Specialty Geotechnical Workshop for Dam + Levee Investigations + Modifications

Fort Lauderdale, FL

Dec 6-8, 2021

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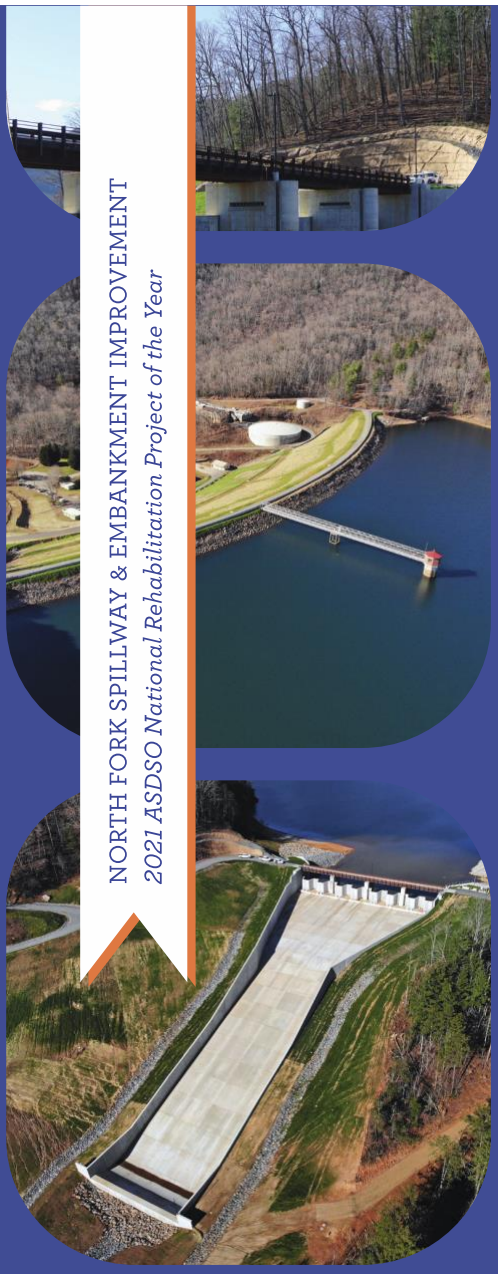
On the Cover

Herbert Hoover Dike modifications (Jacksonville District, U.S. Army Corps of Engineers)

WORKSHOP WIFI:

Network: Westin-meeting room
Password: westin2021



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Proud to be part of the AEG/USSD geotechnical workshop!

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Offices nationwide – get in touch:
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Build Better. Together.

The Planning Committee

This AEG/USSD workshop would not be possible without the hard work and dedication of the following volunteers.

Cassandra Wagner, Co-Chair
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AEG & USSD Upcoming Conferences

Solving Complex Geotechnical Problems on Dams and Levees

AEG and USSD are proud to host this unique workshop to gather together national and international leaders who have been instrumental in solving complex geotechnical problems on dams and levees through proven and unique site investigation methods and construction rehabilitations.

We are pleased to welcome attendees to the first joint AEG/USSD workshop. The workshop offers a rare opportunity to hear directly from key professionals in the dams and levees geotechnical profession and to interact with them through roundtable discussions and evening activities.

Thank you to the planning committee members, speakers, exhibitors, and the sponsors for making the Specialty Geotechnical Workshop for Dam & Levee Investigations & a success.

Day One of the workshop is dedicated to geotechnical site investigations and will include in depth discussion of pre-mobilized planning documents required by federal agencies, presentations on best practices, the theory of hydrofracturing and methods of avoiding damaging embankments, special techniques for investigation for liquefaction, and examples of the use of 3D models to plan and execute site investigations and develop potential failure modes.

Day Two of the workshop will focus on advanced dam remediation applications and risk assessments to include case studies of complex foundation treatments, instrumentation and data management during construction, and the ongoing transition to risk-informed designs for dam and levee remediations.

Day Three of the workshop offers an optional field trip to Herbert Hoover Dike and provides a full day of observation of multiple geotechnical construction techniques and discussion of the applicability of each technique to the differing foundation conditions.

We hope you have a great workshop experience!

