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# Executive Summary

The City of Bellaire has suffered costly damage from flooding. The geography and climate in the region give rise to conditions conducive to flooding. Most recently Hurricane Harvey inundated the City of Bellaire with flood waters causing extensive damage resulting in more than 29% of Bellaire homes experiencing structural flooding. To mitigate future flooding and threats to property and life, the City of Bellaire is updating its flood hazard mitigation plan in accordance with Community Rating System (CRS) credit program through the Federal Emergency Management Agency (FEMA).

The City of Bellaire has been certified with the Community Rating System (CRS) of the National Flood Insurance Program since 1993. Under the CRS, the flood insurance premiums of a community's residents and businesses are discounted to reflect that community's work to reduce flood damage to existing buildings, manage development in areas not mapped by the NFIP, protect new buildings beyond the minimum NFIP protection level, preserve and/or resort natural functions of floodplains, help insurance agents obtain flood data, and help people obtain flood insurance. There are 10 CRS classes. Class 1 requires the most credit points and gives the greatest premium reduction or discount. A community that does not obtain the minimum number of credit points is considered a Class 10 community and receives no discount on premiums. City of Bellaire currently holds a CRS classification of Class 7. This rating provides City residents a 15% reduction on their flood insurance premiums each year.

Bellaire is designated as a Repetitive Loss Community. To maintain its classification of 7, this Floodplain Management Plan must be submitted to the Insurance Services Office (ISO) with sufficient evidence that Bellaire is addressing the floodplain issue.

The purpose of the Floodplain Hazard Mitigation Report (Plan) is to provide a blueprint for the development and implementation of activities that will efficiently use public and private resources to reduce flood losses and encourage support for hazard mitigation activities among the public.

The Staff Technical Advisory Team (Staff) contributing to the development of the Plan, includes ChaVonne Sampson; Floodplain Manager, Michael Leech; Director of Public Works, Terrence Beaman; Chief Financial Officer, Darryl Anderson; Fire Chief, William Davidson; Building Official; Karl Miller; Director of Parks, Recreation, & Facilities, Shawn Cox; Administration Services Manager, and Paul A. Hofmann; City Manager. ARKK Engineers, LLC., Bellaire's Consulting Engineers (Technical Advisory Team) prepared the Plan, and include James Andrews and Marcus McRae.

The Flood Hazard Mitigation Task Force on Drainage Issues are performing oversight review and approval of the Plan. Task Force members are all citizens of Bellaire and it includes Chris Canonico, Yana Kristal, Menny Rosenbaum, Winfred Frazier, Michael Ling, Robyn Rosenblatt, Brian Sanford, Millie Hast, Jonathan Reichel, and David Roynance. The Council Liaison Team consists of Mayor Andrew Friedberg, Council Member Trisha Pollard, and Council Member David Montague.

One of the first steps in the planning process was to establish a list of flood hazards that the City encounters. Subsequent planning steps used this list to identify and assess the risks and issues relating to these hazards, and ultimately a set of goals evolved with associated action plans to mitigate the identified hazards. The three primary overarching goals that evolved during this process are:

1. Establish policies, procedures and activities for the safety and assurance for citizens of City of Bellaire.
2. Develop, fund, design and construct infrastructure improvements to mitigate the effects of flooding.
3. Evaluate and establish the City's position in floodplain regulation in terms of policies and management.

Based on these goals, the Task Force has developed a list of potential activities as part of an Action Plan for the City. This Action Plan provides the blueprint that will guide the City toward a set of projects, policies, and procedures designed to reduce the severity of flooding and its damaging impacts.

The activities for mitigation of floodwaters envisioned by the City have been driven by determining and assessing risk factors associated with flooding within the city, developing a mitigation plan to reduce potential losses identified in the risk assessment, and implementing an action plan to provide tangible solutions for achieving the goals and objectives outlined in the Mitigation Plan.

The City has made a serious commitment to mitigating the effects of flooding. As part of this commitment, the City will continue to implement several of its ongoing activities, while new activities have been identified to further reduce future flood damage. The City has an ongoing program of maintenance and repair of its existing storm sewer system. The storm sewer system is also updated annually with the construction of new storm sewers. These activities will help reduce flood damage to property and the threat to life and health. Through adoption of this Plan, the City underscores its commitment to continue to carry out activities to reduce the effects of flooding.

As this Floodplain Management Plan is developed, progress will be monitored and the Plan will be evaluated periodically so that revisions can be made to keep the Plan current.

# Purpose

The purpose of this Flood Hazard Mitigation Plan is to review and implement a strategy of programs, projects, and measures that will be adopted to reduce the adverse impacts of the flooding hazards that the City may encounter. This plan is designed to mitigate damage and loss, establish post-disaster recovery programs, and educate residents on disaster preparedness and avoidance.

This Plan will review and develop activities to reduce the effects of flooding in terms of damage and loss, and improving resident safety and awareness as well as the following.

- Provide a comprehensive review of possible activities and mitigation measures that can be conducted to minimize hazards;
- Identify existing and future flood-related hazards and their causes;
- Demonstrate the examples that the criteria used in the City land development programs account for the hazards faced by existing and new developments;
- Educate resident and property owners about the hazards, loss reduction measures, and the natural and beneficial functions of the floodplains;
- Assist in building public and political support for activities and projects that prevent new problems, reduce losses, and protect the natural and beneficial functions of floodplains; and
- Assist the City in meeting the goals and objectives of the community.

The Action Plan should provide tangible solutions for achieving the goals and objectives that will be outlined in the Mitigation Plan. Per Resolution No. 17-08, adopted on October 2, 2017 the Mitigation Plan will be outlined by the following focus areas:

- **Local**
  - Assess the Drainage Plan and Recommend Steps Presented by the City Engineer to Council in September 2016.
  - Assess drainage criteria for CIP project selection
  - Assess the hazards and risks related to street and utility flooding
  - Review the hazards and risks related to communications and emergency operations.
  - Review the economic impacts
- **Regulatory**
  - Assess the current Building Code Requirements

- Assess options and develop recommendations concerning whether to pursue property buyouts and potential FEMA funding participation.
- Review the City's Continuing participation in the Community Rating System (CRS) and the National Flood Insurance Program (NFIP)
- **Regionally**
  - Evaluate regional Flood Hazard Plans and their impact on the City of Bellaire
  - Recommend additional efforts
  - Recommend ways to facilitate and expedite current efforts.

# Plan Organization

## (CRS Activity 511.1)

Bellaire City Council, by Resolution No. 17-08<sup>1</sup> adopted on October 2, 2017, authorized the City Manager to establish a Flood Mitigation Task Force to update the Mitigation Plan and to develop actionable local, regulatory and regional policy recommendations for the prevention of future flooding. The City is currently adhering to the 2007 CRS Manual. By establishing the Flood Hazard Mitigation Plan Task Force and updating the City's current Flood Hazard Mitigation Plan, Bellaire will maintain compliance with National Flood Insurance program requirements. The Plan was written with the guidance of the City Manager for the Citizens Advisory Task Force On Drainage Issues (Task Force). Paul A. Hofmann, City Manager for the City of Bellaire, acted as its facilitator for development of the Plan.

Per Resolution No. 17-08 the roles and responsibilities of each group throughout the development of the updated Plan were as follows:

- **Task Force**
  - Identify and assess hazards associated with the problem of flooding and provided recommended solutions for those problems
  - Keep the public informed of its deliberation and recommendations, and any proposed changes to the floodplain structure for the City of Bellaire
  - Prepare a post-flood Hazard Mitigation Plan for the City of Bellaire
  
- **Council Liaison Team**
  - Monitor the level of citizen engagement
  - Ensure broad and ongoing communication
  - Recommend necessary council action
  
- **City Staff Technical Advisory Team (Staff)**
  - Provide support/analysis
  - Provide recommendations
  - Keep the team on track
  - Provide history/background information
  
- **Consulting Advisory Team**
  - Provide initial Risk Assessment & Mitigation Plan
  - Technical support and review
  - Assess effectiveness of recommendations.

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<sup>1</sup> See Appendix – Bellaire City Council Resolution No. 17-08

Members of the Task Force are all citizens of Bellaire. Members of the Task Force consisted of Bellaire Homeowners, builder and developers, utility company representatives and previous board and commissioner members. Members included Chris Canonico, Yana Kristal, Menny Rosenbaum, Win Frazier, Michael Ling, Robyn Rosenblatt, Brian Sanford, Millie Hast, Jonathan Reichel, and David Roynance.

The City Staff Technical Advisory Team (Staff) included ChaVonne Sampson (Floodplain Manager), Michael Leech (Director of Public Works), Terrence Beaman (Chief Financial Officer), Darryl Anderson (Fire Chief), William Davidson (Building Official), Karl Miller (Director of Parks, Recreation, & Facilities), Shawn Cox (Administration Services Manager), and Paul A. Hofmann (City Manager).

ARKK Engineers, LLC., Bellaire's Consulting Engineers (Consulting Advisory Team) prepared the Plan and included James Andrews and Marcus McRae.

The Council Liaison Team consisted of Mayor Andrew Friedberg, Council Member Trisha Pollard, and Council Member David Montague.

# Public Involvement (CRS Activity 511.2)

## Background

The Flood Hazard Mitigation Task Force was comprised of 10 members all of whom were Bellaire residents. These residents represented the following areas:

- Bellaire Homeowner
- Utility Company Representative
- Local Builder/Developer
- Previous Bellaire Board or Commission Member

Members of the Task Force are all private citizens of Bellaire. Members of the Task Force consisted of Bellaire Homeowners, builder and developers, utility company representatives and previous board and commissioner members. Members include Chris Canonico, Yana Kristal, Menny Rosenbaum, Winfred Frazier, Michael Ling, Robyn Rosenblatt, Brian Sanford, Millie Hast, Jonathan Reichel, and David Roynance.

