Pre-Decisional

ENVIRONMENTAL ASSESSMENT

Reducing Aquatic Rodent Damage Through an Integrated Wildlife Damage Management Program in the Commonwealth of Virginia

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VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VIRGINIA DEPARTMENT OF FORESTRY (VDOF)

U. S. ARMY CORPS OF ENGINEERS (USACE)

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SUMMARY OF PROPOSED ACTION

The United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS) proposes to administer a beaver (*Castor canadensis*) and muskrat (*Ondatra zibethica*) damage management program in the Commonwealth of Virginia. An Integrated Wildlife Damage Management (IWDM) approach would be implemented to reduce damage associated with beaver and muskrat activities to property, agricultural and natural resources, and public health and safety. Damage management would be conducted on property in Virginia when the resource owners (property owners) or managers request assistance to alleviate beaver and muskrat damage. Some of the types of damage that resource owners seek to alleviate are: flooding of agricultural land and roads, prevention of road and railroad bed failure due to impounded water, protection of ornamental trees from cutting, protection of commercial trees and tree plantations from cutting and flooding, structural degradation of stormwater ditches, and protection of levees from burrowing. An IWDM strategy would be recommended and used, encompassing the use of practical and effective methods of preventing or reducing damage while minimizing harmful effects of damage management measures on humans, other species, and the environment. Under this action, WS could provide technical assistance and operational damage management, including non-lethal and lethal management methods by applying the WS Decision Model (Slate et al. 1992). When appropriate, physical exclusion or habitat modification would be recommended and utilized to reduce beaver and muskrat damage. In other situations, beaver and muskrats would be removed as humanely as possible using: body-grip (e.g., Conibear-type) traps, snares, leg-hold traps, colony traps, zinc phosphide bait registered for muskrats, and shooting. In determining the damage management strategy, preference would be given to practical and effective non-lethal methods. However, non-lethal methods may not always be applied as a first response to each damage problem. The most appropriate response could often be a combination of non-lethal and lethal methods, or there could be instances where application of lethal methods alone would be the most appropriate strategy.

ACRONYMS

ADC	Animal Damage Control
APHIS	Animal and Plant Health Inspection Service
AVMA	American Veterinary Medical Association
CDFG	California Department of Fish and Game
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CWA	Clean Water Act
EA	Environmental Assessment
EIS	Environmental Impact Statement
EJ	Environmental Justice
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FDA	Food and Drug Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FY	Fiscal Year
IWDM	Integrated Wildlife Damage Management
MIS	Management Information System
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NRCS	Natural Resource & Conservation Service
NWP	Nationwide Permit
SOP	Standard Operating Procedure
T&E	Threatened and Endangered
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDA	U.S. Department of Agriculture
USDI	U.S. Department of Interior
USFWS	U.S. Fish and Wildlife Service
VAC	Virginia Annotated Code
VDACS	Virginia Department of Agriculture and Consumer Services
VDEQ	Virginia Department of Environmental Quality
VDOF	Virginia Department of Forestry
VDGIF	Virginia Department of Game and Inland Fisheries
VDOT	Virginia Department of Transportation
WS	Wildlife Services

NOTE: On August 1, 1997, the Animal Damage Control program was officially renamed to Wildlife Services. The terms Animal Damage Control, ADC, Wildlife Services, and WS are used synonymously throughout this Environmental Assessment.

Chapter 1 PURPOSE OF AND NEED FOR ACTION

1.0 INTRODUCTION

Across the United States, wildlife habitat has been substantially changed as human populations expand and land is used for human needs. These human uses and needs often compete with wildlife which increases the potential for conflicting human/wildlife interactions. In addition, segments of the public desire protection for all wildlife; this protection can create localized conflicts between human and wildlife activities. The *Animal Damage Control Programmatic Final Environmental Impact Statement* (EIS) summarizes the relationship in American culture of wildlife values and wildlife damage in this way (United States Department of Agriculture (USDA) 1997):

> "*Wildlife has either positive or negative values, depending on varying human perspectives and circumstances . . . Wildlife is generally regarded as providing economic, recreational and aesthetic benefits . . . and the mere knowledge that wildlife exists is a positive benefit to many people. However . . . the activities of some wildlife may result in economic losses to agriculture and damage to property . . . Sensitivity to varying perspectives and value is required to manage the balance between human and wildlife needs. In addressing conflicts, wildlife managers must consider not only the needs of those directly affected by wildlife damage but a range of environmental, sociocultural and economic considerations as well.*"

Wildlife damage management is the science of reducing damage or other problems caused by wildlife and is recognized as an integral part of wildlife management (The Wildlife Society 1992). Wildlife Services (WS) uses an Integrated Wildlife Damage Management (IWDM) approach, known as Integrated Pest Management (WS Directive 2.105[1]), in which a combination of methods may be used or recommended to reduce wildlife damage. IWDM is described in Chapter 1:1-7 of USDA (1997). These methods may include alteration of cultural practices and habitat and behavioral modification to prevent or reduce damage. The reduction of wildlife damage may require that the local populations of offending animal(s) be reduced through lethal means.

Biological carrying capacity is the land or habitat's limit for supporting healthy populations of wildlife without degradation to the animals' health or their environment over an extended period of time (Decker and Purdy 1988). Wildlife acceptance capacity, or cultural carrying capacity, is the limit of human tolerance for wildlife or the maximum number of a given species that can coexist compatibly with local human populations (Decker and Purdy 1988). These terms are especially important in urban areas because they define the sensitivity of a local community to a specific wildlife species. For any given damage situation, there will be varying thresholds by those directly and indirectly affected by the damage. This threshold of damage is a primary limiting factor in determining the wildlife acceptance capacity. While the Commonwealth of Virginia has a biological carrying capacity to support more than the current number of beaver and muskrats, the wildlife acceptance capacity is often much lower. Once the wildlife acceptance capacity is met or exceeded, people will begin to implement population or damage reduction methods, including lethal management methods, to alleviate property damage and public health or safety threats.

This environmental assessment (EA) documents the analysis of the potential environmental effects of a proposed Virginia WS beaver (*Castor canadensis*) and muskrat (*Ondatra zibethicus*) damage management program to achieve a balance between the biological carrying capacity and cultural carrying capacity. This analysis relies mainly on existing data contained in published documents (Appendix A), including the *Animal Damage Control Program Final Environmental Impact Statement* (USDA 1997) to which this EA is tiered. USDA (1997) may be obtained by contacting the USDA, Animal and Plant Health Inspection Service (APHIS), WS Operational Support Staff at 4700 River Road, Unit 87, Riverdale, MD 20737-1234.

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[1] WS Policy Manual - Provides guidance for WS personnel to conduct wildlife damage management activities through Program Directives. WS Directives referenced in this EA can be found in the manual but will not be referenced in the Literature Cited Appendix.

WS is the federal agency directed by law and authorized to protect American resources from damage associated with wildlife (Animal Damage Control Act of March 2, 1931, as amended 46 Stat. 1486; 7 USC. 426-426c and the Rural Development, Agriculture, and Related Agencies Appropriations Act of 1988, Public law 100-102, Dec. 27, 1987. Stat. 1329-1331 (7 USC 426C). To fulfill this Congressional direction, WS activities are conducted to prevent or reduce wildlife damage caused to agricultural, industrial and natural resources, property, and threats to public health and safety on private and public lands in cooperation with federal, state and local agencies, private organizations, and individuals. Therefore, wildlife damage management is not based on punishing offending animals but as one means of reducing damage and is used as part of the WS Decision Model (Slate et al. 1992). The imminent threat of damage or loss of resources is often sufficient for individual actions to be initiated. The need for action is derived from the specific threats to resources or the public.

Normally, according to the APHIS procedures implementing the National Environmental Policy Act (NEPA), individual wildlife damage management actions are categorically excluded (7 CFR 372.5(c), 60 Fed. Reg. 6,000-6,003, (1995)). WS has decided in this case to prepare this EA to facilitate planning, interagency coordination, and the streamlining of program management, and to clearly communicate with the public the analysis of individual and cumulative impacts. In addition, this EA has been prepared to evaluate and determine if there are any potentially significant or cumulative impacts from the proposed and planned damage management program. All wildlife damage management that would take place in Virginia would be undertaken according to relevant laws, regulations, policies, orders and procedures, including the Endangered Species Act (ESA). Notice of the availability of this document will be published in newspapers, consistent with the agency's NEPA procedures.

WS is a cooperatively funded, service-oriented program from which other governmental agencies and entities may request assistance. Before any wildlife damage management is conducted, Cooperative Agreements, Agreements for Control or other comparable documents are in place. As requested, WS cooperates with land and wildlife management agencies to reduce wildlife damage effectively and efficiently according to applicable federal, State and local laws and Memorandums of Understanding (MOUs) between WS and other agencies. WSs' mission, developed through its strategic planning process, is: 1) *"to provide leadership in wildlife damage management in the protection of America's agricultural, industrial and natural resources, and 2) to safeguard public health and safety."* WS's Policy Manual reflects this mission and provides guidance for engaging in wildlife damage management through:

- Training of wildlife damage management professionals;
- Development and improvement of strategies to reduce losses and threats to humans from wildlife;
- Collection, evaluation, and dissemination of management information;
- Informing and educating the public on how to reduce wildlife damage;
- Providing data and a source for limited-use management materials and equipment, including pesticides (USDA 1999)

1.1 HISTORICAL AQUATIC RODENT DAMAGE MANAGEMENT

Historically, beaver populations were kept under control by subsistence and commercial hunting and trapping (Hill 1976, Woodward 1983, Novak 1987a). Muskrat meat has also been commonly used for human consumption and in some areas called by names such as *"marsh rabbit."* However, following the decimation of the beaver population in the late 1800's and early 1900's, the number of beaver trappers declined. By the time trapping seasons were reopened, not only were beaver trappers scarce, but demands for short-haired fur were low. Consequently, little beaver trapping was done. The absence of an adequate beaver harvest in conjunction with insignificant non-human predation and an abundance of suitable habitat resulted in beaver populations reaching levels where the animals were considered pests (Woodward 1983, Woodward et al. 1985). The subsequent decline in fur prices in the early 1980's led to further increases in beaver populations, with beaver damage reaching epidemic proportions in some areas. In 1980, 11,154 beaver were harvested in Virginia, as estimated by the number of beaver pelts sold to local fur buyers (R. Farrar, VDGIF, pers. comm.) During the 1998 trapping season, the total number of beaver reported

purchased by furbuyers decreased to 1,685 pelts, although the estimated relative abundance of beaver in Virginia had increased at an annual rate of 6.15% since 1980 (Farrar, VDGIF, pers. comm.). Similarly, according to harvest data since 1964, the muskrat harvest peaked in 1964 with 287,982 muskrat pelts sold. Another peak occurred in 1980 with 213,349 muskrat pelts sold, but in 1997 only 19,926 muskrat pelts were sold (R. Farrar, VDGIF, pers. comm.).

A variety of attempts have been made to reduce damage caused by beaver in the southeastern U.S. For example, a Beaver Cooperative Association formed in Mississippi in 1977 showed promise for reducing beaver damage by increasing the marketability of beaver pelts, but eventually failed due to low pelt values on international markets (Woodward 1983). In addition, a cooperative program between various agencies in North Carolina attempted to reduce beaver damage by allowing trappers to harvest more valuable furs (Woodward 1983) also showed promise but failed due to the decline in the fur markets in the early 1980's. Currently, North Carolina has a cooperative beaver damage management program that includes State highway officials, soil and water conservation districts, municipalities, and private landholders, who collectively funded 97% of the 1997 program. The beaver damage management program saved an estimated $3.8 million in forestry and agricultural resources, waterways, highway infrastructure, and other property. The Virginia WS program is similarly structured.

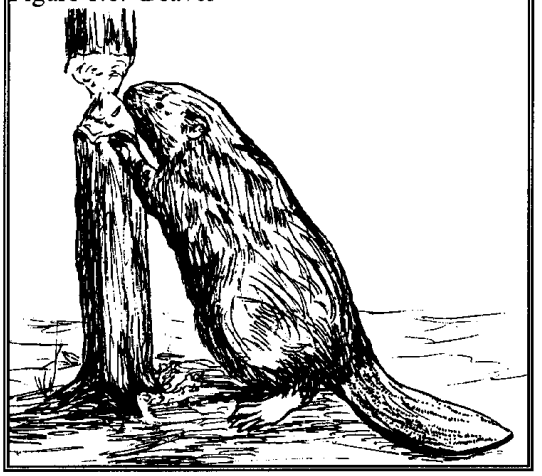
1.2 BEAVER AND MUSKRAT ACTIVITY IMPACTS TO THE ENVIRONMENT AND SOCIETY ATTITUDES

1.2.1 Benefits of Beaver Activities

Although beaver (Figure 1-1) may cause extensive damage, there are also benefits associated with their activities depending on the activities and location. Beaver ponds create valuable palustrine wetland habitat that provides habitat for many species of fish and wildlife (Arner and Hepp 1989, Hill 1982, Novak 1987a). These wetland ecosystems also function as sinks, helping to filter nutrients and reduce sedimentation, thereby maintaining the quality of nearby water systems (Arner and Hepp 1989). According to the EPA, wetlands can provide aesthetic and recreational opportunities for wildlife observation, nature study, hunting, fishing, trapping, wildlife photography, livestock water, and environmental education and added an estimated $59.5 million to the national economy in 1991(EPA 1995, Woodward 1983, Wade and Ramsey 1986).

Beaver pond wetland habitats can be valuable and productive ecosystems (Arner and Hepp 1989). Beaver ponds contribute to the stabilization of water tables, help reduce rapid run-off from rain (Wade and Ramsey 1986), and serve as basins for the entrapment of streambed silt and eroding soil (Hill 1982). Silt-laden waters, particularly carrying eroded soil from cultivated, logged, excessively grazed, farmed, mountainous, or developed areas, slow as they pass through a series of beaver ponds and the heavier particles and colloidals are able to settle out before the water flows into larger streams (Hill 1982). Aquatic and early successional plant species may become established in the newly deposited sediment, allowing conditions to become favorable for the stabilization of the flood plain by more permanent woody vegetation (Hill 1982). The Minnesota Department of Natural Resources has computed a cost of $300 to replace, on average, each acre-foot of flood water storage that

Figure 1.1. Beaver



wetlands can provide (EPA 1995). Producing wetlands/marsh habitat through beaver management in New York was far less costly than developing either small or large manmade marshes, assuming the quality is equal in each case (Ermer 1984).

Beaver ponds may also improve soil quality and provide improved habitat for fish and invertebrates. The anaerobic conditions caused by beaver impoundments may result in the accumulation of ammonium, so that soil storage of inorganic nitrogen is nearly tripled by beaver impoundments during a 50 year period (Johnston 1994). Arner et al. (1969) found that the bottom soils of beaver ponds in Mississippi were generally higher in phosphate, potash, and organic matter than the bottom soils of feeder streams. Greater biomass of invertebrates and healthier fish were also found in beaver ponds than in feeder streams (Arner and DuBose 1982).

Habitat modification by beaver, primarily dam building and tree cutting, can benefit many species of wildlife (Jenkins and Busher 1979, Medin and Clary 1990, Medin and Clary 1991, Arner and DuBose 1982, Arner and Hepp 1989, Hill 1982). Beaver may increase habitat diversity by flooding and opening forest habitats, which results in greater interspersion of successional stages and subsequently increases the floral and faunal diversity of a habitat (Arner and Hepp 1989, Hill 1982). The creation of standing water, edge, and plant diversity, all in close proximity, results in excellent wildlife habitat (Hill 1982). The resulting wetland habitat may be beneficial to some fish, reptiles, amphibians, waterfowl, shorebirds, and furbearers such as muskrats, otter, and mink (*Mustela vison)* (Arner and DuBose 1982, Miller and Yarrow 1994, Naimen et al. 1986). When the ponds are abandoned, they progress through successional stages which improve feeding conditions for deer (*Odocoileus virginianus*), swamp rabbits (*Sylvilagus aquaticus*), and woodcock (*Philoela minor*) (Arner and DuBose 1982). In addition, beaver ponds may be beneficial to T&E species, because the USFWS estimates that up to 43% of the T&E species rely directly or indirectly on wetlands for their survival (EPA 1995).

Waterfowl use beaver pond wetland habitats extensively (Arner and Hepp 1989, Speake 1955, Arner 1964, Novak 1987a, Hill 1982). In particular, wood ducks (*Aix sponsa*), mallards (*Anas platyrhynchos*), black ducks (*Anas rubripes*), and other dabblers benefit from the increased interspersion of cover and food found in flooded beaver ponds (Novak 1987a, Arner and Hepp 1989). Also, the attraction of a beaver pond to waterfowl varies with age and vegetation (Arner and DuBose 1982). In Mississippi, beaver ponds over three years in age were found to have developed plant communities which increase their value as nesting and brood rearing habitat for wood ducks (Arner and DuBose 1982). However, Reese and Hair (1976) found that beaver pond habitats were highly attractive to a large number of birds year-round and that the value of the beaver pond habitat to waterfowl was minor when compared to other species of birds (Novak 1987a).

Beaver are generally considered beneficial where their activities do not compete with people's use of the land or property (Wade and Ramsey 1986). The opinions and attitudes of individuals, communities, organizations, etc., vary greatly and are primarily influenced and formed by the benefits and damage directly experienced by each person or entity (Hill 1982). Property ownership, options for public and private land use, and the effects on adjacent properties or land use impact public attitudes toward beaver (Hill 1982). In many cases, the beaver damage exceeds the benefits, resulting in a demand for beaver damage management. Woodward et al. (1976) found that 24% of landowners who reported beaver activity on their property indicated benefits to having beaver ponds on their land and also desired assistance with beaver pond management (Hill 1976, Lewis 1979, Woodward et al. 1985).

1.2.2 Damage from Beaver Activities

Beaver are a part of the wildlife heritage in Virginia. In Virginia, the reintroduced beaver population exhibited a growth pattern similar to many states and Canadian provinces. This beaver population

expansion has had a negative economic impact in North America (Novak 1987a).

Most of the damage caused by beaver is a result of dam building, bank burrowing, tree cutting, obstructing overflow structures and spillways or flooding, and identifying beaver damage is generally not difficult. Some cases of beaver damage include state highways flooded, reservoir dams destroyed by bank den burrows, and train derailments caused by continued flooding and burrowing (Miller and Yarrow 1994). Housing developments have been threatened by beaver dam flooding. Some small bridges have been destroyed because of beaver dam-building activity. Miller (1983) estimated that the annual damage in the United States was $75-$100 million. The value of beaver damage is perhaps greater than that of any other single wildlife species in the United States -- economic damage was estimated to have exceeded $4 billion in the southeastern U.S. over a 40-year period (Arner and Dubose 1979). In some southeastern states, losses from beaver damage have been estimated at $3 million to $5 million dollars annually (Miller and Yarrow 1994), with timber losses as the most common type of damage (Hill 1982). Tracts of bottomland hardwood timber up to several thousand acres in size may be lost to beaver activity (Miller and Yarrow 1994). Surveys in North Carolina and Alabama indicate that the majority of landowners with beaver damage on their property desire damage management via beaver removal (Hill 1976, Lewis 1979, Woodward et al. 1985). Loker et al. (1999) found that suburban residents may also desire lethal management methods to resolve beaver damage conflicts. Such conflicts, which are viewed as *"damage,"* result in adverse impacts that often outweigh benefits (Miller and Yarrow 1994).

The Virginia Department of Forestry (VDOF) reported beaver damage such as blocked culverts, flooded roads, flooded timber, destroyed riparian forest buffers, loblolly pine plantation loss from flooding and cutting, cutting of peach trees, swamp hardwood loss, etc. Additionally, the VDOF has received complaints about beavers damaging property around ponds and lakes in subdivisions (J.Bassett, VDOF, pers. comm.). One VDOF forester reported estimated losses of more than $200,000 in Hanover County from loss of timber in beaver-flooded and adjacent areas (W. Ruby, email to J. Bassett, VDOF, August 4, 1999).

Beaver activities also destroy habitat types (e.g., free-flowing water, riparian areas, and bird roosting and nesting areas) which are important to many species. Patterson (1951) and Avery (1992) reported that the presence of beaver dams can negatively affect fisheries. Beaver dams adversely affect stream ecosystems by increasing sedimentation in streams, affecting wildlife that depend on clear water such as certain species of fish and mussels. For example, beavers may have a detrimental effect on two federally endangered species found in Virginia, the dwarf wedgemussel (*Alasmidonta heterodon*) and James spinymussel (*Pleurobema collina*), that commonly reside in small streams where beaver can easily create unsuitable habitat by impounding water and increasing silt levels (R. Neves, Virginia Polytechnic Institute and State University, letter to M. Lowney, WS, August 4, 1999). The Louisiana WS program has conducted beaver damage management activities to protect the Loiusiana pearlshell (*Margaritifera hembeli*), which also requires clear, free-flowing water to survive (D. LeBlanc, USDA/APHIS/WS, pers. comm.).

Beaver impacts on trout habitat have been a major concern of Wisconsin Department of Natural Resource fisheries managers and the public since at least 1950. Patterson (1951) found that beaver impoundments in the Peshtigo River Watershed caused significant negative impacts to trout habitat by raising water temperatures, destroying immediate bank cover, changing water and soil conditions, and silting of spawning areas. Studies from other areas also reported negative aspects of beaver impoundments in regard to trout habitat (Sayler 1935, Cook 1940, Sprules 1940, Bailey and Stevens 1951). Evans (1948) suggested a continued increase in beaver populations in Minnesota would probably result in deterioration of streams for trout. The Wisconsin Department of Natural Resources guidelines for management of trout stream habitat stated that beaver dams are a major source of damage to trout streams (Churchill 1980, White and Brynildson 1967). More recent studies have documented improvements to trout habitat upon removal of beaver dams. Avery (1992) found that wild brook trout populations in tributaries to the North

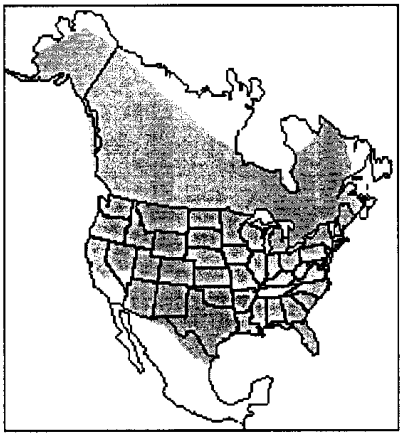
Branch of the Pemebonwon River in northeastern Wisconsin improved significantly following the removal of beaver dams. Also, the species abundance, species distribution, and total biomass of non-salmonids increased following the removal of beaver dams (Avery 1992).

Increased soil moisture both within and surrounding beaver flooded areas can also result in reduced timber growth and mast production and an increase in bank destabilization. These habitat modifications can also conflict with human land or resource management objectives and can oppress some plants and animals, including threatened and endangered (T&E) species. Beaver also cut large trees along rivers, lakes and reservoirs that are used as roosting/nesting trees by bald eagles (*Haliaeetus leucocephalus*) or other avian species. Though the carrying capacity of beaver habitat has not been well defined, there have been cases of overpopulation causing habitat destruction and subsequent declines in populations (Yeager and Ruthford 1957, Langley and Moyle 1963, Bedmarik and Weeks 1971).

Prior to 1998, Virginia WS received few requests for assistance regarding beaver damage, but, since that time, requests for WS assistance have increased. In Virginia, property damage complaints such as the loss of native and ornamental trees with landscaping value and the flooding of private property are reported more often than timber losses (Table 1-1). Beaver often inhabit sites in or adjacent to urban/suburban areas and cut or girdle trees and shrubs in yards, undermine yards and walkways by burrowing, flood homes and other structures, destroy pond and reservoir dams by burrowing into levees, gnaw on boat houses and docks, and cause other damage to private and public property (Wade and Ramsey 1986). Additionally, roads and railroads may be damaged by saturation of the roadbed from beaver flooding or by beaver burrowing into the banks that comprise roadbeds and railroad beds. Beaver also cause an assortment of damage such as flooding of croplands, pastures, and timberlands; feeding on crops such as corn, soybeans, sorghum, etc.; interfering with irrigation systems and water level control structures; and cause washouts of ponds and levees (Hill 1982, Woodward 1983, Miller and Yarrow 1994, Wade and Ramsey 1986).

WS beaver damage management efforts in Virginia are primarily conducted for the purpose of minimizing damage to urban and suburban properties, highway and railroad infrastructures, and agricultural and timber resources. In some cases, efforts are aimed at protecting wildlife habitat which is degraded due to beaver related flooding or dam building. WS personnel employ a variety of methods for reducing beaver damage which allows greater flexibility and more opportunity to formulate an effective strategy for each request for assistance (see Appendix D).

Figure 1-2. Range of Beaver in North America



Beaver have only a few natural predators aside from humans, including coyotes, bobcats, river otter, bears, and mink, who prey on the young (Miller and Yarrow 1994). In other areas, mountain lions, wolves, and wolverines may also prey on beaver.

1.2.3 Damage from Muskrat Activities

The muskrat is a native North American aquatic rodent and is the largest microtine rodent in the United States. It spends its life in aquatic habitats and is well adapted for swimming. Its large hind feet are partially webbed, stiff hairs align the toes, and its laterally flattened tail is almost as long as its body (Figure 1-2). The muskrat has a stocky appearance, with small eyes and very short, rounded ears. Its front feet, which are much smaller than its hind feet, are adapted primarily for digging and feeding. The overall

length of adult muskrats is usually from 18 to 24 inches.

Figure 1-3. Muskrat

Economic loss to muskrat damage can be very high in some areas, particularly in aquaculture producing areas. In some states damage may be as much as $1 million per year (Miller 1994). Elsewhere, economic losses because of muskrat damage may be rather limited and confined primarily to burrowing in farm pond dams. In such limited cases, the value of the muskrat population may outweigh the cost of the damage.

