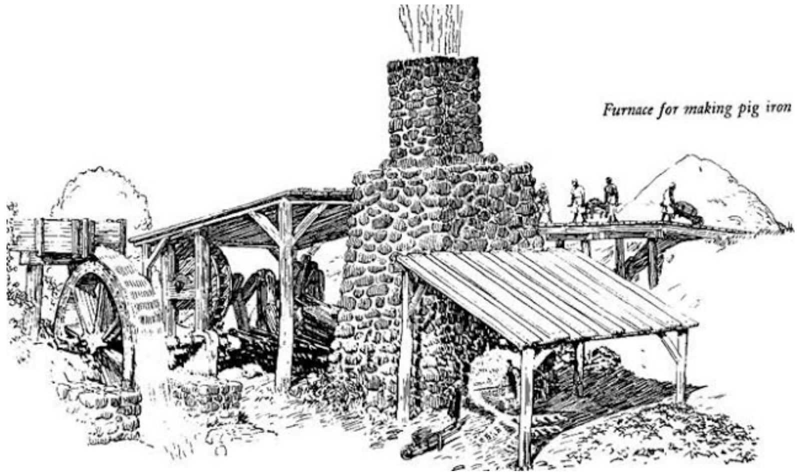
Delta and Lyndhurst – Forged Together

Note: This is an expansion of a shorter article that was published in the Spring/Summer 2021 edition of the Delta Mill Society newsletter. An explanation of some of the terms, such as bloomery, can be found after the end of the main article.



Iron Blast Furnace

This illustration shows a furnace of similar design to that at Lyndhurst in 1801. A waterwheel powers a pair of bellows blowing into the bottom of the furnace stack. Iron ore, limestone and charcoal are dumped in the top and liquid iron flows out the bottom to be cooled as pig iron which was then cast into useful items in the adjacent foundry. Illustration from Colonial Living by Edwin Tunis, 1957.

Delta was founded by Abel Stevens, who settled on the upper reaches of Plum Hollow Creek in February 1794 and was later granted the land over Delta in 1796. Although his initial goal was to create a Baptist community, including mills using the water power at Delta, he soon turned his sights to the iron and water power at Lyndhurst. In his third petition to the government in September 1794, Stevens stated: "in further exploring that County discovered a Bed or Vein of Iron Ore, and being desirous of Erecting a Bloomery [a primitive type of furnace] prays a Grant of One Thousand Acres of Land at the Falls." Stevens was not the original discoverer of iron in the area, the first request to the government to get the rights to mine the iron was made in 1784. But since mining rights were held by the Crown (literally, the King of England), the province could not at that time award these rights.

In 1798 that changed, with the Crown reserving gold and silver rights but allowing the province to award other mining rights, including iron. The story gets complicated at this point. Stevens was given the first opportunity to be awarded the rights to Lyndhurst with a six month deadline to submit a detailed proposal. The province wanted to make sure that whoever they awarded the rights to could in fact do the job. He got Mathew Wing involved, with Wing paying Stevens for his supposed rights to the area (which Stevens didn't have). Wing then petitioned the government and was given the same opportunity as Stevens, who was now late with his proposal. In the meantime, Stevens was in Vermont still trying to find backers and he brought in Ruel Keith, who in turn brought in Wallis Sunderlin, an iron master from Tinmouth, Vermont.

Wing didn't wait for government approval, but instead set up shop at Lyndhurst in 1800. Keith and Sunderlin arrived at Lyndhurst in the spring of 1800 only to find Wing at the site claiming ownership. Sunderlin cut a deal with Wing and returned to the U.S. to sell his assets and gather a crew. However, Wing appeared to change his mind and proceeded by himself to erect a bloomery at the falls, without permission from the province. When Sunderlin returned with a crew of men ready to start building a blast furnace, he found Wing finishing his bloomery and no longer wanting a partner. To meet his deadline, Wing submitted his proposal to complete the bloomery at his own expense. He was dismissed by the government for erecting his bloomery without permission. Sunderlin submitted a proposal of his own with himself as the backer and was given permission to proceed.

In November 1801, magistrate Solomon Jones stated that *"the Iron Works are erected and found things in the following order, a Furnace built the Bellows lying within the building, a good Saw Mill, a good Framed Bridge across the Stream well planked, a Forge erected whereby I saw two bars of Iron manufactured which appeared to be of good quality …"* (Cruiskshank, pg.77). The furnace was a crude blast furnace, 22 ft square by 26 ft high but it doesn't appear to have operated in 1801. Sunderlin seems to have put Wing's bloomery (Jones' forge reference) into working order to produce the first iron bars. Those bars were the first iron produced from native ore in Upper Canada, and on the basis of that success, Sunderlin was granted 1,200 acres of land for wood to produce charcoal for the furnace.

It's unclear how well Sunderlin's blast furnace worked. Recent archaeological work indicates that it may have failed to reach high enough temperatures to liquefy the iron and that the bloomery was used to produce most of the iron. In 1811 the whole complex, consisting of the furnace, forge, sawmill and a grist mill, was destroyed by fire. Sunderlin's family returned to the USA in 1811 and he followed in 1812, only to die a few months later.

The connections between Delta and Lyndhurst, which began before either of them had a name, continued for another century, beginning with the likelihood that iron made at Lyndhurst was used in the construction of the Old Stone Mill. Ephraim Jones (William Jones' father) became a half owner in the iron works by loaning money to Sunderlin to finish the blast furnace and by buying most of the 1,200 acres of land Sunderlin was granted. In 1808, when Sunderlin built a grist mill at Lyndhurst, William Jones became the miller there, before he went on to build the stone mill at Delta in 1810. After the deaths of both Wallis Sunderlin and Ephraim Jones in 1812, William's brothers Charles and Jonas Jones inherited their father's interests including all the land surrounding the falls at Lyndhurst and a half interest in the water power. In 1815, when the British Navy was hoping the iron works would reopen, William Jones supported Ira Schofield, his partner in the Old Stone Mill, in a proposal to re-open the iron works. But this never happened.

