

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES
BENEFICIAL USE FIELD REPORT

A. GENERAL INFORMATION

Permit No: 96-10101
Exam Date: 07/01/2025

1. Current Owner:
WHITNEY BETZ 68 CROSS MOUNTAIN RD SANDPOINT ID 83864 AND/OR
ZACH BETZ 68 CROSS MOUNTAIN RD SANDPOINT ID 83864
2. Accompanied by: Zach Betz
Phone No: 208-946-6339
Address: Same as above
Relationship to permit Holder: Permit Holder

3. **SOURCE:**
FLUME CREEK

Tributary
RAPID LIGHTNING CREEK

Method of Determination: ArcMap and DRG Layer.

B. OVERLAP REVIEW

1. Other water rights with the same place of use: NO Overlap
2. Other water rights with the same point-of-diversion: NO Overlap

C. DIVERSION AND DELIVERY SYSTEM1. **LOCATION OF POINT(S) OF DIVERSION:**

FLUME CREEK SE¼ NW¼, Sec. 18, Twp 58N, Rge 02E, B.M. BONNER County

Method of Determination: GPS; POD is located at -116°15.5688, 48°22.7858; repurposed gray electric power box with mesh screen serving as intake collection box in Flume Creek to 3-inch penstock.

PLACE OF USE: POWER and FIRE PROTECTION

Twp	Rng	Sec	NE				NW				SW				SE				Totals
			NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	
58N	02E	18								X									

Method of Determination: Beneficial Use field exam and ArcMap aerial imagery and Bonner County GIS parcel map.

3. Delivery System Diagram Attached (required). Indicate all major components and distances between components.
X Indicate weir size/pipe as applicable.
- X Map Attached Showing Location(s) of point(s) of diversion and place(s) of use (required). Scale must be 1:24,000 or greater.
- X Aerial Photo Attached (required for irrigation of 10+ acres).
- X Photo of Diversion and System Attached

4.

Well or Diversion ID No.*	Motor Make	Hp	Motor Serial No.	Pump Make	Pump Serial No. or Discharge Size
FLUME CREEK DIVERSION	N/A	N/A	GRAVITY FLOW 3-INCH POWER SYSTEM PENSTOCK		780-FT OF 3-INCH PVC PIPELINE TO POWER UNIT

D. FLOW MEASUREMENTS

1.

Measurement Equipment	Type	Make	Model No.	Serial No.	Size	Calib. Date
5-GAL BUCKET MEASUREMENT						

2. Measurements: I attempted to complete three (3) 5-gal bucket measurements from the overflow pipes from power unit, but each measurement was less than 5 seconds to fill; I've included these measurement computations below but have recommended diversion rate(s) for licensing purposes based on theoretic derived values based on Harris LV800 hydropower unit nozzle(s) flow through gpm rates (for Power Beneficial Use (BU)) and a Manning Equation (for Fire Protection BU).

E. FLOW CALCULATIONS

 X Additional Computation Sheets Attached

Measured Method:

I attempted three 5-gal bucket measurements as follows:

- 5-gal / 3.94 sec x 60 sec/min = 76.14 gpm
- 5-gal / 4.06 sec x 60 sec/min = 73.89 gpm
- 5-gal / 3.96 sec x 60 sec/min = 75.76 gpm with average of three trials equaling 75.3 gpm or 0.17 cfs

Due to the 5-gal bucket measurements being less than 5 seconds to fill per measurement, I used hydropower system design data charts to evaluate nozzle bypass flow rates based on the following system specifications:

- Pipe friction value = $[(1.44 \text{ factor} \times 780 \text{ ft pipe})/100] = 11.23$ friction loss value (reference attachment sheets)
- 60 ft head – 11.23 ft friction loss = 48.8 ft approximate Head resulting in nozzle flow as follows:
 - 2ea 1/4-inch nozzles = 9.51 gpm x 2 nozzles
 - 1ea 3/8-inch nozzle = 21.4 gpm
 - 1ea 1/2-inch nozzle = 38 gpm with total gpm = 78.42 gpm or 0.17 cfs based on Department rounding standards. Mr. Betz asserts the system commonly bypasses approximately 80 gpm by his calculations.
- I've evaluated the nozzle flow rates on the high side, as the pressure gage installed on the Power system was malfunctioning at time of exam. My recommendations are conservative on the high side based on system specification flow through nozzle chart.
- Permit authorized development of Power and Fire Protection with a 0.27 cfs diversion rate respectively.
- Field examination Power observed diversion rate = 0.17 cfs which is supported by system specification flow chart calculations
- Manning Equation derived flow rate for 3-inch penstock pipeline (pipe full value) = 0.35 cfs
- **Power** diversion rate recommended for licensing = **0.17 cfs** (non-consumptive use)
- **Fire Protection** diversion rate recommended for licensing = **0.27 cfs**, limited to maximum diversion rate of permit approval.
- **Maximum Diversion Rate** recommended for licensing = **0.27 cfs**.

F. VOLUME CALCULATIONS

1. Volume Calculations for irrigation: N/A

2. Volume Calculations for Other Uses:

- Fire Protection water use is exempt from the volume reporting requirements IAW Section 035 of Idaho Administrative Code – IDAPA 37.03.02 Beneficial Use Examination Rules; there isn't a Maximum Diversion Volume reported for licensing purposes.
- Power annual volume (non-consumptive use) = $0.17 \text{ cfs} \times 365 \text{ days} \times 1.9835 = 123 \text{ af}$ considering Department rounding standards.

G. NARRATIVE/REMARKS/COMMENTS

I conducted the beneficial use field exam on 7/1/2025 with the Permit Holder, Zach Betz, which showed a micro hydropower system that diverts water from Flume Creek with return flow back to Flume Creek in a lower reach of the creek. At the POD, creek water is diverted into a repurposed electrical control panel box that has been cut with slits to serve as a screened intake collection box in-creek. The penstock incorporates a 3-inch run of PVC pipe(s) 780 ft long that has approximately 48.8 ft of dynamic head before reaching the power station at the POU. Dynamic head was calculated based on 60 ft elevation change minus 11.23 ft calculated friction loss = 48.8 ft dynamic head (reference attached sheets describing hydroelectric power output estimate formula). Near the POD a priming pipe is coupled to the 3-inch pipeline which results in minor discharge that is returned directly to the source; this water is returned to the source near the POD and the priming water discharge isn't calculated as part of the hydropower system rate or volume.

I attempted to capture flow measurements where the power system discharges from four micro hydropower nozzles back to Flume Creek, but each 5-gal bucket measurement was less than 5 seconds to fill resulting in measurements I'm not authorized to use based on Field Examiner Handbook - closed conduit measurement guidance. For reference, the 5-gal bucket measurement resulted in an average of 0.17 cfs. In lieu of direct flow measurements I evaluated the hydropower system as developed: four nozzles (12mm, 7mm, 10mm, 6.75mm) which converts to a ½-inch nozzle, a 3/8-inch nozzle, and two ¼-inch nozzle for flow through nozzle flow rate evaluation. Considering the 48.8 ft of dynamic head and 50-60 PSI system operating pressure, the resulting flow rate as described above on PG2 of this report equals 78.42 gpm or 0.17 cfs considering Department rounding standards. This rate is consistent with the pass-through discharge from micro hydropower unit measurement I gained by 5-gal bucket measurements and I'm recommending **0.17 cfs** for the Power beneficial use diversion rate for licensing purposes.

The Power beneficial use POU is a small pump station that houses the four nozzle Harris brand LV800 micro-hydro generator. During the exam the four nozzles were in operation and the pressure gauge fluctuated between 50-70 PSI. Mr. Betz asserted the pressure gauge was malfunctioning at time of exam reading at 65-70 PSI and asserted the system commonly operates at 50 PSI. I've designated 60 PSI in my flow rate calculations to ensure adequate rate is recommended for this non-consumptive power usage.

Water discharges from the four nozzles into a blue collection bin which has multiple overflow pipes that exit the power station and return immediately to the creek. Multiple discharge pipes are installed, likely due to using materials on hand and needing additional discharge to keep the bin from overflowing within the powerhouse. I collected measurements from all the discharge pipes in my 5-gal bucket measurement attempts discussed earlier in this report.

