Society for Industrial Archeology · New England Chapters

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CONTRIBUTORS

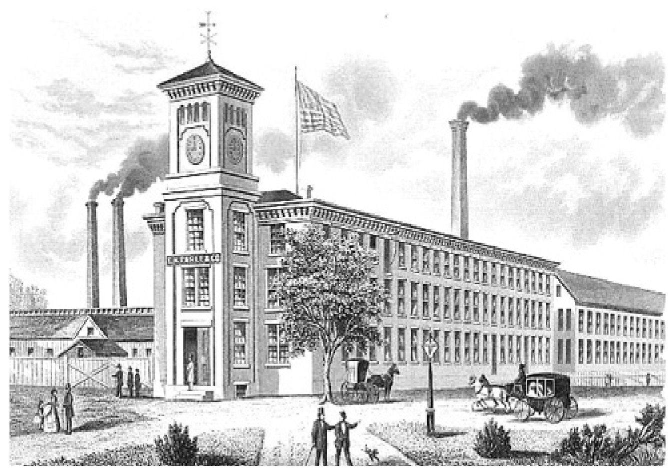
Marc N. Belanger, Bob Brown, Suzanne G. Cherau, John Daly, David Dunning, Ron Klodenski, Elsa E. Loehmann, John Mayer, Susan Navarre, Michael S. Raber, Sharon Spaulding, Sara Wermiel

EDITOR

David Starbuck
PO Box 492
Chestertown, NY 12817-0492

Call for Papers

for the **30th Annual**
New England Industrial Archeology Conference
March 4, 2017
hosted by the Southern New England Chapter – Society for Industrial Archeology



at Clark University Worcester, Massachusetts

The Southern New England Chapter of the Society for Industrial Archeology invites proposals for papers to be presented at the 30th Annual New England Industrial Archeology Conference. The conference is alternately hosted by the Southern New England and Northern New England Chapters as a forum for presenting research of our industrial past. The conference is to be held on March 4, 2017 at Clark University, 950 Main Street, Worcester, Massachusetts, Jefferson Academic Center, Room 218.

Papers are welcomed on all topics related to industrial history, archeology, manufacturing, preservation, engineering, architecture, etc., in New England and elsewhere. Proposals may be submitted for individual papers, team papers, or reports on works-in-progress. The time limit for each presenter will be 30 minutes. Student Papers are welcomed. Presenters do not need to be SIA members.

Format: Each presentation proposal must include: (1) title; (2) an abstract of not more than 300 words; (3) a brief resume of the author(s), including postal address, telephone, and e-mail; (4) final presentations shall be in MS PowerPoint or PDF format, or presenters may bring their own laptops for connection to the a/v equipment.

Deadline: Proposals must be received by January 31, 2017.
Send via E-mail: proposals in PDF or MS Word format to: mnbelanger@comcast.net
or via USPS to: Marc N. Belanger
161 Highland Street,
Taunton, MA, 02780

SNEC-SIA President's Report

Fall 2016

The Southern New England Chapter keeps chugging along with three events held in 2016. On May 14 we visited the Salisbury Iron District in northwest Connecticut and eastern New York. We had a bicycle tour of the Sudbury Aqueduct on August 13, and also an excellent tour of Amesbury, Massachusetts on September 10. (Summaries of these events can be found elsewhere in this issue of the newsletter). On Saturday, March 4, 2017, we will return to Clark University in Worcester for the 30th Annual New England IA Conference. The Call for Papers has been posted. Proposals for presenters shall be sent to me by January 31, 2017.

Over the summer, I was part of a committee to find a new editor for the Society for Industrial Archeology newsletter (SIAN) to replace Patrick Harshbarger, who has held this position for 20 years. We were fortunate to have four excellent candidates apply. I am pleased to announce that the new SIAN editor is Marni Blake Walter from Westmoreland, New Hampshire.

Members of the New England Chapters may be interested in the latest edition of *IA*, the journal of the SIA. It is a theme issue focused on New Bedford, and is an expansion of the February 2014 symposium held at the New Bedford Whaling Museum. Those of you who are not members of the SIA can purchase a copy of the journal for $20 through the museum's website shop: https://store.whalingmuseum.org/collections/local-books/products/industrial-archeology-journal. Of course, SIA members receive the journal as part of their $50 annual dues, so all chapter members are encouraged to join the SIA.

I must apologize for not being able to pull together a previously-planned visit to Pawtucket to celebrate the chapter's 40th anniversary in October. I was also not able to do as much "road show" networking, as I had hoped for earlier in the year. This is a reality of my personal life and many other time commitments that take priority over my SNEC-SIA duties.

You may have noticed on the cover of this newsletter that the SNEC board is now down to only three officers again. Former vice-president Erin Timms has moved back to her native Ohio. I'd like to thank Erin for her service to the chapter, and wish her the best in her future endeavors. We are still in need of a vice-president to help out with event planning and other items. If you are interested, it's not too late. Please let me know. There seems to be a misconception that being an officer is a lot of work. While there are certain times of the year that are busier than others, I think most of us who have served in the past would agree that the feeling of helping out can be enjoyable and rewarding. You do not need to be an officer to propose or organize a tour or other event. Suggestions are always welcomed!

Marc N. Belanger
Taunton, Mass.
mnbelanger@comcast.net

NNEC-SIA President's Report

Fall 2016

The 2016 NNEC-SIA Annual Meeting was held on October 27, 2016, at the Peterborough Diner in Peterborough, NH. Twenty-nine members and guests were in attendance. The only business introduced and conducted was the election of officers for the year 2017. No nominations were presented from the floor and all current officers, being present, agreed to serve in the coming year. An enthusiastic yes vote was recorded.

The 2017 Spring Tour will be in Laconia, NH. It will be hosted by the Belknap Mill Society www.belknapmill.org. This tour will feature the bygone hosiery mills, Scott & Williams machinery manufacturing company, and the Laconia canal system.

Treasurer Rick Coughlin reports that the current checking account balance is $4,714 as of 9/30. That's down $89.00 from last year at this time. The paid membership is about the same at 39.

Chapters Summit, 2016

On Friday October 30, board members from the two chapters met in Nashua, NH. This was in response to interest generated at the Winter Conference in Plymouth. At the conference, Dennis Howe brought up the need for us to assess where SIA is and is going (or not). During Dennis's talk and after, many of us thought of and heard of questions and ideas that warranted further discussion. So, in Nashua, we met after an interesting tour of The Pennichuck Water Works (see article below), and, over lunch at The Portland Pie Co., we discussed many issues. The key topics were membership, tours, the newsletter, collaboration with other groups, and finances.

Declining membership is a big problem for SIA as well as many other groups; it seems to be a generational trend. We have tried publicizing our tours in newspapers and inviting other local historical societies, as well as placing brochure racks in similar places. Those efforts have brought visitors but not new members. Without a continuous influx of new people, any organization atrophies, and we are devoted to preventing that outcome. We intend to find new ways to gain membership.

The NNEC operates on a very tight budget, losing money in some years and gaining in others. The newsletter is our greatest organizational expense, and perhaps our greatest membership benefit. It would cost a lot less to just e-mail it, but would you want that? What if it was free on-line but available in print at a cost (to lifetime and regular members alike)? We will investigate ways to apply the newsletter to stimulate a membership increase.

New tour ideas are sought from the membership (you). Let us know what other interesting sites we should go see. You could plan and run the tour and/or work with us on it. E-mail David Dunning: dunmark@tds.net or call 603-526-6939.

We also discussed collaborating with other similar organizations for mutual benefit. To try this out, the NNE Chapter is planning a joint spring tour with The Belknap mill society, in Laconia, NH. We will also experiment with contributing to each other's newsletter and sharing of mailing lists.

Nametags will be worn at future tours and conferences to help us chat with each other and facilitate discussion of common interests. The NNEC Board also invites members to communicate their research interests, preservation concerns, and general thoughts about Industrial Archeology trends.

David Dunning
NNEC President
dunmark@tds.net
603-526-6939

Pennichuck Water Works (PWW)

Board members of the Southern and Northern New England chapters got a tour of this historic facility on Friday, September 30, 2016. In 1852, the Nashua area realized that it needed to plan for a water supply before the city was even formed. The Pennichuck Brook* flows into the Merrimack River there, but it would need to be dammed up. The brook flows out of Bowers Pond. In 1854 a gravel dam was built to form a Supply Pond. It washed out in a flood in 1866 and was replaced by a stone dam. As time went on, other dams were built along the valley and an immense volume of water impounded. The original pumping station was built in 1854. It was a wooden structure and housed a water turbine-driven pump, made at the Lowell Machine Shop.

In 1865, a very dry year, the water table got so low that an engine and boiler were installed as an auxiliary unit when needed. Previous to that, a treadmill had been attached to the water pump to supplement the power from the brook. The treadmill was operated by a horse, who, tiring of the work, was inclined to shirk. Therefore, a local engineer named Mr. French rigged up what was known as "French's Spanker". After every so many revolutions, a stick or board would drop on the back of old Dobbin, urging him to greater effort.

The present water works area consists of 1400 acres of forest land, except for 287 acres of water. It has been (long ago) seeded or planted to white pine. The pine is harvested regularly and sawed at PWW's own water/electric powered sawmill. In some years, they cut as many as 175,000 feet in a single season.

There are now four dams in the flow of the Pennichuck Brook, impounding 650,000,000 gallons of water. Three pumping units are housed in two brick stations with an obsolete Worthington Pump and a Holly Pump (shown in these pictures), both of which are inactive, but open for inspection by interested groups such as ours. The pump mostly used today is a 6,000,000 gallon a day unit specially designed by Dean & Main. The power for this pump is obtained from water passing through the 72" penstock under a 57' head, driving a 300 h.p. water wheel at the rate of 400 rpm. This wheel, in turn, drives a 16' flywheel attached to a drive shaft turning at the rate of 100 rpm.

The SIA board members were guided through this tour by John J. Boisvert, PWW's Chief Engineer. The tour was arranged by NNEC VP Ray Breslin.

David Dunning
NNEC President
dunmark@tds.net
603-526-6939

*Just north of the Nashua River, which was the subject of last fall's NNEC tour. The Nashua River was dammed up for industrial use; Pennichuck Brook was strictly for drinking water.

First Thursday Talk at the Fitchburg Historical Society Focuses on Alvah Crocker and the Engineers Who Built the Hoosac Tunnel

(Fitchburg, MA) The Fitchburg Historical Society will present an historical talk on "Alvah Crocker: Spirit Behind the Hoosac Tunnel" by author Cliff Schexnayder on Thursday, November 3, at 5:15 p.m. The talk is free to the public and will take place in the George R. Wallace Jr. and Alice Wallace Exhibition Hall of the Fitchburg Historical Society, Phoenix Building, 781 Main Street, Fitchburg.

Long-time residents, and many historians, know of Fitchburg's Alvah Crocker, one of the most successful and influential businessmen in New England during the 1800's. His businesses, family and legacy shaped central Massachusetts and especially Fitchburg, Massachusetts, where he made his home and based his largest businesses. A pioneer in Fitchburg's paper industry, in banking, and in railroad companies, Crocker set himself a nearly impossible task in the building of the Berkshires' five-mile Hoosac tunnel….which involved cutting (or blasting) a way directly through a mountain for the very first time. When it succeeded, Boston and the rest of Massachusetts were directly connected by rail with the western United States: a prerequisite for the economic growth of northern Massachusetts.

Cliff Schexnayder has a Ph.D. in Civil Engineering from Purdue University. He has written about construction and is especially interested in understanding major construction projects from the past; for example, he has worked as an engineering consultant for museum exhibitions on historic building methods. His research for his 2015 book on the Hoosac Tunnel, Builders of the Hoosac Tunnel, was supported with a fellowship from Smithsonian Institute Libraries.

Clifford J. Schexnayder is an Eminent Scholar Emeritus at the Del E. Webb School of Construction, Arizona State University. Taking over from Robert L. Peurifoy, he authored the 5th thru 8th editions of Construction Planning, Equipment & Methods, McGraw-Hill. He received his Ph.D. in civil engineering (construction engineering and management) from Purdue University, and a Master's and Bachelor's in civil engineering from Georgia Institute of Technology. A construction engineer with over 40 years of practical experience, Dr. Schexnayder has worked with major heavy/highway construction contractors as field engineer, estimator, and corporate chief engineer. Additionally, he served with the U.S. Army Corps of Engineers on active duty and in the reserves, retiring as a colonel. His last assignment was as Executive Director, Directorate of Military Programs, Office of the Chief of Engineers, Washington, D.C.

He has served as a consultant to the Autoridad del Canal de Panama, Secretary of the Business, Transportation & Housing Agency of California to review risks associated with constructing the main east span of the San Francisco-Oakland Bay Bridge, and the Smithsonian's National Museum of the American Indian for its *The Great Inca Road: Engineering an Empire* exhibit. Dr. Schexnayder is a Distinguished Member of the American Society of Civil Engineers and a member of the National Academy of Construction and the Beavers. He served as chairman of the ASCE's Construction Division and on the task committee, which formed the ASCE Construction Institute. From 1997 to 2003 he served as chairman of the Transportation Research Board's Construction Section.

The Fitchburg Historical Society is located at 781 Main Street, Fitchburg, in the historic Phoenix building. There is abundant on-street parking near the Historical Society and free parking behind the building. The building is handicapped accessible.

For more information, call 978-345-1157, email welcome@fitchburghistoricalsociety.com,
Visit www.fitchburghistoricalsociety.org
or https://www.facebook.com/FitchburgHistoricalSociety.

Contact: Susan Navarre, Executive Director
director@fitchburghistoricalsociety.com 978-345-1157

Tide Mill Institute Conference

TMI's 2016 conference will be held on Saturday, November 12th, at the Metropolitan Waterworks Museum in Boston's Chestnut Hill district. As a follow-up to our last event's discussion of Boston's early tidal power, this year's gathering will focus on the city's mills. Tide mill relics from the 18th century were found in the area of the former Mill Pond during the famous "Big Dig." Their fascinating details, carefully studied, measured and recorded, shed light on the mechanical wizardry of colonial industrial design. These will be explained, put in historical context, and illustrated with intricate CAD drawings. We will also look at a Boston tidal power project from the 19th century: the famous Back Bay scheme that was designed and built to provide "perpetual power" but didn't work out as well as planned. Other invited speakers, from outside New England, will describe millstone quarries, and tides and tidal power around the world. A tour of the fascinating Waterworks Museum will be included.

Space is limited at the Waterworks Museum, so REGISTER EARLY! Cost: $50 including lunch.

For more info visit: http://www.tidemillinstitute.org/

Exciting News at Chase's Mill
$15,000 Challenge Grant

It has been an exciting summer for Chase's Mill. As you may know, the Mill is now listed on the New Hampshire State Register of Historic Places, we hosted a gathering of donors from The New Hampshire Preservation Alliance, and we have submitted several grant applications including one to the state's Land and Community Heritage Investment Program. On Saturday mornings, people have been stopping by for informal tours. Some have visited for the first time, others were returning after many years and shared their memories of taking shop classes, attending contra dances in the meeting room upstairs, or swimming in the mill pond. All have left with a vision for returning this treasure to the community.

We at the Mill Hollow Heritage Association are even more

Chase Mill. Photo by Tafi Brown.

deeply committed to purchasing the Mill, rehabilitating it, and reopening in 2020 as a living museum and a makerspace /workshop.

Now is a key moment in this effort. Dan and Joyce Curll have generously offered a challenge: they will donate $15,000 towards the project between now and November if we can match it dollar for dollar. This money will help get us over the hump of the purchase, and significantly increase operating capital that will be used toward making immediate repairs to stabilize the building.

Can you help? Your gift to the Mill Hollow Heritage Association between now and November will be doubled by the Curll challenge, up to $15,000. You can make your gift by mailing a check to: MHHA / P.O. Box 825, Keene, NH 03431, or online at: www.millhollowheritageassociation.org/donate/. To donate appreciated stock or to set up a multi-year pledge, please email us. As we are a 501(c)(3) nonprofit, all gifts are tax deductible. If you have already contributed to this challenge match and we've crossed in the mail, thank you for your support.

As we begin to move to the next phase of this project, we are grateful for the many ways people have been willing to contribute their resources. Together, we will be successful in making our collective vision for the Mill a reality. You can count on us to operate with transparency, and to be good stewards of this project.

