Introduction to Non-Lethal Beaver Management

for Culverts and other Surface Water Facilities

This site will introduce you to some of the issues surrounding beavers in human-managed landscapes, non-lethal management methods, and will describe with photographs the installation of a "beaver deceiver" at Peterson Pond in King County, Washington.

Please note that all necessary permits must be obtained prior to starting construction on a "beaver deceiver". For example, the construction at Peterson Pond required permits from King County and the Washington State Department of Fish and Wildlife.

Beaver Management Issues

Beavers were nearly extinct in North America by the late 1800s as a result of the demand for furs. Now that the fur trade has declined beavers are beginning to increase their numbers again. Historically, beaver have been found in every watershed in the country; as their numbers increase and they reclaim their former range, potential conflicts between people and beavers will also increase.

Beavers maintain wetland systems in the landscape. Their activities may change watercourses, raise watertables, and create new habitats for plants, fish, and other wildlife. There are impressive examples in arid climates of streams returned to year round flows with the addition of beavers back into the system. In the Pacific Northwest, beaver ponds are critical for slowing stormwater runoff, trapping sediments, and maintaining summer base flows among other ecological benefits. Recent studies indicate that coho that are reared in beaver ponds find more food, refuge from floods and predators, and may be twice the size of juveniles that are not reared in beaver ponds. To date, artificial structures and "restored" wetlands do not provide comparable levels of ecological functions as wetlands created and maintained by beavers. In addition, beavers maintain wetlands at a significantly lower cost than humans have been able to achieve.

In human-managed landscapes beavers can create several problems. The most common problem is plugging road culverts which causes the water to rise on one side of the road, flooding the road and

potentially undermining the road bed. Culverts are easy to plug and difficult to unplug resulting in continuous and expensive road maintenance costs. The rising waters behind a beaver dam or a plugged culvert also results in land being flooded. Depending on the topography and the surrounding land uses, this problem may become quite serious. Finally, beavers are frequently implicated in the loss of trees around the edges of their ponds. In some cases, these trees may be special landscape trees or valuable orchard trees.

Historically, the most common response to beaver conflicts has been trapping and removal. Trapping can be quite expensive and is never a one-time solution to the problem. Even if an entire beaver family is removed from a site, new beavers are constantly dispersing across the landscape looking for suitable homes. If a place was suitable for one family of beavers, more will quickly move in to replace those removed by a trapping campaign. In addition, if beavers are removed from a system, the wetland area will likely degrade and the ecological functions of the area will decline. Fortunately, more permanent solutions are quite simple.

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Non-Lethal Control Methods

Fencing

Beavers fell trees for food and for materials to create dams and lodges. They typically only fell trees within 200' of the shoreline and usually much closer since they are very vulnerable to predators when on land. Therefore, problems with beavers cutting trees are easily and permanently solved by wrapping important trees with chicken wire or hardware cloth within the riparian zone. Beavers do not climb well so the fencing only needs to be 3 to 4 feet high. Do not wrap trees very tightly as they need room to grow.

To protect larger areas or newly replanted restoration areas, erect a temporary fence of chicken wire or a similar fencing material. Again the fence only needs to be about 3 to 4 feet high, but it should be securely staked to the ground to prevent the beavers from crawling under it or pushing it over. Once plants at a restoration site have established themselves, they should be able to withstand some beaver activity. Typical shoreline tree species such as willows thrive with beaver cuttings resulting in denser growth patterns that benefit a variety of nesting songbirds.

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The Beaver Deceiver

Flooding and damming problems can be countered effectively with well-designed, well-made flow control devices. Skip Lisle, wildlife biologist with the Penobscot Nation in Maine, has devised the "beaver deceiver" flow control device that is shown in the Peterson Pond installation. He has also installed devices of his design at 18 culvert sites on the 130,000 acre Penobscot Nation lands. Beaver-related road maintenance costs had previously been a major cost as most of the land is forested and supports a large population of beaver. For the past 6 years, after installation, road maintenance costs in the Penobscot Nation due to beaver conflicts have been virtually non-existent. Beaver colonies continue to thrive near the devices and to maintain the

wetlands and associated ecological benefits at no additional cost.

