

Harris County Flood Control District San Jacinto River Authority Montgomery County City of Houston

APPENDIX A PROJECT MANAGEMENT MEETINGS



Appendix A.1

Kickoff Meeting



STUDY PARTNERS KICKOFF MEETING AGENDA

Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

April 8, 2019 San Jacinto River Regional Flood Mitigation Plan HCFCD, Brookhollow

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Kickoff Meeting	
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	2:30 PM	
			Meeting Stop Time:	4:00 PM	
Agend	la				
1.	Introductions (HCFCD Leadership/Matt)				
2.	Projec	t Goals and Objectives (Halff)		
	Condu	ct a comprehensive Flood Mitig	ation Plan of the San J	acinto River Basin	
	•	Primary Mitigation Planning			
	•	Secondary Mitigation Planning	g		
	•	Other Mitigation Actions			
	•	Community Outreach and Edu	ucation		
3.	Projec	t Scope Overview (Halff)			
	Project Management and Coordination				
	Data Collection and Review				
	Existing Conditions Flood Hazard Assessment (Approximately 535 stream miles)				
	•	Analysis of Historical Storms			
	•	Future Flood Risk Planning A	ssessment		
	•	Primary Flood Mitigation Planning			
	Secondary Flood Mitigation Planning				
	Other Flood Hazard Mitigation Action				
	•	Community Outreach and Ed	ucation		
	Final Deliverables				
4.	Projec	t Schedule Overview (Halff)			
	•	Existing Conditions H&H and	Calibration Memo – Oc	tober 2019	
	•	Future Conditions Memo – De	ecember 2019		
	•	Sedimentation and Vegetation	n Control Memo – Janu	ary2020	
	•	Alternative Funding Memo – N	March 2020		
	•	Primary Flood Mitigation Mem	no and Implementation	Memo – June 2020	
	•	Secondary Flood Mitigation P	lanning Memo – Noven	nber 2019	
	•	Other Mitigation Actions Mem	orandum – February 20	20	
Draft Report – July 2020					
	Final Report – August 2020				

5.	Project Deliverables (Halff)		
	Overview of what specific items and recommendations will be delivered at the end of the study		
6.	Work Flow (Halff)		
	All deliverables and communication sent through HCFCD; Progress will continue		
	 Four weeks total review time for Existing Conditions and Primary Alternatives: two-week initial review for all partners, one week consultant response, one week final comment to reach preliminary resolution on questions and items 		
	• Four weeks agency review time for Draft Report, four weeks for Halff to address comments		
7.	Vegetation and Sediment Control (FNI)		
	Overview of Process and Goals		
8.	Methodology Discussion (Halff)		
	Terrain data based on HGAC 2018 LiDAR and other pre-2018 sources		
	 Atlas 14 Rainfall using HC regions and calculated 24-hour depths for Montgomery and surrounding counties 		
	Initial and Constant for loss parameters and BDF methodology for transform parameters		
	 New models using LiDAR dataset; Existing HC models adjusted as needed to facilitate the study goals 		
	Future conditions (50-year horizon, Ultimate development)		
	FEMA BCA using county appraisal district data; LiDAR elevations + additional for FFE		
	 Model calibration using 3-storms (Harvey + 2 Others) 		
9.	Data Collection Requests (Halff/FNI)		
	HCFCD will provide the majority of the data (Terrain, Models for Spring, Cypress, etc.)		
	Reports and data from SJRA, MCO, COH		
	Dredging and bathymetry from USACE, TWDB, CWA		
10.	Public Education and Outreach (HCFCD Communications/Crouch)		
	Discuss current scope		
	- Informational material and graphics for web-copy and social media		
	 2-3 standardized presentations study partners can use for meetings 		
	- Talking points		
	- Does not include public meetings		
	Addressing questions		
	- Study specific		
	- Other projects conducted by study partners		
	Web-Presence		
	- Public comment form currently available on project webpage		
	 Individual project webpages vs one study website 		
	 HCFCD's obligation to conduct public outreach within Harris County as part of the 2018 Bond Program (to be pursued through a separate contract and funding) 		

11.	Project/Partner Accounting, Coordination and Communication Protocol (HCFCD PM/Jing)		
	Accounting protocols		
	 Joint invoice review timeframe for partners (5 working days) 		
	One working contact person from each study partner		
	 Project questions, inquires, requests come through HCFCDPM 		
12.	Questions		

SAN JACINTO RIVER SANJAGINTO - Regional Watershed Master Drainage Plan

Study Partners Kickoff Meeting April 8, 2019









Plan Goals

- The goal of the San Jacinto Regional Watershed Master
 Drainage Plan is to
 - Conduct a comprehensive Flood Mitigation Plan
 - Identify vulnerability to flood hazards causing loss of life and property
 - Develop approaches to enhance public information and flood level assessment
 - Evaluate flood mitigation strategies to improve long-term resilience







Plan Objectives

- The plans specific objectives are:
 - Primary Flood Mitigation Planning (Detention, Conveyance, Buy-Outs)
 - Secondary Mitigation Planning (Flood Assessment/Warning)
 - Other Mitigation Actions (Communications Protocols, Flood Response)
 - Community Outreach & Education (Drainage, Maintenance, Projects)







San Jacinto River Basin

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6









Project Scope

- Project Management and Coordination
 - HCFCD Executive Briefings (2)
 - Briefings with SJRA, Montgomery County, City of Houston (2)
 - Coordination Meetings with Supporting Partners (5)
- Data Collection and Review
 - Terrain, Gage Data, Historical Events, Models, Flood Data, Reports, etc.
 - Field Reconnaissance Visits
 - Model and Data Evaluation
 - Field Survey Data







Project Scope

- Existing Conditions Flood Risk Assessment
 - Runoff Risk (Hydrology) Update baseline and verify calculated flows
 - Comprehensive hydrologic model of the basin
 - Update loss and transform parameters
 - Develop to work with Unsteady HEC-RAS modeling
 - Flood Hazard Assessment (Hydraulics) Develop unsteady RAS models
 - Convert existing models from Steady to Unsteady
 - Update parameters and flow data from hydrologic models
 - Develop inundation mapping
- Analysis of Historical Storms
 - Evaluate several historical storms using updated hydrologic model
 - Calibrate models to match historical stage and flow data within tolerance
 - Finalize existing conditions models







Project Scope

- Future Flood Risk Planning Assessment
 - Estimate future conditions in the watershed without mitigation measures
 - Update hydrologic and hydraulic models to reflect future conditions
- Primary Flood Mitigation Planning (Flood Mitigation)
 - Primary Alternatives Identify and evaluate top 4 pre-proposed projects*
 - Secondary Alternatives Identify and evaluate up to 5 additional projects*
 - Identify ROW, environmental, utility and other issues
 - Evaluate alternative funding opportunities
 - Develop and implementation plan
 - Vegetation and sediment control plan

* May include policy changes such as land use or detention







Somerican Star

Project Scope

- Secondary Flood Mitigation Planning (Flood Warning)
 - Coordinate with partners* to discuss potential expansion to the Flood Warning System
 - Evaluate current system and make recommendations for additional ALERT 2 Rain and Stage gages
- Other Mitigation Actions (Flood Response)
 - Meet with partners* discuss existing protocols and develop strategies to improve flood mitigation actions
 - Develop a communications plan/protocol for partners to facilitate information sharing in a timely fashion
 - Locate critical infrastructure
 - Identify evacuation routes and access during flood events
- * HCFCD, SJRA, MCO, COH, TXDOT, HCOEM, MCOEM



Project Schedule

- Major Project Milestones
 - Existing H&H and Calibration Memorandum 10/14/19
 - Primary Alternatives Analysis Memorandum 6/9/2020
 - Vegetation and Sedimentation Control Memorandum 1/6/20
 - Draft Report 7/6/20
 - Final Report 8/31/20









Project Deliverables

- Existing H&H and Calibration Memo
- Primary Alternatives Analysis Memo
- Draft and Final Report
 - Process, Methodology, Recommendations
 - Implementation Plan Specific projects with budget and priority
 - Vegetation and Sedimentation Plan
- Supporting Data (Digital)
 - PDF version of the report, exhibits, appendices
 - Spreadsheets used for parameter calculations
 - Final HMS/RAS models
 - GIS Data (Geodatabase)
 - Photos

* Digital copies will be provided to study partners through HCFCD







Project Work Flow

- All deliverables and communications sent through HCFCD
- Four week review time for Existing Conditions and Primary Alternatives
 - Two week initial review (study partners)
 - One week consultant response
 - One week resolution of questions
 - Does not mean all modeling is updated, just comments and questions are considered and any issues resolved
- Four weeks agency review time for Draft Report
- Four weeks for Halff to update and submit Final Report







Vegetation and Sediment Control

- Goal of Sediment Management Strategy is to:
 - Provide benefit to Flood Risk Reduction
 - Reduce Maintenance Requirements
- Tasks to be performed:
 - Review existing studies, data, and recommendations
 - Sedimentation Rates
 - Historic changes in stream alignments
 - Ongoing maintenance requirements
 - Identify possible sources of sediment contribution
 - Determine possible impacts of sedimentation on flooding
 - Develop mitigation measures to minimize future sedimentation
 - Upper watershed Management Strategies
 - Riverine Management Strategies
 - Regulatory Management Strategies







Project Methodology

- Terrain based on 2018 HGAC LiDAR and other pre-2018 data
- Atlas 14 Rainfall (Weighted average 24-hr depths by watershed)
- Initial and Constant loss parameters
- Basin Development Factors (BDF) method for Clark UH
- New hydraulic models use 2018 LiDAR or best available data
- Existing hydraulic models adjusted as needed
- Model calibration using 3 storms
 - Hurricane Harvey (2017)
 - Tax Day Flood (2016)
 - October 1994 Storm
- Future conditions (50-year horizon)
- FEMA BCA using county appraisal data, LiDAR for FFE est.





Atlas 14 Rainfall Values



Data Collection Requests

- HCFCD is providing majority of the data
 - Combined terrain dataset (HGAC 2018, others)
 - M3 models of Spring, Cypress, Little Cypress, Willow Creeks
 - HCFWS gage data
- Additional reports and data from SJRA, MCO, COH appreciated
- Dredging and Bathymetry from USACE, TWBD, CWA







Public Education and Outreach

- Current Scope
 - Material and graphics for web-copy and social media
 - Standardized presentations study partners can use for presentations
 - Talking points
 - Public meetings NOT included
- Addressing Questions
 - Questions specific to the San Jacinto FMP
 - Other projects conducted by study partners
 - Media Inquiries
- Web Presence
 - Public comment form is available on the HCFCD website
 - Individual project webpages vs. one study website
- HCFCD is obligated to conduct public outreach within Harris County per the 2018 Bond Program (Separate Contract)





Accounting, Coordination, Communication

- Accounting Protocols
- Joint Invoice Review Five (5) working days for partners
- One (1) working contact person per study partner
- All project questions, inquiries, requests will be directed to the HCFCD Project Manager (J. Chen)







SAN JACINTO RIVER QUESTIONS?

Study Partners Kickoff Meeting April 8, 2019

Times











14800 St. Mary's Lane, Ste. 160 Houston, TX 77079-2943 (713) 588-2450 Fax (281) 310-5259

MEETING MINUTES

То:	Jing Chen, P.E., CFM	Attendees:	Marcus Stuckett, HCFCD
From:	Terry Barr, P.E., CFM		Jing Chen, HCFCD
Subject:	Upper San Jacinto River Regional Flood Mitigation Plan – Study Partners Kickoff Meeting		Ataul Hannan, HCFCD Craig Maske, HCFCD Rob Lazaro, HCFCD Susan Whoeler, HCFCD
Meeting Date:	04/8/2019 – 2:30 pm		Jeremy Ratcliff, HCFCD
Location:	HCFCD, Brookhollow Office		Chuck Gilman, SJRA
Minutes Date:	4/16/2019		Darren Hess, Montgomery County
AVO No.:	033465.002		Cliff Edwards, HCP4 Jeremy Phillips, HCP2 (Phone) Terry Barr, Halff Sam Hinojosa, Halff Andrew Moore, Halff Hector Olmos, Freese & Nichols Cory Stull, Freese & Nichols Conner Strokes, Crouch Leslie Halloway, Crouch

Item	Description	Action
1.	Meeting Introduction	
	Mr. Stuckett introduced the project meeting followed by introductions from each study partner. The meeting agenda was provided to the group (See attached agenda for reference). Mr. Barr discussed the intent of the meeting, which was to discuss the project scope and coordination	
2.	Project Goals and Objectives	
	Mr. Barr reviewed the overall study goals and objectives. Ms. Cooper asked what type of historical rainfall will be used. Mr. Stull stated that gridded rainfall adjusted by gauge data would be used. Ms. Cooper asked how the model will incorporate new development and gap development. Mr. Stull stated that the plan will follow the water projection approach which looks at potential development over 50 years. Drainage criteria changes may be considered as mitigation options.	
3.	Project Scope Overview	
	Mr. Barr presented the major items in the scope of the study which included: Project Management, Data Collection, Existing Conditions, Analysis of Historical Storms, Future Flood Risk Planning, Primary and Secondary Flood Mitigation Planning, and Other Mitigation Actions.	
4.	Project Schedule Overview	
	Mr. Barr presented the overall schedule and submittal dates. He stated that the funding requirement with FEMA requires the study be submitted within 18 months. Mr. Edwards asked what happens if deadlines are not met. Ms. Chen responded that the study is FEMA funded and the	



	schedule must be maintained. Ms. Green stated that overall project deadline needs to be met.	
5.	Project Deliverables	
	Mr. Barr reviewed the project deliverables as well as the interim deliverables. He stated that all deliverables will be digital. Mr. Edwards requested that the digital documents be searchable. Mr. Barr stated that 2 weeks will be available for HCFCD and the stakeholders to review the documents. SJRA, Montgomery County, and City of Houston representatives agreed the 2 weeks was sufficient time to review. Ms. Cooper requested enough notification to prepare to review the submittals. Mr. Edwards asked if public meetings will be held with the project. Mr. Barr stated that they are not currently in the scope.	
6.	Work Flow	
	Ms. Cooper asked how comments will be coordinated through each stakeholder. Mr. Barr stated that a comment matrix would be developed and sent along with any submittal. HCFCD will manage the comments and provide the comments template.	
7.	Vegetation and Sediment Control	
	Mr. Stull reviewed the vegetation and sediment control scope. Ms. Cooper stated that Montgomery County does not currently have the authority to manage sediment in the streams. She asked if the recommendation would include the current county jurisdictional authority? Mr. Stull confirmed that the recommendations would include the potential sediment management plans for stakeholder consideration. Mr. Edwards asked if the study would include the USACE data collected for Lake Houston. Mr. Stull stated that the study will be solely based on data from other entities. Sediment modeling will not be included in this study. Ms. Chen stated that HCFCD was currently collected the USACE dredging data.	
8.	Methodology Discussion	
	Mr. Barr presented the hydrologic methodologies to be used for the analysis. Ms. Cooper asked what projection will be used for modeling and base files. Mr. Barr stated that since the LiDAR will be based on the Texas South Central coordinate system, that all models will be created in South Central. He stated that any mapping in Montgomery County could be moved to the appropriate coordinate system. Mr. Stull presented the rainfall depths to be used per watershed based on the Atlas 14 rainfall data. Ms. Cooper asked that the Memorial Day 2016 event be used for calibration. Mr. Hinojosa stated that the Tax Day 2016 event would be extended to include the Memorial Day event.	
9.	Data Collection Requests	
	Mr. Barr reviewed the data currently requested from each entity including reports, terrain, and existing studies.	



10.	Public Education and Outreach	
	Mr. Barr stated that public meetings were not part of the current scope. Ms. Chen stated that HCFCD was working on a separate contract for public meetings. Ms. Green stated that public meetings may be held at various locations in the watershed. Ms. Hollaway stated that the current scope is to provide handouts, maps, and a website so all stakeholders are consistent on data presented to the public. She mentioned that having a project specific website would assist in handling questions and communication with the public. Summaries of ongoing parallel project s could eb provided to the public through the central site. Study partner website could direct the public to the central site. Ms. Cooper discussed having an internal collaboration website to handle data transfer. Mr. Hinojosa stated that Halff could host a website for stakeholder use if needed.	Stakeholders to consider internal coordination website. Also consider a central website for dissemination of material to the public.
11.	Project/Partner Accounting, Coordination and Communication Protocol	HCFCD to coordinate monthly progress
	Ms. Green stated that there will be monthly meetings for the project stakeholders.	meetings.
12.	General Discussion	
	Ms. Wheeler stated that HCFCD is ready to receive the funding from the study partners HCFCD will allow the study partners to review the invoices from Halff. Partners will have 5 days to respond.	
	Study partner contacts will be Matt Barrett (SJRA), Diane Cooper (Montgomery County) and Gary Hill (City of Houston).	
	Ms. Cooper asked if the models would be FEMA ready? Mr. Edwards asked what it would take to get to FEMA ready.	
	Ms. Cooper asked how can the models be managed for use by developers and how do expectations can be managed for the planning level study.	
	Mr. Edwards stated that for the project to be a success, it needs to survive the first recommended project. Mr. Hinojosa stated that the projects will be large and very expensive.	
	Mr. Edwards mentioned that it may be helpful to include other funding source requirements and add the information needed to satisfy their requirements such as the GLO, FEMA, HUD, etc.	
	Ms. Cooper asked how the study can eb used to guide policy. Mr. Barr mentioned that policy recommendations will be included in the study and may be the only feasible option.	
	Mr. Hill asked if we can use the study to determine the existing level of service of the streams. Mr. Barr stated that it could be determined from the modeling. Mr. Bezemek stated that the level of service can be challenging with channels as the bank elevation can change drastically in varying cross sections.	
13.	Ms. Chen concluded the meeting.	



This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not correct, or that any information is missing or incomplete, please contact Halff Associates so that the matter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.



STUDY PARTNERS KICKOFF MEETING

Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

April 8, 2019

Name	Organization	Phone Number	Email
Terry Barr	Halff Associates, Inc.	(713) 588-2451	tbarr@halff.com
LESIE Hollawhy	Chonch	713 868 1043	lestic @ crouchenvironmental. com
-Jing Chen	HLACO	713.684.4264	Jing. Change herfed. org
Connor Stokes	Crouch	713-868-1043	connorperouchenvilonmental, com
Andrew Moone	Halfs	936-777-6377	amoure & half.com
Samtinojosa	HALF	936 777 6372	Shinajoscehafficon
CRAIG MASKE	HCFCD	713 684 4541	craiginastace hefed.org
fob chizmos	HEFD .	713 684-4027	robut. Cazarophated.org
Gary Bezemek	INCECD	713 694 4000	
Dena Groon	HEFCD		lene. cranchalad. and
Matt Barrett	SJRA	936-588-7177	mbarnett@ sjrainet
Diane Couper	Montgoney CO	936-538-8111	Diane, Cooper Comety. org.
Dara fors	MODISEM	936 123 3200	damen hess @ netrong
ATAUL HANNAN	HCFCD	713-684-4117	ataul. hannan chefed.org
Core Stall	FM	717-600-6804	Cory Shilled Arese con
Susan rüheeler	HCFCD		3
Gary Hill	COH/HPW	832-395-3012	gary. hill@houston+x.gov
V			



STUDY PARTNERS KICKOFF MEETING

Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

April 8, 2019

Name	Organization	Phone Number	Email HCPY, NET
GUIF EDWARDS	HC P4	281 787 882	2 GETWARDS 8
Chuck Gilmon	SJRA	936-588-7158	cailmane sira. net.
Jeremy Kater&	HEFED	7) 484-400 5	jeren , rate it & hered.or

Appendix A.2

Executive Briefings





EXECUTIVE BRIEFING AGENDA Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

February 14, 2020 San Jacinto River Watershed Master Drainage Plan HCFCD, Brookhollow

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Executive Briefing
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	2:30 PM
			Meeting Stop Time:	3:30 PM
Agenda				
1.	Introdu	uctions		
2.	San Ja	cinto MDP Presentation		
	•	Community Outreach		
	•	Data Collection Existing Conditions H&H		
	•	Calibration		
	•	Future Conditions		
	•	Primary Mitigation		
	•	Secondary Mitigation		
	•	Schedule		
				
3.	Techni	cal Discussion	.1 1 1	
	•	Future Conditions and BDF M	ethodology	
	•	Primary Mitigation Planning		
4.	Additio	onal Questions/Discussion		

SAN JACINTO RIVER SAN JACINTO - Regional Watershed Master Drainage Plan

HCFCD Executive Briefing February 14, 2020 DRAFT









Agenda

- Communication and Outreach
- Data Collection
- Existing H&H Modeling
- Historical Storm Analysis and Calibration
- Future Conditions

DRAFT

- Primary Mitigation Planning
- Secondary Mitigation Planning
- Other Mitigation Actions
- Project Schedule and Status







Goals and Objectives

- The goal of the San Jacinto Regional Watershed Master
 Drainage Plan is to
 - Conduct a comprehensive Flood Mitigation Plan
 - Identify vulnerability to flood hazards causing loss of life and property
 - Develop approaches to enhance public information and flood level assessment
 - Evaluate flood mitigation strategies to improve long-term resilience
- The plans specific objectives are:

DRAFT

- Primary Flood Mitigation Planning (Detention, Conveyance, Buy-Outs)
- Secondary Mitigation Planning (Flood Assessment/Warning)
- Other Mitigation Actions (Communications Protocols, Flood Response)
- Community Outreach & Education (Drainage, Maintenance, Projects)







San Jacinto River Basin

- 75% HMGP Funded
- 25% Local Funded

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6

DRAFT











GLOSSAR

Communication and Outreach

- Communication
 - Study Partners Meetings (6)
 - Supporting Partners Meeting(7)
- Outreach

DRAFT

- 1st round of public meetings complete – December 2019
- Woodlands Drainage Task Force Meeting – January 28th
- Study Website
 - www.sanjacstudy.org

The San Jacinto Regional Watershed Master Drainage Plan is a comprehensive regional study led by local partners including the Harris County Flood Control District, the San Jacinto River Authority, Montgomery County, and the City of Houston.

This integrated effort, kick started in April 2019, will identify future flood mitigation projects that can be implemented in the near- and long-term to reduce flood risks to people and property throughout the San Jacinto River regional **watershed**.

The goals of the San Jacinto Regional Watershed Master Drainage Plan are • Identify the region's vulnerabilities to flood hazards using Atlas 14 rainfall • Develop approaches to enhance public information and flood level assessm capabilities during a flood disaster event

Evaluate flood miligation strategies to improve community resilience
 Provide a comprehensive Flood Mitigation Plan that supports the needs an objectives of each regional partner

The goals of the project will be achieved by developing a set of hydrologic and hydrolium models for the major thebraines of the Upper San Jacotto River regional waterhold (from the **headvarters**): Na Weller County to the Interstate 10 crossing at the San Jacotto River in Harris County]. The models will use consistent, cohesive methodology and rainfall rates, regardless of the county in which those channels are located.

Information to be developed includes non-regulatory **inutdation maps** into included to replace curvet effective maps) for the udded streams that have the extert and depth of **inversites** (Rooding) of the larger revers within the waterhead on a mary al involuted atome weath. Addisonally, information with the gathered about the number of intractions, acress a fland, properties, and miles of readways that are located within a modeled floodpicity. Subjet weath with the water and update **Hzared Milligation Plans** (So each of the participating partners and be provide agatorias on regulations for the update. While the water and the subjet of the under the subjet of the update. The subjet ones and part of the subjet of the subjet of the update of while the water of the subject of the

The project area covers nearly 3,000 square miles. The expected comp time frame is Fall 2020. The project is budgeted at \$2.7 million.

Contact Us

he participating project partners are interested in hearing from you. Plea ontact your local representative with comments and questions: I Marris County Flood Control Olistrid – Jog Chen, jing cherülthöda beku. 5 an Jacinto River Authority – Matt Barrett mbarrett Bigranet Montgomery County – Diane Cooper, diane.cooperflomte.corg • City of Houston – Gary Hill, garyhill@houstonte.gov





FREQUENTLY ASKED QUESTIONS








Data Collection

- Field Reconnaissance
 - Extensive Site Work
 - Observe, photograph, document
- Field Survey
 - Focus on bridges and culverts
 - More than 20 crossings
- Modeling Data
 - Terrain (2018) LiDAR
 - M3, BLE, Other Models
 - Observed HWM and Gage Data
- Previous Reports

- 9 Relevant Major Previous Efforts
- Reviewed and Documented









Existing Conditions H&H

Hydrology

DRAF

- Atlas 14 Rainfall (varies by watershed)
- Updated Watershed Delineation
- Soils and Percent Impervious
- BDF Values and Slopes (TC+R)
- HEC-HMS Model Development
- Limited adjustment to M3 Models













Existing Conditions H&H

Hydraulics

- Updated cross section geometry
- New/updated bridges and culverts
- Reviewed and adjusted n-values
- Developed unsteady RAS models
- Updated M3 as needed
- Combined into comprehensive model
- Normal lake operations
 - No Additional Gates
 - No Seasonal Lowering











Analysis of Historical Storms

- Historical Storms
 - Memorial Day (2016)
 - Hurricane Harvey (2017)
 - TS Imelda (2019)
 - October 1994
- Leveraged GARR Data
- USGS Gages (Used 22/25)
 - Met with USGS

- Peach Creek Adjustment
- Gage Summary in Report



			-						
Basin		Maximum Rainfall Accumulation (in.)							Total (in)
		1-hr	2-hr	3-hr	6-hr	12-hr	24-hr	48-hr	Total (III.)
Caney Creek	0.5	1.7	2.7	3.5	4.5	7.1	10.2	15.5	28.1
Cypress Creek	0.4	1.2	2.2	3.0	4.9	8.6	14.6	19.0	34.1
East Fork San Jacinto River (North)	0.5	1.6	2.2	3.0	5.4	8.9	11.7	15.7	26.9
East Fork San Jacinto River (South)	0.5	1.6	2.6	3.5	5.8	9.3	12.5	17.5	34.0
Jackson Bayou	1.1	3.5	4.8	5.7	7.1	11.4	16.4	20.9	46.5
Lake Creek	0.3	1.2	1.9	2.7	3.9	6.8	10.8	15.1	23.7
Little Cypress Creek	0.6	2.2	3.7	4.2	6.8	10.7	15.7	20.9	32.2
Luce Bayou	0.5	1.7	3.3	4.6	7.6	11.4	14.4	18.9	33.7
Peach Creek	0.6	1.7	2.6	3.8	4.9	8.3	11.1	16.7	28.8
Spring Creek	0.4	1.3	2.2	2.8	4.8	8.7	14.5	19.9	30.7
West Fork San Jacinto River (to Lake Conroe)	0.3	1.2	2.2	3.0	4.2	7.0	10.1	14.7	24.7
West Fork San Jacinto River (to Lake Houston)	0.5	1.6	2.5	3.3	4.7	8.9	12.8	17.7	36.0
Willow Creek	0.6	1.8	2.8	3.4	5.5	9.3	14.1	18.8	34.2







Calibration

- Calibration Process
 - Stage (Manning's 'n')
 - Flow (Initial/Constant Losses)
 - Timing (BDF for TC+R)
 - Volume (BDF, Manning's 'n')
- Coordination with HDR
- Calibration Complete

DRAFT



0

0.0

2.0

10

3.0

Time (days)

4.0

5.0

6.0

Calibration Results

- Calibration Challenges
 - USGS Peach Creek Gage
 - Initial/Constant Loss Rates
 - Lake Conroe Inflow/Outflow
- Calibration Results*

Ctucom	Location	1% Annual Exceedance Discharge Rate				
Stream		USGS Peak FQ	Effective	SJRWMDP		
West Fork	I-45	111,000	97,000	114,000		
West Fork	Grand Pkwy	120,000	99,000	114,000		
Cypress Creek	I-45	20,700	20,000	24,000		
East Fork	FM 1485 East River	83,100	55,000	60,000		
Caney Creek	FM 2090	34,300	27,000	39,000		
Peach Creek	FM 2090	36,100	36,000	47,000		
Spring Creek	I-45	-	54,000	78,000		
_ake Creek	Sendera Ranch Dr	-	49,000	66,000		
Willow Creek	Kuykendahl Rd, M112	-	7,000	12,000		
uce Bayou	County Limit	-	17.000	25.000		







Future Conditions

- Future Conditions Data
 - Detailed population projection (Harris, Montgomery, Etc.)
 - Harris-Galveston Subsidence District's Regional Groundwater Update Project
 - TWDB population projections
 - 2021 Regional Water Planning (Grimes, Liberty, San Jacinto, Walker, Waller)
- Hydrologic Parameter Adjustments
 - Basin Development Factors (BDF)
 - TC+R
 - % Impervious
- Assumptions

- No changes in Lake Operations
- Detention Requirement
- No floodplain development









Future Conditions

- Future Conditions Results
 - Increases in total volume and peak flows along channels (Variable)
 - Minimal changes to existing lake levels
 - Quicker rising limb than existing but similar receding limb
 - Detention vs. No Detention assumptions require discussion





- Reviewed previous reports and master plans
 - 1943/1957 San Jacinto River Master Plan
 - 1985 Upper San Jacinto River Flood Control Study



- Run models for frequency storm events
- Develop the Structural Inventory Tool
- Identify Damage Centers





- East Fork SJR, West Fork SJR
- Peach, Caney, Spring Creeks

aka Creek

Spring Creek - Instances of Structural Flooding (50-yr Project Life)













• Estimate a range of target volumes













- Evaluate potential volume needs vs. flood reduction benefits
 - High Potential: East Fork SJR, Spring, Peach, Caney Creeks
 - Moderate Potential: Lake Creek
- Consider potential improvements (In Progress)
 - Primary: Previously recommended projects
 - Secondary: New structural and policy ideas
- Primary Alternatives Analysis (Storage)
 - East Fork SJR
 - Caney Creek
 - Peach Creek
 - Lake Creek

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Spring Creek







Sedimentation and Vegetation

- Strategies to reduce flow of sediments into Lake Houston
- Developed annual sediment rating curves for 7 watersheds
 - Predictive tool that relates sediment transport with stream flow
 - Cypress Creek is the highest contributor
- First step toward Regional Sediment Management Plan (RSM)
- Inventory of sediment sources
- Common sediment management strategies
- Recommended strategies for West Fork and Spring Creek
- Full report included as an appendix to Final Report













Secondary Mitigation Planning

- Received input from HCFCD, MCO, USGS, Others
- Considered variety of gage types (Rain, Flow, Stage)
- Flood warning and data for future calibration efforts





Other Mitigation Actions

- Evaluate communications plan/protocol during emergencies
- Identify critical infrastructure and compare to inundation
- Determine expected flood frequency evacuation routes
- Meeting with all Emergency Management Coordinators
 - Completed (Montgomery, Waller, Walker, Grimes, Conroe)
 - Scheduled (Liberty, San Jacinto, Harris, Houston)

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- Workshop (March 12th) to discuss preliminary findings









Project Schedule

- **Major Project Milestones** •
 - Existing H&H and Calibration Memorandum 10/14/2019
 - Primary Alternatives Analysis Memorandum 6/9/2020
 - Vegetation and Sedimentation Control Memorandum 2/7/2020
 - Draft Report 7/6/2020; Final Report 8/31/2020



SAN JACINTO RIVER WMDP - PROJECT SCHEDULE







SAN JACINTO RIVER QUESTIONS?

