



Best Management Practices for Resolving Human-Beaver Conflicts in Vermont



**Vermont Fish & Wildlife Department
Vermont Department of Environmental
Conservation**



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PURPOSE

Goal: The goal of the agency in dealing with human-beaver conflicts is two-pronged. First, as the Agency of Natural Resources, we are interested in maintaining, whenever possible, the valuable wetlands in Vermont that support biodiversity and vital ecological processes. Secondly, we hope to provide the public with the best information available for managing problem situations that result from beaver activity.

This document has been prepared to simplify and unify the legal and regulatory framework related to beaver management. It describes **Best Management Practices (BMPs)**, which provide a logical protocol with steps that should be considered and followed in determining: 1) whether beaver activity threatens the public safety and/or welfare of public or private property; 2) which practices would be applied to resolve the specific problem (including beaver removal, water level lowering and dam removal); 3) how to select the least environmentally damaging alternative; and 4) how to minimize potential conflicts with adjacent and downstream landowners.

The practices and steps outlined in this document (beginning on page 5) are what we would consider to be Best Management Practices for dealing with Human-Beaver conflicts. By following these BMPs, the impacts on resource values associated with beaver ponds, wetlands, and streams may be minimized and the risks to downstream landowners should be reduced.

In addition, any person or organization who complies with these BMPs will need no further authorization from the agency to take the necessary actions to manage human-beaver conflict.

Cooperators:

Department of Fish & Wildlife (VDFW)

Department of Environmental Conservation, Watershed Management Division (VDEC)

United States Department of Agriculture, Wildlife Services (Wildlife Services)

BEAVER MANAGEMENT IN VERMONT

Beavers are North America's preeminent keystone species. They have an ecological importance far greater than that suggested by the tiny percentage of biomass they represent. Beavers increase biological productivity in countless ways. The small wetlands they create in the northern forests increase landscape heterogeneity. This value endures even when beavers leave a wetland. When dams decay through lack of maintenance, flowages initially become wet meadows. Like "active" flowages, these meadows are unique habitats that also have great natural value.

Whether beavers live in flowages or "permanent" water bodies, their rooting, feeding, and digging behaviors have the effect of tillers recirculating nutrients. Their feeding activities and general movements can breakup monocultures like cattails and reed grass (*Phragmites communis*), creating habitat that is more diverse and accessible to a greater number of species. Another common product of beaver activity, dead trees – felled or downed, vertical, horizontal, or diagonal – make fantastic habitats for a wide variety of wildlife.

Beaver offer society many values in addition to a productive landscape. Their pelts, a renewable resource, are the most obvious of these and the only value that is easy to quantify. Beavers also help to abate regional flooding by, paradoxically, damming. Flowages act as small reservoirs that, when numerous in a watershed, retain large amounts of water during floods. In addition, beavers have educational value: their building, chewing and felling activities are fascinating to adults and children alike. These behaviors, combined with a myriad of other wildlife activity, makes flowages perfect places to study ecology. The symphony of color, movement, and song found in flowages also gives them aesthetic and spiritual value. Ironically, many of these values seem most in need where beavers and humans appear least compatible – urban and suburban areas.

Beavers are an ancient species that have been widespread and abundant for a long time. All aquatic and semi-aquatic species in existence today have evolved in their presence. Theoretically, therefore, species such as trout and salmon have learned to survive despite the activities of beaver and in fact probably benefit from them.

Beavers have played a critical role in the history of New England and the United States. The early conflict that went on between the French, English, and Dutch in New England was the result, at least in part, of attempts to control the fur trade. Beaver pelts were a main item of trade and provided the incentive for European settlement, exploration, and expansion into the continent's heartland. Beaver pelts were often used as currency in place of gold. Eighty beaver pelts made a 100 pound pack, which was valued at three to five hundred dollars during the 1800s. Along with uncontrolled trapping, habitat destruction brought about the virtual extinction of beavers in Vermont by the mid-1800s.

In 1910 beaver were protected by state law and thereafter made a slow comeback. Beaver were reintroduced into Vermont by the Vermont Fish & Wildlife Department in the 1920s and 1930s from New York and Maine. The reintroduction coincided with the abandonment of many of Vermont's farms. The reforestation of Vermont created a habitat excellent for the growing beaver population. By the 1940s and 1950s beaver had again become well established in the state. The first open trapping season of 15 days was set in 1950.

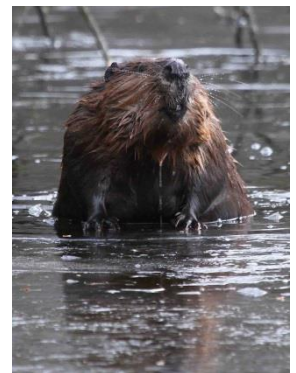
Today the Agency of Natural Resources (ANR) recognizes beaver as a valuable natural resource. The ANR strives to maintain beaver population levels compatible with public uses of land while attempting to minimize impacts to humans. The maintenance of beaver populations not only ensures the continued production and enhancement of valuable wetland habitat but provides an array of social benefits including activities such as regulated hunting, fishing, and trapping, as well as wildlife viewing and educational pursuits. In addition to the

above-mentioned values, beaver can be utilized as a naturally healthy, organic, and renewable source of protein for human consumption. The U.S. Department of Agriculture rated beaver meat higher in protein and lower in fat than beef, based on a pound-for-pound comparison!

While beaver and the habitat they affect are a valuable resource, they can also cause significant problems. The Vermont Fish & Wildlife Department attempts to regulate beaver population levels by varying the time and length of regulated fur trapping seasons. Besides providing a means of controlling beaver numbers, the annual harvest of beaver is a sustainable use of wildlife that provides wildlife-related benefits directly to households who trap. The private trapper (who traps for recreation, food, and financial gain) conducts population reductions at no cost to the general public. The residents of the state derive a financial savings due to decreased amounts of property damage caused by furbearers, as well as a decreased need for paid control agents.

BIOLOGY AND BEHAVIOR OF BEAVER

The beaver, *Castor canadensis*, is the largest rodent in North America with adults ranging from 35 to 46 inches long (including a flattened 12-18 inch tail) and weighing from 40 to 50 pounds. The hind feet are very large with five long webbed toes. Front feet are small and dexterous, which allows the beaver to carry dam construction material such as stones and sticks. Beaver have the characteristics of well-developed yellow-brown teeth and a massive skull that supports strong chewing muscles.



Generally beavers have relatively few offspring. Development of the fetuses requires 120 days with the young being born between April and July. Litter sizes range from one to nine, with an average litter

size of four. The heavier the female, the larger her litter. The number of young a female beaver gives birth to also is inversely related to her family size at the time of breeding. In a beaver family, the adult pair breeds and usually produces one litter per year. The young beavers (kits) are born fully furred and make their first trip outside of the lodge at about two weeks of age.

The occupants of a beaver pond (or group of ponds) generally consist of a family resulting from two breeding seasons. Beaver mate for life; however, if one of the adult breeding pair is removed from the population, the remaining member will readily accept a new mate. The kits remain with the parents until they are two years old and then are driven off to find their own territories. This dispersal of juveniles contributes greatly to the local number of property damage complaints.

As a food source, beaver prefer aspens, birch, alder, willow, cottonwood, and water lilies, but will eat the leaves, twigs, and bark of most species of woody plants found along the water's edge. During the growing season beaver also will consume large quantities of non-woody plants, such as grasses and cattails. During the fall, they will stockpile their woody food supply in the water near their house for use during the winter months. The underwater food piles are cold winter food caches. These piles of branches, sticks, and twig serve as important indicators of an active beaver lodge. During the ice-covered winter months, beaver are generally inactive with regard to tree cutting and dam building.

The beaver dam and lodge are constructed of mud, branches, sticks, and stones with some beaver utilizing bank burrows along streams or ponds. Lodges consist of one or more compartments with each compartment having two underwater entrances which serve as escape routes from potential predators and provide protection from freezing winters. Their aquatic habitat and instinctive behavior minimizes the adult beaver's susceptibility to predators. Domestic dogs, coyotes,

bears, and bobcats are among the larger predators, including humans, which will prey on beaver if the opportunity arises. Because beaver rarely travel far from water, they are relatively safe from most predators. Young beaver are the most susceptible to predators and are occasionally targeted by predaceous mammals, such as otter and mink.

Beaver are most active at dusk and dawn during the ice-free months. Beaver activities focus on building and maintaining dams during high water periods, and activities shift to channels and canals during the drier summer months. During the early fall months tree cutting is at its most intense level as all individuals in the lodge work on building and repairing dams for winter.

Beaver construct dams that form ponds within which the lodge and winter food cache are located. It is believed to be a combination of water flow sensation and the sound associated with running water that stimulates this dam building activity. Within and around the pond, the beaver construct canals for security and for the transport of food and building materials. Beaver are primarily active at night with regard to their dam building and tree cutting activity.

Beaver construct 'scent mounds' by depositing a secretion from their scent gland on a pile of mud. It is believed that this type of chemical communication helps determine their territory.

When food supplies run out, beaver usually abandon the pond site in search of new food supplies. The unmaintained, abandoned dams typically become porous leading to the eventual dewatering of the beaver ponds; however abandoned beaver dams will also occasionally fail in a more dramatic fashion. The nutrient rich substrate that is left in the dewatered pond turns into a meadow where herbaceous plants flourish. The process starts again when beaver return to reestablish themselves and feed on the new growth. This cycle is important to maintain productivity of beaver impoundments for other wildlife.

In some situations, beaver have been associated with concerns about drinking water. A *Giardia* parasite may cause an intestinal ailment referred to as “beaver fever.” Although some beaver may carry the *Giardia* parasite, so may many other animals associated with lakes and ponds, including humans and domestic dogs. The situation may create further concern when the water body is a drinking water supply.

The impoundments created by beaver provide valuable wildlife habitat for assorted furbearer, bird, plant, and waterfowl species. For example, the federally endangered northeastern bulrush occurs in southern Vermont only in beaver flowages. Beaver activities also may stabilize stream banks, control sedimentation of streams, and provide groundwater recharge areas. In this way, the beaver provides ecological benefits to the public at large. On the other hand, the beaver’s dam building activity can result in widespread flooding of woodlands and agricultural land, and cause numerous complaints by plugging road culverts, flooding roads and railroad tracks, and causing general property damage.

