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October 14, 2013 SA Project File 111-12-002

Department of Public Works
Town of Hampton
11 Hardardt's Way
Hampton, NH
Attention: Mr. Chris Jacobs, PE

Re: Report of Initial Study of Alternatives
Old Mill Pond Dam, State ID No. 105.03
Hampton, New Hampshire

Ladies and gentlemen:

Stephens Associates Consulting Engineers, LLC (SA, we, our, or us) has prepared this letter Report presenting results of our Initial Study of Alternatives to repair (reconstruct) or decommission Old Mill Pond Dam (Dam, Project or Site) in Hampton, NH. SA performed these services for the Town of Hampton Department of Public Works (Town, Owner, Client, you, your, etc.) in accordance with our Contract for Engineering for Old Mill Pond Dam Initial Study of Alternatives (Agreement) dated May 17, 2013.

This Report summarizes conceptual alternatives to repair or decommission the Dam, preliminary cost estimates for the alternatives, results of our file review, dam inspection, hydrologic and hydraulic (H&H) evaluation, and evaluation of some factors that influence the Project, including historic resources, sediment, fisheries and wildlife, infrastructure, land ownership, and potential for outside funding.

Descriptions in this Report predominantly use conventional dam engineering terminology with regard to dam features (structures, appurtenances and relative locations). As such, when we speak of the left or right, we refer to the relative locations of the feature looking downstream.

Summary

The purpose of SA's services was to evaluate factors and costs associated with the options of repair (aka reconstruction) and decommissioning for the Town's consideration in selecting a course of action. Results of our evaluation are summarized below. Concept sketches (5 sheets) of repair and decommissioning alternatives are attached. Table 1 summarizes estimated financial outlay for design, permitting, construction and long-term operation and maintenance for each alternative. Figure 4 includes a decision tree listing possible goals, alternatives, benefits and costs. The detailed evaluation, recommendations, and assumptions on which they are

based, described in the body of this Report, should be read in entirety, reviewed and understood prior to decision and implementation.

- We conceptualized five alternatives to repair the Dam. Each alternative includes replacing the spillway combined with various modifications to the embankment. Estimated average cash outlay of the five repair alternatives for design, permitting and construction range between $450,000 and $930,000. Proper long-term operation and maintenance costs over 30-years are estimated as about $200,000 (in 2013 dollars).
- We conceptualized two alternatives to decommission the Dam – one where the channel flows under the Mill and one where the channel passes through the left end of the Dam, bypassing the Mill. In either option, the Mill and much of the embankments will remain. Estimated average short-term cash outlays are about $300,000 and $750,000, respectively. The higher value includes $400,000 to purchase and demolish the residence at 490 High Street. Long-term cash outlay over 30-years is estimated as about $30,000 for maintenance of the breach opening and channel.
- One possible alternative is for the Town to transfer ownership of (sell) the Dam to another party or group who would then be responsible for repairs and future maintenance of the Dam, or its decommissioning.
- Outside funding (e.g. competitive grants) is likely available for decommissioning the Dam, but not for repair. Funding sources, amounts and competition, however, can vary substantially year-to-year.
- Replacement of the High Street culvert is not a requirement for Dam repair or decommissioning. The Town may consider replacing the culvert to reduce flooding of High Street, whether the Dam is repaired, decommissioned, or divested. Replacing or improving the culvert to improve fish passage may be needed to secure outside funding related to fish passage. We estimate average cash outlay to replace the culvert as about $300,000.
- The Dam is classified as Class B, Significant Hazard. Hazard class may be reduced to Class A, Low Hazard if the residence at 490 High Street is demolished, for which cash outlay is estimated at $400,000. Reducing hazard class would reduce the design flood, however, the vast majority of repairs would still be needed to address deficiencies.
- The Dam has significant deficiencies that increase dam safety risks and are required to be addressed by the New Hampshire Department of Environmental Services (NHDES) Letter of Deficiencies.
- The Dam provides a small hydrologic and hydraulic benefit, reducing (staging) the 100-year flood by about 30 percent and reducing the depth of water flowing over High Street (in the 100-year flood) by about 0.2 ft.
- The Dam can be repaired to pass the design flood while meeting NHDES freeboard requirements and maintaining an impoundment (normal pool). The normal pool elevation (and corresponding pond surface area) has varied significantly over time would need to be selected during design of repairs, with cooperation and approval from the NHDES Dams Bureau.
- Historic resources will affect both repair and decommissioning. In our opinion, effects on the Project from historic resources do not favor either option.
- The Natural Heritage Bureau database contained no rare species and/or exemplary natural communities at the Dam or upstream. Pending further ecological review, effects on the Project from rare species and/or exemplary natural communities likely do not favor either option.
- Initial review of sediment quality found few potential contaminant sources located near the upstream ends of the drainage area, suggesting low likelihood for contaminated soils in the impoundment. Comments from NHDES to initial sediment review were not received as of the date of this Report.