Kevin Richards and Cassandra Wagner

Workshop Co-Chairs

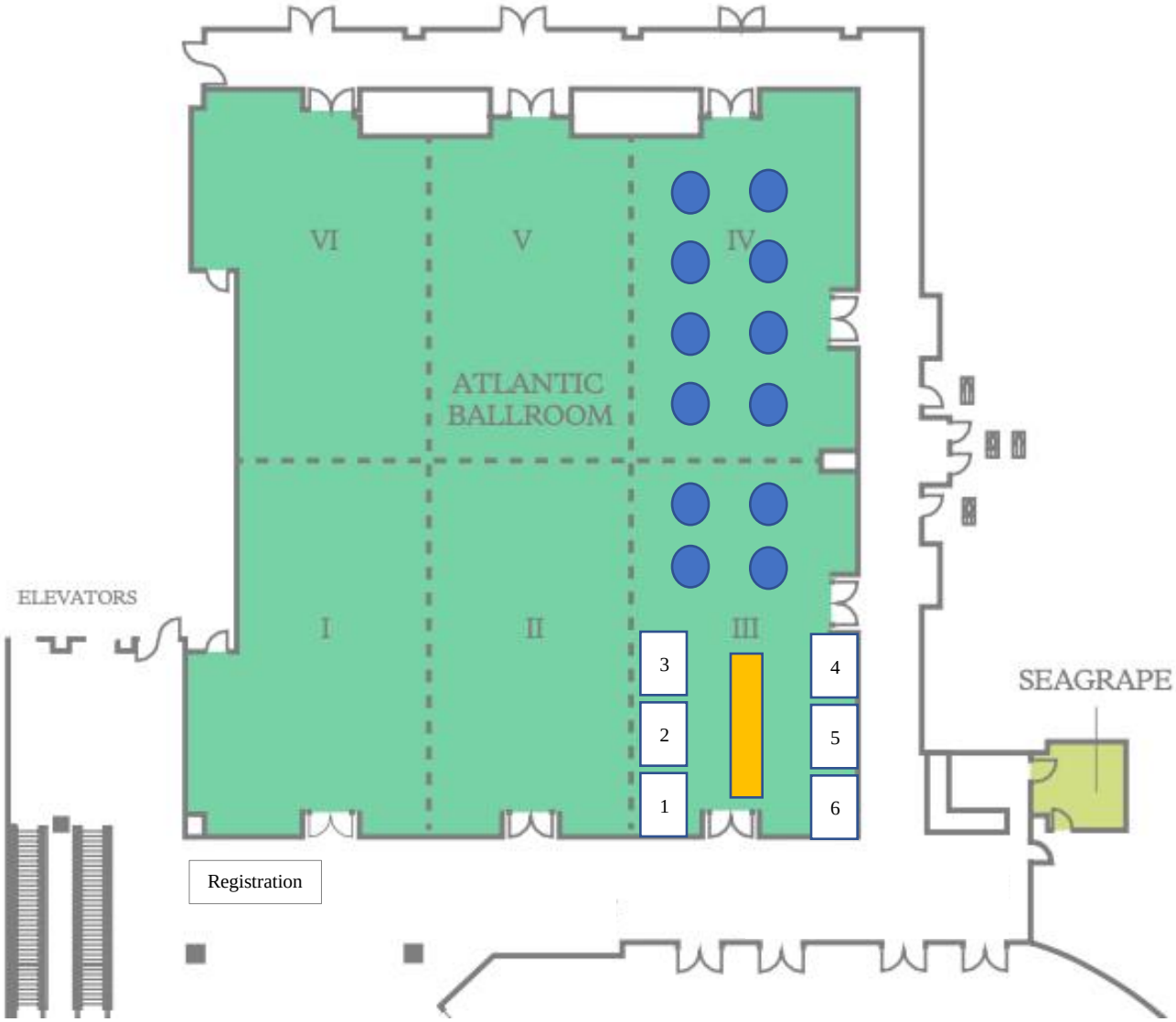
Gary Rogers

Technical Program Chair

Meeting Spaces

Atlantic Ballroom – Convention Center First Floor

Workshop – Atlantic I & II
Luncheons – Atlantic III & IV



Exhibitors

Prime Resins – Booth #4
Schnabel Engineering – Booth #3
Cascade Drilling – Booth #6
G3 Group – Booth #1
Ground Stiffness Surveys – Booth #5
Rite Geosystems – Booth #2

Sky Terrace – Convention Center Rooftop Level

Monday Reception 6:00-7:30pm

Workshop Schedule

MONDAY, DECEMBER 6

Day #1: Geologic and Geotechnical Site Characterization
Sponsored by TREVIICOS
Moderators: Cassandra Wagner and Kevin Richards

7:00am-8:00am		**Breakfast –** *Sponsored by Barr Engineering, Co.*
8:00am-8:10am	Cassandra Wagner Kevin Richards	Welcome and Overview of the Workshop
8:10am-9:10am	Douglas Boyer	Keynote - Overview and Evolution of Geologic and Geotechnical Site Characterization
9:10am-10:15am	Thomas Terry Scott Walker Kathleen Besko Bryan Simpson	Best Practices for Planning Site Investigations at Dams and Levees - Planning
10:15am-10:30am		**Break**
10:30am-11:25am	Thomas Terry Scott Walker Kathleen Besko Bryan Simpson	Best Practices for Performing Site Investigations at Dams and Levee - Implementation
11:25am-12:00pm	Kevin Richards	Round Table - Best Practices for Site Investigations at Dams and Levees
12:00pm-1:00pm		**Lunch** – *Sponsored by Geosystems, LP*
1:00pm-1:50pm	Ron Hall	A Driller's Perspective: Techniques, Problem Resolution, and Common Issues with Specifications and Work Plans
1:50pm-2:30pm	Mark Elson	Best Practices Techniques, Problem Resolution, Specifications
2:30pm-2:45pm		**Break**
2:45pm-3:25pm	Jeff Schaefer	Potential for Hydraulic Fracturing When Drilling in Embankment Dams and Levees
3:25pm-4:05pm	Dom Galic	Investigation Best Practices for Sites with Potential Liquefaction - Prosser Creek Dam Case History
4:05pm-4:45pm	Hawkins Gagnon	Case Histories - Building and Using 3D Models to Plan and Execute Site Characterizations
4:45pm-5:30pm	Cassandra Wagner	Roundtable Discussion
6:00pm-7:30pm		**Welcome Reception on the Sky Terrace –** Sponsored by Gannett Fleming

TUESDAY, DECEMBER 7

Day #2: Advanced Dam Remediation Applications and Risk Assessments
Moderators: Cassandra Wagner and Kevin Richards

7:00am-8:00am		**Breakfast**
8:00am-8:10am	Cassandra Wagner Kevin Richards	Welcome and Overview of the Workshop
8:10am-9:10am	Donald Bruce	Keynote – Review of Specialty Geotechnical Construction Techniques for Dams and Levees
9:10am-10:00am	Steven Shifflett Will Ailstock	Rough River Dam - Foundation Grouting, Cutoff Wall Design, and Design Modifications to Outlet Work Design
10:00am-10:15am		**Break**
10:15am-11:05am	Scottie Barrentine	Boone Dam, TN (TVA) - Instrumentation During Grouting and Cutoff Wall Construction
11:05am-12:00pm	David Paul	Emergency Repairs to Mosul Dam in Iraq: A High-Risk Dam on a Karst Foundation
12:00pm-1:00pm		**Lunch** – *Sponsored by TREVIICOS*
1:00pm-1:40pm	Vanessa Bateman	Keynote: Construction Data Management Systems and Lessons Learned
1:40pm-2:20pm	Stephano Valaussa	Contractors Perspective – Working on Large Projects
2:20pm-2:35pm		**Break**
2:35pm-3:15pm	Jeff Schaefer	Dam and Levee Safety Risk During Remedial Construction
3:15pm-3:55pm	Nathan Snorteland	Keynote: Transitioning to Risk-Informed Designs for Dams and Levees
3:55pm-4:00pm		**Closing**

WEDNESDAY, DECEMBER 8

Day #3: - Field Trip to Herbert Hoover Dike – 7:30am-5:00pm – Trip Leader: John Kendall
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Schnabel is a national firm providing civil engineering services with a focus on dam and levee safety, geotechnical engineering, geostructural design, tunnel and underground engineering, and engineering support during construction. With 22 offices located across the United States, our multi-disciplinary staff of 400+ professionals include dam, geotechnical, civil, hydraulic, structural, mechanical, environmental, and geostructural engineers; hydrogeologists and hydrologists; geophysicists and geologists; wetland specialists; construction quality assurance managers; and engineering technicians. Schnabel is consistently recognized by ENR as one of the top Dams and Reservoir firms in their annual rankings of engineering companies and has more than 160 professionals that work exclusively on dams and levees. These professionals specialize in the planning, assessment, analysis, design, and construction support for all types of new and existing dams.

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TREVIICOS is a geotechnical and foundation contractor and the North American subsidiary of the TREVI Group, a worldwide leader in special foundation works headquartered in Italy. Throughout the United States, TREVIICOS provides innovative specialty foundation applications and a broad range of techniques among which slurry walls, cut-off walls, secant piles, caissons, jet grouting, and deep & shallow mixing. For over two decades, TREVIICOS has prided itself with Dam and Levee rehabilitation projects throughout the country, as well as foundation works for buildings, infrastructures, and underground tunnels.

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Barr provides engineering and environmental consulting services to clients across North America and the world.

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Website

Geosystems LP is an independent consultancy offering technical, advisory, peer review, and managerial services in the specialty aspects of the civil, mining, and tunneling engineering. It has worked on projects throughout the United States, Canada, and also in Europe, South America, South Africa, the Middle East, New Zealand, Australia, and Southeast Asia. Geosystems LP is also heavily involved in teaching and technology transfer, via its links with various universities and professional trade organizations on the one hand, and innovative and challenging projects on the other. Since formation in 1996 by Dr. Donald Bruce, Geosystems LP has successfully completed almost 2,000 projects and assignments, the majority of which have dealt with dam and levee remediation (including Herbert Hoover Dike), deep foundations, quarries, mines, and tunnels. The clients for these projects include Owners (and in particular Federal agencies), Contractors, Consultants, and Attorneys.

