

Introduction to Part 2 – Cross-Cutting & Policy Issues

A number of issues beyond the carcass disposal technologies themselves require appropriate consideration; in order to make sound decisions, decision-makers must balance the scientific, economic, and social issues at stake. Part 2 of this report therefore examines carcass disposal from the perspective of a host of cross-cutting issues: economic and costs considerations, historical documentation, regulatory issues and cooperation, public relations efforts, physical security of carcass disposal sites, evaluation of environmental impacts, geographic information systems (GIS) technology, decontamination of sites and carcasses, and transportation.

As this introduction sets forth, there are numerous issues that will impact large-scale carcass disposal decisions. For any policy designed to provide decision-making guidance, it is necessary to identify the numerous factors that must be considered. Historical documentation of events related to large-scale carcass disposal will prove invaluable to decision-makers facing this dilemma. The selection of the appropriate technology must incorporate the scientific basis for the technology along with the associated needs of security, transportation, location, and decontamination. An understanding of the regulatory factors, the importance of agencies and other entities to work together, and the consideration of public opinion are all key to successfully handling a carcass disposal emergency. Decision-makers must understand the associated economic costs as well as the environmental and societal impacts.

To convey the relevance of these cross-cutting issues, this introduction considers four episodes of historical carcass disposal experience, and then extracts from these episodes preliminary lessons regarding each cross-cutting issue. Subsequent chapters (chapters 9–17) follow and, issue-by-issue, provide more analysis.

Historical Experience

United Kingdom – foot and mouth disease

In 2001, the United Kingdom (UK) experienced an outbreak of foot and mouth disease (FMD), which has, to date, provided the best “lesson in history” on large-scale carcass disposal. The UK government faced the challenge of disposing of a large number of carcasses with limited disposal resources in a tight time frame. In June 2002, the National Audit Office (NAO) published a summary on the 2001 outbreak of FMD. The NAO report summarizes the governmental issues related to the disease outbreak, including carcass disposal. The 2001 epidemic lasted 32 weeks, impacted 44 counties, invaded over 2,000 premises, and impacted the sheep, swine, and cattle industries. During the height of the outbreak, an average of 100,000 animals were slaughtered and disposed of each day in a large and complex operation. In total, more than six million animals were slaughtered over the course of the outbreak for both disease-control and welfare reasons (NAO, 2002; Cumbria Foot and Mouth Disease Inquiry Panel, 2002). In the areas where less infection occurred, authorities were able to keep up with the disposal needs. However, in the worst-hit areas, there were long delays in the slaughter and disposal of infected and exposed animals. The existing contingency plan simply did not allow for sufficient handling of a situation of that scale (NAO, 2002; Hickman & Hughes, 2002).

In the UK, the Department for Environment, Food and Rural Affairs (DEFRA, formerly the Ministry of Agriculture, Fisheries and Foods) maintained lead responsibility for the FMD outbreak and disposal of all animals. DEFRA’s organizational structure in regards to Animal Health is comprised of a policy-making wing and an operational wing, the State Veterinary Service. A variety of other departments and agencies also participated in managing the outbreak and producers, contractors, and other

stakeholders assisted as well (NAO, 2002; Cumbria Foot and Mouth Disease Inquiry Panel, 2002).

DEFRA's veterinary officers initially directed the disposal operations. About a month after the outbreak was detected, it was determined that the State Veterinary Service could not handle all aspects of the epidemic and additional organizational structures were created. Broadening the cooperative structure gave state veterinarians more time for veterinary work, especially for slaughter and disposal management. Increasing the role of other agencies and departments took time, but other government entities, local agencies, voluntary organizations, and other stakeholders made critical contributions to stopping the spread of FMD. The military was not immediately involved but within a month began to play a key role in the slaughter, transportation, and disposal of animals (NAO, 2002).

Timely slaughter is critical to disease control. While rapid disposal of infected and exposed carcasses may not be crucial in controlling the spread of some diseases, it can be if it holds up the slaughter process (NAO, 2002).

