

CITY OF PORTLAND
TERRESTRIAL ECOLOGY ENHANCEMENT STRATEGY

GUIDANCE:



**LIVING WITH
AMERICAN BEAVER**
(Castor canadensis)

Version 1
October 2010



ENVIRONMENTAL SERVICES
CITY OF PORTLAND

CONTENTS	Page
INTRODUCTION	3
PURPOSE	3
AMERICAN BEAVERS IN THE PACIFIC NORTHWEST	4
▪ Beaver Ecology	4
▪ Watershed Benefits	5
▪ Ecological Benefits	6
▪ Beavers in Portland	6
▪ Beaver as a Species of Management Concern	6
GUIDELINES FOR “LIVING WITH BEAVERS”	
▪ Monitor and Characterize Site Conditions	7
▪ Establish Specific Objectives	8
▪ Identify Actions and Management Strategies	9
- Encouraging Beaver Activity	10
- Beaver Re-introduction	10
- Discouraging Nuisance Beaver Activity	11
OREGON LAWS, RULES AND POLICIES	11
RESOURCES AND REFERENCES	14
Appendices	
A—Beavers, Muskrat and Nutria	
B—Encouraging and Discouraging Beavers	

INTRODUCTION

The Terrestrial Ecology Enhancement Strategy (TEES) is part of the City of Portland's 2005 Watershed Management Plan (PWMP). It is intended to help achieve the watershed health goals and objectives for biological communities. Information about terrestrial plant and animal species and habitats in Portland inform the ongoing implementation of the PWMP.

The main elements of the TEES include:

- Identification of priority plant and animal species and terrestrial habitats in need of protection, conservation and/or restoration
- Identification and prioritization of key management issues
- Recommendations for watershed-specific objectives
- Identification of priority strategies and actions
- Selection of species and habitats to be monitored
- *Guidance to city bureaus and citizens for improving species and habitats, and for addressing plant and wildlife management issues*

PURPOSE

American Beavers provide important watershed health and ecological benefits, yet are of management concern because of the damage they sometimes inflict on property. Striking a balance can be challenging, particularly in an urban setting. The purpose of this document is to offer guidance for living in harmony with this species, and (to the extent possible) for incorporating beaver activity into watershed management decisions and restoration projects—particularly for salmon recovery.

There are many excellent websites and resources that address the subject of living with beavers (see the section of this document titled, “RESOURCES and REFERENCES”). This guidance document draws upon those resources, and presents information that is particularly relevant to watershed restoration activities of Portland's Bureau of Environmental Services and management actions of Portland Parks & Recreation. Information presented here may be useful in project selection, project design and habitat management. These guidelines are advisory only, except where state laws and regulations are cited.

This guidance document is organized into four main sections:

Guidance: Living with American Beaver
Draft 10/29/2010

- ▶ **American Beavers in the Pacific Northwest**
Includes information about beaver ecology, watershed benefits beavers provide, presence of beavers in Portland, and issues associated with being a species of management concern.
- ▶ **Guidelines for “Living With Beavers”**
Presents guidelines for characterizing site conditions, identifying specific objectives for encouraging or discouraging beaver activity, and identifying appropriate actions and management strategies.
- ▶ **Oregon Laws, Rules and Policies**
Summarizes current laws, rules and policies pertaining to beavers.
- ▶ **Resources and References**
Contains sources of information used or cited in this document, along with other useful resources for readers desiring additional information.

AMERICAN BEAVERS IN THE PACIFIC NORTHWEST

The American Beaver is widely considered a **functional keystone species**—a “species whose removal would most alter the structure or function of the community” (Marcot and Vander Heyden, *Wildlife-Habitat Relationships in Oregon and Washington*, p. 185). The American Beaver was selected as a focal species for “Riparian Areas of Rivers and Streams Focal Habitat” in the Draft Willamette Subbasin Plan (Northwest Power and Conservation Council by the Willamette Restoration Initiative 2004) because of its capacity to modify habitat in ways that benefit many other species. The biological objectives in the Subbasin Plan are aimed at maintaining or expanding existing numbers and geographic distribution of beaver populations, through protection, restoration, and management of suitable habitat throughout the Willamette Basin.

At the statewide level, the Oregon Department of Fish and Wildlife coordinates a Beaver Workgroup that is focused on identifying and supporting research and information gaps that need to be addressed in order to improve understanding of beaver ecology and management. Such research will help maximize the ecological benefits that beaver provide and minimize negative economic (or other) impacts.

