Repetitive Loss Area Analysis
City of Alvin, Texas

January 31, 2011
The University of New Orleans
Center for Hazards Assessment, Response and Technology
(UNO-CHART)

www.floodhelp.uno.edu

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**Terminology**

**100-year flood:** The flood that has a one percent (1%) chance of being equaled or exceeded each year.

**Area Analysis:** An approach to identify repeatedly flooded areas, evaluate mitigation approaches, and determine the most appropriate alternatives to reduce future repeated flood losses.

**BFE:** Base Flood Elevation: The elevation of the crest of the base flood or 100-year flood.

**UNO-CHART:** Center for Hazards Assessment, Response and Technology at The University of New Orleans

**FEMA:** Federal Emergency Management Agency

**FIRM:** Flood Insurance Rate Map

**Floodway:** The channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent annual chance flood can be carried without substantial increases in flood heights.

**Freeboard:** A factor of safety usually expressed in feet above the Base Flood Elevation (BFE) for purposes of floodplain management.

**GIS:** Geographic Information Systems

**Hazard Mitigation:** Any sustained action taken to reduce or eliminate long-term risk to life and property from a hazard event.

**ICC:** Increased Cost of Compliance, a $30,000 rider on flood insurance policies for policy holders located in the special flood hazard area that can be used to bring the structure into compliance in the event that it is substantially damaged by a flood.

**NFIP:** National Flood Insurance Program

**Repetitive Loss property (RL):** An NFIP-insured property where two or more claim payments of more than $1,000 have been paid within a 10-year period since 1978.

**Severe Repetitive Loss Property (SRL):** A 1-4 family residence that is a repetitive loss property that has had four or more claims of more than $5,000 or two claims that cumulatively exceed the reported building’s value.

**Substantial Improvement:** The repair, reconstruction, or improvement of a structure, the cost of which equals or exceeds 50% of the market value of the structure either, (1) before the improvement or repair is started, or (2) if the structure has been damaged and is being restored, before the damage occurred.
Acknowledgements:

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City of Alvin repetitive loss area analysis Executive Summary

Background
The National Flood Insurance Program (NFIP) is continually faced with the task of paying claims while trying to keep the price of flood insurance at an affordable level. It has a particular problem with repetitive flood loss properties, which are estimated to cost $200 million per year in flood insurance claim payments. Repetitive flood loss properties represent only 1.4% of all flood insurance policies, yet historically they have accounted for nearly one-fourth of the claim payments (over $9 billion to date). Mitigating these repeatedly flooded properties will reduce the overall costs to the NFIP, the communities in which they are located, and the individual homeowners. UNO-CHART conducted an “area analysis” case study in Alvin, TX. An area analysis follows FEMA guidelines to determine why an area has repeated flood losses and what alternative flood protection measures would help break the cycle of repetitive flooding.

Study Area
The study area for this report is located south of Highway 6, and is bounded by Mustang Bayou to the north, west Sealy Street to the south, North 2nd Street to the east, and North 6th Street to the west. There are 178 structures in the study area. All but ten of them are residential. Of those 178 structures, twenty are on FEMA’s repetitive loss list, while five of those twenty (25%) properties are severe repetitive loss (SRL) properties.

Problem Statement:
- Flooding is caused by heavy rains, but aggravated by two problems:
  o Mustang Bayou’s channel cannot carry all the runoff that drains to it
  o The street drainage ditches are overgrown, or otherwise unable to convey water to the Bayou and out of the area
- There have been some drainage improvements made to Mustang Bayou, but they have not stopped all flooding.
- There are 178 properties subject to flooding. Twenty of the insured properties have been flooded to the extent that they qualify as repetitive loss structures under the NFIP. In the study area, five of the twenty repetitive loss properties are severe repetitive loss properties. These twenty repetitive loss properties have made 48 flood insurance claims for a total of $794,126.00 since 1978.

Recommendations for the City of Alvin:
- Encourage everyone to pursue a mitigation measure.
- Assist interested property owners in applying for a mitigation grant.
- Address the issues with the clogged and/or undersized street drainage ditches.
- Institute a ditch maintenance program that encourages homeowners to frequently clear their ditches of debris to ensure open flow for stormwater.
- Seek out and secure funding for the drainage improvements outlined in this report.
- Complete the CRS application process or improve the City’s CRS classification.

For the residents of the study area
- Contact the City of Alvin for more information about possible funding opportunities.
- Review the alternative mitigation measures discussed in this analysis and implement those that are most appropriate for their situation.
- Purchase and maintain a flood insurance policy on the home and its contents.

**Introduction**

Flooding is a problem far too familiar to many neighborhoods across the United States. Enduring the consequences of flooding over and over again can be quite frustrating. When the water rises, life is disrupted, belongings are ruined, and hard-earned money is spent.

This report has been created in collaboration with the City of Alvin, and the owners of homes in a repetitively flooded area who have continually suffered the personal losses and stresses associated with living in a flood-prone house. The goal is to help homeowners reduce their flood risk by providing a broader understanding of the flooding problems in their neighborhood, and the potential solutions to the continual suffering that results from repetitive flooding. The availability of possible funding sources for certain mitigation options is also discussed.

Here, flooding issues and potential mitigation measures are discussed for homes located in the study area in Alvin, Texas. While the homes in this study are representative of other homes throughout the neighborhood, not all the mitigation measures reviewed in this report are appropriate for all homes in the study area.

It is understood that there are many stresses associated with repetitive flooding including worry about how high the water may rise, the loss of personal belongings, the possibility of mold, and whether or not neighbors will return after the next event. Adding to this worry is the uncertainty related to the potential solutions. Should I elevate and if so, how high? How much will mitigation projects cost? What will my neighborhood look like if I am the only one to mitigate, or the only one not to mitigate? Is there a solution that might work for the entire neighborhood?

These questions are common, and this report attempts to answer them according to the specific situation faced by homeowners in the area. Informed homeowners can become even stronger advocates for policy change at the neighborhood, city, county, state and even federal levels. Overall, it is hoped that by gaining a better understanding of the flooding issues, neighborhoods can become safer and homeowners better able to confront the hazard of flooding.
Background

The National Flood Insurance Program (NFIP) is continually faced with the task of paying claims while trying to keep the price of flood insurance at an affordable level. It has a particular problem with repetitive flood loss properties, which are estimated to cost $200 million per year in flood insurance claim payments. Repetitive flood loss properties represent only 1.4% of all flood insurance policies, yet historically they have accounted for nearly one-fourth of the claim payments (over $9 billion to date). Mitigating these repeatedly flooded properties will reduce the overall costs to the NFIP, the communities in which they are located, and the individual homeowners. Ultimately, mitigating repeatedly flooded properties benefits everyone.

The University of New Orleans’ Center for Hazards Assessment, Response and Technology (UNO-CHART) receives funding from FEMA to collect data and analyze the repetitive flood loss areas in Louisiana and Texas in conjunction with local governments, elected officials, residents, and neighborhood associations. Using a geographic information system (GIS) and geo-coded flood insurance claims data, repeatedly flooded areas and properties are being prioritized for attention and analysis. In selected locations UNO-CHART works with local officials and residents to conduct in-depth analyses of the causes and possible solutions to the flooding problem. These efforts are called “Area Analyses.”

UNO-CHART conducted an “area analysis” case study in Alvin. An area analysis follows FEMA guidelines to determine why an area has repeated flood losses and what alternative flood protection measures would help break the cycle of repetitive flooding.

The Area
The City of Alvin is located in northeastern Brazoria County, Texas, and the majority of development in the area is low density and mostly residential. Surrounding the city is mostly rural areas, with open prairie grasslands, and cultivated agricultural lands. The study area for this report is located south of Highway 6, and is bounded by Mustang Bayou to the north, west Sealy Street to the south, North 2nd Street to the east, and North 6th Street to the west. See the map on page 8 for the location of the area.

There are 178 structures in the study area. All but ten of them are residential. Most of the ten commercial buildings are located on the southern edge of the study area. Of those 178 structures, twenty are on FEMA’s repetitive loss list, while five of those twenty properties are severe repetitive loss (SRL) properties.

The area was selected for this area analysis due to the number of repetitive loss and severe repetitive loss properties in the area. Local officials also expressed their interest in addressing the repetitive flooding issues in the area. The high numbers of repetitive loss properties in the study area indicates a flooding problem. The study area has flooded several times since 1978, which is when FEMA began tracking flood claims nationally.

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1Information from the Houston-Galveston Area Council (HGAC) Regional Hazard Mitigation Plan
Process
In May 2010, after a careful review of the locations of repetitive flood loss properties throughout the State of Texas, a team from UNO-CHART visited the city of Alvin and met with several local officials, and a representative from both the Texas Water and Development Board and FEMA Region VI. These local officials demonstrated their knowledge of and concern for the flooding issues in the area. During this meeting, the final study area was decided upon, and a better understanding of the issues in the area was gained.

The FEMA-prescribed five step process for conducting an area analyses is as follows:

**Step 1:** Advise all the property owners in the repetitive flood loss area that the analysis will be conducted.

**Step 2:** Collect data on the analysis area and each building in the identified study area within the neighborhood to determine the cause(s) of the repetitive damage.

