THE HURRICANE EVACUATION PROBLEM IN FLORIDA:
An Analysis of Options

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Mrs. Karen Hagan
Executive Director, Capital Area Chapter of the American Red Cross
187 Office Plaza Drive
Tallahassee, FL 32301

Dear Mrs. Hagan:

I have the honor to submit to you The Hurricane Evacuation Problem: An Analysis of Options. The report is a product of extensive research and analysis over the summer months of 2003. Hurricane evacuation issues are important in Florida for three reasons. First, the state continues to grow and develop. Second, there is a demand for public shelter space. Thirdly, hurricane evacuation clearance times are inadequate. New innovations as well as current state initiatives are already in place; the purpose of this report is to identify the best possible solution.

After examining the options, my recommendation is that the state should continue with the shelter retrofit program, the construction of new public facilities that can be used as shelters, and the practice of contraflow. While all three programs are working toward a solution of the problem, the state should concentrate on shelter retrofit. This is recommended based on the use of three evaluative criteria: fund availability, cost, and feasibility. Shelter retrofit scored highly on feasibility and moderately on fund availability and cost. It scored highest on feasibility because most of the staffing and logistical needs are easy to facilitate. Shelter retrofit scored moderately on fund availability due to limited annual funding. There is $3 million available this year in the budget to fund this initiative. However, there is almost $37 million in proposed retrofit projects around the state. The shelter retrofit program also scored moderately on the cost criterion. This policy option received a lower score on cost because it is cheaper to incorporate hurricane resistant features into a building during construction.

The policy option of constructing new facilities is important to the state as well. The construction of new facilities scored lower due to fund availability. The state has imposed an unfunded mandate on local school districts for building facilities resistant to category four and five hurricanes. Since local school boards are unable to afford the additional costs of construction under this mandate, noncompliant schools have been constructed around the state.
Finally, contraflow is a policy that has some promise, however, it scored lower than the other policy options. Contraflow has the potential to increase traffic flow and evacuation time by as much as 70%. However, it is estimated that it would take 49 hours to implement this plan in Florida. This timeframe is excessive in a disaster situation and must be reduced. Since a contraflow pattern would have to commence on highways before any hurricane watches or warnings were posted, this policy received a very low score on feasibility.

Improved contraflow is important for two reasons. First, it allows individuals to get to public shelter destinations faster. Second, according to the American Red Cross figures, 10 percent of evacuees seek public shelter, which means the other 90 percent are traveling to other destinations. Contraflow is essential in moving all evacuees to safe shelter before a major hurricane impacts the cost, so it is important that the state continues to develop this plan.

This recommendation has the potential to improve the hurricane evacuation process. The state has a need for safe, efficient, cost effective measures in moving evacuees to safety. The focus on shelter retrofit, balanced with the continued construction of new facilities and contraflow programs will insure that residents can find safe refuge from this hazard.

Respectfully,

Thomas A. Magnuson
Disaster Services Specialist
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1. Summary of Alternatives and Evaluative Criteria
EXECUTIVE SUMMARY

There is a need for improved hurricane evacuation in Florida. The state faces the threat of hurricanes six months out of the year. In recent years, there have been several major hurricanes, which threatened the state and required major evacuations. During each of these events, there were major traffic delays on the state’s freeways and interstates. If a hurricane were to increase speed, change direction, or rapidly intensify, it is possible that individuals will be stranded in the storm without safe shelter.

Laws and policies have been developed to resolve this problem, however, there is a shelter deficit within Florida. Additionally, current highway systems are inadequate for handling the large volumes of people that must evacuate. Since there is a shelter deficit, people who would seek shelter in public facilities are adding to the congestion on the state’s highway system during mass evacuations.

Information for this report was collected using four methods. First, unstructured interviews were conducted with emergency managers and members of the American Red Cross to gain insight into the legal issues, possible ramifications, political viability, and professional support of the hurricane evacuation alternatives. Second, laws, rules, regulations, plans, policies, government assembled panels, and reports were reviewed to determine the statutory requirements and efforts to resolve this problem. Thirdly, media reports from newspaper and television outlets were analyzed. Finally, academic literature from a variety of databases are identified and incorporated into the report.

This report presents three policy options for hurricane evacuation: shelter retrofit, the construction of new facilities that can be used as shelters, and contraflow. Each option is evaluated against three criteria: fund availability, cost, and feasibility.
Based on the assessment of alternatives, focus should be placed on Shelter Retrofit. This policy option scored the best under the evaluative criteria. Since there is currently a shelter deficit across the state, this program is a sound investment.

The construction of new facilities as shelters and the development of contraflow must be continued as policy. These options received a score that practically mirrored that of shelter retrofit. A reduction in shelter demand will contribute to a reduction of vehicles on the road during evacuations. The state has mandated new building code requirements for schools; the state should assist local school boards with these additional costs of construction. While construction of new facilities rated slightly lower than shelter retrofit, this policy should not be overlooked.

Additionally, a majority of evacuees use the highway system to seek shelter in distant locations. Contraflow scored lower than shelter retrofit and the construction of new facilities, it needs to be developed farther. Contraflow would have scored higher in the analysis if it did not take so long to implement. There is also a need to continue the development and distribution of Intelligent Information Systems across the state to regulate traffic flow.

In summary, the state’s shelter retrofit program is contributing to a reduction in the state’s shelter deficit. While this program scored the best of all three options, the shelter retrofit program should work in tandem with the construction of new facilities as shelters and the development of contraflow. State assistance should be provided to local school districts to assist with new construction and the Florida should look to reduce implementation times for contraflow.
I. PROBLEM STATEMENT

The Florida Division of Emergency Management (FDEM) strives to accomplish the following mission: “Ensure that Florida is prepared to respond to emergencies, recover from them and mitigate against their impacts” (Florida Division of Emergency Management, 2003). However, the Division’s mission is challenged by a hurricane evacuation problem. Hurricanes pose a grave threat to Florida six months out of the year. This state, which has continued to grow, has a population that is vulnerable to this threat. With a majority of the population perched along the coastline, these disasters seriously endanger life, property and the states economy. Large Hurricanes that approach the state force large movements of people. These evacuees clog the highways and interstates. It is not a question of if, but when will one of these great storms strengthen rapidly at the last minute, change its path, or accelerate to the coast. If this situation occurs while thousands of people are still on the road, the affects could be unimaginable.