Beaver Ecology

Beavers live throughout wooded and partly wooded portions of the Willamette Basin, with highest densities in the Coast Range. They typically inhabit rivers, 2nd to 4th order streams, lakes and sloughs. Beavers select relatively low-gradient channels with geomorphic characteristics that make them suitable for dam and lodge building

(Suzuki & McComb 1998); they usually avoid areas with rocky or bedrock banks¹. There are few beaver lodges in western Oregon; instead, beavers are more likely to tunnel into stream banks for resting, staying warm, overwintering, giving birth and raising young.

Beavers are notorious for building dams across creeks and other watercourses to impound water. This creates deep water for protection from predators, for access to food supplies, and to provide underwater entrances to dens. Beaver typically build their dams August – October when rainfall and stream flows are lowest and water temperatures are highest. As water levels recede in the summer, beaver activity shifts towards building and maintaining channels that lead to nearby ponds and food sources.

Beavers eat the leaves, inner bark, and twigs of trees and shrubs, preferring aspen, cottonwood, willow, fruit trees and some ornamentals. They also eat ferns, aquatic plants, grasses and crops. Although they eat coniferous trees, more often they girdle and kill these trees for dam-building, rather than for food.

A mated pair of beaver will live together for many years—sometimes for life. They breed between January and March, and litters of one to eight kits (averaging four) are born between April and June. Beavers live in colonies of two to 12 individuals, comprised of an adult breeding pair, the kits of the year and kits of the previous year(s).

Watershed Benefits

A beaver's ability to intentionally alter the landscape is second only to humans. Through dam building and feeding, beavers alter hydrology, channel geomorphology, biogeochemical pathways, and community productivity². Perhaps their greatest contribution is their role in creating diverse aquatic habitat structure, which collectively results in many watershed benefits:

- Attenuated peak flow volumes and velocities reduce channel incision and bank erosion while increasing localized flood storage capacity.
- Trapped sediments behind dams and in surrounding floodplains provide a growth medium for grasses and other herbaceous and woody plants.
- Increased vegetative structure strengthens streambanks for protection during erosive flows, and further contributes to increased sediment deposition, retention and filtration on gravel bars and floodplains.
- Increased sediment filtration and accumulation reduces the amount of solids transported downstream, improving water quality.

¹ http://www.dfw.state.or.us/wildlife/living_with/beaver.asp

² Ecosystem Alteration of Boreal Forest Streams by Beaver (*Castor Canadensis*) by: Robert J [Naiman](#), Jerry M [Melillo](#), John E [Hobbie](#); *Ecology*, Vol. 67, No. 5. (1986), pp. 1254-1269.

- Stored woody debris and leaf litter supports aquatic insect production—an important food for fish.
- Riparian plant communities (willow, cottonwood and alder) thrive amongst beaver activity. Beaver cuttings cause dense vegetative growth; each cut willow stem can lead to 3-4 new stems.

Ecological Benefits

In addition to affecting watershed processes and functions, beaver dams and ponds create slack water habitat for juvenile salmon to feed and grow. Debris jams, fallen trees, and brush provide cover for fish to hide from predators and refuge during high flows. The accumulation of downed woody debris in channel and in surrounding floodplain areas also provides nesting and roosting habitat, and food and cover for upland wildlife, waterfowl and songbirds, and other native wildlife, such as mink, otter, turtles, frogs and salamanders. Willows, cottonwood and alder thrive with beaver cuttings (as long as the habitat is extensive enough that forage species are not severely impacted or eliminated by the beaver activity); the resulting denser vegetative growth patterns benefit other species such as nesting songbirds. Hence, American Beavers fill a specific ecological function within a larger biological community; their reduction or extirpation can significantly alter or lower the biological diversity and productivity of an ecosystem. This was observed in Oregon in the early 1900's. Unregulated trapping in streams nearly eliminated the species from Oregon by the early 1900s, and was determined to be a key factor in the decline of stream health and salmonid productivity. With regulated trapping, beaver populations have recovered throughout the State in areas where sufficient suitable habitat is present.

Beavers in Portland

Historically beavers were widespread and were an integral part of Portland's watersheds. Although the current beaver population in Portland area is nowhere near historical levels, beavers currently reside in all of the City's watersheds. As city employees become better informed of the nature and location of beaver activity, a database and linked map for tracking beaver activity can be established. These tools may be useful in designing and modifying projects to accommodate beavers and/or address beaver interactions.