**Step 3:** Review alternative mitigation approaches and determine whether any property protection measures or drainage improvements are feasible.
Step 4: Contact agencies or organizations that may have plans that could affect the cause or impacts of the flooding.

Step 5: Document the findings, including information gathered from agencies and organizations, and relevant maps of the analysis area.

Step 1: Neighborhood Notification

The first step in FEMA’s five-step process is to notify the residents in the area about the project. On May 28th, 2010 the City of Alvin’s Community Development Office sent out a letter to the homeowners introducing them to UNO-CHART and the project. The letter was printed in both English and Spanish, as initial research into the area showed that the area is bilingual.

Accompanying the letter was a data sheet that asked homeowners basic questions about their building and their flooding history. On the back of the data sheet was UNO-CHART’s mailing address and a stamp, so that residents could fold up the data sheet, tape it, and mail it back to UNO-CHART. One hundred and seventy-eight (178) letters were mailed out, of which twenty-four were returned in English, and four returned completed in Spanish. More information on the data sheets will be discussed later in this report on page 16.

Copies of the letter and data sheet in English and Spanish can be found in Appendices A-D of this report.

Step 2: Data Collection

The second step in the process is the collection of data that pertains to the area; both as a whole and specifically about the causes of the repetitive flooding. The data were collected through coordination with several agencies and departments. Step 4 in this report includes a review of the stakeholders who contributed to the project. There are five primary sources of data and information:

I. Community Plans and Studies
II. Flood Insurance Data
III. Drainage Information
IV. Data Sheets
V. On-Site Data Collection

I. Community Plans and Studies

The UNO-CHART team has collected and reviewed the following reports:

A. City of Alvin, Comprehensive Master Plan, September 2005²
B. City of Alvin, Flood Hazard Reduction Ordinance, November 2005³
C. Houston-Galveston Area Council (HGAC) Regional Hazard Mitigation Plan, April 2006⁴

² The Comprehensive Master Plan can be found online at: http://www.alvin-tx.gov/docs/4-CompPlan.pdf
³ The City of Alvin Code of Ordinances can be found online at: www.municode.com
⁴ The HGAC Hazard Mitigation Plan can be found online at: http://www.h-gac.com/community/community/hazard/hazard_mitigation_plan.aspx
A. City of Alvin Comprehensive Master Plan\textsuperscript{5}: The City of Alvin completed a city-wide Master Plan in November of 2005. According to the plan, Alvin is subject to flooding caused by heavy rain events, hurricanes, and tropical storms.

Section 3 of the plan, \textit{Land Use}, details the necessity of land development to Alvin’s economic growth, but is careful to note the equal obligation to protect and restore Alvin’s natural resources.

The goals listed in this section and in Section 4 \textit{Parks and Recreation}, include action items to pursue open space of land along Mustang Bayou in order to reduce the alteration of this natural resource from the impact of development. The floodplain along Mustang Bayou in the northern section of the study area is listed as environmentally sensitive and in need of protection from the impacts of intensive development. The goal, to protect Mustang Bayou’s natural channels and floodplains from alteration in the unified development ordinance would incorporate some flood protection. It would do this by limiting any land use that would lead to an increase in flood height.

Section 5, \textit{Growth Strategies}, notes that the main determining factor to the city’s growth pattern is the amount of 100-year floodplain and other flooding conditions in the city that constrict development in certain areas. Stormwater Drainage is covered in this section, and it is noted that the City of Alvin is responsible for the smaller drainage ditches, whereas the Brazoria County Conservation and Reclamation District #3 is responsible for the larger drainage ditches and Mustang Bayou. Section 5 states that there are issues with localized flooding from 10 or 25-year storm events. Drainage will be discussed in length on page 15 of this report.

B. City of Alvin, Flood Hazard Reduction Ordinance November 17, 2005\textsuperscript{6}: In order to reduce flood losses, the City of Alvin Flood Reduction Ordinance uses the following methods in all areas of special flood hazards for new and substantially improved residential construction:

- The lowest floor of livable space elevated to one foot \textit{above} the base flood elevation (BFE).
- The structure must be adequately anchored to prevent flotation, collapse or lateral movement of the structure.
- Buildings shall be constructed by methods and practices that minimize flood damage;
- Buildings shall be constructed with materials resistant to flood damage;
- Buildings shall be constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.
- All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of floodwaters into the system;
- New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of floodwaters into the system and discharge from the systems into floodwaters; and,
- On-site waste disposal systems shall be located to avoid impairment to them or contamination.

\textsuperscript{5} The City of Alvin Comprehensive Master Plan can be found online at: \url{http://www.alvin-tx.gov/default.aspx?name=ecodev.homepage}
\textsuperscript{6} The city of Alvin’s complete Code of Ordinances, including the Flood Hazard Reduction Ordinance can be found online at: \url{www.municode.com}
The ordinance also notes that encroachments are prohibited so that there is not an increase in flood heights on other properties. This includes fill, new construction, substantial improvements and other development within the adopted regulatory floodway. If it can be demonstrated that the proposed encroachment would not result in any increase in flood levels within the city during the occurrence of the base flood discharge, an encroachment may be permitted. This means there are restrictions on the construction of new buildings, additions, levees, floodwalls or filling on properties in the floodway.

C. Houston-Galveston Area Council (HGAC) Regional Hazard Mitigation Plan, April 2006: The City of Alvin is part of the seventy-four municipalities and eight counties that participated in the Houston-Galveston Area Council’s Regional Hazard Mitigation Plan (hereafter “the Plan”). The Plan serves the needs of the region, and also focuses on local policies that account for and cover population shifts, growth, hazards education and outreach related activities, and the benefits of protecting and restoring natural resources.

Texas leads the country in Federal disaster declarations with a total of eighty-four declarations, the first recorded being disaster declaration #2 in May of 1953. Of those eighty-four declared disasters, only three were for something other than a hurricane, tropical storm, or other rain/flood event. This high frequency of rain/flood related declared disasters illustrates that there is a considerable flooding threat in the region. The Plan notes as much, as Brazoria County is listed under sixteen Federal disaster declarations since 1980, only one of which was for something other than a rain/flood event.

The City of Alvin has a ‘moderate’ extent of flooding and a ‘large’ extent of threat from hurricanes, coastal storms, and severe thunderstorms. The Plan also lists riverine and coastal floods as the number one threat to the counties and various jurisdictions participating in the HGAC’s Regional Hazard Mitigation Plan, with hurricanes, tropical storms, and severe thunderstorms being listed directly after. In Section 4, Vulnerability Assessment, The Plan covers Brazoria County’s exposure to risk from coastal flooding and storm surges. Table 1 below shows the number of people and buildings at risk from categories 1-5 hurricanes and storm surges.

Table 1: Brazoria County people and buildings at risk from category 1-5 hurricanes and storm surges

<table>
<thead>
<tr>
<th>At Risk</th>
<th>Category 1</th>
<th>Category 2</th>
<th>Category 3</th>
<th>Category 4</th>
<th>Category 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>People</td>
<td>21,958</td>
<td>28,130</td>
<td>71,890</td>
<td>106,529</td>
<td>113,565</td>
</tr>
<tr>
<td>Buildings</td>
<td>7,865</td>
<td>10,077</td>
<td>24,539</td>
<td>35,092</td>
<td>37,742</td>
</tr>
</tbody>
</table>

7 For a full list of declared disaster in the State if Texas, please visit: [http://www.fema.gov/news/disasters_state.fema?id=48](http://www.fema.gov/news/disasters_state.fema?id=48)

8 Includes residential, commercial, critical facilities (hospitals, police stations, etc.), and hazardous material facilities. For a breakdown by type of building, see HGAC Regional Hazard Mitigation Plan, section 4.3, pages 35-45
Appendix A of the HGAC Mitigation Plan lists the Locally-specific mitigation actions. The City of Alvin has five mitigation actions listed. They are as follows (current statuses of these actions are given in *italics* where applicable):

- **Purchase 63 properties in the floodway**
  *There have been some acquisitions in the study area along Mustang Bayou on Lobitt. These buy-outs were not for floodplain management reasons; rather they were for back-tax purposes. The City has pursued acquisitions of flood-prone properties before with little success. Acquisitions as a mitigation measure are discussed on page 18 of this report.*

- **Develop stormwater management plan**

- **Develop master drainage plan**
  *There is a Preliminary Master Drainage Plan for the City of Alvin that was completed in June of 2008.*

- **Revise and update Flood Insurance Rate Map (FIRM)**
  *The City of Alvin has not seen floodplain modeling updates since 1968. Though new FIRM's have been release for the City since 1968, these were done with no new modeling.*

- **Conduct outreach, raise disaster awareness**
  *The City of Alvin is always looking for new ways to educate and informs its constituents. More information is always available on the City’s website.*

The HGAC Plan covers seventy-four municipalities and eight counties, and as such the City of Alvin is currently in the process of developing their own Mitigation Plan. The City has completed and submitted the necessary paperwork for a planning grant. If the City receives the grant, it will begin developing a Mitigation Plan that meets the specific needs of the City of Alvin. For more information, stay tuned to the City of Alvin's website: [www.alvin-tx.gov](http://www.alvin-tx.gov).