Recent history has demonstrated that such a circumstance could occur. In 1999, an estimated three million people evacuated from Hurricane Floyd (Federal Emergency Management Agency, 2003). This is considered to be the largest peacetime evacuation in United States history (Disaster Relief Organization, 2003). Inadequate shelter space and highway infrastructure prolonged the evacuation while the hurricane paralleled the coast.

The state of Florida, in cooperation with local agencies, is trying to work for a solution to the evacuation problem. Options are available to limit the risk of injury and move people to safety; these include reversing the traffic flow on highways and interstates, the retrofit of existing structures, and the construction of new facilities to be used as shelters. The purpose of this report is to analyze these options and determine the
best practice for improving the states capacity in providing safe, timely shelter for all Floridians.
II. BACKGROUND AND LITERATURE REVIEW

Background

This section examines the following topics: the growth of Florida during a period of hurricane inactivity, the realization of a crisis, and the evolution of hurricane evacuation policy. All of these elements have led to Florida’s present actions in improving the state’s capacity to evacuate from hurricanes.

First, Florida’s population blossomed during a period of hurricane inactivity. In 1960, the state’s population was approximately five million residents (Censusscope, 2003). During that year, Hurricane Donna rocked the peninsula and produced over $2.1 billion in damages (Barnes, 1998 p. 312). The state’s population continued to swell over the next 30 years, by 1990 there was a population approaching 13 million (Fernald and Purdum, 1992, p. 127). During this period, the peninsula was not impacted by a major hurricane (Barnes, 1998, p. 261).

Second, Floridians realized that the state had an evacuation problem 32 years after Hurricane Donna. In August of 1992, Hurricane Andrew descended on South Florida. As a category five hurricane, Andrew eventually made landfall south of Miami. It has been estimated that 750,000 persons, responded to appropriate warnings and evacuated coastal areas, inland flood prone zones, and mobile homes (Department of Community Affairs [DCA], 2002b, p. 1). This unprecedented movement of citizens and visitors in the face of an impending natural disaster stretched the resources of state, local, and private agencies to provide public shelter (DCA, 2002b, p. 1). It was now obvious that the State had an evacuation problem.
Thirdly, politicians and representatives started to act on the hurricane evacuation issue as Andrew’s winds started to die down. Prior to Andrew, little is known about the state’s hurricane evacuation actions. While the state’s local planning boards did develop regional evacuation plans, there was no serious state legislation. Post Andrew, Governor Lawton Chiles assembled the Governor’s Disaster Planning and Response Review Committee. The committee’s post disaster evaluations of evacuation sheltering concerns, known as the Lewis Commission Report, identified the lack of adequate and appropriate public shelter space as a critical planning issue (DCA, 2002b, p. 1)

The Commission’s findings served as the driving force behind the writing of Chapter 93-128, Laws of Florida and the subsequent revision of Chapter 252.385 (1), Florida Statutes (Shelter Retrofit Report, 2002, p.2 - 1). Chapter 252.385 (1), Florida Statutes, serves to eliminate the deficit of “safe” hurricane evacuation shelter space in the state (Department of Community Affairs [DCA], 2002a, p. vii).

Next, the legislature enacted section 235.26 (8) b, Florida Statutes in 1993 to require that the Department of Community Affairs (DCA) develop a Statewide Emergency Shelter Plan. There are several statutory responsibilities within this plan, including the following:

- Identifying general locations and square footage of shelters.
- Providing the general location and square footage of needed shelters by county for the next five years
- Identifying the types of facilities that should be constructed to comply with the public shelter design criteria.
- Recommend an appropriate, adequate and dedicated source of funding for the additional cost of constructing emergency shelters within those public facilities (DCA, 2002b, p.iii).

The above listed information is revisited and updated every two years, then used by local school boards and emergency management agencies in planning for the construction of
new schools.

Additionally, section 235.26(8) b, Florida Statutes directed the Department of Education to amend school facility design and construction codes to include a requirement for new school facilities to incorporate public shelter design criteria (DCA, 2002b, p. iii). By 1997, the Department of Education implemented its public shelter design criteria for new schools. This criterion requires all new school construction projects in counties with an identified shelter deficit must build up to the requirements outlined in American Red Cross (ARC) 4496 (DCA, 2002b, p. 4).

ARC 4496 requires that facilities are to be built to withstand a category four or five hurricane in order to be used as a public shelter. To date, the 2002 Statewide Emergency Shelter Plan identifies that 71 schools have been built to the public shelter design criteria and another 29 are planned or under construction (DCA, 2002b, p. 5).

The sheltering lessons learned from Hurricane Andrew were further reiterated by the experiences of Hurricane Floyd in 1999; during that event approximately two million people evacuated from the storm (DCA, 2002b, p. 2). Shortly after Floyd, Governor Jeb Bush assembled the Governor’s Hurricane Evacuation Task Force. This group of state officials ordered a hurricane evacuation study. Based on the results of that study, the Task Force made 25 recommendations (Governor’s Hurricane Evacuation Task Force, 1999, Appendix III). Of these recommendations, two have become state programs.

The first program engages in shelter retrofit. It has involved the upgrading of shelter facilities so they can withstand category four and five hurricanes. The state legislature has funded this program $3 million a year since 1999. On top of the $3 million annually, an additional $18 million is being supplied to complete projects
identified in the original 1999 Shelter Retrofit Report. From this, $4 million will be used to supply items such as generators or generator pre-wire connections to these facilities (DCA, 2002a, p. 2 - 11).

The second program involves the planning and testing of highway contra flow, the reversing the direction of traffic on a highway system. Georgia and South Carolina already have this plan in place and it was implemented during hurricane Floyd. Florida has studied the plans of these neighboring states, and practiced the system setup on the Bee-Line Expressway in 2002. While the practice of contra flow is not a law on the books, and the program is in its infancy, the process is going to be implemented during catastrophic disaster situations in the future.

