An Assessment of Coastal Zone Hazard Mitigation Plans in Texas

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A Report Prepared for the
Texas General Land Office
and
The National Oceanic and Atmospheric Administration
Under GLO Contract No. 07-005-21

This investigation was funded by a grant from the National Oceanic and Atmospheric Administration administered by the Texas General Land Office. The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA or any of its sub-agencies.

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January 11, 2009

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1. Introduction

The United States has seen over recent decades an exponential growth in the physical impacts and economic losses due to flooding, hurricanes, and earthquakes. In part this trend is due to increasing concentrations of population and infrastructure in areas with high exposure to natural hazards. The growing concentrations of population and infrastructure in hazards prone areas can easily and clearly be seen by focusing on coastal areas that are susceptible to hurricane hazards.

Population concentrations in coastal areas of the United States have grown since the 1950's by 106.1% compared to only 75.8% in non-coastal areas (U.S. Census 2007). Consequently we now find very large percentages of the nation's population and housing stock are located in highly concentrated vulnerable areas along the coast. For example, in 2000, 48.9% (137.5 million) of the U.S. population resided within 50 miles of the coastline and that population occupied 47.8% (55.4 million) of the nation's housing units. This large percentage of population in a relatively narrow area has resulted in much higher densities along the coast. For example, the population density in coastal counties in 2005 was, on average, 304.6 persons per square mile which was over five times the densities of non-coastal counties.

While these trends may appear more evident elsewhere in the United States, Texas is not immune. Indeed, Texas is a contributor to this trend. First, it should be noted that the Texas coast is home to one of only two of our nation's top ten largest metropolitan areas to be located in a coastal zone – the greater Houston area. Not surprisingly, Harris County which is the heart of Houston, has the highest population of all Texas counties and five of the top twenty most highly populated Texas counties are also located along the Texas Coast (Harris, Cameron, Brazoria, Galveston, and Jefferson counties). Furthermore, when compared to other areas in Texas, the greater Houston-Galveston area is predicted to experience the second highest absolute population growth by 2040 with a predicted population of between 8.5 to 12.8 million according to the State Demographer. Similar high levels of growth are predicted for the coastal counties in the lower Rio Grande area, where population predictions are between 2.1 and 2.6 million. Together the

Houston-Galveston and Lower Rio Grande areas are two of the top 5 growth areas in Texas. But of course, population growth and concentrations are only part of the story.

It is the consensus of the scientific community that disasters are outcome of the interaction between biophysical systems (e.g., climatological systems, geological systems, etc.), human systems (e.g., communities, regional economies, etc.), and their built environments (e.g., homes, other buildings, and infrastructure). Furthermore it was the central conclusion of the *second assessment* of natural hazards and disaster research in the United States undertaken by the scientific community and summarized in the aptly entitled volume *Disasters by Design* (Mileti 1999) that "natural" disasters are in large measure a function of human action or, all too often, inaction. Despite increasing knowledge on natural hazard agents, their potential impacts and other factors that contribute to and exacerbate these impacts, disasters losses increase in part because of where and how we "design" our communities.

In other words, as our nation's communities develop, they all too often continue to expand into areas subject to experience natural hazards and as they do so this development often disrupts and destroys environmental resources such as wetlands that can reduce losses. When this happens, the solution often touted are technological fixes such as levees, sea walls, and beach nourishment programs that themselves can have detrimental environmental consequences and tend to promote increased development in these hazardous areas. The net result is more and more people and more and more infrastructure being located in high hazard areas. And then, when major disasters occur, recovery requires massive infusions of external public and private resources, is often highly uneven in its results, and is likely to reproduce many preexisting vulnerabilities. In short, many of our communities are becoming ever more *vulnerable* to natural hazards even as they rebuild and recover from the last disaster.

It is in part because of the increasing awareness of the growing vulnerability of our nation's communities that we have seen ever increasing calls and policy movement toward mitigation and mitigation planning as part of the solution (Burby 1998). There was a very slow movement toward mitigation issues in the 70s and 80s, but by the mid to

late 1990s FEMA, for example, was an encouraging state and local government to develop and implement mitigation plans by providing financial and technical resources and innovative programs such as Project Impact. This encouragement was greatly enhanced with the passage of the Disaster Mitigation Act of 2000 which requires states and local jurisdictions to develop hazard mitigation plans as a condition of eligibility for hazard mitigation grants from FEMA. As a result of this act community participation has continuously increased. As of May 31, 2007, all 50 States, The District of Columbia, 7 Territories and 36 Tribal governments have their own mitigation plans, and over 14,000 local jurisdictions have developed local hazard mitigation plans or have participated in multi-jurisdiction local hazard mitigation plans (FEMA 2008). FEMA has also been quite permissive when considering the types of entities that can pull together these mitigation plans; hence, there are a range of entities from local municipalities, to large metropolitan areas, and even regional entities and school districts that have approved mitigation plans. FEMA also provides guidance through its crosswalk and other resources to assist local and state agencies in the development of their hazard mitigation plans to better ensure that they meet the requirements of FEMA's Mitigation Planning regulations. However, it must be noted that in many cases, these criteria are minimum requirements and do not necessarily guarantee a high quality plan nor the effectiveness of the plan when implemented to insure decreased hazard losses. Also, despite the development and implementation, there has been very limited research that evaluates hazard mitigation plan quality or effectiveness their desired objectives.

The purpose of this study is to examine the nature of mitigation plans[1] and their proposed actions as they apply to areas located within the coastal management zone of Texas. Specifically, the goal is to provide detailed assessments of the variety of hazard mitigation plans that have been developed at the regional, county and community level. In undertaking this assessment our goal is not to "grade" nor invidiously compare plans,

[1] The terms hazard mitigation plans and hazard mitigation actions plans are use interchangeable throughout this document in part because they are used interchangeably in FEMA documentation and by jurisdictions involved in mitigation planning. Mitigation plans are generally undertaken to identify policies and actions that should be followed by local jurisdictions to lessen the potential impacts of hazard. They are also necessary to qualify for post-disaster mitigation funding from FEMA to undertake mitigation actions. Hence, they are often termed Mitigation Action Plans.

but rather to provide detailed information on hazard mitigation planning initiatives in the hope that local constituencies can assess the relative strengths and weaknesses of their plans and thereby guide future planning activities. Thus, this study is primarily focused on understanding the status of current regional and local mitigation plans through a plan quality assessment that will help establish where plans are doing a good job and where improvements might be made to strengthen the quality of local mitigation plans and thereby assist in improving future mitigation plans as they evolve. Our specific goals are to:

- develop a hazard mitigation plan quality assessment protocol based on FEMA's guidelines and the research literature on plan evaluation and hazard mitigation;
- assess current status of hazard mitigation plans against the developed protocol for areas within the Texas coastal management zone; and
- systematically examine critical components of these hazard mitigation plans, highlighting their strengths and areas that could be improved upon.

The hazard mitigation plans assessed in this study are all FEMA approved mitigation plans for areas that are located partially or wholly in the officially recognized Texas coastal zone which is, of course, particularly vulnerable to a range of both natural and technological hazards. In total this study will assess 12 mitigation plans that have been approved by FEMA in the study area. These include 3 city mitigation plans, 4 county mitigation plans, and 5 regional mitigation plans.

This report will be structured in the following manner. The next section, Section 2, will discuss the development of the protocol used to assess the 12 hazard mitigation plans. It will begin by discussing FEMA's guidelines and then introduce examples of plan evaluation protocols from the research literature. This section also discusses how the protocol was applied to actually measure the quality of these plans. Section 3 provides a brief introduction to the 12 plans analyzed in this research with respect to the coastal jurisdictions that participated in each plan and provides maps detailing areas covered by these plans. Section 4 provides the analysis of the plans beginning with an overview of how the plans preformed in general and with respect to critical components associated

with mitigation plans. This is followed by a very detailed examination of the planning elements included in these plans and concludes with an analysis of the mitigation actions proposed by the jurisdictions that participated in these plans. The final section, Section 5, offers a summary of the findings and a discussion of the implications of these findings for future mitigation planning efforts.

2. Developing a Plan Assessment Protocol for Hazard Mitigation Plans

The first step in undertaking the assessment of mitigation action plans requires the development of an assessment protocol. A protocol is in effect a guide or template that identifies the key topics, sometimes referred to as components or parts that should be covered or addressed in a quality mitigation plan. Furthermore, it should provide additional guidance regarding what types of additional topics should be covered within each of the key topical areas along with some guidance about the specific planning elements or detailed information that should be found within each of the topical areas. Once it is developed a protocol can then be used as a guide or metric to assess or determine if a plan includes key component that should be found in a quality plan and how completely or well a given plan addresses critical planning elements associated with these components. It should also be noted that once a protocol is developed it can also provide an important guideline for planners, emergency managers, and concerned citizens to develop a high quality of hazard mitigation plan in the future.

There are undoubtedly many approaches that could be taken in the development of a protocol to be used in this research. A logical starting point would, of course, be FEMA's guidelines for establishing or developing a mitigation plan. Indeed, as will be shown below, FEMA has in a sense, already developed a protocol, that it terms a "cross-walk" which identifies sections or key elements for a hazard mitigation plan along with elements that should be included in each section. This cross-walk serves as an evaluation protocol for determining whether or not a plan can or should be "approved" by FEMA.

Table 1. Plan Evaluation Concepts and Methodologies

• FEMA Mitigation Planning Guidance
• Critical Exemplars from the Plan Quality Evaluation Literature o Kaiser, Godschalk and Chapin (1995): Three Components of Plan Quality o Brody (2003): Five Component approach to Plan Quality Evaluation o Berke, Rodriquez, Godschalk, and Kaiser. (2006): Eight Component Approach to Plan Quality Evaluation

While FEMA's guidelines or cross walk, might represent a good starting point, it perhaps is not the best place to end. In a very real sense, FEMA's guidelines are minimum requirements, defining what should be in a basic mitigation plan, but not necessarily what should be found in a quality plan. Fortunately there is a rather extensive, albeit recent, plan quality evaluation literature that has developed for over a decade of scientific research. One of the earliest studies of plan quality was published in the mid 1990s by Kaiser, Godschalk and Chapin (1995) in which they defined 3 components to constitute high quality plans. Since that time, there have been a number of addition studies that have not only employed concepts introduced by Kaiser, Godschalk and Chapin in plan quality evaluation, but have also focused more explicitly on environmental and hazard related plans. The protocol development in this research will be based on FEMA's guidelines and those introduced by Kaiser, Godschalk, and Chapin (1995). In addition approaches that have significantly improved on techniques of plan evaluation and assessment, in particular, the work of Brody (2003a, 2003b and 2003c) and Berke, Rodriquez, Godschalk and Kaiser (2006). Table 1 displays the major works and approaches that will be integrated in the development of the protocol to be developed and employed in this research. The next section briefly discusses FEMA's approach, the cross-walk, and nature of plans considered. This is followed by a discussion of the plan evaluation literature and introduces the approach taken here.

2.1. FEMA's Approach and Guidelines

A logical place to start in developing an assessment tool for Mitigation Action Plans is with FEMA's approach and guidelines because they establish the general, yet perhaps minimum requirements for these plans. The basic notion behind mitigation is that while a

natural hazard such as a hurricane or earthquake cannot be prevented or stopped, their impacts on individuals and property can be substantially reduced by undertaking activities prior to hazard events that will reduce their impacts (Godschalk et al. 1999). The action is of course a ***mitigation action*** which FEMA (1999, p1-1) defines as "any sustained action taken to reduce or eliminate long-term risk to people and property from natural hazards and their effects." This definition is more or less consistent with general definitions employed by the broader hazard research community. Perhaps one subtle difference between FEMA's and the research community's definition is somewhat implicit in the notion of reducing "long-term" risk. In the research community mitigation actions are considered to be activities that are taken in advance, generally far in advance, of any potential disaster event that will reduce disaster impacts in the long run (Godschalk et al. 1999). At other times they are referred to as passive actions that do not need to be undertaken just prior to a potential disaster (i.e., preparedness actions), but rather are generally planned for and undertaken before disaster warnings are necessary (Lindell and Perry 2000). These distinctions attempt to differentiate mitigation from preparedness actions with the latter generally refer to short-term activities that are preformed just prior to a hazard event seeking to protect life and property. Classic examples are evacuation and temporary efforts to reduce property damage such as sand-bagging and the temporary boarding of windows with makeshift materials. While this distinction is important, it should be noted that many improvements in emergency response efforts are often included as mitigation efforts by FEMA (1998).

Mitigation actions themselves can be characterized in many ways. One often employed classification of actions is structural versus nonstructural (Burby 1998:8-13; Godschalk et al. 1999:66). Structural mitigation actions generally refer to actions associated with modifications with the built environment. Classic examples of structural mitigation are dams, levees, seawalls, and creating artificial dunes and beach re-nourishment. Nonstructural actions are actions such as avoiding or directing new developments away from hazard zones and maintaining and preserving environmental resources, such as wetlands, that can protect, absorb or reduce hazard impacts. Generally these types of actions are promoted by land-use planning and regulation efforts. Other examples, such

as strengthening building codes and standards as well as construction practices are sometimes characterized as broader land-use tools for they, in part, regulate how we use the land or at least build upon it, but they could be considered structural mitigation efforts when they are implemented.

While there has been a long history of efforts on the part of federal and state governments to include what is now called mitigation efforts in overall disaster policy (Platt 1998; Godschalk et al., 1999:27-87), concerted efforts to integrate mitigation into planning really began to emerge in the mid-1990s. These efforts were, as mentioned above, given heightened emphasis with the passage of the Disaster Mitigation Act of 2000, which linked hazard mitigation planning as a condition of eligibility for hazard mitigation grants. This act also explicitly recognized that the nature of the governmental entity (i.e., local government) that might undertake mitigation planning can vary considerably around the country. As implemented by FEMA, local government is defined by the act as "… any county, municipality, city town township, public authority, school district, special district, intrastate district council of government regardless of whether the council of government is incorporated as a nonprofit corporation under state law, regional or interstate government entity, or agency or instrumentality of a local government: any Indian Tribe or authorized Tribal organization, or Alaska Native village or organization: and any rural community, unincorporated town or village, or other public entity." Any of the above entities can become a participant in or develop its own mitigation plans and therefore can be an applicant for FEMA mitigation grant (Thomas 2007). Thus, FEMA entertains hazard mitigation plans from a host of different entities, including those from school districts or special districts with in communities, through municipalities, counties, tribal districts and states, as well as multiple forms of multi-county or multi-jurisdictional councils of governments. As a consequence, FEMA classified hazard mitigation plan types into five types: Standard State Mitigation Plan (SS), Tribe State Mitigation Plan (TS), Single Jurisdiction Local Mitigation Plan (S), Multi-jurisdictional Local Mitigation Plan (M) and Tribal Local Mitigation Plan (TL).

In the United States planning in general and hazard mitigation planning in particular is often considered to be the responsibility of local government. It is often the case that

State and sometimes County governments can have considerable roles in mandating or setting the parameters for these activities; this is, for example, the case in Florida. In Texas however, the state and county levels of governments have comparatively little legislative power to mandate or control local planning activities in general. The same holds for hazard mitigation planning. In general, land use planning and building codes can only be enacted and enforced by local municipal or city governments, county and state government plays little or no role in enacting or enforcing land-use planning or building codes. Nevertheless, in Texas there are only nine municipalities that have FEMA-approved mitigation action plans. Instead, many local jurisdictions are part of the 28 county or 13 regional plans that have been approved by FEMA. All but one of the 28 county mitigation action plans includes at least one city located in the county with many plans including multiple cities as well as a variety of districts, tribal reservations, and other entities. The majority of the regional plans (11 of 13) were created under the auspices of a regional council of government, and includes counties, cities and other entities as constituent plan partners. Overall then, the majority of the mitigation action plans in the State of Texas are multi-jurisdictional local mitigation plans. As will be more completely discussed below, this report will assess city, county and regional plans that include counties or entities located within Texas's Coastal Management Zone.

According to FEMA (2008), ***mitigation planning*** is recognized as a process for States and communities to identify their resources, policies, and tools to implement mitigation activities. FEMA has identified four major goals in the hazard mitigation planning process as organizing resources, assessing risks, developing a mitigation plan, and implementing the plan and monitoring progress. The mitigation plan itself should include information about resources, risk and vulnerability, mitigation policies and implementation and monitoring. To facilitate the planning process, FEMA has offered guidance to States and local jurisdictions to develop mitigation plans through the *Multi-Hazard Mitigation Planning Guidance under the Disaster Mitigation Act of 2000* which is also referred to as the "Blue Book" and various how-to guides. The Blue Book provides information on the minimum criteria which plans must contain in order to obtain approval from FEMA as well as guidelines for developing an enhanced plan and

important information and methods for undertaking the process. Specifically the Blue Book is divided into three parts with Part 1 providing information and guidelines for developing standard state mitigation plan, while Part 2 discusses enhanced state mitigation plans. Part 3 guides developing local mitigation plans.

Table 2 Components of Local Mitigation Plans According to FEMA Guidelines: Elements and Critical issues

	Element	Critical Issues
Planning Process	Planning process	▪ Open public involvement process (neighboring communities, business and other interest parties) ▪ A plan should include the document about planning process how the plan were prepared, who was involved in the process and how the public was involved. ▪ Review and incorporation of existing plans, studies and technical information.
Risk Assessment	Identifying hazards	▪ Description of all natural hazards which can influence the jurisdiction.
	Profiling hazards	▪ Location or geographical areas of all hazards ▪ Extent of all natural hazards ▪ Probability, likelihood or frequency that the hazard events would occur. ▪ Past history of Hazard events (damage, severity, duration and date of occurrence etc.)
	Assessing vulnerability: Overview	▪ Summary of the community's vulnerability assessment
	Assessing vulnerability: identifying structures	▪ Description of vulnerable structures in terms of the types and numbers of existing and future buildings, infrastructure and critical facilities.
	Assessing vulnerability: Estimating potential losses	▪ Estimation of the extent of a hazard's impact to the structures in terms of dollar value or percentages of damage ▪ Description of the methodology used to the above estimation.
	Assessing vulnerability: Analyzing development trends	▪ General description of land uses and development trends
	Multi-jurisdictional risk assessment	▪ In multi-jurisdictional plans, the risk assessment must consider the entire planning area.
Mitigation Strategy	Local Hazard Mitigation Goals	▪ Description of mitigation goals along which can guide the development and implementation of mitigation actions. ▪ Description of how the goals are developed.
	Identification and analysis of Mitigation actions	▪ Identification of mitigation actions to achieve the above goals.
	Implementation of Mitigation actions	▪ Description of how the actions are prioritized implemented and administered by local governments.
	Multi-jurisdictional mitigation actions	▪ List of each jurisdiction's actions in multi-jurisdiction plan
Plan Maintenance Process	Monitoring, Evaluating and updating the plan	▪ Description of the schedules and methods of monitoring, evaluating and updating of the plans
	Incorporating into exiting planning mechanisms	▪ Indication of how mitigation plans will be incorporated into other existing plans such as comprehensive plans, capital improvement plans, zoning and building codes etc.
	Continued public involvement	▪ Description of how the governments will continue public involvement in the plan maintenance process

Source: Multi-Hazard Mitigation Planning Guidance under the Disaster Mitigation Act of 2000 ("Blue Book")

Table 2 summarizes the basic elements of a local mitigation plan as specified by FEMA's "Blue Book." The first column displays the four major planning components of a plan: ***Planning Process, Risk Assessment, Mitigation Strategy,*** and ***Plan Maintenance***. The second column identifies the key planning subcomponents associated with each component and the final column specifies the critical planning elements that should be addressed in a plan. The *planning process* component focuses on how the mitigation planning process itself was carried out by identifying public involvement, how the plan was prepared, its incorporation of existing plans, technical information and studies, and how it was reviewed. The *risk assessment* component should address the basic factual risk information critical for a hazard mitigation plan by identifying and profiling a jurisdiction's hazard risks as well as spelling out its current and trends with respect to vulnerability. Vulnerability, in this case, is generally conceptualized with respect to structures, infrastructure, and critical facilities. The *mitigation strategy* component should describe the goals, mitigation actions, and priorities established on the basis of the risk assessments. The final component, *plan maintenance*, addresses not only the scheduling and methods for monitoring, evaluating and updating the plan, but also how the plan will be incorporated into other existing planning efforts and continued public involvement. In addition to the plan requirements outlined in Table 2, the Blue Book also includes recommendations on how to develop improved plans. For example, FEMA "encourages" developing mitigation plans for natural and manmade and technological hazards even though FEMA requires communities to address only natural hazards. In addition, other recommendations include the identification of the number of special population at risk such as the elderly, disable or others with special needs, the use of mapping and specific objectives corresponding goals and the need of cost benefit analysis. If local jurisdictions developed mitigation plans which contain these "encouraged" special considerations, the plan would clearly go beyond the minimum requirement and approach a more high quality mitigation plan.[2]

[2] These recommendations and encouragements are, in a way, an implicit acknowledgement that the FEMA guidelines focuses on what is necessary to develop a minimal mitigation plan, not necessarily a fully robust comprehensive mitigation plan. This is perfectly reasonable, given that these guidelines are designed to be applied across the country, in diverse areas with varying planning capabilities and capacities.

The Bluebook also includes a plan review ***crosswalk*** which outlines the basic requirements and criteria by which FEMA's reviewers evaluate or assess a mitigation action plan to determine whether or not it meets FEMA's basic requirements. Table 3 displays the crosswalk by which a plan is reviewed and its approval or disapproval is based. In essence, the crosswalk represents a plan evaluation or assessment protocol. As can be seen by comparing Tables 2 and 3, the crosswalk includes the four components (*planning process, risk assessments, mitigation strategy*, and *plan maintenance*) along with 14 subcomponents (column 1), a list of 32 specific questions associated with each subcomponent which address specific planning elements that should be discussed by each plan (column 2), and scoring options (column 3). In addition to the mitigation plan components, the upper section of the table includes a "prerequisite" section that assesses if the mitigation plan has been officially adopted by the local governing body or, in the case of a multi-jurisdictional plan, bodies. The scoring system for the "prerequisite" section is simply whether or not the plan has or has not met the requirement that it has been adopted. For the 32 planning element questions, the scoring system is simply a determination by the reviewer as to whether or not a particular planning element "satisfactorily" meets the basic plan requirements or needs improvement.

Table 3. The Review of Local Hazard Mitigation Plans: The Plan Review Crosswalk

Topic	Element Related Questions	Scoring System
Prerequisite		
Adoption by the Local Governing Body	▪ Has the local governing body adopted the plan? ▪ Is supporting documentation, such as a resolution, included?	Not met or met
Multi-Jurisdictional plan adoption	▪ Does the plan indicate the specific jurisdictions represented in the plan? ▪ For each jurisdiction, has the local governing body adopted the plan? ▪ Is supporting documentation, such as a resolution, included for each participating jurisdiction?	Not met or met
Multi-Jurisdiction Planning Participation	▪ Does the plan describe how each jurisdiction participated in the plan's development?	Not met or met
Planning Process		
Documentation of the planning process	▪ Does the plan provide a narrative description of how the plan was prepared? ▪ Does the plan indicate who was involved in the current planning process? ▪ Does the plan indicate how the public was involved? ▪ Was there an opportunity for neighboring communities, agencies, businesses, academia, nonprofits and other interested parties to be involved in the planning	Need improvement or Satisfactory

	process? ▪ Does the planning process describe the review and incorporation, if appropriate, of existing plans, studies, reports and technical information?	
Risk Assessment		
Identifying hazards	▪ Does the plan provide a description of the type of all natural hazards that can affect the jurisdiction	Need improvement or Satisfactory
Profiling hazards	▪ Does the risk assessment identify the location of each natural hazard addressed in the plan? ▪ Does the risk assessment identify the extent of each hazard addressed in the plan? ▪ Does the plan provide information on previous occurrences of each hazard addressed in the plan? ▪ Does the plan include the provability of future events for each hazard addressed in the plan?	Need improvement or Satisfactory
Assessing vulnerability	▪ Does the plan include an overall summary description of the jurisdiction's vulnerability to each hazard? ▪ Does the plan address the impact of each hazard on the jurisdiction?	Need improvement or Satisfactory
Assessing vulnerability by identifying structures	▪ Does the plan describe vulnerability in terms of the types and numbers of existing buildings, infrastructure, and critical facilities located in the identified hazard areas? ▪ Does the plan describe vulnerability in terms of the types and numbers of future buildings, infrastructure, and critical facilities located in the identified hazard areas?	Need improvement or Satisfactory
Assessing vulnerability by estimating potential losses	▪ Does the plan present an overview and analysis of the potential losses to the identified vulnerable structures? ▪ Does the plan describe the methodology used to prepare the estimate?	Need improvement or Satisfactory
Assessing vulnerability by analyzing development trends	▪ Does the plan describe land uses and development trends?	Need improvement or Satisfactory
Multi-Jurisdictional Risk Assessment	▪ Does the plan include a risk assessment for each participating jurisdiction as needed to reflect unique or varied risks?	Need improvement or Satisfactory
Mitigation Strategy		
Local hazard mitigation goals	▪ Does the plan provide a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards?	Need improvement or Satisfactory
Identification and analysis of mitigation actions	▪ Does the plan identify and analyze a comprehensive range of specific mitigation actions and projects for each hazard? ▪ Do the identified actions and projects address reducing the effects of hazards on new buildings and infrastructure? ▪ Do the identified actions and projects address reducing the effects of hazards on existing buildings and infrastructure?	Need improvement or Satisfactory
Implementation of mitigation actions	▪ Does the mitigation strategy include how the actions are prioritized? ▪ Does the mitigation strategy address how the actions will be implemented and administered? ▪ Does the prioritization process include an emphasis on the use of a cost-benefit review to maximize benefits?	Need improvement or Satisfactory
Multi-Jurisdictional mitigation actions	▪ Does the plan include at least one identifiable action item for each jurisdiction requesting FEMA approval of the plan?	Need improvement or Satisfactory
Plan Maintenance Process		
Monitoring, evaluating and updating the plan	▪ Does the plan describe the method and schedule for monitoring the plan?	Need improvement or Satisfactory

	▪ Does the plan describe the method and schedule for evaluating the plan? ▪ Does the plan describe the method and schedule for updating the plan?	
Incorporation into existing planning mechanisms	▪ Does the plan identify other local planning mechanisms available for incorporating the requirements of the mitigation plan? ▪ Does the plan include a process by which the local government will incorporated the requirements in other plans when appropriate?	Need improvement or Satisfactory
Continued public involvement	▪ Does the plan explain how continued public participation will be obtained?	Need improvement or Satisfactory

Source: Source: Multi-Hazard Mitigation Planning Guidance under the Disaster Mitigation Act of 2000 (FEMA 2008)

It should be recalled that a mitigation action plan is a requirement to qualify for FEMA mitigation funding. Hence, as part of the plan, at least one "identifiable" mitigation action must be specified for each jurisdiction included in or under the plan. The FEMA guidebook does not dictate specific mitigation actions that local hazard mitigation plans will or must include. Instead, FEMA and other federal and state agencies provide information regarding possible hazard mitigation strategies which may apply to both natural and technical hazards for communities (FEMA 2002). Appendix 1 to this document provides examples of mitigation measures which local communities might consider in their planning process by hazard type. This list is taken from "Mitigation Ideas: Possible Mitigation Measures by Hazard Type (FEMA 2002)."

The crosswalk, as mentioned above, is essentially a mitigation action plan protocol that serves as an assessment tool by which plans are evaluated by FEMA. As such, the crosswalk could also serve as an assessment tool that could be employed by this investigation of hazard mitigation action plans in effect in Texas's coastal management zone. However there are a number of reasons that this would not suffice. First and foremost, each of the plans assessed in this research has already been "approved" by FEMA; hence assessing existing plans using that same instrument would be redundant. Reapplying the same assessment protocol would provide little insight, except to the extent that it might reveal the minimum satisfactory element that would qualify a plan under FEMA's guidelines. Second, by FEMA's own documentation, the crosswalk provides only the minimum expectations for a mitigation action plans. The goal in this research project is not simply to repeat FEMA's assessment; rather, the goal is to

facilitate improvements of mitigation action plans along the Texas coast. Consequently, the assessment should provide information that can stimulate improvements in mitigation action plans and thereby reduce the loss of life, property, and natural resources within the coastal management zone. This implies that the assessment protocol should include elements that will substantially challenge minimum requirements and improve existing plan by providing feedback regarding where a mitigation plan might be improved. To meet this goal, the protocol to be developed and utilized here will take the FEMA crosswalk as its starting point. Further enhancements will be based upon the scientific peer reviewed literature on plan evaluation.

2.2. Plan Quality and Plan Evaluation Research

A plan, as a written document, can be usefully considered as an outcome of a planning process and an important indicator of planning efforts. For most planning practitioners developing a "good" plan is a starting point for accomplishing long term goals and developing and implementing policies that are consistent with the plan. The implication of the notion of a "good" plan is that some plans are of higher quality than other plans, which in turn implies that plans can be critically assessed or evaluated based upon some standard metric. Just like the crosswalk discussed above, the assessment of plan quality begins by defining the key characteristics of plan quality which will serve as criteria for a protocol or metric for plan evaluation.