DEFINITION OF THE PROBLEM

Due to a decrease in pelt values and a corresponding decrease in trapping pressure, beaver populations in Vermont increased by as much as 130% from 1980 to 1990 and continue to exist at high population levels today. The creation of new dams and the expansion of beaver dams within existing wetlands, although beneficial to a whole host of other wildlife species, can create problems for humans. Problem situations may include: an impoundment that threatens downstream property; upstream flooding of land; trees killed or damaged; flooding of highways or railroads; contamination of water supplies; impairments of drainage; interference with the operation of septic systems; flooding of agricultural crops; and flooding of homes. Some of the measures that have been commonly used to address human-beaver conflicts have, in themselves, created

environmental problems, such as loss of valuable wetlands, degradation of water quality, and flooding and damage to downstream property. Therefore, appropriate action should be taken to address the problem and eliminate the hazard in an environmentally sound manner.

Presently, many private landowners, town road commissioners, Agency of Transportation personnel, and railroad employees routinely remove dams where they believe flooding could potentially affect the safety and use of the property, road, or railroad. Since 2010, Vermont Fish & Wildlife wardens have responded to over 55 complaints per year related to beaver conflicts and Wildlife Services has received an average of 38 beaver-related calls annually. In addition, between October 2010 and June 2013, Vermont Fish & Wildlife biologists responded to 295 complaints resulting in 177 site visits.

The use of inappropriate dam removal methods (such as the removal of a beaver dam with a backhoe or dynamite), however, can cause significant environmental damage and should only be used in situations that pose an imminent hazard. Not only is the wetland destroyed, but large amounts of sediment are discharged into the stream, severely affecting invertebrate and fish populations, and threatening life and property downstream. Flooding of downstream properties as a result of the sudden release of large amounts of water can result in extensive property damage. The Vermont Supreme Court has held that liability for damages can rest with either the owner of the land on which the beaver dam is located or the municipality or state agency that removes a beaver dam.

Through the application of the BMPs in this booklet, we hope to reduce the risk to the property owner and adjacent landowners, including their own potential personal liability for damages caused by beaver removal activities, while at the same time protecting important wildlife habitat and water quality.

BEST MANAGEMENT PRACTICES FOR HANDLING HUMAN-BEAVER CONFLICTS

Although some statutes allow the removal of both nuisance beaver and beaver dams, other statutes require that water quality and wetlands be protected (see Appendix 11). These BMPs have been designed to address the issues of nuisance beaver and the alteration or removal of beaver dams while at the same time, to the greatest extent possible and feasible, protect water quality and wetland values. By following these BMPs, including complying with the requirements of the 1272 Order contained in Appendix 10, a person or organization will be considered in compliance with the law.

1. Beaver problems should be brought to the attention of a Fish & Wildlife warden, one of the Agency of Natural Resources regional offices closest to the problem site, the Wetlands office, or Wildlife Services (see Appendix 1).
2. Upon receipt of the call, the responding person will ask the caller to provide the following information:
 - a. What is the nature of the problem (flooding of water supply, concerns regarding *Giardia*, threat to roads or cropland, etc.)?
 - b. Does the dam pose a hazard to human health, safety or property, and what is the nature of the hazard? Is the hazard imminent so that there is an emergency situation?
 - c. What is the location of the dam, how long has it been there, and approximately how large is it?
 - d. What are the property uses downstream?
3. The ANR representative will either refer the call to the appropriate individual or discuss the problem with the affected party and, whenever possible, satisfy his or her concerns through

information and advice. In consultation with the ANR representative, the landowner may decide that there is no immediate problem or that the problem can be solved through prevention or management techniques and, therefore, does not require action by the warden or ANR staff. If the problem cannot be solved through prevention, then an ANR representative will discuss other options.

Beaver-caused conditions can range from very simple to complex. The management approach will vary accordingly. Beavers are adaptable and can readily tolerate living in close association with people. Likewise, people who learn to tolerate a certain amount of beaver influence on their land generally find that co-existing with beavers are simply an inconvenience to landowners, tolerance is the easiest solution. However, when beaver activity results in property damage or concerns about public health and safety, there are a number of steps that may be taken to alleviate the problems. In addition, there are some measures that can be taken during construction projects that can prevent problems from occurring after construction. (Refer to Appendix 8 as an example). The following BMPs relate to the level of complexity of the problem and ecological value of the wetland.



Courtesy of Curtis Smiley

Type 1: Damage Prevention Techniques.

- A. Problem Description:** Beaver are eating ornamental trees and shrubs or damaging other landscape.

Management Response:

- Install caging, electric fencing or abrasive tree paint around ornamentals or landscaping. (Refer to Appendix 6 for examples of how to install this kind of protection).
- Arrange for lethal reduction and/or removal of beaver population (Appendix 2). While problem beavers may legally be removed any time, removal of beaver during the normal trapping season may minimize the cost to the landowner and maximize the use of a renewable resource.

B. Problem Description: Beaver are digging ditches and channels. There also may be a proliferation of small dams and lodges resulting from an expanding beaver population. No damage has occurred yet.

Management Response:

- Provide educational materials and determine if continued beaver activity will create future conflicts.
- Arrange for lethal reduction and/or removal of beaver population (Appendix 2). While problem beavers may legally be removed any time, removal of beaver during the normal trapping season may minimize costs to the landowner and maximize the use of a renewable resource.

C. Problem Description: Landowner is concerned about rabies or *Giardia*.

Management Response:

- Provide educational materials or personal consultation regarding rabies and *Giardia* (Appendix 4).

- Arrange for lethal reduction and/or removal of beaver population (Appendix 2). While problem beavers may legally be removed any time, removal of beaver during the normal trapping season may minimize the costs to the landowner and maximize the use of a renewable resource.

Type 2: Obstructed Culverts and Dams Less Than Two-Years-Old

Problem Description: This applies to the specific condition where beaver have obstructed a culvert or constructed a dam that is less than two-years-old and the dam poses a hazard to public health or safety on public or private property.

Management Response: The following are the BMPs for resolving Type 2 conflicts:

- Municipalities and state agencies should develop a regular monitoring program for roads, highways, and bridges to identify potential beaver problems, implementing appropriate control measures as described and authorized in this document as soon as possible. Regular monitoring can help to prevent expensive repairs and potential liability as well as conserve valuable wetland resources.



than one foot per day. This will help minimize erosion, stream degradation, the potential for downstream flooding, and the personal liability for damages. (Note: Beaver could potentially respond in one or two ways: they may abandon the area or attempt to work against all efforts to reduce water levels).

- ❖ The landowner, municipality, or state agency should investigate the possibility of installing and maintaining water control structures or exclusion devices. If installation of these devices is possible and appears to have some potential for success, follow the installation procedures as listed in Appendices 5, 6, 7 and 8. When installing one of these devices, it may also be necessary to control the size of the beaver population through an annual trapping program. Persons experiencing frequent conflicts with beaver should develop a relationship with a local trapper in order to foster the ability to manage the population during the legal trapping season.
- ❖ Because dam alteration or removal has the potential for flooding adjacent and/or downstream properties, all parties whose land can be affected by the person's dam alteration or removal must be notified in advance of dam alteration or removal.
- ❖ If a decision is made to remove the culvert obstruction or beaver dam as the means of eliminating the hazard, the first step is to lower the water level of the beaver impoundment by using a pump or siphon (refer to Appendix 4 for an example). The water level must be reduced gradually so that the impoundment is lowered not more
- ❖ To maximize the protection of spawning trout and salmon and the development of their eggs and fry, and if no imminent hazard exists, dam removal takes place only between June 1st and October 1st. Dam removal must be done in accordance with the requirements of Appendix 9.
- ❖ Immediately following dam removal, beaver fencing or water control devices should be installed and maintained in accordance with procedures contained in Appendices 6, 7, 8 and 9 for the purpose of preventing future beaver dam construction. Not all water control devices will work for all situations. Landowners should consult with an ANR representative to determine which form of control will work the best in their situation. Examples of different types of water control structures include screening, grills, wire meshes, electric fences, pipes, pond levelers, log drains, low water crossings, and culvert extenders.
- ❖ Persons who remove beaver dams or culvert obstructions in accordance with these BMPs must notify either a Fish & Wildlife warden, one of the Agency of Natural Resources regional offices, or Wildlife Services as soon as possible (Appendix 1).
- ❖ Any person who complies with the requirements listed in this section for Type 2 beaver dam problems will need no further authorization from the Agency for these activities. Compliance with the Type 2 requirements constitutes compliance with the 1272 Order contained in Appendix 11.

Type 3: Conflicts with an Established Beaver Dam or Dam Complex

Problem Description: Beaver dam or dams (inhabited or uninhabited) and which have been in existence two years or more, pose a hazard to human health or safety, or to public or private property.

Management Response: In most cases involving well-established beaver dams and associated wetlands, a site visit by one or more representatives of the agency will be necessary. Agency personnel must be contacted and will work with the landowner, municipality or state agency to identify solutions to the problem. The goal is to appropriately manage the nuisance beaver and associated hazard, while maintaining wetland values and minimizing the negative environmental impacts and personal liability for damages. Responses may vary. For example, with respect to the following situations:

- ✦ If the beaver dam, and any associated wetland, poses a hazard to human health or safety or has in the past caused substantial damage to property, roads or railroads, then the procedures described in Type 2 may be appropriate in some cases and will be determined on a site-by-site basis.
- ✦ In a situation where a beaver pond is no longer inhabited by an active colony, the potential failure of the unmaintained dam poses a likely threat to adjacent and/or downstream properties; and the retention of water no longer serves the ecological function that it once did, the ANR personnel may determine that the dam can be removed, lowering the water level no more than one foot per day. Other measures may be necessary during dam removal to protect downstream water quality and habitats.