The Harris power unit was registering just under 5 amp/hr on the low current indicator at time of exam. For calculation purposes 4.7 ah at 41.4 derives 241.58 Wh power output. Attached to this report is my hydroelectric power output estimation formula that derived a Wh output = (60 ft dynamic head – 11.23 ft friction loss) x (78.42 gpm flow rate) x (0.18 factor value) x (0.35 efficiency percentage for low head system) = 240.9 Wh power output. The power output estimation is comparable to the realized amp/hr power generation gauge reading.

Mr. Betz monitors power generation using a blue tooth app that enabled him to submit December 2024 – June 2025 kWh reports. The 6-month average from Jan 1 – Jun 30, 2025, resulted in 1.1 mWh or 1,100 kilowatts. Mr. Betz asserts the system operates year-round and the power output would be two times the value or 2,200 kilowatts annually. This is system information and demonstrates that power beneficial use is fully developed by the Permit Holder but doesn't equate to an

annual diversion volume. The Power annual diversion volume is based on diversion rate operating 24/7 year-round which is calculated above and equals **123 af** of non-consumptive annual volume. This permit includes a Fire Protection beneficial use that is exempt from volume reporting purposes, so the annual volume for Power is designated on the face of the license but there isn't a maximum diversion volume associated with the face of the license. The Permit Holder's power system supplements a solar power system for total power output for the home and outbuilding on an annual basis. From the power station, the control center is a small shed near the primary residence that houses the battery(s) and converters for the hydro/solar hybrid system.

The Fire Protection beneficial use system incorporates the same 780 ft 3-inch PVC pipeline with a Y-fitting located within the power station that allows each nozzle pipe of the power system to be turned off and all water diverted to the fire protection portion of the system. A bypass valve is installed off the 3-inch penstock pipeline currently necked down to a garden hose cap in preparation for water use. The adapter can be replaced with a flexible fire hose adapter if needed to fill tanks directly from the system or spray water at the lower elevation of the parcel. The garden hose provides adequate pressure to arc water up in elevation to reach the primary residence and higher ground of the parcel.

I was unable to evaluate a direct flow measurement for the Fire Protection beneficial use portion of the water system and have used a Manning Equation to evaluate flow; considering the 3-inch PVC pipeline with 60 ft of elevation change over 780-ft the resulting flow rate achievable is 0.35 cfs. I'm only able to recommend **0.27 cfs** based on maximum diversion rate as Permit approved. In the event active fire suppression is required the addition fire rate beyond 0.27 cfs, up to 0.35 cfs, is an exempt water use by Idaho Code §42-201 which mitigates any concern for enlargement of this Right by diversion rate.

I used ArcMap during licensing review to assign the Power and Fire Protection POD/POU for illustration purposes. Although the power system directs power by cable running to the primary residence, I've designated the power station as the POU for licensing purposes. The Fire Protection POU is also designated as the power station location as that is where the pipeline discharges for beneficial use. Water from the system may be used to fight an active fire anywhere on the property regardless of the POU designation.

During licensing review, I made the following conditions of approval changes:

- I removed condition(s) 029, 01N, and 236 based on Permit Holder's compliance to each condition.
- I replaced condition 17H with R22 based on Departmental condition description guidance.
- I removed condition 08A based on Departmental condition description guidance.
- I revised condition 916 to changing "Permit" language to reflect "License" language.

All other conditions on the Permit shall be carried forward to the license. There are no overlapping water right concerns toward licensing 96-10101.

Have conditions of permit approval been met? X Yes No

H. RECOMMENDATIONS**1. Recommended Amounts**

<u>Beneficial Use</u>	<u>Period of Use</u>	<u>Rate of Diversion</u>	<u>Annual Volume</u>
POWER	1 /1 to 12/31	0.17 CFS	123.0 AF
FIRE PROTECTION	1 /1 to 12/31	0.27 CFS	

Totals: 0.27 CFS

2. Recommended Amendments

____ Change P.D. as reflected above ____ Add P.D. as reflected above X None

____ Change P.U. as reflected above ____ Add P.U. as reflected above X None

I. AUTHENTICATION

Luke Bates – Sr Water Resource Agent

Field Examiner's Name



Date

12/30/2025

Reviewer



Date

6/30/2026

State of Idaho
Department of Water Resources
Attachment to Field Exam
96-10101

This map depicts the POWER system diagram.



0 0.035 0.07 0.14 Miles

-  Place Of Use Boundary
-  Point of Diversion
-  Townships
-  PLS Sections
-  Quarter Quarters



State of Idaho
Department of Water Resources
Attachment to Field Exam
96-10101

This map depicts the FIRE PROTECTION system diagram.

02E



0 0.035 0.07 0.14 Miles

-  Place Of Use Boundary
-  Point of Diversion
-  Townships
-  PLS Sections
-  Quarter Quarters



96-10101
LICENSE REVIEW – EMAIL CORRESPONDENCE
POWER SYSTEM COMPONENT IDENTIFICATION AND HISTORIC USE REPORTS

Water Rights Info



Zach Betz <idaho.offgrid@gmail.com>

To: ● Bates, Luke



Tue 7/15/2025 12:40 AM

If there are problems with how this message is displayed, click here to view it in a web browser.



CAUTION: This email originated outside the State of Idaho network. Verify links and attachments BEFORE you click or open, even if you recognize and/or trust the sender. Contact your agency service desk with any concerns.

Luke,

You were correct in assuming I told you the wrong nozzle sizes on the harris hydro wheel at our site.

The 4 nozzles are:

12mm

7mm

10mm

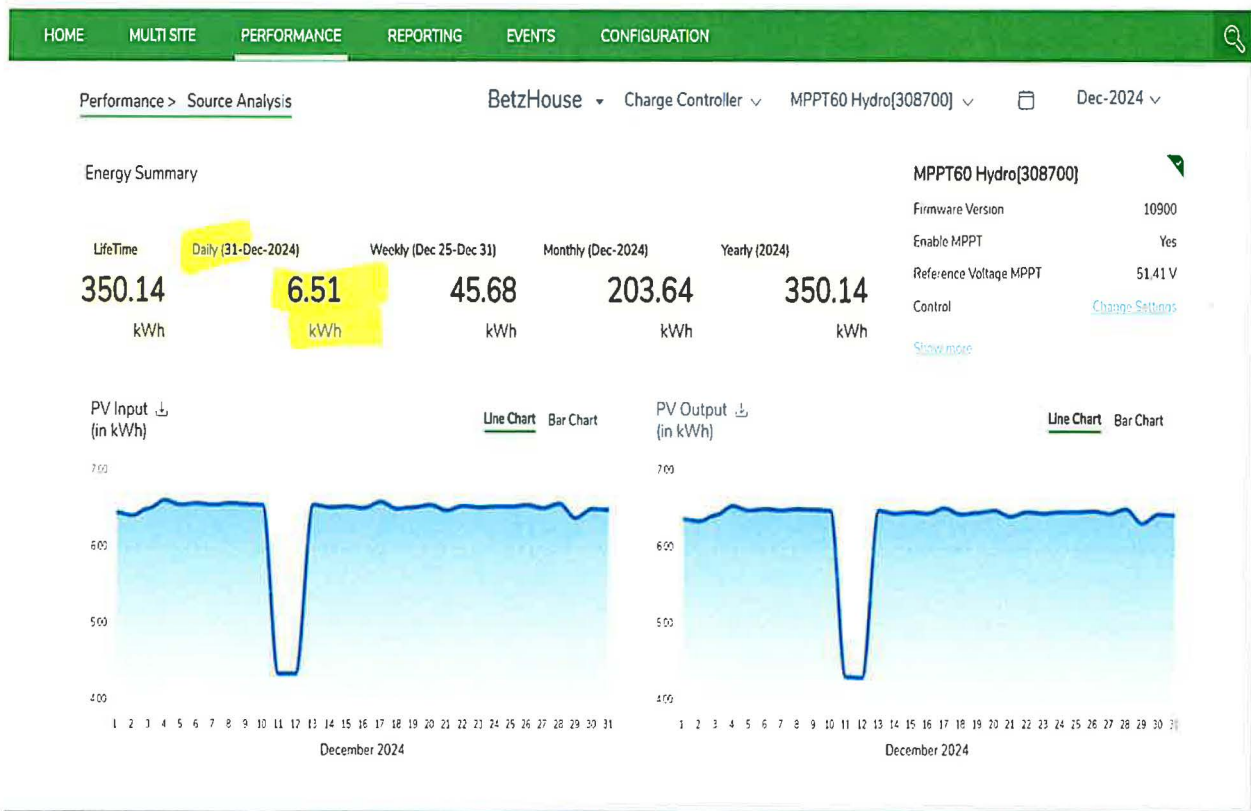
6.75mm

Convert that whatever units you want, that was what my callipers measured for the nozzle openings.