The history of plan quality and evaluation research is not that old, in part because planning profession had been much more focused on the methods and process in plan making rather than questioning the components of plan quality (Berke and French 1994). However, this research has recently been more fully conceptualized and more systematically applied by a group of researchers (Berke 1994; Berke and French 1994; Burby and Dalton 1994; Berke Roenigk and Kaiser 1996) who have been particularly interested in natural hazards and environmental components of comprehensive plans. Their work was based on that of Kaiser, Godschalk and Chaplin (1995) who identified three core components or characteristics of plan quality assessments: *factual basis, goals and objectives, and policies, tools and strategies.* A plan's *factual basis* establishes the

foundation for subsequent components of the plan for it specifies the existing local conditions and identifies needs related to a community's physical development (Deyle, French, Olshansky, and Patterson 1998). *Goals and objectives* represent general aspirations, problem alleviation, and needs that are premised on shared local values. *Policies* (or actions) serve as a general guide for decisions about the location, density, type and timing of public and private development to assure that plan goals are achieved. Policies and actions are essential components of a plan to manage long run development patterns.

Brody (2003a, 2003b, and 2003c) in his important work evaluating ecosystem management principles within comprehensive plans expanded the three key components suggest by Kaiser et al (1995) to five key components. The two addition components address two highly significant dimensions of planning: 1) *inter-organization coordination & capacities* and 2) *implementation*. The *inter-organizational coordination & capacity* component directly addresses local jurisdiction's capacity to engage in planning activities and the ability and need for collaboration with other jurisdictions, organizations and agencies. In a very real sense this dimension recognizes the critically important need of coordination for undertaking planning activities. In other words local jurisdictions must have the capacity as well as the ability to coordinate with other agencies both within and outside their jurisdiction in order to ensure concerted action so critical for environmental and hazard management activities. Rarely will one agency or jurisdiction have the resource capacity to ensure comprehensive hazard or environmental management; rather, these actions must of necessity depend upon cooperative efforts among jurisdictions, agencies, and organizations. The other component added by Brody (2003b), *implementation*, includes designation of responsibility for overseeing actions, a timeline for actions to take place, the scheduling of plan updates and the monitoring of resource conditions and policy achievement. This component directly addresses the issue that plans are only as good as their implementation and must be constantly updated and monitored. If a plan remains a simple document lost on a shelf or hidden in a filing cabinet, it cannot insure long term changes. It must, in a very real sense, be a living and evolving document. The implementation component addresses many of the important

dimensions insuring that the plan become manifest through actions by specific agencies and through the monitoring process can effective evolved to better insure that goals are reached.

Even more recently, Berke et al. (2006), in the newest edition (5th) of *Land Use Planning*, suggested that plan quality assessment should be based on eight component criteria. Furthermore, they classify the evaluation criteria into internal and external dimensions. Internal criteria focus on "internal" elements of a plan and include many dimensions mentioned above, including issues and vision statement, fact base, goal and policy framework and plan proposals. External dimensions focus on factors that better ensure that a plan is shared, coordinates, and includes the broader community. These elements include whether a plan encourages opportunities to use plan, creates clear views and understanding of the plan, account for interdependent actions in plan scope and participate other actors in the planning process. These new dimensions add to an assessment tool or protocol in that they reinforces the importance of a plan not only laying out a broad clear vision for action but also creating opportunities for it to be broadly employed. While these additions have yet to be fully tested in the research literature, they add to the comprehensive nature of a protocol, and hence will be included, albeit in a somewhat modified fashion.

Table 4. Approaches to Plan Quality Evaluation Protocols

	FEMA's four Components	Kaiser et al.'s Three Components	Brody's Five Components	Berke et al.'s Eight Components
Components	▪ Planning Process ▪ Risk Assessment ▪ Mitigation Strategy ▪ Plan Maintenance	▪ Factual bases ▪ Goals & Objectives ▪ Policies, Tools, Strategies	▪ Factual bases ▪ Goals & Objectives ▪ Inter-organization coordination & Capabilities ▪ Policies, Tools, Strategies ▪ Implementation	***Internal Plan-Quality Criteria*** ▪ Issues and vision statement ▪ Fact base ▪ Goal and policy framework ▪ Plan proposals ***External Plan Quality Criteria*** ▪ Encourage opportunities to use plan ▪ Create clear views and understanding of plans ▪ Account for interdependent actions in plan scope ▪ Participation of actors

Table 4 presents as a brief summary of the above discussion highlighting the various component areas included in plan evaluation protocols by FEMA and the planning

literature. Despite the differences in the number of areas included in these protocols, there is actually a good deal shared among them. One of the reasons these shared elements may not seem easily identifiable is the use of different terms to refer to similar components across these approaches. For example, "factual bases" in the planning literature is essentially the same as "risk assessment" in FEMA's crosswalk. Both areas are concerned with establishing the basic physical properties of the environments (i.e., what kinds of environmental hazards) in which the communities or jurisdictions are operating. Similarly mitigation strategy in the FEMA nomenclature is similar to policies, tools, and strategies in the planning literature, while the former focuses on mitigation actions, the latter focus on particular policies or land-use planning tools, but both may actually be refereeing to similar planning elements such as improving building codes, coastal set-backs, etc. Hence, there are many similarities between each of these seemingly different approaches. Together all these approaches provide the foundation for the protocol to be developed in this research.

2.3. Developing Plan Evaluation Protocol for Hazard Mitigation

Based on the literature reviewed above and the hazard mitigation literature, this research has developed a protocol which will serve both as a metric for assessing mitigation action plans and as a guideline for developing high quality mitigation action plans. In order to achieve these twin goals the protocol integrates key components of traditional hazard mitigation policies and the best elements of current mitigation planning into evaluation framework into a single protocol. Specifically the protocol used herein evaluates mitigation action plans by assessing seven components: *vision statement, planning process, fact basis, goals & objectives, inter-organizational coordination, policies & actions, and implementation*. The *vision statement* specifies the overall nature of the hazard problems to be addressed by the plan and sets the plan's general goals and objectives. The *planning process* component provides a description of how the plan was developed and what techniques were employed to ensure public participation. The *fact basis* component is again the meat or the foundation of the plan in that it should clearly lay out the hazards an area is likely to encounter, as well as the area's risk and vulnerability profile with respect to those hazards. A plan's *goals & objectives* establish

the targets that the plan is seeking to reach, such as reducing the economic or physical impacts from a disaster. As mentioned above, it is often critical that a plan addresses the jurisdictions' capacities for undertaking actions as well as coordination among multiple agencies to ensure successful action hence this plan protocol will also include an *inter-organization coordination & capabilities* component. Since the focus here is on hazard mitigation action planning, the protocol will include a *mitigation policies & actions* component that will assess a plan discussion of and inclusion of various forms of potential mitigation policies and actions. Next to the fact basis component, the *mitigation polices & actions* component is one of the most important components of these plans. The final but certainly not least important component of the protocol is the plan *implementation* which assesses not only implementation planning for proposed mitigation actions, but also the evaluation, updating and monitoring of the overall plan.

The entire protocol is presented in much more detail in Table 5. As can be seen, each of the seven (7) plan components has been broken into a series of thirty sub-component areas identifying key dimensions of each component. The actual number of sub-components associated with each component area is variable. Some components like those of *vision statement* and *planning process* have two sub-components each, while other more complex areas like *mitigation policies & actions* may include many sub-components. For example, the *planning process* component is assessed in terms of two sub-components: 1) a general description of the planning process and 2) the actual techniques or methods employed to ensure public participation and input during the development of the plan. Taking all of the seven component areas as a whole, there are a total of thirty (30) sub-component areas included in the protocol. Each of these thirty sub-component areas has been assigned a numbered in Table 5. Sub-components in turn are evaluated by determining if each plan includes specific planning elements or issues that are associated with each sub-component area. So for example, returning to the "*techniques for ensuring public participation*" sub-component (see number 4 in Table 5) of the *planning process* component, each plan will be evaluated based on the types of techniques employed to enhance public participation and input. These techniques include formal public hearings, workshops, household surveys, etc. The more of these techniques

employed, the more likely that public participation and input is ensured in the planning process. The entire protocol assessment of the 30 sub-component areas is based on a total of 164 planning elements or issues. Again, some sub-components will have only one planning element or issue, while others will have many more. As a consequence, each of the seven primary mitigation plan components will be assessed, in the final analysis, by a variable number of planning elements. Each planning element will be examined to determine if 1) it was addressed by the plan, and if it was 2) how well it was addressed or specified in the plan. The scoring technique employed in this study will be discussed in the following section.

Table 5. Hazard Mitigation Action Plan Evaluation Protocol

Component & Sub-Components	***Specific Planning Elements Assessed***
I. Vision Statement	
1. Problem description	1.1 Description of community and historical hazard threats
	1.2 Description of the local hazards impact on the entire state
	1.3 Current or potential hazards issues
2. Vision	2.1 A statement identifying overall image of sustainable and hazard resilient community/state
	2.2 General goals and objectives
II. Planning Process	
3. General Description	3.1 General description of the process to develop a plan
4. Proposed participation techniques in planning process	4.1 Formal public hearings
	4.2 Open meetings
	4.3 Workshops or forum
	4.4 Call-in hot lines
	4.5 Citizen advisory committees
	4.6 Household survey
	4.7 Interviews with key stakeholders
	4.8 Website/internet/email
	4.9 Data acquisition and data management
III. Fact Basis	
5. Hazard Identification	5.1 General description of projected growth and population
	5.2 Hazard profile
	5.3 Hazard identification
	5.4 Delineation of natural resource areas
	5.5 Delineation of location of hazard
	5.6 Delineation of magnitude of hazard
	5.7 Historical data on the hazard
6. Vulnerability Assessment	6.1 Identifies all hazards to the study area
	6.2 Assessment of hazard exposure (property)
	6.3 Social vulnerability assessment
	6.4 Assessment of hazard exposure (population)
	6.5 Assessment of hazard exposure (Public infrastructure such as roadways, water utilities and communication systems)
	6.6 Assessment of hazard exposure (Critical Facilities such as shelters and hospitals)
	6.7 Social Vulnerability (special needs population etc.)

7. Risk Analysis	7.1 Probability of experiencing hazard event (various magnitudes where applicable*)
	7.2 Property Loss Estimation (various magnitudes where applicable*)
	7.3 Infrastructure Impact Estimation (various magnitudes where applicable*)
	7.4 Population Risk (various magnitudes where applicable*)
8. Emergency Management	8.1 Emergency shelter demand and capacity data
	8.2 Evacuation clearance time data
	8.3 Location of emergency shelter
IV. Mitigation Goals & Objectives	
9. Economic Impacts	9.1 Any goal to reduce losses or protect property from loss
	9.2 Any goal to minimize fiscal impacts of hazards
	9.3 Any goal to distribute hazard mitigation cost equitably
10. Physical and Environmental Impacts	10.1 Any goal to reduce hazard impacts on and preserve open space and recreation areas
	10.2 Any goal to reduce hazard impacts on and maintain good water quality
	10.3 Any goal to reduce hazard impacts on and protect wetlands/ forests (critical natural areas)
11. Public Interest	11.1 Any goal to protect safety of population
	11.2 Any goal to promote hazard awareness program or improve information exchange
	11.3 Any goal to use available resources efficiently
	11.4 Any goal to improve preparedness and response to hazard
	11.5 Any goal to promote partnership with other agencies
V. Inter-organization coordination & Capabilities	
12. Cooperation	12.1 Identification of other govt. organizations
	12.2 Identification of representatives for each of above
	12.3 Identification of other stakeholders
	12.4 Identification of representatives for each of above
	12.5 Consistency with state plan/state mitigation plan
	12.6 Integration with other local comprehensive plan
	12.7 Integration with FEMA mitigation programs and initiatives (for example, Flood Mitigation Fund)
	12.8 Integration with other independent governments such as Municipal Utility Districts and Independent School Districts
	12.9 Intergovernmental agreements
13. Proposed Participation Techniques in proposed actions	13.1 Formal public hearings
	13.2 Open meetings
	13.3 Workshops or forum
	13.4 Call-in hot lines
	13.5 Citizen advisory committees
	13.6 Household survey
	13.7 Interviews with key stakeholders
14. Information Sharing on the planned actions	14.1 Brochures or other literature
	14.2 Newsletters
	14.3 Educational workshops
	14.4 TV/Radio
	14.5 Video
	14.6 Internet (Web-site)
15. Capacity Development	15.1 Funding sources for citizen participation and cooperation with other organization
	15.2 Staffing levels (FTE, part time staff, etc.)
	15.3 Joint database
	15.4 Technical assistance to other organization or citizen
	15.5 Improving communications and institutional capacity through training, workshop, etc.
	15.6 Develop and improving technical capabilities (GIS, database etc.)
16. Conflict Management	16.1 Specification of conflict management procedures and processes
VI. Specific Mitigation Policies & Actions	
17. General Policy	17.1 Discourage development in hazardous areas
	17.2 Support adoption of new regulatory legislation at local level
18. Regulatory tool	18.1 Permitted land use
	18.2 Low density conservation or other hazard zone

	18.3 Overlay zone with reduced density provisions
	18.4 Dedication of open space for hazards
	18.5 Policy to locate public facilities in zones not subject to hazards
	18.6 Transfer of development rights
	18.7 Cluster development
	18.8 Setbacks
	18.9 Site plan review
	18.10 Special study/impact assessment for development in hazard zones
	18.11 Building standards/ Building code
	18.12 Land and property acquisition
	18.13 Impact fees
	18.14 Retrofitting of private structures
	18.15 Separate hazard mitigation plan
	18.16 Relocation of structures out of hazard zones
	18.17 Drainage ordinance
19. Modeling technique	19.1 Modeling tools for evacuation
	19.2 Modeling tools for flooding
	19.3 Modeling tools for others (debris etc.)
20. Floodplain regulation	20.1 Floodplain management/development
	20.2 Floodplain ordinance
	20.3 Down zoning floodplains
21. Incentive-based tool	21.1 Tax abatement for using mitigation
	21.2 Density bonus
	21.3 Low interest loans
	21.4 Participation in National Flood Insurance Program (NFIP)
	21.5 Join CRS (Community Rating System)
22. Structural tool	22.1 Levees
	22.2 Seawalls
	22.3 Riprap
	22.4 Bulk heads
	22.5 Detention ponds
	22.6 Channel maintenance
	22.7 Wetland restoration
	22.8 Slope stabilization
	22.9 Storm water management
	22.10 Sewage
	22.11 Drainage
	22.12 Maintenance of structures
23. Awareness/ Educational tool	23.1 Awareness program for community
	23.2 Education/Awareness for staff
	23.3 Educational/awareness for private stakeholders (industry, business, or homeowners etc.)
	23.4 Education/Awareness for students
	23.5 Real Estate Hazard Disclosure
	23.6 Disaster warning and response program
	23.7 Posting of signs indicating hazardous areas
	23.8 Technical assistance to developers or property owners for mitigation
	23.9 Maps of areas subject to hazards
	23.10 Inclusion of floodplain boundaries
	23.11 Education and training in several languages
	23.12 Hazard information center
24. Social consideration	24.1 Identification of special needs population and preparedness of assistance
25. Public Facilities and Infrastructure	25.1 Capital Improvements Plan based on hazard analysis
	25.2 Retrofitting public structure
	25.3 Retrofitting critical facilities
26. Recovery Planning	26.1 Land use change
	26.2 Building design change to meet enhanced safety standards

	26.3 Moratorium
	26.4 Recovery organization
	26.5 Private acquisition
	26.6 Financial recovery
27. Emergency Preparedness	27.1 Evacuation
	27.2 Sheltering
	27.3 Contingency plan/preparedness plan
	27.4 EOC (Emergency Operation Center
	27.5 Require emergency plans
	27.6 Purchasing rescue materials/ other equipments
28. Natural resource protection	28.1 General description of best management practice
	28.2 Forest and vegetation management riparian areas
	28.3 Sediment and erosion control
	28.4 Stream dumping regulations
	28.5 Urban forestry and landscape
VII. Implementation	
29. Implementation	29.1 Description of implementation process
	29.2 Identification of process for prioritizing assistance to local governments
	29.3 Clear designation of responsibility for implementation
	29.4 Provision of technical assistance for implementation
	29.5 Identification of costs for implementation
	29.6 Identification of funding sources
	29.7 Provision of sanctions
	29.8 Clear time-table for implementation outlined
	29.9 Enforcement related issues
30. Evaluating, Updating and Monitoring	30.1 Description of evaluation, updating and monitoring process
	30.2 Identification of participants in the evaluating process
	30.3 Clear designation of responsibility for evaluating, updating and monitoring process
	30.4 Evaluation of funded mitigation projects

Even a cursory examination of the protocol presented in Table 5 suggests that this protocol is much more comprehensive and detailed than the crosswalk methodology utilized by FEMA (see Table 3). Indeed, the simple fact that this protocol includes a detailed assessment of the variety of different mitigation actions and planning elements will result in a much more comprehensive assessment. The goal here, it must be recalled, is not simply to replicate FEMA's approach, but rather to assess mitigation action plans in a manner that will provide feedback, offer guidance, and stimulate enhancements as plans evolve through time. However, there is a danger in adopting this approach if the findings are utilized incorrectly or interpreted in an inappropriate manner. The net result of this analysis is likely to be that existing plans, while qualifying under FEMA's guidelines, may not score highly on a protocol based on more comprehensive and detailed standards. Furthermore some plans are likely to score "higher" than others. As a result, it may be tempting to make invidious comparisons such as, "Plan X is better than Plan Y", or "Plan Y only scored at the 25% level, while Plan Z scored 75%". It must be

remembered that the goal here is not to "grade" plans nor is it to promote invidious comparisons among existing plans. To do so would be an unfortunate interpretation and use of the results of this report. Instead, the protocol should, simply by its detail, promote the consideration of additional and alternative actions or planning elements that may not have been considered or discussed during the plan development process. Furthermore, the results should be interpreted as opportunities to improve and make existing plans stronger and better able to meet the goals of preserving life, property, and the natural resources of coastal areas in Texas.

2.4. Plan Scoring Methodology

While the above discussed the details of the protocol, it does not discuss how plans will be scored using the protocol. There are a variety of approaches that may be adopted to actually "score" a plan with respect to each of the plan elements included in a protocol. As shown above in Table 3, under the crosswalk methodology utilized by FEMA, a reviewer reads through a plan and based upon the nature and content of the plan an assessment is made as to whether or not the plan element has 1) been met or not, with respect to the "prerequisite" elements or, 2) in the case of the plan component elements, whether the plan satisfactorily discusses a specific planning element or if it needs improvement. In a sense, the scoring under this scenario or system is simply dichotomous or binary (yes/no or 0/1) score for each individual item, because an element either does or does not meet the criteria associated with each element.

The plan evaluation literature however offers a variety of methods. One approach might be to simply adopt that of the FEMA crosswalk in that a plan is score 0 if an element is not discussed or discussed inadequately or 1 if discussed adequately. Unfortunately this approach yields little informative information on how "well" an element is discussed or addressed. As a consequence the planning literature offers different solutions. For example, Godschalk et al. 1999, in their assessment of state mitigation plans used a combination of scoring schemes, but for most planning elements they employed an ordinal coding scheme ranging from 0 to 3. A planning element was coded with a 0 if it was not mentioned, 1 if mentioned in only general terms, 2 if mentioned with some detail,

and a 3 if mentioned and provides additional detail. Most other examples in the research on plan evaluation, however, have employed a coding scheme ranging from 0 to 2 (Berke and French 1994; Berke et al. 1996; Brody 2003a, 2003b, and 2003c). This scheme is similar to the above; only the categories 2 and 3 are collapsed. Whether the 0-3 or 0-2 schemes are employed, the advantage is that the resulting code gives an idea regarding how much detail is included in the plan's discussion of a planning element. Furthermore since greater detail suggests greater specificity or information is included, a higher score is generally associated with higher quality (Berke and French 1994).

Since an ordinal coding scheme provides additional information, this research also adopted a similar approach. Specifically, this research utilizes a coding framework based upon a systematically developed set of criteria for each element and an ordinal coding assessment scheme ranging from 0 to 2 based on how well the discussion of a planning element fits the criteria. As discussed above, the evaluation protocol contains 164 elements. Each plan will be scored on each of these individual elements in the following manner. A planning element will be scored with a 0 if the element is not mentioned in plan, a 1 if the planning element is mentioned, but little detail is offered, or a 2 if the plan provides detailed coverage of the planning element. More specifically, if an item was simply not mentioned in a plan, it will get a score of 0. If on the other hand a plan mentions a specific item but offers little detail or the discussion employs modifying terms like "should", "may", "encourage", "prefer", or "suggest" it will receive a score of 1. Similarly, in the case of plan implementation information, if the discussion fails to use terms like "when", "where", "what", and "how" then the item will get a score of 1. However, if a plan discusses or covers a specific item/element in detail using strong terms such as "mandate", "shall", "must", or "will", then it will receive a score of 2. Also, when a plan describes specific implementation information using terms like "when", "what", "where" and "how" a specific item will be realized, it will get a score of 2. This scoring system provides an ordinal scoring where the higher the value (0, 1, or 2) the stronger or higher quality with which a planning element is addressed.

Following approaches developed in the plan evaluation literature to ensure validity and consistency in the scoring, two additional procedures were undertaken. First, a detailed

codebook was developed for each criterion to ensure that plans were all reviewed for similar elements, in a similar manner, using common language. Second, each plan was reviewed independently by at least two sometimes three evaluators. The completed protocols were then examined to determine inter-reviewer consistency. If the scoring was not consistent, each inconsistency was examined by the team of reviewers until an agreed upon a common score was determined. When necessary, coding guidelines for specific items would be revisited and through the conciliation process among the evaluators new or revised guidelines were established. If substantive changes were made to the coding scheme, plans that were coded earlier were recoded based on the new approach. An example of the mitigation plan protocol scoring sheet can be found in Appendix 2.

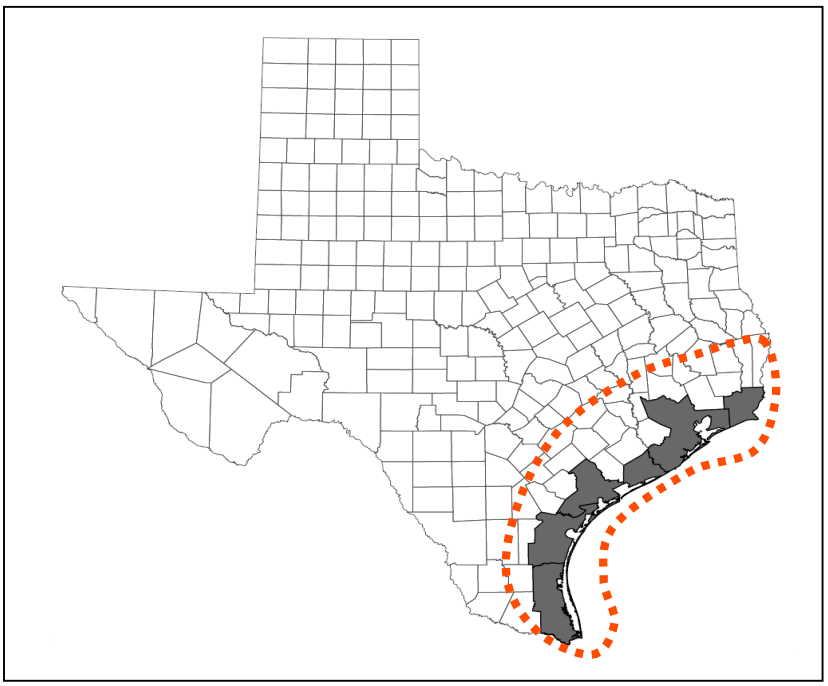
The nature of the mitigation action plans posed some difficulties in coding individual plans that required special attention. Under the *fact basis* component of a plan (and the protocol) each jurisdiction must identify the hazards potentially threatening an area (the *hazard identification (5)* sub-component) and then undertake a risk and vulnerability assessment for these hazards (i.e., *risk analysis (7)* and *vulnerability assessment (6)* sub-components). The FEMA guidebook does not specify which hazards should be included in a specific plan because localities throughout the United States are subject to many different types of hazards. Furthermore, as mentioned above, the guidebook encourages localities to go beyond natural hazards. Not surprisingly then, there may be considerable variability in the number and type of hazards considered by the plans examined in this report. In total and across all plans there were twenty-seven (27) hazards were considered and these ranged from hurricanes, floods and tornados that were considered by all 12 plans to global warming, an influenza pandemic, and nuclear power plant accidents that were only considered in one plan each. A table displaying the various hazards addressed by each plan is presented in Appendix 3. The fewest number considered in a single plan was 9, while the largest number considered was eighteen (18). There were also 5 plans that considered terrorism. For the purposes of this report, the focus was on the eleven (11) most common natural hazards mentioned across all plans. These natural hazards included hurricanes and tropical storms, flooding, hail, tornados, wildfire, thunderstorms, winter storms, excessive heat, drought, earthquakes, and coastal erosion.

The scoring for these items was undertaken in the following manner. Since these were the most frequently mentioned hazards across all 12 plan, each plan was evaluated with respect to each of these hazards when assessing elements of *hazard identification* (see items 5.5 – 5.7 in Table 5), *vulnerability assessment* (specifically items 6.2 - 6.6 in Table 5), and *risk analysis* items (see items 7.1 - 7.4 in Table 5). Each of these items was scored (0, 1, or 2) using the scheme discussed above for all 11 hazards and then the average across all 11 hazards became each plan's score for that particular item. So, for example, each plan was examined with respect to each of the eleven hazard hurricane hazards in terms of how well it delineated each *hazard location* (see item 5.5 Table 5). Then the average score across all 11 hazards was the score the plan received for *hazard location*. This was repeated for the remaining two *hazard identification* items which were *magnitude location* (5.6) and *historical data* (5.7) as well as the items related to *vulnerability assessment* (6.2 – 6.6) and *risk analysis* (7.1 – 7.4). An example of the hazard specific protocol scoring sheet can be found in Appendix 4.

Utilizing the above procedures, each of the 164 plan elements were scored for each of the 12 plans. These scores were then combined for each of the 7 plan component areas to determine how well a plan addressed specific mitigation planning component areas. Since some components have more planning elements than others, the scores for each component was also converted into a percentage by simply dividing the achieved score by the maximum score possible for each component and then multiplying by 100. The resulting score can be thought of as a *component quality score* (*CQS*), where the higher the percentage the more completely and in detail that the component is addressed by a plan. A *total raw score* for each plan was calculated by simply adding the scores across all 164 plan elements. Since the highest score possible on a planning element was a 2 and there are 164 planning elements considered, the maximum or highest score possible is 328. Calculating a *total raw score* in this manner will enable the reader to determine how many actual points a given plan scored, which given the detail of the protocol will provide insights into the comprehensiveness of a given plan. This comparison has some utility since all of these plans are located in the same region, exposed to similar hazards, and the focus of this assessment was based on the 11 most common hazards considered

among the plans. However, it is also important to note that the seven plan components – *vision, planning process, fact basis, goals & objectives, inter-organization coordination, policies & actions,* and *implementation* – include variable numbers of sub-components and planning elements. Therefore, to assess the overall quality of a plan across the 7 planning component areas, a *plan quality score* (*PQS*) or index was also computed.[3] The *plan quality score* is simply the average of the *component quality scores* which again are the percentages of possible points a plan achieved for each component area. *PQS,* like the *CQS*, will range from 0 to 100 with higher scores indicting higher quality plans. The following sections will utilize these scoring procedure to examine how well individual plans preformed with respect to each component and overall. Additional performance based measures related to specific planning elements will be introduced in subsequent sections. However, before beginning the actual analysis of these plans, the following section discussed the geographical areas covered or associated with each of the 12 plans considered by this report.

[3] These component quality scores (*CQS*) and plan quality score (*PQS*) are equivalent to the indexing methods used by Berke et al. (1996 and 1998) and Brody (2003a, 2003b, and 2003c). For example, methods use by Brody generally created *CQS*s that ranged between 0 and 10 and plan quality scores (*PQS*s) were calculated by simply added these component indices resulting in total scores with maximums of 30 or 50 depending on the number of components considered (sometimes 3 sometimes 5). In this research there are 7 components, each with maximum scores of 100, so simply adding the *CQS* scores would result in a *PQS* that ranges between 0 and 700, which may be difficult to interpret. Hence in this research *PQS* is calculated by averaging the seven component quality scores (*CQS*), resulting in a *PQS* that ranges between 0 and 100.



