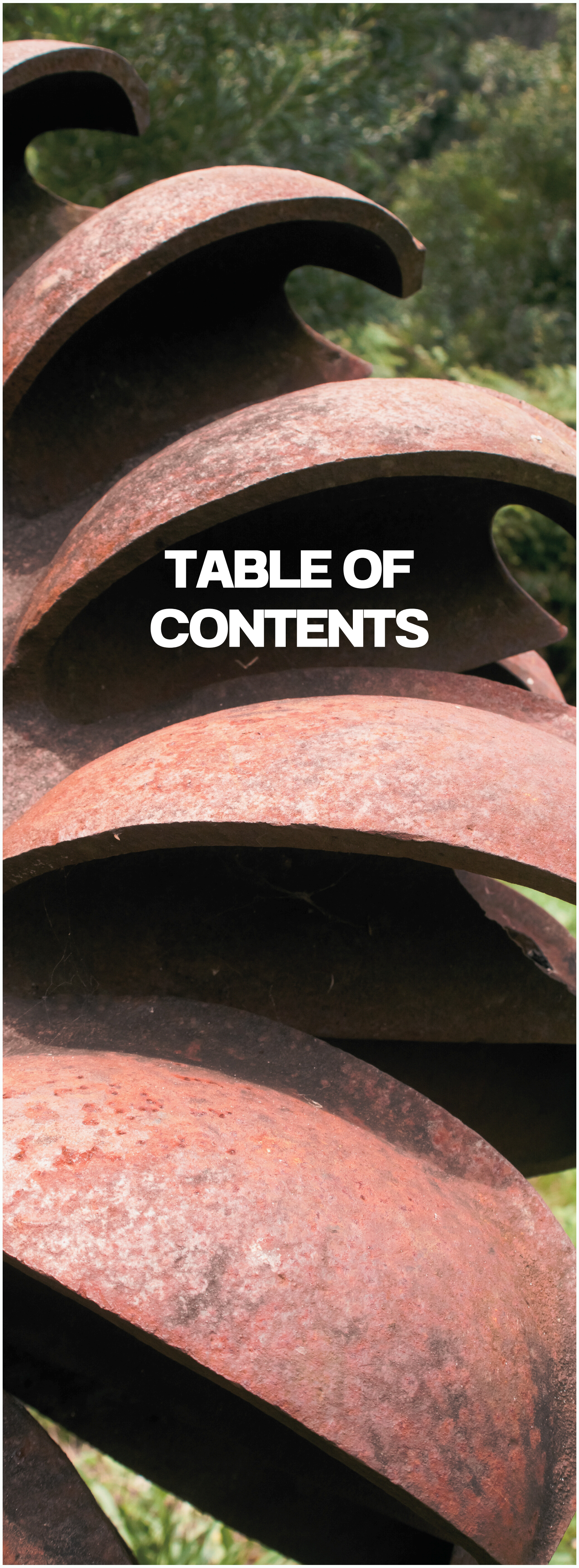
INNOVATIVE APPROACHES IN HYDROPOWER

LIHI CASE STUDIES

2024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LOW IMPACT HYDROPOWER INSTITUTE

INTRODUCTION

> Since 1999, the Low Impact Hydropower Institute (LIHI) has tirelessly championed industry innovation, issuing over 200 certificates representing over 300 hydropower facilities.

For 25 years, we've helped minimize environmental and social impacts through our low impact certification program. The PLUS Standards in our program define innovative hydropower as new ideas, technology, or unique, high-performing, site-specific techniques. These may include advanced safe, timely, and effective fish passage, improved flow management, enhanced water quality outcomes, or increased community engagement.

This summary highlights a few innovative approaches and advanced technologies implemented at LIHI Certified® facilities. Each project example includes a description of the progressive solution, a table with key information, a photograph (if available), and referenced hyperlinks for additional details and data.