In William Jones' 1815 support letter for Schofield's proposal, he noted his knowledge of the production from the Iron Works: *"but for the want of property and proper Management the said Works was not sufficiently built—but notwithstanding such insufficiency they were made to produce—say One ton of Cast Iron per day Consisting of Articles weighing from 500 to 10 lb. Viz—Forge Hammers, Pots, Kettles and Irons—Likewise the Wrought Iron Works were made to produce 4 cwt. [~400 lbs] per Day Consisting of bar Iron, Mill Irons, Plow Irons &c."* (Cruiskhank, pg. 80). The "Wrought Iron Works" are the bloomery/forge which produced soft low carbon iron and the cast iron was hard high carbon (2 to 4%) iron produced from the blast furnace (see Appendix A for a full explanation).

In 1828 Charles and Jonas finally obtained clear rights to the water power and built mills of their own. The Jones mills at Lyndhurst were leased to various tenants over the years, including Walter Denaut, who partnered with William Saunders to lease the mills at Lyndhurst while he was the owner of the Old Stone Mill in Delta. Denaut and Saunders took an apprentice named John Roddick in the mills at Lyndhurst. Roddick is sometimes credited with designing the stone bridge in Lyndhurst that was built in 1855. Roddick carried on operating the mills at Lyndhurst and in 1869 he partnered with Henry Green to purchase the Jones estate and develop the village. Roddick's son John and grandson George built and operated their own mills on the west side of the river until the 1920s, and in 1912 installed a generator for hydro electric power, which was carried on pole lines to Delta as well as Athens.

- Art Shaw & Ken Watson

Selected Bibliography

Bazely, Susan M. and McKendry, Jennifer, "Stage 1 Archaeological Assessment, Lansdowne Iron Works National Historic Site of Canada, 'Furnace Falls', Lyndhurst, Leeds & the Thousand Islands, Ontario, BdGa~37", Cataraqui Archaeological Research Foundation, October, 2008

Cruikshank, E.A., "The Activity of Abel Stevens as a Pioneer", in Papers and Records [Ontario History], XXXI, pp.56-90, Ontario Historical Society, 1936.

Lockwood, Glenn J, "The Rear of Leeds and Lansdowne, The Making of Community on the Gananoque River Frontier, 1796-1996", The Corporation of the Township of Leeds and Lansdowne, 1996.

Russell, William, "The Lansdowne Iron Works" in "Miscellaneous Research Papers", Manuscript Report No. 216, Parks Canada, 1977.

Shaw, Art "Lyndhurst Iron Works NHS", unpublished manuscript, 2018 (on www.deltamill.org)

Watson, Ken W., "The Rideau Route: Exploring the Pre-Canal Waterway", Ken W. Watson, Elgin, Ontario, 2007.

APPENDIX A – How Iron was Made in the 19th Century

How Metal Iron is made

As detailed in the article "The Source of the Iron Ore for the Lansdowne Iron Works" (Watson, 2021), local iron occurs as hematite, Fe_2O_3 (2 Iron with 3 Oxygen), within sandstone. Sandstone, as the name implies, is sand (in our case, shallow sea beach sand) compressed under high pressure in the earth to stone. Its main component is quartz, SiO_2, which generally accounts for 90 to 95% of the rock. Limestone is found locally as crystalline limestone (marble – limestone changed by heat and pressure into a harder version) - $CaCO_3$ (Calcium, Carbon and 3 Oxygen).

In a hot furnace, CO (carbon monoxide) from the burning of charcoal mixes with iron oxide to release the iron; Fe_2O_3 + 3CO to 2Fe + $3CO_2$. This chemical change occurs in either a bloomery (iron ore + charcoal) or in a blast furnace (iron ore + limestone + charcoal).

In a blast furnace, the heated limestone acts as flux, changing from $CaCO_3$ to CaO + CO_2, the CaO combining with impurities such as silica (from the sandstone), allowing those lighter impurities, known as slag, to float above the iron at the base of the furnace and be removed. Also in a blast furnace, the higher temperatures, which produce further chemical reactions, drives some of the carbon released from the charcoal back into the iron, resulting in a hard iron that contains 2 to 4% carbon. A bloomery, due to the lower temperatures, produces a soft low-carbon iron.

Blast Furnace vs Bloomery

Period references are to bloomeries, furnaces and forges. The meaning for each term in period reports has to be read in context. A reference to a furnace for instance could refer to a bloomery or a blast furnace. A reference to a bloomery could be to a bloomery furnace or to a forge where "blooms" from a bloomery furnace are forged into wrought iron.

Bloomery

A bloomery is a primitive type of furnace. Charcoal is used to heat iron ore to produce an iron "bloom", a low carbon porous mix of iron and slag (host rock impurities such as silica). This bloom has to be worked in a forge (heated and hammered) to remove a portion of the slag, the resulting material is known as wrought (worked) iron, a type of soft iron. The heat inside a bloomery is less than a blast furnace, in fact deliberately so that the iron doesn't absorb carbon which would make it too hard to be worked by a blacksmith. A bloomery often used manual bellows to supply the air that helped fire it up.

