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WV PURCHASING
DIVISION

EXPRESSION OF INTEREST

Camp Dawson Pierce Lake Dam Repair Design



May 12, 2020

State of West Virginia
Department of Administration, Purchasing Division
2019 Washington Street E
Charleston, West Virginia 25305

Attention: Ms. Tara Lyle, Buyer

Subject: Response to Expression of Interest
Camp Dawson Pierce Lake Dam Repair Design
CTL Proposal No.: 20980023COL-QUAL

CTL Engineering, Inc. (CTL) appreciates the opportunity to submit our expression of interest to provide professional engineering services to the State of West Virginia in reference to the Camp Dawson Pierce Lake Dam Repair Design project. CTL is a multi-discipline engineering firm specializing in many services requested by the State.

There are at least 4 specific and unique qualities that make CTL a prime candidate to service this project:

- ◆ An established record of over 93 years of providing engineering, testing services, and surveying for regional public and private sector clients.
- ◆ In-house accredited/certified laboratories for soil, concrete, aggregate, and asphalt equipped with automated instruments and updated software for various tests.
- ◆ A local office in Morgantown, WV, as well as the support of CTL's other offices, a total staff of over 300 employees including over 28 professional engineers and 234 inspectors/engineering technicians, architects, professional surveyors, certified geologists, environmental scientists, and support staff.
- ◆ Licensed Geotechnical Engineers with over 25 years' experience. The Morgantown office was established in 1981. We have a vast knowledge of the area and geotechnical conditions that are unique to WV.
- ◆ Capability to perform in-house: geotechnical soil/rock drilling, sampling and in situ testing; geophysical test methods consisting of ground penetrating radar (GPR), Electrical Resistivity Imaging (ERI), and Refraction Micro-tremor (ReMi) to augment subsurface investigations; laboratories for soils/aggregate testing, metallurgical testing, and analytical chemistry testing; environmental field screening and sampling equipment, services thereby reducing project time and costs.

We appreciate this opportunity to submit our qualifications and look forward to a favorable reply to our submittal. Please do not hesitate to contact me at (513) 505-8554 or dbatt@ctleng.com.

Respectfully Submitted,
CTL ENGINEERING, INC.



Doug R. Batt, P.E.
Geotechnical Project Manager



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FIRM'S EXPERTISE

CTL Engineering, Inc. is a full service consulting engineering, testing, inspection, and analytical services company. CTL maintains a staff of over 300 employees, including registered engineers, architects, chemists, environmental engineers & scientists, geologists, hydrogeologists, non-destructive testing specialists, certified welding inspectors and technicians. CTL has a branch office in Morgantown, WV that was founded in 1983 to provide regional service to West Virginia, Maryland and Pennsylvania.

CTL's Morgantown office has a state-wide staff of over 35 people; including licensed professional engineers, licensed land surveyors, and certified engineering technicians. Over our 39 years in West Virginia, CTL has provided numerous civil site designs, geotechnical designs, stormwater plans and surveys for commercial and residential developments and roadway projects. We have successfully prepared State and Federal 401 and 404 Permit submittals, Ms4 Phase II stormwater permits and conducted Environmental Site Assessments. CTL also has significant experience working on mining related projects including mine plans and permitting, mine refuse reclamation and subsidence evaluations and investigation. These projects were completed by conscientious interaction with Architects, Engineers, State and Federal Agencies and Owners.



Strategic Teaming Partner – RIZZO International, Inc.



RIZZO International, Inc. (RIZZO), a women-owned small business, is a client-centric engineering and earth sciences consulting firm with expertise in specialty civil, geotechnical, and structural analysis and design; hydrologic and hydraulic modeling; probabilistic and deterministic seismic hazard analysis; field and office-based geologic and hydrogeologic investigations; and construction support services.

Dam engineering services have been a core component of RIZZO's business for nearly 35 years, and in that time RIZZO has provided new and remedial design and analysis services for hundreds of water supply, flood protection, hydroelectric, and grade stabilization projects involving earth and rock fill embankment dams, buttress dams, concrete gravity dams, and roller compacted concrete (RCC) dams. RIZZO's dam engineering services have also included safety inspections for the Federal Energy Regulatory Commission (FERC) and for state dam safety programs.

RIZZO has completed more than 40 dam rehabilitation projects that have involved significant modifications to existing spillways, complete spillway redesigns and rebuilds, or major rehabilitation designs for embankments and concrete structures. Much of this work has been conducted in the eastern United States, under on-call dam engineering service agreements with electric utilities and state agencies such as the New York Power Authority (NYPA) and the New York State Office of General Services (NYSOGS). Some of our more recent work has also involved remedial design work under the jurisdiction of the Pennsylvania Department of Environmental Protection (PADEP) and remediation design to resolve Ohio Department of Natural Resources (ODNR) consent orders for dam deficiencies. As such, RIZZO has developed a qualified team of dam safety engineers with a strong regulatory knowledge and working relationships with federal, state, and local regulatory personnel.



Team's Relevant Dam Experience

The Project Management Lead, Doug Batt has worked on many projects that fall under the purview of the Dam Safety Regulations. He is supported by other team members who have worked on Dam/Levee Safety projects including assessments, repair, or design of new or replacement dams or levees in many locations throughout the region.

The CTL Team, working either individually or collaboratively as a team, has experience to respond to both emergencies and routine assessments. Their focus will be to prepare cost effective and practical solutions to achieve the project goals, and if necessary, providing construction administration and inspection to ensure adherence to plans and specifications.

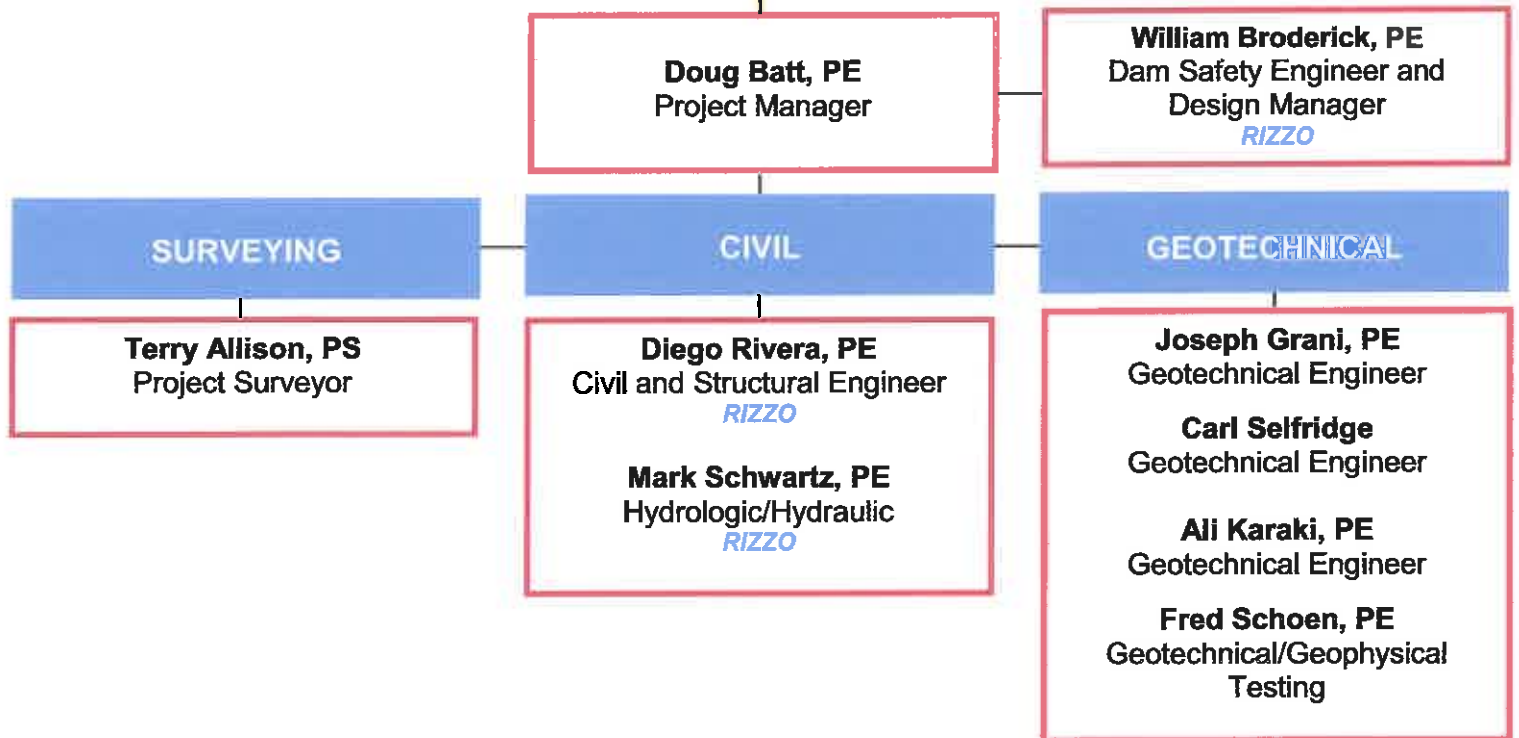
The CTL Team will use the depth and breadth of its team member's expertise to identify, evaluate, design and execute the project goals of the State of West Virginia. This requires flexibility combined with the expertise, while using advanced technology and methods of assessment and analysis. The Team that has been assembled has that ability; including the use of non-invasive investigative methods such as Geophysical investigation including Electrical Resistivity Tomography (ERT), Streaming Potential (SP) and Seismic Wave Surveys along with traditional geotechnical investigative methods of test borings, instrumentation etc. The most important aspect of the team is to work with the Owner to identify alternative solutions that ultimately arrives at the preferred solution which has the highest level of confidence with the lowest level of risk.

The Team's dam safety engineering, design, and construction support services regularly include (but are not limited to):

- Dam safety inspections for normal operations and following extreme events;
- Emergency inspections for abnormal behavior (cracking, sinkholes, etc.);
- Dam safety performance monitoring (instrumentation and data analysis);
- Probable maximum flood (PMF) and inflow design flood (IDF) determinations;
- Dam stability analysis;
- Seepage analysis;
- Spillway and low-level outlet capacity assessments;
- Hazard screening and classification assessments;
- Dam break analysis and inundation mapping;
- Potential failure modes analysis;
- Emergency action plan (EAP) development;
- EAP coordination with state and local first responders;
- Organization and execution of table top and functional EAP training exercises;
- Owner dam safety awareness training;
- Development of dam safety inspection and maintenance plans;
- Comprehensive engineering assessments reports; and
- Dam improvement and remediation work, including (but not limited to):
 - Rehabilitation and modification design;
 - Development of design drawings and specifications;
 - Assistance with regulatory permits;
 - Engineering support during procurement of construction services;
 - Engineering support during construction; and
 - As-built documentation.



ORGANIZATIONAL CHART



▶ **Douglas Batt, M.S., P.E.**
Cincinnati Branch Manager



As a Project Manager and Geotechnical Engineer, Mr. Batt is responsible for supervision of professional, technical and laboratory personnel and resources performing geotechnical engineering services. Mr. Batt's experience as a geotechnical and materials engineering consultant covers a variety of infrastructure, commercial and industrial projects. His technical and project

management experience includes geotechnical investigations, foundation design and evaluations, and construction materials testing and inspections for the following types of projects: roadways and bridges; reinforced earth embankments, earth dams, and earth retaining systems; slope stability analyses and landslide remediations; above and below ground fuel and water storage tanks; wastewater treatment facilities; manufacturing and parking facilities; and multistory office, hotel and school buildings.

In addition, Mr. Batt has performed flexible and rigid pavement designs and assessments; monitored and evaluated pile load tests for industrial and commercial facilities; and has monitored, inspected and authored EPA certification reports for Subtitle D landfill liner and cap construction projects.

EDUCATION

Master of Science

University of Cincinnati, Cincinnati, Ohio 1992

Bachelor of Science, Civil Engineering

University of Cincinnati, Cincinnati, Ohio 1989

PROFESSIONAL REGISTRATION / CERTIFICATION

Registered Professional Engineer, Ohio, Kentucky & New Jersey

CTL PROJECT EXPERIENCE

CLEAR FORK RESERVOIR DAM SEEPAGE INVESTIGATION

City of Mansfield, Ohio

Mr. Batt acted as CTL's Project Manager for the seepage investigation to evaluate the stability of the existing Clear Fork Reservoir Dam. CTL's investigation utilized original construction plans, previous ODNR inspection and evaluation reports, observations of the project site made during various times of the year, test borings, siug (pump) tests, soil laboratory tests, electrical resistivity imaging across the embankment and downstream area, along with monitoring wells equipped with pneumatic piezometers to develop models of the earth embankment and foundation soil.

CTL analyzed pore water migration (seepage) through and beneath the dam using the 2D models to evaluate the exit gradients and comparing these gradients with the

critical exit gradient per USACE requirements and provided recommendations to increase the Factor of Safety to acceptable values. CTL also performed slope stability analysis of the dam embankments and determined all three case met the minimum Factors of Safety against a rotational failure.

SHAWNEE STATE FOREST DAM IMPROVEMENTS AND REPAIRS (ODNR)

Adams and Scioto Counties, Ohio

Developed remediation design plans, specifications and construction cost estimates for the retrofit of the existing earth dams. Executed Preliminary Investigation, Preliminary Design and Final Design phases for four earth embankment dams that required increased storage-discharge capacity, structural repair of the principal concrete box culvert spillways along with evaluating the improvements for stability and seepage control.

Performed geotechnical explorations, hydrologic and hydraulic analyses of watersheds and dam outlet structures, design of earth retaining walls, spillway inlets, sliplining of box culvert outlets and roller compacted concrete (RCC) dam embankment overlayment. His design approach included value engineering of several design alternatives that included increasing the height of three existing embankments along with constructing new emergency spillways and developing a breaching plan for fourth dam embankment.

MEMORIAL PARKWAY TREATMENT PLANT RESERVOIR

Fort Thomas, Kentucky

Mr. Batt acted as CTL's Project Manager for the geotechnical exploration on a project that consisted of the analysis of the existing reservoir embankment slopes, including laboratory testing of the soils encountered in the embankments and slope stability analyses in both long term steady state seepage and rapid drawdown conditions.

Years Experience

45

Level

10

Education

MSCE, Polytechnic Institute of NY – 1978
BSCE, Manhattan College – 1973

Registrations/Certifications

Professional Engineer: NY 1979, CT 1997, NH 2009, VT 2009, MA 2012
Building Code Enforcement, NY 2004
OSHA General Construction Safety, 2005

Affiliations

American Society of Civil Engineers
United States Committee on Dams
Association of State Dam Safety Officials

Publications/Presentations

"Cyber Security Issues for Performance Monitoring Systems" by W. Allen Marr, PhD, PE, GEOCOMP, Action MA, and William Broderick, PE, RIZZO Associates, Tarrytown NY, presented at ASDSO Annual Conference, Providence, RI, in September 2013.

Short Course "Current Trends in Dam Safety" by W. Broderick, at NYSSPE Westchester/Putnam Chapter, Pleasantville, NY, May 2013. This course was evaluated and approved by The Practicing Institute of Engineering, Inc (PEI) for compliance with NYS Mandatory Continuing Education for 1 PDH.