## Public Notices/Information

In keeping with the charge of “keeping the public informed of its deliberations and recommendations”, the Task Force held a total of eight (8) public meetings. The Task Force also held a Public Hearing to allow the residents to provide input and feedback on the Draft Flood Hazard Mitigation Plan<sup>2</sup>. Each meeting, including the Public Hearing, had an agenda<sup>3</sup> and was posted, in accordance with the Texas Open Meeting Act, at least seventy-two (72) hours prior to the meeting. The following additional steps were also taken for each meeting:

- Posting of the agenda online at <http://bellairecitytx.iqm2.com/Citizens/default.aspx>
- Live video stream of the meeting at either <http://bellairecitytx.iqm2.com/Citizens/default.aspx>, or through Facebook Live
- “Notify Me”<sup>4</sup> Email Blast sent to over 3,700 subscribers with each Agenda
- Each agenda included a time for Public Comments

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<sup>2</sup> See Appendix – Flood Hazard Mitigation Plan/Matrix

<sup>3</sup> See Appendix – Agendas

<sup>4</sup> See Appendix – “Notify Me” Emails

- Posting of an Electronic Notebook<sup>5</sup> to provide pertinent information to Task Force Member and the Public. The Mayor made a blog post<sup>6</sup> on November 2, 2017, which highlighted the Electronic Notebook. The Electronic Notebook includes:
  - Task Force Roster and Contact Information
  - Outline of Final Report
  - Meeting Schedule
  - Local “Focus Area” Topics of Interest
  - Regulatory “Focus Area” Topic of Interest
  - Regional “Focus Area” Topics of Interest
  - FEMA Publications
  - Draft Report
  - Meeting Agendas & Notes
  - Meeting Videos & Presentations

Additional steps, including a “News Flash”<sup>7</sup> posting on the City website and a post on the Mayor’s Blog<sup>8</sup> were taken to market the Public Hearing held on Monday, January 29, 2018.

## Public Meetings

### Monday, October 30, 2017 (Regular Meeting):

The first meeting of the Flood Hazard Mitigation Task Force was held on Monday, October 30, 2017. At this meeting, Paul A. Hofmann, City Manager for the City of Bellaire, introduced the members of the Task Force (including Council Liaisons, City Staff, and Consultants) and gave a presentation<sup>9</sup> which reviewed the Task Force’s purpose and outlined roles and responsibilities. The Task Force was asked to provide feedback on the following before the next meeting:

- What are we trying to accomplish with the City of Bellaire drainage improvements?
- What are we trying to accomplish from a regulatory perspective?
- What are we trying to accomplish with other jurisdictions in the region?

### Tuesday, November 14, 2017 (Regular Meeting):

The November 14 meeting included a review of the responses received from the Task Force concerning the questions asked at the previous meeting, and a presentation on the Draft Hazard

<sup>5</sup> See Appendix – Electronic Notebook ([www.bellairctx.gov/taskforce](http://www.bellairctx.gov/taskforce))

<sup>6</sup> See Appendix – November 2, 2017 “Mayor’s Musings-Flood Hazard Mitigation Task Force Gets to Work” (<http://cityofbellairemayormusings.blogspot.com/2017/11/flood-hazard-mitigation-task-force-gets.html>)

<sup>7</sup> See Appendix – News Flash – “Flood Hazard Mitigation Task Force Public Hearing”

<sup>8</sup> See Appendix – January 25, 2018 “Mayor’s Musings-Task Force Public Hearing on Draft Flood Hazard Mitigation Plan – Jan. 29, 6:30 pm” (<http://cityofbellairemayormusings.blogspot.com/2018/01/task-force-public-hearing-on-draft.html>)

<sup>9</sup> See Appendix – Task Force Presentations

Mitigation plan. The presentation included a review of previous drainage studies and of the City Engineer's Report on Hurricane Harvey.

### **Tuesday, December 5, 2017 (Regular Meeting):**

The December 5 meeting included a presentation on the Draft Hazard Mitigation Plan, and provided time for the Task Force to provide input on the current draft, specifically:

- What risks and goals are not yet addressed concerning local drainage improvements?
- What risks and goals are not yet addressed concerning regulatory approach?
- What risks and goals are not yet addressed concerning regional efforts?

The Task Force was also asked to provide staff with a list of 'Overarching Goals' which outlined what the Task Force was trying to accomplish.

### **Tuesday, December 19, 2017 (Regular Meeting):**

The City Engineer presented to the Task Force an overview of Baseflood Elevations, specifically:

- How is it determined?
- What does it mean?
- How does a 100-year event impact Bellaire?

Additionally, the Task Force discussed the "Overarching Goals" provided to staff, and received a status update on the Draft Hazard Mitigation Plan.

### **Tuesday, January 9, 2018 (Regular Meeting):**

At their January 9 meeting, the Task Force was presented with review of the City of Bellaire current regulatory approach to mitigate flooding, a review of the "Overarching Goals", and a review of the unfinished draft matrix. Additionally, the Task Force reviewed the plan for the January 29 Public Hearing.

### **Monday, January 29, 2018 (Public Hearing):**

A Public Hearing was held on January 29, 2018 in the City of Bellaire's Council Chamber to seek public input on the Draft Flood Hazard Mitigation Plan. The Public was presented<sup>10</sup> the Draft Flood Hazard Mitigation Plan and a history of its development. The meeting was then opened for Public comments and questions regarding the Plan and other flood related issues. There were twelve (12) individual speakers who signed up<sup>11</sup> to address the Task Force. Each speaker was granted five (5) minutes to comment and pose questions. Comments and questions from the public were addressed to the Task force, who were able to refer questions to the staff as

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<sup>10</sup> See Appendix – January 29, 2018 Public Hearing Presentation

<sup>11</sup> See Appendix – January 29, 2018 Public Hearing Speaker Sign-Up Sheets

appropriate. The floor was then opened to the Task Force to comment and ask questions to Staff and the Consulting Advisory Team regarding comments from the Public.

**Tuesday, February 6, 2018 (Regular Meeting):**

On February 6, the Task Force met to review the comments received at the Public Hearing on January 29, 2018.

**Tuesday, February 20, 2018 (Regular Meeting):**

The Task Force met to review and finalize the Flood Hazard Mitigation Matrix. Members were asked to provide consensus on the activities listed in the Action/Implementation plan.

# Coordination with Other Agencies (CRS Activity 511.3)

## Background

The City of Bellaire is part of the 137 square mile Brays Bayou watershed<sup>12</sup>. The Brays Bayou watershed is located in southwest Harris County and portions of Fort Bend County and drains parts of the cities of Houston, Missouri City, Stafford, Bellaire, West University Place, Southside Place and Meadows Place. The bayou flows eastward from Fort Bend County to its confluence with the Houston Ship Channel. The Brays Bayou watershed is fully urbanized, although several large urban parks and regions of open space are located within the watershed.

## Coordination

A cooperative effort is currently active between Harris County Flood Control District (HCFCD) and the U.S. Army Corps of Engineers (Corps) to improve Brays Bayou. This \$480 million project will substantially reduce flooding risks in the Brays Bayou watershed. Encompassing more than 75 individual project components, Project Brays will help to reduce flooding risks by widening 21 miles of Brays Bayou, replacing or modifying 32 bridges to accommodate channel modifications and excavating four storm water detention basins that will hold a collective 3.5 billion gallons of storm water.

Upon completion, Project Brays will provided a 1% (100-year) level of protection along the main stem of Brays Bayou upstream of Beltway 8. After the construction of all elements of Project Brays, the area downstream of Beltway 8 will see the removal of the 1% (100-year) floodplain from approximately 15,000 homes and businesses in the watershed. A Conditional Letter of Map Revision (CLOMR) projects that much of the 100-year floodplain will be removed from the City of Bellaire.

The City of Bellaire is working with HCFD and other state and federal government entities to expedite improvements to Brays Bayou to add capacity and lower the flood stage water surface elevations.

On February 13, 2018 City's Consulting Advisory Team and City Staff met with City of Houston (COH) representatives to present<sup>13</sup> and discuss flooding issues that Bellaire encounters. City of Bellaire arterial street drainage systems service storm water from City of Houston. Bellaire

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<sup>12</sup> See Appendix – Map of Brays Bayou Watershed

<sup>13</sup> See Appendix – City of Bellaire presentation to City of Houston

representatives presented that this issue contributes to flooding during localized rain events due to less capacity in the Bellaire system.

City personnel also met with City of Houston personnel to discuss the Richmond Plaza North Drainage and Paving Improvements project<sup>14</sup>. This project is located upstream of Bellaire and it was determined that the City of Bellaire's Chimney Rock drainage system would not be adequate to accommodate runoff from this project. City of Bellaire and City of Houston agreed that a collaborative effort should take place to perform a drainage system study to determine a proposed level of service for the Chimney Rock drainage system as a first step in improving this area.

A Notice<sup>15</sup> to Surrounding Communities and Agencies was prepared and distributed. This Notice notified those communities and agencies of the preparation of the City of Bellaire Flood Hazard Mitigation Report. Those contacted were encouraged to provide comments and information relevant to the proposed Plan and solicited to work with the City to develop partnerships to address the regional problem of flooding.

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<sup>14</sup> See Appendix – Meeting with COH meeting minutes

<sup>15</sup> See Appendix – Notice to Surrounding Communities and Agencies

# Assess the Hazard (CRS Activity 511.4)

## Background

The City of Bellaire participates in the National Flood Insurance Program and the Community Rating System (CRS), a voluntary federal program that rewards communities that implement higher standards by providing discounts on flood insurance policies. Currently, there are approximately 4,783 Bellaire flood insurance policy holders and Bellaire holds a CRS classification of Class 7, which saves policy holders 15% on their flood insurance premiums each year. Bellaire is designated as a Repetitive Loss Community<sup>16</sup> and the current Floodplain map shows most of Bellaire to be within the 1% (100-year) flood plain<sup>17</sup>.