The magnitude of the FMD epidemic made carcass disposal a serious problem. In addition, the massive scale of disposal required by destroying livestock on both infected and "exposed" farms led to problems in disease control, communication, and public perception (Cumbria Foot and Mouth Disease Inquiry Panel, 2002). By mid-April, a backlog of 200,000 carcasses awaiting disposal existed. During the first seven weeks of the epidemic, it was commonplace for dead animals to remain on the ground awaiting disposal for four days or more. The scale of the epidemic combined with resource shortages in both animal health officers and leak-proof transport for off-farm disposal contributed to the problem. The risk of disease spread resulting from off-farm disposal and the need for "robust biosecurity protocols" to minimize virus spread during transport and subsequent disposal was of major concern. The shortage of environmentally suitable and safe disposal sites also led to the delay (NAO, 2002; Hickman & Hughes, 2002).

The legal and environmental framework for disposal of carcasses and animal by-products had changed significantly since the UK's previous outbreak in

1967–68. Plans recognized that disposal methods needed to meet these environmental constraints and be acceptable to the UK Environment Agency and local authorities. Slaughter at a location close to the infected premises was critical to slowing the spread of the disease. At that time, on-farm burial was initially considered the preferred method followed by on-farm burning. However, on-farm disposal proved to be impractical because of environmental constraints and high water tables. In mid-March 2001, the Environment Agency began conducting rapid (within 3 hours) groundwater site assessments and advised on appropriate disposal. The Environment Agency also approved a disposal hierarchy for different species and age of stock. In addition, the Department of Public Health issued guides on how the risks to public health could be minimized. The stakeholders then agreed on a disposal hierarchy that attempted to protect public health, safeguard the environment and ensure FMD disease control. Cost was a material but much less important factor. This new focus on environment and public health was substantially different from the initial approach based on animal health risks and logistics (NAO, 2002; Hickman & Hughes, 2002).

Rendering and fixed-facility incineration were preferred, but the necessary resources were not immediately available and UK officials soon learned that the capacity would only cover a portion of the disposal needs. Disposal in commercial landfills was seen as the next best environmental solution, but legal, commercial, and local community problems limited landfill use. With these limitations in mind, pyre burning was the actual initial method used but was subsequently discontinued following increasing public, scientific, and political concerns. Mass burial and on-farm burial were last on the preferred method list due to the complicating matter of bovine spongiform encephalopathy (BSE) and the risk posed to groundwater (Hickman & Hughes, 2002). The hierarchy and case-specific circumstances determined the methods utilized. Decisions were impacted by the availability of nearby rendering capacity, the relative risks of transporting carcasses, and suitability of sites for burial and burning. Even with the new hierarchy in place, burial and burning remained common choices because of the need to slaughter expeditiously and limit transportation of carcasses. Overall, burning was the most common

method of carcass disposal (29%), followed by rendering (28%), landfill (22%) and burial (18%) (NAO, 2002; Cumbria Foot and Mouth Disease Inquiry Panel, 2002).

TABLE 1. UK 2001 FMD outbreak – approved disposal routes for different species and age of stock (NAO, 2002).

Preferred Method of Disposal	Permitted Animals
Rendering	All
High-temperature Incineration	All
Landfill, on approved sites	Sheep, pigs of any age & cattle younger than 5 (due to BSE concerns)
Burning	All (with a limit of 1,000 cattle per pyre)
Mass Burial or approved on-farm Burial	Sheep, pigs of any age & cattle younger than 5 (due to BSE concerns)

Huge logistical problems developed in the disposal of millions of slaughtered animals. DEFRA cited problems with all disposal methods. Rendering was unavailable until rendering plants complied with necessary biosecurity protocols and transportation vehicles were adequately sealed. In March 2001, protocols for biosecurity of rendering plants and vehicles were approved. However, until late in the epidemic, the rendering plants could not handle the necessary capacity. High-temperature incineration was also difficult to utilize because the facilities were committed to the disposal of BSE-affected cattle. Air-curtain incinerators were used on occasion. Landfill operators and local communities were resistant to the use of landfills for disposal because they were often located near large population centers. While 111 suitable facilities were identified, only 29 were utilized. Over 950 locations were used for burning with most located on-farms. However, the use of mass pyres generated a negative response from the media and devastated the tourism industry. These mass burnings ended in two months because of public opposition. Mass burial was the selected alternative when carcasses began to pile up. However, public protests and technical problems—

such as seepage of carcass liquid—resulted when 1.3 million carcasses were disposed of in mass burial sites. Regardless of public concerns, the efforts of DEFRA, the Environment Agency, the military, and others helped eliminate the backlog of carcasses (NAO, 2002).