This is where some confusion of terminology comes in. For instance, we see Abel Stevens'petition dated February 9, 1799, stating "Your Petitioners mean to set up a Furnace and bloomery," showing those as two separate things. A few days later, Stevens and Elisha Beman submitted a second petition that stated "put up at the Great Falls a Forge of four Fire Places" with a "Master Bloomer" and "Assistant Bloomer" at each fire (Cruikshank, 1936). The actual "bloomery," the furnace that produces the original pre-wrought bloom of iron, could be a temporary affair made of rock and clay and that perhaps explains Steven's "furnace" and "bloomery." His 1799 reference to a bloomery was not to the furnace where iron blooms are created, but rather to the place where the blooms are forged into wrought iron. Other references will call this a forge. The product from a bloomery/forge is soft bar iron, wrought iron that can then be used by a blacksmith to create useful iron objects.

Blast Furnace

A blast furnace is where iron ore, limestone and charcoal are heated to very high temperatures using air at greater than atmospheric pressure. In the early 1800s the "blast" part was done by using a pair of large waterwheel powered bellows. Two were used to deliver a continuous blast of air, one sucking in air while the other was blowing air into the furnace. To get the high temperatures the process started with a large layer of charcoal used as a base on top of which were layered the charges of iron ore, limestone and charcoal. Once the furnace was fully fired up, it operates continuously with new charges added near the top of the stack to maintain the process (see the Tunis image at the beginning of this article). Limestone acted as a flux to allow impurities such as silica to float above the liquid iron which flowed out of the bottom of the furnace as pig iron, a relatively pure form of iron with a carbon content of 2 to 4%. This hard (due to the carbon) iron was then cast into various useful shapes (i.e. a pot or plough).

Adjacent to the furnace was the "Casting House," a covered area where the iron flowed out into troughs made in sand, to cool as pig iron.

Early blast furnaces were known as cold blast furnaces due to the introduction of cold air from the bellows into the furnace. A schematic of a typical cold blast furnace can be found in Appendix B.

At Lyndhurst a bloomery/forge was located on the west side of the falls with the blast furnace on the east side.

- *Ken W. Watson*

APPENDIX B – Figures

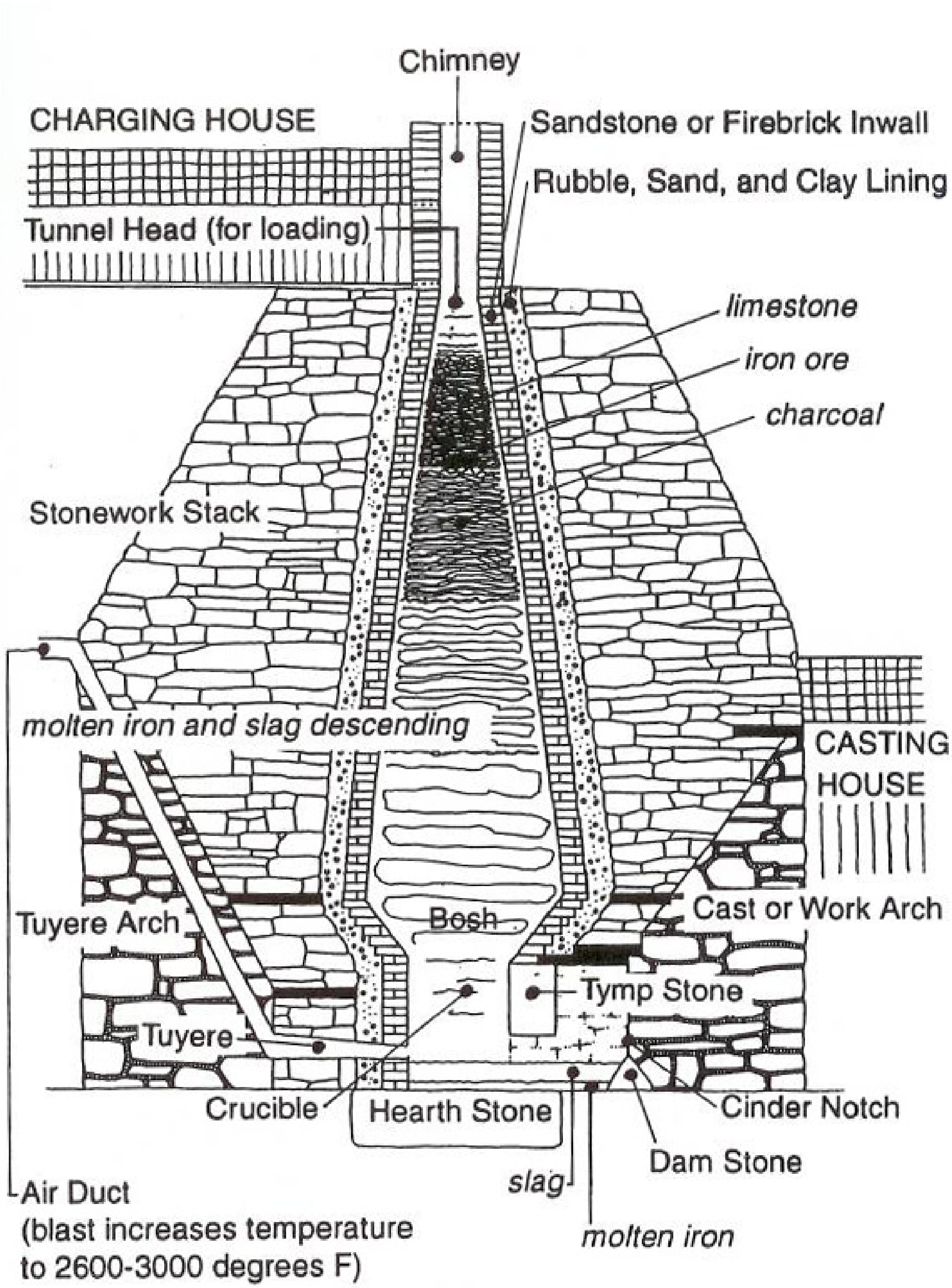
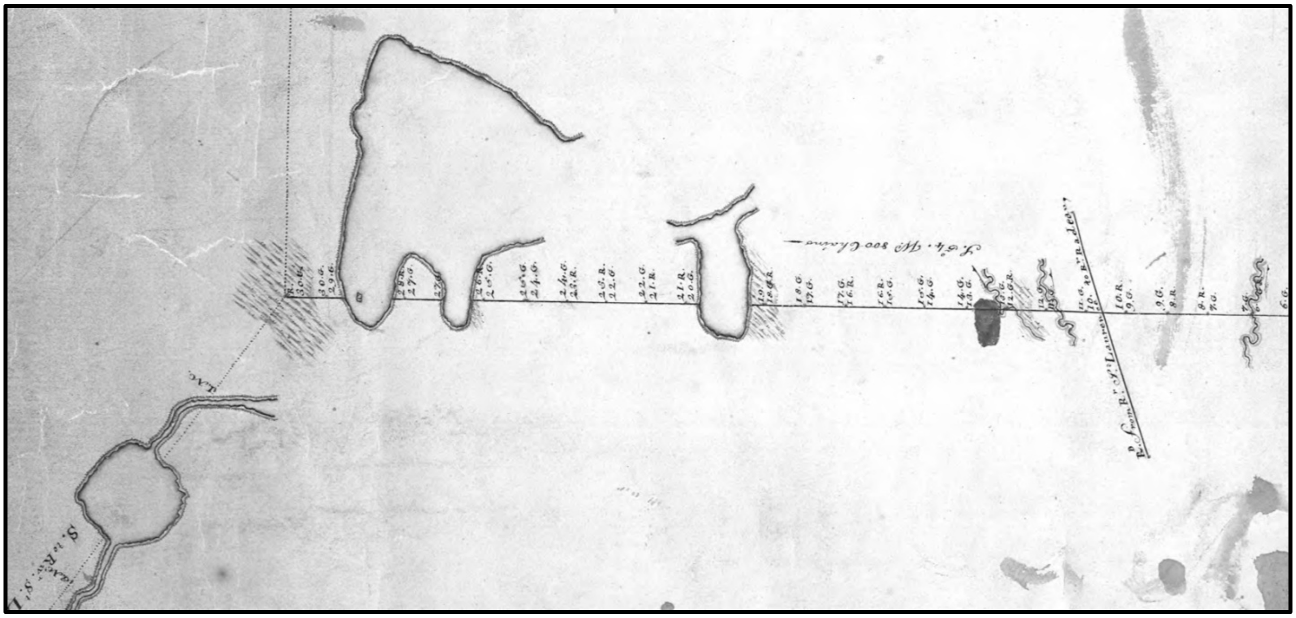


