



Case Studies in Permitting Beaver-Related Restoration

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Introduction

In pre-Columbian times, hundreds of millions of beavers were estimated to have made their homes in the streams, rivers, and wetlands that crisscrossed the land that now makes up the continental United States.¹ They served as ecosystem engineers, intensively modifying river corridors through the building of dams to slow and pool water, creating suitable habitat for building lodges. Beaver-made structures add complexity to riverine systems, often anastomosing single channels into multiple branches able to host more diverse valley bottom ecosystems. Additionally, by slowing down water on the landscape, beavers create more resiliency in the face of drought and flood events.²

The rise of the fur trade following European colonization and development associated with population expansion led to the collapse of beaver population numbers and incalculable losses of beaver-created wetlands, habitats, and landscapes.³ Many river systems, especially in the more arid Western U.S., have subsequently degraded into eroded and channelized stream beds less capable of supporting fish and wildlife and providing fresh water to communities⁴.

Researchers, land managers, and policy makers have been working to quantify and restore the benefits that beavers bring to our landscapes. A 2020 study to quantify ecosystem services associated with beaver-dam building activities estimated that beavers provide hundreds of millions of dollars of economic value every year.⁵ For example, habitat and biodiversity benefits were valued at \$133 million, drought and flood attenuation benefits valued at \$32 million, and water quality benefits valued at \$28 million. An emerging field of stream and river restoration referred to as low-tech process-based restoration (LTPBR), posits that to hold on to and expand these benefits, three major strategies can be employed:

¹ Feldhamer, G. A., Thompson, B. C., & Chapman, J. A. (2003). *Wild mammals of north america: Biology, management, and conservation*. JHU Press.

² Wohl, E., (2021). Legacy effects of loss of beavers in the continental United States. *Environmental Research Letters*. 16. 10.1088/1748-9326/abd34e.

³ Bell, A. (2024). "Overrun byfire": The environmental consequences of beaver removal during the pacific northwest fur trade. *Montana: The Magazine of Western History*, 74(3), 60–73. <https://muse.jhu.edu/pub/549/article/93706>

⁴ Wohl, E., (2021). Legacy effects of loss of beavers in the continental United States. *Environmental Research Letters*. 16. 10.1088/1748-9326/abd34e.

⁵ Thompson, S., Vehkaoja, M., Pellikka, J., & Nummi, P. (2021). Ecosystem services provided by beavers *Castor spp.* *Mammal Review*, 51(1), 25–39. <https://doi.org/10.1111/mam.12220>

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- Where beavers are already living, beaver coexistence devices can be installed to allow beavers to remain in and benefit the ecosystem without causing damage to private property or public infrastructure.
 - In degraded riverine systems without beavers, but which have the habitat capacity to support beaver, the relocation and reintroduction of beaver can successfully restore systems.
 - In degraded riverine systems that can no longer support beaver, mimicry structures can add similar complexity to stream channels as beaver dams.

These strategies have been surging in popularity among the river restoration and beaver restoration communities, however, the regulatory and permitting framework still needs to catch up. A 2025 paper, “*Revisions to Permitting can help Speed the Pace and Scale of Stream Restoration*”, claims that most current regulations are set up to mitigate short-term impacts of heavy machinery use in stream restoration and are unable to adequately scale down to accommodate the minimal impacts associated with LTPBR.⁶ While some states and communities are moving to pilot new permitting processes to facilitate LTPBR, the current policy landscape is a patchwork of regulations that vary from jurisdiction to jurisdiction. This paper provides examples from a variety of states that have existing regulations covering beaver coexistence, beaver relocation, and beaver mimicry to highlight possible pathways for other states to adopt.

Beaver Coexistence

While beavers can provide myriad benefits to an ecosystem, stream damming in more densely populated areas can cause flooding to homes, roadways, and other properties. Historically, federal, state, and local wildlife agencies have handled beaver-human conflicts through lethal trapping and removal. However, this strategy has

Types of Beaver Coexistence Devices:

Culvert Fences are structures of wire mesh installed in front of culverts, often in a large, trapezoidal shape that is an unattractive damming target

Pond Levelers are installed pipes that run through a beaver dam allowing water to pass through without destroying the dam. The intake is submerged to hide the flow of water from beavers, and the outtake height can be adjusted to determine the water level of a beaver pond.

Fence and Pipe Devices: This combines culvert fencing and pond levelers by running a pipe through a culvert fence purposefully designed to be dammed by beavers without causing flooding consequences.

⁶ Clancy, Niall & Bissett, Danielle & Bennett, Stephen & Shallcross, Alden. (2025). Revisions to permitting can help speed the pace and scale of stream restoration. 10.13140/RG.2.2.25707.04641.

been found to be inefficient and ineffective. In most cases where beavers are removed, new beavers move into the area and rebuild structures to cause the same flooding.⁷ Because the underlying conditions remain favorable, beavers continue to find their way to the same areas. A growing body of research shows that the installation of beaver coexistence devices provides a more durable and cost-effective solution to beaver conflicts. These



Photo Credit: Skip Lisle, Beaver Deceivers, LLC

devices work by discretely moving water past existing beaver dams through a series of pipes and filters to keep beaver ponds at an acceptable water level.⁸ Compared to traditional trapping and damage remediation, coexistence devices can cost significantly less while preserving the ecosystem benefits of beaver ponds.⁹ Several states specifically have programs or regulations in place with various permitting requirements:

- **New Hampshire**

New Hampshire’s House Bill 281 was signed into law in 2019 to facilitate the installation of beaver coexistence devices.¹⁰ The law was pushed by municipal officials of the town of Hopkinton who were dealing with repeated flooding from beavers and were seeking the “right to have beaver deceivers” without needing to go through the state.¹¹ The bill amended the New Hampshire revised statutes section 210:9 focusing specifically on the protection of beaver within the state.¹² The law requires a special permit for any alteration to a beaver dam unless the action is done on private property to protect private property. Flow devices (referring to coexistence devices ensuring unimpeded stream flow) are now specifically mentioned as an option available to

⁷ Simon, L. J. (2006). Solving beaver flooding problems through the use of water flow control devices. *Proceedings of the Vertebrate Pest Conference*, 22(22). <https://doi.org/10.5070/V422110285>

⁸ Lisle, S. (2003). The use and potential of flow devices in beaver management. *Lutra* **46**: 211–216.

⁹ Hood, Manaloor, & Dzioba. (2018). Cost-Benefit Analysis of Beaver Coexistence Tools. Miistakis Institute

¹⁰ New Hampshire House Bill 281 (Prior Session Legislation 2019)

¹¹ CBC. (2019, January 9). New Hampshire town seeks state approval to install more beaver deceivers; *CBC Radio*.

¹² 2024 new hampshire revised statutes: Title xviii - fish and game :: chapter 210 - fur-bearing animals :: section 210:9 - protection of beaver.



Photo Credit: Skip Lisle, Beaver Deceivers, LLC

landowners to deal with beaver ponds on their lands. Additionally, if the installation of the flow device does not use heavy machinery or significantly disturb the streambank, one can install a flow device without needing to seek a permit under New Hampshire's fill and dredge of wetlands statutes (chapter 482).¹³

Andover is another town in the state that sought coexistence solutions before the permitting exemption law. The town finished installing devices on eight threatened road culverts in 2017 and put together a cost benefit analysis justifying the techniques to residents. They projected that in a 30-year period, the costs to install and maintain coexistence devices would be around \$48,000 compared to the projected costs of \$540,000 for the traditional methods of removing blockages and repairing roadways.¹⁴ The town continues to maintain the devices.

- **Vermont**

Vermont Fish and Wildlife began the Beaver Wetlands Conservation Project in 2000 to “provide assistance for landowners, road crews and municipalities who were experiencing conflicts with beavers, in order to maintain valuable wetland habitat.”¹⁵ Property owners dealing with flooding from active beaver dams are required to contact an agency representative for a site assessment and to discuss potential solutions. If a coexistence device is called for, it can be installed either by Fish and Wildlife staff or by the landowner with technical guidance from the manual, “Best Management Practices for Resolving Human-Beaver Conflicts in Vermont”.¹⁶

¹³ *2024 new hampshire revised statutes: Title I - water management and protection :: chapter 482-a - fill and dredge in wetlands.*

¹⁴ Mishcon, V. Lisle, S. Andover, New Hampshire Case Study. <https://beaverdeceivers.com/wp-content/uploads/2020/07/Andover-case-study-August-2018.pdf>

¹⁵ *Story map journal.* (n.d.). Retrieved September 22, 2025, from <https://vtanr.maps.arcgis.com/apps/MapJournal/index.html?appid=fd3542198df3484eb23ab04b1c8b712f>

¹⁶ Vermont Fish and Wildlife Department, Vermont Department of Environmental Conservation (2002). *Best Management Practices for Resolving Human-Beaver Conflicts in Vermont*

As of 2025, the program has installed a total of 357 coexistence devices statewide using both state and federal conservation funding.¹⁷ Of those, currently 101 are confirmed to still be functioning at their original site, 18 are still installed but not functioning, and 213 have been removed by the landowner (the rest are in unknown condition). The leading contributor to device failure is cited as lack of maintenance.¹⁸ While the project has resources to aid landowners with installation, those same landowners must then be responsible for maintaining the devices. There are currently no penalties for lack of maintenance.

- **Montana**

Montana Fish, Wildlife, and Parks provide a comprehensive guide to LTPBR titled “Beavers and Their Role in Riparian Restoration in Montana”.¹⁹ The guide covers recognizing problems, finding potential solutions, and implementing restoration techniques- including obtaining the proper permits. For the installation of coexistence devices, projects on private land must obtain a Natural Streambed and Land Preservation Act section 310 permit. These permits are obtained from county conservation districts which each enforce their own rules based on a template and are required for all construction projects in a perennially flowing stream.²⁰ Devices installed on public land must obtain a Stream Protection Act section 124 permit. This is similar to the 310 permit but must be submitted by a government agency to Montana Fish, Wildlife, and Parks.²² Both permits must also be reviewed by an agency fish biologist to ensure the integrity of habitat.

In 2019, a partnership of environmental groups led by the National Wildlife Foundation launched the Montana Beaver Conflict Resolution Project to work with landowners in the state to adopt beaver coexistence measures to deal with nuisance beavers.²³ The program aids with site assessment, device design, permitting and cost-share funding.

