

## Supplementary Materials

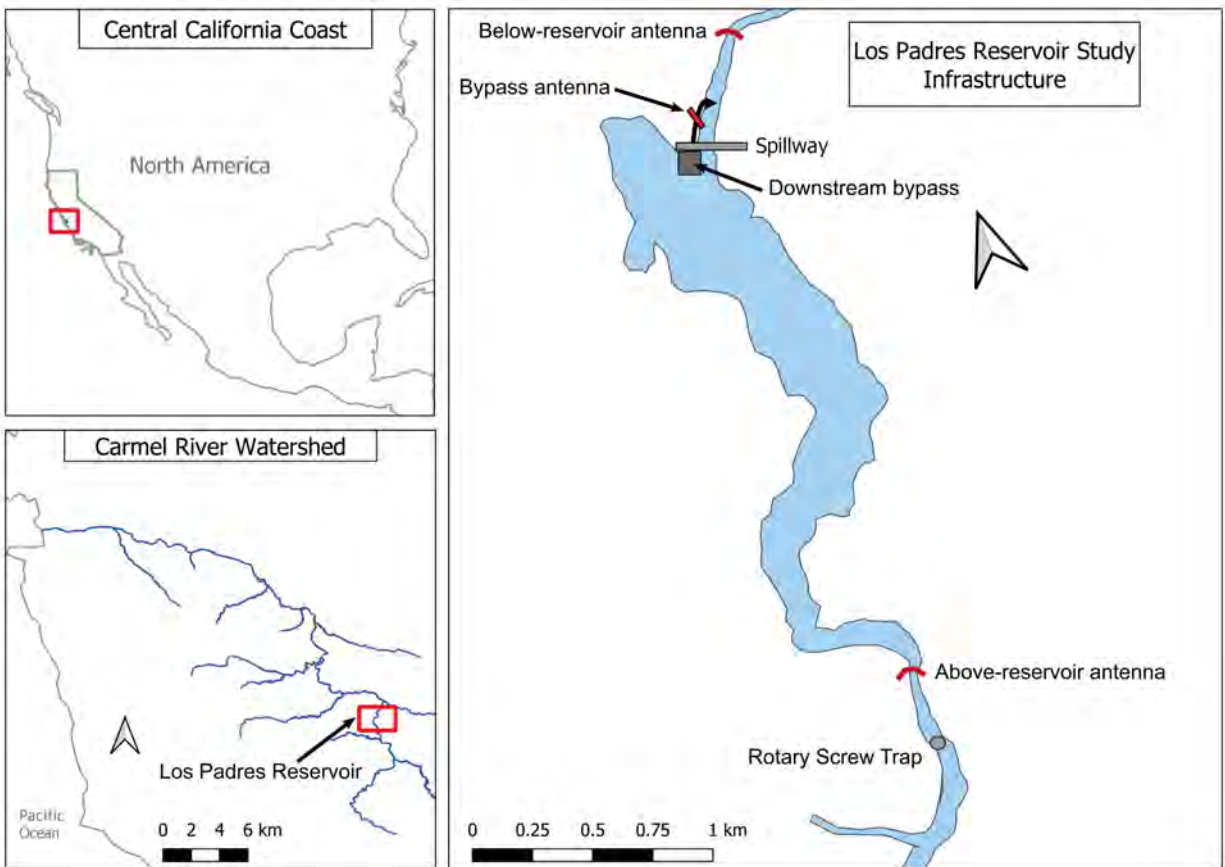


Figure S1: The Los Padres Reservoir is located on the Carmel River on the central California Coast. Our flexible-pass-through PIT tag antennas were located upstream (above) the reservoir and downstream (below) the reservoir. There was an additional PIT tag antenna on the downstream bypass exit pipe.



(a) Above Los Padres antenna



(b) Below Los Padres antenna

Figure S2: The two flexible-pass-through antennas used in our reservoir passage study. The rope and wire inside the PEX pipe are visible in photo (a).



(a) splicer-reducer connector



(b) insulated-tap connector



(c) split-bolt connector

Figure S3: Three electrical splice options for connecting the top and bottom wires on a flexible-pass-through antenna.



(a) tree anchor



(b) deadman anchor in western Oregon

Figure S4: (a) The tree anchor at the above-reservoir antenna. Tree anchors have been more reliable than rock anchors on our projects. Deadman anchors (b) can also be used if tree anchors are not feasible. Deadman anchors can be constructed by burying a piece of wood with a cable loop under cobble. Trees or other fast growing vegetation can be planted on top of the deadman anchor to increase durability.





Figure S5: Rock anchors at an antenna in the upper Carmel River, California. The block anchors with eye bolts held for part of a season, but then broke at the bolt during a high flow event.

Table S1: Flexible-pass-through antennas operated on projects in California and Oregon

Location	Latitude, longitude	Antenna length, height (m)	Average inductance (uH)	Average detection distance (m; 12, 23 mm tags)	Wire sizes	Reader manufacturer	Number of antenna windings
Carmel River, CA; above Los Padres Reservoir	36°22'30"N, 121°39'48"W	14.6, 0.6	59.9	0.6, 0.6	10 AWG top, 2 AWG bottom	ORFID	1
Carmel River, CA; below Los Padres dam	36°23'30"N, 121°39'55"W	14.6, 0.9	132.6	0.3, 0.9	10 AWG romex top, 2 AWG bottom	Biomark IS1001	2
Carmel River, CA; Sleepy Hollow	36°26'20"N, 121°42'18"W	25.3, 0.3	69.3	0.3, 0.3	10 AWG top, O/3 bottom	ORFID	1
Carmel River, CA; Palo Corona	36°32'16"N, 121°53'16"W	15.7, 0.6	126.6	0.6, 0.6	10 AWG romex top, 2 AWG bottom	Biomark IS1001	2