Exhibitors

The Workshop would not be possible without the support of our Exhibitors

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Schnabel is a national firm providing civil engineering services with a focus on dam and levee safety, geotechnical engineering, geostructural design, tunnel and underground engineering, and engineering support during construction. With 22 offices located across the United States, our multi-disciplinary staff of 400+ professionals include dam, geotechnical, civil, hydraulic, structural, mechanical, environmental, and geostructural engineers; hydrogeologists and hydrologists; geophysicists and geologists; wetland specialists; construction quality assurance managers; and engineering technicians. Schnabel is consistently recognized by ENR as one of the top Dams and Reservoir firms in their annual rankings of engineering companies and has more than 160 professionals that work exclusively on dams and levees. These professionals specialize in the planning, assessment, analysis, design, and construction support for all types of new and existing dams.

CASCADE DRILLING – BOOTH #6

Greg Zekoff, gzekoff@cascade-env.com, 480-226-5485
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Cascade is the leading provider of environmental and infrastructure drilling, site characterization, and environmental remediation applications. We are the only nationwide integrated field services firm with expert technical capabilities and fleet to provide seamless environmental and geotechnical solutions, from concept to completion.

G3 GROUP – BOOTH #1

David Harro, david.harro@geo3group.com, 727-376-7833
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A woman owned business established in 1993, G3 has worked throughout the United States and internationally. The G3 Group is an engineering and scientific investigation and analysis firm committed to providing clear answers to the most challenging technical problems.

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David Wilshaw, MS,
PG, davidw@groundstiffnesssurveys.com , 407-342-7737
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Ground Stiffness Surveys is the designer and manufacturer of the Advanced Continuous Surface Wave (ACSW) rapid ground profiling system. The system uses a vibrating seismic source to generate Rayleigh Waves at 100 different frequencies. The Rayleigh Wave Velocity, Vr, is measured at each frequency over a short 10-ft geophone array; the Vr values are then inverted using our custom C-DAS software to create a velocity and/or stiffness vs. depth profile, typically to 30-feet, facilitating rapid (<20-minutes) non-destructive strength testing of embankments, dams and levees.

RITE GEOSYSTEMS – BOOTH #2

Melih Demirkan, melih@ritegeosystems.com, 412-680-2526
www.ritegeosystems.com

Rite Geosystems offers reliable and robust geotechnical monitoring solutions for the construction, transportation, and infrastructure sectors. Our people are customer focused and supportive, and we worked tirelessly in partnership with contractors and monitoring companies, over 50 years, to ensure we provide you with stable, precise and highly user-friendly data from any of your installations.
Rite Geosystems is an instrumentation system provider, where we supply geotechnical instruments, data loggers and cloud based online monitoring platform in house.

Speakers

Keynote: Overview and Evolution of Geological and Geotechnical Site Characterization

Douglas D. Boyer, PE, CEG, Chief, Risk-Informed Decision Making Branch, Division of Dam Safety and Inspections, FERC, Douglas.Boyer@ferc.gov

Well planned and well executed geological and geotechnical investigations are critical to the successful design, construction, maintenance, and operation of dams and levees. Over the years investigation tools and approaches have evolved through scientific and technological advances, empirical evidence, and lessons learned from project case histories. Yet some tools (e.g., standard penetration test) and methods (e.g., observational approach) remain foundational and relatively unchanged over the years. Penned nearly one hundred years ago, Karl Terzaghi wrote, "To pass judgment on the quality of a dam foundation is one of the most difficult and responsible tasks. It required both careful consideration of the geological conditions and the capacity for evaluating the hydraulic importance of the geological facts . . ." - a statement that remains true to this day. This presentation will provide an overview of the evolution of geological and geotechnical investigation tools, methods, and approaches for dam and levees; discuss current practices; and provide some thoughts on future applications and approaches. The use of case histories will highlight many of these topics throughout the presentation.

Bio

Doug is a civil engineer and engineering geologist with 35 years of experience in dam engineering and dam safety working for various federal and state agencies and consulting. Doug has prepared, performed, documented, and reviewed geological and geotechnical investigation plans and proposals for small and large dam projects all over the US and in South America. He has prepared, provided input, or reviewed drilling guidelines for the Bureau of Reclamation, US Army Corps of Engineers, and FERC. Doug is a former vice president of USSD and is the current chair of the USSD committee on foundations. He is a former AEG communications director and awardee of the AEG Claire P. Holdredge publication award. Doug has a B.S. in Geological Sciences and a M.S. in Civil Engineering.

Best Practices for Planning and Implementing Site Investigations at Dams and Levees

Kathleen Bensko, PG, Geologist; Federal Energy Regulatory Commission, Office of Energy Projects, Division of Dam Safety and Inspections; Bryan Simpson, PG, PE, Technical Specialist; US Bureau of Reclamation, Geotechnical Services Division' Engineering Geology and Geophysics; Thomas A. Terry, PE, PG, Engineering Geologist; US Army Corps of Engineers, Risk Management Center; Scott R. Walker, PE, PG, CEG, Senior Specialist – Dam Safety Policy, Dam Safety Governance & Oversight, Tennessee Valley Authority

Management, regulation, and review of planning and implementing site investigations vary within each of four Federal organizations involved with dam and levee safety based upon various roles and responsibilities. The U.S. Bureau of Reclamation (USBR), the Tennessee Valley Authority (TVA) and the U.S. Army Corps of Engineers (USACE) are owner operators of dams that serve multiple purposes, including flood control, hydropower, water supply, and navigation. The Federal Energy Regulatory Commission (FERC) regulates and inspects non-federal hydropower producing dams, and develops and implements policies, programs, and standards to ensure the safety of these licensed projects. Each organization (except FERC) is also responsible for oversight, rehabilitation, and repair of structures including damaged levees, canals, and dams maintained and operated by others. This paper provides a brief overview of the various regulations and guidance related to planning and implementing intrusive site investigations conducted at structures within each organization's portfolio. Discussion will include similarities and differences on site investigation requirements and the reasons behind organizational differences in guidance and practice. Each Federal organization has the same goal of Dam and Levee Safety related to intrusive investigations at dams, levees, and appurtenant structures. One common question asked is, "What is the risk in obtaining the information versus the value of the information gained?" Potential Failure Mode Analyses, oversight and management processes vary between, and sometimes even within organizations. Insight will be provided into organization-specific nomenclature. for various tasks, and the process and procedures for reviewing and implementing drilling plans will be discussed. This paper also provides a programmatic overview of the processes utilized by the different Federal organizations for planning, reviewing, and implementing intrusive investigations. It covers specific requirements (guidance/regulations), time frames that are involved with the review process, and discusses updates and changes that are planned or being considered.