In all cases listed above, if a municipality, railroad or the Agency of Transportation deems a situation to be an imminent hazard (i.e. high water during a significant rain event) to public health or safety, or to public or private property and cannot follow the BMPs due to the need for immediate action, they should contact the Department of Environmental Conservation or the Fish & Wildlife Department as soon as possible after taking immediate action.

Beaver dams obstructing man-made dams or their gates or spillways results in higher pond levels and reduce spillway capacity. This may cause an imminent hazard situation to occur with little to no warning. These beaver dams must be removed immediately upon discovery and as part of routine maintenance of other man-made dams. People who remove beaver dams in this type of situation do not need to comply with the BMPs, but it is recommended that they use the BMPs as guidance.

NOTICE: The alteration or removal of a beaver dam in accordance with these BMPs does not authorize dredging, filling, dam construction or any other activities that may have an adverse effect on wetlands or the waters of the state not authorized by these BMPs.

Scott Johnstone, Secretary
Agency of Natural Resources

Dated: August 5, 2002

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APPENDIX 1 – List of Regional Offices, Wardens, and Other Contacts

A. VERMONT FISH & WILDLIFE OFFICES

Montpelier (802) 828-1000

www.vermontfishwildlife.com

District Fish & Wildlife Offices:

Springfield (802) 289-0603

Wildlife Biologist – *Chris Bernier*

Wildlife Biologist – *Forrest Hammond*

Barre (802) 476-0199

Wildlife Biologist – *John Buck*

Essex (802) 878-1564

Wildlife Biologist – *John Gobeille*

Wildlife Biologist – *David Sausville*

Rutland (802) 786-0040

Wildlife Biologist – *Nick Fortin*

Wildlife Biologist – *Doug Blodgett*

St. Johnsbury (802) 751-0100

Wildlife Biologist – *Cedric Alexander*

B. DEC WATERSHED MANAGEMENT DIVISION

Montpelier (802) 828-1115

dec.vermont.gov/watershed

Rivers Program:

dec.vermont.gov/watershed/rivers

Rivers Management Engineers:

dec.vermont.gov/sites/dec/files/wsm/rivers/docs/RME_districts.pdf

Wetlands Program:

dec.vermont.gov/watershed/wetlands

Wetlands Ecologists:

dec.vermont.gov/watershed/wetlands/contact

C. WILDLIFE SERVICES

USDA, APHIS, WS 1-800-472-2437 and
1-802-223-8697

D. STATE GAME WARDENS

Montpelier (802) 828-1529

www.vtfishandwildlife.com/about_us/contact_a_warden

Warden District Map:

anrweb.vt.gov/PubDocs/FWD/Maps/Warden/WardensAsize.pdf

To contact a Game Warden District Chief, call your nearest district Fish & Wildlife Office:

Essex (802) 879-5669

Rutland (802) 786-3865

St. Johnsbury (802) 751-0103

Springfield (802) 289-0630

To contact a Game Warden, call your local State Police barracks:

Vermont State Police Barracks:

Bradford (802) 222-4680

Brattleboro (802) 254-2382

Derby (802) 334-8881

New Haven (802) 388-4919

Middlesex (802) 229-9191

Westminster (802) 722-4600

Royalton (802) 234-9933

Rutland (802) 773-9101

Shaftsbury (802) 442-5421

St. Albans (802) 524-5993

St. Johnsbury (802) 748-3111

Williston (802) 878-7111



APPENDIX 2 – People Available to Trap Nuisance Beaver

As a general rule, it is preferred that any lethal control of beaver be conducted by trained and licensed trappers during the legal beaver trapping season which runs from the fourth Saturday in October through the end of March the following year. The use of trained, licensed trappers during the beaver season not only provides landowners with the most cost effective means of managing beaver populations, but it also ensures that the most appropriate and humane methods are employed and that the fur resource will be utilized. In situations where the lethal control cannot wait until the legal beaver season, persons undertaking such control activities should notify their local game warden prior to commencing any control methods (Appendix 1). The names and contact information of local trappers can be attained by contacting the Vermont Fish & Wildlife (Appendix 1) or the USDA, Wildlife Services as follows.



For further information covering your area, contact:

United States Department of Agriculture
Animal and Plant Health Inspection Service
Wildlife Services
Parker Professional Center
617 Comstock Road, Suite 9
Berlin, Vermont 05602

Telephone: (802) 223-8690 and (800) 472-2437

WHAT IS GIARDIASIS?

Giardiasis is a gastrointestinal infection caused by a microscopic parasite called *Giardia lamblia*. This is a common parasite causing gastrointestinal illness in the United States. Giardiasis can be a problem in areas where sanitation is poor, in settings in which there may be problems with personal hygiene, such as institutions or day-care centers, or when unfiltered water supplies are contaminated with the organism.

HOW IS GIARDIASIS SPREAD?

A *Giardia* infection can be acquired when you ingest food or water which has been contaminated with the parasite. The parasite multiplies in the small intestine and is passed out with a bowel movement. Any food or drink which has become contaminated with an infected stool can transmit the parasite. The infection also can be spread person-to-person when hands, which are contaminated with an infected person's stool, are brought in contact with the mouth. Swallowing as few as ten parasites can cause the infection. Person-to-person transmission is the main way that giardiasis is spread, such as in day care centers and institutions, where personal hygiene may be poor due to age (infancy, elderly) or disability. Giardiasis also can be spread in this manner in a household setting.

ARE ANIMALS INVOLVED IN THE SPREAD OF GIARDIASIS?

Giardia parasites have been found in the stools of many animals, including rodents, dogs, cats, cattle, and wild animals. Animals living near water supplies, such as beavers and muskrats, have been found to be infected with *Giardia*. The extent of direct animal-to-human transmission of *Giardia* is minimal; there is greater evidence of indirect transmission such as through contamination of water supplies.

DO ALL PEOPLE WHO ARE INFECTED WITH GIARDIA GET SICK?

No. Some people who are infected with the parasite may only have minor symptoms and some people may not have any symptoms at all. However, these people can still pass *Giardia* parasites in their stool and become a source of infection for others.

WHAT ARE THE SYMPTOMS OF GIARDIASIS?

Symptoms of Giardiasis usually appear seven to ten days (and sometimes as long as four weeks) after ingesting the parasite. The most common symptoms are diarrhea, foul greasy stools, abdominal cramps, bloating, increased gas, weakness, and weight loss.

HOW IS GIARDIASIS DIAGNOSED?

Giardiasis is usually diagnosed through a laboratory examination of a stool sample. Your physician will forward the stool sample to a laboratory which will use a microscope to look for the parasite. Several stool samples may need to be examined to detect the parasite. The disease can also be diagnosed through a sample of fluid or a biopsy from the small intestine.

SOME GENERAL GUIDELINES:

1. Always thoroughly wash your hands with soap and water before meals, before preparing food, after having a bowel movement, after changing diapers, and after playing with your pets.
2. Do not drink untreated water from a surface water supply such as a pond, lake or stream. Although the water may appear to be clean, it may contain *Giardia* parasites which cannot be seen without a microscope. If only untreated water is available, boil the water before drinking it.

3. If you are taking care of a person with Giardiasis, use extra precautions after contact with the person's stool (for example, after changing diapers). Promptly and carefully dispose of any material which has been contaminated with stool and always wash your hands after such contact.
4. If your source of drinking water is from a well or another surface water supply, do not allow humans or animals to defecate (have bowel movements) near the water. In addition, appropriate water filtration systems can be effective in removing *Giardia* parasites from contaminated water.

WHAT IS THE TREATMENT FOR GIARDIASIS?

There are several medications which are effective in treating the infection. They are only available by prescription from your physician. Other treatments for diarrhea, such as increased fluid intake, may also be recommended by your physician.

HOW CAN GIARDIASIS BE PREVENTED?

Giardiasis can be prevented by practicing good hygiene and using caution before drinking water from an unknown source.

From: New York State Department of Environmental Conservation Bureau of Wildlife 1996.

APPENDIX 4 – Installing a Siphon to Lower Water Levels

Prior to installing water control structures or exclusion fences (Appendices 6 and 7), it is recommended that the water level of the impoundment be lowered gradually to lessen the risk of a dam “blow out” and to minimize water quality impacts. The most effective way to lower the water level of an impoundment is via the use of a high volume water pump. A gas powered “trash” pump offers the most versatility and can be operated under conditions in which other pump types would become plugged by debris. Depending on the size of the impoundment, multiple water pumps may be necessary to effectively lower the water level.

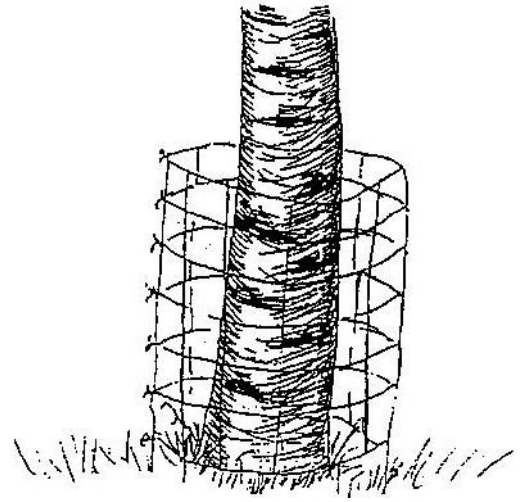
When a water pump is not available, a flexible pipe siphon may be used to gradually lower the water level. The flexible pipe should be placed over the top of the beaver dam with the outflow end of the pipe being firmly anchored within the original streambed below the dam and the intake end being staked in place approximately 12 to 18 inches beneath the surface of the pond. The use of pipe larger than 6 inches in diameter will make it difficult to start the siphon. Depending on the size of the impoundment, multiple pipes may be necessary to effectively lower the water level.

Once the water level has been lowered sufficiently, persons installing water control structures or exclusion devices should act quickly in order to take advantage of the low water conditions before rain and/or additional beaver activity raise the level again.