Damming behavior in beavers is stimulated by the sound and feel of flowing water. System modifications that reduce the noise of running water through a culvert or by the installation of a receiver fence that physically moves the beavers back to a point where water movement is not significant serve to reduce their damming behavior. Modifications to culverts to improve fish passage such as eliminating the "fall" at the downstream end or reducing the slope of the culvert will reduce water noise and hence reduce conflicts with beaver. Both the receiver fence and the round fence act as "filters" by diffusing the incoming water over a large area to prevent the beavers from determining where the water is leaving the system and it prevents them from plugging up the pipe or culvert.

The Peterson Pond installation is composed of three components, a receiver fence, a pipe, and a round fence. The receiver fence serves to exclude the beaver from the outlet of the pond. In many situations all that might be required would be a receiver fence to exclude the beavers from a culvert opening. Where a receiver fence must be smaller than desired because of site characteristics, then a pipe and round fence might be added. The pipe extends upstream from the receiver fence and then the upstream end of the pipe is protected by a round fence.

On August 15 and 16, 2001, the Humane Society of the United States and the King County Wildlife Program sponsored workshops on non-lethal beaver control measures. Over 120 people attended the two workshops, representing many agencies throughout the Puget Sound Region. Workshop presenters included Dr. John Hadidian, HSUS; Dr. Dietland Muller-Schwarze, SUNY Syracuse; Dr. Donald Hey, The Wetlands Initiative; Mr. Skip Lisle, Penobscot Nation; and Dr. Kate Stenberg, King County Wildlife Program. Contact information for the presenters is given in the acknowledgments section. The workshop also included a demonstration portion. The following photo story of the Peterson Pond installation is presented as a visual aid to remind workshop participants of the construction sequence of the various components that were demonstrated. We hope that this information will be helpful to other web users as well.

Before attempting installation of any devices in streams and wetlands, please be sure to get all the proper permit approvals. In Washington, a Hydraulic Permit Approval is required from the Washington Department of Fish and Wildlife and there may be local county or city permits required as well. In the Puget Sound region, additional federal permits may also be required if the proposed work is located on larger stream systems in watersheds where chinook may be present.

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Beaver Biology

Beavers are the largest member of the rodent family in North America and are found from sea level to elevations of 12,000 feet. Beavers are semi-aquatic animals spending much of their lives in ponds, rivers, streams and adjacent woodlands. They have webbed hind feet, small ears, a broad, flat tail and can weigh up to 60 pounds. They den in the banks of streams and rivers or build lodges made up of branches and logs plastered together by mud. Beavers also form dams out of branches, logs and mud to create deep water ponds. These ponds not only create safe areas for the beavers but the diverse wetland systems created support a wide variety of fish, amphibians, birds and mammals. Beavers eat the bark, leaves and twigs of many tree species as well as herbaceous aquatic plants such as lily pads, skunk cabbage, grasses and sedges. Beavers feed close to water where they are safer from predators, therefore feeding activity is restricted to a relatively narrow riparian strip where important trees can be easily protected by fencing.

Building a Beaver Deceiver

About Peterson Pond

Peterson Pond, looking upstream from the outlet. (Click on photo for full screen version)

Peterson Pond, also known as Swan Lake, is located east of the City of Redmond near the intersection of Union Hill Road and 238th Ave NE. The pond is approximately nine acres in size, and is located at the headwaters of Evans Creek, part of the Lake Washington watershed. The drainage basin for Peterson Pond is about 800 acres in size, with two main tributaries to the pond. Prior to construction of the existing facility in about 1988, the outlet to the pond consisted of an uncompacted earthen dike with two box culverts. The dike and culverts had been in place since the early 1900s. The current facility consists of an outlet control structure and fish ladder, and the dam has been replaced.

Resident trout and other fish currently inhabit the pond, which also provides habitat for waterfowl, amphibians, and, of course, beavers. A large beaver lodge is located along the shore. Past studies have documented salmon spawning downstream of the outlet. A recent culvert replacement at a nearby road crossing removed a barrier to fish passage and it is hoped that salmon will start using the pond. Fish habitat in the area has been documented as moderate to high quality.