HCFCD Executive Briefing February 14, 2020 DRAFT

Inne









particular, the 1943, 1957, and 1985 plans were used and the recommendations catalogues and approximately mapped. Many of the proposed projects are not feasible due to current development levels; however, several are being considered as part of the primary mitigation alternatives. Mr. Barr discussed the use of the structural inventory tool to determine the location and frequency of expected structural flooding. Using the damages, graphs were developed that show the number and frequency of flooded structures for each river mile along each of the major streams (Peach, Caney, Spring, etc.) Using this information, the study team was able to identify "damage centers" that will be monitored during the mitigation alternatives analysis. Mr. Poppe suggested providing some exhibits that show graduated visuals for expected damages by flood frequency (i.e. a Heat Map).

Mr. Olmos further explained the process for determination of target storage volumes for each damage center. Instead of trying to determine a specific level of service (LOS) reduction (i.e. reduce current 100-vear flows to current 10-year flows), a range of flow reductions were considered to consider the potential reduction of flooding instances associated with each target volume. A series of LOS reductions were modeled, and the data plotted to estimate the volume that would provide the maximum benefit for the least volume (i.e. the point of diminishing returns). Mr. Barr indicated that, by using this method, a series of target volumes were determined and will be used as a starting point for detention modeling along the various streams. Based on the analysis, the streams with the highest potential benefit vs. volume are East Fork SJR, Spring Creek, Peach Creek, and Caney Creek. Storage on Lake Creek may also provide some benefit to the West Fork SJR.

In addition to structural flood reduction solutions, the study teams may consider the flood reduction benefits of potential policy changes, such as detention of floodplain preservation. Buy-outs are also an option that could be considered. Specific discussion related to policy evaluation is included in Item 4 (Policy Discussion).

Ms. Chen asked if this information would be beneficial to the State Flood Plan. TWBD is currently in the process of selecting the regional planning groups. Mr. Barr indicated that the information could be beneficial to the plan when the San Jac study is complete.

Mr. Barr briefly discussed the **Sedimentation and Vegetation** analysis Halff/FNIprepared by FNI as part of the Primary Mitigation Planning effort. The Consider plan lays out several strategies to help reduce sediment loads into the West Fork San Jacinto River, and into Lake Houston. A complete report has been provided to HCFCD in draft format. Mr. Hannan asked about the potential flood reduction benefits as related to sediment removal. Mr. and flooding Olmos indicated that the investigation focused more on the sediment sources and potential management measures rather than specific flood implications. Previous discussions with HCFCD have yielded a consensus that, while sedimentation may have localized impacts on flooding, the majority of flood volumes are located in the channel and

Halff/FNI-Provide exhibits that include expected damage heat maps

relationship between sedimentation overbanks, above the lower part of the channel where sediment accumulates. Mr. Hannan suggested that the connection at least be mentioned in the report.

Halff/FNI – Add new HCFCD gages into the memo

- Mr. Barr briefly discussed the Secondary Mitigation Planning, which focuses on the existing FWS gage network and the potential for additional gages to augment the gage coverage. The team met with HCFCD, SJRA, MCO, and USGS to discuss gage needs and have provided a draft memo with recommendations for gage location and type. Ms. Chen indicated that HCFCD is already in the process of adding several more gages. The specific locations will be added to the memo. Mr. Poppe mentioned that, given the long-term nature of the proposed flood mitigation projects, the ability to provide better flood warning information was very important. Mr. Hannan and Mr. Poppe also discussed the upcoming flood forecasting capabilities that will become available through HCFCD. Mr. Barr indicated that the potential flood forecasting capability had been discussed with Jeff Lindner (HCFCD) and that the modeling prepared as part of this effort could be leveraged to expand the coverage up into the San Jacinto basin. It was also discussed how surrounding counties use the FWS, and the addition of a flood forecasting capability will be of great benefit to them. Mr. Barr indicated that an implementation strategy will be prepared that includes estimated costs of the gage installation. Mr. Barr discussed the Other Mitigation Actions task, which focuses
- on emergency management and the communication internally and externally during a disaster. Ms. Chen indicated that the study team had held several meetings with the surrounding counties, as well as with Harris County and City of Houston. She also stated that a larger workshop would be held on March 11th. Mr. Barr mentioned that the team was looking at critical infrastructure and major roadway flooding that could impact evacuation routes during a major flood event. Mr. Poppe noted that one of the things that could be mentioned in the meetings with the EMC's is the potential for better resources for the public to call during a disaster. He noted that during Harvey, HCFCD phone lines were maxed out and people started calling 911. Ms. Green suggested a potential centralized call center to distribute information about current flood conditions, forecasts, recommended actions, etc. In addition, the public may be unclear or uneducated about the best places to receive information from those agencies tasked with emergency management. That element should be considered.
- Finally, Mr. Barr provided a brief overview of the schedule. The Mitigation Planning should conclude in early June with the Draft Report to be submitted on July 6th.

3. **Technical Discussion**

• With respect to the **Future Conditions** analysis, Mr. Hannan indicated that the issue with the BDF detention factor default for less developed areas needed to be discussed with the MAAPnext management team. It issue with

	is not unarroaded that a name mathed would have some issues to be	MAADnovt
	is not unexpected that a new method would have some issues to be worked through. Mr. Barr indicated that the volume difference between the existing and future conditions was relatively small (1-2%) so the storage alternatives aren't significantly impacted. However, the discrepancy should be evaluated before the detention policy alternative can be properly considered.	team
	• Another item of discussion was how to best show the benefits of potential projects for comparison and recommendation . Mr. Poppe suggested that the team look at other metrics beyond the traditional BCA, because those metrics may skew projects to certain areas or may show that projects are not economically feasible. The group conversation included other potential metrics such as the number of structures no longer flooded (removed from structure value), acreage reclaimed, roadway miles no longer inundated, critical facilities protected, reduction of per capita flood-related deaths, and others. While there was no knowledge in the group about specific FEMA accounting of fatalities as it related to monetary benefits, they should be considered in our project evaluations and prioritization. These benefits will need to be weighed against the potential costs of these projects. Mr. Barr and Mr. Olmos indicated that the projects could run into the \$ Billions, which will likely result in the need to phase projects. Given the expense, identifying a potential funding source will be an important task.	Halff/FNI – Consider other metrics to measure project success
4.	Policy Discussion	
	• With respect to Detention Policy , there was some back and forth discussion about the potential for evaluating detention scenarios to gain a general understanding of how detention, or a lack thereof, could impact flooding as the basin develops. The current future conditions (year 2070) analysis leverages data from HGSD and TWDB to predict development patterns. However, changes to these projections could have a significant impact how detention changes flow characteristics in the basin.	
	Additional development scenarios should be considered if detention policy is to be effectively evaluated. In addition, different detention rates may need to be considered. The scale of the current study may also be an issue. The modeling completed as part of this study looks at wholesale implementation of detention and it's impacts on the major streams. It does not consider the impacts of detention vs. no detention at the tributary or individual development level. The general consensus of the group was that development will generally have a noticeable impact on the surrounding properties if increases in the flow are not mitigated. Due to timing and other factors, these impacts may not show up at a regional scale. Mr. Poppe suggested looking at some test cases at the tributary level to gain perspective.	
	Mr. Poppe also inquired as to the specifics of Montgomery County's current detention policy. Mr. Barr indicated that the study team can provide specific information. Ultimately, the goal of this study would be to provide some analysis and inform them about the potential negative	

	impacts of allowing undetained development. Montgomery and the surrounding counties will need to determine their own detention policy.Mr. Poppe stated that policy matters, and that Harris County has been gaining knowledge of its own for decades with respect to development and drainage criteria. Our discussion of policy should seek to share that knowledge in the hopes that other counties avoid unintended consequences from under mitigated new or redevelopment before they are developed and costs to address the problems increase significantly.	
5.	Additional Questions and Discussion	
	• The final discussion points were related to the scale of solutions and the potential for phasing. There was concern that the scale of the proposed solutions would be too large to move forward in a timely fashion. Mr. Barr indicated that given the size of the problem, the solutions will be very expensive. However, the availability of land will likely result in the splitting of detention storage into multiple parts. The overall solution will be a combination of multiple projects in different watersheds, not just one single project.	
	The analysis will determine which project should move forward first and can provide the most incremental benefit. At each project phase, incremental benefit will need to be shown. In addition to the localized improvements of each project or project phase, the team will evaluate the improvements downstream. For example, a regional detention basin on Spring Creek would certainly be intended to help flooding along Spring Creek, but the downstream benefits along the West Fork and in lake Houston would also be evaluated to ensure that benefits are not just isolated to one area. The damage center analysis and strategic location of these improvements are intended to solve the larger regional issues.	
6.	Ms. Chen concluded the meeting.	

This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not correct, or that any information is missing or incomplete, please contact Halff Associates so that the matter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.





EXECUTIVE BRIEFING AGENDA Harris County Flood Control District

July 21, 2020 San Jacinto River Watershed Master Drainage Plan Teams Conference Call

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Executive Briefing
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	1:00 PM
			Meeting Stop Time:	2:00 PM
Agenda				
1.	Introdu	ctions		
2.	Goals a	nd Objectives		
3.	H&H a	nd Calibration Recap		
4.	Primar	y Mitigation Planning		
	•	San Jacinto Regional WMDP		
	•	Lake Houston Influence		
5.	Seconda	ary Mitigation Planning		
6.	Other F	Flood Hazard Mitigation Acti	ons	
7.	Implem	entation Planning		
	•	Short-term Strategies		
	•	Long-term Strategies		
	•	Metrics		
	•	Scoring		
	•	Ranking		
	•	Implementation		
	•	Funding		
	•	Challenges		
8.	Next St	eps		
9.	Coordia	nation and Communication		
10.	Project	Schedule and Status		
11.	Questio	ns		

SAN JACINTO RIVER SANJAGINTO - Regional Watershed Master Drainage Plan

HCFCD Executive Briefing No. 2 July 21, 2020 - DRAFT









Agenda

- Goals and Objectives
- H&H and Calibration Recap
- Primary Mitigation Planning
- Secondary Mitigation Planning
- Other Mitigation Actions
- Implementation Planning
- Project Schedule and Status



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Goals and Objectives

- The goal of the San Jacinto Regional Watershed Master
 Drainage Plan is to
 - Prepare a comprehensive Flood Mitigation Plan
 - Identify vulnerability to flood hazards causing loss of life and property
 - Evaluate flood mitigation strategies to improve long-term resilience
 - Consider approaches to enhance public information and flood level assessment
- The plans specific objectives are:
 - Primary Flood Mitigation Planning (Detention, Conveyance, Buy-Outs)
 - Secondary Mitigation Planning (Flood Assessment/Warning)
 - Other Mitigation Actions (Communications Protocols, Flood Response)
 - Community Outreach & Education (Drainage, Maintenance, Projects)





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H&H and Calibration

- Developed Comprehensive Model
- Updated H&H Modeling
 - Atlas 14 Rainfall (varies by watershed)
 - Updated LiDAR Terrain
 - Developed combined unsteady RAS model
- Historical Storms
 - Memorial Day (2016)
 - Hurricane Harvey (2017)
 - TS Imelda (2019)
 - October 1994
- BFE increases of approximately 2'
- Leverage as best available information and updated to meet FEMA standards.



Sedimentation and Vegetation

- Sediment Report Findings
 - USACE has removed ~3% of sediment deposited since Lake Houston Dam's construction (1954)
 - Cypress Creek, Spring Creek, West Fork are highest contributors









Sedimentation and Vegetation

- Identified 49 potential sediment management strategies, including:
 - Sediment traps
 - Stream restoration projects
 - Protection of sand mines
 - Public-private partnerships
 - Sediment bypass tunnel
- Next Steps
 - Complete a regional sediment mitigation (RSM) plan with more detailed sediment transport and volumetric analyses
 - Identify new stream gage locations to pinpoint sediment sources
 - Conduct a feasibility study to implement pilot projects
 - Additional analyses: dam hydraulics, sediment tunnel, stream stabilization







Flood Mitigation Strategies

- Primary Flood Mitigation Planning (Flood Reduction)
 - Primary Alternatives Based on previously identified solutions
 - Secondary Alternatives Developed additional flood reduction projects
 - Developed cost estimates
 - Evaluated potential benefits
 - Identifed implementation path and challenges
- Secondary Flood Mitigation Planning (Flood Warning)
 - Coordinated with HCFCD, MCO, SJRA, TXDOT, USGS, NWS
 - Recommended locations for additional FWS gages
- Other Mitigation Actions (Flood Response)
 - Coordinated with agencies responsible for Emergency Management
 - Provided recommendations for updated communications protocols
 - Identified potential flooding of roadways and critical infrastructure





San Jacinto Regional WMDP



Lake Houston Influence

- Influence of Lake Houston extends from the dam to Lake Houston Parkway.
- Upstream of Lake Houston Parkway, the West Fork controls



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Lake Houston Influence









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San Jacinto Regional WMDP

- Plan Cost: \$2.9B \$3.3B
- Overall Plan Benefits: \$756 M
- BCR: 0.23 0.26

Stream	Existing Structural Damages (\$M)	Combined Alternatives Structural Damages (\$M)	Structural Benefit (\$M)	Cost Range (\$M)
Spring Creek	339.4	117.3	222	313.6 – 388.5
Willow Creek	119	101.4	17.5	-
Cypress Creek	374.1	370.4	3.7	-
Little Cypress Creek	196.7	196.2	0.5	-
East Fork SJR	128.3	78.3	50.1	134.3 – 166.6
West Fork SJR	396.2	198.2	198	966
Lake Creek	16.7	4.5	12.1	303 - 422
Peach Creek	163.9	32.9	131.1	718.0 – 812.0
Caney Creek	190.8	70.5	120.2	478.0 – 533.0
Luce Bayou	20	19.2	0.8	-
Total	2,030.3	1,274.1	756.2	2,912.9 – 3,288.1





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Secondary Mitigation Planning

- Received input from HCFCD, MCO, USGS, SJRA
- 26 Gages recommended (HCFCD Currently installing 5)
- Approximate installation cost range \$240k \$330k (plus maint.)
- Potential for inundation mapping along modeled streams









Other Mitigation Actions

- Other Mitigation Action Goals
 - Evaluate communications plan/protocol during emergencies
 - Identify critical infrastructure and compare to inundation
 - Determine expected flood frequency evacuation routes
- Conducted Emergency Management Workshop (March 11th)
 - Communication during a disaster was effective, no significant changes
 - Some adjustments or efficiencies could be made
 - Variety of flood monitoring approaches from remote to in-person
 - Information gaps in documentation, floodplain mapping, gage coverage






Other Mitigation Actions

- Recommendation Summary
 - Documentation and Staffing
 - Develop and follow written Emergency Response Plan; Keep up to date
 - Perform regular review and conduct practice exercises
 - Communication
 - Link various social media accounts to improve coverage and consistency
 - Improve internal alerts for infrastructure flooding or failure
 - Flood Monitoring and Protection
 - Identify areas that require monitoring and install gages at those locations
 - Work with other agencies to integrate gages into a larger, regional system
 - Leverage flood monitoring to provide timely alerts to the public
 - Public Education
 - Develop a public education strategy that includes social media, radio, TV, and faceto-face discussion
 - Leverage pre-developed resources from agencies like TWDB







Other Mitigation Actions

- Critical Infrastructure
 - Includes city/county facilities, police, fire/EMS, W/WWTP, hospitals, etc.
 - Approximately 1460 "critical" facilities in the San Jacinto basin
 - Approximately 239 potentially impacted by the 500-year event
- Roadway Flood Frequency
 - Evaluated potential flooding for all roadway classifications
 - Four evacuation route crossings inundated by less than 1% ACE
 - Cypress Creek at IH-45
 - West Fork San Jacinto at IH-69
 - Peach Creek at IH-69
 - East Fork San Jacinto at IH-69



Implementation Planning

- Implementation includes short-term and long-term strategies
 - Short-term strategies can be fully/partially implemented within 5 years
 - Long-term strategies will take longer than 5 years, perhaps decades

Master Drainage Plan

- Short Term
- Vision Group
- Policy
- Flood Warning
- Flood Response
- Buyouts
- Mapping

Long Term

- Detention
- Channelization
- Floodplain Preservation









Short-term Strategies

- Develop a San Jacinto River Vision Group to foster collaboration of stakeholders in the basin with the goals of:
 - Establishing common drainage and detention criteria
 - Updating H&H and floodplain analysis standards
 - Implementing recommended MDP projects
- Implement additional gages to augment the flood warning system
- Implement Other Mitigation Action recommendations
- Buyout frequently flooded structures (2-, 5-YR)
- Remap the main streams and tributaries to improve flood risk data
- Develop watershed plans for tributaries in the major watersheds.







Long-Term Strategies

- Channelization and Detention projects may require significant time and funding
- Implementation Plan includes:
 - Metrics
 - Scoring
 - Ranking
 - Project Stages
 - Project Team
 - Funding Options
 - Potential Lead Agencies
 - Challenges







Implementation - Metrics

- Historical Damages Number of historically flooded structures
- Predicted Damages Number of instances of flooding based on a 50-year project life
- Flooding Instance Reduction Number of instances of flooding removed by the project
- Structures Removed Number of structures removed from the 1% ACE floodplain
- BCR Benefit Cost Ratio of the project
- Roadway Total depth of reduction of WSELs along modeled roadways for all frequency storm events
- SVI Average SVI of structures benefitted by project
- LMI Average LMI of structures benefitted by project
- Cost Total cost of project





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Implementation – Scoring

- Metrics are weighted based on priority
- Projects are assigned a score of 0 – 4 based on quartile compare to other projects
- Example: Walnut Creek
 Detention removes 1,296
 structures from the 1% ACE.
 This project removes the most of all projects so receives a 4.0 as a score.

Metric	Assigned Weight
Historical Damages	10%
Predicted Damages	10%
Instance Reduction	20%
Structures Removed	20%
BCR	10%
Roadway	5%
SVI	10%
LMI	10%
Cost	5%





Implementation – Scoring

		% Cost (\$M)	Watershed Historical Damages ¹	Watershed Predicted Damages ¹	00% Instance Reduction ²	Structures Removed from 1% ACE ²	BCR⁴	%5 Roadway	I 0%	۲ МI ء 10%	S%	Total Score
	Walnut Creek	97.2–132.1	2.0	3.0	3.0	4.0	4.0	1.0	1.0	0.0	3.0	2.60
Spring	Birch Creek	81.6–121.6	2.0	3.0	2.0	3.0	3.0	1.0	0.0	1.0	3.0	2.10
Shiing	DC2-200 Channel	53.6–203.6	2.0	3.0	0.0	0.0	3.0	0.0	1.0	0.0	3.0	1.05
	I-45 Channel	81.2–231.2	2.0	3.0	3.0	4.0	4.0	2.0	0.0	1.0	2.0	2.60
	Caney Creek Detention	98.0–163.0	0.0	0.0	1.0	2.0	3.0	1.0	1.0	1.0	2.0	1.25
Lake	Little Caney Creek	98.0–128.0	0.0	0.0	0.0	1.0	2.0	2.0	2.0	1.0	3.0	0.95
	Garret's Creek Detention	107.0–131.0	0.0	0.0	2.0	2.0	2.0	3.0	1.0	2.0	2.0	1.55
	Walker Creek Detention	201.0–218.0	1.0	1.0	1.0	0.0	1.0	3.0	3.0	3.0	1.0	1.30
Peach	SH 105 Detention	356.0–433.0	1.0	1.0	3.0	1.0	0.0	3.0	3.0	3.0	0.0	1.75
	I-69 Channel	161.0–311.0	1.0	1.0	4.0	2.0	3.0	4.0	3.0	3.0	1.0	2.55
Caney	Detention at FM 1097	105.0–131.0	2.0	2.0	2.0	1.0	1.0	4.0	4.0	4.0	3.0	2.25
	Detention at SH 105	179.0–208.0	2.0	2.0	4.0	3.0	2.0	3.0	4.0	4.0	1.0	3.00
	US 69 Channelization	194.0–209.0	2.0	2.0	2.0	3.0	1.0	2.0	2.0	2.0	1.0	2.05
East Fork	Winter's Bayou Dam	134.0–166.6	3.0	1.0	3.0	2.0	2.0	2.0	3.0	3.0	2.0	2.40
West Fork	River Plantation Channel	148.0–538.0	4.0	4.0	1.0	1.0	1.0	0.0	2.0	2.0	1.0	1.75
Westron	Kingwood Benching	818.0-848.0	4.0	4.0	1.0	3.0	0.0	1.0	2.0	2.0	0.0	2.05

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Implementation - Ranking

• Project Ranking - Adjusted

Rank	Project	Score	Cost
1	Caney - Detention at SH 105	3.00	179.0–208.0
2	Spring - Walnut Creek	2.60	97.2–132.1
3	Spring - I-45 Channel*	2.60	81.2
4	East Fork - Winter's Bayou Dam	2.40	134.0–166.6
5	Caney - Detention at FM 1097	2.25	105.0–131.0
6	Peach - SH 105 Detention	1.75	356.0-433.0
7	Peach - I-69 Channel*	2.55	161.0
8	Spring - Birch Creek	2.10	81.6–121.6
9	Caney - US 69 Channelization*	2.05	194.0
10	West Fork - Kingwood Benching	2.05	818.0 - 848.0
11	West Fork - River Plantation Channel*	1.75	148.0
12	Lake - Garret's Creek Detention	1.55	107.0–131.0
13	Peach - Walker Creek Detention	1.30	201.0-218.0
14	Lake - Caney Creek Detention	1.25	98.0–163.0
15	Spring - DC2-200 Channel*	1.05	53.6
16	Lake - Little Caney Creek	0.95	98.0-128.0

*Adjustment to facilitate no adverse impact by ensuring detention prior to channel projects





Long-term Project Implementation

- Project Definition
 - Develop a Project Team
 - Identify Funding Sources
 - Project Development (Feasibility, PER)
- Project Construction
 - Acquire Necessary ROW
 - Complete Design and Permitting
 - Project Construction

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San Jacinto Regional Watershed Master Drainage Plan

Project Land **Design &** Operations and Construction **Project Team** Funding Planning Development Acquisition Permitting Maintenance Phase I - Project Definition Phase II - Project Construction Construction Phase includes acquiring the land Definition Phase includes identifying the agency and consultant team to develop the projects, easements needed for the and project. identifying and securing funding for the program, developing construction drawings, identifying and and additional feasibility and securing any environmental permitting, preliminary and engineering for project specifications project construction.

