Seeing at this point the mill power has appeared, the next logical question to follow should be how did they measure the water flow through the wheels or turbines to establish the mill power? There were two methods that were popular for measuring water flow. The first was simply a hollow pipe weighted on one end and its travel over a measured distance was timed. From that test, the amount of flow could be calculated.

In the case of the water wheel, or turbine, the flume (or weir) was the measuring device of choice.\textsuperscript{30} In the beginning it was simply a wooden chute of known dimensions installed in the tailrace so the amount of water passing through the wheel could be measured with some degree of accuracy. It was cumbersome and wasn’t a piece of equipment to be left in the tailrace permanently.\textsuperscript{31} It was only utilized when there was a doubt as to how much water the mill was actually using verses what they were being charged for. The mill contracted and paid for X mill power and that’s all they were entitled to.

After the advent of the turbine, the measuring end got a little easier with the adoption of the speed gate. Even though the gate that controlled the flow of water through the turbine traveled in feet, the indicating arm only traveled in inches. It was graduated and once the amount of water passing through the turbine for any given indication on the scale was known, by measuring the flow through a flume, or weir, there was no reason for the reading to ever vary. The exact flow could be calculated simply by comparing the scale to as prepared chart.\textsuperscript{32}
About all of the scant material that research has produced has been gone over in the previous text. And all of the material is adaptable to every single mill complex in the system, and every wheel and turbine. No matter what part of this book contains a reference to mill power, it will refer to this section and chapter.

This closing will be accompanied by a representation of the Hamilton Mill complex. One thing all of the cotton mills had in common was the use of every square inch of land that they sat on, and the Hamilton was no exception.
Appleton Manufacturing Company

Incorporated in 1828 to be built to the west of and abutting the Hamilton Mills, the water to power the wheels was drawn from the Hamilton Canal and discharged 13 feet below into the Lower Pawtucket Canal. And like the Hamilton Mills, the buildings were contracted for by the PL&C and the machinery built by the Lowell Machine Shop now fully incorporated into the PL&C. The Hamilton and Appleton Corporations had much in common, including many of the same directors and shareholders active in the Merrimack and Locks and Canals Companies.

The constructions of the Mill buildings have no bearing at all on the water power that flowed through their underground raceways. Still, it doesn’t hurt to acknowledge the existence of the end user of the mill power. To expand on the statement that the PL&C constructed the buildings for the Appleton Corporation, we have to back off a little. When they were scheduled to build and equip the first two buildings, the Merrimack Mills suffered a disastrous fire in 1829. All was put on hold while the Merrimack was reconstructed and refurbished by the PL&C.

Into the picture enters one Capt. John Bassett, a well known builder of the time. It appears, or at least he is given credit for erecting the first two buildings for the Appleton Company. The record of the Directors meeting of July 11, 1829 states “The agent having exhibited a statement of the cost of the Machinery Mills Houses etc. (sic) built for the Appleton Manufacturing Company by the Proprietors of the Locks and Canals on contract.” The fact that the work was done by contract lends some credence to the notion that in fact the buildings were erected by an outside contractor and not by the PL&C themselves. An entry from the Lowell Historical Records found in a volume of Contributions also supports Bassett as being the builder.

But like any well told tale of history, this one also seems a little distorted by a teller somewhere down the line. The fact is on February 4, 1828, a charter incorporating the Appleton Company was awarded to T.H. Perkins, E. Francis and S. Appleton. The fiction seems to be in the statement made by Joshua Merrill that “During the summer of 1828, the Appleton Mills were put into operation” and the statement attributed to Samuel Batchelder that “By the end of 1828, the Appleton Company had commenced operations.”

It’s difficult to disbelieve these statements considering the stature of both the speakers. Joshua Merrill was a leading educator and Batchelder was an original investor in the Hamilton Mills. And yet in the Director’s Record of the Meeting of September 7, 1830, it appears the Directors are still debating over building and equipping two mills for the Appleton Company. It’s doubtful that they are a third and fourth mill building because according to Frank Hill in his book Lowell Illustrated, 1884; those additions were built in 1846 and 1861 respectively.

Also it is stated elsewhere that a mill building could not be put up and machinery installed in one season. If the charter for the Appleton Company was granted in 1828, no way could two mill buildings be up and running by the end of the year no matter who built them or how esteemed the person who described the happenings.