Carcass disposal was a highly controversial issue. Public backlash, especially in response to burning and mass burial, was significant and long-term economic impacts remain in question. DEFRA's Contingency Plan for future FMD outbreaks is to use commercial incineration for the first few cases, followed by rendering and then commercial landfills. The plan would include agreements ensuring minimum rendering capacity and use of national landfill sites. DEFRA also stated that it is unlikely that pyre burning or mass burial would be used again (NAO, 2002). Burning of carcasses on open pyres was an enormous task requiring substantial materials and generating significant amounts of ash for disposal. These pyres were viewed unfavorably by local residents and producers. The images of burning carcasses were broadcast via television around the world and likely contributed to the wider economic damage, especially to the tourism industry. Local residents disliked mass burial as well. The general public reacted most positively to the rendering alternative (Rossides, 2002). At the beginning of the outbreak, the priority was to eradicate the disease. While the Department realized cost control was important, it was also clear that all steps to stop the disease needed to be taken regardless of expense (Hickman & Hughes, 2002).

NAO offered multiple recommendations for future contingency plans. One example of their recommendations is to develop a clear chain of command with defined responsibilities, roles, reporting lines, and accountabilities. They also recommended researching the effectiveness and efficiency of disposal methods of slaughtered animals and continually inspecting and monitoring the environmental impacts of disposal sites (NAO, 2002).

In response to the Government-commissioned inquiries, the UK Government notes the need for multiple strategies for different disease situations. The Government is committed to reviewing preventive culling and vaccination policies. The Government also noted that the disposal hierarchy in

its current contingency plan differs from the hierarchy agreed upon during the actual FMD outbreak by the Environment Agency and Department of Health. The new plan states that first preference will be commercial incineration followed by rendering and disposal in licensed landfills. Mass burn pyres are not advised and on-farm burial will only be used if demand exceeds capacity of the preferred options (Anonymous, 2002).

Further review of the environmental impact by the Environment Agency found 212 reported water pollution incidents, mostly minor, and only 24% were related to carcass disposal. None of the pollution problems were on-going problems in private or public water supplies. Additional monitoring has not shown any ongoing air quality deterioration, and concentrations of dioxins in soil samples near pyres are the same as before the outbreak (UK Environment Agency, 2002).

Taiwan – foot and mouth disease

In 1997, Taiwan experienced an outbreak of FMD that resulted in slaughter and disposal of about five million animals. Carcass disposal methods included burying, rendering, and incineration/burning. With the disposal choice very dependent on farm locations, burial in landfills (80% of carcasses) was the most common method. Swine producers were allowed to send hogs to nearby rendering plants. High water tables and complex environmental regulations complicated disposal. In areas where water resources were endangered, incineration (with portable incinerators or open burning) was the only approved method. Army personnel completed the majority of the disposal work. At the peak of the crisis, disposal capacity reached 200,000 pigs per day. The eradication campaign lagged well behind the identification of potential FMD cases, causing many farms to wait from one to four weeks before animals could be slaughtered. The delay was blamed on lack of manpower and equipment, and large-scale death loss experience combined with the difficulty of disposal. The manpower shortage was alleviated with military assistance. The disposal method selected was dependent on the availability of landfill sites, level of the water table, proximity to residences, availability of equipment and other environmental factors. Major issues related to

carcass disposal included the number of animals involved, biosecurity concerns over movement of infected and exposed animals, people and equipment, environmental concerns, and extreme psychological distress and anxiety felt by emergency workers (Ekboir, 1999; Ellis, 2001; Yang et al., 1999).