TURBINE TECHNOLOGIES

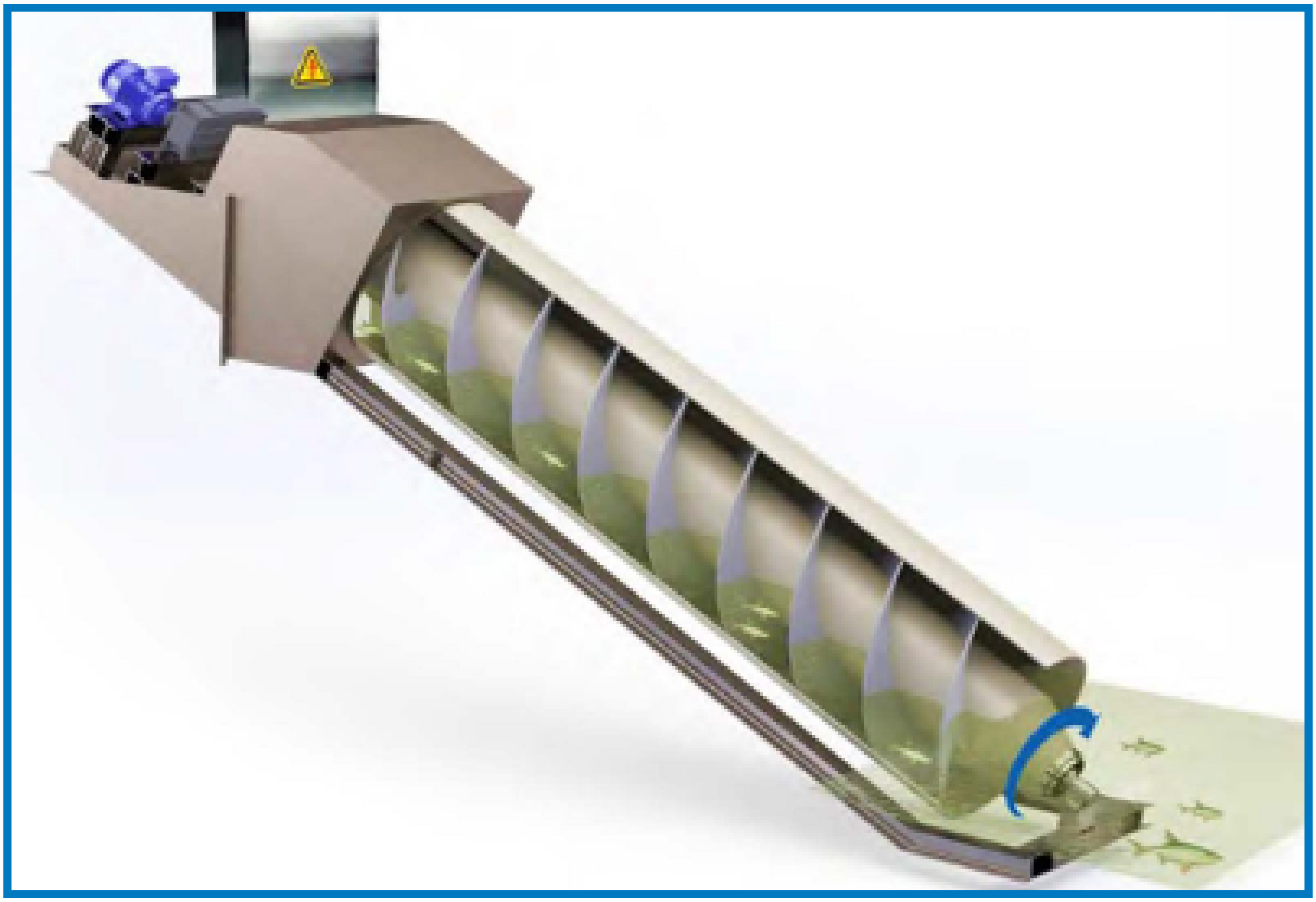


Figure 1. Archimedes Screw Turbine [1].

ARCHIMEDES SCREW TURBINE – ANCIENT TECHNOLOGY, NEW USE

The Archimedes screw pump was invented in Egypt around the 3rd century BC to lift water from a lower to a higher level. The screw was used most often for transporting water to irrigation systems and for dewatering mines or other low-lying areas, including land below sea level in the Netherlands. An auger in a snow blower is essentially an Archimedes Screw. Concrete mixer trucks use Archimedes screws on the inside of their drum to mix or unload material. Modern uses of Archimedes Screw pumps have been deployed in Europe, the United Kingdom, and North America as a safe means to move fish upward for various purposes. Fish hatcheries have employed this technology to transfer fish from tanks to trucks and to serve as an active fish lift in some locations, replacing a passive fishway.

Only in the past 20 years or so has the Archimedes Screw been turned around to operate as a turbine for electricity generation (Figure 1).

The Hanover Pond Dam Project, LIHI #165, is a small project on the Quinnipiac River in Meriden, Connecticut. The facility, owned by New England Hydropower Company, started operation in 2017 and is the first in the US to employ the Archimedes Screw Turbine technology for power generation that safely passes fish downstream.

The AST is 46.5 feet long and 11.65 feet in diameter, oriented at a 30-degree angle. The screw turbine has three blades with a runner diameter of 139.75 inches and rotates slowly at about 15 rotations per minute (RPM). It is also attached to a variable-speed gearbox and generator.

Studies at similar facilities in the United Kingdom suggested that the design and operation of the AST result in very high fish passage survival rates and only minor injury in a small fraction of fish. From 2017 to 2019, studies conducted at Hanover Pond Dam confirmed 100% passage survival with no injuries for downstream migrating alewife, American shad, and American eel.

Hanover Pond Dam Project Summary

Location	River mile 22.5 on the Quinnipiac River, CT
Operation Type	Run-of-river
Turbine Capacity	220 kW
Turbine Hydraulic Range	10 – 194 cfs
Annual Generation	900 MWh (enough to serve 90 average homes)
Dam Height	25 ft
Impounded Reservoir	71 acres
Regulatory Status	FERC exempt No. 14550

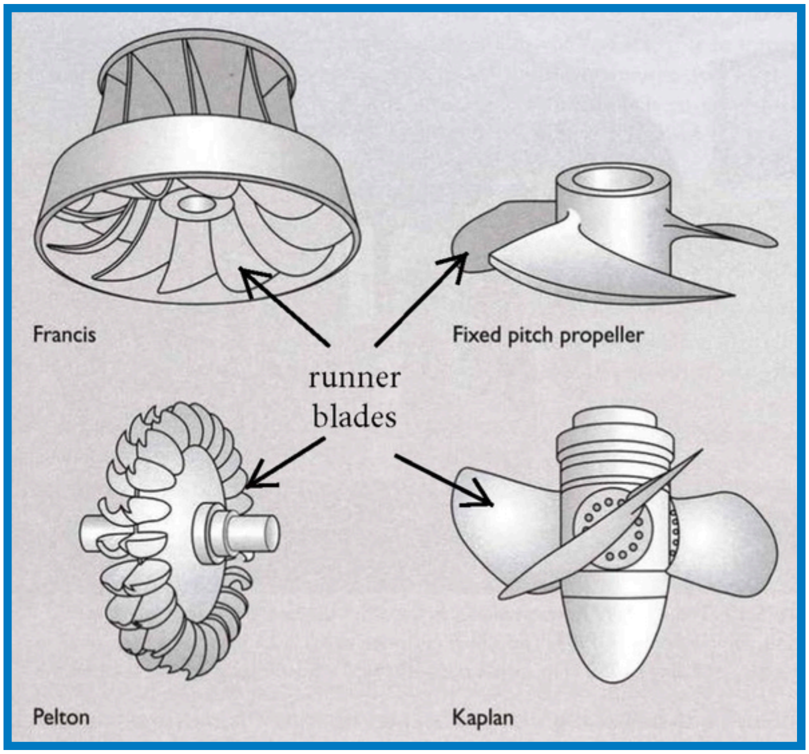


Figure 2. Types of Turbines and Runner Blades[2].

NATAL RESTORATION TURBINE – NEW TURBINE DESIGN PUTS FISH FIRST.

Natel Energy's Restoration Hydro Turbine (RHT) is a new method of incorporating safe fish passage into traditional Propeller, Kaplan, and Francis' turbines (Figure 2) through advanced runner blade design. These turbines provide safe downstream passage to aquatic organisms without reducing hydraulic performance.

RHTs are available for sites with two to forty meters of vertical distance between the water intake and the turbine, and they have uniquely thick blades slanted forward from hub to tip. This new blade shape (Figure 3) increases the chances of fish survival when they pass through the turbine spinning at high speeds. Unique to this design, there is only a tiny gap between the blades and the outer wall of the turbine and no gap where the blades connect to the center rotor. Since fish can get stuck in gaps, these design modifications further reduce the chances of fish injury or death.

These design elements combine to create safe turbines for fish and other aquatic organisms

Figure 3. Natel RHT Blade Designs (blue) versus typical turbine blades (gray)[3].

to pass through, eliminating the need for fine screens typically used to prevent fish from entering a turbine. Fine fish screens are expensive and tend to reduce the amount of electricity a turbine can generate; thus, eliminating their use reduces costs and increases plant efficiency. For fish that can pass through a trash rack and enter the turbine, the RHT minimizes injury and mortality. Survival has been tested in laboratory and field settings to be 98 – 100% even for adult American eels, with less than 1% injury – despite the high turbine speeds (62 – 92 ft/s).

