



Geotechnical
Environmental
Water Resources
Ecological

April 6, 2010
Project 06463-1

Mr. Stephen E. Cotton
Foster's Pond Corporation
19 Pomeroy Road
Andover, MA 01810

Dear: Mr. Cotton:

**Re: Site Visit Observations and Preliminary Recommendations
Fosters Pond Dam, NID # MA00153
Andover, Massachusetts**

This letter report describes our site visit observations of Fosters Pond Dam located in Andover, Massachusetts made on April 2, 2010. We also provide preliminary recommendations based on these observations. The site visit was conducted on May 8, 2008 by R. Lee Wooten, P.E., of GEI Consultants, Inc. of Woburn, Massachusetts.

Fosters Pond Dam is classified as an intermediate size, significant (Class II) hazard potential dam. The hazard potential rating is significant because of the presence of Rattlesnake Hill Road immediately below the dam. Rattlesnake Hill Road is a lightly travelled, two-lane suburban neighborhood road.

We conducted the site visit at your request because of your observations of degradation to the dam following the recent heavy rain events which occurred prior to and during the week of March 28, 2010. We previously conducted a Phase I inspection of the dam on November 10, 2006 and a follow-up inspection on May 8, 2008 documenting maintenance that the Foster's Pond Corporation conducted. We found that the dam was in Poor condition at the time of the 2006 Phase I inspection and in Satisfactory condition on May 8, 2008.

Observations and Evaluations

April 2, 2010 Site Visit by Lee Wooten

We observed the following conditions or deficiencies of concern during our April 2, 2010 site visit. The attached site plan (Figure 1) shows the dam layout and the location of the referenced photos.

- Seepage was flowing at the base of the downstream unmortared masonry wall below and to the southwest or left (for an observer facing downstream) of the main spillway (see Photos 1 and 2). We had observed flow in this area during our previous site visits. The observed flow rate was several gallons per minute. You noted that this flow rate had increased following each of the recent rain events.

- Several sink holes have formed on the crest of the left / southwest embankment of the dam immediately adjacent to the mortared masonry wingwall (see Photos 3 & 4). The deepest sinkhole was at least 3.5 feet deep. The sinkholes extended through the upper embankment soil which appeared to consist of sandy silt / silty sand. You noted that these sinkholes appeared following the rain events of the past week.
- The mortared masonry blocks of the upstream part of the left spillway wingwall have moved out (away from the embankment) and have gaps of up to about ¾ inch at joints between the masonry blocks (see Photo 5). The movement may be the result of frost action pushing on the wingwall.

We did not observe similar conditions on the right embankment or other conditions of concern. However, these observed conditions indicated that internal erosion has taken place in the embankment. We expect that the rains and higher pond levels have caused flow through the wingwall and upstream parts of the embankment which have eroded soil material through the open masonry of the downstream wall. This process of internal erosion is likely to continue, especially when the pond is high, and may result in a breach of the dam.

April 5, 2010 Site Visit by Steve Cotton

We understand that you visited the site on April 5, 2010 and observed the crest of the concrete spillway after the pond level had dropped below the crest (see Photos 6, 7, and 8). You observed at least two holes in the concrete crest cover opening into voids that extended 1 to 2 feet into the crest structure. The voids appeared to be formed in a cobble, gravel and soil matrix.

Recommendations

We recommend the following actions be taken to address the deficiencies observed at the dam during this inspection and evaluation:

- Continue to lower the pond by keeping the sluiceway open. Do not raise the pond as is your usual practice for the summer months.
- Notify local emergency management officials (police or fire department) about the deteriorated condition of the dam and the potential need to close the portion of Rattlesnake Hill Road below the dam. Advise the Department of Conservation and Recreation Office of Dam Safety of the condition of the dam.
- Monitor the embankment on a regular basis, one to two times daily, to look for changed conditions of the sinkholes or formation of a breach. Monitor more frequently during heavy rain or high pond events. Notify local emergency officials to close the portion of Rattlesnake Hill Road below the dam if active erosion likely to lead to a breach is observed. Monitor seepage for changing conditions and new locations downstream of the dam and development of sinkholes within the embankment.
- Place emergency repairs immediately to consist of stuffing two or three 3- to 4-foot square sections of nonwoven geotextile into the sinkholes as deep as they can be pushed and filling the remainder of the sinkholes with concrete sand.