A. INSTALLATION OF RIGID WIRE FENCING TO PROTECT TREES

A firmly anchored and staked cage installed around the base of treasured trees and shrubs will generally offer protection from beaver damage. The cage should be constructed of garden type fencing, not chicken wire. The cage should be at least four feet high in order to prevent beavers from reaching the tree should they come out during periods of deep snow looking for food or if the water level rises. It is best to make a cage that has a diameter at least 2x the diameter of the tree for medium trees and 4-6x the diameter for smaller trees and saplings. This allows the tree to grow for many years before the cage has to be replaced to prevent girdling. This method works best for a small number of individual trees or shrubs but may be prohibitive for larger acreage or orchards.



B. INSTALLATION OF ELECTRIC FENCE OR STRAIGHT FENCE TO PROTECT LARGER AREAS OF SHRUBS AND TREES

An electric fence may be used to protect larger areas. Usually one strand strung no higher than 6 inches from the ground is all that is necessary. Electric fencing used in this manner consists of the same equipment used for livestock and is installed in the same fashion. Similarly, a non-electric fence constructed from garden type fencing and installed along beaver flowages can also be used to keep beavers from accessing larger portions of property such as orchards or crop fields.

Electric fences have also been used to successfully prevent beaver from plugging culverts. Solar fence chargers can be used to power the fence in more remote locations. Fluctuating water levels may result in problems if the wire is set at a certain level.



C. ABRASIVE TREE PAINT PROTECTION

In areas where people have a relatively small number of trees in need of protection and where fencing or caging may not be desirable due to aesthetics or remoteness, the use of abrasive tree paint has proven effective at preventing beaver damage (recipe borrowed from Beaver Solutions, LLC at beaversolutions.com). Abrasive tree paint is mixed and applied as follows:

Ingredients:

- Paint: Exterior Latex (choose a color to match the bark)
- Mason Sand: 30 mil - 70 mil

Formula:

- Mix 5 oz sand per quart of paint, or
- Mix 20 oz sand per gallon of paint, or
- Mix 140 gm sand per liter of paint.

Procedure:

Make in small batches at a time on the day you are going to apply it. Using too much sand will cause the mixture to roll off the tree. Apply paint to bottom three to four feet of tree trunk (2 feet above snow). You do not need to reapply for several years. Consider leaving some trees unpainted for beaver food. This formula does not work for saplings, so protect them with wire fencing.

MAINTENANCE, MAINTENANCE, MAINTENANCE

All too often people install some type of water control structure such as a beaver baffle or an exclusion fence and they assume the problem is solved. Like any other piece of equipment, periodic maintenance is required for these structures to function properly for years to come. Spending a few minutes several times a year will make the difference between success and failure.

A. BEAVER EXCLUSION FENCE

Beaver exclusion fences are a valuable tool managers use to protect expensive road infrastructure while allowing beaver to remain in the flowage. A plugged culvert can fail during a single rain event causing the road to wash out resulting in thousands of dollars in damage. These costly events can often be avoided with the construction of a beaver exclusion fence. Often-times large wetlands begin to narrow and funnel the water into culverts. Beavers looking to establish a territory follow the wetland and find themselves at the mouth of a culvert which announces itself with the sound of water rushing through it. The sound of rushing water signals the beaver to start building a dam. In a few days, sometimes even overnight, a single beaver can completely obstruct an entire culvert causing the road to become a dam making it unsafe and susceptible to erosion.

As water rises up against a roadbed and begins flowing over it, beaver will often try to build a dam across the top of the road surface backing water up even further and exacerbating the dangerous nature of the situation. A properly constructed and installed exclusion device can prevent such situations by restricting beaver from access to the culvert.

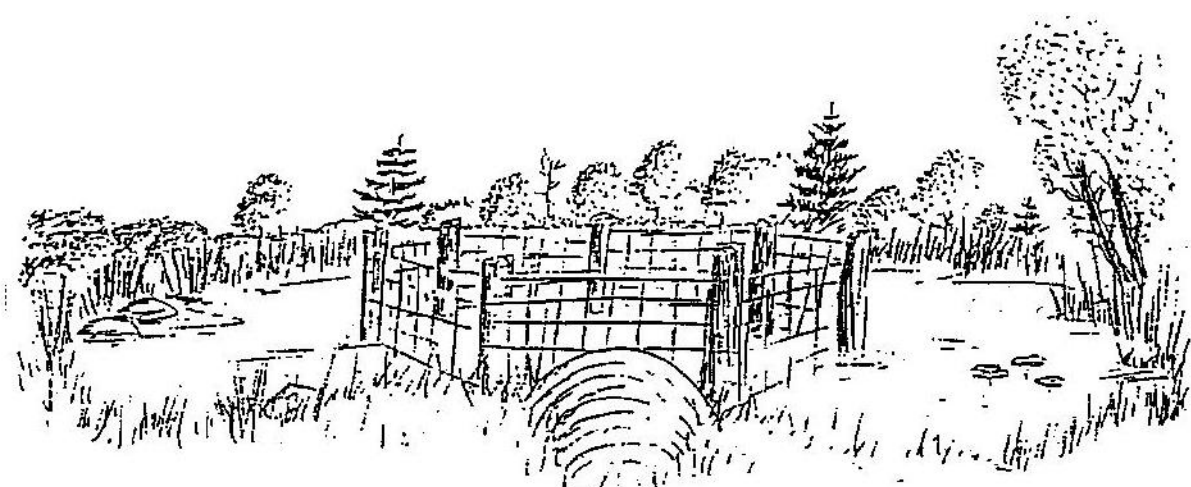
The exclusion fence design was originally developed by Skip Lisle for use on the lands of the Penobscot Indian Nation in Maine. The device consists of sturdy sharpened cedar posts which are pounded into the ground with a post pounding mallet or sledge hammer. Ideally, the posts are

installed approximately five feet apart, however, factors such as buried logs and rocks often dictate where the posts can be placed. The posts should be braced with 2x4's to strengthen the fence. The shape of the fence can vary greatly and for the most part depends on the space in front of the culvert. Past experience has shown that the greater the surface area of the fence and the more angles it has, the more effective it is at discouraging beavers from building around it. Five sided to eight sided fences seem to function best at larger culverts (>3 feet). While simple, triangle or diamond shaped fences can work at smaller culverts.

Ideally, beavers will leave the fence alone and no other issues will arise. However, on occasion, beavers will construct a dam around the fence. If this occurs, it is recommended to clear the debris a few times to discourage the beavers from building. If they are persistent, in some situations a baffle can be installed through the fence. Otherwise, sustainably trapping some beaver during the season may be the best course of action. The fence will at least keep the culvert clear and allow water to pass through during high flow events.

It is important to note that exclusion fences do not work in all situations. The main problem these exclusion devices encounter is high rates of water flow. Beaver frequently find a culvert later in the summer when the water is at its lowest level and flow for the year. The little trickle flowing through the culvert in August can become a roaring river in April. Fences simply cannot withstand these kinds of conditions no matter how much bracing is added

for extra support. As a general rule of thumb, the presence of a seemingly oversized culvert should indicate that it is required in order to handle the high flows it receives at other times of the year and caution should be exercised when considering the installation of an exclusion fence at this site. Additionally, if the substrate is composed of gravel or larger rocks, one can assume the stream flow is too great for a fence. In contrast, places where there are larger more stationary bodies of water receiving less flow or where the substrate is silt or mud are places better suited for exclusion. A common example is a road bisecting a wetland.



Tips and Tricks

1. The fencing should consist of galvanized farm panels which are available at most farm stores and tractor supply stores. They are typically referred to as sheep/goat panels or utility panels. They are 16' long and 48" tall made out heavy duty steel with 4x4 inch openings. **Panels with smaller openings catch too much debris and do not allow for small animal and fish passage. Openings that are too big allow beavers to swim through the fence.**
2. Before beginning to pound posts, use a pry bar or rebar to test the potential post locations to make sure there are not any rocks or other debris that will get in the way of the posts. Metal T posts can be substituted for cedar posts where the bottom is too rocky.
3. Before putting the fencing in the water and attaching it to the posts, use a pair of bolt cutters and cut the bottom of the fence, leaving a 4"

spike. Push this spike in the mud to prevent beavers from burrowing under it.

4. Posts pound easiest from a step ladder or other elevated position.

5. Sometime the fence needs to be cut to properly fit over large rocks and other objects on the bottom.
6. Spruce 2x4's should be used to brace the cedar posts. The fencing should then be attached to the 2x4's using 1-1/2 inch barbed galvanized fence staples.
7. Attach and wrap the fencing on the outside of the cedar posts. This prevents beavers from getting access to and chewing on the posts.
8. Use dry cedar posts. New, green posts will absorb a lot of the energy when pounding the post instead of transferring the energy into the ground.

Material and Equipment List:

- 6' cedar posts or metal T posts (quantity depends on size and shape of fence)
- Goat feedlot panels – 4' tall with 4"x4" openings (quantity depends on size and shape of fence)
- Spruce 2x4's (quantity depends on size and shape of fence)
- 1 1/2" galvanized fence post staples for cedar posts or heavy gage wire for T posts
- 3" framing nails or exterior screws
- Bolt cutters
- Hammer
- Sledge hammer
- Power drill
- Cordless circular saw or hand saw

All of these materials can be purchased at your local hardware, farm supply or tractor supply store.

Examples of Exclusion Fences:



Five sided fences tend to be the most cost effective and successful design.





Diamond shaped fences create sharp angles that seem to deter beavers



Triangle fences can work at small culverts and where space is limited.



Before



Beavers completely buried the inlet of the culvert causing water to back up against a road and flood a nearby pasture.

After



A fence was installed which prevented the beavers from accessing the inlet of the culvert and plugging it.



Beaver were especially persistent at this site trying to stop water from flowing through the drainage structure.

This drainage structure was cleaned out every week for over a year only to be obstructed again by the following week. Once the exclusion fence was installed, beaver ceased causing problems at the site. The rock back-fill around the cement spillway made pounding traditional cedar posts impossible. Metal fence posts were used instead and the wire panels were attached to the posts with galvanized electric fence wire and zip ties.