### II. Flood Insurance Data

There are three sources of flood insurance data that the UNO-CHART team has reviewed. Those sources of data are:

- Flood Insurance Rate Map (FIRM)
- Preliminary Digital Flood Insurance Rate Map (DFIRM)
- Claims data

#### A. City of Alvin Flood Insurance Rate Map, September 1999: A Flood Insurance Rate Map (FIRM), published by FEMA, shows potential flood risk according to zones of severity and is used in setting flood insurance rates. The regulatory floodplain used by FEMA for the floodplain management and insurance aspects of the National Flood Insurance Program (NFIP) is based on the elevation of the 100-year or base flood.

It can be easily misconstrued that the 100-year flood happens only once in 100 years. In actuality, the 100-year flood has a 1% chance of occurring in any given year. For another frame of reference, the 100-year flood has a 26% chance of occurring over the life of a 30-year mortgage. It is becoming more common to refer to the 100-year flood as the 1% annual chance flood. It is important to note that more frequent flooding does occur in the 100-year floodplain, as witnessed by the number of repetitive loss properties.

The study area falls in three zones: the less risky X Zone, the more risky AE Zone, and partially in the Mustang Bayou floodway. The floodway is shown in Figure 3 on page 15. The floodway is
an area that must be kept free of encroachments so that the 1% chance annual flood can occur without substantially increasing the flood heights.

The Base Flood Elevation (BFE) is the elevation of the 1% chance annual flood above sea level. In Alvin, one foot above the BFE is the lowest elevation to which homeowners can build or substantially improve an existing structure. The BFE for the area is between forty-four and forty-five feet above sea level.

B. Preliminary Digital Flood Insurance Rate Map (DFIRM): As part of the FEMA Map Modernization Plan, the United States Army Corps of Engineers has been charged with updating and developing Digital Flood Insurance Rate Maps (DFIRMs). Currently, Brazoria County is expected to have its preliminary DFIRM released in September of 2011. The re-mapping project is currently on hold. More information can be found on FEMA’s website www.floodsmart.gov. The effective FIRM for the City of Alvin is available on the city’s website www.alvin-tx.gov.

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C. Claims Data: The Privacy Act of 1974 (5 U.S.C. 522a) restricts the release of certain types of data to the public. Flood insurance policy and claims data are included in the list of restricted information. FEMA can only release such data to state and local governments, and only if the data are used for floodplain management, mitigation, or research purposes. Therefore, this report does not identify the repetitive loss properties or include claims data for any individual property. Rather, it discusses them only in summary form.

UNO-CHART obtained claims data from FEMA Region VI for all repetitive loss properties in the area. There are twenty (II.23%) properties within the 178 property study area that qualify as repetitive loss. Of those twenty repetitive loss properties, five are considered to be severe repetitive loss properties. Table 3 shows that the homeowners for the twenty repetitive loss properties have made forty-eight claims and received $794,126.00 in flood insurance payments since 1978. The average repetitive flood loss claim is $16,511.58.

Major Flood Events: There have been two major flood events in the study area: September 2008 and April 2009. Table 3 shows that these two flood events produced the highest number of claims and the highest claims totals. In September 2008, Hurricane Ike passed over the Gulf Coast bringing with it heavy, sustained rains that flooded parts of the region. The most costly flood event was an unnamed storm in April of 2009, when there was between 3 and 7 inches of rain throughout both days. Eleven of the twenty repetitive loss properties (55%) made flood claims totaling $282,775.27 for this singular event.

Of the eight claims dates listed in Table 3, three have been declared disasters; Disaster # 595 in July of 1979 for storms and flash flooding, Disaster # 603 in September of 1979 for severe storms and flooding, and Disaster # 1791 in September of 2008 for Hurricane Ike. The remaining five claims dates correspond with heavy rain events in the area. According to the National Weather Service on October 16th, 2006 Brazoria County received upwards of 8 inches of rain.

It is likely that the data in this section underestimate the flooding problem for the following reasons:

1. NFIP records do not include claims data prior to 1978, so there could have been additional losses not shown here.
2. Policy holders may not have submitted claims for smaller floods for fear of it affecting their coverage or premium rates.
3. Only data for listed repetitive loss properties were reviewed. There could be other properties that have been repeatedly flooded, but did not have insurance at the time of the flood or did not submit claims.

The losses only account for items covered by the insurance policy. Things not covered include living expenses during evacuation, swimming pools, and automobiles.
III. Drainage Information

The UNO-CHART team examined three areas of related information on the area’s drainage. Those three areas are:

A. Mustang Bayou
B. Flood Control
C. Roadside Ditches

A. Mustang Bayou: The City of Alvin relies on a number of bayous and ditches to drain stormwater from the streets. The study area is directly south of Mustang Bayou which has a drainage area of roughly 60 square miles\(^1\). There is one major tributary to Mustang Bayou, Ditch M-1, which is a man-made ditch in the western portion of Alvin that outfalls into Mustang Bayou and provides drainage for the southwestern part of Alvin. Mustang Bayou’s floodway covers parts of the study area as shown in Figure 3 below.

![Figure 3: Mustang Bayou Floodway](image)

Mustang Bayou is unable to carry a 25-year rain event without overbank flooding occurring; the most serious of which occurs in the City of Alvin, directly upstream from the study area along SH 6\(^2\). When this floods, it makes it difficult for residents in the study area to evacuate the area. Due to the heavy development along Mustang Bayou within the City of Alvin, the needed right-of-ways for any channel improvements or enlargements are limited. The City of Alvin is

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10 *Brazoria County Final Master Drainage Plan*, August 2002 by Klotz Associates
11 Ibid
responsible for the smaller drainage ditches while the Brazoria County Conservation and Reclamation District #3 is responsible for Mustang Bayou.\textsuperscript{12}

Mustang Bayou is known to flood at Lobitt Street; most likely due to a constriction upstream of the railroad tracks. There is also concern with the roadside ditches that have filled in over the years, and the height and crown of the streets that are unable to drain towards the bayou and ditches. Even with the roadside ditches clean and cleared, when Mustang Bayou reaches a certain level the water will back up into the streets.

**B. Flood Control Projects:** There have been several flood control projects along Mustang Bayou over the years. As already mentioned, the heavy development along Mustang Bayou in the city has caused problems with gaining the necessary right-of-ways for channel improvements or enlargements. Therefore, flood control efforts have focused on other types of projects.

In 2005, the Brazoria County Conservation and Reclamation District #3 funded and built a 240-acre detention area northwest of the study area along CR 190. This helps relieve some of the runoff that would have to be conveyed by the bayou. There is another 180 acre detention pond that was placed to the southeast of the study area east of Mustang Road. Mustang Bayou has also been widened by ten feet in the segment that is directly upstream and to the west of the study area to increase the bayou's capacity.

There was a watershed flood protection planning study conducted for the M-1 ditch recently, and although this watershed is to the east/southeast of the study area the improvements will have a positive effect on the flooding. When the M-1 ditch starts to flood, overland flows back up into Mustang Bayou. The proposed solutions will improve the overland flow coming from the M-1 and reduce flows into Mustang Bayou and the study area.

**C. Roadside Ditches:** Residents have expressed their concern over the roadside ditches being overgrown and clogged. The City of Alvin has been working on improving the roadside ditches by developing a monthly mowing schedule. Each week of the month a new area of the city is having its ditches mowed and cleared. The City only mows ditches that are very deep. The City is also working towards improving the roadside ditches by opening them up for more detention space as seen in the figures below.

\textsuperscript{12} *Alvin Master Drainage Plan; Preliminary Phase, June 2008 by Klotz Associates*
IV. Data Sheets

As discussed in Step 1: Neighborhood Notification, the letter that was mailed out to the residents included a data sheet. This data sheet offered residents the opportunity to provide UNO-CHART with details about their flooding experiences and to voice their concerns regarding the flooding in the area. The letters and data sheets were printed in both English and Spanish.

Of the 178 properties to which letters and data sheets were sent, twenty-one were returned to UNO-CHART as vacant or otherwise undeliverable. Of the remaining 157, twenty-eight were mailed back completed; four of which were completed in Spanish. The response rate for the data sheets is 17.8%, which for a study of this nature is considered to be good.

The residents who completed their data sheet and returned them to UNO-CHART offered insight into the flooding issues in the area:

- 86% have reported their property being flooded or having a water problem
- The most reported flood events were Hurricane Ike (9/13/08) and on April 18, 2009
- 64.3% of respondents cite drainage from a nearby home as the reason they have flooded
- 60.7% of respondents cite a clogged or undersized drainage ditch as the source of their flooding
- 67.85% of respondents have reported taking on a mitigation measure to protect their property

The full results of the homeowner’s data sheets can be found in Appendix C of this report.

V. On-Site Data Collection

On May 4th and June 11th 2010 the UNO-CHART team visited the study area and collected data on each property. The team collected information such as the elevation of each structure above the street and the grade, the type of foundation, and the type of structure.

Ninety-two structures in the area are built on slab (52%), eighty-one are on a crawlspace (46%) and the remaining five (3%) are on piles and/or posts. The average height above grade is actually at grade for some structures in the area (37.5%) while other structures (38.76%) are also at street level. 97% of all structures are single-story, and many (42.69%) are wood frame buildings. A Summary of these data can be found in Appendix E.

