CAASLE Project, Phase II

Presented by
Michael McClendon - Upper Basin Regional Manager
&
Stewart Vaghti P.E. - Gannett Fleming Inc.
Goal - Extend the Service Life
Phased Approach

Phase I: Targeted & Credible Investigation Program

Phase II: Execute Targeted & Credible Investigation Program

Phase III: Investigation & Testing Analysis

Phase IV: Risk Reduction Analysis; Remediation Plans and Recommendations
Scope Outline Flowchart

Record Documents & Previous Studies

Data Review
- Cataloging, bookmarking and/or hyperlinking

Initial STID Update

Simplified Structural Evaluation

PFMA Review & SQRA Workshop
- PFMA Review (Internal)
- Workshop
- Report

Investigation and Testing Plans

Execution Investigation and Testing Program

Investigation and Testing Analysis

Structural Reevaluation

PFMA/SQRA Reassessment

Risk Reduction Analysis/Repair Program
- Alternative Evaluation
- Prioritization
- Remediation Plan(s)

Supplemental Investigation and/or Analysis

Phases:
- Phase I
- Phase II
- Phase III
- Phase IV
Scope of Services

Phase I: Targeted and Credible Investigation Program

Task 1: Site Visit, Data Collection; Document Review – Completed
Task 2: Simplified Structural Evaluation – Completed
Task 3: Potential Failure Mode Analysis – Completed
Task 4: Supporting Technical Information Update – Completed
Task 5: Preparation of Investigation and Testing Plan(s) – Completed
Task 6: Phase II Scoping Development - Completed
SQRA f-N Chart

- What is it?
- What were findings?
- How will it be used?
Scope of Services

Phase II: Execute Investigation & Testing Program

**Goal** – Investigate the concrete and reinforcing conditions related to higher-risk potential failure modes identified in Phase I – *Guide decision making to achieve a longer service life*

**Result** – Assist BRA in prioritizing preventative maintenance, repairs, and/or modifications to extend Morris Sheppard Dam’s service life

**Phase II Schedule** – Approximately 18 weeks

**Overview of Tasks/Testing** – Stewart Vaghti P.E. – Gannett Fleming Inc.
**Priority Features**

**FEATURE SUMMARY**
- Intake Tower
- Hearth
- Gate
- Buttress
- Cutoff Wall
- Corbels
- Slabs
- Foundation Related

**INITIATOR SUMMARY**
- Rim Instability
- Scour/Erosion
- Concrete Deterioration
- Structural Inadequacy
- Foundation/Instability

**Meeting Date:** January 27, 2020
Investigation Areas

Legend

- NDE Areas (downstream Bays)
  - Acoustic
  - GPR
Meeting Date: January 27, 2020

Bay 1 Corbel

Active Delamination

Previous Corbel Repair

Elevation
Seepage Collection Pipe

Collapsed Concrete Pipe

Deteriorated Concrete

Buttress

Tailwater

Approximate Tailwater

4 upstream
8 downstream
Concrete Ballast Block

Gravel

Relief Wells

Upstream Slab Crack/Feature

Hearth Spillway Stabilization/Extension
Active Delamination
Concrete Coring

Legend
- Upstream Cores
- Downstream Cores

- 27 upstream
- 23 downstream
- 50 total

- 11 slab
- 39 buttress/corbels
- 50 total

Bay 1
- 4 Compressive
- 4 Tensile
- 4 Unit weight
- 5 Petro
- 15 Chloride
- 15 Sulfur

Bay 2
- 3 Compressive
- 3 Tensile
- 3 Unit weight
- 4 Petro
- 12 Chloride
- 12 Sulfur

Bay 24
- 3 Compressive
- 3 Tensile
- 3 Unit weight
- 4 Petro
- 12 Chloride
- 12 Sulfur

Bay 31
- 5 Compressive
- 5 Tensile
- 5 Unit weight
- 7 Petro
- 18 Chloride
- 18 Sulfur

Approximate Tailwater

- Bay 1: 6 upstream, 4 downstream
- Bay 2: 3 upstream, 7 downstream
- Bay 24: 9 upstream, 8 downstream
- Bay 31: 9 upstream, 4 downstream

