Tuesday

February 20th, 2018

Flood Hazard Mitigation Task Force

Hazard/Risk Assessment Matrix

Goals

Safety & Assurance

Planning & Implementation of Drainage Improvements

Floodplain Regulation & Management

	Hazard Category	Assessment/History	Risk/Issues	Mitigation Options/Goal	Action/Implementation Plan
		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.
1	Public Communication	Previous events have shown that good communication prior to, during, and after an event can reduce the amount of damage to property and individuals. - Not sufficiently marketing the outlets utilized by the City can limit the reach of the City's messages. - Not providing City messages to outside outlets, can limit their range and effectiveness.	Residents Utilizing Non-City of Bellaire Outlets to Obtain Information	Outlets should be marketed to stakeholders throughout the year Non-City of Bellaire Outlets Should be Utilized to Distribute Information	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. (Target Completion: End of FY 2019)
2		Previous events have shown that good communication prior to, during, and after an event can reduce the amount of damage to property and individuals. - Not ensuring each communication outlet is being utilized can lead to an information vacuum, where some residents may not receive essential information.	Communication Efforts Not Reaching Audience	All outlets available should be utilized by the City	Pre-populate communication outlets with 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. (Target Completion: End of FY 2019)
3		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	Ensure residents are aware of when to call 911 (what constitutes an emergency) Provide redundancies in 911 communication operations	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. (Target Completion: End of FY 2019)
4		During major events access to common communications devices may be unavailable, which impacts the cites ability to regularly update residents.	Failure/Lack of Common Communication Outlets	All outlets available should be utilized by the City	Develop an educational program/campaign to inform residents and stakeholders of regularly utilized communication outlets. (Target Completion: End of FY 2019)

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5	Previous events have shown that good communication prior to, during, and after an event can reduce the amount of damage to property and individuals. - A lack of communication prior to a flooding event can leave residents unprepared for the possible impact of an event. - Additionally, poor communication can cause confusion or misinformation which could become an issue during an event.	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	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. (Target Completion: End of FY 2019)
6	Previous events have shown that good communication prior to, during, and after an event can reduce the amount of damage to property and individuals. - A lack of communication during an event can lead to confusion and hinder decisions needing to be made by residents.	Lack of Communication During an Event	Up-to-date information should continuously be distributed during an event utilizing all outlets available to the City	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. (Target Completion: End of FY 2019)
7	Previous events have shown that good communication prior to, during, and after an event can reduce the amount of damage to property and individuals. - 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.	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	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. (Target Completion: End of FY 2019)
8	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.	Reduced mobility can increase emergency response times	Provide regular up-to-date information on local road conditions	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. (Target Completion: End of FY 2019)
9	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. - Historic flooding events create impassable roadways where vehicle mobility is limited due to high water areas.	Bellaire's Public Safety Components will not be able to respond with "normal" first response equipment	Utilize non-conventional vehicles for response	Develop a plan to identify, utilize, and position non-conventional access vehicles for use when weather events dictate. (Target Completion: End of FY 2019)

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10	Mobility	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. - Extreme flood events makes overland mobility impossible	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	Utilize a multi departmental approach to rescue which includes training and equipping to help solve issue Utilize Citizen Responders (boat owners & high water vehicles), and mobilizes this group as a force multiplier in flood emergencies	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 recue Personal Flotation Devices for flood response). Develop a program to identify, train, and utilize Citizen Rescuers and create MOU (cover liability of the asset use donation). (Target Completion: End of FY 2019)
11		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. - Extreme flood events makes overland mobility impossible	Inability to rescue persons trapped in home, where flood inundation makes continued occupation life threatening	Utilize a mass notification system that will reach all residents with relevant hazard warning and evacuation advice	Research, develop scope and policies & procedures for, and place into affect a Mass Notification System. (Target Completion: End of FY 2019)
12		Flood events of hinders mobility due to flooding of Bellaire streets	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	Evacuate rescued persons from deep water inundation, to shallow water vehicle access area, to area of relative safety, to eventual shelter	Develop a rescue plan which utilizes field-confirmed data to generate on-the-fly response maps for rescuer pathways. (Target Completion: End of FY 2019)
13		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.	Storm water that has backflowed into the City's system results in less capacity for local rainfall events resulting in flooding	Utilize backflow devices to prevent storm water from the bayou, during high water surface conditions, from coming back into the City's underground system	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 stormwater from entering the City's underground drainage systems. (First Phase Completion: End of FY 2020)