United States – natural disasters

Two natural disasters, floods in Texas in 1998 and Hurricane Floyd in North Carolina in 1999, have provided similar yet smaller-scale carcass disposal experience. Dr. Dee Ellis of the Texas Animal Health Commission reviewed these two disasters, collected data, and performed numerous personal interviews (Ellis, 2001). His findings are summarized below.

In October 1998, torrential rains in south central Texas resulted in the flooding of the San Marcos, Guadalupe, San Antonio, and Colorado River Basins. Over 23,000 cattle were drowned or lost in addition to hundreds of swine, sheep, and horses. The Texas Animal Health Commission (TAHC) worked with state emergency personnel from the Governor's Division of Emergency Management, the Texas Department of Transportation, and the Texas Forest Service to manage the disposal of animal carcasses. Local emergency response personnel played integral roles in the actual disposal process. Most animal carcasses were buried (where found if possible) or burned in air-curtain incinerators. Two air-curtain incinerators were utilized. One difficulty that arose was finding a burn site that was not located on saturated ground. Some carcasses were inaccessible and began to decompose before actual disposal could take place. According to Ellis, the main carcass disposal issues were (1) lack of prior delineation or responsibilities between agencies, (2) non-existent carcass disposal plans and pre-selected disposal sites, (3) a short window of time to complete disposal, (4) minimal pre-disaster involvement between animal health and local emergency officials, and (5) inaccessibility of some carcasses (Ellis, 2001).

In September 1999, Hurricane Floyd devastated North Carolina. The hurricane, combined with prior heavy rains, resulted in the worst floods in state history. Animal loss was estimated at 28,000 swine, 2.8 million poultry, and 600 cattle. Disposal of dead

animals was coordinated by the North Carolina Department of Agriculture. Costs were partially subsidized at a cost of \$5 million by the USDA's Emergency Watershed Protection program. The North Carolina State Veterinarian coordinated disposal to ensure safety for both human health and the environment. Major problems related to carcass disposal included contamination of drinking water sources, fly control, odor control, zoonotic disease introduction, and removal and transport of carcasses. These problems were compounded in the cases of highly concentrated swine and poultry losses on heavily flooded property. The order of preference for disposal in North Carolina is rendering, burial, composting, and incineration. However, rendering capacity was so limited that it was not a viable option. Burial was the most widely used option and was utilized for 80% of the swine, 99% of the poultry, and 35% of the cattle. Incineration was used for the remainder of the carcasses. Most burial took place on the land of the livestock producers. They were offered a financial incentive to bury on their own land in order to minimize transport of carcasses. However, this process led to additional environmental concerns as producers often buried carcasses in saturated ground that allowed carcass runoff to leach back into ground water or local water resources. This threat caught the attention of both environmental watch groups and the national media, resulting in a study group that created a multi-agency approach and animal burial guidelines for future use. Ellis noted the major issues in North Carolina to be (1) high number of dead swine located near populated areas, (2) environmental threats to groundwater and water resources, (3) interagency jurisdictional conflicts, (4) lack of well-developed carcass disposal plans, and (5) minimal involvement of animal health officials with the state emergency management system (Ellis, 2001).

United States – chronic wasting disease

In February 2002, chronic wasting disease (CWD) was identified in whitetail deer in southwest Wisconsin. CWD is a transmissible spongiform encephalopathy (TSE). In order to control the disease, a 360-square-mile disease eradication zone and surrounding management zone were developed. All deer within the eradication zone were designated

for elimination, and deer in the surrounding area were designated to be reduced. Many of the deer were destroyed by citizen-hunters, who were not permitted to use the deer for venison. Disposal methods were selected that do not endanger animal or human health or environmental quality. Selected methods had to be able to handle a large number of carcasses and comply with regulations. Cost was also a consideration, and it is anticipated that disposal costs will be one of the most significant expenses of the CWD control program. The four preferred methods used were landfilling, rendering, incineration, and chemical digestion (alkaline hydrolysis) (Wisconsin Department of Natural Resources, 2002).