"PMF Study for Osage Hydroelectric Project" by W. Broderick, P. Martinchoch, M. Frerking (Ameren), & B. Ferguson, presented at Hydro Vision, Louisville, KY, July 2012.

W. Broderick was Panel Moderator for "Outcomes & Impacts of the PFMA Process" presented at Hydro Vision, Louisville, KY, July 2012.

W. Broderick was a Panelist for "New Trends in Dam Safety Surveillance & Monitoring" at Hydro Vision, Louisville, KY, July 2012.

Skill Areas:

Civil/Structural Engineering
Geotechnical Engineering
Design & Analysis
Hydrology & Hydraulics
Instrumentation
Expert Testimony

Dam Safety Inspections
Emergency Action Planning
Potential Failure Modes Analysis
Performance Monitoring
Security Evaluation & Assessment

Mr. Broderick is an approved independent consultant for Federal Energy Regulatory Commission (FERC) Part 12D dam safety inspections for hydroelectric power projects and a facilitator for potential failure modes analysis (PFMA). Mr. Broderick's technical expertise encompasses the fields of civil, structural, geotechnical, and hydraulics engineering. He has personally performed and directed dam safety inspections, dam stability analysis, site exploration and characterization, hydrology and hydraulics analysis, and surveillance monitoring for dams throughout the United States. He has significant experience with boring inspections, soil and rock characterization, groundwater monitoring, seepage investigation, remedial grouting, civil/structural design and analysis, and structural performance monitoring for dams. He successfully performed periodic dam inspections for high, intermediate, and low hazard dams including post seismic event evaluations, post flood event evaluations, site investigations, and remedial designs. Mr. Broderick is experienced in developing comprehensive dam safety programs, regulatory compliance programs, and emergency action plans (EAP). He has provided dam safety and EAP training for management, operations, and maintenance staff. He has developed and facilitated EAP tabletop and functional training exercises for dam owners and state and local emergency responders.

Prior to joining RIZZO Associates (RIZZO) in 2007, Mr. Broderick was employed for 27 years by the New York State Power Authority (NYPA). He served in a variety of roles including: managing director of design drafting services; director of civil/structural engineering; and senior civil/structural engineer. As a responsible charge engineer, he was directly accountable for all civil, structural, geotechnical, and hydraulic engineering for new construction, plant modifications, corrective maintenance, and performance monitoring of structures and civil works at all NYPA facilities. Mr. Broderick was a member of the utility's hydropower relicensing, hydropower development, life extension and modernization, and security task forces. He was chairman of NYPA's Dam Safety and Civil Works Committee.

Mr. Broderick has contributed to various FERC advisory panels on dam safety, performance monitoring, and emergency action planning. He was NYPA's representative to the Dam Safety Interest Group of the Canadian Electricity Association Technologies Institute (CEATI). He has provided expert testimony on dam safety and emergency planning to the International Joint Commission for United States and Canada Boundary Waters.

In 2012, Mr. Broderick was appointed executive director of RIZZO's New York Regional Office.



Publications (continued)

Niagara Power Project – A Success Story of International Cooperation” by W. Broderick, ICOLD, Brazil, May 2009.

“NYPA, Upper Reservoir Dewatering and Penstock Inspections,” by W. Broderick, Ontario Power Generation Civil Alliance Workshop, Niagara Falls, Canada, 2007.

“Gauging the Effectiveness of NYPA Civil Works and Dam Safety Programs,” by W. Broderick NYPA Civil Works/Dam Safety Committee Meeting, Gilboa, NY, 2006.

Dam Instrumentation and Performance Monitoring”, presented by W. Broderick, FERC Workshop, Washington, DC, 2005.

“Potential Failure Modes Analysis & Dam Safety Monitoring”, Panelist, Hydro Vision 2004 Conference, Montreal, Quebec, Canada, 2004.

“Landslide Monitoring and Remediation”, by W. Broderick and F. Xi, 5th International Conference on Geotechnical Engineering, New York City, 2004.

“Monitoring and Remediation of an Active Landslide” presented by W. Broderick, CEATI Dam Safety Interest Group meeting, Ottawa, Ontario, Canada, 2004.

W. Broderick was a Panelist for “Hydro Plant Dam Safety & Security”, at National Hydropower Association Annual Conference, Washington, DC, 2003.

“Security and Emergency Preparedness”, presented by W. Broderick, FERC Workshop, USSD Conference, Charleston, SC, 2003.

“Owner’s Perspective on Inspection of Tunnels, Penstocks, Surge Tanks, & Valves”, by W. Broderick and R. Knowlton, FERC Independent Consultant Workshop, Washington, DC, 2002.

“Dam Safety Inspections & Performance Monitoring Procedures”, presented by W. Broderick, FERC Workshop, Washington, DC, 2001.

Failure Modes and Effects Analysis | Waterton Dam Alberta Environment and Parks | Alberta, Canada

06/2017 – 03/2018

Mr. Broderick provided sub-consultant services to KGS Group, Winnipeg, Manitoba, Canada (KGS) to serve as Facilitator for the 1st Failure Modes and Effects Analysis (FMEA) performed for Waterton Dam. The dam is owned and operated by Alberta Environment and Parks (AEP). KGS was retained to provide assistance to AEP and to lead the organization and implementation of the FMEA. During September 2017, Mr. Broderick participated in a site inspection with KGS and AEP representatives. This was followed by a review of dam safety background information and data. Mr. Broderick then led a two day FEMA session, which was primarily based on Canadian Dam Association (CDA) engineering guidelines, with consideration of current practices used in the United States. Mr. Broderick initiated failure modes thinking through engagement with the core team from KGS and AEP that lead to selection of candidate failure modes. These were discussed until a clear characterization of the failure mode was fully developed. This process identified and described each potential failure mode, highlighted the most significant one, identified key monitoring parameters for each, and identified risk reduction measures including surveillance and monitoring opportunities, and if necessary additional investigations. A qualitative rank-ordered FM likelihood and consequences assessment was performed to provide AEP with a roadmap for risk reduction measures. KGS documented the FEMA session and qualitative risk assessment in a report, which Mr. Broderick reviewed and provided comments.

Failure Modes and Effects Analysis – Grand Rapids Generating Station

Manitoba hydro- Manitoba, Canada

08/2017-05/2018

Mr. Broderick provided sub-consultant services to KGS Group, Winnipeg, Manitoba, Canada (KGS) to service as Facilitator for the 1st Failure Modes and Effects Analysis (FMEA) performed for Grand Rapids Hydro Dam. The dam is owned and operated by Manitoba hydro. KGS was retained to provide assistance to Manitoba hydro and to lead the organization and implementation of the FMEA. During October 2017, Mr. Broderick participated in a site inspection with KGS and Manitoba Hydro representatives. This was followed by a review of dam safety background information and data. Mr. Broderick then led a two day FEMA session, which was primarily based on Canadian Dam Association (CDA) engineering guidelines, with consideration of current practices used in the United States. Mr. Broderick initiated failure modes thinking through engagement with the core team from KGS and Manitoba Hydro that lead to selection of candidate failure modes. These were discussed until a clear characterization of the failure mode was fully developed. This process identified and described each potential failure mode, highlighted the most significant one, identified key monitoring parameters for each, and identified risk reduction measures including surveillance and monitoring opportunities, and if necessary additional investigations. KGS documented the FEMA session in a report, which Mr. Broderick reviewed and provided comments.



Publications (continued)

"Emergency Action Planning in the Event of Dam Failure", presented by W. Broderick and R. Knowlton, FERC Workshop, Niagara Falls, NY, 2000.

"Critical Piezometric Levels for Dam Safety Monitoring," by W. Xia, W. Broderick, F. Xi, ASDO Annual Conference, St. Louis, MO, 1999.

"Assessing The Impact of Instability of Reservoir Side Slopes," by P. C. Rizzo, J. M. Blair, A. Fernandez, (RIZZO), W. Broderick, W. Xia, and L. Y. Yao, (NYPA), USCOLD Annual Meeting, Atlanta, GA, 1999.

"Real Time Piezometric Level Monitoring at Bienhiem -Gilboa Pumped Storage Power Project," by W. Broderick, W. Xia, T. Hinkley, L. Y. Yao (NYPA) and E. Brylawski (GEONOR), USCOLD Annual Lecture, Buffalo, NY, 1998.

"A Quarter Century of Monitoring and Study on a Reservoir Side Slopes," by W. Broderick, W. Xia, L. Y. Yao, USCOLD Annual Lecture, Buffalo, NY, 1998.

"Safety of Dams and Other Structures Operated Under International Joint Commission Orders," W. Broderick (NYPA), Public Hearing of the International Joint Commission, Ottawa, Ontario, Canada, 1997.

"Robert Moses Niagara Power Plant Penstock Repair," by M. Dumont (Acres), C. Baker (Acres), W. Broderick (NYPA), USCOLD Annual Conference, Denver, CO, 1995.

"Hinckley Dam Liquefaction Assessment and Remediation," by A. P. Davis Jr. (GEI), W. Broderick (NYPA), G. Castro (GEI), USCOLD Annual Conference, Phoenix, AZ, 1994.

"FERC Emergency Action Plan Functional Exercise Design," by G. Gotzner (FERC), R. Spath (FERC) and W. Broderick (NYPA), FERC Design Seminars, San Francisco CA (May 1994) and Niagara Falls NY (June 1994).

Shepaug Reservoir Dam Repair

Warren, CT

01/2017 – Present

Mr. Broderick is the responsible charge engineer for the Shepaug Reservoir Dam Repair. The Shepaug Reservoir Dam was completed in 1933. It is owned and operated by the City of Waterbury, CT. The dam has a total length of about 500 feet and a maximum height of 65 Feet. The dam consists of a 73 foot long ogee spillway, with a 146 foot long ogee spillway 1 foot higher, and 175 foot concrete non-overflow section. There is a stone masonry gatehouse at the right end near the spillway and a 110 foot embankment section with a concrete core wall. The concrete gravity dam surface and the top concrete at the crest dam surface together with crest railing are in poor condition. The rehabilitation project consists of a concrete overlay of the downstream face and crest of the spillways; the downstream face of the non-overflow section; resurfacing the top of the non-overflow deck section; replacing the deteriorated handrails with new hand rails and kick-plates that conform to OSHA standards; and replacing the existing gutter on the valve house. The scope of work includes; document review; site evaluation; conceptual design; preparation of construction documents; procurement support, permitting support; and engineering support during construction.

Dam Safety Risk Screening | New York State Canal System

New York Power Authority | Albany, New York

05/2016 – 12/2016

Mr. Broderick served as part of the Senior Review Team for the dam safety risk screening of the New York State Canal System water impounding structures. The NYS Canal System is a navigable 524-mile inland waterway that spans upstate New York and includes more than 350 water impounding structures. The structures include, state regulated dams, levees, dikes, culverts, and other structures. The project included preparing a matrix with dam safety information that is being used in a qualitative screening level risk analysis for the structures.

Rehabilitation of Various Dams

Westchester County Department of Public Works and Transportation | Westchester County, NY

2016 - Present

Mr. Broderick is project manager for developing design plans and specifications for the rehabilitation of four dams (Gedney Pond Dam, Pelham Lake Dam, Wampus Lake Reservoir Dam & Maiden Lane Dam) located within Westchester County Parks. During the 1st phase, review of available documents and dam safety inspections were performed. Site topographic surveys and wetland delineation and mapping were conducted by sub-consultants. 90% rehabilitation designs were prepared for each dam for County approval. Two of the dams require general corrective maintenance. One dam requires a complete removal and replacement to construct a spillway with required capacity. The County decided that the remaining dam should be decommissioned and breached. Final design development has been suspended while the County considers adjustments to their initial plans and budgets.



Publications (continued)

"Dam Safety & Emergency Action Planning," Northeast Hydroelectric Association Annual Conference, Portland, OR, 1993.

"Contingency Planning For Power Dam Failure," presented by W. Broderick, New York State Police Security Seminar, Ellenville, NY, 1988.

"Niagara Hydroelectric Expansion Project," by W. Broderick and J.S. Teraszkiewicz, ASCE National Convention, Denver, CO, 1985.

"A Case Study in Low-Level Radioactive Waste Storage," by W. Broderick and R. J. Rella, ASCE Structural Engineering Conference, North Carolina State University, 1984.

"NASTRAN 3-D Finite Element Model Analysis for the Tokamak Fusion Test Reactor Center Support Column," by W. Broderick, EBASCO Services Inc., NY, NY, 1977.

Muddy Run Pumped Storage Facility

Exelon Power | Susquehanna River, Drumore Township, PA

05/2015 – 12/2017

Mr. Broderick was retained to assist Exelon Power with an evaluation of the Upper Reservoir Embankment Dam (Main Dam) performance monitoring instrumentation system. Exelon desired to evaluate the existing automatic data acquisition system and to develop a remediation plan to rehabilitate it or to replace it with a more reliable system. The evaluation report defines the purpose of instrumentation, aligns instrumentation to PFMA, recommends parameters to be monitored, recommends frequency of monitoring, and evaluated best practices and technology for monitoring dam performance going forward. A complete system upgrade was accepted by Exelon. RIZZO prepared detailed design drawings and specification for a fiber optic based data acquisition system. Construction was performed during spring/summer of 2017.

Pocantico Hills Pond Dam

Nelson Rockefeller, Jr./D.R. Horne & Company | Mount Pleasant, NY

07/2014 – Hold

RIZZO has provided professional engineering services for a proposed new dam and pond located on the Rockefeller Estates. Services provided have included: peer review of dam design plans & specifications by others; hydrology & hydraulics analysis; stability analysis; seepage analysis, and hazard assessment. Permitting support is currently being provided on an on-call basis. RIZZO will provide engineering support during construction and construction inspection services for the new pond and dam. Construction has been postponed due to recent draught conditions and inability to fill the proposed pond.

Dam Inspection and Engineering Services

NY State Office of General Services | State of New York

05/2014 – Present

Mr. Broderick as project manager provides the NY State Office of General Services with professional engineering services for dam safety inspections, engineering assessments, hazard assessments, civil/structural/geotechnical engineering, hydrology and hydraulics engineering, design of remediation, permitting, bid support, engineering support during construction, and construction management. This is a five year service agreement to provide dam safety inspections and engineering for dams at various locations throughout New York State that are owned and operated by NY State Department of Environmental Conservation. RIZZO teams have performed dam safety inspections and preliminary verification of hazard assessments for 30 dams throughout NYS. We have also been assigned one dam decommissioning project and one dam modification project requiring the addition of an auxiliary spillway. Additional assignments continue to be received to perform studies and modification designs for those dams that were hazard classification changes were recommended.

Saranac River Project | FERC Part 12D Safety Inspection | 4 Dams

New York State Electric and Gas Corporation | Plattsburgh, New York

05/2014 – Present

Mr. Broderick was selected by New York State Electric & Gas Corporation, and approved by FERC, as the independent consultant for the 7th Part 12D Safety Inspection of the Saranac River Hydroelectric Power Project. The project includes safety inspections for Kent Falls Dam, Mill C Dam, Cadyville Dam, High Falls Intake, and High Falls Dam. Based on current federal guidelines, this safety inspection includes review of historic information, performing field inspections, assessment of the existing PFMA, update of the supporting technical information document (STID), and assessment of overall project safety. Mr. Broderick's term as independent consultant will expire in 2019. Supplemental stability analyses for Mill C Dam were performed and updated spillway rating curves were developed during 2018 and are waiting for FERC approval.