20 Existing Cores (Gate 2 Intermediate Piers)

- 22 Normally Dry
- 9 Shallow Submergence (Upstream)
- 12 Submerged (Upstream at Sediment Depth)
- 3 Submerged (Tailwater)
- 4 Wetted Zone (Tailwater)

- 3 Compressive
- 3 Tensile
- 3 Unit weight
- 7 Petro
- 18 Chloride
- 18 Sulfur

- 3 Compressive
- 3 Tensile
- 3 Unit weight
- 12 Chloride
- 12 Sulfur
<table>
<thead>
<tr>
<th>Test(s)</th>
<th>Qty</th>
<th>Sample Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrographic Exam. (ASTM C856) w/ SEM (ASTM C1723)</td>
<td>21¹</td>
<td>6&quot; dia, 12&quot; long (min)</td>
</tr>
<tr>
<td>Chem. analysis for chloride (ASTM C1152)</td>
<td>58¹</td>
<td>petro core (outer, mid &amp; inner core)</td>
</tr>
<tr>
<td>Chem. analysis for total sulfur content (LECO) (ASTM C114)</td>
<td>58¹</td>
<td>petro core (outer, mid &amp; inner core)</td>
</tr>
<tr>
<td>Compressive Strength (ASTM C39)</td>
<td>16²</td>
<td>6&quot; dia, 12&quot; long (min)</td>
</tr>
<tr>
<td>Splitting Tensile Strength (ASTM C496)</td>
<td>16³</td>
<td>6&quot; dia, 12&quot; long (min)</td>
</tr>
<tr>
<td>Formation Factor of Concrete test</td>
<td>6⁴</td>
<td>6&quot; dia, 12&quot; long (min)</td>
</tr>
</tbody>
</table>

¹One core will be used for each petrographic analysis (ASTM C856 w/ SEM ASTM C1723) and chloride (ASTM C1152) and sulfur content analysis (ASTM C114); rebar samples to be extracted from this core.
²One core will be used for each Compressive Strength test (ASTM C39)
³One core will be used for each Tensile Strength Test (ASTM C496)
⁴One core will be used for each Formation Factor test.
Testing Methods

- 15 Non-Destructive Tests Evaluated
- 7 Destructive Tests Evaluated
## Feasibility/Execution

### Feasibility Assessment Summary

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SPRAT</td>
</tr>
<tr>
<td>1</td>
<td>High Resolution Imaging (HRI)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Ultrasonic Tomography (UTMA)</td>
<td>P</td>
</tr>
<tr>
<td>3</td>
<td>Impact Echo (IE)</td>
<td>P</td>
</tr>
<tr>
<td>4</td>
<td>Ultrasonic Pulse Velocity (UPV)</td>
<td>P</td>
</tr>
<tr>
<td>5</td>
<td>Ground Penetrating Radar (GPR)</td>
<td>P</td>
</tr>
<tr>
<td>6</td>
<td>Concrete Core Extraction</td>
<td>P</td>
</tr>
</tbody>
</table>

**Legend:**
- P = Preferred Method
- A = Alternate Method
- N = Not Applicable

### Non-Destructive Evaluation Methods

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High Resolution Imaging (HRI)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Ultrasonic Tomography (UTMA)</td>
<td>P</td>
</tr>
<tr>
<td>3</td>
<td>Impact Echo (IE)</td>
<td>P</td>
</tr>
<tr>
<td>4</td>
<td>Ultrasonic Pulse Velocity (UPV)</td>
<td>P</td>
</tr>
<tr>
<td>5</td>
<td>Ground Penetrating Radar (GPR)</td>
<td>P</td>
</tr>
</tbody>
</table>

**Legend:**
- P = Preferred Method
- A = Alternate Method
- N = Not Applicable
Goal

Service Life Extension

Service Life Extension

Preventive maintenance

Essential maintenance

Reliability Index $\beta$

$\beta_0$

without maintenance

Target Reliability

$T^*$

$T^*_P$

$T^*_{P+E}$

Time $t$
The following resolution is presented for consideration to the Board of Directors of the Brazos River Authority for adoption at its January 27, 2020 meeting:

“BE IT RESOLVED that the Board of Directors of the Brazos River Authority hereby authorizes the General Manager/CEO to amend the contract with Gannett Fleming Inc. to perform Phase II engineering services at Morris Sheppard Dam in an amount not exceed $964,000.”