¹⁷ *Arcgis dashboards*. (n.d.). Retrieved September 22, 2025, from <https://www.arcgis.com/apps/dashboards/45d2a21c52a24c0d866459bcf39973d8>

¹⁸ *Story map journal*. (n.d.). Retrieved September 22, 2025, from <https://vtanr.maps.arcgis.com/apps/MapJournal/index.html?appid=fd3542198df3484eb23ab04b1c8b712f>

¹⁹ Ritter, T., McGree, M., Schmetterling, D., Gower, C., Boccadori, V. (2023). Beavers and Their Role in Riparian Restoration in Montana. Montana Fish, Wildlife, and Parks.

²⁰ Garber, J., (2021). 310 Permitting Basics (powerpoint). Montana Department of Natural Resources and Conservation.

²¹ Mohr, J. (2019). NATURAL STREAMBED AND LAND PRESERVATION ACT OF 1975. Montana Legislative Services Division

²² Montana Department of Natural Resources and Conservation (2020). Montana Stream Permitting: A Guide for Conservation District Supervisors and Others.

²³ Chott, E. (n.d.). Montana Beaver Conflict Resolution Project. National Wildlife Federation. Available From: <https://www.nwf.org/en/Northern-Rockies-and-Pacific-Region/Conservation/Beavers2/MT-conflict-resolution>

As of 2024, the project was able to complete 37 tree wrappings (to prevent beaver damage to trees), 34 exclusion fences (to protect culverts), 14 pond levelers, and 2 fence and pipe devices.²⁴ The project found success in adoption through word of mouth between satisfied landowners, showing that the devices were working in a demonstrable way to begin changing attitudes. The Montana Department of Transportation was specifically cited as appreciating that coexistence devices offer a longer term solution to blocked culverts than repeatedly needing to remove blockages.²⁵

- **Oregon**

Oregon is currently at the forefront of passing laws related to LTPBR and beaver restoration more specifically, with multiple pending bills to strengthen protections and establish grant programs towards restoration. A coalition of conservation groups have put out a report for Oregon Department of Fish and Wildlife (ODFW) exploring potential permits that may be necessary for coexistence projects.²⁶ A 2024 update to the rules for general authorizations permits

from the Oregon Department of State Lands (ODSL) added language specifically including beaver coexistence devices thus exempting most projects from requiring a state fill/dredge permit.²⁷

Additionally, ODFW maintains up to date guidance on obtaining fish passage approval for coexistence device installation.²⁸ The



Photo Credit: Skip Lisle, Beaver Deceivers, LLC

²⁴ National Wildlife Federation. (2024). *Montana Beaver Conflict Resolution Project: Impact report 2019–2024*. <https://www.nwf.org/-/media/PDFs/Regional/Northern-Rockies/MT-Beaver-Conflict-Resolution-Project-Impact-Report-2019-2024.pdf>

²⁵ [Beaver Conflict Resolution | U.S. Fish & Wildlife Service](#)

²⁶ U.S. Fish and Wildlife Service. (n.d.). *Beaver conflict resolution*. Retrieved September 22, 2025, from <https://www.fws.gov/project/beaver-conflict-resolution>.

²⁷ Oregon Department of State Lands. (n.d.). *Summary of substantive changes to administrative rules for general authorizations (OAR 141-089)*. Retrieved from https://www.oregon.gov/dsl/LawsRulesDocuments/Div89_Summary_of_Changes.pdf.

²⁸ Oregon Department of Fish and Wildlife. (n.d.). *Beaver flow device ODFW fish passage policy bulletin*. <https://dfw.state.or.us/fish/passage/docs/Beaver%20Flow%20Device%20ODFW%20Fish%20Passage%20Policy%20Bulletin.pdf>

agency will check for the presence of native migratory fish and if present, work with landowners on project design to ensure fish passage.

Recommendations

The adoption and use of coexistence devices to cope with nuisance beaver provide easy cost savings to both public and private lands compared to traditional reactive methods of trap/kill, dam removal, and infrastructure repair. Drawing from the above examples, developing a community of practice around beaver coexistence is necessary for the techniques to gain wider recognition and traction. This could be in the form of organizational coalitions like in Montana or better yet, encouraged directly by state wildlife agencies. Vermont's state program with site assessments to provide landowners with possible solutions and technical advice is a good model towards changing norms by adding an official dimension to the process. Clear permitting language as seen in Oregon and New Hampshire will also help to illuminate a pathway towards coexistence and remove hurdles.



*Photo Credit: Skip Lisle,
Beaver Deceivers, LLC*

A stronger state program could include a monitoring component and adaptive management assistance when needed. The Vermont example specifically cited lack of maintenance as the leading factor in why coexistence devices fail. While regular in-person device check-ins are likely not feasible for state program staff, a helpline or similar support network can help landowners to stay connected for minor issues. Major issues would still likely need to be addressed through direct technical assistance to ensure continued use and adoption. Landowners taking advantage of state technical assistance can also be incentivized to maintain devices by attaching an assistance fee to those who fail to meet monitoring and reporting standards.