Map 1. The Texas Coastal Management Zone and Study Area

3. The Plans and Plan Areas

This study focused on Hazard Mitigation Action Plans for areas along the Texas Coast which are particularly vulnerable to repeated hurricanes and flooding. More specifically the focus of this study will be Mitigation Action Plans (MAPs) that include or apply to areas within the Coastal Management Zone of Texas. The Coastal Management Zone area is illustrated in Map 1. As of April, 2008, there are 3 city mitigation plans (Houston, Pearland and Friendswood), 4 county mitigation plans (Harris County, Jackson County, Orange County and Jefferson County), 5 regional mitigation plans (Houston-Galveston Area Council Regional Hazard Mitigation Plan, Texas Colorado River Floodplain Coalition Mitigation Plan, Guadalupe/Blanco River Authority Hazard Mitigation Plan, Coastal Bend Mitigation Action Plan and Hazard Mitigation Action Plan for the Rio Grande Border) that have been approved by FEMA and apply to areas that are located within the Texas Coastal Management Zone.[4] Overall then, this research report will

[4] There is actually one "other" mitigation plan, the South East Regional Hazard Mitigation Plan, however this plan was excluded in the analysis because "the plan is not a regional mitigation plan nor a collection of local plans, but rather, a combination of a regional plan with local plan (South East Regional Hazard Mitigation Plan, p.1)." As a consequence, instead of including this essentially composite plan, the two

evaluate twelve hazard mitigation plans: 5 regional plans, 4 count plans, and 3 city plans. The specific plans evaluated and their designation as regional, county, and city are displayed in Table 7.

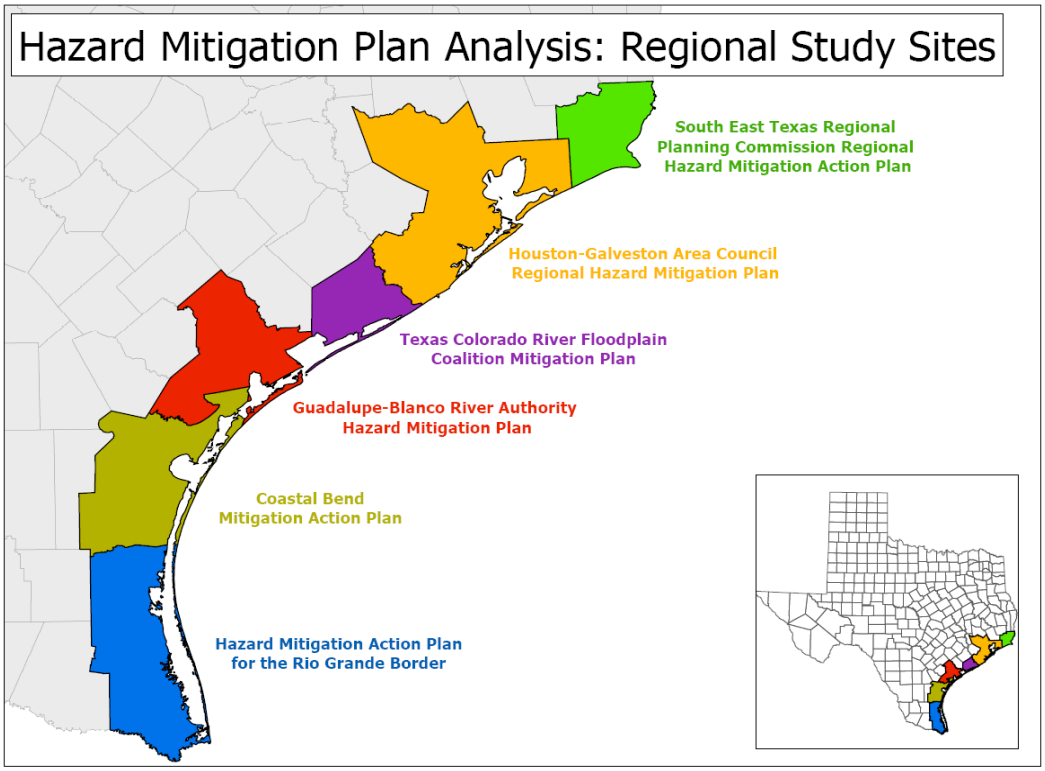
Table 7. The Mitigation Action Plans Assessed by this Research

Plan Type	Name of Plan
Regional	✓ Houston-Galveston Area Council Regional Hazard Mitigation Plan (HGAC Plan) ✓ Texas Colorado River Floodplain Coalition Mitigation Plan (TCRFC Plan) ✓ Guadalupe/Blanco River Authority Hazard Mitigation Plan (GBRA Plan) ✓ Coastal Bend Mitigation Action Plan (CB Plan) ✓ Hazard Mitigation Action Plan for the Rio Grande Border (RGB Plan)
County	✓ Harris County Mitigation Plan ✓ Jackson County Mitigation Plan ✓ Orange County Mitigation Action Plan ✓ Jefferson County Mitigation Action Plan
City	✓ City of Houston Hazard Mitigation Plan ✓ City of Pearland Hazard Mitigation Plan ✓ City of Friendswood Hazard Mitigation Plan

As will become obvious below, many of the regional MAPs include areas that expand far beyond the CMZ. While the purpose of this report is to address mitigation planning along the Texas coast, the funding for this research is directly targeted for areas in the CMZ. As a consequence, when assessing those elements of these plans associated with mitigation actions and policies, only areas that were located in the CMS were considered and included in the analysis. In addition, since this research is assessing plans that were developed by different types of entities (regional councils or coalitions, counties, and cities) this report will consider and examine differences and variations among the plans developed by these entities. The following offers a brief discussion of each plan in terms of its type (regional, county or city), the areas associated with or covered by each plan and the primary entity that prepared each plan along with maps of these areas.

counties (Orange and Jefferson) that participated in the composite plan and had their own independent plans, were included.

3.1. Regional Plans



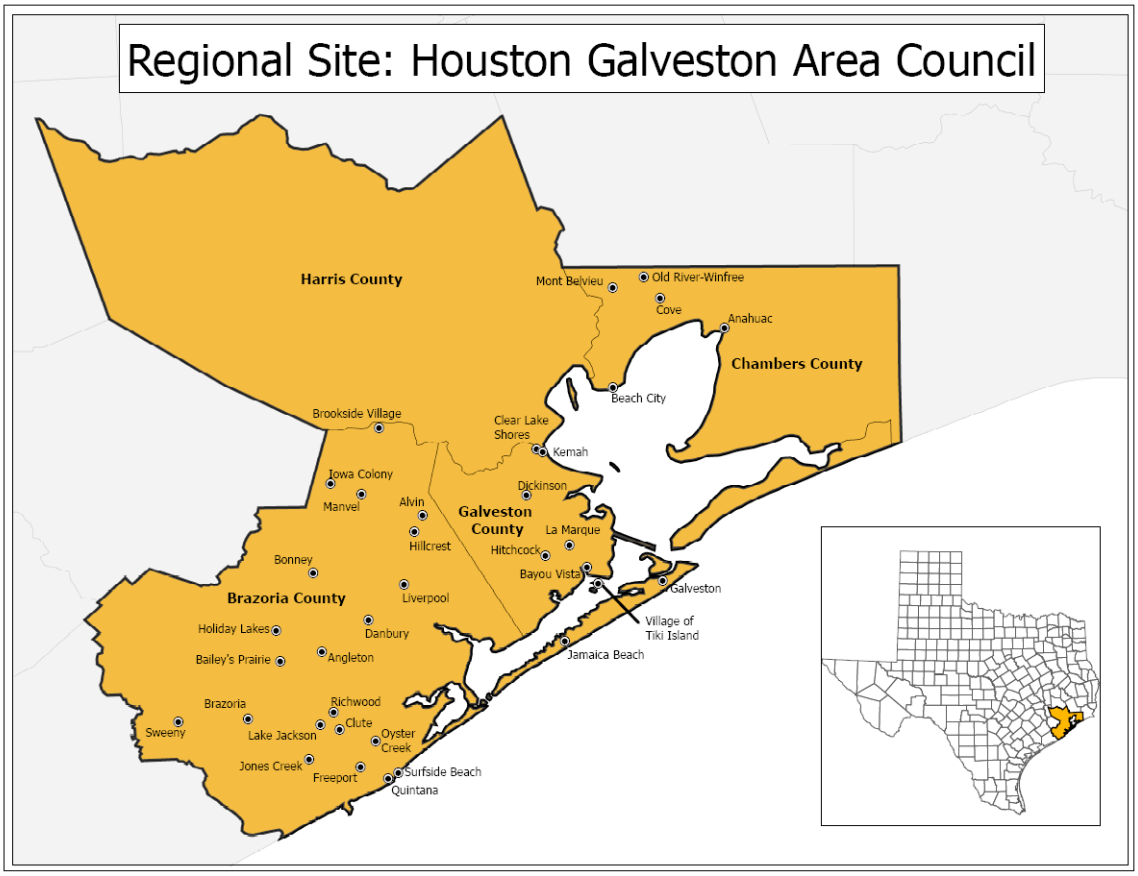
Map 2. Regional Hazard Mitigation Action Plans

Map 2 displays the coverage areas for the regional mitigation plans included in this research report. These regional plans often include county and municipal governments that were far removed from the coastal zone. This map captures areas covered by these regional plans that are also within the coastal zone. As noted above, the South East Texas Regional Planning Commission's Regional Hazard Mitigation action plan is not actually included in this analysis; rather two of its independent stand-alone county plans (Orange and Jefferson) are included.

3.1.1. Houston-Galveston Area Council Regional Hazard Mitigation Plan (HGAC Plan)

The broader Houston-Galveston Area Council Region consists of the 13-county region in and along the Gulf Coast area associated with Houston and Galveston. The Houston-Galveston Area Council Regional Hazard Mitigation Plan (HGAC Plan) includes 8

counties and 74 incorporated jurisdictions. This study focuses attention on the 3 counties and 35 jurisdictions that generally fall into the CMZ. The HGAC Plan was developed by the Houston-Galveston Area Council in partnership with PBS&J and H2O Partners of Austin, Texas. Map 3 depicts the coastal areas included in the HGAC plan and also identifies the counties and many of the participating communities that are included in the plan.

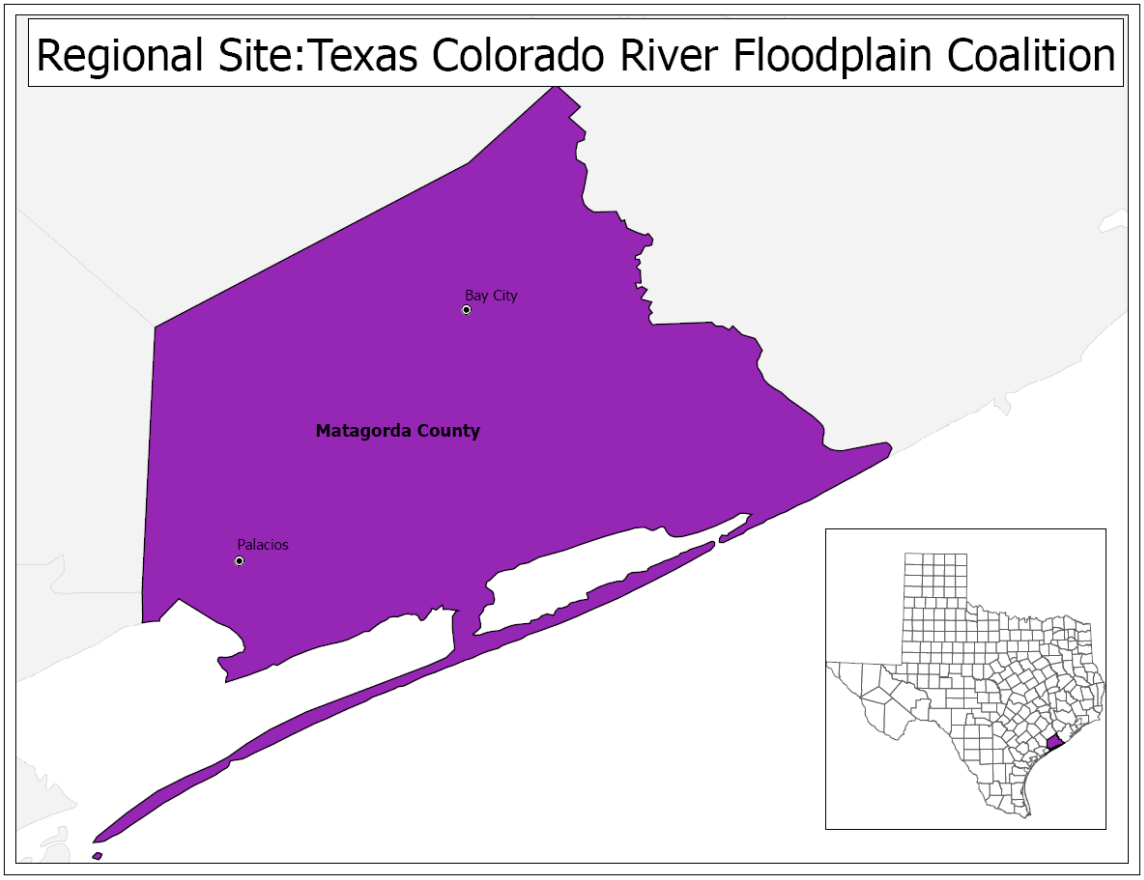


Map 3. Counties and Coastal Jurisdictions in the Houston Galveston Area Council Regional Hazard Mitigation Plan

3.1.2. Texas Colorado River Floodplain Coalition Mitigation Plan (TCRFC Plan)

The Texas Colorado River Floodplain Coalition Mitigation Plan (TCRFC Plan) was prepared by the Lower Colorado River Authority and its contractor, H2O Partners, Inc. of Austin, Texas. A total of 34 cities and 13 counties participated in the TCRFC plan. For the purposes of this study, this report focuses on Matagorda County and 2 participating

cities that are located in the county. Map 4 displays the area and municipalities under consideration for this report.

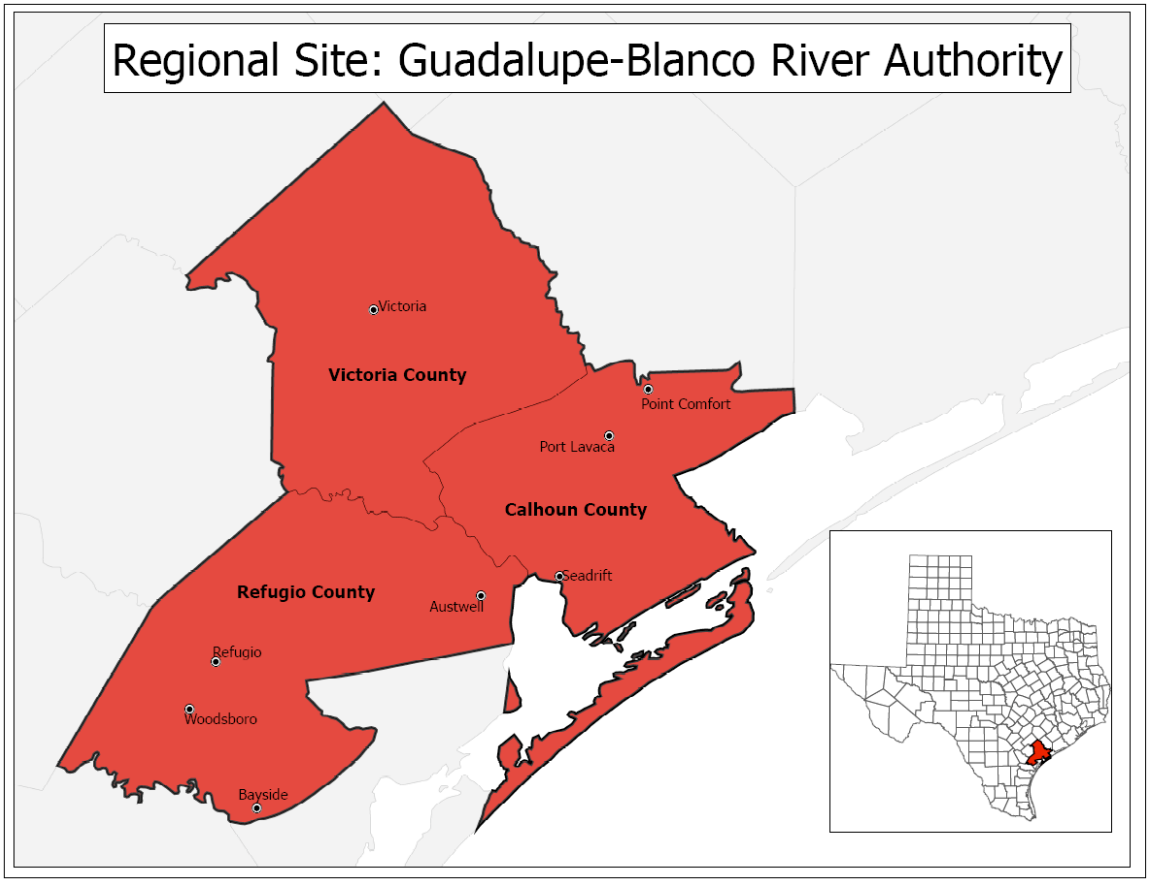


Map 4. Coastal Jurisdictions in the Texas Colorado River Floodplain Coalition Mitigation Plan

3.1.3. Guadalupe-/Blanco River Authority Hazard Mitigation Plan (GBRA Plan)

The Guadalupe-Blanco River Authority (GBRA) covers a ten-county area in the Guadalupe-Blanco river basis along with 26 jurisdictions. However, the Guadalupe-Blanco River Authority Hazard Mitigation Plan (GBRA Plan) included participation by 7 counties and 19 jurisdictions. Of these participants, 3 counties (Victoria, Refugio, and Calhoun) and 8 jurisdictions are located in the coastal zone and these will be the target areas for this study. In addition to the GBRA, H2O Partners of Austin, Texas were

consultants helping to develop the mitigation action plan. Map 5 displays the focus areas for this plan's analysis.

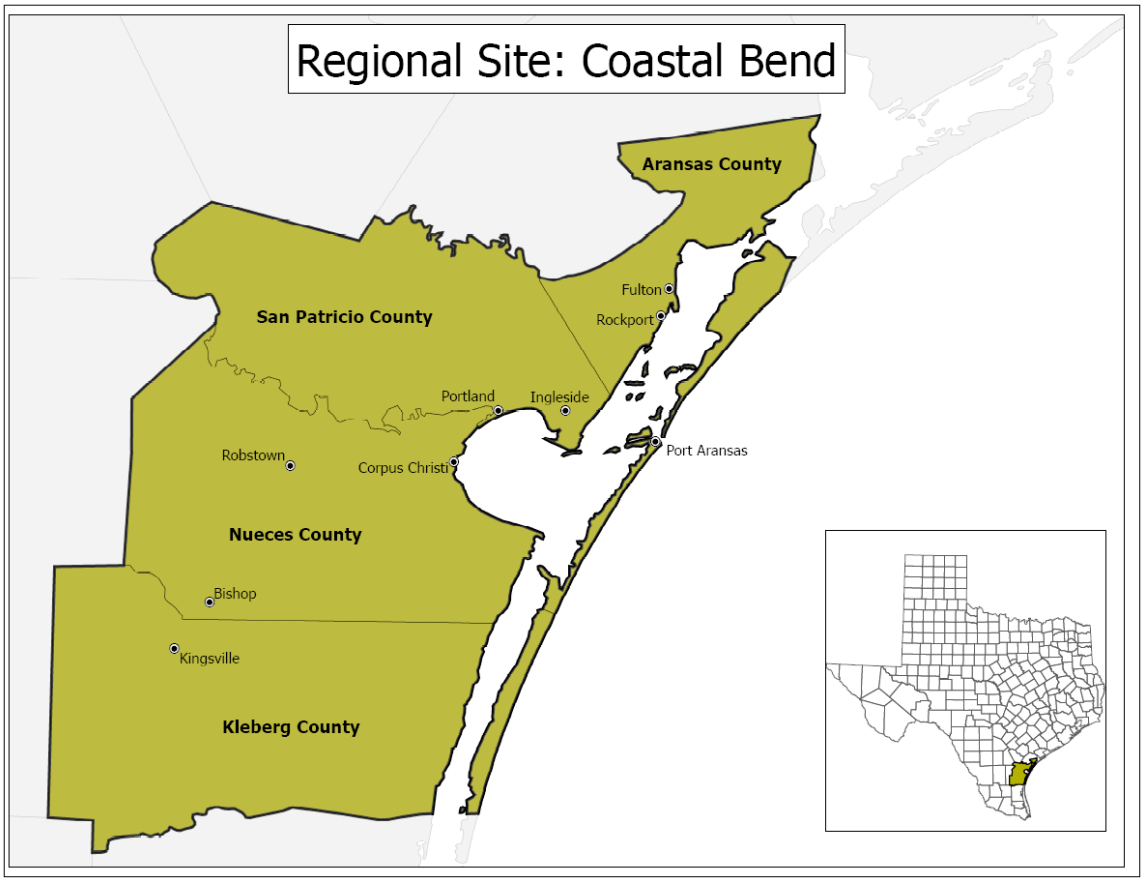


Map 5. Coastal Jurisdictions in the Guadalupe-Blanco River Authority Hazard Mitigation Plan

3.1.4. Coastal Bend Mitigation Action Plan (CB Plan)

The focus area for the Coastal Bend Mitigation Action Plan (CB Plan) includes the four counties, Aransas, San Patricio, Nueces, and Kleberg that are located in the area termed as Texas's coastal bend area where the coast line "bends" from a generally north-south orientation to a northeast-southwest orientation. This plan also includes 9 municipalities – Fulton, Rockport, Ingleside, Port Aransas, Portland, Corpus Christi, Robstown, Bishop, and Kingsville – that are located in these counties. Map 6 displays the counties and

municipalities of the Coastal Bend Mitigation Action Plan area that are the target for this report.

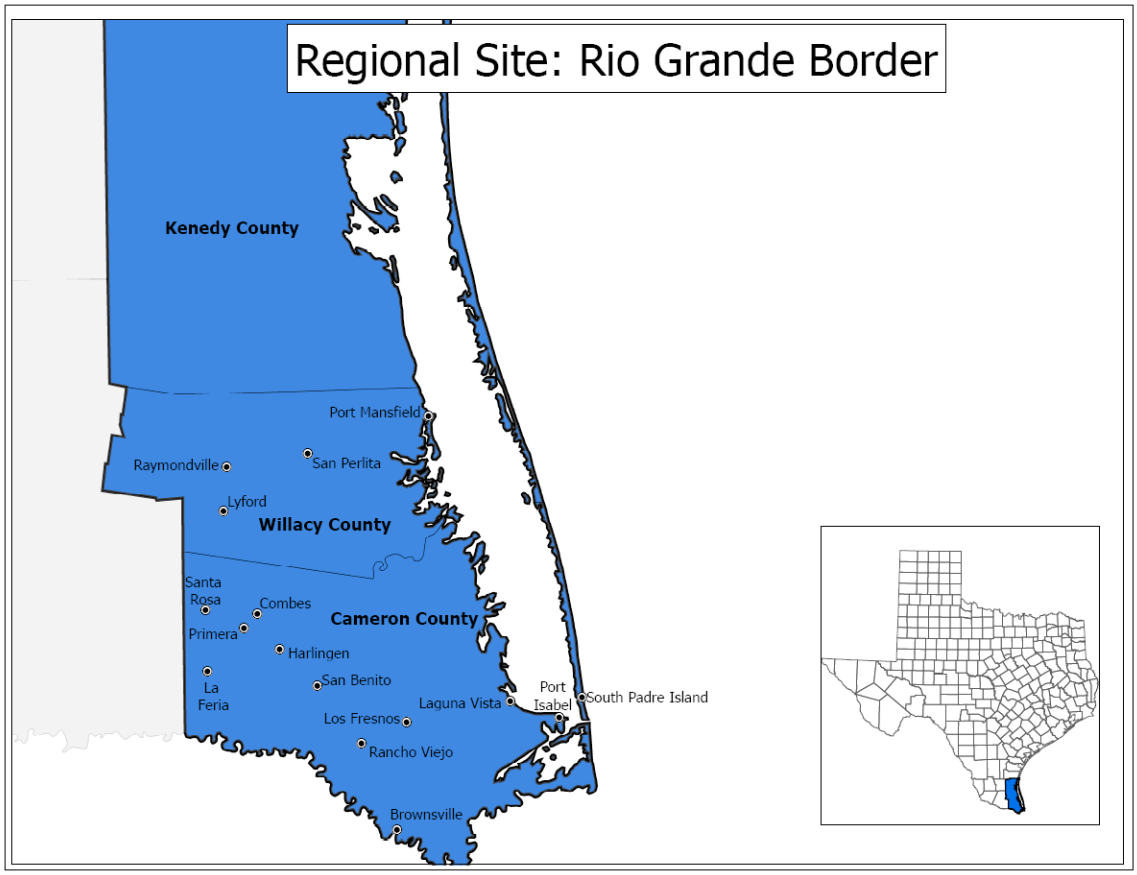


Map 6. Coastal Jurisdictions in the Coastal Bend Mitigation Action Plan

3.1.5. Hazard Mitigation Action Plan for the Rio Grande Border (RGB Plan)

The Hazard Mitigation Action Plan for the Rio Grande Border (RGB Plan) covers the very large area stretching from the three coastal counties just north of Mexico (Cameron, Willacy, and Kenedy) well along the Rio Grande River and Mexico border encompassing 14 counties. For the purposes of this report the areas of concentration included the 3 coastal counties and 16 municipalities within these counties, all of which fall into Cameron and Willacy counties. Map 7 displays these counties and communities. Texas A&M International University (TAMIU) and the non-profit Rio Grande Institute, with

planning and technical assistance from H2O Partners, Inc. participated in developing the plan.

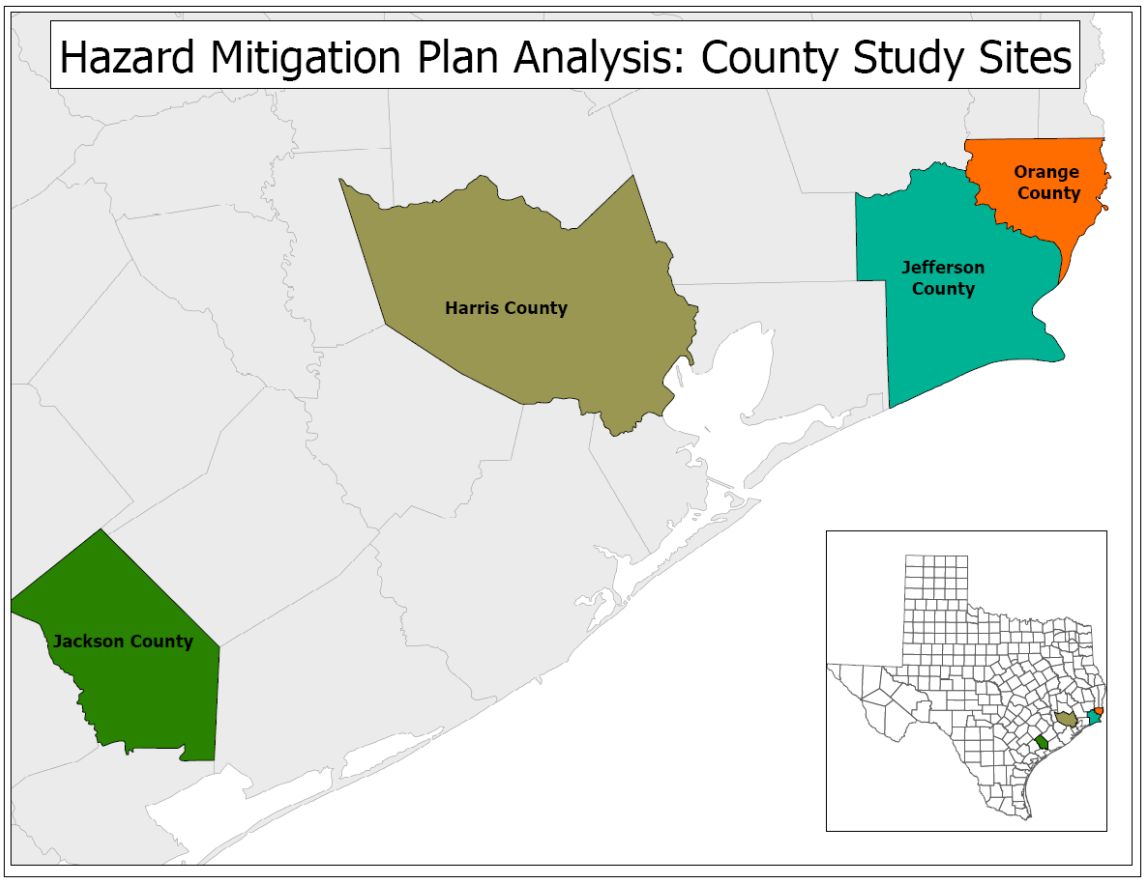


Map 7. Coastal Jurisdictions in the Hazard Mitigation Action Plan for the Rio Grande Border

3.2. County Plans

There were four county mitigation action plans included in this analysis: Jackson, Harris, Jefferson, and Orange. Map 8 displays the locations of these counties. The Harris County Mitigation Plan was developed in the partnership with PBS&J and H2O Partners. This plan includes the one participating county, Harris County, and 21 local jurisdictions within the county. Interestingly, the city of Houston is not included; rather it has its own mitigation action plan, discussed below. The Jackson County Mitigation Plan includes Jackson County and 3 municipalities located in that county. This plan was developed in partnership with H2O Partners of Austin, Texas.

