NERO PROJECT

Duck Laser - Camera-Triggered, Phone-Confirmed Wildlife Deterrent

Ducks cannot hear ultrasound. They can see a green dot.

Paul Schindler | Built with Claude | November 2026

Executive summary

On some nights a group of ducks sleeps on the dock behind our house and fouls it. I designed a silent deterrent that sweeps a low-power green laser dot across the dock for a few seconds, and only after a camera spots ducks and a person confirms the shot on a phone. Five ideas died in research first, including ultrasound, which ducks cannot hear. My first hardware build passed its bench test in July 2026. A laser near neighbors' homes needed my homeowners association's approval, so I built the application around the one objection that could sink it (light reflecting off the water), and the committee approved it 13 days after I filed.

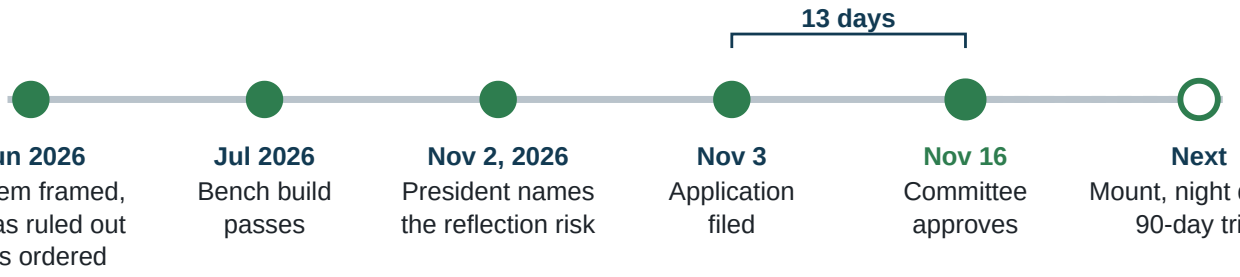
5 mW
green laser, Class 3R, the legal limit for laser pointers

8
independent safeguards, three of them physical

5 ideas
ruled out in research before any build

13 days
from filing to association approval, November 2026

Timeline



What is in this report

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2	The problem, the five ideas I ruled out, the power decision and why wildlife agencies use lasers
3	How it works, what is inside the device and the July 2026 bench build
4	Designing for the objection - side view and plan view of where the beam can and cannot go
5	Eight safeguards, the water-reflection analysis and the rules the system meets
6	Getting to yes, my commitments to the association, status and what this shows about how I work

1. The problem and what I ruled out

On some nights a group of ducks sleeps on the floating dock behind our house. By morning the dock is covered in droppings, unsanitary and slippery, and we sometimes launch a kayak from it. We do not feed the ducks. Before I looked at any product I set four constraints. The fix had to stay quiet for neighbors across open water, stay safe for people and pets, leave the birds unharmed and put nothing permanent in the way.

Idea	Why I ruled it out	Constraint it failed
"Ultrasonic" repellers	Ducks cannot hear ultrasound. Their hearing tops out at 8 to 10 kHz, below human hearing.	Biology
Loud audio	Sound carries across open water to the homes opposite, worst at night. Ducks also tune out any sound that never comes with a consequence.	Neighbors
Motion-triggered sprinkler	Spray on soil and beach grows weeds, a worse chore than the droppings.	Upkeep
Lines strung over the dock	They block carrying the kayak on and off the dock.	Use of the dock
Floodlight	Light across the water at night is certain to bother the neighbors.	Neighbors

A low-power laser was the option least noticeable to neighbors. It is silent, runs for seconds, lands only on our dock and works best at night, when the ducks roost.

The power decision (June 2026)

I considered 8 to 10 mW for daytime use and rejected it. That power crosses into Class 3B, which can injure the retina, including by reflection off water, and it still would not beat bright daylight. The real problem happens at night and 5 mW covers the night. The cap stays at 5 mW, Class 3R.

The off-the-shelf check (November 2026)

No ready-made unit fit. Consumer bird lasers ($235 to $590) sweep red and green patterns across a 60-degree fan on a timer, with no camera trigger. One vendor's spec sheet lists Class 3R beside 50 to 100 mW, a power Class 3R does not allow. A professional autonomous unit is Class 3B and costs $12,500 to $20,000. I kept the custom build, with $78 in parts.

