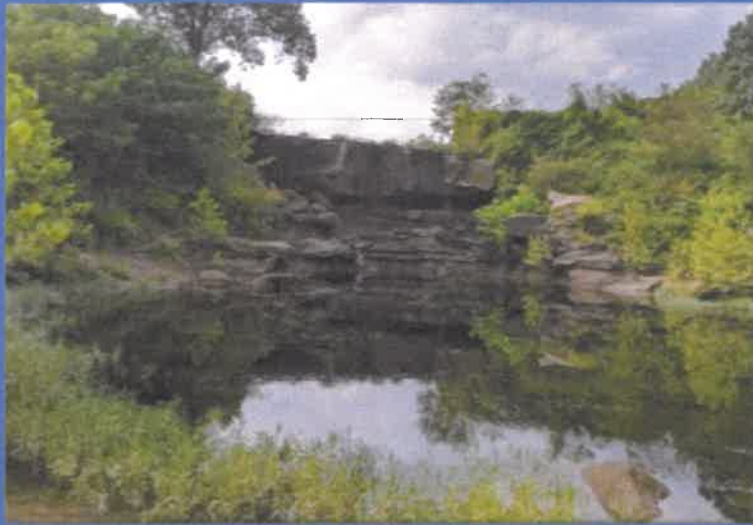


Pendleton Lake Dam Renovations

Blackwater Falls State Park, Tucker County, West Virginia

06/21/23 09:37:21
WV Purchasing Division



Solicitation No.: CEOI 0310 DNR2300000005

June 22, 2023



2800 Corporate Exchange Drive, Suite 360
Columbus, Ohio 43231
(614) 289-0112



June 22, 2023

Josh Hager
State of West Virginia
Department of Administration, Purchasing Division
2019 Washington Street East
Charleston, WV 25305-0130
Fax: 304-558-3970

RE: Expression of Interest for Pendleton Lake Dam Repairs, Solicitation No.: CEOI 0310 DNR2300000005

Dear Mr. Hager,

On behalf of Tetra Tech, please find attached our Expression of Interest for Pendleton Lake Dam Repairs. We understand that the scope of services is to provide design and construction administration services for the renovation of the dam.

Our team will be led by Pete Nix, PE, who has more than 37 years of experience delivering flood risk management projects to clients across the country. Our team provides the state the following distinct advantages:

- Experience with hydrologic, hydraulic and flood routing analyses
- Experience in performing geotechnical analyses pertaining to embankment stability and seepage
- Experience with seepage analyses for earthen embankments
- Experience with assessments of lake drain structures and gates
- Experience in performing structural analyses pertaining to integrity of concrete structures
- Large, experienced team able to commit additional resources, as needed, to meet the project schedule.

We look forward to the opportunity to apply our proven and trusted experience to address this challenging project. Please feel free to contact me to discuss our qualifications or if you have any questions.

Sincerely,
Tetra Tech, Inc.

A handwritten signature in blue ink that reads 'Pete Nix'.

Pete Nix, PE

Project Manager

Prime Contact:

Pete Nix, Project Manager

(614) 289-0117

Pete.Nix@tetrattech.com

1. Project and Goals

We understand that dam improvement projects can require coordination with multiple stakeholders from multiple agencies. As such, communication between Tetra Tech's Project Manager and the State of West Virginia's Project Manager is essential, and it is understood that only West Virginia's (WV) designated Project Manager (PM) can authorize changes in our contract and work. We anticipate establishing a regular progress meeting that can include all appropriate stakeholders.

1.1 Goal/ Objective 1

To start our work, Tetra Tech will review the available existing information. Our intent is always to build upon the existing information, supplementing with additional investigations and analyses as appropriate. It is anticipated the available information may include:

- WV Dam safety inspection reports
- Owner's inspection reports
- Phase 1 report
- Past investigations
- Past engineering analyses
- Topographic surveys
- Construction bid documents
- As-built documents

Based on the RFQ, it is our understanding that trail improvements are planned near the dam, and that our work will need to be coordinated with the trail work.

Tetra Tech understands that the dam is located within a popular State Park. As such, we will work with West Virginia Department of Resources (WVDNR) Division of Parks & Recreation to assess limitations during construction, such as, whether the pool needs to be maintained during construction. Depending on the required improvements, lowering the pool may reduce construction costs, but this needs to be balanced with the Park's needs.

Further, we will work with WVDNR to identify operational issues with the existing facilities and evaluate possible improvements. This may include rehabilitating or improving existing gates and valves, improving access to the site with new roadways, or adding public safety features such as warning buoys, signs, and barriers.

We will also collaborate with our permitting experts to identify any areas that require special protection during our field work or construction, or if the construction period needs to be limited based on seasons of flora or fauna to minimize impacts. Historical issues will be addressed in consultation with both WVDNR and SHPO.

As part of our initial work, we expect to complete a visual inspection of the existing dam and associated features, such as the emergency spillway and abutments. Based on these observations and our review of the available information, we'll assess if additional investigations are appropriate, which could include:

- Remote or hands-on inspection of the principal spillway conduit;
- Geologic mapping of the emergency spillway;
- Subsurface investigations;
- Geophysical surveys;
- Bathymetric and/or topographic surveys;
- Inspection of existing concrete features with use of hand tools and/or obtaining concrete cores.

Permitting

We understand that a Certificate of Approval from WV Dam Safety will be required for the design of improvements. In addition to that, Tetra Tech proposes to develop a list of required permits and anticipated regulatory requirements. We have routinely worked with the following regulatory agencies on past projects:

- US Army Corps of Engineers – Clean Water Act Section 404
- US Fish and Wildlife Service – Endangered Species Act
- State Historic Preservation Office (SHPO) for all cultural regulations.
- State and US EPA



From historical kiosk at Tetra Tech's North Reservoir project

1.2 Goal/ Objective 2

Tetra Tech understands that the next goal is to provide all necessary design services. As expanded in **Section 2.3 "Experience & Past Performance"**, Tetra Tech has provided design services for similar projects and is prepared to do so for this project.

In addition, we understand that agencies have allocated budgets, and the proposed improvements need to be designed within those limits. We utilize several approaches to help us work within the available budgets. The first step is to control our design budget. We anticipate scoping and completing our work in phases, such that at the end of each phase, we'll have a defined scope of work for the next phase. This way, only the elements that will be advanced to final design are included in our scope of work.

Risk Assessment

A risk assessment, such as a potential failure mode analysis (PFMA) or semi-qualitative risk assessment (SQRA) may help direct work into the areas that present the largest risk (defined as the combination of potential and consequences of failure). In addition, it can be useful to help prioritize potential improvements and even present some cost-benefit analyses. Lastly, a detailed risk assessment could potentially change the classification of the dam, if it is determined that the downstream hazards are less than anticipated. Tetra Tech has extensive experience completing risk assessments for dams across the United States.

Evaluations

It is anticipated that, at a minimum, Tetra Tech will evaluate the following items:

- Seepage and stability analyses of the embankment;
- Condition of the emergency spillway, including erodibility of the rock cut,
- Ability to pass the design storm.

In evaluating whether the dam can safely pass/store the design storm, Tetra Tech evaluates and documents six options:

1. Increase storage
2. Increase discharge
3. Increase both storage and discharge
4. Overtopping protection
5. Lowering classification
6. Decommissioning

In addition, Tetra Tech has experience with some of the more problematic specifications such as dewatering and cofferdams during construction. In our experience, providing project-specific versions of these specifications, that reflect the site constraints and conditions, can reduce the contractor's evaluation of risk and the potential for disputes

Cost Estimating

Tetra Tech understands that developing accurate estimates of probable construction cost matters is important, since any proposed improvements need to fit within the available budgets. This has proven to be a challenge in the current market, where significant increases in some work items have occurred. To help with our estimating, Tetra Tech has a center of expertise for cost estimating and cost engineering for dam, levee, and civil works projects nationwide. Our cost engineering group uses the latest software and methods for developing and evaluating potential construction costs. In addition, we have the ability to perform cost and schedule risk analysis on our projects, which allows us to analyze specific projects risks at any point in the design process. The risk analysis would ultimately produce a contingency based on either a quantitative or qualitative assessment of project/location/market specific risks.

As part of our cost estimating, we consider the following:

- USACE Escalation Factors from EM 1110-2-1304, which are updated every 6 months, in September then March. These breakout escalation by various civil project types.
- Use of escalation indices from third parties including RS Means and Marshall & Swift.
- Tracking the local market and escalation values used by other entities. This has the disadvantage of being more focused on vertical construction.

In addition, we have experience with utilizing different strategies that may help reduce the impacts to this project, including:

- Use of escalators for fuel and materials;
- Bidding Alternates for some work items (such as recreational improvements);
- Including Allowances for some work items, such as roadway repairs.
- Alternate delivery models, such as Construction Manager as Constructor.

Quality Assurance and Quality Control

As one of the nation's leaders in the design of dams, levees, and other water resource projects, Tetra Tech and our proposed project manager is committed to providing a quality and successful project for our clients that exceeds their expectations. We meet this commitment by using only experienced managers and senior engineers, following our internal QA/QC protocols, and work and design reviews by discipline leads that have significant and relevant experience in dam design and modifications. As part of our QA/QC program, Tetra Tech will prepare and submit a Quality Control Plan (QCP) for the contract. The QCP will describe:

- Procedures that will be implemented by Tetra Tech to assure quality control
- Breakdown of the responsibilities of each member of the project design team
- Project management notification processes and protocols

Discipline leads will review all critical work items. Mr. Doug Lantz will be assigned to review the work on this project. They will be selected based on the nature of the work performed. Tetra Tech's quality assurance and control program is designed to:

- Actively include all levels of project management in the quality assurance and control program
- Ensure that quality assurance and control is an integral part of the project and not just an "end of job" review. We believe this is critical to providing a quality deliverable to the client on time and within budget
- Consider quality objectives and standards as equal or superior to budget and schedule considerations in all project management decisions
- Review adequacy of budgets and schedules for performing the work
- Commit necessary resources to achieve the project objectives
- Ensure frequent communication on progress of the work, problems, and accomplishments
- Provide periodic review of project performance related to the planned schedule and budget goals

1.3 Goal/ Objective 3

Tetra Tech's team has extensive experience with Construction Administration (CA) on dam rehabilitation and flood control projects. We develop Construction Monitoring Plans for our dam construction projects. Tetra Tech can provide and recommends the following services during the CA processes:

- Experience with CA services on similar projects
- Intend to utilize staff from Morgantown
- Project Manager stays involved through close-out activities
- Testing services
- Construction Monitoring Plans
- Dispute Resolution

Joe Troxell is the Construction Administration Discipline lead. In this role, Mr. Troxell will manage the office requests and design questions during construction, perform critical inspection tasks where an engineer is required and coordinate with other engineers to verify design and construction. He has over 25 years of construction administration experience with dam safety projects including the Furl Williams Reservoir (\$15m construction cost), Dow Lake Dam at Strouds Run State Park for ODNR (\$3m construction cost), and he worked with the State of Ohio on their Owner-Agent agreement providing construction support.