The Appleton was conceived by two long time associates, P.T. Jackson who was one of the founders of the PL&C and Paul Moody who was the top machinist in the system and came from the Boston Manufacturing Company in Waltham when the Lowell Mills were proposed. Along the way Moody had perfected the mill machinery used in the industry that gave it a higher rate of speed and promised great savings and his anticipations were justified. Jackson was an interested investor and it was
he that established the company known as the Appleton Company to utilize Moody’s improved machinery.

Like all other Lowell mills, the Appleton started out with breast wheels providing the motive power. The diameters of the wheels were usually the same as the fall of the head of water which in the case of the Appleton would have been 13 feet. Wood was the standard construction material of both the wheel and shafting back then, and when the change over to iron began it was slow and caused many problems because of the poor quality of the metal.

One thing the Locks and Canals had no shortage of was talent. When reading the history of this company and the feats that were achieved by the workmen using the most rudimentary tools and basic education, it is just short of amazing. How did we evolve into the cluck headed excuses for engineers today still working on $400 toilet seats and having trouble digging a ditch?

Uriah A. Boyden had been a surveyor with the Locks and Canals until moving on in 1834. Where he moved on to was learning all he could about waterpower which was the liquid gold of the day. Boyden’s main interests lie in turbines.

In 1844 Boyden convinced the agent of the Appleton to allow him to construct and test a turbine for a new mill building that he had been experimenting with. The chief engineer for PL&C, James B. Francis aided in the testing and verified the increase in power of the machine while at the same time occupying less space. The bells were sounding the death knoll for the breast wheels, muted at first but getting steadily louder.

It didn’t take the PL&C long to buy up the Boyden patents on the turbine, especially with Francis verifying the results of the tests. And it didn’t take much longer for the PL&C to convince the manufactories to switch over from the breast wheel to the turbine for the savings offered in the use of the water with the same results in horsepower. Still a fairly large expense was involved on the part of the Companies and there is evidence that breast wheels were still supplying 20% of the power to the mills in 1876.36

Finally we are returning to the subject of the waterpower and again to a very light agenda of information available. One thing all of the waterwheels or turbines had in common was the need for water, a lot of water for as said, that was their fuel. The Hamilton Canal had a great excess and seemingly no end but it was useless as a power source for the Appleton Mills without the underground raceways that would funnel the water from the canal to the wheelpits and then provide a return path to another but lower water course in the Pawtucket.

And in the case of the of the Appleton Mills, it is in the most perfect location that a mill could be built, on a spit of land flanked by two flowing canals, the Hamilton 13 feet higher than the Pawtucket as they rush by on either side.
This photo by Janet Pohl is of the Hamilton Canal taken from the street crossing the bridge from the Appleton Mill on the left to Jackson Street on the right.

This photo is by the author of the Lower Pawtucket Canal taken from an extension of the same street with the Appleton Mill site on the right.
This photograph appears to be the entrance of a headrace leaving the Hamilton Canal and entering a wheelpit under the Appleton Mills. Strangely enough it is not covered by a trash rack.

This may indicate that the raceway is not a headrace feeding water to a turbine but instead serving some other purpose. Its location matches perfectly the feeder supplying turbine #3 on the schematic.

Photo by Janet Pohl

This is a photo opposite the raceway entrance above. The water in the Lower Pawtucket Canal is extremely high obscuring most of the opening.

The square shape would give more credence to the object of the channel as being a wasteway rather than a penstock to feed water to a wheelpit and thus a turbine. But no such waterway shows in the schematic of the underground on the next page.

Photo by the Author

Simply dig a ditch, a headrace from the Hamilton Canal to the wheelpits containing the waterwheels under the mill and eject the wasted water from the wheelpits into the Lower Pawtucket Canal through another ditch, the tailrace. In the middle of it all, the waterwheel is turning and the machinery is turning and the cloth is turning the profit for the investors.
In the underground sketch of the raceways and turbines under the Appleton Mills below, three different groupings of penstocks are noted.

All three turbine locations are shown as outlined inside of a schematic of what would indicate a building. Some presentations of the underground show the raceways as simply a solid line. This sketch indicates two turbines to the far left, three in the center location and one to the right.

So far any diagrams of the actual underground raceways and turbine locations within the mills have been sparse at best. These were the earliest mill sites and the builders evidently didn’t think it was of any importance. They knew where the channels went from and to. Who else would even want to know, or care, was probably their thinking at the time.

