyance system surge protection to control hydraulic transients will be evaluated by others. Jacobs will review that evaluation and determine if the surge control recommendations by others are adequately protective of the pumping equipment. Design of a surge control system is not included in the proposed scope of work.
6. Return Flow Pump Station design and construction project milestones will be coordinated with Waukesha Water Utility and the GWA program.
7. The design assumes the CoMag® process is selected by the City for phosphorus removal.
8. The CoMag® system will be constructed within an old Secondary Clarifier.
9. The polyvinylchloride aeration air piping and membrane diffusers in of the activated sludge aeration basins will be replaced in-kind. ~~The stainless steel air drop legs are in good condition and will remain in service.~~
10. Replacement of the Primary Influent and Primary Effluent pumps is limited to in-kind replacement of pumps, motors and associated electrical cabling. Replacement equipment will be installed in the same location as the existing equipment. The pumps' motor starters and variable frequency drives are in good condition and will remain in service.
11. The MCCs located in Buildings 110, 140, and 150 will be replaced in kind in the locations occupied by the existing MCCs. It is assumed that sizes and capacities of new MCCs will be equivalent to existing MCCs and that electrical system computer modeling is not required to confirm adequacy of existing power distribution system. The wiring between the new MCCs and existing equipment remaining in service will not be replaced.
12. Approximately 10 overhead doors and 8 manual slide gates will be replaced.

13. Pumps and piping located in Buildings 240 and 400, along with Facility 230 clarifier baffles, will be painted.
14. Handrail will be added to the top of the digesters as directed by the City.
15. In addition to areas near the new Return Flow Pump Station and Advanced Low Phosphorus Treatment Facility, select areas of CWP pavement will be replaced.
16. If required for this project under the Clean Water Fund Program, the Environmental Assessment and Historical and Archeological Resources review will be conducted under a separate contract.
17. Existing CWP geotechnical boring data and geotechnical reports are sufficient for the project improvements, including buried piping and utilities, and no additional subsurface investigation is required. If upon reviewing the available geotechnical information, Jacobs determines additional data to reduce the City's risk, the collection of additional data will be under a separate agreement.
18. It is assumed that the Return Flow Pump Station Building foundation type will be similar to the foundations of the adjacent structures.
19. Existing available site topographic survey data for the areas of the CWP impacted by the project are sufficient for the planned improvements and no additional survey data is needed.
20. Existing natural gas, water, drain piping systems, needed to service new facilities, are located within or near the plant boundaries. ~~in the vicinicty of the new Return Flow Pump Station and Advance Low Phosphorus Treatment Facility.~~
21. Addressing any impacts to the City's air permit because of the addition of the new Return Flow Pump Station emergency generator is outside this scope of services.
22. The design will be based on the federal, state, and local codes and standards in effect on the date of the authorization to proceed with design. Codes changes may necessitate a change in scope.
23. The design calculations performed by Strand Associates Inc. for the Wastewater Treatment Plant Phase II Improvements for the Return Flow Pump Station are available for review.
24. Jacobs will develop process narratives, with CWP staff input, that describe in detail how each process is intended to function and be controlled and monitored. Those narratives and the P&IDs will be used by others to develop software for the new facilities, modify software as needed for replacement equipment, and integrate controls into the plant SCADA system.
25. Jacobs project cost estimates are prepared in accordance with AACE (Association for the Advancement of Cost Estimating) industry-leading best practices. In providing opinions of cost, econonomic evaluations and schedules, Jacobs has no control over cost labor and materials; unknown conditions; competitive bidding and market conditions; and other factors that may materially affect the ultimate project cost or schedule.
26. The CWP WPDES permit will be final by June 30, 2019.
27. The terms and conditions of the agreement will be substantially like 2018 City of Waukesha Water Utility – CH2M HILL Distribution System Water Quality Project (separate from the GWA program), based on the City of Waukesha standard professional services agreement.

Estimated Final Design Drawings

Table 1 lists anticipated final design drawings was used to prepare the level of effort estimate.

Table 1. Preliminary Sheet List

No.	Type	Title
1	G	Title Sheet, Vicinity and Location Maps
2	G	Engineer Seals and Signatures
3	G	Index to Drawings
4	G	Abbreviations
5	G	Abbreviations and Designations
6	G	Instrumentation and Control Legend
7	G	Instrumentation and Control Legend
8	G	Civil Legend
9	G	Architectural/Structural Legend
10	G	Structural Notes 1
11	G	Structural Notes 2
12	G	Process Mechanical Legend
13	G	Plumbing Legend
14	G	HVAC Legend
15	G	Electrical Legend 1
16	G	Electrical Legend 2
17	G	Electrical Legend 3
18	G	Hydraulic Profile and Process Design Criteria Summary
19	N	Primary Influent Pump Station P&ID
20	N	Primary Effluent Pump Station P&ID
21	N	Phosphorus Removal System - 1 P&ID
22	N	Phosphorus Removal System - 2 P&ID
23	N	Polymer Feed P&ID
24	N	Ferric Chloride P&ID
25	N	Return Flow Pump Station P&ID
26	N	New Emergency Generator P&ID
27	X	Primary Influent Pump Station Demolition Plan
28	X	Primary Effluent Pump Station Demolition Plan
29	X	Electrical One-Line Diagram - Demo
30	X	Building 110 Electrical Demoltion Plan
31	X	Building 140 Electrical Demolition Plan
32	X	Building 150 Electrical Demolition Plan
33	X	Old Secondary Clarifiers Demolition Plan
34	X	Secondary Clarifiers Yard Piping and Buried Utilities Demolition Plan
35	X	Return Flow Pump Station Site and Utility Demo Plan
36	C	Return Flow Pump Station Grading and Yard Utility Plan
37	C	Phosphorus Removal Facility Site Plan