Muskrats dig burrows into banks, levees, and where higher ground is available, for dens (Linzey 1998, Perry 1982). Although muskrats are largely vegetarians, they also eat other animals as part of their diet (Perry 1982). Schwartz and Schwartz (1959), Neves and Odom (1989) and Miller (1994) reported muskrats also ate animal matter including mussels, clams, snails, crustaceans (i.e., crawfish), and young birds. The regular life activities of muskrats results in much of the conflict with man.

Figure 1-4. Range of Muskrats in North America.

Damage by muskrats is usually not a major problem, but can be significant locally in particular situations (Wade and Ramsey 1986). Much of the damage caused by muskrats is primarily through their burrowing activity (Miller 1994, Linzey 1998, Perry 1982) in dikes, dams, ditches, ponds, and shoreline. Muskrats dig burrows with underwater entrances along the shoreline and burrowing may not be readily evident until serious damage has occurred and when the water level drops the muskrat holes are expanded to keep pace with the retreating water level. Additionally, when water levels rise muskrats expand the burrows upward. One way to observe early burrowing in farm ponds or reservoirs is to walk along the edge of the dam or shore-lines when the water is clear and look for *"runs"* or trails. These burrows can also collapse when walked upon by people or animals and crossed over with heavy equipment (i.e., mowers, tractors). The types of damage for which assistance could be requested include burrowing in dams used to hold water or to control water flow such as flood control structures. The burrows can cause washouts which result in loss of water or flood damage depending on the situation, which can then cause the loss of crops and the need to rebuild the dams and levees (Wade and Ramsey 1986).

Where damage is occurring to a crop, plant cutting is generally evident. In aquaculture reservoirs generally maintained without lush aquatic vegetation, muskrat runs and burrows or remains of mussels, crayfish, or fish along with other muskrat signs are generally easy to observe.

The structural integrity of outfall ditches in southeastern Virginia are harmed by muskrat burrowing activity. Muskrat burrowing activity makes driving maintenance equipment along outfall ditches dangerous because burrows collapse when equipment (i.e., tractors) drive over the burrows. Tractors have rolled over when the ground has given way while maintaining these outfall ditches. These burrows eventually collapse on their own over time. Erosion problems from muskrat activities are worsened by

wave action.

Muskrat burrowing activity can seriously weaken earthen dams (Perry 1982). Burrowing activity can result in dams leaking or blowing out. This results in costly repairs and years to restore lost recreational fisheries.

Muskrats eat a variety of natural emergent vegetation (Linzey 1998, Perry 1982) and cultivated crops (Perry 1982). Some of the cultivated crops eaten by muskrats include corn, alfalfa, carrots, and soybeans. When muskrats become over-populated, generally an "eat-out" occurs and the feeding area is ruined for a number of years (O'Neil 1949). An "eat-out" occurs when vegetation, including soil binding roots, are consumed. The loss of vegetation removes food and cover for muskrats and other wildlife. Marsh damage from muskrats is inevitable when areas heavily populated by muskrats are under-trapped (Lynch et al. 1947). While eat-outs are beneficial to some bird species, it also results in stagnant water which predisposes the same birds to diseases (Lynch et al. 1947).

Muskrats consume mussels as part of their diet. However, some mussels consumed by muskrats are listed as federal T&E species under the ESA. Neves and Odom (1989) reported that muskrats appear to be inhibiting the recovery of endangered mussels and are likely placing pigtoe mussels in further jeopardy in the Clinch and Holston Rivers in Virginia. At one site in Virginia, muskrats were known to be feeding on the federally endangered tan riffleshell (*Epioblasma f. walkeri*), but predation on this species decreased drastically after a muskrat trapping program was implemented (R. Neves, Virginia Polytechnic Institute and State University, letter to M. Lowney, WS, August 4, 1999).

1.2.4 Public Health and Safety Risks from Beaver and Muskrat Damage

Beaver and muskrats are hosts for several ectoparasites and internal parasites including nematodes, trematodes, and coccidians. Beaver (Miller 1983, Woodward 1983) and muskrat activity in certain situations can become a threat to public health and safety (e.g., burrowing into or flooding of roadways and railroad beds can result in serious accidents). Increased water levels in urban areas resulting from beaver activity can lead to unsanitary conditions and potential health problems by flooding septic systems and sewage treatment facilities (DeAlmeida 1987, Loeb 1994). Beaver damming activity also creates conditions favorable to mosquitoes and can hinder mosquito control efforts or result in population increases of these insects (Wade and Ramsey 1986). While the presence of these insects is largely a nuisance, mosquitoes can transmit diseases, such as encephalitis (Mallis 1982). In addition, beaver, which are carriers of the intestinal parasite *Giardia lamblia,* can contaminate human water supplies and cause outbreaks of the disease Giardiasis in humans (Woodward 1983, Beach and McCulloch 1985, Wade and Ramsey 1986, Miller and Yarrow 1994). The Centers for Disease Control have recorded at least 41 outbreaks of waterborne Giardiasis, affecting more than 15,000 people. Beaver are also known carriers of tularemia, a bacterial disease, that is transmittable to humans through bites by insect vectors or infected animals or by handling animals or carcasses which are infected (Wade and Ramsey 1986). Skinner et al. (1984) found that in cattle-ranching sections of Wyoming the fecal bacterial count was much higher in beaver ponds than in other ponds, something that can be a concern to ranchers and recreationists. On rare occasions, beaver may contract the rabies virus and attack humans. In February, 1999 a beaver attacked and wounded a dog and chased some children that were playing near a stream in Vienna, Virginia. Approximately a week later, a beaver was found dead at the site and tested positive for rabies (E. Hodnett, Fairfax Animal Control, pers. comm.). Furthermore, damming of streams sometimes increases the number of aquatic snakes, including the poisonous cottonmouth (Wade and Ramsey 1986).

1.3 SCOPE AND PURPOSE OF THIS EA

The scope and purpose of this EA is to evaluate the potential impact from WS beaver and muskrat damage

management to protect agricultural and natural resources, property, and public health and safety in Virginia. Damage problems can occur throughout the State, resulting in requests for WS assistance. Under the Proposed Action, beaver and muskrat damage management could be conducted on private, federal, state, tribal, county, and municipal lands in Virginia. Virginia encompasses about 26,090,880 acres; during Fiscal Year (FY) 97, WS had four *Agreements for Control* to conduct beaver and muskrat damage management on 300 acres or less than 0.0012% of the land area of Virginia (Management Information System (MIS) 1997). In FY 98, fifteen beaver and muskrat damage management projects were conducted on properties covering an area of about 917 acres or about 0.0035% of the land area of Virginia (MIS 1999), and in FY 99 twenty-three beaver and muskrat damage management projects were conducted on approximately 14,050 acres or about 0.054% of the land area of Virginia (MIS 2000).

1.4 NEED FOR BEAVER AND MUSKRAT DAMAGE MANAGEMENT IN VIRGINIA

The need for action in Virginia is based on the necessity for a program to protect: 1) agricultural and natural resources, 2) property, 3) roads, bridges, and railroads, and 4) public health and safety from beaver and muskrat damage. Beaver and muskrat populations can have a negative economic impact in Virginia and southeastern state agencies provide no assistance to landowners with beaver and muskrat damage management due to time and funding constraints and a lack of expertise. Similarly, private trappers generally prove inadequate for reducing beaver damage due to the high costs to landowners, a lack of expertise in damage management, and the seasonal restrictions of the 3 month regulated trapping season in Virginia.

Comprehensive surveys of beaver and muskrat damage in Virginia have not been conducted. However, Virginia WS compiled estimates of the types and value of damage perceived by property and resource owners or managers who requested WS assistance, and public health and safety risks. Conflicts between humans and wildlife are common in Virginia. The Virginia WS Program received 3,559 requests for wildlife damage management assistance from the public between federal FY94 and 98. During this period, beaver damage management requests ranked as the fourth most common type of request for wildlife damage management assistance, with 236 requests for beaver damage assistance received, and with more requests received each year.

Table 1-1. Beaver and Muskrat Damage ($) (MIS 1996, 1997, 1998).

FY	Species	Incidents	Agriculture[1]	Natural Resources	Property[2]	Public Health/Safety
96	Beaver	24	2,100			
	Muskrat	4				
97	Beaver	26	5,800	3,600	2,000	
	Muskat	3			1,100	
98	Beaver	128	2,000		44,120	1[3]
	Muskrat	3			232	

[1] Includes commercial forestry, agricultural crops and pasture.

[2] Includes landscaping, turf, gardens, equipment, vehicles, roads, etc.

[3] Unable to assess damage for public health and safety

Damage data obtained for FY96 through FY98 are summarized (Tables 1-1). These data represent only a portion of the total damage caused by beaver and muskrats because not all people who experience such damage request assistance from WS (Loven 1985). This document addresses the need for Virginia WS assistance in responding to requests for beaver and muskrat damage management.

1.5 PROPOSED ACTION

The proposed action is to implement a Virginia WS integrated beaver and muskrat damage management program for the protection of agricultural and natural resources, property, public health and safety, and roads, bridges, and railroads on all lands in Virginia where a need exists and a request is received. Managers and property owners would continue to be provided technical assistance regarding the use of non-lethal methods. Technical assistance includes: instructional sessions, information about exclusion devices, and for beaver, pond drainage devices. An IWDM approach would be used, which would consider all legal and appropriate methods either used singly or in combination to meet the requester needs for reducing damage, and which are acceptable to the VDGIF. Non-lethal methods include, but would not be limited to, environmental/habitat modification, cultural practices, animal behavior modification, and repellents. Lethal methods used by WS may potentially include shooting, zinc phosphide bait for muskrats, leg-hold traps, cage type traps, snares, colony traps, snap traps, and body-grip (e.g., Conibear) traps. Beaver dams are breached using binary explosives or by hand. Beaver and muskrat damage management would be conducted in the State, when requested, on private or public property after an *Agreement for Control* or other comparable document has been completed. All beaver and muskrat damage management would be consistent with other uses of the area and would comply with appropriate federal, state and local laws. (See Chapter 3 for a more detailed description of the current program and the proposed action).

1.6 OBJECTIVES FOR THE VIRGINIA WS BEAVER AND MUSKRAT DAMAGE MANAGEMENT PROGRAM

1.6.1 Resolve all beaver and most muskrat damage problems within 2 (two) weeks.

1.6.2 Keep the take of non-target otters (*Lutra canadensis*) below 5% of the total take during beaver and muskrat damage management operations.

1.7 RELATIONSHIP OF THIS EA TO OTHER ENVIRONMENTAL DOCUMENTS

1.7.1 ADC Programmatic EIS. WS has issued a final EIS (USDA 1997) and Record of Decision on the National APHIS-WS program. This EA is tiered to that EIS.

1.8 DECISION TO BE MADE

Based on the scope of this EA, the decisions to be made are:

- Should WS implement an IWDM strategy, including non-lethal and lethal damage management methods, to meet the objectives for beaver and muskrat damage management in Virginia?
- If not, should WS attempt to implement one of the alternatives to an IWDM strategy as described in the EA?
- Would the proposed action have significant impacts on the quality of the human environment requiring preparation of an EIS?

1.9 RELATIONSHIP OF AGENCIES DURING PREPARATION OF THE EA

Based on agency relationships, MOUs and legislative authorities, Virginia WS is the lead agency for this EA, and therefore responsible for the scope, contents and decisions made. The VDGIF, Virginia Department of Agriculture and Consumer Services (VDACS), Virginia Department of Forestry (VDOF), Virginia Department of Transportation (VDOT), Virginia Department of Environmental Quality (VDEQ), and U.S. Army Corps of Engineers (USACE) contributed input throughout the EA preparation to ensure an interdisciplinary approach in compliance with NEPA, and agency mandates, policies, and regulations.

1.10 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT ANALYSIS

1.10.1 Actions Analyzed. This EA evaluates planned beaver and muskrat damage management to protect: 1) property, 2) agricultural and natural resources, 3) roads, bridges, railroads, and 4) public health and safety in Virginia. Protection of other resources or other program activities will be addressed in other NEPA analysis, as appropriate. There has been some concern from the state and federal agencies and the public about potential damage from nutria (*Myocastor coypus*). Nutria are non-indigenous, invasive semi-aquatic rodents (Executive Order 13112) that originated in South America and introduced to the United States. In the future, WS may receive requests to alleviate nutria damage. At that time, this document would be reviewed for NEPA compliance and supplemented if necessary.

1.10.2 Wildlife Species Potentially Protected by Virginia WS. Virginia WS assistance may be requested to achieve management objectives for wildlife, including T&E species. If other needs are identified, a determination would be made on a case-by-case basis if additional NEPA analysis is needed.

1.10.3 American Indian Lands and Tribes. Currently, Virginia WS does not have any MOUs with any American Indian tribe. If WS enters into an agreement with a tribe for beaver or muskrat damage management, this EA would be reviewed and supplemented if appropriate to insure compliance with NEPA. MOUs, agreements and NEPA compliance would be conducted as appropriate before conducting beaver or muskrat damage management on tribal lands.

1.10.4 Period for which this EA is Valid. This EA would remain valid until Virginia WS and other appropriate agencies determine that new needs for action, changed conditions or new alternatives having different environmental effects must be analyzed. At that time, this analysis and document would be supplemented pursuant to NEPA. Review of the EA would be conducted each year to ensure that the EA is sufficient.

1.10.5 Site Specificity. This EA analyzes the potential impacts of beaver and muskrat damage management and addresses activities on all lands in Virginia under MOU, Cooperative Agreement and in cooperation with the appropriate public land management agencies. It also addresses the impacts of beaver and muskrat damage management on areas where additional agreements may be signed in the future. Because the proposed action is to reduce damage and because the program's goals and directives are to provide services when requested, within the constraints of available funding and workforce, it is conceivable that additional wildlife damage management efforts could occur. Thus, this EA anticipates this potential expansion and analyzes the impacts of such efforts as part of the program. This EA emphasizes major issues as they relate to specific areas whenever possible, however, many issues apply wherever beaver and muskrat damage and resulting management occurs, and are treated as such. The standard WS Decision Model (Slate et al. 1992) would be the site-specific procedure for individual actions conducted by WS in Virginia (see Chapter 3 for a description of the Decision Model and its application).

1.10.6 Summary of Public Involvement. Issues related to the proposed action were initially developed by an interdisciplinary team involving the VDGIF, VDACS, VDOF, VDOT, and USACE. This Multi-agency team refined the issues and identified preliminary alternatives. Due to interest in the Virginia WS Program the Multi-agency Team concurred that Virginia WS include an invitation for public comment in this EA process. An invitation for public comment letter containing issues, objectives, preliminary alternatives, and a summary of the need for action, was sent to 322 individuals or organizations identified as interested in Virginia WS, VDGIF, or USACE projects. Notice of the proposed action and invitation for public involvement were placed in 4 newspapers (Richmond Times-Dispatch, The Virginia Pilot, The Roanoke Times, and The Washington Times) with circulation throughout Virginia. Public comments were documented from 17 letters or written comments. All comments were analyzed to identify new issues, alternatives, or to redirect the program. All responses are maintained in the administrative file located at

the Virginia WS State Office, P.O. Box 130, Moseley, Virginia 23120.

1.11 PREVIEW OF THE REMAINDER OF THIS EA

The remainder of this EA is composed of four (4) chapters and four (4) appendices. Chapter 2 discusses and analyzes the issues and affected environment. Chapter 3 contains a description of each alternative, alternatives not considered in detail, mitigation and standard operating procedures (SOP). Chapter 4 analyzes consistency with environmental consequences and the environmental impacts associated with each alternative considered in detail. Chapter 5 contains the list of preparers of this EA. Appendix A is the literature cited used during the preparation of the EA, Appendix B is the authorities for conducting wildlife damage management in Virginia, Appendix C describes criteria for beaver dam breaching/removal, and Appendix D is a detailed description of the methods used for aquatic beaver and muskrat damage management.

CHAPTER 2: ISSUES AND AFFECTED ENVIRONMENT

2.0 INTRODUCTION

Chapter 2 contains a discussion of the issues, including issues that received detailed environmental impact analysis in Chapter 4 (Environmental Consequences), issues used to develop mitigation measures and SOPs, and issues not considered in detail, with the rationale. Pertinent portions of the affected environment are included in this chapter in the discussion of issues used to develop mitigation. Additional affected environments are incorporated into the discussion of the environmental impacts in Chapter 4 and the description of the current program in Chapter 3.

2.1 AFFECTED ENVIRONMENT

The areas of the proposed action include state and interstate highways and roads, and railroads and their right-of-ways where beaver activities would cause damage. The areas would also include property in or adjacent to subdivisions and business and industrial parks where beaver impound water and gnaw or fell trees. Additionally, affected areas include timberlands, croplands, and pastures that experience financial losses from beaver flooding or gnawing. The proposed action could also include private and public property where muskrat burrowing damages dikes, ditches, ponds, and levees, and where muskrat feeding causes agricultural crop losses and negatively impacts recovery of T&E species, primarily mussels.

2.2 ISSUES ANALYZED IN DETAIL IN CHAPTER 4

The Multi-agency Team, consisting of representatives from the lead (WS) and cooperating agencies (VDGIF, VDOT,VDOF, VDACS, USACE) identified the following major issues, which were used to develop mitigation measures:

- Effects on beaver and muskrat populations
- Effects on plants and other wildlife species, including T&E species
- Effects on public and pet health and safety
- Humaneness of methods to be used
- Effects on wetlands and wetlands ecosystem
- Effects on landscaping and native vegetation
- Impacts to stakeholders, including aesthetics

2.2.1 Effects on beaver and muskrat populations.

Some persons are concerned that the proposed action or any of the alternatives would result in the loss of local beaver and muskrat populations or could have a cumulative adverse impact on regional or statewide beaver and muskrat populations. WS has removed beaver and muskrats to reduce damage under CE (7 CFR 372.5(c), 60 Fed Reg. 6,000-6,003, 1995). The most beaver and muskrats taken by WS was in FY1999 when 133 beaver and 20 muskrats were removed, which had a minimal impact on the statewide or regional populations. The VDGIF has determined that "there is no evidence to suggest that human mediated mortality resulting from regulated fur harvest and damage management will be detrimental to the survival of the beaver and muskrat populations in the Commonwealth of Virginia (R. Farrar, VDGIF, letter to M. Lowney, WS, December 29, 1999).

2.2.2 Effects on plants and other wildlife species, including T&E species.

A common concern among members of the public and wildlife professionals, including WS personnel, is that the proposed action or any of the alternatives would result in removing individuals or adverse impacts

to populations of plants or other wildlife, particularly T&E species. WS's mitigation and SOPs are designed to reduce the effects on non-target species' populations and are presented in Chapter 3. To reduce the risks of adverse affects to non-target species, WS would select damage management methods that are as target-selective as possible or apply such methods in ways to reduce the likelihood of capturing non-target species. Before initiating trapping, WS would select trapping locations which are extensively used by the target species and use baits or lures which are preferred by the target species.

Removal of beaver and beaver impoundments would be beneficial to some plants and trees which may be killed by the flooding that results from beaver activity. Additionally, some wildlife species (i.e., mussels) would benefit from the removal of muskrats, beaver, and beaver dams.

2.2.2.1 Effects on river otters, a Virginia Species of Special Concern.

River otters, a state listed Species of Special Concern, are infrequently captured in traps and snares set for beaver. Otter that are live captured in snares would be released unharmed. In 1998, WS captured a total of 2 non-target otter. In comparison, 712 river otter were harvested and tagged by trappers during the regular 1998 state regulated trapping season (R. Farrar, VDGIF, pers. comm.). Thus, the effect of the WS take would be minimal as it represents about 0.3% of the total harvest. Otters can sustain serious, debilitating injury in Hancock live traps (Blundell et al. 1999). These traps would not be used by WS.

2.2.2.2 Effects on other non-target species

Other non-target species such as turtles and raccoons may occasionally be captured in beaver traps, although turtles can generally be released alive. In 1998, 16 turtles were captured, but 13 of these were released alive. The small number of non-target animals that are killed by WS has no adverse effects on the populations of these species.

2.2.2.3 Effects on T&E species

There are currently 52 federally listed T&E species in Virginia (39 animals and 13 plants) (USFWS, http://www.fws.gov/r9endspp/endspp.html). The removal of beaver and muskrats, and the breaching of beaver dams from a site could be beneficial to some plant and wildlife species, including T&E species. The removal of beaver and muskrats and breaching beaver dams would be beneficial to some plant species because the increased soil moisture associated with excess flooding may result in reduced plant or timber growth and vitality. Additionally, this increase in soil moisture in flooded areas could be detrimental to wildlife through a decrease in mast (e.g., acorn) production.

Beaver dams can adversely impact stream ecosystems by impounding habitat and increasing sedimentation in streams and affecting wildlife that depend on clear water, such as certain species of fish and mussels (e.g., dwarf wedgemussels and James spinymussel) (R. Neves, Virginia Polytechnic Institute and State University, letter to M. Lowney, WS, August 4, 1999; R. Hoffman, Virginia Museum of Natural History, letter to M. Lowney, WS, September 5, 1999).

Muskrat predation may also be detrimental to T&E species of mussels. Neves and Odom (1989) reported that muskrats appear to be inhibiting the recovery of endangered mussels and are likely placing pigtoe mussels in further jeopardy in the Clinch and Holston Rivers in Virginia. At one site in Virginia, muskrats were known to be feeding on the federally endangered tan riffleshell, but predation on this species decreased drastically after a muskrat trapping program was implemented (R. Neves, Virginia Polytechnic Institute and State University, letter to M. Lowney, WS, August 4, 1999).

WS consulted with the USFWS concerning potential impacts of WS methods on T&E species (USDI

1992) and the USFWS concurred that most Virginia WS beaver and muskrat damage management methods "are not likely to adversely affect listed or proposed species or adversely modify proposed or designated critical habitat in Virginia" (K. Mayne, USFWS, letter to M. Lowney, WS, November 29, 1999). However, the USFWS believes that there is a possibility that the use of zinc phosphide may affect certain federally listed species. Therefore, WS would consult with the USFWS on a case-by-case basis before using zinc phosphide in Virginia "to evaluate the location and potential non-target species, method of application, application rate, and potential concentration rate in the environment before determining whether federally listed species may be affected" (K. Mayne, USFWS, letter to M. Lowney, WS, November 29, 1999).

Additionally, WS would initiate consultation with the USFWS on a case-by-case basis where federally listed T&E fish and mussels are known to occur within 800 meters downstream of the dam (K. Mayne, USFWS, letter to M. Lowney, WS, November 29, 1999). The USFWS is concerned that the removal of beaver dams has the potential to adversely affect federally listed aquatic mussels and fish if high siltation occurs downstream of the breach. This method of damage reduction is being evaluated in the programmatic consultation on wildlife damage management that is currently underway between the USFWS and WS at the national level.

2.2.2.4 Effects on bog turtles

Bog turtles (*Clemmys muhlenbergi*) occur in Carroll, Floyd, Grayson, and Patrick counties in Virginia (C. Haas, Virginia Polytechnic Institute and State University, letter to M. Lowney, WS, August 9, 1999). Bog turtles need soft deep substrate with persistent shallow water (Carter et al. 1999). The northern population of bog turtles was recently listed as threatened by the USFWS because of habitat loss and collection for the pet trade. The USFWS said bog turtles in Virginia are listed as a threatened species because of similarity of appearance with the northern population of bog turtle, however, bog turtles are not a federally listed threatened species in Virginia because their habitat is secure (K. Mayne, USFWS, pers. comm.). Beaver impoundments flood the shallow freshwater marshes and seepage areas in the southwestern counties where bog turtles occur in Virginia (J. Mitchell, Univ. of Richmond, letter to M. Lowney, WS, August 23, 1999). The draining of some beaver impounded wetlands may be detrimental to bog turtles (Carter et al. 1999) or could be beneficial if it restores shallow wetlands (J. Mitchell, Univ. of Richmond, letter to M. Lowney, WS, August 23, 1999, C. Haas, Virginia Polytechnic Institute and State University, pers. comm). Beavers in these areas should be managed in such a way to keep from altering existing habitat (J. Mitchell, Univ. of Richmond, letter to M. Lowney, WS, August 23, 1999) and the possible effects on bog turtles will be considered in areas where they are known to occur.

2.2.3 Effects on public and pet health and safety.

A common concern is whether the proposed action or any of the alternatives pose an increased threat to public and pet health and safety. In particular, there is concern that the lethal methods of beaver and muskrat removal (i.e., trapping and shooting) may be hazardous to people and pets, or that continued increases in beaver and muskrat populations might threaten public and pet health or safety.

Firearm use is very sensitive and a public concern because of safety issues relating to the public and misuse. To ensure safe use and awareness, WS employees who use firearms to conduct official duties are required to attend an approved firearms safety and use training program within 3 months of their appointment and a refresher course every 3 years afterwards (WS Directive 2.615). WS employees who use firearms as a condition of employment, are required to sign a form certifying that they meet the criteria as stated in the *Lautenberg Amendment* which prohibits firearm possession by anyone who has been convicted of a misdemeanor crime of domestic violence.

2.2.4 Humaneness of methods to be used.

The issue of humaneness, as it relates to the killing or capturing of wildlife is an important but complex concept. Kellert and Berry (1980) in a survey of American attitudes toward animals related that 58% of their respondents, "*. . . care more about the suffering of individual animals . . . than they do about species population levels.*" Schmidt (1989) indicated that vertebrate pest control for societal benefits could be compatible with animal welfare concerns, if "*. . . the reduction of pain, suffering, and unnecessary death is incorporated in the decision making process.*"

Suffering has been described as a "*. . . highly unpleasant emotional response usually associated with pain and distress.*" However, suffering "*. . . can occur without pain . . .*," and "*. . . pain can occur without suffering . . .* " (American Veterinary Medical Association (AVMA) 1986). Because suffering carries with it the implication of a time frame, a case could be made for "*. . . little or no suffering where death comes immediately . . .* " (California Department of Fish and Game (CDFG) 1991), such as the WS technique of shooting.