Workshops on Dam Safety Performance Monitoring & Data Management – Best Practices CEATI International Dam Safety Interest Group | Various Locations

01/2014 – 12/2015

Mr. Broderick along with W. Allen Marr, Ph.D., P.E., Geocomp Corporation, Acton, MA, were retained by CEATI to conduct a series of two day "Dam Safety Performance Monitoring and Data Management" training workshops. The purpose was to present the results of our joint research on dam safety best practices and to inform and train dam safety managers and engineers from member organizations who sponsored this research effort. Workshops were held in Atlanta, GA, April 2014 and in New Orleans, LA, October 2015.

New Rochelle Dams

New Rochelle | Westchester County, New York

12/2012 – 12/2017

Mr. Broderick was retained by the City of New Rochelle NY to provide NYS Dam Safety Regulatory Compliance for six existing dams: New Rochelle Dam #1; Dickermans Pond Dam; Carpenters Pond Dam; Paine Lake Dam; Mahstedt Pond Dam; and, Glenwood Lake Dam. Mr. Broderick prepared Annual Certification Letters, evaluated existing data, site conditions and prepared Dam Safety Inspection Reports for all six dams. Dam #1 is a high hazard dam that has been designated by NY State as "unsound." Mr. Broderick prepared an Inspection & Maintenance Plan, EAP with updated inundation maps. The other dams are either intermediate or low hazard dams. Mr. Broderick is continuing to work with the City to implement measures for full regulatory compliance. Design drawings and specifications were developed during 2016 for a neighborhood small pond maintenance dredging project.

Turners Falls Canal Left Dike | 3rd Independent Consultant's Safety Inspection

Turners Falls, Massachusetts

04/2012 – 12/2017

Mr. Broderick was the FERC approved independent consultant for the 3rd Part 12D Dam Safety Inspection. The inspection will be conducted in August 2012. The Inspection Report with updated PFMA and STID will be completed and filed with FERC in December 2012. Mr. Broderick's term as independent consultant for this Project will expire in 2017. Mr. Broderick provided design drawings and specifications for embankment toe drains remediation in response to findings during the inspection. He is providing on-call support during the permit application process and will provide engineering support during construction, which was completed in 2017.

ASCE Task Committee | Instrumentation and Measurements For Monitoring Dam Performance

11/2011 – 11/2017

Mr. Broderick was part of a group of professionals from diverse backgrounds and experience, with the goal of completing and publishing a comprehensive, up-to-date book about monitoring dam performance. Originally published in 2000 by the Energy Division, this update of this valuable reference guideline addresses advances in technology and current state-of-the-practice. It presents the methodology and process for the selection of measurement instruments, measurement techniques, installation, operation, maintenance, and evaluation techniques regarding performance monitoring of all types of dams. RIZZO supported participation in the committee's work and has been acknowledged in the publication. This 2018 version of the updated manual of practice is now available on the ASCE website.

Rainbow Falls Dam | Potential Failure Modes Analysis

08/2011 – 12/2011

Rainbow Falls Hydroelectric Project is a significant hazard potential dam located on the Ausable River in Clinton and Essex Counties, NY. Mr. Broderick was retained by New York State Electric & Gas Corp. (NYSEG) to prepare a STID based on existing dam safety records and to serve as facilitator for the first PFMA. The PFMA report and STID were completed and filed with FERC in December 2011. The PFMA resulted in several recommendations for supplemental stability analysis and evaluations to assign appropriate categories for selected potential failure modes requiring additional information.



Larchmont Dams

Village of Larchmont | Westchester County, New York

01/2010 – Present

Mr. Broderick was retained by the Village of Larchmont as the project engineer for Larchmont Dam, an intermediate hazard potential dam, and Larchmont Dam No. 2, a high hazard potential dam. This Project was intended to bring these dams into compliance with recently updated NYSDEC dam safety regulations. He performed safety inspections at both dams, developed an Inspection & Maintenance Plan, and an EAP. As a result of inspection findings, Mr. Broderick developed and supervised installation of a seepage weir system to monitor foundation seepage at Dam No. 2. He also developed and prioritized a maintenance improvement plan for implementation over a 5 year period. Mr. Broderick continues to serve as a dam safety consultant to the Village. Mr. Broderick completed Engineering Assessments for Larchmont Dam No. 2, a high hazard dam, in August 2014 and for Larchmont Dam, an intermediate hazard dam, in August 2015. A special hydrology and hydraulics analysis was conducted for Larchmont Dam No. 2 in 2015 to evaluate and quantify potential downstream benefits for preemptive lowering of the reservoir water surface elevation when significant storm events are predicted. Mr. Broderick continues to advise the Village on dam safety issues and supports annual EAP updates and agency coordination activities.

CEATI – Dam Safety Interest Group | Best Practices Dam Safety Structural Performance

CEATI International, Inc. | Montreal, Quebec

05/2009 – 12/2012

Mr. Broderick was a principal investigator with Dr. Allen Marr, of Geocomp Corp., and project advisor Professor Fred H. Kulhawy, Cornell University (retired), for development of a dam safety structural performance monitoring and data analysis management best practices report commissioned by the Dam Safety Interest Group (DSIG). Work included by-annual progress reports at CEATI business meetings and several technical review and coordination meetings with the DSIG Technical Advisor and Project Sponsors. At the request of the Project Sponsors, Mr. Broderick and Dr. Marr prepared a 2-day short course to present the results of this research at a series of dam safety workshops at selected locations. The Study Report commenced in May 2009 and was published by CEATI in 2012.

Browns Reservoir Rehabilitation Project

First Taxing District Water Department | Norwalk, Connecticut

12/2007 – 6/2013

Mr. Broderick is the principal engineer for the hydrology, hydraulic, stability, geotechnical aspects of this rehabilitation project located in Lewisboro, NY. The earthen embankments, built between 1908 and 1910, have a maximum height of 45 feet, a length of 1,200 feet, crest width of 14 feet, a concrete core wall, riprap protected upstream slopes of 2H:1V and downstream slopes of 1.5H:1.0V overgrown with trees and brush. The low-level outlet includes an upstream stone masonry intake head wall, a gate house structure extending 50 feet through the Dam from the crest, two cast iron outlet pipes (30 and 16 inches in diameter), and a valve chamber at the downstream end. The concrete spillway is 226-feet-long and has five concrete tiers or steps on the downstream side to form the drop structure. Mr. Broderick prepared applications for Town Planning Board approval of Site Development Plans and Wetland Activity Permit, NYDEC construction permits, and U.S. Army Corps of Engineers (USACE) construction permits. He provided engineering support during construction from December 2011 through June 2013.

Rainbow Falls Hydroelectric Project

New York State Electric & Gas (NYSEG) | Keeseville, NY

09/2015 – 12/2015

RIZZO was retained by NYSEG to perform a stability analysis for the Rainbow Falls East Abutment Embankment and East Abutment Concrete Training Wall in response to concerns raised during the PFMA. Services provided included: surveying as-built conditions; borings and laboratory testing to categorize embankment fill; stability and seepage analyses; and development of findings and recommendations to correct deficiencies. A report was issued in December 2015. Recommendations include raising the embankment concrete core wall to account for current SDF and modifying upstream and downstream embankment slopes to obtain required factors of safety for stability. The training wall was found to be satisfactory. NYSEG is pursuing regulatory permits. Construction is planned for 2018.



Glens Falls Dams

Glens Falls | Warren County, New York

11/2013 – 12/2014

Mr. Broderick performed Dam Safety Inspections for Butler Pond Dam, Butler Storage Reservoir Dam, Halfway Brook Reservoir Dam, Keenan Reservoir Dam, and Wilkie Reservoir Dam. These inspections were done to meet the City of Glens Falls' objectives of ensuring safe operation of the City's five water supply reservoir dams and maintaining compliance with the City's Inspection and Maintenance Plan and New York State Department of Environmental Conservation (NYSDEC) Dam Safety Regulations. Three of the dams are classified as high hazard and two are classified as intermediate hazard dams. Inspection Reports were completed in November 2013. Summary findings and recommendations were provided.

New City Dam No. 1

New City, New York

04/2013

Mr. Broderick was retained to perform a dam safety inspection by the New City Park Club, Inc., for a Class A – Low Hazard Dam, located on a tributary of the Hackensack River. The purpose was to identify potential problems with dam performance, to identify investigations and analysis that may be required, and to provide recommendations to address deficiencies in order to meet NYSDEC dam safety regulations. The inspection and report were completed in April 2013.

Stillwater Dam Liquefaction & Deformation Analysis

Hudson River Black River Regulating District | Webb, New York

07/2010 – 07/2014

Stillwater Reservoir is located on the Beaver River in Herkimer County, NY. As a result of a FERC Part 12D Safety Inspection finding, Mr. Broderick was retained by the NY State Hudson River Black River Regulating District to perform on-site inspection, data collection & review, liquefaction analysis, and technical report preparation to resolve the issue of liquefaction potential at the Stillwater Hydroelectric Project north embankment dam. The analysis has been completed the report has been filed with FERC. In 2014, FERC sent a letter to the Owner accepting the findings and recommendations of the report. This effectively resolves the open Part 12D recommendation on this subject.

Kayuta Hydroelectric Project

Algonquin Power FERC No. 5000 | New York

03/2008 – 12/2008

Mr. Broderick was the FERC approved independent consultant for the 4th Part 12D Dam Safety Inspection. The inspection was completed in June 2008. The Inspection Report with updated PFMA and STID was completed and filed with FERC in October 2008.

Ogdensburg Hydroelectric Project

Algonquin Power FERC Project No. 982 | New York

03/2008 – 12/2008

Mr. Broderick was the FERC approved independent consultant for the 4th Part 12D Dam Safety Inspection. The inspection was completed in June 2008. The Inspection Report with updated PFMA and STID was completed and filed with FERC in October 2008.

Osage Hydroelectric Project

Ameren Missouri | Lake Ozark, Missouri

10/2007 – 07/2009

Mr. Broderick served as the engineering manager for an 18-month probable maximum flood (PMF) study to meet current FERC engineering guidelines for determination of probable maximum precipitation and determination of the PMF for Bagnell Dam. The watershed area is about 14,000 square mile with several intermediate watershed basins including the USACE's Harry S. Truman Dam. The Study was completed and filed with FERC in July 2009.



Silver Lake Reservoir

Wisconsin Public Service Corporation (previously Upper Peninsula Power Company) | Ishpeming, Michigan

10/2007 – 12/2008

Mr. Broderick performed detailed design review of the Silver Lake Reservoir emergency spillway reconstruction project for Upper Peninsula Power Company, Ishpeming, MI. Provided technical comments and drawing mark-ups to engineers and designers for detailing concrete ogee spillway, flop bucket energy dissipater, concrete discharge channel, and associated concrete retaining walls.

Taum Sauk Upper Reservoir Rebuild Project

Ameren Missouri | Lesterville, Missouri

10/2008

Mr. Broderick prepared a conceptual study for Taum Sauk Project Powerhouse Tailrace sediment removal. This involved conceptual design of temporary rock berm at the end of the discharge channel, dewatering of the canal, access roads into the canal, borrow pit development for berm materials, and disposal requirements for removed sediment.

PREVIOUS EXPERIENCE

New York Power Authority

White Plains | New York

10/1980 – 10/2007

Mr. Broderick was the responsible charge engineer for dam safety, emergency action planning, and license compliance at the New York Power Authority (NYPA). During that time, he facilitated and actively participated in all required 5-year Part 12D Safety Inspections with various independent consultants, annual operations inspections, EAP coordination meetings, tabletop and functional EAP training exercises with federal, state, and local emergency response officials, core team member for potential failure modes analyses, and performed detailed instrumentation and monitoring reviews for six (6) high hazard hydroelectric projects.

The following hydroelectric projects are owned and operated by the New York Power Authority:

- Niagara Power Project:** 2400 MW, Niagara River Diversion
- St. Lawrence/FDR Power Project:** 890 MW, St. Lawrence River
- Blenheim-Gilboa Pumped Storage Power Project:** 1000 MW, Schoharie Creek
- Gregory B. Jarvis Power Project:** 12 MW, Hinckley Reservoir, W Canada Creek
- Crescent Power Project:** 9 MW, Mohawk River
- Vischer Ferry Power Project:** 9 MW, Mohawk River

Mr. Broderick was also responsible for civil/structural/geotechnical/hydraulic engineering for new construction, plant modifications, corrective maintenance, and performance monitoring of structures at all facilities. This work included such major maintenance as turbine upgrades, as well as, general plant life extension and modernization.

Terence R. Allison, P.S.

Land Surveying Project Manager



Mr. Terence R. Allison, P.S. has recently joined the CTL Engineering team bringing along over 35 years of all types of surveying in Ohio, around the country and around the world. He is responsible for the supervision, coordination, reporting and consultation of land surveying and construction surveying related services. These responsibilities include reviewing of the scope of

work, project plans and specifications prior to the start of work, assigning appropriate field crews and cad personnel to projects, supervise the training of technicians, reviewing all field and office work for the project and delivering the final plats, deeds and other surveying products requested.

Mr. Allison has been the project manager on a variety of surveying projects that include, but are not limited to boundary and topographic surveys, municipal infrastructure and park surveys, oil and gas well plats and design surveys, FEMA LIDAR check surveys, cell towers, subdivisions, site developments, roads, bridges, sewers and other utilities, flood control studies, and construction layout for major buildings, roads, and bridges.