The Freedom Falls Project, LIHI #178, is the US's first commercially operational Natel RHT. It is a small project located on Sandy Stream in Freedom, Maine. The 21.65-inch diameter RHT propeller turbine has three blades and spins at 543 rpm (Figure 4). Since its installation in 2019, it has outperformed other turbines, generating electricity an average of 90% of the time for the past four seasons. On-site testing of juvenile alewife downstream passage through the turbine resulted in a 48-hour survival estimate of 100% with an injury rate of less than 3%.

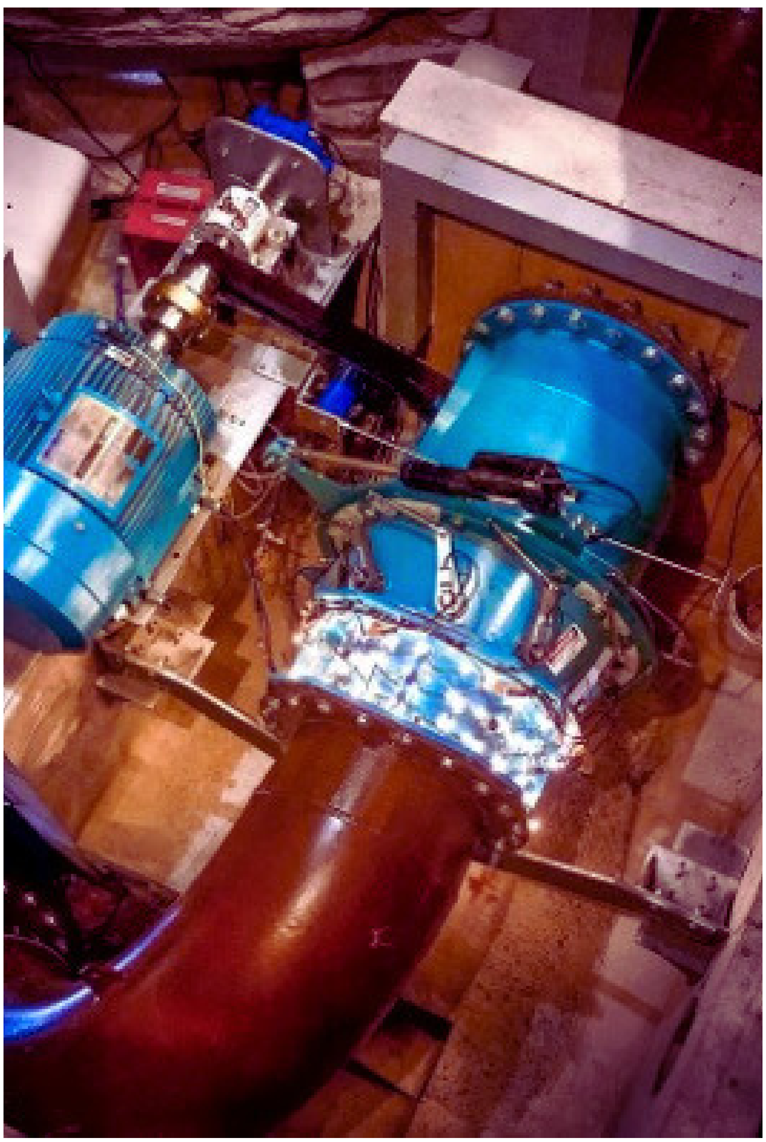


Figure 4. Natel Restoration Francis Turbine (right) and Generator (left) at the Freedom Falls Project.

Freedom Falls Project Summary

Location	River mile 10 on Sandy Stream, ME
Operation Type	Run-of-river
Turbine Capacity	350 kW
Turbine Hydraulic Range	8 – 30 cfs
Annual Generation	65 MWh (enough to serve 6-7 average homes)
Dam Height	12 ft
Impounded Reservoir	1.6 acres
Regulatory Status	FERC exempt No. 14421

The latest turbines have efficiencies of

>90%

The development of highly efficient turbines and generators has significantly increased the power output of hydroelectric power plants.

This is a significant improvement from the

80-85%

efficiency of the older turbines.

SOURCE: STRINGFIXER.COM/NL/FRANCIS_TURBINE

Figure 5. Natel Restoration Turbine (blue) sits between the intake to the right and discharge to the left of the Monroe Drop Project.

The Monroe Drop Project, LIHI #200, is located near Culver, Oregon, in a US Bureau of Reclamation seasonal irrigation canal operated by a local irrigation district. In 2020, the original 250-kW Natel turbine was replaced with a 300-kW Natel Fish-Safe Pit Style RHT (Figure 5). While the canal is screened to exclude downstream moving fish, the hydro project has been an important location for fish passage testing with this innovative turbine. The project has been the site of multiple through-turbine fish passage studies conducted with the Pacific Northwest National Laboratory, using rainbow trout of 200-530 mm (8-21 in) in length. Studies showed 48-hour survival rates of >98-100%.

Monroe Drop Project Summary

Location	North Unit Irrigation District Main Canal, 37 miles downstream of canal intake near Culver, OR
Operation Type	Seasonal run-of-canal
Turbine Capacity	300 kW
Turbine Hydraulic Range	141.3 – 332 cfs
Annual Generation	1,078 MWh (enough to serve 108 average homes)
Drop Height	15 ft
Impounded Reservoir	No impoundment
Regulatory Status	FERC conduit, exempt No. 14430

OPERATIONAL INNOVATION

DYNAMIC VARIABLE SPEED TURBINES FOR TRUE RUN-OF-RIVER OPERATIONS

The Burnshire Project, LIHI #152, is a small run-of-river facility on the North Fork of the Shenandoah River in Woodstock, Virginia, owned by Burnshire Hydroelectric LLC. It operates with three century-old turbines – two Leffel 27-B4 propeller turbines and one Leffel 21-Z Francis turbine.

The proprietary and unique generation and power electronics equipment allows the turbine and generator units to vary in speed and match the river's natural inflow. At the time of LIHI certification in 2019, it was one of only five hydropower sites known in the US using such technology.

Burnshire uses a permanent magnet generator (PMG) (Figure 6) coupled to and controlled by a regenerative inverter, which allows the turbine to turn on and off as needed and efficiently manages the excess heat created during electricity generation to optimize

Burnshire Project Summary

Location	River mile 41.7 on the North Fork of the Shenandoah River, VA
Operation Type	Run-of-river
Plant Capacity	232 kW
Annual Generation	1,400 MWh (enough to serve 140 average homes)
Dam Height	13.1 ft
Impounded Reservoir	38 acres
Regulatory Status	FERC exempt No. 3287

energy. This approach means that the turbine can adjust to dynamic flows and produce power across a broader range than is typical for turbines/generators. A PMG produces variable frequency and voltage proportional to the turbine's rotational speed. Power transforms inside the inverter from AC to DC and back to grid-matched AC power. The equipment and process utilize ULcertified off-the-shelf industrial components that allow for connection to the grid in just a few months rather than requiring years of power grid system studies.