Bios

Kathleen Bensko has served as the Senior Geologist of the Division of Dam Safety and Inspections, Office of Energy Projects at the Federal Energy Regulatory Commission Headquarters in Washington, DC since 2015. Prior to working for FERC, Kathleen spent 30 years with the U.S. Army Corps of Engineers which includes four years with the Risk Management Center and 26 with the Pittsburgh District. In her current position, she provides expert technical assistance and advice to Commission staff and Regional Office personnel on dam safety issues and is actively involved with complex projects requiring a Board of Consultants. Kathleen has a strong construction background and has served in various roles on many high-profile projects to include Point Marion, Gray's Landing, Braddock, and Charleroi Locks and Dams, Wolf Creek Dam, Howard Hanson Dam, Folsom Auxiliary Spillway, and currently Logan Martin Dam, Lower Baker Dam, Cedar Cliff Dam and the 131-feet dam raise at Gross Dam. Kathleen acted as a lead on the FERC team that provided full-time, on-site support during the Response and Recovery of the Oroville Spillway Project. Kathleen has a BS degree from the University of Pittsburgh and is a Professional Geologist registered in the state of Pennsylvania.

Bryan Simpson has 27 Years' Experience:12 years Reclamation, 15 years Private Sector

- Licensed Professional Geologist (Wyoming), Licensed Professional Geotechnical Engineer (Colorado)
- Member of Association of Engineering Geologist (AEG) – Dam and Levees Technical Working Group. Member of United States Society on Dams (USSD) – Chair Unmanned Aerial Systems Technical Working Group. Member of American Rock Mechanics Association (ARMA)
- Education: BS Geology – University of Northern Colorado. AA Engineering – South Plains College.
- Work Experience with Reclamation includes: engineering geology/engineering analysis, which include subsurface characterization foundation acceptance mapping, photogrammetric analysis, seepage analysis, erodibility analysis, hard rock kinematics and soil slope stability, specification preparation/review. Dam Safety Advisory Team Member, Safety Of Dams Risk Analysis Estimator, Safety Of Dams Scoping Member, Value Engineering Team Member, Value

Planning Team Member, Cost/Risk Team Member, Comprehensive Facility Review Team Member, Technical Review Team Member, Technology Development Panel Member, Dam Safety Risk Cadre Member.

Thomas Terry is a Licensed Professional Engineer and Professional Geologist with over 33 years of experience in geotechnical engineering and engineering geology, with Bachelor of Science degrees in Engineering and Geological Engineering, and a Master of Science in Civil Engineering with a geotechnical emphasis. Since joining USACE in 2011 he has facilitated and advised on over 50 risk assessments for dams and levees; and performed Agency Technical Reviews of over 50 USACE dam and levee projects including 17 as the lead. He has performed dam and levee inspections, over a dozen dam investigations, over a dozen design and modifications for dams, and observation of dams, modifications to dams, and water supply projects. Reviewed and managed reviews of over 100 dam and 80 levee Drilling Program Plans from USACE and non-USACE organizations for dam and levee investigations. Performed rock and soil slope stability evaluations, and slope stabilization design for dams, levees, and other projects. Developed, managed and performed hundreds of geotechnical and geological investigations including laboratory, multiple types of non-destructive and in-situ testing, geologic hazards, foundation analysis and design, geophysics, and environmental site investigations for dams, levees, floodwalls, and thousands of other structures. Organized, presented, and led multiple training workshops for USACE, private and professional organizations including the LST training, site Investigation workshops, led PFMA exercises at multiple training events, in-situ testing and have given presentations on specific projects at multiple professional and governmental public meetings. Worked on updates to the engineering regulation, engineering manuals and guidance documents.

Scott Walker is a geological engineer with the Tennessee Valley Authority in Chattanooga. As a corporate agency of the United States, TVA's Dam Safety Program is self-regulated, and Scott currently serves as a member of the Governance & Oversight team. He has over 20 years of professional experience and previously worked for several private consulting firms before joining TVA. Scott holds licenses as a professional engineer, professional geologist, and certified engineering geologist, and has been a member of AEG since he was an undergraduate at the Colorado School of Mines.

A Driller's Perspective: Techniques, Problem Resolution, and Common Issues with Specifications and Work Plans

Ron Hall, Vice President, Operations, Nicholson Construction Company,

The drilling industry has continuously evolved over the last 20 years to address the ever-changing requirements of geotechnical investigation and construction drilling programs. The selection of the proper drilling method and technique must carefully be considered to safely bore through earthen dams, levee embankments and other water retaining structures. The details of the drilling program are also dependent on the specific site characteristics and material properties. Based on the purpose of the drilling program, whether it be exploratory, for the construction of a grouted cutoff wall or deep foundation system, various drilling techniques are available to achieve the intended objectives:

- Rotary Drilling Method
- Auger Drilling Method
- Sonic drilling Method
- Dual-Wall Reverse-Circulation Drilling Method
- Percussion Drilling Method
- Directional Drilling Method
- Cable Tool Drilling Method
- Down the Hole Drilling Method
- Reverse Circulation Drilling Method

Each drilling method has pros and cons, which this paper will address. Every drilling operation, no matter how carefully planned, can result in unforeseen problems because formations are not homogeneous and can behave unexpectedly once disturbed. In planning a drilling program, selecting the proper drilling technique based on anticipating potential problems is key to successfully achieving the design intent. Predominate examples of drilling problems include loss of fluid circulation, hole deviation, drill pipe failures, borehole instability, drilling mud contamination, formation damage, hole cleaning, equipment failure or personnel-related issues. Understanding what causes these issues, experience and preplanning are keys to controlling the drilling process to alleviate or eliminate problems.

Contract specifications have also evolved to include more stringent quality control standards for the drilling process to minimize potential impacts relating to dam safety. Quality control measures include providing the client or engineer with timely data for quality assurance purposes. Examples include use of real-time instrumented drilling, borehole deviation surveys, bore hole imaging, water inflow and outflow monitoring and control, to name a few. Understanding each of these drilling techniques and how they're applied in practical applications is key for the success of the project. Having clear and quantifiable acceptance criteria based on realistic expectation is a key topic that the industry needs to address. Requirements that leave room for interpretation usually result in expectations that are not met. This paper will also address expectation management related to what is realistic and what is not. Understanding all of these topics from the viewpoint of the driller or drilling contractor provides invaluable information and perspective that can lead to early issue mitigation and resolution and more successful projects.

Bio

Ron Hall is the Vice President for Nicholson Construction Company. Throughout his 47-year geotechnical career, he has held various operational roles in the geotechnical construction contracting industry. His two main focuses throughout his career have been leading successful field operations on a variety of complex and challenging projects and building strong relationships with owners, clients, contractors and engineers. He has an acute understanding of drilling and the practical implantation from concept to field.

Sonic Drilling on Embankment Dams and Levees

Mark Elson, PE, Senior Geologist, USACE Nashville District, Mark.S.Elson@usace.army.mil; Steven Widincamp Chief, Explorations Unit, USACE, Savannah District, Steven.D.Widincamp@usace.army.mil

Sonic, along with augering, and cable-tool drilling are the preferred methods utilized to drill through levees and embankment dams. Sonic drilling is the most recently developed of the three and has distinct advantages over the other methods. Notably, sonic drilling offers a high rate of advance through most materials while still protecting embankments from erosion and hydro-fracturing. The method is not without limitations, as cost and space constraints prevent it from being the most effective choice in some circumstances.