Beaver Relocation

The repatriation of beaver to areas where they have been wiped out is a technique with decades of history behind it. One of the most famous instances was the Idaho beaver parachute drop of 1948. Though crude by today's standards, the beavers were able to colonize the backcountry forests bountiful in habitat and create colonies whose

descendants remain to this day.²⁹ The beaver drop was a lucky isolated situation, however. Multiple studies have shown that the survival rate for relocated beavers typically is under 50% with an additional percentage of the survivors leaving their new site to migrate elsewhere.^{30,31} Beaver mortality can be due to predation, lack of food, or lack of time to prepare for winter. Restoration through beaver relocation requires careful analysis of available food and habitat sources for beavers to be able to settle in and thrive. Many institutional barriers to adopting beaver relocation have been identified including the persisting idea that it is ineffective and/or dangerous. Additionally, many decision makers work off the assumption that the current range of beavers is and has always been their maximum extent.³² New research on the benefits of relocated beaver will be important in changing these perceptions and showing that landscape water storage can increase without damage to fisheries from stream temperature increases.³³

Many states currently outlaw any movement of beavers, but several states allow for varying levels of relocation:

- **Maine**

Maine is unique among states in the Northeast in allowing for beaver relocation with conditions. Live beavers can only be trapped by state certified Animal Damage Control agents with the approval of a regional wildlife biologist. Maine Department of Inland Fisheries and Wildlife provides guidelines on relocation timing, destination site water gradient and flow, and available forage and dam construction materials.³⁴ Landowners adjacent to the relocation site must also give permission for the relocation.

²⁹ *Parachuting beavers into Idaho's wilderness? Yes, it really happened.* (2015, January 14). Boise State Public Radio. <https://www.boisestatepublicradio.org/environment/2015-01-14/parachuting-beavers-into-idahos-wilderness-yes-it-really-happened>

³⁰ Petro, V., Taylor, J., Sanchez, D. (2015). Evaluating landowner-based beaver relocation as a tool to restore salmon habitat. *Global Ecology and Conservation*. 85. 10.1016/j.gecco.2015.01.001.

³¹ McKinstry, M., Anderson, S. (2002). Survival, fates, and success of transplanted Beavers, *Castor canadensis*, in Wyoming. *Canadian Field-Naturalist*. 116. 60-68. 10.5962/p.363399.

³² Baldwin, J. (2017). Institutional Obstacles to Beaver Recolonization and Potential Climate Change Adaptation in Oregon, USA. *Yearbook of the Association of Pacific Coast Geographers*, 79, 93–114. <http://www.jstor.org/stable/26385010>

³³ Dittbrenner, B. J., Schilling, J. W., Torgersen, C. E., & Lawler, J. J. (2022). Relocated beaver can increase water storage and decrease stream temperature in headwater streams. *Ecosphere*, 13(7), e4168. <https://doi.org/10.1002/ecs2.4168>

³⁴ *Beavers: How to avoid or resolve a wildlife conflict: Living with wildlife: Wildlife: Fish & wildlife: Maine dept of inland fisheries and wildlife.* (n.d.). Retrieved September 22, 2025, from <https://www.maine.gov/ifw/fish-wildlife/wildlife/living-with-wildlife/avoid-resolve-conflict/beavers.html#:~:text=See%20%22Trapping%20Wildlife%22%20for%20additional,and%20commercial%20scents%20and%20lures>

Extermination is still more common than live trapping in Maine, but efforts are underway to teach the public about the option of relocation with a certified agent.³⁵

The National Park Service also has a history of beaver relocations from Acadia National Park. After being extirpated from park lands as a result of the fur trade, beaver were reintroduced in 1922. In subsequent years, to manage flooding in the park, park staff have implemented relocations from Acadia to other Maine forest lands.³⁶

- **Colorado**

Colorado Parks and Wildlife (CPW) has current regulatory authority over all beaver translocations, requiring practitioners to seek a permit before implementing a move. CPW is currently in the process of developing a state Beaver Conservation and Management Strategy to develop more formal guidance for relocations and to standardize the permitting process statewide.³⁷



Conservation organizations have been piloting relocation projects in partnership with federal land managers, such as an ongoing example in the Rio Grande National Forest.³⁸ Relocations have seen some success in establishing new colonies and restoring headwater streams. Other projects

have sought to analyze federal landscapes for beaver habitat suitability for future relocations.³⁹ Activists and wildlife organizations in Colorado's front range have also

³⁵ *Beaver relocated after causing damage to local waterfront.* (2024, November 20). Lewiston Sun Journal. <https://www.sunjournal.com/2024/11/20/beaver-relocated-after-causing-damage-to-local-waterfront/>

³⁶ Harbor, M. A. P. B. 177 B., & Us, M. 04609 P. 207 288-3338 C. (n.d.). *Beaver—Acadia national park*(U. S. National park service). Retrieved September 22, 2025, from <https://www.nps.gov/acad/learn/nature/beaver.htm>

³⁷ Colorado Parks and Wildlife. *Presentation.* (2025). CPW Beaver Conservation and Management Strategy: Scoping Presentation

³⁸ (2020). *Rio grande headwaters restoration project.* Rio Grande Headwaters Restoration Project. Retrieved September 22, 2025, from <https://riograndeheadwaters.org/wet-meadows-restoration>

³⁹ Beardsley, M., Doran, J., & Meyer, K. (2015). *Beaver Restoration on Thirtynine Mile Mountain: An experiment in restoring wetland and watershed functions on headwaters streams in the Upper South Platte.* EcoMetrics, LLC, and Pike National Forest, South Park Ranger District.

worked for decades to effect the relocation of nuisance beaver in the state and advocate for non-lethal control methods. It is estimated that thousands of beaver have been successfully relocated from areas of high development to open habitat in more remote areas of the state.⁴⁰

- **Oregon**

The Oregon Department of Fish and Wildlife (ODFW) released detailed requirements for beaver relocation in 2017. All permits must be submitted through ODFW and applicants wishing to relocate beaver are encouraged to work with their local watershed council or other local environmental organization



to expedite the process and ensure best practices are followed regarding capture, transport, and site preparation. If a beaver relocation application is approved, the applicant must then submit reports on beaver capture and handle, 30-day post-release monitoring, and a final monitoring report conducted the fall following the release.⁴¹ Requirements and recommendations are attached to each step of the process covering safe handling, prevention of disease, buy-in from nearby landowners, and checking for suitable habitat.

