Proposal for Engineering Services

Columbia River Intake and Discharge Project

Submitted to

Dyno Nobel St. Helens Plant

JACOBS®

April 22, 2019

JACOBS

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April 22, 2019

Ms. Ruth Glass
Plant Environmental Manager
Dyno Nobel Ammonia Plant
63149 Columbia River Highway
Deer Island, OR 97054

Subject: Engineering Services Proposal for the Columbia River Intake and Discharge Project

Dear Ms. Glass,

Jacobs Engineering Group Inc. (Jacobs) has developed the following response to your request for proposal (RFP) for professional engineering services on the upcoming Columbia River Intake and Discharge Facilities Project. Our team understands the importance of qualified professional engineering services for the modification of the Dyno Nobel plant Columbia River intake and discharge facilities as required by the current NPDES permit. We have followed the outline in your RFP for presenting our Proposal for implementing this Project to conduct the required analyses, prepare the design plans and specifications, and obtain the required permits to complete the Project by no later than February 8, 2023.

Our approach to the Project will accomplish the following key objectives:

- Design modifications to the Cooling Water Intake Structure to achieve federal rules for fisheries protection and meet the NPDES permit schedule for submittals and completion
- Determine the best alignment for the new outfall, while carefully considering routing constraints
- Design a new outfall and diffuser with optimized dilution performance to achieve the required thermal discharge requirements and water quality standards with a defined safety factor to allow for future changes in requirements
- Provide a diffuser design that is adaptable to changes in river bedforms, seasonal flow changes, and future more stringent requirements
- Successfully manage permitting and environmental documentation to maintain project schedule and allow for construction in 2022
- Successfully deliver the design, permitting, and construction to allow operational start in 2023

Our team has successfully delivered more than 100 intake and 60 outfall projects and are highly qualified to assess the design and permitting challenges providing long-term solutions for your Project. We are excited about the opportunity to work with you on this important Project. Should you have any questions regarding our proposal, I can be reached at 425-233-3662 or by email at phil.martinez@jacobs.com.

Kind regards,

Mr. Phil Martinez, P.E.
Jacobs Engineering Group Inc.

Mr. Pat Van Duser, P.E.
Jacobs Engineering Group Inc.

cc: Mr. Dave Mustonen, P.E. | Senior QA/QC Lead, Jacobs Engineering Group

Contents

1. Firm Qualifications

Jacobs Engineering Group joined forces with CH2M HILL, an Oregon-grown firm, in 2017. For 71 years, CH2M had provided local agencies and companies with a full range of consulting services—from early planning through final design and construction. Now, with the merger of our two companies, we offer an even deeper bench that is unparalleled in the industry. Jacobs-CH2M has more than 1,300 employees in our Pacific Northwest offices and about 81,000 employees worldwide. Our proposed project team for Dyno Nobel is in the Oregon/Washington area, with many years of local knowledge and experience as industry leaders in the field of wastewater treatment technology, design, and improvements.

DEEP ROOTS
Jacobs was founded in 1947; CH2M was founded in Oregon in 1946

LOCAL RESOURCES
400+ staff in Portland
1,300 in OR/WA

The Jacobs team is well-versed on partnering with public and private clients to tackle the world's most complex infrastructure and natural resource challenges. Our work is concentrated in the water, transportation, energy, environment, and industrial markets.

Jacobs has extensive experience with designing and permitting effluent pipelines and outfalls in the Willamette and Columbia Rivers, and in other water bodies in Oregon, Washington, Alaska, and California. The Columbia River Intake and Discharge Facilities Project (herein "Project") will need to understand and address the site-specific conditions for design and permitting. Section 2 illustrates the magnitude of our local and regional river outfall designs and studies and permitting – most accomplished within the past 10 years. We also list a few projects over 15 years old that demonstrate how our outfall designs withstand the test of time in durability and performance for our clients while meeting hydraulic and dilution needs. In addition, Section 2 also lists our key intake design projects, along with several hydroelectric projects. These example projects reflect the technical skill of our designers in all stages of the process — site selection, geotechnical evaluation, hydraulics analyses, dilution modeling, and structural and mechanical design – as well as our team skills in complex permitting, agency negotiations, and riverbank restorations.

Safety is not what we do, it's who we are. We call it our way of life, **BeyondZero®**, our Culture of Caring.

1.1 Jacobs Prioritizes Safety

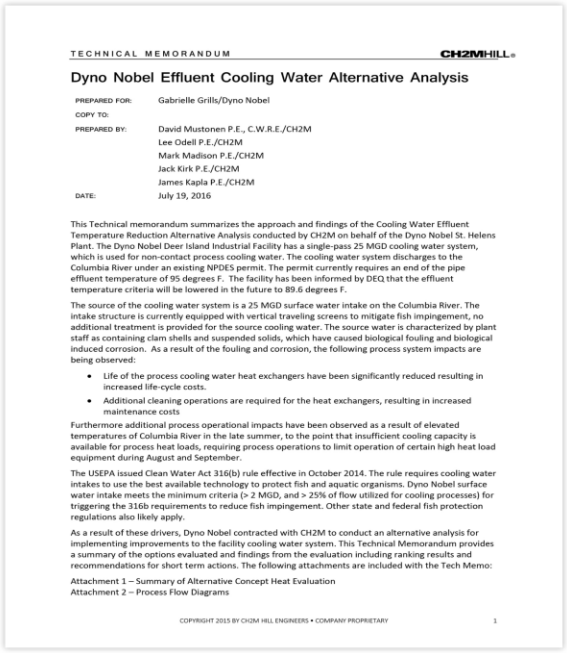
At Jacobs, we believe the wellbeing of our people is fundamental to our success. We are driven by deep emotional commitment and active engagement that creates excellence in health, safety, security, and sustainability across our projects. Our goal is beyond driving statistics to zero. We believe our culture will make our people and communities safer and healthier. We look for ways to recognize and mitigate risks.

Jacobs clearly aligns with Dyno Nobel's goal of prioritizing safety. Jacobs has implemented a BeyondZero® safety culture that is about keeping our people safe. It is about creating a culture of caring by actively engaging and involving employees and influencing their beliefs and behaviors.

Our approach to your Project will leverage the proven Jacobs safety tools and practices. In addition, we will adhere to all Dyno Nobel safety requirements, including site training, implementation of proper personal protection equipment, and meeting all site-specific requirements.

1.2 History of Service to Dyno Nobel

Previously, Jacobs successfully delivered an engineering cooling capacity study to Dyno Nobel for the 20-million-gallons-per-day (mgd) Single Pass Cooling Water Alternative Analysis project (see Exhibit 1-1). The project consisted of an engineering alternative analysis for increasing the cooling capacity of the St. Helens plant's non-contact process cooling water system. Options consisted of providing an alternate groundwater supply, wetlands cooling, cooling tower cooling, increase surface water supply. The project included development of a Section 316(b) compliance strategy and preliminary design of intake screens compliant with U.S. Environmental Protection Agency (EPA) Section 316(b) best technologies available. The project also explored options for mitigating plant heat exchanger fouling and microbial induced corrosion (MIC) issues created by the untreated surface water non-contact cooling water supply.



TECHNICAL MEMORANDUM CH2MHILL

Dyno Nobel Effluent Cooling Water Alternative Analysis

PREPARED FOR: Gabrielle Grills/Dyno Nobel
COPY TO:
PREPARED BY: David Mustonen P.E., C.W.R.E./CH2M
Lee Odell P.E./CH2M
Mark Madison P.E./CH2M
Jack Kirk P.E./CH2M
James Kapla P.E./CH2M
DATE: July 19, 2016

This Technical memorandum summarizes the approach and findings of the Cooling Water Effluent Temperature Reduction Alternative Analysis conducted by CH2M on behalf of the Dyno Nobel St. Helens Plant. The Dyno Nobel Deer Island Industrial Facility has a single-pass 25 MGD cooling water system, which is used for non-contact process cooling water. The cooling water system discharges to the Columbia River under an existing NPDES permit. The permit currently requires an end of the pipe effluent temperature of 95 degrees F. The facility has been informed by DEQ that the effluent temperature criteria will be lowered in the future to 89.6 degrees F.

The source of the cooling water system is a 25 MGD surface water intake on the Columbia River. The intake structure is currently equipped with vertical traveling screens to mitigate fish impingement, no additional treatment is provided for the source cooling water. The source water is characterized by plant staff as containing clam shells and suspended solids, which have caused biological fouling and biological induced corrosion. As a result of the fouling and corrosion, the following process system impacts are being observed:

- Life of the process cooling water heat exchangers have been significantly reduced resulting in increased life-cycle costs.
- Additional cleaning operations are required for the heat exchangers, resulting in increased maintenance costs

Furthermore additional process operational impacts have been observed as a result of elevated temperatures of Columbia River in the late summer, to the point that insufficient cooling capacity is available for process heat loads, requiring process operations to limit operation of certain high heat load equipment during August and September.

The USEPA issued Clean Water Act 316(b) rule effective in October 2014. The rule requires cooling water intakes to use the best available technology to protect fish and aquatic organisms. Dyno Nobel surface water intake meets the minimum criteria (> 2 MGD, and > 25% of flow utilized for cooling processes) for triggering the 316b requirements to reduce fish impingement. Other state and federal fish protection regulations also likely apply.

As a result of these drivers, Dyno Nobel contracted with CH2M to conduct an alternative analysis for implementing improvements to the facility cooling water system. This Technical Memorandum provides a summary of the options evaluated and findings from the evaluation including ranking results and recommendations for short term actions. The following attachments are included with the Tech Memo:

Attachment 1 – Summary of Alternative Concept Heat Evaluation
Attachment 2 – Process Flow Diagrams

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Exhibit 1-1. Front Page of Dyno Nobel Effluent Cooling Water Alternative Analysis

1.3 Unique Qualifications

In our approach, our team will work collaboratively with you to develop a design that provides long-term value, simplified maintenance, and efficient operation. For this Project, we offer Dyno Nobel the following:

PREVIOUS EXPERIENCE DIRECTLY RELEVANT TO LOCATION AND PERMITTING

Jacobs has completed previous geotechnical studies at the outfall site as part of another project that will be leveraged to reduce Project costs. The geotechnical work included borings along a transect near the future outfall (see Appendix G). Jacobs has also developed an approach and preliminary design for the Dyno Nobel plant intake screens that will comply with EPA 316b as part of a Cooling Water Effluent Alternative Analysis Study previously conducted.

INDUSTRY-LEADING RIVER OUTFALL/INTAKE/ HYDROELECTRIC EXPERIENCE AND EXPERTISE

We have selected a team of key staff that offers breadth and depth of planning, permitting, design, and operations experience for outfalls, intakes, and hydroelectric facilities. Our team will be led by Phil Martinez, PE (Project Manager), David Wilson and Byrl Thompson, PE (Outfall Structure), James Kapla, PE (Cold Water Intake), Sonya Reiser, PE (Hydroelectric Evaluation), and Steve Mader, PhD (Permits). Combined, this core group has more than a century of industry-leading experience in the very work required of Dyno Nobel for this Project.

DEMONSTRATED PERFORMANCE ON COMPLEX INTAKE/OUTFALL DESIGN PROJECTS IN THE NORTHWEST IN THE LAST 15 YEARS

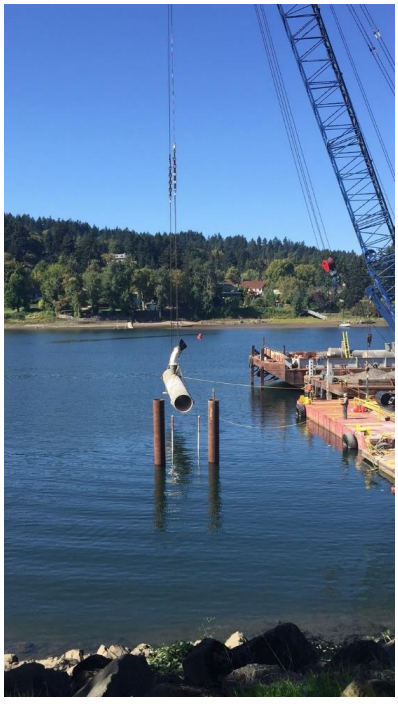
Local intake project examples include Chelan Public Utility District's (PUD) Chelan River Tailrace Pump Station, Xcel Energy's High Bridge Combined Cycle, and various projects for Dominion Energy. Each is further detailed in Section 2. We also have many examples of our outfall and diffuser designs that have been operating successfully for decades, including Portland's Tryon Creek Wastewater Treatment Plant (WWTP) outfall (27 years), Corvallis' Water Resource Recovery Facility's (WRRF) two outfalls (21 years), Vancouver Marine Park and Westside Water Pollution Control Facility (WPCF) outfalls (18 and 22 years), Centralia WPCF outfall (15 years), and the Clark Regional Wastewater District outfall (44 years). We have a keen understanding of how to design outfalls and diffusers to withstand tough physical conditions and to continue to meet hydraulic and dilution requirements for the long-term design life.

A PROVEN APPROACH TO PERMITTING PROJECTS

Our permitting team led by Dr. Steve Mader has a proven ability to systematically progress the Project and work through the requirements with permitting agencies and stakeholders. The permitting staff works closely with our technical team, will apply practical logic and existing agency relationships to successfully navigate the permitting process, and will satisfy permit conditions.

THE RIGHT PROJECT MANAGER.

Phil Martinez, PE, brings 30 years of experience in management and delivery of complex municipal and private water system projects, including pipelines, intakes, outfalls, and treatment facilities. He is particularly adept in guiding teams of leading subject matter experts to complete projects successfully on time and on budget.



2. Similar Project Experience — Permitting on Navigable Waters of Columbia River System

Jacobs' technical capabilities are unmatched specific to river data collections, and river hydraulics, bedform, and dilution modeling for evaluations and design of intakes and outfalls in the lower Columbia River System and Willamette River.

Jacobs has conducted more than 60 field and modeling studies of outfalls in Oregon and Washington during the past 15 years and more than 12 outfall designs in the past 10 years in the Pacific Northwest. Section 2.1 highlights our local outfall designs and studies in the Portland/Vancouver area.

Jacobs has successfully provided Section 316(a&b) services to power utilities, manufacturing plants, and refineries throughout the United States. Our successful project experience includes strategic compliance planning, collecting, and interpreting ecological and impingement and entrainment data, engineering feasibility studies, benefits valuation studies, preparation of permit application reports, along with designing and constructing compliant clean water intake systems (CWIS). This experience is highlighted in Section 2.2.

2.1 Similar Outfall Projects

Exhibit 2-1, along with the following project descriptions, highlight recent outfall design projects completed or underway on the Lower Columbia and Willamette Rivers. Jacobs is proud of our work achievements and working relationships with clients. All seven of these recent projects include the same elements required for the Dyno Nobel Project, and five of the seven recent projects listed here are outfall design projects completed or underway on the Lower Columbia River.

We understand the hydraulic and sediment environment in the Columbia River at the Dyno Nobel discharge site.

The Salmon Creek WWTP, Boise-St. Helens, and Vancouver Marine Park Water Reclamation Facility (WRF) outfall projects are directly comparable to the project requirements of the Dyno Nobel Project. These outfall projects required design of an extended outfall and multi-port diffuser into regions of the Columbia River with active river bedform migration that require analysis and predictions of river sediment bedform

Exhibit 2-1. Examples of Local Jacobs Outfall Designs and Studies

elevations and diffuser design adaptability to provide unimpaired diffuser operations. The Vancouver Marine Park WRF outfall diffuser was constructed in 2010, the Boise-St. Helens outfall extension and diffuser were constructed in 2005, and the Salmon Creek WWTP outfall and diffuser is in final design. The Boise-St. Helens Outfall Extension and Diffuser, Salmon Creek WWTP Outfall, and Portland's Columbia Boulevard Wastewater Treatment Plant (CBWTP) Outfalls 001 and 003 Improvements all required modeling of river bedform migrations and elevations for the design of diffuser risers and ports to allow future unimpaired operations in the Columbia River environment.

Thus, we bring an in-depth understanding of outfall and diffuser designs approaches, permitting strategies, and construction approaches for outfalls in the Columbia River.

Descriptions of similar, nearby outfall projects completed by our Jacobs outfall team are presented here. These outfall projects are similar to the Dyno Nobel outfall project and present many of the same challenges. In addition to these nearby outfall projects, our team has completed dozens of outfall projects throughout North America and beyond. These other outfall projects present similar and different challenges and reflect the wealth and breadth of experience comprised within our outfall team. A partial listing of these other projects is presented in Appendix A.

Kapstone Packaging; Longview Mill Outfall Diffuser Rehabilitation; Columbia River

Work Completed 2014-2015; $1.5 Million Total Cost

Project Elements: bedform evaluation, conceptual and predesign engineering, contractor team workshop, and final design

This project was a fast-track design development to rehabilitate a 350-foot, 48-inch steel outfall diffuser disabled by an anchor-caused break to offshore a 120-foot section and sand wave burial of inshore section. Detailed bathymetry survey images and dive inspection videos were used in design analyses of repair options to meet hydraulic and dilution requirements. Feasible diffuser rehabilitation and repair approaches were developed, an Engineering Report was prepared for agency approval, and final design of the diffuser rehabilitation was completed to allow immediate construction. The design was completed in 9 months to allow pipe procurement and construction completion in 2015.

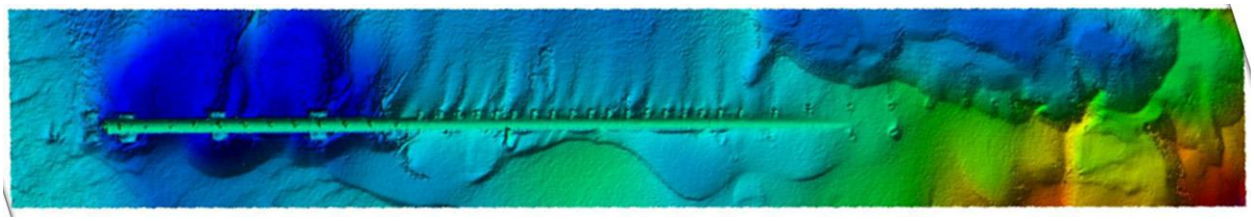


Exhibit 2-2. Outfall Diffuser in Columbia River after Rehabilitation (2016 Multi-Beam Image)

Clackamas County Water Environment Services (WES); Kellogg Creek WRRF Outfall Improvement; Willamette River

Work Completed 2013-2018; $2 Million Total Cost

Project Elements: field studies, bedform evaluation, conceptual design, predesign engineering, final design, construction permitting, and services during construction (SDC)

This work involved the design, permitting, and installation of a 48-inch steel outfall buried on a 33-degree slope with a 120-foot diffuser with 7- to 20-inch elastomeric check valves and access manhole. The design was performed in 2014-15, the outfall installed in 2016, and a Mixing Zone Study conducted in 2017 to meet the Department of Environmental Quality's (DEQ) RMZ-IMD requirements.

Exhibit 2-3. Clackamas Kellogg Creek Outfall 2016

Discovery Clean Water Alliance – Clark County; Salmon Creek Treatment Plant Outfall and Effluent Pipeline Replacement; Columbia River

Work Ongoing 2015-2020; $20 Million Total Cost Estimate

Project Elements: field studies in river and along pipeline routes, bedform modeling, effluent pipeline route study, conceptual and predesign engineering, pump station design, final design, construction and water quality permitting, and workshops

Jacobs in designing and permitting 7,300 feet of a 48-inch steel effluent pipeline crossing under Salmon Creek and Lake River and terminating with a 750-foot outfall into the Columbia River with a 144-foot diffuser with 10- to 16-inch check valve ports. The 30 percent design and Engineering Report were completed in 2018, with development of final design occurring in 2019.

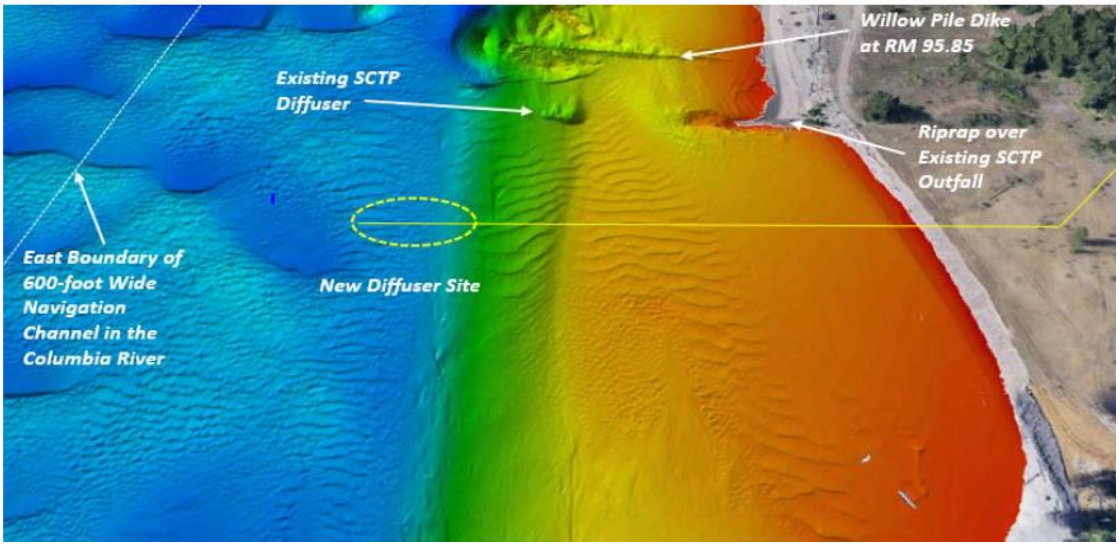


Exhibit 2-4. Overview of Replacement Salmon Creek WWTP Outfall and Diffuser on the Columbia River at RM 96

Boise Cascade and City of St. Helens; Outfall Extension and Diffuser Replacement; Columbia River

Work Completed 2003-2005; $1.2 Million Total Cost

Project Elements: bedform evaluation, conceptual and predesign engineering, permitting, contractor team workshop, and final design

This was a fast-track design development to extend the existing 48-inch steel outfall 700 feet into the Columbia River and design a multi-port diffuser to achieve required dilutions for temperature compliance. Work included detailed bathymetry surveys, sub-bottom surveys, and water quality surveys to use in design analyses. Jacobs also completed an Engineering Report for agency approval, conducted workshops with agencies, and completed final design to allow immediate construction. The design was completed in 10 months to allow pipe procurement and construction completion was in 2004. In 2005, a Mixing Zone Study was conducted to meet DEQ's RMZ-IMD requirements.

Exhibit 2-5. Installation of the Boise-St. Helens Outfall Diffuser Sections on Columbia River

City of Portland Bureau of Environmental Services; Columbia Boulevard Wastewater Treatment Plant Outfalls 001 and 003 Improvements; Columbia River

Work Ongoing 2017-2020; $4.5 Million Total Cost Estimate

Project Elements: field studies, bedform modeling, conceptual and predesign engineering, final design, workshops, construction permitting, bidding support, and SDC

Portland Bureau of Environmental Services' (BES) outfalls (not designed by Jacobs) experienced sand burial of diffuser ports and riser damage. Jacobs developed designs to rehabilitate Outfall 001 (buried 1,130-foot-long, 84-inch steel outfall with 360-foot diffuser with 36 16-inch risers with 12-inch elastomeric check valves ports) and Outfall 003 (buried 850-foot-long, 84-inch steel outfall with 255-foot diffuser with 18 28-inch risers with 24-inch elastomeric check valves ports).

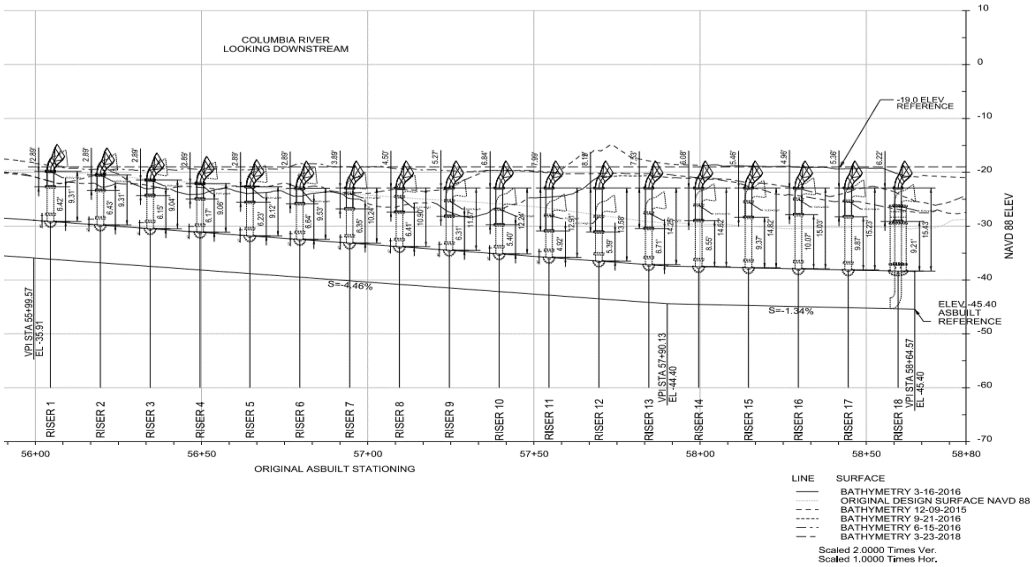


Exhibit 2-6. Columbia Boulevard Wastewater Treatment Plant Outfall 003 Diffuser Improvements to Extend Riser Lengths and Replace Check Valve Ports to Address Bedform Elevations

Jacobs also is designing riser extension and replacement elastomeric check valve ports for all risers on both outfalls for model-predicted future bed elevations, and developing construction approaches with marine construction firms to allow repairs during outfall operation.

Clackamas County WES; Tri-City WRRF Outfall Modification; Willamette River

Work Completed: 2011-2012; $0.4 Million Total Cost

Project Elements: field studies, bedform evaluation, conceptual design, predesign engineering, final design, construction permitting, and SDC

Exhibit 2-7. Tri-City WRRF Outfall Modification

This project was a fast-track design for alternative river discharge concepts to provide dilutions to avoid effluent ammonia limits and comply with DEQ MAO deadline (Dec. 2012). The most expeditious and cost-effective modification to the existing three 42-inch port submerged bankside diffuser was selected. Jacobs also designed installation of a 48-inch elastomeric check valve on one port and flow-control operation changes to direct dry season to check valve. Installation was completed October 2012. In December 2012, WES received a letter of commendation from the Director of DEQ for excellence in completing this project.

City of Vancouver; Vancouver Marine Park WRF Outfall Diffuser Modification (2009) and Outfall Diffuser Design (2002); Columbia River

$1.8 Million Total Cost

Project Elements: field studies, bedform evaluation, conceptual design, predesign engineering, final design, and construction permitting

We designed and permitted a 200-foot extension of a 60-inch steel outfall for a buried 160-foot diffuser in the Columbia River with 20 10-inch risers and 8-inch ports. Our team designed and permitted in 2001 and installed in 2002. In 2008, river bed elevation changes caused some port burials to require modification. We designed, permitted, and installed diffuser modifications in 2009, adding 2-foot riser extensions and adding 10-inch elastomeric check valve ports to resist the potential for sand intrusion.

2.2 Similar Intake Projects

Jacobs brings unique strength in the integration of engineering skills to evaluate screen designs, pump operations, and intake characteristics with the fisheries behavior, life-cycle, swimming speed, and other attributes critical to demonstrate the best application of science and technology to decision makers. Jacobs has significant water intake structure engineering experience, including both physical installations and Section 316(b) engineering studies of alternative intake technologies and operational measures on a variety of facility types across the United States. We have worked on more than 100 water intake structure projects that have included the planning, design, and construction of intake structures, fish screens, and diversion weirs at fossil and nuclear power plants, hydroelectric plants, manufacturing plants, and municipality/public utility districts. Jacobs has experience with more than 50 different intake technologies and operational modifications to address Section 316(b) issues, and we have the expertise to efficiently determine their feasibility and implementation cost based on site-specific factors.

Descriptions of similar fish screen projects within the Columbia River system and similar 316(b) compliance fish screening projects completed by our Jacobs intake team are presented in this section. These intake fish screening projects are similar to the Dyno Nobel intake project with respect to the likely best intake screening options (tee screens). In addition to these intake projects, our team has completed many other similar intake projects throughout North America. These other intake projects present many of the same challenges facing Dyno Nobel. A partial listing of these other projects is presented in Appendix B.

Chelan Public Utility District No. 1; Chelan River Project Tailrace Pump Station; Chelan County, Washington

As part of Federal Energy Regulatory Commission (FERC) re-licensing requirements for the 53-megawatt (MW) Lake Chelan Hydroelectric Project, the District was required to enhance steelhead and Chinook salmon spawning habitat in the Chelan River. Diversions for power generation historically left little or no flows in the Chelan River, which is bypassed by the hydroelectric project. Jacobs provided design and construction-phase services for a 250-cubic-feet-per-second (cfs) (162 mgd) intake, pump station, canal, and diffuser outlet structure. The project provides minimum flows in Reach 4 of the Chelan River to augment releases of up to 80 cfs from the dam. The low-head pump station avoids the lost energy of additional releases from the dam at this 377-foot head project.