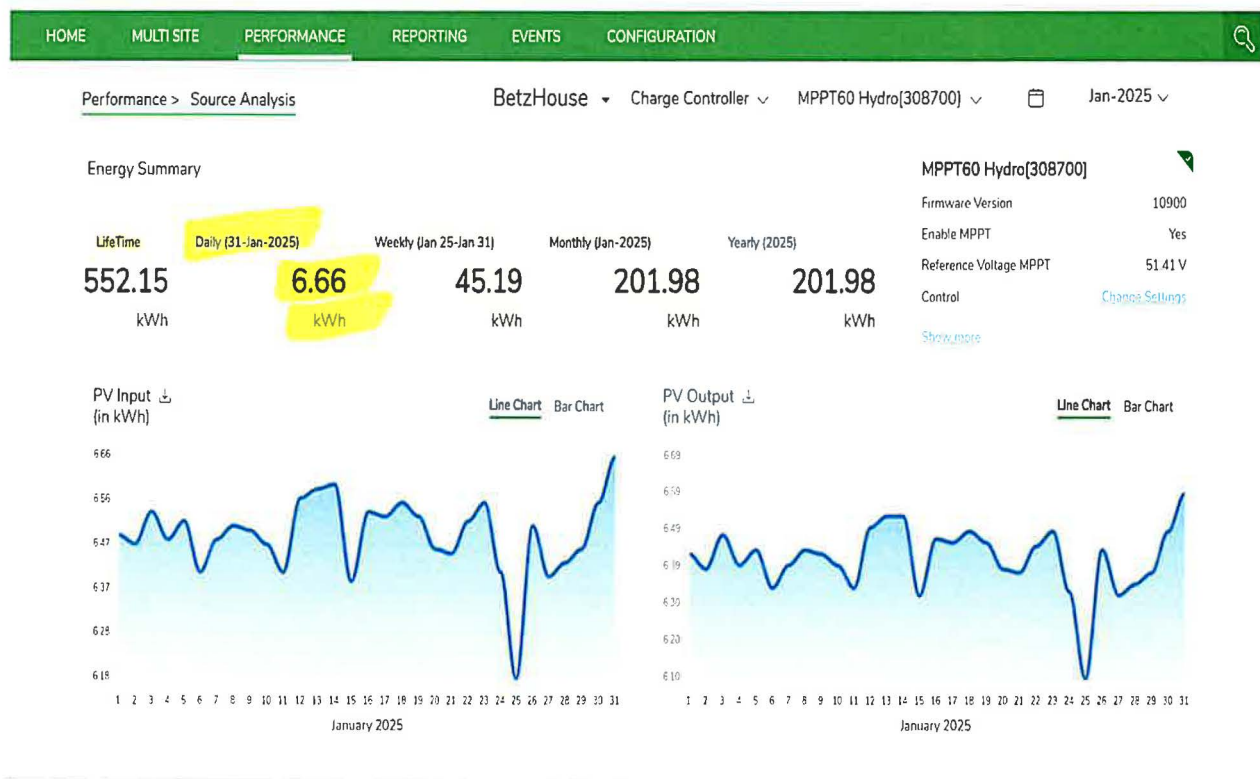
Here are the attached power generation logs for the charge controller that handles the hydro.

Thanks for coming out and checking things out. Hopefully this finishes everything you needed.