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Implementation - Project Team

- **Regional Facilitator** •
 - Coordinate projects among lead agencies
 - Resource for projects and policy
 - **Technical Resource**
 - Agency such as TWDB, Drainage **District**, Task Force
- Lead Agency
 - Coordinate with Regional Facilitator
 - Champion projects from Concept to Construction
 - Identify and Secure Funding
 - Conduct Engineering Analysis and Design
 - Identify and Acquire ROW ____
 - Construction and Maintenance



Implementation - Funding

- Recommended Funding Options
 - FEMA PDM and HMGP Explore grants for buyouts and flood warning systems; Potential funding for western side projects with BCR > 1.0.
 - CDBG-DR and CDBG-MIT LMI threshold requirements better suited to projects in the eastern part of the basin
 - NRCS WFPO Investigate if projects qualify; Requires an NRCS approved plan
 - TWDB FP and FIF Several abridged applications were submitted in June 2020 for projects by various agencies; Partially fund WPS.
 - Local Bonds, Taxes or Impact Fees Local matches may be required by several of the grant sources. Communities and agencies should consider bond elections or budgeting for drainage studies and projects
 - Private Investment Major industry or development interests may be looking for opportunities to reduce flooding in these watersheds



Low to Moderate Income (LMI) Areas



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Implementation - Lead Agencies

Rank	Project	County Location	Potential Lead Agency		
1	Caney - Detention at SH 105	Montgomery	Montgomery County		
2	Spring - Walnut Creek	Waller	USACE		
3	Spring - I-45 Channel	Harris/Montgomery	USACE		
4	Peach - I-69 Channel	Montgomery	Montgomery County		
5	East Fork - Winter's Bayou Dam	San Jacinto	San Jacinto County		
5		San Sacinto	Liberty County		
6	Caney - Detention at FM 1097	Montgomery	Montgomery County		
7	Spring - Birch Creek	Waller	Montgomery County		
		Waller	HCFCD		
8	Caney - US 69 Channelization	Harris/Montgomery	Montgomery County		
9	West Fork - Kingwood Benching	Harris County	HCFCD		
10	Peach - SH 105 Detention	Montgomery	Montgomery County		
11	West Fork - River Plantation Channel	Montgomery	Montgomery County		
12	Lake - Garret's Creek Detention	Grimes County	Montgomery County		
13	Peach - Walker Creek Detention	Montgomery/San Jacinto	Montgomery County		
14	Lake - Caney Creek Detention	Grimes	Montgomery County		
15	Spring - DC2-200 Channel	Harris/Montgomery	HCFCD		
16	Lake - Little Caney Creek	Montgomery	Montgomery County		





Implementation - Challenges

- Short Term
 - Keeping the momentum of the study
 - Consistent floodplain and drainage policy in jurisdictions with different political climates and economic needs
 - Securing funding for a major remapping effort
 - Resistance to buyout of frequently flooded structures
 - Funding for short-term efforts (gages, studies, etc.)
- Long Term
 - Securing funding for major projects
 - Acquiring ROW
 - Environmental permitting and mitigation
 - Utility relocation for major O&G or electrical lines
 - Relocation of transportation infrastructure
 - Rapid change in construction costs
 - Changes in development patterns







Next Steps

- Establish a San Jacinto River Vision Group
- Submit San Jacinto study to TWDB RFPG for inclusion in the State Flood Plan
- Identify Regional Facilitator
- Install recommended gages as funding permits
- Implement Emergency Management recommendations
- Initiate Floodplain Mapping Effort based on SJRWMDP models
- Prioritize tributary watersheds for planning studies
- Progress top 2 projects through development phase
 - Caney Detention at SH 105
 - Spring Walnut Creek







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Coordination and Communication

- Coordination
 - ROW Discussion 06/05/20
 - SJRA Board Meeting 07/23/20
 - HC Precinct 3 Briefing 06/30/20
 - HC Precinct 4 Briefing 07/16/20
- Communications
 - Community Meeting 08/13/20
 - July/August Briefings
 - Council Member Dave Martin
 - Congressman Crenshaw
 - State Representative Huberty
 - Montgomery County Drainage Council
 - Kingwood Association Management
 - Lake Houston Area Chamber
 - Community Activists (Bob Rehak, Barbara Hillburn)



FREQUENTLY ASKED QUESTIONS



The San Jacinto Regional Watershed Master Drainage Plan is a comprehensive regional study led by local partners including the Harris County Flood Control District, the San Jacinto Kiver Authonity, Montgomery County, and the City of Houston.

This integrated effort, kick started in April 2019, will identify future flood mitigation projects that can be implemented in the near- and long-term to reduce flood risks to people and property throughout the San Jacinto River regional **watershed**.

- The goals of the San Jacinto Regional Watershed Master Drainage Plan are to: • Identify the region's vulnerabilities to flood hazards using Atlas 14 rainfall • Develop approaches to enhance public information and flood level assessment capabilities during a flood disaster event
- Evaluate flood mitigation strategies to improve community resilience
 Provide a comprehensive Flood Mitigation Plan that supports the needs and objectives of each regional partner

The goals of the project will be achieved by developing a set of hydrologic and hydrolic models for the major thibutaries of the Upper San Jacinto River regional waterhed (from the **headwatters**): Nalker County to the Interstate 10 corssing at the San Jacinto River in Harris County). The models will use consistent, cohesive methodology and rainfall rates, regardless of the county in which those channels are located.

Information to be developed includes non-regulatory **inundation maps** (not intended to replace current effective maps) for the studied interants that show the extent and depth of **inversine Booding** of the larger three within the wateshed for an array of simulated atom events. Additionally, information will be gathered about the number of stanctures, across cland, properties, and miles of roadway that are located within the modeled Boodplains. Study results will be used to inform and upposte **Hazard Mitigation Plans** for each of the particulary particulary and to provide guidance an engulations for future growth within the study area.

The project area covers nearly 3,000 square miles. The expected completion time frame is Fall 2020. The project is budgeted at \$2.7 million.

Contact Us

The participating project partners are interested in hearing from you. Please contact your local representative with comments and questions: Harris County Flood Control District - Jang Chen, ing chen@hctd.hct.net San Jacinto River Authority - Matt Barrett, mbarret®ispin.et Montgomery County - Diane Cooper, diane.cooper@mch.cog City of Houston - Gary Hill, garyhill@houstonk.gov

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN FACT SHEET | Spring 2019





iverine flooding: Flooding th

Hazard Mitigation Plan





Schedule Update

- 469 Current Progress
 42 Days Remaining
 8/31/2020 Completion Date
- Existing H&H/Calibration 100% (Finalized)
- Primary Mitigation Planning (Under Review) 95%
- Secondary Mitigation Planning (Finalized) 100%
- Other Mitigation Actions (Under Review) 95%







SAN JACINTO RIVER QUESTIONS?

HCFCD Executive Briefing No. 2 July 21, 2020 - DRAFT

Times













STUDY PARTNERS BRIEFING AGENDA

City of Houston

July 9, 2020 San Jacinto Regional Watershed Master Drainage Plan Teams Conference Call

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Executive Briefing
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	4:00 pm
			Meeting Stop Time:	5:00 pm
Agend	a			
1.	Introdu	ictions		
2.	Goals	and Objectives		
	•	Conduct a comprehensive Flo	od Mitigation Plan	
	•	Identify vulnerability to flood	hazards causing loss of	life and property
	•	Develop approaches to enhar	nce public information a	and flood level assessment
	•	Evaluate flood mitigation stra	itegies to improve long-	term resilience
3.	Existin	g Conditions		
	•	Existing Conditions H&H Mod	leling Update	
	Analysis of Historical Storms			
	•	Sedimentation and Vegetatio	n	
4.	Primar	y Mitigation Planning		
	•	Flood Mitigation Strategies		
	•	Primary Mitigation Tasks		
	•	Damage Center Identification	I	
	•	Flood Mitigation Projects		
	•	Additional Mitigation Measur	es	
	•	Implementation Planning		
5.	Second	dary Mitigation Planning		
-	•	Gage Recommendations		
6	Other I	Mitigation Actions Planning		
0.	•	Coordination with Emergency	/ Managers	
	•	Updated communication plan	ns/protocols	
	•	Critical infrastructure and roa	idway flood frequency	
7.	Comm	unity Outreach		
	•	Partners and Stakeholder Cor	nmunication	
	•	Community Outreach		
8.	Study	Schedule		
9.	Questi	ons		

SAN JACINTO RIVER SANJACINTO - Regional Watershed Master Drainage Plan

City of Houston Briefing July 9, 2020 - DRAFT









Agenda

- Goals and Objectives
- Existing Conditions
- Primary Mitigation Planning
- Secondary Mitigation Planning
- Other Mitigation Actions Planning
- Community Outreach
- Project Schedule and Status
- CWA Lake Houston Gate Study
- Questions







San Jacinto River Basin

- 75% HMGP Funded
- 25% Local Funded

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6



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City of Houston

- West Fork San Jacinto
- East Fork San Jacinto
- Lake Houston







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Flood Claim Density



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Goals and Objectives

- The goal of the San Jacinto Regional Watershed Master
 Drainage Plan is to
 - Conduct a comprehensive Flood Mitigation Plan
 - Identify vulnerability to flood hazards causing loss of life and property
 - Develop approaches to enhance public information and flood level assessment
 - Evaluate flood mitigation strategies to improve long-term resilience
- The plans specific objectives are:
 - Primary Flood Mitigation Planning (Detention, Conveyance, Buy-Outs)
 - Secondary Mitigation Planning (Flood Assessment/Warning)
 - Other Mitigation Actions (Communications Protocols, Flood Response)
 - Community Outreach & Education (Drainage, Maintenance, Projects)





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Existing Conditions H&H Analysis

- Developed Comprehensive Model
- Limited Updates to M3 Models
- Hydrology
 - Atlas 14 Rainfall (varies by watershed)
 - Updated Watershed Delineation
 - Updated Infiltration/Transform Parameters
 - HEC-HMS Model Development
- Hydraulics
 - Updated cross section geometry
 - New/updated bridges and culverts
 - Reviewed and adjusted n-values
 - Developed unsteady RAS models











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STRUCT





- Historical Storms
 - Memorial Day (2016)
 - Hurricane Harvey (2017)
 - TS Imelda (2019)
 - October 1994
- Leveraged Gage Adjusted Radar Rainfall (GARR) Data
- USGS Gages (Used 22/25)
 - Met with USGS
 - Gage Summary in Report
- Calibration Report Submitted







Sedimentation and Vegetation

- Strategies to reduce flow of sediments into Lake Houston
- Developed annual sediment rating curves for 7 watersheds
 - Predictive tool that relates sediment transport with stream flow
 - Cypress Creek is the highest contributor
- First step toward Regional Sediment Management Plan (RSM)
- Inventory of sediment sources
- Common sediment management strategies
- Recommended strategies for West Fork and Spring Creek
- Did NOT evaluate relationship between sediment and flooding













Flood Mitigation Strategies

- Primary Flood Mitigation Planning (Flood Reduction)
 - Primary Alternatives Based on previously identified solutions
 - Secondary Alternatives Developed additional flood reduction projects
 - Develop cost estimates
 - Evaluate potential benefits
 - Identify implementation path and challenges
- Secondary Flood Mitigation Planning (Flood Warning)
 - Coordinate with HCFCD, MCO, SJRA, TXDOT, USGS, NWS
 - Recommend locations for additional FWS gages
- Other Mitigation Actions (Flood Response)
 - Coordinate with agencies responsible for Emergency Management
 - Provide recommendations for updated communications protocols
 - Identify potential flooding of roadways and critical infrastructure





Primary Mitigation Tasks

- Evaluate flood damages using the Structural Inventory Tool
- Identify "Damage Centers"
- Determine volume reduction for a range of LOS improvements
- Compare reduction volumes to potential benefits
- Estimate preliminary target volumes for each damage center
- Consider previously identified projects
- Develop new potential projects
- Select watersheds with highest potential for improvements







Damage Center Identification

- Run models for frequency storm events
- Develop the Structural Inventory Tool
- Identify Damage Centers



Spring Creek – Structures at Risk of Flooding







Damage Center Identification



Watershed Mitigation Potential

Higher Potential

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- Spring Creek (Benefits in watershed; Potential reduction downstream)
- East Fork (Major Lake Houston contributor; Available open space)
- Peach/Caney Creek (Available open space; Benefits in watershed)
- Moderate Potential
 - Lake Creek (Available open space; large contributing area to West Fork, Limited benefits in the Lake Creek watershed)
- Lower Potential
 - Cypress Creek (Limited open space; Other HCFD efforts; Overflow)
 - Willow Creek/Little Cypress Creek (Small contribution; Limited space)
 - Luce/Tarkington Bayou (Limited damages; Smaller contribution; Flat)
 - Jackson Bayou (Very small contribution; Downstream of Lake Houston)
 - West Fork (Limited open space; High volume; Benefits in watershed)



Previously Recommended Projects

- Reviewed previous reports and master plans
 - 1943 San Jacinto River Master Plan
 - 1957 San Jacinto River Master Plan
 - 1985 Upper San Jacinto River Flood Control Study
 - 1989 South Montgomery County Flood Protection Plan
 - 1997 Lake Creek Reservoir Study
 - 2000 Lake Houston Regional Flood Protection Study
 - 2015 Cypress Creek Overflow Management Plan
 - 2019 Estimate Land Cover Effects on Selected Watersheds
 - 2019 Hurricane Harvey San Jacinto River Flooding (presentation)







Previously Recommended Projects

- Considered 34 Previously Recommended Projects
 - 1943/1957 San Jacinto River Master Plan
 - 1985 Upper San Jacinto River Flood Control Study


San Jacinto Regional WMDP



San Jacinto Regional WMDP

- Combined projects show increased local and regional benefits
- Current project combinations (by Watershed)
 - Spring Creek: Walnut Detention, Birch Detention, I-45 to Riley Fuzzell
 - Lake Creek: Caney Detention, Little Caney Detention, Garrett's Detention
 - East Fork: Winters Detention, Lower East Fork Channel Improvements
 - Caney Creek: SH105 and FM1097 Detention, Channel D/S of I-69
 - Peach Creek: SH 105 and Walker Detention, Channel D/S of I-69
 - Full Combined Model: Ultimate Flood Reduction Improvements
- Projects in Spring Creek have the highest BCR (0.55 1.22)





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San Jacinto Regional WMDP

- Plan Cost: \$2.9B \$3.3B
- Overall Plan Benefits: \$756 M
- BCR: 0.23 0.26

Stream	Existing Structural Damages (\$M)	Combined Alternatives Structural Damages (\$M)	Structural Benefit (\$M)	Cost Range (\$M)
Spring Creek	339.4	117.3	222	313.6 – 388.5
Willow Creek	119	101.4	17.5	-
Cypress Creek	374.1	370.4	3.7	_
Little Cypress Creek	196.7	196.2	0.5	-
East Fork SJR	128.3	78.3	50.1	134.3 – 166.6
West Fork SJR	396.2	198.2	198	966
Lake Creek	16.7	4.5	12.1	303 - 422
Peach Creek	163.9	32.9	131.1	718.0 – 812.0
Caney Creek	190.8	70.5	120.2	478.0 – 533.0
Luce Bayou	20	19.2	0.8	_
Total	2,030.3	1,274.1	756.2	2,912.9 – 3,288.1

Low to Moderate Income (LMI) Areas



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Additional Regional Measures

• Detention Policy

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- Local detention provides critical mitigation for development and CIP
- Regional benefits are dependent on location and timing of development
- Future conditions modeling indicated limited detention impact, BUT
 - 2070 development was centered on lower basin (1-2% volume increase)
 - Ultimate development along the basin outer boundaries shows a higher increase in runoff volume (>5%)
- Detention DOES have an impact on local flooding issues
- Comprehensive impact analysis should be performed
- Floodplain Preservation
 - Losses to floodplain storage could negatively impact downstream areas
 - Future Conditions modeling does not include floodplain fill
 - Approx. market value of all flooded structures in the 100-year ~ \$3B





Buyouts

- Structures currently located in the 2-, 5-year floodplains may see some benefits, but will continue to flood
- Removed from the instances of flooding for damage centers
- Maintained in the BCR calculations
- Generally a higher BCR on buyouts than structural projects
- Best option may be to buyout structures in this category







Buyouts

• Summary of structures and expected damages in each watershed that flood in the 5-year event

Watershed	Structure Count	Existing Damages (NPV, 50-yr Period) (\$M)	2019 Market Value (\$M)	Estimated Buyout Cost (2.5× Mkt. Value) (\$M)	Benefit-Cost Ratio
Spring Creek	34	46.65	4.38	10.96	4.3
Willow Creek	39	29.92	9.61	24.02	1.2
Cypress Creek	40	69.92	16.80	42.01	1.7
Little Cypress Creek	30	31.02	6.05	15.13	2
East Fork SJR	31	36.53	5.53	13.83	2.6
West Fork SJR	38	40.29	6.41	16.02	2.5
Lake Creek	5	4.72	1.02	2.55	1.9
Peach Creek	71	59.46	8.67	21.67	2.7
Caney Creek	85	74.05	7.80	19.49	3.8
Luce Bayou	9	4.76	1.08	2.70	1.8
Tarkington Bayou	58	57.07	7.34	18.34	3.1
Jackson Bayou	1	1.51	0.21	0.52	2.9
Gum Gully	2	1.57	0.97	2.43	0.6
Totals	443	457.46	75.87	189.67	2.4





Implementation Planning

- Identify projects to be included in MDP
- Finalize modeling of individual selected projects
- Perform project prioritization
 - Update project costs and benefits
 - Select and weight metrics based on study partner input
 - Perform project prioritization
- Develop project phasing plan
 - Model projects cumulatively to ensure no negative impacts
 - Update environmental and cultural data, update utility information, ROW
 - Identify potential funding sources depending on criteria (BCR, LMI, etc.)
- Move forward with Feasibility, Preliminary Engineering, Design



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Secondary Mitigation Planning

- Received input from HCFCD, MCO, USGS, Others
- Updated Secondary Mitigation Memo (05/13/20)
 - 26 Gages recommended (HCFCD Currently installing 5)
 - Approximate installation cost range \$240k \$330k (Plus Maintenance)









Other Mitigation Actions

- Other Mitigation Action Goals
 - Evaluate communications plan/protocol during emergencies
 - Identify critical infrastructure and compare to inundation
 - Determine expected flood frequency evacuation routes
- Conducted Emergency Management Workshop (March 11th)
- Working on draft memorandum













GLOSSAR

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ies of the Upper San Jacinto Rive and (from the **headwaters** in Walker County to the Interstate 10 c

ant and depth of **riverine flooding** of the larger tion will be

Contact U

Harris County Flood Control District - ling Chen, ling ch San Jacinto River Authority Montgomery County - Digne Cooper, digne.c



- Communication
 - Study Partners Meetings (6)
 - Supporting Partners Meeting (8)
 - Emergency Managers Workshop
 - H-GAC Coordination

Outreach

- 1st round of community meetings complete – December 2019
- 2nd Community Meeting (Virtual) in planning – August 2020
- Stakeholder Meetings (Jul/Aug)
- Woodlands Drainage Task Force Meeting – January 28th
- **Study Website** www.sanjacstudy.org



FREQUENTLY ASKED QUESTIONS

Schedule Update

54 Current Progress
478 Days Remaining
8/12/2019 Completion Date

JRAFT - 7/9/202

- Existing H&H/Calibration 100% (Finalized)
- Primary Mitigation Planning (Workshops Completed) 95%
- Secondary Mitigation Planning (Adjusted Schedule) 100%
- Other Mitigation Actions (Adjusted Schedule) 95%



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Study Submittals

- Submitted
 - Existing Conditions Memorandum (08/12/19)
 - Historical Storms Memorandum (04/07/20)
 - Future Conditions Memorandum (04/07/20)
 - Secondary Mitigation Memorandum (05/13/20)
 - Primary Mitigation Memo (06/08/20)
 - Updated Sedimentation/Vegetation Memo (06/26/20
 - Other Mitigation Actions Memo (06/30/20)
- Upcoming
 - Draft Report (07/13/20)
 - Alternative Funding
 - Implementation Plan
 - Final Report (08/31/20)







SAN JACINTO RIVER QUESTIONS?

City of Houston Briefing July 9, 2020 - DRAFT

Times













STUDY PARTNERS MEETING NOTES

City of Houston

July 9, 2020 San Jacinto Regional Watershed Master Drainage Plan Microsoft Teams Conference Call

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Meeting		
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	4:00 PM		
			Meeting Stop Time:	5:00 PM		
Agend	a					
1.	Attend	ees				
	•	Jing Chen, HCFCD				
	•	Dena Green, HCFCD				
	•	Steve Costello, COH				
	•	Laura Patino, COH				
	•	Adam Eaton, COH				
	•	Terry Barr, Halff				
	•	Sam Hinojosa, Halff				
	•	Andrew Moore, Halff				
	•	Cory Stull, Freese & Nichols				
	•	Garrett Johnston, Freese & N	ichols			
2.	Goals	and Objections				
	•	Jing introduced the meeting.				
	•	Terry introduced the San Jacinto study. He showed the watershed included in the study				
		and the funding partners. He	presented the location	of the watershed in reference to City		
		of Houston.				
	•	Terry showed the density of flood claims within the basin.				
	•	 Terry introduced the goals and objectives of the San Jacinto Regional Watershed Master 				
		Drainage Plan.	-			
3.	Existin	g Conditions				
	•	Terry presented the update o	f the Existing Condition	s analysis. He stated that all major		
		streams in the basin have been included in a combined existing conditions model. The				
	model utilized existing models from HCFCD as well as new models for the upper regions.					
	The model utilizes the latest Atlas 14 rainfall and has been calibrated to historical storm					
		events including Hurricane Harvey and Memorial Day 2016. The model has also been				
	validated with the October 1994 and Tropical Storm Imelda events. The calibration and					
		validation including comparin	g the model to 22 USG	5 gages in the watershed.		
4.	Primar	y Mitigation Planning				
	•	Terry summarized the primar	y mitigation process wh	nich included identifying mitigation		
		strategies to reduce flooding	for region.			
	•	The team identified damage of	centers to determine w	hich locations should be targeted with		
	the mitigation projects using the structural inventory tool and the updated existing			tool and the updated existing		

	conditions modeling. Of the damage centers, the highest damage concentrations were in
	those centers closer to the confluence.
•	Using the damage center information, the team identified tiers for mitigation planning to
	rank the potential mitigation projects based on number of damages, regional benefit, and
	potential mitigation volumes.
•	The team reviewed and cataloged projects recommended in several previous reports to
	determine if any of these should be included in the analysis. Many of the projects are no
	longer feasible or were originally intended for water supply purposes; however, the
	information was used as a starting point for many of the projects that were evaluated as
	part of this study. In addition, the team also proposed new mitigation strategies.
•	The team evaluated a total of 25 projects, choosing those deemed most effective to
	develop a regional master plan, which includes detention and channelization project spread
	throughout the watershed. The "most effective" projects are those that performed the
	best for each watershed as well as provided regional benefit. Terry stated that the projects
	improve the areas near the damage center within their respective watershed, but also
	provide flood reduction benefits further downstream, including beyond their confluences
	with receiving streams. He stated that Lake Houston limits the effectiveness of these
	projects downstream (ex. confluence with East Fork) and that reductions to the Lake
	Houston level would be needed to see further improvements. However, this study does
	not evaluate or recommend changes to the lake. A separate Lake Houston study is
	reviewing improvements for the Lake Houston area.
•	The benefit-cost ratios (BCR) for Spring Creek were the highest (0.55-1.22) because more
	development in the Spring Creek Watershed. However, overall cost benefits are not
	positive for many of the projects (0.75 – 1 range). Terry stated that the BCR is not the only
	metric for funding the projects. FEMA will also consider social benefits for this BCR range of
	0.75 to 1 and some funding may still be available for these projects.
•	In addition, Terry showed the low-to-moderate income (LMI) areas as they relate to
	potential projects. Funding will vary based on LMI. Lower income areas could potentially
	be good candidates for CDBG or other funding sources that account for socio-economically
	disadvantaged areas.
•	Terry discussed additional mitigation measures, including detention, floodplain
	preservation, and buyouts, as potential options. Detention associated with local
	development is needed to offset negative impacts for the local streets, sewers, and
	streams. Future projections show that the impact of local detention on the regional scale is
	minor, but much of the analysis depends on assumptions made about the development
	location and timing. Terry reiterated that detention is an important tool to mitigate
	drainage impacts of development especially when considering cumulative effects or
	hydrograph timing.
•	Terry stated that floodplain preservation is recommended because losses in floodplain
	storage can have negative impacts downstream. The study did not evaluate specific areas
	or scenarios related to floodplain preservation. Future conditions do not include floodplain
	fill. Harris County has "no adverse impact" and floodplain fill mitigation policies in place and
	Terry agreed that those policies were beneficial.
•	Terry indicated that while the proposed projects (detention, channel) will provide
	significant benefits, some structures, specifically those that flood during frequent storms (2-
	& 5-year), will likely continue to flood. For these structures, buyouts may be the
	recommended strategy. Buyout is more effective than the mitigation projects from a purely
	economic perspective.

	• The next step is to finalize and prioritize the list of projects to be included in the overall
	master drainage plan and develop a project phasing plan and then finally move forward
	with feasibility, preliminary engineering, design, construction, etc.
5.	Secondary Mitigation Planning
	• Terry presented the additional gages that are recommended in the area including stage, flow, and rainfall. The gages provide first responders early information to flooding in the region. The team recommended 26 gages throughout the San Jacinto Basin, 5 of which are already being installed by HCFCD. Many of the gages are proposed in the upper basin areas where there are currently minimal gages. This is a benefit to Harris County because the gages will identify, early in the storm event, the amount of runoff that is expected to be routed through Harris County from the upper basin.
6.	Other Mitigation Actions
	• Terry discussed coordinating with local agencies to determine how the agencies react to storm events and their communication protocols.
	Ine team also identified roadway levels of service and critical infrastructure within the notantial floodplains
	 Most counties have a plan for responding to flooding events and are already coordinating
	with the region. Identified some areas of improvements for each agency.
-	
7.	Communication and Outreach
	 Terry explained that there is a defined coordination effort, which includes meetings with both the study partners, and other supporting partners, such as the surrounding counties.
	and H-GAC.
	 As part of the Other Mitigation Actions task, the team met with emergency managers for
	each of the regional entities to understand protocol, and also conducted an emergency
	management workshop.
	• The team also has an outreach plan, with the first round of community meetings in
	December 2019 and a second round planned for August 2020 (virtual). In addition, there is
	a study website that provides an overview of the study goals and progress.
0	(www.saijacstudy.org).
0.	• Tarry presented the study schedule with the final report being submitted in August 2020
	• Terry presented the study schedule with the final report being submitted in August 2020.
9.	Questions/Comments
	• Jing stated that the team will be presenting this information to the public as part of a
	community meeting. Terry followed up by stating that additional implementation
	technical and will focus on the sources of flooding in the watershed and the recommended
	path forward.
	 ling asked about the factor used for buyouts in the slides. The current calculation includes
	a factor of 2.5 x Market Value, which was based on the acquisition factor recommended by
	James Wade with HCFCD. Jing indicated that the recommended factor for voluntary
	buyouts is 1.6 x Market Value. Terry indicated that the calculation was done to provide an
	order of magnitude estimate of what it would take to buyout all the property in the
	floodplain. It should also be noted that it is unlikely that all property owners in the
	noodplain would voluntarily sell their property, which would increase costs above the 1.6.

•	Steve Costello mentioned that he is investigating a public private partnership for extracting sand within the watershed. He requested a copy of the sedimentation memo to review before meeting with particular agencies. Cory Stull stated that the SJRA is investigating a pilot project on sedimentation collection within the basin. Steve indicated that a long-term plan for sediment removal is needed and that he would like to sit down and discuss this plan with representatives of the Texas Aggregates and Concrete Association (TACA).
•	Steve Costello asked how the projects would be funded and if they were broken into short term and long-term projects. Terry stated that the implementation is being drafted and will be included in the report along with funding opportunities. Sam stated that some projects are short-term but most are long-term projects that will take decades to implement.