The final two counties, Jefferson and Orange County are the two most northeaster counties along the Texas coast. These counties worked with J. F. Thompson, Inc. of Houston, Texas, in association with Lamar University to develop their hazard mitigation action plans. The Jefferson County Mitigation Action Plan includes the unincorporated county area and 8 incorporated cities. The Orange County Mitigation Action Plan includes the unincorporated areas of Orange County and 7 cities.



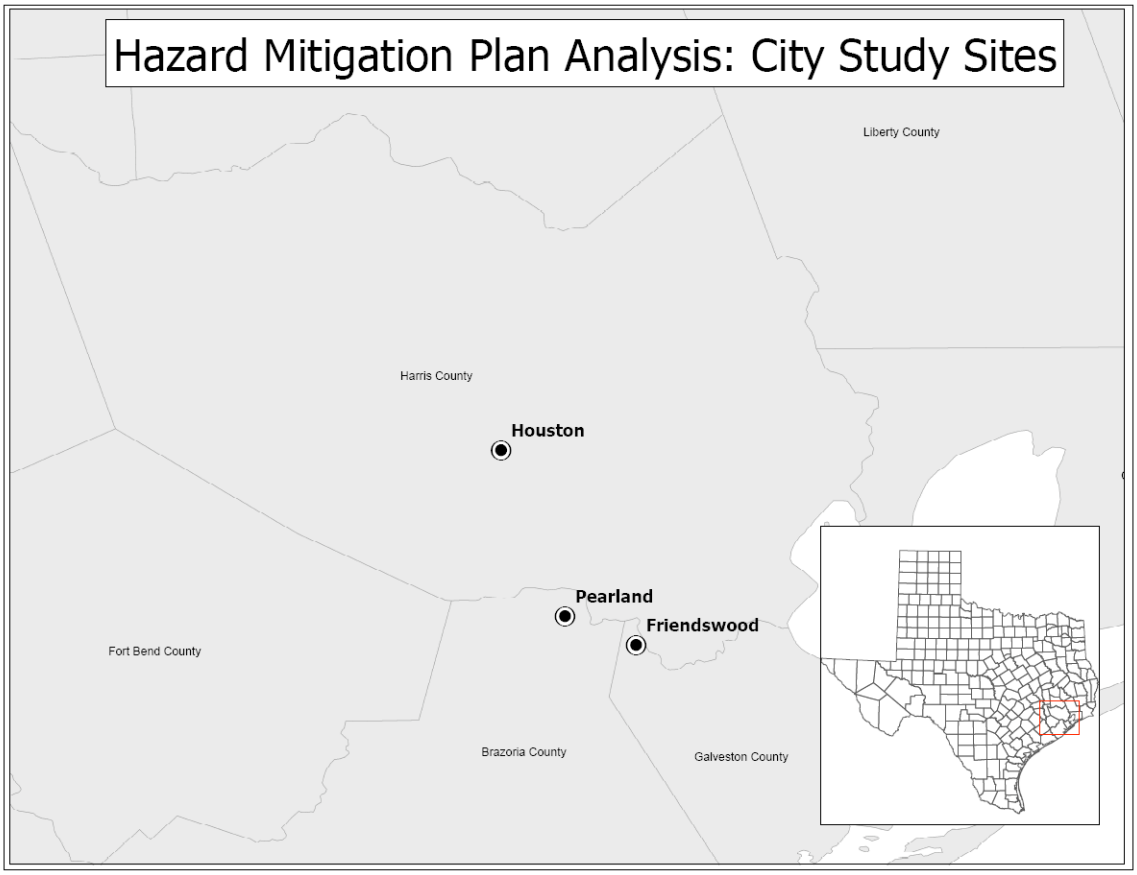
Map 8. County Hazard Mitigation Plans

3.3. City Plans

Three cities or municipalities had independent FEMA approved hazard mitigation action plans. All of these are located in the greater Houston-Galveston areas and include Houston, Pearland, and Friendswood. The City of Houston Hazard Mitigation Plan was prepared by the City of Houston Hazard Mitigation Committee. The Office of Emergency Management staff led the development of this plan. They employed the Mitigation 20/20

software program which helped to guide the activities of the Hazard Mitigation Committee, record and manage the information generated and to produce updates to the plan. The City of Pearland Hazard Mitigation Plan was consulted by Donald R. Ward & Associates, Naples, FL, with support from R. C. Quinn Consulting, Inc., Annapolis, MD. The City of Friendswood is actually located in both Harris and Galveston Counties. Their plan was developed in partnership with Halff Associates, Inc.

It should be noted that the mitigation plans for both Pearland and Friendswood were primarily directed at the Flood Mitigation Assistance Program and the Hazard Mitigation and Pre-Disaster Mitigation Program, paying particular attention to materials for the Community Rating System of the National Flood Insurance Program (NFIP). The NFIP's Community Rating System is adopted in the early 1990s to encourage community flood risk mitigation activities to go beyond minimum NFIP standards. A community which voluntarily participates in this program receives a rating score based on the CRS system; the rating scores are divided into 10 classes which correspond to flood insurance premium discount rate from 5 to 45 percent. The CRS classes for local communities are based on 18 activities which are organized under four categories – public information, mapping and regulation, flood damage reduction, and flood preparedness. In light of this focus, it should not be surprising that the plans concentrated primarily on flood hazard and actions included in the mitigation plan were primarily focused on gaining CRS planning credits. This is not to say that flood prevention and actions focusing on a communities CRS rating are not appropriate for a mitigation action plan. Indeed, they are clearly appropriate and important for an areas mitigation strategy. Rather, these statements are simply added to provide a context by which to view the findings with respect to Pearland and Friendswood.



Map 9. City Hazard Mitigation Plans

4. Assessment of Coastal Zone Hazard Mitigation Plans

Section 4 presents the detailed analysis of the mitigation plans. This section is broadly divided into three sub-sections. The first sub-section (4.1) begins with an overall assessment of the 12 plans as well as a comparison of regional, county, and city plans and then examines the quality of the 12 plans in detail, focusing on the seven basic components – 1) *vision statement,* 2) *planning processes*, 3) *fact basis*, 4) *goals & objectives, 5) inter-organizational coordination*, 6) *mitigation policies & actions*, and, 7) *implementation.* The second sub-section (4.2) will focus on a detailed assessment of the sub-components and 164 individual planning elements across all coastal zone hazard mitigation plans. And the Final sub-section (4.3) will examine the actual mitigation actions proposed by the 130 jurisdictions covered by these 12 mitigation plans that are also located in the Texas coastal management zone.

4.1. Plan Quality Analysis

Table 8 displays the scores for the seven plan components for each of the 12 plans. Each numbered row in the table represents the scoring for one of the 12 plans assessed by this research. The names are not included on the table itself, in part, to discourage making simple comparisons regarding how specific plans scored relative to other.[5] The plans have been sorted into regional, county, and city plans, with regional plans in the upper third of the table, followed by county plans in the middle of the table, and then city plans in the lower third. The scores in each cell in the body of the table represent the points earned by each plan for each component. Below each score is the percentage of total possible points earned for each component, which is referred to here as the component quality score or *CQS*.[6] So, for example, the first regional plan earned 4 points for its vision statement and that represented 40% of the points possible for a plan's vision statement.[7] The second to the last column presents the total raw score or points earned each plan and the percentage of total possible points earned. So, the first plan earned

[5] Nevertheless, the names associated with each row (number) can be found in the table's footnote.
[6] % = (total points earned for a component / total possible points for that component) X 100.
[7] (4 pts. earned /10 max. pts possible) X 100 = 40%

132.36 points, which represented 40.4% of the total points a plan could earn (total possible points possible = 328).[8] The last column presents the plan quality score (*PQS*) for each plan. The *PQS* again is the average the component quality scores (*CQSs)* and therefore represents a measure of the overall quality of each of the plans. The second to the last row on the table presents the average points earned for each component across the 12 plans and the average percentage of points or average *CQS* for the 12 plans. The last row in the table presents the maximum points possible for each component. So again for example, focusing on the last two cells under the *vision* column, the average score for *vision* statements across the 12 plans was 3.83 points which yields an average *CQS* of 38.3% of the maximum possible points possible which was 10.

Table 8. Plan Scoring Result and Plan and Component Quality Assessments

Plans and Types		*Vision*	*Planning Process*	*Fact Basis*	*Goals & Objectives*	*Inter-org. Coordination*	*Policies & Actions*	*Implementation*	Total Raw Score	Plan Quality Score
Regional	1	4 40.0%	12 60.0%	15.36 36.6%	6 27.3%	32 55.2%	48 32.0%	15 57.7%	132.36 40.4%	44.1
	2	7 70.0%	9 45.0%	17.73 42.2%	12 54.6%	21 36.2%	34 22.7%	12 46.2%	112.73 34.4%	45.3
	3	4 40.0%	10 50.0%	18.97 45.2%	9 40.9%	23 39.7%	23 15.3%	12 46.2%	99.97 30.5%	39.6
	4	5 50.0%	13 65.0%	15.55 37.0%	10 45.45%	15 25.9%	41 27.3%	8 30.8%	107.55 32.8%	40.2
	5	7 70.0%	13 65.0%	14.59 34.7%	16 72.73%	27 46.6%	63 42.0%	11 42.3%	151.59 46.2%	53.3
County	6	2 20.0%	12 60.0%	16.64 39.6%	7 31.82%	31 53.5%	58 38.7%	17 65.4%	143.64 43.8%	44.1
	7	5 50.0%	11 55.0%	14.73 35.1%	14 63.64%	11 19.0%	21 14.0%	14 53.9%	90.73 27.7%	41.5
	8	1 10.0%	11 55.0%	13.09 31.2%	15 68.18%	43 74.1%	48 32.0%	16 61.5%	147.09 44.8%	47.4
	9	0 0.0%	6 30.0%	16.27 38.7%	13 59.09%	28 48.3%	47 31.3%	19 73.1%	129.27 39.4%	40.1
City	10	4 40.0%	7 35.0%	9.82 23.4%	13 59.09%	11 19.0%	20 13.3%	18 69.2%	82.82 25.3%	37.0
	11	4 40.0%	12 60.0%	10.18 24.2%	3 13.64%	30 51.7%	55 36.7%	11 42.3%	125.18 38.2%	38.4
	12	3 30.0%	8 40.0%	6.64 15.8%	2 9.09%	22 37.9%	50 33.3%	9 34.6%	100.64 30.7%	28.7
Mean		3.83 38.3%	10.33 51.7%	14.13 33.6%	10.00 45.5%	24.50 42.2%	42.33 28.2%	13.50 52.0%	118.63 36.2%	41.6
Max		10	20	42	22	58	150	26	328	100

1) Houston-Galveston Area Council, 2) Texas Colorado River Floodplain Coalition, 3) Guadalupe-Blanco River Authority, 4) Coastal Bend, 5) Rio Grande Border, 6) Harris County, 7) Jackson County, 8) Orange, 9) Jefferson; 10) Houston, 11) Pearland, 12) Friendswood.

[8] (132.36 pts earned / 328 max. pts. possible) X 100 = 40.4%

On the whole the fifth plan,[9] which is a regional plan, earned the highest total raw score of 151.59 points, which is 46.2% of the maximum points possible. This total score is considerably higher than the average total raw score for the 12 plans which was only 118.63 or 36.2% of total points. This plan also had the highest plan quality score (*PQS)*, scoring a 53.3, indicating that on average its component quality scores (*CQS*s) across the 7 component areas averaged 53.3% of possible points. While the highest *PQS* was above 50%, the average *PQS* for the 12 plans was only 41.6 a good deal lower than the 50% mark. Furthermore, when considering the raw total points, no plan scored over 164 points which would be necessary to reach the 50th percentile. The 10th plan, which is a city plan, earned the lowest total score of 82.82 which was only 25.3% of the total possible points. However, when considering the *PQS* the 10th plan was second to the lowest, with the lowest score going to the 12 plan which is also a city plan. Its *PQS* was only 28.7 indicating that on average it had the lowest average component quality scores (*CQS*s) of the 12 plans. Overall then, while all of these plans were approved by FEMA, they scored below the 50% mark based on the total score possible for this protocol, sometime considerably below that mark. Similarly when considering the *PQS*s, only one plan was above 50, with 7 scoring in the 40s, 3 in the 30s, and one in the 20s. These finding suggests that there is considerable room for potentially strengthening these mitigation plans, both in terms of total points and, most importantly, in terms of overall quality.

Returning again to the plan with the highest total raw and quality scores, the fifth plan, it can be seen that it obtained these high scores not because it earned most of its points in one or two component area, but rather it was strong across all 7 components. Indeed, it earned the highest component quality score (*CQS*) or was tied for the highest *CQS* in four component areas*: vision statement* (tied with the 2nd plan for the highest score), *planning process* (tied with the 4th plan), *goals & objectives* and *mitigation policies & actions*. The 3rd plan, also a regional plan, earned the highest scores for *fact basis* with 18.97 points or 45.2% (*CQS*) of the maximum points for that component. The highest score for *inter-organizational coordination* was a 43 or 74.1% of possible points and was earned by the 8th plan, a county play, while the 9th plan, also a county plan, scored the highest points for

[9] This is the Rio Grande Border hazard Mitigation Action Plan.

implementation, (19 points or 73.1%). No city plan holds the distinction of having the highest *CQS* on any plan component. Indeed, considering only plan quality scores (*PQS*s), it appears that the 1st and 3rd placed plans were regional plans, while the 2nd best plan was a county plan (plan 8). There was a tie for the 4th best plan between the 1st plan, a regional plan, and the 6th, a county plan. The plans with the lowest *PQS*s were all city plans.

The above findings suggest that regional and county plans appear to perform somewhat better than city plans, with perhaps regional plans reflecting slightly higher quality than county plans to the extent that they had the highest *CQS*s for at least 5 out of the 7 plan components. To make the comparisons among different types of plans clearer, Table 9 displays the same general findings as in Table 8 above, only now the individual plans have been averaged across the three plan types: region, county and city plans. The last two columns present the means for the total raw and plan quality scores respectively for the different types of plans. It can now be clearly seen that on average county plans actually had higher total raw scores with an average of 127.68, which was 38.9% of all possible points which was slightly higher than regional plan average or 120.84 or 36.8% of total points. Interestingly the city plan average was only 102.88 or 31.4% of total possible points. With respect to *PQS*s, however, regional plans at 44.5 are slightly higher than county plans at 43.3, and both of these quality scores are much higher than the City *PQS*, which was only 34.7. Interestingly, regional plans only have the highest component quality scores (*CQS*s) for *vision*, *process* and *fact basis* components, while county plans achieved higher *CQS*s on the remaining 4 components including *goals & objectives*, *coordination*, *policies tools & actions*, and *implementation*. Again, no city *CQS* is the highest, although a few times they have the second highest values among the three types of plans (for *vision* and *implementation* components).

The final row presents the F-statistics from one-way analysis of variance (ANOVA) tests for statistical significance among the three plans. In light of the very small sample size (12), it is perhaps surprising that tests were significant for differences with respect to *vision* and *fact basis* are statistically significant, and approached significance with respect to *implementation*. Post-hoc testing suggests that regional plan *vision statements* were on

average higher than county *vision statements* and city *fact basis* components were significantly lower in quality than those of both county and regional plans. The findings with respect to *implementation* suggest that regional plan implementation statements are significantly weaker than those of county plans. On the whole however, there were no statistically significant differences among the plans with respect to other plan components, nor were there any significant differences among plan types in the total raw scores. However, the F-test for differences among plans with respect to *PQS* was statistically significant, with post-hoc testing suggesting that regional plans were of higher quality than city plans and nearing significance when comparing county and city plans. On the whole, these results suggest that regional and county plans are of somewhat higher quality than city plans, although all, as discussed below, clearly have room for improvement in quality and content. It should however be noted that at least two of the city plans were, by their own admission, focused more narrowly on flooding hazards, which accounts for the reduced fact basis *CQS*, and may have contributed to the overall differences as well. While further discussion may shed some light on differences among plans and plan types, given the relatively low overall scores with respect to both *CQS* and *PQS*, it is much more important to more completely discuss the overall plans and their various components.

Table 9. Mean Plan Quality Scores and Percentages by Plan Type

Plan Type	Vision	Process	Fact Basis	Goals & Object.	Inter-org. Coordination	Policies & Actions	Implement -ation	Total Raw Score	Plan Quality Score
Regional	5.40 54.0%	11.40 57.0%	16.44 39.1%	10.60 48.2%	23.60 40.7%	41.80 27.9%	11.60 44.6%	120.84 36.8%	44.5
County	2.00# 20.0%	10.00 50.0%	15.18 36.1%	12.25 55.7%	28.25 48.7%	43.50 29.0%	16.50 63.5%	127.68 38.9%	43.3
City	3.67 36.7%	9.00 45.0%	8.88## 21.1%	6.00 27.3%	21.00 36.2%	41.67 27.8%	12.67 48.7%	102.88 31.4%	34.7&
All Plans	3.83 38.3%	10.33 51.7%	14.13 33.6%	10.00 45.5%	24.50 42.2%	42.33 28.2%	13.50 51.9%	118.63 36.2%	41.6
F-test	4.86**	1.05	17.7**	1.88	0.50	0.02	3.05*	1.06	4.27*

** = P(F) ≤ .05; * = P(F) ≤ .01; # = average County vision score significantly smaller than average regional score; ## = average City fact basis significantly smaller than both county and regional average fact basis scores. & = statistically different than regional plans at the .10.

In addition to the findings presented in Tables 8 and 9, Table 10 provides detailed descriptive statistics on the component and plan quality scores for the 12 plans. In addition, Figure 1 displays box plots providing visual images of the central tendencies and spread of the scores. Specifically, each plot displays the median percentage score (the line inside the box), the 25th percentile (the lower boundary of the box), the 75th percentile (the upper boundary of the box), and the lowest (the horizontal line at the bottom of the vertical line or whisker extending from bottom of the box) and highest (horizontal line at the top of the vertical line extending from the top of the box) scores earned among the 12 plans. Each box gives an idea for where the central 50% of the plans fall. The final box plot on the right is for *PQS* scores across all 12 plans. A reference line is also placed on the graph indicating that 50% of the possible points was reached or earned.

Table 10. Summary Statistics for Component and Plan Quality Scores

Statistic	Vision	Process	Fact Basis	Goals & Objective	Inter-Org Coordination.	Policies & Actions	Imple-mention	Plan Quality Score
Mean	38.3	51.7	33.6	45.5	42.2	28.2	51.9	41.6
Median	40.0	55.0	35.8	50.0	43.1	31.7	50.0	40.9
S.D.	21.2	11.7	8.6	21.1	16.1	9.8	13.7	6.1
Max	70.0	65.0	45.2	72.7	74.1	42.0	73.0	53.3
Min	0.0	30.0	15.8	9.09	19.0	13.3	30.8	28.7

Relative to the plan protocol developed on the basis of the scientific and policy literatures addressing plan evaluation and mitigation, the overall tendency for the 12 coastal management zone plans across all components and in total was for mean quality scores to fall below 50. The exceptions to this statement were the highest average quality scores which were for *implementation*, which had a mean of 52, followed closely by the *planning process* component with a mean of 51.7. These two components also had median values that were at least at the 50% mark. The next two highest average scoring components were the *goals & objectives* component, which had an average of 45.5%, and the *inter-organizational coordination* component with a mean of 42.2%. The *goals & objectives* component did have a median of 50 while the median for coordination was only 43. It should however be noted that within both of these components there were

some plans that had quality scores over 70, while a number of plans that scored very low. Indeed, the minimum was only scored 9.1% for *goals & objectives*" and only 19% for *coordination*. The plan component displaying by far the greatest variation was the *vision statement* followed closely by *goals & objectives*. The relatively low average and median scores with respect to *coordination, goals & objectives,* and *vision* suggest there is considerable room for improving mitigation planning in these areas across the board. However, the variability displayed in these components also suggests that some plans should be targeted to address these issues.

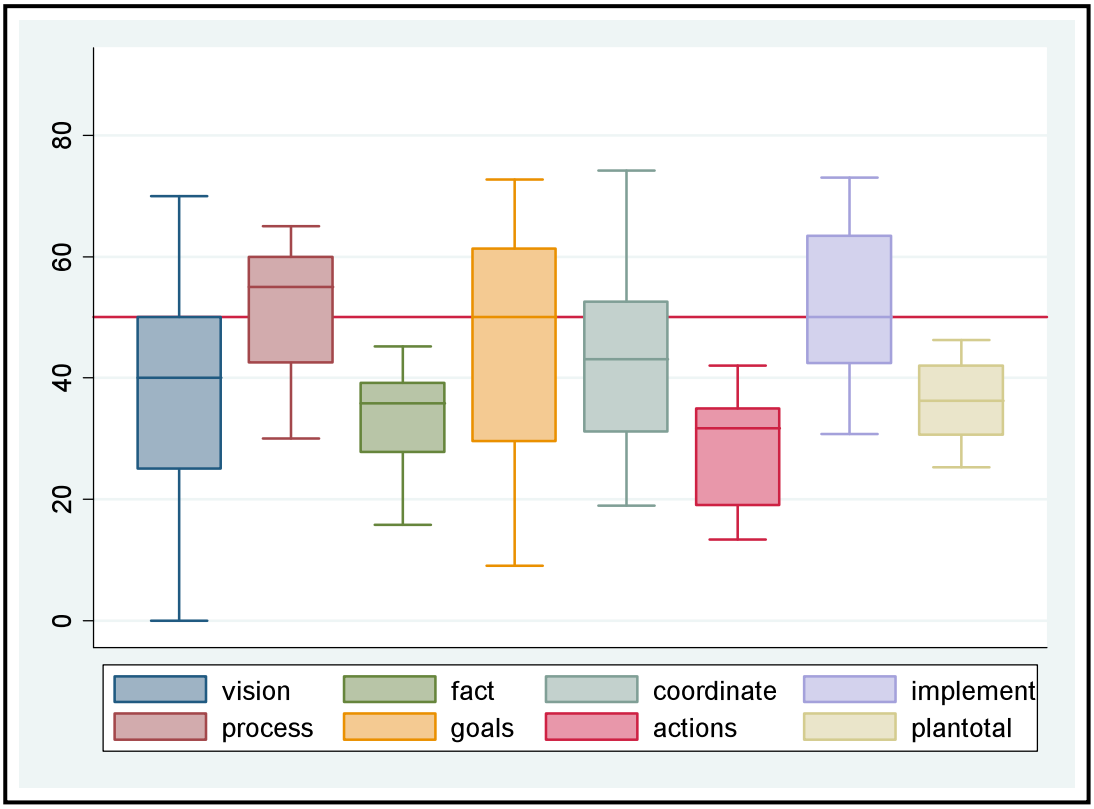


Figure 1. Box Plots for each Plan Component indicating the Percent of Maximum Points Earned by the 12 Plans assessed.

While the above discussion suggests the general need for improvements, the findings with respect to the final two components which also had the lowest mean quality scores are points of major concern. The *fact basis* component had a mean of only 33.6% while the mitigation *policies & actions* component had the lowest mean of only 28.2%. In many respects these two components represent the most important and highly critical parts of hazard mitigation planning. The fact basis component is fundamental for driving rational

and thoughtful mitigation planning efforts (Deyle, French, Olshansky and Paterson 1998). If a local jurisdiction cannot clearly delineate the hazards it faces, the risks associated with these hazards, and the resulting vulnerabilities with respect to the hazard risks, then the determination of which mitigation strategies would be most effective and beneficial for a community becomes highly problematic. In short, the fact basis component lays the fundamental foundation for sound mitigation planning. Without a strong foundation, the entire edifice rests on a very weak footing. Furthermore, the very low mean for the mitigation *policies & actions* component suggests that the nature of the actions under consideration by local jurisdictions were very limited in scope. Indeed, there were regional, county, and city plans with quality scores for this component well below 20, suggesting not only low quality, but also narrow considerations of mitigation actions, a point that will be. When it comes to effective mitigation, the literature often finds comprehensive approaches to mitigation are often critical to meet the full spectrum of vulnerabilities. To the extent that jurisdictions are remaining focused on only a narrow band of mitigation policies, tool, or actions, the community may remain highly vulnerable to hazards and therefore at considerable risk.

On the whole then the analysis thus far suggest that when assessed against a comprehensive planning protocol based on the FEMA guidelines and plan quality and mitigation research literature, the average plan quality score (*PQS*) was only 41.6 on a 100 point scale, with a high of 53.3 and a low of 28.7. Regional and county plans appeared to display slightly higher quality than did city plans. With respect to the 7 plan components a number of plans had component quality scores (*CQS*) at or above 70%, but the averages generally below 50. *Implementation* had the highest average *CQS* at 51.9, followed closely by *planning process* at 51.7, *goals & objectives* at 45.5, *inter-organization coordination* at 42.2, and vision at 38.3. Most disconcerting of all were the very low component quality scores for *fact basis* at *33.6* and mitigation *policies & actions* at only *28.2*. These two components are at the heart of mitigation actions plans for they define the nature of the hazards faced by jurisdictions and the types of mitigation policies and actions that should be undertaken with mitigation funding. These relatively

low scores suggest that there are significant areas of potential improvement that should be undertaken in future iterations of mitigation hazard action plans in the future.

4.2. Planning Element Performance Analysis

It will be recalled from discussions above that each of the 7 plan component areas (*vision, planning process, fact basis, mitigation goals & objectives, inter-organization coordination & capabilities, mitigation policies & actions, implementation*) were divided into thirty subcomponents, which were assessed in turn by specific planning elements associated with each subcomponent (see Table 5). There were a total of 164 subcomponent planning elements considered and each plan was coded based on if and how well each element was addressed. The coding scheme employed range from a 0 if the plan did not address the element at all and 2 if the element was addressed in depth. The previous section examined plans base on how well planning elements were addressed, this section flips that analysis in that it will focus on how well the planning elements in component areas were addressed across plans. Specifically planning element will now be assessed in terms of the *breadth* and *depth* of coverage. *Breadth* is defined as how broadly an element was addressed across all 12 plans and is measured by simply determining the proportion (or percentage) of all plans addressed the element at all (i.e., the proportion of plans scored above a 0). In other words, breadth essentially measures how widely or broadly an element is addressed across all plans in the coastal management zone. Breadth, as a proportion, ranges between zero indicating no plan addressed a particular element and 1 meaning all plans addressed the element. However, multiplying breadth by 100 yields the percentage of plans that addressed on included a discussion of a specific planning element. In the following discussion, breadth will usually be addressed as a percentage, while the proportional form will be presented in the tables.[10]

Depth, on the other hand, assesses how well an element is addressed by the plans under consideration. Depth is assessed in two ways in this research, first by calculating the

[10] Since this analysis only addressed 12 plans, the absolute number of plans will also be presented, often parenthetically, because changing one or two plans in one direction or another can have a seemingly profound impact on percentages and proportions.

average score an element received across *all* 12 plans, and hence throughout the coastal management zone, and second by assessing the average for *only* those plans that specifically addressed the element in the first place. The former is termed *depth 1* and the latter *depth 2*. Remembering that scores of 0, means that an element is not addressed at all, while a score of 2 indicates that an element is not only addressed, but addressed in a detail manner, depth scores at or near 2 are better than scores closer to 0. In addition, since a score of 1 indicates that the planning element is at least mention at a general level, it might be reasonable to suggest that a depth score of around 1.5 would reflect a practicable or reasonable level of specificity and quality. *Depth 1* scores attempt to assess how well and element is addressed throughout the coastal management zone, across all 12 plans, whether the element was specifically addressed or not. *Depth 1* scores will range from 0 to 2, where scores close to zero imply an element is rarely even mentioned throughout the coastal zone area by the 12 plans while average scores closer to 2 suggest that an element is addressed in a detailed manner across all plans. This analysis should provide very detailed assessment of how well planning elements are being addressed throughout the coastal management zone.[11] *Depth 2* scores, on the other hand, only consider plans that at least addressed an element. Hence, depth 2 scores assess how well planning element were addressed among those plans that chose to address the element in the first place. Depth 2 scores allow the reader to assess how well an element was addressed among those plans that at least an attempt to tackle the element, even though it may be only one plan that is applicable to only a relatively small area in the coastal zone.

In sum, the breadth and depth measures will provide an overall assessment of planning quality by examining planning elements in detailed. Breadth provides information on what proportion or percentage of plans address an element in the first place. Depth 1 provides an assessment on how well an element is addressed across all 12 plans while Depth 2 yields an assessment of how well an element is addressed among those plans that actually tackled the element. With these measurement tools, attention is turned to the analysis of planning elements in the coastal management zone.

[11] Two alternate methods of assessing *Depth 1* might be to weight each plans element score based upon either the proportion of coastal population or land area for which the plan applies. The current calculation assumes equal population or land area proportions.