At sites where it is impossible to pound posts deep enough to support a fence or where seasonal water flow makes a traditional beaver exclusion fence impractical, a fence like this can work. It was designed by VTrans personnel. It consists of a metal frame with fencing welded to it. This fence can be removed intact for cleaning as well as during the winter in order to prevent wear and tear, ice damage, and strong spring runoffs. It can also be removed if road work needs to be done such as a culvert replacement or if there is a strong storm predicted that might cause significant flooding.

Examples of poor locations for fences:



Stream flow was too great and during high water caused the far side of the fence to collapse. The presence of larger rocks should have been an indication of the stream flow.

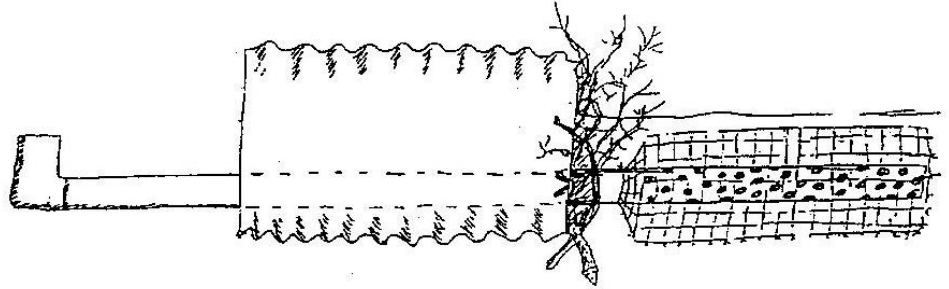


The presence of gravel indicates faster water currents and the likelihood of the fence collapsing during high water.

APPENDIX 7 – Installation of Water Control Structures

A. CLEMSON BEAVER POND LEVELER THROUGH CULVERTS

The Clemson Pond Leveler originated at Clemson University and has been field tested for several years. It is designed to resist clogging by beaver activity and requires minimal maintenance. The wire mesh intake basket



is constructed with at least a 10 foot long section of perforated PVC pipe approximately 8 inches in diameter. A long section will need to be added to extend through the culvert. The tubing is surrounded by welded wire (with a mesh size not smaller than 2 inches x 4 inches) and the end is capped with wire. Support wires are necessary to hold the tubing in the center of the mesh basket.

The downstream end of the tubing should extend at least three to four feet past the end of the culvert. Water levels can be controlled by the elevation of the elbow on the end of the pipe. The mesh basket is supported off the bottom by sturdy metal stakes.

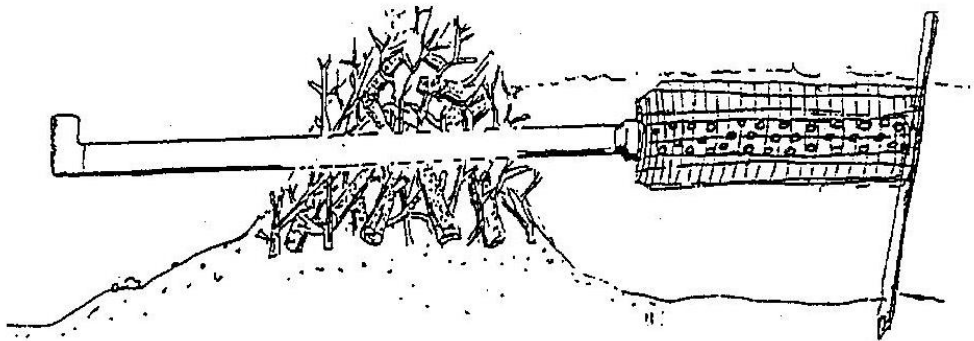
The Clemson Beaver Pond Leveler:

http://files.dnr.state.mn.us/assistance/backyard/privatelandhabitat/clemson_bever_pond_leveler.pdf

B. CLEMSON BEAVER POND LEVELER THROUGH BEAVER DAM

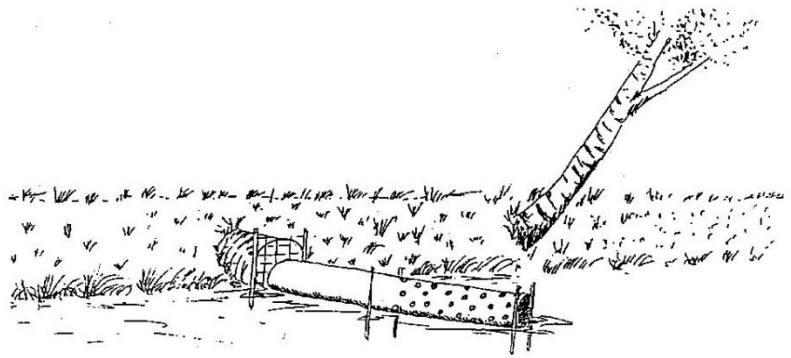
The Clemson Pond Leveler can be used with beaver dams. Once the water level has been lowered by removing a small section of the dam, the plastic pipe can be installed. An approximate rule of thumb is to install an 8-inch plastic pipe for every 3 square miles of drainage. Several pipes may be needed for larger projects.

For construction and installation information, refer to Appendix 8A.



C. PERFORATED CULVERT PIPE

This perforated culvert pipe works best when it is submerged and extended through a culvert. The 8-inch pipe is held off the pond bottom with metal posts. Both ends should be covered with rigid wire. The end of the culvert should also be covered with wire. Generally, the more holes in the pipe, the more difficult it will be for the beaver to plug them. Periodic maintenance is required.



D. BEAVER BAFFLE

- 1) What is a beaver baffle?** A beaver baffle is a simple, inexpensive and effective way of controlling the water level of beaver flowages. It consists of several lengths of 20' single wall (flexible) culvert pipe and a "cage" constructed of sturdy wire mesh which encloses the end of the pipe. The cage is submerged in the beaver pond and the pipe is run from the cage through a notch cut into the beaver dam which dictates the water level of the impoundment. It allows water to exit the pond through the beaver dam without having to breach the dam on a daily basis.
- 2) How does a beaver baffle work?** A beaver baffle works simply by moving water from the beaver pond through the dam in such a way that a beaver cannot figure out how to stop the flow. A notch in the dam is made using hand tools such as a potato rake. The depth of the notch determines the new water level. Once the notch is at the desired depth, the baffle is ready to be installed into the pond. The cage is dropped into the deepest part of the pond. The pipe, which is connected to the cage, runs along the bottom of the pond before passing through the notch in the dam and ending in the original streambed just downstream of the dam. This allows water to flow into the cage, through the pipe, and then through the beaver dam into the stream below. Once the baffle is installed, the water level will continue to drop until the pond is level with the top of the pipe. It is the top of the pipe that ultimately dictates the resulting water level. This system baffles beavers such that they cannot figure out how to prevent water loss from their pond.
- 3) Do beaver baffles require maintenance?** Yes, the effective use of beaver baffles requires regular maintenance. Once the water level subsides and the problem situation is resolved, ongoing attention to the baffle is necessary or it will most likely fail.

The responsibility for regular maintenance should be assumed by the pond owner or a designated party. Fortunately, baffle maintenance is quick and easy if done regularly. The most important part of maintenance is to "shake" the cage so as to keep it from becoming inundated with sediment. Beavers are constantly repairing their dam and, in doing so, are continually stirring up the substrate of the pond particularly in close proximity to the dam where the pipe and cage are located. The resulting sedimentation can eventually overcome the cage and pipe rendering the baffle incapable of moving water. If left too long, the baffle can become completely buried and irretrievable. To prevent this, at least

once a year the cage needs to be hoisted from the pond's bottom and "shaken out" before being put back in place. This frees the baffle of sediment build up and returns it back to its proper position on the bottom of the pond. With larger cages in deep water, a row boat can be used to access the cage and a potato rake used for hooking the cage to jostle it free from sediment.

- 4) **Does a beaver baffle prevent flooding?** A beaver baffle is not a cure for all beaver-related flooding. The installation of a beaver baffle can, however, reduce the effects of potential flood events in several ways. First, lower water levels in an impoundment resulting from the installation of a beaver baffle create additional storm water storage capacity by holding back storm water up to the volume of the original size of the impoundment. Secondly, because impoundments hold less water post baffle installation, a breach of a dam with a baffle installed should not have consequences as significant if the baffle was not installed. Last, and perhaps most importantly, the use of beaver baffles to resolve conflicts allows for the continued existence of beaver within a flowage. These beaver, in turn, typically construct multiple dams within the flowage all of which provide some storm water storage capacity that works to reduce the erosional effects of flash flood events. Although a beaver baffle will not prevent flooding 100% of the time, for people who are tolerant of fluctuating water levels and who are willing to do some minimal yearly maintenance, a beaver baffle can be a very valuable tool for resolving conflicts and mitigating flood potential.
- 5) **Limitations of a beaver baffle:** It is important to understand baffles have their limitations and do not function in every situation. Large ponds or lakes as well as rivers and creeks have a volume of water which is too great for the baffle to be able to sustain. A baffle may function properly during periods of dry weather but with the addition of rain, even a small stream may be too much for a baffle to handle. It can be difficult to determine if a baffle will work in a given situation. Sometimes trial and error is the only way to know.

After a baffle is installed, if the beavers are not satisfied with the lower water level, they may decide to abandon the location completely or, a more common response, they may build a new dam just upstream or downstream of the baffle thereby rendering it ineffective. If this happens, the landowner needs to decide if they want to invest in a second baffle or proceed in a different direction. Under the right conditions, baffles function best when they are maintained on a yearly basis and the beaver population is controlled through regulated harvest during the trapping season.

6) Building a 5' rectangle beaver baffle

Rectangle baffles are best suited for shallow impoundments, preferably with a hard bottom. Because these baffles are only two feet tall, they are prone to becoming inundated with silt and mud without regular maintenance. Depending on the size of the beaver impoundment and your overall goals, a baffle with a reduced pipe of 8 inches may be effective, whereas larger impoundments may need a 12-inch pipe to move the required volume of water. When in doubt, use the 12-inch pipe.



The baffle on the left was built to use a 12 inch pipe to drain off water through the dam while the baffle on the right was equipped with a reducer to allow the baffle to use an 8 inch pipe through the dam.

