

**"Carcass Disposal Issues in Recent Disasters,  
Accepted Methods,  
and  
Suggested Plan to Mitigate Future Events"**

By

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## **ABSTRACT**

### **"Carcass Disposal Issues in Recent Disasters, Accepted Methods, and Suggested Plan to Mitigate Future Events"**

The disposal of dead animals as a result of recent natural disaster events such as Hurricane Floyd in North Carolina (1999), and disease related events such as the Foot and Mouth Disease (FMD) outbreak in the United Kingdom (UK, 2001), created tremendous logistical problems. The difficulties encountered by officials involved in carcass disposal management during recent disaster events have highlighted the need for the establishment of efficient and effective advance planning mechanisms, to mitigate the consequences of future carcass disposal situations. Before problems can be solved however, they must be identified and understood. This paper utilizes numerous methods of study to identify and examine the problems that routinely occur related to carcass disposal management during disasters, including:

1. Literature review of the United States' emergency management infrastructure, carcass disposal methods, and existing state disaster plans and documents.
2. Document review and archive analysis from four recent disaster events that generated large numbers of dead animals, to identify the major problems encountered.
3. Participant observation and direct participation by the author in the Texas Flood of 1998, and the Foot and Mouth disease outbreak in the United Kingdom in 2001.
4. Structured interviews (uniform questionnaire) with state employees currently involved in emergency management activities and planning from North Carolina, Florida, California, and Texas. Officials from four different agency types identified as crucial

to effective carcass disposal management (animal health, emergency management, environmental, and contract services) were interviewed, to assess their current planning status, understanding of disposal issues, and ability to manage future events.

5. Open ended interviews completed with various participants from the disaster events covered, and with state officials active in carcass disposal management or planning.

Working hypotheses are used as an exploratory type of inquiry to identify the pertinent issues surrounding carcass disposal within the public sector emergency management infrastructure. An overview of currently accepted carcass disposal methods is also provided, to give a better understanding of the options available for individuals with a limited background in animal health or environmental science.

As a result of identifying common carcass disposal problems, delineating appropriate disposal methods, and assimilating interview results from public managers involved in recent carcass disposal activities, an ideal plan is suggested to organize and enhance existing state and local preparedness efforts. Major components of the plan include, 1) inclusion of animal health issues in future emergency management plans and training, 2) use of interagency working groups to enhance communication, identify pre-existing jurisdictional conflicts, and delineate funding mechanisms, 3) inclusion of local officials and industry groups in all planning processes, and 4) determination of lead agencies for carcass disposal response activities and resource database management.



## **CHAPTER 1**

### **INTRODUCTION**

Recent natural disasters such as Hurricane Floyd in North Carolina in 1999, and the Texas floods of 1998 caused the deaths of thousands of swine and cattle, and millions of poultry during and after the events (NCSART, Guidelines for Emergency, 1999, p. 1, & TAHC, Appendix B, 1998). Emergency management officials who possessed limited animal health experience, and animal health officials with limited emergency management experience were tasked to solve enormous logistical and environmental problems in disposing of the associated animal carcasses. Animal disease-related disasters such as Foot and Mouth Disease (FMD) outbreaks in Taiwan in 1997, and in the United Kingdom (UK) in 2001 generated millions of dead swine, sheep, and cattle carcasses to be disposed of in a biosecure and time-sensitive manner (Wilson and Tsuzynski, USAHA 1997, p. 15, & DEFRA, 2001, p. 1).

Animal carcass disposal issues can create some of the greatest logistical and health related problems in managing large-scale animal disaster events. For those reasons, both natural and disease related disaster planners have now begun to recognize the need for an integrated emergency response plan, that includes both animal health and emergency management components within it (NAHEM, Strategic Plan, 2000, p. 7). An integrated approach relies on all organizations and agencies having an understanding of their roles and those of other organizations with which they may need to work (WICEN, Millican, p. 1)

Even though the events noted above were considered unusual in scope and occurrence, it is conceivable that they could be repeated again in the US at any time. Agroterrorism seems much more likely today, as the events of September 11 have proven that terroristic activities can be launched successfully on American soil. Although the intentional introduction of a foreign animal disease agent such as the Foot and Mouth disease virus does not get the media attention of other threats that might cause widespread human destruction, such an agent would be easy to acquire, pose no health threat to the terrorist themselves, and cause devastating animal death losses and economic havoc<sup>1</sup> to the American livestock industries if introduced.

Whether the introduction of a highly infectious foreign animal disease agent is accidental or intentional, current industry and public sector prevention and mitigation efforts would not be able to protect the American public from significant adverse consequences. The economic impact of the FMD outbreak in the United Kingdom is currently estimated at 4.1 billion pounds, or .5% of the UK's Gross Domestic Product for 2001 (BBC News, FMD report, 2001, p.1). Biosecure animal carcass disposal procedures are an integral part in preventing further spread of certain diseases, which subsequently will help minimize the established adverse economic impact from such occurrences.

Natural disasters such as hurricanes or floods are infrequent but normal meteorological occurrences, and must be planned for as well in any responsible emergency management infrastructure. Public expectations for timely disposal of animal carcasses also dictate that proper plans must be in place prior to any meteorological event (USDA, READEO Disposal, 2-2-1, 2001).

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<sup>1</sup> Initial estimates by TAHC authorities estimate that the government costs for response activities needed to contain FMD would be approximately 4 billion dollars. This doesn't include affiliated industry losses.

The current emergency or disaster response infrastructure for the United States (US) begins with the local community, and subsequently leads to state level involvement when local resources are exceeded (FEMA, p. A-1-1, 1998). Although emergency managers in recent events have routinely encountered carcass disposal issues, a systemic approach to deal with those issues has not been delineated to guide officials in addressing the myriad of problems that must be solved. The existing non-uniform approaches among states, or the seemingly "flying by the seat of their pants" responses by emergency managers when dealing with large scale animal deaths, is why it is necessary to create a consistent planning mechanism for animal carcass management in disasters. The intent of this paper is to take the first step in bridging this missing link in emergency management, by suggesting a plan to fully integrate animal health and environmental solutions into the current emergency management planning and response systems at the state and local level.

Historically, animal health officials have not been officially included within existing government affiliated emergency management organizations. As recently as 1999 during the Hurricane Floyd response in North Carolina, the various groups that supervised animal issues for the state were not officially part of the emergency management process (Hudson, et al., JAVMA, 2001, p. 355). Texas' animal health agency, the Texas Animal Health Commission (TAHC) was not formally included in its state emergency management system until March of 2001. Proper disposal plans for animals within an emergency management system must include considerations for the type of event generating the deaths, environmental and regulatory factors which could complicate disposal efforts, logistical issues (size and scope), cost, disease biosecurity

concerns, and public perception, (USDA READEO, Disposal, 1a-p.4, 1998). These issues must be planned for in advance, with input from experts possessing the most knowledge for addressing and solving the specific concerns at hand.

Disposal plans should be integrated vertically to include national, state, and local emergency responders, and horizontally to include scientific proficiency from each of the professionals (and their respective state/federal agencies) that will have roles in animal carcass disposal issues. The minimum recommended areas of state level professional involvement for animal carcass disposal planning are animal health, environmental, contract services (similar to debris removal process), and emergency management professionals. Inter-agency coordination will be the key to any successful emergency response effort (Drabek, 1995), and close working relationships developed in advance by the aforementioned groups will greatly facilitate appropriate responses during and after disasters.

## **PURPOSE**

The purpose of this paper is four fold. First, analysis of carcass disposal issues from recent natural disasters (Hurricane Floyd 1999, Texas Flood 1998) and disease related disasters (Taiwan 1997, United Kingdom 2001) would be presented to highlight the problems that developed from catastrophic animal losses. Direct observation of disaster response efforts in the UK in parts of May/June of 2001 by the author, on-site interviews with involved British officials during that time, and interviews with American veterinarians who have returned from helping in the UK during 2001 provide unique insight into the carcass disposal issues encountered there. Interviews and firsthand

accounts from veterinarians and emergency response officials involved with both Hurricane Floyd and the Texas flood will also be utilized, to reinforce issues that are also disclosed in a literature review of the same events.

Second, each of the major carcass disposal techniques are examined, with their strengths and weaknesses discussed. Third, four states currently proactive in emergency planning will be evaluated, to analyze their current state and local infrastructure in relation to animal carcass disposal plans and procedures from environmental, animal health, contract services, and emergency management agency perspectives. The states of Texas, and California are included because they have recently developed comprehensive animal disease state response plans. The states of North Carolina and Florida are evaluated because they have completed extensive planning and preparation for animal issues (including carcass disposal) in natural disasters, as a result of recent hurricane activity in their states. The level of local community (county) involvement in animal carcass disposal planning for those states will be evaluated as well through the structured interview process.

Finally, an (ideal) integrated state agency level emergency management planning mechanism intended to mitigate future animal carcass disposal issues during disasters is presented. The plan is developed as a result of the lessons learned from recent large scale disaster events, knowledge of existing animal carcass disposal methods, and the results of structured interviews with representatives from each of the states mentioned. The similarity of the problems encountered is compelling evidence that changes need to be made in the current emergency management approach to carcass disposal. The suggested integration of state agency planning procedures, is the necessary first step for states that

wish to increase their readiness to handle catastrophic carcass disposal events in the future.

This paper begins in the next chapter by analyzing the carcass disposal implications in recent disasters. It then proceeds through exploration of currently acceptable disposal methods, analysis of considerations routinely encountered when trying to select the appropriate methods of disposal, and a brief overview of the emergency management system within the United States. Finally, the structured interview results are explained, which leads to the presentation of the suggested carcass disposal management plan, as well as a suggested hierarchy of factors that emergency managers can consider when choosing the appropriate disposal method for their situation, whether it be a small scale or catastrophic disaster situation.

## **CHAPTER 2**

### **Carcass Disposal Implications in Recent Disasters**

This chapter examines two natural disaster events that generated animal carcass disposal problems in Texas (1998) and North Carolina (1999), and two studies of animal disease related events that produced high animal mortalities in Taiwan (1997) and the United Kingdom (2001). Similarities in the lack of animal health official's involvement with existing emergency management response plans, and the types of issues that challenged the emergency response efforts are explored. The identified inadequacies in the response efforts relating to carcass disposal from the disasters reviewed are utilized to help develop the proposed ideal plan for future management of carcass disposal.

#### **NATURAL DISASTERS**

##### **TEXAS FLOOD (1998)**

In South-central Texas during the night of October 17 and the early morning of October 18, 1998, torrential rains inundated the San Marcos, Guadalupe, San Antonio, and Colorado River basins. According to news reports, " More than two feet of rain fell in some areas, and by early Saturday (10/18) afternoon, a massive surge of water was transforming the normally tranquil Guadalupe River into a monstrous wall of water that was cutting a path through forests and neighborhoods alike." (Disaster Relief, web report, 10/22/98, p. 1) The late night timing of the rainfall made it impossible for farmers and ranchers to rescue livestock they owned on flood prone river property in the upper river basins, before the flood waters rose to dangerous levels.

As the flood continued to spread through the lower river basins, fences were flattened by the floodwaters, freeing thousands of animals that clustered together on hilltops if possible. The Guadalupe River in Cuero crested at 50 feet, well over its 20-foot flood stage, swamping at least 3/4 of the town. In some places, the Guadalupe stretched six miles across. (Disaster Relief, 10/22/98, p. 1-2) By October 21, President Clinton had declared 20 Texas counties as federal disaster areas. On that same day, Joe Vela of Victoria scrambled onto the roof of his flooded home near the Guadalupe River to escape the rising water. He was quoted as saying, " You see a lot of things when you're sitting on a roof in a flood. I saw refrigerators go by, cars float by. Lots of animals. I saw sheep, cows, and hogs. I even saw a couple of trophy bucks swim by." Joe was finally rescued from his roof by boat later on that same day. (Disaster Relief, web news, p. 2-3, 10/25/98)

As a result of the flooding over 23,000 cattle were drowned or lost, along with hundreds of hogs, horses, and sheep (TAHC statistics, 1998, see Appendix B). Local disaster management coordinators were faced with dead cattle in trees, on the roadside, on resident's porches and garages, and one unlucky bovine was even caught in the city of Luling, Texas' water intake access in the San Marcos River. (TAHC, Allen interview, 1998) Because of the human health and aesthetic considerations, and the scope of destruction experienced by Texas livestock, animal health agencies such as the Texas Animal Health Commission (TAHC) were tasked for the first time with helping dispose of the thousands of animal carcasses.

The TAHC field staff worked along side state emergency personnel from such agencies as the Governor's Division of Emergency Management (DEM), the Texas Forest



Service, and the Texas Department of Transportation. Myriads of animal disaster issues were encountered such as identification and housing of stray livestock, capture and transportation of the same, as well as coordinating the disposal of the many large animal carcasses. Lower Colorado River Authority (LCRA - a pseudo-governmental agency) and local emergency response personnel played integral roles in coordinating the general debris removal and disposal process. Animal carcasses were generally considered as debris during the process, and were buried (where found if possible) or burned in air curtain incinerators along with other refuse. The laborious clean up process for animal carcasses took place over a two-week period in the 20 counties declared disaster areas (Wilson, TAHC internal report, 1998, & Ronsonette, 2001).



(Drowned cattle being buried in flooded orchard near Luling, Texas, Oct. '98)

There is only a short window of time for proper disposal of animal carcasses following their death. Within 7-10 days of death, dependent upon the outside ambient temperatures, animal carcasses become too decomposed to handle easily with disposal equipment such as front end loaders (TAHC Wilson and Allen interviews, 1998). This problem was compounded in the Texas flood by the fact that most of the drowned livestock were located in swamped areas that were too wet to be accessible initially other than by foot. For this reason, many cattle were left to decompose on the surface of the land. By the time they could be accessed to remove, their decomposed bodies were too fragile to handle. Fortunately, their inaccessibility minimized public awareness of the situation in certain flooded areas. (TAHC employee Allen interview, 1998)

In areas closer to towns or within public view, the decaying carcasses did not go completely unnoticed. The city of Cuero distributed lime to cover the carcasses of animals for those landowners that requested it. Two air curtain incinerators were used in the Texas flood response to burn the vast amounts of debris including animal carcasses. One was located in Victoria, and the second in Cuero. The LCRA was the lead agency in charge of the air curtain incineration and debris removal process. The saturated ground also posed problems in site selection where debris was to be burned. The saturated ground forced the burn site in Cuero to be moved 3 times before an acceptable dry location was found. By that time, all animal carcasses that could be retrieved in the Cuero area were hauled to Victoria for destruction. On October 29, 1998, the last dead animal was hauled out of Cuero to the incinerator in Victoria. The animal was a sheep that had washed into a resident's garage (S. Wilson, TAHC, 1998).

The main issues facing the emergency management officials working with animal carcass disposal issues in the flood included, 1) lack of pre-existing dialogue between state emergency response officials and the TAHC to delineate areas of responsibility in regard to animal issues, including identification of a lead agency, 2) poorly planned or non-existent carcass disposal plans, including site selection for both carcass collection and burn sites, 3) a very short window of time in which to remove and dispose of the carcasses themselves, 4) minimal pre-disaster involvement between TAHC employees and local emergency response officials, and 5) the inaccessibility of some carcasses before they decomposed (personal observation, S. Wilson 2001, and Allen 2001).

#### **HURRICANE FLOYD, NORTH CAROLINA (1999)**

Hurricane Floyd, a storm with sustained winds of 110 miles per hour, made landfall during the evening of September 16, 1999, near Cape Fear, North Carolina. The hurricane battered the Carolina's for much of the day prior to its landfall at Cape Fear with torrential rains. The flooding potential of the situation was exacerbated by prior rains, which had already saturated the ground in the area (Disaster Relief, 9/16/99, p. 1). Subsequently, the effects of the hurricane resulted in the most severe flooding and devastation in North Carolina history. The flooding caused an estimated \$813 million in agricultural losses alone. Estimates of drowned animals in the state exceeded 28,000 swine, 2,860, 000 poultry, and 600 cattle. (NCSART, 1999, p.1) Proper burial and disposal was essential to minimizing the public health risks (NCSUCE, 1999, p.1-2)) from the wide spread animal death.

The aftermath of the storm prompted then Secretary of Agriculture Dan Glickman to state, "Hurricane Floyd has produced one of the biggest agriculture-related environmental disasters we've ever seen in North Carolina" (FEMA News, 1999, p. 1). Disposal of dead animals was a significant problem, and the efforts were coordinated by the North Carolina Department of Agriculture, and subsidized in part through the USDA's Emergency Watershed Protection (EWP) Program at a cost of over 5 million dollars (FEMA News, 1999, p. 1). The EWP is administered by the USDA's Natural Resources Conservation Service, and was established to help communities repair environmental damage by bearing up to 75% of the costs (EWP facts, 2001, p. 1).

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are needed to see this picture.

Swine carcasses washing out of flooded barns, Hurricane Floyd aftermath, North Carolina, 1999

The disposal work was coordinated by the North Carolina State Veterinarian to ensure that all of the results were safe for human health and the environment. Secretary of Agriculture Glickman stressed the importance of this operation by stating that, " Water contamination caused by decomposing livestock carcasses poses one of the most immediate threats to public health, and we will do all we can to help communities and farmers eliminate this hazard as quickly as possible" (FEMA news, 1999, page 1).

Problems encountered in the carcass disposal efforts (see Appendix C) included contamination of drinking water sources, fly control, odor control from excessive hydrogen sulfide (H<sub>2</sub>S), possible zoonotic (animal to human) disease introduction such as Leptospirosis, Salmonellosis, or Tetanus, and simple removal of the carcasses to non-flooded disposal sites (NCSUCE, 1999, p. 1-2, see Appendix C). Those problems were especially prevalent in areas of concentrated swine and poultry operations located on flood prone property, that may have previously been deemed unsuitable for other purposes.



Contract clean-up worker with swine carcass, Hurricane Floyd aftermath, North Carolina, 1999

The first priority of animal health officials in the aftermath of the storm was the collection and disposal of dead livestock and poultry on farms where large numbers of drowned animals were concentrated, especially those located near towns (NCSU Floyd update, 1999, p. 6). Disposal options for the swine were burning, burial or rendering, and the poultry could also be composted under strict guidelines. The order of preference for disposal in North Carolina is rendering, burial, composting and incineration. Rendering

capacity during the aftermath was limited and thus not a viable option in most cases.

During the clean up, approximately 400 cattle (65% of total cattle dead), 5800 hogs (20% of dead), and 26,000 poultry (1% of dead) were incinerated. Many of these animals were deposited at local drop off sites established for collection, and they were then dispatched to remote incineration locations (Disaster Relief News, 9/22/99, p. 2). Most of the remaining animals disposed of were buried.

Burial was the method of choice for most affected livestock producers because the livestock owners<sup>2</sup> directly controlled the process if the animals were buried on their own land, and they were also offered a financial incentive to bury their dead animals. The producers could receive 2.4 cents per pound if they buried the dead animals on their property, and 3 cents per pound if the animals were buried on someone else's property (NCDA&CS News Release, 1999, p.1). This incentive for burial was meant to minimize transport of animal carcasses off site that could pose public health risks, and minimize fuel intensive burning operations, but it eventually created other environmental concerns. Producers were tempted to (or did) bury animals in grounds saturated with standing water, which could allow the carcass runoff to leach back into ground drinking water or local streams and tributaries (Tickle interview, 2001, & Dahlen interview, 2001).

It has been estimated that a decomposing cattle carcass can leak out as much as 80 liters of body fluids in the first week following death, and a grown hog could lose 6 liters of body fluid in the same time period (Munro, 2001, p. 5-6). The outcry from environmental watchdogs and the national media over fears the leachate from the burial of carcasses in flooded land areas would contaminate ground water supplies was

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<sup>2</sup> The livestock owner has primary responsibility for disposal of privately owned dead animals in North Carolina

inevitable. It quickly became evident that site selection and burial choice for animals drowned in the disaster elicited strong public opinion and emotions.



Swine carcasses prepared for burial, Hurricane Floyd aftermath, North Carolina, 1999.

As a result of the public health concerns surrounding the large numbers of dead livestock following Hurricane Floyd, a multi-agency study group in North Carolina was formed in 2000 to develop advance guidelines to ensure dead animals are buried quickly and safely in future incidents. The group consisted of state, federal and industry level animal health, environmental, and emergency management specialists. The group's findings centered on developing a multi-agency approach to clarifying in advance what are acceptable plans and guidelines for animal carcass disposal (NC Animal Burial Guidelines, 2000, p. 1).

Dr. Tom McGinn, Assistant State Veterinarian for North Carolina and group member was quoted during the process, "In an emergency, a farm animal owner trying to

act quickly doesn't have the luxury of talking to all the different agencies that have jurisdiction or expertise related to dead animal disposal. This multi-agency approach is an example of how many agencies can work together... while providing the necessary guidance to safely ... respond to animal emergencies" (NCSART News Release, 2000, p. 2). Dr. Edwin Jones, administrator with the North Carolina Cooperative Extension service, and a member of the study group noted, " We lost time during Floyd making sure we knew of all the various guidelines that need to be adhered to. By developing guidelines in advance of any event, we can save animal owners time and money by ensuring they know how and where they can conduct animal burials" (NCSART News Release, 2000, p. 1).