In summary, Florida has experienced explosive population growth over the last forty years. At the same time, many of these individuals were unaware of the hurricane risk until Andrew in 1992. After Andrew, lawmakers realized the importance of meeting the states sheltering needs. Since that time, emergency managers and state and local officials have been involved in a catch up game to provide adequate, safe, and timely shelter for all Floridians during major hurricanes.
**Literature Review**

The pertinent literature addresses three themes that have implications for hurricane evacuation. These themes include Intelligent Transportation Systems (ITS), the implementation contraflow, and local and state efforts to meet the shelter deficit.

First, the literature identified the use of Intelligent Transportation Systems as a resource for improving traffic flow. Several authors have outlined the benefits of this tool for managing a hurricane evacuation (Baxter, 2001; Hulett, 1999; Morrow, 2002; and Plowman, 2001). The authors demonstrated ITS as systems that have increased the ability to manage traffic flow. The writers are correct in stating that Intelligent Transportation Systems resources would allow emergency managers and transportation officials to monitor traffic flow and better coordinate an evacuation. They state that emergency managers rely on traffic counter information to make evacuation decisions.

The application of ITS is considered to be a resource in hurricane evacuation. Hulett (1999) and Morrow (2002) explain that the Intelligent Transportation Systems allow traffic planners and emergency managers to identify increasing congestion. Furthermore, message boards can inform drivers of expected traffic delays and alternative traffic routes. Baxter (2001) states that the traffic counters are able to register the speed and volume of cars on the road. Additionally, many locations that are now applying ITS technology have made the information available on the internet. Many of these internet sites display maps of congestion, camera images and expected delays. The public can access this information before evacuating, and choose an appropriate route for leaving the area. The authors show that these resources can greatly reduce overall evacuation times, they encourage the continued development and field deployment of this resource. In
essence, the pertinent literature demonstrates the necessity of Intelligent Transportation Systems for use in contraflow activities.

Second, the literature reviews the new practice of contraflow, which several hazard-prone states are currently adopting. Several writers encourage the use of contraflow in hurricane evacuation (Henk, 2002; Ward, 2000 and Wolshon, 2001). They identify contraflow as the reverse laning of a major highway system. The authors advocate this technique because it opens several additional highway lanes for evacuation.

According to Wolshon (2001), traffic planners are now engaging in emergency evacuation activities to develop the practice of contraflow. Plowman (2001), who is a planner by profession, calls for the implementation of contraflow because it can cut evacuation times in half. Additionally, Ward (2000) views contraflow as another evacuation initiative that will move the population from the threat. The authors advise that there has been a large increase in population at the coast. Because of this, the expert writings suggest that contraflow provides another opportunity for “people to evacuate in a timely fashion” (Disaster Relief, 2000).

These authors also highlight the limitations of contraflow plans (Urbina, 1998; Wolshon, 2001; and Plowman, 2001). According to them, contraflow is a labor intensive and time-consuming practice to implement. Additionally, there are many ways to establish contraflow patterns and the experts agree that each state has established their own method and criteria for implementation. These writers show that the concept is also planned by different agencies. Depending on the state, some plans were drafted by emergency managers while others were constructed by law enforcement and
transportation officials. They suggest that there is no wrong agency for developing a plan; however, the plans tend to focus on the needs of the agency that drafts the strategy.

Beyond this, the authors acknowledge that contraflow has only been practiced once during a disaster situation. The literature shows that that contraflow was used in Georgia and South Carolina during hurricane Floyd in 1999 (Wolshon, 2001, p. 20). The writers show that contraflow had positive and negative outcomes during this evacuation. This important to consider since the Florida plan mirrors the plans of Georgia and South Carolina. They give merit to reverse laning during Floyd because it increased evacuation times. However, if the evacuation plan was criticized because it was labor intensive, there were increased accidents, changes in traffic flow confused evacuees, and it took time to implement. Wolshon (2001) demonstrates the reluctance of officials to implement contraflow citing that South Carolina started its contraflow during the Floyd evacuation after public complaints about traffic delays. Finally, Urbina (1998) claims that studies of different states show varying activation times for contraflow evacuations (the minimum time being four hours and the maximum being Florida at 49 hours).

Thirdly, several authors criticize state and local efforts to reduce shelter deficits (Monroe, 2001; Orlando Sentinel, 2002 and 2003; Florida Senate 1999). The reduction of shelter deficits across the state has been a mission of the Department of Community Affairs since 1992. These authors see several shortfalls that have occurred over the last several years.

The Florida Senate (1999) claims that the state has been unable to eliminate the shelter deficit due to continued population growth. According to these legislators, the goal of the shelter retrofit program was to eliminate all deficits in shelters by 1998. In
addition to growth, they have indicated that the funds provided for the shelter retrofit program have been inadequate. Since the deficit has not been eliminated at this time, the Department of Community Affairs and the state’s law making bodies advocate an increase in funding. These appropriations are necessary for the retrofit effort to maintain pace with an increasing population.

Another challenge in eliminating the shelter deficit concerns the activities of local school boards. Monroe (2001) blames local school boards for not complying with the Department of Education building codes. According to the code, school boards are to construct facilities that can withstand category four and five hurricanes. Monroe claims that the state is at a disadvantage since there is no penalty for noncompliance. Considering this, it is likely that school boards will continue to violate the code in an effort to lessen construction costs.

The school boards are also frustrated with the existing policy for school construction. Many current facilities have been deemed unsuitable as shelters by the state of Florida (Orlando Sentinel, 2002). These facilities, which may receive retrofit grants later, have been removed from the shelter list, placing an increased burden on local school boards. School boards, who must build new facilities on limited budgets, would like state assistance to compensate for the additional costs of construction (Orlando Sentinel, 2003). Since the state is not assisting the local school boards with funding like the shelter retrofit program, these new facilities are not being constructed to the new construction codes. The hope is that these schools will be eligible for shelter retrofit grant money in the future (Orlando Sentinel, 2003).
In summary, the literature details three themes, which have implications on hurricane evacuation. These themes correspond to the changing nature of the Florida’s hurricane evacuation procedures. However, the literature does not provide a detailed evaluation and comparison of the leading initiatives for resolving the evacuation problem. This report will build upon the literature by comparing the three leading programs against specific criteria, thus enabling an evaluation and providing the most appropriate alternative.
III. METHODOLOGY AND EVALUATION CRITERIA

Methodology

This report on Florida’s Hurricane Evacuation Problem will be collected using the following methods:

- Unstructured interviews of one hour or less with a total of five experts from the American Red Cross and the Florida Division of Emergency Management.
- Reviews of laws, rules, regulations, plans, policies, government assembled panels and reports such as the Governor’s Hurricane Evacuation Task Force Findings, The 2002 Statewide Emergency Shelter Plan, and the 2002 Shelter Retrofit Report.
- Media reports include newspaper articles from the Orlando Sentinel and Palm Beach Post as well as an online television report from CBS news.
- Academic literature from databases such as JSTOR the National Transformational Library, and Lexus Nexus. Documents under research date back to 1985.