Bios:

Mark Elson is a senior geologist responsible for geotechnical engineering and analysis in the Nashville District of the US Army Corps of Engineers. He has a B.S. in Geoscience from the Pennsylvania State University and has 28 years' experience performing foundation design of dams and navigation locks, dam safety inspections and instrumentation evaluations, subsurface investigations, instrumentation installation, and serves as a technical review team member for dam safety and dam safety modification designs in support of the dam safety program. Other areas of expertise include flood control projects, foundation grouting, construction blasting, rock reinforcement and karst geology.

Steven Widincamp became Explorations Unit Chief for the Savannah District Corps of Engineers in 2007. In his current position, Steven is responsible for planning, coordinating and implementing the daily activities of the Explorations Unit. The Savannah District Explorations Unit has the most diverse subsurface exploratory and in-situ testing capabilities in the Corps and provides support throughout the nation to customers within the Department of Defense and to outside government agencies as well, performing work in the military, civil, emergency, environmental and hazardous, toxic and radioactive waste arenas. Steven began his career with the Corps in 1999 as a Drill Rig Operator Helper and was promoted Drill Rig Operator later that year. He served as a Drill Rig Operator until he was promoted to Unit Chief in 2007. Steven has worked on many projects throughout the nation in support of the Corps mission.

Potential for Hydraulic Fracturing When Drilling in Embankment Dams and Levees

Jeff Schaefer, PhD, PE, PG, Consultant/President Schaefer Geotechnical Consulting

Hydraulic fracturing of embankment dams or levees and their soil foundations is a real risk when invasive techniques are used for investigation and remediation. The use of water, drilling mud, compressed air, and grout have resulted fracturing of the embankments or foundations as evidenced by cracking, loss of circulation, connections to other borings, and blowouts on embankment slopes. Numerous incidents have been documented in the literature, but it is likely that many more cases occurred without reporting. There are multiple theories and models available to predict the occurrence of hydraulic fracture ranging from the very complicated and theoretical to the relatively simple and practical. A practical model is compared to laboratory and field data and is the recommended method in USACE ER 1110-1-1807. The model requires the estimation of the total minor principal stress and the undrained shear strength of the soil. Methods for estimating these parameters are discussed. Pressure measurement and comparison to the correct pressures in terms of total stress is critical for evaluation of hydraulic fracture potential along with the potential to damage underground structures. Decisions to drill into dams and levees should be made only after properly evaluating the risk. Use drilling techniques that don't require fluids when possible. If fluids are required limit pressures to gravity. If higher pressures must be used, measure the pressures and keep them below the estimated threshold for hydraulic fracture.

Bio

Dr Schaefer retired as a Lead Civil Engineer at the end of May from the US Army Corps of Engineers Risk Management Center with 33 years of geotechnical engineering, geology, dam safety, levee safety, risk, and litigation experience. Since 2005, as the founding geotechnical member of USACE Dam and Levee Safety Risk team, he primarily worked on the development of risk assessment methodology, performance and review of risk assessments, and oversight of design and construction of national priority dam and levee safety remedial modifications. He has extensive experience in large civil works projects including Olmsted Locks and Dam, McAlpine Locks, Panama Canal expansion, and numerous dam remediation projects including Mississinewa, Wolf Creek, Center Hill, and East Branch Dams. Dr. Schaefer received his Bachelors and Masters in Civil Engineering from the University of Louisville and a Doctorate from the University of Kentucky. He is a registered Professional Engineer and Professional Geologist in the State of Kentucky. Dr Schaefer is currently working as an independent consultant for Schaefer Geotechnical Consulting LLC.

Investigation Best Practices for Sites with Potential Liquefaction - Prosser Creek Dam Case History

Dom Galic, PhD, PE, Geotechnical Engineer, Bureau of Reclamation

Prosser Creek Dam is a 165-foot-high embankment structure near Truckee, CA. The dam was constructed in the early 1960s and is part of Reclamation's Washoe Project. The dam performed well during the 1966 Dog Valley Earthquake (M 6.6) and has not experienced any other performance issues since construction. However, with the introduction of risk informed decision making, the fact that its upstream and downstream shells were constructed over an alluvium foundation became a focus of scrutiny, culminating in a 2012 Safety of Dams recommendation to commence a seismic Issue Evaluation. The effort was completed in 2018 and based on the results of the investigations and analyses performed, the decision was made not to pursue any type of corrective action. This presentation gives an overview of the decision process used for Prosser, the extensive field investigations (including iBPT) used to support it, and the overall geologic setting of the facility.

Bio

Dom Galic is a geotechnical engineer with the Bureau of Reclamation's Technical Service Center in Denver, CO. He joined Reclamation in 2008 and has spent much of his career working on dam safety issues. Dom is an active member of the Reclamation risk cadre, a working group established to provide training and guidance on risk analysis methodology and promote consistency in risk informed decision making. He is a registered professional engineer in the State of Colorado and holds a doctoral degree in geotechnical engineering from the University of California, Berkeley.

Case Histories - Building and Using 3D Models to Plan and Execute Site Characterizations

J. Hawkins Gagnon, PG, Schnabel Engineering;, Nicole Mathis, EI, Frederic G. Snider, PG, Schnabel Engineering

Billions of dollars are spent on dam and levee investigations to gather the geotechnical data necessary to inform our future actions, whether that be for risk analyses, design of new structures, rehabilitation of old structures, or simply to better understand the performance of an existing structure. During a traditional investigation, the collected data is targeted such that it can be used to solve a specific problem or to provide a specific input. However, without the appropriate framing, it is often exceedingly difficult to bring together all of the potentially significant data points to provide the necessary context. Visualizing available data sets in three dimensions allows us to bridge this gap by visually representing all collected data in a singular format. The result is that we are able to see and think at a larger scale, and to better understand the data we have (or don't have). To be effective, a 3D model must serve as a portal to the range of possibilities that our data presents. One crucial aspect of providing as effective communication tool is the ability to provide easy and cost-effective access to the end user. If the end user can't see, or doesn't understand, the available data and means for visualizing it, the objectives of 3D visualization cannot be achieved.

Schnabel has developed a number of 3D models, each with their own specific focus and contents that reflect unique aspects of the project. The common thread between all of our models is that they integrate of a wide range of information, have been created using standard, readily available, software such as Microsoft Excel, Trimble's SketchUp, and are ultimately delivered in an accessible format, the Adobe 3D PDF.

The focus of this presentation will be to demonstrate three case histories where 3D models were developed and used effectively on FERC-regulated projects to plan and execute site characterizations. The first case history will focus on a 3D model developed to identify potentially removable blocks in the abutment of a concrete double-curvature arch dam and was later used to identify and validate the location of rock anchors. The second case history includes a 3D model that was developed for an embankment dam in glacial geology with artesian aquifers. This model has been used to inform a risk-informed decision-making team during a project risk analysis, preparation of a geotechnical investigation, and is currently being used to develop design concepts for the replacement of an existing auxiliary spillway. A final case history a 3D model used to plan an internal erosion and liquefaction-focused investigation for a large embankment dam with a complex construction history and complicated as-built zoning.