Dr. Oscar Fletcher, Dean of North Carolina State College of Veterinary Medicine explained, "Floyd brought out the importance of animals... in an emergency situation, We need to have these guidelines in place well in advance of an emergency" (NCSART News release, 2000, p. 1). Because of the efforts of this group and the lessons learned from the aftermath of Hurricane Floyd, North Carolina state animal health officials and its livestock industry took the first step in becoming better prepared for future disasters, by developing structured animal disposal guidelines at the farm, county, and state levels (NCSART, 2000, p. 1-4).

Hurricane Floyd followed in the footsteps of the floods in Texas as a natural disaster in the United States with significant impact on domestic livestock populations. The major carcass disposal issues during Hurricane Floyd included 1) high number of dead swine in close proximity to populated areas 2) potential environmental contamination by carcasses and flooded lagoons to groundwater and river basins, 3) inter-



agency jurisdictional conflicts, 4) lack of well developed plans for carcass disposal, and 5) minimal prior involvement of animal health officials in the state emergency management system.

In both Hurricane Floyd and the Texas flood, state animal health agencies were tasked with major roles in emergency response efforts. The extensive involvement of those agencies in the emergency management response and recovery responsibilities for the two disasters raised the awareness of the need for their continued involvement in future situations and planning. The benefits of including animal health experts in helping develop plans for future issues surrounding animals (dead or alive) is obvious, as state employed veterinarians and their staff deal with animal health, management, and welfare issues on a routine basis.

## **ANIMAL DISEASE DISASTERS**

### **TAIWAN FOOT AND MOUTH DISEASE (1997)**

On March 14, 1997 near the port city of Hsinchu in Taiwan, a hog farmer noticed that one of his sows had vesicles (blisters) on her nose and mouth, and reported the incident to the local veterinary authorities. As a result of that report, Foot and Mouth Disease (FMD) was diagnosed in Taiwan for the first time since 1929. FMD is a highly infectious viral infection of cattle, pigs, sheep, goats, and all species of deer (not man). Vesicles form on the tongue, feet, and teats of affected animals, and once they rupture can cause severe discomfort, lameness, and secondary infections (Merck, 1998, p.457). The occurrence of FMD in countries previously free of the disease can have a major effect on local and international trading arrangements, due to restrictions on exports of animals, meat, and animal by-products.

As a result, many countries have a policy of immediate slaughter of all affected and in-contact susceptible animals, with severe restrictions on movement of animals (dead or alive) to prevent disease spread. After slaughter, the carcasses must be disposed of in a biosecure manner, and all buildings and equipment thoroughly disinfected (AUSVET, 1996, p.21). FMD is generally regarded as one of the most infectious agents of man or animal, as the virus can travel in the wind, on people's clothing, farm equipment, and in some types of processed meats, as well as normal contact with infected animals (Merck, 1994, 457-8).

Because of the FMD diagnosis in Taiwan in 1997, the largest animal carcass disposal crisis to date began to unfold. Before the incident drew to a close, 6,144 farms were affected and over 5 million hogs were destroyed (Wilson, USAHA 1997, 114-122).

The means of carcass disposal included burying, rendering, and incineration. Due to the infectious nature of the disease, it is desirable in FMD outbreaks to bury destroyed animals on-site, burn the carcasses on-site, or (least preferable choice) transport them in secure sealed trucks to mass burial areas or rendering plants. In Taiwan, burying was the method of choice, but in water resource protection areas (high water tables) only incineration using movable incinerators or open field burning was adopted. Burial of the carcasses was adopted in 80% of all cases and they were primarily disposed of in large municipal landfills, while 15% were rendered, and 5 % were burned (Shieh, FMD update, 5/22/97, p. 1).

The high water tables in Taiwan, and complicated environmental regulations hampered effective disposal efforts throughout the Taiwan FMD outbreak. At the peak of the operation, up to 200,000 hogs per day were destroyed and disposed of. Military conscripts were called in to complete the task. Before the operation was completed, many of the army conscripts reported psychological distress and anxiety requiring medical leave. The economic impact of the outbreak through the end of 1997 was 6.9 billion U.S. dollars for Taiwan, and over 50,000 people were unemployed as a result (Wilson, 1997, 121-2).

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are needed to see this picture.

Preparing swine carcasses for burning, Taiwan FMD outbreak, 1997, courtesy of USDA/EP

The major issues surrounding carcass disposal of the affected animals was, 1) magnitude (high number) of dead animals involved, 2) biosecurity concerns surrounding movement of animal carcasses, people, or equipment from affected premise, 3) environmental concerns complicating the disposal process, and 4) extreme stress felt by emergency workers in handling the dead animals.

### **UNITED KINGDOM FOOT AND MOUTH DISEASE (2001)**

A near repeat of the Taiwan FMD outbreak took place in the United Kingdom (UK) in 2001. FMD was diagnosed in a swineherd in the UK at Heddon-on-the-Wall in northern England in February of 2001. As of September 8, 2001, 3,854,000 animals on 9,327 farms have been destroyed in an effort to stop the spread of the disease. The

breakdown of depopulated animals by species consists of 3,104,000 sheep, 594,000 cattle, 139,000 pigs, 2,000 goats, 1000 deer, and 14,000 other, while 8,000 await euthanasia. The scientific advice is that all animals on an infected premises are slaughtered within 24 hours of the first report of the disease by the owner, thus time is of the essence in accomplishing the operation (DEFRA FMD update, 9/9/01, p. 1).

At the height of the outbreak, over 60,000 animals per week were slaughtered and disposed of. The foot and mouth epidemic has had a severe effect on both agriculture and tourism industries. Current estimates predict the epidemic could cost the UK up to £4.1 billion, with tourism possibly damaged more than agriculture at this point, due to the closing of footpaths, access to public lands, and a decrease in international visitors. Losses of exports are estimated at £400 million (approximately \$575 million) for 2001, and the cost of FMD compensation to farmers for slaughtered livestock is expected to be approximately £1.1 billion (BBC News, FMD Report, 9/5/01, p. 1).

Burial or cremation are the two formal means of disposal of animal carcasses according to the UK animal carcass regulations (DEFRA, Viper chapter 3, 8.1), but because of the logistics of handling the thousands of animals that were destroyed on a daily basis, rendering was also determined to be an acceptable method of disposal (DEFRA, Licensed movement policy, 4/12/01).

Considerable environmental controversies emerged surrounding carcass disposal during the outbreak of 2001. Because of the presence of Bovine Spongiform Encephalopathy (BSE-Mad Cow Disease), numerous risk assessments were done to determine the safest mechanism of disposal for cattle that might be infected. It was determined that high temperature (>850 degrees Centigrade) incineration was the safest

method to minimize the possibility of introducing the BSE agent back into the environment, as it eliminated all but one of the key exposure pathways (Comparative BSE Risks, SEAC, 5/13/2001, p. 2). As a result of concerns about BSE, some animals slaughtered and buried early in the outbreak were exhumed and re-burned, or carried to rendering facilities to ensure that infectious BSE agents were not left in the environment. Farmer concerns about site selection of burial sites also influenced the exhumation of some previously slaughtered animals (personal observation, 2001)<sup>1</sup>.

The burning of animal carcasses as an FMD disposal method also elicited environmental concerns. Health officials temporarily suspended burning of carcasses in open pyres because of concerns about the risk of dioxin exposure, and also spread of BSE if the carcasses were not completely consumed (Channel 4 news, 4/18/01, p. 1-4, online). A news release by the UK's Foods Standards Agency suggested that small amounts of chemical substances were released during the burning of animal carcasses. "Dioxins and hydrocarbons could cause health problems if taken in at high levels over long periods of time and it is important to keep the amounts as low as possible" (Environmental News, 4/23/01, p. 1-2). Ironically, dioxins did not come from the animals themselves, but from the materials used to light the huge pyres of carcasses. The World Health Organization has linked dioxins with birth defects; thus the concerns about smoke residues from the burning carcasses by the public (Environmental News, 4/23/01, p. 1).

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<sup>1</sup> author spent 2 weeks in the United Kingdom from 5/20 to 6/4/01 formally observing the FMD response activities at the national level (MAFF headquarters) and at numerous local command posts throughout the country (District Emergency Command Centers).

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are needed to see this picture.

Pyre consuming FMD infected carcasses, UK, 2001, courtesy of USDA/Emergency Programs.

With the news that burning also posed a slight danger to public health, the country that was still in shock from the sheer magnitude of the FMD outbreak did not understand where to turn, since both of the recommended methods of carcass disposal to control FMD were considered potentially dangerous to humans. The third choice for disposal, rendering, was limited by capacity constraints and location of the rendering plants themselves, so was not a viable option in all cases. This forced already stressed UK FMD officials to choose between three methods of carcass disposal that each had inherent weaknesses (Personal observation, 5/01).

During the outbreak, carcass disposal management was handled exclusively by the military. There is no emergency management infrastructure within the United

Kingdom, so a conglomeration of federal agencies handled the management of the FMD response. Generally, the Department of Environment, Food and Rural Affairs (DEFRA) personnel managed the veterinary aspects of the outbreak (theoretical decisions), and the military managed the implementation of most aspects of the response efforts (personal observations, 5/2001). There is no question that the lack of an emergency management infrastructure, lack of administrative experience by both DEFRA and military personnel in disaster situations, the infectious nature of the FMD disease agent itself, and the sheer magnitude of the operation contributed to a sense of frustration and realized inefficiency by the response personnel (personal observation, 2001, and Drummond interview, 2001).

At the height of the FMD outbreak in the spring of 2001, over 8000 government and military personnel were actively involved in the disease response. Almost 1000 of those were veterinarians (personal observation, 2001). The response officials were fighting the disease out of 12 separate regional command centers throughout the UK (Drummond interview, 6/2/01). The magnitude of such a response effort would have surely stressed the most experienced emergency management system, let alone efforts in a country that does not have such a mechanism in place.

Carcass disposal problems during the FMD outbreak of 2001 were compounded by a variety of problems. First, the volume of animals slaughtered would burden any system, but were overwhelming to a country that did not have a structured disposal plan or emergency management system to facilitate the process. Second, environmental issues and public health concerns hindered response activities throughout the process. Although the BSE contamination factor is somewhat unique to the UK, the issues of compromising air and water quality by large quantities of carcasses, and the public perception of the



disposal activities in general are not. Biosecurity concerns in moving carcasses off site for disposal were challenging but not overwhelming, and the large rendering industry in the UK was actually beneficial in relieving the disposal burden. Because of the volume of material disposed of, all of the major carcass disposal technologies were employed in different degrees. Each of those disposal techniques posed problems that were unique to their mechanism for disposal. Emergency management officials were forced to compensate for each of the methods intricacies to ensure a successful disposal process. The lack of prior comprehensive planning for selection and implementation of the disposal process also contributed to the difficulties faced in the disease outbreak (personal observation, 2001).

The next chapter will provide an overview of the currently accepted methods of carcass disposal routinely utilized by animal health and emergency management officials. A basic understanding of the disposal options available, along with some base line knowledge of their strengths and weaknesses is invaluable for emergency managers charged with deciding which method is most appropriate during a disaster.

## **CHAPTER 3**

### **CARCASS DISPOSAL METHODS**

The following chapter provides a broad overview of the most commonly utilized methods for animal carcass disposal. Each of the five major methods possesses strengths and weaknesses that make them the selection of choice in certain situations, and the same will preclude their consideration in other scenarios. It is essential that emergency response officials understand the consequences of selecting (or not) specific disposal methods as part of any response procedure.

#### **BURIAL**

Burial of animal carcasses is generally recognized as the preferred disposal method of choice when infectious agents are involved (except where prion agents are suspected), but can also be routinely utilized in natural disasters (USDA, Disposal, p. 2-2-1). It is preferred because it is generally quicker, cheaper, environmentally cleaner, easiest to organize, and often the most convenient means of disposing of large numbers of livestock (AUSVET Disposal plan, 1996, 2-3). There are two common methods of burial for animal carcasses.

Historically open pit disposal has been the most common method used by commercial poultry producers for disposing of dead animals. Recent evidence, however, has indicated that burial in disposal pits poses a threat to groundwater quality. The carcasses can leach contaminants for an undetermined length of time if they do not decompose properly (USDA Issues, Environmental Consequences, and Mitigation, 1991, p 14). Ambient temperature and moisture conditions can slow or speed up the

degradation process, thus affecting environmental contamination possibilities as well. Open pits are also susceptible to scavenger intrusions which is highly undesirable in disease related disasters. Therefore freshly closed pits have become the method of choice for the most current disaster situations. By heaping soil on top of the pit, the weight of the soil acts to stop carcasses from rising out of the pit due to gas entrapment, prevents scavengers from digging up carcasses, helps filter out odors, and assists in absorbing the fluids of decomposition.

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are needed to see this picture.

Aerial view of burial trench in UK, FMD outbreak 2001.  
(Note: backhoe at bottom extending pit, while 2nd at top loads sheep carcasses.)

Burial site selection is a critical component of the decision process when first deciding if burial is a feasible alternative, and secondly where to dispose of the animals. An unacceptable burial site can create health, environmental, and aesthetic problems for the disaster response officials (AUSVET, 1996). There are many important considerations to explore in choosing a proper burial site such as:

- access to site
- facilities available
- equipment required
- safety to personnel
- acceptability to owner of property
- protection from public view
- height of water table
- distance from residences/roads
- surface slope
- cultural/historical considerations
- distance from streams or wells
- biosecurity considerations

These considerations should all be taken into consideration in determining if a site is appropriate, and more importantly if burial should even be considered on the location.

There does not appear to be any consensus among governing entities as to the exact distance that burial sites should be from specific areas of concern such as wells or homes. The "Selected Burial Site Criteria' table (3.1) shows that there is obvious disparity among states in what are the recommended offset distances (and depths) for burial sites from the multitude of limiting factors in the selection process.

**TABLE 3-1  
SELECTED BURIAL SITE CRITERIA**

Government Agency	Burial depth (minimum)	Minimum Distance from Streams (ft)	Minimum Distance from Water Wells(ft)	Minimum Distance from Dwellings(ft)
USDA READEO	4-6 feet	150	150	100
Arkansas Livestock/Poultry	2-4 feet	600	600	none
Wisconsin Department of Agriculture	2 feet – natural 6 feet - disease	150	300	100
North Carolina Dept. of Agriculture	3 feet + 1 ft above water table	300	300	none
Florida Dept. of Erg and Consumer Services	3 ft.	none	none	none
California Dept. Food & Agriculture	4 ft	100	1000	100
Texas Animal Health Commission	6 ft	none	none	none

(USDA READEO, 1998, Arkansas 2001, Wisconsin 1998, NCDA 2001, Florida DAOCS 1999, CDFA 1996, TAHC 1998,)

It is obvious that some states have given little or no thought to offset distances, as no guidelines are offered for some criteria. Clarification as to whether stated offsets are guidelines or actual regulations is also important. In California for example, their recommended distances are simply guidelines, and were only developed using "best professional judgement" following review of offset distances posted "online" by other states, and from lessons learned by returning California state employees involved in the UK FMD outbreak (Borkovich, 2001). Knowing in advance what the state offset limits are for burial, and whether they require environmental review (waiver process) or not, is invaluable for an emergency management official trying to quickly determine if onsite burial is a viable option.

### **INCINERATION (Burning)**

Burning of animal carcasses produces a solid waste by-product (bone and ash) that is essentially free of pathogens<sup>3</sup> or putrid material if done properly. For these reasons, it is a desirable form of carcass disposal in many situations. There are limiting factors, however, that can preclude its consideration. Some of the factors are:

- location of site
- access to site
- type of animal carcass involved
- fuel availability
- amount of carcasses to burn
- environmental considerations

(AUSVET, 1996, 6-7, USDA READEO 1998, 14-15)

There are three commonly used methods of incineration. They include open-air burning, biological incineration, and controlled burning. Open air burning of animal

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<sup>3</sup> An exception to this pathogen free assumption is when diseases caused by prion type organisms such as BSE or CWD are suspected. Prions must be heated to 850°C for 2 seconds to be destroyed (SEAC, 1996).

carcasses requires addition of combustible material such as timbers and straw as fuel additives to achieve sufficient temperatures to completely consume the carcasses. Smoke from such fires can be high in particulates and/or produce offensive odors if the burn is not complete. Although many states have strict requirements on outdoor burning, some such as Texas and Florida will routinely waive burning restrictions in emergency situations (TNRCC, 2000, p. 2, & EPA, 1996,16). California has passed Emergency Order 8, which is even more comprehensive than simply waiving burning restrictions.

Order 8 states that:

In a state of emergency...all state and local laws, regulations, and ordinances regulating environmental quality standards may be waived if necessary, to allow for the successful disposition of carcasses (California Emergency Council, 1983, p. 2).

The most critical factors in site location for open air burning are the direction of prevailing winds and selecting locations out of sight of public view. Slow burning pyres in the UK-FMD outbreak of 2001 caused great public concern and were covered extensively by the media (Waldrup, 2001, & Personal observation, 2001). The type of animal to be disposed of will also play a critical role in the success of open air burning as the method for consideration. Animals with high fat content such as hogs will burn much faster and with less fuel requirements than poultry who are low in fat, and whose feathers do not burn easily. North Carolina officials had little success in burning the poultry carcasses present following Hurricane Floyd (Tickle Interview, 2001).

Biological incineration is an efficient disposal method, as it creates almost no pollution or particulates, and achieves virtually complete oxidation of the carcasses (READEO, 1998, 17-18). There are limiting factors for this method unfortunately, such as cost, lack of portability, location of existing incinerators, and capacity restraints. Most incinerators are located in academic or industrial settings and can not handle the amount

of carcasses generated from a large disaster. They are ideal though for small numbers of carcasses located in close proximity to their location, or when the infectious agent must be thoroughly consumed to avoid environmental contamination, such as the prion organism associated with Bovine Spongiform Encephalopathy (BSE or Mad Cow Disease).

The third type of burning technique is controlled burning such as in an open pit, or by air curtain incineration. Air-curtain incinerators (also called Trench burners) are a relatively new technology that is now used in many large-scale natural disasters to burn combustible debris (EPA, 1995, 16). The incinerators consist of large capacity fans driven by diesel engines connected to ducting, which delivers the high velocity air down into a long narrow pit or trench. A commonly recommended dimension for the trench is 8'x8'x35', but the size can be altered according the amount of carcasses or debris to be consumed. The system delivers the air stream at approximately 165 miles per hour down into the pit at an angle to create a "mini-cyclone" within the pit. The continual downward pressure by the incoming air forces the complete destruction (burn) of all material with very little smoke produced, at temperatures of up to 2000° Fahrenheit (Whitton, Air Burners, 1/20/01, p. 4). Fuel considerations are a factor in utilization of this method, however. For example, in one recorded incident the complete incineration of 500 adult swine to two feet of ash required 30 cords of wood and 200 gallons of diesel fuel(READEO, 1998, attachment 1,7 of 7).

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Photo - JPEG decompressor  
are needed to see this picture.

Swine carcasses deposited in air curtain incinerator fire near Pilot Point, Texas, 1994.

The advantages of the air curtain incinerators are that they are portable, environmentally friendly (minimal ash or particulates produced), and can incinerate vegetative debris from natural disasters (as a fuel source) at the same time the carcasses are consumed. Some disadvantages are that the incinerators are expensive to operate, are not available in all locations (no known state or federal entity owns any), and may require excessive fuel depending on the material to be incinerated. A complicating factor in using vegetative debris collected from a disaster for fuel in burning carcasses created from the same incident, is the technical difficulty in creating a "clean " burn from the mixture. In both Hurricane Floyd and Texas floods of 1998, incomplete combustion of the debris, and noxious smoke was created by poor air/fuel mixture arising from moist debris and trash included as fuel (Tickle, 2001, & Wagner, 2001).

## **COMPOSTING**

Composting is defined as the controlled decomposition of organic materials. Decomposition occurs when organic materials go through a "slow cooking" process as



heat and microorganisms consume the organics. Composting consists of two stages, a primary high temperature active stage, and a secondary lower-temperature “curing” or stabilization stage. The primary phase of composting takes 2-3 months and the secondary phase another 2-3 months (NCDENR, 1998, 1-2). The end result of the process is the production of carbon dioxide, water vapor, heat and compost. Composting of animal carcasses can occur in either bins or in windrows (deposited in a straight line within a field or pasture).

Compost is considered to be one of the more environmentally friendly forms of carcass disposal, because it is in effect a form of recycling. It is applicable for many natural disaster situations and is routinely used in the commercial poultry industry today as an accepted form of disposal. It can be applied to large animals in some cases, especially swine, but is not appropriate when disease biosecurity is an issue. In many states though, composting is not legal for large animal carcasses because of the time (3-6 months) it takes to complete the process. The advantages of composting are that initial start up costs are minimal, and the end product can be utilized as fertilizer material or a soil additive. Composting disadvantages are that it is a slow process (months) which requires some monitoring throughout the process, and is usually not appropriate for disease situations because the causative organisms may not be destroyed immediately (AUSVET, 1996, Disposal, 8-130-131).

## **RENDERING**

Rendering is a process of separating animal fats and proteins, usually by cooking. The recovered proteins are used almost exclusively as animal foodstuffs, while the

recovered fats are used both industrially and in animal feeds. There are two primary methods of rendering. The older method uses steam under pressure (with a grinding process) in large closed tanks. A second and newer method is dry rendering, which cooks the material in its own fat by dry heat in open steam-jacketed drums (EPA, CAFO Disposal, 2001, 8-128).