Why lasers - public wildlife agencies use them for this job

> *"WS specialists attempting to relocate waterfowl, such as ducks and geese, have found great success using low-powered lasers. Increasingly, this new tool is being used to help disperse overabundant waterfowl populations in urban and suburban areas across the United States."*
>
> U.S. Department of Agriculture, APHIS Wildlife Services, fact sheet "Low-Powered Lasers - Another Nonlethal Tool for Resolving Wildlife Damage" (July 2002).

> *"Lasers have the advantage of being less noisy than noise deterrents and are more aesthetically pleasing than visual or physical deterrents."*
>
> Ohio Department of Natural Resources, Division of Wildlife, "Lasers" technical sheet. It also warns against "the beam reflecting off the water" (see page 5).

> *"You do not need a federal depredation permit to simply harass or scare birds (except eagles and federally listed threatened or endangered species)."*
>
> U.S. Fish and Wildlife Service, "Frequently Asked Questions About a Federal Depredation Permit" (2025).

2. How it works

1. Camera sees ducks
An existing camera running Frigate detection spots ducks on the dock.

2. Phone gets a photo
Home Assistant sends it with one start button. Nothing has happened yet.

3. A person confirms
I check it and press start. It refuses if the camera sees a person near the dock.

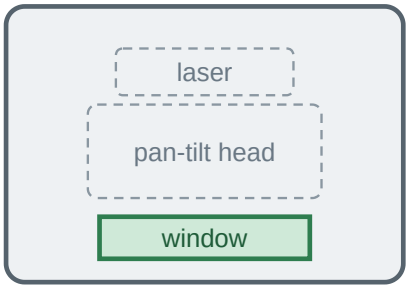
4. The dot moves
A green dot moves toward the ducks for 10 seconds at most. They fly or swim off.

5. Off on its own
The laser switches itself off and stays off after a power outage.

The dot moves toward the birds rather than at them, the method wildlife agencies recommend. The birds see an approaching object and leave before it arrives. Software must see ducks and no person, and a person must agree.

The device

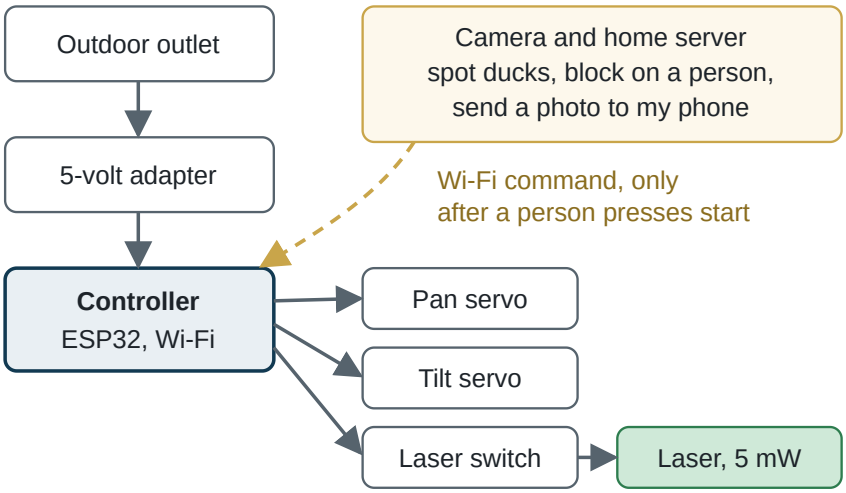
The box, front view



Closed weatherproof box, light grey to match the eave trim.

Its only opening is a window on the underside, facing the dock.