Exhibit 2-8A and 2-8B. Wedge Wire Tee-Screens Attached to Intake Pipe

The pump station includes five 150-horsepower (hp) constant-speed submersible pumps arranged in a slant configuration with 5-foot-diameter cylindrical wedge wire tee-screens dedicated to each pump. The 42- and 48-inch-diameter pump columns are supported on 24-inch-diameter drilled piers. The piers were constructed inside casings placed with a land-based Leffer hydraulic oscillating drill rig, which addressed difficult subsurface conditions. This pump station design approach saved millions of dollars in construction costs in comparison to a traditional cast-in-place concrete wet well pump station. Other aspects of the project included installation of a low-level outlet at Lake Chelan Dam and construction of over 4 acres of stream and riparian habitat. At the time of the project commemoration on November 5, 2009, District biologists counted 281 Chinook redds (or nests) within the enhanced habitat area, a testament to the success of the project. Fulfillment of the FERC re-licensing requirements will allow the District to operate the hydroelectric facility for a 50-year license period. This project was winner of the 2010 National Hydropower Association (NHA) Outstanding Stewards of America's Waters Award and was a 2011 American Council of Engineering Companies (ACEC) Engineering Excellence National Gold Award winner.

Xcel Energy; High Bridge Combined Cycle Project; St. Paul, Minnesota

Jacobs was the engineering, procurement, and construction contractor of this new 570-MW natural gas-fired plant, which replaced an existing 270-MW coal-fired plant built in 1923. The plant uses river water for direct cooling, and Jacobs performed the detail design and construction of a new intake and screening system for the new power station. The existing river water intake system was reconfigured for compliance with 316(b) regulations and included new cylindrical wedge-wire screens, compressed air wedge-wire screen cleaning system, anti-freeze pumping system, and new circulating water pumps.

Exhibit 2-9. Xcel Energy High Bridge Construction

David Wilks of Xcel Energy stated that his company's ongoing focus on safe practices remains unflagging now that High Bridge has been commissioned. "Jacobs' approaches to project safety, planning, and management have been very impressive," Wilks concluded. "Personally, I consider High Bridge a nearly perfectly executed project. My compliments and congratulations to Jacobs for a job well done."

Dominion Energy Resources; Multiple Fossil Stations, Development of Technical Evaluation of Compliance Alternatives for Section 316(b) for 14 Stations; Illinois, Indiana, Massachusetts, Rhode Island, Virginia, West Virginia, and Wisconsin

Jacobs provided Dominion with a review of the technologies and operational measures that could be used at each power station to be fully compliant with the Section 316(b) rule while minimizing compliance costs. Technologies included screening systems, physical and behavioral barriers, and operational measures that could reduce flows. Finally, Jacobs evaluated the possibility of using restoration to meet rule requirements.

Exhibit 2-10. Screening and Debris Trough at a Dominion Facility

Jacobs' exceptionally qualified, one-of-a-kind compliance team of power plant engineers, intake structure engineers, Section 316(b) specialists, and biologists visited the plants to gain an understanding of plant-specific compliance issues and review technical information such as pump data, plant manuals, biological impingement and entrainment data, and intake structure specifications. Jacobs screened the alternatives based on their ability to reduce impingement and entrainment, what were able to be permitted, what did not severely affect plant operations, and what were feasible to install. For the best options, Jacobs developed conceptual-level layouts and cost estimates for Dominion's planners to consider during their assessment of the impacts of Section 316(b) regulations. Jacobs assisted Dominion with a consistent compliance approach across the plants, while also addressing necessary plant-specific aspects.

Dominion Energy Resources; Multiple Fossil and Nuclear Stations, Development of Comprehensive Demonstration Studies for 13 Stations Pursuant to the Final Phase II Rule for Section 316(b) of the Clean Water Act; Illinois, Virginia, and West Virginia

Jacobs managed and prepared Comprehensive Demonstration Studies (CDSs) that identified several strategies Dominion could use to demonstrate compliance with the Section 316(b) rule while minimizing compliance costs. Our team developed a thorough understanding of station-specific engineering constraints, operating conditions, unique station attributes, and source water body biological, chemical, and physical conditions to overcome the primary challenge of developing low-cost strategies for full compliance with the Final Rule for Section 316(b) at 13 generating stations.

Exhibit 2-11. Boats and Equipment Used by Jacobs for Biological Evaluations at a Dominion Facility

These generating stations operated uniquely and were located on a variety of cooling water-source water bodies. The Dominion generating stations studied by Jacobs are located on the Atlantic Ocean, freshwater rivers, the Great Lakes, tidal rivers, Chesapeake Bay, and several cooling reservoirs. Jacobs developed a best-fit approach, ensuring consistency in compliance approach across all plants, while also ensuring necessary plant-specific aspects were addressed. Specific CDS components included:

- CWIS and source water-body data
- Impingement mortality and entrainment characterization (as it pertains to baseline and performance)
- Technology and compliance assessment information, including technology installation and operation plan and (when needed) a design and construction technology plan
- Restoration plan, including adaptive management planning

For feasible alternatives, Jacobs developed detailed layout drawings and cost estimates. Jacobs worked with a consultant to develop site-specific cost-benefit/cost-cost analyses that demonstrated the costs of compliance exceeded the benefits. By demonstrating this important conclusion, the CDS solution to compliance was to recommend restoration as the best rule-compliant approach. Jacobs then developed conceptual, site-specific restoration plans and monitoring processes to be included in the CDS.

Our team also worked with Dominion staff and biological and economic consultants to provide quality assurance/quality control (QA/QC) of field data and prepare verification monitoring planning.

2.3 Similar Hydropower Projects

Jacobs offers the full range of hydropower project services, from planning to final design, commissioning, plant operation, and condition assessments at existing facilities. Services can be delivered alone or together with the total suite of scientific, regulatory/licensing, economic, and public involvement services necessary to develop the hydroelectric potential of water resources, conveyance systems, and treatment facilities. We work with all types of projects and clients, including new installations, rehabilitations and upgrades, additions at federal dams, micro-hydro developments, and additions on irrigation/municipal water systems.

Our extensive experience with these types of facilities helps us to scale evaluations to fit the potential need and outcome. In doing so, we optimize use of our client's resources. We typically recommend a

step-wise approach to evaluation of hydroelectric generation facilities—starting with an evaluation that enables key decisions without great expenditure. This approach is available to Dyno Nobel, if desired, and can be implemented on this Project.

A brief summary listing of our hydroelectric project portfolio is presented in Appendix C. We have also included an overview sheet branded as CH2M HILL of our Hydroelectric Services in Appendix D.

3. Past Experience with DEQ and USACE Permitting

For the many outfall and water intake designs developed in Oregon and Washington by Jacobs over the past 15 years, essentially all these projects have had Jacobs leading the U.S. Army Corps of Engineers (USACE) permitting, including communications and consultations with the National Marine Fisheries Services. Our permitting leads, engineers, and scientists are highly experienced in federal and state agency communications to maintain the project schedule and optimize the least costly in-water construction methodologies. Our proposed project team has decades of experience working with Oregon DEQ staff during the review of outfall project designs, outfall studies, and National Pollutant Discharge Elimination System (NPDES) permit studies and development.

In the last 12 years, our project team has submitted engineering reports for DEQ reviews and held pre-application meetings with DEQ staff for the following outfall projects: Boise-St. Helens Outfall Extension and Diffuser, Clackamas Kellogg Creek WRRF Outfall Improvement, Wilsonville WWTP Outfall Improvement, Clackamas Tri-City Outfall Modification, Coos Bay WWTP#2 Outfall Improvements, and the Portland CBWTP Outfalls 001 and 003 Improvements. We are well versed in the DEQ requirements and expectations for these reports and agency meetings. All of our engineering reports have been approved by DEQ with only minor or no comments.

In addition, our project team lead for diffuser designs, outfall mixing studies, and NPDES permitting – David Wilson – has more than 15 years of direct working experience with key staff in the DEQ Northwest District Office, including Rob Burkhart. David has been working with Rob Burkhart on the Boise-St. Helens Outfall Project, the Oregon LNG Project, and the Troutdale Energy Center Project.

"Your dedication to detail, unsurpassed quality of work, and personal expertise was key to achieving our outfall project success…and your ability to communicate at all levels so everyone understood what was necessary to achieve environmental compliance was invaluable." **—Joseph Kovich (Outfall Project Manager and Environmental Manager, Boise Paper, St. Helens, OR)**

Written about David Wilson in a letter of appreciation after the completion of the outfall design, permitting, and construction.

4. Proposed Approach

Jacobs has developed our project approach based on our understanding of the Dyno Nobel operations, discharge, and intake water systems; the hydraulic and sediment transport environment of the lower Columbia River near Columbia City; our extensive experience designing, permitting, and constructing outfalls on the lower Columbia and Willamette Rivers; the Mixing Zone/Excess Thermal Load Compliance Schedule defined in the new NPDES permit; and Dyno Nobel's need for an effective modification to the cooling water intake structure. The Jacobs team will collaborate with Dyno Nobel to accomplish the following key objectives:

- Design modifications to the Cooling Water Intake Structure to achieve federal rules for fisheries protection and meet the NPDES permit schedule for submittals and completion
- Determine the best alignment for the new outfall, while carefully considering routing constraints
- Design a new outfall and diffuser with optimized dilution performance to achieve the required thermal discharge requirements and water quality standards with a defined safety factor to allow for future changes
- Provide a diffuser design that is adaptable to changes in river bedforms, seasonal flow changes, and future more stringent requirements
- Successfully manage permitting and environmental documentation to maintain project schedule and allow for construction in 2022
- Successfully deliver the design, permitting, and construction to allow operational start in 2023

4.1 Outfall Modification Plan

We understand that Schedule C – Compliance Schedule in the current NPDES permit defines a detailed schedule for interim deliverables required by DEQ and for completion of the Mixing Zone/Excess Thermal Load Limit Compliance Schedule for Dyno Nobel. The compliance schedule specifies:

- 12 months after permit effective (March 1, 2020) – Submit status report on Outfall Modification Plan
- 24 months after permit effective (March 1, 2021) – Submit Outfall Modification Plan (Engineering Report) to DEQ with plans, specifications, and preliminary outfall mixing modeling results; and submittal of a confirmation letter that all permit applications for this Project have been submitted to agencies
- 36 months after permit effective (March 1, 2022) – Submit status report on Outfall Modification Project to DEQ
- 48 months after permit effective (March 1, 2023) – Outfall Modification Project construction completed
- 51 months after permit effective (June 1, 2023) – Submit post-construction Outfall Mixing Study Report to DEQ
- 54 months after permit effective (Sept 1, 2023) – Achieve full compliance with final permit ETL limits

Jacobs has the experience and a successful record of fast-track design and permitting to meet NPDES permit compliance schedules and requirements. We have undertaken this approach for many of the projects presented in Section 2, including: Kapstone Packaging Longview Mill Outfall, the Boise-St. Helens Outfall, and the Clackamas Tri-City Outfall. Our proposed approach for this Dyno Nobel Project is presented in the following sections.

4.1.1 Outfall Structure Design Options

The Jacobs project team will evaluate the two alternatives or “Outfall Structure Design Options” that are identified in the request for proposals (RFP). Other alternatives may be identified and discussed with Dyno Nobel to assess the value in including them in the evaluation. However, our proposed approach is based on maximizing cost efficiency by focusing on the design option(s) that we know from our experience will be successful and lowest cost.

The lower-cost, single-pipe, multi-port diffuser outfall approach will meet applicable current water quality (including temperature) requirements, as outlined in Dyno Nobel’s latest NPDES permit. This outfall approach is common practice, is an approach we have decades of experience implementing, and is far lower in capital and operations and maintenance costs than other alternatives. This approach also enables compliance with potential future, more-stringent requirements, including stricter temperature requirements.

Installing the new outfall pipe in the existing service road to the north and east of the existing cooling water discharge channel represents an excellent, low-cost, low-risk, simple, permit-friendly approach to installing the new outfall pipeline between the existing energy discharge structure and the shoreline of the Columbia River.

No major shut-down of the Dyno Nobel plant will be necessary – only a 1-day connection shut-down is anticipated. Also, this simple, low-cost installation approach negates the need to consider a high-cost, high-risk trenchless installation approach, such as horizontal directional drilling (HDD). HDD is typically reserved for technically challenging conditions and avoidance of sensitive habitat conditions. Neither of these conditions exist for this Project.

Also, note that the Jacobs team is aware of the adjacent Army Corps Section 408 Dike and the potential impact of construction within this existing dike structure. Such construction would trigger review by the USACE, which is a 12-month process. Additionally, there could be temporary and permanent easement implications. It will be critical to engage the USACE early in the planning process with respect to this issue. However, the overall schedule impacts can be largely mitigated by soliciting review in parallel with the other environmental permits. Furthermore, it may be possible to avoid the dike structure.

We understand that it is critical to implement an outfall modification strategy that enables compliance with future changes in requirements, including more stringent temperature dilution requirements. Doing so avoids the potential for “sunk costs.” Fortunately, the most cost-effective strategy available to Dyno Nobel also enables this flexibility for future compliance. We will summarize the results of the evaluation in a brief report that includes cost information to enable Dyno Nobel to select the best approach to meeting current requirements as well as potentially more stringent future requirements.

The estimated fee for this task is presented in the RFP Pricing Form, Line Item 1 as included in Appendix I of this submission.

4.1.2 Hydro Electric Option Feasibility Study

The Jacobs project team will develop cost estimates for the anticipated revenue from a new hydroelectric generation facility. That estimated cost will be compared to the estimated cost of a new hydroelectric generation facility installed in a new concrete vault structure. Additionally, potential costs associated with upstream pipeline replacement will be identified. Permitting requirements will be identified and associated cost estimates will be developed. A pay-back period on the capital investment will be calculated. A report summarizing the work will be submitted to Dyno Nobel for its consideration. The report will be sufficient to enable Dyno Nobel to select whether or not to proceed with implementation of the new facility.

The estimated fee for this task is presented in the RFP Pricing Form, Line Item 2 as included in Appendix I of this submission.

4.1.3 Diffuser Design Development

The diffuser design development is an iterative process to select the suitable diffuser site and then develop the diffuser configuration design to achieve optimized diffuser depth, length, riser, and port configurations to optimize dilution performance – incorporating diffuser riser adaptability for the site-specific river bedform variability. The diffuser site selection will use available and newly collected river bed bathymetry and sediment information in our evaluation of river bedform and elevation change potential at diffuser sites.

We understand the technical analyses, design considerations, and permitting requirements for installation of a new outfall diffuser into the Columbia River. River bed condition, morphology, and current flow characteristics are unique to each diffuser siting and design. Exhibit 4-1 and Exhibit 4-2 illustrate site-specific conditions in the Columbia River and bedform analyses by Jacobs used to design new outfall diffusers and to solve bedform burial challenges at existing outfall diffusers in the river. Bedform changes will need to be evaluated using historical and newly collected detailed bathymetry data, sediment characteristics (sizes), and river current velocities to model and predict bedform elevations and channel changes for the preferred diffuser sites. Our River Analysis and Modeling team have experience and expertise with these bedform evaluations for diffuser designs on many Pacific Northwest rivers, and specifically the Willamette and Columbia Rivers.

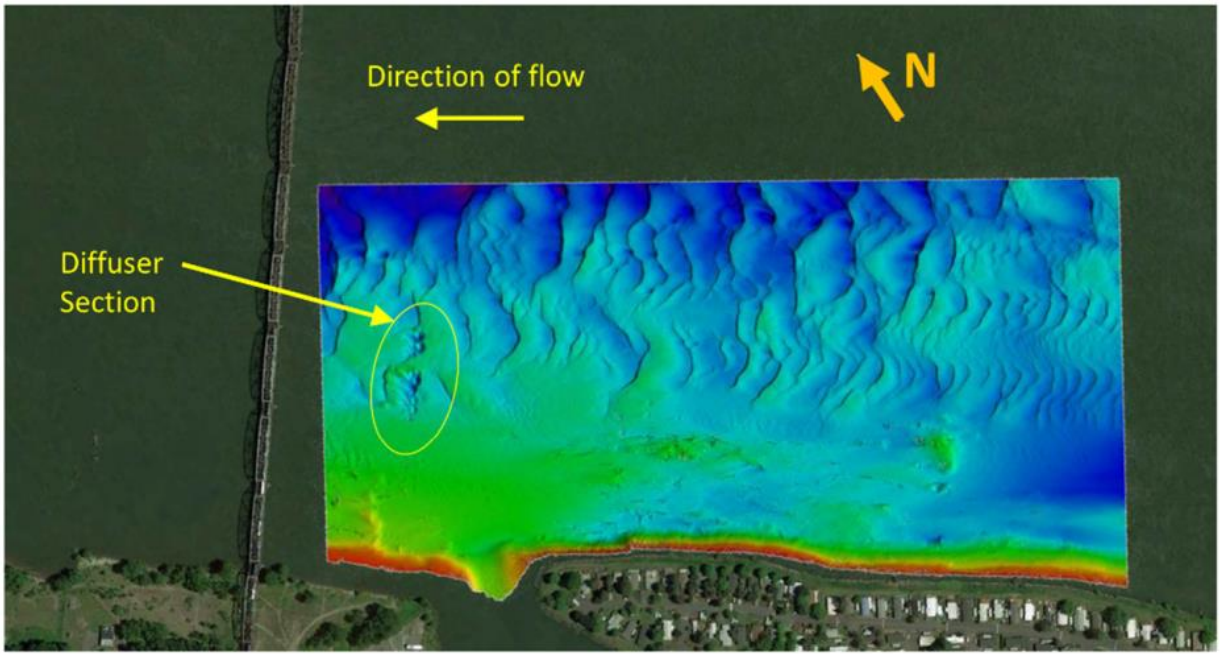


Exhibit 4-1. Illustration of Columbia River Bedform Impacting an Existing Multi-port Diffuser Requiring Design of Retrofits to Maintain Function

Any outfall diffuser in the river will need to recognize and address commercial and recreational uses at the diffuser site and the structure effects on boat navigation, anchoring, and recreational fishing. Site conditions that are particularly important to design include the riverbed slope stability, sub-bottom geological conditions, ambient currents, woody debris transport, and shoreline stability and erosion hazard. Jacobs team will evaluate and discuss these site conditions with Dyno Nobel during the outfall route and diffuser site selection. Private aids to vessel navigation are often installed to protect the new structure.

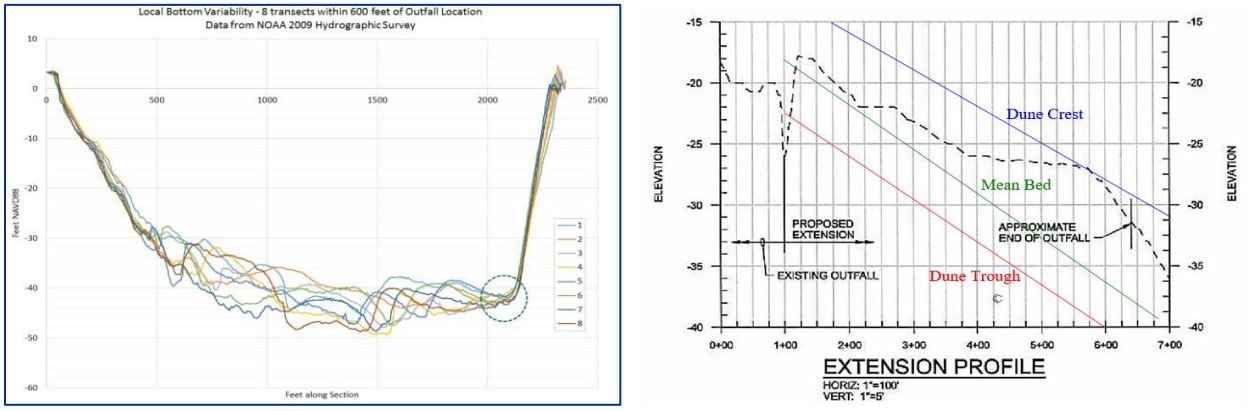


Exhibit 4-2. Illustrations of Bathymetry Data and Bedform Analyses on the Columbia River Used to Select Diffuser Sites and for Diffuser Designs at the New Salmon Creek WWTP Outfall Diffuser and for the Boise-St. Helens Outfall Site

The reasonable potential analysis (RPA) developed using Dyno Nobel wastewater chemistry data and temperature data along with background Columbia River chemistry and temperature data (collected during the survey work) will be used to define the target design dilution factors needed for the outfall diffuser. Our initial evaluation indicates that a minimum dilution factor of 55 is needed to achieve full compliance with the NPDES permit Excess Thermal Load limits.

Our approach will develop the outfall design options that meet the hydraulic and dilution requirements, regulatory restrictions (fish passage and exposure), morphological conditions (that is, velocities, river bed stability and geology, and woody debris loads), and structural durability expectations for design life. Outfall pipe materials, shoreline and riverbed stability, construction methods, and costs will be evaluated in the preliminary design. Shoreline and riverbed stability will be evaluated in the preliminary design based on available information. Review and selection of outfall pipe materials will be conducted in coordination with Dyno Nobel. The design options for the outfall and multi-port diffuser will be influenced by target dilution requirements, hydraulic limitation, riverbed stability, construction methods, and costs.

4.1.4 Preliminary Design Report

The work product from the preliminary design will be the Preliminary Design Engineering Report that defines the basis of the outfall and diffuser design and includes the following: project background and objectives; design issues; project benefits; characteristics of the river site; effluent characteristics; water quality standards and target design dilutions; an evaluation of outfall options and the selected option; dilution and hydraulic modeling of the selected option; a demonstration of water quality standards compliance; a review of design criteria for the selected outfall and diffuser (including plan and profile drawings; pipe material and outfall elements; outfall hydraulics; construction methods; a cost estimate; and a summary of permitting. The Preliminary Design Engineering Report will incorporate the outfall mixing zone information that is required by ODEQ's RMZ-IMD for mixing zone allocation for a new outfall in the Columbia River. Jacobs has successfully applied this approach of combining the mixing zone study

information into the design engineering report in the Clackamas Tri-Cities and Kellogg Creek, Wilsonville, Seaside, and Boise-St. Helens outfall design reports. The Preliminary Design Engineering Report also provides the basis for the information presented in the permit applications and biological assessment document. The Preliminary Design Engineering Report will be submitted to Oregon DEQ for review and approval. Our design engineering reports for outfall projects have typically been approved within 2 to 3 months of submission in Oregon.

4.1.5 Detailed Design, Bidding, and Construction Contract Documents

The Jacobs team will complete detailed design drawings and specifications as well as bidding and contract forms to enable selection of a low-price contractor to complete construction. The Jacobs team will implement its standard design approach that involves review at the 60 percent, 90 percent, and 100 percent completion stages.

4.2 Cooling Water Intake Structure

Our proposed approach is presented herein. It is based on confirming understanding with Dyno Nobel of the NPDES and federal 316(b) requirements and their timing. It is also based heavily on using work that has already been completed to date by our project team for Dyno Nobel.

4.2.1 Review of NPDES Permit Requirements for Compliance

The Jacobs team can meet the schedule requirements presented by Dyno Nobel in the RFP. We note, per our review of the NPDES permit, and our experience with the typical compliance approach with these types of projects, that compliance with the Section 316(b) fish-screening requirements could be implemented over a longer time horizon than what is presented in the RFP. If Dyno Nobel is interested in exploring the possibility of deferring capital expenditure until required by DEQ, we are available to assist with that effort. Otherwise, we are ready and willing to press ahead with the schedule requirements outlined in the RFP. An overview of the Section 316(b) compliance process is included in the CH2M-titled document in Appendix E that was prepared by our team's intake lead, James Kapla, a national leader in intake fish screening projects. We note the following key requirements of the NPDES permit that our work will satisfy:

- A "work plan" within 1 year of the effective date of the NPDES permit (Mach 1, 2019). This document is required to assess current conditions and compliance. Most of this work has already been completed as part of our team's prior work.
- No later than 180 days before the expiration of the current NPDES permit, Dyno Nobel must submit a series of seven PAR reports to DEQ, providing the information required in 40 CFR 122.21(r)(2) and (3) and applicable provisions of paragraphs (4), (5), (6), (7), and (8). This compliance date is late in 2023 and is apparently reflective of the extended compliance timeline being granted by DEQ. Meeting the stated Dyno Nobel compliance strategy would require completion of these reports as an initial activity. These reports include the following permit application requirements (PARs):
  - PAR (r)(2): Source Water Physical Data
  - PAR (r)(3): Cooling Water Intake Structure Data
  - PAR (r)(4): Source Water Baseline Biological Characterization Data
  - PAR (r)(5): Cooling Water System Data
  - PAR (r)(6): Impingement Mortality Reduction Plan
  - PAR (r)(7): Performance Studies
  - PAR (r)(8): Operational Status

4.2.2 Cooling Water Intake Structure Design Options

This portion of the work has essentially been completed already, including provision of costs for alternative approaches. It was completed by our team in 2016, as part of a larger project to address options for lower-temperature cooling water. Refer to a copy of the cover of the technical memorandum report for this work in Appendix F. We propose to review the results of this work with Dyno Nobel to enable selection of the preferred Section 316(b)-compliant fish screening approach. This approach will save Dyno Nobel time and money and leverage the work that has already been completed by the same team that we are proposing for this Project.

The estimated fee for this task is presented in the RFP Pricing Form, Line Item 3 as included in Appendix I of this submission.

4.2.3 Cooling Water Modification Plan

Once a preferred intake screening approach is selected, the Jacobs team will develop a comprehensive Cooling Water Modification Plan (CMP) that will include design development to approximately the 30 percent stage. The CMP would address the required aspects of the Project to enable review by DEQ, the National Marine Fisheries Service, and other applicable agencies. Presuming that tee screens are selected because of their low cost and long history of reliability, approval of this approach should not present substantial challenge.

4.2.4 Detailed Design, Bidding, and Construction Contract Documents

The Jacobs team will complete detailed design drawings and specifications as well as bidding and contract forms to enable selection of a low-price contractor to complete construction. The Jacobs team will implement its standard design approach that involves review at the 60 percent, 90 percent, and 100 percent completion stages.

4.2.5 Post-Construction Monitoring and Optimization

Some impingement and entrainment compliance improvements require monitoring and optimization to be completed and reported to DEQ after installation. However, presuming the tee screens are installed, with design intake velocities of 0.5 feet per second or less, no permit driven monitoring or optimization would be required. The reason for this is that this approach is known to DEQ and other national regulatory agencies to be effective and reliable. The experienced Jacobs team, with its wealth of knowledge of 316(b) compliance will guide Dyno Nobel on the installation of a low-cost, reliable system that is easy to operate and maintain.

4.3 Construction Management Services

Jacobs will provide a veteran construction manager along with the design team to provide construction support. The Jacobs construction manager will conduct regular site observations and provide consistent contractor communications. We also have inhouse construction cost estimators with an extensive database for outfall and in intake projects to baseline construction costs and assist in assessing any construction change order options. Our construction management experience and proven construction management best practices will optimize the potential for a successful construction phase.

4.4 Permit Application Completion

Permitting processes planned properly avoid costly delays. From our experience with our other outfall projects in Oregon and on the Columbia River, successful project permitting requires early, frequent, and clear communication with the design team, our client, and with natural resources and permitting agencies.

We would approach this Project with the understanding that Dyno Nobel expects to review and approve all regulatory submittals and commitments, and that Jacobs assumes the role of executive secretary by coordinating with applicable agencies.

Our team's approach to meeting schedule and permitting needs is to involve our permitting team early so they can guide the project team in the implication(s) of the design decisions on the permitting process. We also like to engage regulatory agencies early in the process to gain their input on potential concerns or special design requirements to avoid rework. Staff at the regulatory agencies know our team well, trust our work, and appreciate our early engagement approach.

We will develop an Environmental Compliance Matrix, use it as a living document, and update it monthly. This helps Dyno Nobel and our team track required permits, investigation/document preparation, and review timelines with dates of recent or upcoming agency communications.

One of our first efforts will be to develop a comprehensive permitting strategy focused on creating defensible route selection, compliant diffuser and intake screen design, and reviewable environmental documentation. Dr. Steve Mader's success in streamlining complex environmental permitting will guide our strategy to address requirements and manage potential risks. This strategy will define a risk-based approach, along with the following key considerations:

- Define the extent to which we can rely on the existing natural and cultural resources information for the Project vicinity
- Leverage regulatory efforts from prior effluent outfall diffuser/intake permitting
- Conduct pre-application meetings with resources and land use agencies
- Prepare alternatives analyses for pipeline routing and outfall siting that comply with Clean Water Act Section 404(b)(1) guidelines
- Engage permitting team early so that the engineering design considers environmental constraints and sensitive sites between the facility and the river
- Applicability of fish screen design criteria in the National Marine Fisheries Service's *Anadromous Salmonid Passage Facility Design* (2011)
- Address agency concerns about indirect and cumulative effects on fish, fish passage, and critical habitat
- Decide whether to proceed with a single or dual permitting effort for the diffuser and intake; also, assess whether separate early approvals will be needed for geotechnical investigation

Our understanding of regulatory requirements and initial assessment of permitting risks and how they interact are presented in Table 4-1 on the following page. Although the list of permits and approvals is meaty, and some uncertainties about levels of effort will be resolved after initial reviews, the risks appear manageable given adequate time to prepare.

The permit list acknowledges the many interdependencies among applicable regulations, which allows for efficiencies in application preparations. The permitting levels of effort and review timelines introduce a certain amount of scheduling uncertainty, but the processes can be aided, and risks reduced, by conducting pre-application meetings, preparing complete application packages, and diligently monitoring the agency reviews.

The estimated fee for this task is presented in the RFP Pricing Form, Line Item 4 as included in Appendix I of this submission.