Project Understanding and Background

Our understanding of the Project is described in our Agreement and is based on the following:

- Letter of Deficiency, dated July 11, 2012, issued to Mr. Frederick Welch, Town Manager, Town of Hampton by Steve N. Doyon, PE, Administrator of New Hampshire Department of Environmental Services (NHDES) Dam Safety and Inspection Section;
- Dam Inspection Form, dated July 2, 2012, prepared by Mr. Chuck Corliss of NHDES (NHDES Inspection Report);
- Letter from Mr. Chris Jacobs, PE, Town of Hampton Deputy Director of Public Work, to NHDES transmitting an Operation, Maintenance and Response form completed by the Town;
- Our telephone and email correspondence and meetings with Messrs. Jacobs and Keith Noyes, DPW Director, between September 25, 2012 and present;

Figures 1 and 2 show the Dam location. The Dam impounds Nilus Brook to form Old Mill Pond, just upstream of a former (historic) mill (The Old Grist Mill), a house (490 High Street), and High Street (Rte. 27). Per their 2012 inspection report, NHDES reclassified the Dam from Low to Significant Hazard. The Dam consists of an earth embankment retained by a downstream stone masonry wall with a stone masonry primary spillway and concrete auxiliary spillway. Based on our Site observations and measurements, we estimate the length and height to be about 300 ft. and 11.2 ft., respectively. The Dam discharges to Nilus Brook, which flows beneath/though the mill located at the toe of the spillway. The auxiliary spillway is located on the left embankment 9 ft. from the downstream residential structure at 490 High Street and has no defined discharge channel.

The Town received a Letter of Deficiencies from the State of New Hampshire Department of Environmental Services (NHDES), Dam Bureau, dated July 12, 2012, requiring the Town to repair (reconstruct) or decommission the Dam.

Purpose and Scope of Services

The purpose of SA's services was to evaluate factors and costs associated with the options of repair and decommissioning for the Town's consideration in selecting a course of action. Our scope of services included the following tasks:

1. Consultation, Funding Research, and File Review
2. Attend Two Public Meetings
3. Dam Inspection
4. Hydrologic and Hydraulic (H&H) Evaluation
5. Decommissioning Evaluation, including historic resources, sediment quantity and quality, fisheries and wildlife, infrastructure and land ownership
6. Option Concepts and estimates of cash outlay
7. Report

Except as expressly state herein, SA's scope of services did not include an environmental assessment of any kind, including but not limited to assessments for the presence or absence of wetlands or hazardous or toxic materials or organisms (e.g., fungi, flora, fauna, bacterial, viruses, etc.) in the soil, surface water, groundwater,

or air, on or below or around this Site. Any observations of odors, colors, or unusual or suspicious items or conditions made by SA are incidental to our services, and any statements regarding such observations are strictly for the information of the Client.

Our scope of services excluded detailed evaluation for, and preparation of, final design of repair/reconstruction or decommissioning. More detailed evaluation, design, and permitting of the alternative selected by the Town will be needed under a later phase.

Evaluation

File Review

SA obtained copies of files maintained by the Town and NHDES Dam Bureau on the Dam. Ms. Candice Stellmach of 488 High Street (located at the right end of the Dam) and the Hampton Historical Society, provided a compilation of historical information pertaining to the Dam. From our review of these files, we note the following points:

- NHDES Dam Bureau (and earlier regulatory bodies such as the NH Water Resources Board) have inspected the Dam at various times since 1935. More recent inspections (since about 2000) note deteriorating condition of the Dam.
- The spillway configuration has changed significantly over time:
  - A portion of the Mill formerly extended upstream over the spillway, however this portion was destroyed by fire circa 1961. The embankments formerly abutted the stone masonry walls of this portion, and the upstream opening included stoplogs to control impoundment levels. Little, if any, remnants of this previous portion are currently visible.
  - A 1973 NHDES inspection notes that the "gate spillway failed; patched with stones and logs."
  - Documents indicate that one or more rings of stones at varying elevations were previously located upstream of the spillway, potentially affecting impoundment elevations and discharge, however, most of these stones are now missing, removed, or buried by (perhaps incorporated into) a beaver dam.
- Old Mill Pond normal pool elevation has varied significantly over time as the spillway configuration has changed. Historical photos show the impoundment nearly drained in 1957 and letters prepared by abutters at various times note concerns over low water levels. Currently, the Pond elevation is predominately controlled by a beaver dam.
- The Town engaged James Verra and Associates, Inc. (surveyors) to prepare a plot plan identifying property boundaries around the Dam and Mill in 2009. This plan references a deed recorded in Book 1551, Page 297 at the Rockingham County Registry of Deeds, dated 1960, also contained in the Town's file, which states that Robert M. Crapo et al. granted to the Town of Hampton, NH, "The Easterly Portion of the Grantor's premises with the so-called grist mill thereon, also the mill dam and stream with all the privileges and appurtenances belonging thereto as it was formerly granted by the said Town of Hampton unto John Tuck by the records of said Town made December 29, 1709 and May 22, 1738 and all other grants relating thereto."