Mr. Troxell has experience with alternative dispute resolution, having participated in several mediation sessions with the State of Ohio as part of the Owner Agent contract. He was actively involved in resolving a dispute on one project, where a Change Order for approximately \$35,000 was negotiated to resolve over \$400,000 in dispute on the project. In addition, Tetra Tech, he provided construction administration on several projects, including the Portage Lakes North Reservoir project, the Kirkersville Channel Improvements, Mad River Stream Bank Stabilization, Rocky Fork Dam Improvements, Lake Louella Dam Improvements, and the City of Sharonville Drainage Improvements. He has also provided expert witness services on two projects in Ohio to resolve disputes.

Jack Wright, in our Morgantown, WV office, will be supporting Mr. Troxell with the construction administration services. Materials testing during design and construction will also be performed in the Morgantown office. Mr. Wright specializes in exploratory drill inspection, foundation construction monitoring, and pressure injection grouting. During his career, he has inspected exploratory drilling projects and logged samples in West Virginia, Colorado, Kentucky, Maryland, New Mexico, New York, Ohio, Pennsylvania, Texas, Virginia. Mr. Wright has experience inspecting earthwork construction including natural gas well pad builds, earthen embankments, access roads, and slope remediation. Mr. Wright has monitored the installation and stressing of high-capacity rock anchors for slide remediation and foundation uplift resistance applications. Recently, Mr. Wright has assisted with the closure of CCR impoundments by providing field support for installation of instrumentation and monitoring equipment.

The Tetra Tech team understands that the most effective solution is to address construction issues in a prompt and direct fashion, following the contract requirements, and reaching a mutually agreed resolution through the Change Order process.

Construction Testing: The Tetra Tech team will schedule and observe construction material testing. Results will be reported with our weekly progress reports. It is anticipated that testing will possibly consist of density testing (possibly fill or RCC), concrete testing (field and laboratory), and lab testing of imported fill materials.

Site Visits and Construction Observation: Site visits will be made by Tetra Tech to observe, document, and report to WVNR and the Contractor whether the project is being constructed in general accordance with the contract documents. In addition, the measurement of unit price quantities will be reviewed, and the completed percentage of lump sum work items will be estimated. Tetra Tech's Project Representative will be present at the site as requested by WVDNR. He will observe, record, and report the progress and degree of compliance of each Contractor working at the site.

If any work is found to be unsatisfactory, faulty, or otherwise does not conform to the project requirements, our Project Representatives will immediately contact Tetra Tech's Project Manager who will immediately notify WVDNR's Project Manager.

Some examples of our past work were a part of the North Reservoir project. The project required a placement plan, and a test section for roller compacted concrete (RCC) for the on-site batching. During the test section issues were noted with the moisture content of the delivered material, bonding between layers of RCC, and overall strength results for the cores broken as part of the QA process. After several iterations, the placement plan was approved. It allowed for more control of the material, additional testing by both the QA and QC, visual inspections by the contractor and Tetra Tech, and a comprehensive acceptance procedure that would allow for unsuitable material to be refused in a streamlined process.

If necessary, Tetra Tech team will interpret or clarify the contract documents for WVDNR or the Contractor. Tetra Tech will assist WVDNR, if necessary, regarding any contractual issues or concerns that arise during construction.

These issues or concerns could include lien affidavits, the Contractor's workmanship, materials, progress, and overall compliance with requirements of the Contract Documents, contract termination, and project acceptance and close-out.



RCC Placement at North Reservoir Dam East Embankment



Rubber Dump encountered at North Reservoir Dam

Tetra Tech has experience working with Contractors to develop recovery schedules and minimize schedule impacts. As an example of our work addressing unforeseen conditions during construction, during construction at North Reservoir, a rubber dump was encountered in the work limits. This issue presented potential schedule impacts due to the tight sequencing of the work in this area, which had not considered the need to remove and replace waste materials. Tetra Tech worked with the contractor to develop a plan to locate the debris that fell within the work limits, testing debris found for hazardous materials, and to develop an action plan to address encountering additional material.

2. Qualifications, Experience, and Past Performance

2.1 Firm Abilities & Expertise

Tetra Tech, Inc. was founded in 1966 to provide engineering services for waterways, harbors, and coastal areas and has grown to be a leading provider of consulting, engineering, and technical services, with more than 22,000 associates worldwide. The office that will be leading any project efforts is located in Columbus, Ohio.

PRIME CONSULTANT

Tetra Tech, Inc.
2800 Corporate Exchange Drive, Suite 360
Columbus, Ohio 43231
www.tetrattech.com

CONTACT PERSON

Pete Nix, P.E.
(614) 289-0117 Office
(614) 572-6237 Cell
pete.nix@tetrattech.com

Over the past 50 years, Tetra Tech has built a legacy of *Leading with Science®* by bringing together the best technical experts using the latest tools and technologies to provide our clients with innovative and sustainable solutions to address their water, environment, infrastructure, resource management, and energy challenges across the US and around the world. These services include feasibility and planning studies, engineering designs, design documents, cost estimating, environmental investigations, geomatics data collection and processing, geotechnical investigation and analysis, numerical modeling, construction, and inspection services.

Tetra Tech has used its national experience, significant depth of qualifications and resources, and comprehensive understanding of flood risk management to support our government and private sector clients throughout our 56-year history. Some of our government clients include The Miami Conservancy District, The Ohio Department of Natural Resources, Natural Resources Conservation Service (NRCS), and more than 30 Corps of Engineers Districts. Tetra Tech is ranked # 1 in Water and the #4 Design Firm by Engineering News-Record (ENR). Tetra Tech's water resources management division specializes in the analysis, planning, and design of projects encompassing hydrology, hydraulics, geomorphology, sediment transport, erosion and sedimentation, computer modeling, hydraulic design, flood control, floodplain management, reservoirs and dams, water quality, water supply, hydropower, stream bank erosion protection, and environmental compliance for flood control projects.



Smart Services, Inc. has more than 27 years of experience in the surveying field and environmental permitting consisting of but not limited to boundary surveys, topographic surveys, construction staking and preparation of record documentation such as subdivision platting, writing legal descriptions for roadway dedications, property descriptions, easement descriptions, 401/404 permits, and Section 106 applications. The firm is licensed in the State of Ohio as a surveying firm;

EDGE-certified with the State of Ohio; and prequalified by ODOT for limited right-of-way plan development. Tetra Tech has worked with Smart Services on past projects in the Portage Lakes System.

For any geotechnical drilling or concrete coring services needed, Tetra Tech will reach out to firms in the area. It is anticipated that **Triad** or **PennDrill** might be used for these services.

Tetra Tech is committed to the standard of care at the highest level within the dam safety industry. Our dam safety professionals continually improve our design approaches using the latest engineering guidance from multiple sources, including but not limited to the following examples:

- West Virginia’s dam safety statutes and regulations (WV Code Chapter 22, Article 14, Dam Control and Safety Act and 47CSR34 Dam Safety Rule).
- FEMA guidance; Federal Guidelines for Dam Safety (FEMA 93) Federal Guidelines for Dam Safety Risk Management (FEMA P-1025), Emergency Action Planning (FEMA P-64), Inundation Mapping for Dam Failures (FEMA P-946), Technical Manual Conduits through Embankment Dams (FEMA 484), Technical Manual Overtopping Protection for Dam (FEMA P-1015), Filters for Embankment Dams – Best Practices for Design and Construction, Evaluation and Monitoring of Seepage and Internal Erosion (FEMA P-1032)
- Natural Resources Conservation Service (NRCS); National Engineering Handbook Part 628 Dams, Part 630 Hydrology, Part 633 Soils Engineering. Technical Release Bulletins; Technical Release 55 Urban Hydrology for Small Watersheds and Technical Release 210-60 Earth Dams and Reservoirs
- U.S. Army Corps of Engineers publications; Engineering Manuals (EM), Engineer Regulations (ER), and Engineer Technical Letters (ETL)
- U.S. Bureau of Reclamation Design of Small Dams, Design Standards 13 and 14, ACER Technical Memo No. 11 Downstream Hazard Classification Guidelines

Tetra Tech’s technical expertise have allowed us to develop industry leading innovations such as the soil-cement gravity overtopping structures constructed at East Reservoir Dam and North Reservoir Dam at the Portage Lakes State Park. Following industry standards, we aim to provide long lasting designs with a project service lives between 50 and 100 years. Equally important, we envision ourselves as the dam owner to create a sustainable design that is maintenance friendly. We routinely work with the owner’s dam safety staff and field personnel to make sure our designs not only meet engineering design standards but also include design elements that are user friendly to operate and maintain.