Table 4-1. Anticipated Permitting Processes for Dyno Nobel Intake and Outfall Projects

Permitting Processes	Outfall	Intake	Data Needs	Interrelationships	Level of Effort	Timeline	Assessment
FEDERAL							
Clean Water Act Section 404 Dredge/Fill (Corps)	X	X	Wetland/OHWL delineation; sediment characterization; hazmat investigation	NHPA Section 106; ESA Section 7; Section 401 Water Quality Cert.; Corps Section 10	Prepare JPA; may need advance JPA for geotech; leverage DEQ order; perform Sediment Evaluation Framework analysis; prepare mitigation plan	9-18 months	Predictable development process; exposure to public comments through public notice; possible special handling of contaminated sediments; off-site mitigation required if any permanent impacts; address disposition of existing canal
Rivers and Harbors Act Section 10 (Corps)	X	X	In-water construction	US Coast Guard; Corps Section 404 Permit	Minimal beyond Section 404 application	9-18 months	Predictable; use construction BMPs to avoid navigation hazards
Rivers and Harbors Act 33 USC 408 (Corps)	X		Verify Corps jurisdiction (e.g., levee, pile dike, navigation channel)	Corps Section 404 Permit	Engineering report for modifications to Corps civil works projects, and to demonstrate project would not impact the integrity of Corps structures	12 months	If Corps has jurisdiction, engineering review could impact design/construction schedule
Endangered Species Act Section 7 and Magnuson-Stevens Act Consultations (NMFS)	X	X	Biological assessment	Corps Section 404 Permit; City Comprehensive Plan	Leverage programmatic biological opinions to reduce new documentation; SLOPES VI expected ~June 2019; negotiation required for Incidental Take Permit	9-18 months	Permit provisions influence construction cost
NHPA Section 106 Cultural Resources (Corps/SHPO)	X		Archaeological/built environment resources survey; tribal consultation	Corps Section 404 Permit	Level of effort uncertain pending archaeological/historic survey findings report; high potential for subsurface investigation plan; and potential supplemental consultation, mitigation, and construction monitoring	30 days for dig permit; 9-18 months	Site is within a “high probability” archaeological resource zone; cultural resource discovery could influence alignment or schedule
Marine Safety Zone Approval (US Coast Guard/Oregon State Marine Board)	X	X	In-water construction methods; river uses	Oregon State Marine Board; Notification to Mariners; PATON permit	Coordinate with USCG/OSMB at bidding; iterative process; requires notice in Federal Register	3 months	Predictable, but requires coordination with several agencies
Marine Mammal Protection Act (NMFS)	X	X	BMPs to avoid “take” (i.e., harassment, injury, or killing) of marine mammals	Steller sea lion, California sea lion, Harbor seal	Must avoid “take” by specifying avoidance measures during construction to circumvent permitting	12 months (if needed)	Mitigated by specifying a competent monitor during construction, and stopping high noise when marine mammals enter vicinity
Bald and Golden Eagle Protection Act (USFWS)	X		BMPs to avoid “take” (including harassment) of bald eagle	Bald eagle and construction activities within 660 feet of a known nest or roosting tree	Must avoid “take” by specifying avoidance measures during construction to circumvent permitting	3–6 months (if needed)	Mitigated by verifying no nests or roosts within 660’, scheduling high noise activities during August-December (or implement sight/noise screening)
Migratory Bird Treaty Act (USFWS)	X		Construction schedule and clearing needs	Construction activities that “Take” migratory birds or their eggs during active nesting	Might require schedule adjustment, or survey to verify no birds are present	No permit available	Mitigated by scheduling vegetation clearing during non-nesting season (i.e., Sept. 1 – Feb. 28)
STATE							
Wetland Removal-Fill (DSL)	X	X	See Corps Section 404	DEQ, ODFW, SHPO, OSMB	Joint permit application (JPA) with Corps Section 404; new procedure for stream functional assessment and mitigation; may need Fish Passage Plan	6 months	Mitigation required for permanent impacts; restoration required for temporary impacts
Clean Water Act Section 401 Water Quality Certification (Corps/DEQ)	X	X	In-water construction methods	Corps Section 404 Permit; NPDES permits	May require a stormwater management plan for new impervious surfaces; stringent conditions for turbidity management during construction	9-18 months	Review for state water quality standards—both construction and operation; provisions become conditions of the Corps Section 404 permit
NPDES Construction Stormwater Discharge 1200-C Permit (DEQ)	X		Project footprint, and construction methods	Corps may request ESC Plan for Section 404 Permit	Prepare Erosion and Sediment Control Plan (ESC Plan), and revise per DEQ comments	3 months	Applicable above OHWE. Requires public notice if >5 acres. Tight specifications reduce non-compliance exposure during construction
Scientific Collection (ODFW/NMFS)	X	X	Fish Salvage Plan	ODFW; NMFS biological opinion	Scientific Collection Permit Application for fish salvage	1.5 months	Requires fish salvage BMPs and monitoring if use in-water containment
Lease for State-Owned Aquatic Lands (DSL)	X	X	Survey; legal description	Corps Section 404 Permit; DSL removal-fill permit	Applications for permanent outfall/intake easements and temporary construction easements	3-12 months	Authorizes use of state-owned aquatic lands; terms and conditions may include fees, survey requirements, insurance, performance security,
COLUMBIA COUNTY							
Zoning Code; Site Design Review	X	X	Site studies; pre-application meeting	Comprehensive Plan; JPA land use compatibility affidavit	Determine through pre-application meeting with County	6 months	Adverse land use impacts must be minimized or mitigated through the development regulations or by specific mitigation measures; utilities typically are allowed outright
Building	X	X	Plans and specs.; pre-application meeting	Design Review; grading/building permits processed concurrently	Grading and building permit application	3 months	Predictable process
Flood Hazard	X	X	Plans and specs.; pre-application mtg.	Design Review	Application for Flood Hazard permit; includes temporary work	3 months	Avoid rise in floodway and net fill in 100-year floodplain
Additional Overlay Districts	X	X	Plans and specs.; pre-application meeting	May include sensitive bird habitat, greenway, riparian corridors, wetlands, water quality, and fish and wildlife habitat protection, wetland area, natural area, or others	Uncertain; determine through pre-application meeting with County	3 months	Minimize impacts to designated significant resources to minimize mitigation requirements

4.5 Preliminary Level 3 Mixing Study

Following the completion of construction, as required as an NPDES permit condition, Jacobs will design, implement, and prepare a technical report for a Regulatory Mixing Zone (RMZ) Study of the new Dyno Nobel Outfall 001. Jacobs will complete this RMZ study in accordance with Oregon DEQ guidelines for a Level 3 RMZ Study (defined in DEQ's Regulatory Mixing Zone Internal Management Directive, 2012; referred to as the RMZ-IMD). The RMZ study will include tracer injection into the effluent flow to allow field measurements of the dilution performance at the defined acute and chronic mixing zone boundaries, as well as concurrent measurements of ambient river currents and tidal elevations to provide key dilution model inputs. These field tracer dilution measurements are collected to calibrate and validate the mixing zone dilution model selection and application. The results of the field study, receiving water and effluent characteristics data, dilution modeling, and assessment of discharge compliance with chemical and temperature criteria will be developed into a technical report for submittal to Oregon DEQ.

The RMZ study will need to be scheduled to occur during low river flow conditions in September following the construction of the new outfall, in accordance with the DEQ's RMZ-IMD. The field tracer study and modeling will provide validated outfall dilution factors for the critical low river flow condition that are used as the critical condition in the NPDES permit. Decades of river flow and stage records for the Columbia River will be used to define the critical river flow statistics (1Q10, 7Q10, 30Q5, and harmonic mean flow) for use in the modeling of the critical river flow conditions, in accordance with the DEQ's RMZ-IMD. In addition, river hydraulic modeling (using the FlowMaster model) will be used to calculate river stage, water depths, and current velocities under specific time periods that correspond with the low river flow condition as well as the Spring river flow conditions. Specifically, river hydraulic modeling will be used to calculate river water depths and current velocities during the Eulachon (smelt) life stages in the Columbia River (February 1-April 30; April 1-30; and May 15-30). Dilution modeling will use these summer and spring river water depths and velocities as inputs to calculate dilution factors for the low river flow condition as well as the spring river flow conditions that correspond to Eulachon life stages present in the Columbia River.

This is precisely the same technical support activity that Jacobs has provided for the Oregon and Washington dischargers shown in our project experience lists. Jacobs' team is widely recognized for our expertise with outfall studies and we have performed approximately 90 percent of all outfall mixing studies for dischargers in Oregon and Washington in the last 20 years.

The estimated fee for this task is presented in the RFP Pricing Form, Line Item 5 as included in Appendix I of this submission.

4.6 Topographical and Geometric Surveys

These surveys will develop essential data for the design development of the new Dyno Nobel outfall structure.

4.6.1 Topographical Survey

Jacobs will subcontract the on-land topographical survey to a firm that is acceptable to Dyno Nobel. We propose using Mackay Sposito because of their familiarity with the Project site and their proximity in Portland. The focus of the survey will be the on-land routing of the outfall pipe. We will discuss routing options with Dyno Nobel, but it appears the lowest-cost and highest-advantage routing option is the existing service road on the north and northwest side of the existing discharge channel. Installing the new outfall pipeline existing discharge channel presents substantial technical and permitting challenges. These will be discussed with Dyno Nobel prior to finalizing the surveying approach.

The estimated fee for this task is presented in the RFP Pricing Form, Line Item 6 as included in Appendix I of this submission.

4.6.2 Bathymetric Survey

The river outfall route and diffuser site selection will rely on collected river bed bathymetry, river bed sediment information, and current measurements that will be used in our evaluation of river bedform and elevation change potential along the outfall route and at diffuser sites. To achieve optimized outfall route, and diffuser depth and alignment will require newly collected river bed bathymetry, sediment, and currents data. Information in our evaluation of river bedform and elevation change potential at diffuser sites.

The river bed bathymetry offshore of the existing cooling water discharge channel is dynamic and influenced by sediment sizes, upstream bedload contributions, and the magnitude, duration and frequency of high river flow and current velocities, and river structures (i.e., pile dikes). A detailed bathymetry survey of the outfall route study region will need to extend from the Dyno Nobel water intake structure on the south to approximately 1,200 feet downstream (north) of the existing cooling water discharge channel on the shoreline and extend to nearly the west edge of the federal navigation channel to provide the coverage data for outfall route selection and for river bedform analyses. Jacobs will have Solmar Hydro, our long-term collaborator on river studies, perform the multibeam sonar survey, assist us in conducting multiple Acoustic Doppler Current Profiler measurements on cross-sections (during ebb and flood tides), and collect surface sediments samples for physical analyses during the same multi-day field event. Exhibit 4-3 illustrates the approximate region for the field data collections. Solmar Hydro will provide a detailed bathymetry chart and survey report for use in the outfall design development.

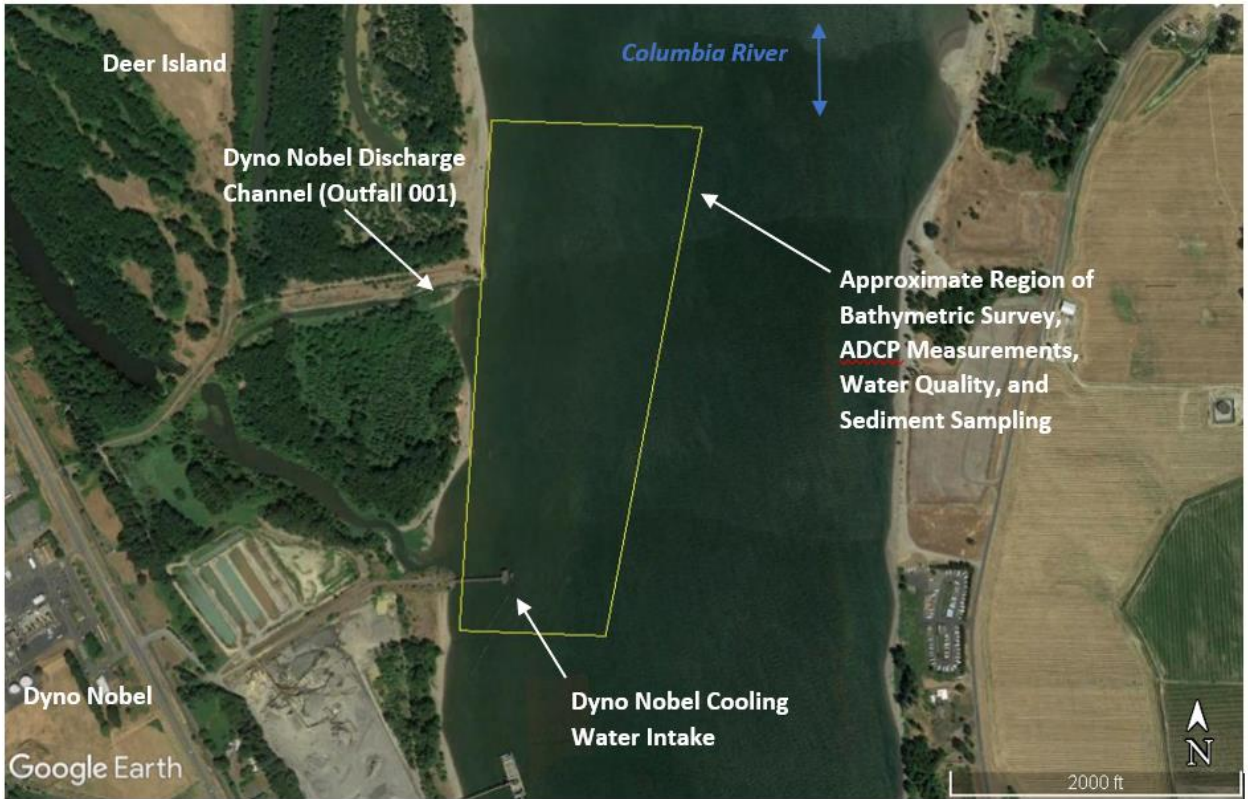


Exhibit 4-3. Approximate Region of Data Collections on the Columbia River for Outfall Design Development (after Google Earth, 2019)

4.6.3 Geotechnical Survey

The Jacobs team will use geotechnical data previously collected as part of a recent project to potentially re-route a liquid natural gas pipeline. The drilling was conducted in 2012. During that project, two bore holes were drilled – one to 120 feet below ground surface and the other to 55 feet below ground surface (see Appendix G for the location of the two borings). These two borings (DR-1 and CR-1) provide adequate information upon which to base outfall design and anchorage. Also collected as part of that project was groundwater information to aid development of construction methods. Note, that this previous project was discontinued. No additional water temperature information is needed to conduct the preliminary evaluation of alternatives. Our project team has what it needs. Whether additional geotechnical information is required depends on the results of the evaluation of the outfall structure design options.

The estimated fee for this task is presented in the RFP Pricing Form, Line Item 6 as included in Appendix I of this submission.

4.7 Water Quality Survey

The Water Quality Survey will develop necessary data for the design development of the new Dyno Nobel outfall structure and for demonstration of water quality compliance. The Water Quality Survey will address two Project needs: provide site-specific background Columbia River water chemistry data and provide Whole Effluent Toxicity test data for discharge compliance documentation.

Three river water samplings will be performed in the summer period of 2019 to provide background Columbia River water quality data. The river water samplings will include water column vertical profiles (using a YSI Pro-DSS water quality instruments to measure temperature, pH, turbidity, and dissolved oxygen over the entire water column) and collection of river water samples at two depths (surface and near-bottom) at four sites in the river. River water sampling sites will be located and timed (with tides) to capture background river water conditions outside of the existing Dyno Nobel discharge plume. Collected river water samples will be submitted for laboratory analyses of metals, nutrients, conventional pollutants, and organic chemicals found in Dyno Nobel wastewater. The first river water sampling event will be coordinated with the bathymetry survey (see Section 4.5.2) and conducted from the Solmar Hydro work vessel. Exhibit 4-3 on the previous page illustrates the approximate region for the field data collections. Note that this first survey will include a multibeam sonar survey, Acoustic Doppler Current Profiler measurements on cross-sections (during ebb and flood tides), collection of surface sediments samples for physical analyses, and water quality survey sampling during the same multi-day field event. The second and third water quality sampling events will be conducted in the summer of 2019 as separate field data collections using the SHI work vessel.

Jacobs will develop RPA sheets using the DEQ Excel spreadsheets with data input from the Dyno Nobel effluent chemistry data collected for the NPDES permit renewal and during the previous permit, along with the background river chemistry data collected in the summer of 2019. The RPA will be used in the diffuser design and engineering documentation of compliance with water quality standards.

In addition, Jacobs will utilize the existing Whole Effluent Toxicity (WET) test data available from Dyno Nobel, as well as WET test results from 2019 testing to evaluate and document compliance with toxicity requirements. If required by DEQ, additional WET tests can be conducted using mixtures of collected wastewater and background Columbia River water. Jacobs has extensive experience performing such site-specific WET tests in our bioassay lab.

We understand that the new NPDES permit requires Dyno Nobel to conduct WET monitoring – acute and chronic bioassay - to cover 4 quarters of a year, and these WET tests can be conducted as 4 quarters in the first year of permit or as one quarter each year for 4 years. We would recommend that Dyno Nobel complete these 4 quarterly WET tests in the first year if possible to provide results to support the outfall design and permitting.

The estimated fee for this task is presented in the RFP Pricing Form, Line Item 7 as included in Appendix I of this submission.

5. Experience of Key Personnel and Resumes

Our proposed project team is extremely experienced in completing intake, outfall, hydropower, and permitting projects. We have a history of working with Dyno Nobel, including the 2016 work that addressed Section 316(b) compliance. Our core project team is used to working as a unit, and we are nearby in both Oregon and Washington.

As shown in Exhibit 5-1, our team's organization provides a clear line of accountability from our Project Manager Phil Martinez to Dyno Nobel's Senior Project Manager David Luneke. Phil understands your project goals, objectives and deadlines, and brings many years of experience managing similar infrastructure improvements. Phil is currently working with our outfall team on a new regulatory-compliant outfall for the City of Port Townsend, Washington.

Phil is supported by a Jacobs team comprised of our most experienced intake, outfall, and permitting experts in the Pacific Northwest. Short introductory bios are included below. Full resumes are provided in Appendix H.

Our core team will be supported by local subconsultant firms MacKay Sposito and Solmar Hydro, and our geotechnical engineer. Additional local expertise from Jacobs personnel in hydraulics, cost estimating, and CADD is available to the team as needed.

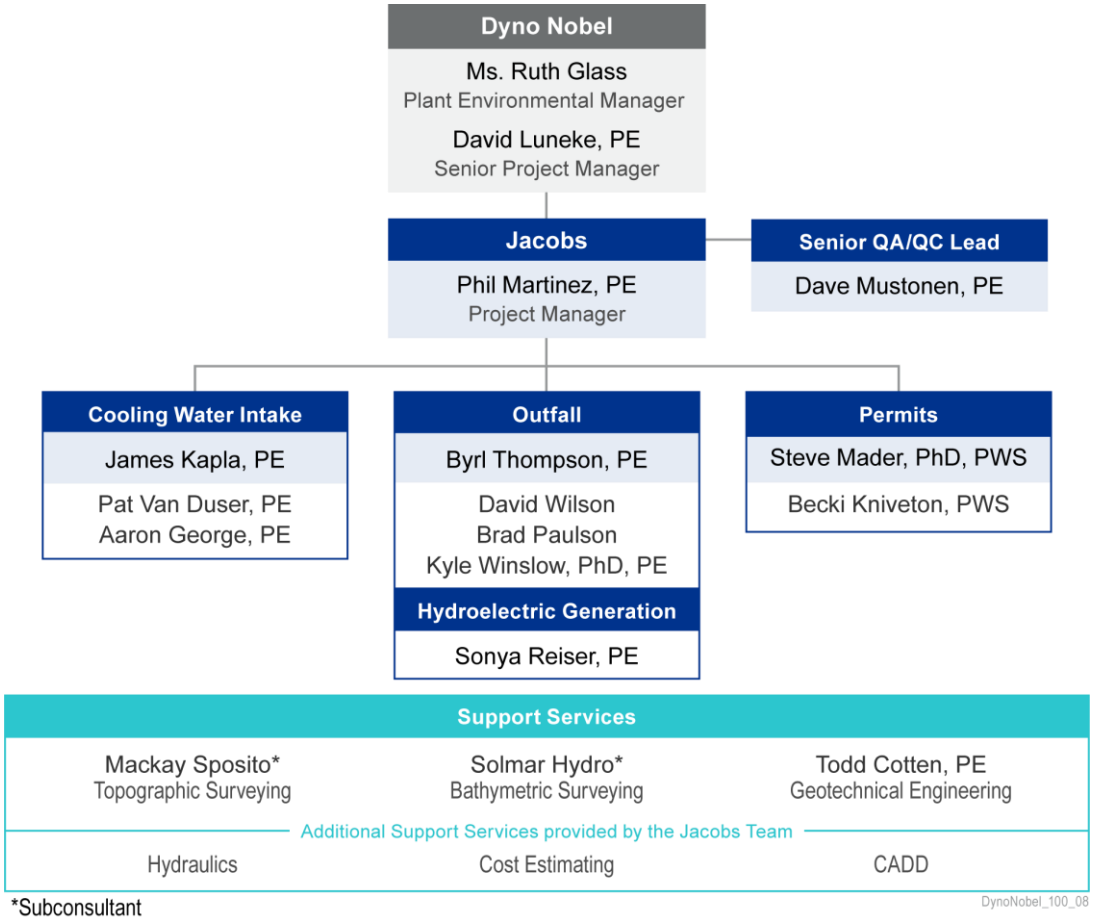


Exhibit 5-1. Jacobs Team Organization Chart

5.1 Proposed Team Profiles

Phil Martinez, PE, Project Manager — Phil is a seasoned project manager with 30 years of experience in planning, designing, and supporting construction of projects for intake, outfall, water and wastewater treatment, system hydraulics, and other similar private and municipal infrastructure improvements. Phil has expertise in leading facility safety and reliability improvement projects, including performance under seismic conditions, through efficient alternatives evaluation processes. He is also experienced in water quality analysis and treatability studies. He was project manager for the City of Port Townsend's outfall replacement at its wastewater treatment plant in Washington. The new 24-inch-diameter, single-pipe, multi-port diffuser outfall extends 900 feet into 25 feet of water off the north shore of Port Townsend. A key aspect of this project was the extensive environmental permitting requirements associated with it.

Dave Mustonen, PE, Senior Quality Assurance/Quality Control Lead — Dave, a Certified Water Rights Examiner in Oregon, has 25 years of experience leading design teams and working with clients ensuring their quality expectations are achieved. He is well versed in LEAN principles and has served as the Chief Designer for numerous infrastructure projects. His experience includes project management, and services during construction in industrial water and wastewater systems. He previously worked with Dyno Nobel at the St. Helens plant on an engineering alternative analysis for increasing cooling capacity. He will provide senior quality reviews to Phil and the Jacobs team as needed.

James Kapla, PE, Cooling Water Intake Lead — James is a water resources expert with 20 years of experience in the design and construction of intakes, diversion dams, weirs, sluiceways, canals, tunnels, and other large hydraulic structures to support water supply, hydropower, and irrigation projects. This includes numerous projects throughout the Pacific Northwest, specifically many facilities located within the Columbia and Willamette River basins. He has previous experience at Dyno Nobel's St. Helens facility, including evaluation of the existing intake facility, calculation of screen velocities, and preparation of a strategy for compliance with state and federal permit requirements in 2015.

Pat Van Duser, PE, Cooling Water Intake — Pat has 24 years of experience in the study and design of water system intakes and fish screens, water treatment and supply projects, and hydroelectric generation projects. His expertise includes the in-water design, permitting, and construction services on more than 10 intake and fish screen designs, upgrades, and consultations. His knowledge was honed on projects requiring multiple agency permitting, multiple stakeholder approval, and construction work during limited duration in-water work periods.

Aaron George, PE, Cooling Water Intake — Aaron has 6 years of experience in 316(b) cooling water intake structure engineering. He also is experienced in general hydraulics analysis, including headloss in rock tunnel and piped systems. Aaron has previous experience working with Dyno Nobel as an intake/screening engineer at the St. Helens facility.

Byrl Thompson, PE, Outfall Lead — Byrl has 30 years of civil engineering experience in planning, design, and construction support of conveyance systems and route evaluations, outfalls, utility coordination, and subsurface utility engineering. On a recent project in Clark County, Washington, Byrl led the civil design tasks for design and permitting of 7,300 feet of 48-inch steel effluent pipeline crossing under Salmon Creek and Lake River and terminating with a 750-foot outfall into the Columbia River, using a 144-foot diffuser with 10- to 16-inch check valves ports and access manhole.

David Wilson, Outfall — David is a senior scientist with 30 years of experience, who specializes in the design of new and improved outfalls and diffusers and conducts analysis of water quality compliance for discharges. His focus includes NPDES permit negotiation and compliance issues. His skills include regulatory strategy development, agency negotiations, study design and implementation of field data collections, design of modeling analyses, statistical analysis, and knowledge of aquatic communities.

Brad Paulson, Outfall — Brad has 25 years of experience in outfall analysis and engineering, water quality studies and analysis, and analysis and modeling of estuarine circulation and pollutant transport. He has conducted numerous water quality analyses of industrial waste discharges into estuarine, fluvial, and coastal areas. He is a leader in field data collection and data analysis, interpretation, and presentation of study results for outfall dilution and mixing zone studies.

Kyle Winslow, PhD, PE, Outfall — Kyle has 23 years of experience in environmental science consulting, and 15 years of experience in numerical modeling of coastal, estuarine, riverine, and reservoir hydraulics, waste-field transport, water quality, and sediment transport. On a recent project in Vancouver, Washington, he calibrated model predictions and applied multiple bathymetric surveys in the vicinity of an existing and proposed replacement outfall in the Columbia River bedform.

Steve Mader, PhD, PWS, Permits Lead — Steve is a principal environmental technologist with 33 years of experience, specializing in Washington and Oregon ecosystems. He brings expertise in regional regulatory affairs and is fluent in local, state, and federal environmental permitting of in-water and environmentally sensitive work. Steve is experienced in NEPA/SEPA, environmental impact assessment, design of constructed ecosystems, and environmental specification writing.

Becki Kniveton, PWS, Permits — Becki is a biologist and permitting specialist with 20 years of experience meeting the permitting requirements and timelines for federal, state, and local permits. She has extensive experience completing State Environmental Policy Act (SEPA) documents to comply with local agency requirements, and Joint Aquatic Resources Permit Applications (JARPAs) for U.S. Army Corps of Engineers (USACE), and state Fish and Wildlife Department permits. She has prepared categorical exclusion checklists for local projects and other NEPA/SEPA permit application documents. Becki's expertise includes performing wetland and stream delineations, completing mitigation and restoration plans, and writing biological assessments.

Sonya Reiser, PE, Hydroelectric Generation — Sonya has 17 years of experience and works on hydropower and other water projects for state and local government, private, and national government clients. Her hydropower experience includes domestic and international project work encompassing studies, design, and owner's engineer on construction projects. She is familiar with the FERC process as well as USACE and U.S. Bureau of Reclamation requirements for implementing hydropower.

Todd Cotten, PE, Geotechnical — Todd is a senior geotechnical engineer with 25 years of experience on a variety of water design and construction projects, including large-diameter pipelines, earth dams and levees, auger boring, horizontal directional drilling, and land stabilization. He has extensive experience performing geological hazard assessments for projects across Oregon, with specific focus on seismicity, liquefaction and lateral spread, tsunamis, and landslides.

5.2 Subconsultant Firm Profiles

MacKay Sposito is a professional consulting firm founded in 1974 in Vancouver, Washington. They serve the energy, public works, and land development markets in Oregon, Washington, and beyond. They specialize in topographic surveying for fish facilities and transmission and distribution projects, with thousands of miles surveyed for both existing and proposed lines.

Solmar Hydro was formed in Portland in 2004 by Mike Stecher to provide hydrographic surveying and mapping services to the engineering and scientific communities. Mike is an ACSM Certified Hydrographer with 14 years of experience conducting hydrographic surveys from inland rivers and estuaries to full ocean depths. Solmar Hydro

offers a wide range of hydrographic services from a variety of surveying platforms with a focus on challenging projects that demand precise and accurate hydrogeomatic data. With their years of experience surveying inland and offshore waters, clients can be assured that their bathymetric data is precise and accurate.

6. References

Reference 1 — Port Townsend Wastewater Treatment Plant Outfall Replacement

Dave Peterson, City Engineer, City of Port Townsend, (360) 379-5088, dpeterson@cityofpt.us

Reference for Phil Martinez for the on-going Port Townsend Outfall Replacement Project.

Reference 2 — Chelan Public Utility District/Chelan River Tailrace Pump Station

Bill Christman, Hydro Engineering Manager, PUD No. 1 of Chelan County Washington, (509) 661-4283, billc@chelanpud.org

Reference for James Kapla for the Chelan PUD Tailrace Pump Station Fish Screening Project.

Reference 3 — Packaging Corp of America/Boise-St. Helens Outfall Project

Rich Garber, Director, Environmental Compliance & Regulatory Affairs; Packaging Corporation of America, (208) 805-1290, RichGarber@Packagingcorp.com

Reference for Dave Wilson for the Boise – St. Helens Outfall Project.

Reference 4 — Clark Regional Wastewater District/Salmon Creek WWTP

John Peterson, General Manager, Clark Regional Wastewater District, (360) 993-8819, jpeterson@crwwd.com

Reference for Dave Wilson for the Clark Salmon Creek WWTP Project.