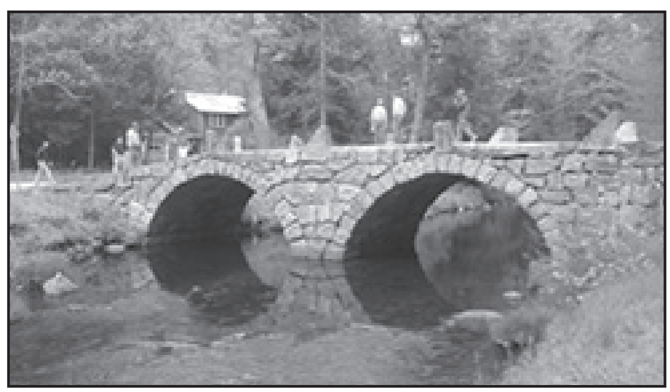
Stay tuned for updates and please make your donation today.
Sincerely,

President Sharon Spaulding and
Vice President Bob Brown

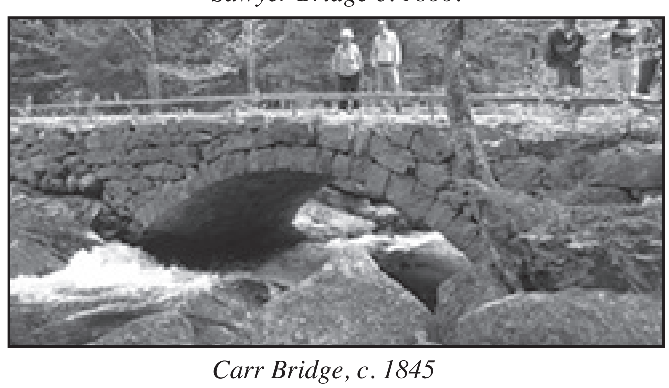
NNEC-SIA 2016 Spring Tour Report

Stone Arch Bridges

The spring tour took place in Hillsborough and Contoocook, N.H., on May 21. The morning was spent looking at five dry-laid stone arch bridges built in the mid-1800's, followed by a visit to pre-industrial Hillsborough Center and watching a pewter bowl being made by hand.



Sawyer Bridge c. 1866.



Carr Bridge, c. 1845

After numerous floods wiped out the town of Hillsborough's wooden bridges, Hiram Monroe, active in town affairs, convinced the town to have a dozen stone arch bridges built. Five now survive and represent the largest cluster of dry-laid stone arch bridges in the U.S. We visited all five. The first was the Sawyer Bridge built in 1866 and the only one of the five no longer in use. This bridge originally had three arches, two over the river which still exist, and the third utilized for cattle to cross under the bridge which collapsed in 1988. The second bridge we visited is another double arch bridge located on the old 2nd NH turnpike road and was built in 1864 for $100. We now went onto dirt roads to visit three older bridges. The Old Carr bridge is another double arch stone bridge with an estimated date of the mid-1840's. It's located at the intersection of Beard and Jones road and reputed to be built by Captain Jonathan Carr using counterfeit money. The Gleason Fall bridge further up Beard Road is the smallest of the bridges, being only a single arch and is also the oldest with an estimated build date in the area of 1830. A large cascade of water runs under this bridge, and it's remarkable that it's been able to withstand flooding for almost two centuries. The last bridge visited was an interesting double arch bridge with different size arches spaced widely apart. It's located west of the intersection of Beard Road and Gleason Falls road near the site of a former grist mill.

Historic Village

We then drove to nearby Hillsborough Center, a pre-industrial town with thirteen colonial houses located around a center triangle. There are two churches, an old schoolhouse, cemetery, and a pound, which gives a glimpse of what these little villages looked like a couple hundred years ago. We were very fortunate that Gibson pewter was open because next year they will have moved to the town of Washington, N.H. Jon Gibson follows the craft his father taught him, and his shop is located in a 200-year-old barn in the village center. As we watched he made a pewter bowl and answered many questions about the alloys and the tools and equipment he uses.

Gibson pewter shop in Hillsborough, NH.

Hopkinton Dam

"Hopkinton Dam" (to locals) is actually "Hopkinton Everett Lakes Flood Risk Management Project" to the US Army Corps of Engineers who built it. It is a series of 2 connected rivers, lakes, 2 dams and 4 dikes (usually dry) spread over 2 towns to control a massive flood area. At least one small town (East Weare) was taken away by eminent domain as part of the flood zone. The dam at Hopkinton Lake, on the Contoocook River, and the dam at Everett Lake, on the Piscataquag River, are connected by a two-mile-long canal and are operated as a single flood control system, when needed. It protects the flood area all the way down through Concord and Manchester. Operating in conjunction with other Corps dams in the Merrimack River Basin, the project also helps protect major industrial centers along the Merrimack River, including Nashua and the Massachusetts communities of Lowell, Lawrence, and Haverhill. Construction was begun

The dam at Hopkinton Lake, on the Contoocook River.

in 1959 and completed in 1963. Design and construction details and further background information can be viewed on line at http://www.nae.usace.army.mil/Missions/Civil-Works/Flood-Risk-Management/New-Hampshire/Hop-Ev/

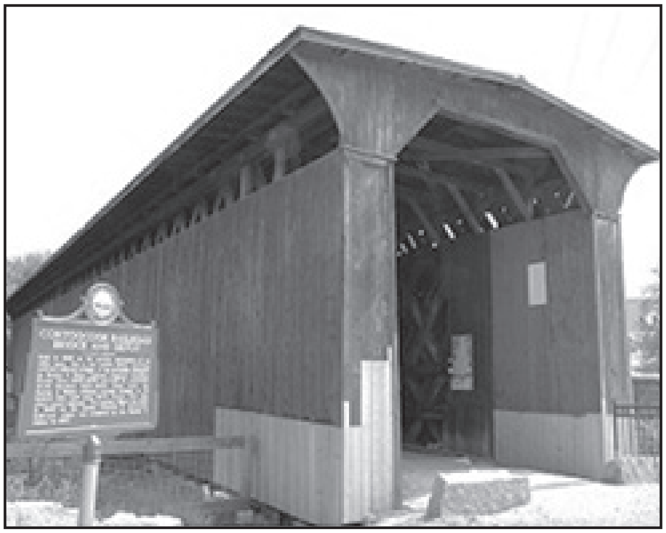
Rowell's Covered Bridge

This Long truss bridge was completed in 1853 and was the third bridge on the site. It is just under 20 feet wide and 167 feet long, and consists of a single span supported by two modified Long trusses meeting on granite abutments. The trusses are distinctive in the addition of several arches, which consist of solid timbers that are spliced or butted together, and mortised into other truss members.

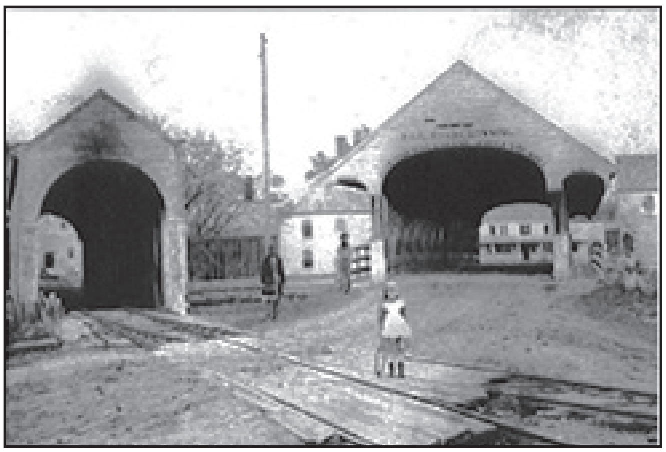
Tour participants view covered bridge trusses.

Contoocook

After lunch we toured a restored railroad covered bridge, train station, and a rail car all resurrected by The Contoocook Riverway Association. The following information and photographs are from their web site, with permission. Readers are encouraged to visit the site for more details and many more photos: www.contoocookdepot.org We especially thank the tour guide and railroad historian, Dane H. G. Malcolm.



World's oldest surviving railroad bridge in Contoocook, NH.



Early 20th Century photo of Contoocook railroad bridge (left) and highway bridge (right).

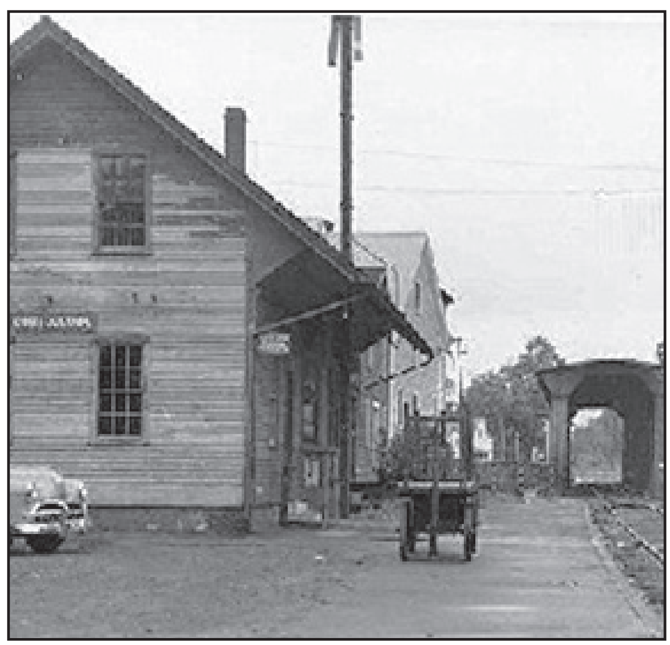
The bridge's sturdy engineering was demonstrated by the addition of a central pier in the 20th century whose intent was to add strength. The pier, however, acted as a fulcrum, causing the bridge to seesaw under load and weaken its joints. The top of this pier was consequently removed, leaving the bridge largely as designed except for the addition of some metal reinforcing rods.

Built in 1889 on the granite abutments of an older span, the railroad bridge located in Contoocook Village is the world's oldest surviving covered railroad bridge. It was probably designed by Boston & Main Railroad engineer Jonathan Parker Snow (1848-1933) and built by carpenter David Hazelton (1848-1908). Under Snow, the Boston & Maine utilized wooden bridges on its branch lines until after 1900, longer than any other major railroad. The railroad was originally known as the Concord & Claremont, which was acquired by the Boston & Maine in 1887. In the 1930's, two major floods pushed the covered bridge from its abutments. The bridge has been retrieved both times and set back in place. The bridge has now been restored, fireproofed and a sprinkler system installed.

During the summer of 2002, the historic Contoocook Railroad Depot and covered railroad bridge began a trip back in time with an extensive renovation to restore them to their 1910 glory. "When you came to Contoocook, you came on the rail" said Chip Chesley, past President of the Contoocook Riverway Association, the non-profit that handled the project. "This was the village's front door and it just seemed natural that it should be restored for the public to enjoy."

Built in 1850, the Contoocook Depot was the first station on what became the Concord to Claremont Railroad, which later became the Boston & Maine Railroad in 1887. The passenger service ended in 1955 and freight service terminated in 1962. The Contoocook Riverway Association bought the depot from the town of Hopkinton for one silver dollar in 1999. The covered bridge, which is on the National Register of Historic Places, is owned by the State of New Hampshire. The $400,000 restoration project was funded by federal grants administered through the State Department of Transportation and by community donations. The journey took approximately three years. Restoration of the depot building was first - the roof stripped and replaced with wooden shingles that resembled the roof until the 1930's. New exterior siding and paint, followed by the sandblasting and painting of the train signal, or semaphore, brought the building's look back nearly a century.

The depot's surviving interior details include two ticket windows and most of the original walls and ceilings, still covered with tongue-and-groove paneling common in the late 19th century. Over the years, many original items have been returned to the depot by the community such as the enameled blue "Contoocook" station sign, luggage cart, seating bench, and other irreplaceable items.



A c. 1955 photo of the Contoocook railroad station with the bridge to right in background.

Tour participants view the restored Contoocook station and the no. 1246 Pullman car.

The Story of the 1246

She was born in Chicago in the summer of 1907. She was the 23rd out of 30 of lot 3512 from the Pullman Co., all sold to the Boston & Maine Railroad. At first, she was assigned to the best passenger trains, but in just a few years, new steel coaches were introduced which put the older wooden coaches into the less glamorous services.

The 1246 went into service on the lesser lines where the best equipment wasn't needed. No doubt she was used on the branch lines in southern New Hampshire or central Massachusetts or in commuter service out of the North Station to places in Massachusetts, such as Reading, Wakefield, Bedford, or Concord. In that less glamorous service, she soldiered on throughout the depression and World War II.

As the automobile took over the majority of the transportation chores, the railroads suffered, particularly in the passenger business. Lines were abandoned and services cut back. Passengers complained about the old wooden cars that were cold, drafty, and worst of all, old fashioned. The railroads wanted to upgrade the coaches used on the remaining lines. The result was that lines and lines of these coaches were hauled unceremoniously out behind the Billerica shops and set on fire. What didn't burn down could be sold for scrap.

By that time, the 1246 had gotten a new number. The railroad bought new coaches so the wooden coaches had to give up their numbers and the old girl was bumped down to 246. She had gone from Pullman green to a coach maroon in the early post war years, but still kept on until January of 1950 when she was taken to the shops in Concord, New Hampshire, and given a new lease on life. The railroad removed all the seats and cut large doors in the sides so that heavy equipment could fit inside. Old 1246 had gone from the best and newest, to a mobile storage trailer working on track maintenance. The nicks and gouges can still be seen where rough handling and carelessness took its toll. She was given the new number, W3238.

Our old friend kept at it while most of her type went up in smoke, until 1959, when a wealthy industrialist, Nelson Blount, bought her for his museum and tourist train operation known as Steamtown. All that Blount had done for her was give her a coat of yellow paint and install some benches, giving her the new name, Mount Sunapee. She ran on his line from Walpole, NH to Keene, and then from Bellows Falls, VT to Chester, VT. This lasted until the late 60's when Blount bought newer steel coaches and stopped using his collection of antique wooden cars. Many of these cars went to Strasburg Railroad in Pennsylvania where they are today, many times rebuilt. But not our friend. She sat on a siding in Vermont at the location of the old Steamtown museum in the company of two other old-timers, all of which were in too bad of condition to travel to Steamtown's new home in Scranton, PA. It really looked like the end for this old girl. Leaks in the roof, missing siding, and rotted floors. She was good for nothing but a catchall for scraps and useless junk.

In the early 1990's, David Woodbury negotiated the release of the 1246 for almost a year. After acquiring the coach, Woodbury had performed much rehabilitation and restoration while she sat on his property for almost 15 years. In the fall of 2007, Woodbury donated the coach to the Contoocook Riverway Association, and this is where she rests today.

Early Industry in Contoocook

The villages of Contoocook and Davisville are actually part of the town of Hopkinton, NH. As with many other New England villages, they grew up around water-powered mills. The original land grant by the Massachusetts Bay Province to citizens of #5 (later the town of Hopkinton) took place in 1735. The Grant included provision #5 that "Granted Twenty five pounds to be paid to that person that undertakes to build a Mill in the propriety near the Place of the Reservations provided he will have the mill completed on or before the first day of December next and that he will keep the Same in good repair for five years next ensuing the money to be paid by the first of December next and in case he does not keep the Same in repair than shall the money be returned."

In 1765 Nathaniel Clement was voted a gratuity by the town "as long as he kept his corn mill in repair". (*Life & Times of Hopkinton* - pg.226)

"In early times manufactures were very much scattered. In fact, every household was a manufacturing establishment in a small way." Numerous small mills were started on the streams of landowners' property throughout the town of Hopkinton. However, the large mills began to appear on the Contoocook River at a time when it was not yet an established residential area and regarded only as primarily a center for waterpower.