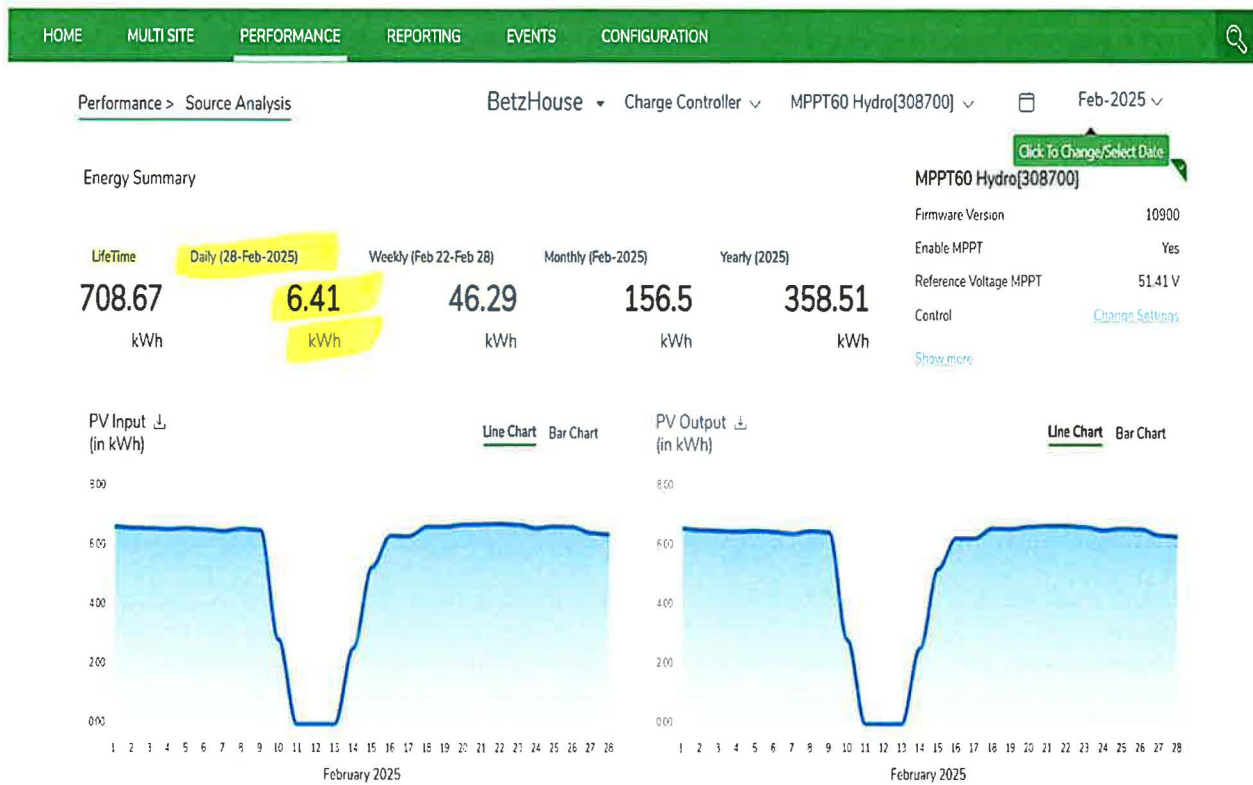
Zach Betz



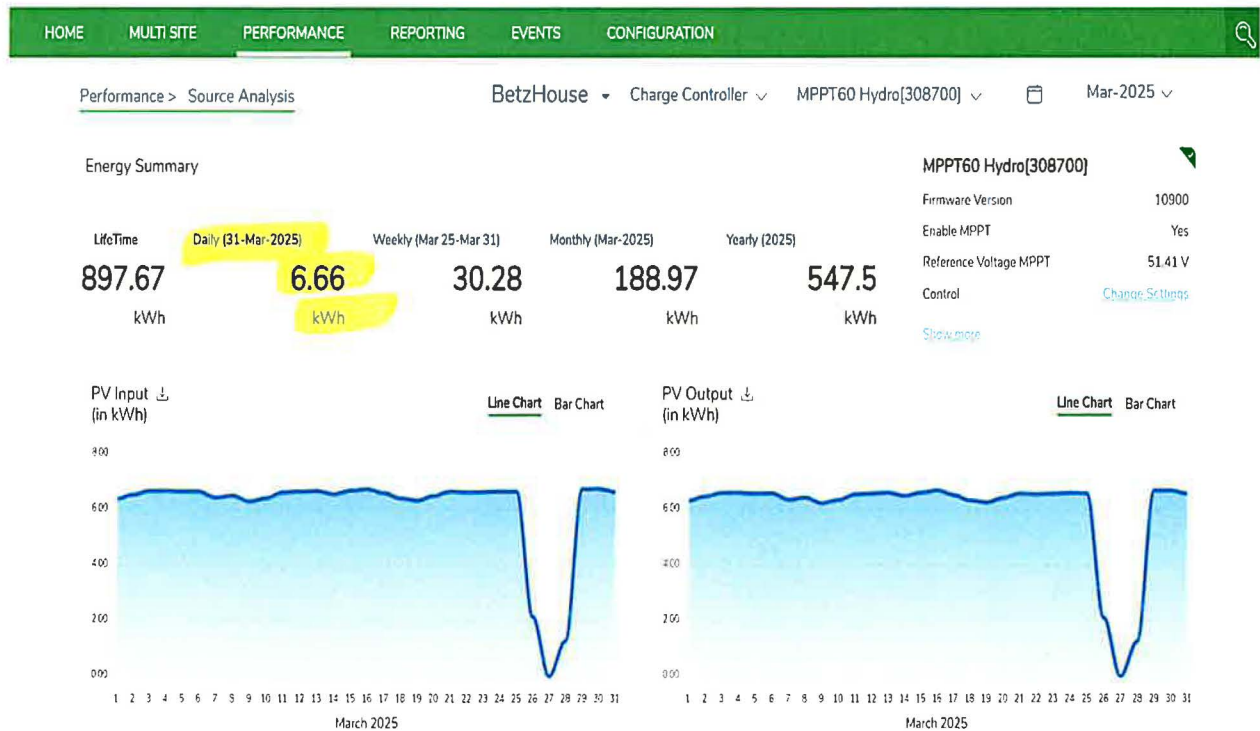
DECEMBER 2024 kWh REPORT



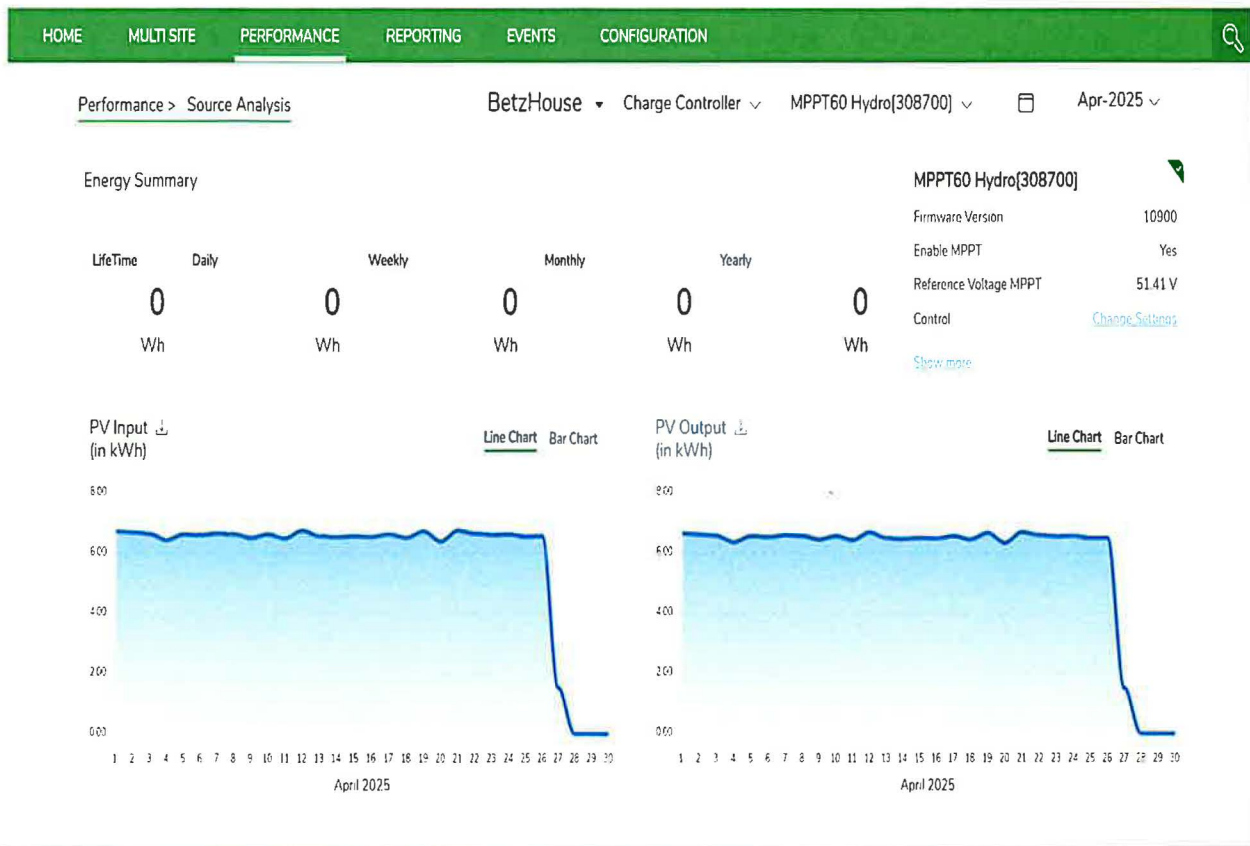
JANUARY 2025 kWh REPORT



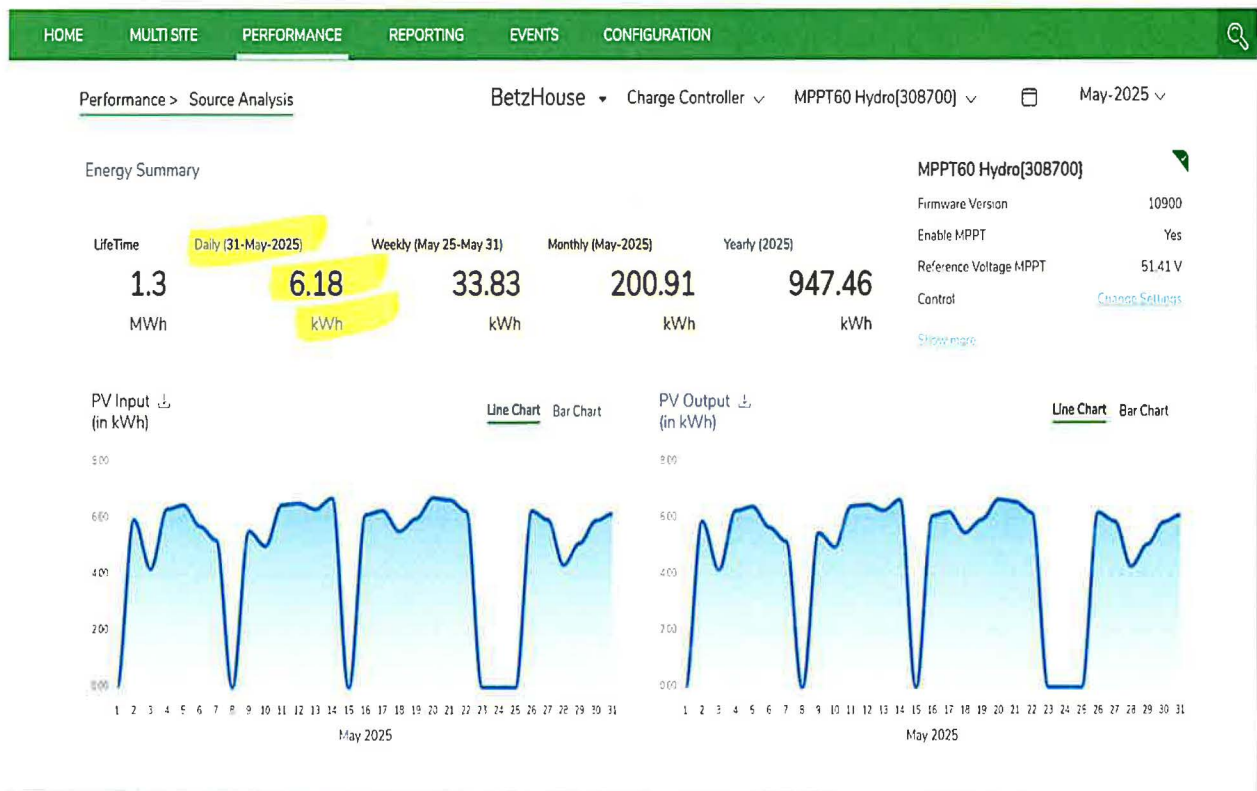
FEBRUARY 2025 kWh REPORT



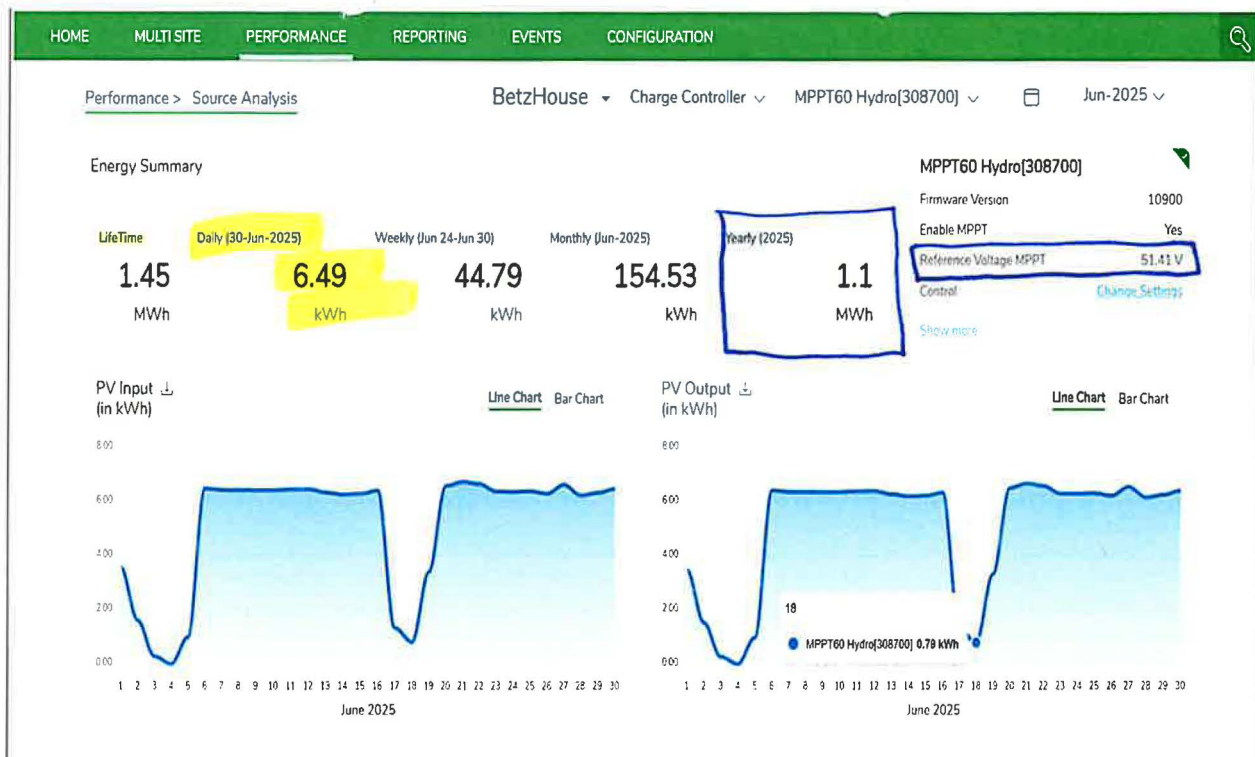
MARCH 2025 kWh REPORT



APRIL 2025 kWh REPORT (ERROR DIDN'T CAPTURE DATA FOR MONTH BUT CHARTS ILLUSTRATE USAGE)



MAY 2025 kWh REPORT



JUNE 2025 kWh

□ Jan 1 - Jan 30 2025

~ 1.1 MWh = 1,100 kWh

□ assume year round use ~ 1,100 kWh x 2 six month periods
= 2,200 kWh
= 2.2 MWh annually

How much power can you generate with a hydroelectric turbine?

The amount of power available depends on the dynamic head, the amount of water flow and the efficiency of the turbine generator combination. To get an idea about available power in watts, multiply the head in feet, times flow in gallons per minute, times 0.18, times turbine efficiency. Turbine efficiency ranges from 35% to 70%, with higher efficiency at higher heads. To get a rough idea, use 0.40 (representing 40%) as a multiplier for efficiency. The Harris Pelton turbines are well suited to higher head and lower flow situations. Flow is limited by nozzle size (a maximum 1/2"). Harris turbines are now available with permanent magnet (PM) alternators providing up to 50% efficiency. Higher flows are accommodated by the ESD Turgo Turbines. They can have nozzles of up to 1" diameter, and provide better efficiency at low heads. The HI-Power

Hydros are ideal for sites where water is available at long distances from power needs. They generate 100+ volts AC that is stepped down and rectified at the batteries. This allows the use of relatively small wire for a distance of up to 10,000 feet. Transmitting the power from the generator to the battery at twice the battery voltage allows you to use 1/4 of the wire size for the same power loss. At 4 times the battery voltage, you can use 1/16 of the wire size required to transmit power at the battery voltage. The HI-Power hydroelectric generator can also deliver up to 3600 watts where higher power is needed. The LV Hydroelectric Generator and the ES&D Water Baby are a good solution for very low flow situations where the head is high enough to make some power.

