

MEMORANDUM

Date: July 27, 2010
To: Water Right File 21-7566
From: medl
Re: license review

Applicant

Steve or Carol Burk are the permit holders and according to Arc Map taxlot information, the owner of record of both the place-of-use and point-of-diversion.

Source and POD

The source of this water right is a spring which daylights on the permit holders property. The property is located on Northwest side of Henrys Lake. The unnamed stream source is locally known as Hatchery Stream/Creek or Sherwood Springs. A small outbuilding houses the collection box at the headwaters of the spring. The spring box is fitted with a weir and staff gage; the measuring device required by the permit.

The spring box/point-of-diversion is shared with Idaho F&G decreed water right 21-2100, (fish propagation use) and the Burk's decreed water right 21-12384, (domestic use). There is evidence of an agreement to share the POD in water right file 21-2100.

Gravity brings the water for the Burk uses through buried pvc pipe from the spring box to the place-of-use, the Henrys Lake Lodge also known as the Joseph Sherwood residence/museum. Each use is separately piped from the box and each pipe is buried several feet deep to discourage freezing in the cold months. Water in excess of the piping capacity, flows over the spring box weir and into the stream channel.

The water for power production continues on from the basement of the residence to an exterior above-ground, micro-hydro sited approximately 50 ft away. The micro-hydro is mounted on a frame over the channel of the source stream. Water exiting the hydro is discharged back into the channel of the source stream.

Water Use

Seasonably variable hydro power is the only use associated with this permit. There is no battery bank or water storage and the system does not supply all of the electricity demand. Maximum real-time generation (900 watts) would be sufficient to operate some lights or fans or start a refrigerator. In a 7/27/2010 phone conversation, I confirmed that the place-of-use is also connected to the local power grid operated by Fall River Rural Electric Cooperative. Fall River electric personnel confirmed that the Burks are members served at the Sherwood residence and that they did not have power buy-back agreement in place.

The actual beneficial use is considerably smaller than the rate authorized by the permit. During the 9/19/2007 beneficial use field exam, IDWR personnel found a custom built, turgo style Pelton waterwheel in place. This type of turbine is capable of producing electricity in a range of flows, depending on the size of the jet nozzles which are installed. The field examiner found that 4 - ¾ inch nozzles were installed. However, he recommended a rate based on penstock pipe capacity which was higher than the combined capacity of the 4 nozzles.

The examiner did not take a flow measurement and both the recommended rate and recommended

volume are higher than I am able to validate for this license. The recommended rate was based on a calculation of the penstock capacity. The combined, maximum flow rate through the largest of the 4 available nozzles is less than the examiners recommended rate for this license.

The examiners recommended volume was based on year-round, continuous use of water at his recommended rate. However, in response to an additional information request, the permit holder submitted a schedule of the typical, seasonal use of the lodge. The licensed volume is based on that adjusted seasonal use rather than continuous use.

As this is a small personal hydropower use, the FERC and PUC are not involved. I set the date for Directors review for Department standard 10 years in the future.

Place of Use

The place-of-use shape was created by IDWR Eastern region personnel.

The Burks are restoring a historic site: the Joseph Sherwood residence/museum and store. They envision recreating a waterwheel-powered sawmill as part of the complete restoration. This permit is a step toward that end.

The place-of-use is also known as the Henrys Lake Lodge.

Calculations

While reviewing this permit for licensing, I requested additional information from the permit holder and he provided some specs for the system. The turgo type wheel was custom built. (The wheel of a turgo is like a Pelton wheel sliced in half). The Burk micro hydro has a range of nozzles sizes available for use. And the field examiner found that 4 - 3/4 inch nozzles were in place.

A reference nozzle chart from Energy Systems and Design Limited (ES& D) indicates that a single 3/4 inch nozzle can deliver 60.5 gpm at ~ 30 head of head or 12.8 psi. The Burk turgo has 4 nozzles and approximately 30 ft of head so Mr. Burk's claimed beneficial use of 230 gpm (or 0.5 cfs) with the 4 x 3/4 inch nozzle configuration is reasonable. Therefore, the licensed rate is 0.5 cfs.

The volume issued through this license is based on the refined season of use provided in an email dated 6/10/2010 from the permit holder to Mr. Shelley Keen. Please refer to the spreadsheet attachment which I created to demonstrate the volume calculation. The licensed volume is 234.05 AF rounded to three significant figures or 234.00 AF.