EDUCATION

A.A.S. Surveying and Construction Technology, 1979
A.A.S. Computer Technology, 1985
Weatherhead School of Management Career Management Series,
Case Western Reserve University

PROFESSIONAL REGISTRATION / CERTIFICATION

Registered Professional Surveyor, State of Ohio
Registered Professional Surveyor, State of West Virginia

CTL PROJECT EXPERIENCE

TRANSPORTATION

ODOT STW ITS Asset Data Collection, Various, Ohio
W 9th Street & Front Avenue Parking Lot - Slope Repair,
Cleveland, Ohio
Akron Canton Airport, GIS Survey and As-Build Survey, Akron,
Ohio
Wells Road Extension Survey, Ashland, Ohio
WAS-T394-0.86, Marietta, Ohio
Orchard Street Topo, Akron, Ohio
Stark County Public Library, Offsite Parking Lot, Canton, Ohio
City of North Canton – Deerfield Drive Improvements
City of Cleveland – Grayton Road Improvements, Euclid Corridor,
Detroit Avenue Streetscape, E. 40th Street Streetscape Survey, E.
9th Street Streetscape Survey
City of Akron – Kenmore Blvd Streetscape
City of Norton – Barber Road Improvement Survey
Ohio Turnpike Commission – Third Lane Addition Survey

SANITARY SEWERS

Akron Northside Sewer, Akron, Ohio
Cleveland Sanitary Engineering Department – Manhole survey
and inspection, St. Clair Avenue Force Main Survey
Akron Environmental and Pollution Control – Botzum Truck Line
Manhole Survey
NEORS - Site Survey of Doan Brook site, Construction Survey
for Southerly Plant improvements, Millcreek Interceptor Survey,
Cuyahoga County Manhole inventory Survey

WATER DISTRIBUTION, STORM SEWER AND DRAINAGE

Akron WRF BioCEPT Improvements, Akron, Ohio
City of Massillon 2013 WWTP Improvements, Ohio
Cleveland City CSO manhole inventory
Multiple surveys for drainage calculations for Subdivision design
and oil and gas well and pipeline site plans
Cleveland Water Department – Site survey of Baldwin, Southerly
and Easterly Plants, Countrywide Hydraulic Modeling survey
Range Resources – Ohio River intake and pipeline survey

RIGHT-OF-WAY ACQUISITION

NEORS - Millcreek project-ROW easements and mapping
Chesapeake Energy – Multiple pipeline routing and lease
acquisition surveys
AEP – ROW survey in Western West Virginia
City of Norton, Ohio – State Route 21 ROW survey

BUILDING DEVELOPMENT

University of Akron Electrical Topo, Akron, Ohio
Chillicothe Correctional Institute, Chillicothe, Ohio
Columbus Airport Residence Inn, Columbus, Ohio
Sunrise Vista Health & Wellness, Canton, Ohio
Euclid High School - Additional Services, Euclid, Ohio
The Ohio State University Wooster Campus OARDC New Lab
Building, Wooster, Ohio
Kent State University, Stark Performing Arts Center, North Canton,
Ohio
Chippewa Local Schools, Doylestown, Ohio
Case Western Reserve University, Cleveland, Ohio
Lake Sherman Mobile Home Park Expansion, Bethlehem
Township, Ohio
Case Western Reserve University, CWRU Adelbert
Gym- Bingham Hall Steam Replacement Topographic Survey,
Cleveland, Ohio
UPS Columbus Hub Expansion and Modernization, Columbus,
Ohio

DAMS / RESERVOIRS

Hargus Lake Dam Survey, Circleville, Ohio
Veto Lake Dam Survey, Belpre, Ohio

Joseph Grani, M.S., P.E.

Manager, Geotechnical Services Department



Mr. Joseph Grani, P.E. has over 28 years of experience in the geotechnical field. He is responsible for the supervision of all geotechnical engineering projects including foundation analyses and recommendations for roadways, bridges, landslides, sewers, buildings, towers, and tanks. He has worked on several roadway rehabilitation projects where unsuitable soils were encountered.

His innovative solutions to projects have included using geo-grid to bridge soft soils and decrease required pavement thicknesses and the use of drying agents such as cement and lime to stabilize the soils. Mr. Grani was the Project Manager for various landslide projects including a 1,590-foot long plug pile wall (HEN-110-0.66), and a 1,170-foot long plug pile wall (ADA-125-13.30).

Also, Mr. Grani served as the Project Manager for the geotechnical explorations with varying level of design calculations on 19 landslides in ODOT District 09, 14 landslides in ODOT District 05, and 23 landslides in ODOT District 11. In addition to landslides, in the past 5 years, Mr. Grani has served as Geotechnical Project Manager on over 50 other transportation projects across Ohio including new highway interchanges, bridge and culvert replacements, and roadway realignments.

EDUCATION

Master of Science

The Ohio State University, Columbus, Ohio 1994

Bachelor of Science, Civil Engineering

The Ohio State University, Columbus, Ohio 1991

PROFESSIONAL REGISTRATION / CERTIFICATION

Registered Professional Engineer, State of Ohio

Member American Society of Highway Engineers

Member Deep Foundation Institute

CTL PROJECT EXPERIENCE

DAMS/RESERVOIRS

Veto Lake, Washington County, Ohio

Stewart Lake Dam, Ross County, Ohio

ODNR Shreve Lake Dam Assessment, Wayne County, Ohio

Muskingum River Lock and Dam Assessment, Muskingum County, Ohio

Buckeye Lake Dam, Buckeye Lake, Ohio

Clear Fork Reservoir Dam Seepage Investigation, Mansfield, Ohio

SLOPE STABILITY/LANDSLIDES

Belmont County Water and Sewer, County Road 3 Landslide Exploration, Ohio

Middleport-slip Repair, Meigs County, Ohio

Carthage Township Trustees, Jordan Run slip, Athens County, Ohio

Island Creek Township Trustees, Jefferson County, Ohio

JEF-TR384 landslide Exploration

TR 350 slip Repair

TR 381 slip Repair

TR 383 slip Repair

Athens County Engineer, Various Landslides, Ohio

ATH-CR75-5.29

ATH-CR57-1.29

ATH-CR57-0.93

ATH-CR48-8.21

ATH-CR48-7.00

ATH-CR48-6.17

ATH-CR89-2.14-Rainbow Lake Rd.

ATH-CR94-0.29-Swett Hollow Rd.

ATH-CR10-7.25

CR 28-4.43 (McDougal Rd slip)

Jefferson County Engineer, Various Slips, Ohio

JEF-CR72

JEF-CR26

CR 26

CR 56

Knox Township, TR 246 Landslide, Jefferson County, Ohio

Ohio Department of Transportation, HEN-110-0.66 Slip, Ohio

Pike County Engineer, Ohio

Watson Rd slip into Ravine

Owl Creek Road

CR 602-slip 1

Scioto County Engineer, Walnut Hill Road, Ohio

Scioto Township, TR144A (Polk Hollow Road) Slip Repair, Ross County, Ohio

Springfield Township, TR265 landslide Exploration, Jefferson County, Ohio

Steubenville Township, STR170, Jefferson County, Ohio

Troy Township Trustee, ATH-TR179-0.92 Sawyer Run Road, Athens County, Ohio

Village of Rayland, Narrows Road Slip Repair, Jefferson County, Ohio

Warren Township Trustee, TR109A and TR113 Landslides, Jefferson County, Ohio

Wayne Township, TR213 and TR166 Slip Repairs, Jefferson County, Ohio

Carl Selfridge

Manager, Geotechnical & Drilling Services



Mr. Selfridge annually manages 100+ various geotechnical projects including; education, transportation, commercial development and a variety of public and private clients. Mr. Selfridge is responsible for directing all aspects of the Geotechnical Engineering Department for CTL Engineering of West Virginia, Inc.

This includes the management of field drilling activities, field classification of soil and rock, field and laboratory safety procedures, the assignment of a laboratory testing program, and performing geotechnical evaluations. Engineering evaluations include foundation recommendations, settlement analysis, slope stability analysis, earth pressure coefficients and report preparation.

EDUCATION

A.A.S. Mechanical Technology – Drafting & Design
Adirondack Community College, Queensbury, N.Y. 1991
A.S. Engineering Science
Adirondack Community College, Queensbury, N.Y. 1994
B.S. Civil Engineering (Geotechnical & Structural)
Rensselaer Polytechnic Institute, Troy, N.Y. 1996
Graduate Studies-Civil Engineering (Geotechnical)
Rensselaer Polytechnic Institute, Troy, N.Y. 1996-1999

PROFESSIONAL REGISTRATION / CERTIFICATION

Engineer Intern (EI): New York, 1996
Pennsylvania Dept of Transportation Level II Drilling
Inspector, 1999

CTL PROJECT EXPERIENCE

MINE & LANDFILL RELATED

Eccles and MacArthur Subsidence-Subsidence Investigation & Mitigation. Raleigh County, W.V.
Shinns Run Portals & AMD-AML Reclamation & Geotechnical Services. Harrison County, W.V.
Tunnel Ridge Slurry Cell A-Piezometer Installations & Geotechnical Services. Ohio County, W.V.
Pine Creek: Omar Landfill-Geotechnical Services. Logan County, W.V.
WV State-wide Landfill-Geotechnical Services.
Buzzard Pond Dam-Geotechnical Services. Marshall County, W.V.

WATER/WASTEWATER TREATMENT

Water Treatment Plant Corrective Action Design-Geotechnical Services. Marion County, W.V.

TRANSPORTATION

Benedum Airport Towers-Geotechnical Services. Harrison County, W.V.
I-81 Martinsburg to Marlowe Interchange-Design Build. Jefferson County, W.V.
Hughes Creek Landslide-Geotechnical Services. Kanawha County, W.V.
Dick Henderson Bridge-Geotechnical Services. Kanawha County, W.V.
Morgantown Airport Alternative Access Road-Geotechnical Services. Morgantown, W.V.
Leon Bridge-Geotechnical Services. Mason County, W.V.
Morgantown Rest Area-Geotechnical Evaluation. Morgantown, W.V.
Veterans Memorial Bridge-Geotechnical Services. Hancock County, W.V.

HEALTHCARE

New Preston Memorial Hospital-Geotechnical Evaluation. Preston County, W.V.
Mon General Hospital Development-Site Design Services. Morgantown, W.V.
Pierpont Centre Dental Office-Geotechnical Evaluation. Morgantown, W.V.
Davis Memorial Hospital Addition-Geotechnical Services. Randolph County, W.V.
Chestnut Ridge Hospital Addition-Geotechnical Services. Morgantown, W.V.
WVU Hospitals Data Center-Geotechnical Services. Morgantown, W.V.
Molecular Lab and Morgue-Geotechnical & Surveying Services. Morgantown, W.V.
Ambulatory Care Center-Geotechnical Services. Morgantown, W.V.

BUILDING DEVELOPMENT

University Park-Civil Site, Geotechnical, Environmental & Surveying Services. Morgantown, W.V.
Gateway Development-Civil Site, Geotechnical, Environmental & Surveying Services. Morgantown, W.V.
Shoney's Restaurant-Geotechnical Investigation. Morgantown, W.V.
Grand Central Apartments-Geotechnical Services. Morgantown W.V.
Oak Valley Garden Apartments-Geotechnical Services. Gilmer County, W.V.
West Minister Apartments: Phase I & II-Civil Site, Environmental, Geotechnical & Surveying Services. Jefferson County, W.V.
University Place-Civil Site, Environmental, Geotechnical & Surveying Services. Morgantown, W.V.

Ali Karaki, P.E.

Project Manager, Geotechnical Services



Ali Karaki, P.E. has been a CTL employee since the mid 1980's with experience in the geotechnical engineering and geotechnical instrumentation. He is responsible for managing and engineering of geotechnical instrumentation, subsurface investigation studies, including complex technical

recommendations for; soils modifications, liquefaction, Karst, underground and surface mines including dynamic compaction, slope stability and seepage analysis, pile/caisson design, reinforced earth design, and preparation of earthwork specifications including Green Infrastructure soil design parameters.

He has worked with numerous municipalities and private clients on many projects including; Road and Bridges, Storm Sewers, Sanitary Sewers, CSO's, Lift Stations, Pump Stations, Interceptors, Water and Wastewater Treatment Plants, Tunnels, Levees, Dikes and Dams, Buildings, Runways and Taxiways, Parking Lots and Garages, Embankments, and Telecommunication Towers including Public Private Partnerships (P3's) and Design Build. Also, he has extensive experience managing geotechnical instrumentation programs for large diameter interceptors, tunnels, lift stations and roadway projects including; installation, monitoring and reporting.

EDUCATION

Master of Science, Geotechnical Engineering
The Ohio State University, Columbus, Ohio 1984
Bachelor of Science, Civil Engineering
The Ohio State University, Columbus, Ohio 1982

PROFESSIONAL REGISTRATION / CERTIFICATION

Registered Professional Engineer, Indiana and Ohio
Member of American Society of Civil Engineers (ASCE)
American Council of Engineering Companies (ACEC)
Member of ASCE Geotechnical Group - Indianapolis
Chi Epsilon, National Civil Engineering Honor Society

CTL PROJECT EXPERIENCE

EAGLE CREEK DAM & POGUES RUN DAM INSPECTIONS

Indianapolis, Indiana

Project Manager for the complete inspection of the Eagle Creek and Pogues Run Dams. Duties consisted of data Collection and Review including reviewing prior inspection reports, data collected from existing piezometers and other available documentations for the dams; Field Observations including visual inspections related to potential geotechnical deficiencies, and obtaining photographs at each dam location; and Reporting of the findings obtained from the data collection and field observation.

CITY OF INDIANAPOLIS DPW LEVEE ACCREDITATION PROGRAM

Marion County, Indiana

Project Manager for the preliminary inspection of the city maintained levees to determine the presence of any geotechnical related maintenance deficiencies (such as visible sloughing) and to provide preliminary summary and general recommendations to address the apparent maintenance deficiencies for each levee.

CITY OF INDIANAPOLIS DPW SOUTHPORT WWTP LEVEE EXTENSION AND EVALUATION

Indianapolis, Indiana

Project Manager for the preliminary inspection of the existing levee was performed to determine the presence of any geotechnical related maintenance deficiencies (such as visible sloughing) and provide preliminary summary and general recommendations to address the apparent maintenance deficiencies.

LAKE OF FOUR SEASONS DAM

Hideaway Hills, Ohio

Project Manager. The purpose of the project was to determine the cause of the seepage at the toe and middle of the existing 50 to 60 feet high, 1100 feet in length dam embankment within the earthen dam. The dam was visually inspected and test borings were taken to determine the existing fill within the earthen dam embankment. Recommendations including pressure injected grout was prepared and performed. CTL also prepared the construction specifications. Additionally, CTL Engineering performed the inspection during construction.

WRIGHT LAKE DAM #2

Licking County, Ohio

Project manager for the earthen dam inspection and evaluation. In conjunction with another Engineering Consulting Design firm, CTL assisted in evaluation of the existing dam. CTL performed the geotechnical investigation including test borings and laboratory testing to determine the soil conditions. Additionally, CTL prepared recommendations for addressing the permeability of existing soil within the earthen dam.

Frederick Schoen, P.E.

Manager, Geotechnical Engineering Services



Mr. Frederick L. Schoen, P.E. has over 22 years of experience in geotechnical engineering as well as construction quality control testing and observation. He has experience providing geotechnical engineering consulting on transportation, school, commercial and manufacturing projects. He is responsible for coordinating the geotechnical field activities, assigning

laboratory testing and writing the geotechnical engineering reports.

His experience also includes conducting electrical resistivity imaging (ERI) in order to locate and/or identify subsurface features and characteristics such as karst, voids, buried structures, differing geology, groundwater sources, as well as mine voids and spoil materials which are difficult to access with conventional drilling equipment.

In addition, he has performed over million square feet of random traffic floor flatness testing and helped revise and implement the company's Quality System Manual. He is also responsible for the calibrations of the company's nuclear densometer gauges. As an engineering technician, Mr. Schoen's responsibilities have included the testing and inspection of concrete, foundations, reinforcing steel, and soils.