SAN JACINTO RIVER SANJACINTO - Regional Watershed Master Drainage Plan

Presentation to Montgomery County June 4, 2020 - DRAFT









San Jacinto River Basin

- 75% HMGP Funded
- 25% Local Funded

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
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Lake Creek	58.9
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Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6



DRAFT - 6/4/2020

2







San Jacinto Flood Mitigation Strategies

- Primary Flood Mitigation Planning (Flood Reduction)
 - Primary Alternatives Based on previously identified solutions
 - Secondary Alternatives Developed additional flood reduction projects
 - Develop cost estimates
 - Evaluate potential benefits
 - Identify implementation path and challenges
- Secondary Flood Mitigation Planning (Flood Warning)
 - Coordinate with HCFCD, MCO, SJRA, TXDOT, USGS, NWS
 - Recommend locations for additional FWS gages
- Other Mitigation Actions (Flood Response)
 - Coordinate with agencies responsible for Emergency Management
 - Provide recommendations for updated communications protocols
 - Identify potential flooding of roadways and critical infrastructure







Existing Conditions Modeling

- Developed Comprehensive Model
- Limited Updates to M3 Models
- Hydrology
 - Atlas 14 Rainfall (varies by watershed)
 - Updated Watershed Delineation
 - Soils, % Impervious, BDF (TC+R)
 - HEC-HMS Model Development
- Hydraulics
 - Updated cross section geometry
 - New/updated bridges and culverts
 - Reviewed and adjusted n-values
 - Developed unsteady RAS models





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Analysis of Historical Storms

- Historical Storms
 - Memorial Day (2016)
 - Hurricane Harvey (2017)
 - TS Imelda (2019)
 - October 1994
- Leveraged Gage Adjusted Radar Rainfall (GARR) Data
- USGS Gages (Used 22/25)
 - Met with USGS
 - Peach Creek Adjustment
 - Gage Summary in Report
- Calibration Report Submitted









Damage Center Identification

- East Fork SJR, West Fork SJR
- Peach, Caney, Spring Creeks



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Watershed Mitigation Potential

Higher Potential

- Spring Creek (Benefits in watershed; Potential reduction downstream)

- East Fork (Major Lake Houston contributor; Available open space)
- Peach/Caney Creek (Available open space; Benefits in watershed)
- Moderate Potential
 - Lake Creek (Available open space; large contributing area to West Fork, Limited benefits in the Lake Creek watershed)
- Lower Potential
 - Cypress Creek (Limited open space; Other HCFD efforts; Overflow)
 - Willow Creek/Little Cypress Creek (Small contribution; Limited space)
 - Luce/Tarkington Bayou (Limited damages; Smaller contribution; Flat)
 - Jackson Bayou (Very small contribution; Downstream of Lake Houston)
 - West Fork (Limited open space; High volume; Benefits in watershed)

Flood Reduction Projects Summary



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Flood Reduction Projects Summary

Watershed	Project Type	General Location	Estimated Costs (\$M)	Present Value Benefit (\$M)	Benefit-Cost Ratio (BCR)
Spring Creek	Detention	Walnut Creek 10 miles U/S of Spring Creek	91 - 120	123	1.02 - 1.35
Spring Creek	Detention	Mill Creek 10 miles U/S of Spring Creek	96 - 126	81.6	0.65 - 0.85
Spring Creek	Detention	Birch Creek 10 miles U/S of Spring Creek	77 - 117	82.6	0.70 - 1.07
Spring Creek	Bench	I-45 to 3 miles D/S of Riley Fuzzell	81	145.3	1.79
Spring Creek	Bench	Between Gosling Road and I-45	123	82.6	0.66
Spring Creek	Bench	DC2-200 U/S of I-45	59	53	0.89
Spring Creek	Bench	DC2-500 U/S Kuykendahl Rd. to Willow Creek	142	70.3	0.49
Lake Creek	Detention	Caney Creek 0.3 miles North of SH 105	98 - 163	34	0.21 - 0.35
Lake Creek	Detention	Little Caney Creek 1.1 miles U/S of Lake Creek	98 - 128	27.6	0.22 - 0.28
Lake Creek	Detention	Garrett's Creek 0.74 miles U/S of Lake Creek	107 - 131	35.4	0.27 - 0.33
Lake Creek	Detention	Lake Creek Mainstem 0.6 miles U/S of SH105	187 - 264	61.8	0.15 - 0.22
Peach Creek	Detention	Peach 12 miles U/S of New Caney @ SH105	299 - 428	57	0.13 - 0.19
Peach Creek	Detention	Peach/Walker 19 miles U/S of New Caney	203 - 222	68	0.30 - 0.33
Peach Creek	Channel	Peach Creek D/S of I-59	180	75.9	0.42
Caney Creek	Detention	Caney Creek 1.0 miles U/S of FM 1097	104 - 131	19.8	0.15 - 0.19
Caney Creek	Detention	Caney Creek 1.9 miles U/S of SH 105	177 - 207	26.3	0.13 - 0.15
Caney Creek	Channel	Caney Creek D/S of US-69 to the East Fork	140	75.9	0.54
East Fork	Detention	Winters Bayou Nebletts 2 miles U/S Cleveland	128 - 176	39.8	0.15 - 0.20
East Fork	Detention	Winters Bayou 5 miles U/S of Cleveland	132 - 163	44.2	0.26 - 0.33
East Fork	Detention	East Fork 10 miles U/S of Cleveland near FM945	138 - 141	34.3	0.15 - 0.16
East Fork	Bench	East Fork FM 1485 to Luce Bayou	326	24.9	0.08
West Fork	Channel	West Fork from I-45 to SH 242	148	33.8	0.22
West Fork	Channel	West Fork from I-45 to 3.2 miles D/S of SH 242	179	30.3	0.15
West Fork	Channel	West Fork D/S of I-59	722	67	0.09
West Fork	Bench	West Fork D/S of I-59	818	55.6	0.07

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Spring Creek

- Most Effective Projects
 - Birch Creek Detention
 - Walnut Creek Detention
 - Channel Improvements from I-45 to Riley Fuzzell
- Total Cost: \$249M \$318M
- Spring Creek WSEL Reduction (Watershed & Basin-wide)

Regional Project Reductions

1% ACE WSEL Reductions (ft)			
Walnut Det.	Birch Det.	Chl. D/S of I-45	
-0.16	-0.1	0.12	
-0.12	-0.12	-0.12	
-0.16	-0.16	-0.16	
-0.11	-0.11	-0.11	
	1% A Walnut Det. -0.16 -0.12 -0.16 -0.11	Walnut Det. Birch Det. -0.16 -0.12 -0.16 -0.12 -0.16 -0.16 -0.11 -0.11	

Spring Creek Reductions

Spring Creek Combined	1% ACE WSEL	
Improvements	Reductions (ft)	
SH249	-2.53	
Kuykendahl	-1.96	
Gosling	-1.45	
I-45	-6.65	
Riley Fuzzell	-6.61	









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Lake Creek

- Most Effective Projects
 - Garrett's Creek Detention
 - Little Caney Creek Detention
 - Caney Creek Detention
- Total Cost: \$303M \$422M
- Lake Creek WSEL Reduction

Regional Project Reductions

Lake Creek	1% ACE WSEL Reductions (ft)			
Improvements	Garrett's Det.	Little Caney Det.	Caney	
Confluence with West Fork	-0.63	-0.58	-1.6	
West Fork I-45	-0.48	-0.44	-1.31	
West Fork SH99	-0.56	-0.56	-1.37	
West Fork I-69	-0.15	-0.16	-0.64	
Lake Houston Parkway	-0.14	-0.15	-0.39	
Lake Houston Dam	-0.09	-0.11	-0.38	

Lake Creek Reductions

Lake Creek Combined	1% ACE WSEL
Improvements	Reductions (ft)
SH 105	-4.5
FM 149	-3.63
Superior Road	-3.32
Splendora Ranch (Fish Crk)	-4.7







Caney Creek

Proj. No.	Project Type	General Location	Estimated Costs (\$M)	Present Value Benefit (\$M)	Benefit-Cost Ratio (BCR)	1
15	Detention	Caney Creek 1.0 miles U/S of FM 1097	104 - 131	19.8	0.15 - 0.19	
16	Detention	Caney Creek 1.9 miles U/S of SH 105	177 - 207	26.3	0.13 - 0.15	
17	Channel	Caney Creek D/S of I-69 to the East Fork	140	47	0.34	









Caney Creek

- Most Effective Projects
 - Mainstem detention upstream of SH105
 - Mainstream detention upstream of FM1097
 - Channel Improvements from US59 to East Fork Confluence
- Total Cost: \$421M \$478M
- Caney Creek WSEL Reduction (Watershed & Basin-wide)

Regional Project Reductions

Caney Creek	1% ACE WSEL Reductions (ft)			
Improvements	SH 105 Det.	FM 1097 Det.	Chl. D/S of I-69	
Confluence with Peach	-0.79	-0.37	-4.66	
Confluence with East Fork	-0.55	-0.42	-0.08	
Confluence with West Fork	-0.08	-0.05	-0.17	
West Fork I-69	-0.05	-0.02	-0.1	
Lake Houston Parkway	-0.04	-0.02	-0.15	
Lake Houston Dam	-0.01	0.00	0.01	

Caney Creek Reductions

Caney Creek Combined	1% ACE WSEL		
Improvements	Reductions (ft)		
SH 105	-6.94		
FM 2090	-4.64		
HWY 242	-2.46		
I-69	-15.59		
FM 1485	-12.1		







Peach Creek



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Peach Creek

- Most Effective Projects
 - Mainstem detention upstream of SH105
 - Mainstream detention upstream of FM1097
 - Channel Improvements from US59 to East Fork Confluence
- Total Cost: \$682M \$830M
- Peach Creek WSEL Reduction (Watershed & Basin-wide)

Regional Project Reductions

Peach Creek	1% ACE WSEL Reductions (ft)			
Improvements	SH 105 Det.	Walker Det.	Chl. D/S of I-69	
Confluence with Caney	-1.02	-0.56	0.02	
Confluence with East Fork	0.23	0.01	0.05	
Confluence with West Fork	0.13	0.06	-0.09	
Lake Houston Dam	0.08	0.03	-0.08	
Lake Houston Parkway	0.05	0.02	-0.04	
I-69	0.00	0.00	0.00	

Peach Creek Reductions

Peach Creek Combined	1% ACE WSEL	
Improvements	Reductions (ft)	
SH 105	-3.76	
FM 2090	-5.39	
169	-13.88	
Roman Forest	-10.75	
FM 1485	-1.38	








East Fork SJR

- Most Effective Projects
 - Mainstem detention upstream of SH105
 - Mainstream detention upstream of FM1097
 - Channel Improvements from US59 to East Fork Confluence
- Total Cost: \$458M \$489M
- East Fork SJR WSEL Reduction (Watershed & Basin-wide)

Regional Project Reductions

East Fork	1% ACE WSEL Reductions (ft)		
Improvements	Winters Det.	Chl. D/S FM1485	
Confluence with Caney	0.08	-1.67	
Confluence with West Fork	-0.50	0.02	
Lake Houston Dam	-0.37	0.01	
Lake Houston Parkway	-0.30	0.01	
I-69	0.00	0.00	

East Fork Reductions

East Fork Combined	1% ACE WSEL	
Improvements	Reductions (ft)	
FM 945	-0.02	
SH 105	-2.16	
I-69	-1.96	
FM 2090	-2.39	
FM 1485	-9.74	









West Fork San Jacinto

- Most Effective Projects
 - West Fork Channelization from I-45 to SH242
 - West Fork Channelization downstream of US59
- Total Cost: \$966M
- West Fork SJR WSEL Reduction (Basin-wide)

Regional Project Reductions

West Fork	1% ACE WSEL Reductions (ft)		
Improvements	Upper WF 750	Bench D/S of I-69	
Confluence with West Fork	-0.17		
West Fork I-45	-3.07		
West Fork SH99	0.13		
West Fork I-69	0.05	-2.34	
Lake Houston Parkway	0.05	0.06	
Lake Houston Dam	0.02	0.04	







San Jacinto Regional WMDP



Low to Moderate Income (LMI) Areas



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San Jacinto Regional WMDP

- Plan Cost: \$3.1B \$3.5B
- Overall Plan Benefits: \$677 M
- BCR: 0.19 0.22

Watershed	Damages, Existing (\$M)	Damages, Combined Alts (\$M)	Benefit (\$M)
Spring	466.6	163.8	302.8
Willow	112.2	86.6	25.6
Cypress	213.2	211.6	1.6
Little Cypress	30.9	30.8	0.1
East Fork	101.4	56	45.5
West Fork	269.7	132.7	137
Lake Creek	10.1	3.2	6.9
Peach	113.1	27.9	85.3
Caney	135.6	63.8	71.9
Luce	14.6	14	0.5
Total	1467.4	790.4	677.2

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Additional Regional Measures

• Detention Policy

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- Detention associated with local development provides critical mitigation, but the regional benefits associated with local detention are highly dependent on the location and timing of development
- 2070 modeling indicated limited detention impact, but development was centered on the urban core lower in the basin (1-2% volume increase)
- Ultimate development along the basin outer boundaries shows a higher increase in runoff volume (>5%); detention impact may increase
- Detention **DOES** have an impact on local flooding issues
- Floodplain Preservation
 - Losses to floodplain storage could negatively impact downstream areas
 - Future Conditions modeling does not include floodplain fill
 - Approx. market value of all flooded structures in the 100-year ~ \$3B







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Buyouts

- Structures currently located in the 2-, 5-year floodplains may see some benefits, but will continue to flood
- Removed from the instances of flooding for damage centers
- Maintained in the BCR calculations
- Generally a higher BCR on buyouts than structural projects
- Best option may be to buyout structures in this category







Buyouts

• Summary of structures and expected damages in each watershed that flood in the 5-year event

Buyouts - Structures Flooding in 5-yr Event					
Watershed	Count	Market Value	Mkt Value * 1.25	Existing NPV 50-yr damage	BCR
Spring	87	12,184,636	15,230,795	80,537,873	5.3
Willow	43	13,197,517	16,496,896	30,707,624	1.9
Cypress	31	12,790,373	15,987,966	55,385,994	3.5
Little Cypress	13	2,468,448	3,085,560	11,513,834	3.7
East Fork	34	4,083,750	5,104,688	21,596,467	4.2
West Fork	10	1,412,655	1,765,819	6,244,840	3.5
Lake Creek	3	519,100	648,875	2,390,871	3.7
Peach	71	7,536,240	9,420,300	44,668,723	4.7
Caney	82	7,288,986	9,111,233	56,872,257	6.2
Luce	5	583,203	729,004	2,845,449	3.9
Tarkington	60	6,657,070	8,321,338	45,279,121	5.4
Jackson Bayou	2	518,533	648,166	1,529,131	2.4
Gum Gully	1	211,015	263,769	1,514,652	5.7
	442	69,451,526	86,814,408	361,086,836	4.2

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Implementation Planning

- Identify projects to be included in MDP
- Finalize modeling of individual selected projects
- Prioritize projects (Watershed or Regional Approach)
 - Select and weight metrics based on study partner input
 - Update project costs and benefits
 - Gather information on the selected metrics
 - Perform project prioritization
- Develop project phasing plan based on priority
 - Model projects cumulatively (i.e. Project 1, Project 1 & 2,...All projects) to ensure no negative impacts
 - Update environmental and cultural data, update utility information, ROW
 - Identify potential funding sources depending on criteria (BCR, LMI, etc.)
- Move forward with Feasibility, Preliminary Engineering, Design







Secondary Mitigation Planning

- Received input from HCFCD, MCO, USGS, NWS, Others
- Updated Secondary Mitigation Memo (05/13/20)
 - 26 Gages recommended (HCFCD Currently installing 5)
 - Approximate installation cost range \$240k \$330k
 - Additional costs for annual maintenance



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Other Mitigation Actions

- Other Mitigation Action Goals
 - Evaluate communications plan/protocol during emergencies
 - Identify critical infrastructure and compare to inundation
 - Determine expected flood frequency evacuation routes
- Conducted Emergency Management Workshop (March 11th)
- Working on draft memorandum











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Tasks to be Completed

- Finalize Implementation Plan AN
- Project Ranking
- Identify Funding Sources
- Detention Policy Recommendations

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Study Deliverables Schedule

- Preliminary Mitigation Planning Memo (June 8th)
- Draft Report (July 13th)
- Final Report (August 31st)



SAN JACINTO RIVER SANJACINTO - Regional Watershed Master Drainage Plan

San Jacinto River Authority Briefing July 23, 2020 - DRAFT









Agenda

- Goals and Objectives
- Existing Conditions
- Primary Mitigation Planning
- Secondary Mitigation Planning
- Other Mitigation Actions Planning
- Community Outreach
- Project Schedule and Status
- Questions

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San Jacinto River Basin

- 75% HMGP Funded
- 25% Local Funded

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6



San Jacinto River Authority

SJRA Jurisdiction

- West Fork San Jacinto
- East Fork San Jacinto
- Lake Creek
- Spring Creek
- Caney Creek
- Peach Creek
- Luce Bayou









Historical Flooding









Goals and Objectives

- The goal of the San Jacinto Regional Watershed Master
 Drainage Plan is to
 - Conduct a comprehensive Flood Mitigation Plan
 - Identify vulnerability to flood hazards causing loss of life and property
 - Develop approaches to enhance public information and flood level assessment
 - Evaluate flood mitigation strategies to improve long-term resilience
- The plans specific objectives are:
 - Primary Flood Mitigation Planning (Detention, Conveyance, Buy-Outs)
 - Secondary Mitigation Planning (Flood Assessment/Warning)
 - Other Mitigation Actions (Communications Protocols, Flood Response)
 - Community Outreach & Education (Drainage, Maintenance, Projects)







Existing Conditions H&H Analysis

- Developed Comprehensive Model
- Limited Updates to M3 Models
- Hydrology
 - Atlas 14 Rainfall (varies by watershed)
 - Updated Watershed Delineation
 - Updated Infiltration/Transform Parameters
 - HEC-HMS Model Development
- Hydraulics
 - Updated cross section geometry
 - New/updated bridges and culverts
 - Reviewed and adjusted n-values
 - Developed unsteady RAS models











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Analysis of Historical Storms

- **Historical Storms**
 - Memorial Day (2016)
 - Hurricane Harvey (2017)
 - TS Imelda (2019)
 - October 1994
- Leveraged Gage Adjusted Radar Rainfall (GARR) Data
- USGS Gages (Used 22/25)
 - Met with USGS
 - Gage Summary in Report
- **Calibration Report Submitted**









Sedimentation and Vegetation

- Strategies to reduce flow of sediments into Lake Houston
- Developed annual sediment rating curves for 7 watersheds
 - Predictive tool that relates sediment transport with stream flow
 - Cypress Creek is the highest contributor
- First step toward Regional Sediment Management Plan (RSM)
- Inventory of sediment sources
- Common sediment management strategies
- Recommended strategies for West Fork and Spring Creek
- Did NOT evaluate relationship between sediment and flooding













Flood Mitigation Strategies

- Primary Flood Mitigation Planning (Flood Reduction)
 - Primary Alternatives Based on previously identified solutions
 - Secondary Alternatives Developed additional flood reduction projects
 - Develop cost estimates
 - Evaluate potential benefits
 - Identify implementation path and challenges
- Secondary Flood Mitigation Planning (Flood Warning)
 - Coordinate with HCFCD, MCO, SJRA, TXDOT, USGS, NWS
 - Recommend locations for additional FWS gages
- Other Mitigation Actions (Flood Response)
 - Coordinate with agencies responsible for Emergency Management
 - Provide recommendations for updated communications protocols
 - Identify potential flooding of roadways and critical infrastructure







Primary Mitigation Tasks

- Evaluate flood damages using the Structural Inventory Tool
- Identify "Damage Centers"
- Determine volume reduction for a range of LOS improvements
- Compare reduction volumes to potential benefits
- Estimate preliminary target volumes for each damage center
- Consider previously identified projects
- Develop new potential projects
- Select watersheds with highest potential for improvements





Watershed Mitigation Potential

- Higher Potential
 - Spring Creek
 - East Fork San Jacinto
 - Peach/Caney Creek
- Moderate Potential
 - Lake Creek
- Lower Potential
 - Cypress Creek
 - Willow Creek
 - Little Cypress Creek
 - Luce/Tarkington Bayou
 - Jackson Bayou
 - West Fork San Jacinto

	Watershed Benefits	Open Space	Regional Reductions	Potential
Luce Bayou		V		Low
East Fork	V	Ø	V	High
Peach Creek	V	Ø	Ø	High
Caney Creek	V	Ø	V	High
West Fork	V			Low
Lake Creek		V	V	Moderate
Spring Creek	Ø	Ø	Ø	High
Willow Creek	Ø			Low
Little Cypress	V			Low
Cypress Creek	V			Low
Jackson Bayou				Low







Previously Recommended Projects

- Reviewed previous reports and master plans
 - 1943 San Jacinto River Master Plan
 - 1957 San Jacinto River Master Plan
 - 1985 Upper San Jacinto River Flood Control Study
 - 1989 South Montgomery County Flood Protection Plan
 - 1997 Lake Creek Reservoir Study
 - 2000 Lake Houston Regional Flood Protection Study
 - 2015 Cypress Creek Overflow Management Plan
 - 2019 Estimate Land Cover Effects on Selected Watersheds
 - 2019 Hurricane Harvey San Jacinto River Flooding (presentation)



Previously Recommended Projects

- Considered 34 Previously Recommended Projects
 - 1943/1957 San Jacinto River Master Plan
 - 1985 Upper San Jacinto River Flood Control Study



San Jacinto Regional WMDP

- Cost: \$2.9B \$3.3B
- **Overall Plan Benefits: \$756 M**

A total of 16 flood reduction projects are recommended

10 regional detention facilities (229,000 ac-ft)

6 channelization Projects (38.5 miles)











Low to Moderate Income (LMI) Areas









Additional Regional Measures

• Detention Policy

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- Local detention provides critical mitigation for development and CIP
- Regional benefits are dependent on location and timing of development
- Future conditions info shows development around existing urban centers
- Comprehensive impact analysis should be performed
- Floodplain Preservation
 - Losses to floodplain storage could negatively impact downstream areas
 - Future Conditions modeling does not include floodplain fill
 - Approx. market value of all flooded structures in the 100-year ~ \$2-3B



Buyouts

- Structures currently located in the 2-, 5-year floodplains may see some benefits, but will likely continue to flood
- Removed from the instances of flooding for damage centers
- Maintained in the BCR calculations
- Generally a higher BCR on buyouts than structural projects
- Best option may be to buyout structures in this category
- Buyout cost is approximately \$190M







Path to Implementation

- Identify projects to be included in MDP
- Finalize modeling of individual selected projects
- Perform project prioritization
- Develop project phasing plan
- Move forward with Feasibility, Preliminary Engineering, Design







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Secondary Mitigation Planning

- Received input from HCFCD, MCO, USGS, Others
- Updated Secondary Mitigation Memo (05/13/20)
 - 26 Gages recommended (HCFCD Currently installing 5)
 - Approximate installation cost range \$240k \$330k (Plus Maintenance)









Other Mitigation Actions

- Other Mitigation Action Goals
 - Evaluate communications plan/protocol during emergencies
 - Identify critical infrastructure and compare to inundation
 - Determine expected flood frequency evacuation routes
- Conducted Emergency Management Workshop (March 11th)













GLOSSAR'

I study led by local partners including the Harris County Flood Control Distri ntgomery County, and the City of

kick started in April 2019, will identify future flood mitigat nout the San Jacinto River regional watershed

Evaluate flood mitigation strategies to imp

iect will be achieved by de ulic models for the major tributaries of the Upper San Jacinto River rshed (from the **headwaters** in Walker County to the Interstate 10 cro

tent and depth of **riverine flooding** of the larger rivers within the waters ation will be gath

en ante a Harris County Flood Control District - ling Chen ling chen San Jacinto River Authority - Matt Br Montgomery County - Diane Cooper, diane.coo City of Houston - Gary Hill, gary.hill@

ited in the near- and lona-term to reduce flood ris abilities during a flood disaster e

Contact Us



- Communication
 - Study Partners Meetings (6)
 - Supporting Partners Meeting (8)
 - **Emergency Managers Workshop**
 - H-GAC Coordination

Outreach

- 1st round of community meetings complete – December 2019
- 2nd Community Meeting (Virtual) in planning – August 2020
- Stakeholder Meetings (Jul/Aug)
- Study Website

www.sanjacstudy.org












Schedule Update

472 Current Progress
39 Days Remaining
8/31/2020 Completion Date

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- Existing H&H/Calibration 100% (Finalized)
- Primary Mitigation Planning (Under Review) 95%
- Secondary Mitigation Planning (Finalized) 100%
- Other Mitigation Actions (Under Review) 95%



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- Submitted
 - Existing Conditions Memorandum (08/12/19)
 - Historical Storms Memorandum (04/07/20)
 - Future Conditions Memorandum (04/07/20)
 - Secondary Mitigation Memorandum (05/13/20)
 - Primary Mitigation Memo (06/08/20)
 - Updated Sedimentation/Vegetation Memo (06/26/20)
 - Other Mitigation Actions Memo (06/30/20)
 - Draft Report (7/14/2020)
- Upcoming
 - Final Report (08/31/20)







SAN JACINTO RIVER QUESTIONS?

San Jacinto River Authority Briefing July 23, 2020 - DRAFT

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MEETING MINUTES

To:	Jing Chen, P.E., CFM	Attendees:	Amber Batson, SJRA
From:	Terry Barr, P.E., CFM		Bret Raley, SJRA Chuck Gilman, SJRA Chervl Turney, SJRA
Subject:	San Jacinto River Watershed Master Drainage Plan Progress Meeting		Chris Meeks, SJRA Cynthia Bowman, SJRA
Meeting Date:	07/23/2020 – 8:00 pm		Heather Ramsey-Cook, SJRA
Location:	Go To Meeting Webinar		James Alexander, SJRA
Minutes Date:	07/23/2020		Kaaren Cambio, SJRA
AVO No.:	033465.002		Pam Steiger, SJRA Pam Steiger, SJRA Raymond Johnson, SJRA Rick Moore, SJRA Ron Kelling, SJRA Ronnie Anderson, SJRA Tom Michael, SJRA Jing Chen, HCFCD Beth Walters, HCFCD Terry Barr, Halff Associates, Inc.

Item	Description	Action
1.	Study Presentation	
	• Mr. Barr started the presentation with a general overview of the project	
2.	Goals and Objections	
	 Terry introduced the San Jacinto study. He showed the watershed included in the study and the funding partners. He presented the location of the watershed in reference to the SJRA coverage area Terry showed the density of flood claims within the basin. Terry introduced the goals and objectives of the San Jacinto Regional Watershed Master Drainage Plan. 	
3.	Existing Conditions	
	• Terry presented the update of the Existing Conditions analysis. He stated that all major streams in the basin have been included in a combined existing conditions model. The model utilized existing models from HCFCD as well as new models for the upper regions. The model utilizes the latest Atlas 14 rainfall and has been calibrated to historical storm events including Hurricane Harvey and Memorial Day 2016. The model has also been validated with the October 1994 and Tropical Storm Imelda events. The calibration and validation including comparing the model to 22 USGS gages in the watershed.	