The advent of the turbine began with its installation in the Appleton Mills and the era of the waterwheel was destined to become history. But it was more than just that cumbersome power device that was disappearing. Any good millwright could fashion a waterwheel. The casting methods and fine machining used in making the turbines removed a skill from his hands forever.
Every mill in Lowell looked just like every other mill, height, width and length and the brick count must have came close also. When one thinks of the untold hours of labor that were expanded inside those walls, the whole scene becomes mind boggling. Entire lives marching to the incessant beat and vibration of the demanding pulse of the machines, only the reaching smoke stacks appeared to have a shot at liberty from the shackles of the daily grind.

The Appleton Company from *Lowell Illustrated*
Middlesex Company

Probably every corporation that arose in Lowell had a story to tell about its history. All had a tale for the telling but none could match the epoch of the Middlesex Manufacturing Company from its inception to its demise. The topic of this book is underground waterpower but a glimpse of its use in the system, and how it evolved, hopefully will serve to expand the interest of the reader.

This is probably the most overlooked of all the mill complexes and by far the most interesting. Maybe one of the reasons so little attention is paid to it is that it wasn’t a cotton mill at all but a woolen mill, the only one in the system. If you study the history of any of the mills closely, mentions will be made here and there as to forays into manufacturing products with wool. Both the Hamilton and the Appleton Companies were incorporated “for the purpose of manufacturing cotton and woolen goods” as were the Suffolk, Tremont and Lawrence.37 The Lowell Manufacturing Company used wool in its carpet industry.

The Middlesex was the only textile Company that stayed with wool as its primary raw material. That in itself probably made the operation different enough to warrant exclusion from the ol’ boy fraternity. Another oddity was that it was the only mill to draw water from two different sources, drawing from the Merrimack River and during it’s early years utilized a source drawing from the Concord. And last but not least maybe the quirkiness of Thomas Hurd, the gentleman that started businesses at several other locations in the area before ending up eventually on these 37 acres38 through various transactions.

Lets start at the beginning. There is another book in this series titled *The Canals That Powered a Textile Industry* that tells the story of Hurd’s Canal on page 23. Hurd’s first two woolen mills on seven acres# and the two canals he dug to power them was the forerunner of the Middlesex Company. The three sources that powered this mill site at various times were the Concord River and the Hamilton and Lower Pawtucket Canals fed from the Merrimack River and they came into use in that order.

The Middlesex got its ambiguous start with an implied act of skull drudgery. Thomas Hurd was accused of an underhanded act while he only duplicated the acts of the Boston investors who conned the locals when acquiring their land on the cheap to begin their textile empire. Hurd simply got to one prime parcel (Bowers sawmill) on the Merrimack River in 1822 before they did and held them up for what he could. Its location on the Dracut side of the river above the falls was where their proposed dam would be anchored on the northern end.39 With out it, no dam. No dam, no reservoir to pool the water of the Merrimack River needed to run the mills. No mills and this tale would be a work of fiction.

This is one chapter where the telling of the story of the waterpower lays the foundation of the tale, not as an afterthought but the inception.

Hurd already had two mills on the banks of the Concord River, the first bought in 1818 and the second he built in 1821. He also built a small dam above the falls in the River and ran a canal from above it and paralleling the Concord River for a source of power for his second mill. The sketch below illustrates the location of the dam on the Concord River and the two waterways that Hurd built. This area and the waterways within it were to form the basis for the Middlesex Company.
This little sketch contains more information and detail than many pages of text would provide. The circled area is the approximate location of the future Middlesex Company. The partial legend below the sketch accompanied the original drawing but the remainder was of no interest so wasn’t included.

1. Although the Locks don’t show, this is the Pawtucket Canal entering the Concord River.

16. This is Hurd’s original canal and Nos. 13 and 15 indicate his first mills.

18. The Hamilton Canal from where this second of Hurd’s canals began would be off the sketch at the top center. The canal is shown tying into Hurd’s original canal to provide additional water.

23. The description given of this waterway is “This was a subterranean canal constructed in 1832.” We will return to this waterway later in the text.
Hurd would need more water power than could be supplied by his canal from the Concord River and he held up the Boston investors for more than money with his little scheme. They agreed to allow Hurd to tap off the end of the Hamilton Canal (waterway designated 18 in the sketch). He had purchased one mill power in 1826 as part of the buyout of his mill site at the Pawtucket Falls. He went underground for a good distance from the Hamilton to avoid existing roadways before just digging along the surface and tying into his original canal.