Rendering is considered an environmentally friendly method of disposal because it recycles the animal protein from the carcasses back into a usable form as meat or bone meal. Nevertheless it has limitations. Rendering is not economically feasible for poultry, and most renderers have voluntarily declined to render sheep carcasses because of concerns that the rendering of sheep infected with Scrapie (which were then used as protein supplements in cattle feed), could have been the instigating event that began the “Mad Cow Disease”(BSE) outbreak in England in the 1980’s. Subsequently, the Food and Drug administration in an effort to decrease the risk of BSE in the US, instituted a rule in 1997 that prohibited the use of mammalian protein (with certain exceptions) in the manufacture of animal feeds to be fed to ruminants. This rule in effect reduced the demand for rendered products that led to the closure of some plants, and substantial consolidation within the industry for the remaining locations (Wisconsin, 1998, 1-2).

The environmentally friendly concept, along with the production of a marketable product is the main advantages of rendering. Disadvantages include the fact that rendering is not always appropriate for disease situations because the carcasses must be transported to the plant, some species are not amenable to efficient rendering practices, and in many areas there is a lack of available rendering facilities (USDA, Carcass Disposal, 1998, 18).

## **ALKALINE HYDROLISIS**

Alkaline hydrolysis or tissue digestion is a relatively new technique for carcass disposal. The process uses alkali at elevated temperature to convert the animal carcasses to a sterile aqueous solution of amino acids, sugars and soaps. The only byproduct of the process is the mineral constituents of the bone and teeth of the carcasses, that are soft enough after the organic matter are degraded to be easily crushed by hand. The bone remnants can be captured and reused as calcium phosphate powder (sterile bone meal). The advantages of the process are that it sterilizes and digests in one operation, is more economical (3 cents/lb. approx.) than some other forms of disposal, and is environmentally responsible. The disadvantages are that there are capacity constraints (200 pounds per load) which precludes its effective use in large scale disasters, and it is not widely available at this time (WR<sub>2</sub>, 2001, 1-4).

The alkaline hydrolysis process is currently utilized for disposal of elk and deer in the United States thought to be infected or exposed to Chronic Wasting Disease (CWD)<sup>1</sup>. There is no known link between CWD and any other TSE of animals or people. Based on experience with other TSE agents though, the CWD agent is assumed to be resistant to enzymes and chemicals that normally break down proteins as well as resistant to heat and normal disinfection procedures. Extra precautions are necessary however, as the origin and mode of transmission of CWD is still unknown (USDA News Release, CWD, October 2001, p. 1-3). Alkaline hydrolysis (AH) digestion is utilized because the high temperature and alkaline solution breaks down animal protein and produces a sterile

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<sup>1</sup> CWD is a newly emerged neurological disease that is considered a type of transmissible spongiform encephalopathies(TSE) or prion diseases. Other TSE's include Mad Cow Disease and Scrapie in sheep.

mass, which is safe to be used as compost or for disposal at a public landfill (Colorado DofA, News release, 2001, p. 1) The capacity limitations for the AH process are overridden by the necessity of ensuring a biosecure end product is produced for prion infected material, that poses no known health risks to animals or humans.

In an effort to comprehensively cover the scope of carcass disposal methods, other forms of disposal must be mentioned, and include the following;

- fermentation
- public landfills (burial)
- fur farms
- alligator farms
- pet food processors
- scavengers (buzzards, etc.)
- deposit in the ocean
- mounding (top of ground)

All of the above methods have limitations for application in disaster situations, but because they are sometimes utilized in private or agricultural business settings as disposal methods, it is not inconceivable that they might be contemplated or discussed in disaster settings as viable options.

This chapter has provided the background necessary to begin the process of choosing the appropriate method of disposal in a disaster. A working knowledge about disposal processes is just the first step however, in choosing the correct method of disposal. The next chapter discusses some overriding factors that may be encountered when disposing of carcasses that may take precedence, and therefore alter which method is ultimately selected.

## **CHAPTER 4**

### **CARCASS DISPOSAL METHOD SELECTION**

The selection of a preferred method of disposal will usually be determined by the cause of death. If the death was due to an infectious organism, then the method that most efficiently prevents further disease spread is usually the preferred choice. In natural disasters, biosecurity issues are not the major concern. When a natural disaster is the cause of death, the disposal method chosen should be the most environmentally acceptable (USDA Carcass Disposal, 1991, p. 11). Logistical considerations (scope of disaster) may also play a factor in the final selection choice. Experience from recent catastrophic situations which create large numbers of carcasses to manage indicate that the most expeditious method may be utilized in an effort to solve the problem, regardless of other usual considerations (Tickle interview 2001, Dahlen interview, 2001). Because of the above factors, biosecurity, environmental, and logistical issues affecting carcass disposal are all reviewed, so that the appropriate method of disposal for various situations can be determined. The final consideration is that when public health issues are involved, mitigation of human death or disease may force the utilization of a method which would not be the preferred method of choice, all other factors considered equal.

#### **BIOSECURITY**

Biosecurity considerations will usually supercede environmental concerns in a large-scale disease related carcass disposal scenario. USDA guidelines for carcass disposal in a disease emergency suggest on-site burial as the preferred method when, 1) a

highly contagious disease is involved, 2) human exposure must be limited, or 3) industry or public objections to carcasses being transported are relevant (READEO, Carcass Disposal, attachment 1, p. 1, 1998). Some disease agents are readily transmitted to other susceptible animals by transportation off-site, so biosecurity measures must be strictly enforced, and are routinely included in any animal health response plans against an infectious agent. For a FMD outbreak as example, on-site burial would be the method of choice in the United States (READEO, FMD manual 1991, p. 99), as it effectively prevents transportation of the virus on fomites such as trucks and trailers traveling off-site.

### **Environmental Considerations**

USDA Veterinary Services has provided a checklist of environmental issues to aid decision-makers in the choice of the proper disposal method (USDA Carcass Disposal, 1998, p.26). The guide quickly identifies environmental issues associated with burial, burning, composting, and rendering methods. The list helps integrate environmental concerns into the decision process in an organized fashion, so that potential negative consequences can be avoided. For any person trying to determine which method of disposal is most appropriate, and is not encumbered by other pre-existing considerations, the process should begin by considering the following ten environmental resources issues;

- groundwater
- wildlife
- air quality
- surface water
- climate
- public health
- solid waste
- cultural resources
- utilities
- vegetation

Many states have minimum offset distances from the above considerations as statute or guidelines to follow. These issues need to be identified in advance by state and local emergency response officials, and mechanisms to waive or modify pre-existing regulations as needed in emergencies should be negotiated in advance.

### **Concentrated Animal Feeding Operations**

When contemplating the environmental effects of natural disasters or disease outbreaks on animal populations, the first concern is often towards large commercial livestock and poultry operations, such as those affected during Hurricane Floyd (NCSUCE, 9/99, p. 6). Disasters involving such operations can quickly generate thousands of livestock carcasses and millions of poultry carcasses over a short period of time in worst case scenarios. Depending on the state, many large agricultural operations are already regulated by state environmental agencies such as the Texas Natural Resource Conservation Commission (TNRCC). Cattle feedlots and commercial swine operations housing thousands of animals in close proximity are two such examples. In Texas (and many other states) such operations are termed “Concentrated Animal Feeding Operations”(CAFO), and are required to obtain environmental permits to ensure air and water quality (TNRCC, 2001, p.104). Currently there are 610 permitted CAFO facilities in Texas. Table 4.1 shows the breakdown of CAFO operations by species and number of animals required on one premise to be considered a CAFO by the TNRCC. Similar categories of animals are designated in most other states, and are regulated by their state

environmental agencies to minimize potential adverse effects of concentrated management practices upon their surrounding ecosystems.

**TABLE 4-1  
Texas Concentrated Animal Feeding Operation Specifications**

Type of operation	Minimum number of head to be considered a CAFO
Slaughter or feeder cattle	1000
Dairy cattle (mature)	700
Swine	2500
Horses	500
Laying hens or broilers	100,000

(TNRCC Chapter 321, Subchapter B)

In many cases these large operations already have developed carcass disposal protocols for their routine death losses. Such plans may include site location and disposal methods. In planning for natural or disease disasters, CAFO 's may serve as learning tools for local or state emergency management planners. Because CAFO managers have addressed routine carcass disposal issues in their business, they may provide an invaluable source of expertise for local emergency planners, not only for their operations, but other livestock in the vicinity as well. CAFO involvement in local planning is underway in states such as California, Florida and North Carolina by including them in county animal health planning committees, which consider large scale carcass disposal issues along with a myriad of other potential situations.

The flooding of hog waste lagoons from the concentrated swine operations, and the large number of carcasses created as a result of Hurricane Floyd was of great concern



to local residents after the storm (NCDER, Hurricane Floyd Update, 10/12/99, p. 2). Subsequently, North Carolina developed guidelines for carcass disposal that requires disposal plans at the farm and county level for premises containing "large" CAFO type populations (NCSART, Dead and Disposal, 12/2000, p. 1). The presence of CAFO's provide a potential liability to the local environment if they were to be destroyed by a disaster. The consequences of such potential environmental liability must be mitigated and planned for in advance by both local and state authorities, to prevent future disaster scenarios such as Hurricane Floyd. As in all emergency management planning, local involvement is crucial to developing effective mitigation or response procedures, so CAFO's should be involved in any planning taking place within their community.

### **LOGISTICAL CONSIDERATIONS**

It is conceivable that a disaster of large enough magnitude could influence the method of carcass disposal by the volume of carcasses created. For example, in both the Taiwan and UK FMD outbreaks, transportation of diseased carcasses to landfills and/or rendering plants was utilized out of sheer necessity to properly process and remove the carcasses in a timely manner (USAHA, Wilson, 1997, p. 118 & MAFF news, 2001, on-line). In the Texas floods of 1998, thousands of cattle were left in pastures to decompose or be consumed by scavengers, simply because the premises were inaccessible to the heavy equipment needed for proper disposal. Abandonment of animal carcasses would not normally be included as an option in most emergency response plans, but the responders had little choice in that situation (Allen, 2001). Therefore, any carcass

disposal plan must assume that there may be situations beyond the control of the responders, and be flexible enough to include unforeseen contingencies as a possibility.

### **FINAL METHOD SELECTION**

In considering all of the ramifications surrounding carcass disposal methods, there is no clear-cut preferred choice. There are multitudes of factors that can influence the final decision. General factors to be considered include;

- nature/amount of disposal material
- suitable site availability
- infectious agent involved
- hydrology/typology considerations
- which disposal options are viable
- fuel availability
- recovery funding requirements
- public perception

When incorporating all of the factors above into the selection process, emergency management officials must possess a broad overview of significant considerations. Because each of the three significant partners (environmental, animal health and emergency management officials) in disaster response carcass disposal issues possess specialized expertise; the only logical choice is to include all of them in any plan to determine the proper and final decision. It is essential then those animal emergency contingency/response plans recognize the required coordination and consideration of all involved parties, so that pertinent issues for each of those areas can be analyzed and prioritized in advance.

It is not enough to simply understand carcass disposal methods and complicating factors that may affect the success of a large-scale operation. An understanding of the existing emergency management system in the United States is also necessary. Changes

in the public sector's realization of the importance of the inclusion of an animal health component within any existing emergency response plan is currently taking place. The next chapter explores the current system, and how carcass disposal issues may be included within the process.

## **CHAPTER 5**

### **United States Emergency Management System**

#### **OVERVIEW**

This chapter provides a brief overview of the United States' emergency management system as it exists today. Because the current infrastructure is a relatively new concept of management, there is still some uncertainty or confusion surrounding how it operates, especially from public sector officials who do not deal with it on a daily basis. A clear understanding of the nation's emergency response system, and where animal health components such as carcass disposal fits within it, are essential to formulating productive planning and response mechanisms to deal with the same disposal issues.

National level emergency management as currently structured in the United States was created in 1979 when the Federal Emergency Management Agency (FEMA) was created by Executive Order. Prior to that time, no single agency was responsible for coordinating federal disaster relief (Mercatus, 2000, p. 1). Five Federal agencies that dealt with many types of emergencies consolidated to form FEMA. Since then, most state and local organizations have changed the names of their organizations to include the words, "emergency management" (FEMA AID, 1998, A 3 - 4). FEMA routinely trains disaster management personnel, distributes disaster aid, helps people rebuild after disasters and tries to move people and property out of harms way before the next disaster strikes (Mercatus, 2000, p. 1).

The name change for FEMA indicated an agency re-orientation from specialized preparedness for narrow categories of hazards, toward an all-hazard approach that includes potential threats to life and property through environmental and technological challenges. This was done in an effort to increase the nation's emergency management response capability for all types of emergency conditions. In addition to preparing for all types of hazards, FEMA is structured to form an emergency management partnership among all levels of government (local, state, and federal), and the private sector. This allows victims of disasters to contribute to emergency management solutions (FEMA, DIA, A3-2, 1998).

The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public law 93-288 was enacted in 1988. It is the centerpiece of the Federal Disaster Relief Programs that are managed by FEMA. The Federal Response Plan was created as a result of the Stafford act, and is implemented to coordinate the overall delivery of Federal assistance to disaster victims. The plan is organized by Emergency Support Function (ESF) and each ESF is composed of a lead or primary agency. For animal health issues in disasters, the lead agency at the national level is the USDA (FEMA, 1999, p. 5).

When a response effort is beyond the capability of local government, the State normally provides the next level of assistance by declaring a "State of Emergency". The State Emergency Management Organization typically evaluates the disaster situation and provides advice to the Governor on the availability of resources. After examining the situation, it may direct the State's Emergency Plan be executed, or the Governor may request the President to declare that a "major" disaster exists under the authority of the Stafford Act. If the President agrees, then the Federal Response Plan becomes applicable.

FEMA and its state counterparts approach emergency planning through four separate categories. The four phases of emergency management are mitigation, preparedness, response and recovery (see appendix A). Mitigation is designed to prevent or minimize the effects of emergencies. Preparedness includes community planning which requires the identification of resources in advance. Response includes actions to save lives or reduce property damage. Recovery consists of action taken to return to normal or an even safer situation following an emergency. Emergency management works best when local, state and federal governments all fulfill their respective responsibilities (FEMA, DIA, A3-4, 1998).

Local involvement in developing plans is essential to the success of emergency management preparation, because city and county governments serve as the direct link between citizens and their state/federal government. A state's emergency management office is responsible for protecting communities and citizens within the state. The State office carries out state level emergency management activities, coordinates efforts between one or more communities, and specifically assists any community that lacks the resources needed to protect itself or recover from a disaster. The State may help with money, personnel, or other resources. The State is the pivotal point between policy guidance and resources available at the Federal level, and the implementation of emergency management programs at the local level (FEMA, DIA, A3-8, 1998).

At the national level, FEMA manages the four previously referenced activities of mitigation, preparedness, response and recovery. FEMA also helps the States in several ways. FEMA offers 1) training programs 2) reviews and coordinates state plans, 3) financial assistance, and coordination of services for disaster response and recovery.

Because of the close working relationships between FEMA and the states, the structures and missions of state level emergency management agencies are usually closely aligned with the FEMA system of response (FEMA, DIA, A3-9, 1998).

The goal of emergency management is to provide protection from all hazards for the citizens, properties and governments within the US, but historically the all hazard approach has not included animal disease related disasters. Until recently, the Veterinary Service (VS) Division of the Animal and Plant Health Inspection Service (APHIS), which is part of the USDA, has been the sole agency charged for managing catastrophic disease outbreaks. Although this is still technically the case, a paradigm shift is currently underway between how traditional emergency management agencies view the importance of animals, and how animal health agencies view their role in current emergency management infrastructures.

Changes in the preparation for animal disaster situations at all levels of government are evident. The National Animal Health Emergency Management Steering Committee (NAHEMSC) Strategic Plan <sup>1</sup> currently calls for the USDA and the Federal Emergency Management Agency (FEMA) to work closely together, exploring formal agreements as part of the Federal Response Plan. The strategic plan also suggests that USDA/APHIS and State Departments of Agriculture (animal health officials) work more closely with emergency management officials in each state (NAHEM Strategic Plan, August 2000, page 3- 4). Animal health officials bring expertise that can assist in responding to natural and man-made disasters, while emergency management officials bring experience that can help in responding to animal health emergencies. These

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<sup>1</sup> (consisting of state and federal animal health organizations including USDA/APHIS/VS, emergency management organizations and livestock industry groups)

partnerships enhance the infrastructure needed to support both the animal health emergency management system specifically, as well as the overall response to disasters.

Recent disasters such as Hurricane Floyd, and the FMD outbreak in the UK have helped facilitate this change. "Foreign Animal Disease" disaster type planning is currently underway at the national level between FEMA and USDA officials, and is slowly being completed at the state level in certain states. This planning process can be evidenced by the completion of the Texas State Foreign Animal Disease Plan in June of 2001. Animal disease response in Texas is now officially included in the Health Annex (H) of the state Emergency Management plan, within the Governor's Division of Emergency Management. For the first time, the Texas Animal Health Commission is a member of the Governor's Emergency Management Council (TAHC News Release, May 29, 2001), and is the lead state agency in the emergency management infrastructure for an outbreak of a catastrophic disease in the state of Texas (Foreign Animal Diseases, Appendix 4 to Annex H, 2001, p. H-4-22). This reality follows the fact that the two agencies had not even formally worked together before the Texas Floods of 1998.

### **Carcass Disposal Component**

Out of necessity, the states most recently affected by catastrophic hurricanes or floods have been the first to consider integrated emergency management plans that address animal issues, and specifically include animal carcass disposal guidelines within the same. As a result of Hurricane Floyd's impact, North Carolina has developed a state carcass disposal plan as part of the existing emergency management infrastructure. North Carolina's plan addresses carcass disposal issues at both the local and state emergency



response level (North Carolina Department of Agriculture, Dead and Disposal plan, 2001, 1-3).

In fact, the concept of ideal integrated animal health/emergency management plans such as North Carolina's have been recommended to all states and FEMA/USDA by the NAHEMSC, as a goal to ensure they formulate effective animal disaster response plans (NAHEM strategic plan, 2000, p. 7).

An integration of the various agency and public sector responsibilities, and finding the best fit or balance to all of the issues seems to be the key to success in emergency management. Jacob Casper noted that, “The most important part of a dead animal disposal plan is the designation within government of someone to make decisions. This person should have the authority to coordinate the responses of the various agencies” (Casper, 1993, 997). Interagency coordination is the bellwether of the current FEMA structured emergency management system. Dr. Sebastian Heath has noted that “Disasters do not create new problems, but exacerbate every day problems” (Heath, 1999, 10). He also dispelled the myth that disasters are extraordinary events and need extraordinary types of preparedness by stating, “Disasters only result in a greater than usual number of everyday events, so the best preparedness is to be prepared for events every day” (Heath, 1999, 10).

Consequently, productive working relationships that can be developed in advance between emergency management officials to solve routine problems would appear to be the foundation for any response effort. In an analysis of six separate disaster responses, Thomas Drabek discovered that, “Cross agency communication was perceived by most to be the greatest weakness, and hence the source of most difficulties” (1985, p. 22). Again

extrapolating back to Heath's suggestion, it could be derived that the more inter-agency coordination and planning that takes place "everyday", the better prepared all will be for a real disaster. Thus, the integrated approach of coordinating environmental, agricultural and emergency agency considerations into any carcass disposal planning mechanism makes perfect sense for creating a functional and comprehensive plan.

## **COMPENSATION**

Inclusion of animal health components within emergency management systems, and the integration of animal health, environmental, and emergency management agencies within the structure are still not enough to assure total success when dealing with large scale animal disaster scenarios. The final piece in the ideal integrated carcass disposal system must include a funding mechanism to support rapid response and minimize cost concerns for completing the needed response. During natural disaster responses, the public expects a quick and efficient clean up process, and during disease responses, quick destruction and disposal of diseased animals may be the most important component of the response efforts. For those reasons, a pre-planned mechanism to fund the necessary efforts must already be in place.

Although USDA has a mechanism to fund the purchase of diseased animals and their biosecure disposal (USDA READEO, FMD plan, 1991), and FEMA has a payment plan for environmental clean up (Emergency Watershed Protection Program) and debris removal (FEMA Public Assistance) following a natural disaster, neither agency specifically accepts total responsibility for the cost of disposal of animals in disasters. Further, the USDA payment is only a 50-50 split in cost sharing between the state and

federal government when the animals are not involved in interstate movement at the time of their destruction (9 C.F.R, Part 53.2b), while the FEMA mechanism is a 75-25 split (EWPP) with FEMA paying the larger share. It would appear however, that the solution to this predicament is fundamental to developing a successful and comprehensive animal carcass disposal plan. Whether FEMA or the USDA is the federal entity paying for disposal, there is still a considerable amount of cost to be incurred by the states, and most states have no funding mechanism created specifically for this scenario. There must be no doubt in the minds of the emergency managers (and the public) that the full faith and credit of the government is fully supporting their efforts in this area.