Beaver as a Species of Management Concern

The American Beaver provides many watershed benefits, but it is also a species of management concern in Portland. Flooding behind dams and tree girdling and felling can damage property and affect human health. In these circumstances, beavers are often a perceived nuisance. The subsequent section describes the City's "Living with Beavers" watershed management approach, and provides guidelines for balancing the benefits and risks of beaver presence in Portland.

GUIDELINES FOR “LIVING WITH BEAVERS”

“Living with Beavers” is the City’s approach on how to best receive the benefits gained by this functional keystone species, while recognizing the potential for human /wildlife conflicts. The following section provides guidelines for City resource managers and municipal property owners on how to best manage for beavers in Portland. These may be applied in both general watershed management and also in project design and implementation situations.

The three main steps (for which details are provided), include:

- *Monitor and characterize site conditions and beaver activity* in the area of interest; identify site constraints or opportunities, and potential human / wildlife conflicts.
- *Establish specific objectives* relative to the City’s watershed goals based on site characteristics, constraints and opportunities - either encourage and manage for beavers, or discourage nuisance beaver activity if human / wildlife conflicts prevail.
- *Identify actions and management strategies* best suited to the area of interest.

Monitor and Characterize Site Conditions

Resource managers should spend time monitoring watershed conditions on sites of interest, including hydrologic conditions (water features), habitat (aquatic and terrestrial), water quality (if relevant) and biological communities. City staff are encouraged to use the *Terrestrial Ecology and Enhancement Strategy Short Form* to document existing conditions, and to help plan potential future actions that both improve conditions for wildlife and minimize human/wildlife conflicts.

<http://www.portlandonline.com/bes/index.cfm?c=51502&a=272859>.

Beavers are not always seen during site visits. Furthermore, they may be confused with two other mammals (native muskrat and non-native nutria). In order to determine whether beavers are present at sites, it is helpful to be able to discern these three species from one another, and to recognize indications of beaver activity such as dams, dens, slides and scent mounds (see **Appendix A**).

Based on the TEES site characterization, resource managers can then document potential opportunities to attract beavers, or conversely recognize constraints that warrant exclusion (or prevention) of beavers. Beavers on their own will colonize riparian areas and creeks that are suitable. However, there may be circumstances that preclude beaver activity due to low population numbers or limited access and migration. With this in mind, there may be areas where resource managers wish to attract (or at least tolerate) beaver activity to stimulate watershed processes, such as re-establishing floodplain connectivity.

Analysis of western Oregon streams by the Oregon Department of Fish and Wildlife suggests that suitable beaver habitat generally has the following characteristics:

- Small, year-round (perennial) streams with an active channel width 13- 20 feet wide
- Valley width greater than 2 times the active channel (bank-full) width
- Less than 6% stream gradient
- Stream canopy cover 25% -50% [not in ODFW guidelines—source?]
- Abundant food supply (i.e., a density of more than 220 trees/acre of small (6 – 12 inches DBH), primarily deciduous trees or shrubs adjacent to the stream

The lower 2.5 miles of Tryon Creek (within Tryon Creek State Natural Area), has characteristics similar to those listed above. Beavers likely played a key role in shaping the ecological form and function of that watershed. The area has greater opportunities for floodplain reconnection due to the absence of homes, roads and other infrastructure in the Coastal Management Zone (CMZ)/floodway of the stream.

An example of site characterization for a stream restoration project in Tryon Creek State Natural Area (Oregon State Parks) near River Mile 1.5 might be as follows:

Beaver activity has been documented in the past. None currently exists. No infrastructure is within 0.5-miles of project reach. The riparian corridor supports young and mature riparian vegetation. Project goal is to increase instream habitat and add complex structure to the channel to better activate surrounding floodplain areas. Beaver dams could provide added value to watershed functions by backing-up water onto surrounding floodplain areas.

Establish Specific Objectives

Recognizing the many watershed benefits that beaver activity can impart as well as the potential risks to property, the decision to attract and encourage beavers into a particular area should be carefully evaluated. Questions to ask when considering beaver activity include:

- What hydrologic and physical conditions should be monitored that have the potential to cause damage to homes, roads or buildings?
- Are there trees that could, if damaged by foraging or changes to hydrologic function, damage homes or buildings?
- Are native riparian plant communities present on site *and also* within a minimum of a half mile of the project site to provide adequate resources for food and dam building over time? A minimum of a half mile of vegetated streambank or 20 acres of forage area are needed during the summer to

support a family unit of 3-12 individuals. Plant communities should consist of a variety of herbaceous and woody plant communities.