Defining pain as a component of humaneness may be a greater challenge than that of suffering. Pain obviously occurs in animals. Altered physiology and behavior can be indicators of pain, and identifying the causes that elicit pain responses in humans would "*. . . probably be causes for pain in other animals . . .* " (AVMA 1986). However, pain experienced by individual animals probably ranges from little or no pain to significant pain (CDFG 1991). Some WS damage management methods such as leg-hold traps and body snares, may thus cause varying degrees of pain in different animal species for varying time frames. At what point pain diminishes or stops under these types of restraint has not been measured by the scientific community.

Pain and suffering as it relates to a review of WS damage management methods to capture animals, has both a professional and lay point of arbitration. Wildlife managers and the public would both be better served to recognize the complexity of defining suffering, since "*. . . neither medical or veterinary curricula explicitly address suffering or its relief*" (CDFG 1991).

Research suggests that with some methods, such as restraint in leg-hold traps, changes in the blood chemistry of trapped animals indicate "*stress*" (USDA 1997: 3-81). However, such research has not yet progressed to the development of objective, quantitative measurements of pain or stress for use in evaluating humaneness.

Thus, the decision-making process involves tradeoffs between the above aspects of pain and humaneness. An objective analysis of this issue must consider not only the welfare of wild animals but also the welfare of humans if damage management methods were not used. Therefore, humaneness appears to be a person's perception of harm or pain inflicted on an animal, and people may perceive the humaneness of an action differently. The challenge in coping with this issue is how to achieve the least amount of suffering with the constraints imposed by current technology and funding.

WS has improved the selectivity and humaneness of management devices through research and is striving to bring new findings and products into practical use. Until new findings and products are found practical, a certain amount of animal suffering could occur when some methods are used in those situations when non-lethal damage management methods are not practical or effective.

Virginia WS personnel are experienced and professional in their use of management methods so that they are as humane as possible under the constraints of current technology and funding. Mitigation /SOPs used to maximize humaneness are listed in Chapter 3. As appropriate, WS euthanizes live animals by methods recommended by the AVMA (AVMA 1986) or the recommendations of a veterinarian, even though the

AVMA euthanasia methods were developed principally for companion animals and slaughter of food animals, and not for free-ranging wildlife.

Some people are concerned about beaver and muskrats that drown while restrained by leghold traps and these people consider drowning inhumane. The AVMA (1993) does not recognize drowning as an approved method of euthanasia for companion or research animals. However, these recommendations were designed for domestic terrestrial animals and not wild aquatic rodents which differ behaviorally and biologically. In fact, the AVMA (1993) recognizes that "for wild and feral animals, many of the recommended means of euthanasia for captive animals are not feasible. In field circumstances, wildlife biologists generally do not use the term euthanasia, but use terms such as killing, collecting, or harvesting, recognizing that a distress-free death may not be possible." Trapper education manuals from Virginia and New York and other wildlife damage management manuals written by wildlife biologists recommend drowning sets for leghold traps set for beaver and muskrat (Bromley et al. 1994, Dolbeer et al. 1994, Howard et al.1980, Miller 1994, Miller and Yarrow 1994, Randolph 1988). In summary, the AVMA did not intend to make the decision which methods of euthanasia are appropriate for feral or wild animals, yet some animal activist organizations are choosing to apply AVMA guidelines to feral and wild animals.

There has been much controversy whether drowning is euthanasia. The debate centers around an uncertainty as to whether the drowning animals are rendered unconscious by high levels of CO_2 and are thus insensitive to distress and pain (Ludders et al. 1999). Death by drowning in the classical sense is caused by the inhalation of fluid into the lungs and is referred to as "wet" drowning (Gilbert and Gofton 1982, Noonan 1998). Gilbert and Gofton (1982) reported that all submerged beaver and some muskrat do not die from wet drowning, but die of CO_2 induced narcosis, and the AVMA has stated the use of CO_2 is acceptable (Gilbert and Gofton 1982, Noonan 1998). However, Gilbert and Gofton (1982) have been criticized because levels of carbon dioxide in the blood were not reported (Ludders et al. 1999) and there was insufficient evidence that the beaver in their study were under a state of CO_2 narcosis when they died (V. Nettles, Southeastern Cooperative Wildlife Disease Study, letter to W. MacCallum, Massachusetts Division of Fisheries and Wildlife, June 15, 1998). Adding to the controversy, Clausen and Ersland (1970) did measure CO_2 in the blood for submersed restrained beaver, yet none of the beaver in their study died, so Clausen and Ersland (1970) could not determine if beavers die of CO_2 narcosis.

The use of drowning trap sets has been a traditional wildlife management technique in trapping aquatic mammals such as beaver and muskrat. In some situations drowning trap sets are the most appropriate and efficient method available to capture beaver and muskrats. For example, a drowning set attachment should be used with leghold traps when capturing beaver and muskrat to prevent the animal from injuring themselves while restrained, or from escaping (Miller and Yarrow 1994). Animals that drown die relatively quickly (e.g., within minutes) versus the possible stress of being restrained and harassed by people, dogs, and other wildlife before being euthanized. Drowning sets make the captured animal and trap less visible and prevent human injury (i.e., bites and scratches) to people who may otherwise approach a restrained animal. Furthermore, some people are offended seeing dead animals and drowning takes the dead animal out of public view. Some sites may be unsuitable for body-grip traps or snares because of unstable banks, deep water, or a marsh with muck bottom, but these sites would be suitable for leghold traps. In some situations where muskrats occur in high densities, multiple catch colony traps may be the most efficient method to reduce populations and alleviate damage, and drowning is a humane way of killing muskrats (Gilbert and Gofton 1982) in colony traps.

2.2.5 Effects on wetlands and wetlands ecosystem.

Some people are concerned about the effects of the alternatives on the wetland ecosystem and that the removal of beaver or breaching beaver dams from an area will result in the loss of wetland habitat and the plant and animal species included in those wetlands.

Beaver build dams primarily in smaller riverine wetlands (intermittent and perennial streams and creeks) with dams consisting of mud, sticks and other vegetative materials. Their dams obstruct the normal flow of water and typically change the preexisting wetlands' hydrology from flowing or circulating waters to slower, deeper, more expansive waters that accumulate bottom sediment; the depth of the bottom sediment depends on the length of time an area is covered by water, and the amount of suspended sediment in the water.

WS beaver damage management activities are primarily conducted to alleviate damages to agricultural crops, timber resources, and public property such as roads, bridges and water management facilities. Activities are also conducted to enhance or reclaim wildlife and stream fishery/mussel habitats. WS operations routinely incorporate beaver removal with dam breaching and/or installation of water leveler or exclusion devices. Dams are breached by hand where possible, or small charges of binary explosives are used as necessary. No heavy equipment such as backhoes or bulldozers are used by WS in these damage reduction and wildlife enhancement activities. These activities take place on small watershed streams, tributary drainages, and ditches and can best be described as small, one-time projects conducted to restore water flow through previously existing channels. Only that portion of the dam blocking the stream or ditch channel is altered or breached. The USACE and VDEQ, Division of Water Quality, have criteria that would be implemented by WS during dam breaching activities to minimize any impacts to the water course basin, adjacent riparian areas, or surrounding vegetation. Projects involving the use of binary explosives would be conducted by trained WS certified explosive specialists. After a blast, any remaining fill material still obstructing the channel is normally washed downstream by water current. The only noticeable side effects from this activity are diluted mud, water, and small amounts of debris from the dam scattered around the blasting site. Considerably less than 10 cubic yards of material would be moved in each of these project activities.

Beaver dams in time can establish new, but different wetlands. The USACE and U. S. Environmental Protection Agency's (EPA) regulatory definition of a wetland (40 CFR 232.2) is:

Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

The preexisting habitat and the altered habitat have different ecological values to the fish and wildlife native to the area. Some species will abound by the addition of a beaver dam, while others will diminish. For example, some species of darters listed as federally endangered require fast moving waters over gravel or cobble beds which beaver dams can eliminate, thus reducing the habitat's value for these species. In general, it has been found that wildlife habitat values decline around bottomland beaver impoundments in the southern U.S. because the hardwoods are killed from flooding and mast production declines. On the other hand, beaver dams can potentially be beneficial to some species of wildlife such as river otter, neotropical birds, and waterfowl.

If a beaver dam is not breached and water is allowed to stand, hydric soils and hydrophytic vegetation eventually form. This process can take anywhere from several months to years depending on preexisting conditions. Hydric soils are those soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. In general, hydric soils form much easier where wetlands have preexisted. Hydrophytic vegetation includes those plants that grow in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content . If these conditions are met, then a wetland has developed that would have different wildlife habitat values than an area that has been more recently impounded by beaver dam activity.

The intent of most dam breaching is not to drain established wetlands. With few exceptions, requests from public and private individuals and entities that WS receives involve dam breaching to return an area back to its preexisting condition within a few years after the dam was created. If the area does not have hydric soils, it usually takes many years for them to develop and a wetland to become established; this often takes greater than 5 years as recognized by the Swampbuster provisions. Most beaver dam removal by WS is either exempt from regulation under Section 404 of the Clean Water Act (CWA) as stated in 33 CFR part 323 or may be authorized under the Corps' Nationwide Permit System in 33 CFR part 330. However, the breaching of some beaver dams can trigger certain portions of Section 404 that require landowners to obtain permits from the USACE. WS personnel determine the proper course of action upon inspecting a beaver dam impoundment. Appendix C describes the procedures used by WS to assure compliance with the pertinent laws and regulations.

2.2.6 Effects on landscaping and native vegetation.

Some people are concerned about the effects of the different alternatives on the wild and ornamental trees and shrubs that are used in landscaping, as well as native trees that have ornamental, aesthetic, or economic value. As stated in the Purpose and Need section, property owners are experiencing damage to landscaping because of beaver. These people are concerned as to whether the proposed action or any of the alternatives would reduce such damage.

2.2.7 Impacts to stakeholders, including aesthetics.

The human attraction to animals has been well documented throughout history and started when humans began domesticating animals. The American public is no exception and today a large percentage of households have pets. However, some people may consider individual wild animals and birds as "pets" or exhibit affection toward these animals, especially people who enjoy coming in contact with wildlife. Therefore, the public reaction is variable and mixed to wildlife damage management because there are numerous philosophical, aesthetic, and personal attitudes, values, and opinions about the best ways to manage conflicts/problems between humans and wildlife.

There is some concern that the proposed action or the alternatives would result in the loss of aesthetic benefits to the public, resource owners, or neighboring residents. Wildlife generally is regarded as providing economic, recreational, and aesthetic benefits (Decker and Goff 1987), and the mere knowledge that wildlife exists is a positive benefit to many people. Aesthetics is the philosophy dealing with the nature of beauty, or the appreciation of beauty. Therefore, aesthetics is truly subjective in nature, dependent on what an observer regards as beautiful.

Wildlife populations provide a range of social and economic benefits (Decker and Goff 1987). These include direct benefits related to consumptive and non-consumptive use (e.g., wildlife-related recreation, observation, harvest, sale), indirect benefits derived from vicarious wildlife related experiences (e.g., reading, television viewing), and the personal enjoyment of knowing wildlife exists and contributes to the stability of natural ecosystems (e.g., ecological, existence, bequest values) (Bishop 1987). Direct benefits are derived from a user's personal relationship to animals and may take the form of direct consumptive use (using up the animal or intending to) or non-consumptive use (viewing the animal in nature or in a zoo, photography) (Decker and Goff 1987). Indirect benefits or indirect exercised values arise without the user being in direct contact with the animal and come from experiences such as looking at photographs and films of wildlife, reading about wildlife, or benefitting from activities or contributions of animals such as their use in research (Decker and Goff 1987). Indirect benefits come in two forms: bequest and pure existence (Decker and Goff 1987). Bequest is providing for future generations and pure existence is merely knowledge that the animals exist (Decker and Goff 1987).

IWDM provides relief from damage or threats to public health or safety to people who would have no relief from such damage or threats if non-lethal methods were ineffective or impractical. Many people directly affected by problems and threats to public health or safety caused by beaver or muskrats insist upon their removal from the property or public location when they cause damage. Some people have an idealistic view and believe that all wildlife should be captured and relocated to another area to alleviate damage or threats to public health or safety. Some people directly affected by the problems caused by wildlife strongly support removal. Individuals not directly affected by the harm or damage may be supportive, neutral, or totally opposed to any removal of wildlife from specific locations or sites. Some people totally opposed to beaver or muskrat damage management want WS to teach tolerance for damage and threats to public health or safety, and that wildlife should never be killed. Some of the people who oppose removal of wildlife do so because of human-affectionate bonds with individual wildlife. These human-affectionate bonds are similar to attitudes of a pet owner and result in aesthetic enjoyment.

Virginia WS only conducts beaver and muskrat damage management at the request of the affected home/property owner or resource manager. If WS received requests from an individual or official for beaver or muskrat damage management, WS would address the issues/concerns and consideration would be made to explain the reasons why the individual damage management actions would be necessary. Management actions would be carried out in a caring, humane, and professional manner.

2.3 ADDITIONAL ISSUES USED TO DEVELOP MITIGATION MEASURES

2.3.1 Cultural Resources Concerns

The National Historic Preservation Act of 1966, as amended, requires federal agencies to evaluate the effects of any federal undertaking on cultural resources and to consult with appropriate American Indian Tribes to determine whether they have concerns for cultural properties in areas of these federal undertakings. The Native American Graves and Repatriation Act of 1990 provides for protection of American Indian burial sites, human remains, funerary objects and sacred objects, and establishes procedures for notifying Tribes of any new discoveries.

In most cases, beaver or muskrat damage management has little potential to cause adverse effects to sensitive cultural resources. The areas where damage management would be conducted are small and pose minimal ground disturbance. The Virginia Department of Historic Resources (VDHR) has reviewed the program as proposed and concluded that the beaver and muskrat damage management program, *"does not have the potential to cause effects on historic properties"*(C. Metz, Virginia Department of Historic Resources, letter to M. Lowney, WS, July 14, 1999). Mitigation to avoid impacts to are listed in Chapter 3.

In consideration of American Indian cultural and archeological interests, the Virginia WS program solicited input from the following Tribes within Virginia: Chickahominy, Mattaponi, and Pamunkey. No comments were received from these Tribes.

2.3.2 Environmental Justice and Executive Order 12898 - *"Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations"*

Environmental Justice (EJ) has been defined as the pursuit of equal justice protection under the law for all environmental statutes and regulations without discrimination based on race, ethnicity, or socioeconomic status. Fair treatment implies that no person or group should endure a disproportionate share of the negative environmental impacts resulting from this country's domestic and foreign policies or programs.

Executive Order 12898 requires federal agencies to make EJ part of their mission, and to identify and

address disproportionately high and adverse human health and environmental effects of federal programs, policies and activities on minority and low-income persons or populations. APHIS plans to implement Executive Order 12898 principally through the provisions of NEPA.

WS activities are evaluated for their impact on the human environment and compliance with Executive Order 12898 to insure EJ. WS personnel use wildlife damage management methods as selectively and environmentally conscientiously as possible. All chemicals used by APHIS-WS are regulated by the EPA through the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), the VDACS, by MOUs with land managing agencies, and by WS Directives. Based on a thorough Risk Assessment, APHIS concluded that when WS program chemicals are used according to label directions, they are selective to target individuals or populations, and such use has negligible impacts on the environment (USDA 1997, Appendix P). The WS operational program properly disposes of any excess solid or hazardous waste. It is not anticipated that the proposed action would result in any adverse or disproportionate environmental impacts to minority and low-income persons or populations. In contrast, WS beaver and muskrat damage management may provide for a safer environment for minority or low-income persons by reducing public health and safety risks.

2.3.3 Protection of Children from Environmental Health and Safety Risks (Executive Order 13045).

Children may suffer disproportionately from environmental health and safety risks for many reasons, including their development physical and mental status. Because WS makes it a high priority to identify and assess environmental health and safety risks that may disproportionally affect children, WS has considered the impacts that this proposal might have on children. The proposed beaver and muskrat damage management would occur by using only legally available and approved methods where it is highly unlikely that children would be adversely affected. For these reasons, WS concludes that it would not create an environmental health or safety risk to children from implementing this proposed action. In contrast, WS beaver and muskrat damage management may provide for a safer environment for children by reducing public health and safety risks.

2.3.4 Public's Concern About the Use of Chemicals.

Much of the public concern over the use of toxicants for wildlife damage management is based on an erroneous perception that WS uses non-selective, outdated chemical methodologies. However, chemical methods used and proposed for use by WS have a high degree of selectivity. Currently, the use of toxicants by WS in all instances is regulated by the EPA through the FIFRA, by MOUs with other agencies, and by WS Directives. Based on a thorough Risk Assessment, APHIS concluded that, when WS program chemicals are used according to label directions, they are selective for target individuals or populations, and such use has negligible impacts on the environment (USDA 1997). A decision to ban toxicants is outside of WS's authority. WS could elect not to use toxicants, but those registered for use in Virginia are an integral part of IWDM and their selection for use would follow criteria in the Decision Model (Slate et al. 1992).

2.4 ISSUES NOT CONSIDERED IN DETAIL WITH RATIONALE

2.4.1 WS's Impact on Biodiversity.

No Virginia WS beaver or muskrat damage management is conducted to eradicate a native wildlife population. WS operates according to international, federal, and state laws and regulations enacted to ensure species viability. Virginia does not have a formal biodiversity policy, however several state policies direct agencies to consider biological sustainability when making management decisions (Defenders of

Wildlife and Center for Wildlife Law 1996). For instance, the policy of the VDGIF is to manage the State's wildlife resources *"to maintain optimum populations of all species to serve the needs of the Commonwealth."* In addition, the Virginia (GAP) system tracks 1,127 species of vertebrate and invertebrate animals and the VDGIF maintains a nongame database, utilizing scientific collection permit reports, breeding bird survey reports, Christmas bird counts and others (Defenders of Wildlife and Center for Wildlife Law 1996). Virginia also has separate acts that cover plant and animal endangered species (Virginia Annotated Code (VAC) §§29.1-563; VA Regs. Reg. 325-01 et seq) (Defenders of Wildlife and Center for Wildlife Law 1996). Under the Endangered Plant and Insect Species Act, listings are based on scientific data (VAC §§3.1-1020 et seq.; VA Regs. Reg 115-04-01) (Defenders of Wildlife and Center for Wildlife Law 1996).

In addition, any reduction of a local population or group is frequently temporary because immigration from adjacent areas or reproduction replaces the animals removed. The impacts of the current WS program on biodiversity are minor and not significant nationwide, statewide, or regionwide (USDA 1997). WS operates on a relatively small percentage of the land area of the State (see Section 1.1), and the WS take of any wildlife species analyzed in this EA is a small proportion of the total population and insignificant to the viability and health of the population (see Section 4.3).

2.4.2 No wildlife damage management at taxpayer expense; wildlife damage management should be fee based.

Funding for WS comes from a variety of sources in addition to federal appropriations. Virginia agency funds, county funds, city funds, private funds, and other federal agency funds are applied to the program under Cooperative Agreements. Federal, state, and local officials have decided that wildlife damage management should be conducted by appropriating funds. WS was established by Congress as the agency responsible for providing wildlife damage management to the people of the United States. Wildlife damage management is an appropriate sphere of activity for government programs, since aspects of wildlife damage management are a government responsibility and authorized and directed by law.

2.4.3 Beaver and muskrat damage should be managed by trappers and nuisance wildlife control agents

The jurisdiction for managing most resident wildlife rests with the VDGIF. Currently, VDGIF manages beaver and muskrats as furbearers (VAC §§ 29.1-100). If deemed necessary, the VDGIF has the option to reduce restrictions on trapping to provide for more harvest and opportunities for sportsmen and women. Virginia, through season and bag limit regulation and trapping method restrictions, has utilized private fur trapping as the main tool in beaver and muskrat population management. Regulated beaver trapping seasons have occurred since 1953, and regulated muskrat trapping has occurred since the creation of the VDGIF in 1916 (R. Farrar, VDGIF, pers. comm.).

The number of recreational fur trappers in Virginia has drastically declined in the past few decades. According to beaver harvest data from the VDGIF, the number of trapping licenses sold annually decreased from a peak of 5,293 licenses in 1979 to a low of 709 in 1993, with 1,042 sold in 1998 (the most current year for which data is available) (R. Farrar, VDGIF, pers. comm.). Recreational fur trappers provide several societal services, including trapping beaver causing damage to property and assisting the VDGIF to manage beaver populations. One cause for the decline in recreational trapping has been lower prices paid for raw fur since the early 1980's. Subsequently, there is an insufficient number of trappers to manage expanding beaver populations. In addition, the legal trapping season for beaver lasts for only 3 months of the year, while beaver damage problems occur year-round. Many beaver damage problems also occur in urban or developed areas where little or no recreational beaver trapping occurs.

Trappers or nuisance wildlife control agents are also allowed to conduct beaver and muskrat removal under the provisions of VAC §§29.1-529, §§29.1-517 and §§29.1-518. Most private trappers cannot afford to provide year-around site-specific beaver or muskrat damage management, however that option remains open to landowners experiencing damage or the threat of damage. Private trappers, nuisance wildlife control agents, and landowners could trap beaver and muskrat to alleviate damage during the regulated trapping season, or outside of the regulated season if a Kill Permit is obtained from the VDGIF. In 1996, 1997, and 1998, VDGIF issued 154, 174, and 335 Kill Permits, respectively, to landowners or their tenants to remove beaver. Additionally, 46, 35, and 31 Kill permits were issued in 1996, 1997, and 1998, respectively, to remove muskrats causing damage. However, some trappers are not willing to trap in urban areas for aesthetic reasons or for fear of trap theft. Trappers also may not be willing to trap beaver or muskrat outside of the regular trapping season because the furs cannot be utilized. The Kill Permit needed to remove beaver and muskrats outside of the regulated trapping season does not allow trappers to transport and keep the furs unless authorized by the game warden (R. Farrar, VDGIF, pers. comm.). Also, furs taken outside the regulated trapping season lack primeness and have little or no economic value.

Site-specific damage management has been necessary to protect property, roads, bridges, and agricultural and natural resources. It is the policy of WS to provide professional damage management upon request and verification of damage at site-specific locations. Assistance from Virginia WS's may be requested to achieve management objectives. Typically damage management involves removing a small number of beaver or muskrats from a localized area. WS is not involved in statewide or large scale beaver or muskrat population reduction (See Section 1.3). Targeted beaver and muskrat populations include those found near damage sites (i.e., site-specific areas, such as bridges, critical wildlife habitat, managed forests and ornamental trees and shrubs).

Some landowners may prefer that a government agency trap beaver or muskrats instead of using private trappers or nuisance wildlife control agents, and large landowners with numerous damage sites (i.e., railroads or highway departments) may prefer to use WS because of reduced administrative burden. Some landowners may prefer to use private trappers or nuisance wildlife control agents instead of WS. Thus, WS beaver and muskrat damage management activities would not eliminate opportunities for private trappers or nuisance wildlife control agents.

2.4.4 Relocation of wildlife should be used

Relocation of problem wildlife species is a technique that is sometimes used to alleviate wildlife damage problems. The success of a relocation effort, however, depends on the potential for the problem individuals to be captured efficiently and the existence of an appropriate relocation site (Nielsen 1988). While relocation may be appropriate in some situations when the species population is low, beaver and muskrats are relatively abundant in much of the suitable habitat in Virginia and relocation is not necessary for the maintenance of viable populations. Because beaver are relatively abundant in Virginia, beaver relocated into suitable habitat are very likely to encounter other beaver with established territories. Beaver are highly territorial and the newly introduced beaver, which are disoriented and at a disadvantage, are often viciously attacked and sometimes killed from these encounters (McNeely 1995).

Relocated beaver may also disperse long distances from the release site (Novak 1987*a*). Hibbard (1958) in North Dakota recorded an average dispersal distance by 17 relocated beaver to be about 9 miles and Denney (1952) in Colorado reported an average dispersal of 10.4 miles and a maximum dispersal of 30 miles for 26 transplanted beaver. Beaver relocated on streams and later recaptured (N=200) moved an average distance of 4.6 miles, and in lake and pothole relocations (N=272) moved an average of 2 miles (Knudsen and Hale 1965). Only 12% of beaver relocated on streams and 33% of beaver relocated in the lake and pothole areas remained at the release site (Knudsen and Hale 1965).

The relocation of beaver or muskrats that are causing damage could result in damage problems at the release site or dispersal site. In this case, the original damage problem has simply been shifted from one property to another. If WS relocated the problem animal, WS would be liable for any subsequent damage caused by that animal.

Live-trapping and relocating beaver and muskrats is not cost-efficient and is biologically unsound (Wade and Ramsey 1986). The AVMA, the National Association of State Public Health Veterinarians, and the Council of State and Territorial Epidemiologists all oppose the relocation of mammals because of the risk of disease transmission, particularly for small mammals (Center for Disease Control 1990). Additionally, the survival of relocated animals is generally very poor due to the stress of relocation, so that in many cases an animal is released only to suffer mortality in a new environment (Craven 1992). Courcelles and Nault (1983) found that 50% (N=10) of radio-collared, relocated beaver died, probably from stress or predation resulting from the relocation. Among animal advocacy groups there appears to be disagreement about relocating wildlife to alleviate damage. The People for the Ethical Treatment of Animals opposes relocation of problem beaver because they believe relocation is cruel (Redmon 1999, 2000). The Humane Society of the United States believes relocation is preferable to death, in some circumstances, but relocation could be stressful and result in suffering or death (Bridgeland et al. 1997). The Humane Society of the United States openly advocates relocating muskrats to alleviate damage but is less clear about beaver (Bridgeland et al. 1991).

Relocation of wildlife in Virginia must be approved by the VDGIF. VDGIF has stated that "with regard to beaver damage conflicts, the relocation of beaver to resolve damage issues is not generally recommended" (R. Farrar, VDGIF, letter to M. Lowney, WS, April 10, 2000). Regulation 4 VAC 15-50 authorizes certain government agencies, including WS, to engage in activities related to wildlife management. VDGIF has interpreted this regulation to allow WS to relocate wildlife in Virginia if necessary (R. Farrar, VDGIF, letter to M. Lowney, WS, April 10, 2000). However, WS did not consider this option in detail because of the unavailability of appropriate release sites for beaver or muskrats, and biological and humaneness concerns related to poor survivorship of relocated animals, competition with established colonies, and the potential for transmission of disease between populations. There is a high probability that damage problems would be transferred from one site to another through relocation of beaver or muskrat. Also, WS would be liable for any damage relocated beaver or muskrat may cause.

