Geosyntec consultants

Dam Assessment and Management Tool Pilot Project

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DAM DASHBOARD
Dam Assessment and Management Tool
Outline

• Introduction
• Pilot Project Summary
• Next Steps
Introduction

- Management of passive infrastructure such as small dams is often based on rough estimates and professional judgement of system response.
• Poor management can lead to unintended downstream (or upstream) consequences.

Low Flow (Image Credit)  

Bank Erosion (Image Credit)
Introduction

- Better data and decision support tools are needed to meet competing goals.

- Storm Resiliency
- Streamflow
- Ecological Management
- Permit Compliance
- Recreation
• Establish an information network for dams and other infrastructure.

• Combine real-time data, forecasts, and model predictions to provide recommended management actions to optimize system operations.

As climate change increases the frequency and intensity of extreme weather, it becomes increasingly important for water suppliers to manage dams as climate resiliency assets rather than liabilities.
Anticipated Applications / Benefits

**Water Supply**
- Permit Requirements (e.g., SWMI, WMA)
- Improve streamflow

**Lake Management**
- Drawdown compliance
- Wetland permit compliance

**Other (e.g., Flood Control Structures)**
- Decision support to reduce flood damage risk
- Protect stream ecology
• Technical Approach

• Three Pilot Sites
  1. Pratt Pond – Upton, MA (Town DPW)
  2. Spectacle Pond – Littleton, MA (Public Water Supplier)
  3. Forge Pond – Westford, MA (Lake Association)
Site Identification

Pratt Pond

Dam
Field Reconnaissance
• **Primary Parameters:**
  – Inflow, Outflow, Stage-Storage

Controllable Volume (Bottom to Top of Weir)

\[ \text{Volume} = 40.661 \cdot (Elevation) - 11,742 \]
Instrumentation

Solar Panel and Communications Enclosure

Monitoring Probe
Installation

- Upstream Junction Box, Stilling Well, and Monitoring Probe
- Solar Panel
- Junction Box
- Stilling Well
- Monitoring Probe (Submerged)

Flow Direction
Dashboard Demonstration
• Annual Drawdown Discharge Compliance Monitoring (Forge Pond)
• Beaver Detection (Spectacle Pond):

What is the Water Level Downstream of the Pond?
This chart shows a continuous time series of measured water level downstream of the pond.
12hr | 24hr | 48hr | 72hr

- Beaver Dam at Outlet
- Outflow Down to a Trickle

[Graph showing water level changes over time]
• Pratt Pond Response to 3-inch+ of Rainfall (10/30/2017):

[Graph showing water level changes over time with a peak at 20 CFS on a small flashboard outlet]
**Pratt Pond Storm Predictions (10/28/2017)**

- **Duration**: 15 hours
- **Average Discharge**: 26.5 cfs
- **Total Outflow (Approx.)**: 32.8 ac-ft

<table>
<thead>
<tr>
<th>48-hr Storm Predictions</th>
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<tr>
<td><strong>Forecasted Rainfall (in)</strong></td>
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<td>10/28/2017 21:59</td>
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<td><strong>Estimated Inflow (ac-ft)</strong></td>
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<td><strong>Available Storage - Normal (ac-ft)</strong></td>
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<td>10/28/2017 21:58</td>
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<td><strong>Available Storage - Drawdown (ac-ft)</strong></td>
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<td>10/28/2017 21:58</td>
<td>-21.4</td>
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<td><strong>Available Storage - Maximum (ac-ft)</strong></td>
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<tr>
<td>10/28/2017 21:58</td>
<td>73.3</td>
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</tbody>
</table>

- **Actual Rainfall**: 3-inches+
- **Actual Inflow**: 50 ac-ft
- **Actual Storage Increase**: +17.7 ac-ft (5-inches in stage)
Winter Drawdown Upstream (Pratt Pond):

Flashboard Removed

3 Days to Reach Equilibrium

27 ac-ft released (~9 Million gallons)
• Winter Drawdown Downstream (Pratt Pond):

What is the Water Level Downstream of the Pond?
This chart shows a continuous time-series of measured water level downstream of the pond.

Flashboard Removed
Downstream Increase of 0.5 ft.

Discharge at Start = 10 cfs
Peak Discharge = 20 cfs
• **Diurnal Battery Voltage**

What is the Battery Voltage of the Upstream and Downstream Monitoring Station?

This chart shows a continuous time-series of battery voltage at the upstream and downstream monitoring stations (Note: systems will go offline at voltages below approximately 11.75 V)

- 12hr
- 24hr
- 48hr
- 1wk

- **11/24/2017 08:24**
  - Upstream Battery Voltage 13.28 V

• **Water Temperature (Forge Pond)**

- **08/27/2017 15:04**
  - Upstream Temperature 75.77 °F
  - Downstream Temperature 75.7 °F
What’s Next?

• Continue Monitoring Existing Sites

• Expand DAM Dashboard Network

• Implement Improvements
  – Automated Reporting
  – Improve Forecast Based Alerting
  – Decision Support
DAM Dashboard 2.0 Project Design

1. Install Instrumentation
2. Collect Data for Calibration
3. Engage Stakeholders in Goal Setting Process
4. Develop Calibrated Existing Conditions Model
5. Test Potential Operational Strategies
6. Provide Decision Support Tools and Dashboard
• **Purpose**
  – Assess opportunities for improvement of streamflow
  – Determine if *coordinated releases* can be made to improve the timing, magnitude, and duration of downstream flows to *mimic natural conditions* without compromising other in-lake uses (e.g., significant impacts to water supply, recreation, or ecology).

• **Anticipated Outcomes**
  – Calibrated Regional Surface Water Model
  – Operational Goals for 6 Impoundments
  – Expanded Streamflow Monitoring Network
  – Recommended Operational Strategies
  – Dashboard with Alerts to Track Success of Recommendations
Flow Thresholds – Forge Pond

Abott Mill Dam Evaluation Thresholds

High Range
Normal Range
Low Range

10 Year Low Flow
2 Year Low Flow
Unimpacted Streamflow (Aug)
Median August Streamflow
Refill Flow Limit (0.5 cfs/m)
Aquatic Baseflow (0.5 cfs/m)
Fish Friendly Flow (1 cfs/m)
Fish Friendly Flow (4 cfs/m)
Drawdown Flow Limit (4 cfs/m)
2 Year Peak Flow

Streamflow (cfs)
Water Level Thresholds – Forge Pond

(Upstream – Pond)

- High Level Range
- Normal Level Range
- Low Level Range
- Winter Drawdown El. = 200.7’ (Appx. 3’ drop)
- Recreation Issues – TBD (Appx. 202.5’)
- Spillway Elevation = 203.7’
- Dam/Outlet Elevation = 203.7’
- TBD (Appx. 204.5’)

(Downstream – Channel)

- High Flow Range
- Normal Flow Range
- Low Flow Range
- 94-cfs (4 cfsm)
- 12-cfs (Aquatic Base Flow – 0.5 cfsm)
- Winter Drawdown El. = 200.7’ (Appx. 3’ drop)
- Dam/Outlet Elevation = 203.7’