Fig. 2 Diagram of a cold-blast, charcoal-fueled iron furnace.

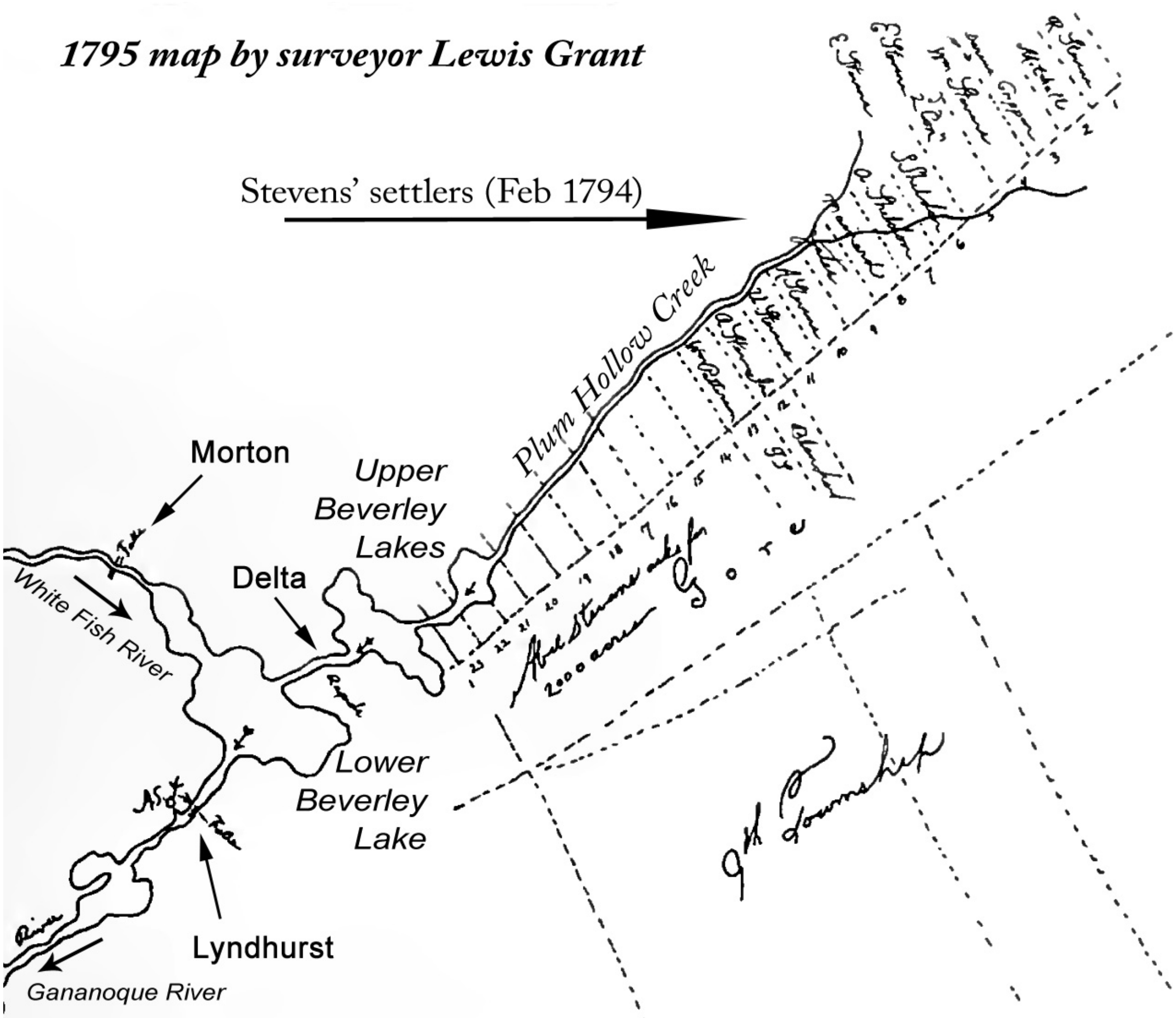
A schematic drawing of a 19th century cold blast furnace