Material List:

5' rectangle baffle with reducer

(4) 1/16" Wire rope clips
(4) 8" split couplers
(1) 12" split coupler
(1) 12" end cap
(1) 12" to 8" reducer
(4) Cinder blocks
5' of 3/32" galvanized cable
5' of 12" single wall Hwy pipe
40' of 8" single wall Hwy pipe
26' of 1.5"x1.5" 12.5 gauge PVC coated wire mesh
Hog rings, 12 gauge wire or aluminum lobster trap clips
Heavy duty zip ties
5' to 10' of poly rope (floating)

5' rectangle baffle without reducer

26' of 1.5"x1.5" 12.5 gauge PVC coated wire mesh
45' of 12" single wall Hwy pipe
5' of 3/32" galvanized cable
(4) 1/16" Wire rope clips
(1) 12" end cap
(4) Cinder blocks
(4) 12" split couplers
Hog rings, 12 gauge wire or aluminum lobster trap clips
Heavy duty zip ties
5' to 10' of poly rope (floating)

Required Tools:

Power drill
2 1/2" hole saw
Circular saw or hand saw
Bolt cutters
Wire cutters
Tape measure
Needle nose pliers
Crimpers
Lobster trap clinch tool (optional)

Step 1. Cut (4) five foot sections and (3) two foot sections from the PVC coated wire mesh. Cut off all tag ends. With (2) of the two foot pieces, cut out the middle section just large enough for the 12 inch pipe to fit through. It should fit snug.



Step 2. Connect (3) of the five foot pieces together using hog rings, wire, zip ties or aluminum lobster trap clips. (We have found using a lobster trap crimper with aluminum clips make the baffles more durable). Then, connect the two foot piece that doesn't have an opening to one end.

Step 3. Take the five foot section of 12 inch pipe and connect the 12 inch end cap to one end. Using the 2.5 inch hole saw, drill holes in the pipe leaving two ribs in between each hole. Do not drill holes closer than 3 ribs to the open end. This is where the coupler will be attached.



Step 4. Attach one of the two foot sections of wire mesh (with the middle cut out) approximately a quarter to a third of way from the end. Then, insert the pipe with the end cap going in first toward the closed end of the cage. Leave a few inches of space between the end cap and back of cage. Zip ties or wire can be used to secure the pipe to the cage.



Step 5. Attach the last two foot piece to the front of the cage. A few inches of the pipe should stick out the front to allow for a coupler to be attached. Connect the last five foot section to the top of the cage. If a reducer is being used, attach it now with a split coupler.



7) Building a Cylindrical (Round) Baffle

Round baffles should be used in impoundments deeper than 6 feet, when the water level is at its desired depth. It's crucial the baffle doesn't become exposed to the surface as it will greatly increase the chances of the beavers burying it. They will be able to hear the water flowing into the pipe. Again, depending on the size of the impoundment, 8 inch or 12 inch pipes can be used. In cases where there is a greater amount of water, two 12 inch pipes can be installed in the same cage.



Depending on the water depth, round baffles can be installed standing on end (as shown), laying on its side with the pipe inserted on the side or end of the cage.

Material list:

Round baffle with 12 inch pipe

- (2) 16' 4"x4" feedlot panels
- (4) Cinder blocks
- (3) 12" split couplers
- 40' of 12" single wall Hwy pipe
- Heavy duty zip ties
- 5' of 3/32" galvanized cable
- (4) 1/16" Wire rope clips
- 5' to 10' of poly rope (floating)

Round baffle with 8 inch pipe

- (2) 16' 4"x4" feedlot panels
- (4) Cinder blocks
- (3) 8" split couplers
- 40' of 8" single wall Hwy pipe
- Heavy duty zip ties
- 5' of 3/32" galvanized cable
- (4) 1/16" Wire Rope clips
- 5' to 10' of poly rope (floating)

Required tools:

- Work gloves*
- Heavy duty pliers
- Bolt cutters
- Tape measure

A second person will make building this baffle a lot easier.

*The cut ends of the panels are extremely sharp. Use a quality pair of work gloves.

Step 1. Take one of the feedlot panels and count 36 of the 4 inch squares. Using bolt cutters, cut the panel leaving the tag ends on the longer section. The smaller section should make a 4 foot square. Do the same thing with the other 16 foot section. Discard the longer section. The 4 foot square is all that is needed from the second panel.



Step 2. With the longer section of panel lying flat on the ground, take the end that was not cut and roll it into a cylinder with the tag end on the outside. This is where having a second person is helpful. Zip tie the two ends together so the first whole section of squares overlap. Bend the tag ends up inside the cylinder to help hold it. Stand it on end and continue to bend the tag ends around so they securely hold the ends together.



Step 3. Place one of the 4 foot panels on top of the cylinder, so the edges overlap the sides. The cylinder may need to be “shaped” for the panel to fit. This can be done by laying the cylinder on its side and pushing on the sides to make it more even and round. Next, cut tag ends all of the way around the 4 foot panel. These ends will be bent down and around the top of the cylinder to hold it in place. Zip ties or wire can be used to help hold it in place, as well.



Step 4. Repeat step 3 to close the other end of the cylinder.



Step 5. Determine how the baffle will be installed (standing up or on its side). If using a 12 inch pipe, cut a 2 square by 2 square opening about halfway up the cylinder, leaving the tag ends on the cylinder. Bend the tag ends 90 degrees inside the cylinder. This is where the pipe will be inserted.



8) Installing a Beaver Baffle

The same process is used for installing a round or rectangle baffle. Although, assembling the baffles may vary slightly between designs. Having a couple of people will make the installation process a lot easier.



An active beaver flowage with adequate water supply is almost always full to the top of the dam. To reduce the likelihood of a dam washing out when installing a baffle, the water level will first need to be lowered either by using a water pump or a siphon (Appendix 5).

Once the water level is lowered, the first step is to notch the dam. This is done by hand or hand tools, such as a potato rake. It works best to start at the back of the dam and pull out all the long branches and sticks. Once all the long sticks are gone, there should be a wall of mud and small sticks left at the top of the dam. Sink the rake into the mud in front of the dam and pull toward the back of the dam. The bottom of the notch should be deep enough so the top of the pipe will be at the desired water level.



If using 12 inch pipes, take a circular saw and slice the top of the ribs on all lengths of pipe going length wise. Make sure the slits are facing up when installed. This allows air to escape the pipe when it is sunk. This step is not necessary with 8 inch pipe as the piping is lighter and more flexible.

Round baffle only: Using a ½ inch drill bit, drill 4 holes (top, bottom and left, right) approximately 1 foot from the end of one pipe. This will be inserted into the caging. Take wire or a spare piece of the feedlot panels and thread it through the holes opposite of each other and fasten it to the cage. Bend the tabs of the cage back toward the pipe to help secure it in place.

Connect all the piping together using the split couplers and zip ties. It is easiest to start at the baffle and work toward the outlet. Depending on the habitat, the easiest place to assemble the baffle maybe on top of the dam unless there is an open field immediately adjacent to the impoundment. Take a length of polyester, floating rope, long enough to reach the surface and tie it to the top end of the cage. This is used to help place the baffle and makes it easier to lift the baffle to clean in the future.





Cinder block weights (saddle bags): Take a 2 ½ foot piece of 3/32" galvanized wire and pass one end through one cinder block with a 1/16" wire rope clip. Loop the tag end back through the clip and tighten the nuts. Repeat with the other cinder block. Create two of these weights. These weights will help keep the pipe on the bottom.

Once all the pipe is connected, place the cage in the back of a row boat or canoe. If the impoundment is shallow enough, the baffle can be waded out. Try to keep the cage above the water if possible, as it becomes much more difficult to move once water is inside the pipe. If there is not access to a boat or canoe, a length of rope can be threaded through the cage. Walk the tag ends of the rope to the opposite shore and pull the baffle in that direction. Once the baffle is at its desired location, one end of the rope can be released and pulled back through the cage.

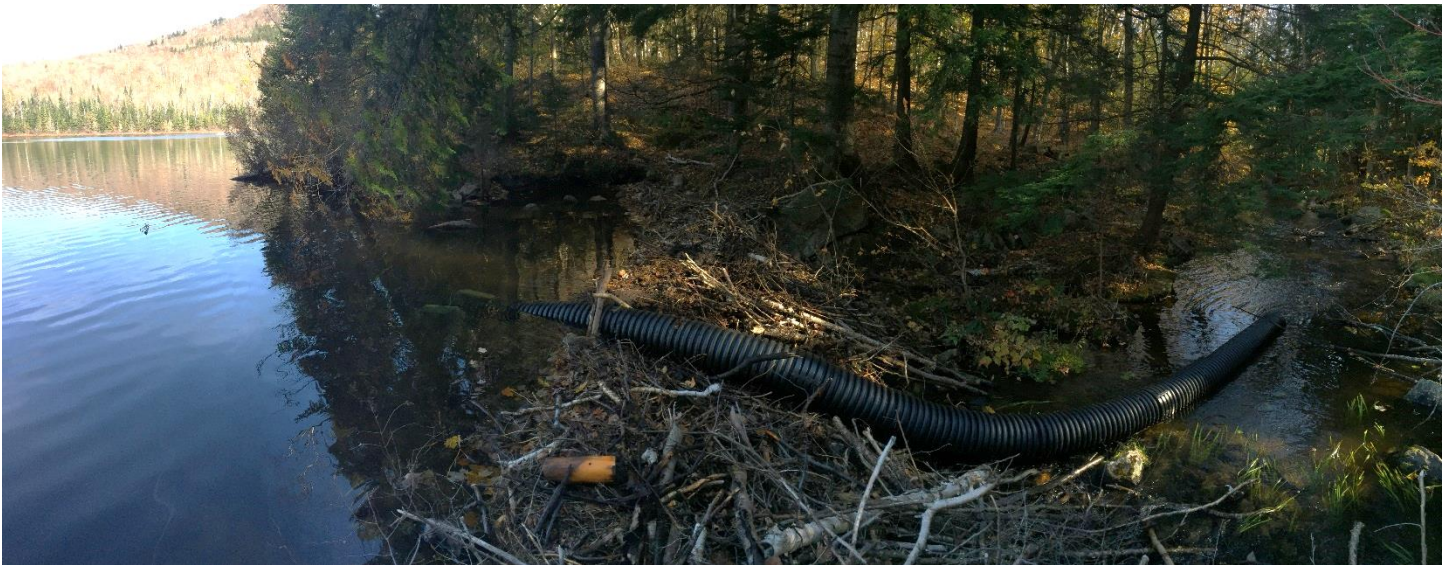


A second person should help “steer” the baffle to the desired location and place the pipe next to the notch. Once the cage is lowered into the water, push the pipe into the notch. Round baffles should be dropped in 6+ feet of water and both style cages should be AT LEAST 30 - 40’ FROM THE DAM. If the cage is dropped too close to the dam, the beavers will find the cage and think it is a leak in the bottom of their dam. They will plug the “leak” by inundating the cage with mud, quickly rendering it useless. If this happens, it is very difficult, if not impossible to retrieve the cage.