Over the last 24 months, Bellaire experienced three (3) significant flood events:

- April 18, 2016 (Tax Day Flood)
- May 25-27, 2016 (Memorial Day Flood)
- Hurricane Harvey

Most recently Hurricane Harvey flooded approximately 2318 structures including garages. Approximately 1936 homes experienced water damage to the main house structure. The areas with the most structures flooded were located in the southeast quadrant of the City followed by the south central area of the City. Both areas are in close proximity to Brays Bayou. While the majority of these homes were not in compliance with the elevation requirements enacted after Tropical Storm Allison (one (1) Foot above Base Flood Elevation), the damage was still severe and devastating to our residents.

After the Memorial Day event, the City of Bellaire contracted with ARKK Engineering to conduct a Drainage Study<sup>18</sup>, the report “addressed drainage problems local to Bellaire and those regional to the Bellaire area”. The City Engineer also provided a report<sup>19</sup> after Hurricane Harvey, which outlined the cause and impact of the event. Utilizing the 2004 Flood Hazard Mitigation Plan and these two reports as a starting point, the City began development of its Hazard Assessment.

The process of updating the City’s Flood Hazard Mitigation Plan began before Hurricane Harvey, however the impact of the event on the process was not dismissed. As it concerns the development of the Mitigation Plan, the decision was made, by staff and through consensus of

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<sup>16</sup> See Appendix – Map of Repetitive Loss Structures in Bellaire

<sup>17</sup> See Appendix – Map of 1% (100-year) Flood Plain for Bellaire

<sup>18</sup> See Appendix – City Engineer Drainage Study

<sup>19</sup> See Appendix – City Engineer Hurricane Harvey Report

the Flood Hazard Mitigation Task Force to focus on the impact of a 1% (100-year) storm event. It is with this in mind that the hazards were assessed.

## Hazard Assessment

The City of Bellaire experiences shallow floodplain flooding as well as ponding/overland flow flooding.

Shallow floodplains exist throughout much of Harris County and Bellaire is located near the Brays Bayou shallow floodplain. When Brays Bayou's capacity is exceeded and flood waters overtop the bayou banks, flooding occurs in the land areas near the bayou that are located at lower elevations. Land areas can remain flooded for hours until water surface elevations drop in the bayou. This type of flooding was prevalent in southeast portions of Bellaire during Hurricane Harvey.

Bellaire is also subject to ponding and overland flow flooding. Ponding and overland flow flooding occurs when intense local rainfall exceeds storm sewer or roadside ditch capacity, the water can "pond" in the streets deep enough to flood residences that are away from the bayou. This type of flood is not restricted to any one area. The storm water ponds until it eventually seeks a path to the outfall by flowing overland. When residences and other structures are below the surrounding land elevation or in the path of the overland flow, flooding may occur. The probability of this type of flooding is not shown on the floodplain on the Flood Insurance Rate Maps.

Staff met on November 22, 2017 to generate an initial draft of a Hazard Risk Assessment Matrix. One of the first steps was to establish a list of flood hazards that the City encounters. Subsequent planning steps used this list to identify and assess the risks and issues relating to these hazards, and ultimately a set of goals evolved with associated action plans to mitigate the identified hazards. An email was sent out to Task Force members to provide input and comments to be included in the Matrix for review in the up-coming meeting.

Hazards identified on the Hazard Risk Assessment Matrix were separated in the following categories:

- Public Communication
- Mobility
- Infrastructure (COB & Other)
- Preparedness
- Facilities and Equipment
- Health and Safety
- Economic Impact
- Storms > 100-year
- Representation

The initial draft was presented to the Task Force at the December 5, 2017 meeting for review and comments. The meeting discussion was focused on the development of the Risk/Issues and Mitigation Option/Goals portions of the Matrix. The identified hazards will allow for the development of effective action plans to mitigate flooding.

# Assess the Risk (Problem)

## (CRS Activity 511.5)

### Background

The City of Bellaire has flooded from various severe storms over the last century. Various degrees of flooding have plagued the City of Bellaire due to the City being predominantly flat in nature, with soils consisting primarily of flat clay. Recently, heavy rainfall amount and large numbers of severe storms have produced more occasions for flooding than normal. While the City of Bellaire is dedicated to minimizing adverse impacts associated with flood events, there are many factors not within the City's control that contribute to flooding in Bellaire. Some of these factors are:

- Very high average annual rainfall of approximately 50 inches
- Very flat topography
- Clay soils that do not absorb water very well
- Close proximity to an undersized Brays Bayou
- Large amounts of storm water from the City of Houston flow into Bellaire from the north
- Localized storm water runoff from Bellaire drains into undersized drainage systems owned by the City of Houston
- Below base flood finished floor elevations of homes constructed prior to the National Flood Insurance Rate Standards

The City of Bellaire does control the drainage improvements constructed within the City limits and the finished floor elevation requirements for new residential and commercial development. The City also controls residential lot drainage and fill requirements and requires storm water detention on commercial developments.

### Risk (Problem) Assessment

Utilizing the hazards assessed, Staff members of the Flood Hazard Mitigation Task Force, along with the engineering consultant assessed the risks (problem) associated with each hazard category. The identification of these risk was compiled using historical information based on previous flood events in the City. In many cases there were multiple risks identified for a specific hazard category.

The draft risk assessment was presented to the Task Force, and members were asked to identify any risk which may have been overlooked. Identified risks were incorporated in to the draft matrix under the appropriate hazard category.

The Task Force utilized these identified risks when developing the Mitigation Option and Action/Implementation Plan.

# Community Goals (CRS Activity 511.6)

The Flood Mitigation Task Force has identified a set of goals for which the City's flood mitigation program should strive to achieve. These goals will provide direction to develop means and methods to effectively mitigate flooding hazards. During implementation, the available resources, statutory authority, and staffing may affect the City's level of attainment of stated goals.

The Task Force has established the following overarching goals for the mitigation planning effort. Each overarching goal has subsequent detailed objectives.

**1. Establish policies, procedures and activities for the safety and assurance for citizens of City of Bellaire.**

- Bellaire residents and property owners should not need to unreasonably worry about flooding.
- Bellaire residents and property owners should be prepared and equipped to deal with flooding.
- During a flood event, communication between rescue agencies and residents need to be meaningful and reliable
- Rescue agencies should have sufficient training, equipment, and access to resources.

**2. Develop, fund, design and construct infrastructure improvements to mitigate the effects of flooding.**

- The cost/benefit of level of protection options needs to be determined, and the level of protection to be provided by local drainage improvements needs to be established
- The City of Bellaire needs to be positioned to secure adequate funding for local capital drainage projects.
- The City of Bellaire needs to be positioned to secure funding and implementation of regional projects that benefit the City of Bellaire
- The relationship between drainage maintenance (e.g. sewer repairs, inlet cleaning) and level of protection should be established
- Sufficient resources for ongoing drainage maintenance needs to exist.

**3. Evaluate and establish the City's position in floodplain regulation in terms of policies and management.**

- The current approach to regulating the flood plain needs to be evaluated with regard to future base flood elevation calculations (elevation requirements, impervious cover, management of flood repair permits)
- The feasibility and effectiveness of property acquisition for the purpose of drainage improvements should be evaluated
- The City of Bellaire should be positioned to advocate for strict upstream development standards.

# Review Possible Activities (CRS Activity 511.7)

A list of Possible Activities was developed for the Hazard Risk Assessment Matrix. These Activities were categorized to one of six types of General Mitigation Strategies:

- Preventive activities that keep problems from getting worse
- Floodplain Management Regulatory (current and future conditions)
- Property protection activities that address individual buildings
- Natural resource protection activities
- Emergency services measures taken before, during, and after an occurrence
- Structural projects that control the hazard
- Public information activities that advise property owners and others

The City of Bellaire has a myriad of mitigation activities already established. This Flood Hazard Mitigation Plan also proposes new possible activities to address the Mitigation Strategies listed above.

## **Preventative Activities**

City of Bellaire currently has a program for maintenance and repairs of inlets and storm sewers. The prioritization schedule of this program is regularly reviewed and revised to address problem flooding, combining multiple approaches that include potential flooding risks and event based property damage.

Coordination with neighboring agencies is paramount to the mitigation efforts for the City. Coordination with neighboring agencies (i.e. TxDOT, City of Houston and HCFCD) and the formation of regional partnerships need to be established in order to prevent backflow of local bayous from entering the City's underground drainage systems. Such backflow results in less capacity in the City's drainage system for local rainfall events resulting in flooding.

Brays Bayou is undersized for extreme rain. Harris County Flood Control District (HCFCD) and the U.S. Army Corps of Engineers have teamed up to widen Brays Bayou to substantially reduce flooding risks in the Brays Bayou watershed. These preventative measures will essentially remove Bellaire from the 1% (100-year) flood plain. Additional coordination should continue to determine how the additional widening of Brays Bayou will reduce flooding for the City of Bellaire.

## **Floodplain Management Regulatory Activities (Current and Future)**

City of Bellaire has adopted Planning and Zoning Regulations for residential and commercial properties in order to regulate the development and/or redevelopment of property within the City. The Code strictly enforces the maximum allowable lot coverage and lot fill for each zoning district, regulates the limits of impermeable surface areas per lot to help reduce runoff. Flood Damage Prevention Ordinances also require building slab finished floors to be a minimum of one foot above the base flood elevation.

Single family housing is the primary economic factor for the City and a primary goal of Bellaire is to reduce the number of unsafe structures in the City. Existing regulations need to be reviewed and evaluated to clearly define development guidelines for structures in designated flood areas, as defined by current flood hazard maps. Potential regulatory updates would allow residents to take proactive mitigation efforts on their property.

### **Property Protection Activities**

The City has taken steps to protect public property and encourages residents to protect their own. Existing building regulations have already been established to protect property owners from potential flood hazards. This plan will direct the City in determine any additional level of service to be achieved for future flood protection measures.

### **Emergency Service Activities**

Emergency Services response is an integral part of the City's operations. The City has in place an early warning system for Staff to respond to impending emergencies, such as hurricanes or severe storms. The system consists of a graduated level of response based on the relative threat of flooding. Notification of local conditions are broadcasted through various broadcasting outlets.