EDUCATION

B.S.C.E. / 1997 / Geotechnical Engineering, The Ohio State University

PROFESSIONAL REGISTRATION / CERTIFICATION

Professional Engineer, State of Ohio, 2002
Professional Engineer, State of Michigan, 2002
Professional Engineer, State of Indiana, 2009

CTL PROJECT EXPERIENCE

DAMS/RESERVOIRS

Cave Lake Dam, Pike County, Ohio
Apple Valley Lake Dam, Howard, Ohio
Lake White Waste Area Slope Evaluation, Pike County, Ohio
Clear Fork Reservoir Dam Seepage Investigation, Mansfield, Ohio
Fawn Lake Dam Repair, Sidney, Ohio

GEOPHYSICAL TESTING PROJECTS

Mr. Schoen performed Electrical Resistivity on the following projects:

OSU Arts District
NOVA Substation

Franklin County Correctional Center
University Parkway
West High Street Sewer Rehabilitation
Turkey Foot Swine Farm
Stillwater Crossing Proposed Development
Union Memorial Hospital Addition

WATER/WASTEWATER TREATMENT PLANTS, SEWER LINES AND WATER TANKS

WWTP Lagoon Expansion, Russia, Ohio
Wharton Sanitary Sewer System, Wyandot County, Ohio
WWTP Flow Equalization Basin and Standby Generator Plant, Piqua, Ohio
NORW Depth to Rock Study, Bellevue, Ohio
Wells Road Residential STS Soil Evaluation, Anna, Ohio
Proposed Water Tower, Russia, Ohio
New 5-Acre Lagoon Project, New Bremen, Ohio
Cooper Farms WWTP Lagoons, Ft. Recovery, Ohio
McCartyville Sanitary Sewer Building, Anna, Ohio
WTP and Water Main Improvement, Urbana, Ohio
Sanitary Sewer and Water Line Improvements, Troy, Ohio
Wastewater Lagoon Project, St. Henry, Ohio
Sanitary Sewer Line Project, Huntsville, Ohio
1.5 Million Gallon Water Tower, Celina, Ohio
St Henry WWTP Expansion, St. Henry, Ohio
Preliminary Water Line Evaluation, East Liberty, Ohio

POWER AND CHEMICAL PLANTS

New Lima Power Plant – Solid Fuel Storage Building, Lima, Ohio
Premcor Refinery – PHT 672, Lima, Ohio
Premcor Refinery – SRU Project, Various Phases, Lima, Ohio

TRANSPORTATION

Russell Road Reconstruction Station 57+1, Sidney, Ohio
Russell Road Bridge over I75, Sidney, Ohio
Phase I Terminal Drive Improvements, Dayton, Ohio
ODOT Project NO 6001 (03), Dayton, Ohio
25A Reconstruction, Piqua, Ohio
DAR-49-30.01 over Stillwater River ODOT, Brown Township, Ohio
ODOT 052(04); Shelby Co., Sidney, Ohio
Residential Bridge over Ludlow Creek, Ludlow Falls, Ohio
MOT-75-11.00, Dayton, Ohio
ODOT 477(03) Shelby Co, Ft. Loramie, Ohio
North Washington Street Reconstruction, Van Wert, Ohio

Years of Experience

14

Title/Level

Principal, New York Region
Level 10

Education

M.S., Civil Engineering, National University of Mexico

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

Languages

Spanish, Fluent

English, Fluent

Professional Registration

Civil Engineer - California

Publications

Moffat, R. and Benard, D.R., "Back-Analysis and In-situ Shear Testing Studies to Estimate Shear Strength Parameters on an Actual Slope," Presented at the 2013 Geo-Congress, San Diego, California.

Tastan, E.O., Fernandez, A., and Benard, D.R., "Numerical Analysis of the Settlement of a Large Scale Nuclear Power Plant for Difficult Subsurface Conditions," Presented at the International Conference on Geotechnical Engineering, 2010, Hammamet, Tunisia.

Bogart, M., and Benard, D.R., "Static and Dynamic Soil Pressures over a Primary Crusher Station at a Copper Mine in Chile," Geo-Congress 2014, Atlanta, Georgia.

Bogart, M., Tastan, E.O., and Benard, D.R., "Three-Dimensional Settlement Analysis of a Primary Crusher Station at a Copper Mine in Chile," 3rd International FLAC/DEM Symposium 2013, Hangzhou, China.

Schwartz, M. and Benard, D.R., "Parameters Describing Breach Formation of Small Dams," 2018 ASDSO Northeast Region Conference, Lancaster, PA, June 2018.

Skill Areas:

Civil Engineering
Structural Engineering
Earthquake Engineering
Geotechnical Engineering

Hydrology and Hydraulics
Dam Breach & Hazard Evaluations
Project Management
Proposals & Cost Estimates

Mr. Rivera has over 14 years of experience on a wide variety of engineering projects, specifically in geotechnical, structural, seismic, hydrological and hydraulic analysis and design. He has performed projects involving analyses for different types of structures, including power plants, concrete and steel buildings, earthen and concrete dams, Mechanically Stabilized Earth (MSE) and concrete walls and foundations. Mr. Rivera's experience also includes technical review, supervision and management of engineering projects; preparation of bid documents; coordination with State and Federal Regulatory Agencies in the U.S. and other countries; and development of detailed engineering reports and proposals.

Cliff Lake Dam Seepage Analysis

Eagle Creek Renewable Energy | Forestburgh, New York

08/2010 – 09/2011

Mr. Rivera is the Project Manager for the Cliff Lake Dam Seepage Remediation Project. Cliff Lake Dam consists of a 270-foot (ft)-long earth embankment, a 100-ft.-long concrete overflow spillway and a 150-ft.-long concrete gravity non-overflow wall on the left side of the spillway. Based on FERC's recommendations on the Independent Consultant's letter, RIZZO has proposed a phased approach to evaluate seepage at the Dam which includes a geotechnical field investigation and a two-dimensional (2-D) seepage analysis based on field and monitoring data. RIZZO will also perform a liquefaction analysis. The field investigation work plan has been submitted to FERC and field work is planned for 2018.

Rio Dam Hydroelectric Project | Stability Analysis

Eagle Creek RE, LLC | Forestburgh, New York

07/2017 – 08/2017

Mr. Rivera was the Technical Reviewer for the stability analysis and evaluation of the dam concrete-rock interface shear strength parameters. RIZZO's provided a geotechnical field investigation, stability analysis of five (5) Dam sections, remedial design, preparation of contract drawings and specifications, and CQA/QC during the construction phase.

Mongaup Falls Project | Pre-Hazard Assessment

Orange and Rockland Utilities | Pearl River, New York

10/2017 – 11/2017

Mr. Rivera was the Project Manager for the pre-hazard evaluation of the Mongaup Falls Dam. The objective of the assessment was to perform a simplified analysis, based on available information, to evaluate if a breach of Mongaup Falls Dam would result in overtopping and potential failure of Rio Dam. The results of this assessment were compared to previous analysis performed by other consultants.



Geotechnical Investigation and Seismic Evaluation – Stillwater Dam

Hudson River-Black River Regulating District | Herkimer, New York

2/2019 – Present

Mr. Rivera is the Project Manager and Technical Lead for the geotechnical field investigation and seismic evaluation of Stillwater Dam. The field investigation includes drilling of several borings on the embankment upstream and downstream faces following FERC Guidelines. The scope of work also includes a seismic stability analysis, a liquefaction triggering analysis and a post-earthquake stability and deformation analysis of the earth embankment in accordance with FERC's current Guidelines.

Mill C Dam | Stability Analysis

Rochester Gas and Electric | Clinton County, New York

07/2017 – 08/2017

Mr. Rivera was the Technical Reviewer for the stability calculations on the gate bulkhead structure. The stability analyses were performed according to the FERC Engineering Guidelines for the Evaluation of Hydropower Projects.

Shepaug Reservoir Dam Repair

City of Waterbury | Connecticut

01/2017 – Present

Mr. Rivera is the Project Manager for the Shepaug Reservoir Dam Repair. The Shepaug Reservoir Dam was completed in 1933. It is owned and operated by the City of Waterbury, CT. The dam has a total length of about 500 feet and a maximum height of 65 Feet. There is a stone masonry gatehouse at the right end near the spillway and a 110 foot embankment section with a concrete core wall. The concrete gravity dam surface and the top concrete at the crest dam surface together with crest railing are in poor condition. The rehabilitation project consists of a concrete overlay the downstream face and crest of the spillway; the downstream face of the non-overflow section; resurfacing the top of the non-overflow deck section; replacing the deteriorated handrails will new hand rails; and replacing the existing gutter on the valve house. The scope of work includes; document review; site evaluation; conceptual design; preparation of construction documents; procurement support, permitting support; and engineering support during construction, including periodic site inspections.

NYS Canal Corporation Syracuse Inner Harbor Sediment Sampling

New York State Canal Corp | Various Locations Statewide | New York

11/2017 – 7/2018

Mr. Rivera is the Project Manager for the sediment sampling and characterization program at the Syracuse Inner Harbor and UDS 5-19 Sites. The main objective of this program is to evaluate sediments that will be dredged from the Inner Harbor and disposed at the adjacent UDS 5-19 Site and other potential locations. The project includes subsurface and underwater drilling and sampling, laboratory sediment testing and surveying activities.

NYS OGS/DEC Dam Inspections & Engineering Services

New York Office of General Services | Statewide | New York

09-2018 – Present

Mr. Rivera is Project Manager for dam safety inspections, preliminary hazard screening, and prioritization of critical dams for 29 NYSDEC owned Class A dams in upstate NY. Six dams have been identified for further verification of hazard classification review and additional hydrology & hydraulic analysis, including simulation of dam break inundation mapping, to decide if these dams should be upgraded to Intermediate - Class B or High-Class C hazard classifications or should remain as Low Hazard - Class A.

Other assigned tasks include the dam decommissioning (i.e., dam removal) design and joint application for permit for Horseshoe Pond Dam. The decommissioning of this dam includes preparation of design drawings and technical specifications for the construction of a breach channel through the original embankment as part of the stream restoration in this area. The restored stream channel will provide habitat connectivity for aquatic species. A thorough assessment of the fringe and emergent wetlands was performed in the area near the dam and also at the shoreline around Horseshoe Pond. The application for permit has been reviewed by the Adirondack Park Agency, the US Army Corps of Engineers, the NYS Department of Environmental Conservation (Construction, Fisheries and Dam Safety Groups) and the NYS Office of General Services, and its approval is expected for the summer-fall of 2018.



Rehabilitation of Various Dams

Westchester County Department of Public Works and Transportation | Westchester County, New York

2016 - Present

Mr. Rivera is deputy project manager for developing design plans and specifications for the rehabilitation of four dams (Gedney Pond Dam, Pelham Lake Dam, Wampus Lake Reservoir Dam & Maiden Lane Dam) located within Westchester County Parks. During the 1st phase, review of available documents and dam safety inspections were performed. Site topographic surveys and wetland delineation and mapping were conducted by sub-consultants. Schematic rehabilitation designs were prepared for each dam for County approval. Detailed design development and the permit applications are currently being performed.

NYS Canal Corporation Dam Safety Program for Water-Impounding Structures

New York State Canal Corporation | Various Locations Statewide | New York

10/2016 - 12/2016

Mr. Rivera is an Independent Technical Reviewer for the development of a Dam Safety Program for the New York State Canal System. The main objectives of this Safety Program are to understand current protocols for identifying and addressing potential safety issues and to provide recommendations for process and safety policy improvements to the Canal's future organization. Mr. Rivera is part of the team conducting interviews to Canal Staff on Sections 3 and 4 of the Canal System.

Rainbow Falls Hydroelectric Project

New York State Electric & Gas (NYSEG) | Keeseville, New York

09/2015 - 12/2015

RIZZO was retained by NYSEG to perform a stability analysis for the Rainbow Falls East Abutment Embankment and East Abutment Concrete Training Wall in response to concerns raised during the PFMA. Mr. Rivera is the Project Manager for this project. Services provided included: surveying as-built conditions; borings and laboratory testing to categorize embankment fill; stability and seepage analyses; and development of findings and recommendations to correct deficiencies. A report was issued in December 2015. Recommendations include raising the embankment concrete core wall to account for current SDF and modifying upstream and downstream embankment slopes to obtain required factors of safety for stability. The training wall was found to be satisfactory. Construction is planned for 2018.

Lake Louise Marie and Treasure Lake Dams

Emerald Green Property Owners Association | Rock Hill, New York

06/2017 - 07/2017

Mr. Rivera was the Project Manager for the revision of the Emergency Action Plan (EPA) that includes Lake Louise Marie (LLM) and Treasure Lake Dams. As part of this project inundation maps including time of and magnitude of peak flows at cross sections along the conveyance were developed. The hydrology and hydraulic analyses were performed using HEC-HMS and HEC-RAS software. The list of emergency contacts and home owners within the inundation zone resulting from a potential dam breach were updated in the EAP in coordination with the Client.

Mongaup Falls Project | Stability Analyses

Orange and Rockland Utilities | Pearl River, New York

10/2017 - 11/2017

Mr. Rivera was the Technical Reviewer for the two-dimensional stability analysis of the Mongaup Falls Gatehouse and the spillway structure. The stability analyses were performed according to the FERC Engineering Guidelines for the Evaluation of Hydropower Projects.

Willow Brook Dam

Town of Blooming Grove | New York

2006 - Present

The Dam is a 550-foot long earthen embankment dam. The crest of the earthen embankments is at El. 587.5. The embankment is approximately 20 feet tall at the maximum section. Mr. Rivera is the Technical Reviewer for this project. Assignments included: evaluation of existing data and site conditions, preparation of a dam safety inspection report, development of an Inspection and Maintenance Plan, an Emergency Action Plan and preparing an Engineering Assessment Report for submission to the NYSDEC. The preparation of the EAP included a comprehensive hydrologic analysis for the dam watersheds, the completion of a dam break analysis



for the dam and the production of flood maps. RIZZO has also prepared the design drawings for an expanded spillway and reinforcement of the downstream slope of the dam. Construction is planned for 2018.

Taum Sauk Hydro Electric Project

Ameren UE | Lesterville, Missouri

08/2008

As an assistant project engineer, Mr. Rivera's activities included surface gradient analysis of the section located at elevation 1,500 feet.

Bear Creek Dam

Tennessee Valley Authority | Hodges, Alabama

08/2007 – 11/2007

As an assistant project engineer, Mr. Rivera's activities included:

- Structural analysis of the TVA RCC berm typical section. A 3D model using plate elements was developed to represent a typical berm section.
- A modal spectral analysis and a time history analysis were performed in the model. Vertical and lateral forces due to the water and soil pressures, earthquake, and gravitational loads were included in the analysis.
- Stress distributions for several load combinations were calculated using the 3D model. Tensile stresses at the berm's base were compared with allowable values.

Carpenter Dam Stability

Entergy, Hot Springs | Arkansas

06/2007

As an assistant project engineer, Mr. Rivera's activities included:

- Structural seismic analysis of the Carpenter Dam. The 3D model was redeveloped based on previous information. The new model was calibrated with available data and additional load combinations were analyzed. The model was changed to include new assumptions and geometry modifications.
- Structural stability, shear force connections, sliding, and overturning calculations were performed.

Blue Ridge Dam and Appurtenances

Tennessee Valley Authority | Blue Ridge, Georgia

05/2007

As an assistant project engineer, Mr. Rivera's activities included:

- Structural seismic analysis of the Blue Ridge Tower. A static equivalent method was utilized in the analysis.
- A foundation structural revision was performed. Concrete columns and walls interaction diagrams were developed to assess elements tension strength.