- Is the stream gradient suitable for prolonged use by beavers (typically less than three percent but up to six percent)?
- Can the stream corridor support dam building (typically bank-full widths of 13-26 feet)?
- Is there a sufficient riparian corridor at/near the project site?
- Are stream banks and channel streambeds “formable” (i.e., not incised down to bedrock), to support dam building? Bedrock channels can be dammed; however upstream habitat usually is not desirable.
- Is there sufficient area to accommodate impounded water?
- Are there nearby beaver colonies (within 5-6 miles of the site)? If so, beavers have a better chance of finding your site.

Considering these characteristics will help resource managers and project managers better establish objectives for a particular area, stream reach, culvert, roadway or property. To the extent feasible, objectives should:

- be specific, measurable, attainable, realistic and time-bound;
- set clear expectations for extent of acceptable beaver activity, and identify “benchmarks” or “triggers” for taking action to prevent and reduce beaver activity; and
- be included in project design, and/or land use plans as appropriate; and
- include site monitoring protocols for monitoring and documenting active use and development at the project site.

An example of an objective for encouraging beaver activity (with contingencies) for a stream restoration project in Tryon Creek State Natural Area (Oregon State Parks) near River Mile 1.5 might be as follows:

Beaver activity including dam building, ponding water, tree girdling and felling are acceptable between river mile 0.5 to 2.4 as long as activity does not cause substantive erosion and damage to storm-water, sanitary line and State Park property. Newly planted riparian plant communities will be protected for first 5-years after projects are constructed.

Identify Actions and Management Strategies

If well-crafted, the objectives will give resource managers and project managers enough information to prescribe site-specific or project-specific actions and management strategies. It should be clear whether the long-term goal is to encourage or discourage beaver activity.

Encouraging Beaver Activity

If it is appropriate to encourage beaver activity and clear objectives have been crafted, the following guidelines may be useful (**Appendix B** provides more specific guidance on these topics):

- Plant tree and herbaceous plant species that are preferred by beavers.
- Plant adequate densities to provide sufficient food and den-building materials, while protecting some trees for succession (beavers will abandon sites when food supplies are inadequate).
- Exclude (e.g., fence-off) constructed and revegetated “natural” areas to protect those areas
- Create or protect corridors to natural forage areas.
- Fence off areas so as to give beavers refuge from predators, pets, and human interactions.
- Construction near beaver communities should occur during the midsummer to avoid times of peak beaver activity (which is in the fall).
- Build structures that provide beavers with stable foundations in which to build dams upon or in front of (i.e. log structures and/or multiple floodable terraces).
- Allow for changes in hydrology; allow for floodable terraces.
- Inform surrounding landowners of your intent and provide materials (e.g., fencing, trees that beavers do not prefer) to mitigate for interactions outside of the project area.

Beaver Relocation and Re-introduction

Oregon Department of Fish and Wildlife’s general policy is to not release beavers into urban areas to re-establish populations. Presumably, most prime habitat is already occupied by beaver, and therefore relocation is not likely to be effective. Beavers require a lot of food and if released into an area without an adequate food supply, will readily move in search of new forage. Notably, in rural areas, only 12% of relocated beavers stay in their new stream systems; the average distance from release site to the area of establishment is 8 miles.

If identified as a desired need, however, all beaver relocation activities and release locations must be pre-approved by ODFW and cannot proceed without a permit from that agency. ODFW adopted *Guidelines for Relocation of Beaver in Western Oregon* in May, 2010. The guidelines establish standards for when, where, and by whom beaver may be relocated on public and private lands in western Oregon, and provide a process for monitoring and evaluating the success of beaver relocation efforts. The guidelines also provide direction to ODFW staff when evaluating applications to relocate beaver.

Discouraging Nuisance Beaver Activity

Depending upon the location of beaver activity and whether it is causing property damage, resource managers and property owners may consider one or more courses of actions to prevent and reduce beaver damage (**Appendix B** provides more detailed guidance on these topics):

- Dam removal and modification is a short term solution; habitat alteration such as removal of forage and construction material may be more effective³.
- Planting sites with species that beavers do not prefer may be effective. Those species include: Sitka spruce, elderberry, cascara, osoberry (Indian plum), ninebark, and twinberry.
- Do not plant species preferred by beavers near beaver trails and other known beaver activity areas.
- Exclusion or fencing of areas and caging trees needing protection works, but needs to be monitored to maintain effectiveness.
- Applying a product called “4 The Birds” to trees has been found to be effective by City of Portland stormwater maintenance crews. Electric fences and abrasive paints may deter some foraging behavior as well. Natural scent deterrents such as scat or urine from predators are less effective; chemical deterrents have not been shown to work.
- As a last resort, ODFW’s biologists should be contacted. They can recommend authorized trappers for culling or relocation, if applicable.