21-7566 Burk hydro							
month	days	op hr/day	%day	cfs	= cfs x %day	monthly cfs	monthly AF
January	31	18	0.75	0.5	0.375	11.625	23.06
February	28	18	0.75	0.5	0.375	10.5	20.83
March	31	18	0.75	0.5	0.375	11.625	23.06
April	30	0	0	0.5	0	0	0.00
May	31	18	0.75	0.5	0.375	11.625	23.06
June	30	24	1	0.5	0.5	15	29.75
July	31	24	1	0.5	0.5	15.5	30.74
August	31	24	1	0.5	0.5	15.5	30.74
September	30	24	1	0.5	0.5	15	29.75
October	31	18	0.75	0.5	0.375	11.625	23.06
November	30	0	0	0.5	0	0	0.00
December	31	0	0	0.5	0	0	0.00
sum cfs						118	
conversion factor	1.9835						
sum af							234.053
created by Michele Edl							

DETERMINING NOZZLE SIZE

Optimal nozzle size can be determined from the design example using the Nozzle Flow Chart.

Two types of turbine runners are offered for the Stream Engine. A standard turgo runner and a high head low flow runner.

The standard turgo runner can use nozzles of up to one inch in diameter. This is used for higher flow sites which are associated with lower heads. The universal type of nozzle is supplied with the conventional runner. With the universal nozzle, it is possible to create any size nozzle jet that might be required by simply cutting the nozzle to the appropriate length. Cutting can be done with a hacksaw, or any other fine toothed saw. The end of the nozzle should then be finished with a piece of sandpaper. This is best done by placing the sandpaper on a flat surface and moving the nozzle against it. Markings are on the nozzle to assist in cutting to the correct size. The numbers are in millimeters and correspond to inches as follows:

mm	3	4.5	6	8	10	13	16	19	22	25
inches	1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	7/8	1

The low flow runner comes with brass nozzle inserts that are supplied in sizes of 1/8" to 1/2" in increments of 1/16" which are screwed into a plastic flange.

Both the standard Stream Engine and the low flow version are supplied with nozzles flanges that have a 1 1/2" pipe thread that is connected to the incoming plumbing.

NOZZLE FLOW CHART FLOW RATE IN U.S. GALLONS PER MINUTE

Head Feet	Pressure PSI	Nozzle Diameter, inches											Turbine RPM
		1/8	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1.0	
5	2.2					6.18	8.40	11.0	17.1	24.7	33.6	43.9	460
10	4.3			3.88	6.05	8.75	11.6	15.6	24.2	35.0	47.6	62.1	650
15	6.5		2.68	4.76	7.40	10.7	14.6	19.0	29.7	42.8	58.2	76.0	800
20	8.7	1.37	3.09	5.49	8.56	12.4	16.8	22.0	34.3	49.4	67.3	87.8	925
30	13.0	1.68	3.78	6.72	10.5	15.1	20.6	26.9	42.0	60.5	82.4	107	1140
40	17.3	1.94	4.37	7.76	12.1	17.5	23.8	31.1	48.5	69.9	95.1	124	1310
50	21.7	2.17	4.88	8.68	13.6	19.5	26.6	34.7	54.3	78.1	106	139	1470
60	26.0	2.38	5.35	9.51	14.8	21.4	29.1	38.0	59.4	85.6	117	152	1600
80	34.6	2.75	6.18	11.0	17.1	24.7	33.6	43.9	68.6	98.8	135	176	1850
100	43.3	3.07	6.91	12.3	19.2	27.6	37.6	49.1	76.7	111	150	196	2070
120	52.0	3.36	7.56	13.4	21.0	30.3	41.2	53.8	84.1	121	165	215	2270
150	65.0	3.76	8.95	15.0	23.5	33.8	46.0	60.1	93.9	135	184	241	2540
200	86.6	4.34	9.77	17.4	27.1	39.1	53.2	69.4	109	156	213	278	2930
250	108	4.86	10.9	19.9	30.3	43.6	59.4	77.6	121	175	238	311	3270
300	130	5.32	12.0	21.3	33.2	47.8	65.1	85.1	133	191	261	340	3591
400	173	6.14	13.8	24.5	38.3	55.2	75.2	98.2	154	221	301	393	4140