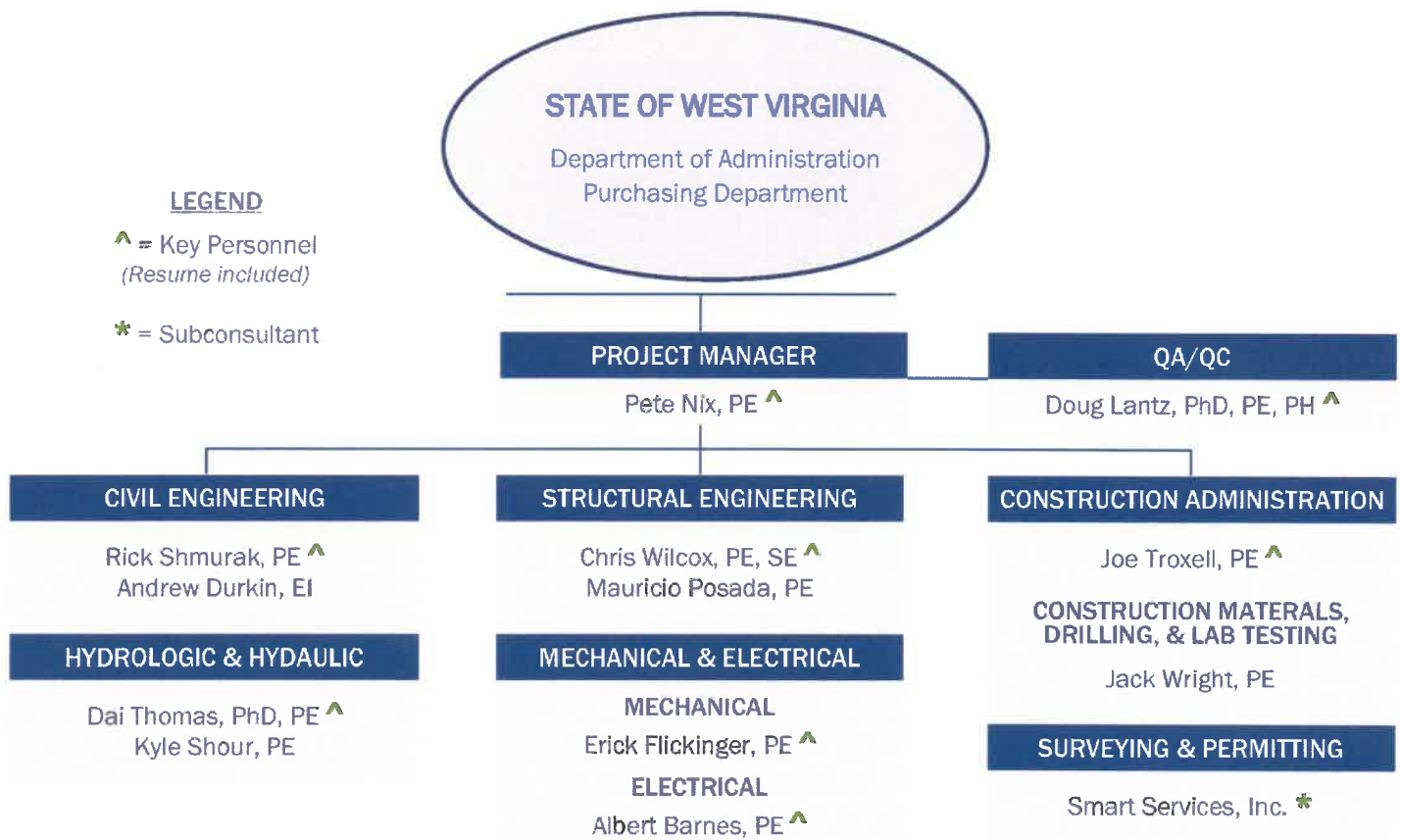
Water	Resources	Environment	Infrastructures	Energy
<ul style="list-style-type: none"> • Water Resources • Coastal/Marine • Drinking Water • Ground Water • Wet Weather Infrastructure/ CSOs • Wastewater • Water & Agriculture 	<ul style="list-style-type: none"> • Oil & Gas • Industrial Process • Mining 	<ul style="list-style-type: none"> • Air Quality • Environmental Compliance • Environmental Management • Environmental Response & Disaster Management • Remediation • Waste Management 	<ul style="list-style-type: none"> • Transportation • Dams & Levees • Buildings • Ports & Harbors / Waterfront • Communications • Airports & Aviation 	<ul style="list-style-type: none"> • Conventional Generation • Emerging Renewable • Energy Efficiency • Hydropower • Nuclear • Solar • Transmission / Distribution • Utilities / Market Analytics • Wind

Tetra Tech’s capabilities—Water, Resources, Environment, Infrastructure, and Energy

2.2 Proposed Staffing Plan

Tetra Tech has assembled a team of experienced interdisciplinary managers, engineers, and scientists to provide the services anticipated to be required under this RFQ. We selected our team members for this contract based on their past quality of deliverables. The organization chart below, included resumes, and included project descriptions demonstrate our understanding and capabilities executing the project requirements. Beginning with the Project Manager, Pete Nix, we have provided specialists in every discipline needed to deliver this project successfully.

The Tetra Tech team has shown the key personnel who will provide the various design services for the projects. The personnel shown have been selected based on their experience with dams, infrastructure projects related to dams, and the anticipated work items. However, the proposed project team is also supported by many qualified personnel who can be made available to meet the requirements of any concern or design or schedule issue that may arise.





Proposed Project Manager. With over 38 years of experience with dam rehabilitation design, **Pete Nix, PE** will serve as the Project Manager for the Tetra Tech team. His experience includes managing improvement designs for two of Ohio's largest dam projects: Dam safety modifications to three dams at the Portage Lakes Project and the dam at Buckeye Lake.

Mr. Nix is registered as a Professional Engineer in the state of West Virginia, License No. 21697

He has an extensive understanding of the State's Dam Safety Regulations and current dam design practice. In addition, his geotechnical background makes him especially suited for projects with difficult subsurface conditions. Some of Mr. Nix's qualification highlights include:

1. Over 38 years of dam experience, specializing in rehabilitations for high-hazard projects.
2. Extensive experience with dam and levee seepage evaluations, seepage collection system design, and relief well installations.
3. Project manager for Tetra Tech's work for the NRCS on dams at Big Ditch Run (Webster County) and Pocatlico River (Jackson County).
4. Registered Professional Engineer in West Virginia.
5. Sufficient dam experience to be approved by FERC to perform Part 12D dam inspections as an independent consultant.

As Project Manager, Mr. Nix will ensure that the appropriate resources are applied to each design and construction element, quality requirements are satisfied, schedules are met, and budgets are effectively controlled. In his management of numerous dam projects, he has developed a track record of managing staffing resources to accomplish scope objectives, as well as delivering quality solutions on time and within budget.



Quality Control. **Doug Lantz** has more than 25 years of civil engineering experience and has provided quality control, served as project principal and/or project manager for more than one thousand water resource engineering projects. He has performed QC review of the Hydrology and Hydraulics (H&H) and preliminary designs For projects across the Midwest and the eastern portion of the country. He is Tetra Tech's dam design discipline lead and serves as the Program Manager for an NRCS Design Contract for assessments, design, design review, and construction management for NRCS dams nationwide.

Additional Team Members. Tetra Tech has assembled a Team of highly qualified individuals who will support the key personnel with the design activities of this project. These team members will also be available and, in some cases, will have larger roles when the project transitions through phases. Their roles are shown in the organization chart and range from day-to-day support of data collection, modeling, and design activities to independent QA/QC of draft deliverables.



EDUCATION

BS Civil Engineering, Ohio State University (1984)

REGISTRATION/CERTIFICATION

Professional Engineer, Civil: WV, License No. 21697 (2016)

Professional Engineer, Civil: OH, License No. 53557 (1989)

Professional Engineer, Civil: MI, License No. 40150 (1998)

Professional Engineer, Civil: CO, License No. 005167 (2016)

PROFESSIONAL AFFILIATION

Association of State Dam Safety Officials

United States Society of Dams

FIRM & OFFICE LOCATION

Tetra Tech (Columbus, OH)

YEARS OF EXPERIENCE

37 Years

YEARS WITH FIRM

10 Years

AREAS OF EXPERTISE

Dam and Levee Designs and Evaluations

Dam and Levee Inspections

Levee Certifications

Subsurface Investigations

Instrumentation System Designs

Pete Nix PE

PROJECT MANAGER

Mr. Nix is a Senior Geotechnical Engineer and Senior Program Manager with Tetra Tech. He has extensive experience with water resource and flood control projects, including dam and levee designs and evaluations, dam and levee inspections, levee certifications, subsurface investigations, and instrumentation system designs. His work has also included geotechnical explorations, analyses and recommendations for locks and dams, large bridges, roadway alignments, landside repairs, and other large civil works projects. Several projects have included embankment or floodwall construction over very soft or organic soils using specialized ground improvement techniques. Pete has worked with a variety of clients, including the USACE, ODNR, IDNR, ODOT, MDOT, INDOT, Northeast Ohio Regional Sewer District, American Electric Power, FirstEnergy, municipalities, counties, and conservancy districts across the Midwest. He has been involved in geotechnical engineering projects for the Los Angeles, Albuquerque, Seattle, Baltimore, Portland, Detroit, Louisville, Chicago, Huntington, and Pittsburgh Districts of the USACE. He has also worked on numerous geotechnical task order contracts with ODOT Districts and ODOT's Office of Geotechnical Engineering.

Relevant Experience

NRCS Big Ditch Run Site 1 & Pocatalico River Site 28 | Cowen & Sissonville, WV (2022- Ongoing)

Project Manager. Tetra Tech teamed as a subconsultant to Pare Corporation to a complete planning level engineering and environmental analyses to support a Supplemental Watershed Plan/Environmental Assessment (Plan/EA) for Big Ditch Run Site 1 & Pocatalico River Site 28. These two high-hazard-potential dams, constructed by NRCS, to provide flood damage reduction, recreation, and wildlife habitat for Cowen & Sissonville, West Virginia. The NRCS and local sponsors intend to rehabilitate both projects to meet NRCS and state dam safety criteria. The planning study was phased to accommodate available NRCS funding.