Hazard Classification

According to the July 2, 2012 NHDES Inspection Report, NHDES reclassified the Dam to Class B, Significant Hazard from Class A Low Hazard, based primarily on the proximity of the residence at 490 High Street, just downstream of the left embankment and auxiliary outlet. We understand that subsequent discussion between the Town and NHDES concluded that the hazard classification could be reduced to Class A, Low Hazard if the house at 490 High Street is demolished. Based on our subsequent discussion with NHDES, such reduction in hazard classification would reduce the design flood from the 100-year flood to the 50-year flood and would reduce future inspection frequency. The reduction in the design flood could potentially reduce the extent of repairs required to meet hydraulic criteria and/or allow a higher normal pool elevation, however, the vast majority of deficiencies noted in the LOD and by SA herein are unaffected by change in hazard classification and the Dam would still require significant repairs.

Geologic Information

SA reviewed readily-available geologic information in our files and online. The Surficial Geologic Map of the Hampton, NH quadrangle[1] and the NRCS Web Soil Survey[2] generally indicate near-surface soils in the Dam vicinity consist of till (aside from the artificial fill comprising the Dam), with swamp deposits upstream of the dam (at Old Mill Pond). The Bedrock Geologic Map of New Hampshire[3] indicates bedrock consisting of Rye Complex composed of metamorphic rocks, predominantly schists and gneisses. SA found no readily-available, reported bedrock depths or elevations in the vicinity of the Dam. Subsurface explorations will likely be needed in a future phase for design of repairs or decommissioning.

Dam Inspection

SA visually inspected the Dam on June 6, 2013. The Inspection Checklist attached in Appendix A describes our observations in detail. The deficiencies noted below will need to be addressed if the Dam is repaired to remain in service. Based on our visual inspection, we noted the following issues:

- Uneven crest elevation
- Significant number and size of stumps on crest
- Seepage at toe of embankment right of spillway and left of auxiliary spillway
- Lack of erosion protection at spillway and embankment slopes abutting spillway
- Auxiliary spillway has no discharge channel
- Trees within 15 ft. of embankment at left and right ends
- Sinkholes/erosion holes at interface of embankment and stone masonry walls
- Portions of stone masonry walls mis-aligned, tilting, or in disrepair
- Animal burrows at base of stone masonry walls

[1] Koteff, C., Gephardt, G.D., Schafer, J.P., (1989). "Surficial Geologic Map of the Hampton 7.5 Minute Quadrangle (East Half of the Exeter 7.5 x 15 Minute Quadrangle), New Hampshire-Massachusetts," US Geological Survey Open-File Report 89-430.
[2] USDA NRCS Web Soil Survey (2013). "Custom Soil Resource Report for Rockingham County, New Hampshire," accessed by SA on July 10, 2013.
[3] Lyons, J.B., Bothner, W.A., Moench, R.H., and Thompson, J.B., Jr., (1997). Bedrock geologic map of New Hampshire: U.S. Geological Survey, scale 1:250000.

Hydrologic and Hydraulic Evaluation

SA evaluated hydrology and hydraulics (H&H) of Old Mill Pond Dam and its upstream drainage area in the 50- and 100-year, 24-hour storms. The purpose of the analysis was to evaluate flows and water elevations at the Dam and discharge capacity of the existing Dam, and to assist in conceptualizing repair and decommissioning alternatives. The Spillway Design Flood (SDF) for Class B, Significant Hazard dams is the 100-year flood (the flood that has a one chance in 100 of being equaled or exceeded in a period of one year, per NH Code of Administrative Rules Env-Wr 100-800).

Appendix B contains details of the analysis, including rating curves and hydrographs, and Figure 3 outlines the drainage area. Elevations given herein are relative to the National Geodetic Vertical Datum (NGVD) of 1929. The results are sensitive to the starting pool elevation (normal pool) of Old Mill Pond, which is controlled by the configuration of the spillway. Key results are summarized as follows.