Recent flood events have exposed the potential inability to rescue persons trapped in homes where flood inundation makes continued occupation life threatening. The plan seeks to utilize a multi departmental approach to rescue citizens by developing a program to identify, train and utilize citizen rescuers. Flooding also hinders the mobility of specialized response vehicles. This hazard inhibits response vehicles from reaching all residents and moving them to a safe haven. The plan intends to develop a rescue plan which utilizes field-confirmed data to generate on-the-fly response maps for rescuer pathways.

### **Structural Projects**

An ongoing program has been in place to improve the City's infrastructure. Existing activities include a multi-year plan that evaluates the existing storm sewer system to identify areas requiring improvements. The ongoing improvements aim to prioritize areas based on adequacy of drainage performance.

In 2016 the City engineer prepared a report addressing drainage problems local to Bellaire and those regional to the Bellaire area. The report recommended drainage improvements to help prioritize future street and drainage capital improvements. Among those recommendations is the plan to construct local underground storage systems by increasing the normal two-year design storm sewer system to store the 100-year storm volumes at selected strategic locations. It was also recommended to construct backflow prevention systems at several of the City's major drainage system outfalls like the Newcastle and IH 610 system outfalls to Cypress Ditch to prevent back water flow from Brays Bayou backing up into City underground systems during high water flood stages.

## **Public Information Activities**

Public information activities advise and educate residents about the hazards of flooding and how to mitigate its effects. The Plan identifies a number of activities to inform residents of possible flood mitigation measures. The City periodically distributes messages to residents advising them of the dangers of driving in high water, staying abreast of weather conditions and other potential flood hazards.

This plan aims to further public information activities by developing a communication template to be utilized prior to, during and after a flooding event which includes updates on information the City has deemed important based on lessons learned from previous events. It is also a goal of the City to utilize a mass notification system that will reach all residents with relevant hazard warning and evacuation advice.

# Draft Action Plan (CRS Activity 511.8)

## **The Problem**

The City of Bellaire lies in a coastal floodplain with a relatively flat topography and clay soils. Close proximity to the Gulf of Mexico and a sub-tropical environment provide an environment of frequent and heavy rainfall. These conditions are conducive to flooding on a regular basis. A significant fraction of the City is currently in the 100-year floodplain because of the nearness to Brays Bayou. All areas of the City are subject to flooding. Historical data from previous floods demonstrate that flooding may be extensive and costly. Being a highly urbanized area, future development in the City is not expected to significantly exacerbate flooding.

## **Program Action Items**

The recommendations made in Section IX and the action/implementation items listed in the Flood Hazard Matrix will become the specific action items proposed below. The action items are organized<sup>20</sup> according to the mitigation strategies outlined in the previous section. The action items have also been prioritized within their respective categories. The City is recommended to continue to implement those action items that are currently being performed. These action items specify what will be done, who is responsible, when it is projected to be done, and how it is expected to be financed.

## **Preventative Activities**

### 1. Activity

Establish a comprehensive asset management plan allowing for better short and long-term planning of maintenance and capital improvement costs and needs.

#### Responsible Person(s)

Public Works will be responsible for implementing this activity.

#### Schedule

Target completion date is End of FY 2019

#### Financing

Financing for this activity will be from Operating Budget.

### 2. Activity

Develop an educational program/campaign warning residents of dangers of blocked storm sewers, and how they can help mitigate this problem.

#### Responsible Person(s)

Public Works will be responsible for implementing this activity.

#### Schedule

Target completion date is End of FY 2019

#### Financing

Financing for this activity will be from Operating Budget.

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<sup>20</sup> See Appendix – Draft Action Plan/Matrix Organization

3. Activity  
Develop plan to inform residents of the importance of not filling in the floodplain.  
Responsible Person(s)  
Development Services will be responsible for implementing this activity.  
Schedule  
Target completion date is End of FY 2019  
Financing  
Financing for this activity will be from Operating Budget.
4. Activity  
Establish a desired level of protection versus the cost to implement (cost benefit analysis).  
Responsible Person(s)  
Public Works will be responsible for implementing this activity.  
Schedule  
Target completion date is End of FY 2020  
Financing  
Financing for this activity will be from Operating Budget.

### **Floodplain Management Regulatory Activities (Current and Future)**

1. Activity  
Update City Ordinances to clearly define development guidelines for structures in the designated flood areas, as defined by current Special Hazard Flood Area Maps. Review and update City Codes based on the recommended changes to the Special Flood Hazard Area Maps.  
Responsible Person(s)  
Development Services will be responsible for implementing this activity.  
Schedule  
Target completion date is End of FY 2019.  
Financing  
Financing for this activity will be from Operating Budget.
2. Activity  
Research and evaluate regional approach to the 50% rule, for the development of City of Bellaire guidelines.  
Responsible Person(s)  
Development Services will be responsible for implementing this activity.  
Schedule  
Target completion date is End of FY 2019.  
Financing  
Financing for this activity will be from Operating Budget.
3. Activity  
At all stages of infrastructure project development in the floodplain, gather community input strategies to be examined; allowing the public to see the results, costs, and benefits for alternatives studied.  
Responsible Person(s)  
Development Services will be responsible for implementing this activity.  
Schedule

Target completion date is End of FY 2020.

Financing

Financing for this activity will be from Operating Budget.

4. Activity

Evaluate a buy-out program for properties that have flooded repeatedly.

Responsible Person(s)

City Manager's Office will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2020.

Financing

Financing for this activity will be from Operating Budget.

5. Activity

Ensure adequate City resources are in place to assist residents when applying for buy-out and elevation grants.

Responsible Person(s)

City Manager's Office will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2023.

Financing

Financing for this activity will be from Operating Budget.

6. Activity

Develop Bellaire specific commercial drainage requirements.

Responsible Person(s)

Development Services will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2023.

Financing

Financing for this activity will be from Operating Budget.

**Property Protection Activities**

1. Activity

Evaluate updates to the Building Code which would allow residents to take proactive mitigation efforts on their property.

Responsible Person(s)

Development Services will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2023.

Financing

Financing for this activity will be from Operating Budget.

## **Emergency Service Activities**

1. **Activity**  
Develop a plan to identify, utilize, and position non-conventional access vehicles for use when weather events dictate.  
**Responsible Person(s)**  
Bellaire Fire Department will be responsible for implementing this activity.  
**Schedule**  
Target completion date is End of FY 2019.  
**Financing**  
Financing for this activity will be from Operating Budget.
  
2. **Activity**  
Properly budget for rescue oriented persons to make logical purchases for rescue equipment. Develop a program to identify, train, and utilize Citizen Rescuers and create MOU (cover liability of the asses use donation). Evaluate reinstating Citizen Emergency Response Team (CERT).  
**Responsible Person(s)**  
Bellaire Fire/Police Department will be responsible for implementing this activity.  
**Schedule**  
Target completion date is End of FY 2019.  
**Financing**  
Financing for this activity will be from Operating Budget.
  
3. **Activity**  
Research, develop scope and policies and procedures, and place into effect a mass notification system.  
**Responsible Person(s)**  
City Manger’s Office will be responsible for implementing this activity.  
**Schedule**  
Target completion date is End of FY 2019.  
**Financing**  
Financing for this activity will be from Operating Budget.
  
4. **Activity**  
Develop a rescue plan which utilizes field-confirmed data to generate on-the-fly response maps for rescuer pathways.  
**Responsible Person(s)**  
Bellaire Fire Department & Public Works will be responsible for implementing this activity.  
**Schedule**  
Target completion date is End of FY 2019.  
**Financing**  
Financing for this activity will be from Operating Budget.
  
5. **Activity**  
Formalize a mechanism within the scope of EOC operations whereby a team would be responsible for field reconnaissance as well as publication of information for use by the public via the website, social media, local news media, etc.

Responsible Person(s)

Bellaire Fire will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2019.

Financing

Financing for this activity will be from Operating Budget.

6. Activity

Develop a plan to address rescues from one-story homes and older two-story homes. Develop a plan to evacuate disabled/physically impaired/elderly individuals from homes in advance of anticipated high rainfall events.

Responsible Person(s)

Bellaire Fire Department will be responsible for implementing this activity.

Schedule

Target completion date is FY 2019.

Financing

Financing for this activity will be from Operating Budget.

**Structural Projects**

1. Activity

Coordinate with Harris County Flood Control District (HCFCD) and the U.S. Army Corps of Engineers to determine how additional widening of Brays Bayou will reduce flooding for the City of Bellaire.

Responsible Person(s)

Director of Public Works will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2021.

Financing

Financing for this activity will be from Capital Improvements Budget.

2. Activity

Evaluate increasing the size of existing storm water drainage culverts in Bellaire while continuing to utilize drainage impact when selecting roads to be reconstructed. Lower street level when streets are under construction. Strategically locate undergoing storage pipes within the existing street right-of-way to store 100-year localized rainfall events.

Responsible Person(s)

Director of Public Works will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2020.

Financing

Financing for this activity will be from Capital Improvements Budget.

3. Activity

Determine partners, study alternatives, and develop cost estimates for improvements to increase capacity of the north/south drainage systems and Cypress Ditch.

Responsible Person(s)

Director of Public Works will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2019.

Financing

Financing for this activity will be from Operating Budget

4. Activity

Include design and installation of backflow prevention systems in the upcoming Bonds for Better Bellaire 2016 Projects<sup>21</sup>. Coordinate with neighboring agencies (i.e. TxDOT, City of Houston, and HCFCD) to prevent backflow<sup>22</sup> storm water from entering the City's underground drainage systems.

Responsible Person(s)

Director of Public Works will be responsible for implementing this activity.

Schedule

First phase completion date is End of FY 2020.

Financing

Financing for this activity will be from Capital Improvements Budget.

5. Activity

Identify any and all regional partnership opportunities (elected & appointed). Determine appropriate representatives from the City for regional agencies.

Responsible Person(s)

City Manager's Office will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2019.

Financing

Financing for this activity will be from Operating Budget.

6. Activity

Identify barriers restricting sheet flow and determine what project could relieve this problem.