New Martinsville Hannibal Hydroelectric Plant Dam Inspections | New Martinsville, WV (2019-2023)

Independent Consultant. Mr. Nix served as the Independent Consultant for this Part 12 inspection of the New Martinsville Hannibal Hydroelectric Plant, located near Martinsville, WV. As part of this work, an investigation of the foundation drains was conducted and the STID reviewed and updated.

Final Design of Portage Lakes Dam Improvements, Ohio Department of Natural Resources | Akron, OH (2015-Ongoing)

Project Manager. Mr. Nix served as the project manager for this large project with ODNR, high hazard dams located in Akron, Ohio. The work consisted of the preparation of the final design for the project, which included the construction plans, specifications, and cost estimates for the preferred alternative solution to correct a severe spillway deficiency. Due to the presence of a road and utilities on the embankment, as well as additional local impacts, a new overtopping structure was constructed in the lake just upstream of the existing embankment. This new overtopping structure was an innovative design, using deep soil mixing techniques to construct a gravity dam section and cutoff wall. Modifications to the two outlet work structures will also be performed as part of the project.

EDUCATION

PhD Watershed Management,
University of Arizona (1998)

MS Watershed Management,
University of Arizona (1989)

BS Watershed Management,
University of Arizona (1986)

REGISTRATION/CERTIFICATION

Professional Engineer, Civil:

AZ License No. 28850 (1995)

CA License No. 63048 (2002)

ID License No. 9687 (2000)

MD License No. 27328 (2002)

NM License No. 16527 (2004)

OR License No. 60864PE (1999)

OK License No. 24042 (2009)

WA License No. 34547 (1997)

Professional Hydrologist: License
No. 98-H-1479 (1998)

PROFESSIONAL AFFILIATION

American Society of Civil
Engineers

Association of State Dam Safety
Officials

American Institute of Hydrology

FIRM & OFFICE LOCATION

Tetra Tech (Tucson, AZ)

YEARS OF EXPERIENCE

34 Years

YEARS WITH FIRM

25 Years

AREAS OF EXPERTISE

Quality Control/ Quality
Assurance

Hydrology & Hydraulics

Dam Breach

Design

Doug Lantz, PHD, PE, PH QA/QC

Mr. Lantz is a Principal Project Manager and Hydraulic Engineer with 34 years of applied project experience in hydrologic/hydraulic analysis and design for flood control and environmental restoration projects. He has developed engineering solutions and designs for interconnected detention basins; overflow spillways; levees and embankments; flood control channels; rock, soil cement, and bio-engineered bank protection; dam rehabilitation; dam removals; stream restoration; fish passage; and wetlands. Doug has prepared construction documents that include contract drawings, specifications, quantity estimates, cost estimates, design reports, permitting, and O&M manuals for federal and municipal public works projects. He has worked on several large multi-purpose restoration projects and dam rehabilitation projects that have required in-depth analysis of the hydrologic, hydraulic, geomorphic, and sedimentation characteristics in the existing and post-project conditions.

Relevant Experience

Final Design of Portage Lakes Dam Improvements, Ohio Department of Natural Resources | Akron, OH (2015-2023)

Quality Assurance. Reviewed hydrologic analyses of the probable maximum flood based on site specific PMP data, preliminary hydraulic analyses, and engineering report for North Dam Reservoir in Portage Lake State.

Bentley Creek Project, NRCS PA/NY | Bradford County, PA and Chemung County, NY (2022-2023)

Project Manager and Quality Assurance. Tetra Tech is a subconsultant to Pare Corporation to complete sedimentation, economic, and environmental analyses in support of a Watershed Plan/Environmental Assessment (Plan/EA) to address flood damage reduction along Bentley Creek near the Towns/Villages of Bentley Creek, PA, Centerville, PA, and Wellsburg, NY. Providing oversight, direction and quality assurance reviews for a Watershed Plan EA that will be used to justify federal involvement in design and construction of levees, channel improvements and non-structural measures to reduce flood damages.

Buckeye Flood Retarding Structure No. 1, Final Design, Maricopa County Flood Control District | Buckeye, AZ (2009-Ongoing)

Engineer of Record and Project Manager. Tetra Tech is under contract with the Flood Control District of Maricopa County to complete final design services for the rehabilitation of the Buckeye FRS No. 1, near Buckeye, Arizona. The dam is a dry, homogeneous earthen embankment, with a length of 7.1 miles, a maximum height of 36.3 feet, and a storm water storage capacity of approximately 10,010 acre-feet from a 76.2-square-mile drainage area. Major features of the project include a central filter, modifications to the principal and auxiliary spillways, removal of existing irrigation outlets structures, an east abutment structure, landscape restoration, and aesthetics. Major components of the contract include development of design criteria, geotechnical and geologic field investigations, development of plans and specification for civil and landscape designs, and engineering support during construction. Other tasks include permitting, value engineering, failure modes and effects analysis, risk assessment, and public/stakeholder coordination. The project is being implemented in multiple phases using the Construction Manager at Risk (CMAR) alternative delivery method

EDUCATION

MS Civil Engineering, Georgia Institute of Technology (1999)

BS Civil Engineering, The Citadel (1988)

REGISTRATION/CERTIFICATION

Georgia PE No. 023370

South Carolina PE No. 019956

North Carolina PE No. 027071

Certified Floodplain Manager, No. NC-09-0341

Georgia Safe Dams Engineer of Record

Georgia Erosion & Sediment Control Level II Certification No. 0000081236

PROFESSIONAL AFFILIATION

Member of Association of State Dam Safety Officials

United States Society on Dams

Member of Tau Beta Pi - National Engineering Honor Society

FIRM & OFFICE LOCATION

Tetra Tech (Atlanta, GA)

YEARS OF EXPERIENCE

31 Years

YEARS WITH FIRM

6 Years

AREAS OF EXPERTISE

Water Resources Engineering

Stormwater Management

Hydrologic & Hydraulic Modelling

Civil / Site Design Engineering

Dam Engineering

Land Development

Environmental and Regulatory Permitting

Rick Shmurack, PE

CIVIL ENGINEERING LEAD

Mr. Shmurack is a subject matter expert in several aspects of civil and environmental engineering including planning, design, and permitting of dams, stormwater systems, and site design projects. His extensive experience in stormwater management and land development supports our municipal clients in on-call engineering contracts. Rick's experience includes dam design, rehabilitation, and safety inspections; hydrological & hydraulic modeling; dam break modeling and flood inundation mapping; civil design; environmental and regulatory permitting; geotechnical investigations; and Federal Emergency Management Agency (FEMA) map revisions.

Relevant Experience

Final Design of Portage Lakes Dam Improvements, Ohio Department of Natural Resources (ODNR) | Akron, OH (2015-2023)

Project Engineer. Assisted in this contract to digitize and map the existing Portage Lakes Emergency Action Plan Mapping for the Portage Lakes reservoirs. This required utilizing HEC-GeoRAS with intimate GIS knowledge to use existing cross section flood depth elevations to create water depth surfaces to intersect with topography from the national elevation dataset. Flood maps for different scenarios was iteratively mapped for the best mapping results, effectively digitizing, with a high degree of detail via GIS analysis, the existing hand drawn emergency action plans for the region.

Forked Run Dam Rehabilitation, Ohio Department of Natural Resources (ODNR) | Meigs County, OH (2019-Ongoing)

Project Engineer. Currently supporting the spillway design for Forked Run Dam. The dam is presently unable to safely pass the PMF. The study will identify alternatives to safely pass the PMF and address other dam safety concerns. A set of design documents will be produced for the construction of Interim Risk Reduction Measures (IRRM).

Lake Louella Dam, Gwinnett County Department of Water Resources | Suwanee, GA (2018-Ongoing)

Engineer of Record for preparing rehabilitation alternative analyses as well as detailed engineering design and construction documents to bring the embankment into compliance with current Georgia Safe Dams Program safety standards for a medium size Category I high hazard dam. Lake Louella Dam is a 26-ft high earthen embankment located along Bennett Creek, a tributary to Suwanee Creek in Suwanee, Gwinnett County, Georgia. It was built to create Lake Louella for recreational purposes around 1960 and is also known by the name of Peachtree Ridge Park Dam. Flow had begun to pass through a low point at the left end of the dam crest and formed an erosion channel along the left groin. A severe head cut approximately 30 feet deep and 15 feet across had formed in this area and was threatening to breach the dam. Several areas of seepage were also discovered along the heavily eroded auxiliary spillway channel along the right abutment near the plunge pool. The selected rehabilitation design safely passes the 1/3 Probable Maximum Precipitation design storm utilizing a new principal spillway riser, labyrinth weir auxiliary spillway, auxiliary spillway chute and USBR Type III energy dissipator system. The design also incorporates a parapet wall to provide necessary freeboard and wave protection during the design storm. impacts

EDUCATION

PhD Civil Engineering, Colorado State University (2014)

MS Civil Engineering (Hydraulics), Colorado State University (1999)

BE Honors Civil Engineering, University of Canterbury (1996)

REGISTRATION/CERTIFICATION

Professional Engineer, Civil: CO, License No. 35677 (2001)

PROFESSIONAL AFFILIATION

American Society of Civil Engineers

FIRM & OFFICE LOCATION

Tetra Tech (Fort Collins, CO)

YEARS OF EXPERIENCE

24 Years

YEARS WITH FIRM

21 Years

AREAS OF EXPERTISE

Hydrologic Modeling and Analysis

1-, 2-, and 3-D Hydraulic Modeling

1- and 2-D Sediment Transport Analyses

Channel Stability and Restoration

Fluvial Geomorphology

Scour Analysis; Countermeasure Design

Debris Flow Analysis

Watershed and Channel Design

Litigation Support

Dai Thomas, PHD, PE

HYDROLOGIC & HYDRAULIC LEAD

Mr. Thomas is a Senior Hydraulic Engineer and Geomorphologist at Tetra Tech with over 24 years of experience. He enjoys applying his extensive range of skills to analyze and solve complex, inter-disciplinary river-related issues and works across a range of climatic zones from the arid areas of Arizona, the tropics of Australia and the Boreal zone of Alaska. He has considerable experience with the range of hydrologic, hydraulic, and sediment-transport models, including 1-, 2-, and 3-D hydrodynamic modeling using industry standard software (HEC-HMS, HEC-SSP, PeakFQ, HEC-RAS, SRH-2D, FLO-2D, SRH-2D, ADH and FLOW-3D). Dai is proficient at carrying out geomorphic analyses, geomorphic mapping, and hazard assessments, as well as performing topographic surveys. The field data is used in conjunction with hydrologic, hydraulic, and sediment-transport analyses to develop recommendations for a broad range of identified problems including issues concerning flood mitigation, channel stability, hazard analysis and aquatic or riparian habitat.