Coya II Hydroelec-Pacific Hydro

Pacific Hydro Chile | Coya II | Rancagua, Chile

08/2012 – 02/2013

Mr. Rivera was responsible to perform a preliminary site characterization for the development of a new run-off-the river hydro project which involves the construction of a 10 km tunnel and a powerhouse. This effort includes the performance of geologic mapping, test pit sampling and lab testing, geophysical investigation, and the analysis and interpretation of LiDAR imagery. Mr. Rivera was responsible for coordinating and supervising several teams, including geologists and geotechnical engineers.

San Pedro Hydropower Project

Colbun | Valdivia, Chile

07/2011 – 07/2012

Mr. Rivera was the Project Manager and responsible for the stabilization of a massive landslide on the left abutment of a proposed dam. This effort included review of the drilling and instrumentation program, evaluation and interpretation of monitoring results, and conceptual design of the stabilization solution for the landslide. Instrumentation includes a series of piezometers and inclinometers installed across the slope at different depths. As part of the stability analysis several models were performed using Slope W and 3DEC software. A



hydrogeological preliminary study was also carried out. In addition to lab testing, two in-situ large-scale direct shear tests were performed in order to validate back analysis calculations.

Geohazard Study for ADM

Municipality of Abu Dhabi | Abu Dhabi, United Arab Emirates

06/2014 – 04/2015

As a technical reviewer, Mr. Rivera is part of a team developing a comprehensive assessment of geological, geotechnical, hydrogeological, and environmental hazards and risks within the Abu Dhabi City area. Mr. Rivera reviewed several calculations, including dewatering guidelines for shallow and deep excavations, damage monitoring, and assessment final report. The team's work includes the following tasks and activities: geological, geophysical, geotechnical, hydrogeological, and environmental data collection from various divisions within the Municipality of Abu Dhabi; an expansion of the Municipality's existing Geotechnical Information Management System (GIMS) with data from 1,225 new geotechnical boreholes; 3D lithostratigraphic and lithologic model development and visualization (based on GIMS borehole data); conceptual hydrogeological and numerical groundwater flow model development; and evaluation of existing data on damage to buildings and infrastructure (including roads) that has been attributed to settlement or subsidence.

Coya II Hydroelec | Pacific Hydro

Pacific Hydro Chile, Coya II | Rancagua, Chile

06/2013 – 08/2013

Mr. Rivera was the technical supervisor for the Project where a series of seismic refraction lines were performed along the proposed path of the Coya II Tunnel in order to obtain information about the subsurface.

Years Experience: 30

TITLE / LEVEL

Engineering Supervisor
Level 7

Education

M.S., Civil Engineering, Auburn
University – Auburn, Alabama – 1989

M.S., Agriculture, North Carolina State
University – Raleigh, NC – 1983

B.S., Agriculture, University of Florida –
Gainesville, Florida – 1980

Professional Registration

Professional Engineer: Colorado
Florida New York
Pennsylvania Texas

Publications

Monte Carlo Simulations for Probabilistic
Flood Hazard Assessment, PSA 2017,
Pittsburgh, PA.

Applying Probabilistic Concepts in
External Applications at Nuclear Power
Plants, TopSafe 2017, Vienna Austria,
February 12-16, 2017.

Accounting for Uncertainty in Probabilistic
Flood Evaluations to Reduce Cost, 10th
Nuclear Plants Current Issues
Symposium, Charlotte, NC, December
11-14, 2016.

Cost-effective Numerical Modeling for
Evaluation of Overtopping Protection
Systems, 2nd International Seminar on
Dam Protection Against Overtopping,
September 7-9, 2016, Fort Collins
Colorado.

Hydrodynamic Simulations of Restoration
Alternative 1 Tenoroc Fish Management
Area: Stormwater Management
Conference, Orlando, Florida, December
4-6, 2002.

Integrated Surface and Ground Water
Modeling of the Upper Peace River
Basin: Land and Water Resource
Management, 21st Annual Water
Management Seminar, Vail, Colorado,
January 2002.

Skill Areas:

GIS programming
Wind and Wave Analysis
Groundwater Modeling
Flood Hazard/Uncertainty Analysis

Surface Water Modeling
Integrate Surface and GW Model
Computation Fluid Dynamics Model

Mr. Schwartz over 30 years' experience including probabilistic flood hazard analysis, surface and ground water modeling, integrated surface and ground water modeling, ground water remediation analysis, wind and wave analysis; and computer interface development. His areas of specialization include hydrologic and , hydraulic modeling, groundwater modeling, GIS, probability hazard assessment, programming, permitting, and project management.

Mr. Schwartz has conducted numerous floodplain analyses, including simulations of embankment erosion and sediment transport, and used L-Moments statistics to evaluate return period for rainfall and wind events. He has used numerical models to evaluate wellfield impacts, groundwater contaminate flows and remediation, mining impact, dam breach, and floodplain studies.

Mark helped develop an integrated surface and ground water model which links MODFLOW, EXTRAN, and a Geographic Information System (GIS). He also developed numerous tools for GIS to assist in watershed management projects. He has used ADCRIC, HEC-RAS, HEC-HMS, ICPR, MODFLOW, Mike-She, Runup, and other hydrologic/hydraulic software. He has performed modeling investigations of sites ranging from a few hundred acres to the integration of hydrological components encompassing more than 200 square miles.

**Gouldsboro Lake – Spillway Capacity and Redesign
Pennsylvania Department of Conservation and Natural Resources
Gouldsboro, PA**

03/2018

Mr. Schwartz used HY-8 and HEC-HMS to size a spillway to safely pass the Probable Maximum Flood without flooding homes around Gouldsboro Lake. The proposed spillway will replace the existing spillway through the dam supporting a railroad tracks. Python code was developed as part of this project to account for submerged conditions and variable weir discharge coefficients of the proposed drop structure of this spillway.

**Wampus Lake Reservoir – Westchester County Parks
& Recreation Dam Rehabilitation**

Department of Public Works and Transportation | Westchester
County, NY

05/2016 – Present

HEC-RAS simulations were used to size a spillway for the dam rehabilitation project at Wampus Lake in North Castle, NY. The spillway was sized for 48 hour and 14 day drawdown requirements, as well as a 150% of the 100-year flood flows.



Osage Dam Post-Tensioned Anchor Replacement

FERC Project No. 0459, Ameren Missouri

1/2015 – 5/2016

For the Osage Dam, a 3D Computation Fluid Dynamics (CFD) model (FLOW-3D) was used to simulate flow over the dam for the revised inflow design flood condition. AutoCAD 3D was used to develop a representation of the dam and spillways in in the CFD analysis. The model was calibrated to the flood of record. Results from the simulation include estimates of water depth and pressures along the face of the spillway.

Mongaup Falls Dam and Rio Dam – Cascading Dam Failure Analysis

Eagle Creek Renewable Energy Forestburgh, NY

10/2017

Mr. Schwartz reviewed and modified a spreadsheet and HEC-RAS model analyses to evaluate the potential for cascading failure of the Mongaup Falls Dam and Rio Dam for conditions of the Probable Maximum Flood.

Taum Sauk Hydroelectric Project

Ameren Missouri | St. Louis, MO

05/2018

Mr. Schwartz used HEC-RAS model results to provide a tailwater rating curve for the Probable Maximum Flood Event conditions at Lower Reservoir dam.

Bloomsburg Flood Risk Management Project

Borton Lawson | Wilkes-Barre, PA

04/2018 – 05/2018

Mr. Schwartz used SEEP/W to calculate seepage through a proposed levee as part of the Bloomsburg Flood Risk Management Expansion Project of Columbia Count, PA.

N.Y. Canal Embankment Seepage Analysis

New York State Canal Corporation | Albany, NY

04/2018

Mr. Schwartz used SEEP/W to evaluate potential seepage through the New York State Canal embankment as part of the Emergency Embankment Repair Project. Model simulation results provided calculated seepage rates and were used in selected sheetpile wall depths.

Wolf Creek Nuclear Power Plant

Wolf Creek Nuclear Operating Corp. | Burlington, KS

04/2018 – Present

Mr. Schwartz used FLO-2D to simulated two-dimension flows for conditions of Probable Maximum Precipitation as part of external flood hazard analysis. Model simulation results were used to evaluate potential changes within the power block area of the plant for reduction of the flood potential at critical safety related structures.

Santa Teresa Border Wall Replacement Erosion Analysis

Barnard | Santa Teresa, NM

04/2018

Mr. Schwartz calculated flow rates along the border fence. The calculated flow velocities were used to size riprap for erosion protection along the fence and an area of fiber optic cable.

Gordon Dam, South Lake Dam, Conesus WMA, Cameron Lake, Rock Tavern Dam, Tonawanda WMA

New York State Office of General Services | Albany NY

05/2016 – Present

Mr. Schwartz is using HEC-HMS to calculate runoff discharge to reservoirs upstream of the dam and HEC-RAS was used to simulate and map the extents of flood inundation with breach of the dams. A series of



inundation maps appropriate for emergency action planning were developed for these sites. In some cases, two-dimensional modules of HEC-RAS were used in this analysis.

Lake Louise Marie Dam

Emerald Green Property Owners Association | Rock Hill, NY

06/2017 – 07/2017

Mr. Schwartz used HEC-HMS and HEC-RAS to update the Emergency Action Plan (EPA) document that includes Lake Louise Marie (LLM) and Treasure Lake Dams. As part of this project inundation maps including time of and magnitude of peak flows at cross sections along the conveyance were developed.

New York State Canals – Qualitative Screening Level Risk Analysis

New York Power Authority | White Plains, NY

05/2016 – Present

Dam safety risk screening was performed for structures along the New York Barge Canals. The inundation area and hazard assessments were made for potential sunny day breach of structures using structure dimensions, water levels, and water volumes.

Moorside Nuclear Power Station

Westinghouse Electric Company | United Kingdom

04/2015 - Present

FLOW-3D was used to minimize flow velocities at a water intake structure for design calculations in an effort to limit harm to fish.

Palo Verde NPP Units 1, 2 & 3 Flood Hazard Reevaluation

Westinghouse Electric Corporation | Palo Verde, Arizona

03/2013 – Present

Mr. Schwartz provided technical review and implemented numerical modeling in support of a Flood Hazard Reevaluation Report for Arizona Public Service Company. The Report was in response to the NRC's NTTF Recommendation 2.1. Preparation of the Report required a reanalysis of all potential sources of flooding using current data and methodologies.

Wolf Creek NPP Flood Hazard Reevaluation

Westinghouse Electric Corporation | Kansas

03/2013 – Present

Mr. Schwartz provided technical review and implemented numerical modeling in support of a Flood Hazard Reevaluation Report for Wolf Creek Nuclear Corporation. The Report was in response to the NRC's NTTF Recommendation 2.1. Preparation of the Report required a reanalysis of all potential sources of flooding using current data and methodologies.

Comanche Peak NPP, Flood Hazard Reevaluation

Westinghouse Electric Corporation | Glenrose, Texas

11/2012 - Present

Mr. Schwartz has provided technical review of numerical modeling conducted in support of the Flood Hazard evaluation Work Plans for the plant.

Estero Casablanca, Chile

NextEra Energy Resources, LLC | Wisconsin

12/2014

A groundwater resource evaluation was conducted using MODFLOW.

Callaway 1 NPP, Flood Hazard Reevaluation

Westinghouse Electric Corporation | Callaway, Missouri

11/2012- 02/2014

Mr. Schwartz has provided technical review of numerical modeling conduct in support of the Flood Hazard evaluation Work Plans for Callaway Energy Unit 1.



Bruce A&B NPP, External Flooding Hazard **ERIN, Ontario Power Generation | Ontario, Canada**

12/2012 – 06/2014

Mr. Schwartz has provided technical review, implemented numerical modeling, and assisted in probabilistic hazard assessments in support of a Flood Hazard Evaluation Report for Bruce A and B Power Plants. The work was evaluated based on hydrological-related site characteristics, performance requirements, and bases for operation of Structures, Systems, and Components (SSCs) important to safety. All of the flood reevaluation is performed according to the guidance and requirements of NRC's NTTF Recommendation 2.1 and NUREG/CR 7046. The software used for this Flood Hazard Evaluation includes HEC-RAS, HEC-HMS, and Delft 3-D. The Flow and SWAN components of Delft 3-D are used for the storm surge evaluation.

Point Beach NPP Units 1&2 Flood Hazard Reevaluation

NextEra Energy Resources, LLC | Wisconsin

06/2013 – 07/2013

A Flood Hazard Reevaluation was performed by another engineering firm. RIZZO conducted an independent review on their deliverables. Mr. Schwartz developed a water balance model for Lake Michigan-Huron as part of this review.

PREVIOUS EXPERIENCE:

Senior Water Resources Engineer

AMEC Environmental Infrastructure | Lakeland, Florida

1997 – 2012

Mr. Schwartz used ADCIRC and other wind and wave analyses as part of a levee certification projects.

He has modeled floodplain extents caused by potential dam failures at reservoirs in satisfaction of the minimum requirements for earthen dams as specified in 62-672.550 of the FAC.

Mr. Schwartz uses computerized data management systems, including GIS and performs computer analysis on a wide variety of hydrologic problems. He has also assisted in data collection for long-term aquifer tests, ground water monitoring programs, and other field investigations.

He has used two-dimensional finite element programs to estimate the rates of seepage and potential effectiveness of dam seepage management for earthen embankments.

Mr. Schwartz modeled the hydrology of about 140-square miles of the upper Withlocoochee and Ocklawaha Rivers as part of an investigation to determine potential impacts of sand mining in the Green Swamp area of Florida.

Mr. Schwartz modeled the hydrology of about 5-square-miles of the Upper Peace River as part of the permitting process required for drainage improvements in the Winter Haven area of Florida. The hydrologic modeling was used in this project to determine the potential downstream impacts especially of wetland hydrology caused by drainage improvements around lakes upstream of Lake Hancock.

Mr. Schwartz calibrated and verified single event and long-term (one to two years) hydrology of clay settling areas within the phosphate mining area of central and north Florida. This project funded by the Florida Institute of Phosphate Research (FIPR) was in part used to develop model parameters that better represent the hydrology of the mined areas and to aid in developing methods to better reclaim these areas.

Mr. Schwartz was lead engineer for AMEC on the FEMA floodplain mapping effort in 2011 and 2012 for the cities of Venice and parts of Sarasota, Florida. The project was managed through the Southwest Florida Water Management District (SWFWMD) and the city utilities. The city provided valuable information including design plans structures information, and flow paths used to map flows through the cities. The SWFWMD provided LiDAR data and assured uniformity of quality and methodology for the FEMA mapping process conducted for the District. Mark with a team of engineers identified, confirmed the identification and



mapped structures within the cities indicated. The map information was placed into formatted ArcMap geodatabase files and HEC-RAS was used to develop the floodplain maps. The models were validated using reported flooding during previous hurricane and tropical storm events. During the community outreach process, information from property owners concerning previous flood event was also used as applicable to update the maps. Projects included:

- FEMA floodplain mapping for City of Venice, Florida;
- FEMA floodplain mapping for City of Sarasota, Florida;
- FEMA floodplain mapping for City of Eagle Lake, Florida; and
- FEMA floodplain mapping of northwestern Hardee County, Florida.