Reference 5 — Dominion Resources/Multiple Projects

Mike Surface, Consulting Engineer, Dominion Resources Services, Inc., (804) 273-2530, mike.surface@dom.com

Reference for James Kapla and Aaron George for several Dominion Resources Section 316(b) Compliance Fish Screening Projects.

7. Proposed Completion Schedule

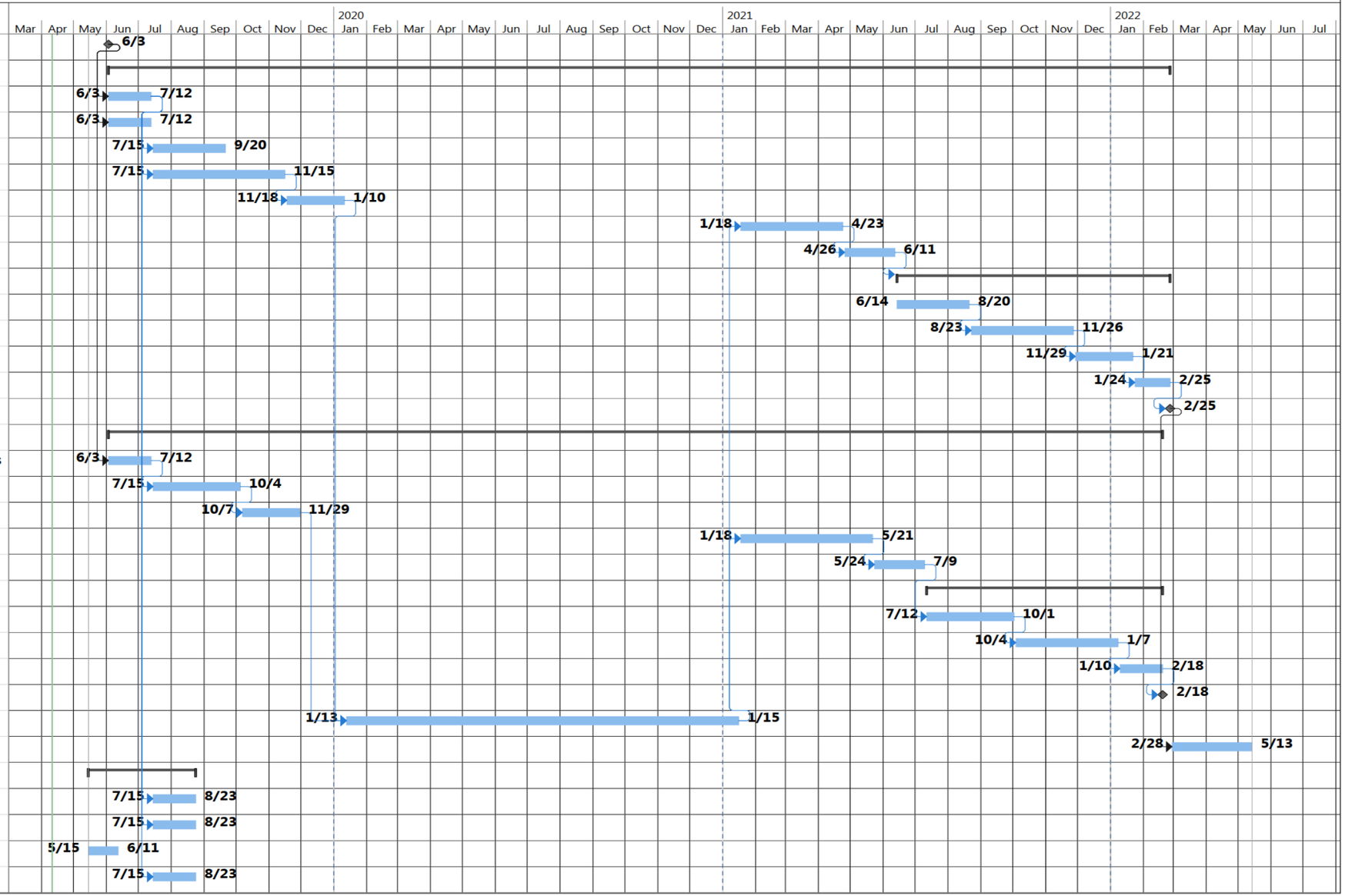
Dyno Nobel has established completion dates, as presented in the RFP. It is possible to meet each of these completion dates. The Approach presented in this proposal and the Proposed Completion Schedule—presented as Exhibit 7-1 on the following page—reflect completion of the Project to meet the dates established by Dyno Nobel in its RFP. The Proposed Completion Schedule presented in Exhibit 7-1 shows the anticipated timeframes and chronology to complete tasks and activities of the Project. The schedule also reflects completion of in-river construction activities during the agency-required timeframe of November 1 through November 28.

Note that the post-construction Level 3 Mixing Study is shown in late winter and Spring of 2022. It is possible that conditions will enable this timing and if DEQ allows it to be completed at this time, our team can make this happen. However, Level 3 Mixing Studies are typically required during low flow conditions, which are more common on the lower Columbia in September. Therefore, this activity could be conducted during September of 2022.

The schedule reflects completion of the project approximately 1 year ahead of the Dyno Nobel established deadlines. The Jacobs team will engage with Dyno Nobel regarding pursuit of a slower schedule if desired by Dyno Nobel. Note that the recently executed NPDES permit does not require completion of the Cold Water Intake Modification by the same November 2023 deadline established by Dyno Nobel. While our team can and will meet Dyno Nobel's schedule objectives, if Dyno Nobel were interested in deferring capital investment on new Section 316(b)-compliant intake screens, we are available to address how a greatly extended schedule may be possible.

Exhibit 7-1. Proposed Completion Schedule for Dyno Nobel Intake and Outfall Project

ID	Task Name
1	Project Start
2	**Outfall Structure**
3	Outfall Structure Design Options
4	Hydroelectric Gen Feasibility Study
5	Diffuser Design Development
6	Preliminary Design Report
7	Agency Review/Approval
8	Detailed Design
9	Bidding of Construction Contract
10	**Construction**
11	Submittals
12	Materials Procurement
13	On-Shore Construction
14	In-River Construction
15	Construction Complete
16	**Cooling Water Intake Structure (CWIS)**
17	Cooling Water Intake Structure Design Options
18	Cold Water Intake Modification Plan (CWIP)
19	Agency Review/Approval
20	Detailed Design
21	Bidding Construction Contract
22	**Construction**
23	Submittals/Mobilization
24	Materials Procurement
25	Construction (In River)
26	Construction Complete
27	Permits Applications
28	Level 3 Mixing Zone Study
29	**Topographical and Geotechnical Survey**
30	On-Land Topographical Survey
31	In-River Bathymetric Survey
32	Geotechnical Review (No Field Work)
33	Water Quality Survey



8. Proposed Cost

Proposed cost information is included on the Proposal Price Form for the specific project tasks requested. This form is included as Appendix I.

9. Appendices

The following pages contain supporting content to the proposal sections. The outline of appendix files is as follows:

Appendix A – Outfall Project History

Appendix B – Intake Project History

Appendix C – Hydropower Project History

Appendix D – Hydropower Services Sheet

Appendix E – Section 316(b) Report

Appendix F – Dyno Nobel Effluent Cooling Water Alternative Analysis Cover

Appendix G – Location of Previous Geotechnical Borings Map

Appendix H – Proposed Team Resumes

Appendix I – Proposal Price Form

Appendix A.
Outfall Project History

Jacobs Experience in the Study, Design, and Construction of Outfalls

Name	Client	End Date	Diameter	Outfall Length	Diffuser Length	Depth	Flow	Study and/or Modeling	Design	Services During Construction
Salmon Creek WWTP Outfall and Diffuser	Clark Regional Wastewater District, WA	2020	54 in	18,600 ft	150 ft	40 ft	72 mgd	x	x	x
Portland CBWTP Outfalls 001 & 003 Improvements	Portland Bureau of Environmental Services, OR	2020	84 in	830 ft	360 ft	35 ft	210 mgd	x	x	x
Wilsonville WWTP Outfall and Diffuser	City of Wilsonville, OR	2018	42 in	650 ft	60 ft	25 ft	16 mgd	x	x	x
Kellogg Creek WPCP Outfall Extension and Diffuser	Clackamas County Service District No. 1, OR	2017	48 in	200 ft	80 ft	80 ft	25 mgd	x	x	x
Kapstone Outfall Diffuser Rehabilitation	Kapstone Packaging, Longview, WA	2015	48 in	2,200 ft	320 ft	40 ft	55 mgd	x	x	
Hoodland STF Outfall	Clackamas County Water Environment Services	2014						x		
Corvallis WWRF Outfall Mixing Zone Study	City of Corvallis, OR	2014						x		
Ford Airport Outfall	GR Ford International Airport, Grand Rapids, MI	2013	48 in	175 ft	60 ft	25 ft	30 mgd	x	x	
Clear Creek WWTP Outfall Mixing Zone Study	City of Redding, CA	2013						x		
Tri-Cities WPCP Outfall Diffuser	Clackamas County Tri-Cities Service District, OR	2012	42 in	100 ft	5 ft	15 ft	35 mgd	x	x	x
City of Seaside WWTP Outfall Replacement	City of Seaside, OR	2011	32 in	1050 ft	20 ft	5 ft	1.5 mgd	x	x	x
Heinz Ontario Outfall and Diffuser	H.J. Heinz Co, Ontario, OR	2010							x	
Willow Lake WPCF Outfall Dillusion	City of Salem, OR	2009						x		
New Bankside Outfall	Springfield Metro Wastewater, OR	2008							x	x
Clear Creek WWTP Outfall Replacement	City of Redding, CA	2008							x	
Rock Creek AWWTP Outfall Dilution	Clean Water Services, Tualatin, OR	2007						x		
Boise-St Helens Outfall Extension and Diffuser	Boise White Paper and City of St. Helens, OR	2005	48 in	700 ft				x	x	x
Kingston Outfall Replacement	Kitsap County, WA	2004	42 in	3,500 ft				x	x	x
Centralia WWTP Outfall	City of Centralia, WA	2003	36 in	35 ft	38 ft	5 ft	30 mgd	x	x	x
Rock Creek AWWTP Bankside Outfall	Clean Water Services, Tualation, OR	2003							x	x
Blue Heron Outfall Diffuser Modification	Blue Heron Paper Co, Oregon City, OR	2003						x	x	
Red River Outfall	Weyerhaeer Paper Company, Valiant, OK	2002	48 in	500 ft	160 ft	3 ft	80 mgd	x	x	
Everett (WA) WWTP and Kimberly-Clark Mill Outfall	City of Everett, WA	2002	60 in	10400 ft				x	x	
Durham Treatment Plant Outfall	Clean Water Services, Tualatin, OR	2002							x	
Marine Park WRF Outfall Extension and Diffuser	City of Vancouver, WA	2001	60 in	700 ft	152 ft	10 ft	16 mgd	x	x	x
Ocean Outfall Pearl Harbour	U. S. Navy, HI	2000						x	x	x
Singapore Deep Tunnel Sewerage System	Republic of Singaore	1998	in design	13,124 ft	3281 ft	112 ft	924 mgd	x	x	x
Singapore Deep Tunnel Sewerage System	Republic of Singaore	1998	in design	6,562 ft	4922 ft	98 ft	1270 mgd	x	x	x
Sequim WWTP Outfall	City of Sequim	1997	18 in	1,500 ft	170 ft	50 ft	1.7 mgd	x	x	x
Corvallis WWRF New Diffuser and Bankside Outfall	City of Corvallis, OR	1997							x	
Smith Island Treatment Plant Outfall	Snohomish River Pulp Company	1996	30 in	1,500 ft	200 ft	14 ft	22 mgd	x	x	x

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Jacobs Experience in the Study, Design, and Construction of Outfalls

Name	Client	End Date	Diameter	Outfall Length	Diffuser Length	Depth	Flow	Study and/or Modeling	Design	Services During Construction
Manchester WWTP Outfall Improvements	City of Manchester	1996	12 in	880 ft	--	35 ft	1.5 mgd	x	x	x
Westside WRF Outfall Diffuser	City of Vancouver, WA	1996	60 in	100 ft	150 ft	16 ft	24 mgd	x	x	x
Terminal Island Ocean Outfall	City of Los Angeles	1995	72 in	5,200 ft	787 ft	66 ft	100 mgd	x	x	
WWTP River Outfall Extension	Metropolitan Sewer District	1995	120 in		400 ft		350 mgd		x	
Indtrial Effluent River Outfall Modifications	Weyerhaeer Paper Company	1995				10 ft		x	x	x
Tipalao Bay Ocean Outfall	Duenas and Associates	1994	28 in	1,800 ft		120 ft			x	
Tongass Narrows Ocean Outfall	Ketchikan Pulp Company	1994	48 in		350 ft	165 ft	40 mgd		x	
Texaco Outfall	Texaco A	1994	30 in	300 ft	200 ft	40 ft	14 mgd	x	x	x
Hyperion Ocean Outfall Modifications	City of Los Angeles	1993	144 in	26,248 ft	7874 ft	200 ft	750 mgd			
Hyperion Ocean Outfall Modifications	City of Los Angeles	1993		5,250 ft		500 ft				
Wastewater Reclamation Plant River Diffuser	City of Corvallis	1993			3 ft	12 ft	30 mgd	x	x	
Industrial Effluent River Outfall	Packaging Corp. of America	1993	24 in	200 ft	NA	30 ft	8 mgd	x	x	x
Papermill River Diffuser	Kerwin Paper Company	1992	16 in	NA	50 ft	10 ft	1.5 mgd	x	x	
Tryon Creek WWTP Outfall	City of Portland (Washington County), OR	1992			90 ft			x	x	x
WWTP River Outfall Extension	Hampton Roads Sanitation District	1991	54 in	2,900 ft	648 ft	8 ft	100 mgd		x	
Marine Outfall Extension	City of Newport	1990	24 in	750 ft	10 ft	20 ft	9 mgd	x	x	x
Sand Island Marine Outfall Evaluation	City and County of Honolulu	1990	84 in	10,573 ft	3398 ft	240 ft	200 mgd	x	x	x
WWTP and Outfall	Mount Pleasant Waterworks and Sewer Commission	1989	30 in	4,420 ft	300 ft	35 ft	15 mgd		x	x
Commencement Bay Outfall	City of Tacoma and Parametrix, Inc.	1988	54 in	3,000 ft	300 ft	120 ft	80 mgd		x	
Papermill Outfall	Simpson Timber & Paramatrixs, Inc.	1988	55 in	600 ft	180 ft	65 ft	60 mgd	x	x	
Point Woronzof Marine Outfall Improvement	Anchorage Water and Wastewater Utility	1987	84 in	7 ft			128 mgd	x	x	x
Marine Outfall A	Cape May County Municipal Utility Authority	1987		5,500 ft		2 ft			x	x
Marine Outfall B	Cape May County Municipal Utility Authority	1987		5,500 ft		3.5 ft			x	x
Alki Point Outfall Improvements	Seattle Metro and Parametrix, Inc.	1987	42 in	1,200 ft	250 ft	150 ft	11 mgd	x	x	
Homer Outfall Extension	City of Homer	1987	20 in	2,400 ft	--	10 ft	3.3 mgd	x	x	
Oakport Bay Outfall	East Bay Municipal Utility District, CA	1986	84 in	200 ft	50 ft	10 ft		x	x	x
Southwest Ocean Outfall Diffuser	City and County of San Fransisco & PBQD	1985	3.6 m in	20,600 ft	3060 ft	78 ft	450 mgd	x	x	
Eugene-Spring Rd Municipal Outfall	Eugene-Springfield	1985	96 in	300 ft	90 ft	10 ft	150 mgd	x	x	
Post Point Outfall	City of Bellingham	1984	60 in	1,560 ft	450 ft	76 ft	55 mgd	x	x	x
CloverPoint Outfall Extension	Capital Regional District	1981	48 in	2,600 ft	620 ft	200 ft	40 mgd	x	x	x
Latrobe Valley Ocean Outfall	Latrobe Valley Water Authority, Morwell, Australia	1981						x	x	x
Kenai WWTP Outfall	City of Kenai, AK	1978						x	x	x
Ocean Outfall	Menasha Paper Company, OR	1973	30 in	4700 ft	500 ft	65 ft	20 mgd	x	x	x
Ocean Outfall extension	Georgia Pacific Corporation, OR	1966	42 in	3800 ft				x	x	x

Appendix B.
Intake Project History

Selected Jacobs Water Intake Project Experience

Owner	Project	Waterbody	Intake Type	Capacity (cfs)	Capacity (MGD)	Year Constructed	Study/ Preliminary Design	Final Design/ Construction	SDCs	Structural	Geotech
Colorado Springs Utilities	Southern Delivery System - Arkansas River Intakes	Arkansas River, CO	Flat panel screens in slant configuration	121	78	N/A	X			X	X
Idaho Power Company	Pine Creek	Pine Creek, ID				N/A	X				
Oregon LNG	Deluge Fire Suppression System Intake Structure	Columbia River, WA		60.2	39	N/A	X			X	X
PacifiCorp	Klamath Hydroelectric Relicensing	Klamath River, OR and CA	Various screening technologies	Various	Various	N/A	X				
U.S. Army Corp of Engineers (USACE)	Lookout Point Head of Reservoir Collection Alternatives	Middle Fork Willamette River, OR	Various screening technologies	1,000	646.4	N/A	X				
USACE	Bonneville Second Powerhouse FGE Program	Columbia River, WA/OR	Vertical barrier screen	8 each at 469	8 each at 303	N/A	X				
U.S. Bureau of Reclamation	Leavenworth National Fish Hatchery	Icicle Creek, WA	Flat panel screens in slant configuration	50	32.3	N/A	X				
PacifiCorp	Soda Springs	N. Umpqua River, OR	Vee Screen	1,600	1,034	2012 (By others)	X				
Port Angeles, City of	Port Angeles Water Intake	Elwha River, WA	1) Trashrack diversion with tunnel to flat panel screens in vee configuration. 2) Cylindrical screens with mechanical brush system.	150 and 67	97 and 43	2008 (by others)	X				
Joint Water Commission	Spring Hill Pumping Plant	Tualatin River, OR	Evaluating various alternatives. Existing is trashrack with traveling screens.	133	86	1977 (by others)	X				
Englishman River Water Service	Englishman River Intake and Pump Station	Englishman River, BC, Canada	Flat panel screens in slant configuration	19.8	12.8	2018	X	X	X	X	X
Lower Colorado River Authority	Lower Basin Reservoir Project	Colorado River, CO		561	363	2017	X	X	X	X	X
Abbotsford Mission Water & Sewer Commission	Stave Lake Intake	Stave Lake on Stave River, BC, Canada	4 each 54-inch-diameter tee screens	186	120	2015		X		X	X

Selected Jacobs Water Intake Project Experience

Owner	Project	Waterbody	Intake Type	Capacity (cfs)	Capacity (MGD)	Year Constructed	Study/ Preliminary Design	Final Design/ Construction	SDCs	Structural	Geotech
Teck Coal	Stream intakes for selinum removal	Fording River near Sparwood, BC	Flat panel screens in slant configuration	2 each at 6	2 each at 3.9	2015	X	X	X		
Orofino, City of	WTP Intake	Clearwater River, ID	Flat panel screens in slant configuration with air backwash	4	2.6	2014	X	X			
Salt Lake City	Creek Side Intake, Big Cottonwood WTP	Big Cottonwood Creek, UT	Coanda	70	45	2014	X	X	X	X	X
USACE	Foster Dam Adult Fish Facility	S. Santiam River, OR	Slant trashrack	166.5	107.6	2014	X	X	X	X	X
USACE	Foster Dam Adult Fish Facility	Foster Reservoir, OR	Louver rack in power intake	127.4	82.4	2014	X	X	X	X	X
Idaho Power Company	Oxbow Hatchery Intake	Hells Canyon Dam Pool (Snake River, ID/OR)	Tee screens	18	12	2013	X	X	X	X	X
Colorado Springs Utilities	Southern Delivery System - Pueblo Reservoir Intake	Arkansas River, CO		139	90	2012	X	X	X	X	X
Natomas Mutual Water Company	Sankey Intake	Sacramento River, CA	Vertical flat panel with brush	434	281	2012	X	X	X	X	X
USBR	Little Creek Diversion (designing adjacent fish ladder and diversion dam and accommodating design by ODF&W for fish screens)	Little Creek, OR	Traveling screens	2 each at 4	2 each at 1.3	2012	X	X	X	X	X
Chelan Public Utility District (PUD)	Chelan Falls Rearing/Acclimation Facility	Chelan Powerhouse Tailrace, Chelan River, WA	Tee screens mounted on slant submersible pump tubes	21.8	14.1	2011	X	X	X	X	X
Chelan PUD	Chelan River Tailrace Pump Station	Chelan Powerhouse Tailrace, Chelan River, WA	Tee screens mounted on slant submersible pump tubes	250	162	2009	X	X	X	X	X
Creswell, City of	Creswell WTP and Intake	Coast Fork of the Willamette River, WA	Flat panel screens in slant configuration	5	3	2009	X	X	X	X	X

Selected Jacobs Water Intake Project Experience

Owner	Project	Waterbody	Intake Type	Capacity (cfs)	Capacity (MGD)	Year Constructed	Study/ Preliminary Design	Final Design/ Construction	SDCs	Structural	Geotech
Portland General Electric	Round Butte Selective Water Withdrawal Intake	Lake Billy Chinook, Deschutes River, OR	Multi-level with vee screens and flat plate screens	16,612	10,738	2009	X	X	X	X	X
Sutter Mutual Water Company	Tisdale Positive Barrier Fish Screen and Pumping Plant	Sacramento River, CA	Flat panel screens in vertical configuration	960	621	2009	X	X	X	X	X
Santa Fe, City of	Buckman Direct Diversion Project	Santa Fe River, NM	Flat panel screens in slant configuration.	32.5	21	2008	X	X	X	X	X
Tarrant Regional Water District, Ft. Worth, TX	Eagle Mountain Raw Water Intake and Pump Station	Lake Georgetown, Trinity River, TX	Tower	325	210	2008	X	X	X	X	X
Xcel Energy	Highbridge Combined Cycle Plant	Mississippi River, MN	Tee screens	312	202	2008	X	X	X	X	X
Regional Municipality of Ottawa-Carleton, Ottawa	Britannia Water Treatment Plant Intake	Ottawa River, ON	Down-turned elbows with bell inlets	149	96	2007		X		X	X
Regional of Peel, Ontario Clean Water Agency	Lakeview WTP Intake	Lake Ontario, ON, Canada (St. Lawrence and Niagara Rivers)	Steel intake plenum and vertical traveling screens	470	304	2007		X		X	X
Southern Nevada Water Association	Lake Mead Intake No. 2	Lake Mead, Colorado River, NV		1,238	800	2007		X		X	X
Albany, City of	Albany Diversion Dam and Fish Screen	S. Santiam River, OR	Vee screen canal intake	260	168	2006	X	X	X	X	X
Brushy Creek Municipal Utility District	Brushy Creek Water Facility	Lake Georgetown, TX	Tee screens	15.5 expandable to 30.9	10 expandable to 20	2005	X	X	X	X	X
FRWA	Freeport	Sacramento River, CA	Flat panel screens in vertical configuration	340	220	2005	X	X	X	X	X
Reclamation District No. 108	Emory Poundstone Combined Pumping Plant Intake	Sacramento River, CA	Flat panel screens in vertical configuration	300	194	2005	X	X	X	X	X
Redding, City of	Pump Station No. 1 Intake	Sacramento River, CA	Tee	45	29	2005	X	X		X	
Salt Lake City and Sandy, UT	Little Cottonwood Creek	Little Cottonwood Creek, UT	Coanda	60	39	2005	X	X	X	X	X

Selected Jacobs Water Intake Project Experience

Owner	Project	Waterbody	Intake Type	Capacity (cfs)	Capacity (MGD)	Year Constructed	Study/ Preliminary Design	Final Design/ Construction	SDCs	Structural	Geotech
Alberta Transportation	Little Bow River Project	Highwood River/Little Bow Canal, AB, Canada	Louver rack	300	194	2004	X	X	X	X	X
FRICO	Standley Lake Intake	Standley Lake, CO (Offline storage from Clear Creek)	Micro-tunneled Multi-Level	2 each at 300	2 each at 194	2004	X	X	??	X	X
Seattle Public Utilities	Cedar - Lake Youngs Intake	Lake Youngs, WA	Multi-Level	278	180	2004		X		X	X
Sacramento Municipal Utility District	Sacramento River Intake	Sacramento River, CA	Flat panel screens in vertical configuration	252	163	2003	X	X	X	X	X
Anderson-Cottonwood Irrigation District	Fish Screen and Fish Ladder Project	Sacramento River, CA	Vee screen canal intake	450	291	2001	X	X	X	X	X
Reclamation District No. 108	Wilkins Slough	Sacramento River, CA	Flat panel screens in vertical configuration	830	537	1999	X	X	X	X	X
Glenn-Colusa Irrigation District	Fish Screen Improvement Project	Sacramento River, CA	Flat panel screens in vertical configuration	3,000	1,939	1998	X	X	X	X	X
Bonneville Power Administration	Cle Elum Hatchery	Yakima River, WA	Tee screens	33 expandable to 72	21 expandable to 47	1996	X	X	X	X	X
Bonneville Power Administration	Jack Creek Rearing/Acclimation Facility	Teanaway River, WA	Flat panel screens in slant configuration	11	7	1996	X	X	X	X	X
Bonneville Power Administration	Easton Rearing/Acclimation Facility	Yakima River, WA	Flat panel screens in slant configuration	11	7	1996	X	X	X	X	X
Bonneville Power Administration	Clark Flat Rearing/Acclimation Facility	Yakima River, WA	Tee screens	11	7	1996	X	X	X	X	X
El Paso, City of	John Rogers WTP Upgrades	Rio Grande River via Riverside Canal, TX	Trashracks	92.8	60	1993	X	X	X	X	X
Chelan PUD	Dryden Rearing/Acclimation Facility	Dryden Canal, Wenatchee River, WA	Flat panel screens in slant configuration on canal			1990	X	X	X	X	X
Chelan PUD	Chiwawa Rearing/Acclimation Facility	Chiwawa River, WA	Tee screens	21	14	1990	X	X	X	X	X

Selected Jacobs Water Intake Project Experience

Owner	Project	Waterbody	Intake Type	Capacity (cfs)	Capacity (MGD)	Year Constructed	Study/ Preliminary Design	Final Design/ Construction	SDCs	Structural	Geotech
Chelan PUD	Chiwawa Rearing/Acclimation Facility	Wenatchee River, WA	Tee screens	12	8	1990	X	X	X	X	X
Chelan PUD	Carlton Rearing Acclimation Facility	Methow River, WA	Tee screens	14.9	9.6	1990	X	X	X	X	X
Chelan PUD	Similkameen Rearing/Acclimation Facility	Similkameen River, WA	Tee screens	21.4	13.8	1990	X	X	X	X	X
Chelan PUD	Dryden Right Bank Fishway	Wenatchee River, WA	Trashrack AWS intake			1986		X		X	X
Chelan PUD	Dryden Left Bank Fishway	Wenatchee River, WA	Trashrack AWS intake			1986		X		X	X
Chelan PUD	Dryden Canal	Wenatchee River, WA	Flat panel screens in diagonal configuration for canal headworks	230	149	1986		X		X	X
Yakima-Tieton Irrigation District	French Canyon Reservoir Intake	French Canyon Reservoir, Cowiche Creek, WA	Tee screens	387	250	1983		X		X	X
Port Angeles, City of	Port Angeles Water Intake	Elwha River, WA	Rainey-type collector	17	11	1977		X		X	X
A&B Irrigation District	Lake Walcott Groundwater Recharge Project	Lake Walcott (Snake River, ID)	Evaluating flat panel, tee, cone, and traveling screens	100	65		X				
Alameda County Water District, Flood Control District & Water Conservation Districts	Conceptual Fish Passage Designs and Cost Estimates for Lower Alameda Creek	Lower Alameda Creek, CA	Various screening technologies	Various	Various		X				
Albany-Millersburg Joint Water Project	South Santiam Intake	S. Santiam River, OR		9	6			X		X	X
Atlanta, City of	Chattahoochee Complex Pump Station Renovations	Chattahoochee River, GA	Traveling screens	312	202			X		X	X
Austin, City of	Lake Travis Intake	Lake Travis, TX						X		X	X
Bellingham, City of	WTP Intake	Lake Whatcom, WA	Various screening technologies	151.6	98		X				
Boardman, City of	Boardman Water Systems Improvements	Columbia River, OR	Horizontal collector well	20	13			X		X	X
Buckland, Town of	Buckland River Intake	Buckland River, AK	Rainey-type collector	0.1	0.06			X		X	X