Take one of the saddle bags and drop it over the pipe approximately 10 feet from the cage so the cinder blocks straddle the pipe - one on each side. The second set of saddle bags can be placed 10 to 15 feet from the dam if the pipe is not sinking very well or they can be placed right at the top of the dam. Sometimes, the pipe will need to be pushed down all the way back to the dam in order to get all of the air out.

Finish securing the pipe to the top of the dam. Take long, sturdy sticks and crisscross them over the pipe. Placing a heavy log over the top of these sticks will help hold everything in place. If there is an active beaver colony in the pond, they will likely rebuild the dam right over the pipe thus securing the baffle in the dam.



A finished installation. The cage has been placed 30 to 40 feet from the dam, the pipe has been sunk with saddle bags, secured to the dam and the outlet of the pipe extends 10 to 15 feet below the dam.



One year after installation. The beavers have repaired the dam over the pipe and the water level is being maintained below the top of the dam. This can reduce the risk of flooding by allowing excess water to be stored in the impoundment during high water. Depending on the watershed size, it may take a few days for the baffle to drain the excess water to the lower level.

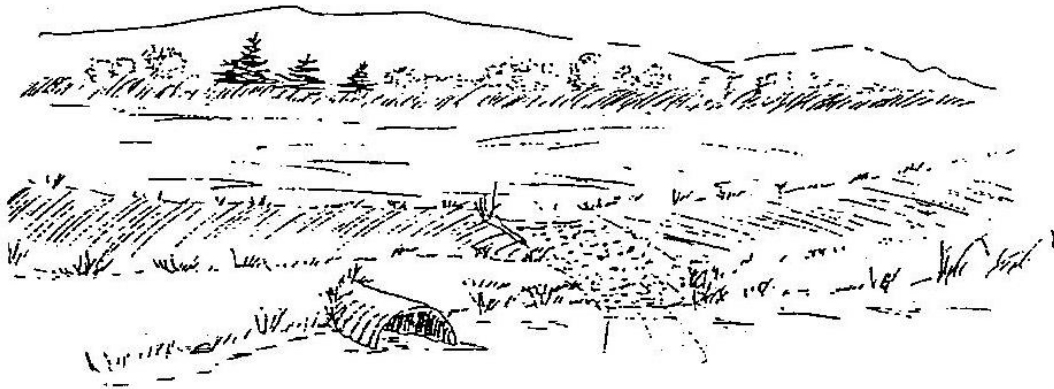
MAINTENANCE, MAINTENANCE, MAINTENANCE

All too often people install some type of water control structure such as a beaver baffle or an exclusion fence and they assume the problem is solved. Like any other piece of equipment, periodic maintenance is required for these structures to function properly for years to come. Spending a few minutes several times a year will make the difference between success and failure.

LOGGERS ROAD CROSSING

This method is used in logging and remote areas that experience periodic flooding because of plugged culverts. The crossing is actually an emergency outlet for ponded water and will allow travel across through the area. This method can also be used in places that receive heavy flows. If the culvert were to become overwhelmed, then the water could still flow through the low crossing in the road. Otherwise, the road will begin to wash away as the water overwhelms the culvert and flows up and over the road.

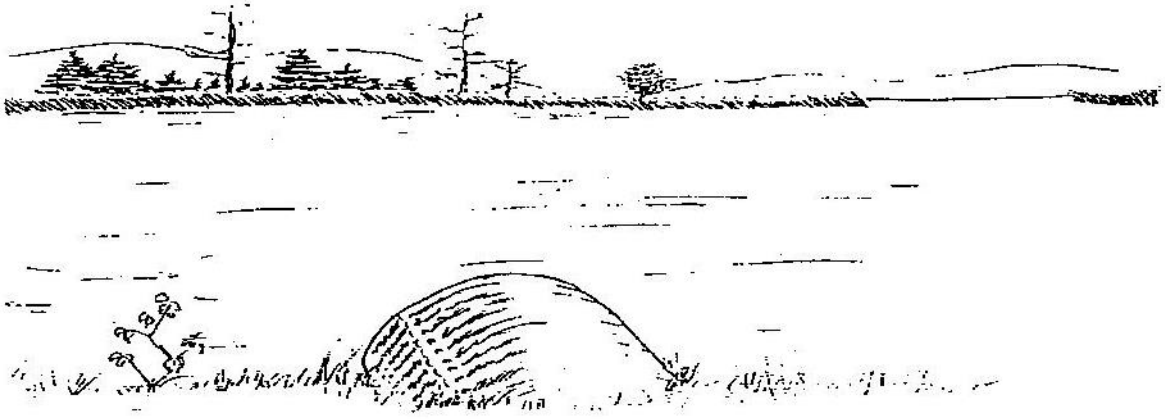
The crossing consists of a sturdy rock base covered with coarse gravel. Some maintenance will still be involved as active beavers could dam the upstream edge causing upstream erosion. Solid construction is important as well as plans for the crossing after it is no longer needed.



APPENDIX 8 – Nicholson Culvert Wing Extension

A. BEFORE – SUSCEPTIBLE TO BEAVER IMPACT

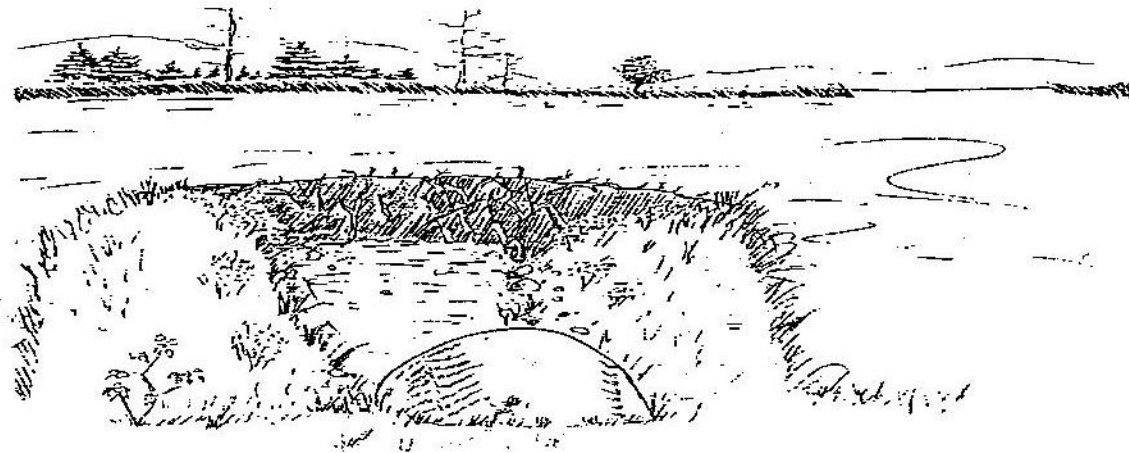
Beaver realize that it takes considerably less effort to plug a culvert with sticks and mud to raise water levels. Culverts located in areas with abundant trees and shrubs can be easily impacted. Not all impacts occur on the end of the culvert. A real problem may occur when the culvert's plugged in the middle (under a road). Rising water levels can impact the road.



B. AFTER – CULVERT WING EXTENSION

Observations of various culvert projects have shown that culverts which had wings constructed during installation had considerably less beaver problems. The wings are extended out from the road bed approximately 20 feet and are generally 10 to 12 feet wide. The beaver will tend to build their dams at the ends of the wings and not impact the culvert.

If the project is in a mapped Class II wetland, a minor Conditional Use Determination may be needed from the Wetlands Office.



APPENDIX 9 – Beaver Dam Removal

The alteration of a beaver dam may be necessary for the removal of an obstruction, lowering of the water level behind the dam, or installation of various types of water control devices (see Appendices 8 and 10). Modifications of the dam must be carried out in a manner that releases water controllably, minimizes the discharge of sediments and debris to waters below the dam, thereby lessening disturbance to fish and wildlife habitats, and avoids damage to downstream properties as a result of flooding, erosion, culvert failure or depositing debris on other lands.

Also, many beaver dams are located on productive trout streams. Trout populations are particularly sensitive to environmental disturbances. The time of year when trout are spawning (fall and spring) and their eggs and fry are developing (winter and spring) must be avoided, whenever possible, when removing or altering beaver dams. By conducting this work in an appropriate manner during the period of June 1st through October 1st, severe adverse impacts on trout resources can be largely avoided.

To prevent potential problems, the water level within a beaver impoundment must be lowered gradually, i.e. less than one foot per day. The

preferable method for lowering the water level is to install one or more siphons constructed from PVC pipes (Appendix 5) or using a gas-powered portable pump. The number of siphons or pumps needed will be determined by the amount of water entering the beaver impoundment. Removing small sections of the beaver dam crest by means of manual tools (e.g., potato rake, pry bar, chainsaw, winches) may be employed but are less effective in preventing downstream problems. Furthermore, unless beaver numbers have been reduced or they have abandoned the site altogether, beaver may quickly repair any breaches made in the dam. *Explosives must never be used to remove a beaver dam.*

Once the water level behind the dam has been lowered to the extent necessary to implement more permanent water control, the remainder of the dam may be removed. Care must be taken during the process to avoid causing problems with downstream water quality and flooding. Dam debris must be transported away from the site and outside of the floodplain to prevent its re-entry into the waterway during the periods of high water or by beaver re-using it as a source of dam building materials.