- Existing configuration, *without a beaver dam* – the Dam can pass the 100-year flood with an impoundment elevation about 1 ft. below the embankment crest (1 ft. freeboard) and about 0.2 ft. below the auxiliary outlet. *The existing configuration without a beaver dam, however, results in a small, virtually dewatered impoundment (about El. 15, about 0.3 acres) at normal pool.*
- Previous configuration, *similar to current beaver dam* – A ring of stones previously located at the upstream end of the spillway and removed in 2012 formerly maintained a higher normal pool elevation. For this previous configuration, we estimate the 100-year flood elevation would be about 0.3 ft. below the embankment crest (0.3 ft. freeboard) and would overflow the auxiliary spillway by about 0.5 ft.
- In either configuration, the 100-year flood exceeds the capacity of the existing Mill opening and flows around the Mill.
- The 100-year flood exceeds the capacity of the High Street culvert, overtopping High Street by about 0.3 ft. The High Street culvert appears to be designed for about 100 cfs (about the 50-year flood).
- The Dam stages about 30 to 32 percent[4] of the 100-year flood; i.e. it reduces downstream flows by about 30 to 32 percent by storing water as the pond fills. The actual benefit, however, appears small, reducing the 100-year flood at the High Street culvert by about 75 cfs and depth of overtopping of High Street by about 0.2 ft. Further, this benefit is provided for short duration, on the order of 2 hours, over which Pond inflow peaks and subsides.

Summary of Hydrologic and Hydraulic Results – Existing Dam Configuration (and without beaver dam)		
Parameter	100-Year Flood	50-Year Flood
Rainfall	9.1 in.	7.6 in.
Peak Inflow to Old Mill Pond	232 cfs	181 cfs
Peak Dam Discharge	157 cfs	104 cfs
Staging by Dam	32%	43%
Peak Impoundment Elevation	17.6 ft. (about 1 ft. freeboard)	17.1 ft. (about 1.5 ft. freeboard)
Water Elevation at High St. Culvert	11.8 ft. (overtops High St. by about 0.3 ft.)	11.6 ft. (overtops High Street by about 0.1 ft.)

[4] Depending on the starting pool elevation.

NHDES regulations require the Dam to pass the design flood with 1 ft. of freeboard to the crest. While the existing configuration *without a beaver dam* achieves 1 ft. of freeboard in the 100-year flood, we assume that the Town (and local residents) would prefer a higher normal pool elevation, such as that created by the existing beaver dam, or higher, if the Dam is repaired. Replacing the spillway will be needed to achieve higher normal pool elevation, required discharge capacity and freeboard and to address erosion-related deficiencies of the current spillway and junction with the embankments. The normal pool elevation will need to be evaluated during design of repairs.

Infrastructure

The Mill, residence at 490 High Street, and High Street and its culverts are downstream of, and subject to risk posed by, the Dam.

The predicted 100-year flood inundates High Street for both Dam repair and decommissioning alternatives. As described above, the Dam discharge in the 100-year flood of 157 cfs overtops (floods) High Street by about 0.3 ft. (depth of water on High Street). With the Dam removed, the flow at the culvert would be similar to the current inflow to Old Mill Pond of 232 cfs, and we estimate that the depth of overtopping on High Street would be about 0.5 ft., increasing by about 0.2 ft. compared to existing conditions. Since High Street inundates (overtops) in the 100-year flood in either alternative, the Town may *consider* replacing the culvert to reduce flooding of High Street and/or to improve fish and wildlife passage. Replacing the culvert is *not a requirement*, however, to either decommissioning or repairing the Dam.

The High Street culvert downstream of the Dam is perched (i.e. the culvert invert or bottom is above the stream channel), potentially reducing fish passage. While the Dam can be decommissioned without replacing the culvert, improving fish passage by replacing or improving the culvert may improve likelihood of award of funding from outside sources (described below).

Both alternatives of Dam repair and decommissioning will reduce risks to the Mill. We estimate the opening under the Mill is about 5.9 ft. tall with hydraulic capacity of about 364 cfs. The concepts of Dam repairs include replacing the spillway such that the 100-year flood passes through the Mill opening, rather than flowing around the Mill.

One decommissioning concept would route the channel through the left end of the Dam, after demolition of the residence at 490 High Street, bypassing the Mill.

The second decommissioning option would lower the stream channel elevation to be the same as the channel elevation under the Mill, directing the 100-year flood (and flows up to 364 cfs, or about 160 percent of the 100-year flood) through the Mill. We estimate 100-year flood at the Mill would be about 232 cfs with corresponding depth of about 4.2 ft. and would pass through the Mill. The resulting water elevation at the Mill would be similar to the water elevation controlled by the High Street culvert.