From: Eggert, Gerald G. The Iron Industry in Pennsylvania. Harrisburg: Pennsylvania Historical Association, 1994 (diagram on explorepahistory.com)



Section from William Fortune's 1794 Survey Map

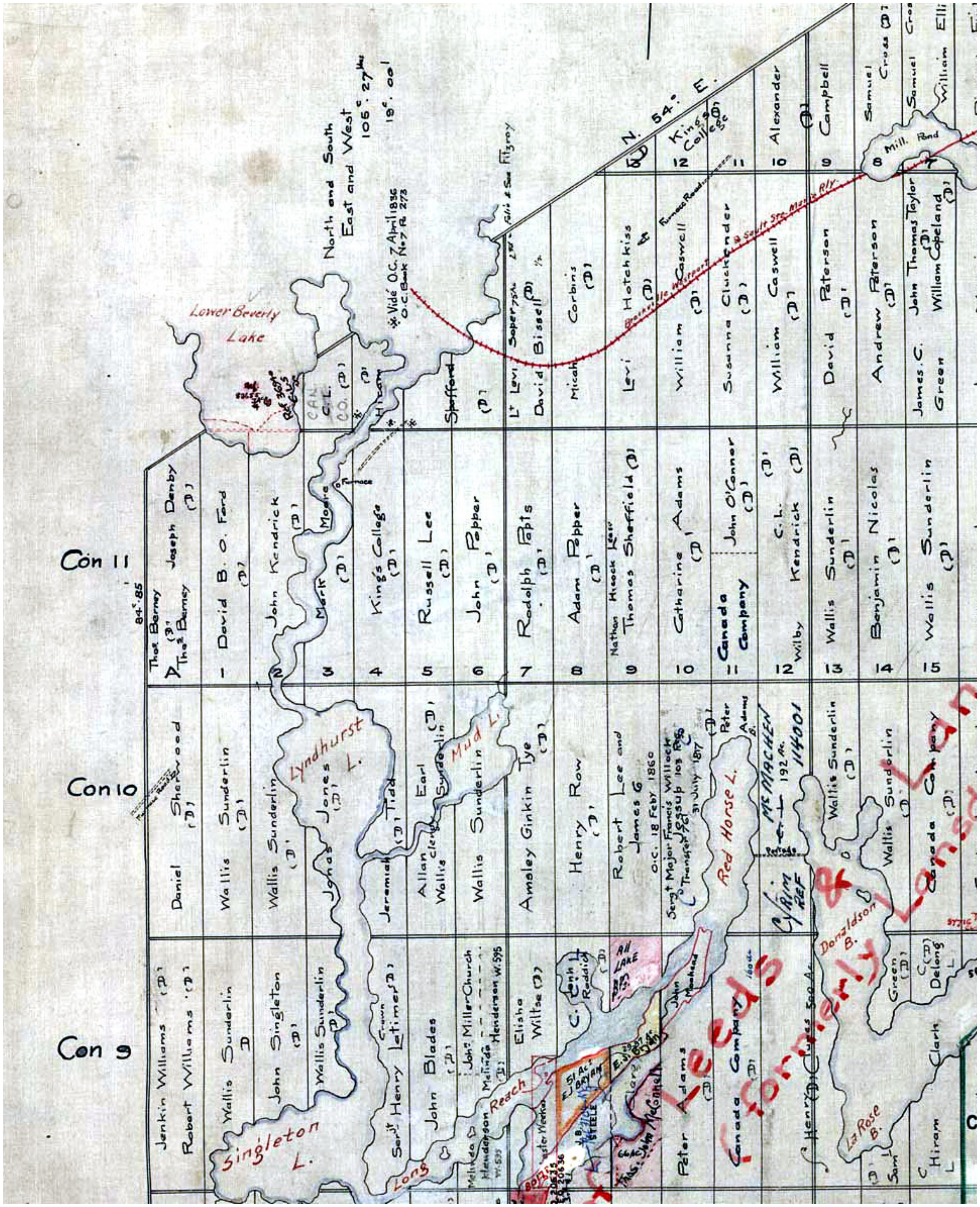
William Fortune spent much of 1794 doing an extensive survey for townships and land along the "River Radeau," – running long tie-lines to create boundaries of what were to become Montague, Wolford, Emsley, Kitley, Burgess and Bastard townships. The section above shows part of that line, the "Fortune Line" that separated Bastard (top) from Lansdowne (below). Lyndhurst Lake is shown on the lower left. Abel Stevens and six families settled on Plum Hollow Creek before Fortune passed through (about 5 months later), squatting on then unsurveyed land. Surveyor Lewis Grant in 1795 and 1796 surveyed Bastard township, allowing Stevens to be granted land in that area, including the land under what is today's Delta in June 1796.