Flow can vary from 5% to 105% of the rated turbine power, allowing the project to match the outflow to the river inflow while still generating power under varying flow conditions. River flow is indirectly measured by water elevation using multiple pressure gauges in the middle of the river. If a measured river level decreases, wicket gates are adjusted to reduce water flow through the turbines. If river flow increases, wicket gates open to allow more water flow, produce more power, or trigger additional turbines to start using the same river-level monitoring feedback mechanism.

Figure 6. While nondescript, the magnet generator shown here (gray) connects to the turbine shaft below.

This type of operational flexibility is becoming more important in changing hydrologic environments, mainly caused by climate change. At the river level, continuous power generation allows for a more natural flow, less hydraulic surging downstream, more constant downstream water temperatures, and less downstream erosion damage. Generation can continue even in extremely low flow periods to maintain the natural biological flow or to augment flow without opening spill gates.

Figure 7. Boulders and cement blocks mimic natural riverbed conditions, allowing multiple fish species to pass upstream and downstream of the Eel Weir project safely[5].

INNOVATIVE FISH PASSAGE

NATURE-LIKE FISHWAYS IMPROVE AQUATIC FLOW

The Oswegatchie River Project, LIHI #161, is a multi-development project in St. Lawrence County, New York. The two most downstream facilities, Eel Weir and Heuvelton, are the second and third dams upstream of the river's confluence with the St. Lawrence River. These facilities have installed nature-like fishways.

Conventional approaches to fish passage generally consist of concrete step-like structures or physical transport systems such as elevators. Nature-like fishways take advantage of the river's inherent terrain and shoreline and mimic the natural river channel, accommodating upstream and downstream migration for a broader range of fish species and sizes at a more extensive flow range than conventional fishways. Fish respond to water currents, varying depths, and channels similar to natural rivers. This design is less likely to cause disorientation and passage injury than concrete or other smooth materials. Natural substrates provide roughness and spaces, enabling small fishes and benthic invertebrates to pass[4].

Nature-like fishways also maintain river connectivity and provide the riffle/pool habitat for fish spawning and other aquatic organisms. These fishways are typically low-cost, require little maintenance, and are more aesthetically pleasing than traditional fish ladders. The nature-like fishways at these facilities are a unique, effective, and natural means for lake sturgeon, American eel, and riverine fish species to travel through the two developments unharmed, with access to a natural waterfall barrier habitat fifty river miles upstream. Field sampling and video at Eel Weir confirmed fishway effectiveness (lake sturgeon and American eels were not observed). During the five days after installation, over 2,000 fish comprising 14 different species used the fishway.

The Eel Weir fishway consists of an excavated bypass

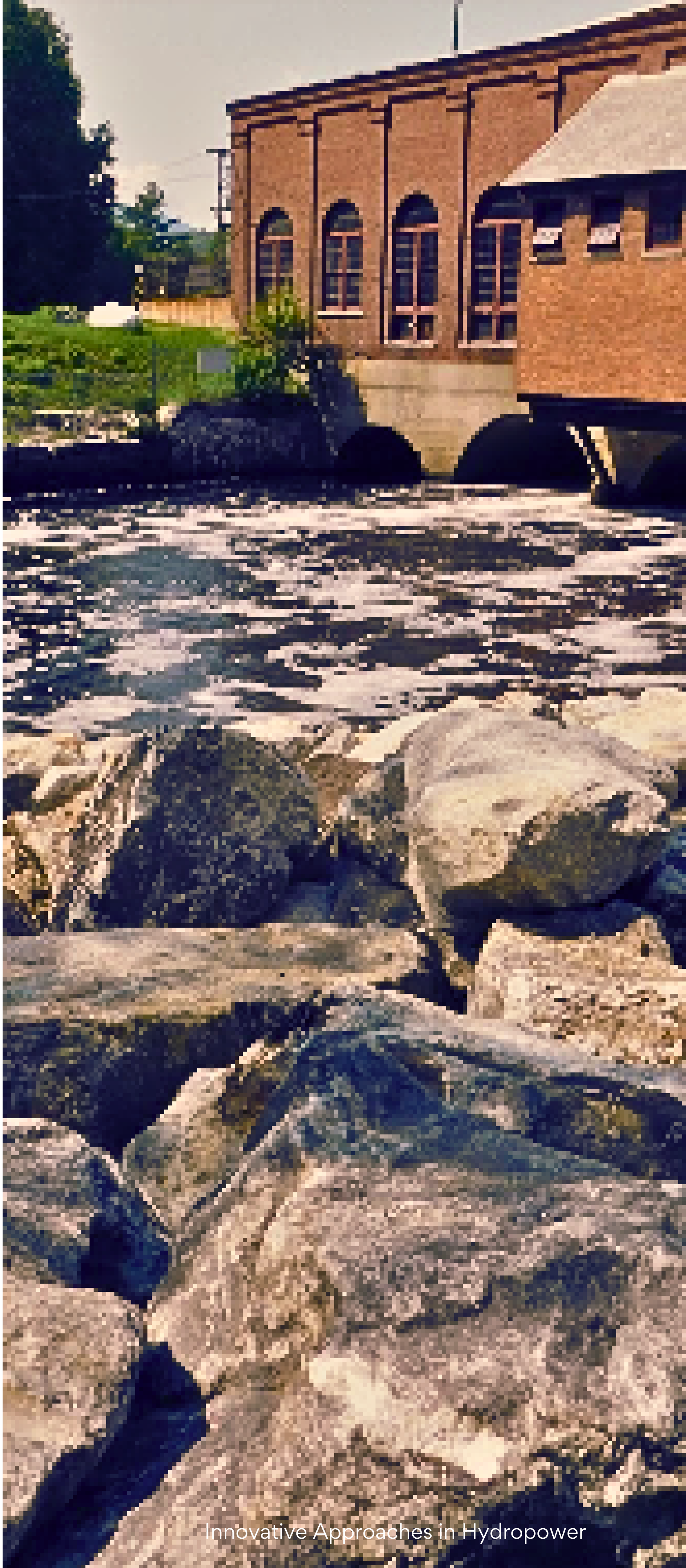
Eel Weir Project Summary

Location	River mile 5.1 on the Oswegatchie River, NY
Operation Type	Run-of-river
Plant Capacity	2.46 MW
Annual Generation	8,822 MWh (enough to serve 882 average homes)
Dam Height	15 ft
Impounded Reservoir	96 acres
Regulatory Status	FERC license No. 2713

channel downstream of the spillway, which contains a series of gapped boulders and pools with a minimum depth of 2 feet (Figure 7).