Anyway he went on his merry way, doing whatever you do in a mill. Hurd must have become sick of combing wool and figured there was an easier way to turn a buck. There was and he hocked the whole works to William and Samuel Lawrence along with W. W. Stone in 1827 for $55,000, defaulted on the payments, went bankrupt in 1828 and faded away. At any rate whether or not Hurd’s Canals were canals in the strict sense or penstocks is a play on words. Hurd’s canals were already defined as such by all previous descriptions and we’ll continue to refer them it as canals.

History being history, and with many people reporting on its contents over the years, one can see why it could get distorted with frequent telling. But when two written records by unimpeachable sources cast doubt on gospel, the fact becomes a flip of the coin. Quoting from the Northern Middlesex Registry of Deeds, by August 9, 1830, the Middlesex Company had possession of Hurd’s property, buildings and machinery. That record is pretty cut and dry. Yet an entry from a Directors of the PL&C meeting dated April 6, 1831 dictates that “The Treasurer be authorized to exchange the mill power sold to Mr. Hurd on the Upper Level for one on the Lower & that he be authorized to receive $4000 on the sum to be paid for the same.” (Authors note: Upper is the Hamilton and Lower is the Lower Pawtucket). The dates of these entries, the bankruptcy, the Registry record and the Directors entry are three years apart. Maybe Hurd didn’t go away.

At any rate, by 1830 the epoch of the Middlesex Manufacturing Company had begun. Its expansion through the mid 1800s necessitated the purchase of more mill power from the PL&C until it totaled over five. It occupied seven acres in the beginning but was to expand to cover 37 acres. It seemed to have waterpower coming from every direction and source available. In a written Report signed by James B. Francis in 1857, an estimate was made of The value of the Land and Water Power belonging to the Middlesex Company in Lowell. Under the heading of WATER POWER, 5 23/30 mill powers were held under lease from the PL&C., Concord River Power with no amount and a third source listed as simply Wamesit Mill lot and water power.

As usual though, the Middlesex Company marched to its own drummer. Long after most mills had changed over to turbines, the Middlesex was still using breast wheels into the 1890s. Their use was most likely confined to the older buildings which were still in service all though there is no mention of this.

Our main interest of underground waterways has been overlooked somewhat. To get back in focus the next page has a series of two photographs that represent the headrace leaving the Lower Pawtucket Canal just above the Lower Locks on the top left and its course through the turbines in new mill number one and to eject the spent water into the Concord River from the Granite arches in the photograph on the top right.
And last but not least are the remnants of the only visible vestiges of the final power source that fed the Middlesex Mills.

Blocked headrace leaving the Pawtucket Canal from under the hotel wall.  
Photo by Author

Tailraces emptying into the Concord River through two granite arches.  
Photo by Author

Middlesex Company Mills  1850  Sidney and Neff
Both of these mill complexes are usually treated as a single entity. The Massachusetts Mills were chartered in 1839 and are regularly carried as being the last of the main mill complexes constructed. In a way this is true even though work on construction of the Prescott buildings was started in 1844. The company was bought by the Massachusetts Corporation in 1847 before it was in full operation and was simply absorbed by the Massachusetts. Geographically all that separates the buildings is East Merrimack Street that runs between the sites. Taken together their combined yards cover about 11 ½ acres and are bordered by the Merrimack and Concord Rivers, the Lower Locks Wasteway, Bridge, Prescott and Central Streets.

But their backgrounds and beginnings were diverse enough to treat the history of the two corporations separately until they merged and for no other reason than to give them their own identity, and their early development certainly allows for that distinction.

The Prescott Mills

The site completely demolished now and occupied by the Middlesex Community College, was the smaller of the two, sitting on about 4 acres. Compared to the larger complexes, even its power need was small, contracting with the PL&C for only 4.6 Mill Power. The five raceways that supplied the water ran from the Eastern Canal and emptied into the Concord River. There is no mention of a waterwheel by any of the early sources. The first reference to a wheel was a turbine installed in 1847 followed by the statement that there were two turbines powering the mills by 1848.