Relevant Experience

Buckeye Lake and South Fork Licking River Hydrology, Ohio Department of Natural Resources (ODNR) | Buckeye Lake, OH (2015)

Senior Hydraulic Engineer. Responsible for development of HEC-RAS 1D/2D model to evaluate dam operations during the design and construction phases of the rehabilitation of Buckeye Lake Dam. The hydraulic conditions along the project reach are very complex due to the limited channel capacity, significant overbank flooding, complex flow patterns, backwater impacts and hydraulic structures. Significant challenges were overcome in applying the newly released beta Version of HEC-RAS. The hydraulic model included the South Fork of the Licking River from the Kirkersville to the USGS Gage at Hebron, Feeder Canal, Bloody Run Weir Return Canal, and Buckeye Lake Dam. The HEC-RAS model was used to route the 2-, 5-, 10-, 50- and 100-year peak rainfall events, the 1997 flood and the Probable Maximum Flood (PMF). The model output was provided to the design team to perform final design of dam improvements, dam breach analysis, develop downstream inundation/hazard mapping, and to develop an updated Emergency Action Plan.

Tarryall Reservoir Hydrology and Hydraulic Analysis, Colorado Parks and Wildlife | Park County, CO (2018-Ongoing)

Senior Hydraulic Engineer. Responsible for the hydrologic, hydraulic and scour analysis to identify, describe, and evaluate the potential failure modes of Tarryall Dam in the Tarryall Reservoir State Wildlife Area. Led the field survey to collect topographic and bathymetric data and field site characterization. Developed a HEC-HMS hydrologic model to estimate the peak flows and flood hydrographs for the: (1) 100-Year, 24-hour storm, (2) Hydrometeorological Report (HMR) 55a Local Probable Maximum Precipitation (PMP), (3) HMR55a General PMP and the (4) the Colorado-New Mexico Regional Extreme Precipitation Study General PMP (CO-NM REPS). Performed hydrologic analysis using the HEC-HMS software and applying the Colorado State Engineers Office's hydrologic methodology. Developed a 1-dimensional hydraulic model that includes the primary and secondary spillways and the bridge geometry. Performed a rock scour analysis to evaluate the potential rock scour at the base of the dam, at the dam abutments, and along the primary spillway. The model was run for a range of dam overtopping flows up to the Probable Maximum Flood

EDUCATION

MS Structural Engineering,
University of California Berkeley
(2000)

BS Civil Engineering, University of
California Los Angeles (1993)

REGISTRATION/CERTIFICATION

Professional Engineer, Structural:
CA License No. S4571 (2001)

IL License No. 081-006288
(2005) WA License No. 45705
(2009)

OR License No. 94815 (2019)

Professional Engineer, Civil:

CA License No. C57019 (1996)

CO License No. 55572 (2019)

NM License No. 24789 (2018)

TX License No. 133558 (2019)

WA License No. 45705 (2009)

AK License No. 164333 (2020)

PROFESSIONAL AFFILIATION

Structural Engineers Association
of California

Earthquake Engineering
Research Institute

Structural Engineers Association
of Washington

FIRM & OFFICE LOCATION

Tetra Tech (Bellevue, WA)

YEARS OF EXPERIENCE

25 Years

YEARS WITH FIRM

10 Years

AREAS OF EXPERTISE

Steel Gates

Hydraulic Structures

Concrete Structures

Steel Structures

Seismic Design

Structural Analysis

Seismic Retrofits

Chris Willcox, PE, SE

STRUCTURAL ENGINEERING LEAD

Mr. Willcox is a licensed Civil and Structural Engineer with extensive experience in the design and rehabilitation of marine, flood control and other hydraulic structures. Chris has served as the Project Manager or Structural Lead on a number of major projects including the IHNC flood control project in New Orleans, where he was the lead structural engineer on the 150-foot sector gate, and the Panama Canal Third Set of Locks, where he led the design of the Inlet and Outlet Wing Walls and the Approach Structures. In addition to his experience on hydraulic structures, Chris has done the structural design and been the engineer of record for numerous buildings in California and across the US.

Relevant Experience

Meldahl Locks and Dam Tainter Gate Analysis and Rehabilitation, USACE Huntington District | Huntington, WV (2015-2016)

Project Manager. Led the development of a design documentation report (DDR), plans, and specifications for the rehabilitation of the 100-foot-wide by 35-foot-high spillway tainter gates at Meldahl Locks and Dam. Inspections of four of the spillway tainter gates found extensive corrosion on the side arms and gate bodies. The analysis of the gates used a STAAD model developed by the USACE and incorporated trunnion friction in addition to the hydraulic and gravity loads. Based on the analysis results, the team developed a set of rehabilitation and retrofit details. The strengthening of the lower side arm changed the distribution of loads in the arms. Therefore, the gate was re-analyzed with the retrofits modeled to confirm the retrofits were adequate.

Rocky Fork Dam Rehabilitation, Ohio Department of Natural Resources (ODNR) | Hillsboro, OH (2022-2023)

Lead Structural Engineer. Chris inspected the existing gate, outlet conduit and operating gallery on this 70-year-old concrete gravity dam to assist in the selection of an alternative for the rehabilitation, partial replacement or total replacement of the low-level-outlet slide gate. Total replacement has been selected and Chris is leading the development of drawings and specifications for the work.

Isleta Diversion Dam and Bosque and Riverline Restoration, Pueblo of Isleta | Isleta, NM (2017-2018)

Structural Engineer. Completed a structural condition assessment on the deck of this dam on the Rio Grande south of Albuquerque in support of a project to improve river flow and prevent island formation due to sedimentation through the automation of spillway gates. The assessment consisted of a visual inspection, documentation of cracking and other damage, and verification of the concrete quality through hammer sounding and Schmidt Hammer testing in selected areas. The report of the assessment findings also included qualitative recommendations on ways to minimize the structural impact of automating the gates.

EDUCATION

BS Mechanical Engineering,
Seattle University (2009)

REGISTRATION/CERTIFICATION

Professional Engineer,
Mechanical:
CO License No. 0056001 (2019)
FL License No. 79554 (2015)
LA License No. PE.0042798
(2018)
OR License No. 90719PE (2015)
TX License No. 121372 (2015)
WA License No. 51684 (2014)
MT License No. PEL-PE-LIC-
84245 (2022)
ID License No. P-21175 (2022)
VA License No. 0402066490
(2023)

PROFESSIONAL AFFILIATION

N/A

FIRM & OFFICE LOCATION

Tetra Tech (Bellevue, WA)

YEARS OF EXPERIENCE

14 Years

YEARS WITH FIRM

13 Years

AREAS OF EXPERTISE

Machine Design
Hoist Design
Processes Water Piping
Hydraulic Power Systems
Autodesk Inventor
SolidWorks
Finite Element Analysis

Erick Flickinger, PE**MECHANICAL ENGINEERING LEAD**

Mr. Flickinger is experienced in the field of mechanical engineering, providing conceptual and detail design services of flood protection, pump stations, water control gates, cranes, hoist, and mechanical operating machinery. Eric has experience with multi-disciplinary design integration, design optimization through finite element analysis, designing large scale mechanical systems, inspection, and analysis of existing mechanical machinery, retrofit of aging mechanical systems, and developing detailed design documents.

Relevant Experience**Arkansas River Diversion Slide Gate Replacement Project, Colorado Springs Utilities | Buena Vista, CO (2022-Ongoing)**

Lead Mechanical Engineer. Replacement of a malfunctioning 66" slide gate on the Arkansas River that serves the critical Homestake water supply system. The project included evaluation of the slide gate and diversion manhole, alternatives analysis, design, and construction phase services. The slide gate design included allowances for a new concrete build-out around the existing pipe to mitigate conflicts with existing anchors in the concrete. Eric worked with the owners, Colorado Springs Utilities and Aurora Water, to secure the replacement slide gate in a procurement contract to keep the project on schedule. This also allowed the bid period to be closer to construction which reduces risk in contractor pricing.

South Boulder Diversion Dam Radial Gate Trunnion Replacement, Denver Water | Denver, CO (2019-2020)

Lead Mechanical Engineer for the field inspection; conceptual design and design criteria memorandum; opinion of probable cost; 30, 60, 90 percent and final design documents for rehabilitation of existing surface water asset. The South Boulder Diversion Dam includes a 17-foot by 20-foot tainter gate to divert water for downstream storage and treatment. The design included an alternatives analysis of proposed pin and bushing material as well as a review of nondestructive demolition options, and construction phasing options.

Meldahl Locks and Dam Tainter Gate Analysis and Rehabilitation, USACE Huntington District | Bracken County, KY (2015-2016)

Mechanical Engineer. Developed a rehabilitation plan for the replacement of the trunnion bushing for two different spillway gates at the Meldahl Dam. The replacement of the trunnion bushings is part of a larger spillway gate rehabilitation project. He produced plans and specifications as well as a design document report to support the rehabilitation project.