Nature-like fishways have been used in Europe since the 1970s, but the fishways on the Oswegatchie River were the first in New York and the second and third at hydro projects in the Northeast. In the US, hydro projects have installed only a few such fishways since resource agencies have traditionally prescribed structural fishways to support specific species rather than a diverse population of organisms at varying life stages.

The National Hydropower Association granted the Eel Weir and Heuvelton fishways the 2019 Outstanding Stewards of America's Waters Award. The award recognizes hydro projects that provide extraordinary recreational, historical, environmental, or educational value.



INSTALLING FLOW CONTROLS AND GUIDANCE STRUCTURES TO IMPROVE FISH NAVIGATION

The Willamette Falls Project, LIHI #33, is on the Willamette River in Clackamas County in north-central Oregon. The project owner implemented numerous innovative modifications to create flow conditions that exploit natural migratory fish behaviors and guide fish safely downstream.

The first Eicher Screen fish bypass was installed in 1980 at this project and was the first such screen deployed worldwide. The Eicher Screen improved on incline-plane screens, which can be more dangerous for fish in low flows. It is an in-penstock passive pressure system that uses a smooth-surfaced wedge wire screen that inclines upward toward a fish bypass channel or pipe and removes fish before they become entrained in a turbine. The screen is mounted on a frame and pivot axis, allowing rotation and backflushing to clean off debris. While rarely used today, the screen system effectively passed federally threatened species, including steelhead trout, coho salmon, and Chinook salmon, with little injury or scale loss[6].

This system was later supplemented by a creative site-specific solution to improve flow conditions by guiding salmonids and juvenile Pacific lamprey safely around the powerhouse so there isn't a need to screen them out of the other 12 turbine intakes. A training wall was installed at an angle to push fish away from the turbine intakes, and the new North Fish Bypass (NFB) was installed for continued operation when flows were high. The NFB can perform independently or with the Eicher

Figure 8. The three inflatable rubber bladders depicted here direct additional water into a deep pool, providing a safe landing for fish that pass downstream over the natural Willamette Falls.

Willamette Falls Project Summary

Location	River mile 26.5 on the Willamette River near Portland, OR
Operation Type	Run-of-river
Plant Capacity	16.9 MW
Annual Generation	130,525 MWh (enough to serve 13,053 average homes)
Dam Height	20 ft
Impounded Reservoir	1,991 acres
Regulatory Status	FERC license No. 2233

screen bypass system. Other modifications included re-contouring the inner trash racks to increase flow, improving hydraulic conditions, and modifying the Eicher screen system to reduce fish injury.

A Flow Control Structure was also integrated at the top of Willamette Falls to focus flow into a large pool, softening the landing for downstream migrating fish drawn past the other passage structures (Figure 8). The structure consists of three inflatable bladders with a concrete foundation flanked by concrete piers. These structures help fish avoid hazardous rocks by guiding them to the deep water at the base of the falls.

Collectively, these modifications improved hydraulic conditions and worked in concert with the project's existing bypasses. Between 2007 and 2009, researchers completed downstream fish passage evaluations, revealing that the whole-project downstream passage performance standard was above 99% and exceeded the project goal of 98%. Injury rates through the various bypass facilities were less than 0.5% and met performance goals[7].

According to a study from Navigant Consulting, nearly 9,000MW of new capacity could be added by modernizing existing hydropower facilities.

Through a $30.6 million award from the Department of Energy’s Recovery Act funding, seven selected facilities modernized their facilities, resulting in...

SOURCE: www.hydro.org/waterpower/modernizing/

Reduced carbon dioxide emissions of over **110,000 tons** per year.

Increased electric generation **by an estimated 187 GWh per year**, at an **average cost of less than 4 cents per kWh**.

More jobs and economic opportunities within the local community.

ADAPTIVE MANAGEMENT APPROACHES

DYNAMICALLY ASSESSING PASSAGE DESIGNS TO OPTIMIZE FISH PASSAGE PERFORMANCE

The Opal Springs Project, LIHI #145, is in a steep canyon on the Crooked River in Culver, Oregon. It supplies irrigation, drinking water, and hydropower.

The fish passage installation at the downstream Pelton Round Butte Project, LIHI #25, opened the river below Opal Springs to migratory aquatic life and drove the need for fish passage. Not compelled by their FERC license, the project owner voluntarily engaged with stakeholders resulting in a multi-party Settlement Agreement establishing appropriate fish prescriptions. In leveraging the adaptive management approach, the project also constructed and operates upstream and downstream passage for steelhead, Chinook salmon, bull trout, and other native fish passage to meet survival criteria of 90% with a goal of 97%. Fish passage facilities began operating in 2020, with the first 5-year evaluation period ending in 2024. *Watch short videos on the fish passage project here.*

Adaptive management efforts consist of field surveys and flow management during migration seasons. The project evaluated fish passage performance against the agreed-upon targets over three 5-year periods. Monitoring efforts for adults included counts, migration timing, real-time passage effectiveness, and aggregate passage performance. The facility tracked relative abundance, emigration timing, real-time passage effectiveness, and aggregate smolt passage performance for juveniles. The aggregated monitoring data helped to identify possible fish passage issues with solutions selected from a suite of agreed-upon potential actions, including modifications in the flow regime. The voluntary efforts of the project owner, well before the expiration of its FERC license, have provided new access to over 120 miles of good to excellent spawning and rearing habitat.

Opal Springs Project Summary

Location	River mile 7.2 on the Crooked River in Culver, OR
Operation Type	Run-of-river
Plant Capacity	4.3 MW
Annual Generation	29,509 MWh (enough to serve 2951 average homes)
Dam Height	21 ft
Impounded Size	14.4 acres
Regulatory Status	FERC license No. 5891

MANAGING FLOWS FOR IMPROVED WATER QUALITY

The [Island Park Project, LIHI #2](), is at the US Bureau of Reclamation (USBR) Island Park Dam on the Henry's Fork of the Snake River in Fremont County, Idaho. The project's generation capacity has release restrictions managed by the USBR. USBR manages the flows for flood control, irrigation, and fishery habitat.

The project enhances dissolved oxygen and temperature discharges, the most common water quality impacts of hydropower facilities, via adaptive management. The aeration basin below the dam (Figure 9) oxygenates water as it comes over the massive drop, retaining it for two minutes at peak flows and adding 12.5 tons of oxygen. Operations are monitored and adjusted in response to water quality conditions.