Responsible Person(s)

Director of Public Works will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2019.

Financing

Financing for this activity will be from Capital Improvements Budget.

7. Activity

Create a proactive approach to repair and maintain drainage systems in desirable development areas and neighborhoods with storm drainage systems. Develop a schedule to perform routine maintenance, inspections, and repairs to storm water infrastructure. Expedite a plan to repair and replace the highly critical local drainage systems in the current Cond for Better Bellaire 2016. Re-evaluate the priorities annually and aggressively pursue future bond programs.

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<sup>21</sup> See Appendix – Bonds for Better Bellaire 2016

<sup>22</sup> See Appendix – Flap Gates Memo

Responsible Person(s)

Director of Public Works will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2020.

Financing

Financing for this activity will be from Capital Improvements Budget

8. Activity

Coordinate with HCFCD to determine steps necessary to increase the size of the outfall of Kilmarnock Ditch. Construct extreme event outfalls at Bellaire Blvd and within the Southdale Subdivision to Kilmarnock Ditch.

Responsible Person(s)

Director of Public works will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2023.

Financing

Financing for this activity will be from Capital Improvements Budget.

9. Activity

Contact surrounding municipalities and the agencies that own the storm sewers to consider upgrading their storm sewer and providing more detention. Investigate City of Houston developments north of Bellaire for total runoff.

Responsible Person(s)

Director of Public Works will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2019.

Financing

Financing for this activity will be from Capital Improvements Budget.

10. Activity

Evaluate the conversion of Bellaire's Wastewater Treatment Plant and the dog park and soccer fields along Edith into detentions areas. Evaluate the conversion of the trash transfer station at Beltway 8 to a reservoir for Brays Bayou.

Responsible Person(s)

Director of Public Works will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2019.

Financing

Financing for this activity will be from Capital Improvements Budget.

11. Activity

Evaluate the feasibility of adding flood stage gauges at strategic locations in the City to provide flood water readings for public safety.

Responsible Person(s)

Director of Public Works will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2019.

Financing

Financing for this activity will be from Capital Improvements Budget.

12. Activity

Evaluate the transfer of Wastewater Treatment for the City of Bellaire to the City of Houston Facility, including hazard mitigation funding opportunities.

Responsible Person(s)

Director of Public Works will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2023.

Financing

Financing for this activity will be from Capital Improvements Budget.

**Public Information Activities**

1. Activity

Develop a marketing plan which identifies the City outlets and how to increase participation in them. The plan should list events, stakeholders, etc. Develop and update a list of frequently utilized non-City outlets which the City should use to distribute its messages. This list should include media contacts, etc.

Responsible Person(s)

City Manger's Office will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2019.

Financing

Financing for this activity will be from Operating Budget.

2. Activity

Pre-populate communication outlets which needed information, allowing contacts to "opt-out", instead of having to "opt-in". Develop a communication matrix to outline what messages should be sent through which outlets. Evaluate the implementation of a "local street warden" program to deliver City produced storm related communication to their assigned area.

Responsible Person(s)

City Manger's Office will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2019.

Financing for this activity will be from Operating Budget.

3. Activity

Evaluate the implementation of a "local street warden" program to deliver City produced storm related communication to their assigned area.

Responsible Person(s)

City Manager's Office will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2019.

Financing for this activity will be from Operating Budget.

4. Activity  
Develop public messages to be used prior to and during an event to outline when residents should use 911. The public messages should also include other communication outlets residents can utilize in non-emergency situations.  
Responsible Person(s)  
Bellaire Fire Department will be responsible for implementing this activity.  
Schedule  
Target completion date is End of FY 2019.  
Financing for this activity will be from Operating Budget.
5. Activity  
Develop an educational program/campaign to inform residents and stakeholders of regularly utilized communication outlets.  
Responsible Person(s)  
City Manager's Office will be responsible for implementing this activity.  
Schedule  
Target completion date is End of FY 2019.  
Financing for this activity will be from Operating Budget.
6. Activity  
Develop a communication template to be utilized prior to, during and after a flooding event which includes updates on information the City has deemed important based on lessons learned from previous events.  
Responsible Person(s)  
City Manager's Office will be responsible for implementing this activity.  
Schedule  
Target completion date is End of FY 2019.  
Financing for this activity will be from Operating Budget.
7. Activity  
Utilize Town Hall meetings to discuss all hazard preparedness. Create a preparedness milestone for families.  
Responsible Person(s)  
City Manager's Office will be responsible for implementing this activity.  
Schedule  
Target completion date is End of FY 2019.  
Financing for this activity will be from Operating Budget.
8. Activity  
Develop an education program/campaign to inform residents on the level of protection provided by the City's infrastructure. Educate the public that street flooding is preferable to structural flooding.  
Responsible Person(s)  
City Manager's Office will be responsible for implementing this activity.  
Schedule  
Target completion date is End of FY 2019.  
Financing for this activity will be from Operating Budget.

9. Activity

Periodically distribute messages to residents warning of dangers of walking or playing in floodwaters. Everyone should refrain from walking or riding bicycles in floodwaters. Develop a plan with local schools to educate children to avoid walking, playing, or riding bicycles in floodwaters.

Responsible Person(s)

City Manager's Office will be responsible for implementing this activity.

Schedule

Target completion date is End of FY 2019.

Financing for this activity will be from Operating Budget.

# Plan Adoption (CRS Activity 511.9)

## Implement, Evaluate, & Revise the Plan (CRS Activity 511.9)

This Plan will be implemented by City Staff that have been involved in the development of the plan. As such, Staff is cognizant of the activities required by this Plan and the steps necessary for implementation. Staff has assessed responsibility for activities as outlined in Section X.

The implementation of the Plan will be monitored so that progress may be measured and necessary changes identified. To properly monitor the Plan, Staff and the City Manager will regularly meet throughout the year to report on progress. Staff and the City Manager will also meet at times of flooding events to discuss how the Plan impacts the flooding effects.

The Task Force will meet on a biannual basis to discuss and evaluate updates for the report. An annual evaluation report will be prepared by Staff prior to the City's annual recertification, to be included with the Plan.

The Plan will be updated at least once every five years by the Task Force. This update will include the following:

- A review of hazard and problem assessments
- A revision of the action plan to reflect the status of projects and changes in hazard and problem assessments
- Submittal of the draft update to other agencies for comment
- A public meeting must be held to explain the changes in the Plan
- The update must be adopted by the City Council

1. Bellaire City Council Resolution No. 17-08
2. Flood Hazard Mitigation Plan/Matrix
3. Agendas
4. Notify Me” Emails
5. Electronic Notebook ([www.bellairetx.gov/taskforce](http://www.bellairetx.gov/taskforce))
6. November 2, 2017 “Mayor’s Musings-Flood Hazard Mitigation Task Force Gets to Work” (<http://cityofbellairemayormusings.blogspot.com/2017/11/flood-hazard-mitigation-task-force-gets.html>)
7. News Flash – “Flood Hazard Mitigation Task Force Public Hearing”
8. January 25, 2018 “Mayor’s Musings-Task Force Public Hearing on Draft Flood Hazard Mitigation Plan – Jan. 29, 6:30 pm” (<http://cityofbellairemayormusings.blogspot.com/2018/01/task-force-public-hearing-on-draft.html>)
9. Task Force Presentations
10. January 29, 2018 Public Hearing Presentation
11. January 29, 2018 Public Hearing Speaker Sign-Up Sheets
12. Map of Brays Bayou Watershed
13. City of Bellaire presentation to City of Houston
14. Meeting with City of Houston Meeting Minutes 2/21/2018
15. Notice to Surrounding Communities and Agencies
16. Map of Repetitive Loss Structures in Bellaire
17. Map of 1% (100-year) Flood Plain in Bellaire
18. City Engineer Drainage Study
19. City Engineer Hurricane Harvey Report
20. Draft Action Plan/Matrix Organization
21. Bonds for Better Bellaire 2016
22. Flap Gates Memo
23. Task Force Meeting Minutes

	Assessment/History	Risk/Issues	Mitigation Options/Goal	Action/Implementation Plan
Hazard Category	The assessment and history is the background information which is being used to determine the hazard and severity. This tells us why a particular hazard is relevant in today's environment.	Risks are the individual situations that are created as a result of the hazard.	The Mitigation Plan should develop a strategy for reducing the potential losses identified in the risk assessment, and include goals and objectives.	The Action Plan should provide tangible solutions for achieving the goals and objectives outlined in the Mitigation Plan.
Public Communication	<p>Previous events have shown that good communication prior to, during, and after an event can reduce the amount of damage to property and individuals.</p> <ul style="list-style-type: none"> <li>- Not sufficiently marketing the outlets utilized by the City can limit the reach of the City's messages.</li> <li>- Not providing City messages to outside outlets, can limit their range and effectiveness.</li> </ul>	Residents Utilizing Non-City of Bellaire Outlets to Obtain Information	<p>Outlets should be marketed to stakeholders throughout the year</p> <p>Non-City of Bellaire Outlets Should be Utilized to Distribute Information</p>	<p>Develop a marketing plan which identifies the City outlets and how to increase participation in them. The plan should list events, stakeholders, etc.</p> <p>Develop and update a list of frequently utilized non-City outlets which the City should use to distribute its messages. This list should include media contacts, etc.</p> <p>(Target Completion: End of FY 2019)</p>
	<p>Previous events have shown that good communication prior to, during, and after an event can reduce the amount of damage to property and individuals.</p> <ul style="list-style-type: none"> <li>- Not ensuring each communication outlet is being utilized can lead to an information vacuum, where some residents may not receive essential information.</li> </ul>	Communication Efforts Not Reaching Audience	All outlets available should be utilized by the City	<p>Pre-populate communication outlets with needed information, allowing contacts to "opt-out", instead of having to "opt-in".</p> <p>Develop a communication matrix to outline what messages should be sent through which outlets.</p> <p>Evaluate the implementation of a "local street warden" program to deliver City produced storm related communication to their assigned area.</p> <p>(Target Completion: End of FY 2019)</p>
	History has shown that at the height of a significant event, emergency communication can be diminished resulting in longer wait times or a requirement to queue 911 callers.	Diminished Emergency Communication (911) Capacity	<p>Ensure residents are aware of when to call 911 (what constitutes an emergency)</p> <p>Provide redundancies in 911 communication operations</p>	<p>Develop public messages to be used prior to and during an event to outline when residents should use 911. The public messages should also include other communications outlets residents can utilize in non-emergency situations.</p> <p>(Target Completion: End of FY 2019)</p>
	During major events access to common communications devices may be unavailable, which impacts the cities ability to regularly update residents.	Failure/Lack of Common Communication Outlets	All outlets available should be utilized by the City	<p>Develop an educational program/campaign to inform residents and stakeholders of regularly utilized communication outlets.</p> <p>(Target Completion: End of FY 2019)</p>