The emergency managers will be interviewed about their role in the hurricane evacuation process. These individuals will indicate whether the current evacuation measures discussed above are improving the process or not. Officials will provide information about the evacuation options and whether the alternatives work.

This report will discuss the initiatives that have been underway, namely, the Governor’s Hurricane Evacuation Task Force, the State Emergency Shelter Plan, and the Shelter Retrofit Program. In addition, there will be review of additional government documents such as, strategic plans, Senate reports, an operational audit of the Department
of Community Affairs, and publications from the Florida Division of Emergency Management.

The media is quick to expose success or failure in policies, procedures and practices. For this reason, investigative research must involve pertinent news reports. Outlets under review include two newspapers (the Palm Beach Post and the Orlando Sentinel) in Florida and one national television agency (CBS News). Other newspapers were investigated (The Tampa Tribune, The St. Petersburg Times, Sarasota Herald Tribune, Tallahassee Democrat, and the Fort Myers News-Press), as well as national news agencies (CNN, NBC, ABC, and FOX News). However, these other news agencies did not provide information that was pertinent to the report.

Academic literature provides a professional perspective on the evacuation issue. Previous research on this topic identifies varying perspectives on the alternatives. Case studies review the success and failure of current initiatives. These professionals also indicate other alternatives that the state can use in resolving the issue.

Finally, other hurricane-prone states are facing evacuation challenges as well. The plans and programs of these locations will be reviewed. Locations such as Georgia and South Carolina have evacuation programs in place; their plans may provide additional input that may lead to improvements in Florida’s initiatives.

**Evaluation Criteria**

Three evaluative criteria will be used in the report. The criteria to be used are the following: fund availability, cost, and feasibility. Each of the criteria will be measured on a scale of one (1) to (5) for each of the discrete options. The definition for each rating
is the following: 1) not beneficial, 2) less beneficial, 3) neutrally beneficial, 4) somewhat beneficial, 5) very beneficial. While each criterion will be reviewed separately, a decision matrix will be assembled to identify the best possible alternative for Floridian’s. In this matrix, the scores for all criteria will be summed; the option with the highest scoring will be the best alternative.

- Fund availability is the dependability of the fiscal source. It is essential to determine where the money comes from and if there are other possible financial opportunities. Additionally, the duration of the funding must be identified as long term or short-lived. The primary resource for this information is the evacuation plans, emergency management documents, interview data and the strategic plans.

- Cost gauges the financial investment of protecting evacuees from hurricanes. Plans and policies should be geared to serving the largest public good for the lowest possible price. A study of pertinent planning documents will measure these costs.

- Feasibility rates the logistics (i.e. barricades, food, vehicles, signs, and cots) and human resource (i.e., law enforcement, volunteers, and government officials) demands of the option and determines if the resources are available to allow the option to work. Each alternative has specific staffing and equipment needs. Governmental documents and interviews will be a determinant for feasibility.

There are two limitations for the evaluative criteria. First, under fund availability, the strategic plans will outline the expected financial investments on programs. However, budget cuts are always a possibility, so it is essential to determine if other potential funding sources exist. Second, the theory of contraflow is new to the state; it has never been tested in Florida during a disaster situation. There is limited information on funding and costs of using contraflow in a disaster. As of this time, the state has not conducted a cost analysis for the use of law enforcement or Department of Transportation resources. Third, Georgia and South Carolina have implemented the plan, but there is no information available about the costs of contraflow from these states.
In summary, this report is built on the information available. However, some of this information is rather limited. Agency strategic plans are intended to serve as a guide for future fund availability. Finally, the state needs to conduct a cost assessment for implementing contraflow.
IV. MANAGEMENT POLICY OPTIONS

Section IV explains three of the most promising alternatives to improve hurricane evacuation in Florida: shelter retrofit, the construction of new facilities, and contraflow. Each alternative is evaluated using the three evaluative criteria detailed previously: fund availability, cost, and feasibility. The management policy options are designed to guide policy makers toward the most viable strategic policy to improve evacuations from hurricanes.

Another option, which is not included in this report, is the identification of existing facilities as useable shelter space. This alternative is not a major policy option for the state. One reason is that emergency managers and representatives from the American Red Cross have identified most of the facilities that are useable for shelters within the state. Therefore, this option does not show promise for eliminating the hurricane evacuation problem in Florida. Furthermore, the inspection of other facilities does not require any fund availability. Since potential shelters have been identified, the costs are very low. This option is very weak and it does not measure under the evaluative criteria.

Option One: Shelter Retrofit

Florida has many existing schools and public spaces. These facilities were not constructed to withstand category four and five hurricanes. Because of this, these locations are not suitable for use as public shelter space in major hurricanes. Shelter retrofit involves the reinforcement of structures so they can withstand the effects of category four and five hurricanes. Reinforcing an existing facility involves to the installation of hurricane roofing straps, windows coverings, generators, generator pre-
wiring, reinforcement of masonry walls, door reinforcement, and the removal of trees that are close to public buildings.

The practice of this policy involves several stakeholders, namely the Florida Legislature, the Department of Community Affairs, local emergency managers, local school boards, construction engineers, and private consultants. Several hundred facilities have an identified need for retrofit in Florida; more facilities are added to this list every year.