Peterson Pond is owned by the Swan Lake Estates Homeowners Association. There is no public access to the pond or fish ladder facility.

Next: Description of the Facility

Building a Beaver Deceiver

Description of the Stormwater Control Facility

Peterson Pond

The culverts in the original dike had become blocked by debris over the years, causing the dike to overtop and erode. Because significant property damage could occur if the dam failed, King County staff decided to replace the dike with a new structure, including replacing the earth dam and constructing an outlet control structure and fish ladder. The facility is maintained by King County Stormwater Services as a regional stormwater facility.

The control structure is a concrete channel and contains a weir and shear gate to control the outflow. The fish ladder was provided due to the documented presence of salmon downstream of the pond outlet. Also, a submerged bypass pipe extends into the pond and drains to the control structure. This pipe was intended to maintain the flow in case the main outlet became blocked.

Outflow from the pond normally stops in late summer, beginning again after the rains begin in the fall.

Next Page: Beaver Conflicts

Building a Beaver Deceiver

Beaver Conflicts

The trash rack protecting the outlet control structure is being dammed by beavers.

(Click on photo for full screen version)

Additional beaver activity at the facility.

(Click on photo for full screen version)

Since construction of the facility, the trash rack protecting the outlet control structure has been dammed repeatedly by beavers. Maintenance crews had not been able to keep the outlet clear. The submerged bypass pipe had also become plugged. This blocked any possible fish passage and caused water to back up in the pond to close to the point of overflow. King County received notification from the Washington State Department of Fish and Wildlife (WSFWS) and the Department of Ecology Dam Safety Office that the beaver dam needed to be removed.

The upstream end of the fish ladder/outlet control structure.

(Click on photo for full screen version)

Beaver dam at the trash rack showing woody debris and mud.

(Click on photo for full screen version)

While the Peterson Pond beavers had demonstrated their ongoing commitment to damming the pond outlet, the local residents strenuously objected to any removal or relocation of the beavers. In September 2000, the beaver dam was removed, and the submerged pipe was cleaned so as to function properly. Maintenance crews were instructed to monitor and remove any debris while Stormwater Services staff determined a long term solution that met the concerns of the Swan Lake Estates residents, Washington State agency staff, and also King County stormwater facility maintenance requirements. By Spring 2001, the persistent beavers were winning the battle and the outlet was again completely blocked.

During this time, the King County Wildlife Program was working with the Humane Society of the United States (HSUS) and Mr. Skip Lisle to sponsor the "Solving Conflicts with Beaver" workshop to be held in King County. Stormwater Services staff approached Dr. John Hadidian from HSUS and Mr. Lisle about the possibility of constructing a "beaver deceiver" facility at Peterson Pond. Mr. Lisle and Dr. Hadidian both agreed with enthusiasm that the "beaver deceiver" concept that Mr. Lisle had developed was appropriate for the Peterson Pond site.

Permits required for the project included a Hydraulic Project Approval (HPA) from the WSFWS and a Clearing and Grading permit from the King County Department of Development and Environmental Services. The residents of Swan Lake Estates were also notified and supported the project.

The "beaver deceiver" was constructed on August 10th, 2001. The following photos and text show the construction sequence in chronological order. Outflow from the pond ceased shortly after construction so that the beavers are less attracted to the outlet, therefore it will not be possible to determine the success of the beaver deceiver until flows resume in the next several weeks.

Building a Beaver Deceiver

Construction Sequence

The beaver dam, woody debris and mud are removed from the trash rack before installing the beaver deceiver.

(Click on photo for full screen version)

The dam was removed a couple of days prior to the scheduled installation day to allow the water level in the pond to drop to normal levels. Since the water depth at Peterson Pond is relatively deep for this type of device, decreasing the water level helped with the installation. However, the pond was not drained, and some work was done from small boats. The round fence at the upstream end of the device was placed in about 10 feet of water.