	Assessment/History	Risk/Issues	Mitigation Options/Goal	Action/Implementation Plan
5	<p>Previous events have shown that good communication prior to, during, and after an event can reduce the amount of damage to property and individuals.</p> <p>- A lack of communication prior to a flooding event can leave residents unprepared for the possible impact of an event.</p> <p>- Additionally, poor communication can cause confusion or misinformation which could become an issue during an event.</p>	Lack of Pre-Event Communication	Provide regular up-to-date information through each of the City's communication outlets to residents, employees, and community stakeholders	<p>Develop a communication template to be utilized prior to an event which includes updates on information the City's has determined is important based on lessons learned from previous events.</p> <p>(Target Completion: End of FY 2019)</p>
6	<p>Previous events have shown that good communication prior to, during, and after an event can reduce the amount of damage to property and individuals.</p> <p>- A lack of communication during an event can lead to confusion and hinder decisions needing to be made by residents.</p>	Lack of Communication During an Event	Up-to-date information should continuously be distributed during an event utilizing all outlets available to the City	<p>Develop a communication template to be utilized during an event which includes updates on information the City has determined is important based on lessons learned from previous events.</p> <p>(Target Completion: End of FY 2019)</p>
7	<p>Previous events have shown that good communication prior to, during, and after an event can reduce the amount of damage to property and individuals.</p> <p>- After an event; residents, employees, business, and numerous other community stakeholders need to have proper information to understand how they and the City are moving forward, post event.</p>	Lack of Post-Event Communication	Provide regular up-to-date information through each of the City's communication outlets to residents, employees, and community stakeholders	<p>Develop a communication template to be utilized after an event which includes updates on information the City's has determined is important based on lessons learned from previous events.</p> <p>(Target Completion: End of FY 2019)</p>
8	<p>Drainage systems, including those in Bellaire rely on the street infrastructure for detention during high intensity rain events. Because drainage capacity is difficult to come by it is unlikely that this will ever change. To that end during high intensity rain events, some City of Bellaire streets will hold water for varying periods of time.</p>	Reduced mobility can increase emergency response times	Provide regular up-to-date information on local road conditions	<p>Formalize a mechanism within the scope of EOC operations whereby a team would be responsible for field reconnaissance as well as publication of information for use by the public via the website, social media, local news media, etc.</p> <p>(Target Completion: End of FY 2019)</p>
9	<p>Drainage systems, including those in Bellaire rely on the street infrastructure for detention during high intensity rain events. Because drainage capacity is difficult to come by it is unlikely that this will ever change. To that end during high intensity rain events, some City of Bellaire streets will hold water for varying periods of time.</p> <p>- Historic flooding events create impassable roadways where vehicle mobility is limited due to high water areas.</p>	Bellaire's Public Safety Components will not be able to respond with "normal" first response equipment	Utilize non-conventional vehicles for response	<p>Develop a plan to identify, utilize, and position non-conventional access vehicles for use when weather events dictate.</p> <p>(Target Completion: End of FY 2019)</p>

	Assessment/History	Risk/Issues	Mitigation Options/Goal	Action/Implementation Plan
10	<p>Drainage systems, including those in Bellaire rely on the street infrastructure for detention during high intensity rain events. Because drainage capacity is difficult to come by it is unlikely that this will ever change. To that end during high intensity rain events, some City of Bellaire streets will hold water for varying periods of time.</p> <p>- Extreme flood events makes overland mobility impossible</p>	<p>Inability to rescue persons trapped in home, where flood inundation makes continued occupation life threatening. More persons calling for rescue than Bellaire has ability to respond</p>	<p>Utilize a multi departmental approach to rescue which includes training and equipping to help solve issue</p> <p>Utilize Citizen Responders (boat owners &amp; high water vehicles), and mobilizes this group as a force multiplier in flood emergencies</p>	<p>Ensure adequate funding to send rescue oriented persons to hazard specific schools to for information to make logical purchases for rescue equipment (i.e. boats, dry suits, helmets, Coast Guard approved rescue Personal Flotation Devices for flood response).</p> <p>Develop a program to identify, train, and utilize Citizen Rescuers and create MOU (cover liability of the asset use donation).</p> <p>(Target Completion: End of FY 2019)</p>
11	<p>Drainage systems, including those in Bellaire rely on the street infrastructure for detention during high intensity rain events. Because drainage capacity is difficult to come by it is unlikely that this will ever change. To that end during high intensity rain events, some City of Bellaire streets will hold water for varying periods of time.</p> <p>- Extreme flood events makes overland mobility impossible</p>	<p>Inability to rescue persons trapped in home, where flood inundation makes continued occupation life threatening</p>	<p>Utilize a mass notification system that will reach all residents with relevant hazard warning and evacuation advice</p>	<p>Research, develop scope and policies &amp; procedures for, and place into affect a Mass Notification System.</p> <p>(Target Completion: End of FY 2019)</p>
12	<p>Flood events of hinders mobility due to flooding of Bellaire streets</p>	<p>Specialized response vehicles will not be able to reach all residents (water too high for truck, water too low for boat) and move to safe haven</p>	<p>Evacuate rescued persons from deep water inundation, to shallow water vehicle access area, to area of relative safety, to eventual shelter</p>	<p>Develop a rescue plan which utilizes field-confirmed data to generate on-the-fly response maps for rescuer pathways.</p> <p>(Target Completion: End of FY 2019)</p>
13	<p>Storm water from Brays Bayou and Cypress Ditch can backflow into the City's underground drainage system. Backflow from Brays bayou and Cypress Ditch reduces the capacity in the City's underground system.</p>	<p>Storm water that has backflowed into the City's system results in less capacity for local rainfall events resulting in flooding</p>	<p>Utilize backflow devices to prevent storm water from the bayou, during high water surface conditions, from coming back into the City's underground system</p>	<p>Include design and installation of backflow prevention systems in the upcoming Bonds for Better Bellaire 2016 Projects.</p> <p>Coordinate with neighboring agencies (i.e. TxDOT, City of Houston and HCFCD) to prevent backflow stormwater from entering the City's underground drainage systems.</p> <p>(First Phase Completion: End of FY 2020)</p>

	Assessment/History	Risk/Issues	Mitigation Options/Goal	Action/Implementation Plan
14	Overland sheet flow from areas inside and outside the City collects in low lying areas that do not have adequate storm drainage systems or positive overland flow capabilities to prevent flooding.	Overland sheet flow causes flooding in low lying areas	Lower the height of the floodwaters during a localized 100-year storm event in areas where overland flow problems exist	<p>Strategically locate underground storage pipes within the existing street right-of-way to store 100-year localized rainfall events.</p> <p>(Target Completion: End of FY 2020)</p> <p>Evaluate increasing the size of existing stormwater drainage culverts in Bellaire.</p> <p>(Target Completion: End of FY 2020)</p> <p>Continue to utilize drainage impact when selecting roads to be rebuilt.</p>
15	Inadequate capacity in Brays Bayou has resulted in a cooperative effort between HCFCD and the U.S. Army Corps of Engineers to widen Brays Bayou to substantially reduce flooding risks in the Brays Bayou watershed.	Brays Bayou is undersized for extreme rain events and flood stages prevent local Bellaire drainage systems from adequately serving the area	<p>Determine if additional improvements to Brays Bayou are possible beyond Project Brays to further increase capacity</p> <p>Provide more flood-hardened rain and flood stage gauges for better flood forecasting</p>	<p>Coordinate with HCFCD and the U.S. Army Corps of Engineers to determine how additional widening of Brays Bayou will reduce flooding for the City of Bellaire.</p> <p>(Target Completion: End of FY 2021)</p> <p>Evaluate the feasibility of adding more flood-hardened rain and flood stage gauges at strategic location in the City, to provide for better flood forecasting.</p> <p>(Target Completion: End of FY 2019)</p> <p>Evaluate the development of a levee along the south side of Bellaire, which would prevent water from Brays Bayou from entering the City.</p> <p>(Target Completion: End of FY 2019)</p> <p>Evaluate the conversion the trash transfer station at Beltway 8 to a reservoir for Brays Bayou.</p> <p>(Target Completion: End of FY 2019)</p>