Problem Statement

Based on the data collected from the five sources of information (community reports and plans, flood insurance data, drainage information, the property owners, and on-site surveying), the following bullets summarize the repetitive flooding problems in the area:

- Structures in the study area fall within the less risky X Zone, but also in the more risky AE Zone and the very risky Mustang Bayou floodway.
- Flooding is caused by heavy rains, but aggravated by two problems:
  - Mustang Bayou’s channel cannot carry all the runoff that drains to it
  - The street drainage ditches are overgrown, or otherwise unable to convey water to the Bayou and out of the area
- There have been some drainage improvements made to Mustang Bayou, but they have not stopped all flooding.
There are 178 properties subject to flooding. Twenty of the insured properties have been flooded to the extent that they qualify as repetitive loss structures under the NFIP. In the study area, five of which are severe repetitive loss properties. These twenty repetitive loss properties have made 48 flood insurance claims for a total of $794,126.00 since 1978.

Step 3: Mitigation Measures
Knowing the flooding history, and types and condition of the buildings in the area leads to the third step in the area analysis procedure — a review of alternative mitigation approaches to protect properties from, or reduce, future flood damage. Property owners should look at these alternatives but understand they are not all guaranteed to provide protection at different levels of flooding. Seven approaches were reviewed:

I. Acquisition
II. Elevating the houses above the 100-year flood level
III. Barriers to floodwaters
IV. Dry floodproofing
V. Utility protection
VI. Drainage improvements
VII. Maintaining flood insurance coverage on the building

I. Acquisition
This measure involves buying one or more properties and clearing the site. If there is no building subject to flooding, there is no flood damage. Acquisitions are usually recommended where the flood hazard is so great or so frequent that it is not safe to leave the structure on the site. An alternative to buying and clearing the whole subdivision is buying out individual, “worst case,” structures with FEMA funds.

A. Cost: This approach would involve purchasing and clearing the lowest or the most severe repeatedly flooded homes. If FEMA funds are to be used, three requirements will apply:

1. The applicant for FEMA must demonstrate that the benefits exceed the costs, using FEMA’s benefit/cost software.
2. The owner must be a willing seller.
3. The parcel must be deeded to a public agency that agrees to maintain the lot and keep it forever as open space.

B. Feasibility: Due to the high cost and difficulty to obtain a favorable benefit-cost ratio in shallow flooding areas, acquisitions are reserved for the worst case buildings. Not everyone wants to sell their home, so a checkerboard pattern of vacant and occupied lots often remains after a buyout project, leaving “holes” in the neighborhood. There is no reduction in expenses to maintain the neighborhood’s infrastructure for the City, although the tax base is reduced. The vacant lots must be maintained by the new owner agency, and additional expense is added to the community. If the lot is only minimally maintained, its presence may reduce the property values of the remaining houses. As mentioned earlier, there were acquisitions along Lobitt, but not for floodplain management. The City of Alvin is not considering acquisitions at this time for the above reasons.
II. Elevation
Raising the structure above the flood level is generally viewed as the best flood protection measure, short of removing the building from the floodplain. All damageable portions of the building and its contents are high and dry during a flood, which flows under the building instead of into the house. Houses can be elevated on fill, posts/piles, or a crawlspace. A house elevated on fill requires adding a specific type of dirt to a lot and building the house on top of the added dirt. A house elevated on posts/piles is either built or raised on a foundation of piers that are driven into the earth and rise high enough above the ground to elevate the house above the flow of flood water.

A house elevated on a crawlspace is built or raised on a continuous wall-like foundation that elevates the house above the flood level. If a crawlspace is used, it is important to include vents or openings in the crawlspace that are appropriately sized: one square inch for each square foot of the building’s footprint. Figure 6 shows an elevated structure in the Alvin study area.

A. Cost: Most of the cost to elevate a building is in the preparation and foundation construction. The cost to elevate six feet is little more than the cost to go up two feet. Elevation is usually cost-effective for wood frame buildings on posts/piles or crawlspace because it is easiest to get lifting equipment under the floor and disruption to the habitable part of the house is minimal. Elevating a slab house is much more costly and disruptive. In Alvin, 52 percent of the houses in the study area are on a slab. The actual cost of elevating a particular building depends on factors such as its condition, whether it is masonry or brick faced, and if additions have been added on over time. While the cost of elevating a home can be high, there are funding programs that can help. The usual arrangement is for a FEMA grant to pay 75% of the cost while the owner pays the other 25%. In the case of elevating a slab foundation, the homeowner’s portion could be as high as $25,000 or more. In some cases, assistance can be provided by Increased Cost of Compliance (ICC) funds, which is discussed on page 30, or state funds.

B. Feasibility: Federal funding support for an elevation project requires a study that shows that the benefits of the project exceed the cost of the elevation. Project benefits include savings in insurance claims paid on the structure. Elevating a masonry home or a slab can cost up to $100,000, which means that benefit/cost ratios may be low. Looking at each property individually could result in funding for the worst case properties, i.e., those that are lowest, subject to the most frequent flooding, and in good enough condition to elevate.

III. Barriers to Floodwaters
Small floodwalls, levees, or berms could be constructed around one or more properties if flood depths are less than 3 feet. Small floodwalls are appropriate for some of the homes in the Alvin study area, since 70 percent of the respondent said they had experienced up to 3 feet of floodwater during a flood event. Homes that typically receive three feet of floodwater or less, or
where the water does not stay up for a considerable amount of time, can benefit from small floodwalls, levees or berms.

Levees and berms are more suitable for larger lots, and small floodwalls that are located close to the house are appropriate for suburban style neighborhoods with front and side yard space. Given the suburban styling of the Alvin study area and neighborhood as a whole, floodwalls are more appropriate than levees and berms that take up space in the smaller lots.

Given the flood depths reported by residents on the returned data sheets, barriers could be an appropriate mitigation measure for some homes in the Alvin study area; although 56% of respondents reported that the floodwaters have remained up between one and seven days. Residents who experience floodwaters that remain for several hours or days should not consider barriers to floodwaters, as seepage can occur and water will end up inside the barrier. The more permeable the soil, the more floodwaters seep under the barrier.

The map on the next page shows the different types of soils in the study area. This map is intended for informational purposes only, and should not be used to determine the soil type at a particular location. It is imperative to test the soils type at any location when considering a barrier to floodwaters.

Homeowners who are interested in constructing a barrier to protect their house should consider the following requirements:

- A method to close openings, such as the door in the photo in Figure 11 on page 23. Generally, this requires “human intervention,” meaning someone needs to be available and have enough time to take action.
- Relatively impervious soils to minimize seepage under the floodwall.
- A system to prevent sanitary sewer backup from flowing into the building.
- A system of drain tile (perforated pipes) that collects water that falls or seeps into the protected area and sends it to a collecting basin or “sump.”
- A sump pump to send the collected water outside the barrier (see figure 10 on page 22).
- Power to operate the sump pump around the clock during a storm.
The lines on the map separate the different types of soils. The numbers on the map designate the different soils types, and they are:

- Bernard clay loam - 7
- Bernard-Urban land complex - 9
- Edna fine sandy loam - 13
- Leton loam - 27
- Lake Charles clay - 24

All of these soils types are considered to be “somewhat poorly drained,” except for the Leton loam which is considered to be “poorly” drained. This means that these soil types are not very permeable, which is preferable for a barrier such as a small floodwall. It is important to have a soil sample checked by a professional to determine the exact permeability.

**A. Cost:** The cost of a local barrier depends on the depth of flooding and the amount of engineering put into the design. Where flooding is only inches deep and of short duration, almost any barrier of concrete or earth will work. The most conservative cost estimate for a

<table>
<thead>
<tr>
<th>Table 3: Floodwall Cost Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two Foot high reinforced concrete cantilever wall, 168 feet @ $200/foot</td>
</tr>
<tr>
<td>Internal drainage and sump pump system</td>
</tr>
<tr>
<td>Sewer backup valve</td>
</tr>
<tr>
<td>Generator for power outages</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
</tr>
</tbody>
</table>
floodwall is based on a two foot high engineered cantilevered concrete floodwall. A cantilevered wall has a footing to provide stability and keep the water pressure from pushing it over. The budget shown in Table 3 on the previous page is for a 40’x 40’ home with a wall one foot outside the building wall. Labor accounts for about half of the price in the cost estimate. It should be noted that smaller, non-engineered walls such as the ones in Figures 9 and 10 have been built by their owners for less than $10,000. FEMA does not fund individual floodwalls for residential properties; therefore, the homeowner must pay 100% of the cost for a floodwall. However, each person can determine how much of their own labor they want to contribute (which reduces out-of-pocket costs) and whether the cost of the wall is worth the protection from flooding that it provides.