2.4.5 Live-capture and euthanasia only.

Live-capture and euthanasia of beaver and muskrats may be used as part of the IWDM approach to reduce aquatic rodent damage. Snares would be used to live-capture beaver. While snares are an effective and at times an efficient tool for capturing beaver, the use of additional methods (e.g., body-grip traps, shooting, leg-hold traps) could be necessary to reduce damage in a cost-effective manner. Also, snares are inappropriate to use in moving water because the current closes or disables the snare. Muskrats could be live-captured in floating colony traps, but these traps are cumbersome and more time consuming to set than body-grip traps and standard colony traps which kill the muskrats.

2.4.6 Breaching of dams or use of water control structures.

This issue addresses attempts to alleviate flooding damage by controlling the water level at the site without removing the beaver. Dams would either be breached manually or with binary explosives, but these methods are usually ineffective because beaver will quickly repair or replace the dam (McNeely 1995). Installing and maintaining water control structures or removing beaver dams on a daily or weekly basis may be cost prohibitive, and would not alleviate damage from gnawing or felling of trees.

Water control devices and pond levelers have been used for many years in many different states, with

varying degrees of success. Various types of beaver pond levelers have been described (Arner 1964, Laramie and Knowles 1985, Lisle 1996, Roblee 1984) and installation of beaver pond levelers can be effective in reducing flooding in certain situations (Minn. Dept. Nat. Res. 1994, Miller and Yarrow 1994, Organ et al. 1996). One study reported water drainage pipes in beaver dams to be effective in only about 5% of flooding situations (Anonymous 1999). This is primarily because these structures were blocked by debris or siltation, and because the beaver often built a new dam nearby (McNeely 1995). If beaver are not removed, they may build dams upstream and downstream or block the device with mud and debris, rendering this method ineffective (B. Sloan, USDA/APHIS/WS, pers. comm.). Suppression or eradication of the local beaver population usually is required for this method to be effective (E. Butler, USDA/APHIS/WS, pers. comm., B. Sloan, USDA/APHIS/WS, pers. comm.).

Water control devices are most effective on wetlands lacking in-stream flow (B. Sloan, USDA/APHIS/WS, pers. comm.), but may be ineffective in beaver ponds in broad, low-lying areas (Organ et al. 1996). They may not be appropriate in streams or ditches with continuous flow because the volume of water is too great for the device to handle, and debris is continuously carried to the site. Also, water control devices may not be effective during periods of unusually high rainfall or increased water flow because the device cannot handle the increased volume of water (Anonymous 1999, Wood et al. 1994).

The use of pond levelers or water control devices may require frequent maintenance, depending on the type of water control device used. Continued maintenance is necessary for the device to remain operational because stream flow, leaf fall, floods, and beaver activity will continuously bring debris to the water control device. This maintenance of water control devices can be expensive. The Maine WS program estimated annual maintenance costs at about $350 per water control device, in addition to a cost of about $250 - $300 for construction and installation (E. Butler, USDA/APHIS/WS, pers. comm.). There may be an annual costs to suppress or eradicate beaver populations to keep the devices operational (B. Sloan, USDA/APHIS/WS, pers.comm.).

The Beaver Deceiver is a relatively recent water control system that attempts to quiet, calm, and deepen the water around culverts (to reduce the attractiveness to beaver) and exclude beaver from a wide area around the upstream opening of the culvert (Lisle 1996). However, the effectiveness of this method is theoretical and has not been evaluated. Recreational fur trapping is an integral part of and justification for using beaver deceivers. Fur trapping keeps beaver populations at acceptable levels by minimizing flooding and road damage (Lisle 1996). Preservation of the fur resource for recreational trapping is the benefit of using beaver deceivers (Lisle 1996).

WS could implement the use of water control devices as part of an integrated beaver management program at appropriate sites. The Maine WS program installed over 160 water control devices in 1998. The primary benefit of the use of these devices in Maine is to minimize flooding damage while leaving beavers for fur trappers to remove during the regulated trapping season each year (E. Butler, USDA/APHIS/WS, pers. comm.). In Mississippi, the WS program commonly installs water control devices at sites where the landowner intends to hunt ducks or lease duck hunting rights on his land (B. Sloan, USDA/APHIS/WS, pers. comm.). Because there are few fur trappers in Mississippi, it is generally necessary to suppress or eradicate beaver annually at the site to maintain the effectiveness of the device (B. Sloan, USDA/APHIS/WS, pers. comm.). Thus, in both Maine and Mississippi, the use of water control devices is supplemented by the continual removal of beaver from the site and an additional benefit is received which helps to justify the expense (i.e. reserving beaver for the fur harvest, providing duck hunting sites). Also, the construction, installation, and maintenance costs of water control devices in Maine and Mississippi are funded, in part, by sources such as state wildlife agencies, county governments, USFWS, or private organizations (E. Butler, USDA/APHIS/WS, pers. comm., B. Sloan, USDA/APHIS/WS, pers. comm.). Without such financial assistance and the existence of additional benefits, water control devices would generally be ineffective to reduce or prevent damage.

2.4.7 Appropriateness of Preparing an EA (Instead of an EIS) For Such a Large Area.

Some individuals might question whether preparing an EA for an area as large as the Commonwealth of Virginia (26 million acres) would meet the NEPA requirements for site specificity. If in fact a determination is made through this EA that the proposed action would have a significant environmental impact, then an EIS would be prepared. In terms of considering cumulative impacts, one EA analyzing impacts for the entire state may provide a better analysis than multiple EA's covering smaller zones. In addition, Virginia WS only conducts beaver or muskrat damage management in a very small area of the Commonwealth where damage is occurring or likely to occur (see Section 1.3) and damage may occur anywhere in the Commonwealth (see Section 1.10.5).

CHAPTER 3: ALTERNATIVES

3.0 INTRODUCTION

This chapter consists of seven parts: 1) an introduction, 2) description of alternatives considered and analyzed in detail including the Proposed Action (Alternative 3), 3) beaver and muskrat damage management approaches used by WS, 4) beaver and muskrat damage methods authorized for use or recommended, 5) methodologies recommended but deemed impractical, ineffective, or unsafe at the present time, 6) a description of alternatives considered, but eliminated from detailed analysis, and 7) a table of mitigation measures and SOP. Alternatives were developed for consideration using the WS Decision Model (Slate et al. 1992), *"Methods of Control"* (USDA 1997 Appendix J) and the *"Risk Assessment of Wildlife Damage Control Methods Used by the USDA Animal Damage Control Program"* (USDA 1997, Appendix P) of USDA (1997). Five alternatives were recognized, developed, and analyzed in detail by the Multi-agency Team (WS, VDGIF, VDOT, VDOF, VDEQ, VDACS, USACE); three alternatives were considered but not analyzed in detail with supporting rationale. The five alternatives analyzed in detail are:

- Alternative 1 - No WS Beaver or Muskrat Damage Management in Virginia. This alternative would result in no assistance from WS in reducing beaver or muskrat damage in Virginia. WS would not provide technical assistance or operational damage management services.

- Alternative 2 - Only Lethal Beaver and Muskrat Damage Management. Under this alternative, only lethal operational damage management and technical assistance would be provided by WS.

- Alternative 3 - Fully Integrated Beaver and Muskrat Damage Management for all Public and Private Land (No Action/Proposed Action). This alternative is the proposed action and is the preferred alternative of WS because it incorporates the use of both non-lethal and lethal methods as appropriate to manage conflicts associated with beaver and muskrats in the Commonwealth of Virginia as requested and appropriate.

- Alternative 4 - Technical Assistance Only. Under this alternative, WS would not conduct operational beaver or muskrat damage management in Virginia. The entire program would consist of technical assistance.

- Alternative 5 - Non-lethal Beaver and Muskrat Damage Management. This alternative would not allow the use of lethal methods by WS as described under the proposed action. Only non-lethal methods could be implemented by Virginia WS to reduce damage caused by beaver or muskrats.

3.1 ALTERNATIVES CONSIDERED, INCLUDING THE PROPOSED ACTION

3.1.1 Alternative 1. No WS Beaver or Muskrat Damage Management in Virginia

This alternative would result in no assistance from WS in reducing beaver or muskrat damage in Virginia. WS would not provide technical assistance or operational damage management services.

All requests for beaver or muskrat damage management assistance would not be responded to by WS and would be referred to the VDGIF, local animal control agencies, or private businesses or organizations. Assistance may or may not be available from any of these entities, or damage management methods could be implemented by resource owners, private businesses, or volunteers. Any assistance (technical or operational) provided by the VDGIF and local animal control agencies would be funded by the respective agency providing the assistance as these agencies could not accept reimbursement from service recipients without legislative approval (R. Duncan, VDGIF, pers. comm.). Private businesses could provide assistance on a reimbursable basis, or volunteer services could be provided at no cost to resource owners.

3.1.2 Alternative 2. Only Lethal Beaver and Muskrat Damage Management

Under this alternative, only lethal operational beaver and muskrat damage management and technical assistance would be provided by WS. Requests for information regarding non-lethal management approaches would be referred to VDGIF, local animal control agencies, or private businesses or organizations. Individuals or agencies might choose to implement WS lethal recommendations, implement non-lethal methods or other methods not recommended by WS, contract for WS damage management services, use contractual services of private businesses, use volunteer services, or take no action. WS damage management services would be conducted as authorized by various federal and state regulations and would be fully funded by service recipients. WS technical assistance would be funded through WS appropriations. This alternative would not allow WS to consider the use of physical exclusion or water-level control devices, even where these non-lethal methods may be beneficial. Lethal methods used by WS would include shooting, trapping, and zinc phosphide bait for muskrats.

Shooting is an effective method to remove small numbers of individual beaver or muskrats in a damage situation, especially where trapping is not feasible. Shooting is mostly conducted at night with the aid of spotlights or night-vision equipment.

Traps that can be used for lethal removal include leg-hold traps, body-grip (e.g., Conibear) traps, colony traps, snares, and Hancock (suitcase/basket type) traps. A more complete description of these methods is available in Appendix D and the ADC Programmatic Final Environmental Impact Statement (EIS) (USDA 1997, Appendix J). These techniques are usually implemented by WS personnel because of the training required to use such devices.

3.1.3 Alternative 3. Fully Integrated Beaver and Muskrat Damage Management for all Private and Public Land (No Action and Proposed Action).

The No Action alternative is a procedural NEPA requirement (40 CFR 1502.14(d)) and is a viable and reasonable alternative that could be selected and serves as a baseline for comparison with the other alternatives. The No Action Alternative, as defined here, is consistent with the Council on Environmental Quality (CEQ) (1981).

This alternative is the proposed action and is the preferred alternative of WS because it incorporates an IWDM approach, as appropriate, to reduce conflicts associated with beaver and muskrats in the Commonwealth of Virginia. An IWDM strategy would be recommended and used, encompassing the use of practical and effective methods of preventing or reducing damage while minimizing harmful effects of damage management measures on humans, other species, and the environment. Under this action, WS would provide both technical assistance and operational damage management services. Non-lethal methods would be given first consideration in the formulation of each damage management strategy and would be recommended or implemented when practical and effective before recommending or implementing lethal methods. However, non-lethal methods would not always be applied as a first response to each damage problem. When appropriate, physical exclusion or habitat modification would be recommended and utilized to minimize beaver and muskrat damage. In other situations, beaver and muskrats would be, as humanely as possible, removed using body-grip traps, snares, leghold traps, shooting, and zinc phosphide bait for muskrats. The most appropriate response would often be a combination of non-lethal and lethal methods, or there could be instances where application of lethal methods alone would be the most appropriate strategy. In some cases, a combination of lethal removal and non-lethal options may provide the best solution. Trapping combined with lodge and dam destruction can sometimes cause beaver to move to another area (McNeely 1995).

Shooting is an effective method to remove small numbers of beaver or muskrat in a damage situation, especially where trapping is not feasible. Shooting is mostly conducted at night with the aid of spotlights

or night-vision equipment.

Traps that can be used for lethal removal include leg-hold traps, body-grip (e.g., Conibear) traps, snares, and Hancock traps. A description of these methods is available in Appendix D and USDA, Appendix J (1997). These techniques are usually implemented by WS personnel because of the training required to effectively and safely use such devices.

Unwanted beaver dams can be breached by hand, with a winch, or with binary explosives. Explosives are used only by WS personnel specially trained and certified to conduct such activities, and only binary explosives are used (i.e., binary explosives are comprised of two parts that must be mixed at the site before they can be detonated as an explosive material).

3.1.4 Alternative 4 - Technical Assistance Only.

This alternative would only allow Virginia WS to provide technical assistance to individuals or agencies requesting beaver or muskrat damage management in Virginia. Virginia WS personnel would only provide technical assistance and make recommendations when requested. However, private landowners, contractors, or others could conduct their own damage management on federal, state, county, and private lands.

The *"technical assistance only"* alternative would place the immediate burden of operational damage management work on other federal, state, or county agencies, and property owners. Individuals experiencing beaver or muskrat damage would, independently or with Virginia WS recommendations, carry out and fund damage management activities. Individuals or agencies could implement damage management as part of the cost of doing business or assume a more active role in providing operational damage management. If this alternative were selected, Virginia WS could not, however, direct how state or county agencies or property owners could implement damage management. Some agencies or property owners may choose not to take action to resolve beaver or muskrat damage problems while other situations may warrant the use of legally available management methods because of public demands.

3.1.5 Alternative 5 - Non-lethal Beaver and Muskrat Damage Management.

Under this alternative, only non-lethal management approaches would be used or recommended by WS. Both technical assistance and operational damage management services would be provided. WS technical assistance would be funded through WS appropriations. Requests for lethal wildlife damage management services would be referred to the VDGIF from whom Kill Permits could be requested to allow the property owners or resource managers to implement lethal methods or contract others to do so.

3.2 BEAVER AND MUSKRAT DAMAGE MANAGEMENT APPROACHES USED BY WS.

Wildlife damage management is defined as the alleviation of damage or other problems caused by or related to the presence of wildlife (USDA 1997). The wildlife damage management approaches used by WS are described below:

3.2.1 Integrated Wildlife Damage Management

During more than 80 years of resolving wildlife damage problems, WS has considered, developed, and used numerous methods of reducing damage problems (USDA 1997). WS's efforts have involved the research and development of new methods, and the implementation of effective strategies to resolve and prevent wildlife damage.

Usually, the most effective approach to resolving wildlife damage is to integrate the use of several methods

simultaneously or sequentially. IWDM is the implementation and application of safe and practical methods for the prevention and reduction of damage caused by wildlife based on local problem analyses and the informed judgement of trained personnel. The WS Program applies IWDM, commonly known as Integrated Pest Management (WS Directive 2.105), to reduce damage through the WS Decision Model (Slate et al. 1992) discussed on page 3-5.

The philosophy behind IWDM is to implement effective management techniques in a cost-effective manner while minimizing the potentially harmful effects to humans, target and non-target species, and the environment. IWDM draws from the largest possible array of options to create a combination of techniques for the specific situations. IWDM may incorporate cultural practices, habitat modification, animal behavior modification, removal of individual animals, local population reduction, or any combination of these, depending on the characteristics of the specific damage problems.

3.2.2 Integrated Beaver or Muskrat Damage Management Strategies used by WS consist of:

- **Technical Assistance Recommendations** (implementation is the responsibility of the requester): WS personnel provide information, instructional sessions, demonstrations and advice on available beaver or muskrat damage management techniques. Technical assistance includes demonstrations on the proper use of damage reduction devices (body-grip traps, leg-hold traps, tree-wraps, etc.) and information on water-level control devices, wildlife habits and biology, habitat management, and animal behavior modification. Technical assistance is generally provided following an on-site visit or verbal consultation with the requester. Bulletins and leaflets on beaver and muskrat biology could be sent to requesters to inform them about aesthetic values of beaver and muskrats, types of damage and damage management methods. Generally, several management strategies are described to the requester for short and long-term solutions to damage problems; these strategies are based on factors such as need and practical application. Technical assistance may require substantial effort by WS personnel in the decision making process, but the actual damage reduction work is the responsibility of the requester.

- **Operational Damage Management Assistance** (management conducted or supervised by WS personnel): Operational damage management assistance is implemented when the problem cannot be resolved through technical assistance and when Cooperative Agreements provide for WS operational assistance. The initial investigation explores and defines the nature and history of the problem, extent of damage, and the species responsible for the damage. Professional skills of WS personnel are often required to resolve problems effectively and safely, especially if restricted pesticides are required or if the problem requires the direct supervision of a wildlife professional. WS considers the biology and behavior of the damaging species, and other factors using the WS Decision Model (Slate et al. 1992). The recommended strategy (ies) may include any combination of preventive actions, generally implemented by the property owner, and corrective actions, generally implemented by WS. Corrective damage management is applying management techniques to stop or reduce current losses. As requested and appropriate, WS personnel may provide non-lethal and lethal information, conduct demonstrations, or take action to prevent additional losses from recurring.

3.2.3 Education

Education is an important element of WS's program activities because wildlife damage management is about finding "balance" or co-existence between the needs of people and needs of wildlife. This is extremely challenging as nature has no balance, but rather, is in continual flux. In addition to the routine dissemination of recommendations and information to individuals or organizations sustaining damage, lectures and demonstrations are provided to farmers, homeowners, and other interested groups. WS frequently cooperates with other agencies in education and public information efforts. Additionally,

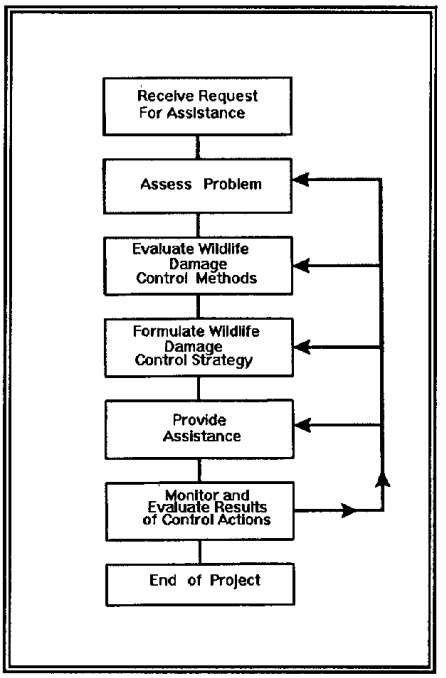
technical papers are presented at professional meetings and conferences so that WS personnel, other wildlife professionals, and the public are updated on recent developments in damage management technology, laws and regulations, and agency policies.

WS provides informational leaflets about beaver and muskrat damage management, biology, and ecology. In federal FYs 1998 and 1999, the WS program in Virginia provided 99 and 62 leaflets, respectively, to the public about beaver damage management.

3.2.4 WS Decision Making

The procedures used by WS personnel to determine management strategies or methods applied to specific damage problems can be found in USDA (1997 Appendix N).

Figure 3-1
WS Decision Model



The WS Decision Model (Figure 3-1) considers the following factors before selecting or recommending damage management methods and techniques:

- Species responsible for the damage
- Magnitude, geographic extent, frequency, historical damage and duration of the problem
- Status of target and non-target species, including T&E species
- Local environmental conditions
- Potential biological, physical, economic, and social impacts
- Potential legal restrictions
- Costs of damage management option[1]

The decision making process is a procedure for evaluating and responding to damage complaints. WS personnel are frequently contacted after requesters have tried non-lethal techniques and found them to be inadequate for reducing damage to an acceptable level. Personnel assess the problem, methods are evaluated for their availability (legal and administrative) and suitability based on biological, economic and social considerations. Following this evaluation, the methods deemed to be practical for the situations are formed into a management strategy. After the management strategy has been implemented, monitoring and evaluation of the strategy is conducted to assess the effectiveness of the strategy. If the strategy is effective, the present need for management is ended.

When damage continues intermittently over time, WS personnel and the requester monitor and reevaluate the situation. If one method or a combination of methods fail to stop damage, a different strategy is implemented. In terms of the WS Decision Model (Slate et al. 1992), most damage management efforts consist of a continuous feedback loop between receiving the request and monitoring the results, with the damage management strategy reevaluated and revised periodically if necessary.

3.2.5 Technical assistance provided by WS to resource owners for decision making

[1]The cost of management may sometimes be secondary because of overriding environmental, legal, public health and safety, animal welfare or other concerns

The WS program in Virginia follows the "Co-managerial approach" to solve wildlife damage or conflicts as described by Decker and Chase (1997). Within this management model, WS provides technical assistance regarding the biology and ecology of beaver and muskrats and effective, practical, and reasonable methods available to the local decision maker(s) to reduce wildlife damage. This includes non-lethal and lethal methods. Technical assistance on alleviating damage caused by beaver and muskrat is also available from VDGIF. WS and other state and federal wildlife or wildlife damage management agencies may facilitate discussions at local community meetings when resources are available, and make recommendations. Resource owners and others directly affected by beaver or muskrat damage or conflicts in Virginia have direct input into the resolution of such problems. They may implement management recommendations provided by WS or others, or may request management assistance from WS, other wildlife management agencies, local animal control agencies, or private businesses or organizations.

Local decision makers have the final decision on which available (legally and administratively) methods would be used to solve a wildlife-people conflict. They may also compare the benefits versus the damage when deciding which methods would be implemented. Local decision makers must also weigh the cost of implementing each methodology or a series of methodologies. These decision makers include community leaders, private property owners/managers, and public property owners/managers.

3.3 BEAVER OR MUSKRAT DAMAGE MANAGEMENT METHODS AUTHORIZED FOR USE OR RECOMMENDED

USDA (1997 Appendix J) describes methods currently used by the WS program. Several of these were considered in this assessment because of their potential use in reducing beaver and muskrat damage to roads and railroads, property, natural and agricultural resources, and public health and safety. A listing and more detailed description of the methods used by Virginia WS for beaver and muskrat damage management is found in Appendix D of this EA.

3.3.1 Non-lethal Beaver or Muskrat Damage Management Methods:

Habitat Management generally refers to riparian vegetation manipulation to reduce the carrying capacity for beaver or muskrats. This would involve the removal of all woody and aquatic vegetation to eliminate beaver and muskrat food resources. However, this would be an extreme and impractical method in most situations. Habitat management may also involve manipulating beaver impoundment water levels to reduce damage or conflict caused by flooding. Water-level control devices are installed to regulate the volume of water and can be effective in reducing flooding in certain situations (Minn. Dept. Nat. Res. 1994). Water-level control devices are also utilized as a means of exclusion at road culverts.

Exclusion (tree wraps, fencing, grit paint) involves preventing beaver or muskrats from gaining access to protected resources.

Beaver Dam Breaching involves the removal of debris deposited by beaver that impedes the flow of water. This debris would be removed either with the use of binary explosives or by hand.

3.3.2 Lethal Damage Management Methods:

These methods involve damage management specifically designed to lethally remove beaver or muskrat in certain situations to a level that stabilizes, reduces, or eliminates damage. The amount of removal necessary to achieve a reduction of beaver or muskrat damage varies according to the resource protected, habitat, species population, the effectiveness of other damage management strategies, and other population factors.

Shooting is selective for the target species and may involve the use of spotlights and either a shotgun or

rifle.

Body-grip (e.g., Conibear) traps are traps designed to cause the quick death of the animal that activates the trap. The appropriate size trap would be used for beaver (generally Conibear 330) and are used in aquatic habitats, with placement depths varying from a few inches to several feet below the water surface. Smaller body-grip traps (generally Conibear 110) would be used for muskrats and can be set either in or out of the water.

Leg-hold traps can be effectively used to capture a variety of mammals. Although beaver and muskrats could be live-captured by this method, all beaver and muskrats would be euthanized. Effective trap placement and adjustment and the selection and the placement of appropriate lures by trained WS personnel contribute to the leg-hold trap's selectivity.

Snares are live-capture devices consisting of a cable loop and a locking device and are placed in travel ways. Most snares are also equipped with a swivel to minimize cable twisting and breakage. Beaver live-captured in snares would be euthanized. Non-target species would be released.

Colony traps are multiple catch traps used to capture muskrats. Colony traps are usually set at the entrance to the den, and can be used for kill-trapping or live-trapping muskrats for later euthanasia.

Snap traps are body-grip traps such as those commonly used for commensal rodent control that could be used for muskrats..

Chemical Management Methods:

All chemicals used by Virginia WS are registered under FIFRA and administered by the EPA and the VDACS or are approved by the Food and Drug Administration (FDA). All WS personnel in Virginia are certified as restricted-use pesticide applicators by the VDACS. No chemicals are used on public or private lands without authorization from the land management agency or property owner/manager. There are currently no chemical methods available for beaver damage management. The only chemical method currently authorized for use for muskrat damage management in Virginia is zinc phosphide. Zinc phosphide is used to reduce muskrat damage, and is applied on bait. The maximum application rate is 10 lbs. of bait (0.6% active ingredient (a..i.) (EPA Reg. No. 56228-6).

3.4 METHODOLOGIES CONSIDERED BUT DEEMED IMPRACTICAL, INEFFECTIVE, OR UNSAFE AT THE PRESENT TIME:

3.4.1 Harassment Activities - Harassment has generally proven ineffective in reducing beaver or muskrat damage problems (Jackson and Decker 1993). Destroying beaver dams and lodges without removing resident beaver rarely resolves damage problems as beaver usually rebuild in the same vicinity in a very short time. Also, removal of food supplies to discourage beaver or muskrat activity is generally not feasible nor ecologically desirable.

3.4.2 Repellents - No effective repellents are registered for beaver or muskrat damage management. However, recent research from the USDA, APHIS, WS, National Wildlife Research Center has suggested that painting trees with a mixture of 1 quart of sand to 1 gallon of exterior latex paint may prevent beaver from gnawing and cutting the painted trees. If this method is found to be effective and practical, and if it is classified as a "repellent" requiring registration under the FIFRA and state pesticide control laws, then WS would consider and use or recommend this repellent method once registered.

