Dams & Hydropower
Kleinfelder understands the importance of water to our clients, communities, and families, and we deliver solutions to sustainably manage this vital resource. Our experience and success with hundreds of dams, levees, and other flood risk management structures nationwide is a direct reflection of our commitment to outstanding delivery on every project.

**Our dam and hydropower capabilities include:**

- Civil design
- Dam surveillance and monitoring
- Foundation analysis and design
- Gate and valve assessment analysis and design
- Geological and geotechnical analysis
- Hydrology and hydraulic analysis and design
- Instrumentation design
- Seepage analysis and design of filter/drainage systems
- Seismic analysis and design
- Stability analysis
- Structural analysis and design

**IN-DEPTH EXPERTISE—FROM CONCEPT THROUGH CONSTRUCTION**

Kleinfelder is a proven leader in all facets of planning, design, and construction of earthfill, rockfill, gravity concrete, and roller-compacted concrete (RCC) dams. We also have extensive capabilities for hydropower generation facilities. Furthermore, we are at the forefront of risk-based dam and levee safety methodologies with extensive dam safety experience, covering inspections, evaluations, and reporting.

**HELPING CLIENTS MANAGE RISK**

Leveraging our global technical network, we have worked on some of the largest dam rehabilitation, design, and decommissioning projects in the United States (U.S.). We provide specialized risk management services supporting the National Dam Safety Program, the National Levee Safety Program, and the U.S. Army Corps of Engineers (USACE) Risk Management Center.

**Over the past 15 years, Kleinfelder has worked on some of the world’s largest dam rehabilitation, design, and decommissioning projects.**
San Vicente Dam

The San Vicente Dam Raise Project is in the final phase of construction for the San Diego County Water Authority's (SDCWA) Emergency Storage Plan. The raised dam creates a 242,000-acre-foot capacity and includes a new spillway, a new outlet tower, and inlet structures to accommodate the higher reservoir levels.

PROJECT RESULTS

Having worked on the project since its inception 12 years ago, Kleinfelder was able to provide upgrades consistent with and tailored to the dam’s history and design. Kleinfelder’s dam knowledge and experience helped the client ensure safety and maintain quality during all phases of construction.

CHALLENGING EXISTING CONDITIONS

The project required moving massive amounts of material, including excavation of 60,000 cubic yards of rock for the dam raise and saddle foundations, placement of 10,000 cubic yards of dental concrete for the foundation footprint of both dams, and placement of 600,000 cubic yards of roller-compacted concrete (RCC). Additionally, existing Marina facilities must be improved to accommodate new reservoir levels for recreational users, including placing 700,000 cubic yards of material for new boat ramps, docks, and piers.

MULTIPLE SERVICES PROVIDED

Kleinfelder provided RCC mix design and construction administration, inspection, change management, schedule monitoring, and quality control services for the project, including startup support to assure project goals and design criteria were met. Kleinfelder’s around-the-clock, onsite materials laboratory and testing personnel provided timely and accurate testing reports that could be reviewed in realtime as construction progressed, to ensure contract compliance by the designer and state dam regulators. Kleinfelder developed a software system that transmitted testing information from each testing machine to a Tablet PC in realtime, which reduced redundancy and delivered improved, accurate information.

Location: San Diego, California

Owner: San Diego County Water Authority
Olivenhain Dam

The core of the San Diego County Water Authority’s (SDCWA) Emergency Storage Plan, this $139-million, 318-foot-high roller compacted concrete (RCC) dam—the tallest in North America—stores more than 24,000 acre-feet of water for the SDCWA and the Olivenhain Municipal Water District.

PROJECT RESULTS

Kleinfelder’s innovative laboratory test reporting and automation program made results understandable and accessible online for all design and construction team members, providing the client with a unique, time-saving, and cost-saving solution to this major dam construction project.

MOST EFFICIENT AND COST-EFFECTIVE OPTION

Kleinfelder staffed the dam project with 12 inspectors and technicians at all hours, six days a week. Besides designing the onsite laboratory, Kleinfelder provided testing and consulting in developing and qualifying the site-manufactured concrete aggregates, including gradation and quality, conducting more than 40 concrete mix designs in order to determine the most efficient and cost-effective option. Kleinfelder compiled and reported results using a state-of-the-art database system, streamlining data processing, and quality assurance evaluation.

