



Above: A thirteen foot diameter overshoot hydro wheel makes 2,000 watts of electric power. Photo by Richard Perez

Handmade Hydro Homestead

Bob-O Schultze

©1993 Bob-O Schultze

In 1975, Matt and Roseanne Olson's diesel generator died. Faced with an expensive repair, Matt figured this was as good a time as any to build the hydroplant which he'd been collecting parts for over the past four years. With the help of his good neighbor and friend, Rod Ward, he set to work building a temporary fix for his generator problems. Eighteen years later, that "temporary" fix is still producing clean, renewable electricity. The old diesel plant has long since been traded for spare parts.

Location is Everything

Matt and Rosie live at the confluence of Methodist Creek and the Salmon River in Northern California. Their homesite lies in the western part of the Klamath National Forest. This river corridor is still very scenic and colorful, despite placer mining before and during the 1930s, the ravages of two major fires, and extensive road building and timber cutting by the Forest Service over the past 30 years. The beauty of the Salmon River Country is due in no small part to reclamation by folks like the Olsons and small-scale miners along the river who have adopted an attitude of stewardship and living with the land rather than from it.

This country is a dandy place for low-impact microhydro because of the many creeks and springs which feed the Salmon River. The nearest electric utility lines are 23 miles away

through one of the steepest, most picturesque river canyons in California. Even if the locals wanted utility power — which they don't — and even if the utility was willing to provide it — which *they* aren't — the cost and visual impact to the area would be prohibitive. So it's a case of using what Mother Nature provides on-site and learning to live on her terms. Not a bad philosophy for all of us.

It's the Water

It takes a fair amount of water to run an overshot wheel. Matt & Rosie's hydro and irrigation water comes from a recycled mining ditch which flows along the back edge of their property. A weir, that is, an adjustable gate, at the intake from Methodist Creek determines the flow into the main ditch which feeds the ram pump, flood irrigation check ditches, and, finally, the overshot wheel itself. This weir restriction serves two functions. First, it keeps out the anadromous fish which use Methodist Creek as a spawning ground. The existence of large redds, or spawning beds, at and above the intake attest to its low impact. Second, the weir limits the flow of water into the ditch during high water periods which would cause erosion of the ditch banks and overspeeding of the wheel.

All along the ditch, trees, bushes, and a giant thicket of blackberry vines drink their share of the water. How much do they take? "About 500 watts/hour worth during a hot summer's afternoon," according to Matt who can watch the power drop as the temperature climbs. "The plants, grass, and especially Rosie's flower garden come first where the water is concerned," said Matt. "In low water years we may have to shut the wheel down for up to three months because they get priority." After the water leaves the wheel, it flows down through an overgrown mining tailrace and into the Salmon River, none the worse for wear.



Above: Bob-O Schultze (left) and Matt Olson (right) examine the power transmission for the hydro. Photo by Richard Perez

Recycle, Reuse, Rebuild

Nearly every part of Matt & Rosie's hydroplant has been reincarnated after dying as something else. The hub and main shaft of the 13 foot diameter overshot were part of a 24 inch Pelton wheel with the cups removed. The one inch steel rods radiating from the hub came from a scrap metal pile. The floor of the buckets and the 18 inch x 12 inch deep buckets themselves were painstakingly cut from an old dump truck body and individually welded into place. Most of the pulleys, sprockets, and jack shafts for the speed multiplier gear train were bartered or scrounged from deceased mining and farming machinery. About the only things purchased new were the bearings for the main and jack

shafts and the V belts. In 1975, those items cost approximately \$250. To replace them all at today's prices would run about \$550.

The 1800 rpm 2.6 kiloWatt Kurz-Root ac generator came out of a 1940s military portable GenSet. Matt replaces the brushes about twice yearly and trues the commutator and slip rings every couple of years. He tells a great story about filling a missing commutator insulator with JB Weld™, which turns out to be nonconductive, and turning it down on a lathe. "That was over a year ago, and the dang thing still runs great."