3.4.3 Toxicants - No toxicants are registered for beaver damage management; however, zinc phosphide

is registered for muskrat damage management.

3.4.4 **Reproduction control** - A review of research evaluating chemically induced and surgically induced reproductive inhibition as a method for controlling nuisance beaver populations is contained in Novak (1987a). Although these methods were effective in reducing beaver reproduction by up to 50%, the methods were not practical or were too expensive for large-scale application. Additionally, reproductive control does not alleviate current damage problems (Organ et al. 1996). Currently, no chemical reproductive inhibitors are legal for use for the species covered by this EA. For these reasons, this method will not be considered further by Virginia WS.

3.4.5 **Bounties** or payment of funds for killing animals (bounties) suspected of causing economic losses is not supported by Virginia State agencies such as the VDACS or VDGIF (P. Eggborn, VDACS, pers. comm., R. Farrar, VDGIF, pers. comm.). Virginia WS concurs with these agencies because:

- bounties are generally not effective in managing wildlife or reducing damage,
- circumstances surrounding take of animals is largely unregulated,
- no process exists to prohibit taking of animals from outside the damage management area for compensation purposes, and
- Virginia WS does not have the authority to establish a bounty program.

3.4.6 **Hancock traps** (suitcase/basket type cage traps) are designed to live-capture beaver. The trap is constructed of a metal frame that is hinged with springs attached and covered with chain-link fence. The trap's appearance is similar to a large clam when closed. When set, the trap is opened to allow an animal to enter the *clam shells*, when tripped the *clam shells* close around the animal. One advantage of using the Hancock trap is the ease of release of beaver or non-target animals. Beaver caught in Hancock traps could also be euthanized. Disadvantages are that these traps are very expensive (approximately $275 per trap), cumbersome, and difficult to set (Miller and Yarrow 1994). The trap weighs about 25 pounds and is relatively bulky to carry and maneuver. Hancock traps can also be dangerous to set (i.e., hardhats are recommended when setting suitcase traps), are less cost and time-efficient than snares, leg-holds, or body-grip traps, and may cause serious and debilitating injury to otters (Blundell et al. 1999). Thus, Hancock traps would not be used by WS.

3.5 ALTERNATIVES CONSIDERED BUT NOT IN DETAIL, WITH RATIONALE

3.5.1 Eradication and Suppression

An eradication and suppression alternative would direct all Virginia WS beaver and muskrat damage management efforts toward planned, total elimination or suppression of these species.

Eradication of beaver or muskrats in Virginia is not supported by Virginia WS or VDGIF. By VDGIF policy, the VDGIF is directed, *to maintain optimum populations of all species to serve the needs of the Commonwealth."* In addition, state statute mandates the acquisition of natural habitat (VCA §§10.1-1017) (Defenders of Wildlife and Center for Wildlife Law 1996). Other statutory policies are to preserve the State's natural resources and wildlife, and to protect wetlands (VCA §§3.1-1020, §§10.1-209, §§10.1-1188, §§10.1-1193, §§10.1-1198) (Defenders of Wildlife and the Center for Wildlife Law 1996). This alternative will not be considered by Virginia WS in detail because:

- Virginia WS opposes eradication of any native wildlife species,
- VDGIF opposes eradication of any native Virginia wildlife species,

- The eradication of a native species would be extremely difficult if not impossible to accomplish, and cost prohibitive, and
- Eradication of native species is not acceptable to most members of the public.

Suppression would direct Virginia WS program efforts toward managed reduction of certain problem wildlife populations or groups. To consider large-scale population suppression as a goal of the Virginia WS program is not realistic, practical or allowable under present WS policy. Typically, WS activities in Virginia are and would be conducted on a small portion of the area where beaver or muskrat damage occurs; in FY 1999, WS only conducted beaver or muskrat damage management on about 0.054% of the area of Virginia (MIS 2000).

In localized areas where damage can be attributed to specific colonies of beaver or muskrats, VDGIF has the authority to lengthen harvest seasons to increase hunter or trapper take (VCA §§29.1-100).

3.5.2 Population stabilization through birth control.

Under this alternative, beaver and muskrat populations would be managed through the use of contraceptives. Beaver or muskrats would be sterilized or contraceptives administered to limit the ability of beaver to produce offspring. However, at present, there are no chemical or biological contraceptive agents for beaver or muskrats. A beaver or muskrat contraceptive, chemosterilant or immuno-contraceptive, if delivered to a sufficient number of individuals, could temporarily suppress local breeding populations by inhibiting reproduction. Reduction of local populations would result from natural mortality combined with reduced fecundity. No beaver or muskrats would be killed directly with this method, however, and treated beaver and muskrats would continue to cause damage. Populations of dispersing beaver and muskrats would probably be unaffected.

Contraceptive measures for mammals can be grouped into four categories: surgical sterilization, oral contraception, hormone implantation, and immuno-contraception (the use of contraceptive vaccines). These techniques would require that beaver or muskrats receive either single, multiple, or possibly daily treatment to successfully prevent conception. The use of this method would be subject to approval by federal and state Agencies. This alternative was not considered in detail because: (1) it would take a number of years of implementation before the beaver or muskrat population would decline, and, therefore, damage would continue at the present unacceptable levels for a number of years; (2) surgical sterilization would have to be conducted by licensed veterinarians, would therefore be extremely expensive; (3) it is difficult to effectively live trap or chemically capture the number of beaver or muskrats that would need to be sterilized in order to effect an eventual decline in the population; (4) no chemical or biological agents for contracepting beaver or muskrats has been approved for use by state and federal regulatory authorities.

The use of contraceptives is not realistic, at this point, since there are no effective and legal methods of delivering contraceptives to beaver or muskrats.

3.5.3 Compensation for Wildlife Damage Losses

The compensation alternative would direct all Virginia WS program efforts and resources toward the verification of losses from beaver and muskrats, and to providing monetary compensation for these losses. Virginia WS activities would not include any operational damage management or technical assistance.

This option is not currently available to Virginia WS because WS is directed and authorized by law to protect American agricultural and natural resources, property and public health and safety (Animal Damage Control Act of 1931, as amended; and the Rural Development, Agricultural and Related Agencies Appropriation Act of 1988). Analysis of this alternative in USDA (1997) shows that it has many drawbacks:

- Compensation would not be practical for public health and safety problems,
- It would require larger expenditures of money to investigate and validate all losses, and to determine and administer appropriate compensation,
- Timely responses to all requests to assess and confirm losses would be difficult, and many losses could not be verified,
- Compensation would give little incentive to limit losses through other management strategies,
- Not all resources managers/owners would rely completely on a compensation program and unregulated lethal control would probably continue and escalate,
- Neither Congress nor the Commonwealth of Virginia has appropriated funds for a compensation program.

3.5.4 Bounties

There are no bounties on beaver or muskrats in the Commonwealth of Virginia. Payment of funds for killing beaver or muskrats (bounties) suspected of causing economic losses is not supported by WS, and Virginia WS does not have the authority to establish a bounty program. Bounties are not considered because:

- Bounties are generally not effective in reducing damage,
- Circumstances surrounding take of animals is largely unregulated,
- No process exists to prohibit taking of animals from outside the damage management area for compensation purposes

3.6 MITIGATION AND SOPs FOR BEAVER AND MUSKRAT DAMAGE MANAGEMENT

3.6.1 Mitigation and SOPs

Mitigation is any feature of an action that serves to prevent, reduce, or compensate for impacts that otherwise might result from that action. The current WS program, nationwide and in Virginia, uses many such mitigations and these are discussed in detail in Chapter 5 of USDA (1997). The following mitigations are incorporated into WS's SOPs and Alternatives 2, 3, 4, and 5:

Alternative 1 - No WS Beaver or Muskrat Damage Management in Virginia.
Alternative 2 - Only Lethal Beaver and Muskrat Damage Management.
Alternative 3 - Fully Integrated Wildlife Damage Management for all Land Classes (Proposed Action).
Alternative 4 - Technical Assistance Only.
Alternative 5 - Non-lethal Beaver and Muskrat Damage Management.

Table 3-1. Mitigation Measures.

MITIGATION MEASURES	ALTERNATIVES				
	1	2	3	4	5
Animal Welfare and Humaneness of Methods Used by WS					
Research on selectivity and humaneness of management practices would be monitored and adopted as appropriate.		X	X	X	X
The Decision Model (Slate et al. 1992) would be used to identify effective biologically and ecologically sound beaver and muskrat damage management strategies and their impacts.		X	X	X	X

MITIGATION MEASURES	ALTERNATIVES				
	1	2	3	4	5
Captured non-target animals would be released unless it is determined by the Virginia WS personnel that the animal would not survive.		X	X		X
The use of traps and snares would conform to current laws and regulations administered by VDGIF and Virginia WS policy.		X	X		X
Where practical, euthanasia procedures approved by the AVMA that cause minimal pain would be used for live animals.		X	X		
The use of newly-developed, proven, non-lethal methods would be encouraged when appropriate.		X	X	X	X
Safety Concerns Regarding WS' Rodent Damage Management Methods					
All pesticides that are used by WS would be registered with the EPA and VDACS.		X	X		
EPA-approved label directions would be followed by WS employees.		X	X		
The Decision Model (Slate et al. 1992), designed to identify the most appropriate damage management strategies and their impacts, would be used to determine beaver and muskrat damage management strategies.		X	X		X
Beaver and muskrat damage management conducted on public lands would be coordinated with the management agency.		X	X		X
WS employees that use pesticides would be trained to use each material and would be certified to use pesticides under EPA approved certification programs.		X	X		
WS employees who use pesticides would participate in VDACS approved continuing education to keep abreast of developments and maintain their certifications.		X	X		
Live traps would be placed so that captured animals would not be readily visible from any road or public area.		X	X		X
Pesticide use, storage, and disposal conforms to label instructions and other applicable laws and regulations, and Executive Order 12898.		X	X		
Material Safety Data Sheets for pesticides would be provided to all WS personnel involved with specific damage management activities.		X	X	X	
Concerns about Impacts of Damage Management on T&E Species, Species of Special Concern, and Non-target Species.					
WS consulted with the USFWS regarding the nation-wide program and would continue to implement all applicable measures identified by the USFWS to ensure protection of T&E species.		X	X		X

MITIGATION MEASURES	ALTERNATIVES				
	1	2	3	4	5
Virginia WS's take would be considered with the statewide *"Total Harvest"* (Virginia WS take and fur harvest) when estimating the impact on wildlife species.		X	X		
Management actions would be directed toward localized populations or groups and/or individual offending animals, dependent on the magnitude of the problem.		X	X		X
WS personnel would be trained and experienced to select the most appropriate method for taking targeted animals and excluding non-target species.		X	X		X
WS would initiate informal consultation with the USFWS following any incidental take of T&E Species.		X	X		

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

4.0 INTRODUCTION

Chapter 4 provides information for making informed decisions on the beaver and muskrat damage management program outlined in Chapter 1, and the issues and affected environment discussed in Chapter 2. This chapter consists of: 1) analysis of environmental consequences, 2) analysis of each alternative against the issues considered in detail, and 3) summary of WS's impacts.

4.1 ENVIRONMENTAL CONSEQUENCES

This section analyzes the environmental consequences using Alternative 3 (the current program) as the baseline comparing the other alternatives to determine if the real or potential impacts are greater, lesser or the same (Table 4-4).

The following resource values within Virginia would not be adversely impacted by any of the alternatives analyzed: soils, geology, minerals, water quality/quantity, flood plains, wetlands, visual resources, air quality, prime and unique farmlands, aquatic resources, timber, and range. These resources will not be analyzed further.

4.1.1 Social and Recreational Concerns are discussed throughout the document as they relate to issues raised during public involvement, and they are discussed in USDA (1997).

4.1.2 Cumulative and Unavoidable Impacts are discussed in relationship to each of the wildlife species and the environmental impacts are analyzed in this chapter. This EA recognizes that the total annual removal of individual animals from wildlife populations by all causes is the cumulative mortality. Analysis of the Virginia WS "*takes*" during 1996, 1997 and 1998, in combination with other mortality, indicates that cumulative impacts are not adversely affecting the viability and health of populations. It is not anticipated that the Virginia WS program would result in any adverse cumulative impacts to T&E species, and beaver and muskrat damage management activities do not jeopardize public health and safety.

4.1.3 Irreversible and Irretrievable Commitments of Resources: Other than minor uses of fuels for motor vehicles and electrical energy for office maintenance, there are no irreversible or irretrievable commitments of resources. Based on these estimates, the Virginia WS program produces very negligible impacts on the supply of fossil fuels and electrical energy.

4.2 ISSUES ANALYZED IN DETAIL

This section presents the expected consequences of each alternative on each of the issues analyzed in detail.

4.2.1 Alternative 1. No WS Beaver or Muskrat Damage Management in Virginia

Effects on beaver and muskrat populations. Beaver and muskrat populations would continue to increase where trapping pressure was low and some populations would decline or stabilize where trapping pressure was adequate. Some resource owners experiencing damage would trap beaver and muskrats, or hire private trappers, during the legal harvest season. Resource owners may also obtain permits from the VDGIF to trap or shoot beaver or muskrats outside of the regular trapping season, but would receive no guidance from WS regarding these options. Other resource owners experiencing damage may take illegal or unsafe action against local populations of beaver and muskrats out of frustration of continued damage.

Effects on plants and other wildlife species, including T&E species. There may be some direct adverse

effects on T&E plant and mussel species from this alternative. The increased soil moisture associated with beaver flooding may result in reduced plant and timber growth. Prolonged excessive soil moisture (> 2 years) may also result in the death of trees and forests. This increase in soil moisture in beaver flooded areas may be detrimental to wildlife through a decrease in mast (e.g., acorn) production. Also, beaver dams can adversely affect stream ecosystems by increasing sedimentation in streams and affecting wildlife that depend on clear water, such as certain fish and mussels. T&E mussels may be harmed by the increased siltation, increased water temperatures, and reduced oxygen in the water that results from beaver impoundments, or by muskrat predation. Additionally, in the absence of WS assistance, some resource owners may attempt to trap beaver or muskrats or hire private trappers with little or no trapping experience. These resource owners or trappers would be more likely than WS personnel to trap non-target species and not report non-target take. In addition, WS has consulted with the USFWS to use their expertise to avoid adverse impacts to T&E species populations in Virginia (K. Mayne, USFWS letter to M. Lowney, WS Nov 29, 1999).

Effects on public and pet health and safety. If beaver or muskrat populations continue to increase without a damage management program in place, there are potential threats to public health and safety. For example, burrowing into or flooding of roadways and railroad beds can result in serious accidents (Woodward 1983, Miller and Yarrow 1994). Beaver are also carriers of the intestinal parasite *Giardia lamblia*, which can contaminate water supplies and cause outbreaks of the disease Giardiasis in humans (Woodward 1983, Wade and Ramsey 1986, Miller and Yarrow 1994). Additionally, resource owners may attempt to solve beaver and muskrat damage problems through trapping and shooting without WS expertise, and there may be increased risks to public and pet safety from improper or inexperienced use of damage management methods.

Humaneness of methods to be used. This alternative would be considered humane by many people. However, resource/property owners could use lethal and non-lethal methods to reduce beaver and muskrat damage. In addition, some resource/property owners may take illegal action against localized populations of beaver or muskrats out of frustration of continued damage. Some of these illegal actions may be less humane than methods used by experienced WS personnel.

Effects on wetlands and wetlands ecosystem. Under this alternative, beaver dam breaching needs would be met by private, State, or local government entities. Some beaver impounded areas that WS would advise against draining might be drained under private or local government management, which could have adverse effects on wetland habitats in limited circumstances.

Effects on urban landscaping and native vegetation. The beaver populations would continue to increase, resulting in increased occurrences of flooding, gnawing and feeding damage to urban landscaping and native vegetation.

Impact to stakeholders, including aesthetics. The impacts of this alternative to stakeholders would be variable depending on their values towards wildlife and compassion for their neighbors. Resource owners receiving damage from beaver or muskrats would likely strongly oppose this alternative because they would bear the damage caused by beaver and muskrats. Animal activists and a minority of environmental activists would prefer this alternative because activists believe it is morally wrong to kill or use animals for any reason. Some people would support this alternative because they enjoy seeing beaver or muskrats, or having beaver and muskrats nearby. However, while WS would take no action under this alternative, other individuals or entities could conduct damage management activities.

4.2.2 Alternative 2. Only Lethal Beaver and Muskrat Damage Management

Effects on beaver and muskrat populations. This alternative could result in a localized decrease in the

beaver or muskrat population at the specific site where the damage management occurs. No impact on the statewide beaver or muskrat population would be expected (R. Farrar, VDGIF, letter to M. Lowney, WS, December 29, 1999). Although the beaver population has continued to increase over the past few decades, the current beaver harvest in Virginia (5,811 beaver sold in 1997) is much less than the peak harvest on record (11,154 in 1980) (R. Farrar, VDGIF, pers. comm.). In addition, the number of beaver and muskrat removed would be monitored be WS and the VDGIF. Furthermore, new beaver or muskrats would likely re-inhabit the site as long as suitable habitat exists. The amount of time until new beaver or muskrats move into the area would vary depending on the habitat type, time of year, and population densities in the area. In our experience in Virginia, some areas are re-colonized by beaver in 6 - 24 months.

Effects on plants and other wildlife species, including T&E species. Non-target species such as otter and raccoons may occasionally be killed during beaver or muskrat damage management. Turtles may also be caught in some traps, but can generally be released alive. However, WS personnel would minimize non-target kills through careful placement of traps or variation in capture methods. No adverse effects on T&E species are expected (K. Mayne, USFWS, letter to M. Lowney, WS, November 29, 1999). Terwilliger (1991), Terwilliger and Tate (1995), and the USFWS list of federal T&E species for Virginia (http://www.fws.gov/r9endspp/endspp.html) were reviewed to identify federal and state T&E species in Virginia. The removal of beaver or muskrats from a site may be beneficial to some plant and wildlife species, including T&E species, because the increased soil moisture associated with flooding may result in reduced plant growth and reduced mast (e.g., acorn) production. Prolonged excessive soil moisture (> 2 years) may also result in the death of some trees and forests. The removal of beaver and muskrats may also reduce gnawing and feeding on certain plants and mussels. Also, beaver dams can adversely affect stream ecosystems by increasing sedimentation in streams and affecting wildlife that depend on clear water, such as certain fish and mussels.

Effects on public and pet health and safety. WS methods of shooting and trapping pose minimal or no threat to public and pet health and safety. All firearm safety precautions are followed by WS when conducting damage management and WS complies with all laws and regulations governing the lawful use of firearms. Shooting with shotguns or rifles would sometimes used to reduce beaver and muskrat damage problems when lethal methods are determined to be appropriate. Shooting is selective for target species and may be used in conjunction with spotlights. WS uses firearms to shoot beaver and muskrats caught in live traps as humanely as possible. WS' traps are strategically placed to minimize exposure to the public and pets. Appropriate signs are posted on properties where traps are set to alert the public of their presence. Body-grip (e.g., Conibear-type) trap sets for beaver are restricted to water sets, which further reduces threats to public and pet health and safety.

Firearm use is very sensitive and a public concern because of safety issues. To ensure safe use and awareness, WS employees who use firearms to conduct official duties are required to attend an approved firearms safety and use training program within 3 months of their appointment and a refresher course every 3 years afterwards (WS Directive 2.615). WS employees who carry firearms as a condition of employment, are required to certify that they meet the criteria as stated in the *Lautenberg Amendment* which prohibits firearm possession by anyone who has been convicted of a misdemeanor crime of domestic violence.

This alternative would reduce threats to public safety by removing beaver and muskrats from a site, and thus alleviating flooding and burrowing damage to roads and railroads, risks of Giardiasis outbreaks, and possible mosquito borne disease outbreaks.

Humaneness of methods to be used. WS personnel are experienced and professional in their use of management methods, and methods are applied as humanely as possible. Under this alternative, beaver and muskrats would be humanely trapped or shot by experienced WS personnel using the best methods

available. Beaver or muskrats live-captured in traps or snares would be euthanized. Some animal activists could perceive these methods as inhumane because they oppose all lethal methods of damage management.

Effects on wetlands and wetlands ecosystem. Under this alternative, WS would remove beaver or muskrats from a site but would not remove the dam. Therefore, needs for beaver dam breaching could or could not be met by private, state, or local government entities. Some beaver impounded areas that WS would advise against draining might be drained under private or local government management, which could have adverse impacts on wetland habitats in limited circumstances.

Effects on urban landscaping and native vegetation. Damage to urban landscaping and native vegetation would be expected to decrease as the beaver and muskrat causing damage are lethally removed from the site. No WS assistance would be available to help property owners to protect their landscaping and vegetation if they did not want to lethally remove beaver or muskrats.

Impacts to stakeholders, including aesthetics. The impacts of this alternative to stakeholders would be variable depending on their values towards wildlife and compassion for their neighbors. This alternative would likely be favored by resource owners who are receiving damage. Although, some resource owners would be saddened if the beaver or muskrats were removed. Animal activists and a minority of environmental activists would strongly oppose this alternative because they believe it is morally wrong to kill or use animals for any reason or they believe the benefits from beaver and muskrats would outweigh the associated damage.

The ability to view and esthetically enjoy beaver or muskrats at a particular site could be limited if the beaver or muskrats are removed. New animals, however, would most likely use the site in the future, although the length of time until new beaver or muskrats arrive is variable, depending on the habitat type, time of year, and population densities of beaver and muskrats in the area. The opportunity to view beaver or muskrats is available if a person makes the effort to visit sites with adequate habitat outside of the damage management area.

4.2.3 Alternative 3 - Fully Integrated Beaver and Muskrat Damage Management (IWDM) for all Public and Private Land (No Action and Proposed Action).

Effects on beaver and muskrat populations. The current program removes only a very small number of beaver and muskrats from the statewide Virginia population (Table 4-1) (see Section 1.3). Unlike Alternative 2, the use of exclusion, habitat modification, water control devices, etc. could be used as part of an IWDM approach. The use of water control devices or the removal of dams would have little or no effect on beaver populations. The amount of time until new beaver or muskrats move into the area would vary depending on the habitat type, time of year, and population densities in the area. In our experience in Virginia, some areas are re-colonized by beaver in 6 - 24 months.

Beaver Population Impact Analysis.

The authority for management of resident wildlife species is the responsibility of the VDGIF and beaver and muskrats are classified as protected furbearers. VDGIF compiles and provided information on

population trends and take, and uses this information to manage beaver and muskrat populations. Therefore, WS used the best information available to generate a population range of beaver in Virginia.

Table 4-1. Beaver and Muskrat Harvest Data for Virginia (MIS 1996, 1997, 1998, VDGIF 1998:15).

Beaver Harvest Data	**1996**	**1997**	**1998**
WS Kill	8	52	81
# Taken During State Regulated Harvest Season[1]	9,418	5,811	1,685
%WS Take (% of total take)	0.08	0.89	4.8
Muskrat Harvest Data			
WS Kill	0	3	3
# Taken During State Regulated Harvest Season[1]	23,925	19,926	4,369
% WS Take (% of total take)	0	0.02	0.06

[1] =Estimated take based on number of pelts reported sold

Beaver occur mostly in family groups that are comprised of 2 adult parents with 2-6 offspring from the current or previous breeding season (Novak 1987a). Average family group size has been documented as ranging from 3.0 to 9.2 (Novak 1987a). Beaver abundance has been reported in terms of families per kilometer of stream or per square kilometer of habitat. Novak (1987a) summarized reported beaver family abundance as ranging from 0.31 to 1.5 families per kilometer of stream, which converts to 0.5 - 2.4 families per mile of stream. Densities reported in terms of families per square kilometer have been reported to range from 0.15 to 3.9 (Novak 1987a) which is the same as 0.24 to 6.3 per square mile. Novak (1987a) indicates that rates of beaver populations are density dependent, which means that rates of increase generally rise as a population is reduced and become less as a population increases toward its carrying capacity[1]. This is a natural function of most wildlife populations that helps to naturally mitigate population reductions. Logan et al. (1996), indicated that wildlife populations being held at a level below carrying capacity can sustain a higher level of harvest because of the compensatory mechanisms that cause higher rates of increase in such populations.

The professional opinion of wildlife biologists at VDGIF (R. Farrar, VDGIF, pers. comm.) and WS suggests that the present beaver family abundance in Virginia is within the range found by Novak (1987a). To be conservative, this analysis assumes actual densities in Virginia are at the lowest of the ranges given by Novak (1987a) or an average of 3 beavers per family and about 0.5 families per mile of stream/river. Virginia has 66,319 miles of streams and shoreline (S. Klopfer, Fish and Wildlife Information Exchange, e-mail to J. Cromwell, WS, March 7, 2000). Under the above reasonable and conservative analysis, a minimum estimate of the beaver population in Virginia is 99,479. WS has found that the average number of beaver per family in Virginia is 3.9 (MIS 1999). Using this figure, a more reasonable estimate of the beaver population, given the miles of stream and using the lowest estimate for beaver families per mile of stream, the estimated population is 129,322 beaver.

WS killed 52, 81, and 133 beavers in FY97, 98 and 99, respectively. The FY99 take was the highest number ever removed in one year by the WS program in Virginia. Private harvest of beaver as reported by the VDGIF during the 1998-99 harvest season was 1,685 beavers as estimated by the number of pelts reported sold. Additionally, VDGIF estimated that 1,290 beaver were taken under Kill Permits to alleviate damage to property (R. Farrar, VDGIF, letter to M. Lowney, WS, December 29, 1999). The ADC FEIS (USDA 1997) determined that beaver populations can withstand an annual harvest rate of up to 30% without declining. Cumulatively, the total kill of beavers during 1999 from the regulated harvest season,

[1] Carrying capacity is the maximum number of animals that the environment can sustain and is determined by the availability of food, water, cover, and the tolerance of crowding by the species in question.