IV. Dry Floodproofing
This measure keeps floodwaters out of a building by modifying the structure. Walls are coated with waterproofing compounds or plastic sheeting. Openings (i.e.; doors, windows, and vents) are closed either permanently, or temporarily with removable shields or sandbags. A floodproofing project has three components:

- Make the walls watertight. This is easiest to do for masonry or brick faced walls. The brick or stucco walls can be covered with a waterproof sealant and bricked or stuccoed over with a veneer to camouflage the sealant. Houses with wood, vinyl, or metal siding need to be wrapped with plastic sheeting to make walls watertight, and then covered with a veneer to camouflage and protect the plastic sheeting.
- Provide closures, such as removable shields or sandbags, for the openings; including doors, windows, dryer vents and weep holes.
- Account for sewer backup and other sources of water entering the building. For shallow flood levels, this can be done with a floor drain plug or standpipe; although a valve system is more secure.

As seen in Figure 11 below, dry floodproofing employs the building itself as part of the barrier to the passage of floodwaters, and therefore this technique is only recommended for buildings with
slab foundations that are not cracked. The solid slab foundation prevents floodwaters from entering a building from below.

![Figure 11: A Dry Floodproofed house](image)

Also, even if the building is in sound condition, tests by the Corps of Engineers have shown that dry floodproofing should not be used for depths greater than 3 feet over the floor, because water pressure on the structure can collapse the walls and/or buckle the floor. Dry floodproofing is a mitigation technique that is appropriate for some houses in the Alvin study area: those with slab foundations that typically receive floodwater up to three feet in the house. From the fieldwork it was found that eighty-nine percent of the houses in the analysis area are on slab foundations, and according to the data sheet responses seventy-six percent of the respondents experienced three feet of flooding.

Not all parts of the building need to be floodproofed. It is difficult to floodproof a garage door, for example, so some owners let the garage flood and floodproof the walls between the garage and the rest of the house. Appliances, electrical outlets, and other damage-prone materials located in the garage should be elevated above the expected flood levels. Examples of floodproofed houses can be seen in Figures 12 through 15 on page 24.

Dry floodproofing has the following shortcomings as a flood protection measure:

- It usually requires human intervention, i.e., someone must be home to close the openings.
- Its success depends on the building’s condition, which may not be readily evident. It is very difficult to tell if there are cracks in the slab under the floor covering.
- Periodic maintenance is required to check for cracks in the walls and to ensure that the waterproofing compounds do not decompose.
- There is no government financial assistance programs available for dry floodproofing, therefore the entire cost of the project must be paid by the homeowner.
- The NFIP will not offer a lower insurance rate for dry floodproofed residences.
A. **Cost:** The cost for a floodproofing project can vary according to the building’s construction and condition. It can range from $5,000 to $20,000, depending on how secure the owner wants to be. Owners can do some of the work by themselves, although an experienced contractor provides greater security. Each property owner can determine how much of their own labor they can contribute and whether the cost and appearance of a project is worth the protection from flooding that it may provide.

B. **Feasibility:** As with floodwalls, floodproofing is appropriate where flood depths are shallow and are of relatively short duration. It can be an effective measure for some of the structures and flood conditions found in the Alvin study analysis area. It can also be more attractive than a floodwall around a house.

V. **Utility Protection**
This measure applies to several different utilities that can be adversely affected by floodwaters such as:

- Heating, Ventilation, and Air Conditioning (HVAC) systems
- Fuel meters and pipes
- Electrical service boxes, wiring and fixtures
Damage to utilities can prevent a residence that remains structurally sound after a flood from being reoccupied. Retrofitting utilities includes things as simple as raising them above the flood level and building small walls around furnaces and water heaters to protect from shallow flooding. According to the homeowner’s data sheets, forty-one percent (41%) of respondents answered that they had moved utilities and/or contents to a higher level as a mitigation measure.

FEMA document 348: Protecting Building Utilities from Flood Damage covers various ways to protect utilities; whether the building is a new construction, declared substantially damaged, or simply an existing structure in need of retrofitting, this document covers different techniques used in protecting utilities.

A. Cost: The cost for protecting utilities varies and is dependent upon the measure itself, condition of the system, structure, and foundation. A lot of the measures can be performed by the homeowners themselves, although it is always a good idea to consult a professional contractor and/or engineer (depending on the project). The costs can be lower when done as
part of a repair or remodeling project. Residents interested in pursuing a retrofitting measure to protect their utilities should contact the City of Alvin to determine whether a permit is required.

B. Feasibility: Given that the flooding experienced by the homeowners in the Alvin study area includes both shallow and deep flooding, utility protection is an acceptable mitigation measure. Interested homeowners should examine their flooding history and decide if utility protection is an appropriate measure for their building.

VI. Drainage Improvements
Klotz and Associates prepared a Master Drainage Plan (“the Plan”) for the entire City of Alvin in 2008. The Plan has a list of recommendations that were created after reviewing previous studies and reports. There are several different drainage improvements called for in the Plan, and these improvements are summarized in Table 4 on the next page.

There are other recommendations given in the Plan that would not necessarily have a direct impact on the flooding, but may have indirect impacts. Those recommendations include:

- Creating a Mustang Bayou Steering Committee with the City of Alvin, Texas Department of Transportation and Development (TxDOTD), and the Brazoria County Conservation & Reclamation District #3.
  - There is an informal steering committee in place between the City and the Brazoria County Conservation & Reclamation District #3. Plans to establish a formal committee are being considered by both entities.
- Creating a flood complaint website: a database using a website provided by the City of Alvin for the residents.
  - Currently, residents can report flooding issues on the City’s website: www.alvin-tx.gov. The website is also host to all sorts of useful information regarding flood protection and safety.

VII. Maintaining Flood Insurance

Although not a mitigation measure that reduces property damage from a flood, a National Flood Insurance Program policy has the following advantages for the homeowner or renter:

- A flood insurance policy covers surface flooding from the overflow of inland or tidal waters or from storm water runoff.
- Flood insurance may be the only source of assistance to help owners of damaged property pay for cleanup and repairs. There are eight flood events listed in Table 3, but only one of them was severe enough to qualify for disaster assistance (Hurricane Ike).
- Once in effect there is no need for human intervention\(^{13}\).
- Coverage is available for the contents of a home as well as for the structure
- Renters can buy contents coverage, even if the building owner does not buy coverage for the structure itself.

\(^{13}\) There is a 30-day waiting period for a new flood insurance policy before it goes into effect.
A. Cost: Flood insurance rates are based on several factors including what flood zone the building falls in and the age of the structure. Generally, homes in the X zone have lower flood insurance rates than those in Special Flood Hazard Areas (SFHA) because the X zone indicates a lower risk from flooding. The homes in the study area fall in the A and X Zones.

Homes constructed before December 31st, 1974 in the City of Alvin are “pre-FIRM” buildings, which means that they were built before the date of the first FIRM for the community, and are thus eligible for the “subsidized” flood insurance premium rates.

A building that is located in the A flood zone and constructed or substantially improved after the date of the most current FIRM — such as one built or substantially improved in 2010 — is required to be built above the base flood elevation and is therefore subject to rates based on the

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Description of work to be done</th>
<th>Estimated cost to implement the recommendations</th>
<th>Work done to date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application to TWDB</td>
<td>Submit application to the Texas Water Development Board for flood mitigation projects</td>
<td>$8,000 per application 1 application = $8,000</td>
<td>Waiting for the City to develop its own Mitigation Action Plan</td>
</tr>
<tr>
<td>Model Updates</td>
<td>Update hydraulic and hydrologic models on Mustang Bayou and specific tributaries; Remap floodplains in the City according to FEMA standards</td>
<td>$30,000 for minor streams $50,000 for major streams 7 minor + 2 major streams = $360,000</td>
<td>Waiting for the City to develop its own Mitigation Action Plan</td>
</tr>
<tr>
<td>Bridge/culvert obstructions</td>
<td>Clear overgrown shrubs and remove bridge/culvert obstructions; regrade and clear roadside ditches</td>
<td>$5,000 per bridge/culvert 24 bridges/culverts = $120,000</td>
<td>Complete; replacing all wood bridges</td>
</tr>
<tr>
<td>Bridge/culvert upgrades</td>
<td>Upgrade bridges and culverts to increase conveyance and reduce flooding (with appropriate detention ponds)</td>
<td>$100,000 per bridge/culvert 30 bridges/culverts = $3 million</td>
<td>Ongoing, based on a case by case need</td>
</tr>
<tr>
<td>Improving Mustang Bayou</td>
<td>Concrete-line Mustang Bayou within the city limits to reduce flooding and increase conveyance</td>
<td>$ 1 million per rive mile 4 miles = $4 million</td>
<td>Waiting on funding</td>
</tr>
<tr>
<td>Diversions</td>
<td>Build diversion channels from various tributaries into Mustang Bayou</td>
<td>$80,000 per diversion mile 1.5 miles = $120,000</td>
<td>Waiting on Model Updates and funding</td>
</tr>
<tr>
<td>Detention</td>
<td>Construct detention ponds and basins (can be used to mitigate channel improvements)</td>
<td>$100,000 per acre 300 acres $ 30 million</td>
<td>Waiting on Model Updates and funding</td>
</tr>
</tbody>
</table>
actual risk rather than a subsidized rate. Rates on pre-FIRM buildings are subsidized because the flood risk was unknown at the time of construction.

Table 5 shows the rates for a policy with $150,000 coverage on the building. For example, a house that meets the BFE with a $150,000 building/$60,000 contents policy will cost the homeowner approximately $1,218 annually to insure. If a pre-FIRM house in the SFHA is elevated to 1 foot above the BFE, the owner will be able to take advantage of the much lower post-FIRM rates, approximately $745 annually.