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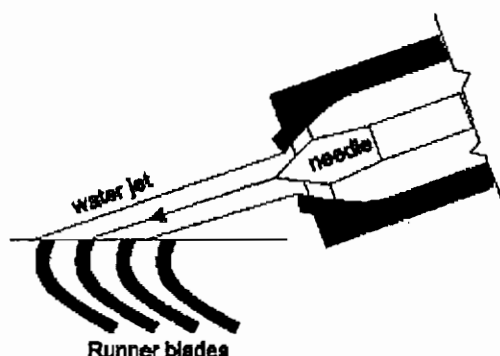
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Turgo turbine

A type of impulse turbine that is similar to Pelton turbine but can handle higher flow rates although it is somewhat less efficient. The runner (wheel) of a Turgo turbine is like a Pelton wheel sliced in half. The incoming jet of water strikes the plane of the runner on one side – usually at an angle of about 20° – and exits on the other. The fact that the incoming and outgoing jets don't interfere (as they do in the case of the Pelton turbine) means that the Turgo wheel can handle a higher flow rate. Also, because the Turgo runner is effectively a Pelton runner split down the middle it can generate the same power as a Pelton wheel with twice the diameter and thus has twice the specific speed of the Pelton. On the other hand, a Turgo runner is more difficult to make than a Pelton and the vanes of the runner are not as sturdy as Pelton buckets.



With their smaller, faster spinning runners, Turgo turbines can sometimes be connected directly to a generator rather than needing an expensive speed-increasing transmission.

Turgos operate in a head range where the Pelton and Francis turbines overlap. Although there are many large Turgo installations, they are especially also popular for microhydro power applications.



A small Turgo runner made by Joseph Hartvigsen for use in a microhydro system

Related category

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Also on this site:

Idaho State Historical Society

Sherwood Photograph Collection

By Linda Morton-Keithley, Administrator, and Carolyn Bowler, Archivist

Note!

Click on any image for a larger view

In 1991 the Idaho State Historical Society acquired a large collection of artifacts from the Joseph Sherwood house, store and museum located on the north shore of Henry's Lake in Fremont County, Idaho. Included were the furnishings of the main building, manuscript materials, and a large photograph collection consisting of glass plate negatives, original prints, postcards, cabinet cards, stereographs, and other miscellaneous items. Of the photographs that have been dated, most were taken before 1910.



Prior to the 1860s, the Henry's lake area was known only to Native Americans, explorers and fur trappers, such as Andrew Henry for whom the lake is named. (Today the area is known by the broader term, "Island Park.") The first permanent settler, Gilman Sawtell, arrived in the late 1860s. Designation of nearby Yellowstone National Park in 1872 brought public attention to the area, and traffic and settlement began to increase. By 1881 a stage line was running between Monida, Montana and Yellowstone Park, by way of Island Park. The trip took three days and visitors spent two nights at so-called "home stations" where meals and a

night's lodging were provided. Area residents made their living from farming and ranching, providing accommodations for visitors, trapping, and fishing.

Joseph Sherwood and his first wife, Susan, arrived at Henry's Lake about 1889 (perhaps earlier). To make a living, Joseph built and operated a store, raised cattle, and on November 4, 1889 was named postmaster of the Lake, Idaho, post office, located in his store. Acting as an agent, he packaged fish from local fishermen and shipped them to various places in Montana and California. In a letter to an interested buyer dated October 31, 1892, Sherwood wrote, "The amount of fish usually caught in winter here varies from 50 to 90,000 pounds." He also began a short-lived commercial fish hatchery on property later leased to the Idaho Department of Fish and Game.



Joseph took a correspondence course to master the art of taxidermy, later teaching the skills to his second wife, Ann, whom he married in 1899 after Susan's death. Both became very proficient in taxidermy and they managed to mount a specimen of nearly every animal and bird native to the area. A room was set aside on the second floor of the house to display the taxidermy mounts to the public. This collection of wildlife became the nucleus of the Sherwood "museum." Joseph was also a prolific photographer, developing the film himself and displaying the work in a picture gallery, also on the second floor of the house.

In addition to housing the general store, post office, family living quarters and museum, the



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building served as a "home station" with four bedrooms available for rent to overnight guests traveling from Montana to Yellowstone. Ann Sherwood was responsible for preparing meals and generally caring for these visitors. Joseph also rented boats for rides on Henry's Lake, took visitors on the lake in his own launch, and hosted celebrations for special events such as the Fourth of July.