WS damage management activities, and under Kill Permits was 3,108 which is 3.1% of the minimum population (Table 2) and 2.4% of the more probable population. Thus, cumulative take appears to be far beneath the level that would begin to cause a decline in the population. Even if the harvest levels were increased by 500%, the impact to the beaver population would be low. Additionally, the WS kill represents only 4.3% of the total harvest estimate for 1999. The cumulative impact on the beaver population is therefore considered to be of extremely low magnitude. VDGIF biologists have concurred with this conclusion (R. Farrar, pers. comm. 1999). The VDGIF has determined that "there is no evidence to suggest that human mediated mortality resulting from regulated fur harvest and damage management will be detrimental to the survival of the beaver and muskrat populations in the Commonwealth of Virginia (R. Farrar, VDGIF, letter to M. Lowney, WS, December 29, 1999).

Table 4-2. Beaver Population Estimates and Take in Virginia Including WS Program Take for FY 99.

	Conservative Beaver Population Estimate	More Probable Beaver Population Estimate
Est. Population	99,479	129,322
WS Kill FY-99	133	133
Private Take (VDGIF data)	2,975	2,975
Total Kill	3,108	3,108
WS Kill - % of Population	0.1%	0.1%
Other Kill - % of Population	2.9%	2.3%
Total Kill - % of Population	3.1%	2.4%

Muskrat Population Information and Impact Analysis. Muskrats are considered abundant in Virginia and scattered in suitable habitat throughout the State. They can be found in marshes, ponds, sloughs, lakes, ditches, streams, and rivers (Boutin and Birkenholz 1987). Muskrats do not cause substantial damage problems in Virginia and WS only killed 26 for depredation purposes from FY97 through 99. It is highly unlikely that the program would kill more than 3000 muskrats in the entire state in any one year under the proposed action which would be more than a1000% increase in the Virginia WS program for muskrat damage management. Private harvest as reported by VDGIF during the 1998-1999 regulated harvest season was 4,389 muskrats, as estimated by the number of pelts reported sold.

Muskrats are highly prolific and produce 3-4 litters per year that average 5-8 young per litter (Wade and Ramsey 1986) which are characteristics that make them relatively immune to overharvest (Boutin and Birkenholz 1987). Harvest rates of three to eight per acre have been reported to be sustainable in muskrat populations (Boutin and Birkenholz 1987). Assuming, very conservatively, that muskrats occupy only 1% of the 808,000 acres of freshwater wetlands in Virginia (Virginia Department of Environmental Quality 1999), then harvest totaling more than 24,240 per year could be sustainable. Clearly, any mortality as a result of fur harvest or damage management would have a imperceptible impact on the population. VDGIF concurs with this conclusion and has determined that "there is no evidence to suggest that human mediated mortality resulting from regulated fur harvest and damage management will be detrimental to the survival of the beaver and muskrat populations in the Commonwealth of Virginia (R. Farrar, VDGIF, letter to M. Lowney, WS, December 29, 1999).

Effects on plants and other wildlife species, including T&E species. Non-target species, such as otter and raccoons may occasionally be taken during beaver or muskrat damage management. Turtles may also be caught in some beaver traps, but can generally be released alive. However, WS personnel would minimize non-target takes with careful placement of traps or variation in capture methods. No adverse effects to T&E species are expected (K. Mayne, USFWS, letter to M. Lowney, WS, November 29, 1999). Terwilliger (1991), Terwilliger and Tate (1995), and the USFWS list of T&E species in Virginia

(http://www.fws.gov/r9endspp/endspp.html) were reviewed. The removal of beaver or muskrats from a site may be beneficial to some plant and wildlife species, including T&E species, because the increased soil moisture associated with beaver flooding which may result in reduced plant growth and mast (e.g., acorn) production and increased plant foraging. Prolonged excessive soil moisture (> 2 years) may result in the death of some trees and forests. Also, beaver dams can adversely affect stream ecosystems by increasing sedimentation and affecting some wildlife that depend on clear water, such as certain species of fish and mussels, and muskrats will feed on T&E mussels.

Beaver ponds are known to have both beneficial and detrimental effects on wildlife. However, the majority of impoundment sites where WS removes beaver or breaches the dam have been in existence for less than a year. Thus, these sites do not possess true wetland characteristics nor the same wildlife habitat values as established wetlands. Thus, in most instances, WS' dam breaching returns a site to its previous status and has no adverse effects on T&E or non-target species.

Effects on public and pet health and safety. WS occasionally uses binary explosives to breach beaver dams. WS personnel that use explosives are required to take and pass in-depth training, are certified to use explosives and must be able to demonstrate competence and safety in their use of explosives. They adhere to WS policies as well as regulations from the Bureau of Alcohol, Tobacco and Firearms, the Occupational Safety and Health Administration, and the Department of Transportation with regards to explosives use, storage, and transportation. Binary explosives require two components to be mixed before they can be actuated which virtually eliminates the hazard of accidental detonation during storage and transportation. Storage and transportation of mixed binary explosives is not allowed. When explosives are used, signs are placed to stop public entry. Where dams are near roads, police or other road officials are used to stop traffic and public entry, much like VDOT crews when they use explosives, to ensure public safety. Therefore, no adverse effects to public safety are expected from the use of explosives by WS.

WS methods of shooting and trapping pose minimal or no threat to public and pet health and safety. All firearm safety precautions are followed by WS when conducting damage management and WS complies with all laws and regulations governing the lawful use of firearms. Shooting with shotguns or rifles is sometimes used to reduce beaver and muskrat damage when lethal methods are determined to be appropriate. Shooting is selective for target species and may be used in conjunction with spotlights. WS uses firearms to humanely euthanize beaver and muskrats caught in live traps. WS' traps are strategically placed to minimize exposure to the public and pets. Appropriate signs are posted on all properties where traps are set to alert the public of their presence. Body-grip (e.g., Conibear-type) traps are restricted to water sets, which further reduces threats to public and pet health and safety.

Firearm use is very sensitive and a public concern because of misuse. To ensure safe use and awareness, WS employees who use firearms to conduct official duties are required to attend an approved firearms safety and use training program within 3 months of their appointment and a refresher course every 3 years afterwards (WS Directive 2.615). WS employees who use firearms as a condition of employment, are required to certify that they meet the criteria as stated in the *Lautenberg Amendment.*

This alternative would reduce threats to public health and safety by removing beaver and muskrats from a site, and thus alleviating damage such as flooding and burrowing damage to roads and railroads, risks of Giardiasis outbreaks, and possible mosquito borne disease outbreaks.

Humaneness of methods to be used. WS personnel are experienced and professional in their use of management methods, and methods are applied as humanely as possible. Under this alternative, beaver and muskrats would be trapped as humanely as possible or shot by experienced WS personnel using the best method available. Beaver or muskrats live-captured in traps or snares would be euthanized. Some animal activists may perceive this method as inhumane because they oppose all lethal methods of damage

management. In addition, this alternative allows WS to consider non-lethal methods, and WS would implement non-lethal methods for beaver and muskrat damage management when appropriate.

Effects on wetlands and wetlands ecosystem. Under this alternative, beaver impounded areas would be breached by hand or with explosives for the purpose of returning streams, channels, dikes, culverts, and irrigation canals to their original channel. Dams are removed in according to Section 404 of the Clean Water Act (see Appendix C). WS breaches most beaver impoundments because they have flooded areas such as yards, parks, roads, railroads, timberlands, croplands, pastures, and other types of property or resources that were not previously flooded or wetlands. Most dams that WS breaches are created as a result of recent beaver activity and less than one year, because WS personnel receive most requests soon after affected resource owners discover damage and become aware of the WS program. These sites do not possess wetland characteristics or the same wildlife habitat values as wetlands.

Effects on urban landscaping and native vegetation. Damage to landscaping and native vegetation on private and public property would be reduced because the most effective methods would be used to reduce damage.

Impacts to stakeholders, including aesthetics. The impacts of this alternative to stakeholders would be variable depending on their values towards wildlife and compassion for their neighbors. This alternative would likely be favored by most resource owners who are receiving damage and by WS as it allows for an IWDM approach to resolving damage problems. An IWDM approach allows for the use of the most appropriate damage management methods. Most stakeholders without damage would also prefer this alternative to Alternative 2, where all beaver and muskrats are killed because non-lethal methods could be appropriate to resolve damage problems. Some animal activists and a minority of environmental activists would strongly oppose this alternative, and most action alternatives, because they believe it is morally wrong to kill or use animals for any reason or they believe that the benefits from beaver and muskrats outweigh the associated damage.

The ability to view and esthetically enjoy beaver or muskrats at a particular site could be limited if the beaver or muskrats are removed. New beaver and muskrats, however, would likely use the site in the future, although the length of time until new animals arrive is variable, depending on the habitat, time of year, and population densities in the area. The opportunity to view beaver or muskrats is available if a person makes the effort to visit sites with adequate habitat outside of the damage management area.

Public reaction would be variable and mixed because there are numerous philosophical, aesthetic, and personal attitudes, values, and opinions about the best ways to reduce conflicts/problems between humans and wildlife. The IWDM approach, which includes non-lethal and lethal methods as appropriate, provides relief from damage or threats to public and pet health or safety to people who would have no relief from such damage or threats if non-lethal methods were ineffective or impractical. Many people directly affected by problems and threats to public and pet health or safety caused by beaver and muskrats insist upon their removal from the property or public location when the wildlife acceptance capacity is reached or exceeded. Some people will have the opinion that beaver and muskrats should be captured and relocated to a rural area to alleviate damage or threats to public and pet health or safety. Some people would strongly oppose removal of the beaver and muskrats regardless of the amount of damage. Individuals not directly affected by the threats or damage may be supportive, neutral, or totally opposed to any removal of beaver from specific locations or sites. Some people that totally oppose lethal damage management want WS to teach tolerance for beaver and muskrat damage and threats to public and pet health or safety, and that beaver and muskrats should never be killed.

4.2.4 Alternative 4 - Technical Assistance Only.

Effects on beaver and muskrat populations. Beaver and muskrat populations would continue to increase over time where trapping pressure was low. Some local populations of beaver and muskrats could decline or stabilize where trapping pressure was adequate or drought conditions exist. Some resource owners may trap beaver or muskrats, or hire trappers during the legal harvest season. Resource owners may also obtain permits from the VDGIF to allow them to trap or shoot beaver or muskrats outside of the regular season, but could receive only technical assistance from WS regarding these options. Some resource owners may take illegal or unsafe actions against local populations of beaver or muskrats out of frustration or ignorance.

Effects on plants and other wildlife species, including threatened and endangered (T&E) species. There may be direct negative effects on T&E plant and mussel species from this alternative. The increased soil moisture associated with beaver flooding may result in some reduced plant or timber growth. Prolonged excessive soil moisture (> 2 years) may also result in the death of some trees and forests. This increase in soil moisture in flooded areas may be detrimental to wildlife through a decrease in mast (e.g., acorn) production. Also, beaver dams can adversely affect stream ecosystems by increasing sedimentation in streams and affecting wildlife that depend on clear water, such as certain species of fish and mussels. T&E mussel species may be harmed by the increased siltation, increased water temperatures, and a reduction in oxygen in the water that results from beaver impoundments, or by predation by muskrats. Additionally, in the absence of WS assistance, some resource owners may attempt to trap beaver or muskrats or hire others with little or no trapping experience. These resource owners would be more likely than WS personnel to trap non-target species and not report non-target take.

Effects on public and pet health and safety. If beaver and muskrat damage continues to increase without implementing damage management, there are potential threats to public health and safety. For example, burrowing into or flooding of roadways and railroad beds can result in serious accidents (Woodward 1983, Miller and Yarrow 1994). Beaver are also carriers of the intestinal parasite *Giardia lamblia*, and can contaminate human water supplies and cause outbreaks of the disease Giardiasis in humans (Woodward 1983, Wade and Ramsey 1986, Miller and Yarrow 1994). Beaver flooded areas also create conditions favorable for mosquitos and increase the potential for transmission of mosquito borne diseases. Washouts or collapse of levees and dikes due to beaver or muskrat burrowing may cause serious accidents or compromise structural stability. Additionally, resource owners may attempt to resolve beaver or muskrat damage problems through illegal use of chemicals/pesticides, trapping, and shooting without WS expertise, and there may be some risk to public and pet health and safety from improper or inexperienced use of these methods.

Humaneness of methods to be used. The issue of humaneness under this alternative is not applicable because resource owners or others would be responsible to implement the damage management methods. Some resource owners may take illegal action against local populations of beaver or muskrats out of frustration or ignorance. Some of these illegal actions may be less humane than methods used by WS personnel.

Effects on wetlands and wetlands ecosystem. Under this alternative, needs for beaver dam breaching would be met by private, state, or local government entities. Some beaver impounded areas that WS would advise against draining might be drained under private or local government management, which could have adverse impacts on wetland habitats in limited circumstances.

Effects on urban landscaping and native vegetation. Beaver and muskrat populations may or may not increase, causing increasing occurrences of flooding and gnawing and feeding damage to urban landscaping and to native vegetation. Resource owners or contracted trappers may reduce local populations or they may elect not to conduct damage management to reduce damages; WS would only be available to consult on legally available methodologies to reduce damages.

Impact to stakeholders, including aesthetics. The impacts of this alternative to stakeholders would vary depending on the damage management efforts employed by resource owners, their values toward wildlife and compassion for their neighbors. Resource owners who are receiving damage from beaver or muskrats would likely oppose this management alternative. Some people would support this alternative because they believe resource owners would do little to remove beaver or muskrats. Others would oppose this alternative because they believe resource owners would use illegal, inhumane, or environmentally unsafe control methods. While WS could only provide technical assistance under this alternative, other individuals or entities could conduct damage management without implementing the recommendations of WS.

4.2.5 Alternative 5 - Non-lethal Beaver and Muskrat Damage Management.

Effects on beaver and muskrat. Under Alternative 5, only non-lethal methods to alleviate damage could be implemented by WS. Total number of beaver and muskrats taken by WS would decrease under this alternative, and removal affects to beaver and muskrat populations could be reduced or could increase depending on others' actions. WS's take of beaver or muskrats under the current program results in a low magnitude of impact. The WS impact on beaver and muskrat populations resulting from implementation of a "Non-lethal Only" Alternative would not likely differ from the current program.

Beaver and muskrat populations would continue to increase where trapping pressure was low. Some local populations of beaver and muskrats would temporarily decline or stabilize where trapping pressure was adequate. Some resource owners may trap beaver or muskrats, or hire trappers during the legal harvest season. Resource owners may also obtain permits from the VDGIF to allow them to trap or shoot beaver or muskrats outside of the regular season, but WS would be restricted to only implementing non-lethal methods. Some resource owners may take illegal, unsafe, or environmentally harmful action against local populations of beaver or muskrats out of frustration or ignorance.

Effects on plants and other wildlife species, including T&E species. There may be direct negative effects on T&E plant and mussel species from this alternative. Without removing beaver or muskrats from a damage situation, the increased soil moisture associated with beaver flooding may result in some reduced plant or timber growth, and beaver and muskrat cutting and feeding behavior could also impact other plant and wildlife species. Prolonged excessive soil moisture (> 2 years) may also result in the death of trees and forests. Additionally, increased soil moisture in beaver flooded areas may be detrimental to some wildlife through a decrease in mast (e.g., acorn) production. By not removing beaver, beaver dams would be maintained and could affect stream ecosystems by increasing sedimentation and affecting adversely wildlife that depend on clear water, such as certain species of fish and mussels. T&E mussel may be harmed by the increased siltation, increased water temperatures, and reduction in oxygen in the water that results from beaver impoundments, or by muskrat predation. Additionally, in the absence of WS assistance, some resource owners may attempt to trap beaver or hire others with little or no trapping experience. These resource owners would be more likely than WS personnel to trap non-target species and not report non-target take.

Effects on public and pet health and safety. Non-lethal methods, exclusion and habitat modifications, would not be efficient or successful in resolving many beaver and muskrat damage situations. If beaver and muskrat populations would continue to increase without implementing lethal damage management, there are potential threats to public health and safety from burrowing, structural damage and disease threats. For example, burrowing into or flooding of roadways and railroad beds can result in serious accidents (Woodward 1983, Miller and Yarrow 1994). Beaver are also carriers of the intestinal parasite *Giardia lamblia*, and can contaminate human water supplies and cause outbreaks of the disease Giardiasis in humans (Woodward 1983, Wade and Ramsey 1986, Miller and Yarrow 1994). Beaver flooded areas also create conditions favorable for mosquitos and increase the potential for transmission of mosquito

borne diseases. Washouts or collapse of levees and dikes due to beaver or muskrat burrowing and of roads and railroad beds due to beaver flooding may cause serious accidents or compromise structural stability. Additionally, resource owners may attempt to lethally resolve beaver and muskrat damage problems through illegal use of chemicals/pesticides, trapping, and shooting without WS expertise, and there may be some risk to public and pet health and safety from improper or inexperienced use of these methods.

Humaneness of methods to be used. Under this alternative, only non-lethal beaver and muskrat damage management methods could be implemented. WS personnel are experienced and professional in their use of management methods, and methods are applied as humanely as possible. Some animal activists may perceive this approach as humane because they oppose all lethal methods of damage management. However, without effective damage management methods available, resource owners may take illegal action against some local populations of beaver or muskrats out of frustration of continued damage. Some of these illegal actions may be less humane than methods used by WS personnel.

Effects on wetlands and wetlands ecosystem. Under this alternative, WS could only conduct non-lethal damage management, however, beaver impounded areas could be breached by hand or with explosives for the purpose of returning streams, channels, dikes, culverts, and irrigation canals to their original channel. Analysis of impacts is the same as Alternative 3. However, if beaver are not removed from a site, the impoundment would probably be reconstructed or repaired relatively quickly.

Effects on urban landscaping and native vegetation. Beaver and muskrat populations may or may not increase; however, flooding and gnawing damage to urban landscaping and to native vegetation could continue. Resource owners may reduce local populations or they may elect not to conduct lethal damage management to reduce damages; WS could only implement non-lethal methodologies to reduce damages. Damage to landscaping and native vegetation on private and public property could remain about the same or increase because the most effective method(s) could not be used to reduce damage or to lethally remove the beaver or muskrats that are causing damage at the site. The use of exclusion devices (e.g., wrapping trees, grit paint, fencing) may help to alleviate some damage to specific trees or vegetation, however, beaver would probably travel further from water to gnaw unprotected trees..

Impact to stakeholders, including aesthetics. The impacts of this alternative to stakeholders would be variable depending on te damage management efforts employed by resource owners, their values toward beaver and muskrats and compassion for their neighbors. Resource owners who are receiving damage from beaver or muskrats would likely oppose this management alternative. Some people would support this alternative because they believe resource owners would do little to remove beaver or muskrats. Others would oppose this alternative because they believe resource owners would use illegal, inhumane, or environmentally unsafe methods. While WS could only provide non-lethal assistance under this alternative, other individuals or entities could conduct lethal damage management.

4.3 SUMMARY OF WS's IMPACTS

Table 4-3 presents a relative comparison of the anticipated impacts of each of the alternatives as they relate to each of the major issues identified in Chapter 2.

4.3.1 Cumulative Impacts

No significant cumulative environmental impacts are expected from any of the alternatives (Table 4-3). With regard to Alternatives 2, Lethal Removal Only, and Alternative 3, the Proposed Action, the lethal removal of beaver and muskrats causing damage would have no adverse affect on beaver or muskrat populations in the Commonwealth of Virginia. No risk to public or pet heath and safety is expected from the proposed alternative (Alternative 3). Although some persons would likely oppose lethal removal of

beaver and muskrats, the analysis in this EA indicates that such removals would result in no significant cumulative adverse impacts on the quality of the human environment.

Table 4-3. Summary of Anticipated Cumulative Impacts from the Alternatives Analyzed

Issues/Impacts	Alternative 1: No Program	Alternative 2: Lethal Only	Alternative 3: IWDM Program (Proposed Action)	Alternative 4: Technical Assistance	Alternative 5: Non-lethal Only
Beaver populations	Populations could increase unless resource owners seek private help private help	Possible reduction in local populations, no statewide effect.	Possible reduction in local populations, no statewide effect.	Populations could increase unless resource owners seek private help	Populations could increase unless resource owners seek private help
Non-target Species, Including T&E Species	No probable effects, except muskrats may eat T&E mussels.	No impact to T&E or non-target species populations.	No impact to T&E or non-target species populations.	No probable effects, except muskrats may eat T&E mussels.	No impact to T&E or non-target species populations, except muskrats may eat T&E mussels.
Public and Pet Safety	Continued risk from flooding, burrowing, and diseases.	No increased threat to safety. Reduction of risks from flooding, burrowing and diseases.	No threat to public and pet safety. Reduction of risks from flooding, burrowing, and diseases.	Continued risk from flooding, burrowing, and diseases.	No increased threat to safety. Reduction of risks from flooding, burrowing, and diseases.
Humaneness of Method	Not applicable because no action by WS.	WS uses the most humane methods available. Some activists would oppose all lethal methods.	WS uses the most humane methods available. Some activists would oppose all lethal methods.	Probably considered more humane by most people than lethal measures.	Probably considered more humane by most people than lethal measures.
Wetlands and Wetland Ecosystem	No probable effect.	No probable effect.	No probable effect.	No probable effect.	No probable effect.
Urban Landscaping and Native Vegetation	No probable effect.	Damage to vegetation would be reduced or eliminated.	Damage to vegetation would be reduced or eliminated.	Damage to vegetation would be reduced or eliminated as resources owners take action.	Damage to vegetation could be reduced, however not to the level of Alt. 2 or 3.
Impact to Stakeholders, Including Aesthetics	Variable. Some people prefer this method. Those receiving damage probably oppose this alternative.	Variable. Those receiving damage would probably favor this alternative. Some activists would oppose this alternative.	Variable. Those receiving damage would probably favor this alternative. Some activists would oppose this alternative.	Variable. Some people prefer this method. Those receiving damage probably oppose this alternative	Variable. Those receiving damage would probably favor this alternative. Some activists would oppose this alternative

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APPENDIX A

LITERATURE CITED

Anonymous 1999. Beaver boom in MA. American Trapper. 39: 21.

Arner, D.H. 1964. Research and a practical approach needed in management of beaver and beaver habitat in the Southeastern United States. Trans. North Amer. Wildl. Nat. Resour. Comm. 29:150-158.

Arner, D.H., and J.S. Dubose. 1979. The impact of the beaver on the environment and economics in the southeastern United States. Pages 241-247 in Proc. XIV International Wildlife Congress.

Arner, DH., and J.S. DuBose. 1982. The impact of the beaver on the environment and economics in the southeastern United States. Int. Congr. Game Biol. 14: 241-247.

Arner, D.H., and G.R. Hepp. 1989. Beaver pond wetlands: A southern perspective. Pages 117-128 *in* L.M. Smith, R.L. Pederson, and R.M. Kaminski, eds. Habitat management for migrating and wintering waterfowl in North America. Texas Tech University Press, Lubbock.

Arner, D.H., J. Baker, D. Wesley, and B. Herring. 1969. An inventory and study of beaver impounded water in Mississippi. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 23: 110-128.

Avery, E.L. 1992. Effects of removing beaver dams upon a northern Wisconsin brook trout stream. Final Report. Wis. Dept. Nat. Res. Madison, WI 59pp.

AVMA, 1986. Journal of the American Veterinary Medical Association. Panel Report on the Colloquim on Recognition and Alleviation of Animal Pain an Distress. 191:1186-1189.

AVMA. 1993. Report of the AVMA panel on euthanasia. J. Am. Vet. Med. Assoc. 202:229-249.

Bailey, R.W., and R.F. Stevens. 1951. Effects of beavers on fish. Wet Virginia Conserv. 15 (6):11 - 16, 26.

Beach, R., and W. F. McCulloch. 1985. Incidence and significance of Giardia Lamblia (Lambl) in Texas beaver populations. Proc. Great Plains Wildl. Damage Cont. Work. 7:152-164.

Bedmarik, K., and J.L. Weeks. 1971. Status of beaver in Ohio. Ohio Federal Aid in Fish and Wildl. Restor. Proj. W-104-R-13 (final report for Job 9). Ohio Div. Wildl.

Beier, P., and R.H. Barrett. 1987. Beaver habitat use and impact in Truckee River Basin, California. J. Wild. Manage. 51: 794-799.

Bishop, R. C. 1987. Economic values defined. Pages 24 -33 *in* D. J. Decker and G. R. Goff, eds. Valuing wildlife: economic and social perspectives. Westview Press, Boulder, CO. 424 p.

Blundell, G.M., J.W. Kern, R.T. Bowyer, and L.K. Duffy. 1999. Capturing river otters: a comparison of Hancock and leg-hold traps. Wildl. Soc. Bull. 27(1): 184-192.

Bridgeland, W, D. L. Burton, J. W. Grandy, J. Hadidian, and G. R. Hodge. 1991. Pocket guide to the humane control of wildlife in cities and towns. Falcon Press Pub. Montana. 116 pp.

Bridgeland, W, D. L. Burton, J. W. Grandy, J. Hadidian, G. R. Hodge, D. Pauli, and J. Valenstein. 1997. Wild neighbors: The humane approach to living with wildlife. Fulcrum Pub. Colorado. 253 pp.

Bromley, P.T., J.F. Heisterberg, W.T. Sullivan, Jr., P. Sumner, J.C. Turner, R.D. Wickline, and D. K. Woodward. 1994. Wildlife Damage Management: Beavers. North Carolina Cooperative Extension Service. 8 pp.

Boutin, S. and D. E. Birkenholz. 1987. Muskrat and round-tailed muskrat. pp. 282-313 *in* M. Novak, J. A. Baker, M.E. Obbard, B. Mallock. Wild Furbearer Management and Conservation in North America. Ministry of Natural Resources,

Ontario, Canada. 1150 pp.

Brooks, R.P., M.W. Fleming and J.J. Kennelly. 1980. Beaver colony response to fertility control: Evaluating a concept. J. Wildl. Manage. 44:568-575.

Carter, S.L., C.A. Haas, and J.C. Mitchell. 1999. Home range and habitat selection of bog turtles in southwestern Virginia. J. Wildl. Manage. 63:853-860.