4. **Primary Mitigation Planning**

- Terry summarized the primary mitigation process which included identifying mitigation strategies to reduce flooding for region.
- The team identified damage centers to determine which locations should be targeted with the mitigation projects using the structural inventory tool and the updated existing conditions modeling. Of the damage centers, the highest damage concentrations were in those centers closer to the confluence.
- Using the damage center information, the team identified tiers for mitigation planning to rank the potential mitigation projects based on number of damages, regional benefit, and potential mitigation volumes.
- The team reviewed and cataloged projects recommended in several previous reports to determine if any of these should be included in the analysis. Many of the projects are no longer feasible or were originally intended for water supply purposes; however, the information was used as a starting point for many of the projects that were evaluated as part of this study. In addition, the team also proposed new mitigation strategies.
- The team evaluated a total of 25 projects, choosing those deemed most effective to develop a regional master plan, which includes detention and channelization project spread throughout the watershed. The "most effective" projects are those that performed the best for each watershed as well as provided regional benefit. Terry stated that the projects improve the areas near the damage center within their respective watershed, but also provide flood reduction benefits further downstream, including beyond their confluences with receiving streams. He stated that Lake Houston limits the effectiveness of these projects downstream (ex. confluence with East Fork) and that reductions to the Lake Houston level would be needed to see further improvements. However, this study does not evaluate or recommend changes to the lake. A separate Lake Houston study is reviewing improvements for the Lake Houston area.
- The benefit-cost ratios (BCR) for Spring Creek were the highest because more development in the Spring Creek Watershed. However, overall cost benefits are not positive for many of the projects (0.75 – 1 range). Terry stated that the BCR is not the only metric for funding the projects. FEMA will also consider social benefits for this BCR range of 0.75 to 1 and some funding may still be available for these projects.
- In addition, Terry showed the low-to-moderate income (LMI) areas as they relate to potential projects. Funding will vary based on LMI. Lower income areas could potentially be good candidates for CDBG or other funding sources that account for socio-economically disadvantaged areas.
- Terry discussed additional mitigation measures, including detention, floodplain preservation, and buyouts, as potential options. Detention associated with local development is needed to offset negative impacts for the local streets, sewers, and streams. Future projections show that the impact of local detention on the regional scale is minor, but much of the analysis depends on assumptions made about the development location and timing. Terry reiterated that detention is an important tool to mitigate

	 drainage impacts of development especially when considering cumulative effects or hydrograph timing. Terry stated that floodplain preservation is recommended because losses in floodplain storage can have negative impacts downstream. The study did not evaluate specific areas or scenarios related to floodplain preservation. Future conditions do not include floodplain fill. Harris County has "no adverse impact" and floodplain fill mitigation policies in place and Terry agreed that those policies were beneficial. Terry indicated that while the proposed projects (detention, channel) will provide significant benefits, some structures, specifically those that flood during fraquent storms (2, & 5 year), will likely continue to flood. For 	
	 during frequent storms (2- & 5-year), will fixely continue to flood. For these structures, buyouts may be the recommended strategy. Buyout is more effective than the mitigation projects from a purely economic perspective. The next step is to finalize and prioritize the list of projects to be included in the overall master drainage plan and develop a project phasing plan and then finally move forward with feasibility, preliminary engineering, design, construction, etc. 	
5.	Secondary Mitigation Planning	
	• Terry presented the additional gages that are recommended in the area including stage, flow, and rainfall. The gages provide first responders early information to flooding in the region. The team recommended 26 gages throughout the San Jacinto Basin, 5 of which are already being installed by HCFCD. Many of the gages are proposed in the upper basin areas where there are currently minimal gages. This is a benefit to Harris County because the gages will identify, early in the storm event, the amount of runoff that is expected to be routed through Harris County from the upper basin.	
	Other Mitigation Actions	
	 Terry discussed coordinating with local agencies to determine how the agencies react to storm events and their communication protocols. The team also identified roadway levels of service and critical infrastructure within the potential floodplains. Most counties have a plan for responding to flooding events and are already coordinating with the region. Identified some areas of improvements for each agency. 	
	Communication and Outreach	
	 Terry explained that there is a defined coordination effort, which includes meetings with both the study partners, and other supporting partners, such as the surrounding counties and H-GAC. As part of the Other Mitigation Actions task, the team met with emergency managers for each of the regional entities to understand protocol, and also conducted an emergency management workshop. The team also has an outreach plan, with the first round of community 	
	meetings in December 2019 and a second round planned for August 2020	

(virtual). In addition, there is a study website that provides an overview of the study goals and progress. (www.sanjacstudy.org)	
 Study Schedule Terry presented the study schedule with the final report being submitted in August 2020. 	
SJRA Board Comments and Questions	
• Kaaren stated that none of the projects in the study presented included projects on Cypress Creek. She asked why it was not included. Terry mentioned that there were already studies and efforts on Cypress Creek.	
• Kaaren asked if the study included any of the other projects on Cypress Creek. Terry stated that most of the large detention available would address the overflow and not issues downstream. He also stated that detention on Cypress Creek did not have much impact on elevations in Lake Houston.	
• Kaaren recommended using FEMA as a partner since most of the money came from FEMA and that it may help in seeking future funding. Terry stated that the draft report mentions the potential funding sources. She mentioned that BRICK funding would be a good opportunity for future funding. Caren applauded the project fact sheets to simplify the information.	
• Lloyd stated that he may have more questions once the study is completed as to how to continue funding these projects.	
• Mark asked if there was any Harris County bond funding for any of these projects. Terry stated that HCFCD would be better suited to answer the question but there may be some funding available for upstream projects.	
• Mark asked if the Lake Houston gates project was included. Terry stated that the	
• Mark asked if the sediment from sand mines are addressed in the report. Terry stated that overall sediment measures are mentioned but that further study may be required for specific sediment measures.	

This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not correct, or that any information is missing or incomplete, please contact Halff Associates so that the matter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.





PRECINCT BRIEFING AGENDA Harris County Precinct 1

May 21, 2020 San Jacinto Regional Watershed Master Drainage Plan Skype Conference Call

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Precinct Briefing	
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	11:00 am	
			Meeting Stop Time:	12:00 pm	
Agend	a				
1.	Introdu	uctions			
2.	Goals	and Objectives			
	•	Conduct a comprehensive Flo	od Mitigation Plan		
	•	Identify vulnerability to flood	hazards causing loss of	life and property	
	•	Develop approaches to enhar	nce public information a	nd flood level assessment	
	•	Evaluate flood mitigation stra	itegies to improve long-	term resilience	
3.	Existin	ng Conditions			
	•	Existing Conditions H&H Mod	leling Update		
	•	Analysis of Historical Storms			
4.	Primar	y Mitigation Planning			
	Flood Mitigation Strategies				
	Primary Mitigation Tasks				
	Damage Center Identification				
	Flood Mitigation Projects Implementation Planning				
	 Sedimentation and Vegetation 				
5.	Secondary Mitigation Planning				
	Gage Recommendations				
6.	Other Mitigation Actions Planning				
	Coordination with Emergency Managers				
	Updated communication plans/protocols				
	•	Critical infrastructure and roa	idway nood frequency		
7.	Comm	unity Outreach			
	•	Partners and Stakeholder Cor	nmunication		
	•	Community Outreach			
8.	Study	Schedule			
9.	CWA Lake Houston Gate Study Update				
10.	Questi	ons			

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Harris County Precinct 1 Briefing May 21, 2020 - DRAFT









Agenda

- Goals and Objectives
- Existing Conditions
- Primary Mitigation Planning
- Secondary Mitigation Planning
- Other Mitigation Actions Planning
- Community Outreach
- Project Schedule and Status
- CWA Lake Houston Gate Study
- Questions







San Jacinto River Basin

- 75% HMGP Funded
- 25% Local Funded

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6



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Harris County Precinct 1

- San Jacinto River
- Lake Houston
- Cypress Creek





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Flood Claim Density



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Goals and Objectives

- The goal of the San Jacinto Regional Watershed Master
 Drainage Plan is to
 - Conduct a comprehensive Flood Mitigation Plan
 - Identify vulnerability to flood hazards causing loss of life and property
 - Develop approaches to enhance public information and flood level assessment
 - Evaluate flood mitigation strategies to improve long-term resilience
- The plans specific objectives are:
 - Primary Flood Mitigation Planning (Detention, Conveyance, Buy-Outs)
 - Secondary Mitigation Planning (Flood Assessment/Warning)
 - Other Mitigation Actions (Communications Protocols, Flood Response)
 - Community Outreach & Education (Drainage, Maintenance, Projects)





Existing Conditions H&H Analysis

- Developed Comprehensive Model
- Limited Updates to M3 Models
- Hydrology
 - Atlas 14 Rainfall (varies by watershed)
 - Updated Watershed Delineation
 - Soils, % Impervious, BDF (TC+R)
 - HEC-HMS Model Development
- Hydraulics
 - Updated cross section geometry
 - New/updated bridges and culverts
 - Reviewed and adjusted n-values
 - Developed unsteady RAS models











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Analysis of Historical Storms

- Historical Storms
 - Memorial Day (2016)
 - Hurricane Harvey (2017)
 - TS Imelda (2019)
 - October 1994
- Leveraged Gage Adjusted Radar Rainfall (GARR) Data
- USGS Gages (Used 22/25)
 - Met with USGS
 - Peach Creek Adjustment
 - Gage Summary in Report
- Calibration Report Submitted





Flood Mitigation Strategies

- Primary Flood Mitigation Planning (Flood Reduction)
 - Primary Alternatives Based on previously identified solutions
 - Secondary Alternatives Developed additional flood reduction projects
 - Develop cost estimates
 - Evaluate potential benefits
 - Identify implementation path and challenges
- Secondary Flood Mitigation Planning (Flood Warning)
 - Coordinate with HCFCD, MCO, SJRA, TXDOT, USGS, NWS
 - Recommend locations for additional FWS gages
- Other Mitigation Actions (Flood Response)
 - Coordinate with agencies responsible for Emergency Management
 - Provide recommendations for updated communications protocols
 - Identify potential flooding of roadways and critical infrastructure





Primary Mitigation Tasks

- Evaluate flood damages using the Structural Inventory Tool
- Identify "Damage Centers"
- Determine volume reduction for a range of LOS improvements
- Compare reduction volumes to potential benefits
- Estimate preliminary target volumes for each damage center
- Consider previously identified projects
- Develop new potential projects
- Select watersheds with highest potential for improvements







Damage Center Identification

- Run models for frequency storm events
- Develop the Structural Inventory Tool
- Identify Damage Centers



Spring Creek – Structures at Risk of Flooding



Damage Center Identification



Watershed Mitigation Potential

- Higher Potential
 - Spring Creek (Benefits in watershed; Potential reduction downstream)
 - East Fork (Major Lake Houston contributor; Available open space)
 - Peach/Caney Creek (Available open space; Benefits in watershed)
- Moderate Potential
 - Lake Creek (Available open space; large contributing area to West Fork, Limited benefits in the Lake Creek watershed)
- Lower Potential
 - Cypress Creek (Limited open space; Other HCFD efforts; Overflow)
 - Willow Creek/Little Cypress Creek (Small contribution; Limited space)
 - Luce/Tarkington Bayou (Limited damages; Smaller contribution; Flat)
 - Jackson Bayou (Very small contribution; Downstream of Lake Houston)
 - West Fork (Limited open space; High volume; Benefits in watershed)



Previously Recommended Projects

- Reviewed previous reports and master plans
 - 1943 San Jacinto River Master Plan
 - 1957 San Jacinto River Master Plan
 - 1985 Upper San Jacinto River Flood Control Study
 - 1989 South Montgomery County Flood Protection Plan
 - 1997 Lake Creek Reservoir Study
 - 2000 Lake Houston Regional Flood Protection Study
 - 2015 Cypress Creek Overflow Management Plan
 - 2019 Estimate Land Cover Effects on Selected Watersheds
 - 2019 Hurricane Harvey San Jacinto River Flooding (presentation)



Previously Recommended Projects

- Considered 34 Previously Recommended Projects
 - 1943/1957 San Jacinto River Master Plan
 - 1985 Upper San Jacinto River Flood Control Study







San Jacinto Regional WMDP



Flood Reduction Projects Summary

Watershed	Project Type	General Location	Estimated Costs (\$M)	Present Value Benefit (\$M)	Benefit-Cost Ratio (BCR)
Spring Creek	Detention	Walnut Creek 10 miles U/S of Spring Creek	91 - 120	123	1.02 - 1.35
Spring Creek	Detention	Mill Creek 10 miles U/S of Spring Creek	96 - 126	81.6	0.65 - 0.85
Spring Creek	Detention	Birch Creek 10 miles U/S of Spring Creek	77 - 117	82.6	0.70 - 1.07
Spring Creek	Bench	I-45 to 3 miles D/S of Riley Fuzzell	81	145.3	1.79
Spring Creek	Bench	Between Gosling Road and I-45	123	82.6	0.66
Spring Creek	Bench	DC2-200 U/S of I-45	59	53	0.89
Spring Creek	Bench	DC2-500 U/S Kuykendahl Rd. to Willow Creek	142	70.3	0.49
Lake Creek	Detention	Caney Creek 0.3 miles North of SH 105	98 - 163	34	0.21 - 0.35
Lake Creek	Detention	Little Caney Creek 1.1 miles U/S of Lake Creek	98 - 128	27.6	0.22 - 0.28
Lake Creek	Detention	Garrett's Creek 0.74 miles U/S of Lake Creek	107 - 131	35.4	0.27 - 0.33
Lake Creek	Detention	Lake Creek Mainstem 0.6 miles U/S of SH105	187 - 264	61.8	0.15 - 0.22
Peach Creek	Detention	Peach 12 miles U/S of New Caney @ SH105	299 - 428	57	0.13 - 0.19
Peach Creek	Detention	Peach/Walker 19 miles U/S of New Caney	203 - 222	68	0.30 - 0.33
Peach Creek	Channel	Peach Creek D/S of I-69	180	75.9	0.42
Caney Creek	Detention	Caney Creek 1.0 miles U/S of FM 1097	104 - 131	19.8	0.15 - 0.19
Caney Creek	Detention	Caney Creek 1.9 miles U/S of SH 105	177 - 207	26.3	0.13 - 0.15
Caney Creek	Channel	Caney Creek D/S of I-69 to the East Fork	140	47	0.34
East Fork	Detention	Winters Bayou Nebletts 2 miles U/S Cleveland	128 - 176	39.8	0.15 - 0.20
East Fork	Detention	Winters Bayou 5 miles U/S of Cleveland	132 - 163	44.2	0.26 - 0.33
East Fork	Detention	East Fork 10 miles U/S of Cleveland near FM945	138 - 141	34.3	0.15 - 0.16
East Fork	Bench	East Fork FM 1485 to Luce Bayou	326	24.9	0.08
West Fork	Channel	West Fork from I-45 to SH 242	148	33.8	0.22
West Fork	Channel	West Fork from I-45 to 3.2 miles D/S of SH 242	179	30.3	0.15
West Fork	Channel	West Fork D/S of I-69 (3000' Wide)	722	67	0.09
West Fork	Bench	West Fork D/S of I-69 (3500' Wide)	818	55.6	0.07







San Jacinto Regional WMDP

- Combined projects show increased local and regional benefits
- Current project combinations (by Watershed)
 - Spring Creek: Walnut Detention, Birch Detention, I-45 to Riley Fuzzell
 - Lake Creek: Caney Detention, Little Caney Detention, Garrett's Detention
 - East Fork: Winters Detention, Lower East Fork Channel Improvements
 - Caney Creek: SH105 and FM1097 Detention, Channel D/S of I-69
 - Peach Creek: SH 105 and Walker Detention, Channel D/S of I-69
 - Full Combined Model: Ultimate Flood Reduction Improvements
- Projects in Spring Creek have the highest BCR (0.70 1.79)





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San Jacinto Regional WMDP

- Plan Cost: \$3.1B \$3.5B SAN
- Overall Plan Benefits: \$677 M
- BCR: 0.19 0.22

Watershed	Damages, Existing (\$M)	Damages, Combined Alts (\$M)	Benefit (\$M)
Spring	466.6	163.8	302.8
Willow	112.2	86.6	25.6
Cypress	213.2	211.6	1.6
Little Cypress	30.9	30.8	0.1
East Fork	101.4	56	45.5
West Fork	269.7	132.7	137
Lake Creek	10.1	3.2	6.9
Peach	113.1	27.9	85.3
Caney	135.6	63.8	71.9
Luce	14.6	14	0.5
Total	1467.4	790.4	677.2







Low to Moderate Income (LMI) Areas









Additional Regional Measures

• Detention Policy

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- Detention associated with local development provides critical mitigation, but the regional benefits associated with local detention are highly dependent on the location and timing of development
- 2070 modeling indicated limited detention impact, but development was centered on the urban core lower in the basin (1-2% volume increase)
- Ultimate development along the basin outer boundaries shows a higher increase in runoff volume (>5%); detention impact may increase
- Detention DOES have an impact on local flooding issues
- Floodplain Preservation
 - Losses to floodplain storage could negatively impact downstream areas
 - Future Conditions modeling does not include floodplain fill
 - Approx. market value of all flooded structures in the 100-year ~ \$3B







Buyouts

- Structures currently located in the 2-, 5-year floodplains may see some benefits, but will continue to flood
- Removed from the instances of flooding for damage centers
- Maintained in the BCR calculations
- Generally a higher BCR on buyouts than structural projects
- Best option may be to buyout structures in this category







Buyouts

• Summary of structures and expected damages in each watershed that flood in the 5-year event

Buyouts - Structures Flooding in 5-yr Event						
Watershed	Count	Market Value	Mkt Value * 1.25	Existing NPV 50-yr damage	BCR	
Spring	87	12,184,636	15,230,795	80,537,873	5.3	
Willow	43	13,197,517	16,496,896	30,707,624	1.9	
Cypress	31	12,790,373	15,987,966	55,385,994	3.5	
Little Cypress	13	2,468,448	3,085,560	11,513,834	3.7	
East Fork	34	4,083,750	5,104,688	21,596,467	4.2	
West Fork	10	1,412,655	1,765,819	6,244,840	3.5	
Lake Creek	3	519,100	648,875	2,390,871	3.7	
Peach	71	7,536,240	9,420,300	44,668,723	4.7	
Caney	82	7,288,986	9,111,233	56,872,257	6.2	
Luce	5	583,203	729,004	2,845,449	3.9	
Tarkington	60	6,657,070	8,321,338	45,279,121	5.4	
Jackson Bayou	2	518,533	648,166	1,529,131	2.4	
Gum Gully	1	211,015	263,769	1,514,652	5.7	
	442	69,451,526	86,814,408	361,086,836	4.2	





Implementation Planning

- Identify projects to be included in MDP
- Finalize modeling of individual selected projects
- Develop Project Tiers (Regional Approach)
 - Select and weight metrics based on study partner input
 - Update project costs and benefits
 - Gather information on the selected metrics
 - Perform project prioritization
- Develop project phasing plan
 - Model projects cumulatively (i.e. Project 1, Project 1 & 2,...All projects) to ensure no negative impacts
 - Update environmental and cultural data, update utility information, ROW
 - Identify potential funding sources depending on criteria (BCR, LMI, etc.)
- Move forward with Feasibility, Preliminary Engineering, Design



Sedimentation and Vegetation

- Strategies to reduce flow of sediments into Lake Houston
- Developed annual sediment rating curves for 7 watersheds
 - Predictive tool that relates sediment transport with stream flow
 - Cypress Creek is the highest contributor
- First step toward Regional Sediment Management Plan (RSM)
- Inventory of sediment sources
- Common sediment management strategies
- Recommended strategies for West Fork and Spring Creek
- Did NOT evaluate relationship between sediment and flooding













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Secondary Mitigation Planning

- Received input from HCFCD, MCO, USGS, Others
- Updated Secondary Mitigation Memo (05/13/20)
 - 26 Gages recommended (HCFCD Currently installing 5)
 - Approximate installation cost range \$240k \$330k (Plus Maintenance)









Other Mitigation Actions

- Other Mitigation Action Goals
 - Evaluate communications plan/protocol during emergencies
 - Identify critical infrastructure and compare to inundation
 - Determine expected flood frequency evacuation routes
- Conducted Emergency Management Workshop (March 11th)
- Working on draft memorandum













GLOSSAR'

study led by local partners including the Harris County Flood Control Distri

ick started in April 2019, will identify future flood mitigat ear- and lona-term to reduce flood ris

Evaluate flood mitigation strategies to in

r tributaries of the Upper San Jacinto Rive thed (from the **headwaters** in Walker County to the Interstate 10 cr

ent and depth of **riverine flooding** of the larger rivers within the waters tion will be gat

Contact U

Harris County Flood Control District - Jing Chen Jing che San Jacinto River Authority Montgomery County - Diane Cooper, diane.co

ina a flood disaster



- Communication
 - Study Partners Meetings (6)
 - Supporting Partners Meeting (8)
 - Emergency Managers Workshop
 - H-GAC Coordination

Outreach

- 1st round of community meetings complete – December 2019
- 2nd round of community meetings in planning – July 2020
- Woodlands Drainage Task Force Meeting – January 28th
- **Study Website**

www.sanjacstudy.org



FREQUENTLY ASKED QUESTIONS
Schedule Update

54 Current Progress
478 Days Remaining
8/12/2019 Completion Date

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- Existing H&H/Calibration 100% (Finalized)
- Primary Mitigation Planning (Workshops Completed) 85%
- Secondary Mitigation Planning (Adjusted Schedule) 100%
- Other Mitigation Actions (Adjusted Schedule) 80%



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Study Submittals

- Submitted
 - Existing Conditions Memorandum
 - Secondary Mitigation Memorandum
 - Historical Storms Memorandum
- Upcoming
 - Other Mitigation Actions Memo (Early June)
 - Alternative Funding Memo (Early June)
 - Updated Sedimentation/Vegetation Memo (06/12/20)
 - Primary Mitigation Memo (06/08/20)
 - Draft Report (07/13/20)

SAN JACINTO RIVER QUESTIONS?

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Time













STUDY PARTNERS MEETING NOTES Harris County Precinct 1

May 21, 2020 San Jacinto Regional Watershed Master Drainage Plan Skype Conference Call

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Precinct Briefing	
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	11:00 AM	
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Agend	a				
1.	Attend • •	ees Terry Barr, Halff Sam Hinojosa, Halff Andrew Moore, Halff			
	• • • •	Jing Chen, HCFCD Gary Bezemek, HCFCD Lance Gilliam, Harris County F Myron Jones, HCFCD Amar Mohite, Harris County F Garrett Johnson, FNI	Precinct 1 Precinct 1		
2.	 Goals and Objections Jing introduced the meeting. Terry introduced the goals and objectives of the San Jacinto Regional Watershed Master Drainage Plan. Amar asked if the study would look at policy rules and regulations to determine how future development could affect flooding. Terry stated that the study did review future conditions to determine how 50-year projected development could affect the major channels. He stated that it is difficult to identify localized flooding issues in a large regional study. While the inclusion of onsite detention for development in the modeling does not show a significant impact, Terry stated that the team believes detention policy is important to avoid local flooding impacts resulting from development. Amar stated that if you look at the past 20 years, the region has grown rapidly. He stated the study should recommend a coalition for the region that promotes the idea that local jurisdictions should coordinate on policies. Terry agreed and stated that some of the future conditions analysis does relay this information. Amar stressed that even general discussion of future coalitions and coordination should occur. 				
3.	Existin •	g Conditions Terry presented the update of streams in the basin have bee model utilizes the latest Atlas including Hurricane Harvey at	f the Existing Conditions on included in a combine 14 rainfall and has been of Memorial Day 2016	s analysis. He stated that all major ed existing conditions model. The n calibrated to historical storm events The model has also been validated	

	with the October 1994 and Tropical Storm Imelda events. The calibration and validation					
	including comparing the model to 22 USGS gages in the watershed.					
4.	Primary Mitigation Planning					
	Terry summarized the primary mitigation process which included identifying mitigation					
	strategies to reduce flooding for region.					
	• The team identified damage centers to determine which locations should be targeted with					
	the mitigation projects using the structural inventory tool and the updated existing					
	conditions modeling. Of the damage centers, the highest damage concentrations were in					
	those centers closer to the confluence.					
	Using the damage center information, the team identified tiers for mitigation planning to					
	rank the potential mitigation projects based on number of damages, regional benefit, and					
	potential mitigation volumes.					
	The team reviewed and cataloged projects recommended in several previous reports to					
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	throughout the watershed. The "most effective" projects are those that performed the					
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	provide flood reduction benefits further downstream, including beyond their confluences					
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	projects downstream and that reductions to the Lake Houston level would be needed to					
	see further improvements. However, this study does not evaluate or recommend changes					
	to the lake. A separate Lake Houston study is reviewing improvements for the Lake					
	Houston area.					
	• The benefit-cost ratios (BCR) for Spring Creek were the highest, but overall cost benefits are					
	not positive for many of the projects. Terry stated that the BCR is not the only metric for					
	running the projects. Acreage recovered, roadway miles removed, and raw structure					
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	good candidates for CDBG or other funding sources that account for socio-economically					
	disadvantaged areas.					
	 Terry discussed additional mitigation measures, including detention, floodplain 					
	preservation, and buyouts, as potential options. Detention associated with local					
	development is needed to offset negative impacts for the local streets, sewers, and					
	streams. Future projections show that the impact of local detention on the regional scale is					
	minor, but much of the analysis depends on assumptions made about the development					
	location and timing. Development locations can change and alter the results. Terry					
	reiterated that detention is an important tool to mitigate drainage impacts of development					
	and agreed with Amar that the study should be careful to clarify the team's position on					
	detention.					
	Amar stated that the study could also bring up regional detention and mention it if this would be more effective then level detention. Amore stated that detention for detention					
	would be more effective than local detention. Amar stated that detention for development					
	and detention for flood reduction should be clarified early in the reports.					

	 Terry stated that floodplain preservation is recommended because losses in floodplain storage can have negative impacts downstream. The study did not evaluate specific areas or scenarios related to floodplain preservation. Harris County has "no adverse impact" and floodplain fill mitigation policies in place and Terry agreed that those policies were beneficial. Terry indicated that while the proposed projects (detention, channel) will provide significant benefits, some structures, specifically those that flood during frequent storms (2-& 5-year), will likely continue to flood. For these structures, buyouts may be the recommended strategy. The next step is to finalize the list of projects to be included in the overall master drainage plan and develop a project phasing plan. Terry briefly discussed the Sedimentation and Vegetation report, which identifies strategies to reduce flow of sediments into Lake Houston. The report is the first step toward a regional sediment management plan.
	effort did not evaluate the impact of sedimentation on flooding.
5.	 Secondary Mitigation Planning Terry presented the additional gages that are recommended in the area including stage, flow, and rainfall. The gages provide first responders early information to flooding in the region. The team recommended 26 gages throughout the San Jacinto Basin, 5 of which are already being installed by HCFCD.
6.	Other Mitigation Actions
	 Terry discussed coordinating with local agencies to determine how the agencies react to storm events and their communication protocols The team also identified roadway levels of service and critical infrastructure within the potential floodplains. Most counties have a plan for responding to flooding events and are already coordinating with the region. Identified some areas of improvements for each agency.
7.	 Communication and Outreach Terry explained that there is a defined coordination effort, which includes meetings with both the study partners, and other supporting partners, such as the surrounding counties and H-GAC. As part of the Other Mitigation Actions task, the team met with emergency managers for each of the regional entities to understand protocol, and also conducted an emergency management workshop. The team also has an outreach plan, with the first round of community meetings in December 2019 and a second round planned for July. In addition, there is a study website that provides an overview of the study goals and progress. (www.sanjacstudy.org)
8.	Study Schedule
	Terry presented the study schedule with the final report being submitted in August 2020.
9.	 GWA Lake Houston Gate Study Update Jing stated that the HCFCD is participating in the Lake Houston Gate project as a stakeholder. She stated that the project is FEMA funded and the team will be looking at benefit costs of the project, including minimizing downstream impacts to the additional gates.

	 She stated the team is identifying successes and constraints of the project. She also mentioned that the project kicked off in mid-April and the H&H analysis is ongoing and will extend through October.
10.	Questions/Comments
	 Amar recommended the study include the discussion on detention policy and floodplain preservation as a potential policy to reduce future flooding. Terry agreed and stated the project report would include information. Jing recommended adjusting language for the detention to recognize that while local detention did not result in significant changes at the regional level given the teams modeling assumptions, detention is still a reliable strategy to mitigate development impacts Amar stated that these regional studies are needed but we need to be thoughtful in how we present the information and to include some of the policy discussion. He stated that pieces of reports can be taken out of context. Terry stated that the recommendations for this region are long term and need to be presented as such. Amar and Lance requested the memos and reports to review and provide high level input on the project.