Risks to the residence at 490 High St. can be mitigated by purchasing and demolishing the residence, decommissioning the Dam, or designing Dam repairs with the residence to remain. The Town should be aware, however, that the Dam can be repaired or decommissioned without removing the residence at 490 High Street, and the cash outlay to purchase and remove the residence is substantial in comparison to the costs to repair or decommission the dam, as described below.

Historic Resources

SA prepared and submitted a Request for Project Review (RPR) to New Hampshire Department of Historical Resources (NHDHR) and met with the Town and NHDHR on September 13, 2013. The RPR form and narrative summarizing our initial review and NHDHR's response are contained in Appendix C. In response to the RPR, NHDHR is requesting additional evaluation, specifically a Phase 1A archaeological assessment and completion of an individual inventory form for the Mill and Dam, irrespective of whether the Town elects to repair or decommission the dam. Although an individual inventory form for the Mill was previously prepared by the local residents, NHDHR is requesting that a qualified consultant prepare a new individual inventory form. Table 1 summarizes estimated cash outlay for historical consulting services.

The Phase 1A archaeological assessment includes literature and file review for any known or potential archaeological resources within the project area and recommendations for potential further evaluation, if necessary. Such further evaluation could include Phase 1B assessment (including test pits), archaeological inventory forms, or other detailed documentation of resources identified, depending on results of each stage of evaluation.

Historic resources will need to be evaluated and considered during design of either repair or decommissioning. Such evaluation is part of a process to identify potential impacts to historic resources, avoid impacts where practicable, and mitigate impacts where necessary. In our opinion, historic resources do not significantly favor selection of repair or decommissioning since both options require significant earthwork to modify the Dam.

Sediment, Fisheries and Wildlife

SA evaluated quantity and quality of sediment that may require removal if the Dam is decommissioned. The attached letter to NHDES RRTF dated August 7, 2013 contained in Appendix D summarizes our evaluation. As of the date of this Report, we have not received review comments from NHDES.

SA used the New Hampshire Natural Heritage Bureau (NHB) DataCheck Tool[5] to check for the potential for presence of rare species and/or exemplary natural communities at the Dam and impoundment. The NHB data indicate the presence for swamp rose-mallow (a plant) and Willet (a bird) in Meadow Pond, downstream of the Dam and are attached in Appendix D. Pending further ecological review, effects on the Project from rare species and/or exemplary natural communities likely do not favor either option.

Potential ecological changes from decommissioning include both short-term (temporary) and long-term (permanent) changes. The duration of the short-term changes would vary, but would generally occur during the time period needed to stabilize (i.e. vegetate) the former impoundment and establish a new stream channel. Some potential changes are listed below.

[5] New Hampshire Department of Environmental Services (2013) NHB DataCheck Tool, https://www2.des.state.nh.us/nhb_datacheck/tool.htm, accessed by SA on July 2, 2013

- Potential Short-Term Changes
  - Sediment transport, including turbidity impacts during construction, although these are likely to be equal or greater for dam repair options;
  - Sediment and turbidity impacts and nutrient releases while new stream channel is forming and stabilizing, though these would be substantially mitigated by planned dredging of upstream stream channel;
  - Temporary water temperature changes and fluctuations in dissolved oxygen levels downstream of the Pond due to its draining;
  - Temporary disturbance of local wildlife populations during dam removal activities, which would also be a factor for Dam repairs;
- Potential Long-Term Changes
  - Conversion of open water habitat to riparian or wetland habitat;
  - Potential spread or reduction of invasive species (plant or animal) as a result of improving connectivity and/or changing habitat/vegetation disturbances.
  - Likely lower water temperatures and higher dissolved oxygen levels in the stream through the former impoundment, improving fish habitat.
  - Potential improvements to fish passage, biodiversity, and habitat/stream connectivity.

Land Ownership

Based on the plan and deed described under File Review above, it appears that the deed transferred the Dam to the Town, but prescribed no boundary for the Dam. The concepts for decommissioning and repairs shown herein will likely require easements from abutters, for either temporary construction access and/or to modify the Dam's footprint. If the Town elects to repair the Dam, we recommend that the Town establish a deeded boundary of the Dam with abutters and permanent maintenance easement after the repairs are constructed.

If the Dam is decommissioned, we anticipate that ownership of the remaining land/embankments would be worked out between the Town and respective property owners according to the existing property boundaries. To the extent that the Town owns the stream deeded to it and the Mill, we anticipate that the Town would be responsible for maintaining the resulting breach opening and Mill. Nevertheless, we would defer to the Town's attorney to interpret and negotiate such ownership and any responsibilities for maintenance thereof.

Regardless of the alternative selected to either repair or decommission the Dam, the Town will need temporary easements from abutting properties for construction.