Selected Jacobs Water Intake Project Experience

Owner	Project	Waterbody	Intake Type	Capacity (cfs)	Capacity (MGD)	Year Constructed	Study/ Preliminary Design	Final Design/ Construction	SDCs	Structural	Geotech
Central Utah Water Conservancy District	Head of the U										
Centralia, City of	Yelm Hydroelectric Plant Intake	Nisqually River, WA via power canal	Flat panel screens in diagonal configuration	800	517			X		X	X
Chelan PUD	Tumwater Fishway	Wenatchee River, WA	Trashrack AWS intake					X		X	X
Chelan PUD	Rocky Reach Juvenile Bypass System	Columbia River, WA	Vee screens	6,000	3,878			X		X	X
Clackamas River Water	Clackamas River Water WTP Intake	Clackamas River, OR		49	32			X		X	X
Colorado Springs Utilities	Homestake Diversion Dam and Intake	Arkansas River, CO	Flat panel screens in slant configuration	170	110		X			X	X
Colorado Springs Utilities	Fountain Creek Recovery Project - Fountain Creek Intake	Fountain Creek, CO	Trasjrack	170	110			X		X	X
Colorado Springs Utilities	33rd Street Pump Station and Intake	Fountain Creek, CO	Trashrack	14	9		X				
Colorado Springs Utilities	Pikeview Intake	Monument Creek, CO	Slide gate	30.06	19.42		X				
Contra Costa Water District	Los Vaqueros Pump Plant Intake	Old River, CA	Lateral intake	300	194						
Deschutes Valley Water District	Opal Springs Hydroelectric Project	Deschutes River, OR	Slant trashrack	1,800	1,164		X	X		X	X
Dominion	Brayton, Bremo, Chesapeake, Chesterfield, Kewaunee, Kincaid, Manchester, Millstone, Morgantown, Mt. Storm, North Anna, Possum Point, Salem Harbor, State Line, Surry, Yorktown	Various	Various thermal power plant cooling water intake structures		115 to 2708		X				
Dow Chemical	Institute, Plaquemine Facility, Taft Facility, Texas Operations, Midland Operations, West Virginia Operations, Louisville	Various	Various thermal power plant cooling water and process waterintake structures		26 to 871 MGD		X				
Dow Chemical	Harris Expansion (TXO)	Brazos River, TX	Two 84-inch-diameter tee screens with mechancial brush system	334.2	216		X				
Dyno Nobel	St. Helens Facility	Columbia River, OR	Vertical traveling screen	46.4	30		X				

Selected Jacobs Water Intake Project Experience

Owner	Project	Waterbody	Intake Type	Capacity (cfs)	Capacity (MGD)	Year Constructed	Study/ Preliminary Design	Final Design/ Construction	SDCs	Structural	Geotech
Eastern New Mexico Rural Water Authority	Ute Reservoir Intake	Ute Reservoir, NM		43.3	28		X				
Eugene Water and Electric Board	Carmen-Smith License Implementation, Trail Bridge Surface Collector	McKenzie River, OR	Vee Screen	2,000	1,293			X		X	X
Forsysth County	Lake Lanier Intake	Lake Lanier, GA						X		X	X
Four Dam Power Pool Agency	Kodiak Terror Lake Intake							X		X	X
Frontier Technology	Falls Creek Hydropower	Falls Creek, OR	Coanda	15	10						
General Electric Aviation	Lynn Cooling Water Intake Structures	Saugus River, MA	Various screening technologies	Various	Various		X				
Golden Valley Electric Association	EPA 316b Evaluations	Nenana River, AK	Trashrack with vertical traveling screens	268 and 122	173 and 79		X				
Grants Pass Irrigation District	Fish Screen/Pump Station	Rogue River, OR	Flat panel screens in vertical configuration	149.26	96.5		X				
Henry Miller Reclamation District	Arroyo Canal Fish Screen and Sack Dam Fish Passage	San Joaquin River, Firebaugh, CA	Vertical plate screen in vee configuration	700							
Houston		Reservoir, TX			480						
Idaho Power Company	Rapid River Hatchery Intatake	Rapid River, ID	Trashrack and flat panel screens in vertical configuration	58.3	38		X			X	X
Lebanon, City of	S. Santiam WTP Intake	S. Santiam River, OR	Flat panel screens in slant configuration	22	14		X				
Lincoln City	Schooner Creek Intake	Schooner Creek, OR		9	6			X		X	X
Longmont, City of	Resiliant St. Vrain Project	St. Vrain Creek, WA	Trashrack	Various, 20 cfs	12.9		X	X		X	X
Metro Vancouver	Coquitlam Intake No. 2	Coquitlam Lake, WA	Selective withdrawal TBD					X		X	X
Natomas Mutual Water Company	Elkhorn Intake	Sacramento River, CA	Flat panel screens in slant configuration with air backwash	210	136			X		X	X
Natomas Mutual Water Company	Pritchard Intake	Sacramento River, CA									

Selected Jacobs Water Intake Project Experience

Owner	Project	Waterbody	Intake Type	Capacity (cfs)	Capacity (MGD)	Year Constructed	Study/ Preliminary Design	Final Design/ Construction	SDCs	Structural	Geotech
North Wasco PUD	Dalles Northshore Fishway Hydroelectric Project	Columbia River, WA	Flat panel screens in diagonal configuration	800	517			X		X	X
PacifiCorp	Dave Johnston, Gadsby, Hunter, Huntington, Jim Bridger, Naughton	Various	Various thermal power plant cooling water intake structures				X				
Port Townsend, City of	Little Quilcene Diversion Reconstruction and Improvements	Little Quilcene River, WA	Flat panel screens in vertical configuration					X		X	X
Reedsport, City of	Reedsport potable water intake	Clear Lake, OR	Tee screens, slant tube submersible pumps	16	10		X	X		X	X
Regional District of Central Kootenay	Arrow Creek Membrane WTP	Settling pond near Creston, BC	Tee screen	12	7.9		X	X		X	X
Regional of Municipality of Niagara	Grimsby Water Treatment Plant Intake	Lake Ontario, ON, Canada (St. Lawrence and Niagara Rivers)	Steel plenum	17	11			X		X	X
Regional of Peel, Ontario Clean Water Agency	Lorne Park Water Treatment Plant Intake	Lake Ontario, ON, Canada (St. Lawrence and Niagara Rivers)	Steel plenum	93	60			X		X	X
Richland Chamber Wetlands	Trinity River Intake Facility		Tee screens	140	90						
Salt Lake City	City Creek	City Creek, UT	Coanda	30	19						
Skagit PUD	Judy Reservoir Intake	Skagit River / Judy Reservoir, WA						X		X	X
Snohomish PUD	Sunset Falls Hydroelectric Project	Skykomish River, WA	Vee Screen	2,500	1,616		X				
Southern Nevada Water Association	Lake Mead Intake No. 3	Lake Mead, Colorado River, NV		1,030	666			X		X	X
Stockton East Water District	Diversion Dam, Fishway and Intake at Bellota	Calaveras River, CA	Flat panel screens in slant configuration	275	178		X				
Stockton East Water District	Fish Screen Facilities at Multiple Landowner Pumps	Calaveras River, CA	Retrievable tee and slant screens	1 to 10	0.6 to 6.5		X				
Tarrant Regional Water District, Ft. Worth, TX	Wetlands Water Reuse Project	Trinity River, TX	Drum screens	139	90		X	X			
Tarrant Regional Water District, Ft. Worth, TX and	Joint Cedar Creek Lake Pump Station and Intake	Cedar Creek Reservoir, TX	Six ISI tee screens	428.5	277		X			X	X

Selected Jacobs Water Intake Project Experience

Owner	Project	Waterbody	Intake Type	Capacity (cfs)	Capacity (MGD)	Year Constructed	Study/ Preliminary Design	Final Design/ Construction	SDCs	Structural	Geotech
Dallas Water Utilities, Dallas, TX											
Tehama-Colusa Canal Authority/USBR	Fish Passage Improvement Project at the Red Bluff Diversion Dam	Sacramento River, CA	Flat panel screens in vertical configuration	2,500	1,616			X		X	X
Town of Cary, NC	B Everett Jordan Lake Intake		Tee Screens	77	50			X		X	X
Unalaska, City of	Icy Creek Reservoir, AK							X		X	X
USACE	Nursery Bridge Fishway - AWS Intake	Walla Walla River, WA						X		X	X
USACE	John Day ITS	Columbia River, WA/OR		2,495	1,613						
Walton County Water and Sewage Authority	Hard Labor Creek Reservoir Raw Water Intake		Tee screens	2 each at 23	2 each at 35						
Weyerhaeuser	Springfield Mill - McKenzie River Intake	McKenzie River, OR	Flat panel screens in slant configuration	80	52		X			X	X
Xcel Energy	Black Dog Power Station	Minnesota River, MN		498	322		X				

Appendix C.
Hydropower Project History

Client	Project Timeline	Project Description
City of San Diego Public Utilities Department	March 2015 – February 2016	**Operations Optimization Program Small-scale Hydro Energy Recovery Project –** Jacobs performed an initial site investigation and feasibility study of 8 potential hydropower projects ranging from 20 kW to 1.2 MW within the City's water distribution system. Potential sites included Water Treatment Plants, Wastewater Treatment Plants, and Pressure Reducing Stations. A more detailed review was then conducted for two of the sites.
PUD No. 1 of Snohomish County, Everett, Washington	2014 to present	**Sunset Fish Passage and Clean Energy Project** – As part of its commitment to the environment and the reduction of greenhouse gases, The PUD is pursuing the development of clean, renewable energy resources, including low-impact hydropower, in lieu of traditional fossil fuel–based energy resources. Following a review of more than 140 potential hydropower sites in western Washington, the District identified Sunset Falls on the South Fork Skykomish River as the best opportunity to develop a substantial amount of generation in an environmentally friendly, cost-effective and socially-acceptable manner. The 30-MW Sunset Fish Passage and Clean Energy Project is the largest project currently under development by the District and is part of a comprehensive program that includes energy conservation in conjunction with the development of tidal, solar, biomass and geothermal energy resources. Jacobs was selected by the District in January 2014 to provide preliminary design, final design and services during construction for this hydropower project. The project includes a 2,500-cfs (1,600-mgd) river intake, fry criteria fish screens with a bypass, approximately 2,300 feet of hard rock tunnel up to 30 feet in diameter, and an underground powerhouse with two 15-MW units. Key components are an innovative river intake that eliminates the need for a diversion weir (while also minimizing aesthetic impacts), and re-location of the fish screen facility away from the river to eliminate the need for a large rock cavern. The 90-foot-tall Sunset Falls is a natural barrier to upstream fish passage; however, ESA-listed fish including Chinook salmon, steelhead and bull trout have been trapped and hauled above the falls since 1958 to facilitate access to 100 miles of formally inaccessible habitat. More than 124,000 fish were transported in 2009 by the Washington Department of Fish and Wildlife (WDFW), making this one of the most successful trap-and-haul operations in the Pacific Northwest. Jacobs has been working with the District since 2009 to design comprehensive upgrades to this rapidly deteriorating facility, and it is anticipated that the upgrades will serve as part of the project protection, mitigation and enhancement measures. Jacobs will also provide general support for the Federal Energy Regulatory Commission (FERC) permitting process, a Stream Power and Debris Study, and a Transportation Impact Analysis. The Phase I preliminary design and studies were completed in 2014. Total construction cost is approximately $130M.
Central Utah Water Conservancy District, Utah	October 2014 – present	**Diamond Fork System Power Development –** Jacobs Is providing all engineering and environmental services for the planning, feasibility assessment, and possible lease of power privilege (LOPP) proposal for the development of the hydropower potential of this conveyance system. The Diamond Fork System includes reservoirs, intakes, tunnels, shafts, pipelines, and flow control structures, as part of the Central Utah Project. The development of hydropower potential at two sites, with available heads of 1,250 and 540 feet respectively, could produce installed capacity of up to 45 MW. The work includes condition assessment of existing conveyance facilities, analysis of hydrology and hydraulics, assessment of environmental issues, generating unit selection, development of power plant alternatives, analysis and planning of transmission alternatives, feasibility assessment, and possible preparation of a LOPP proposal.
Central Utah Water Conservancy District, Utah	August 2013 – September 2018	**Olmsted Power plant Replacement -** Jacobs provided a full range of engineering services for the development of a new power plant at the Olmsted site. Generation will be federal power, under agreements with the U.S. Department of Interior and the Western Area Power Administration. Final feasibility analyses, NEPA compliance assistance, energy analysis, and preliminary design were completed in 2015, followed by selection and specification of the main generating units. Procurement services and technical contract administration for the generating units and main transformer were provided. Jacobs provided final design of all facilities, including pipeline spillway structure, upgraded power tunnel, surge structure, penstock, main power plant, substation, and underground transmission line. The power plant houses 7.8- and 3.2-MW units, along with two micro-hydro units rated 298 and 186 kW. Total flow capacity is 430 cfs under a 360-foot head. Jacobs assisted the District in developing and negotiating a utility interconnection agreement and provided technical coordination of the protection and controls. Jacobs also provided engineering support throughout construction and conducted commissioning, which was completed in July 2018. Jacobs is now assisting the District in the rehabilitation of the original power plant facilities for interpretive programs at the historic site.
Portland General Electric, Portland, Oregon	July 2013 – December 2013	**Harriet Powerhouse Hydroelectric Project** – Jacobs prepared a basis of design report, penstock surge analysis, and procurement specifications for a single, 700 kW, Francis-type turbine-generator to operate on minimum streamflow releases on an existing PGE project. Unit rating was 100 cfs under a net head of 95 feet.
Metropolitan Water District of Southern California, Los Angeles, California	June 2013	**Value Engineering Study of Wadsworth Pump-Turbine Plant Control and Protection System Upgrade -** The Wadsworth Plant houses twelve 3.3-MW, 6.9-kV pump-turbines and is the larger of Metropolitan's two pumped-storage facilities. With Diamond Valley Lake, the multipurpose facility provides for water interchange among the State Water Project, the Colorado River Aqueduct, and the San Diego Canal. The multiple modes of operation and the large LCI drive systems require a complex, networked system of controls and protection that is now due for upgrade and replacement. Jacobs conducted a VE study of the planned program of drive, PLC, network, and protective relaying improvements. The team included MWD and Jacobs staff.
North Side Canal Company, Jerome, Idaho	May 2013 – April 2015	**Head-of-the-U Hydropower Project -** On the basis of the 2012 feasibility investigation and the Canal company's plan to replace and upgrade the existing dam and control structure that serves the M, R, U, and P canals, Jacobs re-evaluated this site's development plan and developed a feasible approach. Jacobs then prepared the final design for the fast-track demolition and reconstruction of the dam/control structure during the winter of 2013-2014. Provisions for the installation of eight 150 kW hydropower units were included. The design of the power plant was based upon an operating flow of 1,200 cfs under a net head of 18 feet. Jacobs then assisted the Canal Company with the utility interconnection application and utility negotiations. Generating equipment procurement was conducted in the spring of 2014 and final design was completed in the summer of 2014. Construction and turbine-generator installation were completed in March 2015, with commissioning completed in April 2015.
North Side Canal Company, Jerome, Idaho	April 2013 – present	**3 North/3 East Hydropower Project** - On the basis of the 2012 feasibility investigation, Jacobs refined this site's development plan, prepared utility interconnection application and has assisted the Canal Company in utility negotiations. Documents to support FERC license exemption application work have also been prepared. Design work is pending.

Client	Project Timeline	Project Description
Metropolitan Water District of Southern California, Los Angeles, California	December 2012	**Yorba Linda Hydropower Project Constructability Review** - The project includes the procurement and installation of a new 5.3 MW turbine-generator unit at the Yorba Linda Power Plant at the Diemer Water Treatment Plant. Jacobs conducted site investigations and review in collaboration with Metropolitan staff, identifying improvements in design and approach in order to facilitate this difficult rehab and plant modification to replace a vertical impulse-type unit with a Francis-type unit at the treatment plant's influent pressure control structure.
City of Fort Collins, Colorado	February 2012 – present	**Fort Collins WTP Hydropower Project -** Jacobs prepared a feasibility evaluation of hydropower development on the raw water supply to the Water Treatment Facility. A hydroturbine would be installed in parallel with twin sleeve-type pressure dissipating valves. An installed capacity of 75 kW is anticipated, operating at 6.6 cfs under a net head of 193 feet. The assessment included a preliminary installation concept, and analyzed technical feasibility and constructability, as well as presented an overview of institutional requirements. Preliminary interconnection negotiations were also conducted with the serving utility. Jacobs assisted the City in the preparation and submittal of the FERC Conduit Exemption application, which has been accepted as of May 2014. Equipment procurement and final design were completed in 2018. Construction was completed in March 2019, with commissioning planned for April 2019.
Twin Falls Canal Company, Twin Falls, Idaho	January 2012 – present	**Feasibility investigation of the Winter Spill hydropower site -** Jacobs assisted the canal company in evaluating the feasibility of the site, which is located at the end of the existing High Line Canal and may develop an installed capacity of 1 MW under a net head of 60 feet.
North Side Canal Company, Jerome, Idaho	October 2011 – February 2012	**Feasibility evaluation of several sites on the irrigation conveyance system -** Jacobs re-evaluated the technical and institutional feasibility of several low-head sites, ranging in installed capacity from 1 to 9 MW, with design flows from 250 to 1,600 cfs. On that basis of this investigation, two projects were further analyzed with refined development concepts providing capacities of 1.1 and 4.8 MW, operating under net heads of 25 and 90 feet.
Southeastern Colorado Water Conservancy District and Colorado Springs Utilities, Colorado	August 2011 - 2015	**Pueblo Dam Hydroelectric Project -** Jacobs conducted a feasibility analysis and preliminary design for a 5 MW hydroelectric power plant addition at Pueblo Dam. A Lease of Power Privilege proposal was prepared and submitted in October 2011. SECWCD and CSU were selected as the potential lessee by the U.S. Department of Interior in early 2012. Jacobs has provided feasibility validation and assistance during negotiation of lease of power, power sales, and interconnection agreements. A preliminary design report, including drawings and draft equipment procurement specifications were prepared in 2014.
Central Utah Water Conservancy District, Utah	June 2011 – February 2012	**Spanish Fork River Flow Control Structure Hydropower Project -** Jacobs conducted feasibility evaluation and preliminary design of a hydropower addition at the Spanish Fork River Flow Control Structure. A Lease of Power Privilege proposal was prepared and submitted in October 2011. The District was selected as potential lessee by the U.S. Department of Interior.
Northern Colorado Water Conservation District, Colorado	April 2011 – March 2015	**Feasibility investigation and engineering services for hydropower addition at Granby Dam, Colorado** - Development of outlet works modifications and new power plant at an existing Reclamation dam. Installed capacity is 1.2 MW. The project was developed under a Lease of Power Privilege proposal accepted by the U.S. Department of Interior in August 2011. Jacobs provided equipment selection, preliminary design, cost and energy production estimates, and evaluation of institutional and interconnection requirements. Final design for the new power plant, housing twin 600 kW units, was completed in March 2015. Construction of the new power plant began in mid-2015 and was commissioned in May 2016.
City of Las Vegas Water Pollution Control Facility, Nev.	March 2011	**Chlorine Contact Basin Hydropower Development** - Prepared preliminary design and conducted feasibility analysis of low-head hydropower installation at the basin's outfall at this wastewater treatment facility, including hydrology and hydraulics, equipment selection, energy production, interconnection, permitting and institutional factors, and economic feasibility. The 20-kW unit was rated for 60 cfs under a net head of 6 feet.
Eugene Water & Electric Board, Oregon	2010 – 2013	**Hydropower Plant Upgrade and Refurbishment, Carmen Powerhouse-Carmen-Smith Hydroelectric Project -** As part of a project-wide program of fish passage and power plant improvements, Jacobs provided a program of upgrades and refurbishment of the 110-MW Carmen Powerhouse. The work included upgrade of two 55-MW Francis-type turbine-generators and governors, the procurement and installation of fixed-cone-type bypass and butterfly-type turbine-isolation valves. The balance-of-plant improvements included complete upgrade of all auxiliary systems, including switchgear and controls. EWEB has not yet proceeded with the project.
City of Hillsboro, Oregon	September 2010 – September 2013	**Will Crandall Reservoir and Pump Station Hydropower Evaluation and Design** - Provided preliminary and final analyses of a hydropower addition at a new water supply reservoir and pumping station where water is delivered under excess pressure from a regional transmission main. Analysis elements included hydrology and hydraulics, equipment selection, energy production, interconnection, permitting, and institutional factors. Equipment was selected and specified for procurement and installation under a CM/GC construction program for the overall facilities. The hydroturbine's rating is 93 kW, operating at 2.45 MGD under a net head of 317 feet. Final design of the facilities was completed in late 2011, followed by construction and equipment procurement services. Jacobs also assisted the city in the preparation and submittal of the required conduit exemption application to the Federal Energy Regulatory Commission for exemption from licensing. Equipment installation was completed in August 2013, with commissioning and utility interconnection approval successfully completed in September 2013.
Rockwood PUD, Portland, Oregon	July 2010	**Micro-hydro Feasibility Assessment** - Jacobs completed feasibility evaluations of three sites where the district receives water from a transmission pipeline. Potential installed capacities ranged up to 150 kW.
Alexandria Sanitation Authority, Virginia	June 2010	**Biological Reactor Basin Outfall Hydropower Investigation -** Conducted preliminary analysis of low-head hydropower installation at the basin's outfall at this wastewater treatment facility, including hydrology and hydraulics, equipment selection, energy production, interconnection, permitting and institutional factors, and economic feasibility. The 150-kW unit was rated for 150 cfs under a net head of 13 feet.
City of Spokane, Washington	June 2010 – April 2011	**Wastewater Treatment Plant Outfall – Hydropower Investigation -** Conducted preliminary and final analyses of low-head outfall site with installed capacity of 250 kW, including hydraulics, equipment recommendations, energy production, and overall feasibility. The single Kaplan unit was rated at 125 cfs under a net head of 27 feet. Final analysis included preliminary design for plant improvements program.
Central Utah Water Conservancy District, Utah	February 2010 – December 2012	**Olmsted Power Plant Evaluation and Upgrade -** Conducted the evaluation of an historic hydroelectric power plant, including condition assessments, and development of plans for improvements with group of governmental and private stakeholders. The existing plant houses three generating units, rated 2.5, 2.5, and 5.5 MW, discharging a total of 450 cfs under a net head of 326 feet. The results of the investigations, including alternative development approaches, were submitted for consideration by the District and Reclamation for long-term project planning.

Appendix D.
Hydropower Services Sheet

Hydropower Services

Delivering technical excellence and innovation for more than 100 years

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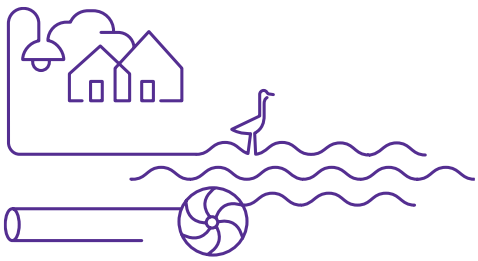
CH2M offers the full range of hydropower project services, from planning to final design, commissioning, plant operation and condition assessments at existing facilities. Services can be delivered alone or together with the total suite of scientific, regulatory/licensing, economic and public involvement services necessary to develop the hydroelectric potential of water resources, conveyance systems and treatment facilities.

We work with all types of projects and clients, including new installations, rehabilitations and upgrades, additions at federal dams, micro-hydro developments and additions on irrigation/municipal water systems.

Very low head siphon turbine application on irrigation infrastructure, Idaho



Engineering Design Services

- Technical professionals in all disciplines – Hydraulics, Hydrology, GIS, Geotechnical, Civil, Structural, Architectural, Mechanical, Electrical, Instrumentation & Controls
- Site selection and feasibility
- Economic and financial analyses
- Preliminary design and equipment selection
- Equipment specification and procurement
- Preparation of budgetary cost estimates
- Final design including 3D modeling
- Construction phase services
- Commissioning

Construction Management

- Resident engineer services
- Construction administration
- Onsite inspection and field testing for all technical disciplines
- Shop drawing, submittal review and preparation of record documents

Environmental Services

- Environmental Assessment (EA) preparation
- Fisheries (Fish passage facilities)
- Wildlife and endangered species
- Water quality
- Water rites evaluations and applications
- Site restoration

Conveyance and Storage at CH2M

Condition Assessment and Rehabilitation

Conveyance Design

Corrosion Engineering

Dams and Levees

Hydropower

Wastewater Collection and Wet Weather

Water Distribution

Control System Design and Integration

- Design – performance specifications, control system documents
- Information technology and telemetry
- Simulation, testing and commissioning
- Hardware and Software engineering
- Field technical services
- Installation and Startup support
- SCADA integration and upgrades
- Cyber security consulting

Operations & Maintenance Consulting

- Large and small hydro plant & project operations management
- Staffing plans, plant operations management, operating budgets
- Best hydropower maintenance practices (Plant Equipment Condition Assessment and Age Tracking)
- Hydro plant operations auditing for NERC compliance
- Operations procedures and O&M manual writing
- Hydropower industrial safety and compliance
- Regional coordination with In-Water-Work Windows (Hydro & Fisheries)

Regulatory Support

- FERC license process – TLP, ALP and ILP
- Small hydro Qualifying Facility and Exemption processes
- License amendments
- Utility interconnection and power sales agreement support

Facilities Rehabilitation

- Condition and operational assessment of existing facilities and equipment
- Powerhouse retrofit consultation and design
- Fire detection system assessments and upgrades
- Dive operations coordination and water based construction safety

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About CH2M
CH2M is a global engineering and project delivery company partnering with public and private clients to tackle the world's most complex infrastructure and natural resource challenges. The firm's work is concentrated in the water, transportation, energy, environment and industrial markets. CH2M has gross revenues of $5.4 billion, has 22,000 employees and is a specialist in program, construction and operations management and design.

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Appendix E.
Section 316(b) Report

Final Regulations to Establish Requirements for Cooling Water Intake Structures at Existing Facilities

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What Does This Mean to You?

Facilities that use cooling water intake structures to withdraw water from the waters of the U.S. and have an NPDES permit will be required to implement BTA to reduce environmental impact.

At a Glance:

The EPA has finalized the regulations to establish requirements for cooling water intake structures at existing facilities.

There are three main components:

- Existing facilities that withdraw at least 25 percent of their water from a water body exclusively for cooling purposes and have a design intake flow of greater than 2 mgd are required to reduce fish impingement.
- Existing facilities that withdraw ≥125 mgd are required to conduct studies to help their permitting authority determine whether and what site-specific controls, if any, would be required to reduce the number of aquatic organisms entrained.
- New units that add electrical generation capacity at an existing facility are required to add technology that achieves one of two compliance alternatives**.**

More information can be found at http://water.epa.gov/lawsregs/lawsguidance/cwa/316b/

On May 19, 2014, the U.S. Environmental Protection Agency (EPA) administrator signed the final rule National Pollutant Discharge Elimination System (NPDES) – Final Regulations to Establish Requirements for Cooling Water Intake Structures at Existing Facilities and Amend Requirements at Phase I Facilities. The final rule establishes requirements under Section 316(b) of the Clean Water Act (CWA) to ensure that location, design, construction, and capacity of cooling water intake structures (CWIS)[1] reflect the best technology available (BTA) for minimizing adverse environmental impacts. The purpose of this action is to reduce impingement[2] and entrainment[3] of fish and other aquatic organisms at CWIS used by power generation and manufacturing facilities to withdraw cooling water. The rule will become effective 60 days after the date of publication in the Federal Register.

Who Does This Apply to?

The regulations apply to facilities that use cooling water intake structures to withdraw water from waters of the U.S. and have or require an NPDES permit. This rule establishes requirements under section 316(b) of the CWA for existing power generating, manufacturing, and industrial facilities that are designed to withdraw more than 2 million gallons per day (mgd) of water from U.S. waters and use at least 25 percent of the water they withdraw exclusively for cooling purposes.

Many industrial sectors are affected. The following sectors have the largest number of regulated facilities:

- Electric generating plants
- Pulp and paper mills
- Chemical manufacturing plants
- Iron and steel manufacturing
- Petroleum refineries
- Food processing
- Aluminum manufacturing

EPA estimates that the final 316(b) rule covers roughly 1,065 existing facilities, 521 of which are manufacturing facilities, and the other 544 are power plants.

What Are the Requirements?

Affected facilities that withdraw at least 25 percent of their water from a water body exclusively for cooling purposes and have a design intake flow of greater than 2 mgd are required to choose one of seven options to reduce fish impingement and perform specific monitoring studies.

The seven options are:

1. A closed-cycle recirculating system and daily monitoring of intake flows.
2. Demonstrated design through-screen intake velocity ≤ 0.5 feet per second.
3. Demonstrated actual through-screen intake velocity ≤ 0.5 feet per second and daily monitoring of velocity.
4. An existing offshore velocity cap ≥ 800 feet offshore and daily monitoring of intake flow.
5. Modified traveling screens whose demonstrated performance represents BTA through a 2-year impingement mortality technology optimization study.
6. A system or combination of technologies or operational measures whose demonstrated performance represents BTA through a 2-year impingement mortality technology optimization study.
7. Demonstrated compliance with the 12-month impingement mortality standard of 24 percent through biological monitoring.

---

[1] *Cooling water intake structure* - the total physical structure and any associated construction waterways used to withdraw cooling water from waters of the United States

[2] *Impingement* – the entrapment of aquatic organisms in the CWIS or against a screening device

[3] *Entrainment* – the drawing in of aquatic organisms into the cooling system

Final Regulations to Establish Requirements for Cooling Water Intake Structures at Existing Facilities

CH2MHILL

New electric generating units with a design intake flow (DIF) of 2 mgd or less, but actual intake flow (AIF) less than 125 mgd added to an existing facility are required to reduce both impingement and entrainment by complying with one of two alternatives under the entrainment standards:

1. Reduce actual intake flow (AIF) at the new unit, at a minimum, to a level commensurate with a closed-cycle recirculating system.
2. Demonstrate to the permitting authority that it has installed, and will operate and maintain, technological or other control measures that achieves a prescribed reduction in entrainment mortality of all stages of fish and shellfish that pass through a sieve with a maximum opening dimension of 0.56 inches.