The area of most promise for funding may be found within the debris removal jurisdiction of FEMA. FEMA Public Assistance funds may be used for debris clearance, removal and disposal operations. Debris that may be eligible for clearance removal and disposal includes trees, sand and gravel, building wreckage, vehicles and personal property. Historically, animals (dead or alive) have been considered personal property by emergency response officials (FEMA Debris Management Guide, 1999, p. 6). FEMA guidelines also state that removal may be eligible (for reimbursement) when it:

- eliminates immediate threats to lives public health and safety
- eliminates immediate threats of significant damage to public property
- ensures economic recovery of the affected areas to the benefit of the public

As discussed previously, animal carcasses can pose significant public health risks in natural disasters, and their prompt removal is essential for economic recovery during certain animal disease outbreaks. In recent disasters in Texas and North Carolina, emergency responders clearing debris used much of their same expertise and equipment in processing the animal carcasses present. The question is whether a structured payment

mechanism by FEMA (to the states) can be identified that explicitly includes animal carcasses as a type of eligible debris. This has not been finalized to date. However, the possibility of such an arrangement is driving the suggestion that any complete "ideal" animal carcass disposal plan should include state or national level contracted funding for debris removal services. If a Governor or Presidential declaration is not enacted because the scope of the situation is too small, then the local government would be charged with clean up costs. This is another reason for local involvement in any animal carcass disposal plan. Regardless of the scope of disaster, productive dialogue between FEMA and the USDA must be immediately began to provide state and local governments with the mechanism to begin immediate local response efforts regarding carcass disposal when needed.

Many states (or local governments in some states) have debris removal companies under retainer or identified on contract vendor lists as available to manage all-hazard debris removal contingencies. In North Carolina during Hurricane Floyd, a private disposal company, J& W Engineering Limited, was contracted to dispose of over 730,000 animal carcasses and 100,000 cubic yards of impacted soils and litter from 26 farms at a cost of \$3,800,000 (J&W, Project Descriptions, Jan. 2000, annex f, p. 11). The North Carolina Department of Agriculture & Consumer Services is currently incorporating the concept of pre-arranged contract vendors for carcass disposal by holding a "bidder conference" in November of 2001, so that all private contract-for-hire businesses in the field of carcass disposal will congregate to discuss the issues. As a result of that conference, contract specifications and available vendors for future carcass disposal activities will be identified (Tickle interview, October 2001). Interested vendors for the

conference will not only include traditional debris and environmental clean-up companies, but also some concentrated animal feeding business entities (CAFO) located in North Carolina.

In the ideal plan suggested later in this paper, the concept of adding general contract retainer services or at least pre-arranged agreements with entities who will oversee large scale carcass disposal will be suggested. It is possible that companies such as J&W Engineering <sup>4</sup>, who already work closely with existing emergency management in the areas of environmental cleanup, and debris removal, should be contracted with for future carcass disposal clean up<sup>5</sup> activities. If the Federal reimbursement mechanism for payment can be clarified to include this type of service, then the fourth component of the integrated emergency system, "pre-arranged contract services for debris removal" at the state level should be included. This concept is explored further in the structured interview component that follows.

## **SUMMARY**

Any discussion of animal carcass disposal methods must begin with a look back at the historical lessons that can be learned from both recent natural and disease related disasters. In all cases, carcass disposal problems were at the forefront of critical issues to be resolved. Each method of carcass disposal has a place in disaster management depending upon the situation. It is up to the responders and planners to evaluate the pros and cons for each incident, and then make the right decision. In attempting to do so, it is

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<sup>4</sup> Examples of other contract providers who specialize in clean up services in Texas include DRC, Inc., Eagle Construction and Environmental Services, Waste Management Inc., and Garner Environmental Services. Company names are provided as resource info only. This list is not intended to be comprehensive.

<sup>5</sup> Officially and unofficially this has already occurred, but some state officials are reluctant to admit that FEMA money designated for debris removal in recent disasters was also used to pay for carcass disposal costs.

obvious that the best approach is an emergency management plan that is both horizontally and vertically integrated. Since all major disaster responses begin at the local level, but are ultimately funded at the national level, then it is appropriate to include county, state and national planners within the vertical integration concept.

For carcass disposal specifically, the three major components of a successful plan will address environmental, animal health, and emergency management objectives. The final factor that should allow a properly developed plan to be effective, is the creation or identification of a funding mechanism to support it. The horizontal integration concept then must include players from each of those areas of expertise. Finally, developing a plan built upon, "an infrastructure that will maximize the capacity of the (emergency response) network to improvise"(Drabek, 1985, 90), but is based upon sound scientific concepts for each of the disciplines involved, will be the carcass disposal planning process with the best chance of success. That success will hold true, whether the situation is a natural or disease related disaster.

The next chapter discusses the conceptual framework and methodology of this paper. The conceptual framework is the basis for the organization of this study, and the methodology is how the evidence was actually collected. Both components will be reviewed in detail.

## **CHAPTER 6**

### **CONCEPTUAL FRAMEWORK /METHODOLOGY**

#### **Conceptual Framework**

The products of this investigation are recommendations for an integrated emergency management planning mechanism for carcass disposal, which must include advance dialogue and preparation by the various state agency professionals who have a vested interest in the process. The key issues were first explored through a literary review of existing state documents and reports from previous incidents.

Second, components of the plan are developed and explored using working hypotheses. The working hypotheses guide collection of the data, and are the conceptual framework of the empirical portion of the study. By exploring issues from past disasters, and selected components of existing state carcass disposal processes, the "practical" ideal plan that can be used in Texas and other states is suggested.

Working hypotheses (exploratory) are used in this study as the conceptual framework to formulate an ideal state plan of organization, which should allow for more efficient and effective management of carcass disposal issues in future large scale events. Babbie noted that exploratory research is associated with problems that are in their early stages, or when the issue is new (The Practice of Social Research, 1989, 6th ed., p.80). Although disasters are not a new phenomena, the emergency management system as currently exists in the United States has only been in existence since 1979 (further refined in 1988 by Stafford Act), and therefore is still maturing in complexity and effectiveness.

According to Shields (1998, p. 215), "Exploratory research purpose is linked with the conceptual framework of working hypothesis". Shields also explained that, "The working hypotheses need to incorporate information from the literature and experience. The working hypothesis is one of those organizing devices that easily cross the boundary into the everyday world and particularly to the day-to-day activities of management" (1998, p. 216). The conceptual framework of this paper attempts to organize the exploration of a relatively new field of public service. The conceptual framework was developed by analyzing available literature on the subject of carcass disposal, and then merging that knowledge with the author's personal experiences from natural and disease disasters, as well as experiences related by the professional personnel who participated in the structured interviews. It is the intent of this paper to develop "common sense" pragmatic solutions to mitigate large-scale carcass disposal issues, regardless of which state they may be located in.

## **WORKING HYPOTHESES**

The working hypothesis concept is used to develop the possible solutions via an ideal plan because, "it is not a guess at the riddle, a hunch as to what the answer might be. It is an idea... about the next steps that may be worthy of taking" (Kaplan, 1964, p. 88).

The Working Hypotheses (WH) utilized are:

**WH1a:** What are the major issues surrounding animal carcass disposal in recent natural disasters (Hurricane Floyd, 1999, & Texas Floods, 1998)

**WH1b:** What are the major issues surrounding animal carcass disposal in recent animal disease disasters (Taiwan 1997 & United Kingdom 2001)

**WH2a:** What are the currently accepted methods of animal carcass disposal.

**WH2b:** What are the major factors that affect disposal method selection.



**WH3:** What is the current status of emergency management in the United States.

**WH4a:** What is the current status of animal carcass disposal regulation and policy activities in four states active in animal emergency management issues.

**WH4b:** What is the current status of animal carcass disposal planning at the local level in the same 4 states.

**WH5:** Identify the suggested ideal state level organizational plan for managing animal carcass disposal in disasters.

Shields states that, "working hypotheses are similar to the small questions that direct an investigation (making it controlled inquiry) (1998, p. 216)." That is exactly what the working hypotheses utilized in this paper are, a series of small questions utilized to help identify the major issues of large scale carcass disposal revealed both from literature and real life experiences.

In attempting to develop a practical ideal plan for animal carcass disposal issues, the issues must first be identified. Dewey noted (1910, p.74) that, "The essence of critical thinking is suspended judgement; and the essence of this suspense is inquiry to determine the nature of the problem before proceeding to attempts at its solution". The working hypotheses utilized in this paper illuminate the routine problems that are associated with animal carcass disposal in disasters. Multiple disaster situations were analyzed to determine what the most common problems were in a variety of settings. By understanding the issues (problems), the pragmatic approach to problem solving should correct or modify the environment (by management intervention or planning) that allowed those problems to develop. The plan suggested in this paper is the result of that pragmatic approach, and addresses the larger research question of the paper, "How can carcass disposal issues be managed more effectively and efficiently in the future?"

The working hypotheses are summarized and linked to the appropriate literature in Table 6.1. As previously noted, the linkage of the literature to the conceptual framework is half of the equation towards conducting a controlled and empirical study.

**Table 6-1**  
**Working Hypotheses linked to Literature Sources**

<b>WORKING HYPOTHESES</b>	<b>SOURCES</b>
<b>WH1a: Natural Disaster Issues</b> <ul style="list-style-type: none"> <li>● Hurricane Floyd 1999</li> <li>● Texas Flood 1998</li> </ul>	(NCDACS, 1999) (NCDENR,1999) ( FEMA, 1999) (FEMA, 1998) (TXDPS, 2001) (NCSART, 2001) (NCSUCE, 1999) (TAHC, 1998) (Disaster Relief, 1998) (NRCS, 2001)
<b>WH1b: Disease Disaster Issues</b> <ul style="list-style-type: none"> <li>● Taiwan FMD 1997</li> <li>● United Kingdom FMD 2001</li> </ul>	(DEFRA, 2001) (BBC, 2001) (SEAC, 2001) (Merck, 1998) (Shish, 1997) (Wilson, 1997) (Vetch/Smith, 2001) (AUSVET, 1996)
<b>WH2: Current Disposal Methods</b> <ul style="list-style-type: none"> <li>● Burial</li> <li>● Incineration</li> <li>● Composting</li> <li>● Rendering</li> <li>● Alkaline Hydrolysis</li> </ul>	(Casper 1993) (CFIA, 2001) (AUSVET, 1996) (CDA, 2001) (USDA, 1998) (Hudson, 2001) (NCDACS, 2000) (Munro, 2001) (EPA ,1996) (USDA, 2001) (Glanville, 1997) (USDA, 1992) (NCDENR, 2001) (USDA, 1991) (NASDA, 2001) (WRI <sup>2</sup> , 2000)
<b>WH2b: Factors Affecting Disposal Method Selection</b> <ul style="list-style-type: none"> <li>● Environmental</li> <li>● Biosecurity</li> <li>● Logistical</li> </ul>	(USDA, 1998) (TNRCC, 2001) (USDA, 2001) (NCSART, 2000) (AUSVET, 1996) (NCSUCE, 1999) (USDA, 1991) (Wilson, 1997) (MAFF, 2001)
<b>WH3: Current Emergency Management system in the United States</b> <ul style="list-style-type: none"> <li>● Overview</li> <li>● Carcass disposal component</li> </ul>	(FEMA, 1998) (FEMA, 1997) (Mercatus, 2000) (EPA, 1995) (NAHEM, 2000) (J&W, 2000) (TxDPS/DEM, 2001)
<b>WH4a: State Carcass Disposal Guidelines and Management</b> <ul style="list-style-type: none"> <li>● Environmental</li> <li>● Agriculture</li> <li>● Emergency Management</li> <li>● Contract Services (funding)</li> </ul>	(CDFA, 1996) (CEC, 1983) (FDACS, 1999) (TxDPS/DEM, 2001) (TNRCC, 2000) (Whitton, 2001) (TNRCC, 2001) (NCDENR, 2000)
<b>WH4b: Local Involvement in Planning for Animal Carcass Disposal in Disasters</b>	(FDACS, 1999) (Millican, 1994) (FEMA, 1998) (Quad Review 1997)
<b>WH5: Integrated Ideal Plan Development</b>	(Heath, 1999) (FEMA, 1998) (Drabek, 1985) (FEMA, 1997) (Casper, 1993) (Mercatus, 2000) (Ausvet, 1996) (Solis, 1995) (TxDPS/DEM, 2001) (CFIA, 2001)

## **Methodology**

This applied research project includes multiple research techniques and methods. The evidence gathered in this investigation identifies the various issues surrounding carcass disposal, and also helps justify the creation of the ideal "plan", which should ultimately address those same concerns. Evidence is drawn from structured and non-structured interviews, archival record analysis and document review processes. Personal observation and participation by the author in response of the Texas Floods of 1998, and the FMD outbreak in the UK are also utilized. Interviews (non-structured) and/or correspondence with participants or observers from all four of the disasters reviewed are referenced as well. Table 6.2 provides an overview of the operationalization of the conceptual framework of this study by linking the working hypotheses to the types of research methods employed for each. A narrative on each of the methods of investigation utilized in this study is also provided.

**Table 6-2  
Operationalizing the Conceptual Framework**

<b>Ideal Type Categories</b>	<b>Research Methods</b>
<b>WH1a: Natural Disaster Issues</b> <ul style="list-style-type: none"> <li>● Hurricane Floyd 1999</li> <li>● Texas Flood 1998</li> </ul>	<ul style="list-style-type: none"> <li>● Structured Interviews</li> <li>● Non-structured Interviews</li> <li>● Archival records</li> <li>● Document analysis</li> <li>● Participant Observation (Texas, 1998)</li> </ul>
<b>WH1b: Disease Disaster Issues</b> <ul style="list-style-type: none"> <li>● Taiwan FMD 1997</li> <li>● United Kingdom (UK) 2001</li> </ul>	<ul style="list-style-type: none"> <li>● Participant observation (UK, 2001)</li> <li>● Direct observation (UK, 2001)</li> <li>● Interview</li> <li>● Archival records</li> <li>● Document analysis</li> </ul>
<b>WH2A : Current Disposal Methods</b> <ul style="list-style-type: none"> <li>● Burial</li> <li>● Incineration</li> <li>● Composting</li> <li>● Rendering</li> <li>● Alkaline Hydrolysis</li> </ul>	<ul style="list-style-type: none"> <li>● Document analysis</li> <li>● Structured interview</li> <li>● Non-structured Interview</li> </ul>
<b>WH2b: Factors Affecting Disposal Method Selection</b> <ul style="list-style-type: none"> <li>● Environmental</li> <li>● Biosecurity</li> <li>● Logistical</li> </ul>	<ul style="list-style-type: none"> <li>● Document analysis</li> <li>● Structured Interview</li> <li>● Simple descriptive statistics</li> </ul>
<b>WH3: Current Emergency Management System in the United States</b> <ul style="list-style-type: none"> <li>● Overview</li> <li>● Carcass disposal component</li> </ul>	<ul style="list-style-type: none"> <li>● Document analysis</li> <li>● Structured Interview</li> <li>● Non-Structured Interview</li> </ul>
<b>WH4a: State Carcass Disposal Guidelines and Management</b> <ul style="list-style-type: none"> <li>● Environmental</li> <li>● Agriculture</li> <li>● Emergency Management</li> <li>● Contract Services</li> </ul>	<ul style="list-style-type: none"> <li>● Document analysis</li> <li>● Structured Interview</li> <li>● Non-Structured Interview</li> </ul>
<b>WH4b: Local Involvement in Planning for Animal Carcass Disposal in Disasters</b>	<ul style="list-style-type: none"> <li>● Structured Interview</li> <li>● Document analysis</li> <li>● Direct observation</li> </ul>
<b>WH5: Integrated Ideal Plan Development</b>	<ul style="list-style-type: none"> <li>● Document analysis</li> <li>● Structured Interview</li> </ul>

## **DOCUMENT REVIEW**

Document review can take many forms, and in fact a multitude of types of document review were utilized in this study. Those types included media accounts, internal state and federal documents (disaster plans, agency fact sheets, and employee field reports), written summary reports by government officials, and other informal communiqués such as letters and memos. Document review was relied upon extensively throughout this study, and was applied to each of the research questions examined through the working hypotheses. Table 6.3 provides examples of the documents reviewed in relation to the working hypotheses.

**Table 6.3  
Documents Reviewed**

<p><b>WH1a: Natural Disaster Issues</b></p> <p><b>Hurricane Floyd (1999)</b></p> <p><b>Texas Flood (1998)</b></p>	<ul style="list-style-type: none"> <li>● Texas Animal Health Commission (TAHC) internal reports on flood response and damage- 1998</li> <li>● North Carolina Department of Agriculture and Consumer (NCDACS) Services Hurricane Floyd Dead Animal Transport - 1999</li> <li>● North Carolina Department of Environment and Natural Resources Daily Response Updates - 1999</li> <li>● NCDENR Solid Waste and Debris Management fact sheet - 1999</li> <li>● North Carolina State University Extension - Public Health releases - 1999</li> <li>● Multiple media accounts - Texas 1998 and North Carolina 1999</li> </ul>
<p><b>WH1b: Disease Disaster Issues - Foot and Mouth (FMD) Disease - United Kingdom 2001 and Taiwan 1997</b></p>	<ul style="list-style-type: none"> <li>● Department of Environment Food and Rural Affairs (DEFRA) - FMD regulations - 2001</li> <li>● DEFRA- Foot and Mouth disease statistics - 2001</li> <li>● DEFRA - Policy Changes Summary - 2001</li> <li>● United States Animal Health Association Report - Taiwan 1997</li> <li>● Multiple media accounts - 1997 Taiwan and 2001 UK</li> </ul>
<p><b>WH2A : Current Disposal Methods</b></p>	<ul style="list-style-type: none"> <li>● USDA Disposal Guidelines - 1998</li> <li>● Australian Disposal Plan - 1996</li> <li>● NCDACS Response to Foot and Mouth Disease - 2001</li> </ul>
<p><b>WH2b: Factors Affecting Disposal Method Selection</b></p>	<ul style="list-style-type: none"> <li>● Environmental Protection Agency pollutant discharge regulations 2001</li> <li>● United Kingdom Spongiform Encephalopathy Advisory Committee internal documents on BSE disposal risks (numerous - 1995 - 2001)</li> <li>● Texas Natural Resource Conservation Commission Concentrated Animal Operations, 2001</li> <li>● USDA Carcass Disposal Guidelines - 1998 &amp; 2001</li> <li>● EPA Planning for Disaster Debris report - 1995</li> <li>● USDA Carcass Disposal Environmental Consequences - 1991</li> <li>● DEFRA License for Movement of Animals - 2001</li> <li>● USAHA Taiwan Foot and Mouth Disease Report - 1997</li> </ul>
<p><b>WH3: Current Emergency Management system in the United States</b></p>	<ul style="list-style-type: none"> <li>● FEMA Animals in Disaster training module - 1998</li> <li>● FEMA Strategic Plan - 1998</li> <li>● Quadilateral Review of the United States - 1997</li> <li>● USDA Emergency Watershed Protection Program brief - 1998</li> </ul>
<p><b>WH4a: State Carcass Disposal Guidelines and Management</b></p>	<ul style="list-style-type: none"> <li>● California Department of Food and Agriculture Response to Foreign Animal Disease - 2001</li> <li>● California Carcass Disposal Rules</li> <li>● TAHC Guidelines for Carcass Disposal</li> <li>● TNRCC Solid Waste Guidelines</li> <li>● Florida Department of Agriculture and Consumer Services Burial Guidelines</li> <li>● NCDACS Burial Guidelines</li> </ul>
<p><b>WH4b: Local Involvement in Planning for Animal Carcass Disposal</b></p>	<ul style="list-style-type: none"> <li>● FEMA Animal in Disasters Module - 1998</li> <li>● Quadilateral Review of the United States - 1997</li> <li>● NCDACS Response to Foot and Mouth Disease - 2001</li> <li>● Emergency Management Principles in Australia - 2001</li> </ul>
<p><b>WH5: Integrated</b></p>	<ul style="list-style-type: none"> <li>● USDA National Response Plan (Draft) - 2001</li> </ul>

<b>Ideal Plan Development</b>	<ul style="list-style-type: none"> <li>● National Animal Health Emergency Management Steering Committee Strategic Plan - 2000</li> <li>● Quadilateral Review of the United States - 1997</li> <li>● Emergency Management Principles in Australia 1994</li> <li>● NCDACS Response to Foot and Mouth Disease - 2001</li> <li>● CDFA Response to Foreign Animal Disease - 2001</li> </ul>
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The strengths of document review are that it is unobtrusive, stable, and can cover many events and settings (Yin, 1994, 80). The weaknesses for document analysis is that retrievability can be low, biased selectivity or reporting is always possible, and access to certain records could be blocked (Yin, 80). Another weakness is that many documents evaluated can not be taken as literal recording of events, but are still important to corroborate and augment evidence from other sources (Yin, p.81). Because multiple sources were used to gather evidence throughout this study (document analysis was never the only method used to research an issue), and the various sources routinely substantiated one another, confidence in the final results is assumed.

Babbie (1999, p. 306) notes that, "you can't trust the accuracy of records, official or unofficial, primary or secondary. Your protection lies in replication. In the case of historical research it lies in corroboration". The use of multiple research techniques in this study provides the corroboration necessary to substantiate the evidence. The interviews were invaluable in corroborating information gleamed from other sources of study such as literature and document reviews. Replication also leads to validity in the study, and many of the same disposal problems were identified in all four events studied, even though the documents reviewed were from a wide disparity of sources. This replication of issues identified through four different events, and as confirmed through the structured interview process, gives credence to the assumption that those are indeed

common and significant problems to deal with in large-scale disposal efforts. The suggested plan addresses those same issues, and since they are considered credible and believable problems, then validity is added to the potential success of the final plan as well.