One alternative is for the Town to transfer (sell) ownership of the Dam to another party or group who would then be responsible to address the LOD and for repairs and future maintenance of the Dam, or decommissioning.

Concepts of Alternatives and Costs

The attached sketches, sheets 1 through 5 show concepts of alternatives for decommissioning and repair. The alternatives are shown on the plot plan prepared by James Verra and Associates, Inc. for the Town, referenced above, as base plan. We conceptualized five alternatives to repair the dam, including a downstream buttress (embankment slope) (Sheet 1), a concrete retaining wall (Sheet 1), and three alternatives where the crest is widened upstream combined with either an upstream blanket, a cutoff trench, or excavating and replacing the

embankment to address seepage (Sheet 2). In each of the alternatives to widen the crest upstream, the existing downstream stone wall will remain, but will not be repaired/improved since it would not be relied upon for dam stability. Each of the five repair alternatives includes replacing the spillway (Sheet 3) since the existing spillway provides little erosion protection, if any, and no impoundment controls and the design flood exceeds the existing Mill opening, jeopardizing its foundations. We conceptualized two options for decommissioning, including breaching the Dam at the Mill (Sheet 4) and breaching at the left embankment end (Sheet 5) to bypass the Mill. The option to divest ownership of the existing Dam, described above, is not shown as a sketch because it includes no modifications by the Town.

Figure 4 shows a decision tree listing possible goals, alternatives, benefits and costs. In our judgment, if the Town's goal is to reduce risks and cash outlay (generally 30 years of operation and maintenance), the Dam should be decommissioned (removed) or divested. If the Town's goal is to maintain the impoundment, the Dam could be repaired at substantially greater short- and long-term cash outlay. The alternatives with least cash outlay for design, permitting and construction (short-term) are decommissioning with breach through the spillway, estimated as $300,000 (average), and repairing the dam by widening the crest upstream and installing a cutoff trench, estimated as $450,000 (average). Long-term cash outlay for decommissioning is estimated as $30,000 compared to $200,000 if the Dam is repaired.

Tables 1 and 2 summarize estimated low, average[6] and high cash outlay for each alternative, including design, permitting and construction (referred to together as implementation costs), and long-term cash outlay over a 30-year design life. Table 1 also summarizes estimates of cash outlay for potential optional ancillary improvements (High Street culvert replacement, adding fish passage to the Dam) and other studies. The preliminary estimates of cash outlay for the alternatives are generally based on New Hampshire Department of Transportation published low, average, and high unit costs (cash outlay), supplemented by our judgment and experience on other projects. The cost comparisons given in this Report are based on our conceptual designs and are intended to provide order-of-magnitude, relative costs for qualitative comparison of alternatives. *We recommend using the average costs for evaluation, comparison between alternatives and decision making.*

Potential for Outside Funding

SA evaluated potential funding for repair and decommissioning by meeting with representatives of the NHDES Dam Bureau, NHDES River Restoration Task Force (RRTF), New Hampshire Fish & Game Department (NHF&G), and NHDES Coastal Program. The results of our evaluation found no funding sources for repairs, though competitive grants for decommissioning are often available from American Rivers, the US Natural Resources Conservation Service, the Environmental Protection Agency, New Hampshire Fish & Game Department, or New Hampshire Coastal Program. Funding sources, amounts and competition, however, can vary substantially year-to-year. Our April 12, 2013 letter to the Town summarizing results of our initial contact with NHDES is attached in Appendix D. Based on our discussions with the entities cited above, it is our opinion that this project would be viewed favorably in competitions for grant funding based on its location near the coast, its size and ease of implementation, but we cannot predict from year to year what funding may be available nor what other projects may compete for the funding.

The goals of the funding organizations are typically related to improving the natural environment, such as restoring fish passage or improving water quality. Design of decommissioning, if selected, may therefore need

[6] Note that the average cash outlay is based on average unit rates for the concept components and is not the average of the total low and high cash outlay estimates.

to include additional improvements to increase likelihood of receiving funding, for example, replacing or improving[7] the High Street culvert to enhance fish passage.

The selection process to secure funding is very competitive. Projects where funding is sought for construction are typically given highest priority, followed by projects where funds are sought for design and permitting. Projects seeking funds for feasibility or other studies are typically the lowest priority to funding organizations. A strong commitment of the dam owner and Town (in this case, one and the same) to the Project are important in competing favorably and in securing (winning) funding.

To complete our scope of services, SA will meet with the Town and present our findings on October 21, 2013. We trust that this Report is sufficient to meet your current needs. If you have any questions, or require clarification, please call us.