It is quite possible the Prescott Mills never went through the waterwheel cycle given the date of its inception that bordered on the introduction of the turbine. At the first appearance of the turbine on the power scene many were doubtful if the new machine could out perform the large and well seasoned breast wheels. The trial installation was reported to be made at the Appleton Mills in 1844 and it was successful with no less than the head engineer for the PL&C, James B. Francis attesting to the excellent test results.
If the first mention of a new mill along the banks of the Concord that appeared in the Minutes of the Directors Meeting held on October 7, 1843 is any indication of the eventual size of the first building in the Prescott Yard, it took a lot of courage to go with an untried power system and install turbines and at this date it is possible the Prescott, and not the Appleton was the first. But even the looms installed in the Prescott were innovative. They were the first ever built by the machine shop with iron instead of wooded frames.

But let’s return to the channels that were to carry the water from the Eastern Canal and drop 17 feet into the Concord River. The sketch below shows the first proposed raceways.
These are the five tail-races leaving the Wheelpits under the Prescott Mills. The water left the Eastern Canal through headraces as shown on page 69 and fell 17 feet to turn the turbines before being returned to the Concord River.

Lowell National Historical Park
LOWE 7937

All of these photographic reproductions were obtained from the collection, www.museum.nps.gov/ These views were taken during 1918/1919 either just before or during reconstruction of the raceways. The photos below show the work in progress of installing a draft tube in the Concord River wall during the installation of 3-33” Hercules turbine wheels that will be attached to electric generators.
The Massachusetts Mills

This was the last major corporation chartered in 1839 and its construction on 7 ½ acres brought further expansion of the canal system to a halt. The simple fact was there was no more land with access to the canal waters available and it took the last mill power that could be produced in the canals to turn the machinery and eventually over 24,000 spindles. By 1841 the four mills were in full operation.

Only the Merrimack Manufacturing Company came up to par with the manufacturing capabilities of the Massachusetts. In the use of mill powers they were almost identical. However it took 1116.267 cubic feet per second of water flowing in the raceways of the Massachusetts to accomplish what the Merrimack could do with 616.667 cfps.47 The difference was in the amount of head the water generated at their respective falls and carried when leaving the respective canal and entering the buckets of the mill wheel. Definition and description of mill powers on page 55 gives a full explanation. The head supplied by the Merrimack Canal feeding the Merrimack Mills was 30 feet while that of the Eastern Canal feeding the Massachusetts was only 17 feet.

Four headraces left the Eastern Canal to supply waterpower to the Massachusetts Mills complex and remains of the two trash racks covering them are quite visible if the water level is down any at all. Here the canal is empty. At one time these raceways were open in the mill courtyard delivering the precious cargo of liquid power to each of the four breast wheels, one under each of the original mill buildings.48 They were covered over many years ago probably to allow other buildings to be built over them during periods of expansion.

Both Photos by Janet Pohl

The two photos above show the deteriorating racks covering the headraces that fed the mill wheels. Mills nos. 1 and 2 paralleled the Concord River and their tailraces emptied into it, now covered over with concrete. Nos. 3 and 4 mills paralleled the Merrimack and evidence of their tailraces can be seen from the Bridge Street bridge mostly covered over by a recently constructed sewerage conduit that hugs the river bank for most of its way.
This sketch is dated November, 1839. The plan shows the original layout of the Massachusetts mill yard including raceways supplying each of the four mills outlined by the dotted lines.

There never seemed to be a problem with engineering for the mill construction centuries ago. The best use of the land and water was determined and laid out in a sketch as presented at the left. The construction methods were kept simple and then the work began following the straight forward layout and designs of the artificer. Their works are still standing and while not serving the original use maybe, a good many are still functional and occupied.

PL&C Archives, Massachusetts Mills

These raceways were dug to supply the wheel pits for 17 foot wooden water wheels but the headraces, pits and tailraces would serve just as well to service the turbines that were beginning to appear on the horizon. After 1850 turbines were installed in all new additions to the complex and by 1869 the last breast wheel was removed.59

In 1856 a central wheel house was built containing four wheel pits containing two 10 foot 375 hp turbines with two pits left empty for future use.50
The two wheel pits designated for future use have long since been pressed into service with the installations of turbines. Eight tailraces can be counted leaving the powerhouse and this is the only instance uncovered in the research so far that indicates two tailraces leaving each turbine wheelpit.