### **ARCHIVAL RECORDS**

Archival record analysis was utilized in the study of the four disaster events. Organizational records revealing budgetary or economic figures (disposal costs), record of agency regulations (statutes), and maps and charts highlighting the location of affected areas during the four events were accessed. Archival records were reviewed primarily to supplement other sources of evidence collection. Archival records were often referenced to substantiate that a policy or plan of operation did or did not exist, which helps indicate a disparity in consistent approaches to effectively managing carcass disposal issues exists. The inconsistency of responses by emergency managers and planners (due to inadequate plan development) in dealing with disposal issues, which leads to confusion and inefficiency, is one of the areas of preparation for future events that the "ideal" plan attempts to alleviate. Archival analysis in this study was a secondary means of investigation however, as more evidence was gathered through the document review and interview processes.

### **NON-STRUCTURED INTERVIEWS**



The types of interviews used in this study were both structured and non-structured. Conversations or other communication documented for inclusion in the study, which was not gathered using the structured interview questions (examined later), are considered as non-structured interview resources. In some cases, participants in the structured interview process were also involved in one or more of the disaster events covered. Additional information provided by them in regard to their involvement in the disasters, which may or may not have been offered during the structured interview, was too valuable to discard. Thus, evidence considered as both non-structured and structured in nature was captured during the same interview or from the same people at different times. Because of direct involvement by the author in two of the four events reviewed, many opportunities arose to gather evidence through interviews in non-structured settings. The non-structured interviews were invaluable in corroborating the importance of critical issues that needed to be solved, which were initially identified through the document analysis or archive review processes.

**Table 6.4**  
**Open Ended Interview References**

Topic	Name/Source of Information/Employer/Date interviewed
Hurricane Floyd	Dr. Tom McGinn/Direct Involvement/NCSART/November '01 Dr. Heidi Hamlen/Direct Involvement/CDFR/October '01 Dr. Jimmy Tickle/Direct Involvement/NCSART/ October '01 Doug Hoyle/Direct Involvement/NCDEM/October '01
Texas Flood	Inspector Rone Allen/Direct Involvement/TAHC/October '01 Inspector Richard Wagner/Direct Involvement/TAHC/October '01 Dr. Mark Michalke/Direct Involvement/TAHC/October '01 Investigator Smokey Wilson/Direct Involvement/TAHC/September '01 Ken Ronsonette/Direct Involvement/Lower Colorado River Authority/ November '01
Taiwan	Dr. Terry Wilson/Direct Observation/USDA/October '01(e-mail)
United Kingdom	Dr. Richard Drummond/Direct Involvement/DEFRA/June '01 Dr. Ken Waldrup/Direct Involvement/TAHC/April '01 Dr. Heidi Hamlen/Direct Involvement/CDFR/November '01
Disposal Methods	Dr. Tom McGinn/Method Observation during disasters/NCSART/November '01 Dr. Heidi Hamlen/ Method Observation during disasters/CDFR/October '01 Dr. Jimmy Tickle/Method Observation during disasters /NCSART/ October '01
Current US Emergency	Dr. Tom McGinn/Direct Involvement/NCSART/November '01 Dr. Heidi Hamlen/Direct Involvement/CDFR/October '01

System	
State Burial Guidelines	Borkovich, John/Program mgr./ California Water Resources Control Board/ Oct. 01,e-mail Angela Stepherson/ Attorney/Texas Natural Resource Conservation Commission/ April '01

## **STRUCTURED INTERVIEWS**

The structured interview process for this study is a type of field research where actual participants in state emergency management processes, or representatives of the four types of state agencies deemed critical to successful carcass disposal management are interviewed using pre-determined questions. The strengths of structured interviews are that they can be targeted to focus directly on the topic, and can provide insight to causal inferences. They can also be biased though if the questions are poorly constructed, and have problems of reflexivity if the interviewee gives what the interviewer wants to hear (Yin, 1994, p. 80). The interviewees are management level employees of agencies who are charged with managing the previously identified components of effective carcass disposal management (environmental, animal health, emergency management, and contract services). The four states the interviewees work in are currently active in animal disaster management planning from either the natural or disease disaster perspective. Table 6.5 provides a profile of the "typical" interviewee. Appendix D provides the names of the interviewees, and the agencies they are employed by in each of the four states examined.

**Table 6-5**  
**State Employee Profile for Structured Interview Participation**

Agency Type	Preferred Interviewee Work Duties
Environmental	Water/Air Quality Division or Emergency Management Liaison
Emergency Management	Plan Developer or Response Manager
Contract Services	Procurement/Contract Manager
Animal Health	Veterinarian or agency level coordinator involved in emergency management planning and response.

The four states included in this study were chosen based upon their active participation in emergency management issues for animals at both the state and national levels. The states of California and Texas are considered leaders in animal disaster planning because they comprise two of the three state members (Delaware is the third) represented on the National Animal Health Emergency Management Steering Committee. That committee provides national leadership and coordination between government and industry groups in the planning for future animal disaster issues (NAHEM, 2000, p. 2). Both California and Texas state animal health agencies have also completed animal disaster plans (CDFA, 2001, DPS/DEM 2001) in the year 2001.

The states of North Carolina and Florida were chosen because they both were impacted by devastating hurricanes in the last decade, which initiated their development of disaster response plans for animals out of necessity. Both state agencies also have foreign animal disease plans implemented as well (Florida 2000, North Carolina 2001). All four of these states have large enough staffs of veterinary and administrative professionals to spend the necessary time and manpower to develop comprehensive

plans. Because of their involvement in developing both natural disaster and disease response plans, these four states' plans are often considered as templates or starting points, for other smaller states to emulate as they begin similar planning processes.

The advantage of this selection process is that a variety of perspectives are derived regarding carcass disposal issues (and their importance) from state employees with diverse backgrounds. Differences in the perspectives between states on the same issues provide a broad overview of major issues surrounding carcass disposal, and the commonality of perceived problems revealed by the various state participants provides validity to the assumption of what the major issues are. A weakness is that bias on the author's perspective may have limited the selection of agency types or states involved, and missed some other factor that might be relevant in developing an ideal plan. From personal experience with animal disaster carcass disposal issues within a state management perspective, and involvement from a planning level at both the state and national level, the author possesses considerable knowledge in this area. Because this research is exploratory in nature, attempting to determine a pragmatic approach to better management of carcass disposal issues, and "Anything goes (in determining) who, what, where, when, why, how issues (Shields, 1998, p. 206), the selection of the four states (with recent planning activities) to study as a starting point for analysis is appropriate.

The individuals targeted for the structured interviews were middle management level state employees with direct involvement in either plan development or actual response activities for animal health and/or carcass disposal issues for their agency. The animal health agency representatives were chosen from work related interchange regarding animal in disaster issues planning with the author over the last three years.

Those four animal health managers were then asked for references of representatives to interview from the other agencies in their state that would also have knowledge and experience in animal disaster issues. The strengths of this process was that through personal experience, there is a high likelihood that qualified knowledgeable individuals were selected. The weaknesses are that personal bias could affect the selection, and there is no way to validate that the employees referred to the author in other states were appropriate to participate in the survey. In fact, at least one employee was not cooperative, and another was never available to participate after repeated attempts to contact him.

The structured interview process was intended to capture the "big picture" aspects of carcass disposal within four states, and from the four different agency perspectives within those states. There is no attempt to compare state policies by statistical analysis, even in broad descriptive terms. The value of the interviews was in developing perceptions and pattern variations between the states, and between the different personnel participating. The attempt to capture evolving issues in a new field is necessary to ultimately recommend an ideal plan of organization by state agencies, to mitigate future difficulties in managing carcass disposal. Because this is a new field, even the participants were not necessarily knowledgeable of all regulations and procedures. Thus conflicting answers were given within a state at times. This misunderstanding of animal carcass issues as identified throughout the interviews is actually part of the current problem, and is the basis for part of the ideal plan's suggested solution, which is to develop working groups in advance to increase dialogue and understanding. The structured interviews were utilized as part of the "exploratory" research question, and the

methodology is not defensible in statistical terms, therefore the results will be reported as trends or patterns rather than absolutes.

For the study of the two natural disasters, document analysis, archival records, and interviews are utilized. In the study of FMD outbreak in the UK, direct observation and participant observation were used as well as the three methods mentioned above. The study of the Taiwan FMD outbreak incorporates document analysis, archival record review, and participant correspondence. The evidence revealed in the study of the four disaster events indicate that many of the problems that occur surrounding carcass disposal are similar whether the event generating the death losses is on domestic or foreign soil, and whether it is due to a natural or disease disaster. The results of the studies can also be applied to facilitate a better understanding of the current emergency management system in the United States, how state carcass disposal guidelines interact within the system, and more importantly how they should interact in the future. Based on the evidence gathered in this study, the components of the suggested plan derive specifically from the previously delineated problems, and are considered potential solution to mitigate such issues.

The next chapter reveals the results of the different methods of research included in this study. The evidence will show that a lack of proper planning and organization in regard to carcass disposal management impeded the efficiency of the operations once a disaster occurred. The results also indicate that a pattern of significant logistical dilemmas were encountered as a result of high volume carcass disposal issues in both the natural and disease disaster events studied.

## **CHAPTER 7 RESULTS**

This chapter presents the results for each research question initially identified as working hypotheses (WH). The findings are the answers to the questions that the hypotheses posed, and eventually serve as the foundation for the ideal carcass disposal plan. The results of the structured interviews are also evaluated in this chapter on a question by question basis. The interview process was constructed to capture the general management practices, trends in state plan development, and to gauge the opinions of the participants from each of the four states. Inconsistencies were expected and revealed from the results concerning attitudes and approaches towards disposal activities, between and within each of the four states studied. Those same inconsistencies lead to many of the disposal problems identified throughout the study.

Finally, an overview of the differences between the state approaches to carcass disposal management as delineated through the interview process is summarized. The total "package" of results presented in this chapter, then leads to justification for the ideal plan content presented in the next chapter.

### **NATURAL DISASTER RESULTS: WH1a**

The initial research question addressed identification of the major problems and issues that arose during recent natural disaster responses that included large-scale carcass disposal components within them. Both the Texas Floods of 1998 and Hurricane Floyd presented similar difficulties encountered by emergency response personnel when attempting to address the tremendous carcass disposal issues. The similarities were

apparent even though the actual type of carcass issues were slightly different. Although the number of swine drowned in North Carolina (28,000) was approximately the same as the cattle drowned in Texas (25,000), the distribution of the dead was different (TAHC 1998appendix B, NCDENR, Hurricane Floyd, p. 1). In Texas, the drowned animals were scattered along river bottoms for over 100 miles of the Colorado, Guadalupe, and San Antonio rivers. This affected numerous local government entities located in varying counties and state agency regions. In North Carolina, because the swine were primarily in CAFO type operations, the carcasses for both hogs and poultry were located in relatively small concentrated areas.<sup>6</sup>

There were similarities revealed in both instances though. Lack of animal health involvement in emergency management infrastructures, poorly developed carcass disposal plans, limited experience in large volume carcass disposal, and lack of inter-agency coordination were universal to both disasters. In Texas, inaccessibility of the carcasses posed tremendous problems that forced delayed disposal (until ground dried out to allow equipment in), or in many cases resulted in the pragmatic decision not to dispose of the animals at all. Hurricane Floyd created greater environmental and public health concerns because the dead were in more concentrated locations. The concentration also emphasized the importance of site selection for burial, and the need of well developed plans in advance to ensure an efficient and timely response (Tickle and McGinn, 2001).

Table 7.1 summarizes the key factors that influence carcass disposal during the Texas flood and Hurricane Floyd.

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<sup>6</sup> TAHC employees who responded to the floods, Inspectors Wilson, Wagner and Allen all reported on the distribution of carcasses over a large area. North Carolina employees directly involved in the Hurricane Floyd response, Dr.'s Tickle and McGinn, confirmed concentrated scope of the death losses.



**TABLE 7.1(WH1A)**  
**Natural Disaster**  
**Factors Influencing Effective Animal Carcass Disposal**

Disaster Event	Factors
Texas Flood 1998	<ul style="list-style-type: none"> <li>● Limited prior inter-agency coordination</li> <li>● No carcass disposal plans.</li> <li>● Short time frame to dispose of carcasses</li> <li>● Inaccessibility of some carcasses.</li> <li>● Inexperience in use and site selection of air curtain incinerators.</li> <li>● Minimal animal health involvement in emergency management infrastructure</li> </ul>
Hurricane Floyd 1997	<ul style="list-style-type: none"> <li>● No experience with mass disposal issues.</li> <li>● Environmental concerns</li> <li>● Inter-agency jurisdictional conflicts.</li> <li>● Poorly developed carcass disposal plan</li> <li>● Minimal animal health involvement in emergency management infrastructure</li> <li>● Inaccessibility of some carcasses.</li> <li>● Flooding of CAFO's resulting in high carcass numbers in small area.</li> <li>● Public health concerns.</li> </ul>

(Texas - Allen 2001, Wagner 2001, Michalke 2001, S. Wilson 2001, TAHC Damage report 1998, Disaster Relief 10/22/98, p. 1-4, direct observation)

(North Carolina - McGinn 2001, Tickle 2001, Hamlen 2001, Hoyle 2001, NCDENR Daily Response 10/12/99 p. 1-2, NCSU zoonosis update 9/20/99, p. 1-6, Disaster Relief News, 9/22/99, p. 1-2)

The results of table 7.1 were gathered by using all of the methods of research discussed in chapter 6. Individual participants who were involved in the disaster processes were interviewed from both states. Document analysis of internal agency and media reports was utilized to confirm first hand accounts of the process, and the first hand reports consequently confirmed the document analysis findings. The author was directly involved in managing TAHC employees who responded to the Texas floods, and also in compiling after action reports and statistics. Two of the key factors that hampered effective responses according to all of the participants interviewed for both disasters (see table 6.4) were the lack of adequate plans developed in advance to deal with carcass disposal, and the lack of integration of animal health expertise into the existing

emergency management infrastructure. Both of these deficiencies are addressed in the ideal plan proposed later.

**DISEASE DISASTER FACTORS: WH1b**

Certain commonalities were also discovered in both disease events studied. The similarities in problems encountered were a result of FMD being the source disease of both outbreaks, which creates large numbers of carcasses that must be disposed of quickly in a biosecure fashion, to successfully halt the disease spread. Biosecurity concerns are paramount to successful completion of a FMD outbreak. Those concerns limit or preclude carcass disposal activities off-site, which subsequently impacts available disposal options. The magnitude of dead animals to manage was also a factor in both situations, which led to psychological distress for both the affected livestock producers and emergency response officials. The major factors identified as significant to carcass disposal management in both Taiwan and the UK are listed in table 7.2.

**Table 7.2 (WH1b)  
Disease Disaster  
Factors Influencing Effective Animal Carcass Disposal**

Disaster Event	Factors
Taiwan Foot and Mouth Disease Outbreak - 1997	<ul style="list-style-type: none"> <li>● Millions of carcasses to dispose of</li> <li>● Biosecurity issues</li> <li>● Environmental contamination.</li> <li>● Psychological stress of disposal workers and farmers</li> </ul>
United Kingdom Foot and Mouth Disease Outbreak - 2001	<ul style="list-style-type: none"> <li>● Millions of carcasses to dispose of</li> <li>● Biosecurity issues.</li> <li>● Environmental contamination.</li> <li>● Public Health concerns.</li> <li>● No emergency management system.</li> <li>● Psychological stress of disposal workers and farmers</li> <li>● Inter-agency coordination</li> </ul>

(Taiwan - Wilson and Tuszyński, 1997, Wilson, 2001, Shieh, 1997)

(UK - Drummond, Hamlen and Waldrup interviews 2001, personal observation and discussion with numerous DEFRA and British Army employees 6/01, BBC 2001, p. 1-2, MAFF, 4/28/01, p. 1-2, DEFRA, 2001)

The identified differences for the two events were related to the concurrent existence of a public health related animal disease in the UK (Mad Cow Disease) which complicated disposal decisions there, topography differences in the two countries (water table levels), animal management peculiarities, and species and concentration of animals involved. In Taiwan, swine were the primary species affected (Wilson and Tuszynski, p. 114). Off-site burial of the carcasses in public land fills was the method choice in Taiwan because the swine were located close to human populations, and were located in concentrated numbers on small farms with high water tables which precluded burial. The logistical and environmental realities overcame the usual biosecurity concerns surrounding FMD management in Taiwan, and thus forced off site burial of the carcasses (Wilson 2001 correspondence, p. 1).

In the UK, sheep and cattle found in rural areas were the primary animal populations affected. Public Health concerns were a major factor in cattle disposal because of BSE fears. Other problems encountered included the overwhelming number of animals and premises to address, and the struggles with inter-agency jurisdiction and communication problems in a country without an emergency management system (personal observation, 2001). During the FMD outbreak, DEFRA<sup>7</sup> (animal health agency) created policy decisions concerning carcass disposal, but the Army actually implemented the process (personal observation, 2001). The use of inexperienced army personnel, and lack of prior well defined working relationships between the Agriculture and Army

officials created a myriad of problems (personal observation and Waldrup interview, 2001).

## **DISPOSAL METHOD EVALUATION: WH2a**

When analyzing the strengths and weaknesses of the various disposal options, tendencies for usage and preferences within certain scenarios are apparent. There are very few concrete "cookbook" rules that can be delineated that assist in the choice of an appropriate method of disposal. In almost all cases, more than one type of disposal method could be implemented if needed.

On-site burial is usually considered the easiest and least expensive method in most cases. It is the method of choice in many scenarios, but it does have inherent weaknesses. Burial is not a viable option when water table levels are high, topography is not conducive to digging, the ground is flooded, or if a disease agent is capable of surviving the burial process and persisting in the environment in an infectious form (TSE-prions for example).

When burial is not an option, and biosecurity issues dictate the carcasses cannot be moved off site, open burning is the option of choice. Air curtain incineration is not useable in flooded areas, but is advantageous for natural disaster clean up, as it can burn debris and carcasses simultaneously if managed properly. The air curtain incinerator can also burn large numbers of dead animals if sufficient fuel is available. Fuel availability is a limiting factor in considering either type of burning process.

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<sup>7</sup> In July 2001, the British national animal health agency was renamed from Ministry of Agriculture, Food, and Fish (MAFF) to the Department of Food and Rural Affairs (DEFRA).

Poultry are not amenable to most burning procedures, and successful burning of carcasses is somewhat dependent on weather conditions (rain can hamper effectiveness). Composting works well for poultry disposal when biosecurity is not a concern such as when the deaths are caused by natural disasters. Composting is also considered to be "environmentally friendly" because it produces a useable end product. The disadvantages are that it is slow, is not appropriate for large numbers of livestock, and is not biosecure in all cases.

The rendering process also produces a useable end product, usually destroys pathogens completely, and is environmentally sound. Rendering poses a different biosecurity concern even though it destroys pathogens completely, because animals must be transported off the farm to reach the plant. There is also limited rendering capacity in many areas, and it is not useable for poultry disposal.

Alkaline hydrolysis is a new technology that has application especially when disposing of carcasses suspected of harboring a TSE. It is inexpensive and biosecure, but poses severe capacity constraints and the technology is not widely distributed. It is currently the method of choice for carcasses suspected of harboring TSE's. Table 7.3 provides an overview of the strengths and weakness for each disposal method evaluated.

**Table 7.3:WH2a  
Carcass Disposal Method Advantages/Disadvantages**

METHOD	ADVANTAGES	DISADVANTAGES
Burial	<ul style="list-style-type: none"> <li>● Inexpensive</li> <li>● Easy</li> <li>● Biosecure (except TSE)</li> <li>● Environmentally sound except for ground water</li> </ul>	<ul style="list-style-type: none"> <li>● Site selection critical</li> <li>● not appropriate in area of shallow water table</li> <li>● TSE threat remains</li> <li>● aesthetics if improperly performed</li> <li>● future stigma for land</li> </ul>
Incineration(open air)	<ul style="list-style-type: none"> <li>● Biosecure (except TSE)</li> <li>● Inexpensive</li> </ul>	<ul style="list-style-type: none"> <li>● fuel/labor intensive</li> <li>● inappropriate for poultry</li> <li>● smoke/odor potential</li> <li>● weather dependant</li> </ul>
Incineration(air curtain)	<ul style="list-style-type: none"> <li>● Biosecure</li> <li>● Concurrent use with debris removal</li> <li>● environmentally sound</li> </ul>	<ul style="list-style-type: none"> <li>● fuel intensive</li> <li>● technically difficult when debris included</li> <li>● inappropriate for poultry</li> <li>● equipment expensive and in limited supply</li> </ul>
Composting	<ul style="list-style-type: none"> <li>● environmentally sound</li> <li>● Good for poultry</li> <li>● Inexpensive</li> <li>● useable end product</li> </ul>	<ul style="list-style-type: none"> <li>● Not biosecure</li> <li>● volume constraints</li> <li>● slow process</li> <li>● requires monitoring</li> </ul>
Rendering	<ul style="list-style-type: none"> <li>● Environmentally sound</li> <li>● biosecure</li> <li>● useable end product</li> </ul>	<ul style="list-style-type: none"> <li>● capacity constraints</li> <li>● biosecure concerns in transport</li> <li>● inappropriate for poultry</li> </ul>
Alkaline Hydrolysis	<ul style="list-style-type: none"> <li>● Biosecure (all diseases)</li> <li>● Inexpensive</li> <li>● Environmentally sound</li> </ul>	<ul style="list-style-type: none"> <li>● Capacity Constraints</li> <li>● Not widely available</li> <li>● specialized equipment</li> </ul>

(USDA Carcass Disposal, 1998, p. 1-32, AUSVET disposal 1996, p. 1-20, NCDENR, Composting fact sheets 1998, p. 1-3, WR<sup>2</sup> 2001, p. 1-5)

**DISPOSAL SELECTION FACTORS: WH2b**

Every disaster has unique considerations that ultimately determine the preferred method of carcass disposal. Even then, other methods may be utilized on a smaller scale for a myriad of reasons. The four major considerations identified in choosing the appropriate disposal method are listed in table 7.4.

