INDEPENDENT EXTERNAL PEER REVIEW PANEL

for the

LOWER CACHE CREEK
YOLO COUNTY, WOODLAND AREA
CALIFORNIA
FEASIBILITY STUDY

The U.S. Army Corps of Engineers submits the following information per requirements in the Water Resources Reform and Development Act of 2014, Section 1044(c)(4)(B).

Entity Conducting the Review	
Outside Eligible Organization:	Battelle 505 King Avenue Columbia, OH 43201
Dates of Review	
Review Initiation:	5 August 2019
Type I IEPR Final Report Submittal:	16 Oct 2019
Reviewer Names and Qualifications	
KEN CASAVANT, Ph.D.	**Plan Formulation/Economics**

Dr. Casavant is a professor and economist at the School of Economic Sciences at Washington State University, Director of the Freight Policy Transportation Institute, and adjunct professor at North Dakota State's Upper Great Plains Transportation Institute. He earned his Ph.D. in agricultural economics from Washington State University in 1971. Dr. Casavant has nearly 50 years of experience as an economist, with expertise in flood risk management plan formulation assignments—particularly, the evaluation and comparison of alternative plans for numerous flood risk management projects, including Cap Section 205 projects. He has served as an economic consultant detailing the tradeoffs necessary on several multi- objective public works projects, most recently on studies of the deep-draft national and international maritime industry and flood risk management. Dr. Casavant is very familiar with USACE plan formulation processes, procedures, and standards. He has more than 15 years of experience in plan formulation, evaluation, and comparison of alternative plans for numerous flood risk projects, navigation studies (lock replacement), ecosystem restoration projects, and feasibility studies, including his technical reviews of the Lower Columbia River Channel Deepening Project, the Upper Mississippi and Illinois Navigation Study, the Barataria Basin Barrier Shoreline Restoration Study, and the Mississippi River Gulf Outlet Ecosystem Restoration Plan, many of which included flood risk management requirements. The Mississippi-Illinois system project was a navigation lock system replacement project that included coastal inland waterway system needs. For the Lower Columbia River project, Dr. Casavant analyzed the costs of deep-draft shipping and the impacts of those costs on the project. The supply chains and alternative movements of maritime steam ships were a focal point of the analyses. For the Delaware River

Main Channel Deepening Project, he assessed and documented the benefits of the project. For the Upper Mississippi and Illinois Navigation Study, he examined alternative shipping flows, including shallow and deep draft, and performed benefits calculations as part of the economic evaluation. Dr. Casavant has worked with USACE methodologies for cost effectiveness/incremental cost analysis (CE/ICA) and has a detailed knowledge of USACE standards and procedures, including the Institute for Water Resource (IWR) Planning Suite. As an economist or a combined Civil Works planner/economist for USACE IEPRs, he has studied and evaluated alternative plans for navigation lock replacement projects. as well as navigation/dredging projects, such as the Savannah Harbor Expansion Project General Re-evaluation Report. Over the last 10 years, he has worked on 13 USACE projects for which he has applied USACE standards and procedures, including the IWR Planning Suite methodologies, with a focus on effective and efficient ecological and natural sustained output per dollar of relevant expenditure for alternative project formulations. He has applied the USACE six-step planning process, which is governed by Engineer Regulation (ER) 1105-2-100, *Planning Guidance Notebook*, during his work as a technical reviewer and peer reviewer on more than 20 projects, such as the Port of Iberia Channel Deepening Project in 2006 for USACE; the External Independent Economic Opinion on Identifying and Measuring NED Benefits: Navigation Shipping; and the Morganza to the Gulf IEPR study, a hurricane protection and storm damage risk project. Dr. Casavant has experience identifying, reviewing, and evaluating impacts on environmental resources from structural flood risk and impacts related to hurricane and coastal storm damage risk reduction projects. As part of other IEPRs, he has reviewed assessments prepared using Hydrologic Engineering Center-Flood Damage Reduction Analysis (HEC-FDA) software, HEC Life Loss/Direct Damage Estimate (HEC-LifeSim) simulation software, and/or HED Flood Impact Analysis (HEC-FIA) software. Whether reviewing risk assessments developed using Monte Carlo evaluations or traditional risk models in the IWR Planning Suite, he has broad and applied experience working with risk-informed approaches to decision making. The six most recent projects he has contributed to had critical components concerning the impacts of environmental resources from flood risk and coastal storm damage. He has also been a plan formulator expert on Louisiana Water Resources Council (LWRC) IEPRs; several of the projects under review had a specific objective to evaluate the damage reduction and the risk associated with achieving benefits from flood risk management, and one project focused specifically on the impact on shorelines. Dr. Casavant has published more than 70 journal articles and has contributed to hundreds of written documents, including chapters in books, books, abstracts, proceedings, professional materials, conference papers, and research bulletins, circulars, and reports. He is a member of numerous professional associations, such as the Transportation Research Board–National Research Council, the International Agricultural Economics Association, and the Logistics and Physical Distribution Association.