Lower Malad Dam Tainter Gate Inspections and Rehabilitation, Idaho Power Company | Hagerman, ID (2016-2020)

Mechanical Engineer. Mechanical design included trunnion pins and bushing and seal design to interact with the 70-year-old structure. Provided mechanical analysis and design of new tainter gates. The work included production of an alternatives report for each site and development of construction plans and specifications for the selected alternatives. Upper Salmon Dam has six 30-foot by 15-foot riveted steel gates with moderate-to-severe corrosion at the bottom of the gates, and the selected alternative was replacement of the skin and supporting ribs at the bottom of the gate

EDUCATION

BASc Electrical Engineering,
University of British Columbia
(1993)

REGISTRATION/CERTIFICATION

Professional Engineer, Electrical:
AB License No. 67238 (2000)
BC License No. 23730 (1998)
MB License No. 35533 (2012)
CA License No. E19001 (2009)
FL License No. 77107 (2014)
GA License No. PE037247
(2012)
LA License No. PE.0039340
(2014)
NM License No. 24417 (2017)
OR License No. 85808PE (2014)
WA License No. 42893 (2006)
TX License No. 131780 (2018)

PROFESSIONAL AFFILIATION

Institute of Electrical and
Electronics Engineers

FIRM & OFFICE LOCATION

Tetra Tech (Bellevue, WA)

YEARS OF EXPERIENCE

26 Years

YEARS WITH FIRM

10 Years

AREAS OF EXPERTISE

Power Distribution
Motor Controls and Variable
Frequency Drive Applications
PLC System Design
Power System Protection and
Protective Device Coordination
Electrical and Controls Cost
Estimating
Electrical Construction
Supervision and Commissioning

Albert Barnes, PE

ELECTRICAL ENGINEERING LEAD

Mr. Barnes is experienced in the planning, designing, managing, constructing, and commissioning of the electrical and controls portions of multi-discipline industrial projects. His experience includes defining project scope, writing design criteria, estimating capital and labor costs, project management, design calculations, permitting, reviewing budgets, writing specifications, reviewing construction bid documents, reviewing shop drawings, PLC programming, construction supervision, shop and site inspections, and commissioning. His extensive design experience includes detailed drawings for power distribution including substations, motor controls including variable frequency drives, grounding, lighting, grounding, conduit and cable tray layout, instrumentation and panel layouts, schematics, and wiring diagrams. He has provided electrical and controls leadership for design, bid, construction, and commissioning on numerous multi-million-dollar projects.

Relevant Experience

Olive Lake Dam Rehabilitation Design, US Forest Service | Olive Dam, OR (2016-2017)

Electrical and Controls Engineer. Part of the team that performed the dam and spillway site inspection and wrote up a report on our findings with recommendations for improvements including order of magnitude costs. Project work also included downstream campsite and road waterway crossing inspection, hydrologic and hydraulic analysis, and hazard classification based on FEMA and USFS guidance. Phase II of the project includes preparation of planning documents, including an Emergency Action Plan, O&M Plan, IRRMP, and an Emergency Warning System Plan.

Houma Navigation Canal Lock Complex Phase Two, Terrebonne Levee and Conservation District | Houma, LA (2015-2019)

Lead Electrical and Controls Engineer. Aided in this project providing preliminary engineering on a new flood gate and lock complex on the Houma Navigation Canal in Southern Louisiana. Provided preliminary engineering on a new flood gate and lock complex. Work included power to the facility, power distribution, controls, and communications within the facility, and remote monitoring of the facility. The facility will be operated to provide environmental benefits including protection from saltwater intrusion and freshwater diversion from the Atchafalaya River Basin. Work includes power to the facility, power distribution, controls, and communications within the facility, and remote monitoring of the facility. The work also includes low wattage lighting design for energy conservation. The facility will be operated to provide environmental benefits including protection from saltwater intrusion and freshwater diversion from the Atchafalaya River basin.

Mud Mountain Dam Fish Passage Project Fish Trap and Haul Design, USACE Seattle District | White River, WA (2015-2018)

Lead Electrical Engineer. The project provided a trap and haul facility for fish passage improvements at Mud Mountain Dam. Work on the project includes power distribution and controls for the facility and low wattage lighting design for energy conservation. Work plans in MicroStation, specifications in SpecsIntact, and a Design Documentation Report. Design team included electrical, structural, and mechanical engineers. Albert is also providing engineering during construction assistance

EDUCATION

BS Civil Engineering,
Pennsylvania State University
(1994)

REGISTRATION/CERTIFICATION

Professional Engineer, Civil: OH
License No. 66227 (2001)

PROFESSIONAL AFFILIATION

Association of State Dam Safety
Officials

FIRM & OFFICE LOCATION

Tetra Tech (Columbus, OH)

YEARS OF EXPERIENCE

26 Years

YEARS WITH FIRM

2 Years

AREAS OF EXPERTISE

Dams and Levee Design
Geotechnical Engineering
Landslide Remediation
Abandoned Mine Subsidence
Construction Administration

Joe Troxell PE**CONSTRUCTION ADMINISTRATION LEAD**

Mr. Troxell is a project manager, civil engineer, and senior geotechnical engineer. His field of work include geotechnical engineering for earth dams, levees, and off-channel reservoirs. In addition, he has experience with the investigation and remediation of landslides. He has extensive experience in the evaluation of abandoned mine lands, including subsidence, highwalls, portals, and shafts. He has experience with administration of large construction projects, both as an agent of the owner and as the design engineer. Construction-related work has included alternative dispute resolution and expert witness opinions. Notable projects include the largest composite liner system in the world, covering 640 acres, for the John R. Doult Upground Reservoir.

Relevant Experience**Final Design of Portage Lakes Dam Improvements, Ohio Department of Natural Resources (ODNR) | Akron, OH (2015-2023)**

Civil Engineer for improvements to the North Reservoir Dam. Mr. Troxell worked on this project both as part of the Owner-Agent team, reviewing design reports, and with Tetra Tech, Mr. Troxell is completed the Internal Technical Review for the 100% plans and specifications. In addition, he has assisted with construction administration.

ODNR Statewide Dam Safety Services (FY 21-22) | Various Locations, OH (2021-2022)

Project manager and lead geotechnical engineer for this task order-based contract. The purpose of the contract was to perform civil, geotechnical, hydrologic, and hydraulic engineering, structural inspection, and construction management in support of dam safety upgrades for dams owned by the State of Ohio on an as-needed basis. To date, five assignments have been authorized, including review of past reports for Shreve Lake Dam, and developing project budget estimates. Tetra Tech evaluated an upstream dam raising alternate and is currently in the process of coordinating with USACE for environmental permitting.

Wingfoot Lake Dam Assessment & IRRM, Ohio Department of Natural Resources (ODNR) | Portage, OH (2021-2022)

Senior Geotechnical Engineer for the Internal Technical Review (ITR) of the design and construction documents. This project involves the rehabilitation of an existing spillway and improvements, including an inverted filter on the downstream toe of the earthen dam.

Forked Run Dam Rehabilitation, Ohio Department of Natural Resources (ODNR) | Portage, OH (2021-2022)

Senior Geotechnical Engineer for the planning and design of Forked Run Dam. The dam is presently unable to safely pass the PMF. The study will identify alternatives to safely pass the PMF and address other dam safety concerns. A set of design documents will be produced for the construction of Interim Risk Reduction Measures (IRRM's).

2.3 Experience & Past Performance

Tetra Tech's Columbus office has extensive experience performing preliminary site investigation, master planning and project assessments, including recommendations for rehabilitation alternatives and associated cost estimates on dam-related projects. The vast majority of the work involves rehabilitation of embankment dams to meet current dam safety standards and requirements. Tetra Tech has national experience with dam repairs and renovation. Representative project descriptions presenting our relevant experience and reference information are provided below.

1. Experience with hydrologic, hydraulic and flood routing analyses

The Tetra Tech team is highly experienced in performing hydrologic and hydraulic analyses for state agencies, NRCS, USACE, USIBWC, and other Federal Agencies. The Tetra Tech team has performed dam breach analyses for ODNR, NRCS, and other projects using a variety of methods.

Highly experienced in performing hydrologic and hydraulic analyses for State & Federal Agencies.

The Tetra Tech team has performed unsteady flow routing of dam-breach hydrographs for numerous dams owned by ODNR, the NRCS, USACE, private mines, and other clients. We have applied 1-dimensional unsteady-flow models (HEC-RAS) to riverine systems such as Sallisaw Creek in Oklahoma, and 2-dimensional models (HEC-RAS 2D and FLO-2D) in cases where a tributary dam spills to a large river floodplain or alluvial fan (e.g., Buckeye Lake, Caballo Arroyos Site 2 - Wasson Dam near Garfield New Mexico). Our H&H engineers have significant experience with developing site-specific rainfall models, hydrologic modeling (HEC-1 and HEC-HMS) and Principal Spillway Hydrographs (PSH), as well as performing hydraulic analyses using 1-dimensional and 2-dimensional methods as appropriate.

2. Experience in performing geotechnical analyses pertaining to embankment stability and seepage

Our PM, Pete Nix, has over 37 years of experience with geotechnical analyses.

Our geotechnical staff has extensive experience performing geotechnical analyses and evaluations for water resource and infrastructure projects. Uncertainty of geotechnical conditions presents significant risks to most water resource projects. Our staff's recent experience on over 15 projects in southeastern Ohio gives us a unique understanding of the challenging geologic conditions in the project area. Successfully managing the geotechnical aspects of any water resource project is often critical to the success of the entire project. Our geotechnical staff in Columbus has completed over 20 projects

involving detailed slope stability analysis of dam and levee embankments, considering both steady-state and transient phreatic seepage conditions. Our engineers use the computer program Slide, developed by Rocscience. This software suite is capable of conducting limit equilibrium evaluations using several methods; typically for water resource projects Spencer's method is used. Tetra Tech engineers typically apply guidance from the U.S. Army Corps of Engineers (EM 1110-2-1902) when developing the criteria used for the assessment of dams. At Tetra Tech, our geotechnical engineers have the experience and knowledge to investigate, evaluate, and formulate geotechnical solutions for any subsurface condition, reducing risk exposure to our clients. Our experience encompasses dam and levee inspections; subsurface explorations and in-situ testing; instrumentation programs; investigation, evaluation, and design of new dams; dam rehabilitations and modifications; embankment armoring (roller-compacted concrete, soil-cement, and proprietary systems).