	Assessment/History	Risk/Issues	Mitigation Options/Goal	Action/Implementation Plan
Infrastructure (COB & Other)	16 Water overflow from the Brays Bayou is a single significant factor for the wide spread flooding in Bellaire and surround areas. The water level at the peak was 4 Ft above the bank on Sunday August 27th 2017.	It flooded many houses South of Bellaire Blvd. Majority of these houses were flooded first time	Move remaining areas (Post Oak Terrace and Southdale ) out of 100 year floor plain even after the completion of the project Brays  Reduce or prevent wide spread damage in the events that are as significant as Harvey (beyond 100 year events)	Evaluate the conversion of Bellaire's Wastewater Treatment Plat to a retention area  Evaluate the conversion of the dog park and soccer fields along Edith into a detention area.  Lower street level when streets are under construction  (Target Completion: End of FY 2019)
	17 Major North/South drainage systems and Cypress Ditch are undersized for the large drainage area.	Inability to convey storm water adequately to Brays Bayou, therefore creating additional flooding risks.	Increase capacity of the North/South drainage systems and the Cypress Ditch	Study alternatives and develop cost estimates for improvements. Determine partners.  (Target Completion: End of FY 2019)
	18 Streets/Roadways are designed to store floodwaters that have overwhelmed the underground storm storage system in order to mitigate structural flooding.	Street Flooding	Increase street storm water storage in order to reduce structural flooding. Assess the advantages and disadvantages of street flooding vs. structural flooding	Educate and inform the public that street flooding is preferable to structural flooding.  (Target Completion: End of FY 2019)  Develop a plan to repair and replace the highly critical local drainage systems within five (5) years. If necessary, issue debt instruments every five years until the major local flood mitigation CIPs are completed.  (Target Completion: End of FY 2020)  Develop a schedule to perform routine maintenance, inspections, and repairs to all storm water infrastructure (such as pipes, or open waterway) on a minimum 5-year cycle.  (Target Completion: End of FY 2019)  Create a proactive approach to repair and maintain drainage systems in desirable development areas and neighborhoods with storm drainage systems.  (Target Completion: End of FY 2019)

	Assessment/History	Risk/Issues	Mitigation Options/Goal	Action/Implementation Plan
19	Bellaire is in a flat coastal area with predominately clay soils that are relatively impervious. Additionally, existing elevations and roadway patterns create barriers that trap sheet flow. Flooding occurs more frequently in areas with these conditions.	Existing topography, soils and roadway patterns contribute to flooding. These conditions and barriers trap sheet flow generated by extreme rain events and make flooding worse	Reduce barriers to flow of flood waters  Educate residents on the local topography and why it exacerbate flooding	Identify barriers restricting sheet flow and determine what projects could relieve this problem.  (Target Completion: End of FY 2019)  Develop communication plan to inform residents of the importance of not filling in the floodplain.  (Target Completion: End of FY 2019)
20	Outfall of Kilmarnock Ditch has proven to be undersized. The undersized outfall causes a backup of floodwaters to the upstream areas and contributes to localized flooding.	Outfall of Kilmarnock Ditch is undersized	Increasing the size of the outfall of Kilmarnock Ditch	Coordinate with HCFCO to determine steps necessary to increase the size of the outfall of Kilmarnock Ditch. Construct extreme event outfalls at Bellaire Blvd and within the Southdale Subdivision to Kilmarnock Ditch.  (Target Completion: End of FY 2023)
21	Debris can clog inlets and storm sewers. This exacerbates localized flooding, since floodwaters cannot drain away quickly.	Blockage of inlets and drainage systems by debris make flooding more severe	Maintain the storm sewer system so that it is free from blockages and operates at its peak efficiency  Ensure adequate staffing to maintain storm sewer system	Develop an educational program/campaign warning residents of the dangers of blocked storm sewers, and how they can help mitigate this problem.  (Target Completion: End of FY 2019)  Establish a comprehensive asset management plan allowing for better short and long-term planning of maintenance and capital improvement costs and needs.  (Target Completion: End of FY 2019)
22	Storm sewers and overland sheet flow from outside the City flow into the City and contribute to flooding.	Drainage from outside the City	Reduce peak flows of storm water into the City from external storm sewers  Eliminate the water Net surplus in Bellaire	Contact surrounding municipalities and the agencies that own the storm sewers to consider upgrading their storm sewer system and providing more detention. Investigate City of Houston developments north of Bellaire for total runoff.  (Target Completion: End of FY 2019)
23	Drainage in the City of Bellaire is heavily influenced by factors not directly under the control of the City. These include, but are not limited to, Brays Bayou, IH610 and the elevated railroad east of the City. The City must partner with these agencies as well as with our neighboring cities to develop regional solutions to improve storm water conveyance and remove impediments to drain from the area.	Attempting to mitigate flooding from a 100-year storm without consulting neighboring agencies and constructing improvements outside the City limits will have limited benefit within the City	Establish Regional Drainage Projects Task Force	Evaluate the installation of a separate storm water drainage culverts for Bellaire only, in addition to existing storm water drainage culverts that carry drainage for Bellaire and Houston both.  (Target Completion: End of FY 2020)

	Assessment/History	Risk/Issues	Mitigation Options/Goal	Action/Implementation Plan
24	Preparedness Bellaire is situated in a portion of the country that receives large storm systems and produces and transports hazardous chemicals	Residents will not be adequately prepared for natural and man made disasters	Community outreach to increase preparedness awareness	Utilize Town Hall meetings to discuss all-hazard preparedness. Create a preparedness milestone for families. Evaluate reinstating Citizen Emergency Response Team (CERT) (Target Completion: End of FY 2019) Develop a plan to address rescues from one-story homes and older two-story homes. Develop a plan to evacuate disabled/physically impaired/elderly individuals from homes in advance of anticipated high rainfall events. Evaluate the provision of storm shelters in Bellaire. (Target Completion: End of FY 2019)
25	Facilities & Equipment The Public Works Department is located in the south eastern most portion of the City. To that end, it is among the first to experience flooding from a highwater event on Brays. To limit future damage is challenging. Further the wastewater treatment facility is located in this area as well and serves all Bellaire residents.	Repetitive loss of equipment and or loss of wastewater services to the community	Sell or close the WWTP and contract with Houston for service Relocate PW facility out of the flood zone	Evaluate the transfer of Wastewater Treatment for the City of Bellaire to the City of Houston facility, including utilizing hazard mitigation funding opportunities. (Target Completion: End of FY 2023)
26	Health & Safety Floodwaters may conceal hidden objects that could cause injury. Residents can inadvertently step into manholes or inlets that have lost their lids. Floodwaters carry dangerous diseases that can make people ill due to overflowing sanitary sewers. Snakes and ants can be found floating in floodwaters.	Danger to people walking, playing, or riding bicycles in floodwaters	Prevent injuries to residents due to walking, playing, or riding bicycles in floodwaters Prevent infiltration into the sanitary sewer so that overflows and contamination of floodwaters will be reduced	Periodically distribute messages to residents warning of dangers of walking or playing in floodwaters. Everyone should refrain from walking or riding bicycles in floodwaters. Develop a plan with local schools to educate children to avoid walking, playing, or riding bicycles in floodwaters. (Target Completion: End of FY 2019)
27	Health & Safety According to the Harris County Health Department, waters associated with flooding carry numerous ground contaminants such as pesticide, hydrocarbons, and herbicides, as well as household chemicals. Flood water also displace rodents, ants and spiders.	Persons, including rescuers, will come in contact with pests and chemicals that may create health hazard	Ensure rescuers have proper Personal Protective Equipment specific to the hazard	Properly budget for rescue oriented persons to make logical purchases for rescue equipment. (Target Completion: End of FY 2019)

	Assessment/History	Risk/Issues	Mitigation Options/Goal	Action/Implementation Plan
Economic Impact	<p>28 Single family housing is the primary economic factor for the City. The current codes and ordinances adopted have increased the life cycle for compliant structures. Additionally, a lack of established guidelines, and how they effect non-compliant structures, has lead to a negative public perception of the housing stock after significant flood events.</p>	<p>Negative public perception of housing stock</p>	<p>Disclosure of Flooding/Flood Variance History</p> <p>Reduce Number of Unsafe Structures in the City</p> <p>Seek community input on development in the floodplain</p>	<p>Ensure adequate City resources are in place to assist residents when applying for buy out and elevations grants.</p> <p>Evaluate updates to the Building Code which would allow residents to take proactive mitigation efforts on their property.</p> <p>Develop Bellaire specific commercial drainage requirements.</p> <p>(Target Completion: End of FY 2023)</p> <p>At all stages of infrastructure project development in the flood plain, gather community input strategies to be examined; allowing the public to see the results, costs, and benefits for alternatives studied.</p> <p>Evaluate a buyout program for properties that have flooded repeatedly.</p> <p>Evaluate the provision of grants to homeowners for newer houses (1988 to 2001) that flooded only once to elevate their homes. These homes are not eligible for FEMA grants, but are not teardowns.</p> <p>Investigate the City providing incentives for raising height of existing homes or materially increasing permeable land/reduce coverage. Cost of the incentives would be financed through special tax assessment/credit for those participating properties. Essentially finance the upgrades through a tax assessment on those properties. The values should increase so City would also benefit from higher overall taxable value.</p> <p>(Target Completion: End of FY 2020)</p>

	Assessment/History	Risk/Issues	Mitigation Options/Goal	Action/Implementation Plan
29	The frequency of significant rain events in the past three years has called to question the accuracy of the Base Flood Elevations as a predictor of flood risk. Past events, such as Tropical Storm Allison, have lead to updates to the local Special Hazard Flood Area maps. The revision of these maps in not the responsibility of the city of Bellaire. It has historically taken 5 to 7 years to implement recommended map revisions.	Uncertain Base Flood elevations in AE and non-AE zones (100 yr. zones)	Provide clear guidelines for development and redevelopment for non-compliant structures	Update City Ordinances to clearly define development guidelines for structures in the designated flood areas, as defined by current Special Hazard Flood Area Maps.  Review and Update City Codes based on the recommended changes to the Special Flood Hazard Area Maps.  (Target Completion: End of FY 2019)
30	As a participant in the National Flood Insurance Program (NFIP), the City of Bellaire follows the 50% Rule to determine substantial damage. Currently the City only applies previous flood repairs to this rule. As a result, future flood repairs can be limited by previous repairs.	A drop in demand for Bellaire homes, compared to the surrounding area, will lead to lower home values, lower tax revenues, and an overall deteriorated community	Adjust the Community Rating System (CRS) to a non-cumulative approach to the 50% rule  A vocal adherence to a stance consistent with the rest of the metro area will eliminate market value deterioration	Research and evaluate regional approach to the 50% rule, for the development of City of Bellaire guidelines.  (Target Completion: FY 2019)
31	Structures who have historically never flooded are being impacted by flooding events. This has lead property owners to evaluate taking extreme mitigation action to limit the impact of future events.	Elevation of new and existing structures improperly meeting future COB codes	Ensure compliance with BFE's are sufficient for known flooding risk	Stay the course collect needed data so that if changes are needed in five years.  Review and revise the prioritization methods used to address problem flooding, combining multiple approaches that would include risk and event-based, as well as individual property damage and clustered property damage.
32	Many of the mitigation efforts in place hinge on regional projects currently in the works or projected. The city will still be subject to some amount of flooding, therefore even when regional projects are completed the impact of a 500 year events still exist.	False sense of City protection levels	Educate public of flooding risks  Continue to enforce development/redevelopment standards	Develop an education program/campaign to inform residents on the level of protection provided by the City's infrastructure.  (Target Completion: End of FY 2019)
				Establish a desired level of protection versus the cost to implement (cost benefit analysis).  (Target Completion: End of FY 2020)
33	The city may not have proper representation within regional agencies or constituents. This could impact the amount or what projects are funded that could have the greatest amount of impact on our mitigation efforts. Currently it is not clear the exact need for representation on regional platforms or participation regional during the planning process.	Failure of Regional Partners to Keep Promises funding opportunity will be missed	Ensure adequate representation to and relationships with regional partners	Identify any and all regional partnership opportunities (elected & appointed).  Determine appropriate representatives from the City for regional agencies.  (Target Completion: FY 2019)