**Fund Availability**: The shelter retrofit program has been a state initiative since 1999. This statewide effort has been possible through grant funding to local municipalities and school boards. These monies have produced a shelter space increase of 381,512 beds since its inception in 1999 (DCA, 2002a, P. 2 - 9). The contributing dollars for this initiative include special legislative appropriations, the Hazard Mitigation Grant Program (HMGP), and the Emergency Management Preparedness and Assistance Trust Fund.

Special legislative appropriations have been a primary source for funding. Since 1999, appropriations have ranged from $3 to $4 million dollars annually. The Department of Community Affairs has requested these funds from the state and the appropriations are approved on a year-to-year basis. In all, the Department is recommending a prioritized list of 356 projects with a potential to create 157,326 hurricane shelter spaces after retrofit. The estimated cost of construction to these locations is $36,950,663 (DCA, 2002a, p. 2 - 9). If appropriated, the DCA anticipates at least $3 million will be available to sponsor these prioritized projects. (DCA, 2002a, p. 2 - 9). While this is a significant shortfall, the Department of Community Affairs
recognizes that there is no other dedicated form of funding to support the program at this time (DCA, 2002a, p. 2 - 9). In order to resolve this issue, the state needs to increase its funding to support the approved projects. The current funding shortfall is at $34 million, with yearly application submissions for retrofit funding; this list of facilities is only going to grow.

In past years, the Hazard Mitigation Grant Program has been an additional fiscal source for shelter retrofit. The HMGP program provides financial assistance after federally declared disasters. Within this grant, the federal government can provide up to 75% of the costs of an approved mitigation project (Department of Community Affairs [DCA], 2003). Generally, other funding sources such as Community Development Block Grants, local and/or state general revenue, and private non-profit funds are used to provide the 25% local/state match. The Department has identified that hazard mitigation grants can be applied to the following projects: structural retrofitting of existing facilities, structural retrofit of Residential and commercial structures, residential acquisition, small-scale improvements to existing drainage facilities and drainage improvements to critical facilities. There are two limitations to the HMGP as a funding source. First, the federal government will only make these funds once a major disaster has occurred (DCA, 2003). Second, the funding is not exclusive to shelter retrofits so the grant may be applied to other needs. The HMGP cannot be considered a reliable source for funding.

The Emergency Preparedness and Assistance Trust Fund has also been a previous source of funding. This is a competitive, yearly grant funded by the state of Florida for local governments. Local governments may apply for up to $300,000 for promoting
public education, enhancing relief effort coordination, improving training and operations capabilities, and furthering state and local initiatives that are considered a priority by the state. (Division of Emergency Management EMPATF, 2002, p. 1)

The fund can be applied to a wide variety of needs. Chris Floyd, Emergency Services Director for the Capital Area Chapter of the American Red Cross, believes the county emergency managers have many other needs for preparing and protecting the public. Considering the shelter retrofit program is already in existence, there is a small likelihood that local government groups will request shelter retrofit assistance through this grant (personal communication, June 26, 2003).

An interview with an emergency manager demonstrated that the current funding is inadequate for eliminating the shelter deficit. Dave Bujak states that legislative appropriations are helpful, but it does not meet key needs. The approved projects on the shelter retrofit list will cost more to compete than the state has budgeted (personal communication, April 16, 2003). In addition, the HMGP is only available after a major disaster and the EMPA has limitations as a funding source since local governments have emergency management needs beyond the retrofit of shelters. Therefore, fund availability for shelter retrofit rates low as a criterion due to these limitations.

Cost: The expenses of retrofitting a public facility apply to any materials that will reinforce a building so it can withstand a category four or five hurricane. This also includes the fees associated with construction or installation. Projects that receive funding include the installation of shutters, tree removal, generators, generator pre-wiring, reinforcement of roofs and walls, and door reinforcement (DCA, 2002a, Appendix J)
DCA recommends a total of 365 retrofit reports that will create 157,326 shelter spaces at a cost of $36,950,663 (2002a, p. 2 - 9). The cost of shelter retrofit is approximately $103,794 per facility of $234 per created shelter space. This figure does not account for future inflation and it applies to project estimates. Dave Bujak, who is an engineer with the Florida Division of Emergency Management states that the cost of retrofit is typically more expensive than implementing the design criteria at the time of construction (personal communication, April 16, 2003). On the other hand, Chris Floyd, believes that there is a need for this retrofit program. Within the Capital Area Chapter’s service area, the state found that most shelters were unsuitable for major storm and they were dropped from the shelter list. Cases like this are statewide, it has contributed to an increase in the state’s shelter deficit and Floyd believes the funding must be available to improve these facilities (personal communication, June 26, 2003). In short, the retrofit of structures can be expensive, but it has value in reducing the state’s shelter deficit.

**Feasibility:** Pursuant to section 252.385(2), Florida Statutes, there has been a need for qualified engineers at the state and local level to conduct shelter studies that could identify two things (DCA, 2002a, p. 4 - 2). First, there is a need to identify if a shelter meets the necessary guidelines to withstand major hurricanes. Second, if the facility does not meet the criteria, there is a need to identify the necessary improvements (DCA, 2002a, p. 4 - 2).

The DCA, along with contracted consulting and engineering services have evaluated over 2,277 buildings in 35 counties (DCA, 2002a, p. 4 - 3). While this survey was extensive, several counties went gone unchecked. In response to the shortfall of trained engineering inspectors, the Division of Emergency Management is providing two
day Shelter Evaluation Guidance Courses around the state. Up to the publication of the Shelter Retrofit Report, the division had trained 767 personnel through the facilitation of 53 classes within 29 counties (DCA, 2002a, p. 4 - 3). In order for the shelter retrofit initiative to be comprehensive, the state will need to maintain its Shelter Evaluation Guidance Course until it reaches all 67 counties.

Logistical demands for the shelter retrofit program are not demanding. The program needs include transportation for the trainers to get around the state. Additionally, these teachers need to have instructional supplies including a laptop computer, an LCD projector, an easel pad and easel, participant manuals, course registration and evaluation forms, and copies of maps and blueprints for building evaluation exercises. The facility used to host the instruction is reserved through cooperation with DCA’s training department and local emergency managers. Once engineers and contractors are certified in shelter evaluation, they also have transportation needs to visit the sites. All shelter evaluation forms are easy to access and can be found on the FDEM website. Otherwise, other logistical needs are associated with construction materials and tools, which the contracted builders already have.