Each case history will illustrate the varying data sets that can be visualized in the 3D models, examples of important discoveries that were made as a result of compiling and assessing the content of model, the added value that each model brings to projects.

Bios

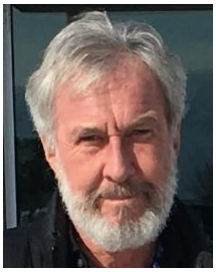
Hawkins Gagnon is an engineering geologist who has spent his professional career working on dams for Schnabel Engineering out of their office in Greensboro, NC. Hawkins specializes in planning and managing geotechnical investigations of dams, including the creation of 3D models. His current professional focus is to expand his knowledge of risk-based analyses including PFMA and SQRA. Hawkins has a B.S. in Geology from UNC-Chapel Hill and a M.S. in Geology from UNC-Wilmington.

Nicole Mathis has a biological engineering degree from North Carolina State University with a concentration in water resource engineering. She began her career in stormwater design before joining Schnabel Engineering in 2017. At Schnabel, she has continued her focus on Hydraulics & Hydrology while also expanding her knowledge in AutoCAD design, Construction Administration, and 3-D model development. She has worked on projects nation-wide but is located in Greensboro, North Carolina where she lives with her fiancé, two dogs and three cats.

Fred Snider is a geologist who has spent his entire 48-year career working for engineering companies on large infrastructure and power projects across the US and overseas. Fred has been with Schnabel Engineering for 15 years, working exclusively on dams and dam safety issues, and currently leads Schnabel's 3D Modeling Team. Fred has a B.A. in Physics from Amherst College, and a B.A. in Geology and Geophysics from Wesleyan University in Middletown CT.

Keynote - Review of Specialty Geotechnical Construction Techniques for Dams & Levees

Donald Bruce, PhD, GeoSystems, L.P.



The last 40 years have seen a remarkable intensity of remedial construction for our aging portfolio of dams and levees in North America. This presentation focusses on a number of specialty geotechnical construction techniques used in such projects. A brief overview is provided for the following techniques, highlighting the scale of the market and the challenges and developments which have marked the evolution of these techniques:

- Rock anchors for concrete dam stabilization
- Drilling and grouting for seepage control
- "Positive" seepage cut-offs
- Deep Mixing, primarily for foundation improvement for both static and seismic remediations

Bio

Donald Holds degrees in Geology and Geotechnical Engineering from Aberdeen University, Scotland. He worked for specialty geotechnical contractor, Colcrete, Ltd., for almost 10 years in the U.K., Pakistan, Hong Kong, Egypt, and the Middle East. He then joined Pittsburgh based Nicholson Construction Company as Technical Director, working on projects throughout the U.S. and Canada. In 1996, he established Geosystems, LP, a consultancy specializing in the more practical aspects of micropiles, drilling, grouting, anchoring, diaphragm walls and deep mixing. Donald works throughout the world, principally as a member of Boards of Consultants or as litigation support. He has published over 350 technical papers and coauthored 3 textbooks. He is an active member of many professional societies, including ASCE, ADSC, DFI, USSD, ASDSO, AEG, an dISM. Dr. Bruce has received the Kapp, Baker and Terzaghi Awards by ASCE. He was the ISM's 2009 Lizzi Lecturer and USSD's 2019 Legacy Lecturer.

Evolution of the Rough River Dam Safety Modification Project

Will Ailstock, USACE and Steven Shifflett, PE, USACE

This paper and presentation will examine a case study of how the Rough River Dam Safety Modification Project has evolved over time from both a technical and project management perspective. Rough River Dam is a flood risk management embankment dam constructed between 1955 and 1958 located in west-central Kentucky. The project has a right abutment cut and cover outlet works founded upon karstic limestone. In 2012 a Dam Safety Modification Report (DSMR) was completed which identified several risk driving failure modes resulting in a DSAC 2 Rating. The DSMR recommended a phased approach with Phase I consisting of a highway relocation and exploratory drilling and grouting. Phase II of the project consisted of a full-length cutoff wall to be constructed over and around the existing outlet conduit, grouting from inside the conduit, and construction of a downstream filter. During construction of the exploratory grouting (2015-2017) several key findings were evaluated and found to warrant expedient construction of the full-length cutoff wall. In addition, a contract modification was executed to complete the upstream and downstream grout lines for the purpose of slurry control during cutoff wall construction. Design of the cutoff wall around the conduit concluded the existing conduit was structurally inadequate to support the cutoff wall and the 2012 DSMR was considered an incomplete solution. A Supplemental DSMR was completed which recommended a new left abutment outlet works design measure to complete the 2012 tentatively selected plan (TSP) and safely install the cutoff wall across the dam foundation. The Phase II Project currently consists of construction of a new approach channel, control tower, tunnel, stilling basin, and retreat channel followed by abandonment of the existing outlet works and installation of a full-length cutoff wall severing the existing outlet conduit.

Bios

Will Ailstock holds a Bachelor Degree (2002) and a Masters in Engineering degree (2003) from the University of Louisville. He has worked for the USACE-Louisville District for over 19 years, of which 17 have been in the Dam Safety/Civil Works arena. He holds certifications as a Professional Engineer and a Project Management Professional and currently serves as the Louisville District's Project Manager for Civil Works Mega-Projects. His current projects include the Rough River Dam Safety Mega-Project, Louisville Metro Flood Protection System Restoration, and the Mill Creek (OH) Flood Damage Reduction project. He served as the Lead Engineer for the Rough River Dam Safety Mega-Project for 5 years and oversaw the design and construction of the Phase 1A and Phase 1B contracts, initial design of the Phase 2 project, re-formulation for the current Phase 2 design, and completion of a Supplemental Dam Safety Modification Report. His other positions have included temporary details as the Endowed Chair with the LRD/NAD Regional Integration Team (RIT) with USACE-HQ and Supervisor of the Levee Safety Section as well as a permanent position (2.5 years) as a Project Engineer with the AE Management section for the Army Reserves.

Steven Shifflett holds a Bachelor's Degree (2008) and a Masters in Engineering Degree (2010) from the University of Louisville. He has worked for the USACE-Louisville District for over 15 years and is a licensed professional engineer in the State of Kentucky. He has been the Lead Engineer for the Rough River Dam Safety Mega-Project for the past 2 years leading design efforts for the New Outlet Works and Cutoff Wall Project. Prior to serving as Lead Engineer, Steven held various positions on previous phases of the Rough River Dam Safety Modification Project serving as the Lead Geotechnical and Materials Engineer, Senior Geotechnical Engineer, and field engineer. Steven has completed a temporary detail as Section Chief of the Geotechnical Design and Levee Safety Section and has a diverse background in engineering design and construction specializing in dams, levees, and military construction. Prior to coming to USACE he worked in the Construction Industry for 5 years.