**Table 7.4:WH2b  
Carcass Disposal Selection Factors**

<b>Factor</b>	<b>Event/Situation</b>
<ul style="list-style-type: none"> <li>● Environmental</li> </ul>	<ul style="list-style-type: none"> <li>● Texas/inaccessible carcasses</li> <li>● Floyd/ground and surface water contamination</li> <li>● Taiwan/ water table level forced off-site disposal</li> <li>● UK/water table level forced off-site disposal</li> </ul>
<ul style="list-style-type: none"> <li>● Biosecurity</li> </ul>	<ul style="list-style-type: none"> <li>● Taiwan FMD/offsite carcass disposal</li> <li>● UK FMD/offsite carcass disposal</li> </ul>
<ul style="list-style-type: none"> <li>● Logistical</li> </ul>	<ul style="list-style-type: none"> <li>● Texas/poor site selection delayed air curtain use</li> <li>● Floyd/carcass volume forced sub-optimal selections</li> </ul>
<ul style="list-style-type: none"> <li>● Public Health</li> </ul>	<ul style="list-style-type: none"> <li>● Floyd/flooded swine lagoons &amp; carcasses close to towns</li> <li>● UK/disposal pyres releasing dioxins into air &amp; food chain</li> <li>● UK/buried or incompletely burned carcasses posed BSE threat</li> </ul>

(Environmental - Wagner 2001, Allen 2001, Tickle 2001, Hoyle 2001, Wilson and Tsuzynski, 1997, p. 14-18, UK personal observation, 2001, NCDENR 10/12/99 p. 1-2), (Biosecurity - DEFRA, 4/12/2001), (Logistical - Wagner 2001, Ronsonette 2001, Tickle 2001, Hoyle 2001), (Public Health - NCDENR 10/12/99 p. 2-4, NCSUCE Zoonosis update, 10/01, p. 1-2, ENN 4/23/01, p. 1-2, SEAC 2001)

Environmental factors affected disposal choices in all four disaster events studied, indicating environmental considerations are routine considerations to assess as part of carcass disposal management. Biosecurity concerns are routine in disease outbreaks, but are not an issue in the early stages of a natural disaster. Public health factors routinely overcome all other issues, with the possible exception of logistical constraints. In the UK, officials were forced to ship FMD infected carcasses hundreds of miles to rendering facilities because of Bovine Spongiform Encephalopathy (Mad Cow disease) concerns, even though this process created severe biosecurity risks, and produced adverse public relations surrounding the response efforts (personal observation, 2001).

As mentioned above, public health concerns in the UK forced the utilization of a disposal method that was not ideal for the disease response. The resistance of the BSE organism to traditional methods will continue to affect disposal of affected carcasses in future incidents where the agent is potentially present. Public health concerns could also be raised as a result of toxic residues, or due to possible indirect contamination of human water supplies or the food chain.

Environmental issues are often a direct extension of public health concerns. Contamination of human drinking supplies or the production of noxious smoke are always a consideration. The location of the dead animals in relation to population densities will raise or lower the importance of environmental considerations. This reality affected carcass disposal in both the Taiwan and North Carolina events (Wilson and Tsuzynski, 2001, and Tickle, 2001). Finally, logistical considerations may override all other considerations, except in extreme public health risk situations. If the magnitude of carcass volume is overwhelming, or the natural elements (wind, rain, fire, and topography) preclude other choices, emergency response officials may be forced to select the only available choice, even though it knowingly violates accepted protocols in otherwise routine situations. This pragmatic approach to solving carcass disposal issues occurred in both the Texas Floods where carcasses out of public sight were allowed to decompose naturally (Wagner, 2001,), and in North Carolina where carcasses were buried in flooded locations because there was no other practical alternative (Tickle, 2001, and Hoyle, 2001).

## **DISPOSAL METHOD HIERARCHY**



By considering the various disposal factors, a general hierarchy of decision making in disposal selection can be created. Although matrixes have been developed and utilized to aid in this process that are well thought out and fairly complex, the presented simplified hierarchy in Table 7-5 will suffice in most cases. The development of working groups and inter-agency dialogue can then be utilized for situations that are not clear cut or require complex professional judgements. Obviously, unforeseen factors can influence decisions in any disaster, so this hierarchy is only a suggested starting point.

**Table 7.5:WH2b  
Carcass Disposal Method Hierarchy**

Order	Factor	Explanation	Example
1st	Logistics	If selection is limited to one choice by scope or external factors, then the option is that choice or no disposal at all	<ul style="list-style-type: none"> <li>● Texas Flood-carcasses inaccessible - no disposal</li> <li>● Floyd-carcasses buried on site in flooded ground</li> <li>● Taiwan -off-site burial used because swine premises too close to populations, or water table too high</li> </ul>
2nd	Public Health	Overriding factor for infectious agents or toxicities - Generally public health is top priority of emergency response.	<ul style="list-style-type: none"> <li>● UK - rendering used to eliminate BSE risk - FMD biosecurity violated</li> </ul>
3rd	Biosecurity	If no public health issues, this is primary factor in disposal for disease	<ul style="list-style-type: none"> <li>● UK - on-site burn or burial preferred</li> </ul>
4th	Environmental	Generates public interest, but usually yields to above factors - water table issue is primarily a public health factor	<ul style="list-style-type: none"> <li>● Floyd - Burned instead of buried in flooded areas</li> <li>● Taiwan - influenced decision to use off-site burial because of water table issues</li> </ul>
last	Ease/Cost	If there are no overriding public health, biosecurity, or environmental concerns, ease of use and cost are primary selection factors	<ul style="list-style-type: none"> <li>● Texas - burn if close to air curtain, bury otherwise.</li> <li>● Bury will usually be selected if no reason not to</li> </ul>

**U.S. Emergency Management System: WH3**

Because the current emergency management system in the US is relatively new, refinement and improvement of its components is an ongoing process. The system is based on federal support and facilitation of state and local responses, once they are overwhelmed. Interagency coordination is the key to this component at all levels. State emergency management systems function as the intermediary between the local and federal entities, and ensure uniform policy development and implementation at the local level. Effective local response efforts and planning are the key to successful emergency operations because actual damage occurs locally. Local response efforts however, will always depend upon state and federal resources to supplement its efforts in large-scale disasters. Table 7.5 provides a brief overview of the current emergency management system in the United States. Appendix A provides more details on the four primary components of emergency management, upon which all activities are based.

**Table 7.6 (WH3)  
United States Emergency Management System**

Federal Level	<ul style="list-style-type: none"> <li>● Only in existence since 1979</li> <li>● Organized by 4 phases of management: 1)mitigation, 2) preparation, 3)response, 4)recovery</li> <li>● Supports state and local response</li> <li>● Animal Health component still not fully integrated into system.</li> <li>● Requires Presidential disaster declaration to activate</li> </ul>
State Level	<ul style="list-style-type: none"> <li>● Organized similar to Federal system</li> <li>● Link between Federal policy/resources and local implementation</li> <li>● Requires Governor's disaster declaration to activate.</li> </ul>
Local Level	<ul style="list-style-type: none"> <li>● All emergency response mechanisms begin at local level</li> <li>● Dependant on state and federal system when local resources exceeded.</li> </ul>

(FEMA AID, 1998, Module A-3-1--A-3-7, FEMA 1997, p. 5, Mercatus 2000, p. 1-37)

The results presented so far in this chapter have answered the larger questions surrounding carcass disposal and emergency management. The main carcass disposal

problems in disasters have been delineated through the evaluation of specific events. Major carcass disposal techniques have been explored to provide a working knowledge of the options available, and the factors that might influence selection options have been illuminated. The primary components of the emergency management system of the United States has also been reviewed. The next section of the results chapter analyzes the structured interview results, which were obtained from a questionnaire, developed to explore the critical issues in more detail.

### **STRUCTURED INTERVIEW RESULTS: WH 4a/b**

It has been established that state emergency management systems are the link between federal support and local response activities. The answers from the structured interview questions take the next step in providing the link between theory (federal oversight) and action (local implementation). State managers have the ability to effectively impact disaster planning and response efforts because they are directly connected to both the national and local levels of government. By drafting a questionnaire based on the "big picture" findings already presented, and linking it to "hands on" activities of state and local emergency managers, the research strikes at the heart of the matter regarding carcass disposal issues in disasters. What are the realities that state managers face daily in creating carcass disposal plans and procedures? Identifying the problems they face, and the hurdles they must overcome to improve the carcass disposal management are the key to correcting any deficiencies.

The assumption is that the issues already identified in the study were valid, and would be confirmed through the structured interview findings. That assumption was

proven correct by the results revealed. The questionnaire provides insight into the successes and failures of state government's involvement in the previously identified carcass disposal issues. Each question in the structured interview process was specifically developed as a result of the previous identification of carcass disposal problems in recent disasters, and was linked to both the research questions answered and the proposed ideal plan. The intent (and reality) of the structured interview results was to validate the proposed plan, and to suggest any changes that might have been missed as well. Table 7.6 explains the linkage between the conceptual framework and the proposed ideal plan, which justifies each question's inclusion in the process.

**TABLE 7.7**  
**Linkage of Survey Questions to Conceptual Framework and Ideal Plan**

<b>Working Hypotheses (Research Question)</b>	<b>Question Content (15 Total questions)</b>	<b>Purpose of Question</b>	<b>Ideal Plan Component Referenced ( 8 total)</b>
Identification of Major Carcass Disposal Problems in Disasters (WH1) Identification of role of local government in recent events (WH 4b)	Question #1 <ul style="list-style-type: none"> <li>Document recent events</li> <li>Determine scope</li> <li>Explore method of disposal</li> <li>Explore management issues</li> </ul>	<ul style="list-style-type: none"> <li>Validate existence of carcass disposal issues in that state</li> <li>Identify state organization and planning weaknesses</li> </ul>	<ul style="list-style-type: none"> <li>Develop Carcass disposal plan within emergency management system</li> <li>Include local government in plan <b>(Component 1 &amp; 7)</b></li> </ul>
Integrated Plan Development (WH5) and Current State Carcass Disposal Plans (WH4)	Questions #2,3,4 <ul style="list-style-type: none"> <li>Existence of state carcass disposal plan</li> <li>Necessity of such a plan</li> </ul>	<ul style="list-style-type: none"> <li>Validate importance of plan</li> <li>Identify potential agency involvement</li> </ul>	<ul style="list-style-type: none"> <li>Develop Carcass disposal plan (as above)</li> <li>Identify agencies involved to form working group <b>(Components 1 &amp; 3)</b></li> </ul>
State Guidelines (WH4a) Disposal Factors (WH2b) Integrated plan ( WH5)	Question #5 <ul style="list-style-type: none"> <li>Site selection component</li> <li>Agencies involved</li> </ul>	<ul style="list-style-type: none"> <li>Validate importance of site selection</li> <li>Identify appropriate level and agency involvement</li> </ul>	<ul style="list-style-type: none"> <li>Working group development and membership</li> <li>County level involvement <b>(Components 4 &amp; 7)</b></li> </ul>
Animal health agency integration in Emergency management system (WH 5) Assess Current Emergency management system in state (WH33)	Question #6 <ul style="list-style-type: none"> <li>Emergency management training status</li> <li>Inclusion of animal issues</li> <li>Inclusion of carcass disposal issues</li> </ul>	<ul style="list-style-type: none"> <li>Assess realization of importance of animal issues (including carcass disposal) by state emergency managers</li> <li>Assess need for animal issue inclusion in training</li> </ul>	<ul style="list-style-type: none"> <li>Include animal issues (including carcass disposal ) component in future disaster training to raise awareness of importance to non-animal health personnel <b>(Component 2)</b></li> </ul>
Integrated plan (WH 5) State Guidelines (WH 4a) Local Involvement (WH4b)	Question #7 & #8 <ul style="list-style-type: none"> <li>Assess Jurisdictional conflicts</li> <li>Identify agency involvement</li> <li>Assess local involvement</li> </ul>	<ul style="list-style-type: none"> <li>Validate problems identified in recent events</li> <li>Validate need for interagency working groups</li> <li>Validate need for local involvement</li> </ul>	<ul style="list-style-type: none"> <li>Develop interagency working group</li> <li>Working group should identify jurisdictional conflicts and develop solutions</li> <li>Include local govt. <b>(Components 3 ,4 &amp; 7)</b></li> </ul>

**TABLE 7.7 (cont.)**  
**Linkage of Survey Questions to Conceptual Framework and Ideal Plan**

<b>Working Hypotheses (Research Question)</b>	<b>Question Content (15 Total questions)</b>	<b>Purpose of Question</b>	<b>Ideal Plan Component Referenced ( 8 total)</b>
Current Emergency management system (WH3) State Carcass Disposal management (WH4a) Integrated plan (WH5)	Question #9 <ul style="list-style-type: none"> <li>● Existence of debris management contracts</li> <li>● Is carcass disposal included within</li> </ul>	<ul style="list-style-type: none"> <li>● Validate contracts exist</li> <li>● Validate possible use for carcass disposal</li> <li>● Determine current payment system</li> </ul>	<ul style="list-style-type: none"> <li>● Expand debris management contracts to include carcass disposal</li> <li>● Raise awareness of importance of carcass disposal costs</li> </ul> <b>(Component 5)</b>
State Carcass Disposal Management (WH4a) Integrated Plan (WH5) Local involvement (WH4b)	Questions #10 & #11 <ul style="list-style-type: none"> <li>● Existence of interagency carcass disposal plan</li> <li>● Assess County involvement</li> </ul>	<ul style="list-style-type: none"> <li>● Validate plan importance</li> <li>● Identify lead agency</li> <li>● Validate importance of local government</li> </ul>	<ul style="list-style-type: none"> <li>● Develop internal carcass disposal plan or identify lead agency to work with</li> <li>● Local government</li> </ul> <b>(Component 6 &amp; 7)</b>
Current Disposal Methods (WH2a) Factors Affecting Selection (WH2b) Local Involvement (WH 4b) Integrated plan (WH5)	Question #12 <ul style="list-style-type: none"> <li>● Hierarchy established for disposal methods in both types of disasters</li> </ul>	<ul style="list-style-type: none"> <li>● Key Component of plan is hierarchy</li> <li>● Expedites selection process and makes method selection uniform</li> </ul>	<ul style="list-style-type: none"> <li>● Develop internal plan that is consistent with state plan</li> <li>● Local involvement in hierarchy exceptions</li> </ul> <b>(Component 6 &amp; 7)</b>
Current State Management (WH4a) Integrated Plan (WH5)	Question #13, 14, 15 <ul style="list-style-type: none"> <li>● Database resource</li> <li>● Database management</li> <li>● Agencies involved</li> </ul>	<ul style="list-style-type: none"> <li>● Validate database creation as necessary part of planning process</li> <li>● ID lead agency</li> </ul>	<ul style="list-style-type: none"> <li>● Develop databases of carcass disposal resources in advance</li> <li>● ID agencies to maintain databases</li> </ul> <b>(Component 8)</b>
All	Question #16 <ul style="list-style-type: none"> <li>● Any Other comments</li> </ul>	<ul style="list-style-type: none"> <li>● Validate other answers</li> <li>● Minimize possibility of leaving out key component of plan</li> </ul>	<ul style="list-style-type: none"> <li>● May refer to all</li> <li>● Could identify other components needed</li> </ul> (No new components identified)

The results of the structured interviews are presented by question, and by state response. Although individual agency representatives were interviewed within each state,

their results are primarily summarized into a single state level answer. Because carcass disposal and animal issues within the emergency management context is a new and developing field, even the officials involved in the various operations are not always well informed of their state regulations and policies. Confusion within states as to the authority and responsibilities of the various agencies is obvious. This confusion is in part due to lack of prior working relationships or dialogue, and also a result of incomplete plan development. Both deficiencies are ultimately addressed in key components of the ideal plan.

The abbreviations listed in Table 7.7 are used throughout the separate tables reporting the structured interview results for each question. The vast array of acronyms and lengthy agency names made it difficult to keep the size of the tables that report the interview results to a workable format. The agency responses are generalized by type of agency, and the acronyms listed below are defined in that manner. Appendix D lists the actual structured interview participant names, complete agency titles, and job titles.

**Table 7.8**  
**Definition of Table Abbreviations**

<b>Acronym</b>	<b>AGENCY TYPE</b>
Ag	Animal Health Agency
En	Environmental Agency
Em	Emergency management Agency
Gs	General Services, Contracts or Purchasing Agency
Tr	Transportation Agency
Ext	Agriculture Extension Service
Hlth	Public Health Agency
PW	Parks and Wildlife Agency
CAFO	Concentrated Animal Feeding Operation
NA	Not Applicable

## **RECENT DISPOSAL EVENTS**

The first question in the survey was intended to validate the fact that each state has had to deal with carcass disposal issues recently. The question also explores the variety of species involved, scope of events, and disposal methods utilized. Table 7.6 provides a summary of the findings. Compensation for the cost of the operations performed was from FEMA reimbursement, or was absorbed by the agency, dependent upon whether a Presidential declaration was enacted or not. The state animal health agency was routinely in charge of the process, and county government appeared to be intricately involved as well in most cases. The fact that the General Service agency representative from three different states was unaware that significant carcass disposal events had recently occurred, suggests that state contract payment mechanisms are not being utilized, and that the same agencies are not included in routine dialogue surrounding carcass disposal. The interagency working group component of the ideal plan will help alleviate this type of disjointed inter-agency involvement (or lack of involvement). County participation in the disposal processes was evident in all the states other than Texas. It should be noted that Texas is the only state of the four studied that does not have county level animal issue committees included as part of its existing emergency management structure.



**Table 7.9  
Recent Carcass Disposal Events**

Question	Texas	California	North Carolina	Florida
Agency managed Carcass disposal in last 3 years	3 yes GS no	2 yes, GS no, 1 no response	3 yes GS - don't know	2 yes(Ag/Em) 2 no (GS/En)
largest number disposed	500 cattle	10,000 cattle 150 cattle	2 million chickens 20,000 hogs	2000 chickens 70 ostriches
Cause of death	drowned	heat stroke	drowned	storm damage
Disposal method of choice	bury 1° burn 2°	render (10k) open burn (150- no render due to toxicity issue)	bury 1° burn 2°	bury -chickens air curtain - ostriches
1° Factor affecting decision	ease/burn if close to air curtain		Easiest	don't know
Lead Agency	Ag/River Authority	Ag	Ag	Ag
Compensation source	FEMA	none - Ag absorbed cost	FEMA 75%-State 25%	FEMA
Local government role	site location	site location for burn	Trucks/equipment producers helped	provide trucks, wood, personnel

## **EXISTING CARCASS DISPOSAL PLANS**

The questions summarized In Table 7.10 explore the existence of emergency management plans in each state that include carcass disposal considerations, and whether those plans contain contingencies for natural or disease related disasters. Questions about which agencies should be included in the planning process were intended to validate the concept of working groups in the ideal plan. The issue of site selection inclusion was also tested, as it has been documented to create problems in some of the disaster events researched. Three of the four states examined have emergency management plans with carcass disposal components. In all three cases, a number of agencies are involved in the planning (working groups). Texas is the only state that does not routinely employ the working group concept. Paul Dahlen (NCDENR) reinforced an earlier assumption in his

response. He noted that, "The working group concept in North Carolina was created out of necessity following the confusion that surrounded the great death losses in swine and poultry from Hurricane Floyd".

Site selection appears to have been overlooked as a component worthy of codified inclusion in the planning processes (except California), even though site selection issues created complications for burial efforts in both natural disaster events studied. The omission is possibly due to the fact that pre-arranged site selection for large scale disposal would be most appropriately determined by local governments and affected producers, and this inquiry was focused at state level plan analysis. Heidi Hamlen of California (CDFA) did state that the California Environmental Protection Agency was drafting regulations for site selection criteria, as a result of involvement in their State's carcass disposal working group, and the issue was also being studied by local emergency committees in California.

**Table 7-10  
Existing Carcass Disposal Plans of Four States**

Question	Texas	California	North Carolina	Florida
Emergency mgt. plan with carcass disposal included	No	Yes	Yes	Yes not detailed - says county responsible
Natural Disaster component	NA	Yes	Yes	Yes - but not incident specific
If no, should state have one?	NA	NA	NA	NA
What agencies should be included	NA	Ag, Em, En, Ext.	Ag, Em, Ext., En	Em, Ag, En, Tr
Which agency should be lead	NA	Ag	County or Ag	Ag
Disease Disaster Component	NA	Yes	Yes	Yes - but not incident specific
Should have one	NA	NA	NA	NA
What agencies should be included	NA	Ag, Em, En, Ext.	Ag, Em, Ext., En	Em, Ag, En, Tr
Which agency should be lead	NA	Ag	County or Ag	Ag
Site Selection Component	NA	No	Yes	Yes
Selection Criteria	NA	NA	none codified	water table level
Agencies Involved	NA	County decision	County or CAFO to decide location	ESF 17 members- Ag,En,Gs,Pw,Hlth, Ext

## **STATE EMERGENCY MANAGEMENT TRAINING**

The next question in the survey assessed the existence of emergency management training courses for each state, and whether they include animal issues within the curriculum. The results are exhibited in Table 7.10. A major problem identified by participants in both Hurricane Floyd and the Texas Floods was that the animal health agencies in both states were not incorporated into the emergency management system. The existence of animal health components in emergency management training courses should reveal whether the emergency management trainers consider animal issues to be legitimate topics for inclusion in their curriculum. The results revealed that all states have

some type of general emergency management training course, but only Florida covers animal issues in the content of its course. These results indicate that Texas and North Carolina animal health officials still have to work closer with their emergency management officials to raise awareness of animal issues in emergency management. California preferred to have its animal health agency (CDFA) teach the course (animals in disasters) separately, and does so routinely at regional workshops. Whether this raises the awareness of the importance of animal issues in disasters, or promotes further compartmentalization of the agencies missions is debatable.