Table 1. Preliminary Sheet List

38	C	Phosphorus Removal Facility Grading and Yard Utility Plan
39	C	Return Flow Pump Station Erosion and Sediment Control Plan
40	C	Phosphorus Removal Facility Erosion and Sediment Control Plan
41	C	Civil and Yard Piping Details
42	C	Civil and Yard Piping Details
43	A	Return Flow Pump Station and Generator Room Life Safety Plan
44	A	Return Flow Pump Station Architectural Plan
45	A	Return Flow Pump Station Architectural Elevations
46	A	Return Flow Pump Station Architectural Sections and Details
47	A	Phosphorus Removal Facility Lower & Upper Life Safety Plans
48	A	Phosphorus Removal Facility Architectural Plan
49	A	Phosphorus Removal Facility Architectural Elevations
50	A	Phosphorus Removal Facility Architectural Sections
51	A	Phosphorus Removal Facility Architectural Sections and Details
52	A	Miscellaneous Building Painting Plan and Schedule
53	A	Overhead Door Replacement Plan and Schedule
54	A	Architectural Schedules
55	S	Return Flow Pump Station Structural Plan
56	S	Return Flow Pump Station Structural Roof Framing Plan
57	S	Return Flow Pump Station Foundation Plan
58	S	Return Flow Pump Station Structural Sections
59	S	Return Flow Pump Station Structural Sections and Details
60	S	Phosphorus Removal Facility Structural Lower Level Plan
61	S	Phosphorus Removal Structural Upper Level Plan
62	S	Phosphorus Removal Facility Structural Section
63	S	Phosphorus Removal Facility Structural Section
64	S	Phosphorus Removal Facility Structural Section
65	S	Phosphorus Removal Facility Structural Details
66	S	Phosphorus Removal Facility Structural Details
67	S/M	Slide Gate Replacement Plan and Schedule
68	D	Phosphorus Removal Facility Mechanical Lower Level Plan
69	D	Phosphorus Removal Facility Mechanical Upper Level Plan
70	D	Phosphorus Removal Facility Mechanical Section
71	D	Phosphorus Removal Facility Mechanical Section
72	D	Phosphorus Removal Facility Mechanical Section
73	D	Phosphorus Removal Facility Mechanical Details
74	D	Phosphorus Removal Facility Mechanical Details
75	D	Polymer Mechanical Plan and Section
76	D	Ferric System Mechanical Modifications Plan and Sections
77	D	Aeration Bays Replacement Piping and Diffusers Mechanical Plan
78	D	Primary Influent Pump Station Mechanical Plan and Section
79	D	Primary Effluent Pump Station Mechanical and Section

Table 1. Preliminary Sheet List

80	M	Return Flow Pump Station HVAC Plan and Schedule
81	M	Return Flow Pump Station Plumbing Plan
82	M	Phosphorus Removal Facility HVAC Plan
83	M	Phosphorus Removal Facility Plumbing Plan
84	M	Phosphorus Removal Facility Schedules
85	E	Modified Electrical One-Line Diagram
86	E	Overall New Electrical Service Site Plan
87	E	Return Flow Pump Station Electrical and Grounding Plan
88	E	Return Flow Pump Station Panel Board Schedules
89	E	Return Flow Pump Station Electrical Schematic Diagrams
90	E	Return Flow Pump Station Lighting Plan and Schedule
91	E	Return Flow Pump Station Emergency Generator Electrical Plan
92	E	Return Flow Pump Station Emergency Generator Switchgear Elevation
93	E	Electrical Duct Bank Sections
94		Phosphorus Removal Facility Upper Electrical Overall Plan
95	E	Phosphorus Removal Facility Upper Electrical Enlarged Plans
96	E	Phosphorus Removal Facility Lower Electrical and Grounding Plan
97	E	Phosphorus Removal Facility Lower Electrical Enlarged Plans
98	E	Ferric and Polymer Area Electrical Partial Plans
99	E	Phosphorus Removal Facility Lighting & Receptacle Upper Plan
100	E	Phosphorus Removal Facility Lighting & Receptacle Lower Plan
101	E	Phosphorus Removal Facility Panel Board Schedules
102	E	Phosphorus Removal Facility Process Conduit Block Diagrams
103	E	Phosphorus Removal Facility Process Conduit Block Diagrams
104	E	Phosphorus Removal Facility Process HVAC Block Diagrams
105	E	Building 110 Replacement MCC Elevation, Panelboard Schedule
106	E	Building 140 Replacement MCC Elevation, Panelboard Schedule
107	E	Building 150 Replacement MCC Elevation, Panelboard Schedule
108	SD	Standard Details
109	SD	Standard Details
110	SD	Standard Details
111	SD	Standard Details
112	SD	Standard Details
113	SD	Standard Details
114	SD	Standard Details
115	SD	Standard Details
116	SD	Standard Details
117	SD	Standard Details
118	SD	Standard Details
119	SD	Standard Details

For additonal information, please contact:

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