MARK RAINS, Ph.D. **Environmental Law Compliance**

Dr. Rains is a Professor of Geology and the Director of the School of Geosciences at the University of South Florida, the President of Coshow Environmental, Inc., and the Associate Editor of Wetland and Watershed Hydrology for the Journal of the American Water Resources Association. He earned his B.A. in Ecology, Behavior, and Evolution from the University of California at San Diego in 1990, his M.S. in Forestry (Wetland Ecology) from the University

of Washington in 1994, and his Ph.D. in Hydrologic Sciences (River and Wetland Ecohydrology) from the University of California at Davis in 2002. He also is a licensed Professional Wetland Scientist. He has more than 25 years of experience in the public and private sectors in the science, policy, and management of wetlands and rivers, including extensive experience in the functional assessment, restoration, and management of degraded wetlands and rivers in agricultural settings. Dr. Rains has worked full time in academia continuously since 2003, conducting research focused on hydrological connectivity, the role that hydrological connectivity plays in governing ecosystem structure and function, and the role that science plays in informing water-related law, policy, and decision-making. He has published nearly 50 peer-reviewed articles that have been cited nearly 1,500 times. He has worked throughout North, Central, and South America and in the Caribbean Basin and is particularly well known for his work on vernal pools, geographically isolated wetlands that are particularly prevalent in the agricultural landscapes in the Great Central Valley of California. He is a nationally acknowledged and award-winning expert on the role of science in the Clean Water Act (CWA), especially in regard to the definition of "Waters of the United States," having served on the U.S. Environmental Protection Agency's Science Advisory Board charged with reviewing the scientific underpinnings of the definition of "Waters of the United States" outlined in the 2015 Clean Water Rule proposed by the Obama Administration. Dr. Rains has also worked as a consultant in the private sector since 1993—full-time from 1993-1997 and part-time since 1997. He specializes in issues related to National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), and the CWA and related programs, with his work resulting in both peer- reviewed papers and technical reports. He worked closely with the national team developing and implementing the Hydrogeomorphic Approach to Functional Assessment (HGM) nationwide, being lead or co-author on HGM guidebooks throughout the nation, including the Northern Prairie, California, and Alaska. He is recognized as an expert on matters related to wetlands in agricultural landscapes, including serving as an expert witness for the U.S. Department of Justice on multiple cases related to vernal pools in the agricultural landscapes in the Great Central Valley of California. One such case, heard by the Supreme Court of the United States, helped define the scope of normal farming practices in wetlands (*Borden Ranch Partnership and Angelo K. Tsakopoulos, Petitioners, v. United States Army Corps of Engineers and Environmental Protection Agency*, 537 U.S. 99 [2002]). Dr. Rains' familiarity with Midwestern U.S. river ecology is reflected in both his consulting and research as well as his involvement as the Environmental expert on the Programmatic Environmental Impact Statement (PEIS) for the Mechanical Creation and Maintenance of Emergent Sandbar Habitat (ESH) on the Upper Missouri River USACE IEPR. He is familiar with changes in river function and processes resulting from the implementation of flood risk management measures and has authored numerous peer- reviewed papers and technical papers on river hydrology, geomorphology, and ecohydrology.