ON-SITE LABORATORY SERVICES

The SDCWA sought a quality assurance team that could provide continuous staffing around the clock throughout this RCC dam’s construction, as well as an onsite laboratory with a reliable and experienced technical staff to provide exceptional materials testing at a high-volume rate.

Location:
San Diego County, CA

Owner:
San Diego County Water Authority
Snoqualmie Falls Hydropower Redevelopment

Puget Sound Energy’s (PSE) three-year, $200-million hydropower redevelopment project involves substantial upgrades to power-generating infrastructure and major enhancements to public recreational facilities at Snoqualmie Falls in the state of Washington. Kleinfelder provided comprehensive quality assurance and quality control services for this exceptional project in one of the Pacific Northwest’s most scenic destinations.

PROJECT RESULTS
Kleinfelder’s close collaboration with PSE’s project management, its design team, and the construction contractor moved this high-profile, complex project towards its scheduled completion in early 2013. The improvements enable PSE to continue to provide exceptional electrical service to customers while meeting its civic commitments and regulatory obligations.

COMpletely UNDERGROUND POWER HOUSE
The project includes the demolition, expansion, and rebuilding of North America’s first completely underground power house, which is a century old and uniquely accessible down a 294-foot vertical shaft. Construction work areas include tunnels, a cavern, multiple intake structures, a dam, high-pressure penstocks, and a second powerhouse located on the Snoqualmie River. Water demolition and construction required scheduling around fish closure windows, requiring some 14 seasonal and 100-year flood cofferdams.

DEVELOPING THE RIGHT SOLUTIONS
Kleinfelder monitored all construction activities to ensure adherence to design plans and specifications. Kleinfelder then consolidated all materials testing to one laboratory and incorporated project documentation directly into owner- and Kleinfelder-maintained databases. To address demanding construction schedules, lead inspectors worked day-to-day with the same construction teams, anticipating needs and developing solutions. Realtime vibration instrumentation and review of construction blasting plans during months of blasting operations maintained the serenity of public viewing areas and the destination resort located at Snoqualmie Falls.

Location:
Snoqualmie, Washington

Owner:
Puget Sound Energy
Significant federal funds were allocated for investigation and design aimed at increasing the capacity of the dam, one of California’s largest reservoirs and the most critical segment of the Sacramento region flood control system.

PROJECT RESULTS
A working partnership with USACE allowed for stable and successful excavations of lake-bottom sediments, construction debris, and rock. Kleinfelder’s thorough analyses provided the client with an accurate understanding of project conditions, avoiding changed conditions claims and costly project expenses.

MULTIPLE STAKEHOLDERS INVOLVED
Increasing the dam’s discharge and storage capacity would involve two phases: increasing outlet flows and elevating the crest heights of eight dikes around the lake’s perimeter. For the first phase, the existing outlets from the dam face would have to be dredged to create greater flow volume. Temporary bulkheads would be placed over the inlets on the lakeside of the dam, requiring excavation of accumulated lake-bottom sediments approximately 20-30 feet below the existing mudline.

BETTER MOBILITY AND HEALTHIER ENVIRONMENT
Kleinfelder’s performance on this project included detailed data compilation and presentation, slope stability analyses involving drilling in more than 200 feet of water, geotechnical and environmental borings, research of mid-century geologic investigation records, permit assessment, subcontractor procurement, laboratory testing, analysis, and report documentation, in addition to spill prevention and worker safety procedures. 2-D and 3-D graphical models helped accurately characterize lake-bottom conditions, identifying undredgeable areas and preventing severe project delays.

Location:
Sacramento, California

Owner:
U.S. Army Corps of Engineers (USACE)
Condit Dam

Located in the state of Washington, this is the second largest dam to be decommissioned in the United States. Completed in 1913, the 471-foot-long, 125-foot-high gravity dam provided electrical power for local industry. As owner’s engineer, Kleinfelder led a multi-disciplinary effort to complete this high-profile dam removal project on schedule in December 2012.

PROJECT RESULTS
Stringent project and construction management strategies kept this project on schedule. Kleinfelder’s responsiveness and technical diversity enabled the utility to respond effectively to unanticipated events and maintain compliance with permit requirements. Use of the flowline saved money, and the soil nail wall enabled the utility to keep the bridge open, satisfying needs of surrounding communities.

STRINGENT REGULATORY REQUIREMENTS
The project’s tight schedule was driven by stringent regulatory requirements from various agencies. Pre-breach work included blasting a 90-foot long drain tunnel through the dam, replacing a city waterline, and replacing foundations of a bridge. Post-breach work included managing former reservoir sediments, removing the dam and related facilities, disposing of 30,000 cubic yards of concrete debris, and restoring and revegetating the stream corridor.