1795 Map of a portion of Bastard and Lansdowne Townships

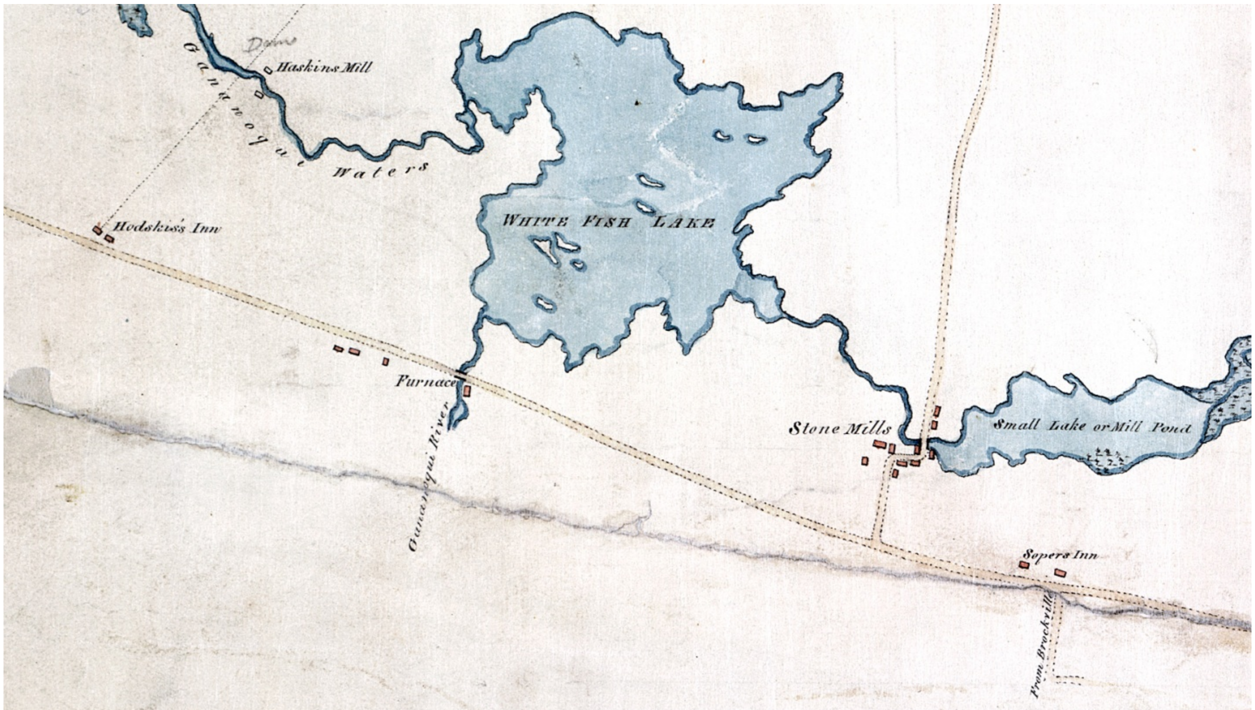
This map shows where the Stevens and the families that arrived in February 1794 settled, on the upper reaches of Plum Hollow Creek. On this map we see a notation that "Abel Stevens asks for 2000 acres." Of note on this map is that at the initials AS, Abel Stevens, is written beside the Great Falls at Lyndhurst showing Stevens' interest in that area. The rapids at today's Delta are shown as are the White Fish Falls, near today's Morton. The surveyor, Lewis Grant, went on to survey Bastard Township and in June 1796, Stevens was granted 3 lots over the rapids on Plum Hollow Creek, the location of present day Delta.

Archives of Ontario RG1-A-1-7 #7 – from "The Rear of Leeds & Lansdowne, the Making of Community on the Gananoque River Frontier, 1796-1996," by Glenn J Lockwood, The Corporation of the Township of Rear of Leeds and Lansdowne, 1996. Annotations by Ken Watson.



Section from the Survey Map of Lansdowne Township

Several of Wallis Sunderlin's granted lots are shown on this map. Notations in red (i.e. railroad line) are later additions to this survey map. Lots and concessions are idealized, they don't actually line up as cleanly as shown on this map. The "furnace road" shown in 3 spots on this map, is in error, offset by about 300 m from its actual location. Lansdowne Township (New Map), Government of Ontario, Archives of Ontario, RG 1-100-0-0-1218



Lyndhurst in 1816

This is a section from Lt. Joshua Jebb's 1816 map of the Rideau Route. In addition to the Rideau Route, he investigated a shortcut, the Irish Creek Route which would have bypassed the Rideau Lake, The route would have taken the Rideau Canal up Irish Creek (just south of Merrickville), over the watershed divide and then down Plum Hollow Creek to Stone Mills (Delta), then through White Fish Lake (Lower Beverley Lake) and up the White Fish River (Morton Creek) to join the present route of the Rideau Canal. Jebb had a problem with this route since there was a 5 mile (8 km) section at the top of the watershed with no water. Not a problem for the young Royal Engineer, he had a solution:

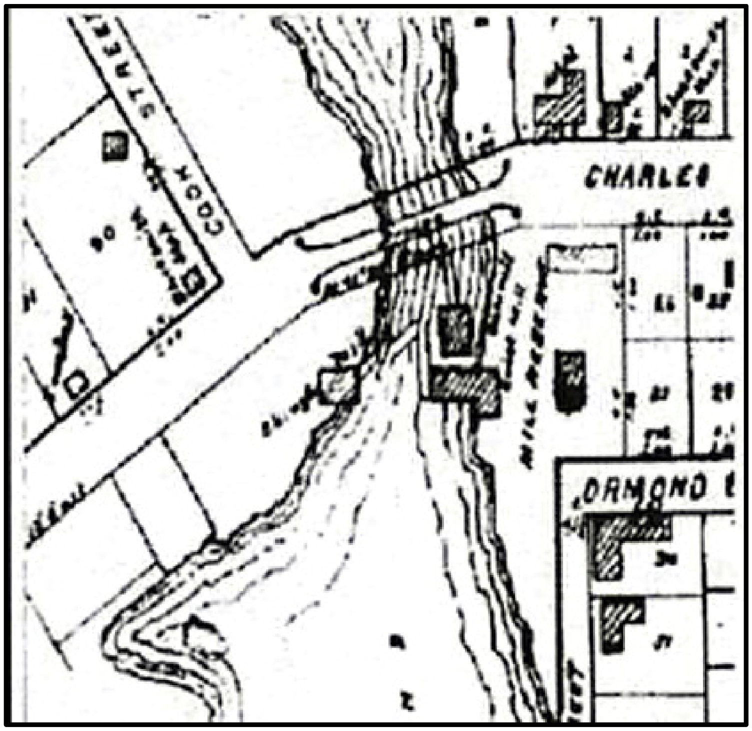
"*I would construct a rail way using a particular description of low cart for transporting stores to where the water communications again commence. I have had frequent opportunities to seeing this contrivance applied with wonderful effect, it is usually made of cast iron, which would be easily obtained and brought by water, if Government would again Occupy and work the furnace on the Gananoqui Stream. The finest ore is in abundance on the spot, and I need not advert to the advantages in an economical point of view that would result from such an establishment in every article of Iron work." (Watson, The Rideau Route, 2008).*

On Jebb's map we see a single building left at Furnace (Lyndhurst), presumably the ruins of the blast furnace. Delta, then known as Stone Mills, was a growing community due to the Old Stone Mill.

Map section from: "Plan of the Water Communication from Kingston to the Grand River" by Lt. J. Jebb, July 8, 1816, Libraries and Archives Canada, NMC 21941 2/3.

The Bear

Art Shaw (pictured at back), organized a 3-year archaeological dig (2017-2019) at Lyndhurst with archaeologist Jeff Earl and volunteer help. They were searching for evidence of the furnace and forge under the rubble of subsequent buildings at the site. The 800 pound “bear” is material that was left in the bottom of the firebox, a mixture of iron and slag, likely left there after the structure burned down. Photo by Ken Watson.



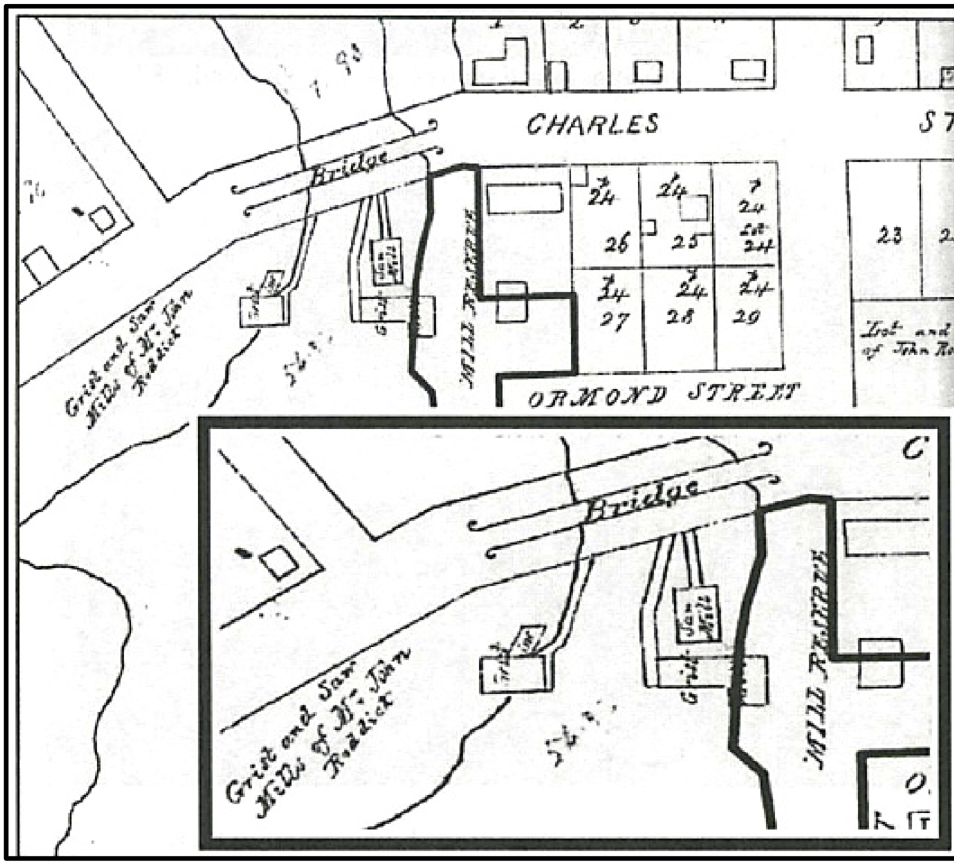
Later Lyndhurst

The top, 1865 image and the bottom, c.1876 image show the later configuration at Lyndhurst