To the right is a small portion of the sketch on page 76 showing the four turbines in the Massachusetts powerhouse and the double tailraces leaving each wheelpit and emptying into the Concord River.
Water, water, water. This was the power that fueled the mill machinery. As long as it flowed through the canals and was distributed through the raceways to the individual wheel pits, everything was working up to par. But what was the result when a mill within a complex lost one or more turbines for whatever causes.

Most mill sites had several power sources, whether they were breast wheels or turbines. Common sense would dictate that somehow the output of the individual wheels would be available for all. The answer would be through shafting. Any one mill that had multiple turbines coupled them together and through this method achieved a more balanced output. Also if one unit was down for any given reason, power was still supplied to all of the machinery, granted with less horsepower.

So why not tie several mills together using the shafting method between them and achieve the same results. And go a step further and supply power to a mill that was added to the complex. Digging a new canal amongst the existing buildings every time a new mill building was added could be daunting at best. It was possible to weaken the supporting foundations of the existing structures or loosen the fill of the banks containing the raceways that were supplying the current water power.

This was probably the concept behind the process of building separate and free standing wheelhouses with all of the wheels centrally located as mentioned previously, detached from the mill buildings and not installing the individual turbines in the basement as was the previous norm. Once this technique was adopted, provisions could easily be provided for future expansion without digging under and around a hodge-podge of scattered buildings with new raceways every time expansion occurred in the complex.

Centralization of the power producing turbines would also free up a large amount of space for production previously occupied by the great breast wheels and inherited by the turbines. One shaft running throughout the mill yard and tapped off at intervals using gearing was the answer. There are other mentions in the records of mechanical methods to feed individual mill sites but this is the first to show up in the order chosen to present the material.

To be sure the waterpower was still the prime motivator. The shafting was simply one more innovation amongst the many that were adapted to the industry to improve on the power transmission and thus add to the production. But this also allowed the output of the steam engines to be tied into the power train as that source was developed.

The composite sketch on the next page show the whole power layout of each site in its entirety. The parallel dotted lines indicated the underground raceways leaving the Eastern Canal and emptying into either the Merrimack or Concord Rivers. The circles are the location of the turbines and the notes tell the manufacturer and horsepower of the units. It’s quite obvious the solid lines are the shafting and they are noted as such. In the lines of shafting in both the Massachusetts and Prescott Mills will be a solid rectangular line heavier than the others. Look close and they are marked Steam Engine.

So through the use of the shafting all of the power motives at each site have been combined to operate as one.
A small section of the composite sketch has inevitably been eliminated effecting the layout of the Massachusetts Mills powerhouse. This has reduced the size and number of turbines shown. The correct layout of the powerhouse shows in the sketch on page 68 but the mistake does nothing to take away from the purpose of the distorted composite sketch.

Power Layout in 1889 at the Massachusetts Cotton Mills
Lowell National Historical Park

The prime study of water power, the delivery of it through a maze of underground raceways from the canals to the wheelpits and thus the wheels at the mill sites, is still the main objective of this book. But still one can’t be faulted for deviating for a moment to include mention of other power sources and methods of delivery such as steam and shafting if it serves to expand the overall picture.
Pause for a minute while looking at this drawing of the building layout of the Massachusetts Manufacturing Company in 1911. Waterpower was still being employed at this date although possibly as hydro-electric units only but still functional and providing power the complex. While steam power had been introduced in the 1870s, it was done so as a supplemental energy source to the water power.\textsuperscript{51}

While there have been changes to the configuration of buildings in the mill yard, and probably some demolished and some added as the industry demanded, just to envision the force of the water from the Merrimack River as the prime motivator of the power supply is almost unbelievable. And multiply the demands of the other ten complexes and it becomes mind boggling.

1911 Insurance Survey of the Massachusetts Cotton Mills
Boott Cotton Mills

Chartered on March 27, 1835 by the Massachusetts General Court, the incorporators of the Boott Cotton Mills were Abbott Lawrence, Nathan Appleton and John Lowell. Talk about the mill owners being a closed society, these same names appear as the controlling interest in many of the corporations. Even the name chosen for the mill complex honored the first agent of the Merrimack Mills who was to pass away in 1837.