In summary, shelter retrofit scores highly on the feasibility criterion. The logistical needs for this program are not demanding. There is a cadre of trained shelter evaluators and the FDEM training program continues to educate contractors. Fund availability and cost criteria rate moderately. The funds are currently insufficient to complete the retrofit of shelters approved in the state’s Shelter Retrofit Report. The cost involved in upgrading facilities is relatively high and there is evidence that implementing hurricane resistant features during construction is significantly cheaper.
Option Two: The Construction of New Facilities

As the state population continues to grow, there is a continued demand for new schools, university buildings, and public buildings. In conjunction with the Department of Community Affairs, the Department of Education has implemented building codes that require new academic facilities to withstand major hurricanes. The mission is to use these facilities as public shelter space during category four and five hurricanes, and to reduce the state’s shelter deficit.

Fund Availability: Local school boards are constructing new facilities statewide. These structures, which are being constructed to a stringent building code, are more expensive than conventional schools of the past.

The funding responsibility for this endeavor rests with the local school boards; however, there is an opportunity for grant assistance through the Public Education Construction Outlay (PECO) funds (DCA, 2002b, p. 12). From time to time, some mitigation-related funds may become available to support the construction cost premium for complying with the design criteria, but this cannot be considered an “appropriate, adequate, and dedicated” source of funding (DCA, 2002b, p.12).

Since the state is unable to provide consistent or adequate funding, and the school boards must assume responsibility for the additional costs of construction, local governments are growing frustrated. Additional costs of construction have been implemented by the state through the new code requirements, so the local officials would like to see more assistance. Marion County Emergency Management Director Chip Wildy illustrates the sentiment of local leaders on this issue. According to him, “You have solid waste, stormwater issues, and everything else that the county has too take on;
the money has to come from somewhere. While the state has spent $40 million dollars to retrofit existing structures, there has been little assistance for new facilities” (Orlando Sentinel, April 7, 2003). Since funds are limited at the local level, and there is little assistance from the state, this option receives a low ranking on fund availability.

Cost: The construction of new facilities that meet the shelter design criteria will be built with an additional cost. The additional cost incorporates labor, architectural design and materials. In order for a public shelter to withstand a category four or five hurricane, it must have features such as steel reinforced masonry walls, wind resistant doors, hurricane shutters on all windows, a continuous load path from the roof to the foundation, interior safe spaces, and specific roof designs (DCA, 2002a, Appendix J).

In Marion County, the school board is constructing a $40 million dollar facility outside of Ocala. In order to use this facility as a public shelter, the additional cost will be $500,000, but it will also create 8,000 new spaces for evacuees (Orlando Sentinel, April 7, 2003). This equates to a cost of $62.50 per additional shelter space unit. This option is significantly cheaper than the shelter retrofit costs and receives a higher score for its cost efficiency.

While the additional cost of new construction is cheaper than retrofit, it is an increased financial burden for local jurisdictions when compared to the opportunity of retrofit grant money. For example, Marion County currently experiences a shelter deficit of 18,485 spaces (DCA, 2002b, Table 6). Adequate construction of Forest High School would create shelter for 8,000 people, a serious cut in the deficit (Orlando Sentinel, 2003). Since the county does not have the resources to cover the additional cost of construction, it has opted to wait for an opportunity of retrofit. Dave Bujak claims that
the state has placed an unfunded mandate on local jurisdictions that is not enforced through penalties. With this in mind, counties are allowed to get away with non-compliance (Personal Communication, April 16, 2003).

Feasibility: The process of construction does not place an additional burden on equipment or human resources. Nonetheless, there is an increased demand shelter workers and equipment needs. These resources include volunteers, shelter managers, cots, food stocks, feeding supplies (i.e., coolers, cuts, plates, and silverware) administrative supplies, and communications equipment.

Palm Beach County is working to eliminate their shelter deficit by opening or renovating nine new schools, which will provide 45,000 new shelter spaces by 2006 (Palm Beach Post, June 1, 2003). The first of these schools is to open in August with 5,000 spaces. These new shelters, designed to hold large masses of people, place a great burden on non-profit agencies such as the American Red Cross. Chris Floyd, with the American Red Cross, indicates that managing shelters as large as these is a serious challenge (personal communication, June 26, 2003). Sheila Kosier, with the American Red Cross, mentioned that the large shelter spaces create challenges outside of the staff and supply needs. Tensions and stress levels can run high for shelter workers and evacuees in a disaster (personal communication, June 2, 2003). This challenge creates an additional staffing need; additional volunteers trained in disaster mental health would need to be present at these facilities.

The construction of new school facilities is feasible, however, staffing and supplying these new facilities will be a challenge. As new shelter facilities come on line, non-profit organizations such as the American Red Cross will need to aggressively recruit
shelter volunteers. In fact, the American Red Cross Chapter serving Palm Beach County placed an advertisement, requesting the training and assistance of shelter workers for the new facility. Additionally, Disaster Service Directors will need to plan the equipment needs for these facilities so they are ready in advance. Overall, the construction of new facilities receives a medium ranking for feasibility.

In summary, the construction of new facilities scores highly on the cost criterion. The creation of shelter space during construction is significantly cheaper than the retrofit of existing facilities. This policy option receives a moderate rating for the feasibility criterion. These new facilities place an additional demand on non-profit agencies to provide appropriate staffing, shelter operations training, and supplies. Non-profit agencies must recruit and train additional volunteers to meet the demand. The construction of new facilities scores low on the fund availability criterion. The state has mandated a new building code without providing financial assistance to cover the additional cost of construction. Local school districts are unable to cover this additional cost in many instances and new schools are not being constructed to code in these locations.

**Option Three: Contraflow**

Contraflow is a relatively new practice in hurricane evacuation. This method of evacuation involves the reversing of traffic flow on major highway systems, increasing the available roadway during emergencies. The philosophy of reverse laning is dependent on Intelligent Transportation Systems that monitor and manage the traffic flow, extensive use of law enforcement, the use of traffic barricades, and roadside signs to alter traffic patterns. Outside of Florida, other states have developed contraflow plans.
Interestingly, there are no recognized standards for design, operation, or the location of contraflow segments at this time (Wolshon, 2001, p. 22). With the development of new technologies, plus the existence of ITS systems on many of the major arteries, contraflow plans are being developed for use when the next major hurricane approaches.