Tetra Tech has extensive geotechnical analyses experience of earthen embankments and has specific experience with ODNR dams including the final design for the East Reservoir Improvements. Analyses at East included stability of the existing embankment and improved embankment under various load cases. Past experience has also included the emergency berm constructed at East Reservoir Dam as well as the preliminary design of improvements for East Reservoir Dam and North Reservoir Dam. Tetra Tech's geotechnical staff has extensive experience with seepage analyses of dams and levees for ODNR, the Corps, and other dam and levee owners, having completed over 40 projects involving detailed seepage analyses of dam and levee embankments, considering both steady-state and transient phreatic seepage conditions. Our engineers use the computer program Slide, developed by Rocscience. Slide uses a built-in finite-element seepage analysis program to compute gradients and pore pressure distribution throughout the foundation. This software suite is capable of seepage evaluations using steady-state or transient phreatic conditions. Our geotechnical staff typically uses the load cases and safety factor requirements from the

Corps engineering manuals related to stability analyses. Our geotechnical staff typically uses the guidance and requirements from the Corps various engineering manuals and technical letters related to seepage analyses, internal erosion, and piping. NRCS standards are used for filter designs and spillway erodibility studies.

3. Experience with seepage analyses for earthen embankments

Tetra Tech has extensive geotechnical analyses experience of earthen embankments. Tetra Tech's geotechnical staff has extensive experience with seepage analyses of dams and levees for ODNR, the Corps, and other dam and levee owners. These analyses have considered both steady-state and transient phreatic seepage conditions. Our engineers use the computer program Slide, developed by Rocscience. Slide uses a built-in finite-element seepage analysis program to compute gradients and pore pressure distribution throughout the foundation. This software suite is capable of seepage evaluations using steady-state or transient phreatic conditions. Our geotechnical staff typically uses the load cases and safety factor requirements from the Corps engineering manuals related to stability analyses. Our geotechnical staff typically uses the guidance and requirements from the Corps various engineering manuals and technical letters related to seepage analyses, internal erosion, and piping. NRCS standards are used for filter designs and spillway erodibility studies.

4. Experience with assessments of lake drain structures and gates

Tetra Tech's structural engineers have extensive inspection experience of lake drain structures and gates. Our structural engineers have extensive experience with a variety of gates, from small slide gates to large tainter gates on spillways to mitre gates on navigation projects.

5. Experience in performing structural analyses pertaining to integrity of concrete structures

Tetra Tech has provided structural analyses and design of concrete dams, gate structures, spillways, intake towers, monoliths, gates, and dam appurtenances including; civil design of excavation, sheet pile systems, mechanical design of cranes, and cost estimates of large dam construction and rehabilitation projects. We can provide all aspects of dam integrity analysis, rehabilitation, layout, and design.

An Innovative, Invisible Dam

2019 East Reservoir Dam Rehabilitation



Drilling a soil-cement column at East Reservoir.



Example of the Portage Lakes Improvement Project (East Reservoir Dam) demonstrating the Tetra Tech team's innovation delivery and design and construction expertise.

**OWNER**

USDA NRCS

LOCATIONCowen, WV
Sissonville, WV**CONSULTANT FEES**Big Ditch: \$306,439
Pocatalico: \$314,758**DATES**

2022 - Ongoing

REFERENCE CONTACTMatt Bellisle
Sr. Vice President, Pare
(508) 543.1755**KEY FEATURES**

- Data Collection & Review
- Geotechnical Investigations
- Hydrologic & Hydraulic Analysis
- WV Dam Safety

NRCS BIG DITCH RUN SITE 1 & POCATALICO RIVER SITE 28

Project Description

Tetra Tech teamed as a subconsultant to Pare Corporation to a complete planning level engineering and environmental analyses to support a Supplemental Watershed Plan/Environmental Assessments (Plan/EA) for Big Ditch Run Site 1 & Pocatalico River Site 28 Dams. These two high-hazard-potential dams owned by NRCS, **Big Ditch Run Site 1**, constructed in 1968 as a Significant Hazard Dam, is currently classified as a High Hazard potential dam. The Dam consists of a 26.3-foot-high earthen embankment with a drop inlet principal spillway system and impact basin, and a 50-foot-wide earthen auxiliary spillway **Pocatalico River Site 28**, constructed in 1987, is a flood control and water supply dam in Jackson County, WV. It is one of two dams constructed on tributaries within the Pocatalico River Watershed. The site is located eleven miles upstream of Sissonville. NRCS and local sponsors intend to rehabilitate both projects to meet NRCS and state dam safety criteria. The planning study was phased to accommodate available NRCS funding: **Phase 1:** Collection & Analysis of Information (Problem Identification/Confirmation). **Phase 2:** Formulation and Evaluation of Alternatives and Preparation of the Draft Supplemental Plan/EA. **Phase 3:** Response to Agency and Public Comments. **Phase 4:** Submittal of the Final Supplemental Watershed Plan/EA

Work completed to date includes Phase 1 and Phase 2. Tetra Tech's role in the project includes: 1) Visual inspection and documentation of the dam, upstream watershed, downstream affected area, and wetlands. 2) Sedimentation evaluation. 3) Hydrologic analyses for existing and future development conditions using the NRCS SITES model. 4) Dam breach analyses using NRCS methods. 5) Hydraulic analyses of auxiliary spillway flows and breach flows using 2D unsteady HEC-RAS. 6) Calculation of previous sediment inflows from bathymetric survey. 7) Preparation of downstream inundation mapping using GIS. 8) Evaluation of downstream impacts on existing utilities and infrastructure 9) Reviews for Conformance with NRCS policy. 10) Preparation of the Phase 1 Report with Appendices for Hydrology/Hydraulics/ Sediment, Economics, Environmental Resources, and Cultural Resources. 11) Formulation of alternatives and supporting analyses for hydrology, hydraulics and sedimentation, economics, and impacts to environmental, cultural, and social resources. 12) Selection of the recommended plan and preparation of the Phase 2 Draft Supplemental Watershed Plan/EA with supporting Appendices. 13) Response to National Water Management Center review comments. 14) Spillway integrity analyses using SITES.

The Phase 3 and Phase 4 reports are currently in progress.



Big Ditch Run Site 1

**OWNER**

New Martinsville Hannibal
Hydroelectric Plant

LOCATION

New Martinsville, WV

CONSULTANT FEES

\$84,418

DATES

2019 - 2023

REFERENCE CONTACT

Kevin Marciniak
NMHHP Plant Manager
C 304.771.1105
nmhydro@frontier.com

KEY FEATURES

- Potential Failure Mode Analysis (PFMA)
- Fault Tree Analysis
- Risk Analysis and Consequence Assessment
- Recommended Risk Reduction Measures
- FERC Compliance
- Field Inspections
- WV Dam Safety

NEW MARTINSVILLE HANNIBAL HYDROELECTRIC PLANT DAM INSPECTIONS

Project Description

Tetra Tech conducted a FERC Part 12 Independent Consultant Dam Safety Inspection and Potential Failure Mode Analysis (PFMA) Review of the Hannibal Locks and Dam, concrete locks, and lift gate dam, located at river mile marker 126.4 on the Ohio River at Hannibal, Ohio, and New Martinsville, West Virginia. The PFMA review included a determination of the Potential Failure Modes (PFMs) for the project. A Fault Tree Analysis (FTA) was performed looking at the critical components involved in each PFM, and a risk analysis and consequence assessment of each PFM was performed. Finally, each PFM was assigned to a risk category, based on the probability and consequences which were established. Monitoring and other risk reduction recommendations were made for all medium or high-risk PFMs. The key features of the work included:

- 1) Perform a field inspection of the dam, intake, spillway, penstock, and powerhouse.
- 2) Lead a Potential Failure Mode Analysis (PFMA) review session with First Energy and FERC representatives. An update to the existing PFMA was written at the end of the PFMA review session and submitted for FERC approval.
- 3) Review of the existing seismic, structural, hydraulic, and flood flow studies for the project and a determination whether these existing analyses still represent best practices in their respective fields.
- 4) Review of the operations and maintenance plan for the project.
- 5) Perform a fault tree analysis, risk analysis, consequence assessment and risk classification of each failure mode.
- 6) Recommend risk reduction actions for all medium and high-risk failure modes.
- 7) Write a Part 12 dam safety report for the project, identifying and prioritizing any deficiencies which were found.





OWNER

USDA NRCS

(Tetra Tech under contract with small-business partner Pare Corporation for this work)

LOCATION

Various Locations, PA

CONSULTANT FEES

\$103,179

DATES

2023 - Ongoing

REFERENCE CONTACT

Allen Orsi
 Vice President
 (508) 470-4453
 AOrsi@parecorp.com

KEY FEATURES

- Dam Assessments
- Dam Inspections
- Hydrology and Hydraulic Analysis
- Geotechnical Exploration

LITTLE YOUGHIOGHENY WATERSHED DAM ASSESSMENTS

Project Description

The assessment of these six dams were performed to provide information on the condition of each dam, and to provide the National Resource Conservation Services (NRCS) and the Maryland Department of the Environment (MDE) with the following: An assessment of the current operational and maintenance condition; Breach inundation zone and hazard classification; Existing hydraulic capacity; Current conditions and current compliance to existing State and NRCS design criteria; and Potential rehabilitation alternatives to bring the Little Youghiogheny Site No. 7 Structure into full compliance. This information was provided to assist the NRCS and MDE in determining future actions concerning the potential rehabilitation of the dam to extend the service life of the dam and to meet current dam safety criteria. The sites included in this assessment are:

- 1) Little Youghiogheny Site No. 1 Dam, sometimes referred to as Hospital Dam, was constructed in 1964 for the purpose of flood protection.
- 2) Little Youghiogheny Site No. 2 Dam, sometimes referred to as Little Yok #2 (Rt 219 North) Dam, or Geroski Dam, was constructed in 1962 for the purpose of flood protection.
- 3) Little Youghiogheny Site No. 3 Dam, sometimes referred to as Little Yok #3 (Winters) Dam, was constructed in 1965 for the purpose of flood protection and recreation.
- 4) Little Youghiogheny Site No. 5 Dam, sometimes referred to as Little Yok #5 (Wonderly's) Dam, was constructed in 1968 for the purpose of flood protection.
- 5) Little Youghiogheny Site No. 6 Dam, sometimes referred to as Little Yok #6 (Broadford) Dam, was constructed in 1971 for the purpose of flood protection, water supply, and recreation.
- 6) Little Youghiogheny Site No. 7 Dam, sometimes referred to as Little Yok #7 (Deer Park) Dam, was constructed in 1960 for the purpose of flood protection, water supply, and recreation.