Discharges are also modulated to ensure optimal temperature for downstream fish habitats. The adjustable rubber collar on the spillway enables the project to mix warm water from the reservoir surface with colder water from deeper within the water column. Water is stored in the reservoir at a higher rate during the fall and early winter, so more can be released during the late winter when it has the most significant benefit to the fish population per discharge unit (cubic feet of water per second).

Figure 9. Water discharged from the Island Park project enters this specially designed aeration basin, where it is churned to add oxygen before being released downstream.

Island Park Project Summary

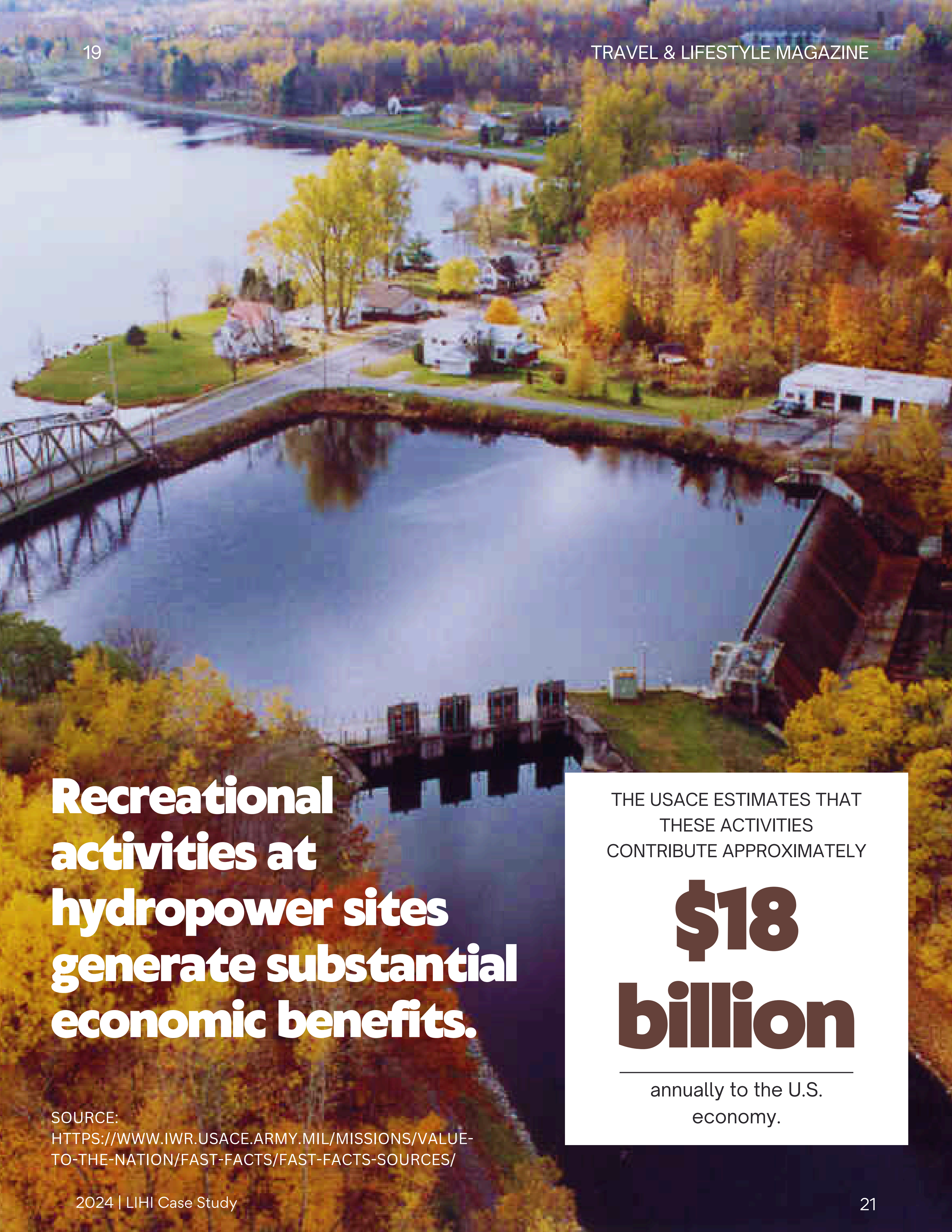
Location	River mile 91 on Henry's Fork Snake River in northeast ID
Operation Type	Run-of-release
Plant Capacity	4.8 MW
Annual Generation	18,537 MWh (enough to serve 1,854 average homes)
Dam Height	94 ft
Impounded Size	7,794 acres
Regulatory Status	FERC license No. 2973

ADAPTIVE MONITORING TO PREVENT WATER QUALITY PROBLEMS

Mother Ann Lee Project Summary	
Location	River mile 117 on the Kentucky River near High Bridge, KY
Operation Type	Run-of-river
Plant Capacity	2.209 MW
Annual Generation	8,535 MWh (enough to serve 854 average homes)
Dam Height	15.3 ft
Impounded Size	777 acres
Regulatory Status	FERC license No. 539

The Mother Ann Lee Project, LIHI #24, is at the Kentucky River Authority's Lock & Dam No. 7 on the Kentucky River in central Kentucky. The project has developed an adaptive management program to aerate water discharges when low dissolved oxygen (DO) levels are detected. Previously, the project would have to shut down the turbines when DO levels dipped below state standards.

The current protocol allows one or more turbines to continue to spin during low DO events by drawing air through the top frame of the turbine's runner (called the crown plate). Turbines idle with closed wicket gates, pulling significant air through them and aerating the discharge into the tailrace. The project monitors dissolved oxygen and water temperature every 15 minutes year-round. Typically, dissolved oxygen levels recover within 15 minutes, but turbine units idle until the next day, even if DO levels rise sufficiently.



Recreational activities at hydropower sites generate substantial economic benefits.

THE USACE ESTIMATES THAT THESE ACTIVITIES CONTRIBUTE APPROXIMATELY

$18 billion

annually to the U.S. economy.

SOURCE: HTTPS://WWW.IWR.USACE.ARMY.MIL/MISSIONS/VALUE-TO-THE-NATION/FAST-FACTS/FAST-FACTS-SOURCES/

COMMUNITY PARTNERSHIPS AND ENGAGEMENT

A HANDS, HEART, AND HEAD APPROACH TO ENGAGING WITH STUDENTS

Figure 10. Artwork created by the local 4th-grade class adds beauty to the powerhouse and creates a learning environment for future school kids.

The Mother Ann Lee Project, LIHI #24, created significant new educational opportunities about the hydroelectric facility's cultural, historical, and STEM-related aspects. These include offering plant tours and presentations about the facility's history, renewable energy, and the local area, including Mother Ann Lee, the founder of the Shakers and the Pleasant Hill Shaker Village.

