UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

RESOURCES, COMMUNITY, AND ECONOMIC DEVELOPMENT DIVISION

B-212013

JULY 7, 1983

General Louis O. Guiffrida
Director, Federal Emergency
Management Agency

Dear General Guiffrida:

Subject: Review of the Federal Emergency Management Agency's Role in Assisting State and Local Governments To Develop Hurricane Preparedness Planning (GAO/RCED-83-182)

At the request of the Chairman, Subcommittee on Legislation and National Security, House Committee on Government Operations, we reviewed the principal Federal programs relating to hurricane preparedness planning as well as the preparedness activities of a number of State and local governments. On May 5, 1983, we testified on our findings before the subcommittee (see enclosure I). This letter summarizes our findings for the Federal Emergency Management Agency's (FEMA's) hurricane preparedness program and makes recommendations to improve program management. Our findings are described in more detail in enclosure I.

OBJECTIVES, SCOPE, AND METHODOLOGY

Our review objective was to evaluate the adequacy of Federal assistance provided to State and local governments for hurricane preparedness planning. For purposes of this review we defined preparedness planning as a tool which would improve State or local governments' response to emergency conditions from the time a hurricane alert is sounded until the storm strikes land. We focused on Federal assistance in providing forecasts and warnings, public education, technical planning assistance, and funding. All these activities affect preparedness planning and are largely centered within FEMA, the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Army Corps of Engineers. The subcommittee additionally requested that we review State planning efforts in Mississippi, Louisiana, Texas, Alabama, Georgia, and Florida and local communities and regions within these States. (See att. I for a listing of these local and regional areas.)

Our review included interviews with officials of the above agencies and appropriate State and local officials. We reviewed

program regulations, laws, and other information relevant to the Federal programs covered. We also reviewed numerous hurricane emergency preparedness plans developed by State and local governments and relevant State regulations and laws. The review of State and local governments centered on geographic locations which were vulnerable to hurricane conditions and which had participated in Federal hurricane preparedness programs.

At the instruction of the requester's office, we did not obtain agency comments on our testimony or on this report. With this exception, our review was performed in accordance with generally accepted government auditing standards. The audit work was done between August 1982 and February 1983.

BACKGROUND

Under the Disaster Relief Act of 1974, FEMA is generally responsible for administering Federal emergency management programs. To carry out its general responsibilities under this act, FEMA has initiated a number of programs to encourage and assist States in disaster planning. One of these programs--the Hurricane Preparedness Planning Program--is specifically designed to offer high-risk locations financial assistance in improving State and local preparedness for coping with hurricane conditions.

FEMA has scheduled 22 high-risk locations to receive funding assistance through State emergency management agencies. The program began in fiscal year 1978, will be completed in fiscal year 1988, and has total funding of $6.2 million. The grants, awarded over a 1- to 3-year period, range from $130,000 to $640,000. Currently, one location has completed its study and six more have ongoing studies.

Additionally, other Federal agencies provide technical and financial assistance to the States for hurricane preparedness planning. For example, the National Weather Service within NOAA has developed the SLOSH (Sea, Lake, and Overland Surges from Hurricanes) model[1] which simulates inland flooding under various hurricane conditions. NOAA's Office of Ocean and Coastal Resources Management and Office of Sea Grant have both provided funding for hurricane preparedness planning, and the Army Corps of Engineers has funded and managed three evacuation

[1]This model is generally accepted as a critical prerequisite for preparing sophisticated, comprehensive hurricane evacuation plans.

studies[2] in Florida. The Corps is the only Federal agency to have "hands-on" experience in such planning. The Corps has no current plans to fund additional evacuation studies, and NOAA has not requested any State assistance funding for either the Office of Ocean and Coastal Resources Management or the Office of Sea Grant in the fiscal year 1984 budget request.

NEED FOR IMPROVED COORDINATION AND OVERSIGHT

Until recently, FEMA's involvement in hurricane preparedness assistance was minimal. FEMA awarded study grants to the States with only limited coordination with other Federal agencies involved in providing funds and technical assistance; it provided no substantive guidance to States for preparing proposals and conducted only limited reviews of ongoing studies. Essentially, FEMA was funding preparedness studies with little or no assurance that these studies were feasible or could lead to workable preparedness plans. In four of the five grants we reviewed, FEMA was fortunate because the selected locations had prior experience and expertise in hurricane preparedness planning. These locations had all received technical and/or financial assistance from NOAA or the Corps prior to their FEMA grant and had no real need for FEMA guidance.