4.2.1. Component 1: Vision Statement

The first component, *vision statement,* is composed of two sub-components and 5 planning elements. The breadth and depth analysis for this component are displayed in Table 11. A relatively high percentage of 83% (10 plans) provided general goals and objectives in their vision statement and 67% (8 plans) provided a discussion of their community's historical hazard threat, potential hazard issues and provided some vision of a hazard resilient and sustainable community. Only 25% (3 plans) discussed how local hazards might impact the overall state. As will be seen in the following discussions, while there is not necessarily a direct connection between breadth and depth 1 scores, since depth 1 assesses quality based on all 12 plans. The higher the breadth, the higher depth 1 scores, holding depth 2 scores constant. With respect to vision statements then, given that on four of five planning elements nearly 70% of the plans addressed them, one might well expect somewhat high depth 1 scores; however 4 of 5 depth 1 scores are less than 1, suggesting limited specify or detail. The exceptions was with respect to the "general goals and objectives" planning element which was addressed in 83% of the plans and where the depth 1 score was 1.25, suggesting at least some specificity across plans in the coastal zone. The relative low depth 1 scores are understandable when viewed in the context of the depth 2 scores which are generally at or very close to 1 even when only considering plans that addressed this element. Indeed, only with respect to "general goals and objectives" was the depth 2 score at levels suggesting that those plans that addressed this element did so with some degree of detail and quality.

Table 11. Vision Statement

Sub-Component	Specific Subcomponent Elements	Breadth (0-1)	Depth 1 (0-2)	Depth 2 (0-2)
1. Problem Description	1.1 Description of community and historical hazard threats	0.67	0.67	1.00
	1.2 Description of the local hazards impact on the entire state	0.25	0.25	1.00
	1.3 Currently or potential hazards issues	0.67	0.75	1.12
2. Vision	2.1 A statement identifying overall image of sustainable and hazard resilient community	0.67	0.92	1.37
	2.2 General goals and objectives	0.83	1.25	1.51

4.2.2. Component 2: Planning Process

It will be recalled that plans tended to score highly on the *planning processes* component as a whole with an average *CQS* of 51.7%. Table 12 presents the breadth and depth measures for the 10 planning elements utilized to assess the two sub-components, "general description" and "participation techniques", associated with *planning processes*. Not surprisingly, most plans (92% or 11) described the general process of plan development and offered a good detail, resulting in a depth 1 score of 1.67 and depth 2 score of 1.82. Most plans relied on open public meetings, household surveys of some form, and website/internet/email. Indeed, all 12 plans utilized open meetings (breadth = 1.0 or 100%) and provided excellent detail regarding these meetings, discussing when, where and how the meetings were held and what issues were discussed. Hence both depth 1 and 2 had averages of 2. There was, however, little use of formal public hearings, with only 33% (4 plans) reporting this participation technique; but when employed, plans tended to give good details regarding their public hearings (depth 2 = 1.76). There was also little use of citizen advisory committees (1 plan) and only 50% (6 plans) actually reported interviewing key stakeholders to solicit their input. Finally, nearly all plans (11) reported on their data acquisition and management techniques, often times providing a good deal of detail, but this was not across all plans.

Before leaving *planning process*, it should be noted that, while household surveys were often cited and employed by these plans, these surveys were not dependent on scientifically drawn random samples of households. Rather they were more generally "surveys" conduced at open meetings or events. These types of samples and subsequent survey results do not provide information that is readily generalizable to the population of households or individuals at large in a geographic areas, but rather provide very limited, often biased, information related to the few individuals that may have participated in the survey at best. This does not mean that properly executed surveys of individual and households will add little in mitigation planning, indeed there as examples of effectively executed surveys leading to improved state mitigation planning and policy development (e.g., Peacock 2003a and 2003b, Peacock and Gladwin 2003; Peacock, Morrow, Alvarez, and Gladwin 1999; Peacock and Morrow 1998a and 1998b). Finally, while it probably is

unreasonable to suggest that all of these techniques should be employed, these findings suggest that exploration regarding the use of formal public meetings, workshops and forums, and particularly, interviews with key stakeholders on order to better insure buy-in by key constituencies might be areas that should be further explored.

Table 12. Planning Process

Sub-Component	Specific Subcomponent Elements	Breadth (0-1)	Depth 1 (0-2)	Depth 2 (0-2)
3. General Description	3.1 General description of the process to develop a plan	0.92	1.67	1.82
4. Proposed Participation Techniques in Planning Process	4.1 Formal public hearings	0.33	0.58	1.76
	4.2 Open meetings	1.00	2.00	2.00
	4.3 Workshops or forum	0.67	1.33	1.99
	4.4 Call-in hot lines	0.00	0.00	0.00
	4.5 Citizen advisory committees	0.08	0.08	1.00
	4.6 Household survey	0.92	1.33	1.45
	4.7 Interviews with key stakeholders	0.50	0.75	1.50
	4.8 Website/internet/email	0.83	1.17	1.41
	4.9 Data acquisition and data management	0.92	1.42	1.54

4.2.3. Component 3: Fact Basis

As discussed above, the *fact basis* component is critical for the development of sound mitigation planning; it provides the foundation upon which a mitigation plan should rest (Deyle et al., 1998). The *fact basis* component consists of four sub-components: hazard identification, vulnerability assessment, risk analysis and emergency management. These sub-components were assessed on the basis of 12 planning elements. The assessments of twelve of these planning elements were directly related to specific hazards. As noted above, these planning elements were therefore assessed across the 11 most frequently mentioned natural hazards (hurricane, floods, tornadoes, hail, winter storms, wildfire, thunderstorms, drought, heat, earthquakes, and coastal erosion) by these 12 plans. In a sense, this can be termed a more or less *all natural hazards* assessment. Given the nature of how these hazard specific planning elements were assessed, breadth[12] scores were not calculated and depth scores were determined by simply taking the mean of the averages

[12] Across the 12 plans evaluated in this report, 4 addressed all 11 hazards, 2 addressed 10, 1 addressed 9, 2 addressed 8, 2 addressed 7 and one addressed 6. So on average 9.1 hazards were addressed by the 12 plans, with over half addressing at least 10 hazards. See Appendix 1 for a table that displays each plan and the hazards that were addressed.

across all 12 plans. Since all plans addressed at least 6 of the 11 hazards, the depth 1 and 2 scores are also set as equivalent for these planning elements. Table 13 presents the planning element analysis results for the *fact basis* component.

Table 13. Fact Basis

Sub-Components	Specific Subcomponent Elements	Breadth (0-1)	Depth 1 (0-2)	Depth 2 (0-2)
5. Hazard Identification	5.1 General description of projected growth and population	1.00	1.83	1.83
	5.2 Hazard profile	1.00	1.75	1.75
	5.3 Hazard identification	1.00	1.75	1.75
	5.4 Delineation of natural resource areas	0.92	1.00	1.09
	5.5 Delineation of location of hazard	-	0.87	0.87
	5.6 Delineation of magnitude of hazard	-	0.92	0.92
	5.7 Historical data on the hazard	-	1.09	1.09
6. Vulnerability Assessment	6.1 Identifies all hazards to the study area	0.83	1.50	1.81
	6.2 Assessment of hazard exposure (Property)	-	0.46	0.46
	6.3 Social vulnerability assessment	-	0.11	0.11
	6.4 Assessment of hazard exposure (Population)	-	0.23	0.23
	6.5 Assessment of hazard exposure (Public infrastructure)	-	0.37	0.37
	6.6 Assessment of hazard exposure (Critical Facilities)	-	0.34	0.34
	6.7 Social Vulnerability (special needs population etc.)	0.50	0.58	1.16
7. Risk Analysis	7.1 Probability of experiencing hazard event	-	0.45	0.45
	7.2 Property Loss Estimation	-	0.38	0.38
	7.3 Infrastructure Impact Estimation	-	0.16	0.16
	7.4 Population Risk	-	0.07	0.07
8. Emergency Management	8.1 Emergency shelter demand and capacity data	0.00	0.00	0.00
	8.2 Evacuation clearance time data	0.00	0.00	0.00
	8.3 Location of emergency shelter	0.17	0.25	1.47

All plans (100%) provided general projections of population growth, identified the hazards they were likely to encounter and provided general profiles of these hazards. Furthermore, the depth 1 and 2 scores were quite high, indicating that these elements were well developed in these plans, providing a good deal of detail resulting in depth scores equal to or greater than 1.75. In addition, 92% (11 plans) delineate natural resource areas. However, the depth analysis suggests that while the first three, population growth, and hazard profiles and identification were relatively well developed elements with depth scores at or above 1.75, the actual delineation of resource areas tends to be only minimally developed. Similarly, 83% (10 plans) identify hazards and provide some detail to those assessments, yielding a dept 1 score of 1.5 and depth 2 scores of 1.81 suggesting high development in those 10 plans that addressed this element. The final

vulnerability assessment element for which a breadth score was calculated was special needs social vulnerability assessment (6.7). Only 50% or 6 plans addressed this element, resulting in a very low depth 1 score of only .58. Furthermore, even among those 6 plans that did address this element, it was minimally addressed resulting in a depth 2 score of only 1.16. The final set of elements for which a breadth scores were calculated were 3 elements associated with emergency management (8.1 – 8.3). No plan addressed two of the three and the final element, location of emergency shelters, was only addressed by 2 plans. However, it should be noted that these "emergency management" element are not generally not associated with mitigation, hence their exclusion in many plans is less significant.

The remaining planning elements, for which breadth scores were not calculated, are associated with hazard identification, vulnerability and risk assessments sub-components across the 11 most often mentioned natural hazards. As noted above, these elements are critical for quality mitigation planning. Unfortunately, the depth scores associated with these elements are generally very low. The depth scores for delineating hazard location (5.5), magnitude (5.6) and historical events (5.7) are among the highest; yet they only range between .87 and 1.09, which suggests only minimum quality across the 12 plans at best. The scores associated with vulnerability assessment planning elements range from a high of only .46 for vulnerability assessment (6.2) associated with property damage to a low of .11 for comprehensive social vulnerability analysis (6.3). These extremely low quality assessment scores are associated with critical mitigation planning elements detailing the vulnerabilities of an area's population, property, infrastructure, and critical facilities, as well as assessing the unique social vulnerabilities of the sub-populations due to low incomes, race, and poverty.

In light of the low vulnerability assessment depth scores, low depth scores associated with the risks analysis planning elements should not be a surprise. Risk analysis, in general, takes vulnerability assessment a step further by estimating the probabilities of impact and loss. The three risk assessment elements assessed are associated with the probability of experiencing hazard events (7.1) followed by overall property loss estimation (7.2), infrastructure impact estimation (7.3) and population risk (7.4). The

highest depth score for these three elements was only a .45 for hazard probability assessment and at the other extreme is the extremely low .07 for population risk assessment. In light of the difficulties recently experienced by the greater Galveston and Houston area associated with Hurricane Ike due to infrastructure impacts, one can more clearly see the relevance of these elements for sound mitigation planning.

The very low depth scores associated with the three *fact basis* sub-components, particularly those related to vulnerability assessment and risk analysis should be of major concern, because they suggest that the foundation upon which mitigation planning is be developed is perhaps not as strong as it could be. Of course, one of the potential reasons for these low scores is possibly due to taking an all natural hazards approach, by considering the eleven most frequently mentioned hazards at once. A different picture may well emerge if individual hazards are considered separately. To perhaps better capture the quality of these critical elements in coastal mitigation planning, Tables 13a and 13b present the findings for the 12 sub-component elements in question exclusively for *hurricane* and *flood* hazards respectively. In addition, the findings are presented for regional, county and city plans. Since all plans address these two natural hazards, these should be considered depth 2 scores.

Table 13a. Depth Scores for Hurricane Hazard

Sub-Components	Specific Subcomponent Elements	All Plans (0-2)	Regional (0-2)	County (0-2)	City (0-2)
5. Hazard Identification	5.5 Delineation of location of hazard	1.33	1.40	1.50	1.00
	5.6 Delineation of magnitude of hazard	1.58	1.80	1.75	1.00
	5.7 Historical data on the hazard	1.58	2.00	1.75	0.67
6. Vulnerability Assessment	6.2 Assessment of hazard exposure (Property)	1.33	1.60	1.50	0.67
	6.3 Social vulnerability assessment	0.00	0.00	0.00	0.00
	6.4 Assessment of hazard exposure (Population)	0.58	1.20	0.00	0.33
	6.5 Assessment of hazard exposure (Public infrastructure)	0.50	0.40	1.00	0.00
	6.6 Assessment of hazard exposure (Critical Facilities)	1.08	1.20	1.50	0.33
7. Risk Analysis	7.1 Probability of experiencing hazard event	1.33	1.40	1.75	0.67
	7.2 Property Loss Estimation	1.33	1.80	1.50	0.33
	7.3 Infrastructure Impact Estimation	0.33	0.60	0.00	0.33
	7.4 Population Risk	0.17	0.40	0.00	0.00

The results presented in Table 13a suggest that there are indeed improvements in depth scores when only considering hurricane hazards, however these improvements are not across the board. Focusing first on *hazard identification*, the delineation of location (5.5) and magnitudes (5.6), as well as the historical assessments (5.7) are significantly higher for hurricane hazards across all 12 plans, ranging from 1.58 to 1.33, and these are particularly for regional and county plans. While there is some improvement with the *vulnerability assessment* elements, the scores are very low for infrastructure (6.5) and critical facility (6.6) vulnerability assessments and zero for social vulnerability (6.3) assessments. There is some variability, but even the highest scores are just slightly over one, implying minimal vulnerability assessments. There are also some improvements with the *risk analysis* elements, particularly for hazard probabilities (7.1) and property loss estimation (7.2) and these improvements are generally because of higher regional and county plan scores. However, the depth scores for risks of infrastructure impacts (7.3) and population risk (7.4) are still very low even when only considering hurricanes.

Table 13b. Depth Scores for Flood Hazard

Sub-Components	Specific Subcomponent Elements	All	Regional	County	City
5. Hazard Identification	5.5 Delineation of location of hazard	1.75	1.80	1.50	2.00
	5.6 Delineation of magnitude of hazard	1.58	1.60	1.50	1.67
	5.7 Historical data on the hazard	1.67	1.80	1.75	1.33
6. Vulnerability Assessment	6.2 Assessment of hazard exposure (Property)	1.67	1.40	1.75	2.00
	6.3 Social vulnerability assessment	0.08	0.20	0.00	0.00
	6.4 Assessment of hazard exposure (Population)	0.75	1.40	0.25	0.33
	6.5 Assessment of hazard exposure (Public infrastructure)	0.75	0.60	1.00	0.67
	6.6 Assessment of hazard exposure (Critical Facilities)	1.08	0.60	1.25	1.67
7. Risk Analysis	7.1 Probability of experiencing hazard event	0.75	0.60	1.00	0.67
	7.2 Property Loss Estimation	1.17	1.40	1.25	0.67
	7.3 Infrastructure Impact Estimation	0.25	0.20	0.25	0.33
	7.4 Population Risk	0.42	0.80	0.00	0.33

The depth analysis results for only flood hazard, presented in Table 13b, also suggest improvement over the "all hazard" results in Table 13, however, here again there are areas with very low depth scores. Similar to the findings with respect to hurricane hazards, the *hazard identification* planning element (5.5 – 5.7) depth scores show

significantly higher scores, but unlike the hurricane results, these depth scores are significantly higher for regional, county and city plans. Indeed, city plans actually earn depth a score of 2 for the delineation of local flooding.[13] A pattern similar to the one seen with hurricane hazard is evident for *vulnerability assessments* with respect to flooding, with relatively high property vulnerability (6.2) depth scores, but the other *vulnerability assessment* elements are all scored low. In particular, even with flooding the social (6.3), population (6.4), infrastructure (6.5), and even critical facility (6.6) vulnerability assessments are earn very low depth scores, with most scores well below the minimal scores of 1. The only exceptions are population vulnerability in regional plans, which at least earned a depth score of 1.4 and critical facilities vulnerability in city plans, which earn a very respectable depth score of 1.67. When it comes to the *risk analysis* elements for flooding hazard, the depth scores are not as high as those found with hurricane hazards. Only in with the property loss estimation (7.2) element are depth scores over 1 and in this case it is just barely over one, due mostly to the relative high average for regional plans. The risk analysis depth scores for flooding probability (7.1), infrastructure estimation (7.3), and population risk (7.4) analysis are all substantially below 1, suggesting minimal risk analyses for most plans with a rather large number of plans failing to even address the issue at all.

On the whole, whether making assessments based on a common set of 11 natural hazards or only assessments based on hurricane and flood hazards separately, the depth assessments for the sub-component elements of the *fact basis* component reveals some issues of concern. On the positive side hazard general identification elements (5.1 to 5.4) were addressed by most plans across the common set of natural hazards producing quality depth scores. However, the delineation of hazards, general vulnerability assessments and risk analysis elements achieved low depth scores across the board. These findings suggest the need to improve the quality of vulnerability and risk assessment sub-components. Some of these improvements would likely require the use of new tools and methodologies associated with delineating hazard areas, vulnerability and hazard risk

[13] It should be recalled that at least two of the city mitigation plans focused more closely on flood hazards. Hence these high flood hazard depth scores, while not unanticipated, do indeed suggest that this hazard was well addressed, at least for hazard identification. Unfortunately the same cannot be said for elements associated with vulnerability assessments and risk analysis, for these depth scores are very low.

assessment. Some plans made use of HAZUS to assess vulnerability and risk, but unless the HAZUS modeling tools are substantially modified by including detailed data of relevance to local areas, the tool tends to provide only coarse analysis, particularly when modeling in small areal units such as cities. In other words, tools that can be utilized to assess vulnerabilities and risks should employ more refined geographical units requiring the development of local datasets, not default data sets that depend upon large census units such as counties or tracts. Furthermore, the use of HAZUS was, for the most part, focused on flood and hurricane hazards. In addition, more recent advancements in social vulnerability analysis and hazard assessment and mapping tools could also enhance the fact basis components of these plans.

4.2.4. Component 4: Mitigation Goals & Objectives

Mitigation Goals & Objectives are much more specifically defined than the general goals associated with the vision statement. As can be seen in Table 14, the *mitigation goals & objective* component is broken down into three sub-components associated with economic impacts, physical and environmental impacts and public interests. In more general terms, these goals are associated with the pillars of sustainability and resiliency which focus on the economic, social and environmental systems of a community. There is considerable variability when comparing the breadth and depth scores among the elements in this component. Focusing first on breadth, the majority of plans include broad goals to protect property (100%) and population (92%) and to promote hazard awareness programs (92%). More modest percentages of plans discuss improving preparedness and response (67%) capabilities, promoting partnerships with multiple agencies (67%), and minimizing hazard fiscal impacts (58%). However, relatively few plans mention goals and objectives associated with distributing the costs of hazard mitigation equitably (17%), protecting natural resources associated with water quality (25%) and environmentally critical areas such as wetlands/floodplains/forests (33%). Even goals like preserving open spaces (50%) and efficient use of available resources (50%) are only mentioned by half of the plans assessed. These findings suggest that plans are focused on reducing property losses and public safety. These issues are clearly important, however narrowly focusing on these and ignoring environmental impacts and

resources runs counter to a growing mitigation literature that directly links mitigation and sustainability, particularly environmental sustainability (Burby 1998; Brody 2008; NRC 2006). For example, in a series of articles Brody et. al. (2007 and 2008) has shown that preserving natural habitat, like wetlands, in Texas can substantially reduce the costs of flooding, whether assessed in dollars or, most significantly, lives. In other words, including reducing environmental impacts and reserving resources also reduces losses in lives and dollars. And yet, the results of this analysis suggest goals like natural resource or ecosystem protection is not likely to be considered a goal for mitigation plans.

Table 14. Mitigation Goals & Objectives

Sub-Components	Specific Subcomponent Elements	Breadth (0-1)	Depth 1 (0-2)	Depth 2 (0-2)
9. Economic Impacts	9.1 Any goal to reduce losses or protect property from loss	1.00	1.50	1.50
	9.2 Any goal to minimize fiscal impacts of hazards	0.58	0.83	1.43
	9.3 Any goal to distribute hazard mitigation cost equitably	0.17	0.25	1.47
10. Physical and Environmental Impacts	10.1 Any goal to reduce hazard impacts on and preserve open space and recreation areas	0.50	0.75	1.50
	10.2 Any goal to reduce hazard impacts on and maintain good water quality	0.25	0.33	1.32
	10.3 Any goal to reduce hazard impacts on and protect wetlands/ forests (Critical natural areas)	0.33	0.42	1.27
11. Public Interest	11.1 Any goal to protect safety of population	0.92	1.42	1.54
	11.2 Any goal to promote hazard awareness program or improve information exchange	0.92	1.58	1.72
	11.3 Any goal to use available resources efficiently	0.50	0.75	1.50
	11.4 Any goal to improve preparedness and response to hazard	0.67	1.08	1.61
	11.5 Any goal to promote partnership with other agencies	0.67	1.08	1.61

The depth scores for *Mitigation Goals & Objectives* planning elements present a very interesting pattern. The depth 2 scores, which again reflect the detail that planning elements are discussed in those plans that directly addressed the issue, fall between 1.3 and 1.7 reflecting a consistently respectable level of detail. The depth 2 scores for public interest planning elements (11.1 – 11.5) reflect relatively high treatment with scores between 1.5 and 1.7, and even with economic impacts planning elements (9.1-9.3) two of the three elements are 1.5, or very close. The scores for physical and environmental impact elements (10.1-10.3) were the lowest, but still fall between 1.3 and 1.5. However,

when translated into depth 1 scores, only goals to reduce property losses and promote hazard awareness retain values at or slightly above 1.5.

On the whole, when addressing the *mitigation goals & objectives* component, mitigation plans tend to focus on important public interest issues, particularly promoting public safety and promoting hazard awareness programs, and reducing economic impacts, at least in terms of losses. Much less prevalent in these plans were goals related to reducing impacts and protecting environmental resources. While plan discussions included a good deal of detail when addressing these goals, if addressed by the plans the first place, the limited and narrow focus with respect to some of these goals resulted in relatively poor quality planning throughout the coastal management zone. These limitations were particularly pronounced for the goals of reducing environmental impacts and promoting and protecting environmental resources.

4.2.5. Component 5: Inter-organization Coordination & Capabilities

The *Inter-organization coordination & capabilities* component, as can be seen in Table 15, includes five subcomponents: cooperation, participation techniques associated with actions, information sharing, capacity development, and conflict management. Cooperation planning elements (12.1-12.9), which address linking mitigation planning between governmental agencies and other planning efforts, have by far the greatest breadth. With respect to cooperation, all plans (100%) identify other government organizations they perceive as important for cooperation and most (92%) also identify key representatives of these organizations. Similarly nearly all (92%) identify key stakeholders groups, although only 42% (5 plans) actually identify representatives for those stakeholder groups. Relatively high proportions of plans also address how they will be integrated with local planning efforts such as other comprehensive plans (83%) and other independent governmental planning efforts (75%), FEMA mitigation initiatives (100%). Integration with state mitigation plans was addressed by 75% and the same proportion addressed inter-governmental agreements. In light of the breadth of cooperation elements, it should not be surprising that there is a good deal of depth across all plans (depth 1) and with respect to those that address each element (depth 2). Those

elements that fall generally short are the elements related to actually identifying representatives of stakeholder groups (12.4), consistency with the Texas State Mitigation Plan (12.5), and other local comprehensive planning efforts (12.6). The latter is perhaps not surprising if it is remembered that in Texas there is little comprehensive planning, particularly at the county and regional level, and no comprehensive planning mandated by the State at even the local/municipal level. The lack of addressing consistency with the State plan is perhaps something that should be striven for, to better insure consistency in planning efforts across the State.

Table 15. Inter-Organization Coordination & Capabilities

Sub-Components	Specific Subcomponent Elements	Breadth (0-1)	Depth 1 (0-2)	Depth 2 (0-2)
12. Cooperation	12.1 Identification of other govt. organizations	1.00	2.00	2.00
	12.2 Identification of representatives for each of above	0.92	1.83	1.99
	12.3 Identification of other stakeholders	0.92	1.25	1.36
	12.4 Identification of representatives for each of above	0.42	0.67	1.60
	12.5 Consistency with state plan/state mitigation plan	0.75	1.08	1.44
	12.6 Integration with other local comprehensive plan	0.83	1.08	1.30
	12.7 Integration with FEMA mitigation programs and initiatives (for example, Flood Mitigation Fund)	1.00	1.92	1.92
	12.8 Integration with other independent governments such as Municipal Utility Districts and Independent School Districts	0.75	1.17	1.56
	12.9 Intergovernmental agreements	0.75	1.17	1.56
13. Proposed Participation Techniques in Proposed Actions	13.1 Formal public hearings	0.08	0.17	2.00
	13.2 Open meetings	0.58	0.92	1.57
	13.3 Workshops or forum	0.58	0.92	1.57
	13.4 Call-in hot lines	0.00	0.00	0.00
	13.5 Citizen advisory committees	0.08	0.17	2.00
	13.6 Household survey	0.17	0.25	1.50
	13.7 Interviews with key stakeholders	0.25	0.33	1.33
14. Information Sharing on the Planned Actions	14.1 Brochures or other literature	0.58	0.92	1.59
	14.2 Newsletters	0.33	0.58	1.76
	14.3 Educational workshops	0.58	1.00	1.72
	14.4 TV/Radio	0.58	1.08	1.86
	14.5 Video	0.25	0.42	1.68
	14.6 Internet (Web-site)	0.75	1.25	1.67
15. Capacity Development	15.1 Funding sources for citizen participation and cooperation with other organization	0.25	0.42	1.68
	15.2 Staffing levels (FTE, part time staff, etc.)	0.33	0.58	1.76
	15.3 Joint database	0.50	0.83	1.66
	15.4 Technical assistance to other organization or citizen	0.42	0.42	1.00
	15.5 Improving communications and institutional capacity through training, workshop, etc.	0.67	1.17	1.75
	15.6 Develop and improving technical capabilities (GIS, database etc.)	0.58	0.92	1.59
16. Conflict Management	16.1 Specification of conflict management procedures and processes	0.00	0.00	0.00

The high breadth scores are not as evident for planning elements associated with mitigation action participation techniques (13.1-13.7) and information sharing (14.1-14.6) sub-components. However, the low breadth scores are not as problematic for these elements, because they are simply the variety of techniques that might be employed to insure participation and information sharing. There seems to be a good deal of variability associated with participation techniques, particularly when view in close conjunction with the depth 2 scores. The very high depth 2 scores, some as high as 2, suggest that the participation techniques were highly dependent upon the actions considered. A similar pattern is evident for information sharing techniques. Use of the Web has the highest breadth score of 75%, with brochures, workshops, and TV/radio all being mentioned by 58% of the plans. Interestingly all forms of sharing have depth 2 scores that are greater than 1.67, indicating rather high quality discussions with in the plans mentioning particular techniques.

The capacity development sub-component is concerned with planning to actually build and enhance the mitigation knowledge and skill sets a community possesses. This sub-component is assessed by 6 elements (15.1-15.6) focusing on everything from staffing, to data base development, and improving technical skills. What is rather surprising is that the breadth scores across the capacity building elements are rather anemic, for there is not a single element with a breadth score higher than 70%. While not surprisingly training workshops (15.5) were the most often mentioned element, they were only addressed by only 67% or 8 of the plans, followed by developing/improving technical capacities (15.6) at 58% (7 plans), and developing joint data bases(15.3) at 50% (6 plans). The elements associated with enhancing staffing levels (15.2) and obtaining funds (15.1) to insure greater citizen participation and cooperative activities with other organizations were only at 33% and 25% respectively. In light of these relatively low breadth scores, the depth 1 scores are also very low, suggesting spotty to mixed coverage by quality planning efforts throughout the coastal management zone when it come so developing the capacities of agencies and communities involved in mitigation planning. Nevertheless the relatively high depth 2 scores suggest that some plans did addressed capacity development in a detailed manner. In the assessment of these plans then it was clear that while some plans

not only addressed capacity development and did so in a quality manner outlining how these activities would be carried out and funded, at the same time a relatively large percentage of plans failed to address these issues at all or focused on a single element to develop capacity. On the whole, much more attention is needed to enhance the mitigation planning capacities of areas to effectively engage in mitigation planning and activities.

The final sub-component associated with coordination was conflict management. Conflict management is often a critical element in effective planning whether discussing environmental, comprehensive, or mitigation planning. Inter-organization cooperation is often jeopardized because a variety of organizations, both governmental and non-governmental organizations, often have competing and contradictory goals and yet must work together to reach broader community goals with respect to mitigation. The chances of conflict are particularly high when addressing issues related to land-use, building codes, natural resource issues, which are often critical for effective mitigation. And yet, not a single plan addressed conflict management issues. This is clearly another area for plan improvements.