STATE LAWS, RULES AND POLICIES

Beaver are legally classified as “Protected Furbearers” in Oregon. Oregon Administrative Rule (OAR) 498.012 states that no one shall take any wildlife the Fish and Wildlife Commission has classified as “protected”. However, there are exceptions to this rule: 1) Beaver may be harvested during established seasons with a valid Furtaker’s License, and 2) Oregon Revised Statute (ORS) 610.105 provides the authority for private landowners to lethally remove beaver and other rodents from their lands without a permit from the Oregon Department of Fish and Wildlife. ODFW promotes “Living With Wildlife,” and encourages public and private landowners to first use beaver exclusion devices and habitat modification techniques for alleviating beaver damage. These methods are also suggested to prevent damage (see **Appendix B**).

ODFW's response to beaver damage (e.g., loss of or harm inflicted on land, livestock or agricultural or forest crops) is guided by Oregon Revised Statute 498.012 which authorizes landowners to take wildlife that is causing damage, is a public nuisance, or poses a public health risk on their land. Beavers causing damage on *public* lands are protected by their status as a Protected Furbearer and require a permit from ODFW before any action can be taken. Beavers on *private* lands fall under OAR

³ Vegetation removal should be done so as to not impact nesting birds or other wildlife. Please refer to the City of Portland’s TEES Guidance document: *Avoiding Impacts on Nesting Birds During Construction and Revegetation Projects* (October 2010).

610.002 (which defines “Predatory Animal”) and OAR 610.105 (which gives a private landowner the authority to “take” predatory animals or noxious rodents). These two statutes are implemented by the Oregon Department of Agriculture.

ODFW typically makes a determination of damage over the telephone based on the information provided by the complainant - e.g., loss of crop trees, damage to roads or other human structures from beaver damming activities. ODFW documents beaver damage complaints on a wildlife damage complaint form that includes fields for describing the claimed damage and quantifying the monetary value of the damage. ODFW generally does not have the staff resources to go to sites and evaluate damage first-hand. They typically provide technical assistance to the landowner - giving them advice and providing them with the current list of ODFW-permitted Wildlife Control Operators (WCO). Multnomah County does not provide assistance with beaver issues. Similarly, the City of Portland does not provide assistance to private landowners.

Trapping to address damage can be done by the landowner or their agent (i.e., Wildlife Control Officer). Trapping to address damage can occur within the furbearer season as per applicable OARs or outside the furbearer season. A landowner cannot retain beavers taken within the trapping season without a proper trapping license.

Live trapping of beavers is legal, but the relocation of beavers (or any wildlife) is illegal without a permit from ODFW. All release locations need to be approved by ODFW. ODFW issued beaver relocation guidelines for Western Oregon in May 2010. These can be downloaded from the ODFW website:

http://www.dfw.state.or.us/wildlife/living_with/docs/Guidelines_for_Relocation_of_Beaver_in_Western_Oregon_052610.pdf.

The purposes of the relocation guidelines are to establish standards for when, where, and by whom beaver may be relocated on public and private lands, and to provide a process for monitoring and evaluating the success of beaver relocation efforts. They also provide direction to ODFW staff when evaluating applications for relocating beaver. *ODFW is currently not releasing beaver into urban areas to re-establish populations.*

Quick Legal Facts Regarding Beavers

On Public Land: Classified as Protected Furbearers. Laws are implemented by ODFW.

On Private Land: Are considered a Predatory Animal. Laws are implemented by the Oregon Department of Agriculture. Landowners or their agents may lethally remove beaver without a permit from ODFW. ODFW's website has a list of ODFW-licensed Wildlife Control Operators.

Live-trapping and Relocating Beavers: Refer to the ODFW Beaver Relocation Guidelines, which include a process for evaluating applications and selecting release sites. An ODFW permit is required to live-trap and/or relocate beaver.

Removal of Beaver Dens: ODFW does not recommend dens be removed, but does not require a permit to do so. *Note: Removing muskrat lodges is prohibited.*

Removal of Beaver Dams: ODFW does not recommend dams be removed, but does not require a permit to do so.



RESOURCES and REFERENCES

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Oregon Department of Fish and Wildlife - Northwest Region
17330 SE Evelyn Street
Clackamas, OR 97015
Tel: (971) 673-6010

U.S. Fish and Wildlife Service (Partners for Wildlife Program) may supply funding and/or materials for a beaver water level control device.