PRECINCT BRIEFING AGENDA Harris County Precinct 2

May 22, 2020 San Jacinto Regional Watershed Master Drainage Plan Skype Conference Call

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Precinct Briefing						
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	2:00 pm						
			Meeting Stop Time:	3:00 pm						
Agend	Agenda									
1.	Introdu	uctions								
2.	Goals	and Objectives								
	•	Conduct a comprehensive Flo	od Mitigation Plan							
	•	Identify vulnerability to flood	hazards causing loss of	life and property						
	•	Develop approaches to enhar	nce public information a	and flood level assessment						
	•	Evaluate noou mitigation stra	itegies to improve long-	term resilience						
3.	Existin	g Conditions								
	•	Existing Conditions H&H Mod	leling Update							
	•	Analysis of Historical Storms								
4.	Primar	y Mitigation Planning								
	Flood Mitigation Strategies									
	Primary Mitigation Tasks Demons Conton Identification									
	Damage Center Identification Elood Mitigation Projects									
	Implementation Planning									
	Sedimentation and Vegetation									
	0									
5.	Secondary Mitigation Planning									
	•	Suge Recommendations								
6.	Other Mitigation Actions Planning									
	Coordination with Emergency Managers									
	Updated communication plans/protocols Critical infrastructure and roadway flood frequency									
			ana, nooa nequency							
7.	Comm	unity Outreach								
	Partners and Stakeholder Communication									
	•	Community Outreach								
8.	Study Schedule									
9.	CWA Lake Houston Gate Study Update									
10.	Questi	ons								

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Harris County Precinct 2 Briefing May 22, 2020 - DRAFT









Agenda

- Goals and Objectives
- Existing Conditions
- Primary Mitigation Planning
- Secondary Mitigation Planning
- Other Mitigation Actions Planning
- Community Outreach
- Project Schedule and Status
- CWA Lake Houston Gate Study
- Questions







San Jacinto River Basin

- 75% HMGP Funded
- 25% Local Funded

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6



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Harris County Precinct 2

- San Jacinto River/Lake Houston
- Luce Bayou
- Jackson Bayou





DRAFT - 5/22/2020

Flood Claim Density



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Goals and Objectives

- The goal of the San Jacinto Regional Watershed Master
 Drainage Plan is to
 - Conduct a comprehensive Flood Mitigation Plan
 - Identify vulnerability to flood hazards causing loss of life and property
 - Develop approaches to enhance public information and flood level assessment
 - Evaluate flood mitigation strategies to improve long-term resilience
- The plans specific objectives are:
 - Primary Flood Mitigation Planning (Detention, Conveyance, Buy-Outs)
 - Secondary Mitigation Planning (Flood Assessment/Warning)
 - Other Mitigation Actions (Communications Protocols, Flood Response)
 - Community Outreach & Education (Drainage, Maintenance, Projects)







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Existing Conditions H&H Analysis

- Developed Comprehensive Model
- Limited Updates to M3 Models
- Hydrology
 - Atlas 14 Rainfall (varies by watershed)
 - Updated Watershed Delineation
 - Updated Infiltration/Tranform Parameters
 - HEC-HMS Model Development
- Hydraulics
 - Updated cross section geometry
 - New/updated bridges and culverts
 - Reviewed and adjusted n-values
 - Developed unsteady RAS models











Analysis of Historical Storms

- Historical Storms
 - Memorial Day (2016)
 - Hurricane Harvey (2017)
 - TS Imelda (2019)
 - October 1994
- Leveraged Gage Adjusted Radar Rainfall (GARR) Data
- USGS Gages (Used 22/25)
 - Met with USGS
 - Peach Creek Adjustment
 - Gage Summary in Report
- Calibration Report Submitted













Flood Mitigation Strategies

- Primary Flood Mitigation Planning (Flood Reduction)
 - Primary Alternatives Based on previously identified solutions
 - Secondary Alternatives Developed additional flood reduction projects
 - Develop cost estimates
 - Evaluate potential benefits
 - Identify implementation path and challenges
- Secondary Flood Mitigation Planning (Flood Warning)
 - Coordinate with HCFCD, MCO, SJRA, TXDOT, USGS, NWS
 - Recommend locations for additional FWS gages
- Other Mitigation Actions (Flood Response)
 - Coordinate with agencies responsible for Emergency Management
 - Provide recommendations for updated communications protocols
 - Identify potential flooding of roadways and critical infrastructure







Primary Mitigation Tasks

- Evaluate flood damages using the Structural Inventory Tool
- Identify "Damage Centers"
- Determine volume reduction for a range of LOS improvements
- Compare reduction volumes to potential benefits
- Estimate preliminary target volumes for each damage center
- Consider previously identified projects
- Develop new potential projects
- Select watersheds with highest potential for improvements





Damage Center Identification

- Run models for frequency storm events
- **Develop the Structural Inventory Tool**
- **Identify Damage Centers**



1,200 Significant number of Structures at Risk of Flooding 1,000 structures at risk during higher **500yr** frequency storms (2-yr - 25-yr) 800 100yr 600 50yr 25yr 400 10yr 200 5vr 2yr 0 62 60 58 56 54 52 50 48 46 44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 8 **River Mile**

Spring Creek – Structures at Risk of Flooding

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Damage Center Identification



Watershed Mitigation Potential

- Higher Potential
 - Spring Creek (Benefits in watershed; Potential reduction downstream)
 - East Fork (Major Lake Houston contributor; Available open space)
 - Peach/Caney Creek (Available open space; Benefits in watershed)
- Moderate Potential
 - Lake Creek (Available open space; large contributing area to West Fork, Limited benefits in the Lake Creek watershed)
- Lower Potential
 - Cypress Creek (Limited open space; Other HCFD efforts; Overflow)
 - Willow Creek/Little Cypress Creek (Small contribution; Limited space)
 - Luce/Tarkington Bayou (Limited damages; Smaller contribution; Flat)
 - Jackson Bayou (Very small contribution; Downstream of Lake Houston)
 - West Fork (Limited open space; High volume; Benefits in watershed)



Previously Recommended Projects

- Reviewed previous reports and master plans
 - 1943 San Jacinto River Master Plan
 - 1957 San Jacinto River Master Plan
 - 1985 Upper San Jacinto River Flood Control Study
 - 1989 South Montgomery County Flood Protection Plan
 - 1997 Lake Creek Reservoir Study
 - 2000 Lake Houston Regional Flood Protection Study
 - 2015 Cypress Creek Overflow Management Plan
 - 2019 Estimate Land Cover Effects on Selected Watersheds
 - 2019 Hurricane Harvey San Jacinto River Flooding (presentation)



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Previously Recommended Projects

- Considered 34 Previously Recommended Projects
 - 1943/1957 San Jacinto River Master Plan
 - 1985 Upper San Jacinto River Flood Control Study



San Jacinto Regional WMDP



Flood Reduction Projects Summary

Watershed	Project Type	General Location	Estimated Costs (\$M)	Present Value Benefit (\$M)	Benefit-Cost Ratio (BCR)
Spring Creek	Detention	Walnut Creek 10 miles U/S of Spring Creek	91 - 120	123	1.02 - 1.35
Spring Creek	Detention	Mill Creek 10 miles U/S of Spring Creek	96 - 126	81.6	0.65 - 0.85
Spring Creek	Detention	Birch Creek 10 miles U/S of Spring Creek	77 - 117	82.6	0.70 - 1.07
Spring Creek	Bench	I-45 to 3 miles D/S of Riley Fuzzell	81	145.3	1.79
Spring Creek	Bench	Between Gosling Road and I-45	123	82.6	0.66
Spring Creek	Bench	DC2-200 U/S of I-45	59	53	0.89
Spring Creek	Bench	DC2-500 U/S Kuykendahl Rd. to Willow Creek	142	70.3	0.49
Lake Creek	Detention	Caney Creek 0.3 miles North of SH 105	98 - 163	34	0.21 - 0.35
Lake Creek	Detention	Little Caney Creek 1.1 miles U/S of Lake Creek	98 - 128	27.6	0.22 - 0.28
Lake Creek	Detention	Garrett's Creek 0.74 miles U/S of Lake Creek	107 - 131	35.4	0.27 - 0.33
Lake Creek	Detention	Lake Creek Mainstem 0.6 miles U/S of SH105	187 - 264	61.8	0.15 - 0.22
Peach Creek	Detention	Peach 12 miles U/S of New Caney@ SH105	299 - 428	57	0.13 - 0.19
Peach Creek	Detention	Peach/Walker 19 miles U/S of New Caney	203 - 222	68	0.30 - 0.33
Peach Creek	Channel	Peach Creek D/S of I-69	180	75.9	0.42
Caney Creek	Detention	Caney Creek 1.0 miles U/S of FM 1097	104 - 131	19.8	0.15 - 0.19
Caney Creek	Detention	Caney Creek 1.9 miles U/S of SH 105	177 - 207	26.3	0.13 - 0.15
Caney Creek	Channel	Caney Creek D/S of I-69 to the East Fork	140	47	0.34
East Fork	Detention	Winters Bayou Nebletts 2 miles U/S Cleveland	128 - 176	39.8	0.15 - 0.20
East Fork	Detention	Winters Bayou 5 miles U/S of Cleveland	132 - 163	44.2	0.26 - 0.33
East Fork	Detention	East Fork 10 miles U/S of Cleveland near FM945	138 - 141	34.3	0.15 - 0.16
East Fork	Bench	East Fork FM 1485 to Luce Bayou	326	24.9	0.08
West Fork	Channel	West Fork from I-45 to SH 242	148	33.8	0.22
West Fork	Channel	West Fork from I-45 to 3.2 miles D/S of SH 242	179	30.3	0.15
West Fork	Channel	West Fork D/S of I-69 (3000' Wide)	722	67	0.09
West Fork	Bench	West Fork D/S of I-69 (3500' Wide)	818	55.6	0.07







San Jacinto Regional WMDP

- Combined projects show increased local and regional benefits
- Current project combinations (by Watershed)
 - Spring Creek: Walnut Detention, Birch Detention, I-45 to Riley Fuzzell
 - Lake Creek: Caney Detention, Little Caney Detention, Garrett's Detention
 - East Fork: Winters Detention, Lower East Fork Channel Improvements
 - Caney Creek: SH105 and FM1097 Detention, Channel D/S of I-69
 - Peach Creek: SH 105 and Walker Detention, Channel D/S of I-69
 - Full Combined Model: Ultimate Flood Reduction Improvements
- Projects in Spring Creek have the highest BCR (0.70 1.79)





San Jacinto Regional WMDP

- Plan Cost: \$3.1B \$3.5B SAN
- Overall Plan Benefits: \$677 M
- BCR: 0.19 0.22

Watershed	Damages, Existing (\$M)	Damages, Combined Alts (\$M)	Benefit (\$M)
Spring	466.6	163.8	302.8
Willow	112.2	86.6	25.6
Cypress	213.2	211.6	1.6
Little Cypress	30.9	30.8	0.1
East Fork	101.4	56	45.5
West Fork	269.7	132.7	137
Lake Creek	10.1	3.2	6.9
Peach	113.1	27.9	85.3
Caney	135.6	63.8	71.9
Luce	14.6	14	0.5
Total	1467.4	790.4	677.2





Low to Moderate Income (LMI) Areas









Additional Regional Measures

• Detention Policy

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- Detention associated with local development provides critical mitigation, but the regional benefits associated with local detention are highly dependent on the location and timing of development
- 2070 modeling indicated limited detention impact, but development was centered on the urban core lower in the basin (1-2% volume increase)
- Ultimate development along the basin outer boundaries shows a higher increase in runoff volume (>5%); detention impact may increase
- Detention DOES have an impact on local flooding issues
- Floodplain Preservation
 - Losses to floodplain storage could negatively impact downstream areas
 - Future Conditions modeling does not include floodplain fill
 - Approx. market value of all flooded structures in the 100-year ~ \$3B







Buyouts

- Structures currently located in the 2-, 5-year floodplains may see some benefits, but will continue to flood
- Removed from the instances of flooding for damage centers
- Maintained in the BCR calculations
- Generally a higher BCR on buyouts than structural projects
- Best option may be to buyout structures in this category







Buyouts

• Summary of structures and expected damages in each watershed that flood in the 5-year event

Buyouts - Structures Flooding in 5-yr Event						
Watershed	Count	Market Value	Mkt Value * 1.25	Existing NPV 50-yr damage	BCR	
Spring	87	12,184,636	15,230,795	80,537,873	5.3	
Willow	43	13,197,517	16,496,896	30,707,624	1.9	
Cypress	31	12,790,373	15,987,966	55,385,994	3.5	
Little Cypress	13	2,468,448	3,085,560	11,513,834	3.7	
East Fork	34	4,083,750	5,104,688	21,596,467	4.2	
West Fork	10	1,412,655	1,765,819	6,244,840	3.5	
Lake Creek	3	519,100	648,875	2,390,871	3.7	
Peach	71	7,536,240	9,420,300	44,668,723	4.7	
Caney	82	7,288,986	9,111,233	56,872,257	6.2	
Luce	5	583,203	729,004	2,845,449	3.9	
Tarkington	60	6,657,070	8,321,338	45,279,121	5.4	
Jackson Bayou	2	518,533	648,166	1,529,131	2.4	
Gum Gully	1	211,015	263,769	1,514,652	5.7	
	442	69,451,526	86,814,408	361,086,836	4.2	







Implementation Planning

- Identify projects to be included in MDP NT
- Finalize modeling of individual selected projects
- Develop Project Tiers (Regional Approach)
 - Select and weight metrics based on study partner input
 - Update project costs and benefits
 - Gather information on the selected metrics
 - Perform project prioritization
- Develop project phasing plan
 - Model projects cumulatively (i.e. Project 1, Project 1 & 2,...All projects) to ensure no negative impacts
 - Update environmental and cultural data, update utility information, ROW
 - Identify potential funding sources depending on criteria (BCR, LMI, etc.)
- Move forward with Feasibility, Preliminary Engineering, Design



Sedimentation and Vegetation

- Strategies to reduce flow of sediments into Lake Houston
- Developed annual sediment rating curves for 7 watersheds
 - Predictive tool that relates sediment transport with stream flow
 - Cypress Creek is the highest contributor
- First step toward Regional Sediment Management Plan (RSM)
- Inventory of sediment sources
- Common sediment management strategies
- Recommended strategies for West Fork and Spring Creek
- Did NOT evaluate relationship between sediment and flooding













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Secondary Mitigation Planning

- Received input from HCFCD, MCO, USGS, Others
- Updated Secondary Mitigation Memo (05/13/20)
 - 26 Gages recommended (HCFCD Currently installing 5)
 - Approximate installation cost range \$240k \$330k (Plus Maintenance)









Other Mitigation Actions

- Other Mitigation Action Goals
 - Evaluate communications plan/protocol during emergencies
 - Identify critical infrastructure and compare to inundation
 - Determine expected flood frequency evacuation routes
- Conducted Emergency Management Workshop (March 11th)
- Working on draft memorandum













udy led by local partners including the Harris County Flood Control Dist

ick started in April 2019, will identify future flood mitigat

GLOSSAR

ries of the Upper San Jacinto Rive and (from the **headwaters** in Walker County to the Interstate 10 cr

ant and denth of **riverine flooding** of the larger rivers within the water tion will be gat

Contact U

Harris County Flood Control District - Jing Chen Jing che San Jacinto River Authority Montgomery County - Diane Cooper, diane.co



- Communication
 - Study Partners Meetings (6)
 - Supporting Partners Meeting (8)
 - **Emergency Managers Workshop**
 - H-GAC Coordination

Outreach

- 1st round of community meetings complete – December 2019
- 2nd round of community meetings in planning – July 2020
- Woodlands Drainage Task Force Meeting – January 28th
- **Study Website**

www.sanjacstudy.org





FREQUENTLY ASKED QUESTIONS






Schedule Update

54 Current Progress
478 Days Remaining
8/12/2019 Completion Date

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- Existing H&H/Calibration 100% (Finalized)
- Primary Mitigation Planning (Workshops Completed) 85%
- Secondary Mitigation Planning (Adjusted Schedule) 100%
- Other Mitigation Actions (Adjusted Schedule) 80%



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Study Submittals

- Submitted
 - Existing Conditions Memorandum
 - Secondary Mitigation Memorandum
 - Historical Storms Memorandum
- Upcoming
 - Other Mitigation Actions Memo (Early June)
 - Alternative Funding Memo (Early June)
 - Updated Sedimentation/Vegetation Memo (06/12/20)
 - Primary Mitigation Memo (06/08/20)
 - Draft Report (07/13/20)





RIVER Ouestions?

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Harris County Precinct 2 Briefing May 22, 2020 - DRAFT

Lives













STUDY PARTNERS MEETING NOTES

Harris County Precinct 2

May 22, 2020 San Jacinto Regional Watershed Master Drainage Plan Skype Conference Call

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Meeting			
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	2:00 PM			
			Meeting Stop Time:	3:00 PM			
Agend	а						
1.	Attend	lees					
	•	Terry Barr, Halff					
	•	Sam Hinojosa, Halff					
	•	Andrew Moore, Halff					
	•	Jing Chen, HCFCD					
	•	Gary Bezemek, HCFCD					
	•	Byron Acevedo, Harris Count	y Precinct 2				
	•	Wilton Ranman, Harris Count	y Precinct 2				
	-						
2.	Goals	and Objections					
	Jing introduced the meeting.						
	Terry introduced the San Jacinto study. He showed the watershed included in the study						
	and the funding partners. He presented the location of the watershed in reference to						
	Precinct 2.						
	 Terry introduced the goals and objectives of the San Jacinto Regional Watershed Mast 						
Drainage Plan.							
3.	Existin	ng Conditions					
	•	Terry presented the update of	of the Existing Condition	s analysis. He stated that all major			
		streams in the basin have been model utilized existing model	en included in a combine	ed existing conditions model. The			
		The model utilizes the latest	Atlas 14 rainfall and has	heen calibrated to historical storm			
		events including Hurricane H	arvey and Memorial Day	~ 2016 The model has also been			
validated with the October 1994 and Tronical Storm Imelda events. The calibration							
		validation including comparir	ng the model to 22 USGS	S gages in the watershed.			
4	Primar	v Mitigation Planning					
	•	Terry summarized the primar	v mitigation process wh	nich included identifying mitigation			
	_	strategies to reduce flooding	for region.				
	•	The team identified damage	centers to determine which locations should be targeted with				
		the mitigation projects using	the mitigation projects using the structural inventory tool and the updated existing				

	conditions modeling. Of the damage centers, the highest damage concentrations were in
	those centers closer to the confluence.
	 Using the damage center information, the team identified tiers for mitigation planning to
	rank the potential mitigation projects based on number of damages, regional benefit, and
	potential mitigation volumes.
	 The team reviewed and cataloged projects recommended in several previous reports to
	determine if any of these should be included in the analysis. Many of the projects were no
	longer feasible or were originally intended for water supply purposes; however, the
	information was used as a starting point for many of the projects that were evaluated as
	part of this study. In addition, the team also proposed new mitigation strategies.
	• The team evaluated a total of 25 projects, choosing those deemed most effective to
	develop a regional master plan, which includes detention and channelization project spread
	throughout the watershed. The "most effective" projects are those that performed the
	best for each watershed as well as provided regional benefit. Terry stated that the projects
	improve the areas near the damage center within their respective watershed, but also
	provide flood reduction benefits further downstream, including beyond their confluences
	with receiving streams. He stated that Lake Houston limits the effectiveness of these
	projects downstream and that reductions to the Lake Houston level would be needed to
	see further improvements. However, this study does not evaluate or recommend changes
	to the lake. A separate Lake Houston study is reviewing improvements for the Lake
	Houston area.
	• Milton asked if there were any projects proposed in the Precinct 2 area. Terry stated that
	most projects were outside Harris County, with the goal of reducing projects within Harris
	County.
	• The benefit-cost ratios (BCR) for Spring Creek were the highest, but overall cost benefits are
	not positive for many of the projects. Terry stated that the BCR is not the only metric for
	funding the projects. Acreage recovered, roadway miles removed, and raw structure
	counts should also be considered. Milton asked if the costs were broken down by County.
	Terry stated that most of the projects are outside the County and costs are broken down by
	project.
	 In addition, Terry showed the low-to-moderate income (LMI) areas as they relate to
	potential projects. Lower income areas could potentially be good candidates for CDBG or
	other funding sources that account for socio-economically disadvantaged areas.
	Terry discussed additional mitigation measures, including detention, floodplain
	preservation, and buyouts, as potential options. Detention associated with local
	development is needed to offset negative impacts for the local streets, sewers, and
	streams. Future projections show that the impact of local detention on the regional scale is
	minor, but much of the analysis depends on assumptions made about the development
	location and timing. Development locations can change and alter the results. Terry
	reiterated that detention is an important tool to mitigate drainage impacts of development
	and specified that the study should be careful to clarify the team's position on detention
ļ	 Terry stated that floodplain preservation is recommended because losses in floodplain
ļ	storage can have negative impacts downstream. The study did not evaluate specific areas
	or scenarios related to floodplain preservation. Harris County has "no adverse impact" and
	floodplain fill mitigation policies in place and Terry agreed that those policies were
ļ	beneficial.
	 Terry indicated that while the proposed projects (detention, channel) will provide
ļ	significant benefits, some structures, specifically those that flood during frequent storms (2-
1	

	 & 5-year), will likely continue to flood. For these structures, buyouts may be the recommended strategy. The next step is to finalize the list of projects to be included in the overall master drainage plan and develop a project phasing plan. Terry briefly discussed the Sedimentation and Vegetation report, which identifies strategi to reduce flow of sediments into Lake Houston. The report is the first step toward a regional sediment management plan. Terry specified that the sediment and vegetation effort did not evaluate the impact of sedimentation on flooding. 			
5.	Secondary Mitigation Planning			
	 Terry presented the additional gages that are recommended in the area including stage, flow, and rainfall. The gages provide first responders early information to flooding in the region. The team recommended 26 gages throughout the San Jacinto Basin, 5 of which are already being installed by HCFCD. 			
6.	Other Mitigation Actions			
	Terry discussed coordinating with local agencies to determine how the agencies react to			
	storm events and their communication protocols			
	 The team also identified roadway levels of service and critical infrastructure within the potential floodplains. 			
	 Most counties have a plan for responding to flooding events and are already coordinating 			
	with the region. Identified some areas of improvements for each agency.			
7.	Communication and Outreach			
	 Terry explained that there is a defined coordination effort, which includes meetings with both the study partners, and other supporting partners, such as the surrounding counties and H-GAC. 			
	 As part of the Other Mitigation Actions task, the team met with emergency managers for each of the regional entities to understand protocol, and also conducted an emergency management workshop. 			
	The team also has an outreach plan, with the first round of community meetings in			
	December 2019 and a second round planned for July. In addition, there is a study website			
	 that provides an overview of the study goals and progress. (<u>www.sanjacstudy.org</u>). Milton asked if the study team had worked with the Lake Houston Chamber of Commerce 			
	group. Jing stated that both HCFCD and SJRA had been attending meetings with the			
	chamber. Milton stated that it may be added value to present to this group the overvie			
	the study as they are an influential group in the region.			
8.	Study Schedule			
	• Terry presented the study schedule with the final report being submitted in August 2020.			
9.	CWA Lake Houston Gate Study Update			
	 Jing stated that the HCFCD is participating in the Lake Houston Gate project as a 			
	stakeholder. She stated that the project is FEMA funded and the team will be looking at			
	gates.			
	 She stated the team is identifying successes and constraints of the project. She also 			
	mentioned that the project kicked off in mid-April and the H&H analysis is ongoing and will extend through October.			

	 Milton stated he had concerns that the gate improvements would cause impacts downstream of the dam. He asked if the team had started a public engagement plan for the project. Jing stated that the City is planning to reach out to the appropriate precincts with a plan for public outreach in the fall in August or September timeframe.
10.	 Questions/Comments Milton stated that the Precinct has \$30 million for three (3) projects within the watershed (F-15, F-110, F-111). He stated that according to the study analysis, these funds would not have a high cost benefit. Jing stated that it is not clear what the next steps are for current funding and projects, but coordination is likely needed between all stakeholders in the area.





PRECINCT BRIEFING AGENDA Harris County Precinct 3

June 30, 2020 San Jacinto Regional Watershed Master Drainage Plan Teams Conference Call

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Precinct Briefing			
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	11:00 am			
			Meeting Stop Time:	12:00 pm			
Agend	Agenda						
1.	Introdu	ictions					
2.	Goals	and Objectives					
	•	Conduct a comprehensive Flo	od Mitigation Plan				
	•	Identify vulnerability to flood	hazards causing loss of	life and property			
	•	Develop approaches to enhar	nce public information a	and flood level assessment			
	•	Evaluate flood mitigation stra	itegies to improve long-	term resilience			
3.	Existin	g Conditions					
	•	Existing Conditions H&H Mod	leling Update				
	Analysis of Historical Storms						
	Sedimentation and Vegetation						
4.	A Primary Mitigation Planning						
	Flood Mitigation Strategies						
	Primary Mitigation Tasks						
	Damage Center Identification						
	Flood Mitigation Projects						
	Additional Mitigation Measures						
	Implementation Planning						
5.	Secon	dary Mitigation Planning					
	•	Gage Recommendations					
6.	Other Mitigation Actions Planning						
•	•	Coordination with Emergency	/ Managers				
	•	Updated communication plan	ns/protocols				
	Critical infrastructure and roadway flood frequency						
7.	Community Outreach						
	Partners and Stakeholder Communication						
	Community Outreach						
8.	Study Schedule						
9.	Questi	ons					

SAN JACINTO RIVER SANJAGINTO - Regional Watershed Master Drainage Plan

Harris County Precinct 3 Briefing June 30, 2020 - DRAFT









Agenda

- Goals and Objectives
- Existing Conditions
- Primary Mitigation Planning
- Secondary Mitigation Planning
- Other Mitigation Actions Planning
- Community Outreach
- Project Schedule and Status
- CWA Lake Houston Gate Study
- Questions







San Jacinto River Basin

- 75% HMGP Funded
- 25% Local Funded

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
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Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6



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- Spring Creek/Willow Creek
- Cypress Creek
- Little Cypress Creek





Flood Claim Density



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Goals and Objectives

- The goal of the San Jacinto Regional Watershed Master
 Drainage Plan is to
 - Conduct a comprehensive Flood Mitigation Plan
 - Identify vulnerability to flood hazards causing loss of life and property
 - Develop approaches to enhance public information and flood level assessment
 - Evaluate flood mitigation strategies to improve long-term resilience
- The plans specific objectives are:
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 - Community Outreach & Education (Drainage, Maintenance, Projects)







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Existing Conditions H&H Analysis

- Developed Comprehensive Model
- Limited Updates to M3 Models
- Hydrology
 - Atlas 14 Rainfall (varies by watershed)
 - Updated Watershed Delineation
 - Updated Infiltration/Transform Parameters
 - HEC-HMS Model Development
- Hydraulics
 - Updated cross section geometry
 - New/updated bridges and culverts
 - Reviewed and adjusted n-values
 - Developed unsteady RAS models













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STRUCT







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- Leveraged Gage Adjusted Radar Rainfall (GARR) Data
- USGS Gages (Used 22/25)
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Sedimentation and Vegetation

- Strategies to reduce flow of sediments into Lake Houston
- Developed annual sediment rating curves for 7 watersheds
 - Predictive tool that relates sediment transport with stream flow
 - Cypress Creek is the highest contributor
- First step toward Regional Sediment Management Plan (RSM)
- Inventory of sediment sources
- Common sediment management strategies
- Recommended strategies for West Fork and Spring Creek
- Did NOT evaluate relationship between sediment and flooding













Flood Mitigation Strategies

- Primary Flood Mitigation Planning (Flood Reduction)
 - Primary Alternatives Based on previously identified solutions
 - Secondary Alternatives Developed additional flood reduction projects
 - Develop cost estimates
 - Evaluate potential benefits
 - Identify implementation path and challenges
- Secondary Flood Mitigation Planning (Flood Warning)
 - Coordinate with HCFCD, MCO, SJRA, TXDOT, USGS, NWS
 - Recommend locations for additional FWS gages
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 - Identify potential flooding of roadways and critical infrastructure







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- Evaluate flood damages using the Structural Inventory Tool
- Identify "Damage Centers"
- Determine volume reduction for a range of LOS improvements
- Compare reduction volumes to potential benefits
- Estimate preliminary target volumes for each damage center
- Consider previously identified projects
- Develop new potential projects
- Select watersheds with highest potential for improvements







Damage Center Identification

- Run models for frequency storm events
- Develop the Structural Inventory Tool
- Identify Damage Centers



Spring Creek – Structures at Risk of Flooding



Damage Center Identification



Watershed Mitigation Potential

- Higher Potential
 - Spring Creek (Benefits in watershed; Potential reduction downstream)
 - East Fork (Major Lake Houston contributor; Available open space)
 - Peach/Caney Creek (Available open space; Benefits in watershed)
- Moderate Potential
 - Lake Creek (Available open space; large contributing area to West Fork, Limited benefits in the Lake Creek watershed)
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Previously Recommended Projects

- Reviewed previous reports and master plans
 - 1943 San Jacinto River Master Plan
 - 1957 San Jacinto River Master Plan
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 - 2015 Cypress Creek Overflow Management Plan
 - 2019 Estimate Land Cover Effects on Selected Watersheds
 - 2019 Hurricane Harvey San Jacinto River Flooding (presentation)







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Previously Recommended Projects