Pipelines

A hydroelectric turbine operates from the pressure at the bottom end of a pipeline. This pressure, usually measured in pounds per square inch (psi), is directly related to the head, the vertical drop from the top of the pipeline where the water goes into the turbine located at the bottom of the pipeline. The pressure at the lowest point of a pipeline is equal to 0.433 times the head, (the vertical distance in feet).

Pressure is important because it is a determining factor in how much power is available and what type of pipe is required. Polyethylene pipe can be used for pressures up to 100 psi, PVC pipe is available with pressure ratings from 160 to 350 psi and steel pipe can withstand 1000 psi or more. Check with your local plumbing supplier for pipe ratings. Pipe diameter is very important. All pipelines will cause the water flowing in them to lose some energy to friction. The pipe must be large enough for the maximum quantity of water it will carry.

The pressure at the bottom of a pipeline when water is not flowing is called static pressure. When water is flowing through the outlet or nozzle of the hydroelectric turbine, the pressure at the outlet is the dynamic pressure or running head. If you install a gate valve on the pipeline just above the turbine and a pressure gauge on a "T" fitting just above the gate valve, you will read the static pressure on the gauge when the valve is closed and the dynamic pressure when the valve is opened. The maximum power that can be delivered by a pipeline will occur when the dynamic pressure is approximately 2/3 of the static pressure.

The actual flow rate of the water in a hydroelectric system is determined by the diameter of the nozzle. We will supply a turbine with the proper size nozzle for your site, depending on the head, flow, length and diameter of the pipe. We carry hydroelectric generators made by Energy Systems and Design, HI-Power Hydroelectric, and Harris Hydroelectric. Use the descriptions on the following pages to help determine which turbine will work best for your site and power requirements.