The Hydroplant

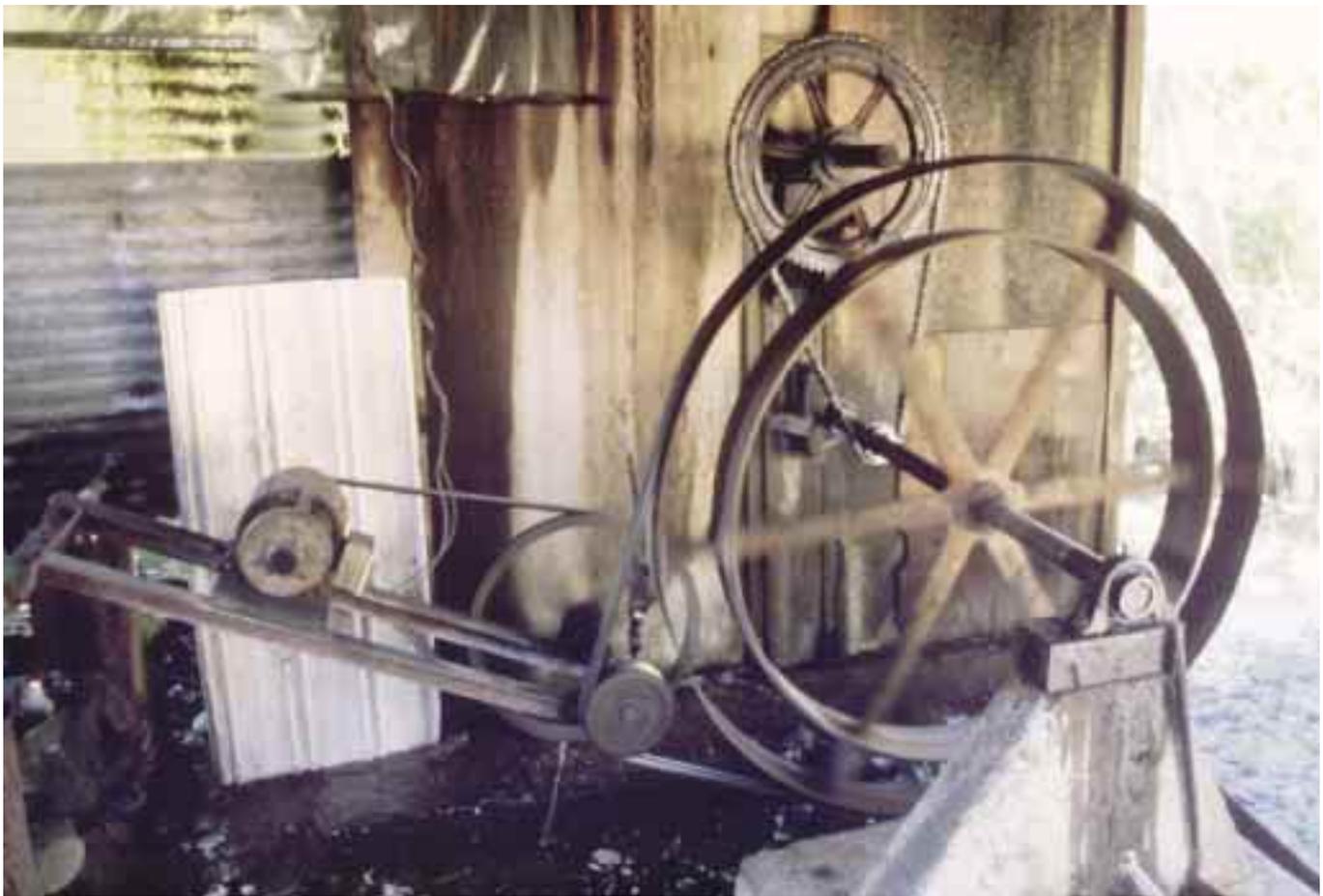
The total head of the Olsons' hydro system is about 14 feet. This includes the pitch on the wooden chute which acts as a nozzle and the 13 foot diameter wheel itself. At full output, the Olsons' hydro system produces 2,500 watts (2.5 kiloWatts) of 120 volt, 60 Hz ac power. This hydro produces a whooping 40 kiloWatt-hours daily.