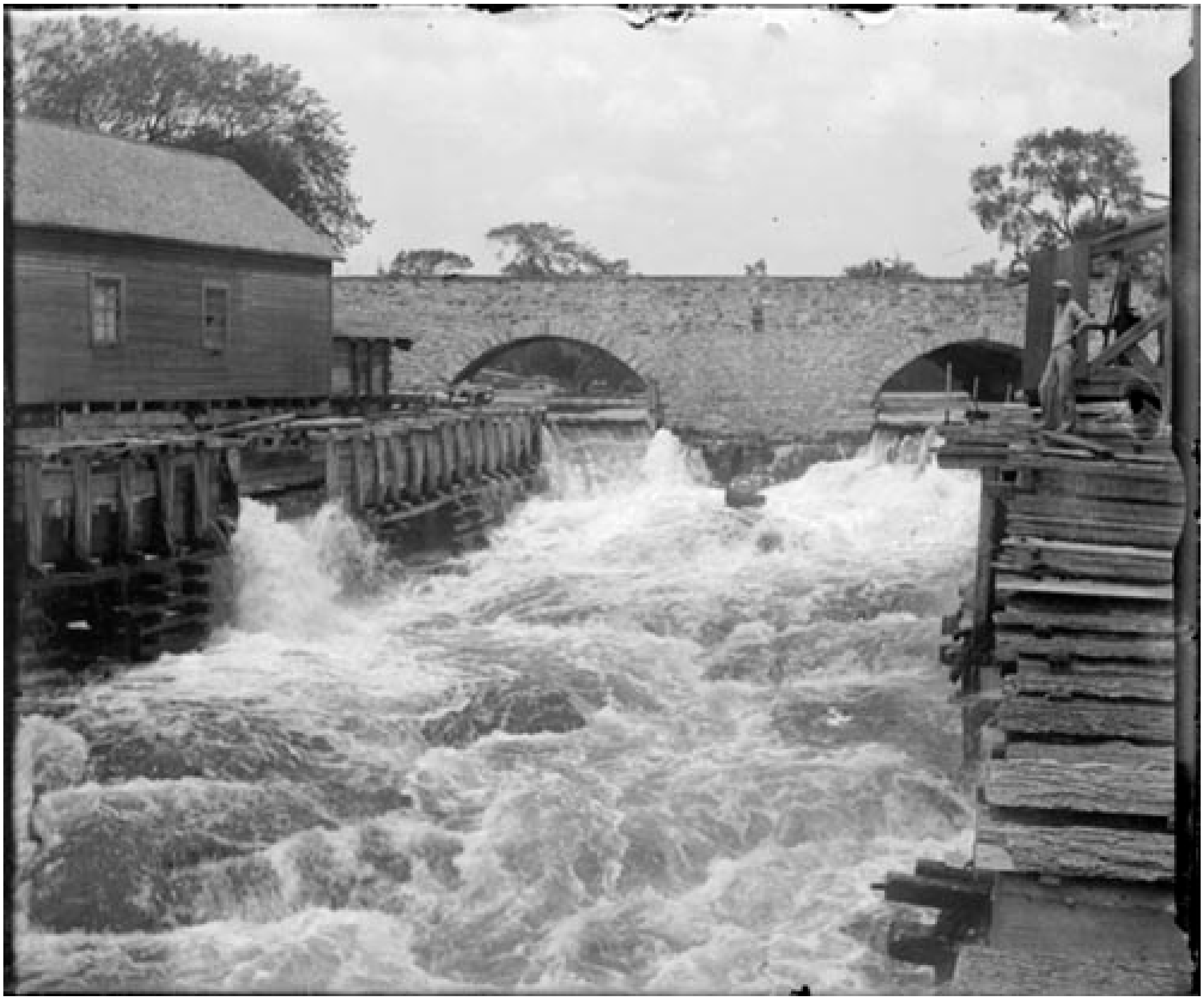
The stone bridge was built in 1857. A dam is located at the south side of the bridge (as it is today), the diagrams show different flume configurations taking the water to the mills (the 1865 flume configuration looks a bit odd).

A new grist mill was built on the east bank in 1881. The mills on on the west bank burned down in 1953 and the east bank mill was demolished in 1967.

Diagrams from Bazely & McKendry, 2008.



Village plan c1876; by now the Roddick stone mill has been built on the west bank; the two mills on the east bank are identified as a gristmill (L-plan) and sawmill – the Green-Harvey brick gristmill has not yet been built (LAC NMC 149559, reproduced in the April 2008 Report for NHSD by David McConnell who added the heavy outlining)



Water Power At Lyndhurst

This early 1900s photo shows the Lyndhurst bridge with Roddick's sawmill on the west bank (left) and the flume of the Green-Harvey gristmill on the east side (right). The flumes are used to provide a controlled water flow to the waterwheel or, by the mid-late 1800s, turbines.

In 1800 there was more water flow through this area since water had not been diverted down to the Cataraqui River as it is today. This started c.1803 when the Haskin brothers built a dam and mill at White Fish Falls (Morton), backing up the water and forcing it south, creating a water connection with the Cataraqui River. This change was formalized with a Rideau Canal dam, built in that location in the late 1820s. For years, Gananoque millers complained that the Rideau Canal was stealing their water. They were quite correct, but never won any legal challenges, their mills had all been built after the canal.

This photo would have been taken in the spring, the waters from the freshet providing a spectacular display. This clearly illustrates why a flume was a necessary method of water control. This standard configuration of an upstream dam with a flume leading to a waterwheel is in contrast to the Old Stone Mill which acted as its own dam, the flume located inside the mill.

Photo by Marsden Kemp. Undated (between 1898 and 1920). Archives of Ontario, C 130-1-0-17-1