“Don’t You Know Step-by-Step”
A three phase dam safety compliance exercise for Koko Lago in East Central Texas

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Background

• Dam inspected by TCEQ in 2009.
• Identified Routine maintenance items
• Questioned hazard classification due to downstream crossings and structures
• Required the Owner to provide a hydraulic adequacy study, O&M, and EAP
• Owner retained Consultant to address requirements

Pertinent Dam Information(s) – Koko Lago

• Classified as a Small-Significant Hazard Dam – required to pass 50% of PMF
• Earthen embankment dam – height = 30 ft above toe and 10 ft above conservation pool
• Conservation Pool storage – 290 AF
• Top of dam storage – 600 AF
• Primary spillway – 9’x9’ drop structure 7’x6’ RCB outlet
• Emergency spillway – 225 ft trapezoidal earthen cut – crest = 3 ft above conservation pool
Downstream Conditions

- Concerned with overtopping of FM Road – 1 mi downstream
- Concerned with impact on downstream lake – Pina Colada (7,500 AF)
- Concerned with impact to houses and structures surrounding Pina Colada
- Hazard classification was in question

Koko Lago – Drainage Area

Step 1: Analysis

- PMF Development to determine % passing
- HMR52 to develop PMP for contributing basin and downstream lateral inflows (used to ratio the total PMP depth - total area > 10 sqmi
- Developed an independent rating curve for both primary and emergency spillways
- SCS hydrologic methods using HECHMS
Step 1 Continued

- Critical storm duration analysis using distributions outlined in TCEQ criteria
- Applied by analyzing multiple duration storm events (1-hour through 6-hour)
- Downstream study points at FM road crossing and Pina Colada Lake Dam

![Temporal Rainfall Distributions](image_url)

Hydrologic Soil Groups – AMC-III CN

![Hydrologic Soil Groups – AMC-III CN](image_url)
Hydrologic Results – 70 % Passing!

<table>
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<th>Duration (hr)</th>
<th>A10</th>
<th>A20</th>
<th>A30</th>
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Critical Storm Duration Summary

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<th>Duration (hr)</th>
<th>Inflow (cfs)</th>
<th>Outflow (cfs)</th>
<th>Stage (ft)</th>
<th>Storage (acre-ft)</th>
<th>Time of Peak</th>
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<td>26,671</td>
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Step 1: Breach Analysis

- HECRAS Unsteady
- Cross Sections developed to maximize storage
- Cross Sections modified upstream of dam to reflect storage below conservation pool
- Incorporated culvert routine at FM crossing
- Downstream boundary condition – Rating Curve at Pina Colada dam

Breach Scenarios

- Full PMF Breach and Non-Breach Events
- Barely Overtopping
- Sunny Day – Dry Weather Breach
Breach Results

- Negligible water surface elevation difference between breach and non-breach events below FM crossing along Pina Colada Lake.
- FM crossing passed the sunny-day breach event w/o overtopping.
- Barely Overtopping breach produced a 1.1 ft difference between the breach and non-breach events – 6 ft over the road!
- No Structures located in breach zone

Barley Overtopping Profile

Barley Overtopping Inundation
Step 1: Conclusions

• TCEQ also required the adoption and implementation of a formal Operations and Maintenance Manual.
• TCEQ determined that an EAP is required because of the barely-overtopping impact at the FM road crossing.

Step 2: Operations and Maintenance

• Operations pertain primarily to the bi-annual inspections
• No mechanical features other than a valve release.
• Maintenance pertains primarily to controlling vegetation and erosion issues along the embankment.

Inspection

• To coincide with bi-annual mowing in May and September
• To be conducted after any extreme event: engagement of the emergency spillway, overtopping, or hurricane/tornado
• Conducted by Owner and Designated Individual
• Qualitative to note anything unusual with the dam
• Animal borrows and controlling fire ants seemed to be the primary concern
Inspection Continued

- Noting unusual slumping or sloughing of the embankment
- Noting any desiccation cracking in the embankment
- Noting movement of the embankment
- Monitoring benching erosion caused by waves
- Noting any erosion rills along the embankment

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Inspection Continued

- Noting any seepage or sand boils
- Noting any evidence of overtopping
- Noting any trees less than 4 inches in diameter
- Noting any brush piles or debris in the emergency spillway overflow area
- Downstream investigation – periodically checking to make sure no new structures are present. Checking for obstructions in FM Culvert

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Step 3: Emergency Action Plan

- Used TCEQ sample for small dams
- Notification flow chart with contact information for all key individuals
- Activation level based on situational phase
- Recognition that primary failure risk is overtopping
- Initially researched and included contact information for downstream property owners, but elected to remove for simplicity.
- Concerned primarily with the closure of the FM road during a Barely-Overtopping breach event
Notification Chart

EAP Phases

- Non-Failure Concern
- Potential Failure
- Imminent Failure
- Sample messages
- Coordination with County Emergency Coordinator who will coordinate with Sheriff and DOT

Questions?

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