Summary of the Final 316(b) Rule Impingement Mortality and Entrainment Requirements

Facility Characteristic	Applicable Requirements
Existing facility with a DIF > 2 mgd and an AIF >125 mgd, uses 25 percent of their water from a water body exclusively for cooling purposes and has or requires a NPDES permit	Impingement mortality standards and site-specific entrainment requirements under the entrainment standards
Existing facility with a DIF >2 mgd, but AIF not greater than 125 mgd, uses 25 percent of their water from a water body exclusively for cooling purposes and has or requires a NPDES permit	Impingement mortality requirements and site-specific entrainment requirements under the entrainment standards
New electric generating unit with a DIF >2 mgd but AIF less than 125 mgd at an existing facility, uses 25 percent of their water from a water body exclusively for cooling purposes and has or requires a NPDES permit	Impingement and entrainment mortality standards for new units
Other existing facility with a DIF of 2 mgd or smaller or that has an intake structure that withdraws less than 25 percent of the water for cooling purposes on an AIF basis and has or requires a NPDES permit	Case-by-case, best professional judgment by the permitting authority

Notes:
AIF = actual intake flow over the previous five years
DIF = design intake flow (maximum instantaneous rate of flow of water the cooling water intake system is capable of withdrawing from a source waterbody)

Information to be submitted with the NPDES permit renewal application is dependent upon a facility's applicable standards and the selected compliance option.

316(b) Final Rule Permit Application Requirements

	Submittal Requirements at 40 CFR 122.21(r)	Existing Units with Closed Cycle Cooling	Existing Units DIF ≤ 125 mgd	Existing Units AIF > 125 mgd	New Unit at Existing Facility
(2)	Source water physical data	X	X	X	X
(3)	Cooling water intake structure data	X	X	X	X
(4)	Source water baseline biological characterization data	X	Applicable provisions[1]	Applicable provisions[1]	Applicable provisions[1]
(5)	Cooling water system data	X	X	X	X
(6)	Chosen method of compliance with IM standard	X	X	X	Applicable provisions[1]
(7)	Entrainment performance studies		X	X	Applicable provisions[1]
(8)	Operational status	X	X	X	X
(9)	Entrainment characterization study	X if > 125 mgd[2]		X	X if > 125 mgd[2]
(10)	Comprehensive technical feasibility & cost evaluation study	X if > 125 mgd[2]		X	X if > 125 mgd[2]
(11)	Benefits valuation study	X if > 125 mgd[2]		X	X if > 125 mgd[2]
(12)	Non-water quality & other environmental impacts study	X if > 125 mgd[2]		X	X if > 125 mgd[2]

Final Regulations to Establish Requirements for Cooling Water Intake Structures at Existing Facilities

	Submittal Requirements at 40 CFR 122.21(r)	Existing Units with Closed Cycle Cooling	Existing Units DIF ≤ 125 mgd	Existing Units AIF > 125 mgd	New Unit at Existing Facility
(13)	Peer review	X if > 125 mgd[2]		X	X if > 125 mgd[2]
(14)	Method of compliance for new units				X

Notes:

[1]Specific provisions within that permit requirement may apply and are based upon the selected compliance option.

[2]Facility may request alternative requirements or permitting authority has the authority to reduce or waive some or all of the information if the facility complies with the BTA standards for entrainment using a closed-cycle recirculating system.

What Is the Compliance Schedule?

The final 316(b) rule becomes effective 60 days after publication in the Federal Register. The requirements will be implemented through NPDES permits as the permits are issued or renewed. The compliance schedule is based on each facility's NPDES permit cycle:

1. Permit proceedings begun prior to 45 months after effective date of the final rule: The facility will need to submit the appropriate permit application materials during their next application.
2. Permit expiring prior to 45 months after effective date of the final rule: The facility may request that the permitting authority waive the submission date of the permit application requirements by showing that it could not develop the information by the time required for submission of the permit renewal application.
3. Permit expiring after 45 months after effective date of the final rule: The facility must submit permit application materials with its next NPDES permit renewal application.
4. Permit applications subsequent to the first permit issued with all required information: The permitting authority may approve a request to reduce information required if conditions at the facility and in the water body remain substantially unchanged since the previous application.

Contact

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james.kapla@jacobs.com

Clean Water Act Section 316 Services

CH2M HILL has the experience, technical expertise, engineering staff, and regional understanding to provide a full spectrum of CWA Section 316(a) and (b) needs. CH2M HILL specializes in providing the following services:

- Compliance strategy support
- Management and integration of multidisciplinary studies
- Fisheries, aquatic invertebrate, and water quality studies
- Impingement mortality and entrainment characterization field studies
- Threatened and endangered species and critical habitat consultation and assessments
- Fisheries adult equivalent and population modeling
- Benefits valuation studies
- Hydrodynamic and thermal plume field studies and modeling
- Water quality and mixing zone modeling analysis
- Preparation of permit applications
- Innovative intake and discharge alternatives analysis
- Engineering design and cost estimating
- Engineering procurement and construction

Appendix F.
Dyno Nobel Effluent Cooling Water Alternative Analysis (Cover Page)

TECHNICAL MEMORANDUM CH2MHILL®

Dyno Nobel Effluent Cooling Water Alternative Analysis

PREPARED FOR:	Gabrielle Grills/Dyno Nobel
COPY TO:	
PREPARED BY:	David Mustonen P.E., C.W.R.E./CH2M
	Lee Odell P.E./CH2M
	Mark Madison P.E./CH2M
	Jack Kirk P.E./CH2M
	James Kapla P.E./CH2M
DATE:	July 19, 2016

This Technical memorandum summarizes the approach and findings of the Cooling Water Effluent Temperature Reduction Alternative Analysis conducted by CH2M on behalf of the Dyno Nobel St. Helens Plant. The Dyno Nobel Deer Island Industrial Facility has a single-pass 25 MGD cooling water system, which is used for non-contact process cooling water. The cooling water system discharges to the Columbia River under an existing NPDES permit. The permit currently requires an end of the pipe effluent temperature of 95 degrees F. The facility has been informed by DEQ that the effluent temperature criteria will be lowered in the future to 89.6 degrees F.

The source of the cooling water system is a 25 MGD surface water intake on the Columbia River. The intake structure is currently equipped with vertical traveling screens to mitigate fish impingement, no additional treatment is provided for the source cooling water. The source water is characterized by plant staff as containing clam shells and suspended solids, which have caused biological fouling and biological induced corrosion. As a result of the fouling and corrosion, the following process system impacts are being observed:

- Life of the process cooling water heat exchangers have been significantly reduced resulting in increased life-cycle costs.
- Additional cleaning operations are required for the heat exchangers, resulting in increased maintenance costs

Furthermore additional process operational impacts have been observed as a result of elevated temperatures of Columbia River in the late summer, to the point that insufficient cooling capacity is available for process heat loads, requiring process operations to limit operation of certain high heat load equipment during August and September.

The USEPA issued Clean Water Act 316(b) rule effective in October 2014. The rule requires cooling water intakes to use the best available technology to protect fish and aquatic organisms. Dyno Nobel surface water intake meets the minimum criteria (> 2 MGD, and > 25% of flow utilized for cooling processes) for triggering the 316b requirements to reduce fish impingement. Other state and federal fish protection regulations also likely apply.

As a result of these drivers, Dyno Nobel contracted with CH2M to conduct an alternative analysis for implementing improvements to the facility cooling water system. This Technical Memorandum provides a summary of the options evaluated and findings from the evaluation including ranking results and recommendations for short term actions. The following attachments are included with the Tech Memo:

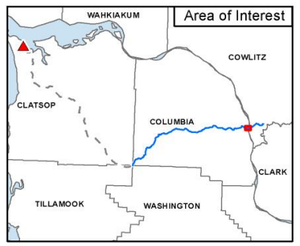
Attachment 1 – Summary of Alternative Concept Heat Evaluation
Attachment 2 – Process Flow Diagrams

Appendix G.
Location of Previous Geotechnical Borings

Figure 6C-4
Geotechnical Exploration Plan — Columbia River

LEGEND

- Completed Boring Location
- Proposed Boring Location (Approximate)
- New Pipeline Segment Milepost
- New Pipeline Segment
- Pipeline Under Docket Number CP09-7-000



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Appendix H.
Proposed Team Resumes

The following pages contain resumes for each of the proposed team members with selected project history similar to this important Project.

JACOBS

Phil Martinez, PE

PROJECT MANAGER

EDUCATION

M.S., Environmental Engineering, University of California, Davis

B.S., Civil Engineering, University of New Mexico

B.S., Geology, University of New Mexico

REGISTRATIONS/ CERTIFICATIONS

Professional Engineer: Washington, 1995 (No. 32187)

Jacobs Certified Project Manager

DISTINGUISHING QUALIFICATIONS

- Experienced local project manager who delivers his projects on time and within budget
- Specializes in water and wastewater outfalls, intakes, and pumping and storage systems
- Experienced with multi-discipline projects, managing experienced subject matter experts
- Experience conducting alternatives analysis processes to enable cost-effective selection

Phil Martinez is a seasoned project manager with 30 years of experience in planning, designing, and supporting construction of projects for intake, outfall, water and wastewater treatment, system hydraulics, and other similar private and municipal infrastructure improvements. Phil has expertise in leading facility safety and reliability improvement projects, including performance under seismic conditions, through efficient alternatives evaluation processes. He is also experienced in water quality analysis and treatability studies.

Relevant Project Experience

Project Manager; Port Townsend Wastewater Treatment Plant Outfall Replacement; Port Townsend, WA. Managed replacement of the City's existing outfall pipe in Puget Sound with a new, 24-inch-diameter, single-pipe, multi-port diffuser outfall that extends 900 feet into 25 feet of water off the north shore of Port Townsend. A key aspect of this project was the extensive environmental permitting requirements associated with it.

Project Manager/Project Engineer; Second Supply Pipeline (Pipeline 5); Tacoma Water, WA. Involves 9-mile-long Middle Reach – Western Section phase of the pipeline design and construction. Also managed the final Headworks Reach of the 35-mile (total pipeline length) pipeline.

Project Manager; Dissolved Air Flotation (DAF) Treatment Plant; City of Bellingham, WA. Managed the planning, design, and construction of the 30-million-gallons-per-day (mgd) DAF treatment facility. As part of this project, guided our project team and City staff through multiple alternative evaluations process. These included enabling decisions regarding treatment approaches, facility site selection, supply rehabilitation approaches, and other important decisions. Each evaluation process was tailored to enable quick and effective decisions by the City.

Project Manager; Water System Plan; City of Bellingham, WA. Project manager for preparing an updated water system plan in conformance with Washington Department of Health (WDOH) requirements. Worked closely with City and WDOH staff to develop an agreement on how to rectify the previous plan's deficiencies. The water system plan was completed and approved by WDOH in 2009. The plan identified facility improvements to address issues related to isolated low pressure areas, pump station upgrades, and storage requirements. The completed plan also addressed the mean water line requirement to install meters in those portions of the city's system that do not yet have them. This is a major capital expense estimated at more than $9,000,000 that required evaluation of rate adjustments for the next several years.

Project Manager; North Wenatchee Reservoir; Chelan Public Utility District, WA. The project included design of a new pre-stressed concrete storage reservoir on a hill directly behind the backyards of residents in a well-established, upscale neighborhood and above an important irrigation channel. Managed the project and led the design team from the initiation of preliminary design through construction, and addressed siting impacts on neighbors. Preliminary design included geotechnical evaluation by Ken Green, requisite site stormwater plan, preparation of a report to meet the requirements of WAC 246-290-110, and 30 percent. Final design and construction services were completed using the same project team.

Project Manager; Forest Rim Standpipe Replacement; City of Issaquah, WA. Managed the design team for replacement standpipes to comply with current seismic standards. A key challenge was to "shoe-horn" two 15-foot-diameter by 110-foot-tall standpipes to replace the existing 26-foot-diameter, 90-foot-tall standpipes on an extremely small site. The extreme aspect ratio (height to diameter), and the fact that the existing tank buckled in response to seismic conditions, required the establishment of conservative minimum standards with respect to shell thickness and anchorage design.

Project Manager; Pacific Beach/Moclips Water System Plan; Grays Harbor County, WA. Project manager, primary author, and technical advisor. The project was developed to comply with Department of Health (DOH) requirements and address the water supply to the adjacent Navy Recreation Base, which had previously supplied itself from a separate groundwater supply. Initiating supply to the Navy facility enabled an innovative approach to addressing storage deficiency by installing additional piping and valving.

Project Manager; West Urban Growth Area Utilities Project; City of Port Angeles, WA. Directly responsible for the successful execution of the project within an extremely limited timeframe. Design contract included new sewer line, new water line, a new sewer lift station, and a new water pump station.

Project Manager/Principal Design Engineer; Fairmount Pump Station; City of Port Angeles, WA. Involved a pump station that was specified in late 2003 and early 2004 as an above-grade, packaged, contractor-designed facility with a normal operating capacity of 350 gallons per minutes (gpm). Fire flow capacity up to 2,000 gpm was also provided. The station comprises three 10-horsepower (hp), single-speed centrifugal pumps that alternate to provide continuous pumping through a re-circulation loop. A single high flow pump and an emergency diesel generator are also provided.

Project Manager/Primary Author; Water System Plan; City of Port Angeles, WA. The Plan was prepared to comply with DOH requirements and to address several key challenges faced by the City, including the potential degradation of its water supply by the federal government's removal of the Elwha dams, the fact that its supply was declared GWI (groundwater sources under the direct influence of surface water) by DOH, and continuing compliance with an agreement with DOH related to copper corrosion mitigation.

Mill Creek Pump Station; City of Port Angeles, WA. Participated in design, shop drawing review, and construction inspection for this project that involved a substantial upgrade and replacement of an existing pump station. Four new 75-hp vertical turbine pumps were installed to provide a station capacity of 3.5 mgd.

JACOBS

Dave Mustonen, PE

SENIOR QUALITY ASSURANCE/QUALITY CONTROL LEAD

Dave Mustonen has 24 years of experience in design, project management, and services during construction for industrial water and wastewater systems. He will provide senior quality reviews to Phil and the Jacobs team as needed.

EDUCATION

M.S., Environmental Engineering, Georgia Institute of Technology

B.S., Civil Engineering, Oregon State University, Magna Cum Laude

REGISTRATIONS/ CERTIFICATIONS

Professional Engineer: Oregon, 1997 (No. 18926)

Oregon Certified Water Rights Examiner (No. 451)

DISTINGUISHING QUALIFICATIONS

- Successfully delivered numerous infrastructure projects for the City of Tualatin, City of Beaverton, City of Portland BES, Tualatin Valley Water District, Southfork Water Board, and Port of Kalama
- Currently serving in the chief designer role for execution of a 2,000 gpm industrial wastewater treatment project using the advanced oxidation process followed by a biological denitrification process

Relevant Project Experience

Project Manager/Process Engineering; Single Pass Cooling Water Alternative Analysis; Dyno Nobel, St. Helens Plant; OR. Project consisted of an engineering alternative analysis for increasing the cooling capacity of the 20-million-gallons-per-day (mgd) non-contact process cooling water system. Options consisted of providing an alternate groundwater supply, wetlands cooling, cooling tower cooling, and increased surface water supply. Project included development of 316(b) compliance strategy and preliminary design of intake screens compliant with EPA 316(b) with best technologies available. Also explored options for mitigating plant heat exchanger fouling and microbial induced corrosion issues created by the untreated surface water.

Chief Engineer; Plating Acid Waste Treatment System; Confidential Client. Led engineering for execution of a 2,000-gallons-per-minute (gpm) industrial wastewater treatment project using the advanced oxidation process followed by a biological denitrification process. Process includes pH adjust systems, two 0.5-million-gallon plug flow reactors, ozone oxidation treatment followed by ultraviolet ozone destruct and biological denitrification utilizing moving bed biological reactors.

Lead Process Engineer; Industrial Wastewater Cooling Project; Confidential Client. This fast-track project reduced heat load to an existing industrial waste stream by 15 mm BTU/hour, which effectively reduced a 2,200 waste stream by 13°F. Project included a new wastewater lift station, shell and tube heat exchangers, 1,250-ton chiller plant, and cooling towers.

Design Manager; Industrial Stormwater Zinc Treatment System; Confidential Client. Project consists of programming and developing preliminary design for a 1-mgd stormwater treatment system to reduce excessive dissolved zinc concentrations from an industrial facility. Scope consisted of a stormwater conveyance comprising four lift stations and approximately 2,000 linear feet (lf) of pressurized force main, as well as a vendor treatment system consisting of direct filtration follow by ion exchange.

Senior Process Engineer; Large-Scale Reclaimed Softened Water System for Large Industrial Facility; Confidential Client. Project consisted of more than 1,000 lf of large bore

(up to 24-inch) HDPE piping for a high-capacity, high-purity reclaimed water that included multiple blending stations with reverse osmosis reject streams for re-use.

Design Manager; Vacuum Swing Adsorption/LOX Oxygen Generation System; Confidential Client. Developed supporting infrastructure and installation design for new vendor turn key VSA and LOX oxygen generation system. Infrastructure consisted of structural, process piping, instrumentation and controls, and geotech.

Project Manager/Mechanical Lead; Collector Well/Pump Station Adjacent to Columbia River; Port of Kalama, WA. Developed schematic design for new 15-mgd collector well intake and six 3-mgd pumps and 1,000 lf of pumping, including backup power generator.

Project Manager; Collector Well Intake Adjacent to Columbia River; Port of Kalama, WA. Managed detailed design for new 15-mgd collector well industrial water intake adjacent to the Columbia River. Prepared final well construction drawings, details, and specifications for a 22-foot collector well equipped with 200-ft radial laterals.

Design Manager; High-Purity Sulfuric Acid Bulk Storage Transfer System; Confidential Client. Managed programming and detailed design of first-of-its-kind high-purity concentrated sulfuric acid bulk storage and distribution system. Project consisted of three 3,000gallon isotainers, containment structure with weather protection shelter, transfer pump, and double contained distribution piping.

Project Manager/Process Engineer; Ultra-Pure Water Evaluation; Confidential Client. Managed a team of experts to conduct a detailed process evaluation of a mircoelectronics fabrication facility ultra-pure water (UPW) system's effectiveness for treating a source water that was impacted with a significant organic and nitrogen loading event. The evaluation resulted in formulating potential causes and developing recommended improvements for the facility UPW system.

Project Manager; Hazardous Waste Treatment System; Confidential Client. Project manager for design and construction of supporting infrastructure for a vendor hazardous waste treatment system for a Subtitle C landfill, which is a certified Hazardous Wastes Treatment Storage Disposal Facility.

Project Manager/Construction Quality Assurance; Subtitle C Landfill Expansions; Arlington Landfill, OR. Provided quality assurance for Subtitle landfill cell construction. Included preparation of a Certified Construction Report.

Project Manager; Hazardous Waste Drum Storage Facility; Subtitle C Landfill. Developed master plan/programming report for a 40,000-square-foot hazardous waste drum storage facility intended to improve operations for receiving/sorting and offloading hazardous waste for an active Subtitle C landfill. Project consisted of developing schematic design and preparing Class 4 construction cost estimate.

Project Manager; Potable Water System Improvement; PGE Beaver Power Plant. Developed schematic design for improving water quality and low pressure conditions. Project consisted of hydraulic modeling to identify flow restrictions and guide improvements. Improvements included demolition of existing 75-KGAL tank, and installing new booster pump station and new transmission loop to reduce system headlosses and achieve desire delivery pressures.

Design Manager; CMP Waste Evaluation and General Acid Waste System Upgrade; LSI Logic; Gresham, OR. Managed development of a predesign report for a general acid waste conveyance system upgrade, and evaluation of the Gresham Facility CMP waste treatment system. Project consisted of upgrading an acid waste pump station from a 500-gpm capacity to 1,800-gpm capacity without interrupting service. System included 1,000 feet of double-walled polypropylene transmission line. Project also included evaluation of alternatives for improving the performance and capacity for CMP and HF waste treatment systems.

JACOBS

James Kapla, PE

COOLING WATER INTAKE LEAD

EDUCATION

B.S., Civil and Environmental Engineering, University of Michigan

REGISTRATIONS/ CERTIFICATIONS

Professional Engineer: Oregon, 2002 (No. 58615PE); Washington, 2002 (No. 39151)

DISTINGUISHING QUALIFICATIONS

- Specialist in the planning, design, and construction of fish screening and fish passage facilities
- Significant experience in the design and construction of intakes, diversion dams, weirs, sluiceways, canals, tunnels and other large hydraulic structures to support water supply, hydropower, and irrigation projects
- Knowledgeable in water rights transactions, Federal Energy Regulatory Commission (FERC) project re-licensing and implementation, and EPA Clean Water Act §316(b) and §308 requirements

James Kapla is a principal project manager and water resources expert with more than 20 years of experience in the planning, design, and construction of water, wastewater, surface water, and transportation projects. He has completed numerous fisheries engineering and hydropower projects throughout the Pacific Northwest including many facilities located within the Columbia and Willamette River basins. James' experience elsewhere includes projects on the Sacramento and San Joaquin Rivers in California; the Arkansas River in Colorado and Oklahoma; the Buckland and Nenana Rivers in Alaska; the Klamath River in Oregon and California; the Coquitlam and Englishman Rivers in British Columbia; the Raven River in Alberta; the Assiniboine River in Manitoba; and projects on Rhode Island's Narragansett Bay, Lake Michigan, the Mississippi and Ohio River basins, and throughout the Chesapeake Bay watershed.

Relevant Project Experience

Project Engineer; EPA §316(b) Evaluation; Dyno Nobel St. Helens Facility; OR. Prepared compliance strategy plan for a 30-million-gallons-per-day (mgd) intake located on the Columbia River below Portland. Included evaluation of existing intake facility, calculation of screen velocities and preparation of a strategy for compliance with state and federal permit requirements.

Project Manager; Chelan River Project Tailrace Pump Station; Public Utility District No. 1 of Chelan County, WA. Project manager for final design and construction of a 250-cubic-foot-per-second (cfs) (162-mgd) intake, pump station, canal, and diffuser outlet structure. As part of Federal Energy Regulatory Commission (FERC) re-licensing requirements for the 59-MW Lake Chelan Hydroelectric Project, the District is required to enhance steelhead and Chinook salmon spawning habitat in the Chelan River. Diversions for power generation historically left little or no flows in the Chelan River, which is bypassed by the hydroelectric project. The project provides minimum flows in Reach 4 of the Chelan River to augment releases of up to 80 cfs from the dam. The low-head pump station avoids the lost energy of additional releases from the dam at this 377-foot head project. The pump station includes five 150-horsepower (hp) constant-speed submersible pumps arranged in a slant configuration with 5-foot-diameter cylindrical wedge wire tee screens dedicated to each pump. The 42- and 48-inch-diameter pump columns are supported on 24-inch-diameter drilled piers.

Project Engineer; Fish Protection Screen Evaluations; Dominion Power; IL, IN, MS, RI, VA, WV, and WI. Advising a large power utility with regard to Clean Water Act 316(b) and Section 308 requirements for the screening of thermal power

plant cooling water intakes. The work includes evaluation of over 16 existing river, lake and estuary cooling water intakes ranging in capacity from 178 to 4,189 cfs (115 to 2,708 mgd), development of various alternatives for modification or new facilities, and preparation conceptual drawings and construction cost estimates. A number of intake screen technologies and configurations were evaluated, including Ristroph fish protection and conventional traveling screens manufactured by Hydrolox, Siemens, Geiger, Beaudrey and Brackett Green. Other screening technologies included cylindrical wedge wire screens, vee screens, vertical and inclined flat panel screens, cone screens, louver racks, conventional traveling screens, rotary drum screens, velocity caps, porous dikes, barrier nets, aquatic filter barriers, and electric and sound barriers.

Senior Technical Advisor; EPA §316(b) Evaluations; Various Clients and Approximately 40 Separate Facilities. Evaluated cooling water intake structures for thermal power plants and industrial/manufacturing facilities. Prepared compliance strategies, including engineering evaluations, conceptual drawings and cost estimates to meet EPA §316(b) requirements. A number of intake screen technologies and configurations were considered, including modified Ristroph-type fish protection traveling screens manufactured by Hydrolox, Siemens, Geiger, Beaudrey and Brackett Green. Other screening technologies included cylindrical wedge wire screens, vee screens, vertical and inclined flat panel screens, cone screens, louver racks, conventional traveling screens, rotary drum screens, velocity caps, porous dikes, barrier nets, aquatic filter barriers, and electric and sound barriers. Also supported due diligence process for sale of power generation facility by evaluating costs and risks associated with future EPA §316(b) compliance.

Project Engineer; Fire Suppression Intake Structure on Columbia River; Warrenton, OR. Prepared conceptual design for a 45-cfs deluge fire suppression intake structure associated with a liquefied natural gas (LNG) import/re-gasification and storage facility. The fire suppression system includes an intake on the Skipanon Waterway near its confluence with the Columbia River, pump station, and discharge line. The system is intended to protect the LNG tanks in the event they are exposed to heat from an adjacent fire. The proposed intake design includes a stainless-steel wedge wire screen in a conical configuration with a mechanical brush cleaning system. This type of intake is particularly well-suited for estuaries and shallow marine areas.

Project Engineer; Leavenworth NFH Water Supply Intake and Pump Station; U.S. Bureau of Reclamation, Pacific Northwest Region; Leavenworth, WA. Prepared the final design for a 42-cfs (27-mgd) intake, pump station and discharge pipeline to serve the Leavenworth National Fish Hatchery located on Icicle Creek near Leavenworth. The facility will be integrated with related improvements including modifications to an existing headgate structure, an inflatable weir and a roughed channel for upstream fish passage. The facility will be designed to operate over a range of flow regimes and severe winter conditions including frazil ice formation.

Project Engineer; Creswell Water Treatment Plant Intake; City of Creswell, OR. Prepared final design drawings and construction specifications for a 5-cfs (3.2-mgd) water treatment plant intake located on the Coast Fork of the Willamette River. The intake consisted of flat panel screens oriented in a slant configuration with an air backwash cleaning system. This intake replaced an existing Ranney-type horizontal collection well system that had lost capacity over time.

Project Manager; Chelan Falls Rearing/Acclimation Facility; Public Utility District No. 1 of Chelan County, WA. Managed the alternatives evaluation, site selection, conceptual design, final design and construction of the Chelan Falls Rearing/Acclimation Facility. Due to the poor release location and lack of spawning grounds in the vicinity of Turtle Rock Island on the main stem Columbia River, sub-yearling Chinook historically reared at this location have tended to stray to other tributaries. As such, the District and the Habitat Conservation Plan (HCP) Hatchery committee made the decision to convert to a yearling program and to construct a replacement facility for the acclimation of Summer Chinook. Relying on extensive knowledge of the District's existing hatchery program, Jacobs evaluated various facility configurations and site locations to identify a preferred alternative which efficiently and cost-effectively met the goals of the program. The selected facility is located adjacent to the 59-megawatt Chelan Falls Powerhouse and accommodates 600,000 Chinook in four 45-foot-diameter Cornell-type round ponds. The facility includes a 22-cfs (14 mgd) pump station with two 75-hp submersible pumps in a slant

configuration, and an intake with two 27-inch-diameter tee screens and an air backwash cleaning system. The ponds are located in a pre-fabricated metal building with predator control netting. The ponds include volitional fish drains and provisions for future water reuse/recirculation and water treatment equipment. Water from the pond center drains with concentrated total suspended solids is conveyed to radial flow settlers for additional treatment. Effluent is then pumped to secondary settling basins. The site also includes a control building; facility building with a break room, locker room and office space; water quality lab; equipment and feed storage; and chemical handling facilities.

Project Manager; Bonneville Second Powerhouse Vertical Barrier Screen Debris Cleaning and Gatewell Debris Handling Alternatives Study; U.S. Army Corps of Engineers, Portland District; Portland, OR. The 558-MW Bonneville Second Powerhouse on the Columbia River uses vertical barrier screens (VBS) to direct migrating juvenile salmonids into the downstream fish bypass system. Each of the 24 VBS handle a gatewell flow of approximately 469 cfs (303 mgd). The screens experienced a structural failure in 2002 due to excessive debris loading. Prepared an alternatives study that identified a VBS and gatewell debris handling system that improved upon current labor-intensive maintenance practices. The study involved the conceptual design of several alternatives and the selection of a preferred alternative for prototype testing in the spring of 2004. The alternatives were prepared and evaluated with input from a variety of disciplines including structural, mechanical and hydraulic engineers, operations personnel and fisheries biologists.

Project Engineer; EPA §316(b) Evaluations; Golden Valley Electric Association (GVEA); Healy, AK. Advised GVEA with regard to Clean Water Act 316(b) and Section 308 requirements as well as Alaska Department of Fish and Game requirements for the screening of cooling water intakes at their Healy facility located on the Nenana River. The work included evaluating two existing cooling water intakes with a combined capacity of approximately 101 cfs (65 mgd), reviewing applicable regulations, and developing various alternatives including operational modifications and/or facility improvements. The Nenana River is unique in that low streamflows occur during the early spring time period with peak streamflows in late summer. This regime is the opposite of typical river systems in the Lower 48 and is due to the glacial origins of the river in the Alaska Range. As such, careful consideration of these regional characteristics and site-specific measures will be required.

Project Engineer; Fish Protection Screen Evaluation; General Electric Aviation; Lynn, MA. Advised GE with regard to Clean Water Act 316(b) and Section 308 requirements for the screening of cooling water intakes at their Lynn, Massachusetts facility located on the Saugus River. The work included evaluation of three existing cooling water intakes, development of various alternatives for operational modifications and/or facility improvements, and preparation of conceptual drawings and construction cost estimates.