Boone Dam, TN (TVA) - Instrumentation During Grouting and Cutoff Wall Construction

Scottie Barrentine, PE Principal Engineer – Dam Safety, TVA

On October 20, 2014, a sinkhole appeared near the downstream toe area of the earthfill embankment at Boone Dam. Six days later, turbid seepage was observed in the tailrace area, immediately downstream of the hydroelectric generating units. These events initiated a large-scale response by TVA and its engineering and construction partners in which the embankment dam was remediated through a multi-step construction process involving grouting and the construction of a cutoff wall. The project was awarded the 2019 AEG Outstanding Environmental and Engineering Geologic Project Award.

An advanced instrumentation system for the design and implementation of a grouting and cutoff wall construction project is a vital element for the success of the project. This presentation will go over the details for setting up and interpreting an instrumentation system for monitoring the performance of the dam.

Key topics and examples will be provided for:

- Details for setting up an advanced instrumentation system
- Karst considerations for instrumentation systems
- Controlling and real time engineering of grouting programs by observations of the dam performance
- Detection of hydrofracturing of soils in the instrumentation system
- Response of the dam to cutoff wall construction

Bio

Scottie Barrentine is a senior civil engineer for the Tennessee Valley Authority's Dam Safety Organization and has a career of more than 20 years in construction, geotechnical engineering, instrumentation, and materials engineering. Mr. Barrentine served as the team lead for the Boone Dam Project from the initial engineering response team and later as the engineer of record for the construction of the cutoff wall. The work of the team at the Boone Project has brought several innovations to the TVA and the industry, including innovative use of GIS information systems, compaction grouting in dams, instrumented packers for grouting, and the development of hydrogeological models for dams. He has worked for Tennessee Valley Authority in dam safety for the last 10 years and has been the lead engineer for several dam investigations and remediation design modifications. Scottie was awarded the TVA Safety, River Management, and Environment Business Unit's Engineer of the Year Award in 2015 and Service Award for Innovation. The Boone Dam Remediation Project received the AEG's Outstanding Environmental and Engineering Geologic Project Award for the year 2019. Prior to joining TVA, Scottie was a consulting engineer and has worked for both general construction contractors and civil earthwork contractors. Scottie has a B.S. in Civil Engineering and a B.S. in Cooperative Education from Auburn University.

Emergency Repairs to Mosul Dam in Iraq: A High-Risk Dam on a Karst Foundation

David Paul, PE, Paul GeoTek Engineering, LLC

Mosul Dam, on the Tigris River is the largest dam in Iraq and provides a significant percentage of water for the Country.It was constructed on problematic karst geology. Based upon an engineering assessment of Mosul Dam in early 2015, the Government of Iraq with support of the US Government entered into an agreement to have the US Army Corps of Engineers provide technical support to perform emergency repairs. Project was an international effort by the governments of Iraq, Italy, and the United States of America. The risk analysis of Mosul Dam showed that up to 1.5M citizens would be impacted by a catastrophic failure of the dam. This is the highest risk profile of any dam in the world. This context forged the international partnership needed to rapidly address the situation. The initial challenges included public reluctance to accept the risk posed by the dam, financing a project of this scope, establishing a secure area to execute the works, awarding a contract with Italian firm Trevi, and completing a bilateral agreement to commission the US Army Corps of Engineers as the Engineer. From February 2015 to June 2019 emergency repairs were executed to reduce risk of failure.

Bio

David B. Paul, P.E., is Managing Partner of Paul GeoTek Engineering LLC, Denver CO. He retired from the US Army Corps of Engineers (USACE) at the end of 2018 after 42 years of Federal service, as the Dam Safety Officer for the Mosul Dam Task Force which provided technical assistance to the Government of Iraq in to mitigate dam safety issues associated with Mosul Dam. He also served as Special assistant for Dam Safety at the U.S. Army Corps of Engineers (USACE) headquarters in Washington, D.C., responsible for managing the USACE's portfolio of 715 dams. He is a national specialist on critical

infrastructure design, dam design, levee design, construction engineering, engineering risk assessments, interim risk reduction measures (IRRM), and dam and levee safety modifications. He recently participated in the Risk Assessment for Oroville Dam in California which is the tallest earth dam in the United States. He has been involved in the design and construction of 10 new dams and over 75 dam modifications around the world. Mr. Paul is currently a Trustee of the Deep Foundations Institute and a member of the United States Society of Dams (USSD), Association of State Dam Safety Officials (ASDSO) and American Society of Civil Engineers (ASCE). He is DFI Trustee for the Seepage Control and Grouting Committees and serves as Chairman of the USSD Committee on Construction and is also active with the Embankment Dams Committee. He is the USSD Representative to the International Commission on Large Dams (ICOLD) Embankment Dams Committee.

Keynote: Construction Data Management Systems and Lessons Learned

Vanessa Bateman, Chief of Civil Works Engineering, Engineering & Construction, Headquarters, U.S. Army Corps of Engineers

Data generation on construction projects has exploded in recent years, with radically increased quantity of data available from a wide variety of sources - including computer monitoring of construction equipment, automated instrumentation, monitoring while drilling and other in-situ testing equipment. These tools can greatly aid the engineer and geologist in evaluating the risks and potential failure modes of projects as well as the effectiveness of construction techniques. However, the dramatic increase in the amount of data presents its own risks. If the data generated produce a "needle in the haystack" effect, and overwhelm people, and older handling systems, the data will not be properly evaluated and understood and will provide little value. Thus, newer tools and techniques are needed to organize, store, compare, analyze, and evaluate the data that are generated on projects to fully capture the benefits. For complex projects, such as major dam and levee safety modifications, both careful evaluation of the efficacy of the construction techniques and monitoring against potential failure modes during construction must be completed successfully. This data explosion, with an appropriate construction data management system, provides a unique opportunity to better evaluate the success of dam and levee modifications as well as provide for better real time monitoring of potential failure modes while using techniques such as grouting, barrier wall construction and more. Tools, techniques, and lessons learned from projects such as the Wolf Creek Dam Barrier Wall, Center Hill Dam Barrier Wall and Stability Berm as well as the Mosul Dam Foundation Grouting illustrate the scale of the problem; the need to change and update how data are handled on projects to realize the benefits from an effectively implemented construction data management system.

Bio

Vanessa Bateman, PG, PE, D.GE is currently the Chief of Civil Works Engineering, Engineering & Construction Division at the US Army Corps of Engineers and previously served as the Principle Geotechnical Engineer for USACE as the Geotechnical, Geology and Materials Community of Practice lead. She has 25+ years in the field of geology and geotechnical engineering working at both the Tennessee Department of Transportation and at USAC with a wide background in geotechnics and geotechnical data management with particular interests in rock slope engineering, grouting, karst and dam safety working on many large projects such as Wolf Creek Dam Barrier Wall, Center Hill Dam Barrier Wall and Stability Berm, Mosul Dam Foundation Grouting, Chickamauga Lock, Kentucky Lock, Ocoee River Rockslides as well as major transportation infrastructure. She has been involved in construction and geotechnical data management starting with the Rockfall Management program at the State of Tennessee as well as on major dam safety modification projects at USACE starting with Wolf Creek Dam Barrier Wall project. She has a BS in Geology from Middle Tennessee State University as well as a BS and MS in Geological Engineering from the University of Idaho. She is Professional Geologist and Professional Engineer registered in the state of Tennessee and is a D.GE (Diplomate, Geotechnical Engineering) with the ASCE.