Little Youghiogheny Site No. 2



OWNER

Ohio Department of Natural Resources (ODNR)

LOCATION

Akron, OH

CONSULTANT FEES

\$7.3M

DATES

2015-Ongoing

REFERENCE CONTACT

Jeremy Wenner, PE
(614) 265-6719
jeremy.wenner@dnr.state.oh.us

KEY FEATURES

- Flood Control
- Construction Manager at Risk (CMR)
- Alternative Delivery Methods
- Environmental Permitting

FINAL DESIGN OF PORTAGE LAKES DAM IMPROVEMENTS

Project Description

This project consists of advancing the preliminary improvement designs of East Reservoir Dam, North Reservoir Dam and Long Lake Dam to final design level and to provide services during construction. In addition, preliminary investigations, feasibility studies, preliminary design reports, PFMA, expert elicitation, emergency action plans, consequence estimation, final design and construction services are included under this contract

An updated hydrologic and hydraulic technical report was prepared for the Portage Lakes Watershed using current ODNR Dam Safety requirements and recommendations. The watershed is comprised of six dams (East, North, West, Long Lake, Tuscarawas, and Nimisila) and a series of canals and feeder canals. The results from the analysis are to be used for the dam improvements at East Reservoir Dam, North Reservoir Dam and Long Lake Dam. The hydrologic and hydraulic model of the Portage Lakes Watershed was developed using HEC-1, HEC-HMS, and HEC-RAS. Emergency Action Plans were developed for each dam including dam breach analyses and inundation mapping produced using FLO-2D. HEC-FIA was used to estimate the economic consequences and to estimate the population at risk. Critical facilities were identified as well.

East Reservoir Dam: East Reservoir Dam is a state-owned, high hazard embankment dam located in Portage Lakes State Park in Summit County Ohio. The existing embankment has a maximum height of 23 feet and is roughly 1,400 feet long in three embankment segments (south embankment, main embankment, and north embankment). The embankment is constructed of sand and is founded on a sand and silty sand foundation. The work initially consisted of planning and evaluating alternatives for the final design of the dam improvements to bring the project into compliance with the state's dam safety regulations. A PFMA session was conducted, and expert elicitation was used to identify the likelihood of failure of different PFMs and to identify interim risk reduction measures. The deliverables for the work included the construction plans, specifications, and cost estimates **Long Lake Gate Replacement:** This project consists of the geotechnical and structural investigation, preliminary design, and final design of an embankment dam with a concrete center gate structure at Long Lake to replace a 50-year-old structure that was in very poor condition. The existing gate was a 105-foot-long concrete structure supported on timber piles with six slide gates are provided to control flows. The Preliminary Design consisted of the development of alternatives, preliminary structural and geotechnical evaluations and designs, the preparation of construction cost estimates, and the selection of a preferred alternative. Final Design included the final plans, specifications, and construction cost estimate for the selected dam replacement alternative. **North Reservoir Dam:** North Reservoir Dam is a state-owned, high hazard dam located in Summit County Ohio. The dam is comprised of two embankments of approximately equal length that are separated by several hundred feet of natural ground. The total length of the embankments is approximately 650 feet. The principal spillway consists of a concrete gravity structure with a 24-foot long and 2.5-foot wide broad-crested weir with a 30-inch diameter corrugated metal pipe extending through the spillway structure serving as the principal lake drain



OWNER

Ohio Department of Natural Resources (ODNR)

LOCATION

Various Locations, OH

CONSULTANT FEES

\$250,000

DATES

2021-2022

REFERENCE CONTACT

James Hilovsky
(614) 295-6967
james.hilovsky@dnr.ohio.gov

KEY FEATURES

- Dam Rehabilitations
- Dam Inspections
- Site Assessments
- Sampling and Lab Testing
- Structural Analyses
- Flood Plain Improvement
- Wetland Protection

ODNR STATEWIDE DAM SAFETY SERVICES (FY 21-22)

Project Description

Tetra Tech’s services included civil, geotechnical, structural, hydraulic, and hydrologic engineering on various dams and channels. Projects include:

Shreve Lake Dam. Completed an evaluation to update previous project level budget estimates to complete repairs to Shreve Lake Dam, in Wayne County, Ohio. The lake was drained in 2014 after sinkholes were observed on the downstream slope of the embankment. The lake drain has since remained open, and the lake is currently drained. It is anticipated that the construction of dam rehabilitation improvements would be completed in 2024. As requested by ODNR, Tetra Tech reviewed past assessment reports and evaluated the proposed alternates and budget estimates. In addition, a Preliminary Wetland Jurisdiction Determination (PWJD) has been completed and submitted to the USACE.

Zepernick Lake Dam Spillway. Visited Zepernick Lake Dam to observe a joint leak in the primary spillway riser and the separation of the outlet pipe with the concrete headwall at the upstream end of the exit channel. The 2012 riser consists of two sections of stacked precast concrete. The joint between the two pieces was sealed with waterproofing material on the lake side. Inspected the headwall at the downstream end of the primary spillway outlet pipe. The outlet consists of a precast concrete headwall with the 24-inch HPDE pipe. Recommendations include Riser Repair: Spalled concrete in the NW corner at the joint should be patched and the joint should be waterproofed using a Type B waterproofing on the lake side per ODOT specifications; and Headwall Outlet Pipe Opening Repair: Damaged concrete to be removed and replaced with non-shrink mortar complying with 705.22 of the ODOT specifications and on the qualified products list.

Wingfoot Lake Wetland – Phase 1. Surveyed culverts, embankments, water surface elevations, and topo/bathy cross sections at Mishler Road, the railroad, and Wingfoot Lake Road. Downloaded aerial photography, LiDAR mapping, precipitation, and soils data from the State or appropriate federal agencies. Located and reviewed reports on Wingfoot Lake, wetlands, local hydrology, and cross structures. Estimated 2-, 25-, and 100-year peak flows using USGS StreamStats. Developed three HY-8 models to assess the capacity of the existing culverts. Used existing HEC-1 models to estimate inflows to Wingfoot Lake. Assessed which culvert(s) act as hydraulic controls triggering flooding upstream of Mishler Road by running the scenarios.

East Reservoir Feeder Canal. Conducted a site visit to investigate damages to the embankment along the feeder channel adjacent to East Reservoir’s primary spillway. Along the right side of the feeder channel, a drain was constructed to reroute water away from the structure, leaving a hole in the embankment that appeared to extend five-feet-down and four-feet-wide along the crest. The toe had a significant amount of material washed out from the base of the embankment and the adjacent channel bank. Discussed interim risk reduction measures that should be completed to reduce the danger posed by the washed-out void, including damming off the channel directly behind the damaged area, pumping out as much water as possible from this channel section, and getting stone material placed allowing the toe of the embankment to be stabilized

DESIGNATED CONTACT: Vendor appoints the individual identified in this Section as the Contract Administrator and the initial point of contact for matters relating to this Contract.

(Printed Name and Title) Pete Nix, PE; Project Manager

(Address) 2800 Corporate Exchange Drive, Suite 360 , Columbus, Ohio 43231

(Phone Number) / (Fax Number) Phone: (614) 289-0117 / Fax: (614) 289-0122

(Email address) pete.nix@tetratech.com

CERTIFICATION AND SIGNATURE: By signing below, or submitting documentation through wvOASIS, I certify that: I have reviewed this Solicitation/Contract in its entirety; that I understand the requirements, terms and conditions, and other information contained herein; that this bid, offer or proposal constitutes an offer to the State that cannot be unilaterally withdrawn; that the product or service proposed meets the mandatory requirements contained in the Solicitation/Contract for that product or service, unless otherwise stated herein; that the Vendor accepts the terms and conditions contained in the Solicitation, unless otherwise stated herein; that I am submitting this bid, offer or proposal for review and consideration; that this bid or offer was made without prior understanding, agreement, or connection with any entity submitting a bid or offer for the same material, supplies, equipment or services; that this bid or offer is in all respects fair and without collusion or fraud; that this Contract is accepted or entered into without any prior understanding, agreement, or connection to any other entity that could be considered a violation of law; that I am authorized by the Vendor to execute and submit this bid, offer, or proposal, or any documents related thereto on Vendor's behalf; that I am authorized to bind the vendor in a contractual relationship; and that to the best of my knowledge, the vendor has properly registered with any State agency that may require registration.

By signing below, I further certify that I understand this Contract is subject to the provisions of West Virginia Code § 5A-3-62, which automatically voids certain contract clauses that violate State law; and that pursuant to W. Va. Code 5A-3-63, the entity entering into this contract is prohibited from engaging in a boycott against Israel.

Tetra Tech, Inc.

(Company) 

(Signature of Authorized Representative)

Pete Nix, PE; Project Manager

(Printed Name and Title of Authorized Representative) (Date)

Phone: (614) 289-0117 / Fax: (614) 289-0122

(Phone Number) (Fax Number)

pete.nix@tetratech.com

(Email Address)