Active relocation projects are being carried out by environmental organizations and new legislation (HB3143)⁴² is working its way through the legislature that would create a fund for landowners to manage nuisance beavers non-lethally through relocation or coexistence.⁴³

⁴⁰ Home. (n.d.). WildLife2000. Retrieved September 22, 2025, from <https://sherritippie.com/>

⁴¹ Oregon Department of Fish and Wildlife. (2012). *Guidelines for relocation of beaver in Oregon*.

⁴² *Hb3143 2025 regular session—Oregon legislative information system*. (n.d.). Retrieved September 22, 2025, from <https://olis.oregonlegislature.gov/liz/2025R1/Measures/Overview/HB3143>

⁴³ *Beavers reintroduced to southwest Oregon to restore wetlands*. (n.d.). Opb. Retrieved September 22, 2025, from <https://www.opb.org/article/2025/03/23/beavers-return-vesper-meadow/>

- **Washington**

Washington state enacted legislation to create a permanent beaver relocation regulatory program in 2024 (WAC 220.450.230).⁴⁴ It was the culmination of over a decade of legislative momentum beginning in 2012 with the initial legalization of beaver relocation (RCW 77.32.585) and the establishment of a more comprehensive pilot program in 2019. The program works by permitting individuals as beaver relocators who are required to complete a comprehensive 3-day training every three years and must have access to a beaver husbandry facility for safe care during transportation. Permitted beaver relocators must then follow capture, housing, and release requirements for each translocation. They must also have approved relocation plans and monitor release sites after 30 days, the following fall, and the subsequent spring.^{45,46}

During the pilot phase from 2019 to 2022, Washington Department of Fish and Wildlife (WDFW) issued 33 permits to relocate 68 beavers.⁴⁷ Monitoring associated with the permitting process found beaver signs in 60% of release sites after one month. WDFW struggled to get long term monitoring data with only 42% of projects reporting a site visit after the initial one-month monitoring (non-compliance with monitoring requirements can lead to rescinding of permits though there is no data for this enforcement)⁴⁸. GIS analyses of sites show an average 11% increase in surface water area at release sites, suggesting a relationship between relocation and stream restoration, but individual beavers are not tracked by the program.

Recommendations

Beaver relocation can be an effective restoration tool, but strong state regulations and guidelines need to be established for the safety and well-being of beavers. Permitting programs should have a strong focus on suitable habitat in the destination site, as seen in the Oregon program and in Colorado restoration projects. This may mean that years of vegetation planting and/or the use of other LTPBR techniques may be required prior to a

⁴⁴ *Chapter 220-450 WAC*: (n.d.). Retrieved September 22, 2025, from <https://app.leg.wa.gov/WAC/default.aspx?cite=220-450&full=true#220-450-230>

⁴⁵ *Beaver relocation in washington | washington department of fish & wildlife*. (n.d.). Retrieved September 22, 2025, from <https://wdfw.wa.gov/species-habitats/living/nuisance-wildlife/beaver-relocation>

⁴⁶ *Chapter 220-450 WAC*: (n.d.). Retrieved September 22, 2025, from <https://app.leg.wa.gov/WAC/default.aspx?cite=220-450&full=true#220-450-230>

⁴⁷ Washington Department of Fish and Wildlife. (2023). Beaver Relocation Permit Program Status Update: 2019-2022.

⁴⁸ *Beaver Relocation Permits - CR-102 - PublicInput*. (n.d.). [https://publicinput.com/beaver#:~:text=\(19\)%20The%20permittee%20is%20responsible,without%20supervision%20by%20the%20permittee.](https://publicinput.com/beaver#:~:text=(19)%20The%20permittee%20is%20responsible,without%20supervision%20by%20the%20permittee.)

relocation to ensure the best chance of success. Guidelines in the above examples relating to relocation timings, safe handling, and moving family units rather than individuals should also be adopted by any new relocation framework.⁴⁹ Tools such as the Beaver Restoration Assessment Tool can factor in data from national datasets to make predictions on a site's suitability.⁵⁰ Monitoring requirements, to the extent feasible, should be attached to relocation permits to gather data on program efficacy by studying survival rates for future improvement.

In states like Maine, where restoration is not likely to be the goal of relocation, coexistence strategies would make more sense from a sustainability and practicality perspective as a non-lethal nuisance beaver solution. Beaver management programs in these states should adopt a flow chart of preferred methods starting at coexistence, moving to relocation, and finally trapping and killing if other options are not feasible. Any relocations will also need to follow the above recommended guidelines, paying extra attention to surrounding landowners and a stream's carrying capacity for beavers where beavers are already established and endemic.