Contractors Perspective - Working on Large Projects

Fabio Santillan, Vice President for Major Projects and Stefano Valagussa, President & CEO, TREVIICOS Corporation

During the last 30 years or so, there has been an unprecedented volume of activity in the dam and levee market in North America, and we are proud to have been one of the most active participants, particularly in large, complex remediations of high hazard active dams and levees. These projects mostly feature cut-off wall and Deep Mixing solutions, but jet grouting, grouting, and anchoring are also commonly used techniques. This presentation provides perspective from our viewpoint, while operating typically as the prime contractor, or occasionally as the key subcontractor. The presentation basically follows the chronological order of the evolution of a major project from the procurement phase throughout the project closeout:

1. Bid Stage
   - Provision of early briefing information to prospective bidders (e.g., draft specifications, "industry day") and relevant Contractor's input.
   - Prescriptive vs Performance Specifications.
   - Geotechnical data, their completeness, and their contractual standing.
   - Experience and Qualifications, both Corporate and Individual.
   - Adequate time for bidding and Owner Review with regard to type of bid (Best Value vs. Lowest Price Technical Acceptable).
   - The advisability of a comprehensive Q & A interaction, and its impact on Solicitation Amendments. The concept of "one on one" meetings with the Owner.
2. Award Process
   - Notice of Award.
   - Notice to Proceed, and the contrast between a hard date and a coordinated, phased approach.
3. Communication with the Owner During the Work
   - Mutual understanding of the Specifications – actual wording vs intent, and the concept of allowing flexibility in the field.
   - Documenting issues vs. creating more bureaucracy that make the processes less efficient.
   - Partnering – formal and informal.
   - Issue resolution process.
   - Internal and external technical audits of processes.
4. Data Management Systems
   - Type and number of staffing structures.
   - Initial commissioning and trouble shooting.
   - Flow of data, and the review process.
5. Panel of Experts
   - Board of Consultants (Owner).
   - Internal Advisory Panel (Contractor).
6. Contract Close-Out
   - Resolution of Issues.
   - Litigation options (Mediation, Arbitration, etc.).
   - Final Owner Evaluation.

Each of these topics will be illustrated by reference to several major case histories including: WF George Dam, AL; Tuttle Creek Dam, KS; Wolf Creek Dam, KY; LPV111 Levee, LA; Herbert Hoover Dike, FL; Bolivar Dam, OH; Wood River Drainage and Levee, IL; and Boone Dam, TN.

Bios

FABIO SANTILLAN is Vice President for Major Projects with TREVIICOS Corporation in Boston, MA. He has twenty-four years of experience in geotechnical specialty construction in the U.S. and Argentina, including sixteen years on USACE dam and levee rehabilitation projects.

STEFANO VALAGUSSA is the President and CEO of TREVIICOS Corporation, the North American subsidiary of the Italian TREVI Group. He has more than twenty-five years of experience in the geotechnical and specialty construction industries, beginning in Italy and North Africa before continuing to the United States in 1996. Stefano has been involved in dam and levee rehabilitation projects for the last two decades.

Dam and Levee Safety Risk During Remedial Construction

Jeff Schaefer PhD, PE, PG, Consultant/President, Schaefer Geotechnical Consulting

Structural modifications to dams and levees can create life safety risk during the construction period. It is important for all parties involved to understand the potential risk, evaluate methods to mitigate the risk, and consider the risk when making decisions. Most importantly, it is critical to always strive to DO NO HARM and prevent activities that could potentially increase risk. This presentation will provide examples of conditions that can lead to increased risk during construction. One of the key tasks to help prevent increasing risk during construction is to have multiple constructability reviews during the development of the project design. If the potential for construction risk is properly identified, the risk can often be mitigated or reduced. Decision maker involvement is necessary to assure risk are understood and proper decisions can be made. A key component of many construction projects is a temporary cofferdam to protect the work area from flooding. Cofferdams have a high potential to create risk during construction. Several case histories are presented to demonstrate how risk during remedial construction are evaluated and incorporated into decision making.

Bio

Dr Schaefer retired as a Lead Civil Engineer at the end of May from the US Army Corps of Engineers Risk Management Center with 33 years of geotechnical engineering, geology, dam safety, levee safety, risk, and litigation experience. Since 2005, as the founding geotechnical member of USACE Dam and Levee Safety Risk team, he primarily worked on the development of risk assessment methodology, performance and review of risk assessments, and oversight of design and construction of national priority dam and levee safety remedial modifications. He has extensive experience in large civil works projects including Olmsted Locks and Dam, McAlpine Locks, Panama Canal expansion, and numerous dam remediation projects including Mississinewa, Wolf Creek, Center Hill, and East Branch Dams. Dr. Schaefer received his Bachelors and Masters in Civil Engineering from the University of Louisville and a Doctorate from the University of Kentucky. He is a registered Professional Engineer and Professional Geologist in the State of Kentucky. Dr Schaefer is currently working as an independent consultant for Schaefer Geotechnical Consulting LLC.

Keynote: Transitioning to Risk-Informed Designs for Dams and Levees

Nathan J. “Nate” Snorteland, M.S., P.E., Director, Risk Management Center Institute for Water Resources, USACE

The Corps of Engineers began transitioning to risk-informed dam safety decisions in 2006. Corporately making decisions based primarily on life safety risk has been critical to transition to an approach that focuses on public safety. As with many organizations, the Corps of Engineers follows a mix of internal and external standards to design and construct new structures or to modify existing ones. The combination of traditional design standards, traditional design engineers, the nature of engineering geology, and risk-informed decision frameworks has sometimes been a challenge. The Corps has been using a new risk-informed process for several dams and levees that are being modified to reduce risks. This presentation will discuss how risk and design standards were integrated for two dam modifications and a levee modification. Additionally, this will lead to a discussion of some of the challenges associated with decisions and liability that have been encountered.

Bio

Nate Snorteland has been with the Corps of Engineers as the Director of the Risk Management Center since 2009. In this role, Mr. Snorteland is responsible for managing risks for the Corps of Engineers portfolio of more than 740 dams and 15,000+ miles of levees. His background includes experience designing and constructing a wide variety of dams across the United States. He has experience with grouting, RCC, seismic analysis, and embankment dam construction, culminating with being a designer and construction engineer for Ridges Basin Dam, a 275-foot-high pump-storage dam in Southwest Colorado. Following his work as a designer and construction engineer, he worked in the dam safety program for the Bureau of Reclamation in a variety of roles. He was Reclamation’s project manager and lead engineer for the Joint Federal Project, a $1.6 Billion flood risk management and dam safety project at Folsom Dam in California. Since coming to the Corps of Engineers, he has led efforts related to risk, risk analysis, risk management, portfolio management, design standards, and risk-informed design. He sits on the Dam and Levee Safety Committees for USSD and the Journal Committee for ASDSO. He holds a B.S. in Civil engineering from the University of Colorado, Denver and a M.S. in Geotechnical Engineering from Virginia Tech. He is a registered professional engineer in the State of Colorado.

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