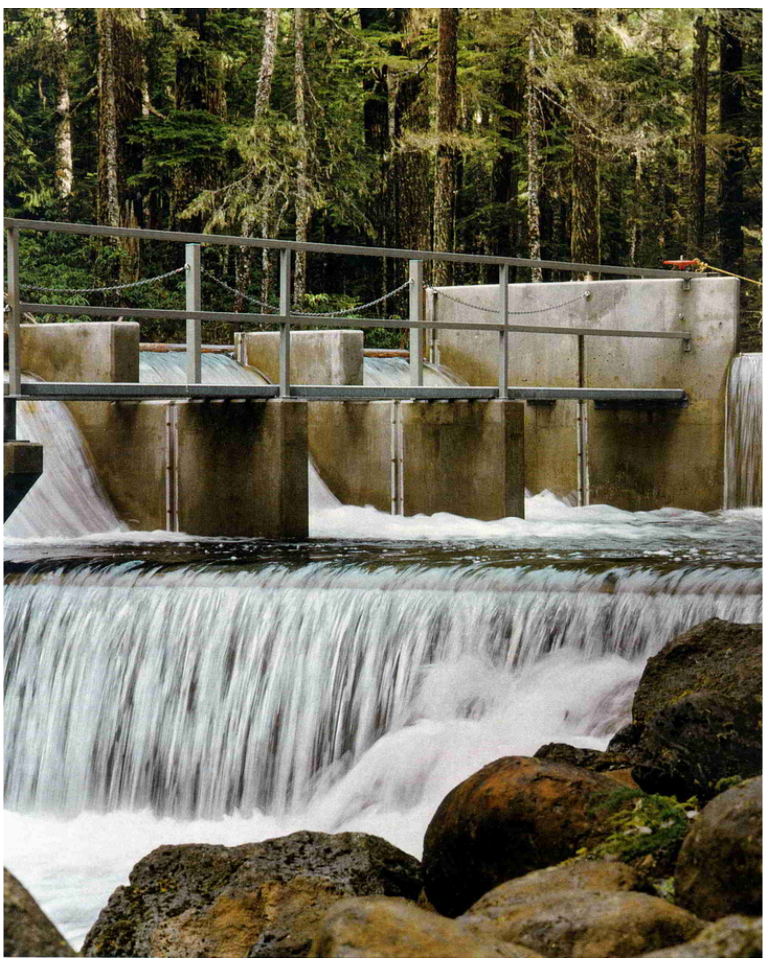
The owner initiated a project with a local 4th-grade class at Bloom Elementary in Louisville, Kentucky, to allow students to paint the generators with local fish species (Figure 10). Students learned about renewable energy and the project's history, effectively transforming the project into a children's art gallery. The project owner also donated an old runner from the powerhouse to the Jessamine County Parks and Recreation Department for display, with plans to add interpretive signage that discusses the runner's operations from 1927 – 2014 and the Kentucky Lock and Dam system's impact on settlement in the region.

The project hosts tours for Kentucky River Authority staff, lock tenders, and students from Centre College, which, as part of its sustainability program, also buys renewable energy credits from the facility, representing approximately 30 of the College's anticipated use.

LONG-TERM PARTNERSHIP FOSTERS KNOWLEDGE AND CONSERVATION

The Falls Creek Project, LIHI #4, is on Falls Creek in the Willamette National Forest near Sweet Home, Oregon. The owner proactively engages with the community to enrich educational opportunities that are unique and relevant to hydropower and the local area, fostering an appreciation for natural, cultural, and historic resource preservation.

For over two decades, project staff have hosted a creative, fun, hands-on tour for area school children to learn about hydropower, environmental resources, and energy conservation. Project staff also conduct tours and campfire presentations for visitors to the nearby National Forest campground. *Watch a short video highlighting the school tours here*.



Falls Creek Project Summary

Location	River mile 2.3, Falls Creek and South Santiam River, near Sweet Home OR
Operation Type	Run-of-release
Plant Capacity	4.9 MW
Annual Generation	15,200 MWh (enough to serve 1,520 average homes)
Diversion Height	5 ft
Impounded Size	0.5 acres
Regulatory Status	FERC license No. 6661

PARTNERSHIP FOSTERS CONNECTIONS

Mahoning Creek Project Summary	
Location	Mahoning Creek, 23 miles upstream from the confluence with the Allegheny River, near New Bethlehem, PA
Operation Type	Run-of-release
Plant Capacity	6.0 MW
Annual Generation	18,500 MWh (enough to serve 1,850 average homes)
Dam Height	162 ft
Impounded Size	280 acres
Regulatory Status	FERC license No. 12555

The Mahoning Creek Project, LIHI #114, is at a US Army Corps of Engineers dam in Armstrong County, Pennsylvania.

The project provides tours and hosts a summer internship program for Pennsylvania State University students from the engineering and environmental science departments. Students are involved in all aspects of the project, including design, management practices, power generation, economics, and environmental impact. Pennsylvania State University also purchases all of the net electric output from the facility and retains the environmental attributes.

RECREATION

A SKATEPARK FOR WHITEWATER ENTHUSIASTS

The Holtwood Project, LIHI #116, is on the lower Susquehanna River in southeast Pennsylvania. The project provides recreational boating and fishing, camping, and picnicking opportunities. As part of federal licensing for a new second powerhouse, the project owner constructed the Holtwood Playpark (Figure 11) in coordination with the whitewater boating community. It is one of only two such parks in the US associated with a hydropower project[8].

The park provides flow forecast information[9] and whitewater boating opportunities for 264 hours per year. Islands within the project boundary are available for informal recreational use, and the owner offers portage service for through-boaters. *Watch a privately filmed video of the park here.*

Figure 11. The Holtwood playpark provides a Class III or higher-difficulty whitewater course for those wanting an exciting path downriver. A portage is available for those who'd prefer a less exciting passage.

Holtwood Project Summary

Location	River mile 25, Susquehanna River near Holtwood, PA
Operation Type	Store/release
Plant Capacity	252 MW
Annual Generation	924,436 MWh (enough to serve 92,444 homes)
Dam Height	55 ft
Impounded Size	2,600 acres
Regulatory Status	FERC license No. 1881

BUILDING AN ENTERTAINMENT VENUE FOR WILDLIFE

The Kingsley Dam Project, LIHI #37, is a multi-development project and part of an extensive irrigation supply system on the Platt and North Platt Rivers in west-central Nebraska. The project provides various recreational resources, including boating, fishing, swimming, picnicking, hiking, and camping.[10]

The owner voluntarily constructed bald eagle and wildlife viewing facilities at the Kingsley Dam development on Lake Ogallala (Figure 12) and at the Johnson No. 2 development[11]. Bleachers and large windows look out over the supply canal, where eagles swoop to capture fish and rest in the trees along the banks. Attendees can view eagles through the provided spotting scopes, and naturalists are available to answer questions.