The wheel uses one cubic foot per second (cfs) of water, and turns at 12 rpm while under load. Through a system of jack shafts that would do Rube Goldberg proud, the speed is increased to approximately 2000 rpm. Maintenance consists of greasing all the bearings weekly and knocking some of the ice build-up off the wheel during the coldest part of the winter.

Living with an ac Hydroplant

There are no batteries, inverter, or controls that we normally associate with a stand-alone renewable energy system. It's rolling thunder and you have to use what you produce — one way or another. Increasing the wattage loading past the generator's output will cause low voltage brownouts and lower than 60 Hz power frequency. Decreasing the load on the generator will cause the wheel to spin faster, subjecting all the appliances and lights to a high voltage and frequency condition.

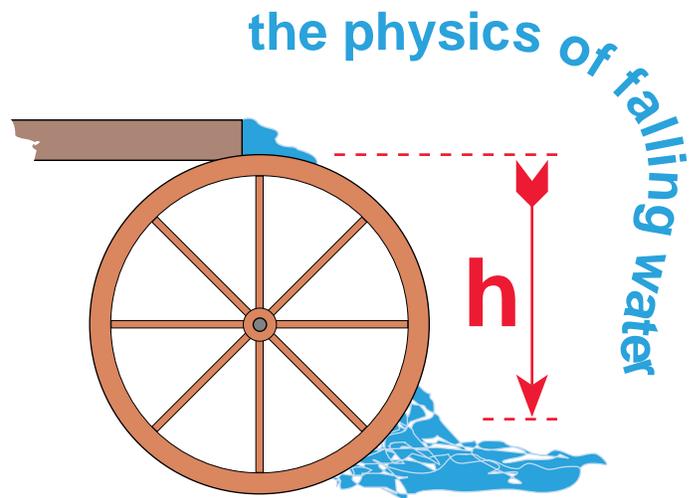
Below: The power transmission increases the low speed (12 rpm) of the overshot water wheel to high speed (≈2000 rpm) at the electric generator. The wheel is coupled to the uppermost shaft in the photo. Here a chain drive is used to transfer the power to the next shaft at a higher speed. In all, four shafts are used to speed up the water wheel's power output by about 160 times for electric power generation. Photo by Richard Perez





Above: Matt and Rosie's hydro powered homestead. Not only does falling water provide the electricity, but it also drives a ram pump to pump water for the house and gardens. Note the lights burning in the living room during the middle of the day. This is a typical practice in 120 vac 60 cycle hydro systems.

Below: The flume delivers about one cubic foot of water to the wheel every second. Photos by Richard Perez



Gravity powers the overshoot water wheel. The water falls and as it falls it does what physicists call work because its mass is accelerated by the pull of gravity. The overshoot water wheel converts the energy of the water's falling mass into mechanical power at the wheel's axle. The amount of power available for conversion depends on two factors: the amount of water per second flowing over the wheel, and the vertical distance that the water falls. Here's the equation.

$$P = \frac{W h}{0.7376}$$

where:

P = the available power in watts

W = the weight (in pounds) of water flowing over the wheel per second. A gallon of water weighs about eight pounds. A cubic foot of water weighs about 64 pounds.

h = the distance (in feet) that the water falls. Most overshoot wheels only capture the water for 120° of their rotation. With 120° rotation, h is equal to 1.5 times the wheel's radius.

The 0.7376 is a fudge factor to make the Power unit come out as watts rather than foot-pounds per second.

From the equation, two facts are obvious to every hydromaniac — the more water flowing over the wheel per second the better, and the longer distance that the water falls the better. These two factors, flow and head, determine the power potential of all hydros regardless of type.