Lessons Learned Regarding Cross-Cutting and Policy Issues

The historical experiences related to large-scale carcass disposal have provided “lessons” from which the livestock industry and regulatory agencies can learn. Many of these lessons are discussed in terms of the cross-cutting and policy issues addressed in subsequent chapters:

- **Economic & Cost Considerations.** Any large-scale animal death loss will present significant economic costs. The disposal of large numbers of carcasses will be expensive and fixed and variable costs will vary with the choice of disposal method. In addition, each method used will result in indirect costs on the environment, local economies, producers, and the livestock industry. Decision-makers need to better understand the economic impact of various disposal technologies. Broader policy considerations involving carcass disposal and a large-scale animal disaster need to be identified and discussed as well. Chapter 9 discusses these issues.
- **Historical Documentation.** An important resource for the development of a carcass disposal plan is historical documentation from previous large-scale animal death losses. However, serious deficiencies exist in historical documentation of past events and significant variances occur among agencies relative to

planning, experience, and preparation for a catastrophic event. Chapter 10 examines the state of historical documentation of past carcass disposal events within the United States and explores the potential for developing a Historic Incidents Database and Archive (HIDA).

- **Regulatory Issues and Cooperation.** Previous experiences dictate that strong interagency relations and communications are critical to effectively dealing with a large-scale animal disaster. Federal, state, and county regulations related to carcass disposal may be unclear or perhaps in conflict with one another. Interagency issues may result in additional problems or the extension of the disaster. Steps must be taken to identify interagency relationship problems and develop a plan for dealing with large-scale carcass disposal. Chapter 11 identifies opportunities for agency coordination and plan development.
- **Public Relations Efforts.** A disaster-related animal death loss will cause significant public concern. Historical experience shows that the disposal of carcasses creates public dismay and apprehension. To facilitate positive public perception, decision-makers handling massive livestock mortality and carcass disposal must have access to expert public-information professionals and agree to make communicating with the public a top priority. Chapter 12 provides guidance to public information professionals, subject matter experts, and disposal managers to understand the role and importance of communicating with the public about large-scale carcass disposal.
- **Physical Security of Carcass Disposal Sites.** History suggests a need for security systems during carcass disposal operations. Examples of security threats related to carcass disposal include potential equipment theft, angry and discontented livestock owners and citizens, and unintentional animal or human activity. The most important aspect of security is keeping the disease from spreading from the site to other areas. A well-designed security system would control these issues. Chapter 13 identifies potential threats, security technology, and potential security designs.

- **Evaluating Environmental Impacts.** Carcass disposal events can result in detrimental effects on the environment. The specific impacts vary by carcass disposal technology, site specific properties of the location, weather, the type and number of carcasses, and other factors. To accurately determine the impacts of a specific carcass disposal event on the environment, environmental monitoring will be necessary. Chapter 14 provides an overview of monitoring that may be necessary or desirable to quantify environmental impacts for a carcass disposal event, and introduces models that may be useful in this regard.

- **Geographic Information Systems (GIS) Technology.** GIS technology should play a significant role in the management of mapped or spatial data prior to, during, and after carcass disposal events. At the simplest level, GIS can provide maps while, at the more complex level, can serve as a decision support capability. Chapter 15 contains an overview of GIS and how it has been used in recent livestock disease and carcass disposal efforts.

- **Decontamination of Sites & Carcasses.** Regardless of the carcass disposal method utilized, concern must be given to contain the disease and limit any potential disease spread. Decontamination will prove to be vital in this endeavor. The first, and most important, step in the process of decontamination is the identification of the disease agent present and assessment of the situation. Those involved must understand how the causative agent works and exactly how it spreads. Chapter 16 identifies various infectious agents, groups of disinfectants, and decontamination procedures.

- **Transportation.** The disposal of carcasses following a large-animal disease event will likely require transportation to an off-site disposal location. The transportation of large numbers of diseased animals or carcasses requires significant planning and preparation in order to prevent further dissemination of the disease. Chapter 17 focuses on critical issues related to transportation during a carcass-disposal event.

Chapters 9–17 serve as an overview of these cross-cutting and policy issues by highlighting critical

information, summarizing available background material, offering recommendations to decision-makers, and identifying critical research needs.

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