4.2.6. Component 6: Specific Mitigation Policies & Actions

The most important component of these mitigation plans, next to the *fact basis* component, is of course the component dealing with the actual specification of the *mitigation policies & actions*. The protocol was developed to assess a full range of mitigation policies and actions by including 12 sub-components assessed by 75 planning elements. The sub-components include: general polices (2 elements); regulatory tools (17 elements); modeling techniques (3 elements); floodplain regulations (3 elements); incentive based tools (5 elements); structural tools (12 elements); awareness and education tools (12 elements); social considerations (1 element); public facilities and infrastructure retrofits (3 elements); recovery planning (6 elements); emergency preparedness (6 elements) and natural resource protection (5 elements). To facilitate discussion, the mitigation policies and action sub-components will be broken into four sets that can more easily be displayed on individual tables along with the breadth and depth scores. These four sets include: 1) Table 16: general policies, regulatory tools, and

modeling techniques, 2) Table 17: floodplain regulation, incentive based tools, and structural mitigation tools, 3) Table 18: recovery planning, emergency preparedness and natural resource protection, and finally 4) Table 19: awareness/education tools, social considerations, and public facilities and infrastructure. The discussion will begin with general mitigation policies, regulatory tools and modeling techniques.

Table 16. Specific Mitigation Policies & Actions:
General, Regulatory Tools and Modeling Technique

Sub-Components	Specific Subcomponent Elements	Breadth (0-1)	Depth 1 (0-2)	Depth 2 (0-2)
17. General Policy	17.1 Discourage development in hazardous areas	0.33	0.42	1.27
	17.2 Support adoption of new regulatory legislation at local level	0.67	1.08	1.61
18. Regulatory Tool	18.1 Permitted land use	0.33	0.42	1.27
	18.2 Low density conservation or other hazard zone	0.00	0.00	0.00
	18.3 Overlay zone with reduced density provisions	0.00	0.00	0.00
	18.4 Dedication of open space for hazards	0.17	0.33	1.94
	18.5 Policy to locate public facilities in zones not subject to hazards	0.17	0.25	1.47
	18.6 Transfer of development rights	0.00	0.00	0.00
	18.7 Cluster development	0.00	0.00	0.00
	18.8 Setbacks	0.08	0.08	1.00
	18.9 Site plan review	0.17	0.17	1.00
	18.10 Special study/impact assessment for development in hazard zones	0.50	0.83	1.66
	18.11 Building standards/ Building code	0.92	1.67	1.82
	18.12 Land and property acquisition	0.83	1.42	1.71
	18.13 Impact fees	0.00	0.00	0.00
	18.14 Retrofitting of private structures	0.67	0.83	1.24
	18.15 Separate hazard mitigation plan	0.25	0.33	1.32
	18.16 Relocation of structures out of hazard zones	0.33	0.42	1.27
	18.17 Drainage ordinance	0.50	0.92	1.84
19. Modeling Technique	19.1 Modeling tools for evacuation	0.00	0.00	0.00
	19.2 Modeling tools for flooding	0.58	1.00	1.72
	19.3 Modeling tools for others (debris etc.)	0.08	0.08	1.00

Table 16 presents the first set of *mitigation policies & actions* subcomponents associated with general policies (17.1-17.2), regulatory tools (18.1-18.17), and modeling techniques (19.1-19.3) which together have 12 planning elements. With respect to general policies, the idea of integrating hazard mitigation and land use by discouraging development (17.1) in hazardous areas is only mentioned by only 33% (4 plans) of plans, although there was more wide spread though still moderate support across plans with 67% (8 plans) of the plans discussing the adoption of new regulatory policies (17.2) at the local level.

However, this finding is rather deceptive, because while there appeared to be at least moderate support for the adoption of "new" policies to address mitigation, there were not many regulatory tools related to newer land use planning incorporated into the mitigation plans examined in this research. Specifically the breadth scores for regulatory tool planning element are generally quite low. In particular, land use policies like low density conservation zones (18.2), overlay zones with reduced density provisions (18.3), transfer of development rights (18.6), cluster development (18.7) and impact fees (18.13) were not even mentioned in any of these plans. In addition, only one plan mentioned setbacks (18.8) and only 2 plans mentioned dedicated open spaces for hazard zones (18.4) and locating public facilities in non-hazard zones (18.5). Instead, 92% (11 plans) of hazard mitigation plans mentioned adopting building standards or building codes (18.11), 82% (10 plans) mentioned acquiring repetitively damaged land and property (18.12), and 67% (8 plans) discussed retrofitting private structures (18.14) and half mentioned special study or impact assessment hazard zones (18.10). The large number of plans that discussed improving building codes and even retrofitting are indeed important, but overall the spectrum of possible mitigation policies, particularly with respect to land use planning is quite narrow and focused, despite general statements suggesting support for new regulatory policies at the local level.

Given the rather narrow focus, it is not surprising that the depth 1 scores, which reflect the general coverage of these elements throughout the coastal management zone, are, on the whole very low, with most substantially less than 1 and often zero or very near zero. The exception was in the important area of building codes, which at least obtained a depth 1 score higher than 1.5. The depth 2 scores suggested that there was some quality among plans that did address rarely mentioned elements, but even with respect to depth 2 scores only 4 of the 17 regulatory tools were addressed with sufficient detail to warrant scores greater than 1.5. In other words, even when mentioned, most of the regulatory tools were not discussed in sufficient detail to garner very high quality scores.

When considering modeling tools, only tools associated with flooding were likely to be mentioned, however even in this case only 7 or 58% of the plans discussed flooding tools. No plan discussed tools for evacuation and only 1 mentioned any other form of modeling

tools. However, in the case of flooding tools, when mentioned, the quality of those discussions was of sufficient specificity to earn a 1.7 across those 7 plans. It should be noted that modeling techniques and tools, can be rather expensive to develop and support, often requiring data and expertise that are difficult to support, particularly in smaller communities. Nevertheless, these tools can range in specificity, such that even more simplistic descriptive tools can facilitate a local communities ability to better understand mitigation needs and generate political support and will to promote local mitigation policies.

The findings with respect to regulatory tools and modeling techniques suggest that there is a potential for substantial improvement in coastal mitigation planning. The relatively low breadth scores suggest that plans tend to focus on only a few types of tools and models to the exclusion of others that may have a good deal of utility. However even when considering those included within these plans, the relatively low depth scores suggest that the discussions are far from detailed and may lack a good deal of specify. These results suggest the need to enhance the breadth of tools and policies potentially employed to improve mitigation. This might be accomplished by better education and awareness programs for those involved with mitigation planning of the variety land use policies, and of tools and models available as well as how these policies and tools might be adapted to the legal environment along the Texas coast.

Table 17 presents the findings for *mitigation policies & actions* associated with floodplain management and both incentive based and structural tools. The majority of the mitigation plans focused on floodplain management/development issues (9 plans or 75%) and floodplain ordinances (8 plans or 67%). Perhaps not surprisingly, with respect to incentive based tools, the majority of plans focused on joining the Community Rating System (CRS) (10 plans or 83%) as well as participating in the National Flood Insurance Program (NFIP) (9 plans or 75%). Unfortunately, very few plans (2 plans or 17%) discussed down zoning or changing zoning to reduce vulnerabilities in areas susceptible to hazard impacts and not a single plan addressed other incentive based tools to promote hazard mitigation such as tax abatements for using mitigation technologies, density bonuses or low interest loans to enhance and promote the adoption of mitigation

technologies. Despite the concentration of so many plans on floodplain management issues and participation in CRS and NFIP, the depth 1 scores are surprisingly low with flood plain ordinance only achieving a score of 1.0, floodplain management only a 1.17, NFIP participation 1.17, and joining the CRS earning a 1.42. None of these reach at least a 1.5 suggesting at least some quality across coastal zone plans. While the depth 2 scores for floodplain management (20.1) and ordinances (20.2), along with participation in the NFIP (21.4) and joining the CRS (21.5) reach at least a 1.5 (after rounding), with the exception of joining the CRS, which had a depth 2 score of 1.71, these scores were not substantially higher suggesting that there is room to improve the quality with which some plans address these issues.

Table 17. Specific Mitigation Policies & Actions:
Floodplain Regulation and Incentive and Structural Tools

Sub-Components	Specific Subcomponent Elements	Breadth (0-1)	Depth 1 (0-2)	Depth 2 (0-2)
20. Floodplain Regulation	20.1 Floodplain management/development	0.75	1.17	1.56
	20.2 Floodplain ordinance	0.67	1.00	1.49
	20.3 Down zoning floodplains	0.17	0.17	1.00
21. Incentive-based Tool	21.1 Tax abatement for using mitigation	0.00	0.00	0.00
	21.2 Density bonus	0.00	0.00	0.00
	21.3 Low interest loans	0.00	0.00	0.00
	21.4 Participation in National Flood Insurance Program (NFIP)	0.75	1.17	1.56
	21.5 Join CRS (Community Rating System)	0.83	1.42	1.71
22. Structural Tool	22.1 Levees	0.25	0.42	1.68
	22.2 Seawalls	0.17	0.25	1.47
	22.3 Riprap	0.08	0.08	1.00
	22.4 Bulk heads	0.08	0.08	1.00
	22.5 Detention ponds	0.50	0.75	1.50
	22.6 Channel maintenance	0.58	0.83	1.43
	22.7 Wetland restoration	0.08	0.08	1.00
	22.8 Slope stabilization	0.25	0.33	1.32
	22.9 Storm water management	0.67	1.33	1.99
	22.10 Sewage	0.50	0.75	1.50
	22.11 Drainage	0.83	1.58	1.90
	22.12 Maintenance of structures	0.67	1.33	1.99

Structural solutions to hazards focus on modifying the physical environment through the creation of some form of structure that will reduce the exposure to hazard. Employing structural tools or technologies has long been the dominate hazard mitigation policy and program in the United States and are still essential elements of choice for achieving

hazard mitigation in coastal Texas. Of the 12 structural tools, the majority of mitigation plans mentioned 5 structural tools generally associated with flooding such as drainage (10 plans or 83%), storm water management (8 plans or 67%), channel maintenance (7 plans or 58%), detention ponds (6 plans or 50%) and sewage (6 plans or 50%), as well as the overall maintenance of these structures (8 plans or 67%). Despite the clear focus on flooding hazards, of particular concern, is that only one plan directly addresses wetland restoration (22.7) as a mitigation tool, despite a growing literature that suggests that wetland protection can have substantial benefits at reducing lives and monetary losses in coastal Texas (Brody, Zahran, Highfield, Grover, and Vedlitz 2007; Brody, Zahran, Maghelal, Grover, and Highfield 2007; Zahran Brody Peacock, Vedlitz and Grover 2008). Three structural mitigation technologies generally associated with coastal areas (seawalls, riprap, and bulkheads) along with levees are mentioned but only in 3 or fewer plans.

With the exception of drainage which had a depth 1 score of 1.58, all other structural planning elements had depth 1 scores that were less, often substantially less, than 1.5. This perhaps is not surprising given the relative dispersion of plans across structural planning element, with relatively few elements mentioned by a majority of the plans evaluated. Nevertheless, this does suggest relatively low quality across the coastal management zone for these elements. In contrast to the depth 2 scores achieved for floodplain regulation and incentive based tools, the scores achieved for a number of these structural planning elements suggests a good deal of detail paid to these tools when mentioned in specific plans. In this case 7 of the twelve planning elements have depth 2 scores over 1.5, with those for storm water management, maintenance, and drainage falling in the 1.9 range, suggesting high quality. The combination of relatively even and moderate breadth, low depth 1 scores, with relatively high depth 2 scores reflects the fact that structural tools are utilized unevenly and when included as part of a plan tend to have very detailed discussions. Unfortunately, it should also be noted that the one plan that does indeed addresses wetland restoration, does so without much detail resulting in a depth 2 score of only 1.0.

Table 18. Specific Mitigation Policies & Actions: Awareness/Educational, Social Consideration and Public Facilities and Infrastructure Tools

Sub-Components	Specific Subcomponent Elements	Breadth (0-1)	Depth 1 (0-2)	Depth 2 (0-2)
23. Awareness/ Educational tool	23.1 Awareness program for community	1.00	2.00	2.00
	23.2 Education/Awareness for staff	0.75	1.33	1.77
	23.3 Educational/awareness for private stakeholders (industry, business, or homeowners etc.)	0.75	1.25	1.67
	23.4 Education/Awareness for students	0.42	0.50	1.19
	23.5 Real Estate Hazard Disclosure	0.08	0.17	2.00
	23.6 Disaster warning and response program	0.75	1.33	1.77
	23.7 Posting of signs indicating hazardous areas	0.42	0.75	1.79
	23.8 Technical assistance to developers or property owners for mitigation	0.33	0.33	1.00
	23.9 Maps of areas subject to hazards	0.75	1.42	1.89
	23.10 Inclusion of floodplain boundaries	0.00	0.00	0.00
	23.11 Education and training in several languages	0.08	0.17	2.00
	23.12 Hazard information center	0.08	0.08	1.00
24. Social Consideration	24.1 Identification of special needs population and preparedness of assistance	0.58	1.00	1.72
25. Public Facilities and Infrastructure	25.1 Capital Improvements Plan based on hazard analysis	0.75	1.17	1.56
	25.2 Retrofitting public structure	0.58	0.83	1.43
	25.3 Retrofitting critical facilities	0.75	1.00	1.33

Table 18 presents the findings with respect to awareness/education programs (23.1-23.12), consideration of social vulnerable populations (24.1) in mitigation and public facilities/infrastructure (25.1-25.3). All of mitigation plans mention public awareness programs for the community (12 plans or 100%) and almost all plans included education programs for staff (9 plans or 75%) and private stakeholders (9 plans or 75%) as well as maps of hazard areas (9 plans or 75%) and disaster warning and response education programs (9 plans or 75%). Fewer programs mentioned education program for students (5 plans or 42%), posting hazard signs for the public (5 plans or 42%) or technical assistance on mitigation for developers and property owners (4 plans or 33%). Very few programs discussed conducting education in other languages (1 plan or 8%) despite Texas' multi-lingual population and very few plans discussed real estate disclosure as a form of public education and awareness (1 plan or 8%). The depth 1 score was a perfect 2 for public education programs in general, but substantially less for most other programs or planning elements, with 7 falling below 1 and none reach even a 1.5. These relatively low scores, particularly for planning elements mentioned by a sizable proportion of the

plans evaluated, suggest poor quality coverage throughout the coastal management zone. Nevertheless, if a plan did mentioned some form of education/awareness program, then the depth 2 scores tended to be high. Indeed there were 3 perfect 2s for community education programs in general, multi-lingual programs, and for real-estate disclosures and 5 other tools had depth 2 scores greater than 1.6. Interestingly 7 plans (58%) did consider special need populations in their mitigation initiatives, and when these programs are mentioned, they tend to be discussed in detail (dept 2 = 1.72). Overall then, there was good breadth for many education program in general, but some programs that are often mentioned, at least anecdotally, as being effective such as education/awareness programs in schools, public signs that can clearly demarked hazard area raising the public's awareness, and real-estate disclosure are rarely mentioned in hazard mitigation plans.

Relatively large percentages of plans considered capital improvements (25.1) and retrofitting (25.3) as part of their mitigation plans. Specifically, 9 plans (75%) discuss undertaken capital improvements based on hazard analysis and also considered undertaking retrofitting critical facilities. In addition 7 plans (58%) also discuss retrofitting public structures (25.9) as mitigation actions. Undertaking these forms of mitigation can potentially accomplish two important things. First, they have the potential of reducing losses if there is a disaster event and hence make the community more resilient. Secondly, if properly publicized they can also serve as important public awareness programs leading by example on why and how mitigation is important. Nevertheless, despite the relatively high breadth scores, the depth 1 scores were all low, hovering around 1, suggesting very little quality in coverage throughout the coastal management zone. Even more disconcerting, when considering the depth 2 scores, only one planning element, capital improvements based on hazard analysis, was just above 1.5 suggesting little real development of these elements within mitigation plans. These low depth 1 and 2 scores suggests that there is significant room for improvement, particularly with respect to the quality in which these planning elements are addressed in mitigation plans.

Table 19 displays the breadth and depth scores for the final set of *mitigation policies and actions* which are related to recovery planning (26.1-26.6), emergency preparedness

(27.1-27.6), and natural resource protection (28.1-28.5). In the aftermath of Hurricane Ike and its impacts on the greater Houston and Galveston areas, particularly Galveston Island, it should perhaps be easier to understand the salience of considering mitigation issues within recovery planning. Generally in the aftermath of a disaster it is often difficult to consider mitigation actions when facing the multitude of demands and needs that must be met to get a community up and on the road toward recovery (Peacock, Morrow, and Gladwin 1998). However it can be an extremely important period to consider mitigation because otherwise a community under the pressure to move quickly toward recovery efforts may make the same mistakes that led to its high levels of vulnerability in the first place (Smith and Wenger 2006). In short, without thoughtfully considering mitigation long before a disaster event, communities are likely to repeat the same mistakes that led to earlier disasters.

Table 19. Specific Mitigation Policies & Actions: Recovery Planning, Emergency Preparedness and Natural Resource Protection

Sub-Components	Specific Subcomponent Elements	Breadth (0-1)	Depth 1 (0-2)	Depth 2 (0-2)
26. Recovery Planning	26.1 Land use change	0.00	0.00	0.00
	26.2 Building design change to meet enhanced safety standards	0.00	0.00	0.00
	26.3 Moratorium	0.00	0.00	0.00
	26.4 Recovery organization	0.17	0.17	1.00
	26.5 Private acquisition	0.00	0.00	0.00
	26.6 Financial recovery	0.00	0.00	0.00
27. Emergency Preparedness	27.1 Evacuation	0.58	0.92	1.59
	27.2 Sheltering	0.33	0.58	1.76
	27.3 Contingency plan/preparedness plan	0.50	0.83	1.66
	27.4 EOC (Emergency Operation Center)	0.42	0.75	1.79
	27.5 Require emergency plans	0.25	0.42	1.68
	27.6 Purchasing rescue materials & other equipment	0.75	1.42	1.89
28. Natural Resource Protection	28.1 General description of best management practice	0.08	0.08	1.00
	28.2 Forest and vegetation management riparian areas	0.08	0.08	1.00
	28.3 Sediment and erosion control	0.33	0.50	1.52
	28.4 Stream dumping regulations	0.00	0.00	0.00
	28.5 Urban forestry and landscape	0.25	0.25	1.00

The results in Table 19 do not bode well for pre-event mitigation planning of actions that should be considered within recovery processes. Of the six mitigation actions that are assessed as part of this sub-component, only one, identifying organizations likely to be involved in recovery planning, was addressed by any of the 12 plans evaluated and even

then it was only addressed by 2 plans (17%). Furthermore, the two plans only minimally discussed this issue rating an average depth 2 score of 1. Mitigation actions such as considering land-use changes in response to a disaster (26.1), building code changes (26.2), development moratoria (26.3) in highly vulnerable areas, addressing the problems of financing recovery (26.6), and considering the potential for acquisition of private holdings (26.5) to move development away from high hazard areas were not considered by any mitigation plans at all. Clearly, there is major room for improvements within the context of mitigation planning within recovery.

While few if any plans addressed mitigation during recovery, the picture that emerged with respect mitigation in the context of 6 emergency preparedness planning elements was considerably different. The most often addressed mitigation action was the advanced purchasing of rescue materials and equipment (9 plans or 75%). Additional actions considered included evacuation planning (7 plans or 58%), contingency planning (6 plans or 50%), establishing and emergency operations center (EOC) (5 plans or 42%), planning for sheltering (4 plans or 33%), and emergency planning (3 plans or 25%). Not surprisingly, given the breadth pattern for these planning elements, the depth 1 scores were, with the exception of rescue materials and equipment, were quite low. However, what is most interesting and unlike earlier patterns, the depth 2 scores indicate that on average if a plan addressed one of the emergency preparedness issues as a mitigation action they were addressed with sufficient detail that the average scores were all above 1.5, ranging between 1.66 and 1.89.

The last mitigation policy and action sub-component assessed 5 planning elements associated with natural resource protection (28.1-28.5). As briefly mentioned above with respect to wetland preservation, the literature has increasingly called for the consideration of preserving natural environmental resources, rather than introducing structural mitigation technologies to enhance resilience. Dependence on structural mitigation, such as levees can actually promote development in hazard prone areas, while preserving natural resources enhances the capabilities of these naturally occurring resources to mitigate against hazards and better ensures that development is kept out of harm's way. Unfortunately the five planning element assessed have very low breadth scores indicating

that very few plans address these issues. At the high end, only 4 plans (33%) discussed sediment and erosion control (28.3), followed by 3 plans (25%) that address urban forestry and landscaping (28.5). Only one plan (8%) actually addressed best management practices (28.1) with respect to resource protection and forest/vegetation management in riparian zones (28.2), while none of the plans addressed the regulation stream dumping (28.4). Given the very low percentages of plans that addressed these issues it should not be surprising that the depth 1 scores were extraordinarily low. But, even more unfortunate are the low depth 2 scores for almost all of these planning elements suggesting that even when addressed, these elements are only addressed in a superficial manner reflecting low quality. Only the depth 2 score for sediment and erosion control (28.3) reaches 1.5, while the others are either at 1 or 0. In sum natural resource protection which can insure the ability of natural mitigation features servicing communities with respect to hazard mitigation, is of little consideration in coastal hazard mitigation planning, and even when addressed, the plans really do not incorporate these element in a quality manner, leaving much to be desired. Planners and officials in the coastal areas should be well aware of the importance of natural resource protection not only to protect ecosystem, but also to mitigate against potential hazard impacts. However, the integration of the environmentally sensitive area protection policies into actual plans is not being realized in these coastal mitigation plans. Planners, emergency managers and consulting firms who participate in plan making as well as federal and state officials who can provide guidance to local hazard mitigation planning, should seek to incorporate natural resource protection and ecosystem management actions for achieving hazard mitigation.

4.2.7. Component 7: Implementation

The final component assessed in this analysis focuses on plan *implementation*. There are two sub-components. The first sub-component assesses 9 planning elements associated with the general implementation processes and mechanisms (29.1 – 29.9) and the second focuses on 4 planning elements assessing the evaluation, updating, and monitoring (30.1-30.4) the mitigation plan. In marked contrast to recent assessments above, with the exception of a few planning elements, most of these planning elements have high breadth scores suggesting that most of elements are broadly addressed across the 12 mitigation

plans. Focusing first on general implementation it can be seen that 83% (10 plans) of the plans offered a description of the process, identify processes for assisting local governments, identify the cost for implementation and offer a time table. In addition, all plans (100% or 12 plan) identify responsibility for implementation and 92% (11 plans) identify funding sources. Similarly with respect to evaluation, updating, and monitoring, all plans offer a description of this process and designate responsibility and 92% (11 plans) also identify participants in the evaluation. Where these plans fall short, however is addressing the provision of technical assistance for implementation, where only 25% (3 plans) discuss this issue, the actual evaluation of funded project, where only 17% (2 plans) addressed the issue, enforcement, where only 8% (1 plan) addressed the issue, and no plan addressed the issue of the provision of sanctions for failure to carry successfully implement mitigation actions.

Table 20. Implementation

Sub-Components	Specific Subcomponent Elements	Breadth (0-1)	Depth 1 (0-2)	Depth 2 (0-2)
29. Implementation	29.1 Description of implementation process	0.83	1.58	1.90
	29.2 Identification of process for prioritizing assistance to local governments	0.83	1.50	1.81
	29.3 Clear designation of responsibility for implementation	1.00	1.50	1.50
	29.4 Provision of technical assistance for implementation	0.25	0.33	1.32
	29.5 Identification of costs for implementation	0.83	1.25	1.51
	29.6 Identification of funding sources	0.92	1.42	1.54
	29.7 Provision of sanctions	0.00	0.00	0.00
	29.8 Clear time-table for implementation outlined	0.83	1.08	1.30
	29.9 Enforcement related issues	0.08	0.08	1.00
30. Evaluating, Updating and Monitoring	30.1 Description of evaluation/monitoring process	1.00	1.67	1.67
	30.2 Identification of participants in the evaluating process	0.92	1.42	1.54
	30.3 Clear designation of responsibility for evaluating, updating and monitoring process	1.00	1.50	1.50
	30.4 Evaluation of funded mitigation projects	0.17	0.17	1.00

Given the relatively high breadth scores for many of these planning elements, it might be expected that they would also have relatively high depth 1 scores reflecting good quality coverage throughout the coastal management zone. In total, 5 of the 13 elements had depth 1 scores of 1.5 or greater. Three of the 5 elements addressed implementation and 2 focused on the evaluation process. The two highest scores were the two elements

associated with the general description of the evaluation, updating and monitoring processes (30.1), which achieved a depth 1 score of 1.67, and the general description of the implementation process (29.1) itself which scores a 1.58. The remaining 3 elements that achieved scores of 1.5 were those addressing prioritizing implementation assistance (29.2) and establishing responsibility for the implementation (29.3) and evaluation (30.3). Unfortunately the elements defining the actual provision of technical assistance (29.4), enforcement (29.9), sanctions (29.7) and the specification of the evaluation of funded mitigation projects themselves (30.4) had very low depth 1 scores, reflecting limited quality throughout the coastal management zone.

Eight of the 13 planning elements had depth 2 scores that were 1.5 or above with the general description of the implementation process achieving the highest average score of 1.9 for the 10 plans that included this element. On the whole, for the majority of the plans that included specific elements produced overall descriptions of both the implementation (29.1) and evaluation (30.1) processes that were of high quality and there was usually good quality of detail in the specifications of responsibility for both the implementation (29.3) and evaluation processes (30.3). Plans generally did a good job of identifying cost (29.5), funding sources (29.6), as well as prioritizing assistance in implementation (29.2) and participation in evaluations (30.2). However, there is a need to provide more detail with respect to time tables (29.8) and the actual provision of technical assistance (29.4) in the implementation. Even more importantly, much greater detail is needed when it comes to specifying the actual evaluation of funded projects (30.4), enforcement of guidelines (29.9) and sanctions (29.7).

In sum, with respect to the 13 planning elements associated with plan implementation and evaluation there was broad coverage with at least 10 of the 12 plans addressing 9 of these elements within their plans. And, when addressed, most plans offered a good deal of detail in their discussions that should help ensure guidance in the implementation of the mitigation plans and subsequent evaluation, monitoring and updating. Overall, however, there is a need to focus on specific details associated with technical assistance and the evaluation of actual funded projects, enforcement of the plan, and possible sanctions.

4.2.8. A Brief Summary of Planning Element Analysis

The above provides an extremely detailed analysis of the 164 planning elements associated with the seven key mitigation planning components. The final section of this report will give a more detailed, yet concise, summary of the above findings. But it may be worthwhile capturing a very broad overview of the findings before trying to provide a general set of conclusions. To assist in capturing this overview, Table 21 presents the basic descriptive statistics for the breadth and depth results across the planning elements. Beginning with the breadth scoring, it can be seen that on average the 152 planning elements for which breadth scores were calculated[14] were addressed on average by 46.7% or 5.6 plans with a median value of 50% which is, of course, equivalent to 6 plans. Interestingly only 11 or 6.7% of the planning element were actually addressed by all 12 plans and 22 or 13.4% of the planning elements were not addressed by any of the plans. However, 142 or 86.6% of all planning element were at least addressed by one of the 12 plans.

Table 21. Descriptive Statistics for Breadth and Depth Scores

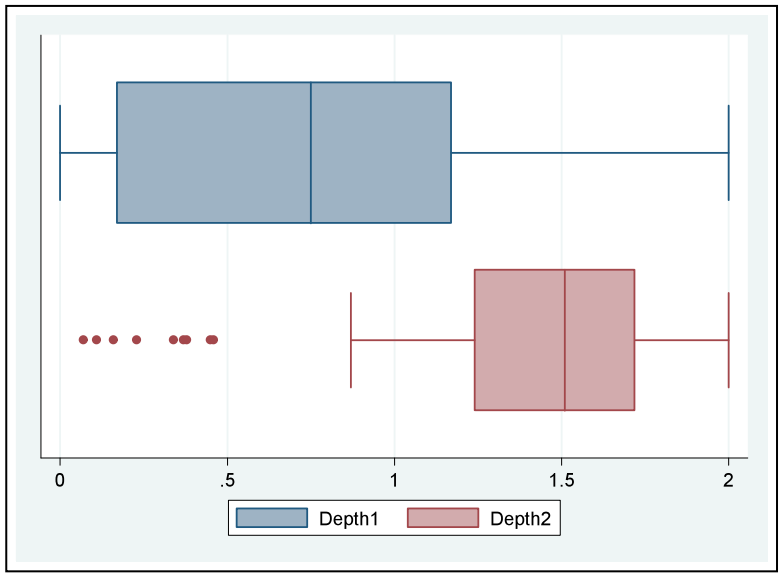
Statistic	Breadth	Depth 1	Depth 2
Mean	.467	.723	1.43
Median	.50	.750	1.51
S.D.	.336	.57	.43
N	152	164	142

There are, as one might expect given the analysis in the previous section, considerable differences when comparing the descriptive statistics for depth 1 and depth 2 scores. As was consistently seen above, depth 1 scores tended to be lower than depth 2 scores. A primary factor contributing to these lower scores was the fact that many plans did not address a given planning element, indeed as was just shown, on average only 5.6 plans addressed any given planning element. If all plans addressed actually addressed an item,

[14] It will be recalled that breath scores were not calculated for the 12 planning elements assessed across the 11 common natural hazards. Hence, there were only 152 planning elements for which the average is calculated. Similarly, there are technically only 142 planning elements for which depth 2 scores were calculated since there were 22 planning element not addressed by any plan.

then scores would of course rise. Indeed, examination of the descriptive statistics for depth 2 scores shows that for the 142 planning elements that were addressed by at least one plan, the average depth 2 score was 1.43 and the median value was 1.51. The median suggest that at least 50% of all the planning element had an average depth 2 of just slightly better than 1.5. Furthermore, the 75 percentile for depth 2 scores was 1.7, which indicated that at least 25% of the planning elements had depth 2 scores of 1.7 or better. Figure 2 offers box plots for depth 1 and depth 2 scores. As can be clearly seen the overall dispersion of depth 1scores is much greater than depth 2 scores, however the lion's share of these scores are below 1. Some of the depth 2 scores are below 1 because of the 12 planning elements that assessed depth over the 11 common hazards, resulting in some of these planning elements being substantially less than 1. However, the lion's share of depth 2 scores are substantially above 1, with over half above 1.5. Assuming that future iterations of mitigation plans become more comprehensive and address more of the planning elements included in the protocol, it can be expected that through time, as mitigation plans improve. These improvements would be reflected in the graph by the boxes shifting further to the right and eventually converging.