STEVEN BROWN, P.E., CFM **Hydrology and Hydraulic (H&H) Engineering**

Mr. Brown has 11 years of experience as a civil engineer responsible for hydraulics studies/analyses, site hydrology, storm sewer systems design, roadway drainage design, and hydraulic modeling for bridges and flow control structures. He has a B.S.in civil/environmental engineering and is a professional engineer (PE) in Indiana and Illinois. He is also a certified

floodplain manager (CFM) in Illinois. Mr. Brown is experienced with the Sedimentation and River Hydraulics 2D (SRH-2D) modeling software and has used his knowledge to train Illinois Department of Transportation staff in its use for bridge projects. The class covered topics ranging from basic 2D modeling concepts from mesh generation and optimization to modeling bridge piers and pressure flow conditions. Mr. Brown developed the 2D modeling for the proposed configuration, developed all course materials, and delivered the presentations related to the proposed configuration. Class participants were provided class materials, model solutions, and references as a guide to future projects using SRH-2D. For the Lake Decatur Dam Spillway Structure Repairs and Emergency Action Plan. Decatur, Illinois, Mr. Brown developed a HEC-Hydrologic Modeling System (HEC-HMS) model of the reservoir and watershed using Hydrometeorological Report-51 (HMR-51) and HMR-52 to develop Probable Maximum Flood (PMF) hydrographs. He also developed HEC-RAS 1D and 2D models used for semi-quantitative risk assessment of dam failure over a range of flood events up to the PMF and development of inundation mapping. He helped produce flood risk maps of the downstream infrastructure to aid the city in warning and evacuating residents in the event of a dam failure. He also helped the city and emergency responders coordinate emergency action plans. In support of Lake Bloomington and Evergreen Lake Dam Breach Modeling, Emergency Action Plans and Federal Emergency Management Agency (FEMA) Letter of Map Revision (LOMR), Bloomington, Illinois, he conducted hydraulic modeling of the flow over the dam spillways and downstream inundation areas. The project included topographic survey of the dams and hydraulic survey of channels and bridge structures to develop HEC-RAS modeling of Money Creek to define the floodway and floodplain boundaries in preparation of the LOMR submittal to FEMA. Other hydraulic components include development of an unsteady flow model of the Mackinaw River to route dam breach flows from both lakes and produce breach inundation mapping and structure identification in support of an Emergency Action Plan (EAP) and Operation and Maintenance (O&M) manuals. Hydrology components of the project include calculations in HEC-HMS for the 700-square-mile Mackinaw River basin. The HEC-Statistical Software Package (HEC-SSP) was used to analyze gage data via Bulletin 17B and calibrate the model to the gages. Nexrad data was also utilized in the calibration effort. The project also included preparation of design plans for a bridge deck replacement, structural repairs at each dam, and underwater investigations of both dam faces. In addition to updating the FEMA map, he performed dam breach analyses of both dams and generated flood risk maps to aid the City in flood warning and evacuation efforts. Mr. Brown was the hydraulic engineer responsible for models and the permit package for the Komatsu Manufacturing Facility Illinois River Levee Raise, Design and Permitting, Peoria, Illinois. The project designed and permitted a levee system improvement that included a 1- to 6-foot earthen levee raise and construction of two floodgates at Komatsu's Peoria Manufacturing Operations facility along the Illinois River in Peoria. Modeling efforts included river modeling as well as interior drainage design to develop FEMA floodplain map elements. He also helped develop an emergency action plan for the levee district. Mr. Brown conducted water balance modeling analyzing of different alternatives to develop a supplemental water supply for a new flue gas desulphurization system (scrubber) at a Central Illinois Reservoir. The investigation included the feasibility of using existing water supplies from nearby cities, ground water sources (including the abandoned coal mine underlying the plant area), the Mississippi River, surface water possibilities (including new