35% efficiency Rating applied based on lower head.

$$\text{Dynamic Head} \times \text{Flow} \times \text{Factor} \times \text{Efficiency} = \text{Output Watts/hr}$$

$(60\text{ft} - 11.25\text{ft Friction Loss}) \times (78.42\text{gpm}) \times 0.18 \times 35\% = 240.9 \text{ output watts/hr}$

Hydroelectric Power Output Estimation Formula:

$$\text{Dynamic Head (ft)} \times \text{Flow (GPM)} \times 0.18 \times \text{Turbine Efficiency (use 0.40)} = \text{Output Watts}$$

We can help you design your system

If you think you have a suitable site, contact us and we will help you choose the best unit for your situation. Please provide the following information about your site:

1. **Head** – The total vertical elevation from the place where the water enters the pipe to the point where the turbine will be located.
2. **Flow** – The number of gallons per minute that are available.
3. **Distance** – The length of pipe that will be necessary to carry the water from the pickup to the turbine. If the pipe is already installed, what is the type and diameter?
4. **Location** – Distance from turbine to batteries.

Nozzle selection

Power output of a hydroelectric generator is determined by the pressure of the water at the nozzle and the amount of water flowing out of the nozzle. The larger the nozzle, the greater the flow will be. The nozzle must also be sized small enough to keep your pipeline full and keep the speed of the water in the pipe below 5 feet per second. The nozzle selection table on the next page shows water flow through various size nozzles at given pressures. Use this table to determine what size nozzle and how many nozzles you need to accommodate the flow of water you have and to deliver the amount of power you need. A pressure gauge in the pipe feeding your turbine, installed before the shutoff valve, can help you check proper operation and diagnose problems. When the valve is shut off, the gauge will read the static pressure in pounds per square inch (head in feet x 0.433). When the valve is turned on the gauge will read a lower (dynamic) pressure.

The difference between these two pressures represents your loss to friction in the pipe. The greater the flow, the greater your loss will be. (See PVC pipe loss table on the next page.)

$\sim 4.7 \text{ ah at } 51.4 \text{ V} = 241.58 \text{ Wh}$

Water Flow Information for Pumping and Hydroelectric Design

Flow Through Nozzles

The table below shows the flow in gallons per minute (gpm) through various diameter nozzles at a range of heads from 5 feet to 400 feet. Use table to choose what nozzle size to use and how many nozzles a turbine must have to give the required flow to use all of the water available in the system.

Nozzles = (x2) (x1) (x1) Higher Pressure Shows chart Readings.

Head		Flow in gpm through these nozzle diameters:											Rpm for 4" turbine
feet	psi	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	8.4	11	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	47.6	62.1	650
15	6.5	-	2.68	4.76	7.4	10.7	14.6	19	29.7	42.8	58.2	76	800
20	8.7	1.37	3.09	5.49	8.56	12.4	16.8	22	34.3	49.4	67.3	87.8	925
30	13	1.68	3.78	6.72	10.5	15.1	20.6	26.9	42	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	2.38	5.35	9.51	14.8	21.4	29.1	38	59.4	85.6	117	152	1600
80	34.6	2.75	6.18	11	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	36.6	49.1	76.7	111	150	196	2070
120	52	3.36	7.56	13.4	21	30.3	41.2	53.8	84.1	121	165	215	2270
150	65	3.76	8.95	15	23.5	33.8	46	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	21.3	33.2	47.8	65.1	85.1	133	191	261	340	3590
400	173	6.14	13.8	24.5	38.3	55.2	75.2	98.2	154	221	301	393	4140

PVC Pipe Loss Table

$$9.5 \text{ gpm} + 9.5 \text{ gpm} + 21.4 \text{ gpm} + 38 \text{ gpm} = 78.42 \text{ gpm} = 0.17 \text{ cfs}$$

Use the table below to determine what pipe size is required to efficiently allow necessary flow for your power need. Once you know the required flow for your system (gpm), find the head loss for various pipe sizes. Multiply the head loss number by the length of the pipe divided by 100 and you will get the loss of head for that pipe size. The actual head minus the head loss will give you the effective dynamic head in the system.

Pipe Friction Loss Table – Head Loss in Feet per 100 Feet of Schedule 40 PVC Pipe

		Flow (gallons per minute)																						
		1	2	3	4	5	7	10	15	20	25	30	40	50	60	70	80	100	150	200	250	300	400	500
Pipe diameter (inches)	1/2	2.08	4.16	8.7	14.8	23.5	43																	
	3/4	0.51	1.02	2.2	3.7	5.73	10.5	20.1	42.5															
	1	0.1	0.55	0.68	1.15	1.72	3.17	6.02	12.8	21.8	32.9	46.1												
	1-1/4	0.03	0.14	0.19	0.31	0.44	0.81	1.55	3.28	5.59	8.45	11.9	22	30.5	45.6									
	1-1/2		0.07	0.08	0.13	0.22	0.38	0.72	1.53	2.61	3.95	5.53	9.43	14.3	20	28.6	36.7							
	2			0.03	0.05	0.07	0.11	0.21	0.45	0.76	1.15	1.62	2.75	4.16	5.84	7.76	9.94	15.1	34.8	59.3				
	2-1/2				0.03	0.04	0.05	0.09	0.19	0.32	0.49	0.68	1.16	1.75	2.46	3.27	4.19	6.33	13.4	25.0	37.8	46.1		
	3						0.02	0.03	0.07	0.11	0.17	0.23	0.4	0.6	0.85	1.13	1.44	2.18	4.63	7.88	11.9	18.4	40.1	
	4										0.04	0.06	0.11	0.16	0.22	0.3	0.38	0.58	1.22	2.08	3.15	4.41	7.52	
	5											0.03	0.04	0.05	0.07	0.1	0.13	0.19	0.4	0.69	1.05	1.46	2.49	3.76
6													0.02	0.03	0.04	0.05	0.08	0.16	0.28	0.43	0.6	1.01	1.53	

$$\frac{1.44 \text{ factor} \times 780 \text{ Ft p.p.e}}{100} = 11.23 \text{ ft friction loss}$$

HI-Power

Low-Voltage LV Hydroelectric Generators

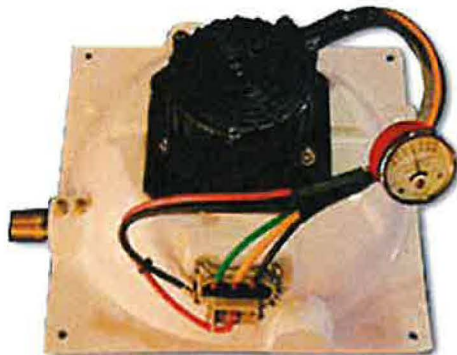
HI-Power is now offering a low-voltage brushless PM generator. This user-friendly unit requires no adjustments and is more efficient than car alternator types over a wider range of head and flow.

- Head range: 40 to 400 feet
- Flow range: 5 to 400 gpm
- Maximum power: 1200 watts
- Efficiency: 30% to 70%
- Battery voltage options: 12V, 24V, 48V, 96V

Available in the four voltages above for direct battery charging. The 48- and 96-volt units allow the use of smaller gauge wire between the generator and the battery. An MPPT charge control, like the OutBack MX-60, can be used to efficiently step the voltage down for charging and regulating 12-, 24- or 48-volt batteries.

The sealed permanent magnet alternator is mounted on a Harris housing with the bronze Harris Pelton wheel. The external rectifier is water-cooled and all fasteners are stainless steel. It comes with an induction meter and 3 feet of 1" flexible hose per nozzle.

Order multiple nozzles for convenient adjustment to varying flows. Alternator has 2 sealed 6203 bearings which should be changed every 5-10 years, depending on use. When ordering, specify battery voltage, transmission line length and size, flow, pressure, pipe size and length.



Description	Item code	Price
LV Hydro with 1 nozzle	017-02005	\$1,350
LV Hydro with 2 nozzles	017-02007	\$1,400
LV Hydro with 3 nozzles	017-02009	\$1,450
LV Hydro with 4 nozzles	017-02011	\$1,500
Car alternator upgrade kit for older Harris Hydro-electric units with brush type alternators	017-02039	\$500

Higher Voltage HV Hydroelectric Generators

HI Power Hydroelectric generators are ideal for sites where water is far from power needs (up to 10,000 feet) or when greater power is required. High transmission voltage can be sent over a mile before being 'stepped down' to battery voltage. It comes complete with step-down transformer, rectifier, fuses and amp meter. Use a diversion-type regulator with these units.