These are two of only six such facilities in the country[12]. They are popular with the general public, and visitors have included elementary through college-aged students. *Watch a video highlighting eagles and recreational opportunities at the project here.*

Figure 12. The viewing building at Kingsley Dam provides amazing views of nesting and hunting eagles while keeping birds safely away from humans[13].

Kingsley Dam Project Summary

Location	The project spans from river mile 57.3 on the North Platte River to river mile 246.5 on the Platt River in south central NE
Operation Type	Seasonal Storage/peaking, diversion, and conduit
Plant Capacity	115.7 MW
Annual Generation	373,373 MWh (enough to serve 37,337 homes)
Dam Height • Kingsley • Central Diversion • Jeffrey • Johnson	• 163 ft • n/a - diversion • 70 ft • 47 ft
Impounded Size • Kingsley • Central Diversion • Jeffrey • Johnson	• 30,500 acres • 25 acres • 575 acres • 2,500
Regulatory Status	FERC license No. 1417

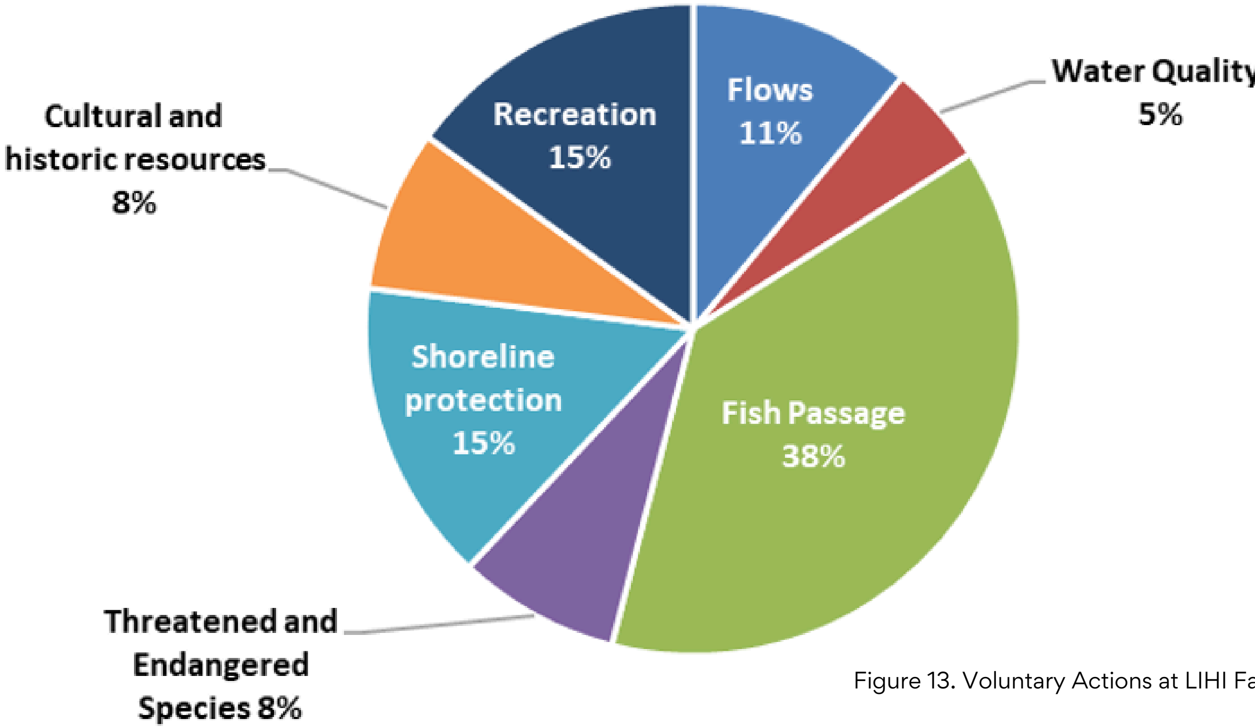


Figure 13. Voluntary Actions at LIHI Facilities

SUMMARY

These are only some examples of the many and varied innovative approaches and technologies that LIHI Certified® facilities have implemented to foster stewardship of rivers for the people and wildlife that depend on them. Overall, 29% of certified projects have exceeded the minimum LIHI requirements and earned one or more "PLUS" standards and an extended certification term. Others have implemented voluntary measures beyond their strict regulatory requirements, but which may not rise to the level of LIHI's standards.

Figure 13 above shows the breakdown by LIHI criterion of voluntary measures planned or already implemented. Some voluntary actions apply to more than one criterion. For instance, a facility may manage flows or increase dissolved oxygen in its discharge to protect specific threatened or endangered aquatic species.

Most voluntary measures are related to fish passage, primarily downstream. Examples include operational approaches such as adjusting flow volumes or discharge locations, turbine shutdowns during migration periods, or modifying physical structures to convey fish downstream safely.

LIHI strongly encourages hydro owners and operators to incorporate available technological advances into their designs and provide holistic solutions to address environmental concerns during project planning, retrofitting, and relicensing. LIHI also urges owners, regulators, and community members to evaluate the many “softer” innovative approaches that do not require significant capital investment but can effectively improve river resource protection and enhance cultural and social benefits at existing projects.

REFERENCES

1. Image source: FishFlow Innovations https://fishflowinnovations.nl/en/innovations/screw_turbine/
2. Image source (edited): http://www.publicresearchinstitute.org/Pages/hydroturbines/hydroturbines.html
3. Image source: https://www.natelenergy.com/turbines
4. https://repository.library.noaa.gov/view/noaa/28919/noaa_28919_DS1.pdf
5. Image source: https://medium.com/the-hydroelectric/brookfield-renewable-constructs-nature-like-fishway-to-transport-migratory-fish-species-ffeeb9efed
6. EPRI 2002. Upstream and Downstream Fish Passage and Protection Technologies for Hydroelectric Application: A Fish Passage and Protection Manual. https://www.epri.com/research/products/1005392
7. https://elibrary.ferc.gov/eLibrary/filedownload?fileid=01625040-66E2-5005-8110-C31FAFC91712
8. Based on a FERC e-library search conducted on October 20, 2023, and input from American Whitewater.
9. https://safewaters.com/facility/holtwood
10. https://cnppid.com/recreation%20
11. https://cnppid.com/recreation/recreational-resources/
12. Based on a FERC e-library search conducted on October 20, 2023
13. Image source: https://cnppid.com/eagles/

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