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<http://www.woodlandfishandwildlife.org/publications.htm#beaver>.

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http://www.dfw.state.or.us/wildlife/living_with/nutria.asp.

Appendix A [add photo credits]

BEAVERS, MUSKRAT AND NUTRIA

There are three large semi-aquatic rodents in the Portland area — beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*) and nutria (*Myocastor coypus*). Beaver and muskrat are native; nutria are non-native. Although they resemble one another, there are some important differences that will help you tell them apart.

Native Species

American Beaver (*Castor canadensis*)

Characteristics: Broad (horizontally flattened) and almost hairless tail. Length is between 39 and 47 inches. They weigh between 35 and 50 pounds or more. Fur color appears reddish brown to black. Each foot has 5 digits. The hind feet have webbing, but the front do not.

Also look for: “Girdled” or “felled” trees, limbs with bark removed. Beaver prefer certain tree and shrub species. These include aspen, cottonwood, willow, conifers, fruit trees, and ornamentals. Dams and lodges made from limbs and mud. Primary dam building is August – October. “Slides” (“slicked-down” paths where they enter and leave water; 15 – 20 inches wide and at right angles to the shoreline). Channels that lead to their ponds (sometimes look human-made). Look also for scent mounds.



Muskrat (*Ondatra zibethicus*)

Characteristics: Much smaller than a beaver, and not as large as a nutria. About 16 – 25 inches in length. May reach a maximum of only 4 pounds. Long, rat-like tail that is flattened vertically. The dense grayish underfur is overlaid by long, glossy guard hairs that vary in color from dark brown to yellowish brown. Guard hairs are long and coarse on the back and finer on the side and the belly. Food consists of aquatic and semiaquatic vegetation (including grasses, rushes, sedges, cattails, etc). They also eat mussels, snails, and crayfish. Unlike beavers, they are not strict vegetarians.

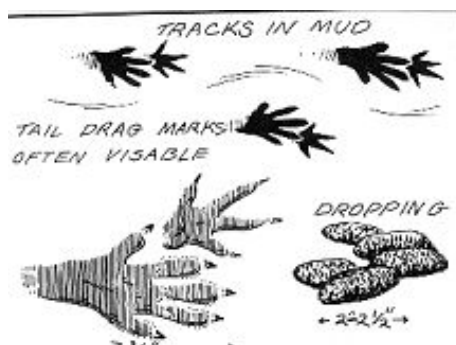
Also look for: Lodges that are smaller than beaver lodges and built from marsh vegetation, not sticks.



Non-native Species

Nutria (*Myocastor coypus*)

Characteristics: Much smaller than the beaver; much larger than the muskrat. May reach a maximum of 20 pounds. Mature adults are about 2 feet in length. Muzzle is covered by white coarse hair. Tail is hairy and round (not compressed from side to side) and pointed at the tip. Hind legs are much longer than the front legs, giving them a hunched appearance when on land. Hind feet are webbed. Large incisors are yellow to orange-red.



Also look for: Floating platforms up to 3 feet high that they make from aquatic vegetation. Burrows in vegetated banks near waterways and collapsing banks and road beds (especially where slope is more than 45°).

Food consists almost entirely of aquatic and semiaquatic vegetation (including grasses, rushes, sedges, cattails, etc).



Appendix B. ENCOURAGING AND DISCOURAGING BEAVERS

ENCOURAGING BEAVERS

Treatment Category	Description	Example / Specifications
Tree and Other Plantings	<p><u>Species</u> – Plant tree and herbaceous plant species preferred by beavers.</p> <p><u>Plant Density</u> – Plant adequate densities to provide sufficient food and den-building materials. Protect some trees for future use (beavers will abandon sites when food supplies are inadequate).</p>	<p>Densely plant aspen, cottonwood, willow, spirea (hardhack), and red-twig dogwood. Once their roots are well-established, the upper parts of these species often re-sprout after being eaten by beavers.</p> <p>See specifications under “Tree Protection” in “Discouraging Beavers”.</p>
Access to Food	<p><u>Corridors</u> – Create or protect corridors to natural forage areas. Remove existing barriers.</p>	<p>Identify any corridors that beaver are using and avoid creating barriers to foraging areas.</p>
Natural Attractants		<p>In California, there has been some success in luring beavers to new locations by leaving otter scat at the site, spraying almond extract on willow trees? to attract beavers to willow stands that need thinning, and placing favorite food (e.g., fresh willow or poplar branches) at the desired site.</p>
Safe Refuge	<p><u>Fencing</u> – Fence off areas to give beavers refuge from predators, pets and human interactions.</p>	<p>See specifications under “Tree Protection” in “Discouraging Beavers”.</p>
Promoting Dam-building	<p><u>Structures</u> – Build structures that provide beavers with stable foundations on which dams can be built (or can be built in front of).</p> <p><u>Flowing water</u> - Damming behavior in beavers is stimulated by the sound and feel of flowing water. Make system modifications that increase the noise of running water.</p>	<p>Construct log structures and/or multiple floodable terraces.</p> <p>A series of 3 – 5 inch diameter non-treated lumber posts or live willow posts spaced 18 – 24 inches apart can serve as a foundation for beavers to build a new dam. If you place the woody material from a dam that has been removed or blown out upstream from the posts, beavers will use it to start the new dam.</p> <p>Add rocks and other features that increase the noise of running water.</p>