As detailed in our testimony, however, the study proposal submitted by the State of Louisiana for the New Orleans area had serious technical and financial concerns which were not noted by FEMA. Although the Corps or NOAA could have commented in detail on the State proposal, FEMA did not have the proposal reviewed by either agency. The State agency submitting the New Orleans area planning proposal did not have the advantage of prior experience and received little assistance from FEMA.

FEMA has since become aware of these problems and has met with State and local officials to better coordinate the ongoing study. However, because FEMA neither has the inhouse expertise nor coordinates the review of these study proposals with agencies having such expertise, the problems experienced with the New Orleans proposal could well recur in other locations.

Additionally, FEMA's initial lack of coordination with other Federal agencies did little to assure that the various Federal assistance programs would be used to their full advantage. For example, when scheduling its 22 high-risk locations, FEMA did not consider the National Weather Service's schedule for making SLOSH available for 22 geographic locations

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[2]One of these studies done for the Tampa Bay region is considered to be a prototype for comprehensive preparedness planning.

or "basins".[3] As a result, while only three FEMA-designated high-risk areas would not at some time have had the SLOSH model available, scheduling differences between the two agencies created a situation whereby several FEMA high-risk locations would have received grant awards before SLOSH was available.

Within the past year, FEMA has largely recognized the need to improve program management and has taken the following steps:

--Acknowledged the importance of SLOSH in generating technical data and rescheduled the funding order of remaining high-risk locations to maximize SLOSH availability in developing preparedness plans.

--Developed guidelines (to be issued later this summer) for its regional offices to use in assessing planning proposals. These guidelines set out the tasks necessary to develop the technical data needed for planning and generally offer the regions a good overview of what a planning proposal should include. One especially important consideration made by FEMA in these guidelines is its new emphasis on evacuation of population at risk as the first step in preparedness planning. Initially, FEMA placed study emphasis on property at risk.

--Helped establish the Interagency Hurricane Work Group (FEMA, NOAA, the Corps of Engineers, and the American Red Cross) in June 1982. This Group has been instrumental in providing FEMA with a hurricane-specific technical and planning perspective not available within FEMA.

--Increased available funding for most scheduled locations.

Although the above measures are a step forward, some problems still persist:

1. FEMA regional and headquarters staffs do not have the specific modeling, engineering, and meteorological expertise needed to critically review or monitor State-submitted proposals and have not used available expertise within the Corps or NOAA. As a result, FEMA has no real assurance that these proposals can lead to satisfactory preparedness plans.

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[3]The 22 FEMA locations and 22 Weather Service locations were designated separately. Although there is considerable overlap between the two lists--19 of 22 FEMA locations are on the Weather Service list--FEMA and the Service largely developed lists independently of one another.

2. Completed evacuation plans have not been reviewed to determine the usefulness and applicability of various data-gathering techniques and planning approaches for other locations. The Corps was very successful in "pyramiding" its experience in its studies but has not formally documented the procedures it followed. Such documentation is extremely valuable in assisting planners to avoid past mistakes and build on past success.

While FEMA has taken positive steps to improve program direction, particularly in defining what the individual study grants should accomplish, FEMA now needs to take additional steps to better assure that such results are achieved. With the disappearance of NOAA and Corps funds and faced with approving and awarding new study grants for locations lacking existing hurricane planning expertise, FEMA must shoulder more responsibility in coordinating Federal hurricane preparedness programs and in providing adequate guidance to States and local areas developing such plans.