**Table 7.11  
State Emergency Management Training in Four States**

Question	Texas	California	North Carolina	Florida
Basic Emergency Mgt. Course	yes	yes	yes	yes
Include Animal disaster issues	no	no	no	yes- covers ESF 17 Animal Protection
Should include Animal issues	yes -2 don't know - 2	no - Ag teaches own course	yes -3 don't know - 1	yes
Does Include Carcass Disposal	no	no	no	yes
Should Include Carcass Disposal	yes -2 don't know - 2 (Gs & En)	yes - 2 GS - don't know En - no response	yes -3 1 qualified yes - prefers working group concept	yes - 3 don't know - 1 (En)
If yes, what issues should be covered	jurisdiction conflicts & coordination	county responsibility	county responsibility	payment, disposal method, water table, site selection,

All of the animal health and emergency management participants agreed that animal issues (including carcass disposal) should be included in basic emergency management training courses, and all four of the states hold such training. Only Florida currently includes animal health components however. The ideal plan suggests that state emergency management training includes animal issues, and this interview process

validates the concept. The suggested topics include clarification of jurisdiction, county (local) responsibility, environmental concerns and payment mechanisms. All of these issues are addressed in the ideal plan, either through the training course suggestion or other mechanisms.

## **INTERAGENCY JURISDICTIONAL CONFLICTS**

Assessment of inter-agency jurisdictional conflicts and the existence of any mechanisms within the states to mediate such conflicts were the intent of the next survey questions. The results are summarized in Table 7.12. In all four states, inter-agency conflicts surrounding jurisdiction over carcass disposal existed. The conflicts are often present because carcass disposal issues are usually expressed as guidelines or suggestions (optional) by animal health agencies, but environmental considerations are routinely stated as regulation or statute (mandatory). Lack of understanding of the different agency's involvement (through little or no dialogue), and what flexibility each agency possesses in waiving its responsibilities also contributes to the problems.

**Table 7.12  
Interagency Jurisdictional Conflicts**

Question	Texas	California	North Carolina	Florida
Multi-Agency Disposal Jurisdiction	Yes	Yes	Yes	Yes
What agencies	Ag, DH,En,	Ag, En, County	Ag, En, DH	Ag, DH, En
Working Group	No	yes -Rendering industry organized	yes	yes - ESF 17
Frequency of meeting	NA	2x per year	as needed now - plan complete	1x per year - ESF plan complete
Lead Agency	NA	Ag & En	Ag & Em	Em
Member agencies	NA	county committee members	Ag, Em,Ext, En,DH	ESF 17 members - Ag, En,Gs,Pw,Hlth,Ext
County mechanism	NA	yes	yes	yes
Should group exist	yes	NA	NA	NA
What jurisdictional conflicts exist	county burn bans, burn & water permits	Environmental - water/air	ground water, air quality permits	air curtain permit required, air, water, solid waste
Mechanism to resolve	For air- En will waive permit	Executive Order waives all En rules in emergency	State vet order has precedence in animal disasters	In disaster, En can issue one blanket permit for all

Three of the four states (excluding Texas) utilize some type of working group process to help ameliorate the problems. County government participation was evident in all three of those states' working groups as well. A variety of conflicts were identified as potential problems, including county orders (burn bans), air quality permit issuance, water pollution, and solid waste disposal concerns. The mechanisms to resolve the issues included waivers of environmental regulations during disasters, and delineating that the animal health agency has final jurisdiction in disasters affecting animals. Dr. Jimmy Tickle of North Carolina Department of Agriculture stressed the importance of the working group concept, by stating that the working groups were, "especially productive by meeting regularly to resolve issues between the agricultural and environmental agencies."

An unresolved conflict in Texas concerns identifying which issue takes precedence when a county burn ban is in effect, but burning of carcasses is deemed to be the method of choice by animal health officials. This actually represents two different levels of conflict. The first is public safety versus public health, and the second level is that of county versus state jurisdiction. Local government integration into emergency planning activities and pre-arranged mechanisms to solve such conflicts are the key to minimizing confusion in the future. Both contingencies are included in the ideal plan.

## **STATE DEBRIS MANGEMENT CONTRACTS**

Evaluation of state contractual processes for debris management during disasters was the intent of the next interview question. The key issues were whether pre-existing debris management contracts existed in each state, and were carcass disposal components included within the contracts. The results indicate that Florida and North Carolina use pre-arranged contracts routinely as part of their hurricane preparedness, and the contracts cover carcass disposal. The only difference between the two was whether the contracts are developed at the county or state level. According to interviewee Carla James of Texas' General Service Commission (GSC), pre-existing contracts were statutorily prohibited in Texas until the 2001 legislative session amended the law. The GSC is currently evaluating the creation of pre-existing debris management contracts in the state, and will consider carcass disposal issues within them.

**Table 7.13  
Debris Management Contracts**

Question	Texas	California	North Carolina	Florida
Pre-existing debris mgt. contracts	no-illegal until last legislative session except w/River Authorities	no pre-existing contracts - but have pre-existing relationships	yes agency controlled "delegation", and county contracts	yes pre-event contracts at county level only
carcass disposal included	NA	NA	yes for FMD plan, no for natural disaster but could	yes at county level, Ag would develop specific contract for large disaster
Should carcass disposal be included in debris mgt. contracts	yes - include equipment costs	yes but necessary - could fall under umbrella of other debris removal	yes, especially for pre-arrangement with landfills	yes- Ag,Gs, don't know - En yes for natural only-Em
How included	En - as line item, GS - for all contingencies	use emergency contract process	don't know other than to id landfills and equipment	recognize debris chain includes animals

Interviewees from all four states agree that carcass disposal clean up and associated costs could be planned for through pre-existing contracts. The benefit of such planning is not only in the development of a payment mechanism, but that emergency response officials will have already identified the company (through contractual agreements) who will perform clean up activities. Thus, the necessary expertise and equipment to perform the activities will be available sooner for use. Inclusion of carcass disposal coverage through pre-agreed debris management contracts (as suggested in the ideal plan) will require inter-agency dialogue, raise awareness of carcass disposal issues in various state agencies, and improve response time during an actual event.



## STATE AGENCY CARCASS DISPOSAL PLANS

The next topic explored in the structured interview process was whether internal agency carcass disposal plans were created, or that each agency at least recognized it had some responsibility in regard to carcass disposal issues. Except for the animal health agencies, it was not expected that all other agencies would have a plan, but the issue of whether they even recognized carcass disposal as a legitimate area of involvement for their agency was important to assess. The results are listed in table 7.14. In addition to whether a plan existed, an understanding of the types of agencies who had developed plans, who the perceived lead agencies were within each state, and whether there was local involvement in the process was also examined.

**Table 7.14**  
**State Agency Carcass Disposal Planning**

Question	Texas	California	North Carolina	Florida
Agency carcass disposal plan	En - yes Ag,Em,GS - no	in progress - 1 don't know - 2 no response - 1	yes - inclusive for all agencies	no -2 Ag, Em, - ESF 17 may cover -not finished - not sure
Lead person identified	NO	NA	Ag, En, Em - yes GS - no response	NA
County Involvement	no	yes for 1 in progress -County level Ag and Em	yes County Animal Response Team	yes in some counties active with ESF 17
County ID of largest herd	no	yes part of county plan	no	no
Should county analyze local issues	yes-1(Ag) no - 1 don't know - 2	yes-2 Ag, Em don't know - 1GS no response - 1 En	yes-2 Ag, En, no - 1 Em, no response- 1 Gs	yes- Ag, En, Gs Don't know - 1 Em
Should have an agency plan if doesn't	yes -2 Ag, Em no - 2 En, Gs	3 - believe umbrella state plan sufficient, 1 no response En	yes - 2 Ag, Em no - 1 will use Ag plan En, no response - 1 Gs	yes - 4

The carcass disposal planning process ranged from an all inclusive plan in North Carolina, to Texas whose only state level plan was in relation to environmental waivers necessary for disposal. County involvement in the planning processes was again included in all states except Texas. The consensus of each state polled was that carcass disposal plans should be developed at some level in the state, and local planning should be part of the process.

### **Disposal Method Hierarchy**

Exploration of the existence of disposal preferences by the various states was the next topic of study. All states have some type of preference delineated at either the state or agency level, but only California's is comprehensive. The importance of creating a hierarchy for method selection is that it can only be completed within the context of a larger planning process, and it must include dialogue between all interested parties to be successful. California provides a suggested matrix format to determine the appropriate method, which mirrors USDA guidelines. California's stated preference is rendering, although the matrix provided does not relate that preference. North Carolina also endorses rendering, while on-site burial was the first choice in Florida, if other complicating factors are not present. Because Texas does not have a carcass disposal hierarchy developed within its animal health agency, the only stated preference is from its environmental agency (TNRCC), which views burning as more desirable than burial.

**Table 7.15  
Disposal Method Hierarchy**

Question	Texas	California	North Carolina	Florida
Does state have preferred disposal hierarchy	no state plan En agency has preference	yes	yes	yes
If so, what is it?	1. Air curtain, 2. open burn, 3. bury	1. render 2. location dependent	1. render 2. burial on site 3. burial off-site 4. compost 5. burn	1. Burial on site, 2. Incineration on-site, 3. burial off site, 4. Incineration off-site, 5. render

The results reflect an interesting contrast of preferences for method selection, primarily based on pragmatic evaluation of the method limitations. For example, Florida listed rendering as it's last choice, not because it disapproves of the process, but according to Joe Kight of the Florida Division of Animal Industry, " There isn't any rendering capacity in Florida, so there is no reason to list it as a viable option". In North Carolina rendering is listed as the first choice, but Dr. Jimmy Tickle noted that, " Since we have limited rendering capacity in the state, on-site burial is our realistic first option". Regardless of what hierarchy is developed, the key issue is that state agency planners have sat down and talked about the issues involved in advance. The hierarchy component of the ideal plan is complimentary to the development of working groups, analysis of inter-agency jurisdictional conflicts, and local involvement, all of which have been established as important to successful carcass disposal management in the ideal plan.

**DISPOSAL RESOURCE DATABASES**

Questions about database development in the survey attempt to analyze preparedness levels for each of the state agencies, as well as examining interagency coordination and communication activities. The importance of examining database existence was to validate that the state managers felt databases were important to the planning process, and the maintenance of the databases would indicate agencies who are in leadership roles for carcass disposal. The results are listed in Table 7.16. In keeping with the philosophy of facilitating response efforts rather than leading them, the emergency management representatives did not feel that their agency should maintain any databases, but they all wanted access to them. The generally recognized lead agency for database maintenance in regard to carcass disposal resources were the animal health agencies for each state.

**Table 7.16  
DISPOSAL RESOURCES DATABASES**

Question	Texas	California	North Carolina	Florida
Does Agency maintain database	2 - yes Ag, En 1 - no Em 1- vendor list GS	1- yes Ag 1 - no Em 1- vendor list Gs 1 - no response En	1-yes Ag 2 - no Em, En 1 - no response GS	2 - yes - Ag, Em 2 - no - En, 1 - vendor list GS
Who keeps air curtain list	Ag, En, Gs	Ag, Gs(on vendor list)	Ag	Ag, Em
renderer list	Ag	Ag	Ag	Ag
Commercial Incinerator list	En	Ag	Ag	Ag, Em
Alkaline Hydrolysis list	none	none	none	none
Other disposal resource lists kept	kilns - En	Medical Incinerator Ag	County landfills Ag	Public Incinerator Ag
Should database lists be kept	Em - yes Gs - no vendor list ok En - yes Em should	3- no let Ag keep it	3 - no let lead agency (Ag) keep it	yes let lead agency keep or Em access

The contract services and environmental agencies were not expected to be maintaining databases, but the question was asked to analyze if they understood the type

of disposal methods and mechanisms that would be utilized in a disaster. The contract service agencies relied primarily on master vendor lists, and the environmental agency representatives did not keep any lists except in Texas. The consensus of the groups seem to be that databases were appropriate to pre-identify resources as needed, but only the lead agency for each type of resource needed to maintain the information. The other agencies simply wished to access the information as needed. The animal health agencies appeared to be the agency most appropriate to maintain master lists of resources for the various carcass disposal methods.

### **OTHER CONSIDERATIONS**

The final question of the survey was open ended to give the participants the opportunity to stress or include previously omitted topics that they felt were important to successful carcass disposal planning and management. The importance of this question was that it allowed a process to identify overlooked critical issues that should be addressed in any ideal plan. The questionnaire was developed on perceived issues and attempted to validate the ideal plan components that would mitigate the same issues. There is always the possibility that bias or other factors may have allowed the omission of critical plan components.

**Table 7.17**  
**Other Considerations**

Questions	Texas	California	North Carolina	Florida
Are there other considerations or components of carcass disposal that are important?	En - consider jet powered air curtain incinerators Gs - working on developing pre-existing contracts - will include carcass disposal	Em- Inter-agency communication is key - main role of Em is to facilitate cooperation among agencies	Ag - producers have main responsibility for disposal Em - emphasize prior planning En - inter agency coordination, county involvement, working groups	Em -Public information crucial En - County involvement Gs - solve environmental issues in advance Ag- public education, county involvement

The responses reflected concerns about problems that had occurred in past experiences of those respondents in real situations. The expressed concerns validated the types of major issues identified previously during analysis of the four disaster events.

The most significant areas mentioned as critical to carcass disposal planning were:

1. Inter-agency cooperation
2. Importance of pre-planning
3. County involvement

All of three of the issues listed above, which the participants felt were important enough to re-iterate in their closing remarks, are included as key components in the suggested ideal plan.

## **SUMMARY OF RESULTS**

As mentioned previously, the intent of the structured interview process was to confirm that the "big picture" issues identified from the four disaster events were the same problems encountered by those individuals managing the day to day functions of carcass disposal management. The results of the interviews validated that the issues initially identified in this study were indeed the same problems faced by the interviewees. The second purpose of the structured interviews was to validate that the components of

the suggested plan would indeed correct or mitigate the common problems that occur in large-scale disposal efforts. The questions were linked to the conceptual framework and also to the key components of the ideal plan to ensure that all significant factors were discussed during the interviews. The participants were not specifically asked in all cases if a suggested component would be successful, but through direct or indirect discussion, all key points within the plan were validated as important and necessary from the participants.

From the study of the four disasters, it had been determined that lack of involvement and dialogue between the animal health agency and emergency management officials led to confusion and inefficient responses during a disaster. The interviews revealed that the states were beginning to recognize this reality, and had begun to solve the issue through some form of working group concept. Integrated planning processes that linked all levels of involvement were also key factors according to the participants. Resolution of inter-agency conflicts and development of "best-method" response mechanisms were both deemed critical to success. The states were also beginning to address the planning and communication deficiencies through the development of planning processes, which ensured that all involved parties were included.

## **IDEAL PLAN JUSTIFICATION**

The validity of any ideal plan to manage future carcass disposal issues during disasters is incumbent upon first understanding the issues that complicate the process, and then ensuring that the suggested plan addresses those issues. Table 7.18 provides an

overview of this study's journey to satisfy both criteria, which would ultimately ensure that the suggested plan is valid and reasonable.

**Table 7.18**  
**Ideal Plan Justification**

Component	Research Method	Evidence	Source
Animal disaster plan that includes carcass disposal <ul style="list-style-type: none"> <li>● Part of state disaster plan</li> <li>● internal agency plan</li> </ul>	<ul style="list-style-type: none"> <li>● Non-structured interviews</li> <li>● Structured Interviews</li> <li>● Document Review</li> </ul>	<ul style="list-style-type: none"> <li>● Past disposal efforts hampered by lack of planning</li> <li>● Emergency management system facilitates success</li> </ul>	<ul style="list-style-type: none"> <li>● Texas Flood</li> <li>● Hurricane Floyd</li> <li>● UK FMD outbreak</li> </ul>
Carcass Disposal Issues presented to Emergency Management professionals <ul style="list-style-type: none"> <li>● basic training</li> <li>● agency specific</li> </ul>	<ul style="list-style-type: none"> <li>● Document Review</li> <li>● Structured Interviews</li> <li>● Non-structured interviews</li> </ul>	<ul style="list-style-type: none"> <li>● prior relationships and understanding of issues facilitates success</li> <li>● carcass disposal implementation not always managed by animal health professionals</li> </ul>	<ul style="list-style-type: none"> <li>● Texas Flood</li> <li>● Hurricane Floyd</li> <li>● UK FMD</li> </ul>
Interagency working group created <ul style="list-style-type: none"> <li>● Members</li> <li>● jurisdiction</li> <li>● waiver mechanism</li> </ul>	<ul style="list-style-type: none"> <li>● Non-structured interviews</li> <li>● Structured Interviews</li> <li>● Document Analysis</li> <li>● Literature review</li> </ul>	<ul style="list-style-type: none"> <li>● Jurisdictional conflicts hamper response efforts</li> <li>● inter-agency communication key to success</li> <li>● understanding disposal issues key to proper selection</li> </ul>	<ul style="list-style-type: none"> <li>● Hurricane Floyd</li> <li>● UK FMD</li> <li>● Taiwan FMD</li> <li>● Drabek 1985</li> <li>● Casper 1993</li> <li>● Heath 1999</li> </ul>
Predetermine Payment mechanism	<ul style="list-style-type: none"> <li>● Non-structured interviews</li> <li>● Document Review</li> <li>● Structured Interviews</li> </ul>	<ul style="list-style-type: none"> <li>● predetermined funding mechanism facilitates selection of method and vendor</li> <li>● Payment for disease carcass disposal different mechanism</li> </ul>	<ul style="list-style-type: none"> <li>● NAHEM 2000</li> <li>● Hurricane Floyd</li> <li>● Texas Flood</li> </ul>
County involvement <ul style="list-style-type: none"> <li>● County planning committee</li> <li>● identification of hazards</li> <li>● site location</li> <li>● Locate equipment</li> </ul>	<ul style="list-style-type: none"> <li>● Non-structured interviews</li> <li>● Structured Interviews</li> <li>● Document Review</li> </ul>	<ul style="list-style-type: none"> <li>● County component critical to success</li> <li>● site selection facilities response efforts</li> <li>● Resource identification facilitates response</li> </ul>	<ul style="list-style-type: none"> <li>● Texas Flood</li> <li>● Hurricane Floyd</li> <li>● USDA 1998</li> <li>● AUSVET 1996</li> <li>● FEMA 1998</li> </ul>
Database Maintenance <ul style="list-style-type: none"> <li>● Id databases to keep</li> <li>● Id agency to maintain</li> </ul>	<ul style="list-style-type: none"> <li>● Non-structured interviews</li> <li>● Structured Interviews</li> </ul>	<ul style="list-style-type: none"> <li>● Advance planning facilitates response</li> </ul>	<ul style="list-style-type: none"> <li>● Hurricane Floyd</li> <li>● Texas Flood</li> <li>● UK FMD</li> </ul>



The major issues surrounding carcass disposal have been established in this study, and potential solutions for those problems have been explored and validated through the structured interview process. The only remaining step is to present the suggested ideal plan, which will be accomplished in the next chapter.

## **CHAPTER 8 CONCLUSION**

This paper has analyzed the dynamics of carcass disposal in disaster situations from a variety of perspectives. The reality of deciding how to manage the disposal of thousands of livestock carcasses, or millions of poultry, has proved to be a logistical nightmare in the past for emergency management and animal health officials. The benefit of pre-existing plans, and a baseline understanding of the major issues that affect carcass disposal management, should prove to be invaluable assets to individuals charged with the task. The suggested ideal plan proposed in this chapter, is presented as the first step in improving disaster related carcass disposal management processes. The pragmatic approach of simply working out issues in advance, and effectively communicating between agencies and affected parties are the overriding themes of the plan. As practical as those ideas seem, the research has proven that most emergency response and planning mechanisms have been deficient in both areas. This plan is presented as a logical solution to accomplish those ends.

The suggested ideal state level carcass disposal management plan will consist of the following parts:

**Table 8.1**  
**IDEAL PLAN**

**Suggested Template to Manage Carcass Disposal Planning and Response  
within State Emergency Management Systems.**

1. Develop a comprehensive emergency management plan for animal health issues within the context of both natural and disease disaster events. Carcass Disposal management should be included in the plan.

2. Animal Carcass Disposal issues should be included curriculum in basic emergency management courses offered by the state emergency management agency, or offered as an adjunct to that basic training by the animal health agency in the state for emergency response officials.

3. An interagency working group should be created that meets regularly and consists of at least the state environmental, animal health, contract service, and emergency management agencies. Other suggested partners include the public health, extension service, transportation, and wildlife agencies.