Pat Van Duser, PE

COOLING WATER INTAKE

EDUCATION

M.S., Mechanical Engineering, University of Washington

B.S., Engineering, Harvey Mudd College

REGISTRATIONS/ CERTIFICATIONS

Professional Engineer: Oregon, 1997 (No. 18936), Washington, 2001 (No. 37661)

DISTINGUISHING QUALIFICATIONS

- Expertise includes the in-water design, permitting, and construction services on more than 10 intake and fish screen designs, upgrades, and consultations
- Experienced on conventional water treatment and disinfection processes and has conducted numerous water treatment pilot studies on source waters in the Pacific Northwest, including the Rogue River and Willamette River in Oregon

Pat Van Duser has 24 years of demonstrated success managing and designing water system intakes and fish screens, hydroelectric projects, individual treatment processes, pump stations and pipelines, and drinking water plant upgrades and reservoirs. His knowledge was honed on projects requiring multiple agency permitting, multiple stakeholder approval, and construction work during limited duration in-water work periods. He is an enthusiastic and collaborative problem-solver applying innovation and team building for on-time and on-budget delivery of complex, tightly scheduled projects.

Relevant Project Experience

Project Manager; Pumping and Storage Components and River Intake Pump Station; Lake Oswego Tigard Water Partnership (LOTWP); Lake Oswego, OR. Responsible for overall delivery of three of the six projects in the LOTWP program: 38-million-gallons-per-day (mgd) River Intake Pump Station, 3.5-million gallon Waluga 2 Reservoir, and 20-mgd Bonita Pump Station. Intake project constructed an 85-foot-tall oval concrete intake tower with ISI-type rotating tee-screens, four 400-horsepower vertical turbine pumps, water quality sampling, and a 26-foot-wide access bridge. Led coordination with the Program Management Team and permitting team, sponsors, and eight key subconsultants, including during the very tight pre-design schedule to meet the permitting deadline. Construction was completed in 2015.

Project Manager; Middle Fork Nooksack Diversion Pipeline Rehabilitation Study; City of Bellingham, WA. Led team to recommend technology and segment location for future rehabilitation of the 10-mile-long, 40-inch-diameter reinforced concrete cylinder pipe (AWWA C303) from the Middle Fork Nooksack River diversion tunnel portal to the Lake Whatcom discharge. Work included review and assessment of previous inspection results, reconnaissance of the entire pipeline route, evaluation of available rehabilitation technology, recommendation of HDPE slip-lining, and identification of access pit locations along the pipeline. Summarized City-issued change order for a series of project recommendations on the entire Nooksack diversion dam, tunnel, and pipeline to facilitate City decision-making for the future direction of the infrastructure. Report was finalized spring 2017.

Project Engineer; Middle Fork Nooksack Tunnel Intake; City of Bellingham, WA. Performed feasibility, conceptual and preliminary design on new intake and siphon from the seasonally flashy river, through 8,900-linear-foot hard rock tunnel and existing steel pipelines to Lake Whatcom for the City's surface drinking water supply. Project included physical and computational fluid dynamic modeling by a subconsultant.

Design included siphon refill pumps, vacuum pumps, steel pipe sleeved through the tunnel and security measures for the remote site.

Project Manager; Middle Fork Nooksack Diversion Dam Assessment; City of Bellingham, WA. Led team to inspect, assess, and make recommendations for the structural, civil, and mechanical continued operations of the dam. Inspection included test samples for compressive strength and petrographic analysis. Results indicated deterioration of the ogee spillway crest due in part to alkali silica reaction with other elements of the facility showing expected wear.

Engineering Manager/Project Manager; Hayden Bridge MacKenzie River Intake Improvements; Eugene Water and Electric Board; Springfield, OR. Responsible for design of tee-screen, new raw water pumps, and associated electrical and structural improvements to the existing two intake structures with a combined firm capacity of 111 mgd. Included two-phase execution and two design packages.

Project Manager; Geren Island Water Supply Study; City of Salem, OR. The City was faced with decreasing water supply to the Geren Island Water Treatment Facility (GITF) in the North Santiam River and direction from fish protection agencies to eliminate regular dredging of the river. Project evolved and evaluated alternative methods to supply the GITF with the up to the 147 mgd of permitted water rights. Alternatives considered included a new intake at the upstream of the island, sources of subsurface supply including vertical and collector wells, and river improvements to channel more flow past and reduce bed loading deposition at the existing bank intake.

Engineering Manager; Rogue River Intake Improvements Project; Medford Water Commission, OR. Responsible for design, permitting, and construction administration of fish screen improvements to the 40-foot-tall concrete intake tower for the Robert A. Duff Water Treatment Plant. Design included 65-mgd total capacity, twin 60-inch-diameter tee-screens mounted to the intake with 1,550-gallon receiver supplied air burst system in a new building. Design was completed in spring 2009 and construction performed during the 2010 in-water work period. Project was selected for a 2011 American Water Works Association Pacific Northwest Section (AWWA PNWS) Excellence in Engineering Award for projects less than $2 million in constructed cost.

Project Engineer; Clackamas River Raw Water Intake; Clackamas River Water (CRW); Clackamas, OR. Conducted improvements to CRW's existing raw water intake on the Clackamas River. Project screened the 30-mgd intake to meet current National Marine Fisheries Service (NMFS) standards. A construction manager/general contractor (CM/GC) project delivery method was used to safely complete in-water work prior to the close of the Oregon Department of Fish and Wildlife-mandated in-water work period in August 2003. Design aspects included two 42-inch-diameter wedge-wire tee-screens and a 1,600-gallon compressed air burst screen cleaning system. Design was completed in 5 weeks.

Project Engineer; Clackamas River Intake Improvements; City of Lake Oswego, OR. Conducted improvements to the City's 16-mgd river intake, which was a relatively small footprint hexagonal concrete tower 50 feet tall freestanding out away from the bank. The project tripled the screened intake area, installed three vertical profile bar screens meeting NMFS velocity criteria, and retrofitted four seismic anchors at 300 kips. Performed preliminary and final design and specification of an original 4,300-gallons-per-minute (gpm)/screen fixed spray array screen cleaning system with pressure-reducing control valves and with 204 zero-degree nozzles per screen, of the intake screens, and of the optional baffles to meet agency requirements all installed in the tight footprint of the intake floor. Coordinated with permitting staff to develop site mitigation and turbidity control during in-water excavation at intake exterior. Duties during construction included office and field engineering and coordinating daily with the contractor on execution of the project through the CM/GC teaming arrangement. The project was constructed primarily during a 6-week in-water work period ending August 2002.

Project Manager; Pump Station 1 Pump Replacement; Multnomah County Drainage District; Portland, OR. Responsible for delivery of project to replace three pumps, motors, piping and appurtenant station upgrades. Pump 1 and Pump 5 each have capacity of 32,000-gpm and Pump 3 has a capacity of 45,000 gpm. The station pumps surface drainage over a U.S. Army Corps of Engineers flood control levee to protect Portland International Airport and surrounding area.

Aaron George, PE

COOLING WATER INTAKE

EDUCATION

B.S., Environmental Engineering, University of Vermont

REGISTRATIONS/ CERTIFICATIONS

Professional Engineer: Washington (2017)

DISTINGUISHING QUALIFICATIONS

- Expertise includes fish screening, fish passage, water intake engineering, and hydraulics
- Experience includes data management for program with more than 400 unique projects
- Knowledgeable in construction engineering

Aaron George has 6 years of experience in 316(b) cooling water intake structure engineering. He also is experienced in general hydraulics analysis, including headloss in rock tunnel and piped systems. Aaron has previous experience working with Dyno Nobel as an intake/screening engineer at the St. Helens facility. His relevant experience includes multiple projects throughout PacifiCorp's East and West regions, including Washington, Oregon, Wyoming, and Utah. This includes hydraulic and fish screening engineering services for multiple hydropower projects in the state of Washington, including Snohomish and Chelan counties. Fish passage projects include the study and design of modifications to an existing fishway for enhanced passage of non-salmonid species such as Pacific lamprey. He has also served as a screening and intake engineer for more than 20 power and manufacturing facilities across the nation in support of regulatory compliance with the final rule under Section 316(b) of the Clean Water Act. PacifiCorp thermal power facilities in Wyoming and Utah are among the sites where Aaron is supporting ongoing assessments of the design and operation of intake structures, including fish screening and bypass systems, in order to minimize adverse environmental impacts to the aquatic habitat and organisms.

Relevant Project Experience

Hydraulics/Fish Screening Engineer; Sunset Fish Passage and Energy Project; Snohomish County Public Utility District (PUD); Washington Department of Fish and Wildlife (WDFW) Index, WA. Supported design of the river intake structure, rock tunnel and piped conveyances, fish screening, and bypass facilities, as well fish handling facilities for this greenfield hydropower project. Completed a hydraulic analysis of the full proposed system from intake to powerhouse including head loss through the intake, intake structure screening and gates, fish screening and bypass facilities, rock conveyance tunnels, and piped penstock to the powerhouse. Supported design of upgrades to the existing fish handling facility located near the proposed powerhouse at the base of Sunset Falls. The facility is operated by the WDFW for trap-and-haul operations.

Hydraulics/Fish Passage Engineer; Tumwater Fishway Modifications (Pacific Lamprey Passage); Chelan County PUD; Leavenworth, WA. Involved in feasibility study of improvements and further development of conceptual design alternatives for modifications at the Tumwater Dam Fishway along the Wenatchee River. The objective of the project is to modify the existing vertical slot fishway to enhance the upstream migration of Pacific Lamprey (Entosphenus tridentatus), a species with much different needs than the salmonids typically considered for

fishway design. Completed an initial literature review to better understand the swimming abilities and behavior of this non-salmonid species, as well assess state-of-the-art technologies currently in use and development in the Pacific Northwest. This literature review was ultimately used to establish key design criteria and identify potential technological and operational modifications for consideration. Prepared conceptual designs of the top alternatives selected by the project team including modifications of weir sills, screening and pickets, as well as the design of a dedicated Lamprey Passage Structure (LPS). A LPS uses the unique swimming abilities of Pacific lamprey by providing a separate aluminum duct-type climbing structure fit within the existing footprint of the fishway to provide enhanced lamprey passage with minimal interference to existing salmonid fish passage.

Intake/Screening Engineer; 316(b) Cooling Water Intake Structure Engineering; PacifiCorp; WY and UT. Providing ongoing engineering support of regulatory compliance with the final rule under Section 316(b) of the Clean Water Act for 6 PacifiCorp thermal power generation facilities in Wyoming and Utah including Dave Johnston, Gadsby, Hunter, Huntington, Jim Bridger, and Naughton power plants. Possesses in-depth intake and fish screening experience in support of 316(b) regulatory compliance at a wide variety of facility types with saltwater and freshwater water supplies for nearly 20 additional power and manufacturing facilities across the nation. Leads the technical assessment of the design and operation of intake structures, fish screening, and bypass systems at these facilities, including hydraulic analysis of existing intakes and water supply systems. Completed assessments of technologies including vertical traveling screens, modified-Ristroph type traveling screens, fine mesh traveling screens, coarse and fine opening wedgewire screens, physical diversion barriers and sills, and variable frequency drives for intake flow optimization. Appreciates the importance of gaining a firm understanding of the operational needs of each facility as a foundation for assessments and design of modifications at existing facilities. In addition, he has on the ground experience supporting the installation and operation of field testing equipment in harsh weather conditions, including temporary pumps, piping, and collection system for fish entrainment sampling at PacifiCorp's Dave Johnston Plant.

Intake/Screening Engineer; 316(b) Projects; Various Clients and Locations:

Dyno Nobel, St. Helens; Deer Island, OR
Dominion Energy, Possum Point Power Station; Dumfries, VA
Dominion Energy, Chesterfield; Richmond, VA
Dominion Energy, Bremo Power Station; Bremo Bluffs, VA
Dominion Energy, Manchester Street Station; Providence, RI
PacifiCorp, Dave Johnston Power Plant; Glenrock, WY
PacifiCorp, Jim Bridger Power Plant; Point of Rocks, WY
PacifiCorp, Huntington Power Plant; Huntington, UT
PacifiCorp, Hunter Power Plant; Castle Dale, UT
PacifiCorp, Gadsby Power Plant; Salt Lake City, UT
PacifiCorp, Naughton Power Plant; Kemmerer, WY
Chemours, Louisville; Louisville, KY
Dow Chemical Company, Texas Operations; Freeport, TX
Dow Chemical Company, West Virginia Operations South Charleston; South Charleston, WV
Dow Chemical Company, West Virginia Operations Institute; Institute, WV
Dow Chemical Company, Louisville Operations; Louisville, KY
Dow Chemical Company, Midland Operations; Midland, MI
Dow Chemical Company, St. Charles Operations; Taft, LA
Dow Chemical Company, Louisiana Operations; Plaquemine, LA
AdvanSix, Hopewell; Hopewell, VA
AdvanSix, Chesterfield; Chester, VA
Marathon Petroleum Corporation, Garyville Refinery; Garyville, LA
Morgantown Energy Associates, Morgantown Energy Facility; Morgantown, WV
PowerSouth, Central Generation (McWilliams/Vann); Gantt, AL

Byrl Thompson, PE

OUTFALL LEAD

EDUCATION

M.S., Civil Engineering, University of Washington

B.S., Civil Engineering, Montana State University

REGISTRATIONS/ CERTIFICATIONS

Professional Engineer: Oregon (No. 85914); Washington, 1992 (No. 29159); Alaska (No. CE-8572)

DISTINGUISHING QUALIFICATIONS

- Expertise using tools for modeling of existing and new conveyance systems, routes, and utilities
- Experience with outfalls into the Columbia River

Byrl Thompson has more than 30 years of experience in roles as lead civil engineer, design manager, and project manager for water and wastewater facilities. He brings a well-rounded skill set for planning, design, and construction support of projects with civil site development, conveyance, and utilities components. Byrl's role as lead civil engineer on large project teams has given him the expertise to manage multi-disciplinary teams that include numerous subconsultants, identify and involve the right people to execute teams efficiently, oversee the production of contract documents for both large and small projects, and stay within budget and schedule.

Relevant Project Experience

Lead Civil Engineer; Salmon Creek Treatment Plant Outfall and Effluent Pipeline Replacement Project; Discover Clean Water Alliance; Clark County, WA. Led civil design tasks for design and permitting of 7,300 feet of 48-inch steel effluent pipeline crossing under Salmon Creek and Lake River and terminating with a 750-foot outfall into Columbia River, using 144-foot diffuser with 10- to 16-inch check valves ports and access manhole. The 30 percent design and engineering report were completed in 2018, with development of final design in 2019. Project elements included field studies in river and along pipeline routes, bedform modeling, effluent pipeline route study, conceptual and predesign engineering, pump station design, final design, construction and water quality permitting, and workshops.

Lead Civil Engineer; Wilsonville Wastewater Treatment Plant (WWTP) Outfall Improvement; City of Wilsonville, OR. Led civil design tasks for project that installed 300 feet of 42-inch steel outfall buried on 30-degree slope terminating with 60-foot diffuser with 5- to 20-inch elastomeric check valves and access manhole. Installed 2018 and Mixing Zone Study conducted in 2018. Project scope included field studies, outfall routing study, bedform evaluation, conceptual design, predesign engineering, final design, workshops, construction permitting, and services during construction (SDC).

Lead Civil Engineer; City of Portland Bureau of Environmental Services (BES) Outfalls 001 and 003 Improvements; Portland, OR. Led civil design tasks for two large outfalls (not designed by Jacobs) that experienced sand burial of diffuser ports and some riser damage. Jacobs will investigate and develop designs to rehabilitate Outfall 001 (buried 1,130-foot-long, 84-inch steel outfall with 360-foot diffuser with 36 total 16-inch risers with 12-inch elastomeric check valves ports) and Outfall 003 (buried 850-foot-long, 84-inch steel outfall with 255-foot diffuser with 18 total 28-inch risers with 24-inch elastomeric check valves ports). Jacobs designed riser extension and replacement elastomeric check

valves ports for all risers on both outfalls for model-predicted future bed elevations and develop construction approaches with marine construction firms to allow repairs during outfalls operating. Scope to include field studies, bedform modeling, conceptual and predesign engineering, final design, workshops, construction permitting, bidding support, and SDC. Construction is planned for 2020.

Lead Civil Engineer; Kapstone Packaging Longview Mill Outfall Diffuser Rehabilitation; Longview, WA. Led civil design tasks for fast-track design development to rehabilitate 350-foot 48-inch steel outfall diffuser disabled by anchor- caused brake to offshore 120-foot section and sand wave burial of inshore section Detailed bathymetry survey images and dive inspection videos used in design analyses of repair options to meet hydraulic and dilution requirements. Assisted in development of feasible diffuser rehabilitation and repair approaches, engineering report was completed in 9 months to allow pipe procurement in 2015 and construction to be completed in January 2016.

Civil Engineering Lead; SE Interceptor – Segments 1-5; City of Bend, OR. Led civil engineering tasks for the City's new major interceptor project (approximately 6 miles of 24-inch and 30-inch diameter sewer pipe and HDPE manholes) Responsible for leading and coordinating with four segment design teams as well as being the lead designer for one of the segments, and also had the role of technical specifications lead. Design included modeling of the existing utilities and layout of the conveyance system The interceptor route is underlain by bedrock, which complicated the design and installation of the gravity sewer system The system used high-density polyethylene manholes because of the corrosive nature of the City's sewer flows, and an improved HDPE manhole detail and specifications were developed for the project Blasting activities and protection of existing utilities required additional measures during design and construction.

Lead Civil Engineer; Brightwater Wastewater Project; King County Department of Natural Resources; Washington; Woodinville, WA. Responsibilities included interfacing with the lead designers for all facilities, building and landscape architects, and other team members; and design, design management, and coordination with the County and the GC/CM contractor. Civil site design elements included roads, yard piping, grading, and oversight of erosion and sediment control and drainage design. Pavements were designed for the expected number and type of vehicles accessing each building onsite. Yard piping and conveyance design included all piping associated with the facilities, 1,200 feet of 84-inch-diameter effluent piping, 1,700 feet of 48 and 66-inch-diameter influent piping, potable water supply piping and utilities, and coordination with electrical duct banks and conduit feeds. Assistance was provided to the County for coordination with utility purveyors and regulatory agencies for temporary erosion and sediment control facilities, and water, power, telephone, and sanitary sewer systems. Grading and other details were designed for placement of a major SNOPUD substation onsite, and transmission pole locations were coordinated with onsite landforms and facilities. Design and construction activities were coordinated with Washington Department of Transportation improvements along SR-9, which were occurring concurrently. Subsurface utility engineering was provided for existing and as-built utilities during construction. Construction support included review of civil related submittals and requests for information.

Lead Civil Engineer; Graymont Wastewater Treatment System (WWTS) Upgrade and Outfall Replacement; Graymont Industries; Tacoma, WA. Led civil engineering tasks for this new treatment system and outfall. The WWTS treats effluent for pH adjustment and the new outfall discharges into the Blair Waterway Design activities included, grading, access and roads, yard piping, subsurface utility engineering, and design of a new outfall. Work also included management of collection of survey data, and coordination with discipline leads.

Lead Civil Engineer; Belfair Water Reclamation Facility; Mason County; Belfair, WA. Activities included civil design management, design of roadway and site grading at the WWTP, yard piping, new utilities, fire water storage, and preliminary design for an effluent storage pond. All utilities and yard piping were 3-D modeled during design. Project also included a new sanitary sewer conveyance system along the SR3 corridor. Preliminary design activities included modeling of the conveyance system, utilities, and civil site design of three pump stations.

JACOBS

David Wilson

OUTFALL

Dave Wilson is a senior scientist with more than 35 of experience, who specializes in the design of new and improved outfalls and diffusers and conducts analysis of water quality compliance for discharges. He focuses on environmental analysis for wastewater dischargers, with a specialty in NPDES permit negotiation and compliance issues. His skills include regulatory strategy development, agency negotiations, study design and implementation of field data collections, design of modeling analyses, statistical analysis, knowledge of aquatic communities, and project management.

Relevant Project Experience

Project Manager and Technical Lead; Outfall Diffuser Rehabilitation Design Project; KapStone Packaging Longview Mill; Longview, WA. Led fast-track development of outfall diffuser rehabilitation design options for a damaged 350-foot diffuser, including dilution and hydraulic modeling, water quality compliance assessment, and developing the engineering report. Evaluated six diffuser repair options including phased implementation based on sediment removal and retrofit of ports with elastomeric check valve ports. Engineering Report was submitted to Ecology in January 2015; final design was completed in July 2015; and construction was completed in January 2016.

Technical Lead; Salmon Creek Wastewater Treatment Plant (WWTP) Diffuser Design; Clark Regional Wastewater District (CRWWD); Clark County, WA. Has provided technical support to the CRWWD for nearly 30 years. Designed and directed field data collections, led modeling and reporting of outfall mixing studies, and led technical exchanges with Washington State Department of Ecology. Has assisted the CRWWD with NPDES issues and shoreline conditions surveys to assess shoreline erosion at the outfall site. Recently, as technical lead for diffuser design for the replacement river outfall, has included extensive field studies in the Columbia River, diffuser designs and modeling, water quality compliance assessment, and engineering report development. Developed design concepts for multiple outfall routes into river and for range of diffuser sites, and CRWWD select a buried 48-inch steel outfall with ten 16-inch elastomeric check valve ports to meet dilution requirements (with safety factor). The design report was submitted to Ecology in March 2018 and final design will begin in 2019.

Task Lead, Outfall Extension and Diffuser Replacement Project (Columbia River), Boise Cascade and City of St. Helens, OR. Led diffuser design development for 500-foot outfall extension with a new diffuser section in the Columbia River. Directed field studies, dilution modeling analyses, diffuser concepts, development of the engineering report, and led

EDUCATION

M.S., Marine Sciences, Oregon State University

B.S. , Zoology, Oregon State University

REGISTRATIONS/ CERTIFICATIONS

List registrations or accreditations

MEMBERSHIPS AND AFFILIATIONS

Identify organizations and roles

AWARDS/HONORS

Identify award title, year received, and sponsor

DISTINGUISHING QUALIFICATIONS

- Project technical leader for NPDES permit projects for clients throughout the Pacific Northwest, including more than 20 years working with key personnel at the Oregon Department of Environmental Quality (DEQ)
- Technical lead for Clean Water Act compliance assistance with wastewater discharge clients, including NPDES permits, 401 certification, anti-degradation analyses, TMDL studies, and 404 permits

permitting agency communications. This unique cooperative project between an industry and municipality was completed (studies, permitting, design, and construction) in 18 months and began service in November 2005.

Technical Lead; Kellogg Creek Water Pollution Control Plant (WPCP) Outfall Improvement Design Project; Clackamas County Service District No. 1; Milwaukie, OR. Led concept development of outfall improvement options, dilution modeling, water quality compliance assessment, and field studies of this outfall in the Willamette River Technical analyses complied with water quality criteria based on existing and projected maximum effluent ammonia discharge values. An extended outfall and new 7 port diffuser was selected as the preferred design to meet dilution requirements (with safety factor). Design report was submitted to DEQ in February 2015; and outfall construction was completed in October 2016. In September 2017, led planning and then directed a field and modeling outfall mixing study of the new outfall and diffuser.

Technical Lead; Columbia Boulevard Wastewater Treatment Plant Outfalls 001 and 003 Diffuser Improvement, Columbia River; Portland Bureau of Environmental Services, OR. Designed diffuser modifications for the City's two large outfall diffusers in the Columbia River to address sand burial and riser damages. Development includes river bedform modeling, hydraulic and dilution modeling evaluations of Outfalls 001 (dry weather) and 003 (wet weather) under range of effluent flow and river flow conditions. Work included field data collections for the river bedform modeling, discharge flow modeling to represent season river flows and stages, dilution modeling, design of diffuser improvements, permitting, and support during construction.

Diffuser Lead; Tri-City WPCP Outfall Remediation Project; Clackamas Tri-City Service District; Oregon City, OR. Led development of diffuser improvements to the Willamette River outfall to comply with ammonia criteria in Oregon water quality standards. This time-critical project (conducted to meet MAO), evaluated improvements to existing three-port outfall diffuser, along with new outfall and diffuser options. The District selected a combination of diffuser port modification, dry season flow control into the modified outfall, and ammonia treatment .The engineering documents and construction were completed within the MAO timeline in 2012, and effluent ammonia limits were eliminated from the Tri-City WPCP permit.

Technical Lead; Wilsonville WWTP Outfall Improvement Project; City of Wilsonville, OR. Led development of outfall improvement options, diffuser design, dilution modeling, water quality compliance assessment, and field studies in the Willamette River. Developed six outfall options. Extended 42-inch steel outfall with new five port diffuser was selected as the preferred design to meet dilution requirements (with safety factor). Engineering Design report was submitted in August 2016; permits approved in 2017; and construction was completed in August 2018. In September 2018, planned and directed an outfall mixing study of the new outfall and diffuser.

Technical Lead; Marine Park Water Reclamation Facility Outfall Diffuser Modification Design and Outfall Dilution Performance Study, Columbia River; Vancouver, WA. Directed the design of diffuser port extensions and retrofits with elastomeric check valves to address encroaching sand waves and potential burial of open ports. Directed riverbed monitoring and analysis of the Columbia River bedforms upstream of the outfall and diffuser, hydraulic and dilution modeling of diffuser modification designs, and prepared an engineering report, which was approved and diffuser modifications were completed in 2010. Directed a dilution performance study.

Technical Lead; City of Redding Clear Creek WWTP Outfall Mixing Zone Study; City of Redding, CA. Designed and directed field data collections (tracer study), dilution modeling, and report development to document the dilution performance of the plant's newly constructed dry and wet weather outfall diffusers under critical low river flow conditions in the Sacramento River. The study was developed and completed in accordance with the Regional Board's requirements. Work included field data collections and tracer studies of two outfall diffusers, discharge flow modeling to represent season river flows and stages, dilution modeling, environmental mapping, preparing reasonable potential analysis, reporting to Control Board.

JACOBS

Brad Paulson

OUTFALL

EDUCATION

M.S., Geological Oceanography, University of Washington

B.S., Oceanography, Humboldt State University

DISTINGUISHING QUALIFICATIONS

- Expertise conducting outfall dilution, mixing zone, and water quality analyses using Environmental Protection Agency dilution and dispersion models
- Experienced with a variety of standard and modified public domain and proprietary models for water quality,
- waste field transport, sediment transport, and contaminant transport in river, estuarine, and coastal systems
- Leader in field data collection and data analysis, interpretation, and presentation of study results for outfall dilution and mixing zone studies

Brad Paulson has 25 years of experience in water and sediment quality, contaminant transport, and outfall analysis and engineering. His work includes outfall dilution/water quality studies and analysis and modeling of estuarine circulation and pollutant transport He has conducted numerous water quality analyses of industrial and sanitary waste discharges into estuarine, fluvial, and coastal areas. These studies have been used to evaluate the environmental impacts of existing and proposed wastewater discharges, alternative discharge designs, and siting of new discharges.

Relevant Project Experience

Modeling Lead; Outfall Studies and Engineering; Various Clients and Locations. Has worked on numerous projects involving outfall modeling, design, sampling, and analysis including projects along the west coast of the United States and in Alaska, Florida, Puerto Rico, British Columbia, the South Pacific, and the Caribbean. Has served as project manager, task manager, and modeling lead on numerous NPDES permit projects for municipal and industrial companies in the Pacific Northwest. On most of these projects, he collected data on water and sediment quality, currents, waves, tides, and winds, and then applied EPA-approved models for outfall diffuser analysis to determine the hydrodynamics of the effluent plumes, the predicted initial and farfield dilution, and the mixing zone geometry. Examples of dilution and mixing zone models that he has used extensively include Visual PLUMES, CORMIX, DOS-PLUMES, UDKHDEN, UMERGE, RDIFF, CDIFF, PDS, and PSY.

A partial list of representative projects involving outfall dilution and mixing zone analyses for municipal water and wastewater and various industrial facilities follows:

- Outfall Dilution Evaluation and NPDES Permit Assistance; Salmon Creek Wastewater Treatment Plant; Clark County and Hazel Dell Sewer District, WA
- Outfall Mixing Zone and Dilution Studies for Kellogg Creek and Tri-City Water Resource Recovery Facility; Clackamas County Service District No. 1; Oregon City and Milwaukie, OR
- Mixing Zone Study; Marine Park Water Reclamation Facility, Columbia River; City of Vancouver, WA
- Outfall Extension and Diffuser Replacement, Columbia River; Boise Cascade and City of St. Helens, OR
- Multiple Outfalls Dilution Evaluation and
- NPDES Permit Assistance; City of Corvallis, OR

- Seaside Wastewater Treatment Plant Outfall Replacement; Seaside, OR
- Mixing Zone and Dilution Study, Tualatin River; Clean Water Services; Hillsboro, OR
- Diffuser Performance Evaluation; City of
- Salem, OR
- Outfall Dilution Study and Diffuser Operation and Management Plan; City of Albany, OR
- Weyerhaeuser Paper Company; North Bend and Springfield, OR, and Everett and Longview, WA
- Georgia Pacific-Albany; Albany, OR
- Smurfit Newsprint; Oregon City, OR
- Blue Heron Paper Company; Oregon City, OR
- Georgia Pacific Corporation, Toledo, OR
- James River Corporation, Camas, WA

Technical and Modeling Lead; Cooling System Upgrades and Phased Modifications of Outfall Flows; Confidential Industrial Client; Ferndale, WA. Helped to implement changes in two of the three major discharge streams at the facility, and these changes would affect stormwater and cooling water discharges from the facility. The changes in the discharges were developed to reduce water use, reduce thermal discharge loads, relocate the stormwater discharge site (for most flows), and to improve mixing (dilutions) for the stormwater discharges. Assisted in the preparation of a technical report that provided details on the compressor cooling water upgrades, diversion of industrial site stormwater, evaluation of the dilution performance of Outfall 001 for the phased flow modifications, and the schedule and permitting of these projects. Dilution modeling was conducted to evaluate the existing and a modified diffuser to assess dilutions and hydraulic operations with the changed effluent flows. Performed modeling runs that provided plausible and defensible predictions of dilution performance that would be achieved under critical (worst-case) conditions and defined the range of anticipated dilutions that will be achievable for the existing and modified outfall diffuser configurations.