Senior Water Resources Engineer

SDI Environmental Services Inc. | Greensburg, Pennsylvania

1988 - 1997

Mr. Schwartz was a modeling task leader in the development of an integrated hydrologic model to evaluate well field and drought-related impacts on the ground water and surface water systems in the vicinity of Cypress Bridge, Cypress Creek and Cross Bar Ranch Wellfields. His responsibilities included: development of the hydrologic framework, development and calibration of the integrated model, and conducting well field management scenarios. The model was used to evaluate well field and drought-field related impacts and to develop well field management strategies.

As a part of a water resource assessment project, Mr. Schwartz aided in developing, calibrating, and verifying an integrated hydrologic model to represent the surface and ground water systems of the 700-square mile Hillsborough River Basin for the City of Tampa Water Department and the West Coast Regional Water Supply Authority. Using the model, he determined rainfall-runoff characteristics, and simulated pumpage impacts on the Tampa Bypass Canal, the Hillsborough River Reservoir, and the surrounding ground water system. The integrated hydrologic model was then used to evaluate a selected withdrawal/augmentation scenario and the results were used to assess hydrologic and biologic conditions of downstream river reaches.

At a Connecticut site a hydrocarbon spill threatened municipal wellfields, Mr. Schwartz aided in development of a ground water flow model and conducting a particle tracking investigation to determine the effectiveness of four recovery wells. The model represented a 400-acre portion of a complex glacial outwash aquifer. The model was calibrated to 4 long term aquifer tests with water level impacts measured at more than 20 monitor wells. A ground water particle tracking model was used to determine effective zones of capture for hydrocarbon recovery wells and the areas of the aquifer system which contributed flow to the municipal wellfields. The models demonstrated effective containment of the hydrocarbon contamination, indicating that the wellfields could resume normal operations. Mr. Schwartz also utilized the MT3D mass transport model to replicate observed contaminant migration in order to evaluate source release scenarios.



PROJECT UNDERSTANDING & APPROACH

The CTL's Team project approach will consist of performing the following tasks described below.

Throughout the project's execution, CTL's Project Manager, Doug Batt, will actively communicate with the Owner's Project Representative and Camp Dawson personnel to keep them aware of project's progress. The Team anticipates conducting a kickoff meeting to discuss the project goals and responsibilities, and to further identify site constraints or protocols in the execution of our work for the project. Project progress meetings will be conducted with the Owner and key personnel from Camp Dawson and CTL's Team to plan and coordinate effort for project completion. A project schedule, with identification of each major task and their corresponding durations, will be developed and provided to the Owner's Project Representative. The purpose is to not only track completion of milestones and overall project delivery but to also proactively identify hurdles which may affect the completion of the project on time and within budget.

1. **Review of Existing Project Information** – The CTL Team will review readily available information including (but not necessarily limited to) previous inspection reports, hydrologic and hydraulic analyses and data related to water storage and releases, original design drawings, as-built drawings, construction records and photographs, drawings and construction records related to major modifications or maintenance, and geotechnical exploration reports and studies/investigations performed by other engineering consultants for previous construction or improvement studies. The information reviewed will assist in forming the basis for the scope of services to be performed by CTL's Team.
2. **Site Reconnaissance** – CTL Team personnel will visit the project site to perform a general reconnaissance of the project area and a specific inspection of the existing site conditions within the seepage area(s). In addition, CTL's Team will observe and inspect any existing control structures (as/if present) to determine condition and functionality.
3. **Site Survey and Mapping** - Our survey crew will complete an existing conditions topographic survey of the impoundment site. This survey will include locating the embankment, the edge of water within the impoundment, observed seepage areas within a minimum distance of 100 ft from the impoundment's edge, and surface drainage features that contribute to the existing impoundment. CTL Team personnel will also locate surrounding surface and underground utilities, relevant structures close to the embankment, and inlet and outlets structures that pertain to the function of the impoundment. The existing site conditions map will be used to develop the model for seepage analysis and for hydrologic and hydraulic analyses and designs for a new control structure, if necessary. CTL Team personnel will also locate the geotechnical borings after completion.
4. **Geotechnical Exploration** – A geotechnical exploration will be performed to determine subsurface conditions and support evaluation and modeling of the apparent seepage either through or beneath the dam. We anticipate the following tasks being performed as part of the geotechnical exploration:
 - a. **Test Borings:** In the vicinity of the seepage area(s), the CTL Team will perform test borings to develop subsurface cross sections of the dam where the seepage is observed. The number of cross sections and test borings will be based upon the information reviewed and our site visit. At each cross section, we plan to drill and sample test borings at the crest and toe of the embankment slope to a suitable depth to determine the conditions for evaluation, modeling, and analysis. The underlying embankment fill materials and native soils will be sampled continuously to identify the soil strata and their in situ properties for the seepage analysis. We anticipate the installation of monitoring wells equipped with instrumentation (vibrating wire piezometers) to determine the phreatic surface within the embankment and /or underlying soil strata.



- b. **In Situ Field Testing:** Standard Penetration Tests (SPTs) will be performed in the test borings during the soil sampling. Subsequent to drilling and sampling, the test borings will be converted to monitoring wells by installing 2-inch casing with a minimum length of 10 feet of screened casing in the granular foundation soils. If underlying granular soil strata are encountered, CTL Team personnel will perform slug testing within the granular foundation soils to determine in situ permeability for the purpose of developing the seepage analysis model. The groundwater level in each new monitoring well will be continuously collected by vibrating wire piezometers using a data logger and downloaded at predetermined intervals for a suitable period of time, after monitoring well installation is completed, to provide sufficient data to develop and calibrate seepage analytical models.
- c. **Geophysical Testing:** In addition to performing the test borings as described above, the CTL Team intends to perform a limited geophysical survey utilizing Two-Dimensional Electrical Resistivity Imaging (ERI). The ERI geophysical technique should provide insight into the degree of variability found in the existing subsurface materials, including potential groundwater within and below the dam's embankment. Furthermore, it should delineate the depth to rock and indicate if anomalous features, such as depressions or voids, are present. This technique should provide sufficient resolution to image subtle variations in the subsurface stratigraphy.
- Once the 2D resistivity data sets have been acquired, they will be processed for recognition of variations in subsurface materials and apparent moisture content. The modelling and inversion processing will be conducted using EarthImager 2D software by Advanced Geosciences, which is a resistivity inversion program. Once the profiles are inverted and the data sets adjusted, we will plot each profile. Depending on the actual field data line locations, it may be possible to develop constant depth or constant elevation resistivity 'slice maps' of sufficient accuracy that indicate the potential pathway connections between the profile lines with depth.
- d. **Soil Laboratory Testing** – The CTL Team will perform index classification tests on the recovered soil samples. Permeability tests will be performed on undisturbed soil samples of the fine-grained cohesive materials within the embankment and underlying foundation soils, if encountered.
5. **Seepage Analysis** – The CTL Team will perform a two dimensional (2D) seepage analysis utilizing the findings from the results of the test borings, field and laboratory testing, geophysical testing and the topographical mapping of the project site, to determine the critical exit gradient parameter at the toe of the downstream slope due to the seepage through and/or beneath the embankment at the two cross section locations.
6. **Hydrologic and Hydraulic Study** – As/if needed, the CTL Team will develop a hydrologic model of the Camp Dawson Pierce Lake Dam drainage basin and outlet reaches using the USACE's Hydrologic Engineering Center (HEC) Hydrologic Modeling System (HMS) software and information from our site survey and mapping effort. Model parameters related to watershed land-use, soil conditions, and runoff transformations will be similarly developed using data from state and federal agencies, standard references, and engineering judgement. Information on hydraulic structures in the watershed will be developed using observational information from site reconnaissance.

Using our HEC-HMS model, we will independently compute a probable maximum precipitation (PMP) event for the site and a corresponding probable maximum flood (PMF) for any existing control structures at the dam. We will also develop a breach simulation for the embankment in order to evaluate possible inundation extents at Camp Dawson. These simulations will include tabulations and flood routing information such as peak flood elevations, peak discharges, and peak flow arrival times for critical locations.

The CTL Team personnel will develop the breach simulations for Camp Dawson Pierce Lake Dam using the USACE's HEC River Analysis System (RAS). Inundation extents will be drafted/drawn on high-resolution aerial



imagery and thus will also identify infrastructure (roads, bridges, etc.) and structures relevant to the hazard classification.

- 7. Engineering Report** – CTL Team will prepare a written engineering report that will summarize the results of the geotechnical exploration, seepage analysis, and hydrologic and hydraulics study. The report will include a topographic survey of the site, test boring logs, boring locations plan and scaled soil profiles of the dam embankment and foundation soil where the test borings were performed, geophysical test results, graphical representations of the seepage analysis, and flood hazard model output.

Based on the results of the seepage analysis performed, CTL Team will present recommendations for addressing the seepage. In addition, we will provide recommendations related to control structure rehabilitation or replacement.

- 8. Control Structure Design** – If the hydrologic capacity of the dam is deemed deficient, The CTL Team will begin to develop a conceptual design (or designs) for the remediation of any existing control structures, or construction of a new control structure, to comply with West Virginia Department of Environmental Protection (WVDEP) Division of Dam Safety requirements for the safe passage of the PMF or some other acceptable inflow design flow (IDF). Our conceptual design is specifically expected to consist of an engineering sketch, a schedule for full design, and a preliminary budgetary construction cost estimate.

Based on feedback from relevant stakeholders at Camp Dawson, the Team will further optimize and advance (to a 30 percent level) our conceptual designs for the remediation or replacement of the dam control structure. We expect to then develop a short preliminary design letter report that will include a description and evaluation of the potential modifications and identify an optimal modification to carry forward to detailed design. We intend to develop a drawing package for the recommended design option as part of the preliminary design report. We anticipate that this drawing package will include a cover sheet presenting a map of the wider project area and a list of drawings; a sheet showing existing dam appurtenances and topographic conditions; a sheet showing control structure modification or replacement plans; and a sheet showing modification sections and details.

Prior to undertaking detailed (i.e., final) designs, we propose a meeting between our project team and WVDEP engineering staff to present our preliminary (30 percent) design results. Corresponding construction schedules and cost estimations for the recommended option are also expected to be developed as part of the presentation. It is expected that the meeting will result in a general agreement on an optimal design option, and a clear directive with respect to project advancement.

Following our in-person preliminary design review meeting with WVDEP engineering staff, we will develop and submit a 75 percent detailed design drawing package for WVDEP review. A final (100 percent) design package will then be developed on receipt of WVDEP comments. The CTL Team will ensure that relevant comments provided by the WVDEP have been addressed and resolved accordingly in the 100 percent design package.

- 9. Construction Plans and Specifications** – Our 75 percent and 100 percent design submittals are expected to include detailed design drawings for control structure modifications and for the remediation of seepage-related issues and are expected to be used (ultimately) for construction. As such, our 75 percent and 100 percent design submittals will include technical/construction specifications for clearing, grubbing, and earthwork, for concrete, for masonry, and for steel (as appropriate). We will then provide engineering support during bidding and construction as required and as directed. Our support during the bid process will likely include participation in a pre-bid conference, responses to contractor requests for information, issuance of addenda to bid documents, and updates to our drawings and specifications for construction.

We are also prepared to provide engineering support during construction, and on-site inspection during construction.



Project: Austin Lake Dam Improvements

Owner: Austin Lake, Inc.

Location: Jefferson County, Ohio

Project Features

The project consists of improving the Austin Lake Dam (ODNR No. 0305-001) located at TR 285A in Knox Township, Jefferson County, Ohio. The improvements consist of construction the following:

1. Two retaining walls at outlet of existing primary spillway, west side of dam.
2. New concrete emergency spillway channel/slab with retaining walls.
3. New parapet wall along crest of dam.
4. Improve existing E. Road Emergency Channel.

Soil data obtained from field and laboratory testing were used to determine the existing soil conditions and to develop subsurface models required to perform the required scour potential, seismic coefficients and retaining wall/foundation support for the dam improvement.

Client Reference

Mr. William Cable (740) 544-5253
Austin Lake, Inc.

Project Duration

6/23/2014 – 6/23/2016



Project: Barnesville Reservoir | Seepage Investigation/Spillway Repair

Owner: Village of Barnesville

Location: Barnesville, Belmont County, Ohio

Project Features

The project consisted of repairing and/or rehabilitating the existing spillway. It was understood that ongoing seepage beneath the spillway may have created voids, and the spillway integrity may be compromised.

CTL Engineering, Inc. performed visual and Eco Hammer sounding observation of the existing Spillway structure, advanced 5 slab cores, and performed Ground Penetrating Radar (GPR) along the spillway. The purpose of this investigation was to:

1. Identify possible voids and seepage under the spillway slab.
2. Determine the slab thickness of the spillway, its compressive strength, and integrity.
3. Evaluate existing subgrades along spillway slab.

Client Reference

Mr. Roger Deal (740) 425-1880

Project Completion

2019



Project: Buckeye Lake Dam Improvements

Owner: Ohio Department of Natural Resources

Location: Buckeye Lake, Ohio

Project Features

The original dam was a 4.1 mile long earthen dam that was constructed nearly 200 years ago and was determined to be at a significant risk of failure. The project included the installation of a seepage barrier and buttress to strengthen the dam. These elements extend from 25 to 40 feet below the surface and were constructed by deep soil mixing which is the process of mixing Portland Cement Grout with the existing soil. The overall construction cost was approximately \$110M.

CTL and Gannett Fleming provided Phase I design services included Probably Failure Modes Analysis workshop, geotechnical investigations, laboratory testing, mix design testing for soil-mixed materials, surveying, hydrologic and hydraulic analyses, and design of a 43-foot-deep soil-mixed cutoff wall. Construction phase services includes construction administration, inspection, and performance of verification coring of soil-mixed materials. Phase II (New Replacement Dam) design was completed in 2017 and construction is ongoing and scheduled to be completed in mid-2019. Design phase services include preliminary and final dam design, final hydrologic and hydraulic analyses, and modification of the forebays of each of the two spillways.

Client Reference

Mr. Robert Kline, P.E. (717) 763-7211
Gannett Fleming

Project Completion

2018



Project: Buzzard Pond Dam
Owner: West Virginia DNR
Location: Marshall County, WV

Project Features

In 2011, CTL Engineering was contracted by Kelly Surveying to perform Geotechnical Engineering services for the investigation, evaluation, and stability analysis of The Buzzard Pond Dam. Five test borings were advanced using a truck-mounted, rotary drill rig. These samples were then returned to CTL's in-house testing laboratory and analyzed in reference to minimum slope stability values. After these tests were performed, the conclusion was made that the dam embankment conditions and the fill material should be considered stable

Client Reference

Mr. Kenneth Kelly (304) 338-6985
Kelly Surveying

Project Duration

03/29/2011-12/31/2011



Project: Clear Fork Reservoir Dam | Seepage Investigation

Owner: City of Mansfield

Location: Mansfield, Ohio

Project Features

The Clear Fork Reservoir Dam has developed wet surface areas downstream of its north embankment that were first documented in an inspection prepared in 1979 on behalf of the USACE. Subsequent inspection reports and investigations indicated that under seepage occurs beneath the north embankment but did not pose a threat to the stability of the dam's north embankment, however monitoring of the seepage, and then later investigation of the seepage was required by ODNR. CTL Engineering, Inc. conducted an investigation to evaluate seepage at the existing Clear Fork Reservoir Dam.