Beaver Mimicry

In some locations, employing beaver mimicry techniques and structures (like LTPBR techniques) is more feasible and tenable than reintroducing the animals themselves. This could be because the surrounding habitat is not suitable to support beavers or beaver relocation is illegal. Beaver-dam analogues (BDAs) and post-assisted log structures (PALS) are two of the most common types of in-stream interventions. Both involve driving wooden posts into the stream bed as a structural anchor. PALS use these posts to hold woody debris in place to simulate natural logjams while BDAs involve intensively weaving branches, mud, sod, and other natural materials to simulate a beaver dam.⁵¹



Photo Credit: Ian Grosfelt, NAWM

⁴⁹ Left Hand Watershed Center. (n.d.). Landowner Guide to Beavers. Available From: https://watershed.center/wp-content/uploads/2023/11/DRAFT_Beaver_FactSheet_FORREVIEW.pdf

⁵⁰ *Brat*. (n.d.). Retrieved September 22, 2025, from <https://brat.riverscapes.net/>

⁵¹ Diamond, A. (2023, September 1). *Building beaver dam analogs to restore watersheds | autumn 2023 | articles | features*. <https://northernwoodlands.org/articles/article/beaver-dam-analogs>

As in stream structures that affect streamflow, beaver mimicry often requires federal, state, or local permits depending on jurisdiction. Most beaver mimicry activities taking place in a Water of the United States (WOTUS) will need approval for a US Army Corps of Engineers (USACE) Nationwide Permit 27 for aquatic habitat restoration, establishment, and enhancement activities.⁵² At the state and local level, the permitting landscape resembles a mosaic, with several states specifically including beaver mimicry language in their regulations but most remaining uncertain or ambiguous. Barriers to adopting regulations include trepidation from downstream landowners, and concerns of water rights and availability.⁵³ As this restoration technique become more widely adopted and its benefits more measured, other states may opt to adopt regulatory frameworks in the footsteps of the following state and Tribal examples.

- **Pennsylvania**

Beaver mimicry in the eastern United States is much less common than in the west, where climate and geography have driven stream incision and degradation to a much greater extent. However, Pennsylvania's Susquehanna University piloted the use of BDAs in 2023 to slow down water and mitigate heavy erosion in an intermittent stream bed caused by heavy rain events with contributing runoff from nearby impervious surfaces.⁵⁴ University project staff and students worked with the Pennsylvania Department of Environmental Protection (PDEP) and the Pennsylvania Fish and Boat Commission (PFBC) to determine how such a project could be permitted under state regulations. PFBC conducted a site visit to confirm there would be no impact to native brook trout habitat as part of their permitting review capacity. PDEP then determined that BDAs could be exempted from needing a permit by defining it as a "dam" that falls under the threshold for permit exemption at 50 feet of width and 3 feet of height (25 Pa. Code § 105.12).⁵⁵ Eight (8) BDAs were installed for the pilot project.

⁵² Walla Walla District. (n.d.). *Nationwide permit 27: Aquatic habitat restoration, enhancement, and establishment activities*. <https://www.nww.usace.army.mil/Portals/28/docs/regulatory/NWPs/NWP27.pdf>

⁵³ Pfaeffle, T., Moore, M. A., Cravens, A. E., McEvoy, J., & Bamzai-Dodson, A. (2022). Murky waters: Divergent ways scientists, practitioners, and landowners evaluate beaver mimicry. *Ecology and Society*, 27(1). <https://doi.org/10.5751/ES-13006-270141>

⁵⁴ *Early data shows benefits of analog beaver dam effort in stream management at Susquehanna Univ.* (n.d.). Middle Susquehanna Riverkeeper. Retrieved September 22, 2025, from <http://www.middlesusquehannariverkeeper.org/1/post/2024/07/early-data-shows-benefits-of-analog-beaver-dam-effort-in-stream-management-at-susquehanna-univ.html>

⁵⁵ *25 pa. Code chapter 105. Dam safety and waterway management.* (n.d.). Retrieved September 22, 2025, from <https://www.pacodeandbulletin.gov/display/pacode?file=/secure/pacode/data/025/chapter105/chap105toc.html>



Photo Credit: Ian Grosfelt, NAWM

Two years of stream data with the BDAs in place show significant effects on hydrogeomorphology in the channel.⁵⁶ The research team measured upstream and downstream sediment deposition and inundation period following storm events. Net positive sediment deposition was measured upstream while downstream showed net negative. Upstream inundation duration was also significantly longer, suggesting the BDAs were successfully slowing the water down. Ideally, data can be used to show the efficacy of BDAs for similar intermittent streams in the northeast that experience erosion from impervious surface runoff. Regulations can then be added to clarify best practices for BDA installation and ensure protection of brook trout.⁵⁷

- **California**

The Habitat Restoration and Enhancement Act of 2014 (HREA) (Fish & G. Code §§ 1650-1657)⁵⁸ created an expedited permitting pathway for voluntary habitat restoration projects in California. To be eligible, projects must meet the state Water Resources Control Board's criteria for Clean Water Act Section 401 certification for small habitat restoration projects. This involves maintaining a small sized footprint under 5 acres or 500 total linear feet. Under this process, eligible applicants need only obtain a HREA permit with all other typical permitting requirements for streambed alterations waived.