RECOMMENDATIONS TO THE DIRECTOR, FEMA

To better assure that FEMA's Hurricane Preparedness Program provides more effective assistance to States and local governments, we recommend that the Director, FEMA,

--formally review current hurricane planning efforts to determine the best methods for developing and inplementing a workable preparedness plan;

--carefully review State proposals to see that (1) the proposals are technically feasible, (2) the proposed studies will be conducted by technically competent planners, (3) funding is generally available to complete the proposals, and (4) officials having ultimate responsibility for implementing emergency operating procedures during a hurricane are involved in the planning process; and

--have the proposals reviewed by the Corps of Engineers and relevant NOAA agencies. This is especially important since FEMA has limited inhouse expertise in engineering, modeling, and forecasting which might be required for a thorough review of the proposal.

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As you know, 31 U.S.C. §720 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the House Committee on Government Operations and the Senate Committee on Governmental Affairs no later than

60 days after the date of our report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

We are sending copies of this report to the Director, Office of Management and Budget; the U.S. Army Corps of Engineers; the Administrator, National Oceanic and Atmospheric Administration; and other interested parties.

Sincerely yours,

J. Dexter Peach
Director

Enclosure

Contents

ABBREVIATIONS

FEMA	Federal Emergency Management Agency
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
SLOSH	Sea, Lake, and Overland Surges from Hurricanes
SPLASH	Special Program to List the Amplitude of Surges from Hurricanes

ENCLOSURE I

UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

FOR RELEASE ON DELIVERY
EXPECTED AT
THURSDAY, MAY 5, 1983

STATEMENT OF
J. DEXTER PEACH, DIRECTOR
RESOURCES, COMMUNITY, AND ECONOMIC DEVELOPMENT DIVISION
BEFORE THE
SUBCOMMITTEE ON LEGISLATION AND NATIONAL SECURITY
OF THE COMMITTEE ON GOVERNMENT OPERATIONS
HOUSE OF REPRESENTATIVES
ON
THE FEDERAL ROLE IN HURRICANE PREPAREDNESS PLANNING

Mr. Chairman and Members of the Subcommittee:

We welcome your invitation to discuss our review of the Federal role in hurricane preparedness planning. Hurricane preparedness planning--covering that time period from the hurricane advisory until the hurricane reaches land (landfall)--is a State and local responsibility. The Federal Government provides funds and technical assistance which, if properly used, can greatly facilitate and improve the planning process.

At the request of this subcommittee, we reviewed the principal Federal programs and activities relating to hurricane preparedness at the Federal Emergency Management Agency (FEMA), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Army Corps of Engineers. We also visited 6 States and 16 city, county, and regional planning jurisdictions within those States to determine how hurricane preparedness plans are developed. (Att. I lists State and local areas visited during our review.)

The Federal Government provides three services having a direct impact on local preparedness levels:

--Forecasting. NOAA's National Weather Service (NWS) issues hurricane advisories to affected areas through the National Hurricane Center.

--Technical assistance. NWS has developed a computer simulation model that can be used by planners to predict flooding levels. Models are scheduled to be developed for 22 designated areas or basins.

--Financial assistance. FEMA is funding hurricane preparedness studies for 22 high-risk areas at a total cost of $6.7 million. The Corps and NOAA have also funded individual preparedness studies but have no current plans to fund additional studies.

Overall, the programs have helped improve preparedness levels in those communities that have received Federal assistance. However, problems in some areas have kept the programs from being as effective as possible. For example:

--FEMA provides little or no guidance to States on how to develop a preparedness plan;

--FEMA has no criteria by which to review planning proposals. FEMA has funded several studies with little assurance that the proposals would lead to a successful plan;

--NWS has provided computer model simulation runs for five basins but has insufficient funds to complete these runs for all areas; and

--Six of the 22 FEMA-designated, high-risk areas will not be able to take advantage of the NWS simulation models because of inadequate coordination between FEMA and NWS.

To better assure that available Federal assistance is effectively used in hurricane preparedness planning, FEMA must (1) coordinate and "package" available Federal technical andfinancial assistance and (2) assure that State-submitted proposals for technical studies and preparedness plans will adequately address stated needs. Additionally, FEMA, NOAA, other involved Federal agencies, and affected State and local areas should consider options and agree on a funding approach for the computer model simulations needed to assist in developing hurricane preparedness plans.

During the course of our review, FEMA initiated some steps to strengthen its coordination with other Federal agencies and is developing guidelines for evaluating State-submitted study proposals. These guidelines are not yet ready for review.