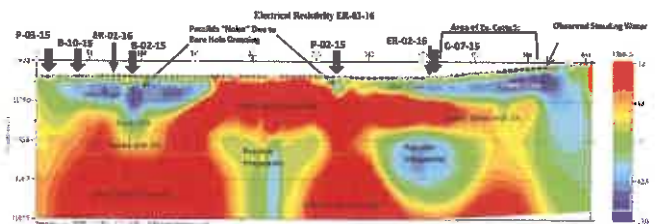
CTL's investigation utilized original construction plans, previous ODNR inspection and evaluation reports, observations of the project site made during various times of the year, test borings, slug (pump) tests, soil laboratory tests, electrical resistivity imaging across the embankment and downstream area, along with monitoring wells equipped with vibrating wire piezometers with data loggers to develop models of the earth embankment and foundation soil. CTL analyzed pore water migration (seepage) through and beneath the dam using the 2D models at two cross sections to evaluate the exit gradients and comparing these gradients with the critical exit gradient per U.S. Army Corps of Engineers (USACE) Engineering Manual EM 1110-2-1901.

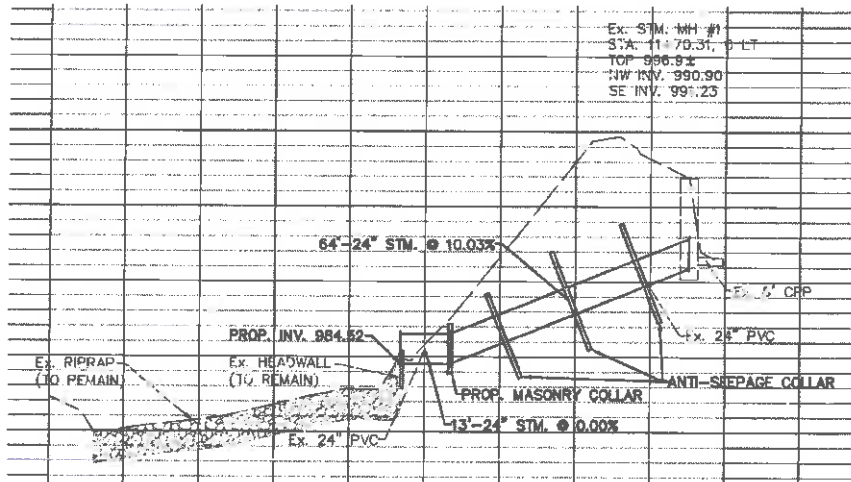
Client Reference

Mr. Robert Bianchi, PE (419) 755-9702

Project Completion

2019





Project: Fawn Lake Dam Improvements

Owner: Fawn Lake Association

Location: Sidney, Ohio

Project Features

Fawn Lake is a man-made, Class III, ±10.1-acre lake with by a 20-foot high, 675-foot long embankment acting as an earthen dam. It was reported that the dam began to leak and following a site visit by Ohio Department of Natural Resources (ODNR), the leak was verified, and it was expressed that the cause of the leak was a sinkhole that formed on the waterside of the earthen embankment that allowed the retained water to seep into the embankment alongside an existing storm sewer that acts as the lake drain. The initial cause of the sinkhole was suspected to have been associated with animal activities.

CTL Engineering was asked to investigate, consult, and observe the repair of the leak per the requirements of ODNR. In doing so, CTL Engineering performed a geotechnical evaluation of the existing dam for problems associated with the leak. We were also the lead Engineer in creating design plans and specifications for the dam repair. Subsequent to plan approval, CTL worked with the owner in hiring a contractor for the dam repair. CTL also provided construction observation and material testing during construction of the dam repair.

Client Reference

Mr. Jerry Long (937) 497-1488

Project Completion

2012



Project: Low AMD Impoundment | Seepage Investigations

Owner: Murray American Energy

Location: West Virginia

Project Features

The Low Impoundment which was constructed in the 1960's has over time developed random areas of wet surface areas from seepage on the face of the downstream slope and along the groin areas from ground water infiltration.

In an effort to capture, control and effectively discharge this seepage and infiltration, CTL designed a series of blind ditches (French Drains) to transverse the face of the downstream slope near the decant discharge pipe valve box. Additionally, CTL designed a new anti-seep collar to be installed on the upstream face to prevent seepage from traveling along decant internal discharge pipe tied into the valve box.

Client Reference

Mr. Larry Jimison (304) 534-4734

Project Completion

2016



Project: Nelly Hollow AMD Impoundment | Seepage Investigations
Owner: Murray American Energy
Location: West Virginia

Project Features

The Neely Hollow Impoundment which was constructed in the 1960's has over time developed random areas of wet surface areas from seepage on the face of the downstream slope and along the groin areas from ground water infiltration.

In an effort to capture, control and effectively discharge this seepage and infiltration, CTL designed a series of blind ditches (French Drains) to transverse the face of the downstream slope and parallel along the groin areas. Additionally, CTL performed an updated stability analysis of the impoundment to verify the current factor of safety.

Client Reference

Mr. Larry Jimison (304) 534-4734

Project Completion

2016



**Project: Northern WV Region & Western Pennsylvania Region
Annual & Quarterly Impoundment Certifications
Owner: Murray American Energy & Consol Energy, Inc.
Location: West Virginia & Pennsylvania**

Project Features

Provide annual and quarterly inspection and certification services for the AMD Facilities for the Northern WV Region and the Western Pennsylvania Region for Murray American Energy Inc and CONSOL Energy Inc respectively as required by the WVDEP, the PADEP and M.S.H.A.

On behalf of Murray and Consol, CTL annually and quarterly inspects and certifies for stability approximately 120 varying size major impoundments, sedimentation, ponds, settling ponds and aeration ponds at various operating and closed mine facilities throughout both regions.

Client Reference

Mr. Larry Jimison (304) 534-4734
Mr. Brian Bogden (724) 485-4059

Project Completion

Ongoing

CAMBRIDGE SPRINGS DAM REPLACEMENT SPILLWAY CRAWFORD COUNTY, PENNSYLVANIA		YEAR COMPLETED	
		PROFESSIONAL SERVICES 1996 – Jul 2011	PROJECT CONSTRUCTION N/A
PROJECT OWNER/CLIENT Pennsylvania Department of General Services			
OWNER/CLIENT – CONTACT NAME PA Department of General Services Mr. David Folk	OWNER/CLIENT – CONTACT EMAIL dafolk@state.pa.us	OWNER/CLIENT – CONTACT TELEPHONE NUMBER (717) 346-4021	

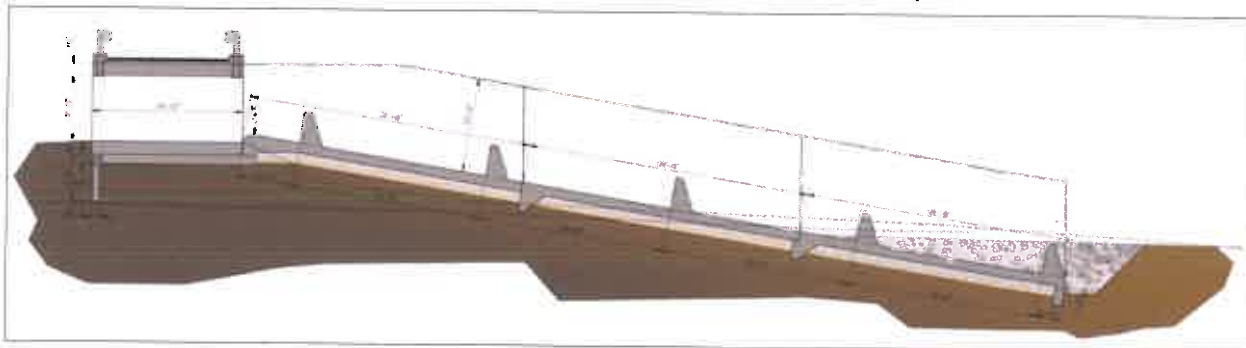
RIZZO International, Inc. (RIZZO) acquired RIZZO Associates, Inc. in November 2017. RIZZO remains a global engineering and consulting firm headquartered in Pittsburgh, Pennsylvania US. This project was contracted/completed under the RIZZO Associates name.



RIZZO completed designs for a replacement spillway and a downstream flume for flood control and stream bank erosion control at Cambridge Springs Dam, a small earthen embankment located in northwestern Pennsylvania. Water impounded by the 240-foot-long and 14-foot-high dam is used for fire protection at a Pennsylvania Department of Corrections facility. As part of this project, RIZZO reviewed early conceptual designs for an 80-foot-wide replacement spillway for the Cambridge Springs Dam, but determined that the design flood and corresponding spillway size could be reduced by more than 65 percent using an incremental dam breach analysis approach.

The PADEP approved the flood flow analyses and spillway design, comprising a concrete ogee structure and a concrete baffle chute for energy dissipation, and issued a permit for construction. RIZZO subsequently prepared various construction drawings and specifications, construction cost and schedule estimates, and construction plans; and provided construction supervision. Construction of the rehabilitation design was completed in July 2011.

Since completion of the construction, RIZZO has continued to support the Department of Corrections with various safety inspections and other engineering analyses. Most recently, RIZZO completed updates to existing dam break inundation maps for the embankment and corresponding revisions to the EAP for the facility.



RIZZO Contract Amount: \$126,983
RIZZO Project NO.: 96-1600



LAKE LOUISE MARIE DAM IMPROVEMENTS ROCK HILL, NEW YORK		YEAR COMPLETED	
		PROFESSIONAL SERVICES 2014 – 2015	PROJECT CONSTRUCTION N/A
PROJECT OWNER/CLIENT Emerald Green Property Owners Association			
OWNER/CLIENT –CONTACT NAME Mr. Michael Hoyt	OWNER/CLIENT –CONTACT EMAIL N/A	OWNER/CLIENT –CONTACT TELEPHONE NUMBER (845) 796-2410	

RIZZO International, Inc. (RIZZO) acquired RIZZO Associates, Inc. in November 2017. RIZZO remains a global engineering and consulting firm headquartered in Pittsburgh, Pennsylvania US. This project was contracted/completed under the RIZZO Associates name.

RIZZO was retained by the Emerald Green Property Owners Association (EGPOA) to prepare analysis, design, and construction documents for required improvements to the Lake Louise Marie Dam, a class “C” high-hazard dam located in Sullivan County, New York. Lake Louise Marie Dam is an earthen embankment 1,100 feet in length, 15 feet in height, and 18 feet to 25 feet in width (at crest). As originally constructed, the dam included a downstream laid-up stone retaining wall and riprapped upstream face, a 220-foot-long service spillway consisting of a stoned line tunnel, and a stone masonry and concrete auxiliary spillway structure.



RIZZO ultimately developed a remedial design for the Lake Louise Marie Dam that included decommissioning of the existing auxiliary spillway, construction of a new 80-foot-wide concrete auxiliary spillway and stilling basin, grouting of the service spillway ceiling and tunnel walls to reduce seepage and prevent piping, and the installation of a new 30-inch diameter low-level outlet pipe and control gate. As part of the design work, RIZZO completed new hydrologic and hydraulic analyses for the dam that included considerations for nearby Davies Dam and Treasure Lake Dam. RIZZO also completed slope stability analyses for the downstream embankment considering load cases for steady-state seepage under a maximum storage pool and for a maximum surcharge pool; slope stability analyses for the upstream embankment for a rapid drawdown loading condition; and slope stability analyses for the upstream and downstream embankments for a pseudo-static seismic loading case.

Following completion of design calculations and a design report, RIZZO coordinated the preparation of construction permit applications to the NYSDEC and the United States Army Corps of Engineers. RIZZO also developed bid documents for construction of the remedial design, provided support to the EGPOA in the bid process, and provided engineering services during construction.

Since completing the rehabilitation of Lake Louise Marie Dam, RIZZO has continued to provide engineering support to the EGPOA via updates to the EAP and inspection and maintenance plan for the dam, and, most recently, via the completion of a dam safety inspection (in August 2018).

RIZZO CONTRACT AMOUNT: \$114,774

RIZZO PROJECT NO.: 13-5060



PAHAGACO DAM SPRING GROVE, PENNSYLVANIA		YEAR COMPLETED	
		PROFESSIONAL SERVICES 2011 – 2012	PROJECT CONSTRUCTION N/A
PROJECT SPONSOR P.H. Glatfelter			
CLIENT – CONTACT NAME Bradley Martin	CLIENT – CONTACT EMAIL N/A	CLIENT – CONTACT TELEPHONE NUMBER (717) 225-4711 Ext. 2685	

RIZZO International, Inc. (RIZZO) acquired RIZZO Associates, Inc. in November 2017. RIZZO remains a global engineering and consulting firm headquartered in Pittsburgh, Pennsylvania US. This project was contracted/completed under the RIZZO Associates name.



For nearly ten years, RIZZO has provided inspection and engineering services to the P.H. Glatfelter Company (now Pixelle Specialty Solutions) for Lake Pahagaco Dam, a homogenous earthfill dam located in south-central Pennsylvania. The dam was designed and built in the 1950s to impound water for Glatfelter’s Spring Grove manufacturing facility. Presently, the dam is used primarily for recreational purposes, and for some limited water supply to the Spring Grove facility.

In 2011, the dam owner observed surface cracking at the crest of the dam and bulging at the toe along the downstream slope of the dam about 75 feet from the right abutment. In turn, RIZZO conducted a more complete inspection of the dam crest and upstream and downstream slopes, and provided Glatfelter with an evaluation of the observed cracking and bulging. Based on this inspection and evaluation, RIZZO subsequently developed a plan to repair the sloughing by completely removing the displaced material and replacing it with engineered fill.

The slough area on the downstream face of the dam was specifically repaired by removing the displaced material to a maximum depth of 5 feet. The average depth of removal was approximately 3 feet. A series of benches were then constructed to facilitate the compaction of new material, to form side slopes at 2H:1V to tie into the existing dam. After excavation, the area was backfilled with compacted clay material from an off-site source and the area was covered with topsoil and an erosion control mat.

Since late 2018, RIZZO has supported Glatfelter by preparing design specifications for modifications to Lake Pahagaco Dam that will specifically involve a lowering of the dam spillway via removal of a trapezoidal notch from the existing concrete weir, leveling of the existing dam crest from elevation (EL) 590 feet to EL 586 feet, subsequent grading of the slope of the downstream dam face, and permanent lowering of normal reservoir water levels to EL 570 feet. Presently, RIZZO is working with Glatfelter to secure the permits necessary for construction and will provide engineering support during construction (project to begin in the fall of 2020).

RIZZO CONTRACT AMOUNT: \$32,000
RIZZO CONTRACT NO.: 11-4674