- Initiate permanent repairs of the dam as soon as practical after the pond reaches the level of the sluiceway sill. Permanent repair should include:
 - A graded filter against the upstream side of the high section of the left downstream unmortared masonry dam. We expect that the graded filter should include:
 - A 12-inch-thick (minimum) layer of large crushed stone (e.g., 3-inch) or small cobbles (e.g., 6-inch). The large crushed stone or cobbles must be larger than the voids in the masonry.
 - A 12-inches-thick (minimum) layer at least of 1-¼ inch crushed stone (Massachusetts Highway Department [MHD] M2.01.3) over the large crushed stone. The 1-¼ inch crushed stone must be larger than the voids in the large crushed stone layer.
 - A 12-inches-thick (minimum) layer of ¼-inch crushed stone (MHD M2.01.6) over the 1-¼ crushed stone layer.
 - A 12-inches-thick (minimum) layer of concrete sand (ASTM C33 fine aggregate) the ¼-inch crushed stone layer.The upstream half of the dam should be made as watertight as possible before starting the excavation to install the graded filter. You may want to consider using large plastic tarps and sand bags to form the upstream water barrier. We expect that dewatering the excavation will require a construction dewatering pump.
 - Repairs to the upstream half of the left wingwall consisting of a 2-foot or thicker reinforced concrete back wall extending to as deep a depth as practical, but at least 4 feet to get below frost depth. Reinforcing should consist of #4 rebars spaced no greater than 9 inches apart. The reinforcing will reduce the potential for cracking. Concrete should be mixed to provide a strength of about 4000 pounds per square inch and should include air entrainment to reduce the potential for freezing damage. The wingwall repairs may be done before or after installation of the graded filter, but both repairs should not be performed at the same times so that the amount of excavation is minimized. Backfill around the new back wall should consist of soil materials similar to the existing dam materials so that a preferential seepage path is not placed next to the wall. The top of the backfill over the wall should be graded to provide good surface drainage.
 - Repairs to the spillway crest structure consisting of pouring a flowable mortar or grout into the cavities that have formed in the crest. The flowable mortar mix product Sika Monotop 611 should be suitable for the repairs of the voids and is available in Boston.

Limitations

This letter describes our observations from a limited site visit. We did not perform a full inspection of the dam but focused on the features of obvious concern. Our recommendations are preliminary and may not be applicable depending upon conditions that develop subsequent to our visit and upon conditions that may be uncovered during remedial construction.

Mr. Stephen E. Cotton

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April 6, 2010

Please call (781-721-4034) or e-mail (lwooten@geiconsultants.com) me if you have any questions.

Sincerely,

GEI CONSULTANTS, INC.

A handwritten signature in blue ink that reads "R. Lee Wooten".