- Considered 34 Previously Recommended Projects
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San Jacinto Regional WMDP



San Jacinto Regional WMDP

- Combined projects show increased local and regional benefits
- Current project combinations (by Watershed)
 - Spring Creek: Walnut Detention, Birch Detention, I-45 to Riley Fuzzell
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 - East Fork: Winters Detention, Lower East Fork Channel Improvements
 - Caney Creek: SH105 and FM1097 Detention, Channel D/S of I-69
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 - Full Combined Model: Ultimate Flood Reduction Improvements
- Projects in Spring Creek have the highest BCR (0.55 1.22)





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San Jacinto Regional WMDP

- Plan Cost: \$2.9B \$3.3B
- Overall Plan Benefits: \$756 M
- BCR: 0.23 0.26

Stream	Existing Structural Damages (\$M)	Combined Alternatives Structural Damages (\$M)	Structural Benefit (\$M)	Cost Range (\$M)
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West Fork SJR	396.2	198.2	198	966
Lake Creek	16.7	4.5	12.1	303 - 422
Peach Creek	163.9	32.9	131.1	718.0 – 812.0
Caney Creek	190.8	70.5	120.2	478.0 – 533.0
Luce Bayou	20	19.2	0.8	-
Total	2,030.3	1,274.1	756.2	2,912.9 – 3,288.1







Low to Moderate Income (LMI) Areas









Additional Regional Measures

• Detention Policy

SAN JACINTO

- Local detention provides critical mitigation for development and CIP
- Regional benefits are dependent on location and timing of development
- Future conditions modeling indicated limited detention impact, BUT
 - 2070 development was centered on lower basin (1-2% volume increase)
 - Ultimate development along the basin outer boundaries shows a higher increase in runoff volume (>5%)
- Detention DOES have an impact on local flooding issues
- Comprehensive impact analysis should be performed
- Floodplain Preservation
 - Losses to floodplain storage could negatively impact downstream areas
 - Future Conditions modeling does not include floodplain fill
 - Approx. market value of all flooded structures in the 100-year ~ \$3B





Buyouts

- Structures currently located in the 2-, 5-year floodplains may see some benefits, but will continue to flood
- Removed from the instances of flooding for damage centers
- Maintained in the BCR calculations
- Generally a higher BCR on buyouts than structural projects
- Best option may be to buyout structures in this category







Buyouts

• Summary of structures and expected damages in each watershed that flood in the 5-year event

Watershed	Structure Count	Existing Damages (NPV, 50-yr Period) (\$M)	2019 Market Value (\$M)	Estimated Buyout Cost (2.5× Mkt. Value) (\$M)	Benefit-Cost Ratio
Spring Creek	34	46.65	4.38	10.96	4.3
Willow Creek	39	29.92	9.61	24.02	1.2
Cypress Creek	40	69.92	16.80	42.01	1.7
Little Cypress Creek	30	31.02	6.05	15.13	2
East Fork SJR	31	36.53	5.53	13.83	2.6
West Fork SJR	38	40.29	6.41	16.02	2.5
Lake Creek	5	4.72	1.02	2.55	1.9
Peach Creek	71	59.46	8.67	21.67	2.7
Caney Creek	85	74.05	7.80	19.49	3.8
Luce Bayou	9	4.76	1.08	2.70	1.8
Tarkington Bayou	58	57.07	7.34	18.34	3.1
Jackson Bayou	1	1.51	0.21	0.52	2.9
Gum Gully	2	1.57	0.97	2.43	0.6
Totals	443	457.46	75.87	189.67	2.4





Implementation Planning

- Identify projects to be included in MDP
- Finalize modeling of individual selected projects
- Perform project prioritization
 - Update project costs and benefits
 - Select and weight metrics based on study partner input
 - Perform project prioritization
- Develop project phasing plan
 - Model projects cumulatively to ensure no negative impacts
 - Update environmental and cultural data, update utility information, ROW
 - Identify potential funding sources depending on criteria (BCR, LMI, etc.)
- Move forward with Feasibility, Preliminary Engineering, Design



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Secondary Mitigation Planning

- Received input from HCFCD, MCO, USGS, Others
- Updated Secondary Mitigation Memo (05/13/20)
 - 26 Gages recommended (HCFCD Currently installing 5)
 - Approximate installation cost range \$240k \$330k (Plus Maintenance)







Other Mitigation Actions

- Other Mitigation Action Goals
 - Evaluate communications plan/protocol during emergencies
 - Identify critical infrastructure and compare to inundation
 - Determine expected flood frequency evacuation routes
- Conducted Emergency Management Workshop (March 11th)
- Working on draft memorandum













GLOSSAR

udy led by local partners including the Harris County Flood Control Distr

ick started in April 2019, will identify future flood mitigat

ies of the Upper San Jacinto Rive and (from the **headwaters** in Walker County to the Interstate 10 c

ant and depth of **riverine flooding** of the larger tion will be

Contact U

Harris County Flood Control District - ling Chen, ling ch San Jacinto River Authority Montgomery County - Digne Cooper, digne.c



- Communication
 - Study Partners Meetings (6)
 - Supporting Partners Meeting (8)
 - Emergency Managers Workshop
 - H-GAC Coordination

Outreach

- 1st round of community meetings complete – December 2019
- 2nd Community Meeting (Virtual) in planning – August 2020
- Stakeholder Meetings (Jul/Aug)
- Woodlands Drainage Task Force Meeting – January 28th
- **Study Website** www.sanjacstudy.org



FREQUENTLY ASKED QUESTIONS

Schedule Update

54 Current Progress
478 Days Remaining
8/12/2019 Completion Date

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- Existing H&H/Calibration 100% (Finalized)
- Primary Mitigation Planning (Memorandum Submitted) 90%
- Secondary Mitigation Planning (Finalized) 100%
- Other Mitigation Actions (Memorandum Coming) 90%


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Study Submittals

- Submitted
 - Existing Conditions Memorandum (08/12/19)
 - Historical Storms Memorandum (04/07/20)
 - Future Conditions Memorandum (04/07/20)
 - Secondary Mitigation Memorandum (05/13/20)
 - Primary Mitigation Memo (06/08/20)
 - Updated Sedimentation/Vegetation Memo (06/26/20)
 - Upcoming
 - Other Mitigation Actions Memo (06/30/20)
 - Draft Report (07/13/20)
 - Alternative Funding
 - Implementation Plan
 - Final Report (08/31/20)



SAN JACINTO RIVER QUESTIONS?

Harris County Precinct 3 Briefing June 30, 2020 - DRAFT

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STUDY PARTNERS MEETING NOTES

Harris County Precinct 3

June 30, 2020 San Jacinto Regional Watershed Master Drainage Plan Teams Conference Call

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Precinct Briefing			
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	11:00 AM			
			Meeting Stop Time:	12:00 PM			
Agend	a						
1.	Attend	ees					
	•	Terry Barr, Halff					
	•	Sam Hinojosa, Halff					
	•	Ryan Londeen, Halff					
	•	Jing Chen, HCFCD					
	•	Gary Bezemek, HCFCD					
	•	Dylan Epley, HCFCD					
	•	Matthew Lopez, HCFCD					
	•	Eric Heppen, Harris County P	recinct 3				
Randy Schillab, Harris County Precinct 3			Precinct 3				
	•	Cory Stull, Freese & Nichols					
2.	Goals	and Objections					
	•	Jing introduced the meeting.					
	• Terry introduced the San Jacinto study. He showed the watershed included in the study						
	and the funding partners. He presented the location of the watershed in reference to						
		Precinct 3.					
	• Terry showed the density of flood claims within the basin.						
 Terry introduced the goals and objectives of the San Jacinto Regional Watershe 				Jacinto Regional Watershed Master			
	Drainage Plan.						
3.	Existin	g Conditions					
	•	Terry presented the update of	of the Existing Condition	s analysis. He stated that all major			
		streams in the basin have bee	en included in a combine	ed existing conditions model. The			
	model utilized existing models from HCFCD as well as new models for the upper re						
	The model utilizes the latest Atlas 14 rainfall and has been calibrated to historical						
	events including Hurricane Harvey and Memorial Day 2016. The model has also been						
		validated with the October 19	994 and Tropical Storm	Imelda events. The calibration and			
		validation including comparing	ng the model to 22 USGS	sgages in the watershed.			
4.	Primar	y Mitigation Planning					
	•	Terry summarized the primar	ry mitigation process which included identifying mitigation				
		strategies to reduce flooding for region.					
	•	The team identified damage	centers to determine wi	nich locations should be targeted with			
	the mitigation projects using the structural inventory tool and the updated existing						

	conditions modeling. Of the damage centers, the highest damage concentrations were in
	those centers closer to the confluence.
•	Referring to the Spring Creek damage center slide, Eric Heppen asked what mile marker
	Cypress Creek intercepts Spring Creek. Terry said that the Cypress Creek intercept location
	is not far from the West Fork and that the Spring Creek damage center is near The
	Woodlands.
•	Using the damage center information, the team identified tiers for mitigation planning to
	rank the potential mitigation projects based on number of damages, regional benefit, and
	potential mitigation volumes.
•	The team reviewed and cataloged projects recommended in several previous reports to
	determine if any of these should be included in the analysis. Many of the projects are no
	longer feasible or were originally intended for water supply purposes; however, the
	information was used as a starting point for many of the projects that were evaluated as
	part of this study. In addition, the team also proposed new mitigation strategies.
•	The team evaluated a total of 25 projects, choosing those deemed most effective to
	develop a regional master plan, which includes detention and channelization project spread
	throughout the watershed. The "most effective" projects are those that performed the
	best for each watershed as well as provided regional benefit. Terry stated that the projects
	improve the areas near the damage center within their respective watershed, but also
	provide flood reduction benefits further downstream, including beyond their confluences
	with receiving streams. He stated that Lake Houston limits the effectiveness of these
	projects downstream (ex. confluence with East Fork) and that reductions to the Lake
	Houston level would be needed to see further improvements. However, this study does
	not evaluate or recommend changes to the lake. A separate Lake Houston study is
	reviewing improvements for the Lake Houston area.
•	The benefit-cost ratios (BCR) for Spring Creek were the highest (0.55-1.22) because more
	development in the Spring Creek Watershed. However, overall cost benefits are not
	positive for many of the projects (0.75 – 1 range). Terry stated that the BCR is not the only
	metric for funding the projects. FEIVIA will also consider social benefits for this BCR range of
	0.75 to 1 and some funding may still be available for these projects.
•	In addition, Terry showed the low-to-moderate income (LIVII) areas as they relate to
	potential projects. Funding will vary based on Livii. Lower income areas could potentially
	disadvanta and areas
	disadvantaged areas.
•	Terry discussed additional mitigation measures, including detention, floodplain
	preservation, and buyouts, as potential options. Detention associated with local
	development is needed to onset negative impacts for the local streets, sewers, and
	streams. Future projections show that the impact of local detention on the regional scale is
	minor, but much of the analysis depends on assumptions made about the development
	location and timing. Terry reiterated that detention is an important tool to mitigate
	orainage impacts or development especially when considering cumulative effects or hydrograph timing
	nyurograph ummg.
•	rerry stated that hoodplain preservation is recommended because losses in floodplain
	storage can nave negative impacts downstream. The study did not evaluate specific areas
	fill Harris County has "no adverse impact" and flood alars fill with action policies in alars and
	Torry agreed that these policies were hereficial
	i erry agreed that those policies were beneficial.

	Terry indicated that while the proposed projects (detention, channel) will provide
	significant benefits, some structures, specifically those that flood during frequent storms (2-
	& 5-year), will likely continue to flood. For these structures, buyouts may be the
	recommended strategy. Buyout is more effective than the mitigation projects from a purely economic perspective.
	• The next step is to finalize and prioritize the list of projects to be included in the overall
	master drainage plan and develop a project phasing plan and then finally move forward
	with feasibility, preliminary engineering, design, construction, etc.
5.	Secondary Mitigation Planning
	 Terry presented the additional gages that are recommended in the area including stage,
	flow, and rainfall. The gages provide first responders early information to flooding in the
	region. The team recommended 26 gages throughout the San Jacinto Basin, 5 of which are
	already being installed by HCFCD. Many of the gages are proposed in the upper basin areas
	where there are currently minimal gages. This is a benefit to Harris County because the
	gages will identify, early in the storm event, the amount of runoff that is expected to be
	routed through Harris County from the upper basin.
6.	Other Mitigation Actions
	 Terry discussed coordinating with local agencies to determine how the agencies react to
	storm events and their communication protocols.
	The team also identified roadway levels of service and critical infrastructure within the
	potential floodplains.
	 Most counties have a plan for responding to flooding events and are already coordinating
	with the region. Identified some areas of improvements for each agency.
7.	Communication and Outreach
	• Terry explained that there is a defined coordination effort, which includes meetings with
	both the study partners, and other supporting partners, such as the surrounding counties
	and H-GAC.
	As part of the Other Willigation Actions task, the team met with emergency managers for
	management workshop
	 The team also has an outreach plan, with the first round of community meetings in
	December 2019 and a second round planned for August 2020 (virtual) In addition there is
	a study website that provides an overview of the study goals and progress
	(www.sanjacstudy.org).
8.	Study Schedule
	• Terry presented the study schedule with the final report being submitted in August 2020.
9.	Questions/Comments
	Eric Heppen stated that this was great and helpful information.





PRECINCT BRIEFING AGENDA Harris County Precinct 4

July 17, 2020 San Jacinto Regional Watershed Master Drainage Plan Teams Conference Call

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Precinct Briefing			
Facilitator:		Sam Hinojsoa, P.E., CFM	Meeting Start Time:	10:00 am			
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1.	Introductions						
2.	Goals	and Objectives					
	•	Conduct a comprehensive Fl	ood Mitigation Plan				
	•	Identify vulnerability to floo	d hazards causing loss of	life and property			
	•	Develop approaches to enha	ance public information a	and flood level assessment			
	Evaluate flood mitigation strategies to improve long-term resilience						
3	Existin	g Conditions					
0.	•	Existing Conditions H&H Mo	deling Update				
	•	Analysis of Historical Storms					
	Sedimentation and Vegetation						
4.	Primar	y Mitigation Planning					
	Flood Mitigation Strategies						
	Primary Mitigation Tasks						
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7.	Community Outreach						
	 Partners and Stakeholder Communication 						
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8.	Spring Creek Siting Study Update						
9.	Lake Houston Gates Study Update						
10.	Study	Schedule					

11.	Questions

SAN JACINTO RIVER SANJAGINTO - Regional Watershed Master Drainage Plan

Harris County Precinct 4 Briefing July 17, 2020 - DRAFT









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Harris County Precinct 4

- Spring Creek/Willow Creek
- Cypress Creek
- West Fork/Lake Houston











Flood Claim Density



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San Jacinto Regional WMDP



Lake Houston

- Influence of Lake Houston extends from the dam to Lake Houston Parkway.
- Upstream of Lake Houston Parkway, the West Fork controls



San Jacinto Regional WMDP

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- Current project combinations (by Watershed)
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Little Cypress Creek	196.7	196.2	0.5	-
East Fork SJR	128.3	78.3	50.1	134.3 – 166.6
West Fork SJR	396.2	198.2	198	966
Lake Creek	16.7	4.5	12.1	303 - 422
Peach Creek	163.9	32.9	131.1	718.0 – 812.0
Caney Creek 190.8		70.5	120.2	478.0 – 533.0
Luce Bayou 20		19.2	19.2 0.8	
Total	2,030.3	1,274.1	756.2	2,912.9 – 3,288.1





Low to Moderate Income (LMI) Areas







Additional Regional Measures

• Detention Policy

SAN JACINTO

- Local detention provides critical mitigation for development and CIP
- Regional benefits are dependent on location and timing of development
- Future conditions modeling indicated limited detention impact, BUT
 - 2070 development was centered on lower basin (1-2% volume increase)
 - Ultimate development along the basin outer boundaries shows a higher increase in runoff volume (>5%)
- Detention DOES have an impact on local flooding issues
- Comprehensive impact analysis should be performed
- Floodplain Preservation
 - Losses to floodplain storage could negatively impact downstream areas
 - Future Conditions modeling does not include floodplain fill
 - Approx. market value of all flooded structures in the 100-year ~ \$3B







Buyouts

- Structures currently located in the 2-, 5-year floodplains may see some benefits, but will continue to flood
- Removed from the instances of flooding for damage centers
- Maintained in the BCR calculations
- Generally a higher BCR on buyouts than structural projects
- Best option may be to buyout structures in this category







Buyouts

• Summary of structures and expected damages in each watershed that flood in the 5-year event

Buyout Candidates - Structures Flooding in the 5-year Event						
Watershed	Structure Count	Existing Damages (NPV, 50-yr Period) (\$M)	2019 Market Value (\$M)	Estimated Buyout Cost (2.5× Mkt. Value) (\$M)	Benefit-Cost Ratio	
Spring Creek	34	46.65	4.38	10.96	4.3	
Willow Creek	39	29.92	9.61	24.02	1.2	
Cypress Creek	40	69.92	16.80	42.01	1.7	
Little Cypress Creek	30	31.02	6.05	15.13	2	
East Fork SJR	31	36.53	5.53	13.83	2.6	
West Fork SJR	38	40.29	6.41	16.02	2.5	
Lake Creek	5	4.72	1.02	2.55	1.9	
Peach Creek	71	59.46	8.67	21.67	2.7	
Caney Creek	85	74.05	7.80	19.49	3.8	
Luce Bayou	9	4.76	1.08	2.70	1.8	
Tarkington Bayou	58	57.07	7.34	18.34	3.1	
Jackson Bayou	1	1.51	0.21	0.52	2.9	
Gum Gully	2	1.57	0.97	2.43	0.6	
Totals	443	457.46	75.87	189.67	2.4	





Implementation Planning

- Identify projects to be included in MDP
- Finalize modeling of individual selected projects
- Perform project prioritization
 - Update project costs and benefits
 - Select and weight metrics based on study partner input
 - Perform project prioritization
- Develop project phasing plan
 - Model projects cumulatively to ensure no negative impacts
 - Update environmental and cultural data, update utility information, ROW
 - Identify potential funding sources depending on criteria (BCR, LMI, etc.)
- Move forward with Feasibility, Preliminary Engineering, Design



DRAFT - 7/17/2020

Secondary Mitigation Planning

- Received input from HCFCD, MCO, USGS, Others
- Updated Secondary Mitigation Memo (05/13/20)
 - 26 Gages recommended (HCFCD Currently installing 5)
 - Approximate installation cost range \$240k \$330k (Plus Maintenance)









Other Mitigation Actions

- Other Mitigation Action Goals
 - Evaluate communications plan/protocol during emergencies
 - Identify critical infrastructure and compare to inundation
 - Determine expected flood frequency evacuation routes
- Conducted Emergency Management Workshop (March 11th)
- Submitted a draft memorandum













GLOSSAR

udy led by local partners including the Harris County Flood Control Distr

ies of the Upper San Jacinto Rive and (from the **headwaters** in Walker County to the Interstate 10 c

ant and depth of **riverine flooding** of the larger tion will be

Contact U

Harris County Flood Control District - ling Chen, ling ch San Jacinto River Authority Montgomery County - Digne Cooper, digne.c

ick started in April 2019, will identify future flood mitigat



- Communication
 - Study Partners Meetings (6)
 - Supporting Partners Meeting (8)
 - Emergency Managers Workshop
 - H-GAC Coordination

Outreach

- 1st round of community meetings complete – December 2019
- 2nd Community Meeting (Virtual) in planning – August 2020
- Stakeholder Meetings (Jul/Aug)
- Woodlands Drainage Task Force Meeting – January 28th
- **Study Website** www.sanjacstudy.org



FREQUENTLY ASKED QUESTIONS

DRAFT - 7/17/2020

Schedule Update

- Existing H&H/Calibration 100% (Finalized)
- Primary Mitigation Planning (Memorandum Submitted) 90%
- Secondary Mitigation Planning (Finalized) 100%
- Other Mitigation Actions (Memorandum Submitted) 90%


DRAFT - 7/17/2020



Study Submittals

- Submitted
 - Existing Conditions Memorandum (08/12/19)
 - Historical Storms Memorandum (04/07/20)
 - Future Conditions Memorandum (04/07/20)
 - Secondary Mitigation Memorandum (05/13/20)
 - Primary Mitigation Memo (06/08/20)
 - Updated Sedimentation/Vegetation Memo (06/26/20)
 - Other Mitigation Actions Memo (06/30/20)
 - Draft Report (07/13/20)
 - Alternative Funding
 - Implementation Plan
- Upcoming
 - Final Report (08/31/20)







SAN JACINTO RIVER QUESTIONS?

Harris County Precinct 4 Briefing July 17, 2020 - DRAFT

Times













STUDY PARTNERS MEETING NOTES Harris County Precinct 4

July 17, 2020 San Jacinto Regional Watershed Master Drainage Plan Skype Conference Call

Meeting o	alled by:	Jing Chen, P.E., CFM	Type of Meeting:	Precinct Briefing
Facilitator	:	Sam Hinojosa, P.E., CFM	Meeting Start Time:	10:00 AM
			Meeting Stop Time:	11:00 AM
Agend	da			
1.	Attendee	S	• Ke	ennedy Purser. HCP4
	● Jii	ng Chen, HCFCD	• La	andon Reed, HCP4
	• G	ary Bezemek, HCFCD	• Pa	amela Rocchi, HCP4
	• W	/illiam Sherman, HCFCD	• Li	ndsey Trahan, HCP4
	• Vi	ictoria Bryant, HCP4	• Cl	narlie Williams, HCP4
	● Fr	reddie Jebousek, HCP4	• Sa	am Hinojosa, Halff
	• R	on Layton, HCP4	• AI	ndrew Moore, Halff
	• Ja	acob Lee, HCP4	• H	ector Olmos, FNI
2.	Goals and	d Objections		
	• Jii	ng introduced the meeting.		
	• Sa	am introduced the San Jacinto	o study. He showed the	e watershed included in the study and
	th	ne funding partners. He prese	ented the location of th	e watershed in reference to Precinct 4.
	• Sa	am showed the density of floo	od claims within the ba	sin.
	• Sa	am introduced the goals and	objectives of the San Ja	cinto Regional Watershed Master
	D	rainage Plan.		
3.	Existing	Conditions		
	• Sa	am presented the update of t	he Existing Conditions a	analysis. He stated that all major
	st	reams in the basin have beer	included in a combine	d existing conditions model. The
	m	odel utilized existing models	from HCFCD as well as	new models for the upper regions. The
	m	nodel utilizes the latest Atlas	L4 rainfall and has been	calibrated to historical storm events
	in	cluding Hurricane Harvey and	d Memorial Day 2016.	The model has also been validated with
	th	ne October 1994 and Tropical	Storm Imelda events.	The calibration and validation including
	cc	omparing the model to 22 US	GS gages in the watersh	ned.
4.	Primary N	Mitigation Planning		
	• Sa	am summarized the primary r	nitigation process whic	h included identifying mitigation
	st	rategies to reduce flooding for	or region.	
	• TI	he team identified damage ce	enters to determine wh	ich locations should be targeted with
	th	ne mitigation projects using the	ne structural inventory	tool and the updated existing
	co	onditions modeling. Of the da	amage centers, the high	nest damage concentrations were in
	th	nose centers closer to the con	fluence.	

•	Using the damage center information, the team identified tiers for mitigation planning to
	rank the potential mitigation projects based on number of damages, regional benefit, and
•	The team reviewed and cataloged projects recommended in several previous reports to
	determine if any of these should be included in the analysis. Many of the projects were no
	longer feasible or were originally intended for water supply purposes: however, the
	information was used as a starting point for many of the projects that were evaluated as part
	of this study. In addition, the team also proposed new mitigation strategies.
•	The team evaluated a total of 25 projects, choosing those deemed most effective to develop
	a regional master plan, which includes detention and channelization project spread
	throughout the watershed. The "most effective" projects are those that performed the best
	for each watershed as well as provided regional benefit. Sam stated that the projects
	improve the areas near the damage center within their respective watershed, but also
	provide flood reduction benefits further downstream, including beyond their confluences
	with receiving streams. He stated that Lake Houston limits the effectiveness of these
	projects downstream and that reductions to the Lake Houston level would be needed to see
	further improvements. However, this study does not evaluate or recommend changes to the
	lake. A separate Lake Houston study is reviewing improvements for the Lake Houston area.
•	The benefit-cost ratios (BCR) for Spring Creek were the highest, but overall cost benefits are
	not positive for many of the projects. Sam stated that the BCR is not the only metric for
	runding the projects. Acreage recovered, roadway miles removed, and raw structure counts
	Should also be considered.
•	projects I ower income areas could notentially be good candidates for CDBG or other
	funding sources that account for socio-economically disadvantaged areas.
•	Sam discussed additional mitigation measures, including detention, floodplain preservation.
	and buyouts, as potential options. Detention associated with local development is needed
	to offset negative impacts for the local streets, sewers, and streams. Future projections
	show that the impact of local detention on the regional scale is minor, but much of the
	analysis depends on assumptions made about the development location and timing.
	Development locations can change and alter the results. Sam reiterated that detention is an
	important tool to mitigate drainage impacts of development and specified that the study
	should be careful to clarify the team's position on detention.
•	Sam stated that floodplain preservation is recommended because losses in floodplain
	storage can have negative impacts downstream. The study did not evaluate specific areas or
	scenarios related to floodplain preservation. Harris County has "no adverse impact" and
	Sam indicated that while the proposed projects (detention, shapped) will provide significant
•	sam indicated that while the proposed projects (detention, channel) will provide significant benefits, some structures, specifically those that flood during frequent storms (2_{-} & 5_year)
	will likely continue to flood. For these structures, buyouts may be the recommended
	strategy
•	The next step is to finalize the list of projects to be included in the overall master drainage
-	plan and develop a project phasing plan.
•	Sam briefly discussed the Sedimentation and Vegetation report, which identifies strategies
	to reduce flow of sediments into Lake Houston. The report is the first step toward a regional
	sediment management plan. Sam specified that the sediment and vegetation effort did not
	evaluate the impact of sedimentation on flooding.

5.	Secondary Mitigation Planning
	• Sam presented the additional gages that are recommended in the area including stage, flow,
	and rainfall. The gages provide first responders early information to flooding in the region.
	The team recommended 26 gages throughout the San Jacinto Basin, 5 of which are already
	being installed by HCFCD.
6.	Other Mitigation Actions
	Sam discussed coordinating with local agencies to determine how the agencies react to
	storm events and their communication protocols
	The team also identified roadway levels of service and critical infrastructure within the
	potential floodplains.
	 Most counties have a plan for responding to flooding events and are already coordinating
	with the region. Identified some areas of improvements for each agency.
7.	Communication and Outreach
	• Sam explained that there is a defined coordination effort, which includes meetings with both
	the study partners, and other supporting partners, such as the surrounding counties and H-
	GAC.
	As part of the Other Mitigation Actions task, the team met with emergency managers for
	each of the regional entities to understand protocol, and also conducted an emergency
	management workshop.
	The team also has an outreach plan, with the first round of community meetings in
	December 2019 and a second round planned for August. In addition, there is a study
	website that provides an overview of the study goals and progress. (<u>www.sanjacstudy.org</u>).
	 Sam mentioned that the study is being presented to the SJRA board next week.
8.	Study Schedule
	• Sam presented the study schedule with the final report being submitted in August 2020.
9.	CWA Lake Houston Gate Study Update
	• Jing stated that the HCFCD is participating in the Lake Houston Gate project as a stakeholder.
	She stated that the project is FEMA funded and the team will be looking at benefit costs of
	the project, including minimizing downstream impacts to the additional gates.
	She stated the team is identifying successes and constraints of the project. She also
	mentioned that the project kicked off in mid-April and the H&H analysis is ongoing and will
	extend through October.
10.	Questions/Comments
	Jing mentioned that the initial virtual public meeting will be August 13th and that the team
	will be meeting with other agencies/groups to present the findings of the study.