CDFG (California Department of Fish and Game). 1991. California Department of Fish and Game. Final Environmental Document - Bear Hunting. Sections 265, 365, 366, 367, 367.5. Title 14 Calif. Code of Regs. Cal F&G, State Of California, April 25, 1991. 13pp.

Center for Disease Control. 1990. Morbidity and Mortality Weekly Report. Compendium of Rabies Control. 39, No. RR-4:6.

CEQ (Council for Environmental Quality). 1981. Forty most asked questions concerning CEQ's National Environmental Policy Act regulations. (40 CFR 1500-1508) Fed. Reg. 46(55):18026-18038.

Churchill, J.E. 1980. Beaver are killing our trout streams. Trout. 21(4): 22-25.

Clausen, G., and A. Ersland. 1970. Blood O_2 and acid-base changes in the beaver during submersion. Respiration Physiology. 11:104-112.

Cook, D.B. 1940. Beaver - trout relations. Journal of Mammology 21 (4): 397 - 401.

Courcelles, R., and R. Nault. 1983. Beaver programs in the James Bay area, Quebec, Canada. Acta Zool. Fenn. 174:129-131.

Craven, S.R. 1992. Summary of a survey on translocation of urban wildlife. Final report to the NPCA. 10 pp.

Davis, D.S. 1961. Principles for population control by gametocides. Trans. N. Am. Wildl. Conf. 26:160-166.

De Almeida, M. H. 1987. Nuisance furbearer damage control in urban and suburban areas. Pages 996-1006 *in* M. Novak, J. A. Baker, M. E. Obbard, and B. Malloch, eds. Wild Furbearer Management and Conservation in North America. Ontario Trappers Assoc., Ontario.

Decker, D. J. and L. C. Chase. 1997. Human dimension of living with wildlife - a management challenge for the 21st century. Wildl. Soc. Bull. 16:53-57

Decker, D. J., and G. R. Goff. 1987. Valuing Wildlife: Economic and Social Perspectives. Westview Press. Boulder, Colorado, p. 424.

Decker, D. J., and K. G. Purdy. 1988. Toward a concept of wildlife acceptance capacity in wildlife management. Wildl. Soc. Bull. 16:53-57

Defenders of Wildlife and the Center for Wildlife Law. 1996. Saving biodiversity: a status report on State laws, policies and programs. Defenders Wildl. and Center for Wildl. Law, Washington, D.C. 218pp.

Denney, R.N. 1952. A summary of North American beaver management, 1946-1948. Colorado Game and Fish Dep., Curr. Rep. 28. 58 pp.

Dolbeer, R.A., N.R. Holler, and D.W. Hawthorne. 1994. Identification and control of wildlife damage. Pages 474-506 *in* T.A. Bookhout, ed., Research and management techniques for wildlife and habitats. The Wildlife Society; Bethesda, Maryland.

EPA. 1995. Facts about wetlands. USEPA. Office of water, Office of wetlands, oceans and watersheds (4502F). EPA 843-F-95-00le.

Ermer, E.M. 1984. Analysis of benefits and management costs associated with beaver in western New York. NY Fish and

Game J. 31:119-132.

Evans, T.R. 1948. Beaver - trout - waterfowl problems. Unpubl. paper presented at 10th Midwest Wildl. Conf. 9 pp.

Evans, J. 1970. About nutria and their control. Bureau of Sport Fisheries and Wildlife, Denver Wildlife Research Center. Res. Pub. No. 86. 65pp.

Forbus, K., and F. Allen. 1981. Southern beaver control. Georgia For. Res. Pap. No. 23. 10 pp.

Gilbert, F.F., and N. Gofton. 1982. Terminal dives in mink, muskrat, and beaver. Physiol.& Behav. 28:835-840.

Gordon, K. L. and D. H. Arner. 1976. Preliminary study using chemosterilants for control of nuisance beaver. proc. Southeast Assoc. of Game and Fish Comm. 30: 463-465.

Hibbard, E. A. 1958. Movements of beaver transplanted in North Dakota. J. Wildl. Manage. 22: 209-211.

Hill, E. P. 1976. Control methods for nuisance beaver in the southeastern United States. Proc. Vertebr. Pest Control Conf. 7:85-98.

Hill, E. P. 1982. Beaver. Pages 256-281 *in* J.A. Chapman and G.A. Feldhamer, eds. Wild Mammals of North America. The John Hopkins University Press, Baltimore.

Hill, E.P., III, D.N. Lasher, and R.B. Roper. 1977. A review of techniques for minimizing beaver and white-tailed deer damage in southern hardwoods. Proc. 2nd Annu. Symp. On Southeastern Hardwoods, Dothan, Ala. pp. 79-93.

Howard, R., L. Berchielli, G. Parsons, and M. Brown. 1980. Trapping furbearers: Student manual. Dept. of Conservation, New York. 59 pp.

Jackson, S., and T. Decker. 1993. Beavers in Massachusetts. Univ. of Massachusetts Coop. Ext. System, Amhurst. 16pp.

Jenkins, S. H., and P. E. Busher. 1979. *Castor canadensis*. Mammalian Species No. 120. Shippensburg, PA: Amer Soc. Mammal. 8pp.

Johnston, C.A. 1994. Ecological engineering of wetlands by beavers *in* Global Wetlands: Old world and new. (W.J. Mitsch). Elsevier Science B.V. Pp. 379.

Kellert, S.R., and J.K. Berry. 1980. Knowledge, affection and basic attitudes toward animals in American society. U.S. Fish and Wildlife Service and US Dept. of Commerce, Springfield, VA.

Knudsen, G.J., and J.B. Hale. 1965. Movements of transplanted beavers in Wisconsin. J. Wildl. Manage. 29:685-688.

Kolz, A.L., and R.E. Johnson. 1997. In-water electro-shock techniques to repel aquatic mammals and birds. *In*: J.R. Mason, ed. Repellents in Wildlife Management Symp. Proc. Aug. 8-10, 1995 Denver & Ft. Collins , CO. USDA, APHIS, WS, Nat. Wildl. Res. Cen.:203-215.

Langley, W.H., and J.B. Moyle. 1963. The beaver in Minnesota. Minn. Dept. Conserv. Div. Game and Fish Tech. Bull. 6.

Laramie, H. A. Jr., and S. W. Knowles. 1985. Beavers and their control. Univ. of New HampshireCoop. Ext. Service. Wildlife Fact Sheet 10. Durham, NH. 4 pp.

Lewis, J. W. 1979. Significance of beaver and beaver ponds in the Tombigbee Resource Conservation and Development Area Alabama-1978. Ala. Coop. Ext. Serv., Auburn Univ., Circ. CRD-7. 10 pp.

Linzey, D. W. 1998. The mammals of Virginia. McDonald and Woodward Pub. Blacksburg, VA. 459 p.

Lisle, S. 1996. Beaver deceivers. Wildl. Control Tech. Sept. - Oct. pp. 42-44.

Loeb , B. F., Jr. 1994. The beaver of the old north state. Pop. Govern.:18-23.

Logan, K. A., L. L. Sweanor, T. K. Ruth, and M. G. Hornocker. 1996. Cougars of the San Andred Mountains, New Mexico. A Final Report, Fed. Aid Wildl. Restor. Proj. W-128-R, Hornocker Wildlife institute, P. O. Box 3246, Moscow, ID.

Loker, C.A., D.J. Decker, and S.J. Schwager. 1999. Social acceptability of wildlife management actions in suburban areas: 3 cases from New York. Wildl. Soc. Bull. 27:152-159.

Loven, J. E. 1985. Reported beaver damage and control methods used in Texas. Proc. Great Plains Wildl. Damage Cont. Work. 7:145-151.

Ludders, J.W., R.H. Schmidt, F.J. Dein, and P.N. Klein. 1999. Drowning is not euthanasia. Wildl. Soc. Bull. 27:666-670.

Lynch, J. J., T. O'Neil, and D. W. Lay. 1947. Management significance of damage by geese and muskrats to gulf coasts marshes. J. Wildl. Manage. 1:50-76.

Mallis, A. 1982. Handbook of pest control, 6th ed. Franzak & Foster Co., Cleveland. 1101 pp.

McNeely, R. 1995. Missouri's Beaver: A guide to management, nuisance prevention and damage control. Missouri Dept. of Conservation. Jefferson City, MO. 30 pp.

Medin, D. E., and W. P. Clary. 1990. Bird populations in and adjacent to a beaver pond ecosystem in Idaho. USDA, Forest Service, Intermountain Res. Sta., Res. Paper INT-432.

Medin, D. E., and W. P Clary. 1991. Small mammals of a beaver pond ecosystem and adjacent riparian habitat in Idaho. USDA, Forest Service, Intermountain Res. Sta., Res. Paper INT-445.

Miller, J. E. 1983. Control of beaver damage. Proc. East. Wildl. Damage Control Conf. 1:177-183.

Miller, J. E. 1994. Muskrats. pp B-61 to B-70 *in* S. E. Hygnstrom, R. M. Timm and G. E. Larson (eds.) Prevention and Control of Wildlife Damage. Univ. Nebraska and USDA-APHIS-WS and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

Miller, J. E., and G. K. Yarrow. 1994. Beavers. Pages B1-B11 *in* R. M. Timm, ed. Prevention and control of wildlife damage. Great Plains Agric. Counc., Wildl. Res. Comm. and Nebraska Coop. Ext. Serv., Univ. of Nebraska, Lincoln.

Minn. Dep. Nat. Res. 1994. The clemson beaver pond leveler. St. Paul, MN. 6 pp.

Naimen, R.J., J.M. Melillo, and J.E. Hobbie. 1986. Ecosystem alteration of boreal forest streams by beaver (*Castor canadensis*). Ecology 67: 1254-1269.

Neves, R. J., and M.C. Odom. 1989. Muskrat predation on endangered freshwater mussels in Virginia. J. Wildl. Manage. 53:934-941.

Nielsen, L. 1988. Definitions, considerations, and guidelines for translocation of wild animals. Pages 12-49 *In* Translocation of Wild Animals. Edited by L. Nielsen and R. D. Brown. WI Humane Society, Inc. and Ceaser Kleberg Wildlife Research Instit. 333 p.

Noonan, B. 1998. The Canadian terminal dive study. Wildl. Control Tech. May - June. pp. 24-26.

Novak, M. 1987a. Beaver. Pages 282-312 *in* M. Novak, J.A. Baker, M.E. Obbard, and B. Mallock, eds. Wild Furbearer Management and Conservation in North America. Ontario Trappers Assoc., Ontario.

Novak, M. 1987b. Traps and trap research. Pages 941-969 *in* M. Novak, J.A. Baker, M.E. Obbard, and B. Mallock, eds. Wild Furbearer Management and Conservation in North America. Ontario Trappers Assoc., Ontario.

O'Neil, T. 1949. The muskrat in the Louisiana coastal marshes. Louisiana Dept. Wildlife and Fish., New Orleans. 152 p.

Organ, J.F., T. Decker, J. DiStefano, K. Elowe, P. Rego, and P.G. Mirick. 1996. Trapping and furbearer management: Perspectives from the Northeast. Northeast Furbearers Resources Technical Committee. USDI-Fish and Wildlife Service. Hadley, Ma. 33 pp.

Patterson, D. 1951. Beaver-trout relationships. Investigational Report No. 822. Wis. Cons.Dept. Madison, WI 34pp.

Payne, N. F. 1989. Populations Dynamics and harvest response of beaver. Proc. East. Wildl. Dam. Workshop. 4:127-134.

Perry, H. R. 1982. Muskrats. Pages 282 - 325 *in* Wild mammals of North America. J. A. Chapman and G. A. Feldhamer, eds. John Hopkins Univ. Press. Baltimore, MD.

Randolph, J. P. 1988. Virginia trapper's manual. Dept. of Game and Inland Fisheries, Richmond, VA. 48 pp.

Redmon, J. 1999. Problem gnaws at neighborhood. Richmond Times Dispatch. December 28, 1999.

Redmon, J. 2000. Group urged to seek federal help for beavers. Richmond Times Dispatch. January 6, 2000.

Reese. K.P., and J.D. Hair. 1976. Avian species diversity in relation to beaver pond habitats in the piedmont region of South Carolina. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agen. 30: 437-447.

Roblee, K.J. 1983. A wire mesh culvert for use in controlling water levels at nuisance beaver sites. Proc. East. Wildl. Damage Control Conf. 1:167-168.

Roblee, K. 1984. Use of corrugated plastic drainage tubing for controlling water levels at nuisance beaver sites. N.Y. Fish Game J. 31: 63-80.

Roblee, K.J. 1987. The use of T-culvert guard to protect road culverts from plugging damage by beavers. Proc. East. Wildl. Damage Control Conf. 3:25-33.

Sayler, J.C. 1935. A program of beaver management. American Game 24 (1, 3, & 4): 39 - 64.

Schmidt, R. H. 1989. Animal welfare and wildlife management. Trans. N. A. Wildl. And Nat. Res. Conf. 54:468-475

Schwartz, C. W., and E. R. Schwartz. 1959. The wild mammals of Missouri. Univ. Missouri Press and Missouri Conserv. Comm., Columbia . 341 p.

Skinner, Q. D., J. E. Speck Jr., M. Smith, and J. C. Adams. 1984. Stream water quality as influenced by beaver within grazing systems in Wyoming. J. Range. Manage. 37:142-146.

Slate, D. A., R. Owens, G. Connolly, and G. Simmons. 1992. Decision making for wildlife damage management. Trans. North Am. Wildl. Nat. Res. Conf. 57:51-62.

Speake, D.W. 1955. Seasonal abundance of waterfowl on sample areas in Lee County, Alabama. M.S. Thesis. Alabama Polytechnic Institute, Auburn. 110 pp.

Sprules, W.W. 1940. Effect of beaver dams on insect fauna of a trout stream. Trans. Amer. Fish. Soc. 64: 236 - 248.

Terwilliger, K. 1991. Virginia's Endangered Species: Proceedings of a symposium. McDonald and Woodward Publ. Blacksburg, VA 638 p.

Terwilliger K., and J. R. Tate. 1995. A guide to endangered and threatened species in Virginia. McDonald and Woodward Publ. Blacksburg, VA. 220 p.

The Wildlife Society. 1992. Conservation policies of The Wildlife Society: A stand on issues important to wildlife conservation. The Wildlife Society, Bethesda, Md. 24pp.

USDA (U. S. Department of Agriculture). 1997 (revised). Animal Damage Control Program Final Environmental Impact

Statement. Vol. 1-3. Animal and Plant Health Inspection Service, Hyattsville, MD.

USDA. 1999. USDA, Animal and Plant Health Inspection Service, Animal Damage Control Strategic Plan. USDA, APHIS, ADC (*WS*), Operational Support Staff, 6505 Belcrest RD, Room 820 Federal Bldg, Hyattsville, MD 20782.

USDI. 1992. Biological Opinion. Animal Damage Control Program U.S. Fish and Wildlife Service, Washington D.C.

Virginia Department of Environmental Quality (VDEQ). 2000. Virginia's water resources: Shaping our lives and our land. Virginia Explorer. Winter 2000: pg.2

Wade, D. A., and C. W. Ramsey. 1986. Identifying and managing aquatic rodents in Texas: beaver, nutria and muskrats. Texas Agric. Ext. Serv., Texas A&M Univ., College Station.

Wayland, R. H., III, and E. V. Shaeffer. 1997. Corps of Engineers/Environmental Protection Agency guidance regarding regulation of certain activities in light of American Mining Congress v. Corps of Engineers. EPA. Memorandum issued to the field April 11, 1997. 4 pp.

Weaver, K.M., D.H. Arner, C. Mason, and J.J. Hartley. 1985. A guide to using snares for beaver capture. South. J. Appl. For. 9(3):141-146.

Wesley, D.E. 1978. Beaver control in the Southeastern United States. Pages 84-91 *in* Proc. 6th Annu. Hardwood Symp. Hardwood Res. Council, Chashiers, N. C. 94 pp.

White, R.J., and O.M. Brynildson. 1967. Guidelines for management of trout stream habitat in Wisconsin, Wis. Dept. Nat. Resour. Technical bulleting No. 39. Madison, WI 64 pp.

Wigley, T. B., Jr. 1981. A model of beaver damage and control. Ph.D. Diss. Mississippi State Univ., Miss. State, Miss. 141 p.

Wood, G. W., L. A. Woodward, and G. K. Yarrow. 1994. The Clemson beaver pond leveler. AFW Leaflet 1, Clemson Cooperative Extension Service, Clemson, SC.

Woodward, D. K. 1983. Beaver management in the southeastern United States: a review and update. Proc. East. Wildl. Damage Contr. Conf. 1:163-165.

Woodward, D. K., J. D. Hair, and B. P. Gaffney. 1976. Status of beaver in South Carolina as determined by a postal survey of landowners. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 30:448-454.

Woodward, D. K., R. B. Hazel, and B. P. Gaffney. 1985. Economic and environmental impacts of beaver in North Carolina. Proc. East. Wildl. Damage Contr. Conf 2:89-96.

Yeager, L.E., and W.H. Ruthford. 1957. An ecological basis for beaver management in the Rocky Mountain Region. Trans. N. Am. Wildl. Conf. 22: 269-300.

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APPENDIX B

AUTHORITY AND COMPLIANCE

The USDA is directed by law to protect American agriculture and other resources from damage associated with wildlife. The primary statutory authority for the WS program is the Animal Damage Control Act of March 2, 1931, as amended (7 U.S. C. 426-426c; 46 Stat. 1468), which provides that:

> *"The Secretary of Agriculture is authorized and directed to conduct such investigations, experiments, and tests as he may deem necessary in order to determine, demonstrate, and promulgate the best methods of eradication, suppression, or bringing under control on national forests and other areas of the public domain as well as on State, Territory or privately owned lands of mountain lions, wolves, coyotes, bobcats, prairie dogs, gophers, ground squirrels, jackrabbits, brown tree snakes and other animals injurious to agriculture, horticulture, forestry, animal husbandry, wild game animals, furbearing animals, and birds, and for the protection of stock and other domestic animals through the suppression of rabies and tularemia in predatory or other wild animals; and to conduct campaigns for the destruction or control of such animals. Provided that in carrying out the provisions of this Section, the Secretary of Agriculture may cooperate with States, individuals, and public and private agencies, organizations, and institutions."*

Since 1931, with the changes in societal values, WS policies and its programs place greater emphasis on the part of the Act discussing *"bringing (damage) under control", rather than "eradication" and "suppression"* of wildlife populations. In 1988, Congress strengthened the legislative mandate of WS with the Rural Development, Agriculture, and Related Agencies Appropriations Act. This Act states, in part:

> *"That hereafter, the Secretary of Agriculture is authorized, except for urban rodent control, to conduct activities and to enter into agreements with States, local jurisdictions, individuals, and public and private agencies, organizations, and institutions in the control of nuisance mammals and birds and those mammals and birds species that are reservoirs for zoonotic diseases, and to deposit any money collected under any such agreement into the appropriation accounts that incur the costs to be available immediately and to remain available until expended for Animal Damage Control activities."*

Virginia Department of Game and Inland Fisheries Legislative Mandate

The VDGIF, under the direction of the Governor-appointed Board of Directors, is specifically charged by the General Assembly with the management of the state's wildlife resources. Although many legal mandates of the Board and the Department are expressed throughout the Virginia Annotated Code (VAC), the primary statutory authorities include wildlife management responsibilities (VAC §§ 29.1-103), public education charges (VAC §§29.1-109), law enforcement authorities (VAC §§ 29.1-109), and regulatory powers (VAC §§ 29.1-501). In 1990, the Board of Directors adopted mission statements to help clarify and interpret the role of VDGIF in managing the wildlife resources of Virginia. They are:

- To manage Virginia's wildlife and inland fisheries to maintain optimum populations of all species to serve the needs of the Commonwealth;
- To provide opportunity for all to enjoy wildlife, inland fisheries, boating and related outdoor recreation; and
- To promote safety for persons and property in connection with boating, hunting, and fishing.

Compliance with Other Federal and State Statutes

Several federal laws, state laws, and state statutes regulate WS wildlife damage management. WS complies with these laws and statutes, and consults and cooperates with other agencies as appropriate.

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National Environmental Policy Act (NEPA). Environmental documents pursuant to NEPA must be completed before actions consistent with the NEPA decision can be implemented. WS also coordinates specific projects and programs with other agencies. The purpose of these contacts is to coordinate any wildlife damage management that may affect resources managed by these agencies or affect other areas of mutual concern.

Endangered Species Act (ESA). It is federal policy, under the ESA, that all federal agencies shall seek to conserve T&E species and shall utilize their authorities in furtherance of the purposes of the Act (Sec. 2(c)). WS conducts Section 7 consultations with the USFWS to use the expertise of the USFWS to ensure that "*any action authorized, funded or carried out by such an agency. . . is not likely to jeopardize the continued existence of any endangered or threatened species. . . Each agency shall use the best scientific and commercial data available*" (Sec. 7(a)(2)).

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). FIFRA requires the registration, classification, and regulation of all pesticides used in the United States. The EPA is responsible for implementing and enforcing FIFRA. All chemical methods integrated into the WS program in Virginia are registered with and regulated by the EPA and VDACS, and would be used by WS in compliance with labeling procedures and requirements.

Clean Water Act (Section 404). Section 404 (33 U.S.C. 1344) of the Clean Water Act prohibits the discharge of dredged or fill material into waters of the United States without a permit from the USACE unless the specific activity is exempted in 33 CFR 323 or covered by a nationwide permit in 33 CFR 330. The breaching of most beaver dams are covered by these regulations (33 CFR 323 and 330). In addition, a recent court decision, the Tulloch Rule Decision, determined that minimal quantities of material released during excavation activities, such as may occur during beaver dam breaching, may be considered "*incidental fallback*" which would not be governed by Section 404 and is allowed (Wayland and Shaeffer 1997).

Food Security Act. The Wetland Conservation provision (Swampbuster) of the 1985 (16 U.S.C. 3801-3862), 1990 (as amended by PL 101-624), and 1996 (as amended by PL 104-127) farm bills require all agricultural producers to protect wetlands on the farms they own. Wetlands converted to farmland prior to December 23, 1985 are not subject to wetland compliance provisions even if wetland conditions return as a result of lack of maintenance or management. If prior converted cropland is not planted to an agricultural commodity (crops, native and improved pastures, rangeland, tree farms, and livestock production) for more than 5 consecutive years and wetland characteristics return, the cropland is considered abandoned and then becomes a wetland subject to regulations under Swampbuster and Section 404 of the Clean Water Act. The Natural Resource Conservation Service is responsible for certifying wetland determinations according to this Act.

Possession, Transportation, and Release of Wildlife by Authorized Persons. This regulation (4 VAC §§15-30-50) authorizes employees of federal wildlife management agencies and local animal control officers in the performance of their duties to take problem wildlife in the Commonwealth of Virginia.

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APPENDIX C

CRITERIA FOR BEAVER DAM BREACHING/REMOVAL

Beaver dam breaching is generally conducted to maintain existing stream channels and drainage patterns, and reduce flood waters. Beaver dams are made from natural debris such as logs, sticks, and mud that beaver take from the area. It is this portion that is dislodged during a beaver dam breaching operation. The impoundments that WS removes are normally from recent beaver activity and have not been in place long enough to take on the qualities of a true wetland (i.e., hydric soils, aquatic vegetation, preexisting function). Beaver dam breaching by hand or with binary explosives does not affect the substrate or the natural course of the stream and returns the area back to its preexisting condition with similar flows and circulations. Because beaver dams involve waters of the United States, dam breaching is regulated under Section 404 of the Clean Water Act (CWA).

Wetlands are recognized by three characteristics: hydric soils, hydrophytic vegetation, and general hydrology. Hydric soils are either composed of, or have a thick surface layer of, decomposed plant materials (muck); sandy soils have dark stains or streaks from organic material in the upper layer where plant material has attached to soil particles. In addition, hydric soils may be bluish gray or gray below the surface or brownish black to black and have the smell of rotten eggs. Wetlands also have hydrophytic vegetation present such as cattails, bulrushes, willows, sedges, and water plantains. The final indicator is general hydrology which includes standing and flowing water or waterlogged soils during the growing season; high water marks are present on trees and drift lines of small piles of debris are usually present. Beaver dams usually will develop a layer of organic material at the surface because siltation can occur rapidly, but aquatic vegetation and high water marks (a new high water mark is created by the beaver dam) are usually not present. However, cattails and willows can show up rapidly if they are in the vicinity, but most hydrophytic vegetation takes time to establish.

When a dam is breached, debris is discharged into the water and the debris that ends up in the water may be considered "*incidental fallback*" or an incidental discharge of fill in waters of the U.S. The Tulloch Rule Decision (Court Case No. 93cv01754) determined that "*incidental fallback*" did not trigger Section 404 permit requirements. It was not determined if beaver dams fit this category, but EPA and the USACE issued guidance to their regulatory offices that beaver dam breaching may not require permits under Section 404 (Wayland and Shaeffer 1997). These agencies stated that they would give their field offices further guidance at a later date. However, in most beaver dam breaching operations, the material that is displaced is exempt from regulation under Section 404 of the CWA (33 CFR Part 323). A permit would be required if the impoundment caused by a beaver dam was considered a true wetland. WS personnel survey the beaver dam site and impoundment and determine whether conditions exist suggest that the area may be a wetland as defined above. If such conditions exist, the landowner is asked the age of the dam or how long he/she has known of its presence to determine whether Swampbuster, Section 404 permit exemptions or NWPs allow breaching of the dam. If not, the landowner is required to obtain a Section 404 permit before the dam could be removed by WS personnel.

The following explains Section 404 exemptions and conditions that pertain to the breaching of beaver dams.

33 CFR 323 - Permits For Discharges of Dredged or Fill Material into Waters of the United States. This regulation provides guidance to determine whether certain activities require permits under Section 404.