Figure 2: Box Plots for Depth 1 and Depth 2 Scores.



4.3 Analysis of Proposed Mitigation Actions

The final step in evaluation of these mitigation plans is an examination of the different types of mitigation actions proposed for future funding by the various jurisdictions participating in the twelve mitigation action plans. The analysis of these actions provides additional insights into the nature of and tendencies toward the types of actions actual planned for and proposed by communities for implementation. In the analysis above there were clear patterns regarding the types of planning elements were addressed and the quality of the discussions. For example, as see above, the mitigation plans tended to focus on flooding issues, address certain types of structural tools, educational/awareness tools, while rarely addressing natural resource protection issues. These patterns suggest that the types of actions will tend to target similar types of tools or actions. Hence, this analysis will also provide additional clues regarding the types of mitigation actions that are being proposed.

As discussed above, the 12 plans examined in this research represent three different types of plans, regional, county and city plans. The regional and county plans actually include multiple jurisdictions participating in and are covered by these plans. Table 22 displays the numbers of jurisdictions participating in and therefore covered by each of the 12 plans. As can be seen in Table 22, there were a total of 130 coastal jurisdictions that included 18 counties and 112 municipalities.

Table 22. Plans and Participating Coastal Jurisdictions

Plan Name	Coastal jurisdictions
HGAC Plan	3 counties and 35 municipalities
TCRFC Plan	1 county and 2 municipalities
GBRA Plan	3 counties and 8 municipalities
CB Plan	4 counties and 9 municipalities
RGB Plan	3 counties and 16 municipalities
Harris County Plan	1 county and 21 municipalities
Jackson County Plan	1 county and 3 municipalities
Orange County Plan	1 county and 7 municipalities
Jefferson County Plan	1 county and 8 municipalities
City of Houston Plan	0 county and 1 municipality
City of Pearland Plan	0 county and 1 municipality
City of Friendswood Plan	0 county and 1 municipality
Total	18 counties and 112 municipalities = total 130 Jurisdictions

As part of the examination of these plans, a detailed listing of mitigation actions proposed by each jurisdiction was compiled. In total there were 836 mitigation actions proposed by the 130 jurisdictions participating in the twelve mitigation plan. Of these, 814 were clearly identified specific actions. In addition there were 22 proposals that specified multiple actions or activities. After developing the list of actions proposed by each jurisdiction, the proposed single mitigation actions were classified into one of five mitigation action categories. The specific categories of actions or tools were: 1) Education & Awareness, 2) Regulatory, Planning & Research, 3) Structural, 4) Emergency Response, and 5) Natural Resource Protection. Table 23 displays these categories with examples of the mitigation actions that are categorized within each.

Table 23. Mitigation Policies & Action Categories

Education/Awareness Actions • Awareness and education program for community, private stakeholders and students • Training for city staff etc. • Developing education brochures, pamphlet and materials • Creating maps
Regulatory/Planning/Research Actions • Developing and updating plans or ordinances • Conducting research or studies regarding risk assessment, impact assessment or advance technology. • Using zoning, urban design and property acquisition tools. • Participation in NFIP or CRS
Structural Actions • Building or maintaining structures such as levees, seawalls, detention facilities, or storm water management facilities etc. • Retrofitting or strengthening structures
Emergency Actions • Emergency shelter, evacuation • EOC (Emergency Operation Center) • Purchasing rescue materials or ambulance • Improving and preparing emergency warning and response system
Natural Resource Protection Actions • Vegetation, or forestry conservation • Dune conservation • Wetland conservation • Stream dumping regulations

Table 24 presents the basic frequencies and descriptive statistics for the mitigation actions proposed by the 130 jurisdictions involved in the 12 mitigation plans. The data are broken down into the single and multiple action categories and into the more detailed hazard mitigation categories that correspond to those employed in the hazard mitigation planning protocol. In addition the means or averages for the different types of mitigation

actions across the 130 jurisdictions and for the 18 county and 112 city jurisdictions are also presented.

Table 24. Mitigation Actions

	Min.	Max.	Freq.	Percent	Overall Means	County Means	City Means
Total Mitigation Actions	1	37	836	100.0	6.43	8.22	6.14
Single Actions	1	36	814	97.4	6.26	7.88	6.00
Multiple Actions	1	5	22	2.6	0.17	0.33	0.14
Mitigation Action Categories:							
Education/Awareness	0	15	117	14.4	0.90	1.44	0.81
Regulatory/Planning/Research	0	12	210	25.8	1.62	2.11	1.54
Structural tools	0	19	280	34.4	2.15	1.94	2.19
Emergency tools	0	14	196	24.1	1.51	2.17	1.40
Natural resource protection	0	2	11	1.4	0.08	0.22	0.06

As can be seen from the results displayed in Table 24, there were again 836 mitigation actions proposed by the 130 jurisdictions. The maximum number of mitigation actions proposed by any one jurisdiction was 37 and the minimum was 1, with an average of 6.43 mitigation actions proposed by each jurisdiction. There were some variations between counties and cities with respect to the number of actions proposed. On average the number mitigation actions proposed by the 18 counties was 8.22, while municipalities propose on average 6.14 actions. Of the 814 single mitigation actions proposed, 280 or 34.4% were related to structural tools or actions such as the funding of storm water management facilities, detention ponds, drainage facilities, as well as levees and seawalls. On average there were 2.15 of these types of actions proposed across the 130 jurisdictions, with cities proposing slightly more of these actions on average (2.19 actions) than counties (1.94 actions). The second largest number of actions at 210 or 25.8% had to do with regulatory/planning/research tools. Interestingly counties proposed slightly more than cities, although counties can be limited on the types of policies they can successfully implement in Texas. The numbers of regulatory, planning and research tools were followed closely by emergency management tools at 196 or 24.1%. Again, there were some variations with counties proposing more of these actions (2.17 actions) on average than cities (1.4 actions). Education and public awareness actions represented 117 or 14.4% of propose actions, with counties more likely to mention these types of actions (1.44 actions) when compared to cities (.81 actions). By far, the smallest number of proposed

mitigation actions had to do with natural resource protections. There were only 11 such actions proposed, representing only 1.4% of the proposed actions addressing these issues. While both cities and counties were not likely at all to mention these types of actions, counties were on average (.22 actions) slightly more likely to include these types of actions than were cities (.06 actions).

It is perhaps not surprising that structural tools are by far the most often mentioned mitigation actions proposed by these mitigation plans for as discussed above, structural or technological solutions to hazards have been the most often considered types of mitigation actions nationally (Burby 1998, Mileti 1999, and Godschalk et al., 1999). Interestingly, this tendency is more pronounced among city plans where the average number of was the highest across the five action areas considered. While cities proposed on average 2.19 structural actions, the next highest average was regulatory/planning/research at only 1.54 and then emergency tools at 1.4. For counties on the other hand, the highest average number of actions related to emergency tools at 2.17, followed by regulatory, planning and research tools at 2.11, and then structural actions at 1.94. These results suggest that cities are slightly more focused on structural solutions when compared to counties. In fairness to cities, it may well be that they are dealing with much more confined areas, with more impermeable surfaces due to concentrated development, and hence are more targeted at addressing problems with structural solutions. Nevertheless, many of the cities participating in these plans are not highly developed, concentrated urban areas, and it may well be that nonstructural approaches do offer possible solutions.

Returning to the overall findings, while structural tool and actions do have the highest overall frequency and average, they clearly were not the only types of mitigation actions being proposed. Indeed, regulatory/planning/research tools were only about 9 percentage points behind and they were followed quite closely by emergency management related mitigation actions. However, it should be noted that relative large numbers of the regulatory/planning/research actions were related to flooding issues by jurisdictions seeking to better insuring participation in the NFIP and their CRS rating and not necessarily related to broader land use issues and perhaps even hazards. The fact that

slightly more than a quarter of all actions are in the areas related to promoting hazard planning and regulatory policies does suggest some openness to alternative approaches to mitigation. Unfortunately, resource protection issues, such as dune and wetland conservation, forest and vegetation protection in riparian areas, as well as prompting more urban forestry and hazard mitigation landscape features are rarely considered or proposed mitigation actions.

5. Summary and Discussion

The purpose of this report is to provide a comprehensive assessment of FEMA approved hazard mitigation action plans developed for and being implemented in areas located in the Texas Coastal Management Zone. Specifically, this report offers an evaluation of twelve hazard mitigation plans that include three municipality plans, four county plans and five regional plans. Together these plans were developed to shape mitigation policies and actions in a total of 130 jurisdictions composed of 18 counties and 112 municipalities located in Texas's Coastal Management Zone.

The goal in undertaking these assessments was not simply to replicate FEMA's approval process but rather to undertake a systematic analysis of current mitigation action plans, based on the most recent scientific literature on plan evaluation and hazard mitigation. This assessment is designed to provide feedback to the various constituencies, stakeholders, and jurisdictions involved in developing future versions of these and other mitigation plans. That feedback focuses on identifying the relative strengths of these plans as well as areas that should be improved upon as these plans evolve. The hope is that by improving mitigation planning and subsequent mitigation actions, communities in Texas's coastal management zone can significantly enhance their abilities to reduce the loss of life, property, and natural resources.

To undertake this assessment a comprehensive hazard mitigation plan protocol was developed based on FEMA guidelines and the research literature on plan evaluation and hazard mitigation. FEMA guidelines specify four plan components (*planning process, risk assessment, mitigation strategy,* and *plan maintenance*), composed of 15 sub-

components, and 32 planning element upon which all hazard mitigation plans were evaluated. The protocol developed for this research recognized and targeted seven plan components: *1) vision statement, 2) planning process, 3) fact basis, 4) goals & objectives, 5) inter-organizational coordination, 6) policies & actions, and 7) implementation.* These seven components have been divided into 30 sub-components which in turn were composed of 164 planning elements. Plans were scored based on these 164 planning elements which were evaluated by first determining if a plan dealt with each of these elements and second, if addressed, the level of detailed and direction with respect to each element was assessed. The explicit assumption was that the greater the detail and guidance in an element's assessment, the higher the quality displayed by the plan. Based on this scoring scheme, individual plans were assessed in terms of their total raw score and standardized plan and component quality scores (*PQS* and *CQS* respectively) which ranged between 0 and 100. In addition, each planning element was evaluated across all 12 plans in terms of the proportion (or percentage) of plans that actually discussed each element and how well each was addressed on average across all twelve plans and across those plans that explicitly addressed the element. The following provides a brief discussion of major findings.

5.1 Overall Plan and Component Quality Assessments

When assessed against a comprehensive planning protocol based on the FEMA guidelines and the research literature on plan quality and mitigation, the average plan quality score (*PQS*) was only 41.6 on a 100 point scale, with a high of 53.3 and a low of 28.7. Regional and county plans appeared to display slightly higher plan quality scores than did city plans. With respect to the seven plan components a number of plans had component quality scores (*CQS*) at or above 70%, but the averages for these components were at best just slightly above, but usually well below 50. *Implementation* had the highest average *CQS* at 51.9, followed closely by *planning process* at 51.7, *goals & objectives* at 45.5, *inter-organization coordination* at 42.2, and *vision statement* at 38.3. Most disconcerting of all were the very low component quality scores for *fact basis* at *33.6* and mitigation *policies & actions* at only *28.2*. These two components are at the heart of mitigation actions plans for they define the nature of the hazards, risks and

vulnerabilities faced by jurisdictions and the types of mitigation policies and actions that should be undertaken with mitigation funding in response to those risks and vulnerabilities. These relatively low scores *PQS* and *CQS* results suggest that there are significant areas of potential improvement that should be undertaken in future iterations of mitigation hazard action plans.

5.2 Detailed Planning Element Analysis

Following the general assessments of the overall plans and the seven key components, a very detailed assessment of each of the 164 planning element associated with the seven principle planning components was undertaken. The following is a summary of the major findings with respect to each of the primary seven components and their associated planning elements:

- *Vision Statement:* In general, planning elements associated with the *vision statement* component are addressed by nearly 70% of mitigation plans; however, they are addressed only minimally, resulting in somewhat low quality measures for the depth of coverage throughout the coastal zone. While not an absolutely critical component of a mitigation plan, this element can be important to insure "buy-in" by various constituencies and stakeholders, as well as motivating participation and political will. These can be critical for the overall success and implementation of a plan.
- *Planning Process:* The *planning process* component was one of the higher scoring components in the plan analysis, yielding a *CQS* of 51.7%. Not surprisingly detailed analysis of the 10 planning elements associated with this component found that most plans incorporated detailed discussions of the planning process undertaken for the development of their plans, and techniques such as open meetings, surveys, websites and even workshops were widely employed and well described. However techniques such as formal public hearings, citizen advisory committees and interview with key stakeholders are not widely employed and yet may increase broader public involvement and more significant input.

- *Fact Basis:* A plan's *fact basis* is critical for laying the foundation of mitigation analysis for it analyzes hazard exposure, vulnerabilities and risks. Unfortunately the *fact basis* component earned the second to the lowest *CQS* of only 33.6%. The detailed analysis of planning elements associated with the sub-components (*hazard identification, vulnerability assessment, risk analysis and emergency management*) in this *fact basis* component area do not lessen the concerns expressed above, but they do provide some additional guidance. First, on the positive side, most plans include and produce relatively high quality scores for general *hazard identification* planning elements. In other words, the general picture with respect to the hazards areas are exposed to and their general profiles are good. Unfortunately the same cannot be said for the other sub-component areas:
    - When considering a common set of eleven natural hazards (hurricane, floods, tornadoes, hail, winter storms, wildfire, thunderstorms, drought, heat, earthquakes, and coastal erosion) the planning elements associated with the delineation and history of hazards, vulnerability assessment and risk analysis achieved consistently low depth scores suggesting little planning detail in addressing these eleven hazards across all plans.
    - When focusing more narrowly on hurricane and flood hazards separately, the result showed a mark improvement with hazard delineation and vulnerability assessments related to property, but still yielded low depth scores for population, infrastructure and, at times, critical facility vulnerability assessments. Narrowing the hazard focus had no consequences for risk analyses, for these elements still had very low depth scores.
    - On the whole, these results suggest the need to target mitigation planning efforts to better address vulnerability assessments, particularly assessments associate with social, population, public infrastructure and critical facilities vulnerabilities, as well as risk assessments across the board. While particular attention needs to be extended to all major natural

hazards, even the more frequently encounter hazards of flooding and hurricanes, should not be ignored.

- *Mitigation Goals & Objectives:* When addressing the *mitigation goals & objectives* component, mitigation plans tend to focus on important public interest issues, particularly promoting public safety and hazard awareness programs, and reducing economic impacts, at least in terms of losses. Much less prevalent in these plans were goals related to reducing impacts and protecting environmental resources which should go hand in hand with promoting safety and reducing economic impacts in the long run. While those plans that discussed these issues did included a good deal of detail addressing these goals, , the combination of a limited number that did address them and the narrow focus on a limited set of these goals resulted in relatively poor coverage of these mitigation planning issues throughout the coastal management zone. These limitations were particularly pronounced for the goals of reducing environmental the impacts and promoting and protecting environmental resources.
- *Inter-Organizational Coordination & Capabilities:* On the whole large proportions of these plan addressed basic issues of coordination among organizations and between mitigation plans and other planning efforts. However the issues of mitigation planning capacity development was not pervasive and need to be better addressed. In addition, conflict management, which can be critical to insure coordinated community efforts in mitigation planning and implementation, was not addressed by a single plan. It may well be that when focusing and considering how to expend limited potential resources, issues like building capacity were not seen as important. In other words, the issue may be, "why spend on building organizational capacities and skill sets, when storm water management is more important, life threatening, and helpful at addressing NFIP and CRS issues." Facilitating and targeting capacity development may well be an area that the TGLO can be particularly helpful in promoting.
- *Mitigation Policies & Actions*: The heart of a mitigation plan addresses the policies and actions that should be undertaken in an area, given a jurisdiction's hazard exposure, vulnerabilities, and risks. In light of its centrality and importance,

the protocol for this component was the most comprehensive and detailed. Unfortunately, the results suggest that like *fact basis,* this component also had a very low, indeed, the lowest component quality score (*CQS*). Scoring only 28.2 out of 100. In truth, given the comprehensive nature of the protocol associated with this component, there was a likelihood that *CQS* would have been low in the first place, simply because it can be difficult for plans to address all planning element associated with this component. Indeed, an argument might be made that some planning elements may not be as relevance or salience for some jurisdictions as others. Nevertheless, on the whole, the majority of the planning elements have relevance particularly since the focus was on mitigation issues of relevance for coastal hazards and areas. Furthermore mitigation plans should be more comprehensive, not narrowly focused, in order to insure their effectiveness. Hence a more comprehensive assessment tool will better capture broader based plans. Following the discussion above, this summary also addresses ….

- *General policies, regulatory tools and modeling techniques*: While there was at least moderate (67%) support for adopting new regulatory, the nature of the regulatory tools under consideration was, for the most part limited to building codes and standards (92%), land and property acquisition (82%), and retrofitting private structures (67%). These are very important. However, additionally important land use policies like low density conservation zones, overlay zones, transfer of development rights, cluster development, impact fees, setbacks, dedicated open spaces for hazard zones and locating public facilities in non-hazard zones were mentioned by two or fewer plans.
- *Floodplain regulation, incentive based tools and structural tools*: A relatively large percentage of plans addressed floodplain management (75%) and ordinances (67%) as well as incentive based approaches such as participation in the National Flood Insurance Program (75%) and joining the Community Rating System (83%). In addition when addressed by a plan, the discussions of these planning elements displayed good detail and hence quality. Unfortunately additional incentive based tools such as

tax abatements, density bonuses, etc were not addressed at all. Structural tools addressed by these plans also focused on flooding related issues such as drainage (83%), storm water management (67%), detention ponds (50%), and the maintenance of these structures (67%). Here too, the plans that addressed these tools generally offered good quality detailed discussions. Unfortunately planning elements like wetland restoration received scant attention.

- *Awareness/Educational tools, social considerations, and public facilities and infrastructure*: As might be hoped, public awareness programs were unanimously mentioned across all plans. In addition a solid majority of plans discussed education programs for their staff (75%) and private stakeholders (75%) as well as disaster warning and response programs (75%) and maps of hazard areas (75%). Each of these elements is addressed with good detail, although a combination of some low scores and the failure of some plans to even address these basic element results in relatively low quality coverage in the coastal zone. Substantial percentages of plans also address capital improvement based on hazard analysis and retrofitting public and critical facilities, however the quality of these elements even for plans addressing them are relatively low.
- *Recovery planning, emergency preparedness and natural resource protection*: Preplanning for mitigation actions during a post disaster recovery period can be critically important to better ensure that a community reduces vulnerabilities rather than repeating the same mistakes in the aftermath of a disaster. Unfortunately, with the exception of two plans that identified recovery organizations, planning element such as considering land-use changes in response to a disaster, building code changes, development moratoria, financing recovery, and the acquisition of private holdings were not addressed by a single plan. Similarly, the percentages of plans that addressed five planning elements associated with natural resource protection were very low and lacked quality, with the exception being sediment erosion control. The relative high points were

mitigation issues in emergency response, where a sizable percentage addressed the purchasing of equipment (75%), and moderate percentages also addressed evacuation (58%) and contingency planning (50%). In addition, if plans addressed emergency preparation mitigation issues, they generally did so in a quality fashion.

- *Implementation*: In sum, with respect to the thirteen planning elements associated with plan implementation and evaluation there was broad coverage with at least ten of the twelve plans addressing nine of these elements within their plans. And, when addressed, most plans offered a good deal of detail in their discussions that should help ensure guidance in the implementation of the mitigation plans and subsequent evaluation, monitoring and updating. Overall, however, there is a need to focus on specific details associated with technical assistance and the evaluation of actual funded projects, enforcement of the plan, and possible sanctions. The combination of good coverage and depth in general, but low enforcement issues and sanctions, raises the question of how likely is it that the proposed planning actions will actually be implemented. This is to not say that they will not be implemented, but rather without these additional mechanisms being addressed, the question does arise.

5.3 Mitigation Actions Analysis

In total there were 836 mitigation actions proposed by the 130 jurisdictions participating in these twelve plans, with 814 or 97% representing single actions that could be classified into different categories consistent with those examined by the protocol. Not surprisingly, given the general analysis of these plans, the largest single category of actions, 34.4%, proposed had to do with structural mitigation actions, but the second largest at 25.8% were related to regulatory, planning and research policies and issues, follow closely by emergency management related mitigation actions. Interestingly, the tendency toward focusing on structural mitigation actions was even more pronounced among cities than among counties. Unfortunately very few mitigation actions were related to natural resource protection. The sense is that there is a general tendency to focus mitigation actions on structural solutions to mitigation, with some consideration of non-structural

mitigation solutions related to land use planning policies, however these tend to be focused, at this time, more narrowly on flooding such as the NFIP and CRS ratings. Nevertheless there is clearly recognition that mitigation cannot be confined exclusively to structural solutions.

5.4 Some Final Thoughts and Considerations

This report began with the general goal of undertaking a detailed assessment of hazard mitigation plans that have been developed for jurisdictions along the Texas coast in order to better understand the strengths and weaknesses of these plans; not to grade what has been accomplished, but rather to shape the nature of future plans. The hope is that this information will influence future mitigation planning efforts in a positive way resulting in more effective mitigation plans which in turn will reduce future losses in lives, property and natural resource. This report also offered the caveat and expressed concerns that this research should not be viewed as an attempt to grade existing plans or to make invidious or pejorative statements regarding current plans or the planning efforts that generated them. In that spirit, the following statements are offered about this research effort itself.

As is the case with all research, there are going to be limitations that should be recognized in order to frame its results as well as improve upon future research efforts. While the development of the protocol used in this research sought to enhance and improve upon FEMA's cross walk and past research efforts, the resulting protocol was not necessarily perfect and it is undoubtedly the case that it could be improved upon. In this context, it might be argued that it was too comprehensive or that some of the planning elements employed should have been modified or excluded and perhaps others added. It might also be argued that the "common" set of hazards considered was too broad and perhaps even irrelevant for some jurisdictions. That in part is why modified assessments for just flooding and hurricanes were undertaken as part of the analysis in section 4.2.3. If a narrower set of hazards had been considered, this might have resulted in improved depth scores for many planning elements and hence planning component quality scores.

Another potential weakness may well have been in the application of the protocol to assess city, county, and regional mitigation plans. When first approached by the GLO staff to consider undertaking this assessment, the fact that three types of plans would be assessed was not fully recognized. To address this issue, the protocol was changed and modified over an extended period of months, which resulted in many plans being re-evaluated several time by the team, because the protocol itself changed. Of course, it must be recognized that FEMA's cross walk is employed to assess even more divergent types of plans. The final protocol utilized in this research, along with the validity and reliability controls undertaken, did result in consistent application regardless of the jurisdiction or type of plan considered. Nevertheless, developing a very refined and specific protocol for addressing city, county and regional plans would have result in variations in findings.

A final limitation concerns what the protocol measures and what it does not. Strictly speaking, the protocol simply evaluates the mitigation plans developed by these various jurisdictions. It does not and is not based upon what types of mitigation efforts may already be in place within these communities. The protocol reveals nothing about the current mitigation status of a community, other than what might be implicit, to a certain extent, in the fact basis component of these plans, which as seen above was not the strongest component across these plans. Nevertheless, a community's current "mitigation status" is not addressed; rather, the focus is on the mitigation plans as specified and developed. So, simply because a jurisdictions plan did not score well in this research, does not necessarily mean that its mitigation status is very low as well.

There are undoubtedly other limitations that the reader might bring forward. The important point is that there are always likely to be problems in any research application and there will always room for improvement. Despite the limitations, the comprehensive nature of the protocol developed and its usage to assess the twelve coastal mitigation plans reviewed here in, does provide a good deal of information regarding the relative strengths and weaknesses mitigation plans currently in effect. It is our sincere hope that the findings of this research are employed to strengthen future planning efforts.

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Appendix 1. Possible Mitigation Measures by Hazard Type[15]

Hazard type	Mitigation measures
All hazards	▪ Public education and awareness ▪ Mutual aid/interagency agreements ▪ 9-1-1 and 3-1-1 ▪ NOAA weather radio ▪ Emergency alert system ▪ Continuity of operations planning ▪ Land use planning ▪ Site emergency plans ▪ Emergency response personnel ▪ Community emergency response teams ▪ Insurance ▪ Real estate disclosure ▪ Family disaster plans and supply kits
Flood	▪ Acquisition ▪ Relocation ▪ Elevation ▪ Dry-Flood proofing ▪ Wet-Flood proofing ▪ Floodplain/Coastal Zone management ▪ Capital improvement plans ▪ Zoning ordinance adoption or amendments ▪ Subdivision ordinances or amendments ▪ Building code adoption or amendments ▪ Conservation easements ▪ Transfer of development rights ▪ Purchase of easement/development rights ▪ Storm water management/ordinances or amendments ▪ Multi-jurisdiction cooperation within watershed ▪ Comprehensive watershed tax ▪ Post-disaster recovery ordinance ▪ Flood insurance ▪ Floodplain ordinances or amendments ▪ Community rating system ▪ Updated floodplain mapping ▪ Strom drainage systems ▪ Drainage system maintenance ▪ Drainage easements ▪ Wetland protection ▪ Roads ▪ Structural flood control measures ▪ Minor structural projects ▪ Dam and levee maintenance ▪ Community outreach and education ▪ Debris control ▪ Hazardous and buoyant material protection ▪ Manufactured homes ▪ Flood warning ▪ Back-up generators ▪ Basement backflow prevention
Landslide and Debris Flow	▪ Mapping ▪ Building codes ▪ Zoning ordinances ▪ Slide-prone area ordinance ▪ Code enforcement

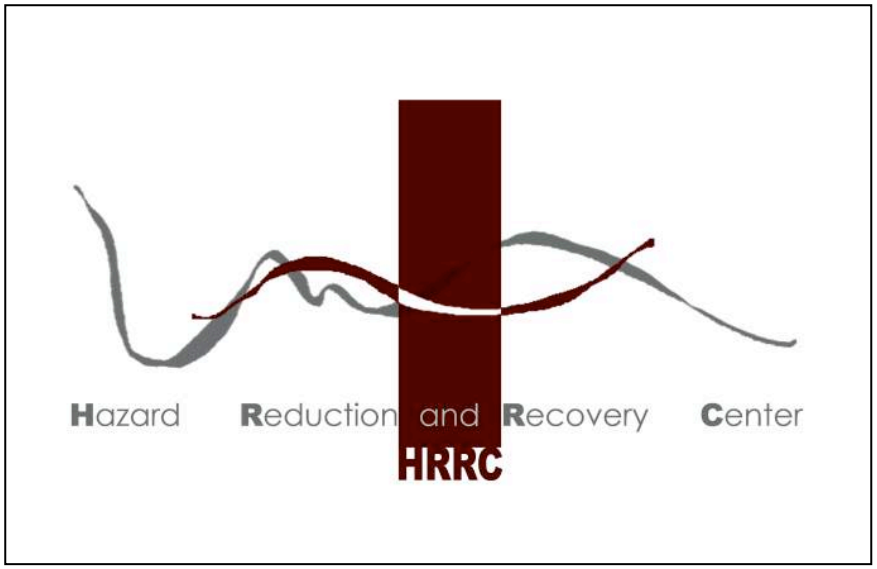
[15] Source: Mitigation Ideas: Possible Mitigation Measures by Hazard Type (FEMA 2002).