4. The working group should examine all existing state regulations for jurisdictional conflicts or authority issues that need to be resolved. A lead agency should be identified for carcass disposal issues. A waiver process or mechanism for resolving conflicting authorities should be developed and agreed upon.

5. Each state agency included in the working group should develop an internal plan for their responsibilities surrounding carcass disposal, or acknowledge their participation in a comprehensive state level plan, and understand their role within it.

6. Existing state debris management retainer (pre-existing) contracts should be expanded to include a carcass disposal component. Companies that can perform large-scale carcass disposal functions should be identified in advance, and negotiated with for cost and scope of services to be performed.

7. County level emergency management involvement is key to successful management of carcass disposal. County involvement should be formally included in the state level plan. Mass burial site selection and identification of hazards unique to that location should be primary responsibilities of county/local officials. Concentrated Animal Feeding Operations located in each county should be included in the planning process.

8. Carcass Disposal Resource Databases should be maintained at the state and county levels, and a lead agency identified in each state with responsibility for maintaining at minimum the following carcass disposal resources:

- a. Rendering plants
- b. Air curtain incinerators
- c. Institutional incinerators
- d. Alkaline hydrolysis equipment
- e. Public landfill locations

Although planning alone cannot ensure success in responding to unforeseen circumstances such as the unexpected death of a large number of animals, it is the first step towards a successful response. In a new field of public sector service such as animal disaster management, dialogue is essential between all parties to better understand the issues and conflicts. Planning alone is not enough however. In recent closing remarks to the International Workshop on Animal Disposal Alternatives, former USDA/APHIS Administrator Lonnie King was quoted as saying, " I think that you have to make sure that your plans don't become just another pretty report-that you have to take the knowledge and transfer it into actions" (IWADA, 2000, p. 38). The intent of the ideal plan presented in this study was not to conclusively delineate all actions to be taken. Nevertheless, it is an appropriate starting point to take some actions. If any portion of the plan is adopted, it can be assumed that the participants involved will be better prepared for future carcass disposal events.

Improvement to carcass disposal processes specifically, and to a greater degree animal issues within emergency management systems, is simply the beginning of a long and difficult scientific inquiry into government systems, animal health concerns, environmental science and human psychology. Unfortunately, it will take future disasters and the revelation of existing weaknesses in the emergency management infrastructure to completely refine the process. Reality is a cruel but effective teacher of lessons. In the mean time, adoption of any or all parts of the plan presented here will surely facilitate future carcass disposal responses by the appropriate officials.

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## Appendix A



The following table briefly describes each of these phases

## The Four Phases of Emergency Management

<p><b>Mitigation</b> Preventing future emergencies or minimizing their effects</p>	<ul style="list-style-type: none"> <li>• Includes any activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies.</li> <li>• Buying flood and fire insurance for your home is a mitigation activity.</li> <li>• Mitigation activities take place before and after emergencies.</li> </ul>
<p><b>Preparedness</b> Preparing to handle an emergency</p>	<ul style="list-style-type: none"> <li>• Includes plans or preparations made to save lives and to help response and rescue operations.</li> <li>• Evacuation plans and stocking food and water are both examples of preparedness.</li> <li>• Preparedness activities take place before an emergency occurs.</li> </ul>
<p><b>Response</b> Responding safely to an emergency</p>	<ul style="list-style-type: none"> <li>• Includes actions taken to save lives and prevent further property damage in an emergency situation. Response is putting your preparedness plans into action.</li> <li>• Seeking shelter from a tornado or turning off gas valves in an earthquake are both response activities.</li> <li>• Response activities take place during an emergency.</li> </ul>
<p><b>Recovery</b> Recovering from an emergency</p>	<ul style="list-style-type: none"> <li>• Includes actions taken to return to a normal or an even safer situation following an emergency.</li> <li>• Recovery includes getting financial assistance to help pay for the repairs.</li> <li>• Recovery activities take place after an emergency.</li> </ul>

## Appendix B

### 1998 TEXAS FLOOD LOSSES

#### Livestock

(estimated by county)

<u>LOCATION</u>	<u>TAHC STATS</u>	<u>USDA/FSA STATS</u>
<b><u>TAHC Area 7</u></b>		
	<u>Animal Losses</u>	<u>Animal Losses</u>
CALDWELL	1500 cattle/20 horses	3000 cattle
HAYS	200 cattle	200 cattle
BURLESON	0	0
LEE	0	0
BASTROP	0	200 cattle/150 poultry
<b><u>TAHC Area 5</u></b>		
BEXAR	400 cattle	100 cattle
GOLIAD	45 cattle	50 cattle
GUADALUPE	2500 cattle	2000 cattle/ 50 hogs
KARNES	2 cattle	0
REFUGIO	0	0
WILSON	400 cattle/50 hogs	400 cattle/50 hogs 30 sheep/ 10 horses
COMAL	0	300 cattle/100 sheep
<b><u>TAHC Area 8</u></b>		
DEWITT	7000 cattle	5000 cattle
JACKSON	0	200 cattle
VICTORIA	1000 cattle/50 hogs	1000 cattle/50 hogs
WHARTON	0	0
GONZALES	10,000 cattle	10,000 cattle
COLORADO	0	100 cattle
FAYETTE	0	50 cattle
LAVACA	0	500 cattle
CALHOUN	0	100 cattle
<b>TOTAL</b>	<b>23,047 cattle</b> <b>100 hogs</b> <b>20 horses</b>	<b>23,200 cattle</b> <b>150 hogs</b> <b>10 horses</b> <b>100 sheep</b> <b>150 poultry</b>

TAHC internal document prepared by Dr. Dee Ellis, TAHC emergency management lead person, 12/3/98

## Appendix C

**Hurricane Floyd Zoonosis Update**  
**North Carolina State University Cooperative Extension**  
**by**  
**Donna Carver, Extension Poultry Veterinarian**  
**Morgan Morrow, Extension Swine Veterinarian**

People working to clean up areas containing swine or poultry carcasses should take the following precautions:

- \* wear protective clothing including waterproof gloves, waterproof boots, and protective eyewear (cover any open wounds)
- \* use duct tape to seal tops of gloves and boots to prevent water seepage
- \* wear protective breathing apparatus (respirator equipped with HEPA filter if possible; mask will do for dust but not bacteria)
- \* **\*\*if you smell hydrogen sulfide (rotten egg smell) get out of the building and call your county Extension office**
- \* clean and disinfect all clothing and boots after handling carcass-contaminated materials
- \* wash work clothes separately from street clothes
- \* wash hands thoroughly before placing fingers in mouth (nail biting, etc.)
- \* shower and wash hair thoroughly after handling carcass contaminated materials

Human Disease	Principle Animals	Probable Means of Spread	Risk
<i>E. coli</i>	Poultry, Swine	contaminated of food or water	
Erysipeloid	Swine , Turkeys	wound infection	low
Campylobacteriosis	Poultry, Swine	contaminated food or water	low
Leptospirosis	Swine	contact with infected tissue; contaminated water or soil	low
Yersiniosis	Swine	contaminated food or water	rare
Psittacosis	Turkeys	inhalation of dust from feces or feathers	rare
Salmonellosis	Poultry, Swine	contaminated food or water	low
Tetanus	Poultry, Swine	wound infection	rare
Encephalitis	Poultry	mosquitoes	rare



## **Appendix D**

### **Participants in Structured Interview Process**

#### **NORTH CAROLINA**

Paul Dahlen-North Carolina Dept. of Environment and Natural Resources-Water Quality  
Doug Hoyle-North Carolina Division of Emergency Management-Chief of Operations  
Dr. Jimmy Tickle-North Carolina Dept. of Ag and Consumer Affairs-Veterinary Medical Officer  
Tim Laster-Department of Administration and Purchasing Controls-Purchasing Manager

#### **FLORIDA**

Greg Lee-Dept. of Environmental Protection-Emergency Coordinating Office  
Chuck Hagan-Division of Emergency Management-Logistics Chief  
Joe Kight-Division of Animal Industry(FDACS)-Emergency Management Coordinator  
Jeff Milligan-Dept. of Management Services - Contract Manager

#### **TEXAS**

Phil Winsborough-Texas Natural Resource Conservation Commission-Emergency Response Coordinator  
Dave Tomkins-Governor's Division of Emergency Management-Chief Planner  
Dr. Mark Michalke-Texas Animal Health Commission-Veterinarian/Emergency Response Team  
Carla James-Texas Building and Procurement Commission-Procurement Purchasing Mgr.

#### **CALIFORNIA**

Steve Monk-California Environmental Protection Agency-  
Linda Pryor-Governor's Office of Emergency Services-Plans Developer  
Dr. Heidi Hamlen-CDFA-Emergency Programs Coordinator  
Dr. Annette Whitford-CDFA Animal Health Branch-Veterinary Medical Officer  
Sandy Conry-CDFA Purchasing and Contracts Division-Acquisition Manager

## **APPENDIX E**

### **EXPLANATION OF ACRONYMS**

APHIS	Animal and Plant Health Inspection Service (USDA)
APHIS-VS	APHIS Veterinary Services
AUSVET	Australian veterinary emergency response system
BSE	Bovine Spongiform Encephalopathy
CDFA	California Department of Food and Agriculture
CDW	Chronic Wasting Disease
DEFRA	Department of Environment, Food, and Rural Affairs (United Kingdom)
DEM	Division of Emergency Management
EPA	Environmental Protection Agency
ESF	Emergency support function
FDACS	Florida Department of Agriculture and Consumer Services
FEMA	Federal Emergency Management Agency
GSC	General Services Commission (Texas)
NCDAPC	North Carolina Department of Administration and Purchasing Controls
NCDOACS	North Carolina Dept. of Ag and Consumer Affairs
NCDEM	North Carolina Division of Emergency Management
NCDENR	North Carolina Dept. of Environment and Natural Resources
TAHC	Texas Animal Health Commission
TNRCC	Texas Natural Resource Conservation Commission
TERT	Texas Emergency Response Team
TSE	Transmissible Spongiform Encephalopathy
USDA	United States Department of Agriculture
WR <sup>2</sup>	Waste Reduction Incorporated

## **APPENDIX F STRUCTURED INTERVIEW QUESTIONNAIRE**

### **Structured Interview Questions - Carcass Disposal Planning**

Interviewee --- State-Agency-Name-Title

**1. Has your state agency dealt with carcass disposal situations within the last 3 years? If no or unknown, go to number 2.**

- a. What was the largest number of carcasses disposed of in a single incident?
- b. What was the cause of the animal deaths?
- c. What was the method of choice for disposal in the largest incident?
- d. What was the primary factor that affected the disposal method decision?
- e. What government agency was in charge of the process?
- f. What was the mechanism of compensation for the agency overseeing disposal ?
- g. What role did local government or industry play in the disposal process.

**2. Does your state have an emergency management plan that specifically includes carcass disposal issues. If no or unknown, go to 6.**

**3. If yes, does your state have a plan for carcass disposal issues as a result of natural disasters?**

- a. If no, Would it be helpful to have one?
- b. What agencies should be involved in the planning?
- c. What agency should be the lead agency?

**4. Does your state have a plan for carcass disposal issues as a result of disease related disasters?**

- a. If no, would it be helpful to have one?
- b. What agencies should be involved in the planning?
- c. What agency should be the lead agency?

**5. If yes to 3 or 4, is site selection a component of the plan. If no, go to 6.**

- a. If yes, what criteria are considered?
- b. What state agencies have input into site selection considerations?

**6. Does your state provide a basic emergency management course for state and local responders? If unknown, go to 7.**

- a. Does it include any curriculum on animals in disaster issues?
- b. Does it include any curriculum specifically on carcass disposal issues?
- c. Would it be helpful to include basic discussion of animals in disaster issues in the course?
- d. Would it be helpful to specifically discuss carcass disposal issues in the course?

**7. Does more than one agency in your state have jurisdiction over any aspect of carcass disposal.**

- a. Who are the agencies involved?
- b. Does a standing working group of all agencies involved exist to discuss carcass disposal issues. If no, go to i.
- c. If so, how often does it meet?

- d. What jurisdictional or organizational conflicts exist within your state for animal carcass disposal?
- e. Is there a mechanism or waiver process to resolve the conflicts?
- f. What are those mechanisms?
- g. Which agency facilitates the group?
- h. What are the member agencies of the group?
- i. If not, would it be beneficial for such a group to convene in your state?

**8. Does your state maintain debris management contracts (retainers) as part of its emergency preparedness plan? If unknown, go to 9.**

- a. Can large-scale carcass disposal efforts be covered under the contract?
- b. Would it be helpful to include carcass disposal costs within existing debris management and removal contracts?
- c. If yes, how would you recommend this be developed?

**9. Is there a carcass disposal contingency plan written by your agency or by another state agency that includes your agency responsibilities within it? If no or unknown, go to 10.**

- a. Has a lead person been designated who is in charge of maintaining the plan?
- b. Is there local (county) involvement in developing the plan? If no or unknown, go to 10?
- c. Have local planners identified the largest herd of animals located in their jurisdiction, and determined what method of disposal would be utilized if large-scale animal death occurred?
- d. If not, would it be helpful for local stakeholders to analyze potential carcass disposal issues within their jurisdiction?

**10. If a state level carcass disposal plan has been developed, is there a hierarchy of preferred methods developed for both natural and disease disasters? if so, what is it.**

**11. Does your agency maintain a database of carcass disposal resources including:**

- a. Air curtain incinerators
- b. rendering plants
- c. incinerators
- d. Alkaline hydrolysis equipment
- e. any others not mentioned above

**12. If not, would it be helpful to maintain such databases? Why?**

**13. Which agency should maintain those same databases?**

**14. Are there any other components or consideration of emergency planning for large-scale carcass disposal not previously mentioned that should be considered?**

## GLOSSARY

**Air Curtain Incinerator:** High velocity air is introduced into a burning chamber and burns material under an air curtain in such a way that temperatures of 2,500° F or greater are created.

**Alkaline Hydrolysis:** A digestion process that uses high temperature to convert the proteins, nucleic acids, and lipids of cells and tissues, and infectious microorganisms to a sterile, aqueous solution of small peptides, amino acids, sugars, and soaps. ( The alkali itself is consumed in the process by generating the salts of the hydrolysis products.) Also known as tissue digestion.

**Animal by-product** - Part or product of animals for industrial use. Includes bones, feathers, fertilizer, fur, hair, hides, hoofs, and skins.

**APHIS:** Animal Plant Health Inspection Service, a division of USDA

**Best Management practice (BMP):** A practice or combination of practices that are determined to be the most effective and practicable(including technological, economic, and institutional considerations) means of controlling point and nonpoint pollutants at levels compatible with environmental quality goals.

**Biosecurity:** All processes to contain a disease or disease agent.

**Bovine Spongiform Encephalopathy (BSE):** A degenerative central nervous system disease also known as "Mad Cow Disease", that causes cattle to become nervous, lose coordination, lose weight, have difficulty walking, and eventually die two weeks to six months after symptoms appear. BSE is caused by an organism smaller than a virus. It is a protein material called a "prion" that is resistant to many conventional methods of disinfection. The incubation period runs from two to eight years, with five years as the norm.

**Chronic Wasting Disease (CWD):** A newly emerging disease of some free ranging and captive elk and deer in the Western United States, that is progressive and fatal following a prolonged incubation period. Chronic weight loss and behavior changes are characteristic symptoms. There is no live animal diagnostic test for CWD. The CWD agent has not been completely characterized, but is smaller than most viral particles and does not evoke any detectable immune response or inflammatory reaction in the host animal. The CWD agent is assumed to be resistant to enzymes and chemicals that normally break down proteins, and is resistant to heat and normal disinfection procedures.

**Compensation:** The sum of money paid by government to an owner for animals that die or are destroyed and property that is compulsorily destroyed because of a disease control program.

**Composting:** A process that takes waste products such as carcasses, straw, and poultry litter and converts them into an odorless, inoffensive, pathogen free product that can be used as a soil amendment or organic fertilizer.

**Debris:** Scattered items and materials either broken, destroyed, or displaced by a natural disaster. Example: trees, construction and demolition material, personal property.

**Dead animals:** carcasses or parts of carcasses of those animals which are consider livestock, including poultry and equine: and any blood, effluent, intestinal, or stomach contents and all necessary waste material involved in handling carcasses.

**DEFRA :** Department of Environment, Food and Rural Affairs (United Kingdom). The agency tasked with leading the Foot and Mouth Disease eradication efforts in 2001.

**Disposal:** 1) The discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste (whether containerized or uncontainerized) into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwaters, 2) Sanitary removal of animal carcasses and things by burial, burning or some other process so as to prevent the spread of disease.

**Emergency:** Any natural or man-caused situation that results in or may result in substantial injury or harm to the population or substantial damage to or loss of property.

**Emergency (Under the Stafford Act):** Any occasion or instance for which, in the determination of the President, Federal assistance is needed to supplement State and local efforts and capabilities to save lives and to protect property and public health and safety, or to lessen or avert the threat of a catastrophe in any part of the US.

**Emergency (Under USDA Authority):** Process by which the Secretary of Agriculture may transfer funds from other agencies or corporation of the Department to reimburse certain Federal, State and local animal health emergency response expenses, including reimbursement of operation costs, such as quarantine enforcement, perimeter control, depopulation, carcass disposal, and decontamination.

**EPA:** Environmental Protection Agency

**Federal Response Plan:** A plan developed to facilitate the delivery of all types of Federal response assistance to States following a disaster. It outlines the planning assumptions, policies, concept of operations, organization structures and specific assignments and agencies in providing Federal response assistance to supplement the State, tribal and local response efforts.

**FEMA:** Federal Emergency Management Agency

**FMD :** Foot and Mouth Disease

**Fomite:** An object that is not harmful itself, but may harbor pathogenic microorganisms and thus serve as an agent of transmission of infection.

**Foot and Mouth Disease:** A highly infectious viral infection of cattle, pigs, sheep, goats, buffalo and artiodactyl wildlife species characterized by fever, vesicles (blisters) in the mouth and on the muzzle, teats, and/or feet; and death in young animals. Affected animals may become completely incapacitated or be unable to eat/drink due to pain associated with the vesicles.

**Groundwater:** Water below the land surface in a zone of saturation.

**Hazardous waste:** Any solid waste identified or listed as a hazardous waste by the administrator of the EPA pursuant to the federal Solid Waste Disposal Act.

**Infected premise:** A defined area, which may be all or part of a property, in which an exotic pathogen exists or is believed to exist.

**Leachate:** Any liquid, including any suspended components in the liquid that has percolated through or drained from hazardous waste.

**Local Government:** Any county, city, village, town, district, or political subdivision of any State, and Indian tribe or authorized tribal organization, or Alaska Native village or organization, including any rural community or unincorporated town or village or any other public entity.

**Mad Cow Disease:** See Bovine Spongiform Encephalopathy.

**Municipal Hazardous Waste:** Solid waste resulting from or incidental to municipal, community, commercial, institutional, and recreational activities; including garbage, rubbish, ashes, street cleanings, dead animals, abandoned automobiles, and all other solid waste other than industrial waste.

**Off-site:** Property that cannot be characterized as on-site

**On-site:** The same or geographically contiguous property which may be divided by public or private rights-of-way, provided the entrance and exit between the properties is at a cross-roads intersection, and access is by crossing, as opposed to going along, the right-of-way. Noncontiguous properties owned by the same person but connected by a right-of-way which he controls and to which the public does not have access, is also considered on-site property.

**Poultry:** chickens or ducks being raised or kept on any premises in the state for profit.

**Poultry carcass:** the carcass, or part of a carcass, of poultry that died as a result of a cause other than intentional slaughter for use for human consumption.

**Prion:** A prion has been defined as "small proteinaceous infectious particles, which resist inactivation by procedures that modify nucleic acids". Prion diseases are often called spongiform encephalopathies because of the post mortem appearance of the brain with large vacuoles in the cortex and cerebellum.

**Pyre:** A British term for a large controlled fire. Pyres were used as one method of carcass disposal in the UK during the FMD outbreak of 2001.

**READEO:** Regional Emergency Animal Disease Eradication Organization

**Rendering:** A process that subjects animal tissue to heat that inactivates pathogens and separates fat from protein and mineral components. Resulting products may be used for meat, bone or meal depending on disease restrictions.

**Saturated zone:** That part of the earth's crust in which all voids are filled with water.

**State Livestock or Animal Health Official:** The State employee, such as the State Veterinarian, who is in charge of each State's regulatory activities concerning livestock health.

**Scrapie:** TSE of sheep thought to be possibly linked to the emergence of BSE in cattle when Scrapie infected carcasses of sheep were fed back to cattle as protein/bone meal sources within the food chain.

**TAHC:** Texas Animal Health Commission

**TNRCC:** Texas Natural Resource Conservation Commission

**TSE:** Transmissible Spongiform Encephalopathy - fatal neurodegenerative diseases. Included among them are Bovine Spongiform Encephalopathy (BSE), Scrapie of sheep and goats, Chronic Wasting Disease (CWD) of mule, deer, and elk. They are caused by prion proteins (proteinaceous infectious particles) that lack nucleic acid. Prions are composed largely, if not entirely, of an abnormal isoform of a normal cellular protein.

**Unsaturated zone:** The zone between the land surface and the water table.

**USDA:** United States Department of Agriculture

**Zoonosis:** A disease that can affect humans as well as animals.