But their projected operation would prove to represent more profit for the Proprietors of the Locks and Canals [PL&C]. The outstanding shares of the PL&C had been purchased in 1822 by the Merrimack Manufacturing Company and the company was now effectively controlled by the investors so they were welcome by any name. In 1825 the Merrimack Company realized the scope of building new canals, leasing water power and constructing new mill buildings was proving to be too complex on top of running their own cotton mills so the PL&C was re-organized and all of the excess land in their control, which was effectively all of it, was sold the new PL&C. The object of the game was to sell water and for that the PL&C was more than willing and certainly able, even to the point of digging a new canal to get the water to the chosen site of the Boott Mills, and they wasted no time. In fact the PL&C was one step ahead. At the Directors meeting of September 20, 1834, “the agent informed the board of an application for the purchase of four mill sites & machinery, and at the same time submitted a plan locating nine mills on the lower level & the canal to supply them with water.” In two subsequent votes, a committee was appointed to sell the mill sites applied for and to contract for the machinery and the agent authorized to proceed with construction of the canal.

Winter months were sure to put a cramp in any plans concerning the PL&C and their building operations but on March 16, 1835 the committee reported to the Directors at their meeting that they had contracted with Abbott Lawrence for a total of nine mill powers “for a price not less than Five Dollars pr. Spindle.” Another source quotes the price of the land and mill privileges as over $84,000. The site would prove to consist of 5.7 acres bounded by the Merrimack River, Bridge, French and Kirk Streets. An indenture dated November 16, 1835 also records the annual rent for each mill power as “sixteen ounces, seventeen penny weights, twelve grains troy weight of gold or two hundred and sixty ounces troy weight of silver.” We’ll stick to the dollar figures where possible.

This is the only mention found of the request for locating nine mills to supply them with water. No additional buildings except for the original four proposed for the site appear on the original plan of the Boott Mill yard. It is more possible that this line was meant in reference to nine millpower and was copied into the directors minutes wrong.

At any rate the Eastern Canal was dug from the Lower Pawtucket to the Merrimack Wasteway to provide waterpower in anticipation of the Boott construction. It was recorded as being of rectangular in shape at 2,000 feet in length, eight feet in depth and from 42 to 66 feet wide. An accounting ledger page presented at the Directors meeting dated July 30, 1836 gives a cost from the PL&C Records under the heading of Eastern Canal as $18,874.16.
This is a copy of the original plan of the Boott Mill yard in 1835 that accompanied the Deed. It can be found in the files of the *Middlesex County Deeds—Southern Registry: Plan Book 36, Plan 17*. The Eastern Canal is bisecting the property horizontally from Bridge Street at the left to the Merrimack Wasteway on the right. At the top of the canal is shown the proposed company boarding houses and to the bottom is depicting the four mill buildings each to be approximately 150 by 45 feet with the raceways to carry the water outlined between the dotted lines and emptying into the Merrimack River.

Proprietors of Locks and Canals, Draw 155, Drawing 7

Nine millpower were contracted for by the Boott Mills in 1835 which gave the mill complex the right to draw 45.5 cubic feet per second from the canal with a head of 17 feet as the water dropped from the canal to the Merrimack River. All four mills were completed by 1839. The Massachusetts Mills would also be built along side this canal and tap it for their source of waterpower.

Prior to 1852 when adjustments of the water powers were decided on, the Boott Mills had added one more millpower bringing the total to ten. After the adjustments were finalized on September 20, 1853 the total amount of mill powers contracted for was recorded at 17. The underground water distribution system for the canal system is the topic of interest and to plot these particular routes under the Boott Mills we started with the simple plot plan on this page dated 1835. Although the raceways
would expand considerably over the years with the expansion of the millyard, the source of the waterpower from the Eastern Canal would remain constant.

By 1896 the layout of the underground raceways at the Boott Mill site had been expanded considerably to accommodate the added mill buildings that had been constructed in the millyard and it remains substantially the same today.

In most cases, only the trash racks covering the entrances to the headraces are visible today. All of the remaining structure of the underground raceways are completely covered and out of sight. However the National Park Service has commissioned a report titled the *Historic Structure Report* that describes the construction of the raceways as “The four mill sites were provided waterpower by four brick barrel-vaulted underground raceways that ran perpendicular to the canal. It is likely that the water turned 17’ diameter wood and iron breast wheels that would have been set into the cellars of each mill.”

Proprietors of the Locks and Canals   Draw 155   Drawing 7