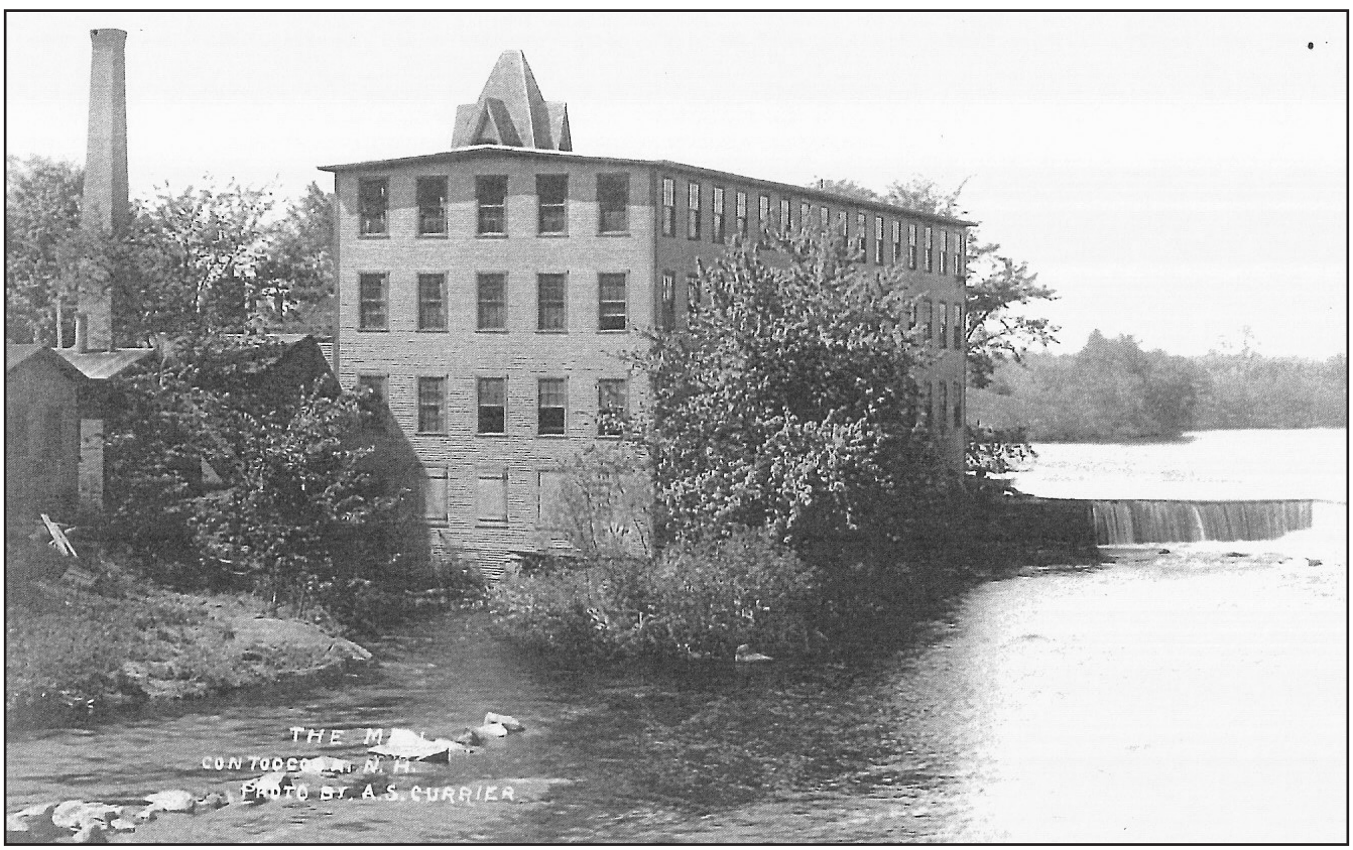
Eliphalet Poor built the first sawmill on the Contoocook River in 1787. It was located on the south side of the river (near today's Covered Bridge Restaurant - where we ate lunch) near "Poor's Bridge". In 1795, Benjamin Hill had mill property on the river. Records show that Joseph Towne, Simone Dow and Solomon Phelps were also taxed for mills within several years. Contoocook "was little more than a location of waterpower" at the time. Despite the mills bringing in men from far and near, the growth of homes in Contoocookville was delayed because of the annual flooding along the river. It was noted, "The area had an unsavory reputation and was considered, 'morally depraved' until after the Freewill Baptist Church was established in 1827." (Lords - Life & Times of Hopkinton) Plains Road in Contoocook was reported to be originally called "Poverty Plains Road" because of the many shacks on the road inhabited by all the women working in the silk mills.

The types of mills in Contoocook in the 1800's included: Saw Mills (which also manufactured Box kits & Mackerel kits), grist, silk, textile, threshing mills, fulling, clapboard, and paper mills. One of the most successful companies in Contoocook grew into the Kingsbury & Davis Machine Company; its story follows:

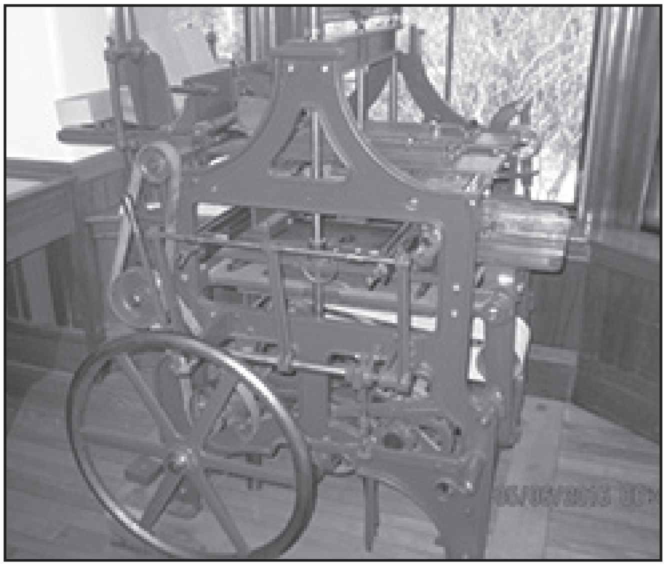
Walter Davis (1834-1899) - Walter lived and worked in the Contoocook and Warner area for his whole life. He attended Contoocook High School in the 1850s. Over time Davis became active in the lumber business. In 1866 with a partner, Davis built a large circular saw mill. In 1871 Davis and a new partner "bought the ruins of a burned paper mill (formerly Rowels in West Hopkinton), and built a straw board mill of twenty five hundred pounds capacity daily. Later it was changed from a sun drying mill to a steam dry mill." In 1873 two others were admitted to the firm and the capacity double. "In 1875 Walter Davis became sole partner and then took his brother Henry as a partner. The mill capacity was now six tons daily. The lumber business increased proportionately, and the result (was) success and wealth for the firm. Mr. Davis (was) so gifted in the inventive power that all the plans in use in the mills are his: and, as one instance, he patented a most useful gate arrangement for the turbine water-wheel, as also a machine for making paper boxes" - see photo. (from ACCESS GENEALOGY - Biography of Walter Scott Davis)

In 1887 Walter S. Davis purchases all the waterpower in Contoocook except for the sawmill of Frank Morrill. In 1890 Walter Davis joined with Addison Kingsbury to build a tree-story building and dam, producing enough power to supply the electricity needed for the building. They had enough power for "lights to fill 130 windows". (see *The Contoocook Village Quilt*) Davis and Kingsbury controlled the waterpower on the Contoocook River well into the 20th century.

In 1947, a new plant was erected and the company was acquired by FMC (Food Machinery & Chemical Corp.) in 1953. The Contoocook plant closed in 1971 and the operation moved to Pennsylvania, where it operated until 1983. At that time, it was acquired by Charles Crathern and Richard Smith, and renamed Crathern & Smith. Crathern Engineer-



Kingsbury & Davis mill building and dam in Contoocook, NH. (Photo by A.S. Currier, date unknown.)



Davis & Kingsbury Box Making Machine. (Photo by author.)

ing Co. Inc. operated in Contoocook until early 2000 making paper converting machinery and then became RSN Crathern but is now gone. *The original three story building was later leased to a Henniker chicken farmer; however, the village of Contoocook had to evict him as most of the residents objected to the odor.*

Demise of the mills

The large mills grew for the first couple of decades of the 1900's. Then, as other forms of power became available, the use of waterpower, provided by the mills, became less important. Also, cheaper sources of labor made it more difficult to compete with other manufactures outside New England. The Annual Report of Contoocook Mills Corp. (located in Henniker) is specific about the demise of the very successful mill located on the Contoocook River that was about to close.

The Annual Report stated that Net sales for the company peeked in 1918 at $1,216,995. From that point on, sales began to drop. Their net sales for 1930 were $164,100 for a net loss of $87,853. The company's 1930 report states that "The depression in the textile industry continued during the year 1930 but in a more acute way." In 1931 it was voted that the company be dissolved. All the mills located on the Contoocook River and elsewhere in New England experienced the situation at this time.

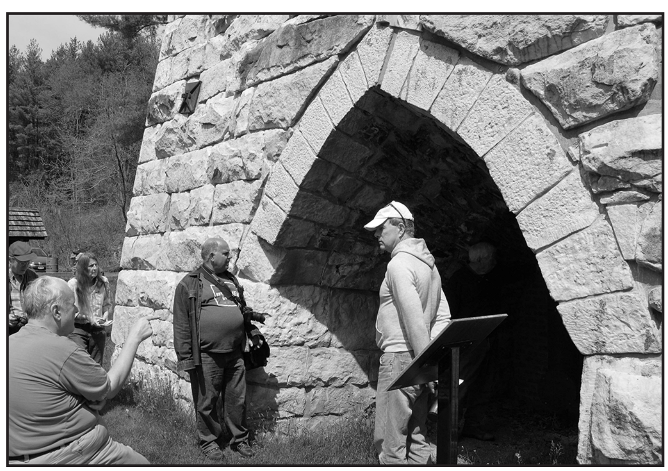
David Dunning
NNEC President
dunmark@tds.net
603-526-6939

SNEC-SIA Visit to the Salisbury Iron District

On May 14, 2016, SNEC-SIA members met in the hills of northwest Connecticut and eastern New York for a tour of three historic blast furnaces and a lime kiln located within the famed Salisbury Iron District. The day began at Beckley Furnace in East Canaan. We were greeted by the Friends of Beckley Furnace (FOBF), a non-profit organization formed in 1996 to preserve Connecticut's only official state industrial monument. The furnace was built in 1847 by John A. Beckley. It was sold to the Barnum & Richardson Company in 1858. It was rebuilt in 1880 and operated until 1919. The impressive stone stack that remains today is the remnant of what was once a much larger complex that included charcoal storage sheds, a charging bridge and casting shed. These wooden features no longer exist.

Several FOBF members, led by Ed Kirby and Dick Paddock, gave a brief overview of the iron making history of the area. Kirby explained how the area's geography made it ideal for the production of iron, since it contained all the basic raw materials needed as well as an abundance of waterpower. The Salisbury District was once known for producing high quality charcoal iron that was especially suitable for the manufacture of railroad car wheels. The presentation included an excellent collection of laminated historic photos, samples of the three basic raw materials used to make iron; brown hematite ore, limestone and charcoal, as well as various types of slag and finished iron artifacts.

In addition to the restored blast furnace, the Beckley Furnace site also includes a stone dam across the Blackberry River, once used to power the blowing engine as well as a sawmill. The dam was restored by the state in 2010. (See detailed article by Michael Raber and Robert Gordon in Vol. 33, No.



Dick Paddock of the Friends of Beckley Furnace discusses the tuyere arch at Beckley Furnace. (All photos by Marc N. Belanger.)

Lime Rock #2 Furnace

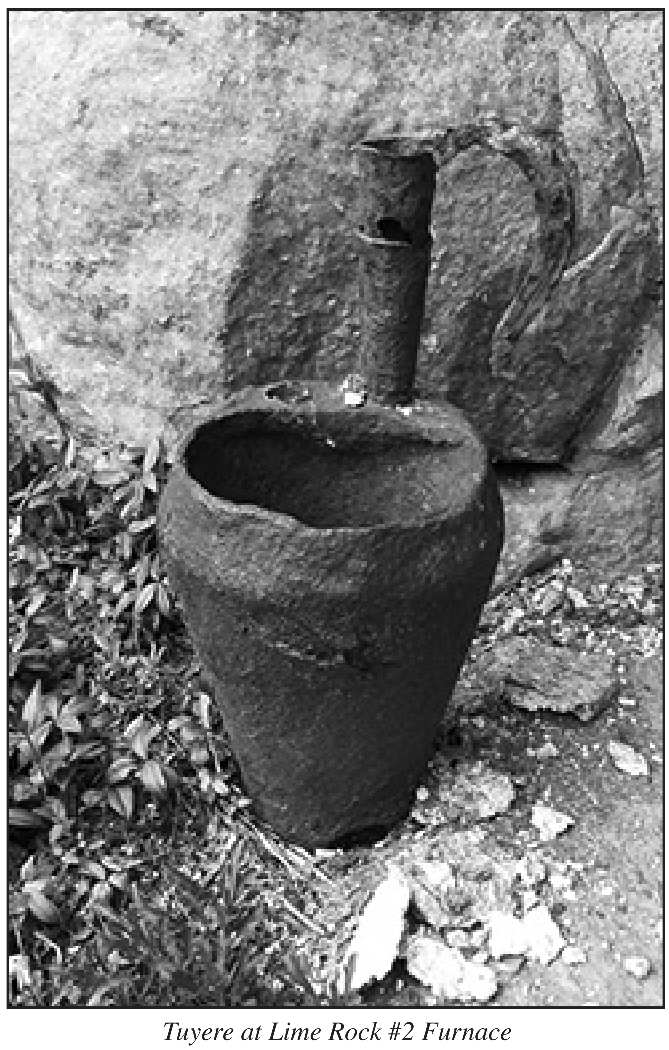
2 of the New England Chapters Fall 2012 newsletter.) Adjacent to the dam is the Hercules Turbine exhibit showing how the furnace's blast pump operated. Also nearby is a Leffel Turbine that was recently found buried in the mud along the riverbank, and once used to power the sawmill.

After lunch in North Canaan, the tour continued with a stop at Lime Rock #2 Furnace, in Lime Rock Village (within the Town of Salisbury). Located not far from the race track of the same name, the Lime Rock furnace site is unusual in that it is located in the yard of a private residence. What was once a busy industrial site is now a quiet residential neighborhood. The owners graciously welcomed us so that we could have a close up view of the site. The furnace was built in 1865 by the Lime Rock Iron Company and powered by the Salmon Creek. It too was purchased by Barnum & Richardson. This furnace has been restored. It is surrounded on two sides by high stone walls that once formed the foundation of the wooden structure that enclosed the furnace and casting shed. The site also contains small artifacts including several pig iron bars and a cast iron tuyere (nozzle).

Next we visited Sharon Valley Lime Kiln, located in the Town of Sharon. While unrelated to the iron industry, the production of lime (a.k.a. quick lime) was notable in the area due to the abundance of marble deposits (calcium carbonate). Lime "burning" reduces the marble to calcium oxide. Lime was used primarily in the building trades (mortar, plaster and paint) and by farmers to "sweeten" their soil. Built in the 1870's by Isaac Newton Bartram, the Sharon stack is constructed of locally quarried Stockbridge dolomitic marble. Unlike earlier intermittent-type kilns, which required the fire to be put out and cooled in between burnings and then reloaded, the Sharon kiln was a perpetual type and could be operated continuously. Finished product was raked out and cooled on a cement floor that was covered to protect the lime from rain. Once cooled, the lime was put into barrels and delivered to the nearby depot for shipment. The kiln operated until about 1905. It was sold to the town in 1941. The Sharon Historical Society has been in the process of preserving the structure since 2002. Interpretive signage has also been installed.

The final stop of the day was in nearby Copake Falls, New York, with a visit to Copake #2 Furnace in what is now Taconic State Park. The Copake Iron Works was founded in 1845 by Lemuel Pomeroy II, a gun manufacturer from Pittsfield, Mass. Power for the site was supplied by a dam across nearby Bash Bish Brook. The current furnace dates from 1872. It operated until 1903, although the foundry operation, which supplied castings for the Copake Plow Works, continued until about 1923.