ENCOURAGING BEAVERS

Treatment Category	Description	Example / Specifications
Hydrologic Considerations		Allow for changes in hydrology by allowing for floodable terraces.
Timing of Project Construction		Construction near beaver communities should occur during the midsummer to avoid times of peak beaver activity (which is in the fall). However, care must be taken to avoid impacts on nesting birds.
Maintain Beaver Dams and Ponds	<u>Flow devices</u> – Install a beaver deceiver or flexible leveler.	It may be possible to make a change in the depth of a beaver pond to prevent flooding by installing a flow device at the intended depth that extends upstream and downstream of the dam. The flow device (a beaver deceiver or flexible leveler) keeps the rise in water level in the pond at a minimum by using one or more plastic pipes to continually drain the pond area. In general, at least 3 feet of water in the pond area will need to be maintained for the beavers to stay.
Public Relations	<u>Communication Strategy</u> – Develop and implement a communication strategy early in project design. Implement the strategy throughout project implementation and thereafter.	Inform surrounding landowners of your intent. Provide materials (e.g., fencing) to mitigate for interactions outside of the project area. Provide landowners with trees that beavers do not prefer. Sitka spruce, elderberry, cascara, osoberry (Indian plum), Pacific ninebark and twinberry are <i>not</i> preferred food plants. Plan to have ongoing communication with, and outreach to, landowners.

DISCOURAGING BEAVERS

Treatment Category	Description	Example / Specifications
Protection of Individual Trees	<u>Tree Cages</u> - If beaver are cutting down trees and the number of trees susceptible to damage is minimal, tree cages can be used to prevent damage.	<p>Cages can be made from fencing material (e.g., hog wire, welded wire, or heavy-gauge chicken wire). Metal fence posts can be pounded in around the tree. Wrap wire around the fence posts and anchor with hog rings or zip ties. Leaving a 6-to-12 inch space between the wire cage and the tree trunk may discourage beavers from trying to chew between wires and allow for tree growth. Some form of stake or support will be needed to keep beavers from pushing fencing against the tree trunk to chew. Tree trunks should be wrapped to a height of at least 4 feet, or (in areas where flooding is common) at least 2 feet above the high-water mark. Barriers can be painted to make them less noticeable. Welded wire fencing coated with green vinyl helps fencing blend in. Lengths of corrugated plastic drainpipe can be attached around trunks of narrow-diameter trees. However, dark-colored pipe can burn trunks that are in full sun. If so, try using wider-diameter pipe or pipe with holes to prevent overheating.</p> <p>Place wire cages (beaver guards) on 50% of mature deciduous trees at time of site preparation (e.g., invasive species removal) to insure shade cover while restoration plantings are establishing. If needed increase the number, type and extent of cages.</p>
	<u>Abrasive Paint</u> – Beaver don't like the gritty texture.	<p>Use exterior latex paint (with a color to match the bark) mixed with masonry sand (30 mil or 70 mil) in a ratio of 5 oz. (2/3 cup) sand to 1 quart paint. Mechanically mix on the day of application. Paint trunks up to about 4 feet above the ground. Avoid painting young trees less than about 6 feet tall, as it is not effective at protecting seedlings and small saplings, and may harm them.</p> <p>For more information, contact Dale Nolte (Olympia, WA) 360-956-3793.</p>
Protection of Tree Groves	<u>Temporary Fence</u> - To protect larger areas, newly-replanted restoration areas, or if a large number of trees is involved, and cages are not practical, a temporary fence of chicken wire or other similar fencing material may work.	<p>Fencing should be 3 – 4 feet high, securely staked to the ground to prevent beavers from crawling under it, or pushing it over. It should be made from materials that beavers cannot chew through, since they sometimes will use wooden construction materials, even if they do not eat them.</p>