**Goals**

**Safety & Assurance**

**Planning & Implementation of Drainage Improvements**

**Floodplain Regulation & Management**

## **DRAFT ACTION/MATRIX ORGANIZATION**

### **Preventative Activities**

1. **Activity – Matrix Line Item 4 (Public Communication)**  
Develop an educational program/campaign warning residents of dangers of blocked storm sewers, and how they can help mitigate this problem.
2. **Activity – Matrix Line Item 19 (Infrastructure (COB & Others))**  
Develop plan to inform residents of the importance of not filling in the floodplain.
3. **Activity – Matrix Line Item 21(Infrastructure (COB & Others))**  
Establish a comprehensive asset management plan allowing for better short and long-term planning of maintenance and capital improvement costs and needs.
4. **Activity – Matrix Line Item 32 (Storms > 100 yr)**  
Establish a desired level of protection versus the cost to implement (cost benefit analysis).

### **Floodplain Management Regulatory Activities (Current and Future)**

1. **Activity – Matrix Line Item 28 (Economic Impact)**  
Ensure adequate City resources are in place to assist residents when applying for buy-out and elevation grants.
2. **Activity – Matrix Line Item 28 (Economic Impact)**  
Develop Bellaire specific commercial drainage requirements.
3. **Activity – Matrix Line Item 28 (Economic Impact)**  
At all stages of infrastructure project development in the floodplain, gather community input strategies to be examined; allowing the public to see the results, costs, and benefits for alternatives studied.
4. **Activity – Matrix Line Item 28 (Economic Impact)**  
Evaluate a buy-out program for properties that have flooded repeatedly.
5. **Activity – Matrix Line Item 29 (Economic Impact)**  
Update City Ordinances to clearly define development guidelines for structures in the designated flood areas, as defined by current Special Hazard Flood Area Maps. Review and update City Codes based on the recommended changes to the Special Flood Hazard Area Maps.
6. **Activity – Matrix Line Item 30 (Economic Impact)**  
Research and evaluate regional approach to the 50% rule, for the development of City of Bellaire guidelines.

## **Property Protection Activities**

### 1. Activity – Matrix Line Item 29 (Economic Impact)

Evaluate updates to the Building Code which would allow residents to take proactive mitigation efforts on their property.

## **Emergency Service Activities**

### 1. Activity – Matrix Line Item 9 (Mobility)

Develop a plan to identify, utilize, and position non-conventional access vehicles for use when weather events dictate.

### 2. Activity – Matrix Line Item 10 (Mobility)

Properly budget for rescue oriented persons to make logical purchases for rescue equipment. Develop a program to identify, train, and utilize Citizen Rescuers and create MOU (cover liability of the asses use donation). Evaluate reinstating Citizen Emergency Response Team (CERT).

### 3. Activity – Matrix Line Item 11 (Mobility)

Research, develop scope and policies and procedures, and place into effect a mass notification system.

### 4. Activity – Matrix Line Item 12 (Mobility)

Develop a rescue plan which utilizes field-confirmed data to generate on-the-fly response maps for rescuer pathways.

### 5. Activity – Matrix Line Item 8 (Mobility)

Formalize a mechanism within the scope of EOC operations whereby a team would be responsible for field reconnaissance as well as publication of information for use by the public via the website, social media, local news media, etc.

### 6. Activity – Matrix Line Item 24 (Preparedness)

Develop a plan to address rescues from one-story homes and older two-story homes. Develop a plan to evacuate disabled/physically impaired/elderly individuals from homes in advance of anticipated high rainfall events.

## **Structural Projects**

### 1. Activity – Matrix Line Item 24 (Infrastructure (COB & Others))

Coordinate with Harris County Flood Control District (HCFCD) and the U.S. Army Corps of Engineers to determine how additional widening of Brays Bayou will reduce flooding for the City of Bellaire.

### 2. Activity – Matrix Line Items 14 & 16 (Infrastructure (COB & Others))

Evaluate increasing the size of existing storm water drainage culverts in Bellaire while continuing to utilize drainage impact when selecting roads to be reconstructed. Lower street level when streets are under construction. Strategically locate undergoing storage pipes within the existing street right-of-way to store 100-year localized rainfall events.

3. Activity – Matrix Line Item 17 (Infrastructure (COB & Others))  
Determine partners, study alternatives, and develop cost estimates for improvements to increase capacity of the north/south drainage systems and Cypress Ditch.
4. Activity – Matrix Line Item 13 (Infrastructure (COB & Others))  
Include design and installation of backflow prevention systems in the upcoming Bonds for Better Bellaire 2016 Projects. Coordinate with neighboring agencies (i.e. TxDOT, City of Houston, and HCFCD) to prevent backflow storm water from entering the City’s underground drainage systems.
5. Activity – Matrix Line Item 33 (Representation)  
Identify any and all regional partnership opportunities (elected & appointed). Determine appropriate representatives from the City for regional agencies.
6. Activity - Matrix Line Item 19 (Infrastructure (COB & Others))  
Identify barriers restricting sheet flow and determine what project could relieve this problem.
7. Activity – Matrix Line Item 18 (Infrastructure (COB & Others))  
Create a proactive approach to repair and maintain drainage systems in desirable development areas and neighborhoods with storm drainage systems. Develop a schedule to perform routine maintenance, inspections, and repairs to storm water infrastructure. Expedite a plan to repair and replace the highly critical local drainage systems in the current Cond for Better Bellaire 2016. Re-evaluate the priorities annually and aggressively pursue future bond programs.
8. Activity – Matrix Line Item 20 (Infrastructure (COB & Others))  
Coordinate with HCFCD to determine steps necessary to increase the size of the outfall of Kilmarnock Ditch. Construct extreme event outfalls at Bellaire Blvd and within the Southdale Subdivision to Kilmarnock Ditch.
9. Activity – Matrix Line Item 22 (Infrastructure (COB & Others))  
Contact surrounding municipalities and the agencies that own the storm sewers to consider upgrading their storm sewer and providing more detention. Investigate City of Houston developments north of Bellaire for total runoff.
10. Activity – Matrix Line Items 15 & 16 (Infrastructure (COB & Others))  
Evaluate the conversion of Bellaire’s Wastewater Treatment Plant and the dog park and soccer fields along Edith into detentions areas. Evaluate the conversion of the trash transfer station at Beltway 8 to a reservoir for Brays Bayou.
11. Activity – Matrix Line Item 15 (Infrastructure (COB & Others))  
Evaluate the feasibility of adding flood stage gauges at strategic locations in the City to provide flood water readings for public safety.

12. Activity – Matrix Line Item 25 (Facilities and Equipment)

Evaluate the transfer of Wastewater Treatment for the City of Bellaire to the City of Houston Facility, including hazard mitigation funding opportunities.

**Public Information Activities**

1. Activity – Matrix Line Item 1 (Public Communication)

Develop a marketing plan which identifies the City outlets and how to increase participation in them. The plan should list events, stakeholders, etc. Develop and update a list of frequently utilized non-City outlets which the City should use to distribute its messages. This list should include media contacts, etc.

2. Activity – Matrix Line Item 2 (Public Communication)

Pre-populate communication outlets which needed information, allowing contacts to “opt-out”, instead of having to “opt-in”. Develop a communication matrix to outline what messages should be sent through which outlets. Evaluate the implementation of a “local street warden” program to deliver City produced storm related communication to their assigned area.

3. Activity – Matrix Line Item 2 (Public Communication)

Evaluate the implementation of a “local street warden” program to deliver City produced storm related communication to their assigned area.

4. Activity – Matrix Line Item 3 (Public Communication)

Develop public messages to be used prior to and during an event to outline when residents should use 911. The public messages should also include other communication outlets residents can utilized in non-emergency situations.

5. Activity – Matrix Line Item 4 (Public Communication)

Develop an educational program/campaign to inform residents and stakeholders of regularly utilized communication outlets.

6. Activity – Matrix Line Item 5, 6 & 7 (Public Communication)

Develop a communication template to be utilized prior to, during and after a flooding event which includes updates on information the City has deemed important based on lessons learned from previous events.

7. Activity – Matrix Line Item 24 (Preparedness)

Utilize Town Hall meetings to discuss all hazard preparedness. Create a preparedness milestone for families.

8. Activity – Matrix Line Items 18 & 32 (Infrastructure (COB & Others)& Storm > 100yr)

Develop an education program/campaign to inform residents on the level of protection provided by the City’s infrastructure. Educate the public that street flooding is preferable to structural flooding.

9. Activity – Matrix Line Item 26 (Health & Safety)

Periodically distribute messages to residents warning of dangers of walking or playing in floodwaters. Everyone should refrain from walking or riding bicycles in floodwaters. Develop a plan with local schools to educate children to avoid walking, playing, or riding bicycles in floodwaters.