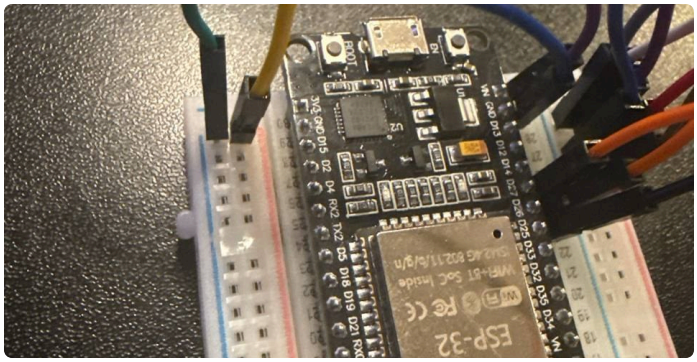
Inside the system



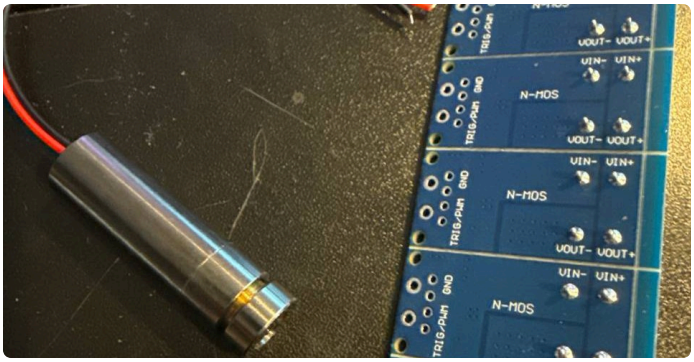
Everything runs on 5 volts from a plug-in adapter, like a phone charger.

Parts - a 520 nm green laser (5 mW, Class 3R), two servos, a laser switch and an ESP32 running ESPHome.

The bench build (July 2026)



The ESP32 controller on the breadboard, wired to the servos and laser switch.



The 520 nm laser module beside the switch boards, before wiring.

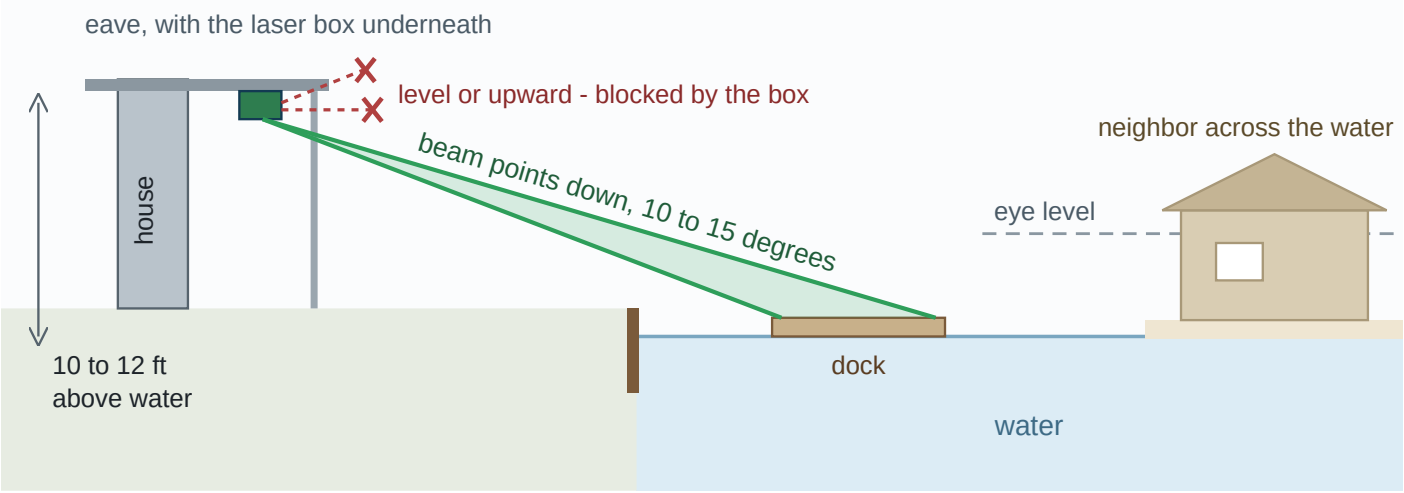
Result - passed on July 20, 2026

From my phone over Wi-Fi, both servos moved and the laser switched on and off. The controller boots with the laser off every time. Nothing was mounted or aimed outdoors. I did the wiring myself from a step-by-step guide an AI agent wrote.