BACKGROUND

Hurricanes are among the most destructive of all natural hazards. The risk of loss of life and property is enormous, second only to that caused by tornadoes. Ninety percent of all hurricane-related deaths and most of the damage are caused by storm surge. As a hurricane approaches land, a dome of water some 40-50 miles across and as much as 25 feet or more above sea level--the storm surge--takes shape. The surge initially damages or destroys beach front property, but most of the damage and loss of life is caused by the resultant flooding. To minimize loss of life, all six of the States visited during our review required coastal areas to have in place emergency preparedness plans. These plans are designed to reduce loss of life or bodily harm by evacuating or sheltering at-risk individuals during a hurricane.

We found that responding to hurricane threats presents local and State officials with the need to make critical decisions, frequently without essential information. The local official must decide if evacuation is necessary, who should evacuate, where they should go, and by what route. If time were not a factor, these problems could be dealt with relatively simply. However, the lead warning time is typically 12-16 hours, and some communities require more than 30 hours for a full evacuation. Such lead times may require local officials to make evacuation decisions on uncertain information long before the official warning. A false warning may cost several hundred thousand dollars in unnecessary evacuation costs; conversely, a failure to order a needed evacuation could literally endanger thousands of lives.

Although we did not specifically evaluate individual hurricane preparedness plans, our review of State and local plans in Texas, Louisiana, Mississippi, Alabama, Florida, and Georgia led to the following observations:

--Local plans ranged from sophisticated efforts encompassing detailed technical information and covering a variety of storm conditions to informal plans that relied primarily on the residents' good sense to leave when a hurricane is expected.

--Most local areas develop preparedness plans on one of three bases: (1) an informal, historical recollection relying largely on common sense, (2) a more formal vulnerability analysis based largely on historical data for storm information, and (3) a formal vulnerability analysis combining historical data with a technical data base developed from simulation models and containing information on probable surge height, evacuation zones, and appropriate evacuation routes for a variety of hypothetical storms.

--Those local or regional areas having a formal vulnerability analysis based on simulation models are in a better position to define actual problems to be faced during a hurricane emergency than those without such a base.

--Each location that has a formal vulnerability analysis based on simulation models was able to do so because of relatively large amounts of funding and technical assistance received from the Federal Government.

--Last, and most important, planning efforts are largely useless unless the plan results in operational guidelines that can be used by local jurisdictions before and during a hurricane emergency. Plans need to be developed by or in cooperation with those officials responsible for taking action. Local areas with strong local involvement in designing or conducting the vulnerability analysis seemed to be better equipped to translate the resultant data base into a plan of action.

Mr. Chairman, I will now briefly address the Federal Government's role in hurricane preparedness.

NATIONAL WEATHER SERVICE

NWS plays a key role in assisting State and local governments to develop and improve hurricane preparedness programs through its warning systems, storm surge models, and public awareness programs. We were impressed with NWS efforts in working with State and local governments to improve emergency response to a hurricane threat.

Hurricane advisories

NWS issues special storm advisories--hurricane warnings--for specific areas 24 hours or less before expected

landfall with most warnings coming 12-16 hours before expected landfall. NWS uses data from weather satellites and reconnaissance aircraft to make its forecasts. Although the data received from the planes provides the most detailed information, state-of-the-art meteorological equipment is not being used for all weather reconnaissance activities. Reconnaissance missions are flown primarily by the U.S. Air Force using 18-22 year old planes (11 total) that are not well equipped and can transmit meteorological data by voice only. Additionally, these planes have maintenance problems that could affect reliability during a hurricane emergency. Two better-equipped NOAA research planes, having an on-board computer capability and automatic plane-to-ground communication links via satellite, are used only on a limited basis. The Air Force is considering updating its air fleet to include these capabilities, but any such update will be expensive and take considerable time.

Many local areas use the specific warning generated by NWS as a guide in ordering evacuation, but some communities have determined that evacuation times exceed this time period. For example, Houston, Texas, could require up to 26 hours to evacuate for a major storm; the Florida Keys could take more than 30 hours; and the Tampa Bay, Florida, region could take more than 20 hours. Preevacuation mobilization can add another 3 hours to the required time. If a community had 40-50 hours of lead time, hurricane evacuation would not be a major problem. However, NWS does not anticipate any imminent advances in forecasting technology that would allow the warning time to be extended.