B. Community Rating System (CRS): The Community Rating System is a “voluntary incentive program that recognizes and encourages community floodplain activities that exceed the minimum National Flood Insurance Program (NFIP) requirements” (www.FEMA.gov). Participating communities are rewarded with reduced insurance premiums. Communities that join the CRS complete floodplain management activities that are worth a certain amount of credit. The more credit earned, the better the class ranking of that community. The CRS has 10 classes; a Class ranking of 10 carries the lowest flood insurance premium reduction, whereas a Class 1 carries the maximum discount. The City of Alvin is expected to enter the CRS at a Class 8 effective October 2011.

VII. Possible Funding Sources: There are several possible sources of funding for mitigation projects:

A. FEMA grants: HMGP, SRL, FMA, & PDM
B. Flood Insurance
C. Rebates
D. Small Business Administration Mitigation Loans

A. FEMA grants: Most of the FEMA programs provide 75% of the cost of a project. In most Gulf communities, the 25% non-FEMA share is paid by the benefitting property owner. Each program has different Congressional authorization and slightly different rules.
1. The Hazard Mitigation Grant Program (HMGP): The HMGP provides grants to States and local governments to implement long-term hazard mitigation measures after a major disaster declaration. Projects must provide a long-term solution to a problem (e.g., elevation of a home to reduce the risk of flood damages as opposed to buying sandbags and pumps to fight the flood). Examples of eligible projects include acquisition and elevation, as well as local drainage projects.

2. The Severe Repetitive Loss Program (SRL): The Severe Repetitive Loss (SRL) grant program funds mitigation projects for properties on the severe repetitive loss list. Eligible flood mitigation projects include:
   - Acquisition and demolition or relocation of structures that are listed on FEMA’s severe repetitive loss list and conversion of the property to open space
   - Elevation of existing SRL structures to at least the Base Flood Elevation (BFE).
There is a new SRL ICC Program that can be used to cover the non-FEMA share of the cost. That program is discussed under Flood Insurance on page 30 of this report.

3. The Flood Mitigation Assistance Program (FMA): FMA funds assist States and communities in implementing measures that reduce or eliminate the long-term risk of flood damage to structures insured under the NFIP.
   - Project Grants to implement measures to reduce flood losses, such as elevation, acquisition, or relocation of NFIP-insured structures. States are encouraged to prioritize FMA funds for applications that include repetitive loss properties; these include structures with 2 or more losses each with a claim of at least $1,000 within any ten-year period since 1978.

4. Pre-Disaster Mitigation Program (PDM): The Pre-Disaster Mitigation (PDM) program provides funds to states, territories, Indian tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. For more information visit [http://www.fema.gov/government/grant/pdm/index.shtm](http://www.fema.gov/government/grant/pdm/index.shtm). These FEMA grants and the mitigation projects that they cover are summarized in Table 6.

<table>
<thead>
<tr>
<th>Types of Projects Funded</th>
<th>HMGP</th>
<th>FMA</th>
<th>PDM</th>
<th>RFC</th>
<th>SRL</th>
<th>ICC</th>
<th>SBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition of the entire property by a gov’t agency</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relocation of the building to a flood free site</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Demolition of the structure</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevation of the structure above flood levels</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Replacing the old building with a new elevated one</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Local drainage and small flood control projects</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry floodproofing (nonresidential or historic buildings)</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent paid by Federal program</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
<td>100%</td>
<td>75%</td>
<td>100%</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 6: Different FEMA grants and the projects covered under each

14 For more information please visit [http://www.fema.gov/government/grant/hmgp/index.shtm](http://www.fema.gov/government/grant/hmgp/index.shtm)
15 For more information please visit [http://www.fema.gov/government/grant/srl/index.shtm](http://www.fema.gov/government/grant/srl/index.shtm)
16 For more information please visit: [http://www.fema.gov/government/grant/fma/index.shtm](http://www.fema.gov/government/grant/fma/index.shtm)
B. Flood insurance: There is a special funding provision in the National Flood Insurance Program (NFIP) for insured buildings that have been substantially damaged by a flood, “Increased Cost of Compliance.” ICC coverage pays for the cost to comply with floodplain management regulations after a flood if the building has been declared substantially damaged. ICC will pay up to $30,000 to help cover elevation, relocation, demolition, and (for nonresidential buildings) floodproofing. It can also be used to help pay the 25% owner’s share of a FEMA funded mitigation project.

The building’s flood insurance policy must have been in effect during the flood. This payment is in addition to the damage claim payment that would be made under the regular policy coverage, as long as the total claim does not exceed $250,000. Claims must be accompanied by a substantial or repetitive damage determination made by the local floodplain administrator. For more information, contact the insurance agent who wrote your flood insurance policy or visit www.fema.gov/plan/prevent/floodplain/ICC.shtm. Coverage under the ICC does have limitations:

- It covers only damage caused by a flood, as opposed to wind or fire damage
- The building’s flood insurance policy must have been in effect during the flood
- ICC payments are limited to $30,000 per structure
- Claims must be accompanied by a substantial or repetitive damage determination made by the local floodplain administrator
- The Structure must be located in an A Zone.

The average claims payment in the study area is $16,511.58. With an average claim of that amount, it is not likely that many homes in the study area would sustain substantial damage from a flood event. Homeowners should make themselves aware of the approximate value of their homes, and in the case of incurring flood damage, be aware of the need for a substantial damage declaration in order to receive the ICC coverage.

Severe Repetitive Loss ICC Pilot Program: While the conventional ICC only covers buildings that are located in the Special Flood Hazard Areas (SFHA), there is a new pilot program that is aiming to target buildings not in the SFHA. Focusing specifically on Severe Repetitive Loss (SRL) buildings, this pilot program will offer ICC benefits to those SRL properties that are located in X zones and will include those SRL buildings that have grandfathered X zone rates. Under this new pilot program, the ICC benefits could be used to cover the homeowner’s 10% match in a SRL grant. This could be helpful to the 5 SRL properties in the Alvin study area.

Alternative language adopted into the local floodplain management ordinance would enable residents with shallower flooding to access ICC funding. Since local ordinances determine the threshold at which substantial damage and/or repetitive claims are reached, adopting language that would lower these thresholds would benefit the homeowners of repetitive loss properties. Adopting alternative language allows for cumulative damages to reach the threshold for federal mitigation resources more quickly, meaning that some of the properties in Alvin that sustain minor damage regularly would qualify for mitigation assistance through ICC.
C. Rebates: A rebate is a grant in which the costs are shared by the homeowner and another source, such as the local government, usually given to a property owner after a project has been completed. Many communities favor it because the owner handles all the design details, contracting, and payment before the community makes a final commitment. The owner ensures that the project meets all of the program’s criteria, has the project constructed, and then goes to the community for the rebate after the completed project passes inspection.

Rebates are more successful where the cost of the project is relatively small, e.g., under $5,000, because the owner is more likely to be able to afford the bulk of the cost. The rebate acts more as an incentive, rather than as needed financial support\(^\text{17}\).

D. Small Business Administration Mitigation Loans: The Small Business Administration (SBA) offers mitigation loans to SBA disaster loan applicants who have not yet closed on their disaster loan. Applicants who have already closed must demonstrate that the delay in application was beyond their control.

Measures eligible for SBA mitigation loans may only protect real estate property, not personal items, from the same type of future declared disaster. For example mitigation loans made following a flood can only be used for a measure to protect against future flooding, not a tornado. If the measure existed prior to the declared disaster, an SBA mitigation loan will cover the replacement cost. If the measure did not exist prior to the declared disaster the mitigation loan will only cover the cost of the measure if it is deemed absolutely necessary for repairing the property by a professional third-party, such as an engineer\(^\text{18}\).

**Step 4: Coordination**

Coordination with relevant agencies, offices, and organizations is an important step in the analysis process. This step helps to open lines of communication among those interested in flood protection in the Alvin area and to see what other groups are addressing the flood problems.

The following agencies and organizations were contacted by the UNO-CHART team in order to complete this analysis:

- FEMA Region VI, Mitigation Office
- Texas Water Development Board
- City of Alvin, Department of Community Development
- City of Alvin, Department of Public Services
- City of Alvin, GIS Department
- Brazoria County Conservation and Reclamation District # 3
- United States Army Corps of Engineers, Galveston District

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\(^{17}\) More information on rebates can be found in the Corps of Engineers’ report Local Flood Proofing Programs found at: [http://www.nwo.usace.army.mil/nfpc/NFPC_Publications.htm](http://www.nwo.usace.army.mil/nfpc/NFPC_Publications.htm).