TIMELY AND ENVIRONMENTALLY RESPONSIBLE SOLUTIONS
Initial work included reservoir sediment characterization and preparing decommissioning plans and specifications, permit submittals, and post-decommissioning management plans. Kleinfelder provided preliminary design of a replacement waterline and protection measures for a bridge foundation. Kleinfelder also prepared the Environmental Monitoring Plan to provide guidance for water and sediment quality monitoring during post-decommissioning recovery of the nearby river. Kleinfelder proposed innovative solutions, including a flowline to dispose concrete demolition rubble and a soil nail wall to stabilize an exposed bridge abutment.

Location:
Washington State

Owner:
Prominent Western U.S. Utility
Lake Isabella Dam

Constructed in 1953, Lake Isabella Dam consists of two primary embankment dams located on the Kern River east of Bakersfield, California. With severe seepage and seismic deficiencies, the dam is one of the highest-risk dams among the U.S. Army Corps of Engineers’ (USACE) inventory of more than 600 U.S. dams.

PROJECT RESULTS

Since 2009, Kleinfelder has provided continuity to the project while helping the USACE meet an accelerated schedule in a demanding, changing regulatory environment. Kleinfelder assisted the USACE in identifying Potential Failure Modes, helping to rank each on the basis of risk and consequence in order to prioritize critical path rehabilitation concepts.

REEXAMINING REGULATIONS

A dam breach related to seepage and seismic deficiencies could result in significant downstream flood inundation that would affect people and properties in less than four hours. The USACE Sacramento District is evaluating these deficiencies and developing solutions for rehabilitating the dam while addressing new and changing pre-existing risk-informed regulatory guidelines. Recommendations for dam rehabilitation were submitted in late 2011.

INVESTIGATION AND IMPROVEMENT

As a member of a joint venture team, Kleinfelder assisted the USACE with site investigations, site characterization, structural performance monitoring, and seepage and seismic analysis. Kleinfelder performed geologic and dam safety investigations, as well as seepage modeling and performance-based calibration of the seepage model. Working closely with joint venture partners and the USACE, Kleinfelder helped the USACE meet the new risk-based requirements using cutting-edge risk analyses processes to redesign and modify recommendations where needed.

Location:
Kern County, California

Owner:
U.S. Army Corps of Engineers (USACE), Sacramento District
San Pablo Dam Construction Management

The largest cement deep soil mixing (CDSM) project in North America, this project required installing a remote monitoring survey system, removing a 140,000-cubic-yard buttress, installing 137,000 cubic yards of CDSM to maximum depths of 118 feet (average depth approximately 80 feet), and replacing a new buttress (approximately 280,000 cubic yards).

PROJECT RESULTS
Kleinfelder’s oversight saved the client several million dollars in construction costs and avoided the significant environmental impacts associated with draining the dam’s reservoir to build a temporary pipeline. In addition, the Kleinfelder team saved water during a time of drought.

SUSCEPTIBLE TERRAIN, SIGNIFICANT RISK
A study commissioned by the East Bay Municipal Utility District (EBMUD), in coordination with the California Division of Safety of Dams (DSOD), confirmed that the soils and foundation that make up the dam are susceptible to liquefaction. The study predicted that a magnitude 7.5 earthquake on the Hayward fault would cause the dam to slump and decrease in height sufficiently to allow water to flow over the top, resulting in a breach of the dam and flooding downstream.

COLLABORATIVE SERVICE AND SOLUTIONS
Kleinfelder was selected to provide construction management services for this two-year-long project valued at $54.6 million. Our team was pivotal in achieving the project’s milestones and in maintaining the working relationships between the owner, design engineer, contractors, and agencies. Kleinfelder also provided EBMUD-associated project control support, quality assurance services, environmental/safety compliance monitoring, and assistance in addressing operational constraints in and around an active earth embankment dam and recreation area.

Location:
Contra Costa County, California

Owner:
East Bay Municipal Utility District (EBMUD)
Architects. Engineers. Scientists.

Kleinfelder is a team of architects, engineers, and scientists working together to meet the world's most complex infrastructure challenges. Leveraging our global technical network of resources and expertise, we partner with clients to deliver leading-edge solutions for every project, at any location on the planet.

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