To increase the usefulness of information from available forecasts, NWS plans on releasing probability information to the public during the 1983 hurricane season. The probability of hurricane conditions will be released for specific locations up to 72 hours in advance of the predicted arrival time. The probabilities for any specific area are low--the maximum assigned value for the 72 hour warning (before landfall) is 12

percent going up to a maximum of 50 percent for the 24 hour warning--but could be very useful to local officials in assessing the relative risks of hurricane conditions. (Att. II shows how this information might be presented.)

Some local areas have been requesting such information, especially in those areas having long evacuation times. However, release of this information is causing concern among some State officials. They believe that the probability data will be confusing to the public, and they would prefer that NWS make the probability information available only to State officials.

Storm surge models

NWS has developed two models, SPLASH (Special Program to List the Amplitude of Surges from Hurricanes) and SLOSH (Sea, Lake, and Overland Surges from Hurricanes), to determine storm surge effects. SPLASH is used to model surge effects along the coastline. SLOSH is a more sophisticated model that better accounts for more complex topographical features such as bays or estuaries and will also simulate or predict inland flooding.

These models have proved to be indispensable to local and regional areas wanting specific information on hurricane effects. Before the advent of computer simulation models, planners were forced to rely primarily on historical data for preparedness planning. They could review the flooding effects of past hurricanes and combine this with information from topographical maps to develop evacuation zones. With simulation models the planner can go well beyond this. These models give the planner a capability to review the probable flooding effects of dozens of hurricanes, each of a different intensity or direction. The planner can use this information to determine when and where particular locations will be flooded or

when evacuation routes will become impassable. When used in conjunction with population data and transportation studies, the planner can quantify evacuation times.

The SLOSH model is completed in two phases. First, the model is adapted or "fitted" to a specific coastal area or basin. At this point the model can be used for forecasting purposes. The second phase involves three steps: (1) running an average of 250 simulations for various hurricane scenarios, (2) consulting with local planners using these simulations to develop evacuation plans, and (3) summarizing all information and data in a storm surge data atlas that serves as a reference guide. At this point the SLOSH model results can be used for both forecasting and planning.

NWS has scheduled 22 basins for SLOSH development. The first model was operational (through phase one) in April 1979, and phase one work has since been completed on another 11 basins. The remaining basins will be completed by September 1985. (Att. III lists SLOSH basins.) Phase two computer simulation runs have been completed for only five basins and are currently being used in the Tampa Bay and Southwest Florida areas and along the Texas coast. I should emphasize that, fortunately, no community has yet to test SLOSH results under actual hurricane conditions.

While NWS has obligated money to complete phase one development, no funding is currently available for phase two. Fourteen other basins have requested a SLOSH model, and two of these will be funded from currently obligated funds. No funding is presently available or has been requested by NOAA for the other 12 basins. (Att. IV lists these additional basins.) NWS estimates phase one development costs at about $131,000 per basin with phase two costing about $108,000 per basin. The computer simulations done within phase two cost approximately $88,500 per basin.

FEDERAL EMERGENCY MANAGEMENT AGENCY

Under its general responsibility to assist State and local governments in developing emergency preparedness plans, FEMA has become the primary Federal funding source for hurricane prep - edness planning. By authority of the Disaster Relief Act of 1974, FEMA has established a Hurricane Preparedness Planning Program for assisting States and local governments in their planning efforts. FEMA has identified 22 high-risk locations and will fund preparedness studies through the States for each area. The program began in fiscal year 1981 and will be completed in fiscal year 1988 at a total cost of about $6.7 million. (Att. V lists each of the 22 areas.)

Each grant is funded for a 2- or 3-year period at a cost of $300,000 to $640,000. The grants are not intended to cover all costs. Four of the five grants awarded in the two FEMA regions covered in our review have also received funding from State and other Federal sources. (A total of seven grants have been awarded; two of these were outside our review area.) In the case of Tampa Bay and Southeast Florida, the Corps of Engineers was the principal funding source.