**Fund Availability:** Contraflow program funding is based on existing infrastructure, equipment and personnel resources. Funds for contraflow will come directly from law enforcement agencies, the Florida Department of Transportation (DOT), and emergency management.

Law enforcement will have to provide officers and vehicles on the city, county and state level to regulate the traffic flow. These agencies will have to pay for the expected costs (i.e., overtime, fuel for vehicles and maintenance). However, Florida likely would be under a State of Emergency in this scenario and local entities would be able to apply for reimbursement from the state. According to Ann Rowe, a Public Information Officer with the Florida Division of Emergency Management, contraflow will only occur when a catastrophic event threatens (personal communication, June 12, 2003).

The Department of Transportation is responsible for the ITS system and other highway safety systems such as barricades and road signs. The Florida Department of Transportation identifies the following as funding sources for the Intelligent Transportation System and road safety systems: State Fuel Taxes, Motor Vehicle Fees, Federal Appropriations and grants, and the State Transportation Trust Fund (Department of Transportation, 1999, p. 40).
Information is limited on the available funding from the Florida Division of Emergency Management. Future funding for the development of this program may come from grants such as the Hazard Mitigation Grant Program or the Emergency Management Preparedness and Assistance trust fund. To date, none of these options are mentioned as possible sources of funding. HMGP funds are federal funds that only become available after a disaster declaration from the president. EMPA funds are yearly competitive grants for counties; those counties have many emergency management needs besides highway improvements. Because of this, these grants are not considered to be viable sources for funding.

**Cost:** To date, reverse laning has not been used in Florida for evacuations, so the cost is difficult to estimate. Once there has been an evacuation that requires contraflow, it will be possible to assess its cost on the Florida public. Contraflow has been used during hurricane Floyd in Georgia and South Carolina, but the cost data from those states are unreliable because their evacuation methods and needs are different from Florida’s.

The state of Florida needs to conduct a cost assessment of law enforcement costs for contraflow. Multiple law enforcement agencies would be involved in contraflow operations including The Florida Highway Patrol, County Sheriffs, City Police and Department of Transportation officers. According to Calvin Sherman, with the American Red Cross, these officers are at different pay scales, and each agency has varying levels of overtime pay, which makes estimated costs difficult to calculate (personal communication, June, 26, 2003). The resource needs could be greater that the law enforcement could handle as well. For this reason, the governor would have to activate the National Guard in order for the process to work.
Information Transportation Systems are currently being deployed around the state to assist in day-to-day traffic flow. These systems will be used for any hurricane evacuations. According the ITS Strategic Plan, the amount of money spent on ITS deployment is difficult to determine since some ITS projects are included within roadway capacity projects. The publication recommended that a summary of statewide ITS capital project costs be gathered by the Intelligent Transportation Systems Program Office to measure cost effectiveness and performance in the further development of this equipment. While specific information was not provided, the Department of Transportation did acknowledge that the state spent approximately $2.3 billion dollars on projects that incorporated this technology. This funding fell under the following categories, highway construction and engineering, pre-construction and design services, transportation planning, materials testing, research and traffic operations (Department of Transportation, 1999, Table 7). From this $2.3 billion, it is estimated that 0.375% or about $8.5 million dollars was spent on ITS technology.

Finally, the state also needs to conduct a cost assessment for moving traffic control devises. The Department of transportation will need to provide cones, barrels and signs before contraflow is commenced. Costs that would be included in any estimation would involve the equipment itself, vehicle maintenance and fuel expenses.

Feasibility: Chris Floyd, the American Red Cross, states that about 10% of the evacuating public seeks public shelter (personal communication, June 26, 2003). This estimate indicates that a majority of the population travels to other locations to find shelter. Contraflow is widely viewed as the best way to increase outbound flow during evacuations (Wolshon, 2001, p. 20). There are at least four different ways to redirect
traffic on the states highway system (Urbina, 2002, p. 74). Much like Georgia and South Carolina, Florida has chosen a method where all lanes on both sides of the highway are traveling in the same direction. One study estimates that this practice is the best for maximizing highway capacity. According to this study, a full lane reversal would provide a near 70% increase in capacity over conventional two outbound lane configurations (Wolshon, 2001, pp. 20-21).

While the theory of contraflow sounds easy, it is quite difficult to do in practice. In fact, the true costs and benefits of contraflow in terms of its capacity improvements, safety, and manpower requirements remain largely unknown (Wolshon, 2001, p. 20). Contraflow was implemented in Georgia during Hurricane Floyd in 1999 with mixed, though overall positive results. Contraflow was improvised during that same storm in South Carolina due to public outcry (Wolshon, 2001, p. 20). The experiences of Georgia and South Carolina during Hurricane Floyd are the only two examples where contraflow has been applied during a disaster situation. While the policy has been planned in some states, there are no recognized standards or guidelines for design, operation and location of contraflow segments. (Wolshon, 2001, p. 22).

According to Wolshon (2001) and Urbina (1998) that the practice of contraflow may not work. There are several variables that account for this. First, highway agencies agree that reverse flow operations will likely be inconvenient and confusing for drivers. They also expect contraflow to be labor intensive to initiate, difficult to enforce, and potentially dangerous for drivers (Wolshon, 2001, p. 25). Ann Rowe states that the Florida Division of Emergency Management is going to initiate a media and internet campaign starting in August to educate the public. Additionally, pamphlets will be made
available to drivers in the contraflow evacuation (personal communication, June 12, 2003).