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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	Strategically locate underground storage pipes within the existing street right-of-way to store 100-year localized rainfall events. (Target Completion: End of FY 2020) Evaluate increasing the size of existing stormwater drainage culverts in Bellaire. (Target Completion: End of FY 2020) Continue to utilize drainage impact when selecting roads to be rebuilt.
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	Determine if additional improvements to Brays Bayou are possible beyond Project Brays to further increase capacity Provide more flood-hardened rain and flood stage gauges for better flood forecasting	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. (Target Completion: End of FY 2021) 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. (Target Completion: End of FY 2019) Evaluate the development of a levee along the south side of Bellaire, which would prevent water from Brays Bayou from entering the City. (Target Completion: End of FY 2019) Evaluate the conversion the trash transfer station at Beltway 8 to a reservoir for Brays Bayou. (Target Completion: End of FY 2019)

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16	Infrastructure (COB & Other)	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)

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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 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. (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)

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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		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)

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28	Economic Impact	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.	Negative public perception of housing stock	Disclosure of Flooding/Flood Variance History Reduce Number of Unsafe Structures in the City Seek community input on development in the floodplain	Ensure adequate City resources are in place to assist residents when applying for buy out and elevations grants. Evaluate updates to the Building Code which would allow residents to take proactive mitigation efforts on their property. Develop Bellaire specific commercial drainage requirements. (Target Completion: End of FY 2023) 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. Evaluate a buyout program for properties that have flooded repeatedly. 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. 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. (Target Completion: End of FY 2020)

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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 yeas 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	Storms >100year	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 am 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	Representation	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 reginal 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**

Suggested Approach To Cumulative Rule

A Cumulative approach for improvements or damages to structures in special flood hazard areas ensures that flood protection measures are incorporated in the permitting process.

The cumulative rule would be applied to flood related damage sustained by a structure only after two (2) separate flood occasions

Suggested Approach to Cumulative Rule

1st Flood Permit/Claim

(No Cumulative Review)

2nd Flood Permit/Claim

(No Cumulative Review)

2nd Flood Permit/Claim with RR Permit

(Cumulative Review Begins)

3rd Flood Permit/Claim with RR Permit

Scenario 1-Home Market Value $100,000

2015 Flood Permit

$10,000

2017 Flood Permit

$20,000

3rd Flood Permit/Claim with RR Permit

$20,000 Only

3rd Flood Permit/Claim with RR Permit

NO PERMIT

Scenario 2-Home Market Value $100,000

2017 Flood 1st Permit

$50,000

2025 Flood 2nd Permit

$50,000

3rd Flood Permit/Claim or RR Permit

No Permit Issued

Scenario 3-Home Market Value $100,000

2017 Flood Permit

$50,000

2020 Remodel Permit

$50,000

2027 2nd Flood Permit/Claim or RR Permit

$50,000

3rd Flood Permit/Claim or RR Permit

No Permit Issued

Review of Final Plan Draft Narrative

Schedule

Work Plan:	Date:
~~Kick Off Meeting (1)~~	~~Monday, Oct 30, 17~~
~~Present Risk Assessment & Mitigation Strategy with Task Force (2)~~	~~Tuesday, Nov 14, 17~~
~~Address Task Force Comments on Risk Assessment & Mitigation Strategy (3)~~	~~Tuesday, Dec 5, 17~~
~~Review Action Plan with Task Force (4)~~	~~Tuesday, Dec 19, 17~~
~~Review of Action Plan with Task Force (5)~~	~~Tuesday, Jan 9, 18~~
~~Action Plan Public Hearing~~	~~Monday, Jan 29, 18~~
~~Task Force Review of Public Hearing Comments (6)~~	~~Tuesday, Feb 6, 18~~
~~Finalize Action Plan (Matrix) (7)~~	~~Tuesday, February 20, 18~~
Approve Action Plan (8)	Tuesday, March 6, 18
Adopt and Implement Action Plan	Monday, March 19, 18