Each study is completed in two steps. First a vulner- ability analysis is conducted to predict depth and extent of flooding from hurricane surge and resulting loss of property and human casualties. Secondly, plans are developed for evacuation, response, recovery, and mitigation based upon the vulnerability analysis. FEMA has strengthened its program by placing increased emphasis on evacuation planning during the first stage of the hurricane studies. This change will be reflected in guidelines going to the FEMA regional offices. FEMA has also decided to increase the funding amount for each individual study from an original level of $200,000 to $300,000 per area up to $300,000 to $640,000 per area.

FEMA review and guidance

FEMA has done little to assure that the hurricane preparedness studies will result in workable plans. Our review of FEMA regions IV and VI and FEMA headquarters revealed that the agency has no real criteria by which to evaluate proposals, and reviews have been cursory at best. Officials within each region have relatively little specific knowledge of the risks associated with hurricanes, the types of information needed to prepare for those risks, and the types of available technical support necessary to support planning efforts. In four of the five ongoing or completed studies covered by our review--Tampa Bay; coastal Georgia; Galveston, Texas; and Southeast Florida--this lack of FEMA guidance has had little negative effect because assistance and guidance were available elsewhere and those performing the studies were technically competent. For example, the Tampa Bay Regional Planning Council had already developed a definitive technical data base--largely paid for by the Corps of Engineers.

FEMA was not so fortunate, however, for the proposed New Orleans study. Before submitting the proposal, the Louisiana Office of Emergency Preparedness reqested FEMA guidance (specifically use of the Texas proposal) in developing their ownstudy proposal. FEMA informed the State that they should develop their own methodology. The resultant study proposal had problems with funding and a major technical element; however, FEMA approved the proposal without being aware of those problems. FEMA is now aware of these problems and as a result has delayed additional funding by 1 year. With better review and coordination by FEMA, however, problems in the proposal could have been recognized early on.

The proposal included steps to update regional topographical data at an estimated cost of $400,000 because State officials believed that available topographical maps were outdated. NWS officials believe, however, that existing maps are adequate.

The State was informed of this at a later meeting with NWS but still intends to perform the mapping. (Funds are not currently available for mapping.)

Additionally, the State assumed funding from largely unavailable sources. The State estimated that the vulnerability analysis would cost $1 million. Funding was to be secured with a $75,000 FEMA hurricane grant, $123,000 from other FEMA grant programs, $400,000 from NOAA's Office of Coastal Zone Management, and additional funds from the Corps of Engineers. Neither the Office of Coastal Zone Management nor the Corps had available funds. To date, FEMA has awarded $75,000 to the State but, as noted above, is delaying additional funding by 1 year until the proposal is sorted out.

Finally, FEMA did not coordinate its review with appropriate Federal and local officials. For example, FEMA did not check with NWS to review the mapping proposal nor did it check with NOAA or the Corps to see if funding was available. FEMA was initially concerned that the State had not coordinated its proposal with appropriate local officials. The State did form a local government advisory committee, but one of the New Orleans' area parishes told us they intend to develop their own vulnerability analysis.

FEMA is now developing guidelines for its regional offices to better assist States in preparing grant proposals and to allow the regional offices to provide a more thorough review of those proposals. These guidelines, in the early stages of development, are not yet available for review.

SLOSH coordination

In selecting the 22 high-risk areas to receive funding assistance, FEMA did not take into consideration which areas had previously been selected for SLOSH modeling. At that time FEMA

did not consider SLOSH to be essential for developing a vulnerability analysis. Consequently, 6 of the 22 areas--coastal Georgia, Maryland, Hawaii, New Jersey, Puerto Rico, and the Trust Territories--either were or will be unable to use SLOSH for preparedness planning. (NWS recently agreed to develop a SLOSH model for Georgia; however, the vulnerability analysis has already been completed.)

During our review, FEMA officials began to recognize the importance of using the SLOSH model to generate technical data needed for preparedness planning. FEMA is now coordinating more closely with NWS on SLOSH model development. FEMA also reordered its schedule of hurricane studies to coincide with the timing of future SLOSH models. However, FEMA does not intend to delay studies for areas not currently scheduled for SLOSH if the State or locality wish to proceed with the study, especially if these are "open coast" areas (areas without major bays and estuaries) where FEMA believes SPLASH data can be used effectively.