The first project implemented under this permitting program was the Sugar Creek and Scott River Beaver Dam Analogue Project with the goal to restore migratory fish habitat.⁵⁹ The project saw success through adaptive management and monitoring for habitat and biodiversity, following principles laid out in the US Fish and Wildlife

⁵⁶ Wilson, M. Unpublished paper

⁵⁷ Interview with Matt Wilson

⁵⁸ California Fish and Game Code – FGC DIVISION 2. DEPARTMENT OF FISH AND WILDLIFE [700 - 1958] (Heading of Division 2 amended by Stats. 2015, Ch. 154, Sec. 21.) CHAPTER 6.5. Habitat Restoration and Enhancement Act [1650 - 1657]

⁵⁹ *Lower sugar creek beaver dam analogue project – accelerating restoration*. (n.d.). Retrieved September 22, 2025, from <https://acceleratingrestoration.org/projects/lower-sugar-creek-beaver-dam-analogue-project/>

Service's 2015 Beaver Restoration Guidebook.⁶⁰ This involved ongoing maintenance of the BDAs and design changes to accommodate new goals in the face of changing river and stream beds.⁶¹ A two-year monitoring report highlighted a 20 fold increase in coho salmon rearing capacity compared to pre-restoration conditions.⁶² The BDAs created ponds that were able to increase overall water volume in the system and increase attenuation towards overheating above optimal salmonid temperature ranges. Adult and juvenile salmon were able to travel over BDAs, dispelling fears of impeded fish passage. The new habitat created by the BDAs also lured beaver back to recolonize the area and several BDA structures were co-opted by the beavers for their own damming activities.

- **Oregon**

Both the Oregon Department of State Lands (ODSL) and the Oregon Department of Fish and Wildlife (ODFW) have updated their rulemaking to expedite permitting for beaver mimicry projects. In 2024, ODSL added language to include BDAs and PALS to projects eligible for general authorizations (ORS 141-089-0790)⁶³, negating the need for a state fill/dredge permit.⁶⁴ ODFW released a guidance bulletin that same year for instream habitat restoration in regard to the Oregon Fish Passage Policy (ORS 509-585). Under the new guidance, permits are not required where migratory fish are not present, structures do not span the entire stream, or posts driven into the streambed meet a threshold for horizontal space between posts.⁶⁵ Otherwise, projects are eligible for expedited approval after submission of a BDA/PALS fish passage application.

Prior to the streamlining and codification of BDA permitting in Oregon, the state was the site of early beaver mimicry restoration experimentation with the Bridge Creek project beginning in 2006. The project was a collaboration between federal, state, and local agencies to explore mitigation efforts for major dams on the Columbia River that were leading to decline in salmon populations. The project set the stage for showing the possibilities of BDAs in raising groundwater tables, expanding aquatic habitats, and

⁶⁰ Ibid.

⁶¹ Yokel, E., Witmore, S., Stapleton, B., Gilmore, C., & Pollock, M. M. (May 2023). Notice of Applicability for the Lower Sugar Creek Beaver Dam Analogue

⁶² Scott River Watershed Council. (2015). *SRWA_BDAReport_2015*. [PDF]. https://scottriver.org/wp-content/uploads/2024/04/SRWA_BDAReport_2015.pdf. You can find the PDF at scottriver.org.

⁶³ Oregon Department of State Lands, Chapter 141, Division 89, ADMINISTRATIVE RULES GOVERNING THE ISSUANCE AND ENFORCEMENT OF GENERAL AUTHORIZATIONS WITHIN WATERS OF THIS STATE

⁶⁴ Oregon Department of Fish and Wildlife. (n.d.). *Instream restoration ODFW fish passage policy bulletin*.

Retrieved from

<https://www.dfw.state.or.us/fish/passage/docs/Instream%20Restoration%20ODFW%20Fish%20Passage%20Policy%20Bulletin.pdf>.

⁶⁵ Ibid.

regulating stream temperatures through increased overall water volume.⁶⁶ Notably, interest spread organically in the stakeholder community following the pilot project with soil and water conservation districts assisting private landowners in navigating the permitting requirements.

- **Blackfeet Indian Reservation**

The Blackfeet Nation’s Ksik Stakii project is a pilot project to test, demonstrate and implement LTPBR techniques on Blackfeet Reservation land. As part of this project, a Beaver Mimicry Guidebook was released detailing best practices in planning, construction, and maintenance. The guidebook includes a section on project permitting, detailing the likely permits one will need to obtain from Federal and Blackfeet agencies. New projects are advised to first consult with the Blackfeet Tribal Historic Preservation Office (THPO) for advice on cultural requirements and best practices. Federal agencies will need a National Historic Preservation Act section 106 consult to assess and minimize any impacts to cultural areas within the Blackfeet Indian Reservation.⁶⁷ Additionally, THPO offers consultations on Traditional Ecological Knowledge (TEK) for projects rooted in agriculture, fisheries, habitat and wildlife management. Projects that receive cultural approval and USACE approval will then need to obtain a permit through the Blackfeet Tribe Aquatic Lands Protection Ordinance No. 117.⁶⁸ This applies to any activity affecting streams, wetlands and waterways of the reservation to ensure the conservation of water resources. Application forms are reviewed along with project descriptions, sketches/blueprints, and adjacent landowner permissions.⁶⁹