\(^{18}\) For more information visit the SBA Disaster Loans home page on the web at [http://www.sba.gov/services/disasterassistance/](http://www.sba.gov/services/disasterassistance/)
Table 7: Summary of the Alternative Mitigation Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition</td>
<td>Removes the property from the floodplain</td>
<td>Removes the City’s tax base while the cost of upkeep remains</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Checkerboard Effect</td>
</tr>
<tr>
<td>Elevation</td>
<td>More secure flood protection</td>
<td>High cost</td>
</tr>
<tr>
<td></td>
<td>Flood insurance rate reduction</td>
<td>Need source of non-FEMA cost share</td>
</tr>
<tr>
<td>Floodwalls</td>
<td>Effective for shallow flooding</td>
<td>Subject to seepage if water stays up for a long time</td>
</tr>
<tr>
<td>Flydry Floodproofing</td>
<td>Low cost</td>
<td>Exposes homes to wall/floor damage</td>
</tr>
<tr>
<td>Utility Protection</td>
<td>Homeowners can take on most projects themselves</td>
<td>Does not protect the structure itself</td>
</tr>
<tr>
<td></td>
<td>Cost effective</td>
<td></td>
</tr>
<tr>
<td>Flood Insurance</td>
<td>In effect as long as policy is renewed</td>
<td>Does not prevent flood damage (but does provide funds for repairs)</td>
</tr>
<tr>
<td></td>
<td>Works for all flood levels</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Under ICC, can be a source of funds for elevation</td>
<td></td>
</tr>
<tr>
<td>Drainage Improvements</td>
<td>Will decrease the frequency and severity of the flooding</td>
<td>Securing funding for the larger projects will take time as they are of higher costs, which will delay the projects</td>
</tr>
</tbody>
</table>

Step 5: Findings and Recommendations

I. Findings
Properties in the Alvin study area are subject to flooding due to heavy rains and drainage problems. When Mustang Bayou is inundated by heavy rains, it does not have the capacity to convey the water out of the area quickly enough. This is mainly due to constrictions upstream of the study area along the railroad tracks. There are projects outlined in the Alvin Master Drainage Plan; Preliminary Phase that will address these constrictions, as well as the capacity of Mustang Bayou. Funding for these projects will take some time to secure given the high costs.
There is also concern over the street ditches being filled in and unable to convey water from the street in a timely fashion.

II. **Recommendations**

a. **For the City of Alvin**
   - Encourage everyone to pursue a mitigation measure.
   - Assist interested property owners in applying for a mitigation grant.
   - Address the issues with the street drainage ditches in order to improve the drainage in the study area.
   - Institute a ditch maintenance program that encourages homeowners to frequently clear their ditches of debris to ensure open flow for stormwater.
   - Seek out and secure funding for the drainage improvements outlined in this report.
   - Complete the CRS application process and improve the City’s CRS classification.
   - Adopt this Area Analysis according to the process detailed in the CRS Coordinator’s Manual.

b. **For the residents of the study area**
   - Contact the City of Alvin for more information about possible funding opportunities
   - Review the alternative mitigation measures discussed in this analysis and implement those that are most appropriate for their situation.
   - Purchase and maintain a flood insurance policy on the home and its contents.

**Public Meeting – January 31st, 2011**

The UNO-CHART team – along with representatives from FEMA Region VI, French & Associates, the Texas Water Development Board, The Brazoria County Conservation & Reclamation District, and The City of Alvin – held a public meeting to discuss the findings of this report. The following bullet points summarize the discussion after that meeting:

- Residents reported that over the years the City has raised the roads in the study area so that they are now higher than the homes. Many feel this contributes to their flooding as the raised roads direct water directly into their yards.

- Some residents reported that in the past, flood gates were removed from drainage pipes that led into Mustang Bayou. The City contends that these flood gates would often rust open/shut and be rendered ineffective. The City is looking into the possibility of replacing those floodgates. “Duckbills” were also discussed as another possibility, funding permitted. See the photo.

- The City Manager attended the meeting and pledged to look into the street heights and the possibility of replacing the flood gates or other similar mechanisms to help the residents in the area who suffer from repetitive flooding.

An example of a duckbill; water pressure forces it open to drain without letting water flow back through it.
Report References

City of Alvin Code of Ordinances
FEMA Region VI Repetitive Flood Loss Data
Brazoria County Flood Insurance Rate Map
Protecting Building Utilities from Flood Damage. FEMA P-348, 2000
Houston-Galveston Area Council (HGAC) Regional Hazard Mitigation Plan, April 2006
Homeowners Guide to Retrofitting: Six ways to protect your house from flooding. FEMA-312, 1998
Reducing Damage from Localized Flooding – A guide for Communities. FEMA-511, 2005
The U.S. Army Corps of Engineers – Galveston District
Alvin study area residents
Appendix A: Letter to the Residents (English)

May 28th, 2010

City of Alvin Resident
Alvin, TX 77511
RE: Alvin Repetitive Flooding Project

Dear Alvin Resident:

The City of Alvin is reviewing ways to reduce some of our repetitive flooding problems. Your property is located in a part of Alvin that has tentatively been designated as an area to study for such possible improvements.

As part of this project, a team from the University of New Orleans' Center for Hazards Assessment, Response and Technology (UNO-CHART) is preparing a "local area analysis" for the target area. The approach which they take includes collecting some data specific to your property such as its flooding experiences.

UNO-CHART staff was in the area during the day on May 5th, 2010, collecting general information from the street, such as the type of foundation and approximate height of the house above the street. They will be back in the area during the day on June 11th finishing the work they started in May.

This work would be greatly improved with additional data that you might be able to provide. Attached is a data sheet that we hope you will complete and return by June 11th. After you fill the form out, please fold it, tape it, and mail it to the address on the flip side. A stamp has been provided.

After the analysis is completed, some preliminary recommendations will be developed. You will be invited to a meeting with us and the UNO-CHART team to review the findings. The meeting time and location will be advertised once the analysis is near completion. If you have any questions about this project, please feel free to call Michelle Holley-Lira at 281-388-4341 or Erin Patton from UNO-CHART, at (504)280-1404

Thank you for your assistance in helping us to complete this project.

Michelle Holley-Lira, P.E., CFM
Community Development Director
Mayo 28, 2010

Ciudad de Alvin, residente
Alvin, TX 77511
RE: Alvin repetitivas de desbordamiento de proyecto

Estimado de Alvin, residente:

La Ciudad de Alvin está examinando formas de reducir algunos de nuestros problemas repetitivos de las inundaciones. Su propiedad está situada en una parte de Alvin que tentativamente ha sido designada como un área de estudio para tales posibles mejoras.

Como parte de este proyecto, un equipo del centro de la Universidad de Nueva Orleans para la evaluación de riesgos, la respuesta y la tecnología (UNO-CHART) está preparando un “análisis de área local” para el área de destino. El enfoque adoptado incluye recolectar algunos datos específicos a su propiedad como sus experiencias de las inundaciones.

Personal de la UNO-CHART estuvo en el área durante el día de mayo 6to, 2010, recopilación de información general de la calle, tales como el tipo de base y altura aproximada de la casa por encima de la calle. Serán en el área durante el día en 11 de junio, acabado el trabajo que comenzaron en mayo.

Este trabajo se mejorarían enormemente con datos adicionales que es posible que pueda proporcionar. Adjunte una hoja de datos que esperamos se completar y devolverse por el 11 de junio. Después de rellenar el formulario fuera, por favor, déjelo, cíntelo y envíelo por correo a la dirección de la cera. Ha proporcionado un sello.

Una vez finalizado el análsis, será desarrollados algunas recomendaciones preliminares. Será convocada una reunión con nosotros y con el equipo de la UNO-CHART para revisar los resultados. El tiempo de la reunión y la ubicación se anunciarán una vez que el análisis es cerca de terminar. Si tiene alguna pregunta acerca de este proyecto, por favor llágame libre de Michelle Holley-Lina en el 281-388-4341 o Erin Patton desde UNO-CHART, al (504) 280-1404

Gracias por su ayuda para ayudarnos a completar este proyecto.

Atentamente,

Michelle Holley-Lina, P.E., CFM
Community Development Director
Appendix C Homeowner’s Data Sheet (English)

Alvin Repetitive Flooding Analysis
Flood Protection Data Sheet

Name: ________________________________, Alvin, TX

Property address: ________________________________, Alvin, TX

1. In what year did you move into the home at this address? ____________

2. What type of foundation does your house have? □ Slab □ Crawlspace
   □ Post/piles □ Other: ____________________________

3. If your house has a crawlspace or post/piles foundation, please indicate approximately how high from grade your lowest floor of living space is. ____________

4. Has the property ever been flooded or had a water problem? □ Yes □ No (If No, please skip to question 8)

5. In what year(s) did it flood? ____________

6. What was the deepest that the water got?
   □ Over first floor: ________________ deep
   □ In yard only: ________________ deep
   □ Water kept out of house or building by sandbagging or other protective measure

7. What was the longest time that the water stayed in the house? ____________ hours or ____________ days
   a. When was this? ____________ (month/year)

8. What do you feel was the cause of your flooding? Check all that affect your building.
   □ Drainage from nearby properties
   □ Storm surge from nearby waterways
   □ Clogged or undersized drainage catch
   □ Overflowing from nearby ditch
   □ Sanitary sewer backup
   □ Stormwater backup
   □ Floating water next to house
   □ Other: ____________________________

9. Have you taken any flood protection measures on your property?
   □ Moved utilities/contents to a higher level
   □ Elevated all or parts of the building
   □ Regraded yard to keep water away from building
   □ Installed drains or pipes to improved drainage
   □ Sandbagged when water threatened
   □ Waterproofed the outside walls
   □ Built a wall to keep water away
   □ Other: ____________________________

10. Did any of the measures checked in item 8 work? If so, which ones? If not, do you know why
    they didn’t work?

11. Do you have Flood insurance? □ Yes □ No

12. Are you interested in pursuing measures to protect the property from flooding?
    □ Yes □ No (If yes, please refer to our website (www.floodhelp.unl.edu) for useful
    information.