We were greeted by Edgar Masters, of the Friends of Taconic State Park. In recent years, Copake Furnace has undergone an ambitious restoration effort. Once covered in



Tuyere at Lime Rock #2 Furnace

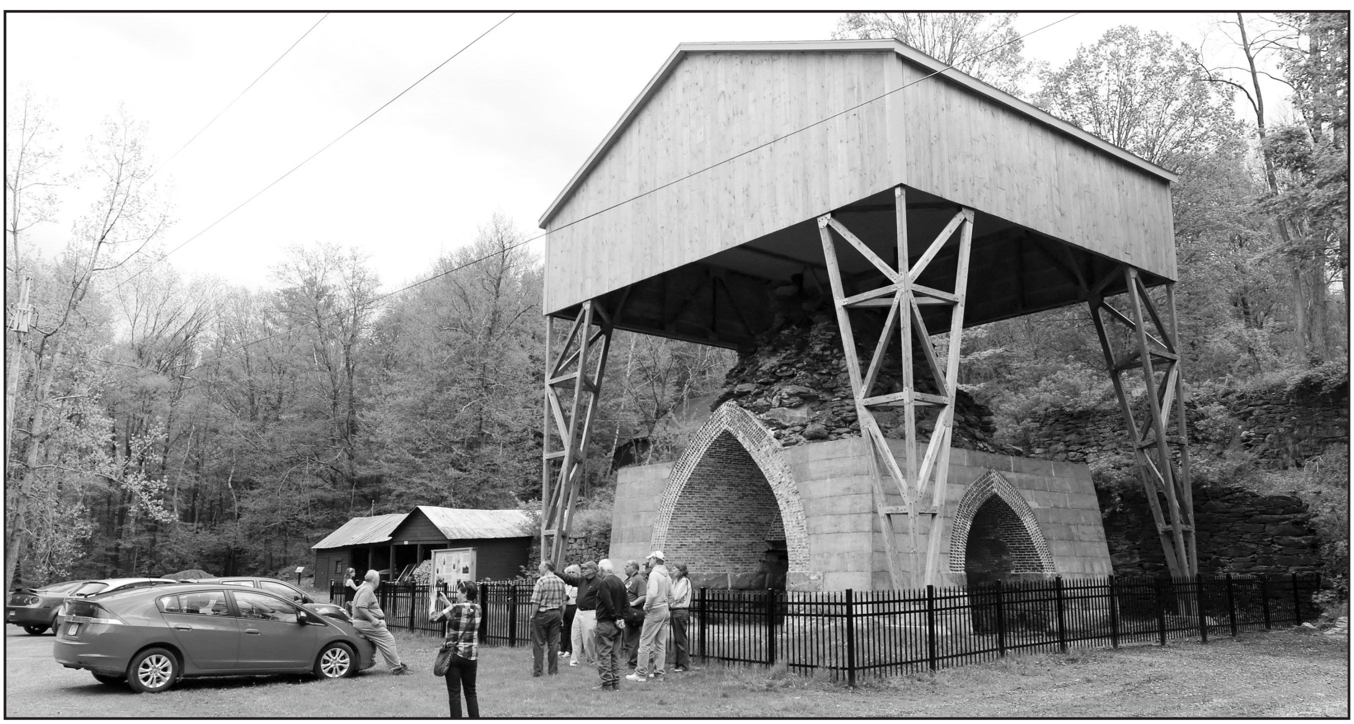
Sharon Valley Lime Kiln

vegetation and barely recognizable, the restoration efforts include the construction of a wooden canopy to protect the fragile masonry from further damage. The brick arches have been rebuilt, and the lower portion of the furnace has been stabilized with concrete blocks, carefully designed to mimic the furnace's original cut marble façade, which was unfortunately removed in the 1930's for the construction of a nearby roadway retaining wall. While the concrete blocks may seem unsightly to some, they serve an important function to prevent the structure from crumbling further. Copake Furnace is also unique in that it contains the only known surviving example of a cast iron water jacket, used to cool the lower portions of the furnace to protect the masonry hearth from the extreme heat of the crucible. Next to the furnace is Copake Iron Works Museum, located in the former blowing engine house of the iron works. The small museum contains an excellent diorama of the entire iron works and village when it was in operation, as well as a collection of machinery and tools, including several Columbia Chilled Plows. The grounds also contain various large artifacts related to the iron works and blast furnace.

Marc N. Belanger
Taunton, Mass.
mnbelanger@comcast.net

Select References and Further Reading:

- Friends of Beckley Furnace website: www.beckley furnace.org
- Friends of Taconic State Park website: www.friendsoftsp.org
- *The Iron Heritage Trail*, brochure and map published by the Friends of Beckley Furnace, 2012.
- *The Dam at Beckley Furnace, North Canaan, Connecticut: Documentation of Vernacular Engineering and Waterpower Issues*; Michael S. Raber and Robert B. Gordon, Vol. 33, No. 2, of the *New England Chapters Newsletter*, Fall 2012
- *Sharon's Industrial Monument*, article on Sharon Valley Lime Kiln, Town of Sharon website, www.sharonct.org



Edgar Masters of the Friends of Taconic State Park discusses the cast iron water jacket at Copake Furnace, with protective wooden canopy.

SNEC-SIA Tour of the Sudbury Aqueduct in Newton and Wellesley on Bikes

On August 13, 2016, an intrepid group of SNEC tourons mustered with their bicycles to tour a section of the Massachusetts Water Resources Authority's Sudbury Aqueduct – the section passing through Newton and Wellesley, Massachusetts.

Only since 2013 has the MWRA opened this section of the aqueduct's route for recreation. Since reading a Boston Globe article several years ago about this new dispensation, and the existence of the Waban Arches aqueduct bridge, I've wanted to check it out. Of course I'd go by bike, and I thought this might make a good SNEC tour. But what was there to see, apart from Waban Arches? Was this something a group could do safely on bikes? After many weeks of research and planning, a tour program materialized.

The Sudbury Aqueduct

First a bit about the subject of the tour: the Sudbury Aqueduct. It was built as part of the City of Boston's water supply system and was the first major expansion following the creation of the Cochituate system. Constructed between 1875 and 1878, the Sudbury Aqueduct carried drinking water from the Sudbury River watershed – initially Farm Pond in Framingham – some 16-18 miles, by gravity, to the Chestnut Hill Reservoir in Brighton. Although more reservoirs were built over time as demand for water increased, eventually new sources had to be developed (e.g., the Wachusett system and reservoir, which SNEC visited as part of a tour of Clinton, Mass., in 2008). In the 1970s, the Sudbury Aqueduct was taken out of regular service but is maintained for back up in emergencies. There was such an emergency in May 2010, when a water main broke, and the Sudbury Aqueduct was temporarily put into operation.

Today the MWRA manages the water supply and sewage/wastewater treatment systems for the Boston metropolitan area, including the Sudbury Aqueduct. The aqueduct's route, buildings, and structures are on the National Register of Historic Places.

The aqueduct consists primarily of a horseshoe-shaped conduit about 7 ½ feet high and 8 ½ feet across lined with brick (Figure 1). To carry the conduit across rivers and valleys, various structures were built, including high embankments, two bridges (Echo Bridge in Newton and Waban Arches in Wellesley), and the Rosemary Brook Siphon (across a low-lying section in Wellesley), as well as tunnel sections.

SNEC's tour on bikes

The first stop on the tour was Echo Bridge, originally Charles River Bridge, over the Charles River in Newton Upper Falls, which carries the conduit over the river (Figure 2).

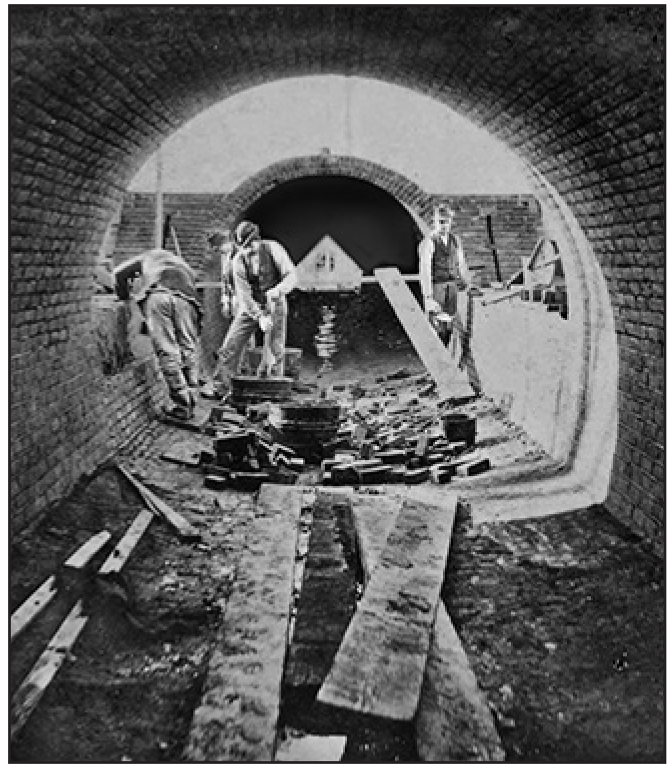


Figure 1. *Building the conduit of the Sudbury Aqueduct, 1876. The conduit is a brick-lined structure, about 7 ½ feet high. (MWRA)*

This is a masonry arch bridge formed of seven arches and, as built, about 475 feet long including the terminal chambers. It has inner walls made of brick and outer walls made of rubble stone faced with beautifully cut stone. Brick spandrel walls line the top, in which the conduit runs, and it is finished with an iron fence with "BWW" for Boston Water Works on the sides. And indeed, under the main arch, there is an excellent place to shout to hear an echo.

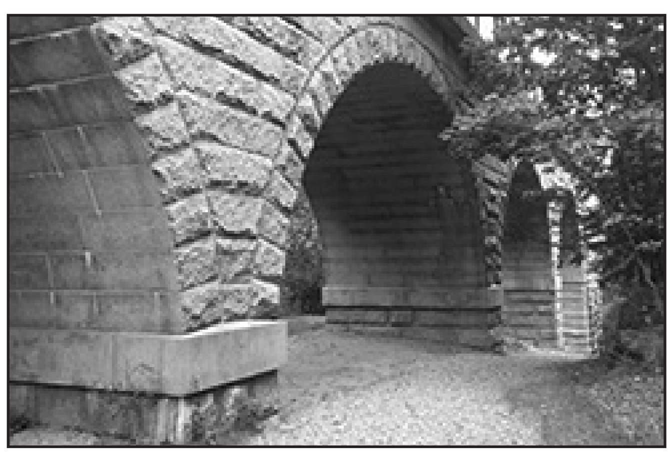


Figure 2. *Echo Bridge, a masonry arch bridge that carries the Sudbury Aqueduct over the Charles River at Newton Upper Falls, 2016. (Marc Belanger)*

Figure 3. *Rosemary Siphon; laying additional siphon pipe across valley of Rosemary Brook, connecting portions of the Sudbury Aqueduct, Wellesley, Mass., 1898. (MDC, Digital Commonwealth)*

From here we rode west along the embankment of the aqueduct to the next structure, the siphon that crosses the Rosemary Brook valley (Figure 3). The siphon carries water about 1,800 feet in iron pipes, and the pipes are connected to the conduit at small houses at the start and end of the siphon. These siphon-chambers are brick with stone trim, and the west one has a turret that was a lookout tower, although today trees obscure the view. These buildings were being repaired and are fenced off, so we could not get too close.

The next structure we encountered was the small brick house of Waste-weir C (Figure 4). This is over Fuller (a.k.a. Fuller's) Brook, which meanders through Wellesley.

Not part of the aqueduct, but worth a visit as we cycled across the Babson College campus, is the World Globe, so we stopped by. It is a 28-foot diameter outdoor globe built in 1955.

Figure 4. *Cycling along the line of the Sudbury Aqueduct in Wellesley, heading for Waste-weir C, 2016. (Marc Belanger)*

The last aqueduct structure we saw was the Waban Bridge, a.k.a. Waban Arches. It has nine arches and as built, measured 536 feet long. It carries the conduit over a low-lying area where Waban Brook meets the Charles River (Figure 5). Like Echo Bridge, this is a masonry bridge with fine facing stone, and internally it is of the same construction.

Next we returned to our starting place. The first leg of the return ride was along what had been Fuller Brook – the same brook that intersected the route the aqueduct. This little waterway, in what today is Fuller Brook Park, has been in a manmade course since the town acquired the land with the brook in the 1890s, for use as a park and sewer. After the park, we rode on town streets to a lunch spot and had a break. Then completed the steep final leg to the start.

Even the weather cooperated: the day was sunny and not too hot. There were five participants, and a good time was had by all.

Sara Wermiel,
Tour organizer and leader
Treasurer, SNEC

Figure 5. *Tourons, except for Marc Belanger (who was behind the camera), on the Waban Bridge looking at the stream below, 2016. (Marc Belanger)*

Volunteers Researching Amesbury's Industrial History

On September 10, about 35 members of the New England Chapters of the Society for Industrial Archeology and of the Amesbury Carriage Museum participated in the "Industrial Amesbury Tour" to learn about ongoing research into the industrial history of Amesbury, Mass. The effort is being led by John Mayer, executive director of the museum, with a team of about eight volunteer researchers.

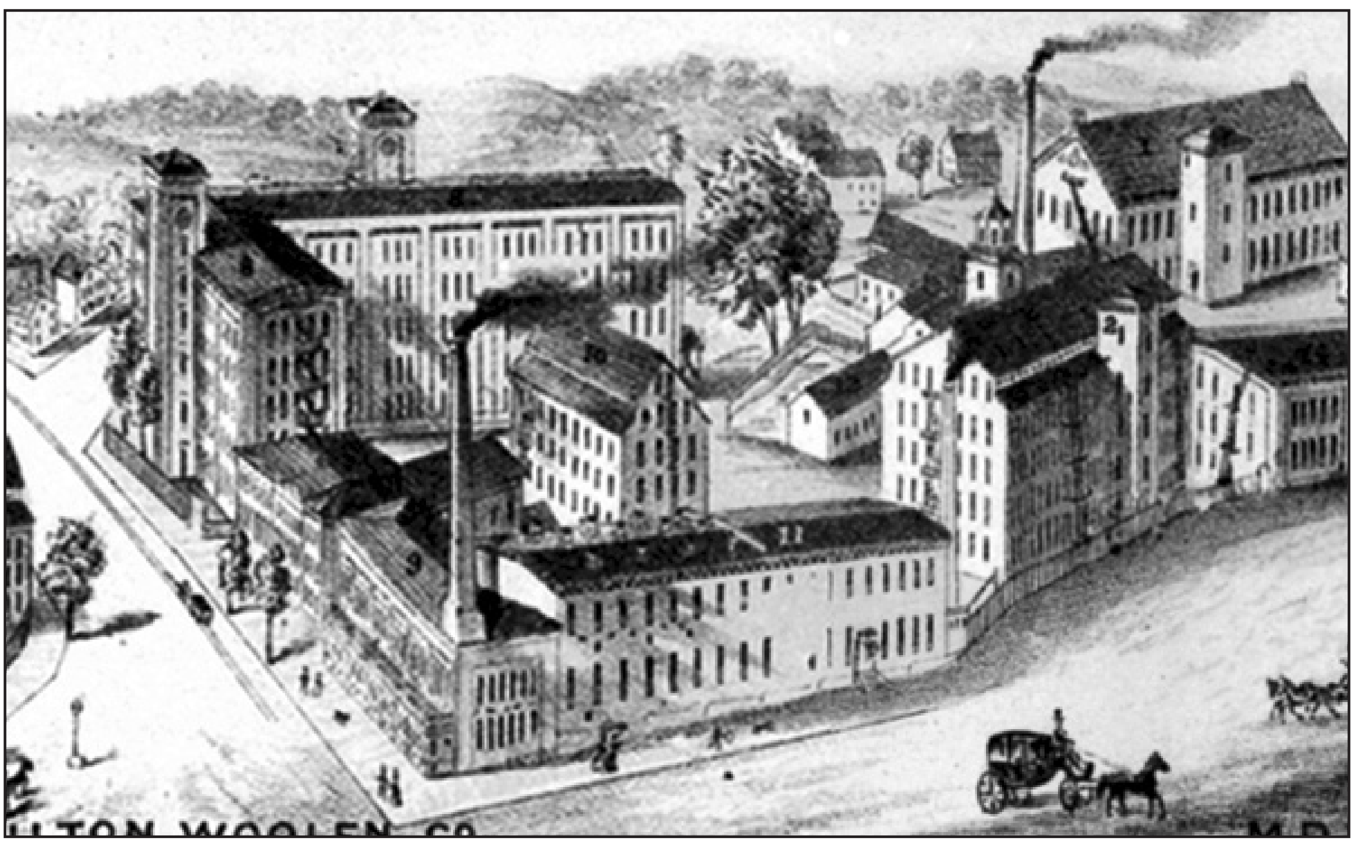
At work since the spring of 2016, the team has gathered a variety of sources that document the industrial history of the town. The team is working on a range of programs including an updated guide to the Amesbury millyard as well as museum-based exhibit and school programs.