10 V.S.A. §1272

Re: Removal of Beaver Dams

The Secretary (“Secretary”) of the Agency of Natural Resources (“Agency”), pursuant to the provisions of 10 V.S.A. §1272, hereby makes the following findings in support of the issuance of an Administrative Order.

FINDINGS

1. The construction of dams and lodges by beavers can result in situations where beaver activity can pose a hazard to public safety or welfare or public or private property through flooding, contamination of water supplies, impairment of drainage and/or septic systems, impairment of agricultural lands, and other hazards.
2. In order to abate the hazard, landowners, municipalities, and state agencies may be required to drain and/or remove beaver dams.
3. The drainage and/or removal of beaver dams can reasonably be expected, in many instances, to create or cause a discharge to waters of the state in violation of 10 V.S.A. Chapter 47 of the Vermont Water Quality Standards and, in some situations, may violate the Vermont Wetlands Rules.
4. The Secretary has determined that for some situations, reasonable and proper methods exist which, if followed, can reduce or eliminate the potential violations.

Based on the above findings, the Secretary hereby issues the following:

1. Any person who removes a beaver dam that is obstructing a culvert or who dewateres a beaver pond and removes the associated beaver dam is authorized to do so provided the following conditions are met:
 - a. The dam and associated pond are less than two years old unless the dam is obstructing a culvert, in which case the time limitation does not apply;
 - b. The dam and/or associated beaver activities pose a hazard to public health or safety or public or private property; and
 - c. The dewatering of the beaver pond and/or removal of the dam is performed in accordance with the *“Best Management Practices for Resolving Human-Beaver Conflicts in Vermont”* issued by the Agency dated August 5, 2002.
2. This approval does not grant any exclusive rights or privileges which would impair any rights possessed by other riparian or littoral owners of the State of Vermont. It does not grant any right, title, or easement to or over any land not owned in fee by the applicants, nor does it authorize any damage to private property or invasion of private rights or the violation of Federal, State, or local laws or regulations.

3. Any person granted approval under this Order is not relieved of his or her responsibility to comply with any other Federal, State, or local laws.
4. The Department of Environmental Conservation maintains continuing authority over this activity and may at any time under additional protective measures be taken to protect water quality or significant wetlands.
5. The Department of Environmental Conservation in granting this approval accepts no legal responsibility for any damage direct or indirect of whatever nature and by whomever suffered arising out of the activity described.

Christopher Recchia, Commissioner
Department of Environmental Conservation

By Christopher Recchia
Date August 5, 2002

APPENDIX 11 – Statutes and Regulations Pertaining to Beaver and Beaver Dams

- 1) **Title 10 V.S.A. §1259 – Prohibitions: (a)** “No person shall discharge any waste, substance, or material into waters of the state, nor shall any person discharge any waste, substance, or material into an injection well or discharge into publicly owned treatment works any waste which interferes with passes through without treatment, or is otherwise incompatible with those works or would have a substantial adverse effect on those works or on water quality, without first obtaining a permit for that discharge from the secretary.”
- 2) **Title 10 §4828 – Taking of rabbit or fur-bearing animals by landowner; selectmen; certificate, penalty: (a)** “The provisions of law or regulations of the board relating to the taking of rabbits or furbearing animals shall not apply to an owner, his employee, tenant, or caretaker of property protecting the same from damage by rabbits or furbearing animals, or to the selectmen of a town protecting public highways or bridges from such damage or submersion with the permission of the owner of lands affected...”
- 3) **Title 10, App. §43 – Method of taking: (e)** “A person shall not interfere in any manner with dams, dens, or houses of beaver except upon special permit in writing from the commissioner, provided, however, that these provisions shall not apply to an owner of property, the agent, employee, tenant, or caretaker of the owner protecting the same from damage by beaver, or to the legislative body of a municipality or the agency of transportation, within their respective jurisdictions, when protecting public highways or bridges from such damage or submission, with permission of the owners of lands affected, or to a person acting under authority of an order under section 37 of Title 19.
- 4) **Title 10 V.S.A. §4138 – Control of fish, game; powers of commissioner: (c)** “Any measures which involve temporary pollution of waters shall be carried out in accordance with the provisions of section 1263a of chapter 47 of this title.”

(d) “The commissioner shall cooperate with the transportation board in any proceeding brought under section 37 of Title 19 to protect a highway, railroad, or public airport from impoundments of water by beaver.”
- 5) **Title 10 V.S.A. §1263 – Discharge permits: (a)** “Any person who intends to discharge waste into the waters of the state or who intends to discharge into an injection well or who intends to discharge into any publicly owned treatment works any waste which interferes with, passes through without treatment, or is otherwise incompatible with that works or would have a substantial adverse effect on that works or on water quality shall make application to the secretary for a discharge permit. Application shall be made on a form prescribed by the secretary. An applicant shall pay for an application fee in accordance with 3 V.S.A. §2822.”
- 6) **Title 19, §37 – Impoundments of water created by beaver: (a)** “Transportation board jurisdiction. On petition of the agency of transportation, the legislative body of an affected municipality, or the owner or operator of an affected railroad or sponsor of an affected public airport, or on its own motion, the transportation board may, after notice and hearing under chapter 25 of Title 3, issue an order requiring the removal or abatement of an impoundment of water created by beaver which threatens to damage or substantially submerge a highway, railroad, or public airport. Notice shall be given to the owner or owners of affected land, the legislative body of the affected municipality, and the secretary of the agency of natural resources. If the board determines that an impoundment of water created by beaver threatens to substantially damage or submerge a highway, railroad, or public airport, its order shall direct that the impoundment be abated which as minimal impact on affected land and natural resources as possible, or if necessary, removed.

Persons taking actions pursuant to an order of the board under this subsection shall be exempted from the requirements of 10 V.S.A. 905(7).”

7) **Wetlands Regulations**

- 8) **Title 10 V.S.A. §1272 – Regulations of activities causing discharge or affecting significant wetlands** – “If the secretary finds that any person’s action, or an activity, results in the construction, installation, operation or maintenance of any facility or condition which reasonably can be expected to create or cause a discharge to waters in violation of this subchapter, or to violate the board’s rules under section 905(9) of this title relating to significant wetlands, the secretary may issue an order establishing reasonable and proper methods and procedures for the control of that activity and the management of substances used therein which cause discharges or violations of board rules with respect to significant wetlands in order to reduce or eliminate those discharges and rule violations with respect to significant wetlands. Any person who receives an order pursuant to this section may appeal to the board as provided in section 1269 of this title.
- 9) **Title 10 V.S.A. §1274 – Enforcement: (a)** “Notwithstanding any other provision or procedure set forth in this chapter, if the secretary finds that any person has discharged or is discharging any waste in violation of this chapter or that any person has failed to comply with any provisions of any order or permit issued in accordance with this chapter, the secretary may bring suit in the superior court in any county where the discharge or noncompliance has occurred to enjoin the discharge and to obtain compliance. The suit shall be brought by the attorney general in the name of the state. The court may issue a temporary injunction or order in any such proceedings and may exercise all the plenary powers available to it in addition to the power to:
- (1) Enjoin future discharges.
 - (2) Order the design, construction, and installation or operation of pollution abatement facilities or alternate waste disposal systems.
 - (3) Order the removal of all wastes discharged and the restoration of water quality.
 - (4) Fix and order compensation for any public property destroyed, damaged, or injured. Compensation for fish taken or destroyed shall be deposited into the fish and wildlife fund.
 - (5) Assess and award punitive damages.
 - (6) Levy civil penalties not to exceed \$10,000.00 a day for each day of violation.
 - (7) Order reimbursement to any agency of federal, state, or local government from any person whose discharge caused governmental expenditures.
- (b)** “The secretary, by rule, shall define those violations which are significant, based upon the magnitude, duration, consequences, and causes of the violation. When a significant violation occurs, the secretary may initiate proceedings to compel compliance by and seek penalties from the violator. A court, upon finding that such a violation has occurred, shall order compliance and retain jurisdiction to assure that compliance schedules are met. The court also shall impose penalties. Action under this section shall not restrict the secretary’s authority to proceed under section 1267 of this title.”
- 10) **Title 10 V.S.A. Chapter 37, §905 – Duties; powers: (7)** “Adopt rules for the identification of wetlands which are so significant that they merit protection. Any determination that a particular wetland is significant will result from an evaluation of at least the following functions which the wetland serves:

- (A) provides temporary water storage for flood water and storm runoff;
 - (B) contributes to the quality of surface and groundwater through chemical action;
 - (C) naturally controls the effects of erosion and runoff, filtering silt and organic matter;
 - (D) contributes to the viability of fisheries by providing spawning, feeding, and general habitat for freshwater fish;
 - (E) provides habitat for breeding, feeding, resting, and shelter to both game and nongame species of wildlife;
 - (F) provides stopover habitat for migratory birds;
 - (G) provides for hydrophytic vegetation habitat;
 - (H) provides for threatened and endangered species habitat;
 - (I) provides valuable resources for education and research in natural sciences;
 - (J) provides direct and indirect recreational value and substantial economic benefits; and
 - (K) contributes to the open-space character and overall beauty of the landscape.
- (8) Act on petitions, or on its own motion, to designate specific wetlands as significant, when considered under the criteria established in subdivision (7) of this section;
- (9) Adopt rules protecting wetlands which have been determined under subdivision (7) or (8) of this section to be significant; provided, however, that the rules may only protect the values and functions sought to be preserved by the designation. The board shall not adopt rules that restrain agricultural activities without the consent of the commissioner of the department of agriculture, food and markets and shall not adopt rules that restrain silvicultural activities without the consent of the commissioner of the department of forests, parks and recreation.”

APPENDIX 12 – References and Additional Readings

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