- Head range: 60 to 500 feet
- Flow range: 10 to 400 gpm
- Maximum power: 3600 watts
- Efficiency: 30% to 60%
- Transmission voltage: 110V to 440V
- Battery voltage: 12V, 24V, 48V

These hydroelectric generators use brushless alternators for reliability and versatility. They produce 110V, 220V, or 440V "wild" (unregulated) AC, which is then stepped down with the supplied transformer and rectifier.

The heavy-duty brushless alternator is housed on the Harris housing and uses the Harris Bronze Pelton Wheel for flows up to 200 gpm and the ESD Turgo Wheel and housing for flows of 200 to 400 gpm. Available in 4 sizes ranging from 600 to 3600 watts. The HV600 is available with 2 or 4 nozzles. The larger units come with 4 nozzles.

2-year warranty. Specify battery voltage when ordering.



Description	Item code	Price
HV 1200 – 1200 watt 4 nozzle	017-02030	\$3,600
HV 1800 – 1800 watt 4 nozzle	017-02031	\$4,200
HV 3600 – 3600 watt 4 nozzle	017-02034	\$6,000
Hi-Power turgo nozzle	017-02037	\$600

96-10101
LICENSING REVIEW
WATER CONVEYANCE SYSTEM SUPPORT DOCUMENTATION

MANNING EQUATION DATA:

Manning's Equation Calculator for Flow Rate in a Circular Conduit Flowing Full

S = 0.0769 ft/ft
n = 0.009 manning's coefficient
d = 3.0 pipe diameter (inches)
D = 0.25 pipe diameter (feet)
r = 0.13 pipe radius (feet)
A = 0.05 area (ft²)
WP = 0.79 wetted perimeter (ft)
R = 0.06 hydraulic radius (ft)

Q = 0.35 flow rate (CFS)

Channel Slope Slope Options
☐ Manual Entry ☒ Slope Calculator

Slope Calculator

Rise = 60 feet
Run = 780 feet
Slope, S = 0.0769 ft/ft

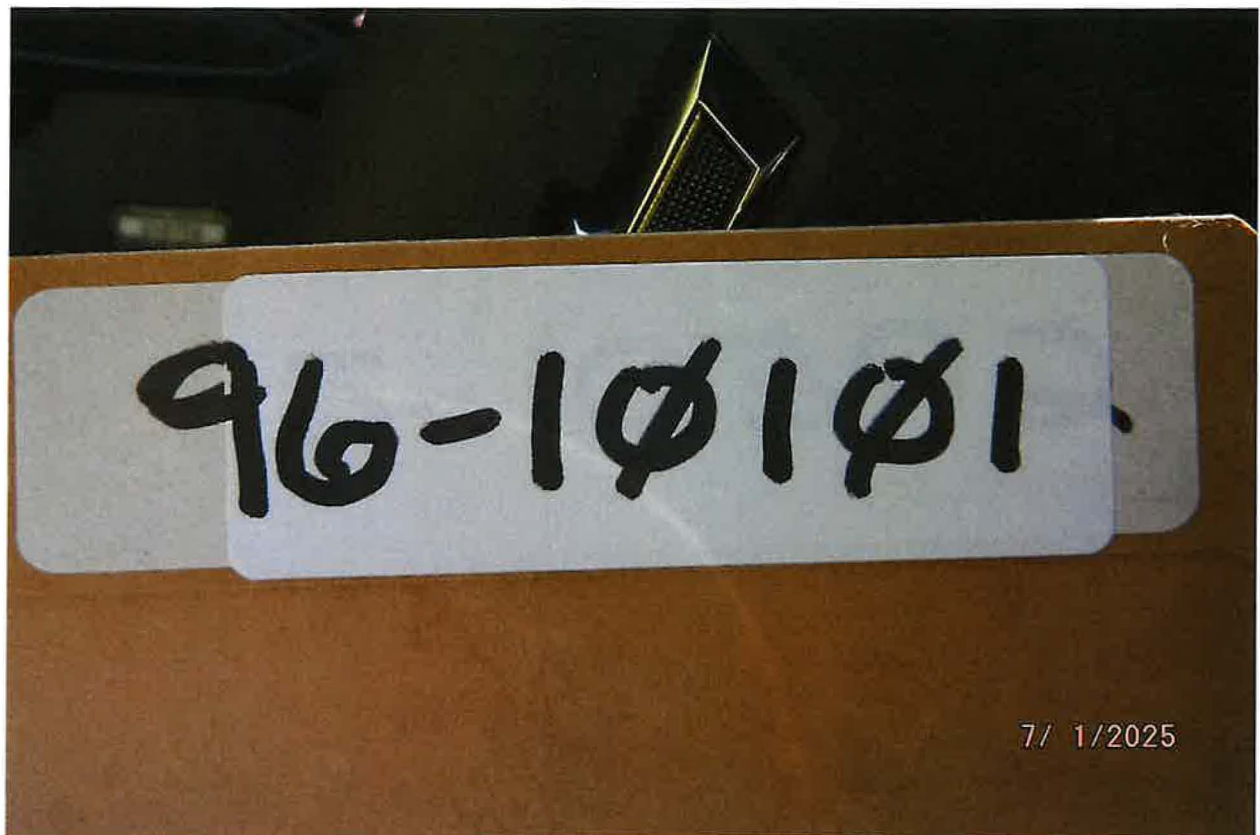
Pipe Material, (n): plastic (pvc, abs)

Pipe Diameter (inches) 3.0 inches

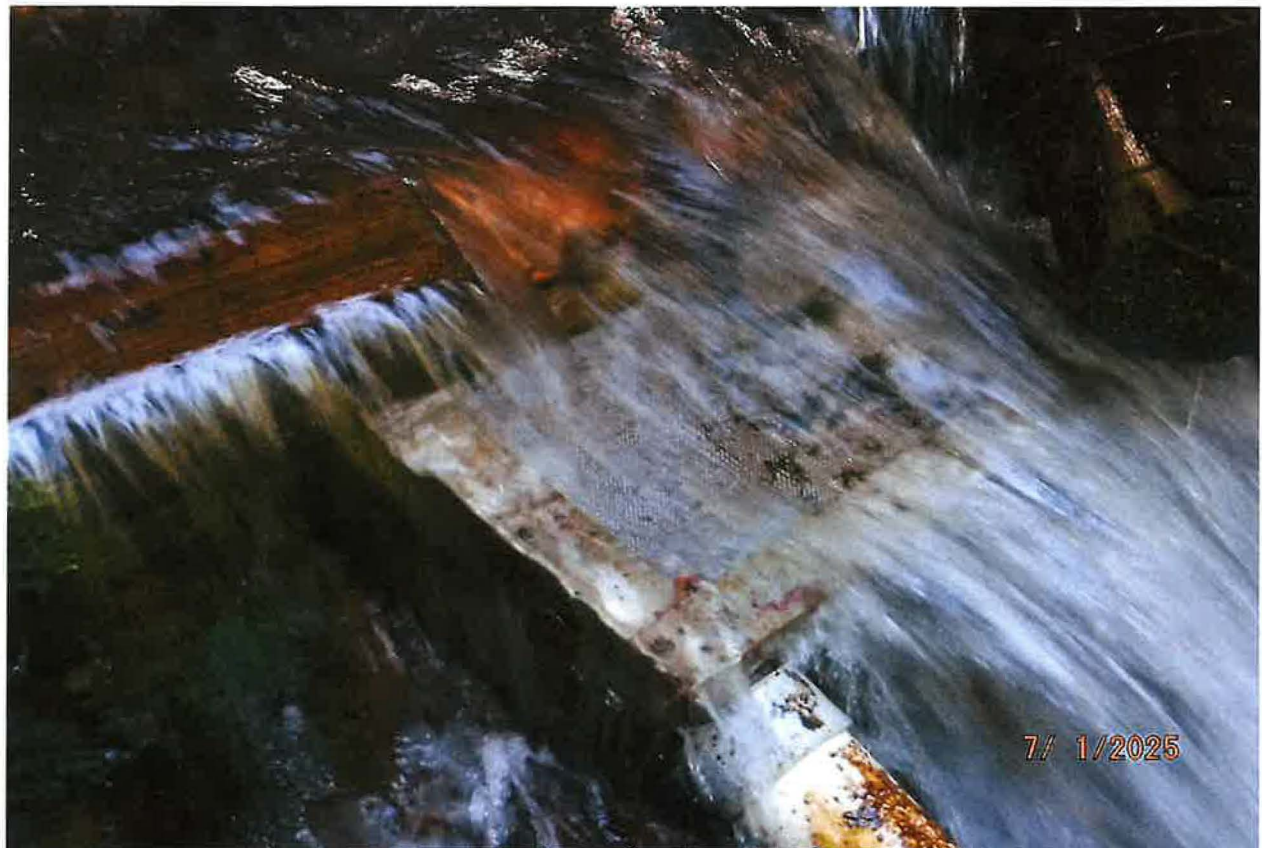
- Manning Equation developed to illustrate the flow rate (free flow not restricted) through the 3-inch PVC pipeline that could be harnessed for fire protection purposes based on factors detailed above.