R. Lee Wooten, P.E.
Massachusetts License No: C31830
Vice President

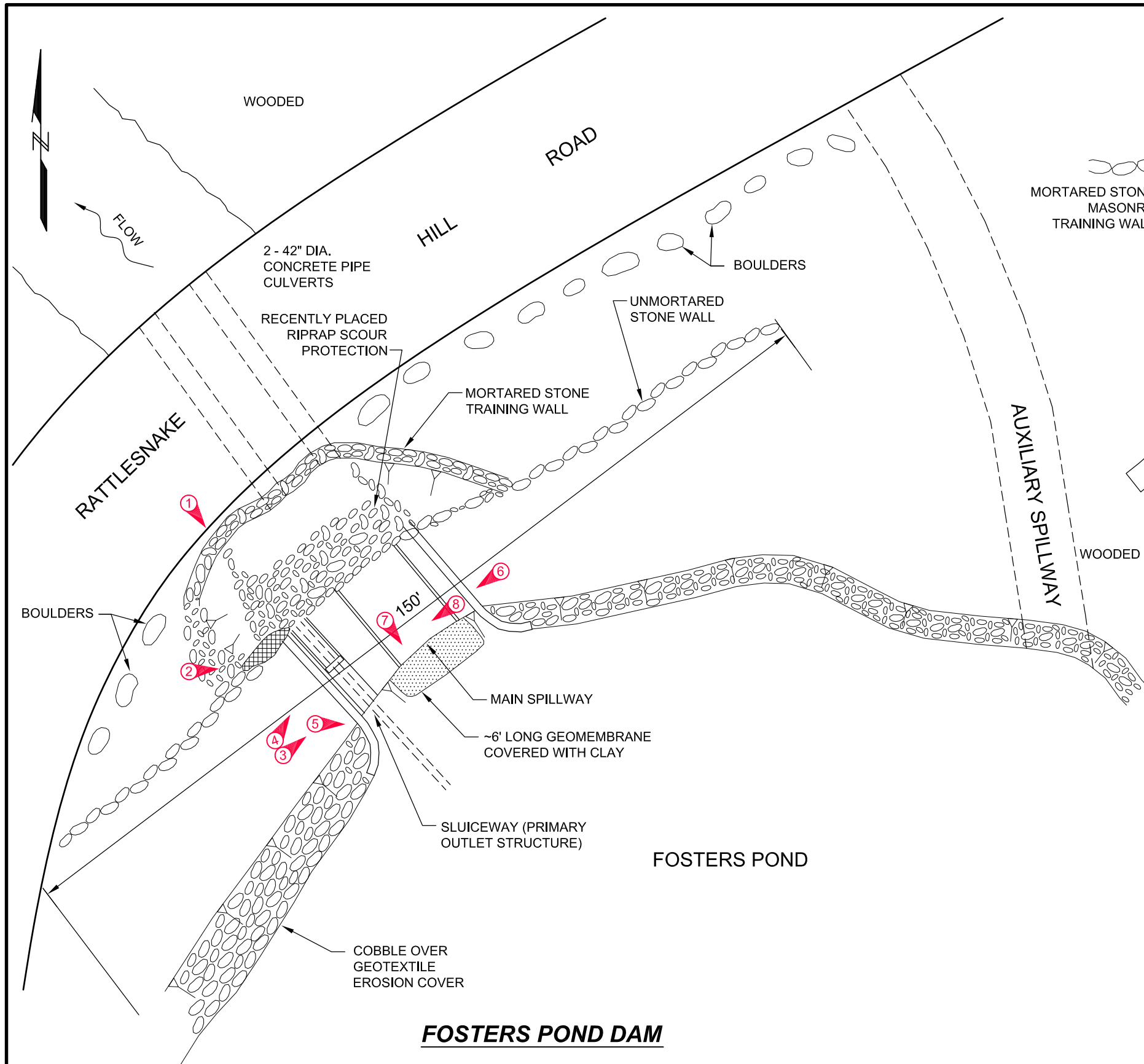
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Attachments:

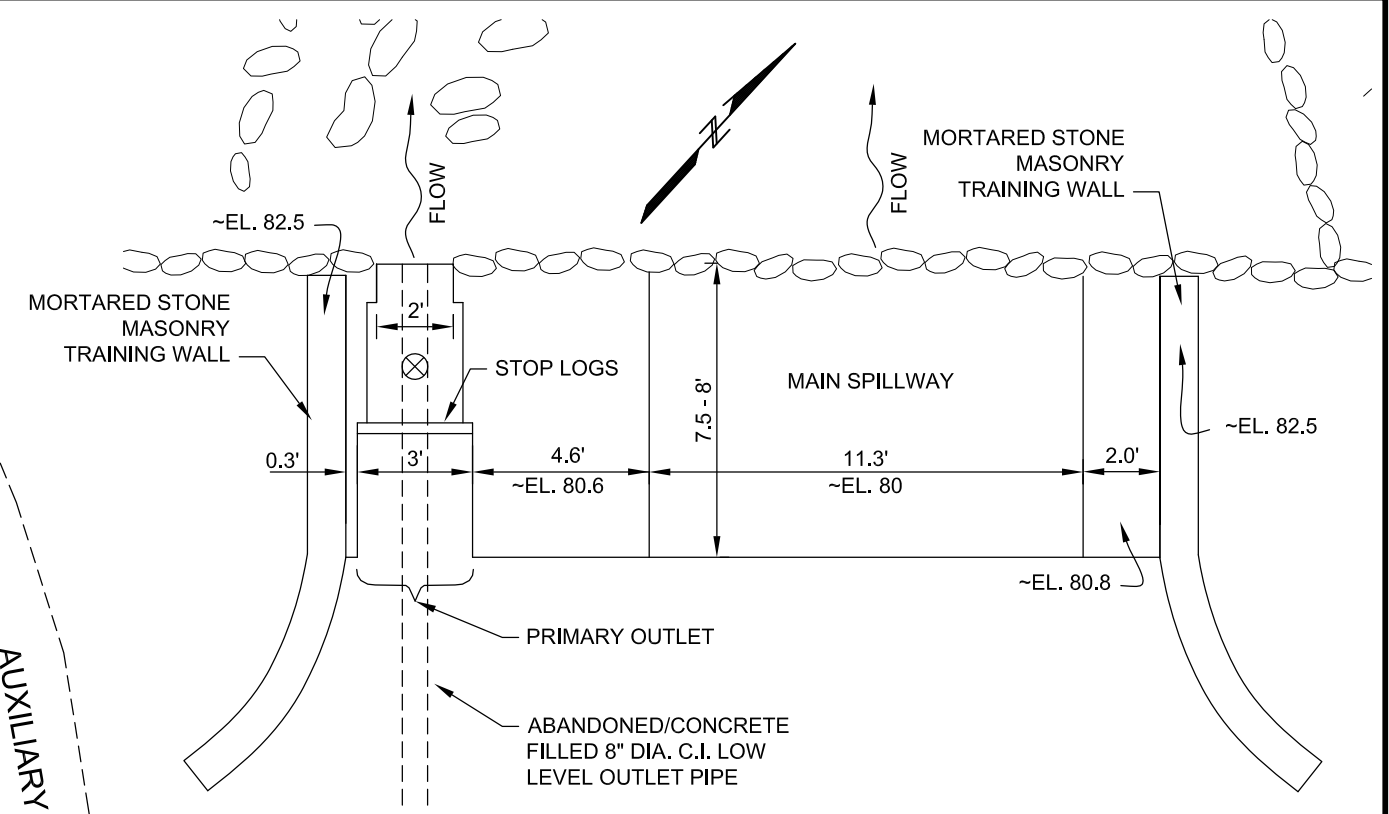
Figure 1 – Site Plan

Site Visit Photos

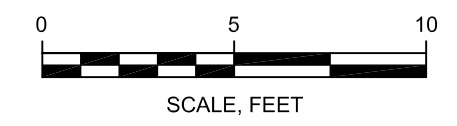


FOSTERS POND DAM



NOT TO SCALE



**MAIN SPILLWAY AND PRIMARY OUTLET
DETAIL**



LEGEND:

-  SEEPAGE AREA
-  PHOTOGRAPH NUMBER LOCATION AND DIRECTION

NOTES:

1. BASE PLAN TAKEN FROM SITE PLAN PREPARED BY FOSTERS POND CORP. MEMBERS.
2. DIMENSIONS FROM HISTORIC INSPECTION RECORDS AND MEASUREMENTS TAKEN DURING INSPECTION ON NOVEMBER 10, 2006 AND MAY 8, 2008.
3. SPILLWAY ELEVATIONS ASSUME SPILLWAY CREST AT EL. 80.0.


Dam Safety Inspection Fosters Pond Dam, NID MA00153 Andover, Massachusetts		SITE PLAN
Fosters Pond Corporation Andover, Massachusetts	Project 06463-1	April 2010 Fig. 1



Photo 1 – Seepage locations along left downstream wall from downstream



Photo 2 – Seepage, looking down at wall base



Photo 3 – Sinkholes on left embankment looking toward the spillway



Photo 4 – Sinkhole on left embankment looking toward the spillway



Photo 5 – Left spillway wall, cracked joints, and sinkholes



Photo 6 – Spillway crest*



Photo 7 – Spillway crest void*



Photo 8 – Spillway crest void*

*Photos taken by Steve Cotton on April 5, 2010