While Amesbury is well known as a center for carriage and auto body manufacturing, volunteer researchers are uncovering a broader history of industry and innovation. The abundant waterpower and water transportation attracted Colonial-era entrepreneurs and industrialists, who built grist mills and sawmills on the falls of the Powow River. These mills were followed by iron works, nail-making mills, textile factories, hat and shoe shops, and carriage and automobile works. Industrial figures Ezra Worthen and Paul Moody, well known for their successes in Waltham and Lowell, got their start in Amesbury's textile factories.

The tour included visits to local workshops and industrial buildings. Here are a few highlights of the places visited on the tour:

Mill 2 (currently Amesbury Industrial Supply) – built 1825
Built in 1825 for the Salisbury Manufacturing Company, Mill 2 is now occupied by Amesbury Industrial Supply, a retail hardware store. Originally, the five-story building served as a woolen mill and a major component of the textile company that developed in downtown Amesbury. Those operations evolved through a series of acquisitions, the last textile company to own the building – the Hamilton Manufacturing Company – operated until 1914. The building was then used by the Bailey Company as part of automobile-parts manufacturing. In the 1980s, the Jardis family acquired the building, refurbished the space, and moved Amesbury Industrial Supply to the building.

The tour was able to visit all floors of the building. Unfortunately evidence of the early water wheel and raceways has been removed. Some stonework in the basement foundation appears to be the location of a penstock for a later turbine. The



1880 bird's eye view of Amesbury's millyard viewed from the north. Most of the buildings were the property of Hamilton Woolen Co. and were engaged in cotton and wool fabric manufacturing. The mill buildings in the foreground survive today as retail, office and other commercial space. From Amesbury and Salisbury Mills, Bird's Eye View, 1880.

building still has some original details including the stair towers with a step winding tread and years of wear. From the top floor of the building, the group was able to get a view of the remaining mill yard. Photographs from the 1890s illustrated the density of the yard at that time and the extensive removal and alteration of buildings that has happened over the past 100 years.

For hardware store enthusiasts, Amesbury Industrial Supply should be a destination. Two floors are open for customers, and the range of inventory is extensive, giving the feel of a historic hardware company.

Silversmith Process tour - Mill 7 (currently a mixed-use facility) – built 1848

In its space in Amesbury's Mill 7, Geoff Blake of Old Newbury Crafters provided a demonstration of hand-wrought silverware making, which has changed little over the last two centuries. In about 45 minutes, Geoff used a hammer and anvil to transform a 3-ounce sterling-silver bar into a handsome spoon ready for final finishing and polishing.

Blake showed how each piece starts with a brass pattern for gauging the final dimensions and shape. As hammering and shaping proceed, the piece is heated and quenched at frequent intervals to anneal or soften it, preventing the silver from flaking and cracking while being worked.

Old Newbury Crafters began producing hand-wrought silver products under its current name in 1915 in Newburyport, Mass. The company used an apprentice system to pass down the craft to the present day. The company prospered until the Great Depression, but it managed to survive by making its products "for a small but intensely loyal following," according to company literature. Volume again started to grow in the 1960's, with peak employment of 35 craft people in 1977. Old Newbury Crafters moved in 1979 from Newburyport to Mill 7 in Amesbury. A company history points out that Old Newbury Crafters silver pieces have been presented to John F. Kennedy, Gerald Ford, Queen Elizabeth II, Pope John Paul, Mao Tse Tung and the Empress of Iran. Today, the company is owned by a Connecticut businessman and still offers an extensive line of sterling silver flatware.

Mill 7, which houses Old Newbury Crafters and several other businesses, was built in 1848 on the west bank of the Powow River as a textile mill by the Salisbury and Amesbury Manufacturing Company. According to Massachusetts Cultural Resource Information System (MACRIS) data recorded in 1976, "The mill was originally 5 stories in height with a pitch roof, dormers, and two stair-water towers. A small brick wheel house is attached to the eastern end of this mill. The mill is essentially intact, and is a good example of Greek Revival mill architecture." MACRIS documents reveal that three floors were removed in 1927 and a storefront was created on the first floor adjacent to Main Street. The wheel house portion of the structure has been removed.

An 1854 map shows a dam adjacent to the building, and remains of water wheel machinery are said to still be visible in the basement. (The Carriage Museum researchers intend to investigate this further in the near future.) The dam shown on the map is no longer visible in the river bed.

Mill 4 (currently a mixed-use facility) – 1854

The visit to Mill 4 (21 Water Street) provided another look into an early textile mill. The building has been extensively modified for commercial use and now is a condominium for businesses. The group was able to ride a freight elevator to the attic level where the original queen post framing system is still intact. Like Mill 2, this building was also used by the Bailey Company for manufacturing of automobile parts. The group was able to see a small collection of late-19th century Bailey Company wagons stored in the attic as well.

Mill 4 retains much of its original features including an impressive granite foundation for the west façade of the building along the bank of the Powow River. Still visible is the opening for the turbine penstock and sockets for beams used in the lower dam.

Lunch time presentation – a Timeline and Analysis of Industrial Amesbury

A lunchtime presentation by volunteer researcher Mike Harrold outlined the rise, evolution and decline of Amesbury's textile and carriage-making industries. The presentation showed how textile manufacturing came to Amesbury about 1790. As this industry started to decline in the 1900's, the makeup of industry in Amesbury transitioned to low-capitalization and horizontally structured carriage and auto body manufacturing. While a single company (Hamilton Woolen Company) and its predecessors dominated the town's economy up until the 1880s, the carriage industry in Amesbury was distributed among about 200 sole proprietor and partnership businesses at its peak.

Amesbury's carriage-making began about 1805 in what is now the neighboring town of Merrimac, which was still Amesbury at that time. (Merrimac became a separate town in 1876.) This early manufacturing produced high-quality carriages with an average price of $250.

Carriage-making came into Amesbury's current borders in 1853, when Jacob Huntington started building carriages for the middle class, selling them at a wholesale price of about $100. Huntington was able to reduce costs by standardizing parts, using assembly lines (long before Henry Ford made this technique famous), and distributing to dealers and other outlets instead of selling retail to individuals. Compared with traditional carriage-making techniques, Huntington's factory made 2.5 times as many carriages per employee.

Huntington's methods soon spread to many other carriage manufacturers in town. Amesbury carriage production reached about 20,000 units in its peak year, placing Amesbury among the top five carriage-making towns in the U.S.

The world-wide Panic of 1893 caused a reversal of Amesbury's fortunes. This depression, which lasted until 1897, closed many businesses, including many of those in Amesbury. When recovery from this economic disaster finally began, the textile mills remaining in Amesbury were closing and moving to the south and carriage manufacturing was migrating to the Midwest.

At this time, carriage-making in Amesbury was evolving into auto body manufacturing. From 1900 to 1930, Amesbury factories produced car bodies for Hudson, Buick, Cadillac, Oldsmobile, Franklin and Stanley Steamer automobiles.

The internal combustion engine was still in its infancy, so steam and electric power competed during the first 15-20 years of auto manufacture. Stanley Steamer bodies were manufactured in Amesbury for cars built in Newton, Mass. The Bailey Company of Amesbury cooperated with Thomas Edison's battery development efforts by building a car called the Bailey Electric. Amesbury also produced electric trolley cars, starting about 1889.

According to a 1955 history of Amesbury carriage manufacturing by John Allen, the maker of the Bailey electric car said its cost of operation was "about one cent a mile, figured at a rate of six cents per kilowatt hours—less than the upkeep of a horse and carriage." In 1909 and 1910, road tests were conducted with the Bailey electric, and the car had been driven 11,000 miles by August 1911. Allen's history states, "This was considered remarkable mileage for an electric, and well above that attained by most gasoline cars at that time. The Bailey cars with Edison batteries could run one hundred and

1910 Bailey Electric car, made in Amesbury. Thomas Edison (left), driver George Langdon and Edwin Bailey of Amesbury. From History of Early American Automobile Industry, 1891-1929, *(www.earlyamericanautomobiles.com).*

fifty miles on one charge, and average a speed of eighteen to twenty miles an hour."

By the Great Depression in the 1930's, automobile manufacturing was becoming vertically integrated in Detroit and other Midwest centers, eliminating body making in Amesbury. The Bailey Company, however, continued to dominate Amesbury's economy. It no longer manufactured automobiles, but patented, perfected and produced felt-lined channels for automobile window glass until the 1970's.

Afternoon tour – Hume Carriage Co. and others (Chestnut Innovation Center) – built 1888/89

Mary Friery welcomed the group and provided an overview of the Chestnut Innovation Center, a "business incubator" recruiting tenants for the nearly 100,000 feet of space in this complex of buildings. This was less of a historical tour and more of an introduction to this newly created business operation. The Innovation Center leases spaces of a variety of sizes (some as small as 500 sq. ft.) to technical or manufacturing in the hope of creating a collaborative environment. There is a collection of machines available to tenants and an active exchange of ideas. Mark showed the work space for Blackburn Energy - http://blackburnenergy.com/ - a small company developing a regenerative braking system for long-haul trucks. The design of this system can be fitted to new or existing trucks and yields benefits of reducing fuel consumption and pollution.

D.T. Folger Carriage Building (Chestnut Innovation Center) – built 1880

The tour of the Innovation Center moved into the Folger Carriage Company building, another space that houses a number of small technical companies. The building is notable because it survived a major fire on "Carriage Hill" in 1888 that destroyed the majority of carriage-making buildings located there. Workers of the Folger Company climbed to the roof of the building and kept embers from igniting the structure. While the interior of the building has been heavily modified to accommodate the needs of manufacturers over the years, the name of the Folger Company is still visible on the exterior.
Plans for the Carriage Museum in Amesbury

John Mayer, executive director, provided information about the survey project as well as insights into much of the area history. John began working for the Museum in March 2016, and in a short period has begun to develop a program focused on the industrial history of the town. The Museum is exploring the potential to establish a heritage center in the lower millyard along with programs for local students and general visitors.

For more about the Amesbury Carriage Museum, visit www.amesburycarriagemuseum.com

John Mayer and Ron Klodenski
Amesbury Carriage Museum

Amethyst Brook Timber Dam, Pelham, Massachusetts

In January 2016 a team of industrial archeologists and historians, led by Jennifer Banister and John Daly, from The Public Archaeology Laboratory, Inc. (PAL) in Pawtucket, Rhode Island, was hired to conduct archeological monitoring and recordation of the Amethyst Brook Timber Dam (the Timber Dam). The dam was first exposed in Amethyst Brook as a result of natural fluvial processes set in motion by the 2012 removal of the Bartlett Rod Shop Co. Dam (BRSCD) approximately 400 feet downstream, which caused the down-cutting of the channel in the former dam's impoundment and the exposure of the Timber Dam structure (Figure 1). Prior to its exposure, the previously unrecorded Timber Dam had been completely buried under sediments in Amethyst Brook and was therefore treated as an unanticipated discovery under the terms of the Memorandum of Agreement executed for the BRSCD removal project. The Timber Dam was determined by the project partners, including the National Oceanic and Atmospheric Administration, Massachusetts Department of Ecological Restoration, Massachusetts Historical Commission, and Pelham Historical Commission, to be an impediment to natural fluvial processes in the reach of Amethyst Brook upstream of the BRSCD. In order to achieve the project goals, which included the restoration of aquatic habitat, partial breaching or mechanical removal of the Timber Dam was required.

PAL's archeological monitoring and recordation effort was guided by a set of research questions focused on the age, historical associations, and design of the structure. Historically, Amethyst Brook's rapid westerly descent out of the central Massachusetts uplands into the Connecticut River Valley afforded multiple opportunities for water-powered manufacturing. The stream has a rich and well-documented history of industrial use dating to the mid eighteenth century, with multiple closely-spaced privileges surrounding the Timber Dam site. PAL's examination of historical data during the preliminary assessment of the structure had yielded two hypotheses for the origins of the dam:

Figure 1. *General view of Timber Dam prior to excavation, looking northeast (upstream).*

1. The dam powered John Crawford's gristmill—the first in Pelham—active between 1739–1820.

And 2. The dam was associated with a forge (later used for a fulling and carding mill) established by Jonathan Snow between 1772 and 1792 and active until 1820.

Dam removal activities extended from the south (river left) bank to the center of the active stream channel; the north (river right) bank and dam segment were not excavated. After removal of sediment overburden through a combination of machine and hand work, the Timber Dam was recorded with high-resolution digital photographs, measured drawings, written notes, Total Station survey, and GPS mapping. A portion of the timber cribbing and the abutment were preserved in place. The results of the archeological recordation were detailed in a report filed with the Massachusetts Historical Commission.

The recorded portion of the dam measured approximately 55 ft long (north-south) and 20 ft wide and consisted of a 50 ft-long timber crib spillway and a 5 ft-long stone and wood abutment (Figures 2–4). The dam spillway had a triangular cross-section with a 6.6 ft-high downstream face, 20 ft-wide base, and approximately 18 ft-wide angled upstream face. The upstream face of the dam was partially collapsed. The dam frame was assembled from tree boles (up to 18 inches in diameter) saddle-notched and pegged into cribbing. All of the timbers were cut with axes and adzes, and no metal fasteners or hardware were found anywhere within the dam. The sloping upstream face of the spillway was sheathed in heavy pit-sawn planks measuring 9–14 inches wide and 1.5 inches thick, laid longitudinally, and pegged to the cribbing with 1-inch square treenails. Shallow carpenters' marks were preserved on the planks; "X"'s were used to indicate peg locations, and one plank was marked with a "□" symbol—a variation on the Roman numeral "I" often used as a framing mark. Additional tree boles were pegged longitudinally across the crest of the dam to serve as cap logs. Only limited data concerning the internal structural configuration of the spillway and any spillway substructure could be recovered. Select transverse timbers in the lower courses of cribbing were squared off along their top faces and mortised, apparently to accommodate vertical bracing. Very few rocks were noted within the spillway cribbing—apparently the stone ballast that was often used in crib dams was not employed at the Timber Dam. The stone and wood abutment was structurally integrated with the spillway. The core of the abutment was dry-stacked fieldstone and was flanked on two sides by the cribbing of the dam spillway. A vertical log projected

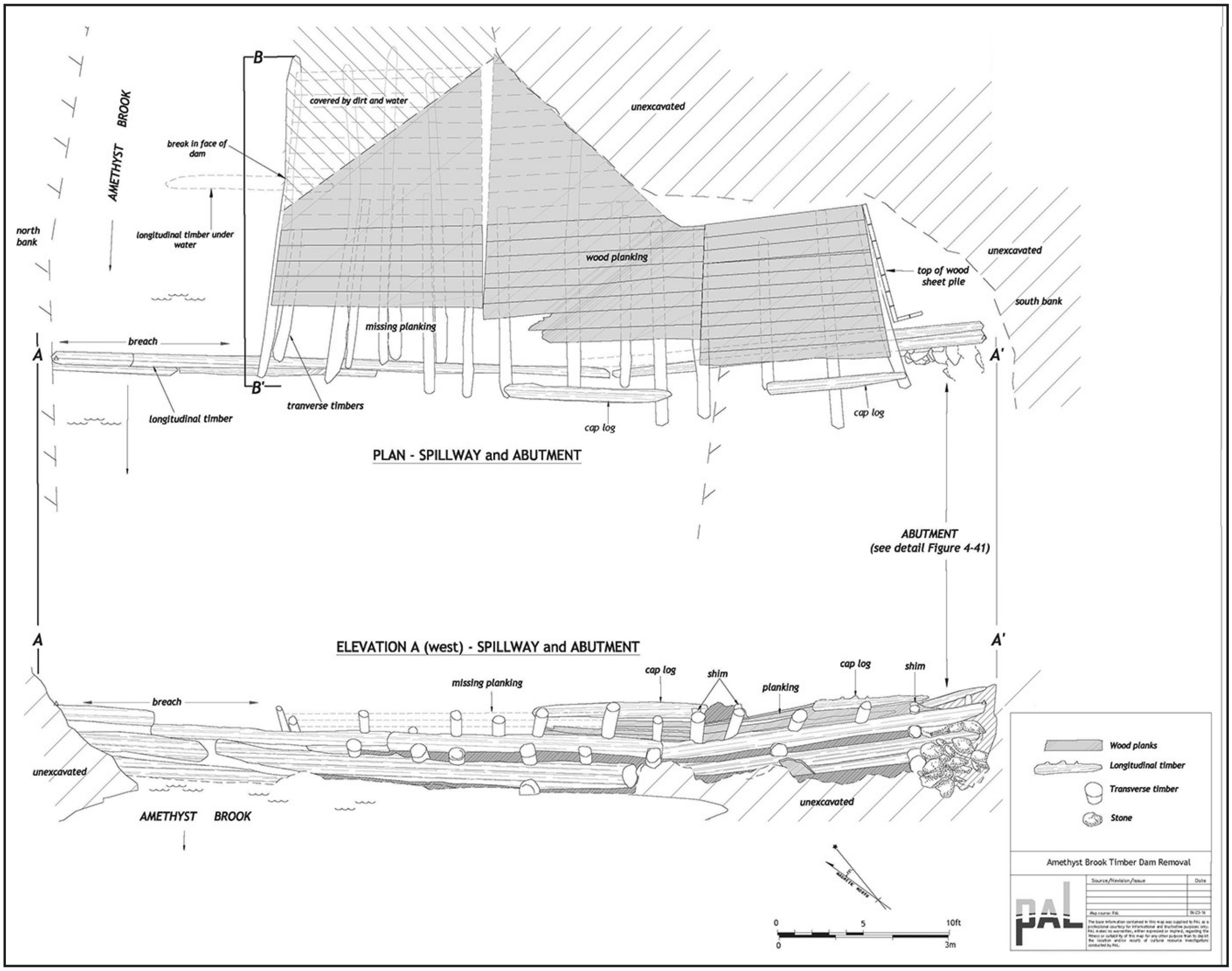


Figure 2. *Plan and elevation views of the excavated Timber Dam at Amethyst Brook.*

from the top surface of the abutment and presumably served as a piling to anchor the structure horizontally. Vertical sheet piling of heavy planks was driven between the abutment and spillway to form a spillway training wall. No water control features such as gates, flumes, or canals were found; and no non-structural cultural artifacts were recovered that could assist in dating the dam.

