DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT, CORPS OF ENGINEERS
700 FEDERAL BUILDING
KANSAS CITY, MISSOURI 64106-2896

EXECUTIVE SUMMARY

In accordance with the National Environmental Policy Act (NEPA), the U.S. Army Corps of Engineers (Corps/USACE), Kansas City District has prepared a Final Evaluation Report and Final Environmental Impact Statement, dated July 2002, for the Tuttle Creek Dam Safety Assurance Program, Big Blue River, Kansas. Based on the current engineering knowledge, Tuttle Creek Dam was found deficient with respect to: seismic stability; hydrologic adequacy, and spillway gate reliability.

This study considers the environmental impacts of proposed alternatives identified to address seismic issues associated with the Tuttle Creek Dam. In addition, NEPA evaluations of the minor measures proposed to address hydrologic adequacy spillway gate reliability are addressed in these documents. The U.S. Environmental Protection Agency-Region VII is serving as a Cooperating Agency for this study.

Tuttle Creek Lake is located in Riley and Pottawatomie Counties on the Big Blue River just upstream from the City of Manhattan, Kansas. Tuttle Creek Lake was constructed and is operated by the U.S. Army Corps of Engineers, Kansas City District as a multipurpose lake project. The Congressionally authorized project purposes include: recreation; fish and wildlife; navigation; water supply; water quality; and flood control. Tuttle Creek Lake covers approximately 12,500 surface acres at the multipurpose pool elevation of 1,075 feet, mean sea level. The total for the lake and surrounding Corps lands is 33,574 acres.

As part of the Corps' ongoing Dam Safety Assurance Program, the Tuttle Creek dam was evaluated for adequacy considering the design earthquake (Maximum Credible Earthquake, moment magnitude 6.6 at 20 km from the site). The design earthquake is capable of inducing liquefaction of the foundation sands, failure of the embankment slopes, significant deformation of the entire embankment, and probable release of the lake within 2 to 6 hours.

A 5.7 magnitude earthquake could induce limited liquefaction beneath the downstream toe, and damage to the relief wells due to slope deformation. With the loss of the relief wells, uncontrolled release of the pool initiated by piping through the foundation could occur.

A damaging earthquake in the 5.7 to 6.6 magnitude range that could impact Tuttle Creek Dam would most likely originate from the Humboldt Fault Zone, near Wamego, Kansas. Based on the probability of the corresponding peak ground acceleration occurrence, the 6.6 magnitude earthquake is the largest possible

earthquake that believed to be possible and the approximate return period of the 5.7 magnitude earthquake 1800-years.

The consequences of dam breach would include the loss of the function of the project, loss of all project benefits, extensive downstream damage, and high potential for loss of life. As compared to a flooding induced dam failure, additional damages and a higher potential for loss of life would be expected from a seismic breach due of the lack of warning time and the high probability foundation liquefaction and failure of the City of Manhattan owned levee system during the same seismic event that would cause failure of Tuttle Creek Dam.

Although the probability of earthquakes of this magnitude occurring in the Tuttle Creek Lake area is extremely low, Corps regulations require that all dams "are required to survive and remain safe during and following a Maximum Credible Earthquake event". In addition, Corps regulations require that the dam "must be capable of remaining operational with only minor repair during and after an Operating Basis Earthquake (4.9 magnitude for Tuttle Creek Dam)." Corps' regulations further require that "seismic safety of USACE embankment dams, where failure would result in loss of life, must be assured". These documents describe the existing conditions at Tuttle Creek Lake, potential alternatives that would address the seismic stability issue and their environmental impact.

The Corps' Notice of Intent to prepare an Environmental Impact Statement was published in the Federal Register on July 11, 2000. The Corps scoping process was conducted during the spring/summer of 2001 and included meetings with local, state and Federal agencies, organizations and the general public. On May 14, 2001, the Corps held a public information/scoping meeting, attended by over 400 members of the public and agency representatives, at Manhattan, Kansas to present information on the study and receive input from the public on resources in the affected area, alternatives and potential impacts. Comments were solicited from the public at this initial meeting and accepted through a comment period, which closed on July 1, 2001.

The following categories of alternatives were considered for seismic retrofit:

- No Action
- Partial Correction: foundation seepage cutoff; enhanced underseepage control system; enhanced emergency action planning; restricted lake operation; enhanced drainage capacity.
- Complete Correction: reinforce embankment with (with piles; with anchors); stabilize foundation soil (removal and replacement of liquefiable material; dynamic compaction; vibrofloation; jet grouting; soil mixing; stone columns; gravel drains); enlarge embankment (berm upstream; berm downstream; buttress downstream).
- Breach Embankment.
- Replace Embankment.