Second, there is a time element involved in commencing a contraflow procedure. There is a lot that has to be done to prepare. Traffic control devices and barricades must be erected, inbound lanes must be cleared of vehicles over the entire length of the lane reversal, and law enforcement and DOT field personnel must be positioned at their assigned areas (Wolshon, 2001, p. 26). Most states anticipate the process will take from four to 12 hours (Wolshon, 2001, p. 26). Due to the long stretches of road where contraflow would be required, authorities estimate that 49 hours will be needed to prepare an evacuation (Urbina, 2002, p. 90). This estimate includes the notification from the governor, the time necessary to activate the National Guard, and 12 hours of set up time (Urbina, 2002, p. 90). The National Guard would have to come in and assist due to the scope of the activity. This timing is not feasible considering hurricane watches are issued 36 hours in advance of landfall. Contraflow would have to begin before any hurricane watches or warnings are in effect. This is a key factor in the deficiency of contraflow; it is unlikely that people will act until there is a perceived danger so the feasibility of this policy option is completely undermined.

ITS systems are considered to be a feasible component of contraflow evacuations. It should be noted that this resource is in place and used on a day-to-day basis in cities and on interstates in Florida. Because of this, the DOT is continuing to expand the Intelligent Transportation System network around the state.

Finally, the termination of contraflow operations will occur at nightfall (Wolshon, 2001, p. 27). Since evacuation activity slows during nighttime hours, all traffic will have
to merge to the same side of the highway. Since contraflow may not work as planned, local jurisdictions have developed alternate plans for emergencies. The Palm Beach County Division of Emergency Management has plans for “refuges of last resort”. (Wolshon, 2001, p. 27). These buildings, located within one mile of evacuation routes, are for extreme circumstances only and may not necessarily have food, water, utilities, or supervision (Wolshon, 2001, p. 27). Another concern is that these facilities are not even guaranteed to be safe in strong hurricanes, but they offer evacuees a better option than being trapped in their vehicles (Wolshon, 2001, p. 27). While this option shows promise for evacuating the public, it rates low in this criterion because of the timeframe of implementation.

In summary, contraflow scores highly on the fund availability criterion. The implementation of reverse laning is dedicated for catastrophic events. Provided the event occurs, it is likely that affiliated agencies will be reimbursed through a disaster declaration. Contraflow ranks moderately for the cost criterion. There is a need for cost studies to better understand the expense of contraflow. Finally, this policy option ranks poorly under the feasibility criterion. While contraflow has the potential to decrease evacuation times significantly, the estimated time of implementation is way too long.
V. Conclusion

This report presented three different policy alternatives for resolving Florida’s hurricane evacuation problem. Each policy was evaluated based on fund availability, cost and feasibility. Table 1 summarizes these results.

<table>
<thead>
<tr>
<th>Policy Alternative</th>
<th>Fund Availability</th>
<th>Cost</th>
<th>Feasibility</th>
<th>Score</th>
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<td>4</td>
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<tr>
<td>New Facility Construction</td>
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<td>9</td>
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<td>Contraflow</td>
<td>4</td>
<td>3</td>
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<td>8</td>
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Ranking Scale: 1 to 5 with 1 being not beneficial and five being very beneficial

All three alternatives are needed to deal with the state’s evacuation problem. The options show that each have particular benefits over the other. The state should continue to implement all of these initiatives to accomplish the mission of moving people to safety. While all three ranked fairly similar, Florida should focus on strengthening and developing the programs which rate the highest for the evaluative criteria used in this report.

The shelter retrofit program scored the highest of all three policy options when analyzed against the evaluative criteria. Among the criteria, shelter retrofit scored highest on feasibility. The staffing and logistical demands of this program are not demanding. The primary needs are for trained shelter evaluators, transportation, instructional supplies, construction workers, and tools for construction. The program rated moderately for fund availability and cost. Legislative appropriations are available
on a yearly cycle for retrofit, but they are insufficient when compared to the needs of the proposed projects in the report. Additionally, other sources for possible funding are considered unreliable. Finally, cost scored moderately because it is more expensive to retrofit facilities than to incorporate design criteria in new construction. While retrofit is an important program, it is essential that new facilities are built to the correct design criteria to limit future retrofit needs.

The construction of new facilities and contraflow options scored lower than the shelter retrofit program. However, both of these programs ranked close enough to the shelter retrofit program that they must be considered as important initiatives. Of the two, the construction of new facilities scored better than contraflow.

The construction of new facilities scored highly for cost. The application of hurricane resistant techniques is significantly cheaper during construction than incorporating them later. The estimated additional cost per shelter space is about $62.50 for new construction compared to $234 during retrofit. This policy option scored moderately for feasibility, the demands of new construction are low. However, the demands of staffing and supplying these additional facilities are quite high. Many additional resources such as cots, food, and other supplies are required. In addition, there is a need to recruit and train more public shelter workers for these facilities. The fund availability criterion scores the lowest for this alternative. The state has mandated a new building code for educational facilities. This new standard adds an extra cost to the construction of these buildings. However, this is an unfunded state mandate that leaves local school districts to pay for the additional costs. The state needs to assist these school boards to insure the new facilities are built to code.
Of the three policy options, Contraflow scored the lowest when analyzed against the evaluative criteria. It rated highest for fund availability out of the three criteria. The reverse laning of highways and interstates is reserved for catastrophic emergencies. Provided that a Federal Disaster Declaration is issued by the president, the state will be eligible for reimbursement from the federal government. Contraflow scored moderately on the criterion of cost. ITS systems that will be needed for evacuations are already in place. These systems are being used on a day-to-day basis and the DOT continues to add more equipment to the system. To better understand the cost impact from contraflow, the state will need to conduct an analysis of law enforcement and equipment costs. Contraflow scored the lowest when measured against the feasibility criterion. While it is quite possible to set up a contraflow operation, it takes too long. It is estimated that it will take 49 hours to implement contraflow in Florida, this completely undermines its feasibility.

In conclusion, the shelter retrofit program scored the highest based on all evaluative criteria. Emphasis should be placed on this program, however, the alternatives of new construction and contraflow ranked tightly with the retrofit program. All three of these programs will assist in resolving the hurricane evacuation problem in Florida. The state need to continue to refine and reinvest in these programs to insure the state’s residents and visitors are able to find a safe location before a major evacuation.
References


About the Author

Thomas A. Magnuson (B.S., Geography, Florida State University; MPA, Florida State University) has served an internship with the Florida Division of Emergency Management. Mr. Magnuson is interested in emergency management policy, planning, training, and instruction. He is currently a Disaster Services Specialist with the Capital Area Chapter of the American Red Cross, Tallahassee, Florida.