Sincerely,
Stephens Associates Consulting Engineers, LLC

Nathaniel A. Olson, Ph.D	James E. Turner	Robert S. Stephens, P.E.
Staff Engineer	Project Manager	Principal Engineer

RSS:tgbg

Attachments:
Figure 1 – Site Location Map
Figure 2 – Site Aerial Photograph
Figure 3 – Drainage Area
Figure 4 – Decision Tree
Concept Sketches, Sheets 1 through 5

NOTE: This is a truncated PDF file of the report. Only Figure 4 and Table 1 are attached.

Table 1 – Summary of Preliminary Estimated Financial Costs
Table 2 – Short-Term Cash Outlay Breakdown (7 sheets)

Appendix A – Dam Inspection
Appendix B – Hydrologic and Hydraulic Evaluation
Appendix C – Correspondence with NHDHR
Appendix D – Correspondence with NHDES and Natural Heritage Bureau

[7] If fish passage at the High Street culvert is a concern to funding organization(s), it may be possible to negotiate with those organizations to design and install improvements to the High Street culvert that provide fish passage (e.g. fish ladder or mitigation if the perched outlet, etc.) at lower implementation cost, rather than replacing the culvert at higher cost. Representatives of New Hampshire Fish & Game Department have commented that elvers (eels) are already passing through the current culvert.

Original Work:
By: J. Turner Date: October 11, 2013
Checked By: RSS Date: October 11, 2013

Project: Number: 111-12-002 Sheet 1 of 1
Name: Old Mill Pond Dam
Hampton, NH
Initial Study of Alternatives
Subject: **FIGURE 4 - Decision Tree**

GOALS	ALTERNATIVE SOLUTIONS			BENEFITS		COSTS
Reduce Risks and Costs	**Divest Ownership (Transfer/sell to Others)**			• Reduces short- and long-term cash outlay and • Responsibility for repairs, operation and maintenance or decommissioning transferred to others		• Estimated short-term cash outlay = from $0 to lowest cost of other alternatives ($300,000) • Estimated long-term (30-year) cash outlay = $0
	Decommission (Remove) Dam	Breach Spillway and excavate channel leading to Mill, eliminating impoundment; retain much of stone wall and embankment (Sheet 4)		• Reduces risks to residence at 490 High St. and to High Street from dam overtopping and breach • Reduces future operation, inspection and maintenance costs • May reduce Town's liability and possibly insurance cost. • Meets Regulatory requirements • Dam removed from state jurisdiction • Does not increase extent of Dam	• Likely less costly to Town than repair, particularly if grants obtained • Potentially less historical impacts than repair	• Impoundment and its uses for abutters • Increased flows at High Street culvert. Marginal increase in overtopping in 50- and 100-year floods • Average estimated short-term cash outlay = $300k • Estimated long-term (30-year) cash outlay = $30k
		Breach dam near left abutment, demolish 490 High St. Structure & excavate channel bypassing Mill and eliminating impoundment; retain much of stone wall and embankment (Sheet 5)			• Could be less costly than repair if grants obtained • Likely least historical impacts, least modification near Mill	• Impoundment and its uses for abutters • Increased flows at High Street culvert. Marginal increase in overtopping in 50- and 100-year floods • Purchase and demolition of residence at 490 High St. • Average estimated short-term cash outlay = $750k • Estimated long-term (30-year) cash outlay = $30k
Maintain an Impoundment	**Repair/ Reconstruct Dam** Address Deficiencies, Regulatory Requirements, and Risks to Dam Safety Replace Spillway (Sheet 3) for All Repair Alternatives	Downstream Buttress (Sheet 1, Detail B)	• Demolish 490 High St. structure • Regrade Crest • Stabilize dam and control seepage with embankment buttress • Remove existing stone wall	• Maintains an impoundment • Addresses deficiencies • Passes Q_{100} with 1 ft. freeboard • Reduces risk of Dam breach from overtopping and piping • Meets Regulatory requirements • Dam continues to stage water, reducing flow at High Street Culvert in 100-year flood (compared to dam removal), but High Street still overtops in 100-year flood;	• Eliminates risk to 490 High Street residents • More work on Town owned or acquired property • Maintains similar upstream extent of Dam • Potentially easier access to Dam crest via downstream slope (e.g. for maintenance) • Cost is least susceptible to potential for environmental contamination in impoundment	• Purchase and demolition of residence at 490 High St. • Change of appearance from stone masonry wall to vegetated slope • Continued long-term operation, maintenance, & inspection costs • Average estimated short-term cash outlay = $860k • Estimated long-term (30-year) cash outlay = $200k
		Concrete Retaining Wall (Sheet 1, Detail C)	• Regrade crest • Stabilize dam and control seepage with concrete wall • Remove existing stone wall and reuse as downstream facing		• Maintains similar extent (footprint) of Dam, and smaller extent than other repair options • Maintains similar appearance with stone masonry facing	• Continued long-term operation, maintenance, & inspection costs • Potentially more historical/cultural impact than other options • Existing stone masonry wall removed, reused as facing • Average estimated short-term cash outlay = $930k • Estimated long-term (30-year) cash outlay = $200k
		Upstream Crest Cut-off Trench (Sheet 2, Detail E)	• Regrade and widen crest • Control seepage with cut-off trench		• Maintains existing stone wall, but no longer relies on it for stability • Maintains similar appearance to existing • Potentially least costly repair alternative	• Dam enlarged upstream • Continued long-term costs for operation, maintenance, and inspection • Average estimated short-term cash outlay = $450k • Estimated long-term (30-year) cash outlay = $200k
		Upstream Crest Replace Embankment (Sheet 2, Detail F)	• Regrade and widen crest • Control seepage by excavating and reconstructing embankment		• Maintains existing stone wall, but no longer relies on it for stability • Maintains similar appearance to existing • Larger excavation extent allows examination and potential mitigation of seepage	• Dam enlarged upstream • Continued long-term costs for operation, maintenance, and inspection • Average estimated short-term cash outlay = $540k • Estimated long-term (30-year) cash outlay = $200k
		Upstream Crest Upstream Blanket (Sheet 2, Detail G)	• Regrade and widen crest • Control seepage with upstream blanket of low permeability fill		• Maintains existing stone wall, but no longer relies on it for stability • Maintains similar appearance to existing • Reduces excavation of existing Dam and potential historical impacts	• Dam significantly enlarged upstream • Continued long-term costs for operation, maintenance, and inspection • Average estimated short-term cash outlay = $470k • Estimated long-term (30-year) cash outlay = $200k