Modeling Lead and Field Team Member; Outfall Mixing Zone and Dilution Study, Willamette River; Confidential Client; Portland, OR. Conducted an outfall mixing zone/dilution study to provide site-specific field measurements for the outfall under low river flow; develop river flow and stage statistics for critical discharge conditions; apply field measurements in dilution modeling; develop dilution modeling results for a range of critical river flow conditions; and evaluate the discharge with the mixing zone rules including the thermal plume provisions in the Oregon Administrative Rules. The field team collected site-specific data during a 1-week period at low river flow and stage. The field activities included cross-sectional profiles of depths and velocities in the river near the outfalls, and extensive dye dilution measurements at the existing mixing zone boundaries as well as more distant locations. Following the field studies, analyzed and summarized the results of the field measurements. These field data and past tracer studies were used to select and calibrate appropriate dilution models for each outfall. Dilution modeling analyses included low river flow condition and off-season design conditions to represent critical receiving water conditions at the discharge sites. Based on the results of the field study and dilution modeling, alternative mixing zone dimensions were proposed for acceptance by the Department of Environmental Quality.

Project Scientist and Modeling Lead; Outfall Diffuser Replacement, Port Townsend Wastewater Treatment Plant; City of Port Townsend, WA. Developed a water quality compliance evaluation for design of the replacement outfall diffuser. This replacement outfall will provide necessary effluent dilutions under all receiving water conditions. The evaluation of water quality compliance was based on the characteristics of the plant effluent and on the state water quality standards. A compliance evaluation was developed for specific diffuser design and operational parameters to achieve the necessary effluent dilutions under all receiving water conditions. The work included bathymetric and geophysical surveys, oceanographic and water quality measurements, a geotechnical exploration diver survey, outfall diffuser preliminary design and dilution modeling, and an eelgrass (diver) survey.

Kyle Winslow, PhD, PE

OUTFALL

EDUCATION

Ph.D., Environmental Fluid Mechanics, University of California at Berkeley

M.S., Environmental Water Resources, University of California at Berkeley

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

REGISTRATIONS/ CERTIFICATIONS

Professional Engineer: California

DISTINGUISHING QUALIFICATIONS

- Numerical modeling specialist with extensive experience in coastal and riverine hydrodynamics
- Experience includes a recent outfall project in the Columbia River bedform

Dr. Kyle Winslow has 23 total years of experience in environmental science consulting, and 15 years of experience specific to numerical modeling of coastal, estuarine, riverine, and reservoir hydraulics, waste-field transport, water quality, and sediment transport. He has extensive knowledge of hydrodynamic, hydraulic, sediment transport, and water quality numerical models from U.S. Army Corp of Engineers, U.S. Environmental Protection Agency, California Department of Water Resources (DWR), U.S. Bureau of Reclamation, and U.S. Geological Survey. His experience also includes modeling of 1-, 2-, and 3-dimensional circulation in bays and estuaries.

Relevant Project Experience

Bedform and Hydraulic Modeling Lead; Effluent Pipeline and Outfall Replacement Project; Clark Regional Wastewater District; Vancouver, WA. Developed hydraulic river model and bedform modeling alternatives to evaluate and predict the range of river bed elevations. Calibrated model predictions applied multiple bathymetric surveys in the vicinity of existing and proposed replacement outfall in the Columbia River Bedform evaluation used to inform outfall riser height modifications to avoid port burial.

Numerical Modeling Specialist; Hydraulic and Water Quality Impacts; Sacramento-San Joaquin Delta; Cities of Fairfield, Vacaville, and Benicia, CA. Applied the DWR's Delta Simulation Model II (DSM2) to quantify potential impacts to hydraulics and water quality throughout the Delta due to increased surface water withdrawals for three municipalities in the Sacramento-San Joaquin Delta. Salinity changes were investigated for a range of alternatives covering expected increases in withdrawals to supply population growth in the study area. Velocities in select locations were analyzed to ascertain whether increased pumping could cause an increase in suspended sediments in the water supply.

Bedform and Hydraulic Modeling Specialist; Outfalls 001 and 003 Rehabilitation; City of Portland Bureau of Environmental Services (BES); Portland, OR. Developed hydraulic river model and bedform modeling alternatives to evaluate and predict the range of river bed elevations Calibrated model predictions applied multiple bathymetric surveys in the vicinity of the BES Outfalls 001 and 003 and 4,000 feet upstream. Bedform evaluation used to inform outfall riser height modifications to avoid port burial.

Modeling Lead; Sutter Bypass Hydraulic Modeling; Central Valley Flood Protection Board (CVFPB); Sacramento, CA. Constructed an RMA2 Model of the Sutter Bypass, a 30-mile

long floodway off the Sacramento River, for the CVFPB and the California DWR to investigate existing flood channel capacity. The growth of vegetation in the bypass over several decades has reduced the flood control capacity of the bypass, and the hydrodynamic model was built as a tool to assist in planning vegetation management and achieve greatest water level reductions with limited maintenance fund.s The model was calibrated for existing conditions and used to determine levee freeboard under existing vegetation conditions for the project design flood of 385,000 cfs. Simulations were conducted to quantify the potential reduction in water level during flood conditions for a series of potential maintenance projects.

Modeling Specialist; Outfall Dilution Study; Confidential Power Company; San Francisco, CA. Performed an outfall dilution study on a discharge that varied from positively to negatively buoyant. Applied various dilution models to determine the dilution achieved for a wide variety of discharge conditions for a power company discharging to San Francisco Bay.

Numerical Modeling Specialist; Humboldt Bay Power Plant; Pacific Gas and Electric; Arcata, CA. Developed a two-dimensional hydrodynamic model for the plant's discharge canal and adjacent area of Humboldt Bay to investigate near field dilution under proposed alterations to the plant's cooling water discharge flows. The model predicted dilution with time subject to tidal exchange and was used to determine the dilution achievable by various batch discharge frequencies. Used the hydrodynamic model constructed for the dilution study to study the impacts of reduced cooling water discharges on sedimentation in the discharge canal.

Modeling Lead; Trinity River Restoration Program; City of Dallas, TX. Led a multi-dimensional hydraulic modeling and sediment transport analysis that utilized the USACE's RMA-2 and SED- 2D hydrodynamic and sediment transport models to construct and calibrate an existing conditions model of the Trinity River . The flow model was calibrated for a range of flows, including storm conditions generating spill from the channel onto the floodplain. The model was used as a baseline for comparison of proposed river realignments and modifications to the floodplain. Project size was a 10-mile reach of Trinity River (or a floodplain approximately 7 miles long and 2,000 feet wide).

Steve Mader, PhD, PWS

PERMITS

Steve Mader is a principal environmental technologist with more than 33 years of experience in corridor planning, permitting, alternatives analysis, environmental and wetland assessments, biological surveys, NEPA documentation, mitigation and landscape design, erosion control plans, and specifications for construction. He brings expertise in regional regulatory affairs and is fluent in local, state, and federal environmental permitting of in-water and environmentally sensitive work. Steve is experienced in NEPA/SEPA, environmental impact assessment, and design of constructed ecosystems, and environmental specification writing.

EDUCATION

Ph.D., Forestry, North Carolina State University

M.S., Silviculture, SUNY College of Environmental Science and Forestry

B.S., Forest Biology, SUNY College of Environmental Science and Forestry

REGISTRATIONS/ CERTIFICATIONS

Professional Wetland Scientist (PWS), Society of Wetland Scientists

Certified Senior Ecologist, Ecological Society of America

Certified Forester, Society of American Foresters

Certified Professional in Erosion and Sediment Control, EnviroCert International

DISTINGUISHING QUALIFICATIONS

- Specializes in Washington and Oregon ecosystems
- Provided full in-water work permitting services for Kellogg Creek, Tri-City, Rock Creek and Durham, Wilsonville, and Woodburn outfall projects
- Providing comprehensive permitting and environmental services during construction for replacing the Sellwood Bridge over the Willamette

Relevant Project Experience

Environmental Permitting Lead; Discovery Clean Water Alliance Effluent Pipeline and Outfall; Vancouver WA. Worked as the environmental lead to track and manage document preparation of over 20 permits for local, state and federal agencies. Prepared Environmental Compliance Matrix to communicate monthly with client on permitting status. Worked closely with archaeological and environmental subconsultants to ensure consistency of permitting messages for agencies. Closely coordinated with design team on all permitting requirements to facilitate obtaining all project environmental permits.

Environmental Permitting Lead; Wilsonville Riverbank Restoration and Outfall; City of Wilsonville, OR. Led all the permitting work and agency coordination for successful permitting of the replacement outfall. Led the riverbank restoration design and assisted during construction to ensure restoration met permitting requirements.

Project Manager; Innovative Wet Weather Program (IWWP); City of Portland Bureau of Environmental Services (BES), OR. Worked to identify and address prompt and proven actions that improve water quality and watershed health in Portland by reducing combined sewer overflow stormwater runoff peaks and volumes and associated pollutant concentrations, and by monitoring the effectiveness of green solutions as alternatives to expensive wastewater transport and treatment. Prepared the NEPA environmental assessment of EPA's decision to fund portions of the IWWP. That federal nexus triggered the project need for the preparation of a biological assessment, and to conduct Endangered Species Act and Magnuson Stevens Act consultations.

Permits Strategist; Outfall Repair; KapStone; Longview, WA. Prepared three-phase permit strategy for repairing an effluent outfall to the Columbia River that was damaged by a

ship anchor and buried by sediment deposits from the Cowlitz River.

Environmental Permits Lead; Outfall Repair; Wilsonville Wastewater Treatment Plant (WWTP); Wilsonville, OR. Obtained federal and state water permits, and National Marine Fisheries Service approval, for effluent outfall repair. Permits were secured in less than 2 months, allowing repairs in the in-water work window ending October 2014.

Environmental Permits Lead; Outfall Remediation Project; Tri-City Service District and Clackamas County Water Environment Services; Oregon City, OR. Provided permitting services to comply with the DEQ's Mutual Agreement Order for the Tri-City Water Pollution Control Plant. Compliance required water quality improvements for ammonia discharges to the Willamette River. Obtained wetland permits and performed ESA Section 7 consultation for outfall remediation and a new outfall diffuser in the Willamette River.

Environmental Review Lead; Oak Lodge Sanitary District; Oak Lodge, OR. Performed comprehensive State Environmental Review Process, including NEPA documentation and ESA Section 7 consultation, to support the District's Clean Water State Revolving Fund loan application.

Project Manager; North Clackamas Revitalization Area; Clackamas County Service District No. 1; Oregon City and Milwaukie, OR. Prepared strategy and NEPA documentation to address the DEQ Exhibit F Environmental Review to support the District's application for Clean Water State Revolving Funds related to the Johnson Creek Sanitary Sewer Collection System.

Environmental Lead; Wastewater Treatment Facility Upgrade; City of Woodburn, OR. Assisted with the evaluation of temperature reduction alternatives, performed initial environmental permitting assessment, conducted site reconnaissance for treatment wetlands, and obtained floodplain permit for demonstration wetland. Prepared DEQ Exhibit F Environmental Review to support the city's application for Clean Water State Revolving Fund related to the publicly owned treatment works temperature and winter ammonia reduction alternative for the Woodburn plant.

Contributor; Fish Friendly Erosion Control Program Project; Oregon Association of Clean Water Agencies (ACWA); OR. Assisted in an effort to relieve regulatory uncertainty and potential gridlock over the way federal agencies that administer the Endangered Species Act (ESA) treat municipal erosion control programs. Helped develop a model program that has been ESA-tested and protects ACWA members from ESA liability.

Project Manager; Durham WWTP Expansion; Clean Water Services; Tigard, OR. Performed alternatives analyses, assisted with engineering designs to minimize environmental impacts, prepared jurisdictional wetland delineations, determined wetland impacts, designed streambank bioengineering mitigation, and obtained the required permits.

Becki Kniveton, PWS

PERMITS

EDUCATION

B.S., Environmental Science Huxley College of Environmental Studies, Western Washington University

REGISTRATIONS/ CERTIFICATIONS

Certified Professional Wetland Scientist, 2007

WSDOT Certified Biological Assessment Writer, 2004

DISTINGUISHING QUALIFICATIONS

- Excellent working relationships with permitting agencies, resulting in efficient and predictable outcomes
- Deep understanding of local, state, and federal permitting requirements, applications, and processes
- Experience managing multiple permits with multiple stakeholders

Becki Kniveton is a biologist and permitting specialist with more than 20 years of experience meeting the permitting requirements and timelines for federal, state, and local permits. She has extensive experience completing State Environmental Policy Act (SEPA) documents to comply with local agency requirements, and Joint Aquatic Resources Permit Applications (JARPAs) for U.S. Army Corps of Engineers (USACE), Washington Department of Ecology (Ecology), and Washington Department of Fish and Wildlife (WDFW) permits. She has prepared categorical exclusion checklists for Pacific Northwest area programs projects and other NEPA/SEPA permit application documents. Becki has extensive experience performing wetland and stream delineations, completing mitigation and restoration plans, and writing biological assessments

Relevant Project Experience

Environmental Lead; Forest Road (FR) 1106 Culvert Removal and Bridge Installation; Puget Sound Energy; Whatcom County, WA. Project involved replacing a temporary bridge and two failing 10-foot culverts with a permanent bridge. This work was located on United States Department of Agriculture (USDA) Forest Service property but was initiated and funded by Puget Sound Energy because FR 1106 is the main access road to the Upper Baker Dam. The project was deemed an emergency because the culverts span Sulphur Creek, which has known bull trout spawning habitat downstream of the bridge, and the culverts were likely to be washed out and deposited downstream with the upcoming winter flooding. Based on the fish window for this stream system, the team had 1 month to remove the culverts and complete all in-water work. Completed the wetland delineation and JARPA. Through close coordination with the USACE and WDFW, obtained a Section 404 Nationwide Permit and Hydraulic Project Approval (HPA) for the project in 2 weeks. Based on this quick turnaround, the culverts were removed and all in-water work was completed in the allotted time.

Biology Lead and Environmental Manager; Lynnwood Link Extension Northgate Station to Lynnwood Transit Center; Sound Transit; Lynnwood, WA. Involves building high-capacity light rail transit within the Cities of Seattle, Shoreline, Mountlake Terrace, and Lynnwood. The project will impact 25 wetlands and eight stream corridors. Managed the wetland and stream delineation fieldwork and the mitigation plan, in-lieu-fee use plan, and critical areas report preparation. Also managed the preparation of all local, state, and federal permit applications. Construction of this project will begin in 2019.

Environmental Lead; Newport Way; City of Bellevue, WA. This road improvement project included the alternative analysis through final design of roadway improvements for

approximately 4,500 linear feet of arterial roadway to enhance corridor safety and provide continuous non-motorized facilities along a constrained corridor. Managed the wetland and stream delineation, conceptual mitigation design, permit application preparation, and USACE, Ecology, WDFW, Muckleshoot Indian Tribe, and City of Bellevue agency coordination. This project is currently in final design.

Biology Lead; West Sammamish River Bridge/68th Kenmore; City of Kenmore, WA. This bridge replacement project will replace the existing two-lane bridge over the Sammamish River with a new two-lane bridge with an added 16-foot-wide bicycle and pedestrian path that meets current Americans with Disabilities Act standards. This WSDOT Local Programs project will have in-water work in a salmon-bearing stream and includes work on a Section 4(f) (public park) property. Conducted the wetland and stream delineation and biological assessment for this project, and has been providing agency coordination with USACE, Ecology, WDFW, and City of Kenmore planning staff. Construction of this project will begin in 2020.

Lead Biologist; Deming Levee Extension, Whatcom County Flood Control District; Whatcom County, WA. Project included extending the Deming Levee 1,000 feet to prevent overtopping of the existing substandard structure. Conducted a wetland and stream delineation to document baseline conditions and prepared a biological assessment to evaluate the project's impacts to federally listed threatened and endangered species. Also coordinated with the project team to design a new levee that minimized wetland and stream impacts. Based on the project hydrologic monitoring, prepared a mitigation plan to create additional wetlands and stream channel habitat on site to compensate for project impacts. This project was completed in 2017.

Environmental Lead; 244th Avenue NE Improvements Project; City of Sammamish, WA. This project widened existing portions of 244th Avenue and connected the 244th Avenue corridor with a bridge that spans one of the City's Category I wetlands. Verified the wetland boundary, quantified project impacts, and prepared the wetland mitigation design. Using a combination of on-site mitigation and purchasing credits at an off-site mitigation bank, saved the City significant budget by avoiding costly purchase of private property. Obtained all local, state, and federal permits and testified at the local hearing when the project was contested by nearby property owners. This project was completed in 2010.

Sonya Reiser, PE

HYDROELECTRIC GENERATION

EDUCATION

B.S., Mechanical Engineering, Baylor University

REGISTRATIONS/ CERTIFICATIONS

Professional Engineer: Colorado (No. 43346), Washington (No. 50175)

DISTINGUISHING QUALIFICATIONS

- Expertise conducting hydropower studies and facility design
- Familiar with the FERC process as well as U.S. Army Corp of Engineers and U.S. Bureau of Reclamation requirements for implementing hydropower projects in the United States.
- Process mechanical experience includes gates, valves, and pumps specification and design, equipment inspection, and refurbishment coordination and design

Sonya Reiser has 17 years of experience in engineering projects and works as design manager and technical lead on hydropower and other water projects for state and local government, private, and national government clients. Technical mechanical engineering roles on water projects include equipment specification, design, and equipment inspection. As design manager, she is responsible for multidiscipline design teams across various offices. Sonya's hydropower experience includes domestic and international project work from studies to design to owner's engineer role on construction projects.

Relevant Project Experience

Hydropower Engineer; Denver Water, CO. Task lead responsible for evaluating the technical and economic feasibility of adding hydropower to the inlet to a new 150-million-gallons-per-day Water Treatment Plant. Hydropower at this location will help meet the Utility's net-zero energy goals for the new facility. The capacity of the hydropower unit is estimated to be about 575 (kilowatts) kW, and would parallel pressure-reducing valves in the headworks facility.

Lead Hydro-Mechanical Engineer; Central Utah Water Conservancy District. Responsible for vendor pre-qualification, Francis turbine equipment procurement, and plant mechanical design for a 12-megawatt (MW) hydropower facility at the existing Olmsted Hydroelectric Power Plant site. The existing historic power plant will be converted to a museum featuring the century old hydropower facility, and a new hydropower plant will be constructed at the same site.

Hydropower Engineer; City of Fort Collins, CO. Designing 65-kW hydropower facility at the existing Fort Collins water treatment facility. The new hydropower unit will parallel an existing pressure reducing valve designed to reduce the pressure head of water entering the water treatment facility from Horsetooth Reservoir. The hydropower production will offset the amount of energy consumed by the facility in a net-metering arrangement.

Hydropower Facility Lead; United Utilities. Designing 430-kW hydropower facility at the inlet to the Oswestry Water Treatment Works facility in the United Kingdom. The hydropower facility is a portion of the overall design build water treatment works upgrade project.

Hydropower Engineer; City of San Diego Public Utilities Department, CA. Evaluating the feasibility of adding hydropower to seven sites in the Department's water and wastewater delivery systems to meet the City's Climate Action Plan. The micro-hydropower units ranging in size from 1,200

kW to 20 kW would parallel existing pressure reducing elements at each site.

Hydropower Engineer; Eastern New Mexico Water Users Association. Studied the possibility of adding hydropower to five locations in the design of a new water treatment and distribution facility. The micro hydropower units ranging in size from 270 kW to 14 kW would parallel existing pressure reducing valves in the system.

Hydropower Engineer; Northern Colorado Water Conservancy District. Design manager responsible for the final design of a 1.2-MW hydropower facility at the existing Granby Dam owned by the U.S. Bureau of Reclamation (USBR). The project includes tying into the existing outlet works piping with a new 36-inch-diameter steel pipe suspended from the roof of an existing 11.5-foot-diameter concrete lined tunnel. The new powerhouse located at the toe of the dam, houses two 600-kW horizontal Francis turbines.

Hydropower Engineer; Metropolitan District of Connecticut. Evaluating the feasibility of including hydropower on the pipeline between Reservoir 6 and Reservoir 5, which feeds the West Hartford Water Treatment Plant. The small hydropower facility could generate up to about 300,000 kWh annually.

Experience Prior to Jacobs

Design Manager; 45-Mile Hydropower Project; OR. Managing design-build of a 3-MW run-of-canal hydropower facility on an existing USBR irrigation canal. The project includes an intake and bypass structure, steel penstock, powerhouse with three vertical fixed blade turbine/generator units, and a discharge structure.

Hydropower Project Engineer; Abiquiu and El Vado Hydroelectric Plant Design and Inspection; NM. Design-build of a 3-MW addition to the existing 14-MW Abiquiu hydroelectric facility. Conducted mechanical and electrical condition assessment of the approximately 25-year-old Abiquiu and El Vado hydroelectric plants. Prepared budget estimates for the County's capital improvement plan.

Hydropower Project Engineer; Small Hydropower Development; WA. Performed feasibility analysis of eight small hydropower projects ranging from 500 kW to 3.5 MW on the GCPHA canal irrigation system. Also involved in planning of the 1,000-MW North Dam pumped storage project.

Hydropower Design Manager; Roza Canal Hydrokinetic Project; WA. Conceptual and final design of the structural, mechanical, and electrical components of a support structure for a 25-kW prototype hydrokinetic turbine in an existing canal.

Task Manager; Lower Sunshine Hydropower Project; WY. FERC project coordinator for the 5-MW exemption process for the addition of a 5-MW hydropower plant at the discharge of the existing pressure reducing valve at the dam outlet.

Hydropower Project Engineer; Ilopango Hydropower Feasibility Project; El Salvador. This 20-MW hydropower feasibility study funded by USTDA. Project work includes technical, social, environmental and financial components. For USTDA/Ingendehsa.

Hydropower Project Engineer; Plateau Creek Hydro Feasibility Study and Preliminary Design; CO. Feasibility study and conceptual level design for 600-kW small hydropower project at an existing pressure reducing valve vault.

Hydropower Project Engineer; Santa Fe Canyon Hydropower; NM. Design of a 90-kW hydropower facility on an existing municipal water system. Included pump-turbine technology at an existing pressure reducing valve.

Todd Cotten, PE

GEOTECHNICAL ENGINEERING

EDUCATION

M.S., Engineering/Geotechnical Engineering, Colorado State University

B.S., Civil Engineering, Colorado State University

REGISTRATIONS/ CERTIFICATIONS

Professional Engineer: Oregon, 1998 (No. 58496); Washington (No. 55243); Virginia (No. 0402058342)

DISTINGUISHING QUALIFICATIONS

- Extensive experience performing geological hazard assessments for projects across Oregon, with specific focus on seismicity, liquefaction and lateral spread, tsunami, and landslides

Todd Cotten is a senior geotechnical engineer with 25 years of professional experience on a variety of water and wastewater, energy, and transportation projects. His project experience includes a variety of design and construction projects, including large wastewater and water treatment facilities, water reservoir tanks, large-diameter pipelines, earth dams and levees, highway expansion, auger boring, horizontal directional drilling, landslide investigation and stabilization. His construction management roles include work on numerous challenging geotechnical sites, roadways, bridges, pipelines, water and wastewater treatment plants, braced excavations, ground improvement, and trenchless pipeline installations.

Relevant Project Experience

Lead Geotechnical Engineer; Pipeline Main 5.0 Segment; Willamette Water Supply Program (WWSP); Beaverton, Oregon. Project includes the evaluation and design of approximately 7.5 miles of 66-inch and 36-inch-diameter welded steel pipeline as part of PLM_5.1, 5.2, and 5.3 segments of the WWSP. Lead a multi-firm effort to plan, coordinate, and complete a large geotechnical field exploration program consisting of over 100 geotechnical borings, more than 50 cone penetration test (CPT) probes, and geophysical surveys including seismic refraction and electrical resistivity imaging. Managed the field program and assisted with permitting and discussions with land owners to obtain right-of-entry agreements. The project involves one segment of trenchless pipe installation beneath an existing bridge and drainage. Required a detailed evaluation of seismic design requirements with the level of service goal for the pipeline to remain fully operational following a 2,500-year return interval seismic event. The seismic design is dominated by the Cascadia Subduction Zone event, but also includes contribution from local crustal faults. Detailed assessment of liquefaction triggering susceptibility, evaluation of residual soil strengths, potential for slope failures both during and following the design seismic event has been completed for the project and presented to a peer-review seismic design group. Participated in a seismic design working group to review and set seismic design criteria for the project and to review seismic designs completed by other consulting teams for other segments of the pipeline project.

Geotechnical Task Lead; Colwood Pipeline Project; Port of Portland; Portland, OR. Lead geotechnical engineer for design of a 72-inch-diameter reinforced concrete stormwater pipe to connect McBride Slough to Columbia Slough. The project, which included design of intake and outfall structures on the banks of the two sloughs, had segments of pipeline with burial depths more than 25 feet. Responsibilities included

developing and overseeing the geotechnical exploration and laboratory testing program, geotechnical and seismic design, development of geotechnical data and recommendation reports, and providing observation during construction.

Lead Geotechnical Engineer; Kinsman Road Pipeline; WWSP; Wilsonville, OR. Led the geotechnical evaluation and design of 3,000-foot section of 66-inch-diameter water supply pipeline. This welded steel transmission main is located adjacent to and beneath a new segment of Southwest Kinsman Road, between SW Barber Street and Boeckman Road. The pipeline is being designed to remain operational following the 2,500-year return interval seismic event. Designing to this event involves careful evaluation of liquefaction susceptibility of underlying soil, assessment of static and seismic slope stability and flow failure mechanisms, and consideration for other seismic risks such as fault rupture and impacts from nearby utilities that could be damaged during a seismic event. The project involved one segment of trenchless pipe installation completed using open-face pipe jacking to pass beneath an existing 24-inch-diameter water supply pipeline. This pipeline is located in an area of high groundwater, along a BPA transmission corridor, and the design was completed on a compressed design schedule to allow construction at the same time as the new road.

Geotechnical Engineer; Will Crandall Reservoir; City of Hillsboro; Portland, OR. This $26 million project includes a 10-million-gallon AWWA D110 wire wound concrete reservoir and 20-million-gallons-per-day (mgd) pump station. The soils at this particular site were determined to be highly susceptible to seismic induced liquefaction to depths of up to 100 feet. Alternative methods evaluated for mitigation of the liquefiable soils beneath the reservoir and pump station included deep driven piles, cement deep soil mixing (CDSM), and jet grouting. CDSM was selected as the least cost and least disruptive alternative and an extension ground improvement program was incorporated into the contract. Assisted with development of earthwork and ground improvement specifications and coordinated with construction management staff to perform geotechnical observations during construction.

Geotechnical Task Lead; Oregon Pipeline Project; LNG Development Company, LLC, and Oregon Pipeline Company, LLC (doing business as Oregon LNG); Warrenton, OR. Lead geotechnical engineer for pipeline corridor assessment and evaluation of geologic hazards for 87 miles of proposed 36-inch-diameter natural gas pipeline running between a proposed terminal in Warrenton, Oregon and the City of Woodland, Washington. Between August 2007 and March 2009 managed and supervised geotechnical field explorations at 11 proposed river, levee, and highway crossings where horizontal directional drilling (HDD) installation methods would be used to construct the proposed pipeline. The HDD crossings include three bores with proposed lengths greater than 4,500 feet. Authored the Geologic Resources Report for the Federal Energy Regulatory Commission (FERC) permitting process. Currently working to develop a Section 408 permit application for the U.S. Army Corps of Engineers for pipeline crossings of flood control levees and navigation channels, including the Columbia River. Work included evaluation of geologic hazards along the 87 miles of pipeline. Geologic hazards evaluated included seismic ground shaking, landslides, liquefactions, subsidence, and flooding. Conducted meetings with landowners to discuss geologic conditions and concerns, performed reviews of the pipeline route to evaluate and avoid areas of high landslide potential, and provided internal review and updates to the geotechnical investigation report and site-specific seismic hazard evaluation.

Geotechnical Engineer; Bend Southeast Interceptor Segment 6; City of Bend, OR. Involved during final design of Segment 6. The project included 3,400 feet of 18-inch gravity interceptor and 450 feet of 8-inch gravity collector and the relocation of 900 feet of sewer forcemain.

Geotechnical Task Lead; Wilsonville Wastewater Treatment Plant; City of Wilsonville, OR. Completed geotechnical design and developed earthwork specifications as part of this $34 million design-build-operate project for a major retrofit of a 4-mgd facility.

Geotechnical Task Lead; Durham Advanced Wastewater Treatment Plant Phase 5B2 Primary Treatment and Hydraulic-Capacity Improvements; Clean Water Services; Washington County, OR. Involved design of a new biofilter, headworks effluent structure, roadway improvements, and 1,000 feet of 48-inch-diameter primary influent pipeline. Completed geotechnical analyses and developed earthwork recommendations for facility foundations, trench excavation, backfill, and shoring.

Appendix I.
Proposal Price Form

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