ISHS #1994.21.101

On February 19, 1907, Joseph was granted U.S. Patent No. 844,963 for an "auto snow-car," devised to fight deep snow drifts and also provide hauling capabilities. He based his design on a horse-drawn four-runner sled. The front runners were used to steer and were controlled by a sprocket gear which could lift them up and over snowdrifts. The sleigh weighed less than a thousand pounds and may have reached speeds up to 12 miles per hour. Joseph also built what is believed to be the first automobile in Island Park. Called "The Black Car," its design was based on

pictures Joseph had seen in magazines.

In 1909 a rail line was completed from St. Anthony, Idaho to Yellowstone Park by way of Island Park. Many former stage stops were put out of business by the railroad and also by the introduction, in 1916, of automobile traffic in the Park. The Sherwoods were among those who adjusted to the new traffic patterns by selling gasoline and oil, and offering overnight camping facilities to the motorists.



Following Joseph Sherwood's death in 1919, Ann and other members of the family continued to operate the post office (until 1937) and the store/museum (until the mid-1960s.)

In 2002 the Idaho State Historical Society Public Archives and Research Library was awarded a grant from the Idaho Heritage Trust to make new copy prints from the original glass plate negatives in the Sherwood collection. A complete set of the prints is available in the reading room of the Public Archives and Research Library in Boise; a second set of prints has been donated to the Island Park Historical Society. To request additional information, please click [here](#).

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Guide to the Sherwood Museum Photograph Collection 1892-1907

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Title: Sherwood Museum Photograph Collection

Dates: 1892-1907 (inclusive)

Quantity: approximately 900 items, 275 glass plate negatives, 63 identified original prints, approximately 350 unidentified items (prints, cabinet cards, stereographs, postcards), and 201 contact prints produced in 2003 with a grant from Idaho Heritage Trust

Collection Number: P1996.21

Summary: The Sherwood family were early settlers in the Henry's Lake area of Idaho. The collection contains photographs documenting the Henry's Lake area, their neighbors and activities, and their activities as early ranchers, storekeepers and inventors.

Repository: Idaho State Historical Society
Public Archives and Research Library
2205 Old Penitentiary Road
Boise, Idaho 83712-8250
208-334-3356 - phone
208-334-3198 - fax
www.idahohistory.net

Languages: No textual or other language materials are included in the collection.

Sponsor: Funding for encoding this finding aid was provided through a grant awarded by the National Endowment for the Humanities.

Biographical Note [+/-](#)

Joseph Sherwood and his first wife, Susan, arrived at Henry's Lake, Fremont County, Idaho in 1889. Joseph built a store which subsequently burned down and was replaced about 1899. Joseph raised cattle, operated the store and on November 4, 1889 was named postmaster of the Lake, Idaho post office, located in his store. He also began a short-lived commercial fish hatchery on the property which later was leased to the Idaho Department of Fish and Game.

One of Joseph's earliest projects was developing a series of ponds on a bench above the house. Using a canvas flume, he carried the captive water down to a turbine which powered a sawmill. He provided lumber for his own house and also sold lumber to many of his neighbors. Other structures on the Sherwood property included a horse barn, corrals and dock located on the lake.

Joseph took a correspondence course in taxidermy and later taught taxidermy to his second wife, Ann, whom he married in 1899 after Susan's death. Both Joseph and Ann became taxidermists and managed to mount a specimen of every animal and bird native to the area. A room was set aside on the second floor of the house to display the mounted specimens to the public. This collection became the nucleus of the Sherwood "museum." Joseph was also a prolific photographer and prints were displayed in a picture gallery also on the second floor of the house.

The Sherwoods provided overnight lodging for travelers, rented boats and took visitors. Joseph invented an "auto snow-car" and an automobile called "The Black Car."

Joseph Sherwood died in 1919. Ann continued to promote the museum and was named postmaster in 1920. The store operated until the mid-1960s.

Content Description [+/-](#)

The Sherwood Collection contains photographs of people including Native Americans, local settlers, and the Sherwood family. Activities such as ice fishing, horseback riding, skiing, sledding and boating are documented. There are photographs of Joseph Sherwood's inventions including a boat, snow vehicle, and car. Also included are scenic views and images of buildings including houses, stores, mills, and barns. A large portion of the collection illustrates the taxidermy mounts that were displayed in the museum. The photographs are dated from 1892 to 1907.

Use of the Collection [+/-](#)

Restrictions on Access :