Photo Credit: Ian Grosfelt, NAWM

The Ksik Stakii project also implements the best practices described in its guidance, with several demonstration structures to show the efficacy of BDAs. A two week field

⁶⁶ Pollock, M. M., Jordan, C. E., & Beechie, T. J. (2010). *Working with beaver to restore salmon habitat in the Bridge Creek Intensively Monitored Watershed* (PNW-RP-612). U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. https://www.fs.usda.gov/pnw/pubs/pnw_rp612.pdf

⁶⁷ *Blackfeet-THPO | amánissin*. (n.d.). Retrieved September 22, 2025, from <https://www.blackfeet-thpo.com/>

⁶⁸ Blackfeet Environmental Office. (2019). *Aquatic Lands Protection Ordinance No. 117*. [http://www.blackfeetenvironmental.com/ordinance117/ORDINANCE_117_FINAL_VERSION_\(3-21-2019\).pdf](http://www.blackfeetenvironmental.com/ordinance117/ORDINANCE_117_FINAL_VERSION_(3-21-2019).pdf)

⁶⁹ Blackfeet Environmental Office. (n.d.). *Aquatic Lands Protection Ordinance No. 117 application form*. Retrieved from http://www.blackfeetenvironmental.com/ordinance117/ordinance117_application_form.pdf

workshop for youth and community organizations intensively trained participants in analyzing streams, designing mimicry solutions to restoration needs, and respecting the natural and cultural heritage of beaver on the land.⁷⁰

Recommendations

Beaver mimicry techniques can provide significant benefits to degraded streams with minimal environmental impact and should be afforded a streamlined regulatory pathway to reflect this. California and Oregon provide good state models of how to expedite the permitting process while also providing simple guidelines for installation to ensure long-term project success. Other western states should follow suit to spur the rate of beaver mimicry implementation. Eastern states like Pennsylvania should adopt similar regulatory models modified to protect intermittent streambeds fed by stormwater.

It is also important to recognize that beaver mimicry, as well as all beaver related restoration, is rooted in traditional ecological knowledge. Programs by the Blackfeet Indian Reservation to bring communities together to implement LTPBR projects and tie them to a broader natural heritage will help to build a community of practice around these techniques and encourage their broader adoption. Just as programs exist to help train and assist with coexistence device installation, states and Tribes should organize similar resources for beaver mimicry.

Conclusion

LTPBR techniques are still in their relative infancy in the environmental world but are continuing to be studied to understand both efficacy and benefit to cost ratio. But as a 2025 study of trends pointed out, “beyond environmental factors... streams are social-ecological systems, meaning that the use and outcomes of LTPBR are additionally dependent on multiple social dimensions.”⁷¹ For more widespread adoption, attitudes will first have to follow the science, and reexamine long-held notions of beaver as a nuisance instead of a vital ecological keystone. Policy will need to evolve in more locations to allow beaver to return to their work. The examples listed in the above case studies are leading the way in recognizing and facilitating LTPBR techniques to restore degraded riverscapes. They

⁷⁰ Blackfeet Challenge Project. (2018). Final 2018 Ksik Stakii Project Field Program report. <https://bcapwebsite.wordpress.com/wp-content/uploads/2018/09/final-2018-ksik-stakii-project-field-program-report.pdf>

⁷¹ Scamardo, J., Munger, W., Loria, K., Nauman, B., Wang, J., Leopold, S., Heggli, A., Huntly, N., Baker, M., & Meadow, A. M. (2025). Trends in the outcomes, practice, and law of low-tech process-based restoration in western rangelands. *Rangeland Ecology & Management*, 98, 344–356. <https://doi.org/10.1016/j.rama.2024.08.032>

illustrate the following principles that should be incorporated into developing new regulatory frameworks and programs:

1. Permitting requirements should be clear and provide an expedited pathway.

Whether by statute or by agency rulemaking, specificity in including LTPBR techniques removes them from any legal gray areas and allows for more reliable project planning. As these techniques do not usually cause large environmental



disturbances, they should be put on streamlined permitting tracks that reflect their minimal impact and encourage their use in restoration.

2. Permit processes should include best practice guidelines backed by current scientific standards.

Though minimal in their potential for environmental disturbance, LTPBR techniques still require rigorous planning, monitoring, and adaptive management for project success. LTPBR projects are long-term investments in restoration and guidelines to ensure proper planning and implementation will ensure the safety of beavers, positive relations with landowners, and acceptance of techniques.

3. Programs should build a community of practice through technical assistance.

Because LTPBR techniques are relatively unknown, landowners and communities need to be introduced to them and shown their efficacy. State and Tribal agencies can play a role in helping to spread and legitimize these techniques through open workshops, site visits and consultations, and partnerships with other community organizations.

4. When feasible, resources and requirements for monitoring and upkeep should be provided.

LTPBR techniques are designed to be long-term restoration solutions and require long-term upkeep. After communities and landowners are engaged in the initial adoption and installation process, the relationship should continue for the life of the device, structure, or relocation. Regular communication, call-in resources, or in-person maintenance assistance for implementers is crucial to ensure that projects are not neglected or abandoned. Permits should include clear monitoring requirements attached to fees or penalties (either monetary or loss of licensure) for failure to meet these requirements.



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