DISCOURAGING BEAVERS

Treatment Category	Description	Example / Specifications
Plant Selection and Establishment	<p>Plant species <i>not</i> preferred by beavers.</p> <p>Densely plant species that survive beaver activity.</p> <p>Plant desired plants away from known beaver trails and dams, and plant ample beaver food source plants nearby.</p>	<p>Sitka spruce, elderberry, cascara, osoberry (Indian plum), Pacific ninebark and twinberry are <i>not</i> preferred food plants.</p> <p>Densely plant aspen, cottonwood, willow, spirea (hardhack), and red-twig dogwood. Once their roots are well-established, the upper parts of these species often re-sprout after being eaten by beavers.</p>
Habitat Modifications	<p>To maintain some benefits of beaver dams and ponds, but minimize flood damage, consider ways to minimize dam construction.</p>	<p>It may be possible to make a change in the depth of a beaver pond to prevent flooding by installing a flow device at the intended depth that extends upstream and downstream of the dam. The flow device (a beaver deceiver or flexible leveler) keeps the rise in water level in the pond at a minimum by using one or more plastic pipes to continually drain the pond area. In general, at least 3 feet of water in the pond area will need to be maintained for the beavers to stay.</p> <p>Clemson Beaver Pond Leveler and the Beaver Pond Control Structure The Clemson Beaver Pond Leveler frustrates beavers by continually lowering the water level behind the dam. A key feature is protective mesh near the intake that prevents beavers from plugging intakes. For further information about the Clemson Beaver Pond Leveler, contact the Department of Aquaculture, Fisheries and Wildlife, Clemson University, Clemson, SC 29634 (503-656-3117) or download information from http://www.clemson.edu/psapublishing/Pages/AFW/afw1.pdf.</p>
Natural Repellants		<p>In California, there has been some success in luring beavers from problem areas to new locations by leaving otter scat at the site, spraying almond extract on willow trees? to attract beavers to willow stands that need thinning, and placing favorite food (e.g., fresh willow or poplar branches) at the desired site.</p>
	<u>Electric Fence</u>	<p>An electric fence may be another option (a 110 Volt, solar-powered, or battery-powered charger attached to a single strand of fencing wire stretched 4 - 6 inches above the ground creates an effective barrier).</p>

DISCOURAGING BEAVERS

Treatment Category	Description	Example / Specifications
<p><i>Culvert Modifications</i></p>	<p>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 physically move beavers away from a culvert will help reduce dam-building behavior.</p> <p>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 reduce conflicts with beaver.</p> <p>A "receiver fence" or a "round fence" can function as a "filter" by diffusing incoming water over a large area, thus minimizing the sound of running water.</p>	<p>To stop dam building at culverts and allow for fish passage, refer to Beaver Deceiver Plans (including Peterson Ponds). http://www.co.snohomish.wa.us/documents/Departments/Public_Works/SurfaceWaterManagement/Deceivergraphs.pdf.</p> <p>To prevent beaver dams from blocking culverts refer to the BeaverStop® and the Flexible Leveler http://www.fsiculvert.com/common/pdfs/Beaverstop-AD-3-54.pdf.</p> <p>http://www.co.snohomish.wa.us/documents/Departments/Public_Works/SurfaceWaterManagement/Flexleveler.pdf.</p> <p>To allow beavers to build dams without plugging a culvert, and allowing fish passage refer to Beaver Diversion Dam. http://www.co.snohomish.wa.us/documents/Departments/Public_Works/surfacewatermanagement/community/pondcontrolplan.pdf.</p>

DISCOURAGING BEAVERS

Treatment Category	Description	Example / Specifications
<i>Relocating or Euthanizing</i>	Removing beavers from an area is difficult and often costly; and in the long-term has not been shown to be effective. Neighboring populations most often recolonize the area for the same reasons the prior community took-up residence. For these reasons, beaver relocation and/or euthanasia should only be considered after actions to prevent and avoid beaver damage have been tried and deemed unsuccessful.	<p>Beaver removal, euthanization, and/or relocation must be pre-approved by the Oregon Department of Fish and Wildlife.</p> <p>Note: Oregon Revised Statute 610.105 provides the authority for private landowners to lethally remove beaver and other rodents from their lands without a permit from the Oregon Department of Fish and Wildlife. However pre-approval and a permit from the Oregon Department of Fish and Wildlife is required to <i>relocate</i> beaver.</p>

Questions? Contact:

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