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Revisions:
By: _____ Date: _____
By: _____ Date: _____

NOTES: The purpose of this Decision Tree is to aid the Town in understanding and evaluating Conceptual Options related to Old Mill Pond Dam. This Decision Tree should be considered in conjunction with SA's Report of Initial Study of Alternatives. Estimated costs for design, permitting and construction. Estimated costs are based on conceptual designs and are intended to provide orger-of-magnitude costs for qualitative comparison of alternatives and are in today's dollars (2013).

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TABLE 1 - SUMMARY OF PRELIMINARY ESTIMATED FINANCIAL COSTS (2013 Dollars)

Concept Alternative[2]	Concept Sketch Reference	Range of Short-Term Costs[1]			Long-Term Costs[1]
		High	Average	Low	
Divest Ownership	none	≤ lowest cost of other alternatives		$0	$0
Decommissioning	Sheet 4	$400,000	$300,000	$220,000	$30,000
Cutoff Trench Repair	Sheet 2, Detail E	$620,000	$450,000	$310,000	$200,000
Upstream Blanket Repair	Sheet 2, Detail G	$650,000	$470,000	$320,000	$200,000
Replace Embankment Repair	Sheet 2, Detail F	$760,000	$540,000	$370,000	$200,000
Decommissioning Alternate[3]	Sheet 5	$910,000	$750,000	$610,000	$30,000
Downstream Buttress Repair[3]	Sheet 1, Detail B	$1,080,000	$860,000	$680,000	$200,000
Concrete Wall Repair	Sheet 1, Detail C	$1,320,000	$930,000	$630,000	$200,000

Other Improvements[4]	High	Average	Low
High Street Culvert Replacement	$345,000	$300,000	$255,000
Add fish passage to spillway replacement	$45,000	$35,000	$25,000

Historical and Ecological Consulting Estimates[5]	Consultant 1	Consultant 2
Phase 1A Archaeology	$2,350	$3,530
Individual Inventory Form	$3,230	$6,000
Ecological Study	$3,270	

[1] Estimated costs are based on conceptual designs and are intended to provide order-of-magnitude costs for qualitative comparison of alternatives. Refer to SA's Report of Initial Study of Alternatives for limitations and further information. Short-term costs include design, permitting and construction, with a 20 percent contingency. Low, high and average costs estimated from low, high, and average unit costs for the concept components. Average costs shown are not the average of the high and low estimates. Long-term costs include operation and maintenance over 30-years in 2013 dollars.

[2] Each alternative for repair includes replacement of the spillway shown on concept sketch sheet 3. Decommissioning alternatives include cost for dredging a new stream channel through the former impoundment.

[3] Includes average cost of $400,000 to purchase and demolish residence at 490 High Street, increased/decreased by 10% for high/low costs.

[4] Other optional improvements; not requirements to decommission or repair dam. Costs for other improvements not included in costs for alternatives above.

[5] Costs for historical evaluation included in concept alternatives. Costs for ecological study included in alternatives for decommissioning.