	▪ Drainage control regulations ▪ Grading ordinances ▪ Hillside development ordinances ▪ Subdivision ordinance ▪ Sanitary system codes ▪ Geological hazard overlay zones ▪ Open space designations ▪ Relocation ▪ Acquisition ▪ Restraining structures ▪ Debris-flow measures ▪ Grading ▪ Vegetation placement and management plans ▪ Utility location ▪ Abatement districts ▪ Restrictive covenants
Thunderstorms/Lightning	▪ Community outreach and education ▪ Early warning systems ▪ Building conservation ▪ Surge protectors and lightning protection ▪ Burying power lines
Tornado	▪ Construction standards and techniques ▪ Safe rooms ▪ Manufactured homes ▪ Loose items ▪ Temporary debris disposal
Severe wind	▪ Roofing shingles ▪ Building construction ▪ Manufactured home tie-downs ▪ Burying power lines ▪ Designed failure mode ▪ Backup power ▪ Tree management
Extreme temperature	▪ Outreach/public awareness ▪ Heating requirements ▪ Heating bills ▪ Heating and cooling centers
Winter weather/snowstorms	▪ Family and traveler emergency preparedness ▪ Driver safety ▪ Power lines ▪ Code enforcement and building maintenance ▪ Shelters ▪ Outreach ▪ Animal protection ▪ Roads ▪ Snow fences
Snow load	▪ Snow load design standards ▪ Snow weight data collection ▪ Maintenance ▪ Modifications ▪ Analysis and repair or replacement of structural systems
Subsidence	▪ Community awareness ▪ Mapping ▪ Open space ▪ Acquisition ▪ Filling or buttressing ▪ Relocation ▪ Hydrological monitoring
Earthquake	▪ Seismic hazard mapping ▪ Relating hazard mapping ▪ Map education ▪ Rapid visual screening

	▪ Loss estimation studies ▪ HAZUS ▪ Seismic safety committee ▪ School survey procedures ▪ Capital improvement planning ▪ Guidelines and model ordinances ▪ Building codes ▪ Seismic code training ▪ Buildings as structural hazards ▪ Non-structural hazards ▪ Technical assistance for homeowners ▪ Infrastructure hardening ▪ Bridge strengthening ▪ Hazard mitigation awareness ▪ Financial incentives ▪ Insurance ▪ Reference library
Drought	▪ Water-saving ▪ Water storage ▪ Water use ordinance ▪ Contingency plans ▪ Water delivery systems ▪ Crop insurance
Wildfire	▪ Public education ▪ Neighborhood groups ▪ Zoning ▪ Defensible space ▪ GIS mapping ▪ Power line maintenance ▪ Insurance company promotions ▪ Property maintenance ▪ Fireplace and chimney maintenance ▪ Building codes ▪ Waste disposal ▪ Arson prevention ▪ Burning restriction ▪ Road and driveway clearance ▪ Hillside construction ▪ Building foundations ▪ Motorized equipment ▪ Flammable materials ▪ Smoke/fire detectors and sprinklers ▪ Spotters ▪ Media ▪ Response personnel ▪ Water supplies ▪ Evacuation ▪ Individual response
Hazardous materials	▪ Safety procedures and policies ▪ Public awareness and worker education ▪ Local emergency planning committee ▪ Emergency plans ▪ Risk management plans ▪ Transportation ▪ Disposal ▪ Emergency response teams ▪ Search and rescue ▪ Industrial site buffering ▪ Radioactivity and radon ▪ Cleanup of brown fields ▪ Security
Utility failure	▪ Water and sewer

	▪ Electrical lines ▪ System redundancies ▪ Backup power ▪ Maintenance ▪ Rolling blackouts and brownouts ▪ Lightning protection ▪ Tree trimming ▪ Digging hotlines ▪ Vulnerable populations
Oil and gas wells and pipelines	▪ Safety regulations ▪ Contingency plans ▪ Well segregation ▪ Pipeline location and design ▪ Digging hotlines
Radiological emergencies	▪ Users of radiological materials ▪ Emergency planning for transportation routes ▪ Radiological emergency preparedness for nuclear plants ▪ Three ways to minimize exposure ▪ Shelters and warning systems ▪ Safe rooms ▪ Building materials
Sabotage/terrorism	▪ Assessment ▪ Critical infrastructure protection ▪ Computers ▪ Building materials ▪ Monitoring and reporting ▪ Emergency responder preparedness ▪ School violence ▪ Public gatherings ▪ Mental health services ▪ Private emergency plans

Appendix 2
Local Mitigation Plan Evaluation Protocol



Conducted by Hazard Reduction & Recovery Center
Supported by General Land Office
June, 2008

Title of Plan: _____

Jurisdiction: _____

Organization that prepared document: _____

Date adopted: _____

Date of most recent plan update: _____

Hazards evaluated

Flood _____

Hurricane _____

Wildfire _____

Landslide _____

Others _____

Name of Coder: _____ Date coded: _____

Coding Categories: 0 = not mentioned in plan; 1 = no detailed coverage; 2 = detailed coverage of topic in plan

Part I. Plan Contents Quality

Items		Score	Page No. Reference	Comment
I. Vision Statement (0 - No mention, 1 - mentioned, 2 - described in detailed)				
1. Problem description	1.1 Description of community and historical hazard threats			2- only if community profile and the Hazards situation, both are discussed 1- if partly or obliquely mentioned
	1.2 Description of the local hazards impact on the entire state			2 – if the nature of relationship and consequences are discussed 1- if there is only a mention of relationship with state
	1.3 Currently or potential hazards issues			2 – a more detailed discussion of hazard issues 1- a mere mention of issue
2. Vision	2.1 A statement identifying an over-all image of sustainable and hazard resilient community			2 – only if the statement seems holistic and satisfactory 1- a mere mention of broad vision
	2.2 General goals and objectives			2 – if the goals and objectives seem comprehensive and holistic 1 – If goals are not followed with objectives or reasoning
II. Planning Process				
3. General Description	3.1 General description of the process to develop a plan			2-how the planning team was formed, how were the team members involved, and how the plan was prepared 1 – just a mention of the process
4. Proposed participation Techniques in planning process	4.1 Formal public hearings			2- when, how, where and why was the hearings happened 1- just mention
	4.2 Open meetings			2- When, how, where and why the open meetings was held. 1- just mention

	4.3 Workshops or forum			2- when, how, where the forum were organized and who participated to forums 1- Just mention.
	4.4 Call-in hot lines			2- yes, with data on usage 1 – yes but no details
	4.5 Citizen advisory committees			2 – yes with details 1 – yes, but no details
	4.6 Household survey			2- When they conducted survey, how. And what kind of questionnaire was surveyed. 1-just mentioned
	4.7 Interviews with key stakeholders			2 – Who was interviewed as key stakeholders, what and why are they interviewed. 1- identified but not detail
	4.8 Website/internet/email			2-yest with detail 1- yet, but no detail
	4.9 data acquisition and data management			2- Mention data source, how they get and manage data. 1 – just mention
III.	***Fact Basis (0- No data, 1- Some data, 2-detailed data/satisfactory data)***			
5. Hazard Identification	5.1 General description of projected growth and population			2-detailed data with description/maps/visuals 1- Some data,
	5.2 Hazard profile			2: Mentions **all** hazard by county 1: mention some of hazards or mention some of counties
	5.3 Hazard identification			2- If they describe "Which hazard should have priority for mitigation" as low, medium and high priority for all counties 1 - If mentioned only hazard threats, not mention priority
	5.4 Delineation of natural resource areas			2- If the areas are mapped legibly 1- if resource areas are mentioned and identified (they exist). Includes poor quality maps.

6. Vulnerability Assessment	6.1 Identifies all hazards to the study area			2- Evaluator to ascertain if all hazards are included. 1- If the evaluator ascertains that some hazards have been ignored or overlooked.
	6.7 Social vulnerability (special needs population etc.)			2 – Identification and assessment special needs population; elderly, disable, children……. Etc.
8. Emergency management	8.1 Emergency shelter demand and capacity data			2 – estimated of shelter demand and capacities 1 – one of the above is missing
	8.2 Evacuation clearance time data			2 – Details of methodology and the final estimates 1 – one of the above is missing
	8.3 Location of emergency shelter			2– Only if mapped location of shelters along with designation (nuclear, general etc.) 1 – just mentioned
IV. Mitigation Goals & Objectives (0- not mentioned, 1- just mentioned, 2- mentioned with some detailed aspects)				
9. Economic Impacts	9.1 Any goal to reduce losses or protect property from loss			0- not mentioned, 1- just mentioned, 2- mentioned with some detailed aspects
	9.2 Any goal to minimize fiscal impacts of hazards			0- not mentioned, 1- just mentioned, 2- mentioned with some detailed aspects
	9.3 Any goal to distribute hazard mitigation cost equitably			0- not mentioned, 1- just mentioned, 2- mentioned with some detailed aspects
10. Physical and Environmental impact	10.1 Any goal to reduce hazard impacts on and preserve open space and recreation areas			0- not mentioned, 1- just mentioned, 2- mentioned with some detailed aspects
	10.2 Any goal to reduce hazard impacts on and maintain good water quality			0- not mentioned, 1- just mentioned, 2- mentioned with some detailed aspects
	10.3 Any goal to reduce hazard impacts on and protect wetlands/ forests (critical natural areas)			0- not mentioned, 1- just mentioned, 2- mentioned with some detailed aspects
11. Public Interest	11.1 Any goal to protect safety of population			0- not mentioned, 1- just mentioned, 2- mentioned with some detailed aspects

	11.2 Any goal to promote hazard awareness program or improve information exchange			0- not mentioned, 1- just mentioned, 2- mentioned with some detailed aspects
	11.3 Any goal to use available resources efficiently			0- not mentioned, 1- just mentioned, 2- mentioned with some detailed aspects
	11.4 Any goal to improve preparedness and response to hazard			0- not mentioned, 1- just mentioned, 2- mentioned with some detailed aspects
	11.5 Any goal to promote partnership with other agencies			0- not mentioned, 1- just mentioned, 2- mentioned with some detailed aspects
V. Inter-organization coordination & Capabilities (0-no mentioned, 1-just mentioned, 2- identified with sufficient detail)				
12. Cooperation	12.1 Identification of other govt. organizations and specification of their roles and responsibilities			2– Identify all levels (federal, state and other local governments) of governments. 1- mention about some of them
	12.2 Identification of representatives for each of above			2- mention about specific names or titles of representatives 1. just mentioned
	12.3 Identification of other stakeholders and specification of their roles and responsibilities			Other stakeholders include interested parties such as business industry, professional associations, non-profit groups and community representatives (neighborhood groups)
	12.4 Identification of representatives for each of above			2 – mention about specific names or titles of representatives
	12.5 Consistency with state plan/state mitigation plan			2: mentioned with detail 1. just mentioned
	12.6 Integration with other local comprehensive plan			1: just describe the existing plans. 2: describe the existing plans and then describe how they consolidated the actions from other plans and what actual actions are as the result of integration.
	12.7 Integration with FEMA mitigation programs and initiatives (for example, Flood Mitigation Fund)			1: just describe the existing programs and initiatives 2: describe the existing programs and then describe how they consolidated the actions from other programs and what actual actions are as the result of

				integration.
	12.8 Integration with other independent governments such as Municipal Utility Districts and Independent School Districts			1: just mention other independent governments. 2: describe other independent governments and describe how they will integrate with them. (includes any other special districts)
	12.9 Intergovernmental agreements			2- Indentified with sufficient detail. 1- Just mentioned or need identified..
13. Proposed participation Techniques in proposed actions	13.1 Formal public hearings			2- when, how, where/ for which projects/actions would it be necessary 1- just mention
	13.2 Open meetings			2- when, how, where/ for which projects/actions would it be necessary 1- just mention 1- just mention
	13.3 Workshops or forum			2- when, how, where/ for which projects/actions would it be necessary 1- just mention 1- Just mention.
	13.4 Call-in hot lines			2- when, how, where/ for which projects/actions would it be necessary 1- just mention
	13.5 Citizen advisory committees			2- when, how, where/ for which projects/actions would it be necessary 1- just mention
	13.6 Household survey			2- when, how, where/ for which projects/actions would it be necessary 1- just mention
	13.7 Interviews with key stakeholders			2- when, how, where/ for which projects/actions would it be necessary 1- just mention
14. Information sharing on the planned actions	14.1 Brochures or other literature			2- yes, with details of steps taken for higher efficacy 1 - yes
	14.2 Newsletters			2- yes, with details of steps taken for higher efficacy

				1 - yes
	14.3 Educational workshops			2- yes, with details of steps taken for higher efficacy 1 - yes
	14.4 TV/Radio			2- yes, with details of steps taken for higher efficacy 1 - yes
	14.5 Video			2- yes, with details of steps taken for higher efficacy 1 - yes
	14.6 Internet (Web-site)			2- yes, with details of steps taken for higher efficacy 1 - yes
15. Capacity Development	15.1 Funding sources for citizen participation and cooperation with other organization			2 – identified with funds availability 1 – mention of sources
	15.2 Staffing levels (FTE, part time staff, etc.)			2 – includes technical, advisory and administrative staff 1 – just a simple estimation or identification of need
	15.3 Joint database			2: describes what kind of database (for example, GIS etc.), purpose and the process which the database was developed. 1- identifies to the need of creating a joint database
	15.4 Technical assistance to other organization or citizen			2 – kind of assistance along with access details 1 – identification of the need/ just mention
	15.5 Improving communications and institutional capability through training, workshop etc.			2- yes, with detail info on when, how, what projects/actions would it be necessary 1- just mention
	15.6 Develop and improving technical capabilities (GIS, database etc.)			2- yes, with detail info on when, how, what projects/actions would it be necessary 1- just mention
16. Conflict management Strategy	16.1 Specification of conflict management procedures and processes			2 – details of conflict resolution procedures along with identification of responsible organization./agency 1 – identification of the need

VI. Specific Mitigation Policies & Actions (0-no mention, 1-just mention, 2-write specific details/more than mention (when/where/how etc.)

17. General Policy	17.1 Discourage development in hazardous areas			2 – identifies areas with maps/locations 1 – identifies the need
	17.2 Support adoption of new regulatory legislation at local level			2 – Mentions what legislations. 1 – identifies/ mentions the need to do so
18. Regulatory tool	18.1 Permitted land use			2 – identifies areas with maps/locations 1 – identifies the need
	18.2 Low density conservation or other hazard zone			2 – identifies areas with maps/locations 1 – identifies the need
	18.3 Overlay zone with reduced density provisions			2 – identifies areas with maps/locations 1 – identifies the need
	18.4 Dedication of open space for hazards			2 – identifies areas with maps/locations 1 – identifies the need
	18.5 Policy to locate public facilities in zones not subject to hazards			2 – identifies areas with maps/locations 1 – identifies the need
	18.6 Transfer of development rights			2 – identifies areas with maps/locations 1 – identifies the need
	18.7 Cluster development			2 – identifies areas with maps/locations 1 – identifies the need
	18.8 Setbacks			2 – identifies areas with maps/locations 1 – identifies the need
	18.9 Site plan review			2 – identifies areas with maps/locations 1 – identifies the need
	18.10 Special study/impact assessment for development in hazard zones			2 – identifies areas with maps/locations 1 – identifies the need
	18.11 Building standards/ Building code			2 – identifies areas with maps/locations 1 – identifies the need
	18.12 Land and property acquisition			2 – identifies areas with maps/locations 1 – identifies the need
	18.13 Impact fees			2 – identifies areas with maps/locations 1 – identifies the need
	18.14 Retrofitting of private structures			2 – identifies areas with maps/locations 1 – identifies the need
	18.15 Separate hazard mitigation plan			2 – identifies areas where it is required

				1 – identifies the need
	18.16 Relocation of structures out of hazard zones			2 – identifies areas of from and relocation areas 1 – identifies the need
	18.17 Drainage ordinance			2 – identifies areas of from and relocation areas 1 – identifies the need
19. Modeling technique	19.1 Modeling tools for evacuation			2 – identifies tools that are developed or applied 1 – identifies the need
	19.2 Modeling tools for flooding			2 – identifies tools that are developed or applied 1 – identifies the need
	19.3 Modeling tools for others (debris etc.)			2 – identifies tools that are developed or applied 1 – identifies the need
20. Floodplain regulation	20.1 Floodplain management/development			2 – identifies areas with maps/locations 1 – identifies the need
	20.2 Floodplain ordinance			2 – identifies areas with maps/locations 1 – identifies the need
	20.3 Down zoning floodplains			2 – identifies areas with maps/locations 1 – identifies the need
21. Incentive-based tool	21.1 Tax abatement for using mitigation			2 – identifies areas where it is required 1 – identifies the need
	21.2 Density bonus			2 – identifies areas where it is required 1 – identifies the need
	21.3 Low interest loans			2 – identifies areas/ population groups where it is required 1 – identifies the need
	21.4 Participation in National Flood Insurance Program (NFIP)			2 – identifies areas with maps/locations 1 – identifies the need
	21.5 Join CRS (Community Rating System)			2 – identifies areas with maps/locations 1 – identifies the need
22. Structural tool	22.1 Levees			2 – identifies areas with maps/locations 1 – identifies the need
	22.2 Seawalls			2 – identifies areas with maps/locations 1 – identifies the need
	22.3 Riprap			2 – identifies areas with maps/locations

				1 – identifies the need
	22.4 Bulk heads			2 – identifies areas with maps/locations 1 – identifies the need
	22.5 Detention ponds			2 – identifies areas with maps/locations 1 – identifies the need
	22.6 Channel maintenance			2 – identifies areas with maps/locations 1 – identifies the need
	22.7 Wetland restoration			2 – identifies areas with maps/locations 1 – identifies the need
	22.8 Slope stabilization			2 – identifies areas with maps/locations 1 – identifies the need
	22.9 Storm water management			2 – identifies areas with maps/locations 1 – identifies the need
	22.10 Sewage			2 – identifies areas with maps/locations 1 – identifies the need
	22.11 Drainage			2 – identifies areas with maps/locations 1 – identifies the need
	22.12 Maintenance of structures			2 – identifies areas where it is required 1 – identifies the need
23. Awareness/ Educational tool	23.1 Awareness program for community			2- yes, with details of steps taken for higher efficacy 1 - yes
	23.2 Education/awareness for staff			2- yes, with details of steps taken for higher efficacy 1 - yes
	23.3 Education/awareness for private stakeholders (industry, business, or homeowners etc.)			2- yes, with details of steps taken for higher efficacy 1 - yes
	23.4 Education/awareness for students			2- yes, with details of steps taken for higher efficacy 1 - yes
	23.5 Real Estate Hazard Disclosure			2 – identifies areas where it is required 1 – identifies the need
	23.6 Disaster warning and response program			2 – identifies areas where it is required 1 – identifies the need

	23.7 Posting of signs indicating hazardous areas			2 – identifies areas where it is required 1 – identifies the need
	23.8 Technical assistance to developers or property owners for mitigation			2 – identifies areas where it is required 1 – identifies the need
	23.9 Maps of areas subject to hazards			2 – identifies areas with maps/locations 1 – identifies the need
	23.10 Inclusion of floodplain boundaries			2 – identifies areas with maps/locations 1 – identifies the need
	23.11 Education and training in several languages			2- identifies areas and with details of steps taken 1 - yes
	23.12 Hazard information center			2- identifies areas and with details of steps taken 1 - yes
24. Social consideration	24.1 Identification of special needs population and preparedness of assistance			2. having their list, giving information to them, preparedness for them
25. Public Facilities and Infrastructure	25.1 Capital Improvements Plan based on hazard analysis			2 – identifies areas where it is required 1 – identifies the need
	25.2 Retrofitting public structure			2 – identifies areas where it is required 1 – identifies the need
	25.3 Retrofitting critical facilities			2 – identifies areas where it is required 1 – identifies the need
26. Recovery Planning	26.1 Land use change			2 – identifies areas where it is required and with maps/locations 1 – identifies the need
	26.2 Building design change to meet enhanced safety standards			2 – identifies areas where it is required 1 – identifies the need
	26.3 Moratorium			2 – identifies areas where it is required 1 – identifies the need
	26.4 Recovery organization			2- mention about specific names or titles of representatives 1. just mentioned
	26.5 Private acquisition			2 – identifies areas where it is required and with maps/locations

				1 – identifies the need
	26.6 Financial recovery			2 – identified areas and with funds availability 1 – mention of sources
27. Emergency Preparedness	27.1 Evacuation			2 – yes with details 1 – yes, but no details
	27.2 Sheltering			2 – yes with details 1 – yes, but no details
	27.3 Contingency plan/ Preparedness plan			2 – yes with details 1 – yes, but no details
	27.4 EOC(Emergency Operation Center)			2 – yes with details 1 – yes, but no details
	27.5 Require emergency plans			2 – yes with details 1 – yes, but no details
	27.6 Purchasing rescue materials/other equipments			2 – yes with details and meet the need 1 – yes, but no details
28. Natural resource protection	28.1 General description of best management practice			2- yes with details on how the management will be implemented 1 – just a mention of the process
	28.2 Forest and vegetation management riparian areas			2 – identifies areas with maps/locations 1 – identifies the need
	28.3 Sediment and erosion control			2 – identifies areas with maps/locations 1 – identifies the need
	28.4 Stream dumping regulations			2 – identifies areas with maps/locations 1 – identifies the need
	28.5 Urban forestry and landscape			2 – identifies areas with maps/locations 1 – identifies the need
VII. Implementation (0- no mention, 1- mention without details, 2- mention with sufficient details)				
29. Implementation	29.1 Description of implementation process			2- yes with details on steps need to be taken 1 – just a mention of the process
	29.2 Identification of process for prioritizing assistance to local governments			2- yes with details on steps need to be taken 1 – just a mention of the process

	29.3 Clear designation of responsibility for implementation			2- yes with details (mentioned the agency/ institution) 1 – just mentioned
	29.4 Provision of technical assistance for implementation			2- yes with details, mentioned how and what type of assistance 1 – just mentioned
	29.5 Identification of costs for implementation			2 – yes with details 1 – yes, but no details
	29.6 Identification of funding sources			2 – identified with funds availability 1 – mention of sources
	29.7 Provision of sanctions			2- yes with details, mentioned how and what type of sanction (no grants) 1 – just mentioned
	29.8 Clear time-table for implementation outlined			2 – yes with details 1 – yes, but no details
	29.9 Enforcement specified			2- yes with details on what type of enforcement 1 – just mentioned
30. Evaluating, Updating and Monitoring	30.1 Description of the overall evaluating, updating and monitoring process			2- Description of overall process and concrete time schedule for the update, evaluation and monitoring. 1 – just mentioned
	30.2 Identification of participants in the evaluating process			2- mention about specific names or titles of representatives 1. just mentioned
	30.3 Clear designation of responsibility for evaluating, updating and monitoring process			2- yes with details (mentioned the agency/ institution) 1 – just mentioned
	30.4 Evaluation of funded mitigation projects			1– identified the achievement or the degree of implementation of the already funded projects on the regular basis 1 – just mention

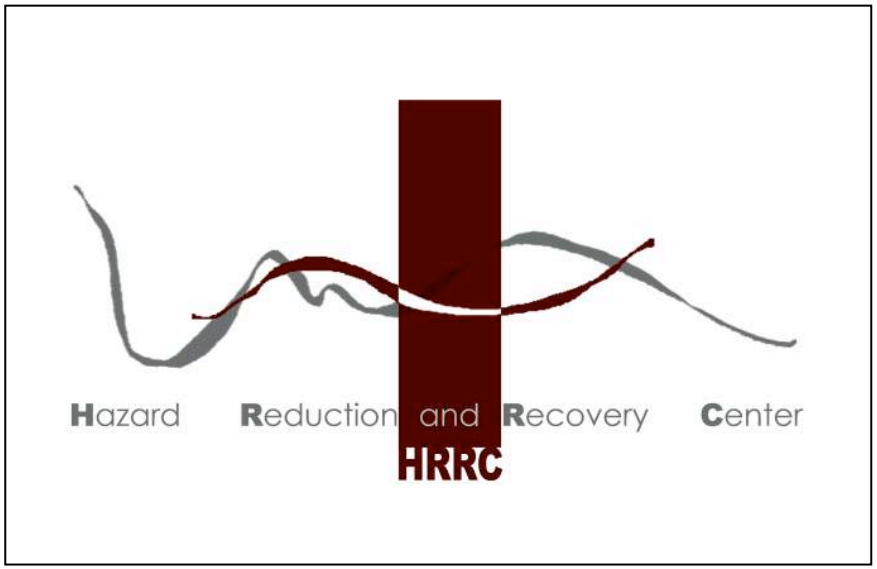
Appendix 3. Hazards Identified in Local Hazard Mitigation Plans

Hazard	1	2	3	4	5	6	7	8	9	10	11	12	Tot.
1) Hurricanes (tropical storm)	X	X	X	X	X	X	X	X	X	X	X	X	12
2) Floods	X	X	X	X	X	X	X	X	X	X	X	X	12
3) Tornado	X	X	X	X	X	X	X	X	X	X	X	X	12
4) Hail	X	X	X	X	X	X	X	X	X	X		X	11
5) Winter storms	X	X	X	X	X	X		X	X	X	X	X	11
6) Wildfire	X	X	X	X	X	X		X	X	X	X	X	11
7) Thunderstorm	X	X	X	X		X	X	X	X			X	9
8) Drought				X	X	X	X	X	X	X	X	X	9
9) Heat	X			X	X	X		X	X	X	X		8
10) Earthquakes	X			X	X	X		X	X	X	X		8
11) Coastal Erosion	X			X		X		X	X	X			6
Sub-Total	**10**	**7**	**7**	**11**	**9**	**11**	**6**	**11**	**11**	**10**	**8**	**8**	-
12) landslides				X				X	X	X	X		5
13) Subsidence	X			X				X	X	X			5
14) Lightning										X		X	2
15) Tsunami	X									X			2
16) High Winds					X								1
17) Sinkholes						X							1
18) Expansive soils										X			1
19) Volcanic activity										X			1
20) Avalanche										X			1
21) Global Warming					X								1
22) Energy failure	X	X	X		X		X				X	X	7
23) Dam/Levee Failure	X	X	X		X	X	X			X			7
24) Hazardous mat.	X	X	X		X						X	X	6
25) Terrorism (etc.)		X	X		X						X	X	5
26) Nuclear accident							X						1
27) Pandemic influenza					X								1
Total	15	11	11	13	16	13	9	13	13	18	12	12	
Ave. by type	13.2					12.0				14			

1) Houston-Galveston Area Council, 2) Texas Colorado River Floodplain Coalition, 3) Guadalupe-Blanco River Authority, 4) Coastal Bend, 5) Rio Grande Border, 6) Harris County, 7) Jackson County, 8) Orange, 9) Jefferson; 10) Houston, 11) Pearland, 12) Friendswood.

Appendix 4

Local Mitigation Plan Evaluation Protocol



Conducted by Hazard Reduction & Recovery Center
Supported by General Land Office
June, 2008

Title of Plan: _____

Jurisdiction: _____

Organization that prepared document: _____

Date adopted: _____

Date of most recent plan update: _____

Hazards evaluated

Flood _____

Hurricane _____

Wildfire _____

Landslide _____

Others _____

Name of Coder: _____ Date coded: _____

Coding Categories:

0 = not mentioned in plan; 1 = no detailed coverage; 2 = detailed coverage of topic in plan

Part I. Plan Contents Quality

Items		Score	Page No. Reference	Comment
III. Fact Basis(0=no mention, 1= just mention, 2=mention in detail)				
5. Hazard Identification (About the threat)	5.5Delineation of location of hazard			2: specific location and geographical areas of hazard that can affect the community. Map and text description. Some hazards may not need a map so evaluator to recognize it. 1: just mention. If those hazards not geographically determined (i.e. tornado etc.) and the plans describe about this.
	5.6 Delineation of magnitude of hazard			2: magnitude or severity of potential hazard events along with various threat level maps. 1. some kind of delineation
	5.7 Historical data on the hazard			2: including damage, level of severity, date, duration, location of previous occurrence of hazard events. Map or table description. 1. just mention
6.Vulnerability Assessment (how vulnerable/ Threat assessment)	6.2 Assessment of hazard exposure (property)			2: table and text description. Assessment of all counties. Number of Residential and commercial buildings by county. 1. just mention
	6.3 Social vulnerability assessment			2. assessment along with the theoretical/practical basis for the assessment methodology 1. Identification of high risk groups even though not a part of formal social vulnerability assessment.
	6.4 Assessment of hazard exposure (population)			2: table and text description. Assessment of all sub-regions. 1. just mention

	6.5 Assessment of hazard exposure (Public infrastructure: such as roadways, water utilities and communication systems.)			2: assessment should include size (number) and type by sub-regions. 1. just mention
	6.6 Assessment of hazard exposure (Critical Facilities : such as shelters and hospitals)			2: Assessment should include types and number by county. 1. just mention
7. Risk Analysis (what happens it the disaster strikes)	7.1 Probability of experiencing hazard event (various magnitudes where applicable*)			2. Mentioned with details. For example, the probability of a flood event is expressed as the percent chance that a flood of a specific magnitude will occur in any given year. (10-year, 50-year, 100-year, 500-year…) 1. just mention
	7.2 Property Loss Estimation (various magnitudes where applicable*)			2: residential and commercial buildings. Potential dollar losses values by county. 1. just mention
	7.3 Infrastructure Impact Estimation (various magnitudes where applicable*)			2: potential dollar losses values of public infrastructure, estimation should include value by type by county. 1. just mention
	7.4 Population Risk (various magnitudes where applicable*)			2: number of people for various levels of vulnerability/risk 1. just mention

* will be applicable to floods, hurricanes, earthquakes.