OTHER FEDERAL INVOLVEMENT

Several other Federal agencies have been instrumental in initially assisting State and local areas to develop preparedness plans. For example, the Corps of Engineers' Jacksonville, Florida, district office has taken the lead in developing prototypical hurricane evacuation plans--first in Lee County, Florida; then in the Tampa Bay, Florida, region; and currently in Southeast Florida. These studies were among the first to develop an integrated preparedness plan. Tampa Bay was the first area to use SLOSH to develop an evacuation plan.

Although these studies are considered to be pioneering efforts, no documentation of procedures followed, methods used, or lessons learned has been developed. At this time the Corps has

no plans to provide such documentation. The Corps also has no immediate plans to fund additional hurricane preparedness studies.

NOAA's Office of Sea Grant and Office of Ocean and Coastal Resource Management (OCRM) have also played important roles in preparedness planning. The Office of Sea Grant funded a large part of the initial development work for the SLOSH model and funded various individual studies such as the evacuation study done by Texas A&M University for the Galveston, Texas area. OCRM has provided funds for numerous hurricane preparedness studies in Florida under the Coastal Zone Management Act. NOAA is not seeking program funds for either office for fiscal year 1984. OCRM will continue to coordinate coastal hazard programs within NOAA and could possibly help fund the SLOSH computer simulation runs out of its fiscal year 1983 continuing appropriation.

FEMA, the Corps, NOAA, and other interested parties such as the American Red Cross regularly meet to discuss hurricane preparedness planning. These meetings, originally intended to discuss vertical evacuation or refuge (moving residents up rather than out), have become an effective communications network for exchanging information among involved parties.

CONCLUSIONS

In conclusion, Mr. Chairman, I would like to emphasize that FEMA, NOAA, and other Federal agencies simply provide tools to assist in preparedness planning. The responsibility for that planning rests with State and local governments.

Federal assistance in hurricane preparedness planning is at a crossroads. The instructive, pioneering planning efforts largely supported by the Corps and NOAA's Office of Sea Grant, OCRM, and NWS are in place or nearing completion, and much of that Federal support--with the notable exception of NWS--is,

at least for the moment, largely unavailable for future preparedness studies. On the other hand, critical technical assistance is still available from NWS, and FEMA has in place a comprehensive funding program covering most of the high-risk coastal areas in the United States.

To better assure that these areas develop adequate preparedness plans, FEMA must shoulder more responsibility in coordinating remaining Federal hurricane preparedness programs and in providing necessary guidance to State and local areas developing such plans. Effective implementation will also likely require additional State expenditures.

For the program to succeed, we believe that FEMA must

--formally review current hurricane planning efforts to determine the criteria necessary for development and implementation of a workable preparedness plan;

--carefully review State proposals to see that (1) the proposals are technically feasible, (2) that the proposals will be developed by technically competent planners, (3) that funding is generally available to complete the proposals, and (4) that officials having ultimate responsibility for implementing emergency operating procedures during a hurricane are involved to some degree in the planning process; and

--have the proposals reviewed by the Corps of Engineers and relevant NOAA agencies. This is especially important since FEMA has limited inhouse expertise in engineering, modeling, and forecasting which might be required for a thorough review of the proposal.

Additionally, for most areas, availability of the SLOSH computer simulation runs is critical in developing information necessary for a vulnerability analysis and subsequent evacuation

and preparedness plans. The ultimate utility of FEMA'shurricane preparedness program could be seriously weakened without the data provided by these runs. We feel that FEMA, NWS, other interested Federal agencies, and affected State and local governments should work closely together to determine funding options for completing this phase of SLOSH development. A State may well determine that the utility of the simulation runs warrants State funding. For example, South Carolina plans to partially reimburse NWS for computer simulation runs.

That concludes my prepared statement, Mr. Chairman. I will be happy to respond to any questions you or other subcommittee members might have.