Table S1: Flexible-pass-through antennas operated on projects in California and Oregon

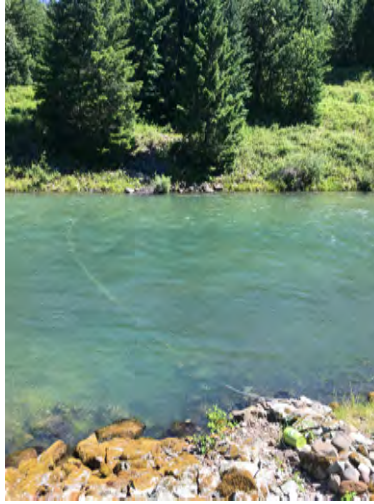
Location	Latitude, longitude	Antenna length, height (m)	Average inductance (uH)	Average detection distance (m; 12, 23 mm tags)	Wire sizes	Reader manufacturer	Number of antenna windings
Middle Fork (MF) Willamette River (A), OR	43°29'55"N, 122°24'6"W	29.2, 1.2	75	1.2, NA	10 AWG top, O/4 bottom	ORFID	1
MF Willamette River (B), OR	43°36'11"N, 122°27'25"W	36.3, 1.2	93	1.2, NA	10 AWG top, O/4 and O/2 bottom	ORFID	1
MF Willamette River, OR; below Hills Ck. Dam	43°43'8"N, 122°26'11"W	22, 1	55.2	1, NA	10 AWG top, O/2 bottom	ORFID	1
Willamette River, OR; below Cougar Dam	44°8'18"N, 122°14'59"W	36.3, 1.2	93	1.2, NA	10 AWG top, O/2 bottom	ORFID	1



(a) M.F. Willamette River antenna A



(b) M.F. Willamette River antenna B



(c) Below Hills Creek Dam antenna



(d) Below Cougar Dam antenna

Figure S6: The four flexible-pass-through antennas used in our Oregon research (Table S1).

Table S2. Flexible-pass-through antenna parts list.

**Flexible-pass-through antenna**

<b>Parts</b>	<b>Name/Material</b>	<b>Size</b>	<b>Source</b>	<b>Tensile Strength (kN)</b>	<b>Amount</b>	<b>Cost (USD)</b>
Tree anchor	Tubular webbing/Nylon®	1-inch	Metolius Climbing	18	2 x 6-9ft.	\$0.50/ft.
	D-shaped, wire-gate, carabiner		Metolius Climbing	24	2-10	\$7.95 ea.
Boulder anchor	Double-wedge bolt/A-304 stainless steel	3/8-inch dia. x 3-3/4 inch	Fixe Hardware®		2-4	\$8.95 ea.
	3/8 hanger/3.5 mm stock; 316 stainless steel	3/8-inch	Fixe Hardware®	25	2-4	\$4.55 ea.
Antenna top wire	Stranded THHN or Romex wire	10 AWG	Ancor (West Marine); Electrical supply; McMaster-Carr		> Stream width	\$0.31-1.89/ft
Antenna bottom wire	Welding cable wire	1-2/0 AWG	Electrical supply; McMaster-Carr		> Stream width	\$4.79-10.76/ft
Wire connections	Wire splicer-reducer	14 to 2/0 AWG	Electrical supply; McMaster-Carr		2-3	\$9.99-24.99/each
	Liquid tape		Electrical supply; McMaster-Carr		1 bottle	\$11.98/118 ml bottle
	Self-vulcanizing tape		Electrical supply; McMaster-Carr		1-2 rolls	14.43/roll
Antenna top wire cover	PEX pipe/cross-linked high density polyethylene	½-inch inside diameter (ID)	Plumbing supply; Home Depot		< Stream width in 10 ft sections	\$4.26/10 ft piece
Antenna ropes	Maxim® Tech cord/Technora®	5-mm	Metolius Climbing; New England Ropes	5	> 2x Stream width	\$74/100 m spool



## Readers and Power

Parts	Name/Material	Size	Source	Tensile Strength (kN)	Amount	Cost (USD)
Oregon RFID system	HDX Reader (ORSR)		Oregon RFID		1	\$2,795
	HDX Tuner		Oregon RFID		1	\$225-280
	Twinax Cable (20 AWG stranded twisted pair with shield, 100 Ohms (Beldon type 9207)		Electronics supply; McMaster-Carr		Stream to reader distance	\$316/100-ft.
	Noise filter		Oregon RFID		1	\$155
Biomark system	Dual Reader (IS1001)		Biomark		1	\$1,100
Solar power	300-watt solar panels		Various		1-3	\$245
	Outback FlexMax FM60 charge controller		Unbound Solar		1	\$455
	MidNite MNPV6 combiner (breaker) box with breakers (DC DIN MNEPV)		Unbound Solar		1 (3-6 breakers) Distance between equipment	\$205
	Connection wire (10 AWG)		McMaster-Carr			\$0.31/ft
	Deep cycle batteries (12-24 V, 90 amp hour)		Various		2-4	\$225/each
AC power	AC to DC 12V converter		12V Oregon RFID		1	\$69.00
	AC to DC 16-18V converter		12-18V Acopian		1	\$230.00

Sheltered equipment  
boxes

Large

Jobox (McMaster-Carr)

1-2

\$229

Small

Bud Industries, Inc

1-2

\$199