Construction day: unloading materials

(Click on photo for full screen version)

See the Tools and Materials list

Next: Installing the Receiver Fence

Building a Beaver Deceiver

Installing the Receiver Fence

Installing Corner Posts

Cutting points on the corner posts makes it easier to pound them into the substrate.

(Click on photos for full screen version)

Sharpened corner posts at the water's edge.

(Click on photos for full screen version)

Installing the first post and adding bracing.

(Click on photos for full screen version)

Using stringers to determine where the rest of the corner posts should go.

(Click on photos for full screen version)

Using a step ladder to pound the corner posts into the substrate with a sledge hammer.

(Click on photos for full screen version)

The receiver fence is installed at the mouth of the fish ladder (or a culvert mouth in a more typical situation). The first two posts are located on either side of the top of the outlet and are as close to the opening as possible. In this situation we installed them right at the ends of the metal railing that defined the edges of the trash rack at the entrance of the fish ladder/outlet control structure.

The other corner posts should be placed with the site specific characteristics in mind. The area defined by the receiver fence may be any size - but the larger the better, and it may be any shape, though Skip has found that shapes that flare out from the outlet in a trapezoidal manner are most effective. At Peterson Pond, space was not limiting though bottom depth was beginning to be, so the simplest shape was one that had four corners, flared out from the edge of the trash rack and which had sides and an upstream end each equal to half of a length of fencing material. This shape simply minimized the amount of cutting needed to fit the fencing to the posts while still maximizing the optimal trapezoidal shape.

An additional consideration is the height of the fence. The fence should extend above the high water line at least 2 feet to prevent beavers from clambering over with branches. You will need to know the water depth. The fencing material is 7.5 feet wide and in most applications this will be sufficient to reach the bottom and still extend above the high water line by about 2 feet. Typically the limiting factor will be the depth of water in which one can still work using manual labor and hand tools. The size of the receiver fence at Peterson Pond was based on the ability to construct the fence using chest waders.

Post ends are sharpened with a chainsaw to make installation easier. Sharpened posts can be driven into most substrates with a sledge hammer. Posts are braced with 2 X 4's or 2 X 6's. The bracing boards should be sliced at an angle to create sharp points on the ends. The sharp points again are driven into the substrate and the upper ends are nailed into the corner posts.

Installing the Footing

Cutting and bending the fencing material to create a footing.

(Click on photos for full screen version)

Footing is ready for installation.

(Click on photos for full screen version)

Installing the footing.

(Click on photos for full screen version)

A footing is required along all of the outside edges at the bottom of the receiver fence to prevent beavers from easily digging under the vertical fence and reaching the outlet with branches and debris. A footing is easily created by cutting off a five "square" wide section of the fencing material. Cut the wire between the short lengths to create a three "square" wide fence with "prongs" on each side running the whole length of the footing. Bend these "prongs" so that they are at right angles to the main body of the fence. Bend the prongs on each side in the same direction. These prongs will be placed down when the footer is installed to hold the footing in the place in the substrate along the bottom of the fenceline. When the footing is in place, step or jump firmly on the footing to seat the prongs well into the substrate along the entire length. If the substrate is very hard, you can enclose the bottom of the receiver fence area instead, to prevent the beavers from getting inside the receiver fence.

Attaching the Stringers and Side Fencing

Attaching the stringers to the side posts.

(Click on photos for full screen version)

Cutting the fencing to match the contours of the pond bottom.

(Click on photos for full screen version)

Attaching the fencing to the sides of the receiver fence.

(Click on photos for full screen version)

"Prongs" on the bottom of the fencing to seat into the substrate.

(Click on photos for full screen version)

Fence is attached to the corner posts and the bottom of the stringers with staples.

(Click on photos for full screen version)

Last section being lowered into place. Note the hole cut out for the pipe to extend through.

(Click on photos for full screen version)

Attach the stringers to the corner posts at a height that will both allow the fence to reach the bottom of the pond securely as well as extend at least 2 feet above the high water mark. The top of the fencing will be secured to the bottom of the stringers with staples, so include this consideration when deciding the placement of the stringers.

Cut the fencing to roughly match the contours of the bottom. Crosswise wires are cut out close to the bottom to create "prongs" that can be pushed down into the substrate to further secure the bottom edge of the receiver fence.