lakes and dams), perched impoundments, raising the existing lake, pumping from a nearby creek, and possible combinations of different alternatives. For the Vistra East Fork Shoal Creek Pump Station and Gate Structure, Coffeen, Illinois, Mr. Brown worked as a civil engineer responsible for laying out erosion control measures and creating various exhibits, as well as conducting a water supply study of Coffeen Lake that accounted for additional water from the gate pumping and various other potential options to increase available water supply in the lake. Mr. Brown worked on the Cedar Rapids Flood Protection System–West Side Phase I, Cedar Rapids, Iowa, as a Geographic Information System (GIS) designer responsible for conceptual design of the alignment of the flood protection system for the west side of the Cedar River in Cedar Rapids. The flood risk reduction system consisted of earthen levees, floodwalls, demountable floodwalls, combination floodwalls, road and railroad closure structures, pump station analysis and critical infrastructure penetrations of the net levee section. He was part of a team responsible for the geotechnical, structural, and hydraulic design of the system using USACE design criteria. For the South Suburban Airport (SSA) Tier 2 Master Plan and Environmental Impact Statement (EIS) Floodplain Study, Will County, Illinois, Mr. Brown was the hydraulics engineer in charge of establishing detailed flood profile information regarding the water features that existed within the limits of the proposed SSA for the waterway study limits as approved by the Federal Aviation Administration (FAA) for Rock Creek. Specifically, 100-year floodplain limits were developed for all water features that were currently indicated as unnumbered Zone A floodplain within the approved FAA study limits. In addition, existing land use and stream system conditions (channel alignment, cross section shape, channel roughness, and hydraulic structure characteristics) were evaluated. Mr. Brown was the hydrology / hydraulic engineer for the BNSF Railroad Embankment Washouts, near Chillicothe, Illinois (various locations). This project focused on emergency repair and analysis of a Crow Creek flooding event which severely eroded the existing channel banks and formed a new cut-off channel immediately adjacent to an existing rail embankment. The creek was modeled in HEC-RAS with available hydrology information and at various locations where the rail embankment was damaged. Project analysis included an evaluation of the flood event to determine the cause of the damage and design of erosion control measures to prevent future damage to existing rail infrastructure. Project included the design of a rock ramp to isolate normal creek flows from the new cut-off channel. Mr. Brown is a member of the Association of State Dam Safety Officials, Illinois Society of Professional Engineers, American Society of Civil Engineers, and Illinois Association of Floodplain and Stormwater Management.

MICHAEL LAMBERT, P.E.	**Geotechnical Engineering**

Mr. Lambert is an independent consultant with more than 30 years of direct geotechnical and soil engineering experience. As a former geotechnical engineer with Shannon and Wilson, Inc., he oversaw site investigations, developed geotechnical-related design and construction recommendations, developed and reviewed project plans and specifications, and monitored compliance with project plans and specifications. He earned his M.E. in civil engineering from the University of Louisville in 1988, and is a registered PE in Missouri, Arkansas, Oregon, Tennessee, and California. Mr. Lambert has been involved with pre-construction flood risk management projects such as Howard Bend Levee, Missouri; Yakima River Levee, Washington; and the Missouri Bottom Levee System, Missouri. Post-construction flood risk management projects include St. Louis City Flood Wall Evaluation; Stockton, California,

Levee Evaluation/Design for the Department of Water Resources; Lewiston, Idaho, Levee; Chesterfield Levee, Missouri; East St. Louis Flood Protection Project, Illinois; Marine Corps Base Camp Pendleton Air Station Levee, California; City of Reedsport Levee, Oregon; and Coweeman Levee, Washington. For each of these projects, design activities were conducted in accordance with USACE methods and criteria. In addition, risk and fragility analysis concepts were considered as part of each project. Mr. Lambert is experienced with the geotechnical aspects of urban levees, floodwalls, earthen levees, and channel structures along large river systems, including the Mississippi River, Ohio River, Missouri River, and Illinois River. Relevant urban levee projects have included support for the Howard Bend Levee System in Maryland Heights, Missouri, and the City of St. Louis Floodwall along the Mississippi River. He has also performed inspections for more than 484 miles of USACE levees and over 56 miles of U.S. Bureau of Reclamation irrigation canals. His experience with floodwall design and construction is demonstrated by the Howard Bend Levee System in Maryland Heights. As senior geotechnical engineer and project manager, he was responsible for reconstruction and upgrading to provide protection from a 500-year flood event. The flood protection system included earthen levee floodwalls, closure structures, and a pump station. Engineering and design evaluations of channel structures conducted by Mr. Lambert include several locks and dams (LandD) along the Mississippi River (LandD 25 and Mel Price), and Ohio River (Olmsted, LandD 52, LandD 53, Canelton Lock, and Markland Lock). All of these projects, including the non-USACE projects, were completed in accordance with USACE guidance, including USACE's safety assurance review (SAR) policy and guidance and applicable risk assessment methodology. Mr. Lambert has served on the Type I IEPR for the Phase II Post-Authorization Decision Documents (PADD) for the Sacramento River Bank Protection Project (SRBPP), California; the Delaware River Basin Comprehensive Flood Risk Management Interim Feasibility Study and Integrated Environmental Assessment for New Jersey, New Jersey; and multiple Type II IEPR teams for levee

projects, including two projects for the Chesterfield-Monarch Levee, six projects for the Wood River Levee system, and one project for the mainline Mississippi River Levee in Tunica, Mississippi.