~~ Please return this data sheet by June 14th ~~
Appendix D: Homeowner’s Data Sheet (Spanish)

Alvin Análisis de las inundaciones repetitivas
Hoja de datos de protección de inundaciones

Nombre: 
Dirección de propiedad: _______________________________________, Al via, TX

1. En qué año movern en el hogar en esta dirección?

2. Que tipo de fundación tiene su casa? □ Slab □ Crawl space □ post pilas □ otros.

3. Si su casa tiene una Fundación Crawl space o post pilotes, siéntese indicar en aproximadamente como alto desde el grado de su piso más bajo del espacio de la vida.

4. La propiedad nunca ha sido inundada o tenía un problema de agua?
   □ S □ N (si “no”, por favor vaya a la pregunta 8)

5. En qué años inundan?

6. Lo que fue la más profunda que el agua?
   □ En el primer piso _________ profunda
   □ En el piso _________ profunda
   □ Agua mantuvo fuera de casa o edificio por _________ mes meses

7. Lo que fue el tiempo más largo que el agua se mantuvo en la casa? _________ horas o días de _________

8. ¿Qué le sensación fue la causa de la inundación? Todos los que afectan a su edificio. Marque □ Drenaje de propiedades cercanas □ Copia de seguridad de alcantarillado de tormenta □ Marcapasos donde las vías de las vías no amuralladas □ Copia de seguridad de alcantarillado sanitario
   □ Configuración de drenaje Clogged microcompressionado. Permanente de agua junto a la casa
   □ Overbank inundaciones de masa cercana □ Otros.

9. Han tenido cualquier inundación medidas de protección en su propiedad?
   □ Utilidades contadas de paso a un nivel superior, elevado de todos o parte de la construcción
   □ Pantalla de separación para mantener el agua lejos de estructuras impermeabilizadas, las paredes
   □ Juntar drenajes o tuberías para mejorar drenaje. Construcción de un muro para mantener el agua fuera
   □ Vuelva hasta cuando amenaza de agua □ Otros.

10. Hizo cuál de las medidas que se comprueba en el tema 8 del trabajo? Si es así, cuáles? Si no, sabe usted por qué no trabajan?

11. ¿Tiene usted seguro de inundación? □ S □ N

12. ¿Usted interesado en la consecución de las medidas para proteger la propiedad de las inundaciones?
   □ S □ N
   si, por favor consulte nuestro sitio Web (www.decdhelp.uco.edu) para útil información.

Vuelva esta hoja de datos por el 14 de junio.

38
Based on the data collected from the five primary and numerous secondary sources of information, the following bullets summarize the repetitive flooding problems in the area:

**Step 3: Mitigation Measures**

Knowing the flooding history, and types and condition of the buildings in the area leads to the third step in the area analysis procedure – a review of alternative mitigation approaches to protect properties from, or reduce, future flood damage. Property owners should look at these alternatives but understand they are not all guaranteed to provide protection at different levels of flooding. Five approaches were reviewed:

**Appendix E: Data Sheet Results**

<table>
<thead>
<tr>
<th>Total Respondents: 28</th>
<th>%</th>
<th>Answer</th>
<th>Number out of 28</th>
</tr>
</thead>
<tbody>
<tr>
<td>In what year did you move into the home at this address?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.7</td>
<td>No Response</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>7.1</td>
<td>1950 - 1960</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>17.8</td>
<td>1971 – 1980</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1981 -1990</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>17.8</td>
<td>1991 – 2000</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>21.4</td>
<td>2001 - 2010</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What type of foundation does your house have?</th>
<th>%</th>
<th>Answer</th>
<th>Number out of 28</th>
</tr>
</thead>
<tbody>
<tr>
<td>53.5</td>
<td>Slab</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>3.5</td>
<td>Crawlspace</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3.5</td>
<td>Post/Piles</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>32.1</td>
<td>Other:</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>21.4</td>
<td>Cement Blocks</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>10.7</td>
<td>Mixed</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

If your house has a crawlspace or post/piles, please indicate how high from grade your lowest floor is.

<table>
<thead>
<tr>
<th>%</th>
<th>Answer</th>
<th>Number out of 28</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5</td>
<td>0 – 1 foot</td>
<td>1</td>
</tr>
<tr>
<td>3.5</td>
<td>1 – 2 feet</td>
<td>1</td>
</tr>
<tr>
<td>7.1</td>
<td>Over 2 feet</td>
<td>2</td>
</tr>
</tbody>
</table>

Has the property ever been flooded or have a water problem?

<table>
<thead>
<tr>
<th>%</th>
<th>Answer</th>
<th>Number out of 28</th>
</tr>
</thead>
<tbody>
<tr>
<td>85.7</td>
<td>Yes</td>
<td>24</td>
</tr>
<tr>
<td>14.3</td>
<td>No</td>
<td>4</td>
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</tbody>
</table>
### Appendix E: Data Sheet Results (continued)

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<tr>
<th>Total Respondents: 28</th>
<th>%</th>
<th>Answer</th>
<th>Number out of 28</th>
</tr>
</thead>
<tbody>
<tr>
<td>In what years did it flood? (Multiple answers were allowed)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.7</td>
<td>1973</td>
<td>3</td>
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</tr>
<tr>
<td>3.5</td>
<td>1978</td>
<td>1</td>
<td></td>
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<tr>
<td>28.5</td>
<td>1979</td>
<td>8</td>
<td></td>
</tr>
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<td>3.5</td>
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<td></td>
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<tr>
<td>3.5</td>
<td>1988</td>
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<td>7.1</td>
<td>1989</td>
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<tr>
<td>3.5</td>
<td>2001</td>
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</tr>
<tr>
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<td>2002</td>
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<tr>
<td>3.5</td>
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<td>2006</td>
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<tr>
<td>3.5</td>
<td>2007</td>
<td>1</td>
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<tr>
<td>32.1</td>
<td>2008 (Hurricane Ike)</td>
<td>9</td>
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<td>32.1</td>
<td>2009</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>7.1</td>
<td>2010</td>
<td>2</td>
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</tr>
<tr>
<td>What was the deepest the water ever got? (Multiple answers were allowed)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.4</td>
<td>0-2 feet in the house</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>14.3</td>
<td>3-6 feet in the house</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>17.8</td>
<td>0-2 feet in the yard</td>
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</tr>
<tr>
<td>7.1</td>
<td>3-6 feet in the yard</td>
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</tr>
<tr>
<td>21.4</td>
<td>No Response</td>
<td>6</td>
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</tbody>
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## Appendix E: Data Sheet Results (continued)

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<th>Total Respondents: 28</th>
<th>%</th>
<th>Answer</th>
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<td>0-12 hours</td>
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<td></td>
<td>28.5</td>
<td>1-4 days</td>
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<td>21.4</td>
<td>5-7 days</td>
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<td></td>
<td>7.1</td>
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<td>10.7</td>
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<td>What was the longest time that the water stayed in the house? (Multiple answers were allowed)</td>
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<td></td>
<td>64.3</td>
<td>Drainage from nearby homes</td>
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<td>Storm surge from nearby waterway</td>
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<td>Sanitary sewer backup</td>
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<td>Standing water</td>
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</tr>
<tr>
<td></td>
<td>3.5</td>
<td>No Response</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>21.4</td>
<td>Other:</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td>Clean drains</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td>Streets not blocked</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td>Heavy rains, drainage pipe caps removed</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td>Bayou needs building up</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>7.1</td>
<td>Built a new subdivision nearby/Poor planning</td>
<td>2</td>
</tr>
</tbody>
</table>
## Appendix E: Data Sheet Results (continued)

<table>
<thead>
<tr>
<th>Total Respondents: 28</th>
<th>%</th>
<th>Answer</th>
<th>Number out of 28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have you taken any flood mitigation protection measures on your property?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Multiple answers were allowed)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>Moved utilities/contents to a higher level</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>7.1</td>
<td>Regraded yard to keep water out</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>7.1</td>
<td>Installed drains/pipes to improve drainage</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Sandbagged when water threatened</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>10.7</td>
<td>Elevated all or parts of the building</td>
<td>3</td>
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<tr>
<td></td>
<td>3.5</td>
<td>Waterproofed the outside walls</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>7.1</td>
<td>Built a wall to keep water away</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>21.4</td>
<td>No Response</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>7.1</td>
<td>Other:</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td>Cleaned drain by corner</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td>Will be building a wall</td>
<td>1</td>
</tr>
<tr>
<td>Do you have flood insurance?</td>
<td>85.7</td>
<td>Yes</td>
<td>24</td>
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<td></td>
<td>14.3</td>
<td>No</td>
<td>4</td>
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<tr>
<td>Are you interested in learning more about mitigation?</td>
<td>82.1</td>
<td>Yes</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>17.8</td>
<td>No</td>
<td>5</td>
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</tbody>
</table>