3. Designing for the objection

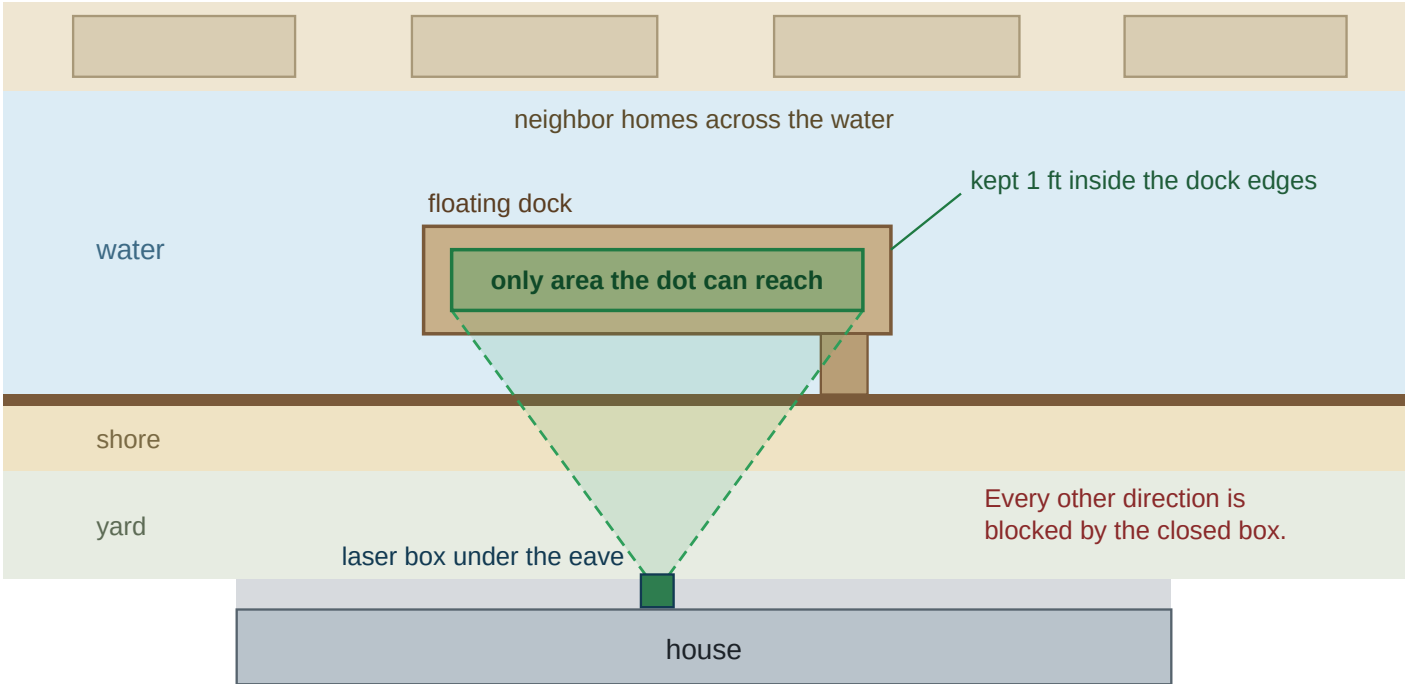
Before I filed, I raised the idea with the association's president. He routed it to the architectural committee and named his concern - light reflecting off the water into neighbors' homes. I treated that question as the design requirement and added a closed box with a dock-only window to the hardware.

Side view - why the beam cannot reach anyone across the water



Not to scale. Every possible beam path ends on the dock surface, well below eye level on the far shore.

Plan view - looking down from above



Not to scale. The shaded strip is the only place the dot can land, which keeps the beam off the water.

What a neighbor may notice

A small green dot on our dock for a few seconds, on nights when ducks are there. In fog, a faint green line between eave and dock.

What no one will experience

The beam on anyone's home, yard or dock, on the water or in the sky. Any sound, floodlight or flashing light.

4. Eight safeguards and the water question

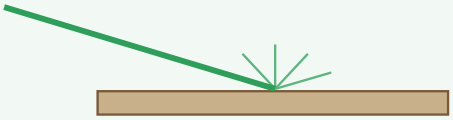
The approved design has eight separate safeguards, so a failure in any one leaves the others in place. The first three are physical and hold even if all electronics fail. The status column shows what exists today and what the mounted build (Phase 2) must add.