The general design and configuration of the structure indicates that it was a run-of-the-river (weir) type structure typically used for small scale milling and manufacturing in New England between the seventeenth and early nineteenth centuries. The dam's design and workmanship corroborated PALs' original hypotheses (but did not confirm either of them), indicating that the structure was likely built between circa (ca.) 1740 and 1820. Two elements were particularly noteworthy in this respect: the limited use of sawn lumber and the lack of metal fasteners. Sawmills were not established in Pelham or adjacent Amherst until 1740–1745, providing a strong beginning date for the possible period of construction of the dam. A review of dam and waterpower engineering trade publications (including Oliver Evans's 1795 treatise) suggests that engineers and builders shifted from joinery and pegs to metal fasteners as soon as it was feasible. By the late nineteenth century, these works described the use of metal fasteners in wood dams as a component of "modern methods" of construction that eschewed traditional carpentry techniques such as those found in the Timber Dam.

As anticipated, the Timber Dam relies on traditional vernacular design principles of dam construction that were imported from Europe, chiefly the triangular, timber, gravity-type structure that has a long history of use in North America and is described in professional treatises. The abutment design, in particular the use of vertical plank sheet piling, may also be found in these publications. However, the mortises found in the spillway of the dam show that the structure utilized a combination of timber crib and frame dam elements, rather than relying exclusively on timber crib design as previously anticipated. This hybrid timber crib/timber frame design demonstrates that early dam construction in New England can vary widely in practice and underscores the value of archeological survey of such structures.

Figure 3. *General view of fully excavated Timber Dam, south bank of brook looking northwest.*

Figure 4. *General view of fully excavated Timber Dam, north bank of brook looking southwest.*

The dam's design implies that the contractor or millwright responsible for its construction had some knowledge of dam construction techniques, but two noteworthy deviations from these techniques indicate that the builder probably did not have a high level of experience. The Timber Dam lacked a downstream apron for the spillway—a feature generally recommended to prevent scouring and undermining. Also, the Timber Dam spillway crest incorporated raised cap logs, a discouraged practice as spillways were (and still are) designed to allow the easy flow of debris over the structure to prevent damage. Amethyst Brook is an extremely active stream with highly variable water levels. These deviations from established norms may have created ongoing maintenance issues, and the apparent subsidence or collapse of the Timber Dam—initially attributed to the overburden of sediment, may be due in part to scouring caused by a lack of a spillway apron.

Analysis of archeological data recovered from the Timber Dam within the context of Pelham's industrial development and the history of New England building technology and dam engineering answered many of PAL's research questions and provided insights into traditions of vernacular timber dam construction in New England. The Timber Dam was almost certainly associated with the Crawford or Snow mills and was built in the eighteenth century during Pelham's early industrial and economic development. The dam is an outstanding and well-preserved example of a timber crib dam—possibly the oldest recorded intact timber dam in the Commonwealth of Massachusetts. Future archeological investigation of the dam site, combined with additional archival research and wood species identification and dendrochronology, could more definitely pinpoint the Timber Dam's historical associations and construction date.

John Daly and Suzanne Cherau
The Public Archaeology Laboratory, Inc.
Pawtucket, RI

River Restoration and Dam Documentation at Two Connecticut Sites

As many readers of this newsletter know, there has been increasing interest in removing non-operating, often poorly-maintained dams in New England to restore river environments and fish passage. Despite their importance in the region's industrial history, dams disrupt a river's natural course and flow, alter water temperatures, redirect river channels, transform floodplains, and disrupt river continuity. In addition to transforming the biological makeup of rivers, dams also prohibit the natural migratory patterns of native fish species. Several centuries of water-powered industrial development led to construction of over 14,000 dams in the region, of which over 150 have been removed since 1990 – almost a fifth of dam removals in the United States. In many cases, these environmental improvements remove significant historic resources, often when a dam is a potential flood hazard or a poor candidate for fish passage via a ladder. Fish ladders or fishways, in use for over a century, vary greatly in effectiveness depending on design, species, and height of passage. They require maintenance, and will provide relatively limited benefits if installed on dams which are failing and unlikely to be repaired. For industrial historians, however, dam removals can provide opportunities to study vernacular engineering features which can only be revealed during demolition.

Archeological monitoring, at two recent examples on Connecticut streams flowing into Long Island Sound, contributed new information on the wide variety of designs used by entrepreneurs at relatively small projects, usually without professional engineering assistance. These projects were completed by the Connecticut Fund for the Environment's Save the Sound program, with federal and local partners. Based on assessment studies or other information, the Connecticut State Historic Preservation Office concluded both dams appeared eligible for the National Register of Historic Places, and initiated steps leading to documentation studies at each site.

Dam Locations and Removal Project Objectives

Pond Lily Dam, New Haven

Pond Lily Dam is just east of Whalley Avenue (Route 169) on the West River, an approximately 34.5-square-mile drainage tributary to Long Island Sound at New Haven, with headwaters in Bethany, Connecticut. About half the drainage area is upstream of the dam, which is the most downstream impoundment on the river above tidewater. Prior to dam construction, topography and sediment sampling suggested the channel above the dam had a sand, gravel, and cobble streambed flowing through a low floodplain amenable to ponding by an impoundment built on higher ground at the dam site. West of the river and upstream of the dam, historical pond limits extended approximately 700 feet (Figures 1,3).

Removal project objectives included restoring free-flowing river habitat, enabling passage of target anadromous fish species, and mitigating the danger of potential dam failure. The target species were alewife and blueback herring. Collectively known as river herring, these species form an essential part of the marine ecosystem. These species are foraged by almost every creature in the marine environment, including cod, haddock, bluefish, tuna, dolphins, and whales, and are eaten by gulls, ospreys, and eagles. Regional dam construction has greatly reduced the populations of river herring, which are now protected under the U.S. Fish and Wildlife Service Anadromous Fish Conservation Act. A steel Alaskan steeppass fish ladder installed at the west end of the spillway in 2001 had not been very effective. Removal of the Pond Lily Dam spillway restores a natural migratory corridor for river herring and other anadromous and diadromous fish to approximately 1.7 miles of the West River, as well as to 60 acres of prime spawning and nursery habitat located upstream. The project reinforces other restoration efforts completed for the West River, including installation of tide gates at the mouth of the river to improve migratory fish passage. The two projects together expand and restore the range of migratory fish native to the West River.

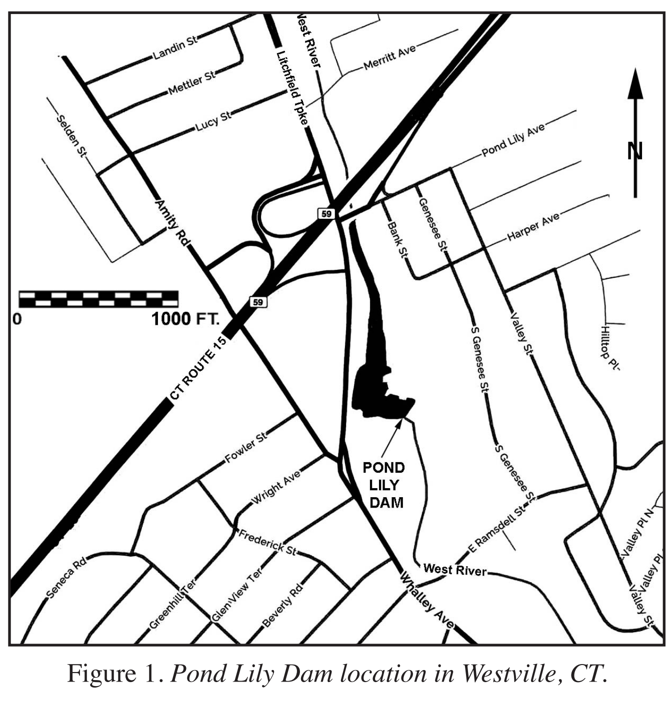


Figure 1. *Pond Lily Dam location in Westville, CT.*

Hyde Pond Dam, Stonington/ Groton/Ledyard
Whitford Brook is the main tributary of the tidal Mystic River, flowing through the towns of North Stonington, Stonington, Ledyard, and Groton. Hyde Pond Dam is located approximately 3000 feet upriver of tidewater, at a shallow drop in the brook created by a narrow glacial moraine deposited on gneiss bedrock. The moraine, with coarse sediments and boulders, impounded a late glacial pond with a bottom of fine compact sediments, on which later meltwater and streamflow deposited sand and gravel. Holocene alluvium accumulated in the broad floodplain above the moraine. Original dam design discussed below is unknown, but may have extended across the entire channel and floodplain at the moraine. The impoundment created by the dam filled with sediment over the years, and was actively transitioning from open water to a scrub-shrub wetland complex. The dam was in deteriorating condition, and a fishway first installed in 1985 did not function properly, effectively halting migration of anadromous species at the Hyde Pond Dam (Figures 2,7).

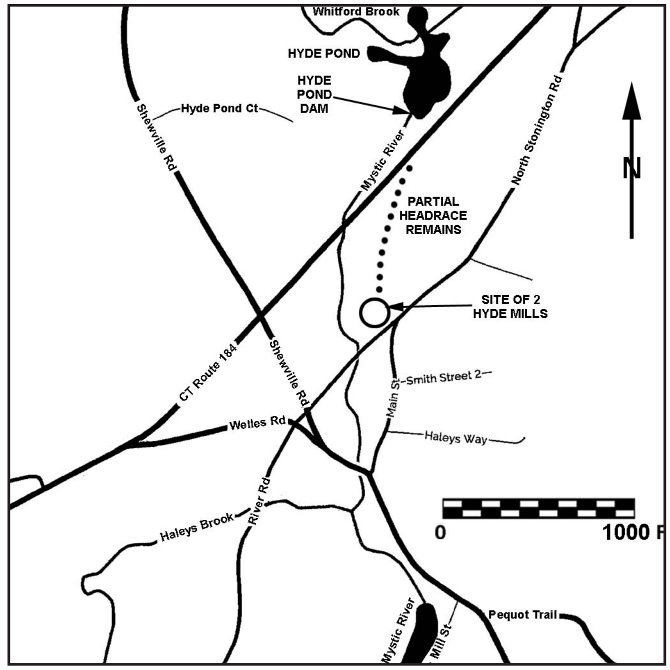


Figure 2. *Hyde Pond Dam location in Old Mystic, CT.*

The dam was the most downstream to fish migration on Whitford Brook, which hosts sea-run brown trout, alewives, blueback herring, American shad, and American eel. In addition to serving as forage species in the marine ecosystem, sea-run brown trout and American shad also serve as forage buffer species that reduce the impact to Atlantic salmon during their migration. The American eel is critical in transporting mussels to new habitat. Taken together, the restoration of these species establishes and supports a functioning freshwater ecosystem, with the end goal of improvement to marine commercial fisheries. Removal of the dam opened an additional 4.1 river miles to active migration and access to forage, spawning, and nursery habitat.

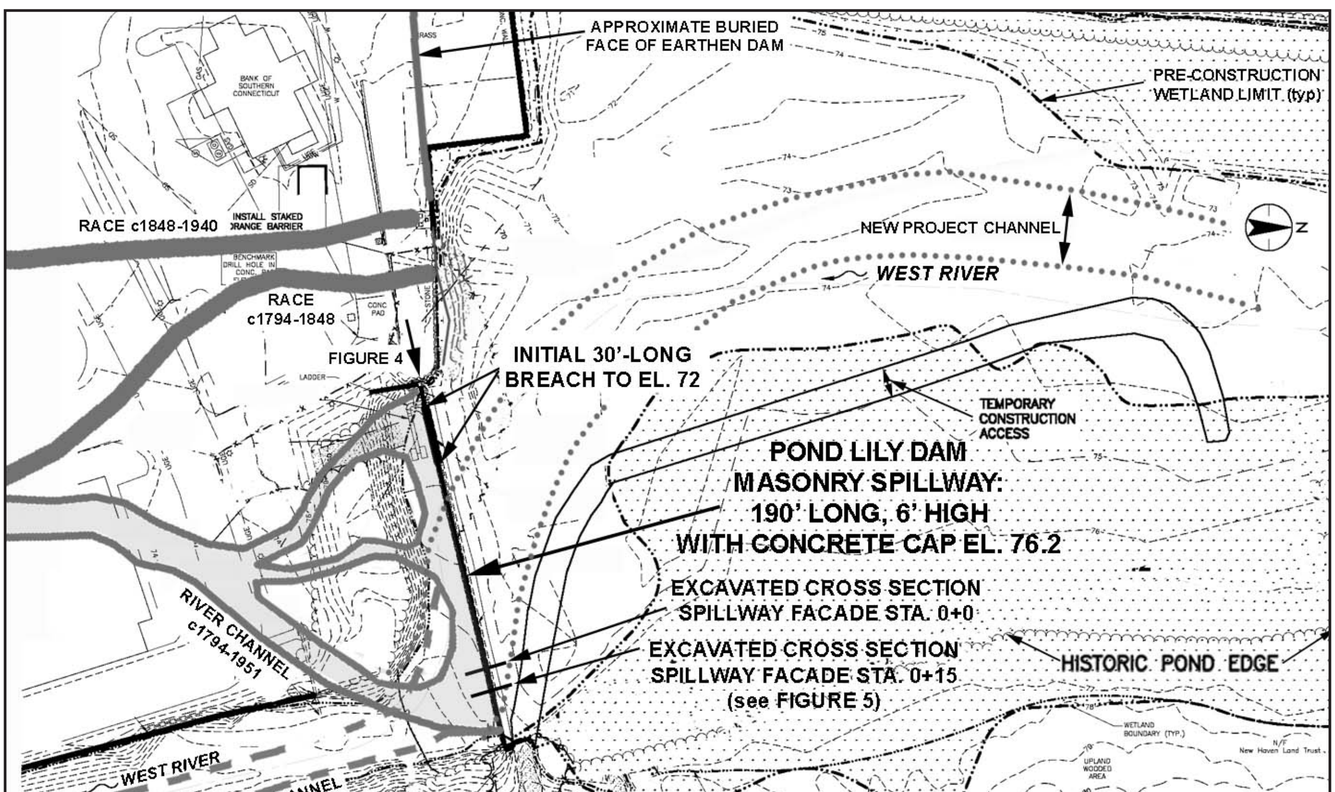


Figure 3. *Pond Lily Dam project area with approximate historical channels and races.*

Dam Designs, Histories, and Documentation Results

Pond Lily Dam

Pond Lily Dam was a gravity structure immediately east of Whalley Avenue (Route 69) with a 250-foot-long earthen section adjacent to the road, and a 190-foot-long spillway serving as an overflow weir. The dam was not well-documented and has been partially obscured by recent commercial reconstruction of a large former industrial site. There were no known low-level outlets. The earthen section has a vertical masonry upstream face, replaced in part by a concrete wall which now angles upstream to enclose fill added after 1995. It is possible the earthen section has no foundations but is instead a modified edge of original land along the floodplain.