□ Theorized Flow Potential if system open Discharged to waste.

✓ Fire Protection Diversion Rate Limited by Permit authorized 0.27 cfs.



BENEFICIAL USE FIELD EXAM DATE 7/1/2025



POD – FLUME CREEK DIVERSION USING GRAVITY FLOW PIPELINE



POD – REPURPOSED ELECTRIC CONTROL PANEL BOX WITH MESH SCREEN
CAPTURING CREEK WATER INTO 3-INCH PVC PIPELINE



POWER SYSTEM PENSTOCK/CONVEYANCE CONSISTS OF 780-FT OF 3-INCH PVC;
VENT/PRIMING PIPE LOCATED NEAR POD RETURNS FLOW TO STREAM



3-INCH PIPELINE RUNS ABOVE GROUND AND BURIED FOR A LARGE SECTION OF RUN, DAYLIGHTING AND ABOVE GROUND LAST 40-FT TO POWER STATION



POWER POU – 3-INCH PIPELINE ENTERING POWER STATION



POWER POU – HARRIS LV800 MICRO-HYDRO GENERATOR



POWER POU – PELTON WHEEL MICRO HYDRO WITH FOUR (4) ACTIVE NOZZLES IN
POWER PRODUCTION



WATER SYSTEM PRESSURE GAUGE IDENTIFIES 65 PSI (PERMIT HOLDER ASSERTS THE GAUGE MAY BE MALFUNCTIONING AS THE SYSTEM NORMALLY OPERATES AT 50 PSI)



POWER SYSTEM AT TIME OF EXAM MEASURING 4 AMP/HR ON LOW CURRENT INDICATOR ~5 (83)



OVERFLOW FROM HYDRO POWER UNIT COLLECTS IN BLUE BIN WHERE IT'S
PIPED AS OVERFLOW DISCHARGE BACK TO FLUME CREEK



OVERFLOW DISCHARGE PIPES (2EA) IN ORDER TO CAPTURE ALL WATER
THROUGH NOZZLES WITHOUT FILLING UP BLUE COLLECTION BIN



POWER POU – OVERFLOW DISCHARGE RETURNED DIRECTLY TO FLUME CREEK
(NON-CONSUMPTIVE USE)



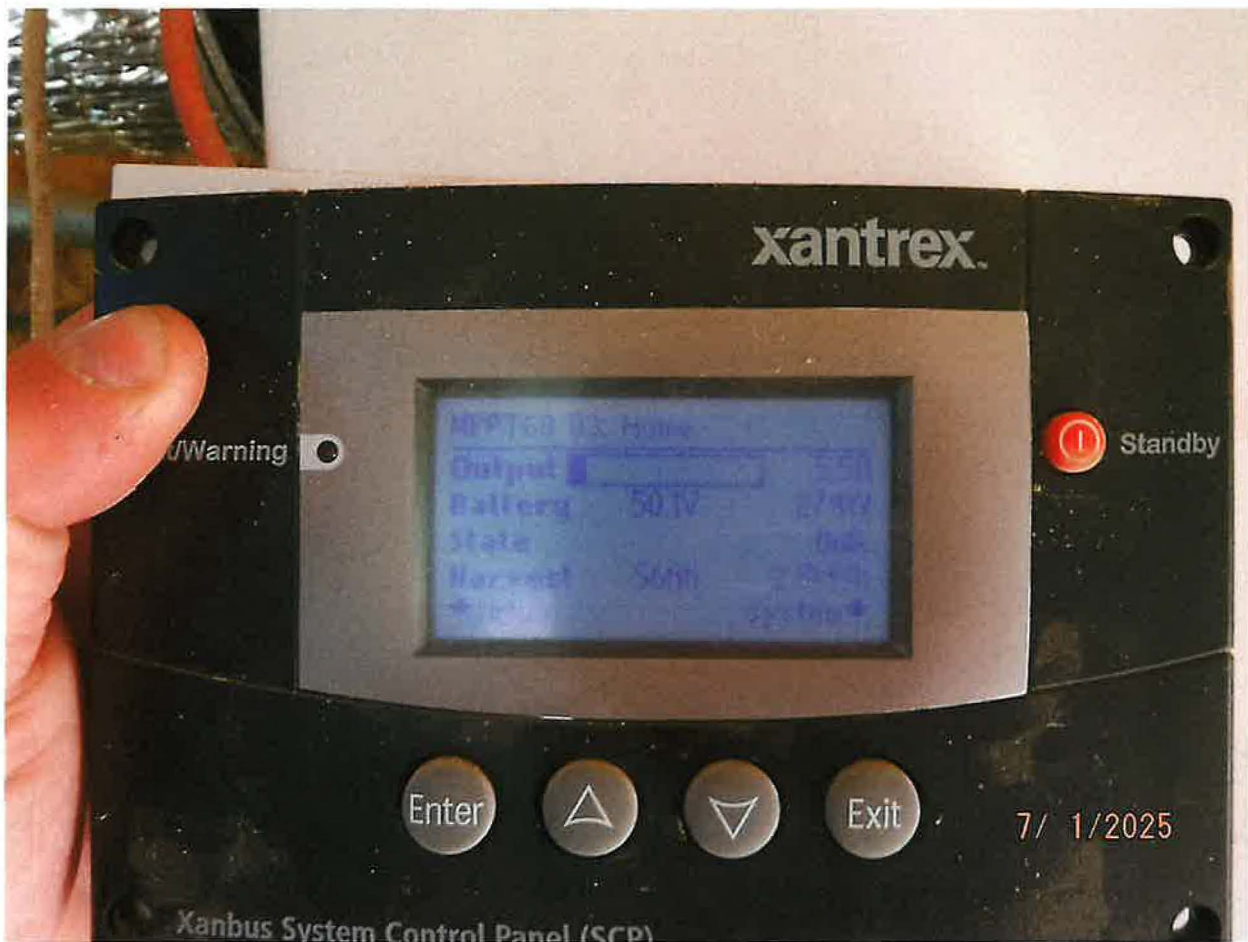
5-GAL BUCKET MEASUREMENT ATTEMPTED AT TIME OF EXAM (LESS THAN 5 SEC
FILL TIME)



FIRE PROTECTION – MAIN 3-INCH PVC PIPELINE AT END OF POWER NOZZLE TEE(S); NOZZLES CAN BE CYCLED OFF TO ALLOW FULL PIPELINE FLOW THROUGH BALL VALVE (BLUE BRASS VALVE IN PHOTO) EXITING REAR OF POWER STATION



FIRE PROTECTION POU – BYPASS VALVE OFF 3-INCH PENSTOCK PIPELINE TO MULTIPLE 100-FT HOSE ROUTED UP TO PRIMARY RESIDENCE STAGED FOR FIRE SUPPRESSION



HYDRO-POWER / SOLAR POWER HYBRID SYSTEM CONTROL PANEL



HYBRID HYDRO-SOLAR POWER BATTERY BANK (CO-LOCATED WITH RESIDENCE)