#	Safeguard	What it does	Status
1	**Low power**	5 mW, Class 3R, the federal limit for laser pointers. The 520 nm diode emits no hidden infrared.	**In hand**
2	**Closed box**	An opaque box whose only opening is a window sized so a beam can leave only toward the dock.	Phase 2
3	**Physical stops**	Metal stops on the mount limit turn and tilt to inside the window.	Phase 2
4	**Software limits**	The controller rejects any aim outside the dock and keeps the dot 1 ft inside its edges.	Phase 2
5	**Downward geometry**	Mounted 10 to 12 ft above the water, the beam always points down, never level or skyward.	Phase 2
6	**A person decides**	It never fires on its own. A person presses start after seeing a camera photo.	**On bench**
7	**Person lock-out**	The camera system blocks start if it sees a person on or near the dock.	Phase 2
8	**Automatic off**	Off after 10 seconds at most, and off whenever power returns after an outage.	**Part built**

The president's question - light reflecting off the water

The concern is real, and it shaped the design. Calm water acts like a mirror at shallow angles. From eave height, a beam that reached open water would strike it at 10 to 15 degrees, and water reflects 21 to 35 percent of that light onward and upward toward the far shore. So the beam never touches the water. The window, the stops and the software all confine it to the dock surface.

On the dock - what the system does



Rough boards scatter weak light every way.

On open water - what the design prevents



This is why the beam is kept off the water.

Reflection figures are my own calculation from the standard optics formula for water (Fresnel equations, refractive index 1.333), not a measurement. Wet boards can add some glint, so the night demonstration checks for it.

Rules the system meets

Rule	How the system meets it
Federal laser product rules (FDA, 21 CFR 1040.10 and 1040.11)	The FDA limits laser pointers to Class IIIa (3R), 5 milliwatts. The laser is rated 5 mW, Class 3R.
State penal code on aiming lasers at people; federal law on aiming lasers at aircraft (18 U.S.C. 39A)	It cannot point upward, stays on the dock and locks out when it sees a person.
Migratory Bird Treaty Act	Scaring birds away needs no federal permit. The system never harms birds or disturbs nests.
Association nuisance and noise rules	Silent. No light reaches a neighbor's property and nothing sits on the dock or common area.

5. Getting to yes

A laser near neighbors' homes is an easy request to refuse. I treated the committee like a buyer with one serious objection and answered it before anyone had to ask. Six moves carried it.

1. **Talk to the decision-maker first.** I raised the idea with the association's president before filing. He named the risk that mattered to him and routed it to the right committee.
2. **Change the product, not the pitch.** I added the closed box with a dock-only window to the hardware so the answer to his question is physical, not a promise.
3. **Lead with neutral authorities.** USDA, a state wildlife agency, the U.S. Fish and Wildlife Service and FDA rules carry the case.
4. **Show the experience, not only the engineering.** In plain words, a neighbor may see a small green dot on our dock for a few seconds, and no one will see the beam on the water, at a home or in the sky.
5. **Prepare the neighbors.** I drafted a heads-up for a neighbor, with the packet attached, inviting concerns before I filed.
6. **Cap the downside with commitments.** The committee could say yes knowing exactly how to stop it.

My commitments to the association

Commitment	What it means
Night demonstration first	Before regular use I run a night test and check from the far shore that no light reaches anyone's property, with the committee invited.
90-day trial, then a report	How often it ran, whether it worked and any concerns raised.
Same-day shutoff	Any neighbor concern switches the system off the same day while I look into it.
Easy removal	If the association withdraws approval, the box comes down within 7 days.

6. Status and what is next

When	State
June 2026	**Done.** Five ideas ruled out, 5 mW cap set, $78 of parts ordered.
July 2026	**Done.** Bench build passed. Pan, tilt and laser all work from a phone.
November 2026	**Done.** Application filed on November 3 and approved on November 16.
Phase 2 (next)	Solder the trigger connection, fit metal-gear servos and physical stops, build the closed box, mount it under the eave, then wire the camera trigger and person lock-out. Nothing has fired outdoors yet.
Before regular use	Deliver every commitment above, starting with the night demonstration.

7. What this shows about how I work

The approval is the part I would repeat at work. I found the decision-maker's real objection early, changed the design to answer it, backed each claim with a public agency source and offered commitments that gave a cautious committee a clear way back. Moving a public agency to adopt new technology takes the same steps. I set the requirements, made each design call and verified the results on the bench. AI agents wrote the controller configuration, the build guide and the first drafts of the application.