The dam spillway crest was approximately 2 feet lower in elevation than the adjacent earthen section. Incomplete information available prior to the 2016 removal project suggested the spillway consisted of rock, cobble and/or compacted earth, with an approximately 7-foot-wide base sloping into the pond upstream of the spillway crest, a vertical rubble masonry downstream face 4.3-6.1 feet above the riverbed, and a 1-foot-thick, 4.5-foot-wide unreinforced concrete cap. There were no pre-removal data on spillway foundations, or on any structures in the spillway embankment retaining the coarse fill. At the east bank, the spillway had a mortared-rubble, 2-foot-thick training wall approximately 15 feet long. West of the river and upstream of the dam, historical pond limits extended approximately 700 feet. An earthen berm along Whalley Avenue defines most of the original west side of the pond. Downstream of the dam, the pre-removal 50-foot-wide river channel ran from the spillway's east end, defined by approximately 12-foot-high gabions on both banks for over 250 feet (Figure 3).

The dam is in the Westville section of New Haven, where early industrial development was limited to several 18th-century grist and paper mill sites along the West River downstream of the later Pond Lily Dam. All use of the West River at this location probably required a dam across the full width of the river, as opposed to a wing dam, to create a pond high enough to feed races excavated through the face of the earthen dam section. The length and height of the impoundment may also reflect concerns about high-water events, prior to construction of dams upstream in the late 19th or early 20th centuries. A wing dam or a lower spillway may have been more subject to potential flooding, and as discussed below one flood event prior to construction of the dams upstream did inflict significant damage.

Until circa 1951, the river below the dam had a sinuous course up to 200 feet west of the present channel, but relatively long races were required to secure sufficient head to run waterwheels or turbines. The first such project was a grist mill built by Levi Sperry in 1794, which may have operated in the 1840s. The Sperry family owned the property into the late 20th century and ran a textile plant noted below, but for most of the 19th century it appears the family leased the site to other manufacturers including a triphammer and machine shop (late 1840s-1856), and a paper mill (circa 1865-95). The spillway failed during an October 1869 freshet, following a severe storm which led to dam and bridge damage through much of New England. The paper mill was evidently not operating in mid-1870, suggesting at least some of the present spillway dates to a reconstruction

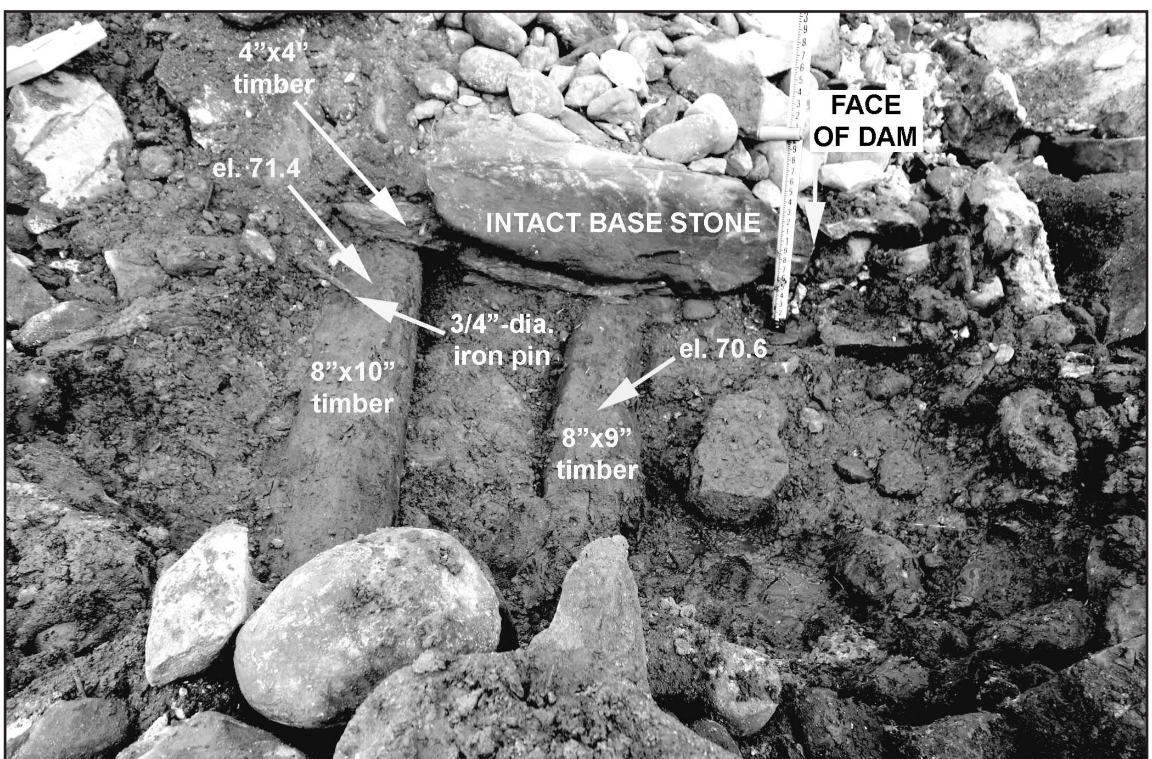
Figure 4. *October 2015 view east of Pond Lily Dam profile exposed during initial breach. Two concrete caps are visible, along with full width of spillwat backfill. Couresy of Santec Consulting Services, Inc.*

completed that year. Waterpower drove a 30-hp turbine, but was probably insufficient to run the mill's beaters and a Fourdrinier machine during all periods of operation in 1880, when the mill ran six months full time and six months at half time. Several steam engines may have supplemented waterpower as well as perhaps providing steam to the paper machine's drier section. It is not known if the paper mill still relied on any waterpower by 1890. In the apparent absence of a low-level outlet in the dam, sediment probably reduced the storage capacity of the pond, and would have been very difficult to remove. Beginning in 1896, the Sperry family took more direct control of the site, owning and sometimes running the Pond Lily Company which dyed and finished cotton piece goods, shoes, and other fabric until 1978. The steam-powered plant used the pond for process water, and retained erone race as an intake as well as a drain for at least industrial wastewater. To accommodate plant expansion, the company re-channeled the river into its approximate present course circa 1951. The channel was reinforced as a flood control measure in 1982 (Figure 3).

Creation of a new stream channel in 2016 required removal of the entire spillway including footings for the masonry face, with the earthen embankment section left in place. Archeological monitoring included two principal components: inspection, photography, and measurement of features exposed during an initial breach at the west end of the dam; and controlled machine excavation and supplementary hand-powered exposure of masonry spillway components at two cross sections, each approximately 5 feet wide and located approximately 15 feet apart. The breach revealed three previously-undocumented spillway components investigated later in the excavated cross sections: a substantial unreinforced concrete cap/rear spillway wall behind the cap visible at the spillway face; several disarticulated 6-to-8-inch-diameter timbers; and several disarticulated pieces of yellow pine sheet piling with pointed ends. The rear cap proved to extend along the entire spillway, and as discussed below was not a uniform feature. The sheet piling was originally installed immediately behind the rear cap. The breach also revealed the spillway and its earthen backing were far wider than first estimated (Figures 4-6).

Monitoring data indicated there were at least two and possibly three undocumented episodes of spillway construction, making the spillway a composite structure. The earliest component included a simple timber framework to support boulders at the base of what monitoring indicated was an unmortared spillway face. The principal timber members, set parallel to the spillway face on an approximately 4-foot-wide bed of cobbles probably placed on the riverbed as fill, were two lines of 8-by-9-to-10-inch logs milled with slightly beveled edges. The timbers were set approximately 1.2 feet apart, with the lowermost near the spillway face and the second line set at the elevation of the top of the first line. Short timbers, 4 to 6 inches in diameter, were installed on top of the principal members to join the two rows. Monitoring of the two 5-foot-wide sections did not reveal more than one cross piece in each section, suggesting the cross piece interval was probably 6 to 8 feet. The means of fastening the cross pieces to the principal timbers remained somewhat unclear, but included spikes and notched connections (Figures 5-6).

Figure 5. *Annotated January 2016 detail to north-east of intact Pond Lily Dam timber footings exposed at Station 0+15. Most of spillway face was demolished prior to excavation of eroded section. See Figure 6 for reconstruction of complete spillway cross section.*



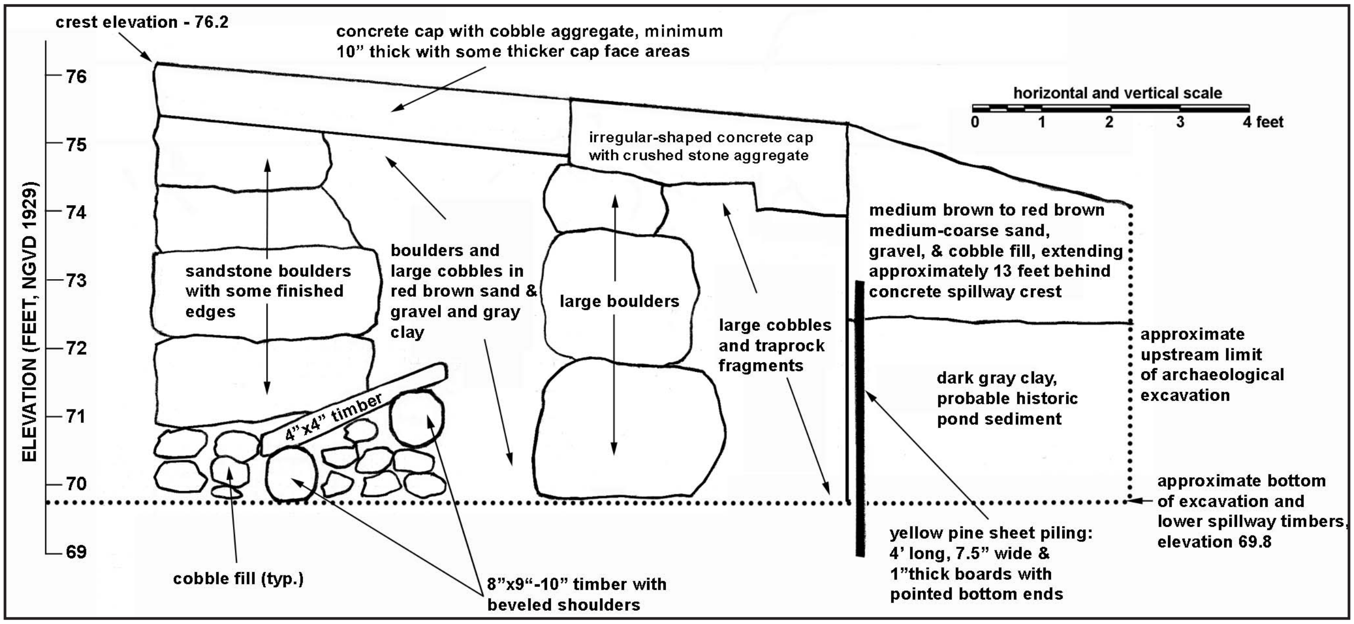


Figure 6. *Typical Pond Lily Dam west-facing spillway cross section, approximate spillwat facade Stations 0+0 to 0+15.*

The timber framework, likely dating to original dam construction in 1794, formed a simple, lightweight 1-cell-deep crib structure, set at an angle to receive large boulders as a base course for a 1-stone-deep spillway face approximately 4.5 to 5 feet high and 3 feet deep. The unmortared sandstone boulders in the face were of widely-varied size, and some had partly finished edges to accommodate fitting. The face was backed with earthen fill, of unknown original depth or composition. Monitoring revealed another rough wall of very large stacked boulders approximately 2.5 feet behind the face course, retaining fill of boulders and cobbles in a matrix of red-brown sand and gravel with some gray clay. It is not clear if the crude rear wall of boulders was part of original construction, or whether it was added during one of at least two reconstruction episodes with the first documented in 1870. It is possible the original spillway fill extended well upstream of the face with no visible footings or rear wall (Figures 3,6).

The original spillway cap, if any, is not documented. As noted above, there were two concrete caps revealed during monitoring. The front cap was a minimum of 10 inches thick and approximately 6-7 feet deep, with a discontinuous front face thickness but a very uniform crest elevation. It had cobbles as an aggregate, and was most likely a Portland cement concrete intended for submerged conditions. Portland cement, developed in England beginning in the mid-18th century, was imported to the United States from England and Germany by the mid-19th century and first manufactured in this country circa 1871-75. By the late 19th century, Portland cement concrete aggregate was commonly crushed stone rather than cobbles, which is what was visible in the rear Pond Lily Dam spillway cap. The chronology of the dam as well as the availability of the material suggests the front cap was installed during the 1870 dam reconstruction. As the cap's width appeared to reach the interior wall of large stacked boulders, it is possible this stack was part of original construction, but as noted above it is also possible the stack was added in 1870.

The rear concrete cap likely dated to sometime between the late 19th century and the closure of the Pond Lily Company in the 1970s. This cap was part of a major reinforcement of the spillway, including excavation of 2-3 feet of clay pond sediment behind the wall of large boulders at the upstream side of the earlier spillway components described above. The upstream side of the trench was evidently held in place by driving the yellow pine sheet piling noted above. The top of the sheet piling was approximately 1 foot below the upstream end of the concrete cap, suggesting the piling may have been driven before the cap was poured. The sheet piling may have served primarily as a cut-off structure to resist undermining of the spillway. The stabilized trench was then filled with large cobbles and traprock fragments to an elevation just below the top of the boulder wall, and the cap was poured in a somewhat asymmetrical manner. The cap has an ell-shaped section with irregular surfaces and varied dimensions, although the upper rear edge appeared to have a consistent elevation. The cap was 3.5-4.5 feet long, approximately 1 foot high at the downstream edge where it met the earlier cap, and had a rear face 2.5-3.5 feet high. The final component of this reinforcement episode was fill deposited on the pond sediment extending approximately 13 feet upstream of the concrete cap, consisting of medium brown to red brown medium-coarse sand, gravel, and cobbles (Figures 4,6)

Hyde Pond Dam

The dam prior to 2015 removal activities was a 200-foot long structure with two 15-foot-wide, approximately 6-foot-high earthen embankments lined on both faces with large rubble or rubble masonry walls, and a 4.8-foot-high, 41-foot-long concrete-capped spillway with an unmortared masonry downstream face retaining earthen fill of sand, gravel, and cobbles. The spillway masonry, consisting of large boulders below a top course of semi-finished blocks and a 6-inch-thick concrete cap, was approximately 4-5 feet wide at the top and 15 feet wide at the bottom, resting on dense deposits of material similar to the backfill. Spillway backfill extended approximately 50 feet upstream of the masonry, although it is possible some of the backing represented post-construction alluvial deposits. The downstream face of the east embankment was similar to that of the spillway, while the facing of the west embankment consisted only of large boulders with no well-defined upper course. The embankments were approximately 2 feet higher than the spillway. Prior to installation of the steel steeppass fish ladder in the west embankment, there was a 10-foot-wide, 5-foot-deep rubble masonry channel in that embankment, and a 12-foot-wide, approximately 10-foot-deep rubble masonry channel in the east embankment. The smaller channel may have been associated with a gristmill discussed below, and the larger channel may have served as an emergency spillway. Fish ladder construction and repair was evidently associated with the addition of the concrete cap to the spillway, and installation of a 4-foot-diameter corrugated-metal-pipe low-level outlet in the east embankment channel (Figures 7-8).