> **Part 323.4 Discharges not requiring permits.** This section establishes exemptions for discharging certain types of fill into waters of the United States without a permit. Certain minor drainage activities connected with normal farming, ranching, and silviculture activities where they have been established do not require a permit as long as these drainages do not include the immediate or gradual conversion of a wetland (i.e., beaver ponds greater than 5 years old) to a non-wetland. Specifically, part (a)(1)(iii)(C)(i) states, "*...fill material incidental to connecting upland drainage facilities* (e.g., drainage ditches) *to waters of the United States, adequate to effect the removal of excess soil moisture from upland croplands...*". This indicates that beaver dams that block ditches, canals, or other structures designed to drain water from upland crop fields can be breached without a permit.

Moreover, (a)(1)(iii)(C)(iv) states the following types of activities do not require a permit "*The discharges of dredged or fill materials incidental to the emergency removal of sandbars, gravel bars, or other similar blockages which are formed during flood flows or other events, where such blockages close or constrict previously existing drainageways and, if not promptly removed, would result in damage to or loss of existing crops or would impair or prevent the plowing, seeding, harvesting or cultivating of crops on land in established use for crop production. Such removal does not include enlarging or extending the dimensions of, or changing the bottom elevations of, the affected drainageway as it existed prior to the formation of the blockage. Removal must be accomplished within one year of discovery of such blockages in order to be eligible for exemption.*"; this allows the breaching of beaver dams in natural streams to restore drainage of agricultural lands within one year of discovery.

Part 323.4 (a) (2) allows "*Maintenance, including emergency reconstruction of recently damaged parts, of currently serviceable structures such as dikes, dams, levees, groins, riprap, breakwaters, causeways, bridge abutments or approaches, and transportation structures. Maintenance does not include any modification that changes the character, scope, or size of the original fill design. Emergency reconstruction must occur within a reasonable period of time after damage occurs in order to qualify for this exemption.*"; this allows beaver dams to be breached without a permit where they have resulted in damage to roads, culverts, bridges, or levees if it is done in a reasonable amount of time.

33 CFR 330 - Nationwide Permit (NWP) Program. The USACE, Chief of Engineers is authorized to grant certain dredge and fill activities on a nationwide basis if they have minimal impact on the environment. The NWPs are listed in Appendix A of 33 CFR 330 and permittees must satisfy all terms and conditions established to qualify for their use. Individual beaver dam breaching by WS may be covered by any of the following NWPs if not already exempted from permit requirements by the regulations discussed above. WS complies with all conditions and restrictions placed on NWPs for any instance of beaver dam breaching done under a specific NWP.

Nationwide permits can be used **except** in any component of the National Wild and Scenic River System such as waterways listed as an "*Outstanding Water Resource*", or any waterbody which is part of an area designated for *"Recreational or Ecological Significance"*.

NWP 3 authorizes the rehabilitation of those structures, such as culverts, homes, and bridges, destroyed by floods and "discrete events," such as beaver dams, provided that the activity is commenced within 2 years of the date when the beaver dam was established.

NWP 18 allows minor discharges of dredged and fill material, including the breaching of beaver dams, into all waters of the United States provided that the quantity of discharge and the volume of excavated area does not exceed 10 cubic yards below the plane of the ordinary high water mark (this is normally well below the level of the beaver dam) or is in a "special aquatic site" (wetlands, mudflats, vegetated shallows, riffle and pool complexes, sanctuaries, and refuges). The District Engineer must be "notified" (general conditions for notification apply), if the discharge is between 10-25 cubic yards for a single project or the project is in a special aquatic site and less than $^{1}/_{10}$ of an acre is expected to be lost. If the values are greater than those given, a permit is required. Beaver dams rarely would exceed 2 or 3 cubic yards of backfill into the waters and probably no more than 5 cubic yards would ever be exceeded. Therefore, this stipulation is not restrictive. Beaver dams periodically may be breached in a special aquatic area, but normally the aquatic site will be returned to normal. However, if a true wetland exists, and beaver dam breaching is not allowed under another permit, then a permit must be obtained from the District Engineer.

NWP 27 provides for the discharge of dredge and fill for activities associated with the restoration of wetland and riparian areas with certain restrictions. On non-federal public and private lands, the owner must have: a binding agreement with USFWS or NRCS to conduct restoration; a voluntary wetland restoration project documented by NRCS; or notify the District Engineer according to "notification" procedures. On federal lands, including USACE and USFWS, wetland restoration can take place without

any contract or notification. This NWP "*...applies to restoration projects that serve the purpose of restoring "natural" wetland hydrology, vegetation, and function to altered and degraded non-tidal wetlands and "natural" functions of riparian areas. This NWP does not authorize the conversion of natural wetlands to another aquatic use...*" If operating under this permit, the breaching of a beaver dam would be allowed as long as it was not a true wetland (i.e., 5 or more years old), and for non-federal public and private lands the appropriate agreement, project documentation, or notification is in place.

A quick response without delays resulting from permitting requirements can be critical to the success of minimizing or preventing damage. Exemptions contained in the above regulations or NWPs provide for the breaching of the majority of beaver dams that Virginia WS encounters. The primary determination that must be made by WS personnel is whether a beaver impounded area has become a true wetland or is just a flooded area. The flexibility allowed by these exemptions and NWPs is important for the efficient and effective resolution of many beaver damage problems because damage escalates rapidly in many cases the longer an area remains flooded.

Pre-Decisional

APPENDIX D

METHODS USED BY VIRGINIA WS FOR BEAVER AND MUSKRAT DAMAGE MANAGEMENT

Resource owners and government agencies have used a variety of techniques to reduce beaver and muskrat damage. However, all lethal and non-lethal methods developed to date have limitations based on costs, logistics, or effectiveness. Below is a discussion of beaver and muskrat damage management methods currently available to the Virginia WS Program. If other methods are proven effective and legal to use in Virginia, they could be incorporated into the Virginia WS program.

NON-LETHAL DAMAGE MANAGEMENT METHODS:

Habitat Management for the reduction of beaver and muskrat damage refers to vegetation manipulation to reduce the carrying capacity for beaver and muskrats.

Muskrat - The best ways to reduce habitat for muskrats are to eliminate aquatic or other suitable foods eaten by muskrats, and where possible, to construct pond dams to prevent muskrats from burrowing into the dams by drawing the water down in winter and filling the burrows with rip-rap. Habitat alterations to reduce cattail wetlands could reduce the density of muskrats. This type of management practice would be conducted by entities other than WS.

Beaver - Habitat alteration through forest type conversion might be the most effective long-term method of reducing beaver density in some areas (Payne 1989). Forest management practices that discourage the establishment of aspen and promote long-lived hardwoods and conifers within 200 - 400 feet of streams may reduce beaver populations on those streams. Payne (1989) suggested that reduced food availability might force beaver colonies to move more often, however, this movement could increase nuisance complaints.

Physical factors may have a greater impact on beaver habitat use than food availability, and habitat alteration may have little effect on beaver populations (Beier and Barrett 1987). Habitat management to reduce or stabilize beaver populations has been a component of beaver management recommendations. Habitat management may also involve manipulating beaver impoundment water levels to reduce damage or conflict caused by flooding. Impoundments can be completely drained by breaching, by hand or with explosives, major dams. Water levels may sometimes also be lowered by use of a drain tube or leveler placed in the dam (Laramie and Knowles 1985, Lisle 1996, Miller and Yarrow 1994, Roblee 1983, Roblee 1984, Roblee 1987) (Figure D-1). However, application of this strategy has been limited. Habitat management to reduce beaver populations has the greatest potential for application on federal, state, and county forest lands. At present, there appears to be no large-scale and consistent programs dealing with this beaver damage management strategy.

Continual breaching of dams and removal of dam construction materials on a daily basis sometimes will cause beaver to move to other locations. Water control devices such as the three-log drain (Roblee 1983), the T-culvert guard (Roblee 1987), wire mesh culvert (Roblee 1983), and the Clemson beaver ponds leveler (Miller and Yarrow 1994) can sometimes be used to regulate water levels in beaver ponds. Additionally, the Beaver Deceiver is a water control system that attempts to quiet, calm, and deepen the water in front of culverts (to reduce the attractiveness to beaver) and exclude beaver from a wide area around the upstream opening of the culvert (Lisle 1996). However, the effectiveness of this method has not been evaluated in published documents.

Explosives are defined as any chemical mixture or device which serves as blasting agents and detonators, and these are generally used to breach beaver dams after beaver have been removed from a damage situation. The binary explosives consist of ammonium nitrate and nitromethane, and are not classified as explosives until they are mixed, therefore, are subject to fewer regulations and controls. However, once mixed, binary explosives are considered high explosives and subject to all applicable federal requirements. Detonating cord and blasting caps are considered explosives and WS must adhere to all applicable State and federal regulations for storage and handling. All WS explosive specialists are required to attend 30 hours of extensive explosive safety training and spend time with a certified explosive specialist in the field prior to obtaining certification. All blasting activities are conducted by well trained, certified blasters and

closely supervised by professional wildlife biologists. Explosive handling and use procedures follow the rules and guidelines set forth by the Institute of Makers of Explosives, the safety arm of the commercial explosive industry in the United States and Canada. WS also adheres to transportation and storage regulations from State and federal agencies such as Occupational Safety and Health Association, Alcohol-Tobacco-Firearms, and the Departments Of Transportation.

Beaver Dam Breaching involves the removal of debris deposited by beaver that impedes the flow of water and is generally conducted to maintain existing stream channels and drainage patterns, and reduce flood waters that have affected established silviculture, agriculture, and ranching/farming activities or drainage structures such as culverts. The impoundments that WS removes are normally from recent beaver activity that have not had enough time to take on the qualities of a true wetland (i.e., hydric soils, aquatic vegetation, preexisting function). Unwanted beaver dams can be removed by hand or with explosives. Explosives are used only by WS personnel specially trained and certified to conduct such activities, and only binary explosives are used (i.e., they are comprised of two parts that must be mixed at the site before they can be detonated as an explosive material). Because beaver dams involve waters of the United States, removal is regulated under Section 404 of the CWA.

Beaver dam breaching does not affect the substrate or the natural course of the stream and returns the area back to its preexisting condition with similar flows and circulations. When a dam is breached, debris is discharged into the water. The debris that ends up in the water is considered *"incidental fallback"* or discharge fill does not trigger Section 404 (Tulloch Rule Decision (Court Case No. 93cv01754). It was determined that beaver dams fit into this category, but EPA and the USACE issued guidance to their regulatory offices that beaver dam breaching may not require permits under Section 404 (Wayland and Shaeffer 1997). However, most beaver dam breaching operations, if considered discharge, are covered under 33 CFR 323 or 330 and do not require a permit. A permit would be required if the beaver dam was considered a true wetland. WS personnel survey the site and determine the apparent age of the dam by conditions such as aquatic plants. If the area is over 5 years old or appears to be a wetland, the landowner is required to obtain a Section 404 permit before proceeding (See Appendix C for information that explains Section 404 exemptions and conditions for breaching beaver dams).

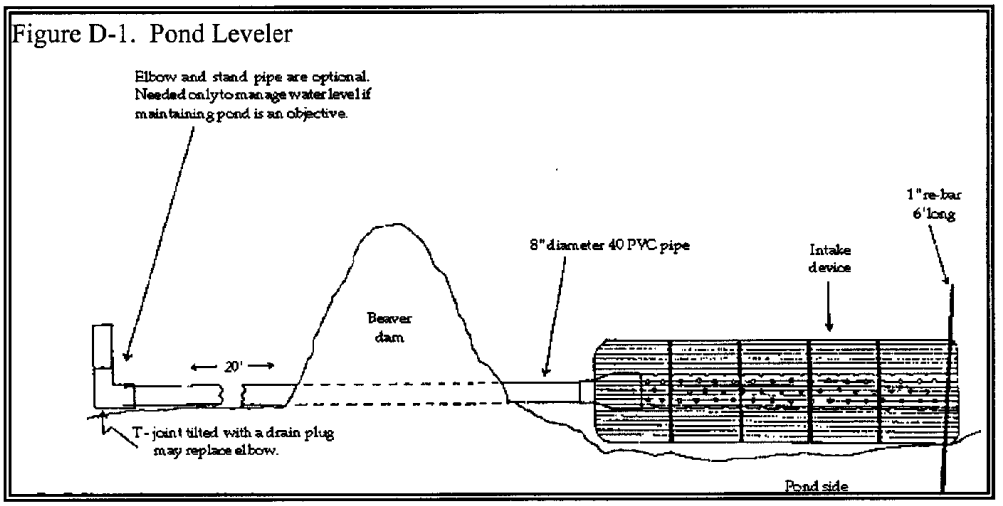
Water control devices (pond levelers) have been used for many years in many different states, with varying degrees of success (Figure D-1). Various types of beaver pond levelers have been described (Arner 1964, Laramie and Knowles 1985, Lisle 1996, Roblee 1984) and installation of beaver pond levelers can be effective in reducing flooding in certain situations (Minn. Dept. Nat. Res. 1994, Miller and Yarrow 1994) if properly maintained. Water control devices generally are of two designs. One design is a perforated pipe passing through the beaver dam (Figure D-1) and the second design is a fence erected 15 - 90 feet in front of the culvert to prevent the beaver from blocking the culvert with debris (Lisle 1996, E. Butler, USDA/APHIS/WS, pers. comm.). The second design may have a perforated pipe going from the fence to the culvert to allow water to flow since the fence may become clogged with debris.

The cost of water control devices is variable, depending on number of devices per dam, type of device, materials used, and labor. Dams may need multiple devices to accommodate the volume of water in the flowage. Materials and installation of water control devices can be relatively modest for a three-log drain (Arner 1964), $496 - $560 for a single modified Clemson leveler (B. Sloan, USDA/APHIS/WS, pers. comm.), $1050 - $2,300 for a single beaver stop (DCP Consulting, Calgary, Canada, 1996), or over $1,000 for a beaver deceiver. A modified beaver deceiver can be constructed for $250 -$300, however, annual maintenance costs were estimated at $350 (E. Butler, USDA/APHIS/WS, pers. comm.).

The use of pond levelers or water control devices may require frequent maintenance, depending on the type of water control device used. Continued maintenance is necessary for the device to remain operational because stream flow, leaf

fall, floods, and beaver activity will continuously bring debris to the water control device. This maintenance of water control devices can be expensive. There may be an annual costs to suppress or eradicate beaver populations to keep the devices operational (B. Sloan, USDA/APHIS/WS, pers. comm.).

Figure D-1. Pond Leveler



Water control devices are most effective on wetlands lacking in-stream flow (B. Sloan, USDA/APHIS/WS, pers. comm.), but may be ineffective in beaver ponds in broad, low-lying areas (Organ et al. 1996). They may not be appropriate in streams or ditches with continuous flow because the volume of water is too great for the device to handle and debris is continuously carried to the site. Also, water control devices may not be effective during periods of unusually high rainfall or increased water flow because the device cannot handle the increased volume of water (Anonymous 1999; Wood et al. 1994).

Exclusion involves physically preventing beaver and muskrats from gaining access to protected resources through fencing or other barriers. Fencing of small critical areas such as around culverts and drain pipes can sometimes prevent beaver from plugging them or it is used in situations where girdling or gnawing of trees or shrubs is a concern. In these situations hardware cloth, flashing, grit paint (D. Nolte, National Wildlife Research Center (NWRC), unpubl. data) or chain links are wrapped around the plants to be protected. Recent preliminary tests by WS's NWRC suggest that sand mixed in paint may be an effective barrier against beaver gnawing and cutting of trees or other objects (D. Nolte, NWRC, unpubl. data). Exclusion has also been used to prevent beaver from plugging road culverts when a metal screen, grate, or fencing is secured in front of the opening. Construction of concrete spillways may reduce or prevent damage to dams by from burrowing. Rip-rap can also be used on dams or levees at times, especially to deter burrowing. Electrical barriers have proven effective in limited situations for mammals and birds; an electrical field through the water in a ditch or other narrow channel, or hot-wire suspended just above the water level in areas protected from public access, have been effective at keeping mammals and birds out. The effectiveness of an electrical barrier is extended when used in conjunction with an odor or taste cue that is emitted because beaver will avoid the area even if the electrical field is discontinued (Kolz and Johnson 1997).

Protecting ornamental or landscape trees from beaver and muskrat damage by using hardware cloth, similar screening, grit paint or chain link fencing is frequently recommended WS. This method is used most frequently by property and home owners. It is rarely, if ever, used to prevent large-scale timber or forest damage due to the high material cost and labor required to wrap hundreds or thousands of trees in a managed forest. A variety of road culvert screens or fences have been used by county and local highway departments. In most cases the screens do not solve a damage problem, as workforce is still required to remove beaver dam materials from the screen or fence itself. The main benefit of this technique is to prevent beaver dam materials from being deposited inside the culvert.

Leg-hold traps can be effectively used to capture a variety of mammals (Figure D-2). Leg-hold traps are either placed beside, or in some situations, in travel ways being actively used by the target species. Placement of traps is contingent upon the habits of the respective target species, habitat conditions, and presence of non-target animals. Effective trap placement and adjustment and the use and placement of appropriate baits and lures by trained WS personnel also

contributes to the leg-hold trap's selectivity. An additional advantage is that leg-hold traps can allow for the on-site release of non-target animals. The use of leg-hold traps requires more skill than some methods, but they are indispensable in resolving many damage problems. Beaver or muskrat live-captured in leg-hold traps would be euthanized.

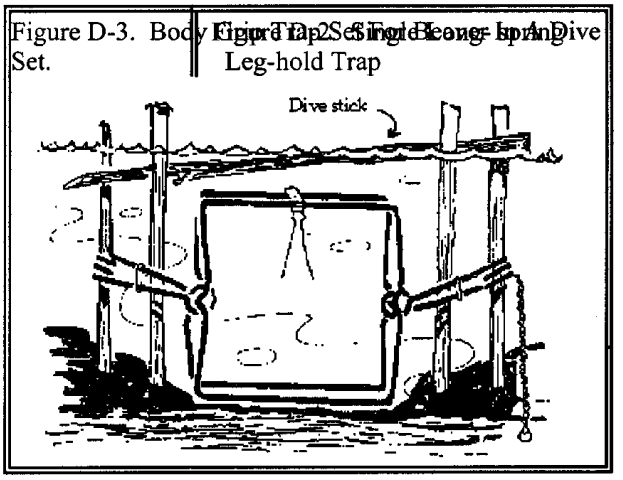


Figure D-3. Body Grip Trap Set For Beaver In A Dive Set.

Figure D-4. Single Foot Beaver In Leg-hold Trap

Snares are capture devices comprised of a cable formed in a loop with a locking device and placed in travel ways. Most snares are also equipped with a swivel to minimize cable twisting and breakage. Snares are also easier than leg-hold traps to keep operational during periods of inclement weather. Snares set to catch an animal around the body or leg are usually a live-capture method. Beaver captured in snares would be euthanized.

LETHAL DAMAGE MANAGEMENT METHODS

These methods involve damage management specifically designed to remove beaver and muskrat in certain situations to a level that stabilizes, reduces, or eliminates damage. The level of removal necessary to achieve a reduction of beaver and muskrat damage varies according to the resource protected, habitat, population, the effectiveness of other damage management strategies, and other ecological factors. Despite the numerous damage management methods developed, trapping remains the most effective method of removing beaver (Hill 1976, Hill et al 1977, Wigley 1981, Weaver et al 1985) and muskrats from specific damage areas. Intensive trapping can eliminate or greatly reduce the beaver populations in limited areas (Hill 1976, Forbus and Allen 1981). Specific methods of lethal population reduction involve removing beaver with body-grip (e.g., Conibear) and leg-hold traps, snares, and shooting. Beaver can also be live-captured with leg-hold traps, cage-type traps and snares. However, because WS does not relocate beaver and muskrat in Virginia, beaver and muskrats that are live-captured would subsequently be euthanized. Muskrats may be removed with body-grip and leg-hold traps, colony or cage-type traps, snap traps, shooting, or toxicants. These specific methods are described in USDA (1997, Appendix J: 9 - 12). A formal risk assessment of all mechanical devices used by the WS program in Virginia can be found in USDA (1997, Appendix P). These techniques are usually implemented by WS personnel because of the technical training required to use such devices.

Shooting is selective for target species and may involve the use of spotlights and either a shotgun or rifle. Shooting is an effective method to remove small numbers of beaver or muskrat in damage situations, especially where trapping is not feasible. Removal of specific animals in the problem area can sometimes provide immediate relief from a problem. Shooting is sometimes utilized as one of the first lethal damage management options because it offers the potential of resolving a problem more quickly and selectively than some other methods, but it does not always work. Shooting may sometimes be one of the only beaver or muskrat damage management options available if other factors preclude setting of damage management equipment. WS personnel receive firearms safety training to use firearms while performing their duties.

Firearm use is very sensitive and a public concern because of safety issues relating to the public and misuse. To ensure safe use and awareness, WS employees who use firearms to conduct official duties are required to attend an approved firearms safety and use training program within 3 months of their appointment and a refresher course every 3 years afterwards (WS Directive 2.615). WS employees who carry firearms as a condition of employment, are required to certify that they meet the criteria as stated in the *Lautenberg Amendment* which prohibits firearm possession by anyone who has been convicted of a misdemeanor crime of domestic violence.

Body-grip (e.g., Conibear-type) traps are designed to cause the quick death of the animal that activates the trap. The

size 330 Conibear trap is generally used for beaver are used exclusively in aquatic habitats, with placement depths varying from a few inches to several feet below the water surface (Figure D-3). Smaller Conibear traps, such as those used for muskrats, can be set either in or out of the water (Figure D-4). Placement is in travel ways or at lodge or burrow entrances created or used by the target species with the animal captured as it travels through the trap and activates the triggering mechanism. Safety hazards and risks to humans are usually related to setting, placing, checking, or removing the traps. Body-grip traps present a minor risk to non-target animals because of the placement in aquatic habitats and below the water surface.

Colony Traps are multi-catch traps used to either live- capture or capture and quickly drown muskrats. There are various types of colony traps. One common type of colony trap consists of a cylindrical tube of wire mesh with a one-way door on each end (Novak 1987b). The traps are set at the entrance to muskrat burrows or placed in muskrat travel lanes. Colony traps are effective and relatively inexpensive and easy to construct (Miller 1994). The stovepipe trap, a common type of colony trap, is usually made with sheet metal and may capture two to four muskrats on the first night (Miller 1994).

CHEMICAL MANAGEMENT METHODS:

All chemicals used by Virginia WS are registered under FIFRA and administered by the EPA and the VDACS. All WS personnel in Virginia are certified as restricted-use pesticide applicators by the VDACS. No chemicals are used on public or private lands without authorization from the land management agency or property owner/manager. The chemical methods used and/or currently authorized for use in Virginia are:

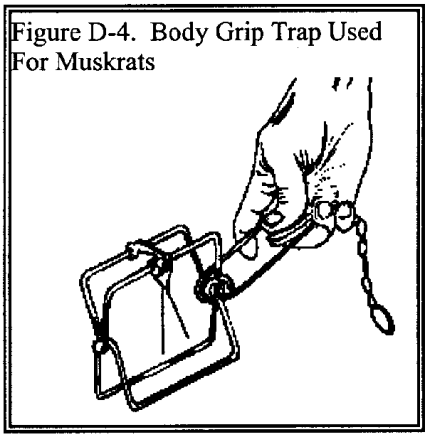


Figure D-4. Body Grip Trap Used For Muskrats

Zinc Phosphide - The toxicant registered in Virginia for use in muskrat damage management is zinc phosphide. No toxicants are registered for use on beaver. The use of zinc phosphide on various types of fruit, vegetable or cereal baits (apples, carrots, sweet potatoes, oats, barley) has proven to be effective at suppressing a local population. All chemicals used by WS are registered under FIFRA and administered by EPA and VDACS. Zinc phosphide is federally registered by APHIS-WS. Specific bait applications are designed to minimize non-target hazards (Evans 1970). Zinc phosphide presents minimal secondary hazard to predators and scavengers. Zinc phosphide is an emetic, so meat-eating animals such as mink, dogs, cats and raptors regurgitate animals that are killed with zinc phosphide with little or no effect. No T&E species occurring in Virginia would be affected by use of this formulated product. However, WS would consult with the USFWS on a case by case basis prior to using zinc phosphide in Virginia. WS and the USFWS would evaluate the location, potential non-target species, method of application, application rate, and potential concentration rate in the environment prior to determining whether federally listed or proposed T&E species may be affected (K. Mayne, USFWS, letter to M. Lowney, WS, November 29, 1999). WS personnel that use chemical methods are certified as pesticide applicators by VDACS and are required to adhere to all certification requirements set forth in FIFRA and the Virginia pesticide control laws and regulations. No chemicals are used on federal or private lands without authorization from the land management agency or property owner/manager. A quantitative risk assessment evaluating potential impacts of WS's use of chemical methods when used according to the label concluded that no adverse effects are expected from the above (USDA 1997, Appendix P).

THE FOLLOWING METHODS WERE ALSO CONSIDERED BUT ARE NOT AVAILABLE AT PRESENT:

Reproduction control - This method involves the use of chemicals or surgical procedures to inhibit reproduction of beaver and muskrats and reduce populations levels. Chemical sterilants can be classified into one of three types: chemosterilants, immunocontraceptives, and temporary, short term contraceptives. Chemosterilants have been

suggested as a means to managing beaver populations (Davis 1961, Arner 1964). Several reproductive inhibitors have been proposed for use in beaver population reduction, including quinestrol (17-alpha-ethynyl-estradiol - 3-cyclopentylether) and mestranol (Gordon and Arner 1976, Wesley 1978). While chemosterilants have been shown to reduce beaver reproduction in controlled experiments, there are no practical, effective methods for distributing chemosterilants in a consistent way to wild, free ranging beaver populations (Hill et al. 1977, Wesley 1978). There are no chemical reproductive inhibitors currently registered to use for beaver or muskrat damage management in the United States.

As with chemical repellents and toxicants, a reproduction inhibitor could potentially affect non-target wildlife and the environment. Any material would have to be intensively tested and approved for use. Inhibition of reproduction may also affect behavior, physiological mechanisms, and colony integrity (Brooks et al 1980). Additional research is needed before the environmental affects, and affects to populations and individual animals, from reproductive inhibitors are known. Should a technique or chemical become registered for use, it could be incorporated into the IWDM Program in Virginia.