ATTACHMENT I

STATE AND LOCAL AREAS VISITED

Georgia

Coastal Area Planning and Development Council (covers the six coastal Georgia counties)

Florida

Tampa Bay region
Bay County
Dade County

Alabama

Mobile County

Mississippi

Harrison County
Jackson County
Hancock County

Louisiana

Orleans Parish
Jefferson Parish
St. Bernard Parish
St. Tammany Parish
Calcasieu Parish

Texas

Brownsville area
Galveston/Houston area
Beaumont/Port Arthur area

ATTACHMENT II

PROBABILITY OF HURRICANE CONDITIONS

Coastal location	Less Than 24 hr	24-36 hr	36-48 hr	48-72 hr	Total for 72 hr period
Marco Island, Fla.	*	*	*	1	1
Fort Myers, Fla.	*	1	*	*	1
Venice, Fla.	1	*	1	*	2
Tampa, Fla.	1	*	1	1	4
Cedar Key, Fla.	2	3	1	1	7
St. Marks, Fla.	7	5	2	*	14
Apalachicola, Fla.	16	3	*	1	20
Panama City, Fla.	19	3	*	1	23
Pensacola, Fla.	21	3	1	*	25
Mobile, Ala.	16	6	1	*	23
Gulfport, Miss.	14	6	1	1	22
Buras, La.	16	4	1	*	21
New Orleans. La.	8	7	1	1	17
New Iberia, La.	1	6	3	2	12
Port Arthur, Tex.	*	1	3	3	7
Galveston, Tex.	*	1	2	2	5
Port O'Connor, Tex.	*	*	1	2	3
Corpus Christi, Tex.	*	*	1	1	2
Brownsville, Tex.	*	*	*	1	1

* Probability less than 1 percent.

The probability of hurricane conditions is defined as the probability that the storm center will pass within 75 miles to the left or 50 miles to the right of the coastal location within the forecast period.

There is an approximate maximum probability within each forecast period:

48-72 hours	12 percent
36-48 hours	20 percent
24-36 hours	30 percent
Less than 24 hours	50 percent

ATTACHMENT III

STATUS OF SLOSH DEVELOPMENT PROGRAM

	Basin	Phase I Operational Model	Phase II Simulations	Atlas
1.	Lake Okeechobee, Fla.	Completed		
2.	Lake Pontchartrain, La.	Completed		
3.	Tampa Bay, Fla.	Completed	Completed	
4.	Galveston Bay, Tex.	Completed	Completed	
5.	Charlotte Harbor, Fla.	Completed	Completed	Completed
6.	Florida Bay, Fla.	Completed		
7.	Biscayne Bay, Fla.	Completed		
8.	Corpus Christi, Tex.	Completed	Completed	Jan. 1984
9.	Mobile Bay, Ala.	Completed		
10.	Sabine Lake, Tex., La.	Completed	May 1983	
11.	Pensacola, Fla.	Completed		
12.	Charleston Harbor, S.C.	Completed	Completed	
13.	Pamlico Sound, N.C.	June 1983		
14.	Matagorda Bay, Tex.	Nov. 1983		
15.	Lower Laguna Madre, Tex.	Nov. 1983		
16.	Delaware Bay, Del.	Oct. 1983		
17.	Buzzards Bay, Mass.[1] Narragansett Bay, R.I.[1]	Dec. 1983		
18.	Chesapeake Bay, Md.	Sept. 1983		
19.	Long Island Sound, N.Y.	Sept. 1985		
20.	Boston Bay, Cape Cod, Mass.	Sept. 1985		
21.	Hilton Head, S.C.[2]	Sept. 1985		
22.	Brunswick, Ga.[2]	Sept. 1985		

[1]These basins were combined to reduce the number of original basins from 21 to 20.

[2]These two basins were added to the original list. NWS plans on completing these basins using currently obligated funding.

ATTACHMENT IV

AREAS REQUESTING SLOSH MODEL DEVELOPMENT

1. Myrtle Beach, S.C.
2. Cape Canaveral, Fla.
3. Crystal River, Fla.
4. Apalachicola Bay, Fla.
5. Puerto Rico
6. Hawaii
7. Jacksonville, Fla.
8. Palm Beach, Fla.
9. Vermillion Bay, La.
10. New Jersey coast
11. Portland, Me.
12. Penobscot, Me.