Whitford Brook and the Mystic River became political borders in the colonial period. Groton was part of the original town of New London, established in 1646 by John Winthrop, the Younger, who later served as governor of the Connecticut colony for most of the period 1657-76. English settlement of present Groton along the Thames River began in the early 1650s, and a small number of English families settled along both sides of the Mystic River a few years later. New London's eastern border was a matter of contention between

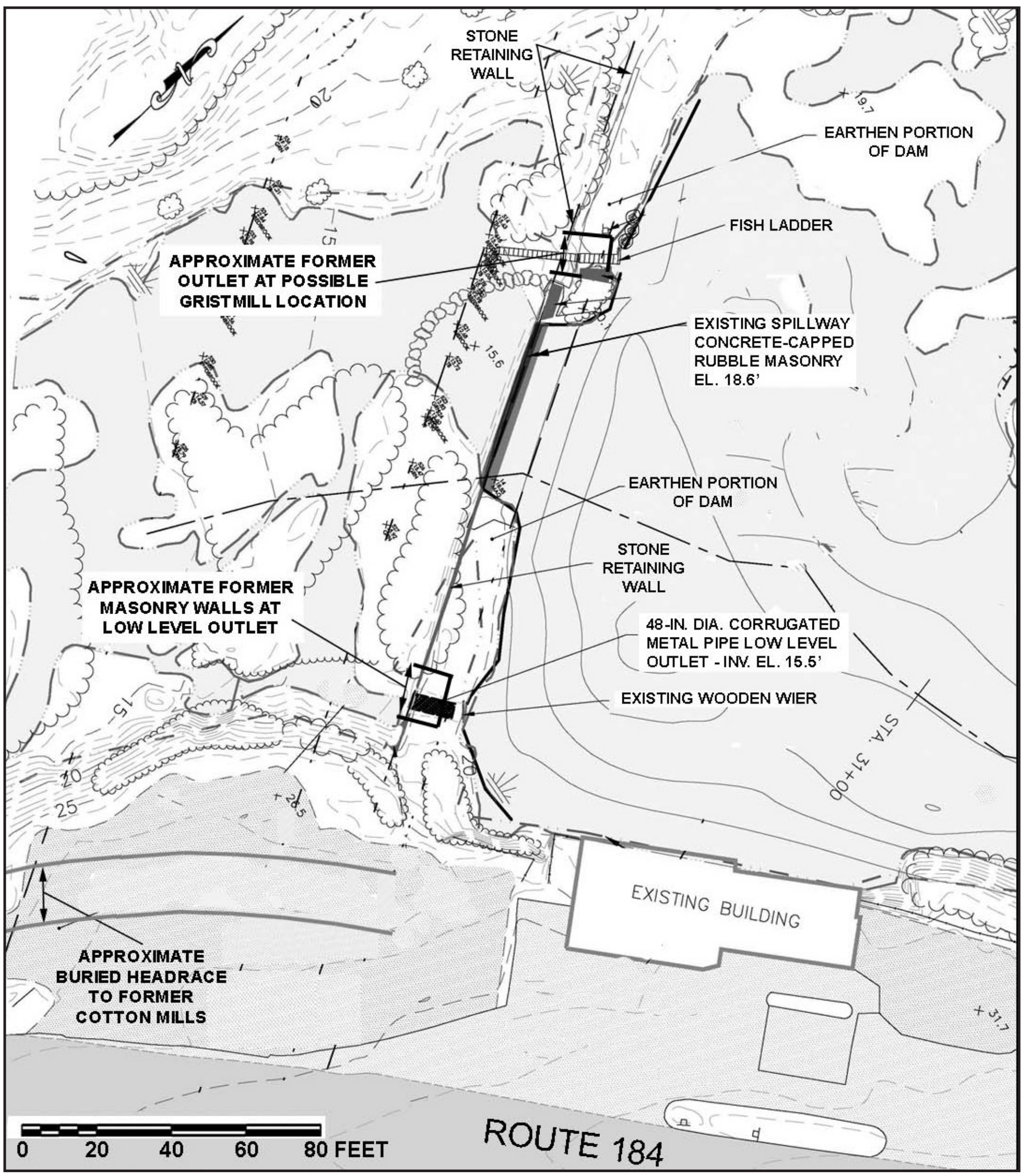


Figure 7. *2014 plan of Hyde Pond Dam with buried or modified features. Sources: Fairchild Aerial Survey, 1934; Victor Galgowski 1972.*

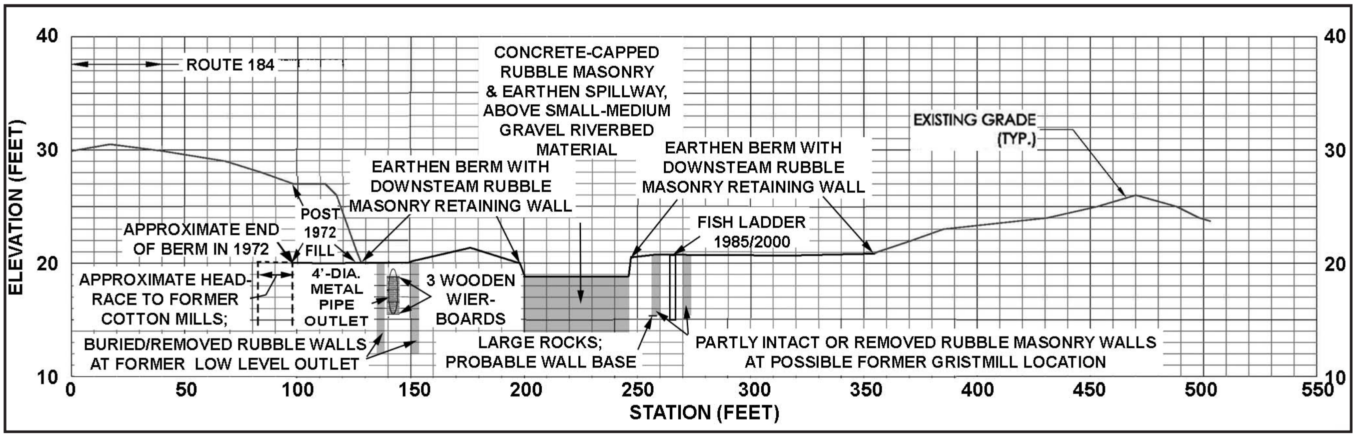


Figure 8. *2014 upstream Hyde Pond Dam elevation with buried/modified features. Sources: Fairchild Aerial Survey, 1934; Victor Galgowski 1972; 2015 archaeological monitoring.*

Connecticut and Massachusetts Bay Colony for some years, but appears to have extended initially to Mystic River until Connecticut's southeastern boundary was established at the Pawcatuck River in 1663. Probably soon after the 1663 boundary adjustment, Winthrop received a grant of both sides of Whitford Brook from head of tidewater to Lantern Hill in present North Stonington. His son Fitz-John Winthrop built a gristmill circa 1674 on the west side of the brook in present Groton at or very near the location of present Hyde Pond Dam. The mill was expanded with a fulling mill, rebuilt in 1699, and operated until 1813-14. Owner Stephen Avery leased the privilege and possibly the mill building to the Mystic Manufacturing Company, whose 1814 state charter of incorporation noted the firm's intention to undertake cotton or wool cloth production, gristmilling, and machine shop work. By 1822, shareholder John Hyde gained control of the company, which built two new cotton mills in Old Mystic at the end of a 1100-foot-long earthen headrace which ran from the east side of the present dam. The location of the headrace and the chronology of textile operations beginning in 1814 suggest the present dam is located at the impoundment first built for the 17th-century gristmill, but it has not been possible to date pre-1980 dam components. Given the enlarged scale of operations in the 1820s, requiring more waterpower, it is possible some of the dam was rebuilt by the Mystic Manufacturing Company. The gristmill was not operating by 1833 and was perhaps removed in the 1820s. The cotton mills evidently had insufficient waterpower from the approximately 7-acre pond, and were fitted out with at least one steam engine during initial construction. This appears to have been among the earliest uses of steam power in a New England textile mill, likely facilitated by proximity to the tidal Mystic River for coal delivery. The pond may also have provided water for cloth-dying operations. Hyde's sons continued cotton production and dying until the business failed in 1873.

Part of the headrace for the cotton mills was filled or removed during the 1935 construction of present State Route 184, but the headrace intake at the dam was apparently largely intact after road construction until after 1972, when the southeast end of the dam including the headrace intake was buried under 8-10 feet of fill for expanded operations at an auto repair and towing business above the south end of Hyde Pond along Route 184. The stone-lined channel through the embankment west of the brook may correspond to the gristmill location, but no evidence of the mill was observed prior to or during 2015 demolition activities. Construction of fish ladders at this channel in 1985 and 2000 could have removed evidence related to the mill. Aside from the dam, remains of the Mystic Manufacturing Company facilities include sections of the approximately 15-foot-wide earthen headrace south of Route 184, and what appears to be the east and fragmentary south unmortared masonry walls of the northern mill (Figures 2, 7-8).

Archeological monitoring of spillway removal did not indicate any stone or timber foundations under the spillway face or backing. Monitored excavations extended 6-7 feet below the spillway bottom. A small number of disarticulated pointed timbers, approximately 6 feet long and 6 inches in diameter, were found within spillway fill, perhaps representing sheet piling from original dam construction which was removed during modifications made to the dam for cotton mill operations. The absence of any foundation structures under the spillway or the embankments appears highly unusual among contemporary structures.

Significance of Documentation Findings

The Pond Lily and Hyde Pond dam spillways are example of masonry overflow weirs with vertical or nearly vertical faces of blocks, boulders, and rubble on sand, gravel, and cobble streambeds. Overflow weirs must resist potential undercutting of the spillway by falling water or partial vacuum conditions created between falling water and the spillway face, as well as upward pressure on the upstream face which could lead to sliding in sandy streambeds. At both dams, the latter problem was addressed primarily by earthen backing. Backing in similar structures elsewhere frequently included rubble-filled timber framing, sometimes associated with spillway footings of large stones or arrays of timbers, but there was no such framing in either case. Like many contemporary mill dams in the northeastern United States, both dams ware almost certainly designed and built without professional engineering assistance, at least until 20th century modifications.

At Pond Lily Dam, the narrow spillway face of large unmortared stones, backed by coarse materials, offered little resistance to spillway undercutting. Design solutions in other dams could include timber or masonry downstream aprons, construction of low dams downstream to create cushions of water, and curtain walls of sheet piling or masonry against the upstream face. The boulder wall behind the spillway face may have represented a crude effort to create a curtain wall, and the sheet piling likely installed in the 20th century appears to have been an attempt to inhibit undercutting or displacement of spillway face stones. The poor condition of the spillway prior to removal appears to reflect limitations in original design which subsequent reconstruction and repair could not fully address. The most important decisions in this regard were the lack of any low-level outlet construction, and the lack of deeper timber framing or masonry footings to allow for more substantial spillway masonry given the porous nature of the channel bed. The former problem decreased the ability of mill operators to reduce sediment build-up in the pond, and lower water levels during periods of high flow. The dramatic increase in sediment and wetland development raised the river bed elevation, narrowed the channel upstream of the spillway, and increased the potential for flooding and damage to the spillway. The spillway appears to be one of the longest built in Connecticut, and its length may have been particularly notable in the late 18th century. The lack of wider timber framing, masonry footings, or a stronger rear masonry wall appears unusual relative to other 18th-and 19th-century examples. It is possible the dam's large scale, especially relative to its original use for a small gristmill, may have led mill owner Levi Sperry to proceed with the lowest-cost plan to impound the entire West River. Monitoring revealed that in this case, vernacular design was not entirely successful, in contrast to the relative stability seen at many other contemporary but smaller structures, including Hyde Pond Dam.

Hyde Pond Dam lacked any signs of an apron, stepped downstream face, or curtain wall, but had no history of failure. The probable, undated low-level outlet contributed to dam stability, but the rare structural simplicity of the dam may reflect a combination of geological conditions, partial downstream obstruction, and a certain amount of intuition or skill on the part of the unknown builders. The glacial moraine and Holocene alluvium underlying the streambed at the dam location provided not only potential rubble construction material, but a dense base of boulders, sand, and gravel not readily undermined by streamflow below the spillway or embankments, or by falling water at the spillway. The spillway's low height and upstream backfill diminished the threat of upward pressure from the head of water. Streambed materials appear to have acted as a natural apron, a condition enhanced by the shallow gradient of the brook downstream of the dam which diminished the velocity of water over the weir. Downstream flow was also diminished, and somewhat backed up, to an unmeasured extent by two road crossings in the village of Old Mystic approximately 1600-2200 feet from the dam: the early east-west Pequot Trail which continues west of Whitford Brook as Welles Road, and the section of present North Stonington Road north of the Pequot Trail. The latter crossing was built as part of the Groton-Stonington Turnpike c1819-1820, shortly before the cotton mills were built. Although original dam design c1674 remains uncertain, the builders chose a spot with at least a slight natural drop and a base allowing little if any foundation preparation. Even without allowing for any pondage, Whitford Brook streamflow may have sufficed to run the gristmill for many years. It is possible that backwater created by the turnpike section across the brook slightly diminished head at the dam, further increasing the need for steampower at the two mills built by the Mystic Manufacturing Company

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Michael S. Raber
Raber Associates

Elsa E. Loehmann, P.E.
Associate Director of River Restoration,
Save the Sound, a project of
Connecticut Fund for the Environment

Firm Buys TransCanada Dams in New England

By John Lippman
Valley News Staff Writer
Tuesday, November 01, 2016

Wilder — A Boston-based private equity firm managed by an energy industry investor with deep ties to the Tuck School of Business at Dartmouth College has emerged as the buyer of the Wilder dam and 12 other hydroelectric power facilities along the Connecticut and Deerfield Rivers in Vermont, New Hampshire and Massachusetts.

ArcLight Capital Partners said late Tuesday that its affiliate Great River Hydro had signed a definitive agreement to acquire TransCanada's New England hydroelectric power assets. TransCanada announced in March that it was putting its New England power generation business up for sale in order to help finance its acquisition of a Texas natural gas company.

Terms of the deal were not disclosed. TransCanada bought the 13 hydroelectric dams in 2005 for $505 million when their former owner, USGen of New England, was in bankruptcy.

The deal came the same day that Tuck announced the formation of the Revers Center for Energy, named after Tuck alumnus, board member and ArcLight co-founder Daniel Revers. Tuck said the center was established with a "generous gift" from Revers to educate "leaders in the field of energy, making permanent the activities of the Revers Energy Initiative to facilitate student education and career exploration in this important and multifaceted sector."

A spokesman for ArcLight did not return a call for comment.

Vermont for several months weighed whether it should buy a partial or full stake in the dams, but a working group last month recommended that the state not do so. Some documents indicated the dams could be worth close to $1.4 billion, VtDigger reported.

The Wilder Station, as the dam is officially called, has been in operation since 1950, is a major source of tax revenue for both Hartford and Lebanon.

Hartford officials had expressed concern that if Vermont acquired the dam it would create a hole in the town's budget because state ownership would exempt the property from the tax roles. Presumably the town and state would have hammered out an agreement over payments and maintenance, although there could be no assurances of the outcome.

The Wilder dam, which Hartford assesses at $32.4 million, contributed $750,000 in annual tax revenue to Hartford in 2016, or about 6 percent of the town's total tax revenue — roughly equivalent to what the town spends on its planning department and library.

Lebanon, meanwhile, assesses the Wilder dam at $44.9 million, which generated $563,000 in tax revenue for the city during the year's first half period, according to online tax records. TransCanada says that the 13 hydroelectric stations pay property taxes in 53 communities in the three states in which they operate.

ArcLight, in its announcement, said the company "has committed to retain all existing operational personnel, plans to assume the recently negotiated union contract, and will continue the (Federal Energy Regulatory Commission) relicensing process currently underway at the Bellows Falls, Wilder and Vernon facilities."

The Wilder dam's license is set to expire in 2018.
The Wilder dam backs up the Connecticut River 45 miles upstream to Newbury and Haverhill, according to the Hanover Conservancy, and receives drainage from 3,375 square miles of watershed in the Twin States.

The three turbines have a combined generating capacity of 41 megawatts.

One megawatt of hydroelectric-generated electricity can power between 750 to 1,000 "average" homes, according to the Electric Power Supply Association, although actual amounts can be less and depend on a variety of factors, including geographic location, plant equipment and demand.

ArcLight Capital, which says it has invested in more than $3.1 billion in "renewable power assets" in the U.S., was co-founded in 2000 by Revers, a 1989 graduate of Tuck who also sits on the business school's board of overseers and previously endowed the Revers Professor of Business Administration.

On Tuesday, as part of announcement about the Revers Center for Energy, Tuck unveiled a new website featuring the center's three professors and eight fellows, the latter all members of the Class of 2017.

Tuck said the gift "continues Revers' long-standing support of Tuck and its students. Revers provided catalyzing funding to launch the initiative in 2012, endowing the Revers Professor of Business Administration that same year. Revers has also shown his appreciation for Tuck by funding the Revers Board Fellows Program and a faculty fellow."

John Lippman can be reached at 603-727-3219 or jlippman@vnews.com.

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