Since it was not practical to reduce the noise generated by the control structure/fish ladder and the size of the receiver fence was limited by the water depth, it was determined that the beaver might attempt to dam around the receiver fence. A hole was cut in the upstream section of fence to allow a pipe to extend into the pond. If the receiver fence does become blocked over time, the flow will be maintained through this pipe. A round fence will protect the upstream end of this pipe from beaver activity.

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For questions about information on this page, please contact Kate O'Laughlin, Environmental Scientist

For questions about the Water and Land Resources Web Site, please contact Fred Bentler, webmaster.

Heron banner photo by Bill Priest.

Related Information

King County Capital Projects and Open Space Acquisition

Stormwater Services Section

Sammamish Watershed page

Department of Natural Resources and Parks
Water and Land Resources Division

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Building a Beaver Deceiver

Installing the Pipe and Round Fence

Cutting holes in the pipe

(Click on photos for full screen version)

The pipe is prepared by cutting holes to allow trapped air to escape and the pipe to sink. These holes need to be large enough so that air is not trapped by surface tension across the hole. Since the upstream end of the pipe will be protected by a filter or round fence and the downstream end is protected by the receiver fence, there should be no concerns about the beavers detecting water movements through these holes. In a double walled polyethylene pipe, holes should be cut on the top and the bottom to allow the pipe to completely fill with water. In some cases it may be necessary to anchor the pipe in the middle to keep it from floating.

Rolling up fencing for the round fence.

(Click on photos for full screen version)

Bending the prongs to close the round fence.

(Click on photos for full screen version)

Creating a top and bottom for the round fence.

(Click on photos for full screen version)

Cut a length of fence in half lengthwise to create a piece approximately 20 feet X 3.5 feet. Cut the crosswise wires at one end to create prongs. Roll up each end to start the bend in the fencing material. Wrap the two ends together and bend the prongs to secure the ends together to create a circle. Lay another section of fencing on top and trim to fit the circular shape and to create prongs. Bend the prongs around the sides of the fence to secure the top. Turn the round fence over and repeat to create a secure bottom. In very shallow water where the round fence would extend at least 2 feet above the high water mark, it may not be necessary to add a secure top, however, the top and bottom add strength to the structure as well as securing the pipe opening from beavers.

Insert the pipe into the round fence filter.

(Click on photos for full screen version)

Drill a hole on either side of the pipe. Insert the pipe into a hole cut into the side of the round fence. Thread a ¼ inch steel rod through the fence grid and through the holes in the sides of the pipe to secure it to the fencing. This steel rod will prevent the pipe from twisting or pulling out of the round fence. The pipe may be secured in a similar fashion to the fencing on the receiver fence. The downstream end of the pipe at Peterson Pond is not attached to the receiver fence.

Moving the pipe and round fence out into position.

(Click on photos for full screen version)

Moving the pipe into place by the receiver fence.

(Click on photos for full screen version)

Dropping the round fence into place while securing the pipe in place at the receiver fence.

(Click on photos for full screen version)

Since Peterson Pond dropped off to around 8 to 10 feet in depth shortly past the end of the receiver fence, a small boat was needed to move the round fence into place. The round fence and pipe was loaded onto the boat. As the boat moved out into position the downstream end was guided over the receiver fence and into the hole in the receiver fence that was cut prior to installing the end of the fence. The pipe was held in place while the pipe and the round fence were dropped into place. The round fence was simply dropped off the boat into the water. The holes that were predrilled into the pipe allowed trapped air to escape and the pipe and fence sank to the bottom. In this situation where there aren't any significant currents and the fencing provided significant weight, it was determined that no additional measures were needed to secure the round fence in place.

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The Completed Beaver Deceiver

Since small beavers might fit through the existing metal railing along the trash rack additional fencing material was added along the length of the railing. Most installations will probably need some additional measure like this to prevent beavers from getting branches and other material around the landward side of the fence and into the culvert or other structure being protected. In addition, steel wire was stapled to the corner posts and the braces to prevent beavers from chewing through them in the unlikely event that one should get inside the structure.

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