Five alternatives are discussed in detail in the FEvR/FEIS. These alternatives include: the "No Action" Alternative; Restricted Lake Operation; Stabilize Foundation Soil with Drawdown; Stabilize Foundation Soil without Drawdown; and Enlarge Embankment. These documents identify Stabilize Foundation Soil without Drawdown as the Corps' Preferred Alternative. The resources in the project area and potential environmental impacts associated with each of these alternatives are discussed in the Final Environmental Impact Statement and the Final Evaluation Report. These documents also discuss the minor measures needed to ensure satisfactory performance of the dam and spillway during a major flood, and an interim measure proposed to enhance public safety.

Seismic Stability

Upstream Slope: Soil stabilization (Jet Grouting) of the liquefiable foundation silty clays and sands through pre-drilled holes through the embankment. The work will be performed from a working platform constructed on the upstream face of the dam. A portion of the soil stabilization will be extended to foundation rock to form a seepage cutoff.

Downstream Slope: Soil stabilization (Deep Soil Mixing) of the liquefiable foundation silty clays and sands after temporary removal of the existing downstream berm.

The current technologies of Jet Grouting and Deep Soil Mixing are proposed, however, as technologies improve and develop, adjustments to the exact nature of the soil stabilization equipment, techniques, and admixtures may be made. It may also be possible that the either technology may be used both upstream and downstream to avoid weather and pool related delays.

The implementation of soil stabilization would include conducting additional exploratory borings and soil testing, a test drilling program through the embankment, a soil stabilization technology demonstration during design and replacement of upstream slope protection due to construction damage and disturbance.

Interim Risk Management

As an interim measure to enhance downstream community safety before and during construction, a dam failure warning system is proposed for installation as soon as possible. The system would be tied to automated instrumentation on, in, and below the dam. The system would provide warning for the area from the dam to the confluence of the Big Blue and Kansas Rivers where the highest population density and lowest warning times exist. Coordination with local authorities in development of an evacuation plan for the area covered by the warning system would also be undertaken.

Hydrologic Adequacy

Assuming that the spillway gates are fully reliable, re-analyses of the Probable Maximum Flood indicates that the static pool would be within 2.2 feet of the crest of the dam. Wave action of 4.6 feet could be experienced at the maximum pool level during a Probable Maximum Flood event. Therefore, wave action could overtop the dam by 2.4 feet. The installation of concrete traffic barriers in place of the upstream guardrail to withstand wave action is recommended.

Tainter Gate Reliability

The original spillway gate design did not fully consider friction in the bearings for all of the appropriate load cases. Reanalysis of the gates indicates that the gate structure is not adequate under all loading conditions. The inability to open two gates would result in overtopping of the dam during a Probable Maximum Flood. In order to ensure the ability to safely pass these flows and avoid overtopping of the dam by the static pool, the structural integrity of the spillway gates must be ensured. As such, general spillway and spillway gate modification are critical to the safety of the dam.

Implementation

The anticipated implementation time for the alternative components summarized above is anticipated to be from seven to ten years. The Total Project Cost of all aspects of the preferred alternative is approximately $206 million including engineering, planning, design, construction, implementation, oversight, management and lands and damages. This estimate increased from $195 million in the Draft Evaluation Report and Draft Environmental Impact Statement based on the inclusion of revised rates for ground modification equipment and the inclusion of the appropriate quality control measures.

The Draft Evaluation Report and Draft Environmental Impact Statement were released to the public on April 16, 2002 and comments were accepted until June 10, 2002. A community meeting on the Draft Evaluation Report and Draft Environmental Impact Statement was held in Manhattan, Kansas on Thursday, May 2, 2002. Written comments on the FevR/FEIS can be mailed to U.S. Army Corps of Engineers, 601 E. 12th Street, Kansas City, MO 64106, ATTN: Bill Empson, EC-GD. Comments can also be provided via e-mail at tcdam.nwk@usace.army.mil. Copies of the FEvR/FEIS may be requested from the address listed above or viewed on the Tuttle Creek Dam Safety Assurance Program website at http:/www.nwk.usace.army.mil/tcdam. Copies of the FEvR/FEIS may be viewed on the above listed web page, at local Corps' offices including Tuttle Creek, or at community libraries in the project area. For further information concerning the TCDSAP or the FEvR/FEIS, you should contact William B. Empson, P.E., Project Manager for the Tuttle Creek Dam Safety Assurance Study at the above address or by telephone at 816-983-3556.