Above: Matt Olson.

Matt and Rosie use the simplest form of manual load management. They leave the lights on. Rosie jokingly says, "I've had friends who don't know about the system come to the house and tell us 'That must have been a hell of a party last night for you to go to bed and leave all the lights on!'" They also keep an eagle eye on the voltage and frequency meters mounted in the kitchen between the sink and the refrigerator. "We just always glance at it as we go by, it's not even something we think about anymore," according to Rosie. What better place for metering than the highest traffic area in the house? It's a great place to install the system instrumentation in any RE powered home.

This kind of load management would be very difficult — even dangerous — with a high rpm impulse wheel system like a Pelton, but the overshot wheel turns at only 12 rpm. Consequently, it takes a while to change the rpm of the generator, and hence change the voltage and frequency, one way or the other. Time enough to turn an appliance on and some lights off without a mad dash for the switch.

Hydro-power Appliances

Matt and Rosie's system powers all the electrical appliances they need. Like most folks powered by hydro, they were vague about their power consumption. When your concern is keeping the hydro's constant power output under control, things like lights burning all

night are common. Matt and Rosie power lighting, a satellite TV system with color TV, Matt's machine shop full of power tools, and a slew of kitchen appliances. Cooking and water heating is fueled by propane.

Using Water to get Water

Rather than using electricity to run a pump for the house water, Matt and Rosie use a 40 year old Rife™ ram pump. The Rife is fed through a 2 inch diameter pipeline dropping about 20 feet from the ditch into another ancient mining tailrace. They've been using the Rife continuously for the past 24 years!

The ram pumps against a large pressure tank which also feeds a couple of sprinklers for the lawn during the summer and an open overflow line in winter. Matt figures that the Rife produces about 10–15 gpm. By keeping track of the amount of water being used continually, they can maintain about 25–30 psi of pressure in the tank. Plenty for most household uses.

Matt has modified the captive air tank on the ram pump by adding a couple of small petcocks. These valves make the weekly chore of draining the water and re-establishing the air "cushion" in the pump just a five minute job. The only other maintenance Matt has performed during the ram pump's 24 year tenure is

Below: Rosie Olson visits in her beautiful garden.





Above: This Rife™ hydraulic ram pump has been pumping the Olson's water for the last 24 years. replacing the rubber seals and gaskets "every five years or so." After buying the first set of replacement gaskets, Matt has been making his own out of a section of discarded rubber conveyor belt.

Conclusion

It wasn't all that long ago when the Olson's lifestyle and philosophy of recycling, rebuilding, and reusing was considered pretty backward. Today, most of us have caught on to the three "Rs" in one way or another, and it turns out the Olsons are pretty forward after all.

Access

Matt and Roseanne Olson, Methodist Creek, Forks of Salmon, CA 96031

Author: Bob-O Schultze, Electron Connection, POB 203, Hornbrook, CA 96044 • 916-475-3401 voice or FAX



RIFE Hydraulic Pumps
 Camera ready
 3.5 inches wide by 3.25 inches tall

Join us and get your hands-on!

Learn the practical use of solar, wind and water power.

- Oct. 4-7 Solar Water Pumping
- Oct. 11-21 Micro-Hydro Electric Systems
- Oct. 25-Nov. 4 Solar Home Design Principles
- Oct. 25-Nov. 4 Wind Power
- Nov. 8-18 Advanced Passive Solar Design

*Call now
 for Fall workshop
 details —
 or write for
 more info
 and our 1994
 Workshop
 Schedule*

# of Weeks	Tuition Cost
1	\$400
2	800
3	1,150
4	1,500
5	1,800
6	2,100
7	2,400
8	2,700
9	2,950
10	3,200
<i>Additional weeks at \$200 per week</i>	

Solar Energy International

Renewable Energy Education and Sustainable Development
 BOX 715, CARBONDALE, COLORADO 81623
 (303) 963-8855 • FAX (303) 963-8866