Appendix A.3

Study Partners Progress Meetings



STUDY PARTNERS MONTHLY MEETING AGENDA Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

May 8, 2019 San Jacinto River Regional Flood Mitigation Plan HCFCD, Brookhollow

Meeting ca	lled by:	Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Kickoff Meeting
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	1:30 PM
			Meeting Stop Time:	3:00 PM
Agend	la			
1.	Introd	uctions		
2.	Comm	unications and Outreach (Cr	ouch)	
	•	PowerPoint Presentation		
	•	Comment Forms		
	•	Study Fact Sheet		
3.	Activit	ies Conducted this Month		
	•	Project Methodology Discussi	on (03/19/2019)	
	•	Study Partners Kickoff Meetin	ig (04/08/2019)	
	•	TDEM Kickoff Meeting (04/26	/2019)	
	•	Started site work in all waters	heds	
	•	Started survey of bridges and	culverts	
	•	Initial hydrology work (waters	hed delineations, BDF)	
	•	Community Outreach efforts		
4.	Activit	ies Planned next Month		
	•	Complete site work for all wat	ersheds; prepare field c	observation reports
	•	Continue survey for bridges a	nd culverts	
	•	Complete watershed and drai	nage area delineations	
	•	Develop hydrologic paramete	rs (BDF methodology)	
		Start convorsion of existing H	CECD models to unstar	
	•	Community Outreach efforts		
5	Toohn			
5.	•	None		
6	∆dmin	istrative Discussion		
•	•	None		
7.	Quest	ions		



Minutes Date:

AVO No.:

5/28/2019

033465.002

14800 St. Mary's Lane, Ste. 160 Houston, TX 77079-2943 (713) 588-2450 Fax (281) 310-5259

MEETING MINUTES

То:	Jing Chen, P.E., CFM	Attendees:	Jing Chen, HCFCD
From:	Terry Barr, P.E., CFM		Matt Barrett, SJRA Chuck Gilman, SJRA (phone)
Subject:	San Jacinto Regional Watershed Maste Drainage Plan Progress Meeting	r	Diane Cooper, Montgomery County Gary Hill, City Houston PW Terry Barr, Halff
Meeting Date:	05/8/2019 – 1:30 pm		Conner Stokes, Crouch
Location:	HCFCD, Brookhollow Office		

Description Action Item Introductions 1. Ms. Chen started the meeting. 2. **Communications and Outreach** Crouch to provide Mr. Stokes described the PowerPoint presentation that Crouch was a list of websites assembling for HCFCD. A general comment form for public meetings has they have been developed. The study fact sheet has been developed and has developed for already been used at a meeting. Crouch is working on a communications others. plan memorandum. Branding was discussed and HCFCD is looking into using a round logo for the project. Mr. Stokes sad that he would provide Project partners HCFCD a list of websites that they had developed for others. are to keep track of what they Ms. Cooper stated that she will be presenting the study goals to present to the Montgomery County Commissioners. She asked if she needed to keep public. track of things presented to court. Ms. Green stated that keeping track or presentations and what is presented would be required for consistency. 3. **Activities Conducted This Month** Mr. Barr summarized three meetings that had been held since March. A HCFCD to provide project methodology discussion was held 3/19/2019. The project kickoff the LAS files. meeting was held 4/8/2019. A kickoff meeting with TDEM was held on 4/26/2019. Ms. Chen stated that the TDEM consultant did not want HCFCD to stop work on the project even though some questions needed to be answered. Mr. Barr stated that the Halff team has started work on all the watersheds by conducting site visits. Survey has also started on select bridges and culverts. Initial hydrology using BDF methodology has started. Ms. Green would like to see how BDF performs in the upper region of the study area. HCFCD asked that Halff compare the survey data to the new LiDAR. Ms. Chen stated that since Halff has not received the LAS files, she will track them down and provide. Halff may need to bring back the hard drive.



4.	Activities Planned Next Month	
	Mr. Barr stated that filed observation reports are being prepared. Survey work will continue on bridges and culverts. Hydrology will continue with basin delineation and BDF parameter development. Cross section layout for the hydraulic modeling will begin. The conversion process from steady to unsteady HEC-RAS for the existing models of Spring, Cypress, Willow and Jackson will begin.	Ms. Cooper to
	Ms. Cooper stated that she has the plans for SH 99 and the plans for the TxDOT bridge on Caney Creek. She will provide the plans and models she has received.	provide plans and models for SH 99 and the new
	Mr. Barr also stated that Primary Flood Alternatives (PFA) will also begin. The goal will be to review the available studies that have been collected by the Halff team and identify and rank potential projects. Ms. Cooper stated that Montgomery County is interested in the policy recommendations that may come from this study. The policy recommendations should consider detention requirements, floodplain mitigation and finished floor elevations. Consideration should also be given to regional detention vs local detention. Mr. Barr stated that the PFA task preliminary project identification should be complete by mid-August. The H&H portion would not begin until November. HCFCD would like to have a workshop on the PFA in the latter part of July. At this time, preliminary results for the Existing Conditions analysis could also be presented.	Crossing. HCFCD to plan a PFA workshop near the end of July.
5.	Technical Discussion	
	None	
6.	Administrative Discussion	
	None	
12.	General Discussion	
	Ms. Cooper asked for a better description of the Secondary Flood Mitigation Alternatives vs the Secondary Flood Mitigation Planning task. Mr. Barr describe that the alternatives are additional alternatives to be developed. The Secondary Flood Mitigation Planning Task primarily outline flood warning system improvements/enhancements.	
	Ms. Green stated that HCFCD will look at adopting Atlas 14 in mid-June. With the adoption will be revised detention rates as well as mitigation requirements for the 500-year. Ms. Cooper and Mr. Barr asked if 500-year mitigation will be for the current 500-year or for the Atlas 14 500-year. Ms. Green said she would look into it.	Ms. Green will look into the 500- year mitigation requirements with the new Atlas 14 changes.
	Ms. Chen/Ms. Green stated that USACE has provided data on the dredging of Lake Houston. HCFCD will provide to Halff. HCFCD will forward a Terracon report that discusses the sediment sizes/loads from the West Fork and Spring Creek. Ms. Green does not want the Halff team to just review the Brown and Root report but to also make	HCFCD to provide the Lake Houston Terracon report and also the



	recommendations to perform addiment transport studies. Mo Chan also	TM/DD hathy was strike
	has received some prelim bathymetric data of Lake Houston from the TWDB. She will share with Halff. Ms. Green stated that HCFCD has received plans for the dredging and will share with the team. Apparently the USACE has found some areas where clay was found instead of the expected sand.	data.
	Mr. Barrett and Mr. Gilman stated that the Spring Creek Reservoir Sighting Study had been deferred as the WJPA MUDs decide to wait for finding from the state legislature. It is possible that the MUDs revisit the study with SJRA after the legislative session comes to an end.	
	Ms. Cooper stated that gates will be added to the Lake Houston dam in the next 5 to 7 years. The gates have the strongest BCA and should move forward according to the City of Houston.	
	Ms. Chen state that she would ask the flood watch group is any gages are currently proposed in the watershed. She said the group has a TxDOT grant for gages. She will forward any information to Halff.	Ms. Chen to provide potential gage location as proposed by Flood Watch.
13.	Ms. Chen concluded the meeting.	

This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not correct, or that any information is missing or incomplete, please contact Halff Associates so that the matter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.



STUDY PARTNERS MONTHLY MEETING AGENDA Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

June 12, 2019 San Jacinto River Regional Flood Mitigation Plan HCFCD, Brookhollow

Meeting ca	lled by:	Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Kickoff Meeting
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	1:30 PM
			Meeting Stop Time:	3:00 PM
Agend	a			
1.	Introd	uctions		
2.	Comm	unications and Outreach (Cr	ouch)	
	•	PowerPoint Presentation		
	•	Comment Forms		
	•	Study Fact Sheet		
3.	Activit	ies Conducted this Month		
	•	Monthly Study Partners Kicko	off Meeting (05/07/2019)	
	•	Field Work Completed/Field C	Observations Reports ne	early complete
	•	Report Review Complete (Ba	sed on current data)	
	•	Survey of Bridges/Culverts (7	5% Complete)	
	•	Hydrology (Watershed/Subba	isin Delineation; Land U	se; Preliminary BDF Work
	•	Hydraulics (Stream and Cross	s Section Layouts; Unste	eady Conversions, n-Values)
	•	Draft Communications Plan, V	Vebsite Outline	
4.	Activit	ies Planned next Month	D .	
	•	Complete all Field Observatio	on Reports	
	•	Complete Survey of Bridges a	and Cuiverts	
	•	Complete BDF Farameter Ca	CD Models to Unstandu	
		Preliminary HEC-BAS models	of non-HCECD stream	•
	•	Community Outreach efforts		
	•	Start Primary Mitigation Action	ns Discussions	
5.	Techn	ical Discussion		
_	•	None		
6.	Admin	istrative Discussion		
	•	None		
7.	Quest	ons		

SAN JACINTO RIVER SANJACINTO - Regional Watershed Master Drainage Plan

Study Partners Progress Meeting June 12, 2019









San Jacinto River Basin

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6









Coordination and Communication

- Coordination
 - Study Partners Meeting 5/7/2019
 - Weekly progress calls with HCFCD
- Communications
 - Collateral Items Developed (Presentation, Comment Form, Fact Sheet)
 - Communications Planning Memorandum
 - Stakeholder Database and Draft
 Stakeholder Letter
 - Draft Study Website
 - Study Partners Logos

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

SPRING 2019





The San Jacinto Regional Watershed Master Drainage Plan is a comprehensive regional study led by local partners including the Harris County Flood Control District, the San Jacinto River Authority, Montgomery County, and the City of Houston.

This integrated effort, kick started in April 2019, will identify future flood mitigation projects that can be implemented in the near- and long-term to reduce flood risks to people and property throughout the San Jacinto River regional **watershed**.

The goals of the San Jacinto Regional Watershed Master Drainage Plan are to:

- Identify the region's vulnerabilities to flood hazards using Atlas 14 rainfall
 Develop approaches to enhance public information and flood level assessment
- capabilities during a flood disaster event • Evaluate flood mitigation strategies to improve community resilience
- Evaluate noor mingation strategies to improve community resulence
 Provide a comprehensive Flood Mitigation Plan that supports the needs and objectives of each regional partner

The goals of the project will be achieved by developing a set of hydrologic and hydraulic models for the major tributaries of the Upper San Jacinto River regional watershed (from the **headwaters** in Walker County to the Interstate 10 crossing at the San Jacinto River in Harris County). The models will use consistent, cohesive methodology and rainfall rates, regardless of the county in which those channels are located.

Information to be developed includes non-regulatory **inundation maps** (not intended to replace current effective maps) for the studied streams that show the extent and depth of **riverine flooding** of the larger rivers within the watershed for an array of simulated storm events. Additionally, information will be gathered about the number of structures, acres of land, properties, and miles of roadway that are located within the modeled floodplains. Study results will be used to inform and update **Hazard Mitigation Plans** for each of the porticipating partners and to provide guidance on regulations for future growth within the study area.

The project area covers nearly 3,000 square miles. The expected completion time frame is Fall 2020. The project is budgeted at \$2.7 million.

Contact Us

The participating project partners are interested in hearing from you. Please contact your local representative with comments and questions:

- Harris County Flood Control District Jing Chen, jing.chen@hcfcd.hctx.net
 San Jacinto River Authority Matt Barrett; mbarrett@sjra.net
- Montgomery County Diane Cooper, diane.cooper@mctx.org
- City of Houston Gary Hill, gary.hill@houstontx.gov

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN FACT SHEET | Spring 2019

GLOSSARY Watershed: A aeographical

Watershea A geographica region of land or "drainage area" that drains to a common channel or outlet, mostly creeks and bayous. Drainage of the land con occur directly into a bayou or creek, or through a series of systems that may include storm severs, roadside ditches, and/or tributary channels.

Headwaters: Headwaters are simply the initial source of the water in a river.

Inundation maps: Maps that show where flooding may occur over a range of water levels in a community's local stream or river.

Riverine flooding: Flooding that is the result of creeks and bayous leaving their banks due to heavy rainfall.

Hazard Mitigation Plans:

Hazard mitigation is the effort to reduce loss of life and property by lessening the impact of disasters, such as flooding. Governmental organizations engage in hazard mitigation planning to identify risks and vulnerabilities associated with natural disasters, and develop long-term strategies for protecting people and property. Mitigation plans are key to breaking the cycle of disaster damage, reconstruction, and repeated damage.

Page 1 of 2





Birinplace of the Unit



• Field Recon









• Field Reconnaissance and Reporting

HALFF

14800 Saint Mary's Ln.; Suite 160 Houston, TX 77079 (713) 588-2450

Stream: GLO	000-00-00	Field Grid: N/A		HMS Subbasin:
OBJECTID: 137030_a	Face of 5' diameter, 4 upstream side of CR 239.	4 barrel culvert on 240 between TX-30 and CR	OBJECTID: 137030_b	Face of 5' diameter, 4 barrel culvert on upstrear side of CR 240 between TX-30 and CR 239.
OBJECTID: 137030_c	View of channel upst between TX-30 and 0 vegetation.	ream of culvert on CR 240 R 239. Moderate bank	OBJECTID: 137031_a	Face of 5' diameter, 4 barrel culvert on downstream side of CR 240 between TX-30 and CR 239.
		1		







Legend

Highways

Status

Survey Locations

Surveyed

Highways

To Be Surveyed

Stream Centerlines

Revised Watershed Boundaries

• Field Survey of Bridges and Culverts









• Field Survey









• Watershed Boundaries









• Preliminary Sub Drainage Areas









- Existing Land Use
 - Forest
 - Pasture
 - Development in southern area











Legend

BDF Value

0

2.5

Stream Centerlines

Drainage Subbasin

Caney Creek BDF
 Calculations









Legend

Stream Centerlines Drainage Subbasin

Percent Impervious 1.5 - 4.9 5.0 - 7.4 7.5 - 11.0 11.1 - 13.3 13.4 - 19.2

 Caney Creek % Impervious Calculations









• Stream Centerlines and Cross Section Layouts









Primary Mitigation Alternatives

- Previous Studies
 - 1943 San Jacinto River Master Plan
 - 1957 San Jacinto River Master Plan
 - 1985 Upper San Jacinto River Flood Control Study
 - 1989 South Montgomery County Flood Protection Plan
 - 1997 Lake Creek Reservoir Study
 - 2000 Lake Houston Regional Flood Protection Study
 - 2015 Cypress Creek Overflow Management Plan
 - 2019 Estimate Land Cover Effects on Selected Watersheds
 - 2019 Hurricane Harvey San Jacinto River Flooding (presentation)







Primary Mitigation Alternatives

• Previous Studies

Number	Name	Year	Size
1	East San Jacinto No. 1	1943	950 Acres
2	East San Jacinto No. 0	1943	22,000 Acres
3	East Fork Reservoir	1985	3-5 Feet of Storage
4	San Jacinto No. 3	1943	6,000 Acres
5	San Jacinto No. 1	1943	3,890 Acres
6	San Jacinto No. 4	1943	2,744 Acres
7	San Jacinto No. 2	1943	1,032 Acres
8	Lake Creek Reservoir	1985	6,000 Acres
9	Lake Creek No. 1	1943	6,000 Acres
10	Lake Creek No. 2	1943	1,018 Acres
11	Lake Creek Reservoir	1997	15,000 Acres



ALINNOS SINA CONTROL





Primary Mitigation Alternatives

• Previous Studies

Number	Details	Year	Size
12	Spring Creek No. 1	1943	5,550 Acres
13	Spring Creek Reservoir 1	1985	1,000 Acres
14	Spring Creek Reservoir 2	1985	643 Acres
15	Spring Creek No. 2	1943	180 Acres
16	Caney Creek No. 1	1943	805 Acres
17	Caney Creek Reservoir	1985	
18	Peach Creek No. 1	1943	485 Acres
19	Peach Creek No. 2,	1943	1,277 Acres
20	Peach Creek Reservoir 1	1985	
21	Peach Creek Reservoir 2	1985	
22	Stewart Creek No. 1	1943	300 Acres

Schedule Update

54 Current Progress
478 Days Remaining
8/12/2019 Completion Date

- Data Collection and Review 80%
- Existing Conditions H&H 20%
- Community Outreach and Education 5-10%



SAN JACINTO RIVER QUESTIONS?

Study Partners Kickoff Meeting April 8, 2019

Times











14800 St. Mary's Lane, Ste. 160 Houston, TX 77079-2943 (713) 588-2450 Fax (281) 310-5259

MEETING MINUTES

To:	Jing Chen, P.E., CFM	Attendees:	Jing Chen, HCFCD
From:	Terry Barr, P.E., CFM		Amy Crouser, HCFCD Matt Barrett, SJRA
Subject:	San Jacinto Regional Watershed Maste Drainage Plan Progress Meeting	r	Diane Cooper, Montgomery County Paresh Lad, COH (phone) Terry Barr, Halff
Meeting Date:	06/12/2019 – 1:30 pm		Hector Olmos, FNI Conner Stokes, Holloway
Location:	HCFCD, Brookhollow Office		Monica Vagholkar, Hollaway
Minutes Date:	6/19/2019		

AVO No.: 033465.002

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Item	Description	Action	
1.	Introductions		
	Ms. Chen started the meeting.		
2.	Communications and Outreach		
	Barr stated HCFCD and Project Team are coordinating meetings with stakeholders. The communications plan is currently under internal review. Stokes stated the website will be developed after the plan is accepted. He stated a domain name was being discussed as well as the dropbox folder structure for sharing information internally. Cooper asked why dropbox is being used instead of Sharepoint. Barr stated that dropbox is simpler for this use since there are only a few users. He stated that anyone is able to upload and download files.	Halff to finalize communications plan.	
3.	Activities Conducted This Month		
	Barr summarized the data collection task and presented the locations the team has photographed and documented. He stated that for each watershed a field observation report is being compiled with reference identifications for each photo. He stated the field survey effort is at approximately 85% with 4 major structures left. Green asked how were survey locations determined. Barr stated they were based on major crossings and locations were field recon did not make sense.	MCO to provide major thoroughfare plan.	
	Barr summarized the existing conditions analysis. Green asked what the changes in the unsteady conversion versus the effective models were. Barr stated comparisons were not available yet, but can be provided at the next meeting. Green asked if there was a major thoroughfare plan for Montgomery County which could impact the drainage basin delineation. Cooper stated there is one and would share with the group. Barr stated the plan could be used to adjust drainage basin breaks if needed.		
	Cooper asked if the land use data would capture larger residential lots and how it will be used for determining detention locations. Barr explained that it is just used for loss and impervious percentage calculations and		



	that detention locations will be verified with aerial imagery, parcel data, and field investigation.	
	Cooper asked if BDF will accurately depict the drainage infrastructure in Montgomery County since it is mostly roadside ditch. Barr stated that the BDF considers roadside ditches and rural areas and assigns values based on these parameters. Green stated that HCFCD had done testing throughout the watershed and has had good results. Hinojosa stated that all initial values will be adjusted through the calibration process. Green asked if the Census data would provide any information. Barr stated it likely wouldn't be more detailed than the HGAC land use information. Moore stated the BDF parameters can be compared to the FEMA effective model for Lake Creek.	Halff to compare TC+R values to the Lake Creek FEMA effective model.
	Barr presented the preliminary cross section alignments. He stated that cross sections will be edged matched near crossing locations.	
	Chen asked if the LAS information was still needed for Lake Houston. Barr stated it would be and that Halff is considering obtaining survey of the dam.	Halff to determine if survey is needed for Lake Houston.
	Barr asked if there are any historical flooding records for Montgomery County. Cooper stated she is requesting the data from FEMA. Barr mentioned he may be able to obtain and would contact FEMA.	Halff to try to obtain FEMA historical flooding
	Barr stated the project is currently on schedule.	records.
4.	Activities Planned Next Month	
	Barr presented a summary of the previous reports reviewed. He stated after combing through the alternatives a workshop would be needed with the study partners to determine the primary mitigation alternatives. Chen suggested the next progress meeting. Barr stated a half day would likely be needed and suggested toward the end of the existing conditions analysis.	HCFCD and Halff to plan a PFA workshop near the end of July.
5.	Technical Discussion	
	Barr mentioned that Vieux could obtain rainfall information for the 1994 event. He stated that this event would be run as a validation event since it was the previous event of record. Olmos stated that the cost would be approximately \$10,000 for the data. Cooper asked for the source of the rainfall data since this was an older storm. Olmos stated they would use whatever was best available. Barr stated they could include the fee in the additional scope of work developed for the community outreach. Green and Chen agreed with this approach.	Halff to include rainfall cost in scope of work.
6.	Administrative Discussion	
	None	
7.	General Discussion	
	Chen asked for an update on the sedimentation report review. Olmos stated the reports are currently being reviewed and analyzed. She stated	



	she has another report request in for a Mouth Bar Report developed by the City of Houston Sold Waste Division. She stated it is different than the dredging conducted by the USACE. She stated that the report stated there are areas where they are hitting clay sooner than expected and that there is a lot of debris removal. Barr asked about a USACE report that was not provided to the team. Green stated the USACE stated it was a rough analysis of the dredging and the USACE requested it not be used for any engineering analysis.	
8.	Ms. Chen concluded the meeting.	

This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not correct, or that any information is missing or incomplete, please contact Halff Associates so that the matter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.



STUDY PARTNERS MONTHLY MEETING AGENDA Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

July 10, 2019 San Jacinto River Regional Flood Mitigation Plan HCFCD, Brookhollow

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Kickoff Meeting
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	1:30 PM
			Meeting Stop Time:	3:00 PM
Agend	a			
1.	Introd	uctions		
2.	Comm	munications and Outreach (Crouch)		
	•	Project website development		
	•	Upcoming public meetings and supporting partner meetings		
3.	Activit	Activities Conducted this Month		
	•	 Monthly Study Partners Progress Meeting (06/12/2019) 		
	•	Completed field observation reports		
	•	Completed survey of bridges and culverts		
	•	 Completed watershed and sub-watershed delineations, preliminary BDF calculations, Developed preliminary HMS models for all watersheds 		
	•	Developed preliminary RAS models for all streams (No structures)		
	•	Completed conversion and comparison of most HCFCD streams (Willow)		
	•	Stakeholder database and draft letter; Team Dropbox; Started study website		
4.	Activit	ctivities Planned next Month		
	•	Complete field observation reports		
	•	Complete survey for bridges and culverts		
	•	Complete HMS models for all watersheds		
	•	Refine hydrologic parameters (BDF methodology)		
	•	Complete RAS models for all streams		
	•	Work on Existing Conditions Memo preparation		
	•	Deliver preliminary alternatives matrix; prepare for August workshop		
	•	Continue developing study website; Start work on supporting partners briefing		
			and vegetation plan	
5.	lechn			
	•	GARR data acquisition		
6.	Administrative Discussion			
	•	Provided amendment docume	ents to HCFCD for addit	ional analysis and meetings
7.	Questions			

SAN JACINTO RIVER SANJACINTO - Regional Watershed Master Drainage Plan

Study Partners Progress Meeting July 10, 2019









San Jacinto River Basin

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6









Coordination and Communication

- Coordination
 - Study Partners Meeting 5/7/2019
 - Study Partners Meeting 6/12/2019
 - Weekly progress calls with HCFCD
- Communications
 - Collateral Items Revised
 - Communications Planning Memorandum
 - Stakeholder Database and Draft
 Stakeholder Letter
 - Team Dropbox
 - Website in development (sanjacstudy.org)

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN

PRING 2019





GLOSSARY

The San Jacinto Regional Watershed Master Drainage Plan is a comprehensive regional study led by local partners including the Harris County Flood Control District, the San Jacinto River Authority, Montgomery County, and the City of Houston.

This integrated effort, kick started in April 2019, will identify future flood mitigation projects that can be implemented in the near- and long-term to reduce flood risks to people and property throughout the San Jacinto River regional **watershed**.

The goals of the San Jacinto Regional Watershed Master Drainage Plan are to:

- Identify the region's vulnerabilities to flood hazards using Atlas 14 rainfall
 Develop approaches to enhance public information and flood level assessment
- capabilities during a flood disaster event • Evaluate flood mitigation strategies to improve community resilience
- Provide a comprehensive Flood Mitigation Plan that supports the needs and objectives of each regional partner

The goals of the project will be achieved by developing a set of hydrologic and hydraulic models for the major tributaries of the Upper San Jacinto River regional watershed (from the **headwaters** in Walker County to the Interstate 10 crossing at the San Jacinto River in Harris County). The models will use consistent, cohesive methodology and rainfall rates, regardless of the county in which those channels are located.

Information to be developed includes non-regulatory **inundation maps** (not intended to replace current effective maps) for the studied streams that show the extent and depth of **riverine flooding** of the larger rivers within the watershed for an array of simulated storm events. Additionally, information will be gathered about the number of structures, acress of land, properties, and miles of roadway that are located within the modeled floodplains. Study results will be used to inform and update **Hazard Mitigation Plans** for each of the participating partners and to provide guidance on regulations for future growth within the study area.

The project area covers nearly 3,000 square miles. The expected completion time frame is Fall 2020. The project is budgeted at \$2.7 million.

Contact Us

The participating project partners are interested in hearing from you. Please contact your local representative with comments and questions:

- Harris County Flood Control District Jing Chen, jing.chen@hcfcd.hctx.net
- San Jacinto River Authority Matt Barrett; mbarrett@sira.net
 Montgomery County Diane Cooper, diane.cooper@mctx.org
- City of Houston Gary Hill, gary.hill@houstontx.gov

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN FACT SHEET | Spring 2019

of land or "drainage area" that Irains to a common channel or outlet,

drains to a common channel or outlet, mostly creeks and bayous. Drainage of the land can occur directly into a bayou or creek, or through a series of systems that may include storm sewers, roadside ditches, and/or tributary channels.

Watershed: A geographical r

Headwaters: Headwaters are simply the initial source of the water in a river.

Inundation maps: Maps that show where flooding may occur over a range of water levels in a community's local stream or river.

Riverine flooding: Flooding that is the result of creeks and bayous leaving their banks due to heavy rainfall.

Hazard Mitigation Plans:

Hazard mitigation is the effort to reduce loss of life and property by lessening the impact of disasters, such as flooding. Governmental organizations engage in hazard mitigation planning to identify risk and vulnerabilities associated with natural disasters, and develop long-term strategies for protecting people and property. Mitigation plans are key to breaking the cycle of disaster damage, reconstruction, and repeated damage.

Page 1 of 2








Data Collection

• Field Survey of Bridges and Culverts







Highways

Legend

Highways

Stream Centerlines Revised Watershed Boundaries







• Watershed Boundaries









- Sub Drainage Areas
- 381 sub drainage areas
- Avg. Size ~ 6.0 sq. mi.



Hydrologic
 Parameters









Preliminary HEC-HMS Models •

> Meteorologic Models 10-YEAR ATLAS 14

> 25-YEAR ATLAS 14

> S-YEAR ATLAS 14 . SO-YEAR ATLAS 14

Control Specifications Control 1

Paired Data

🕖 Basin Model

Description:

Replace Missing: No Local Flow: No

Default Grid Region: --None

Sediment: No

Flow Ratios: No





• Preliminary HEC-RAS Models



• Preliminary HEC-RAS Models



Lake Creek Comparisons



- HCFCD Effective Conversions
 - Similar WSELs for effective conversion
 - Increase in WSELs with Atlas 14 Rainfall







HCFCD Effective Conversions







HCFCD Effective Conversions







- Previous Studies
 - 1943 San Jacinto River Master Plan
 - 1957 San Jacinto River Master Plan
 - 1985 Upper San Jacinto River Flood Control Study
 - 1989 South Montgomery County Flood Protection Plan
 - 1997 Lake Creek Reservoir Study
 - 2000 Lake Houston Regional Flood Protection Study
 - 2015 Cypress Creek Overflow Management Plan
 - 2019 Estimate Land Cover Effects on Selected Watersheds
 - 2019 Hurricane Harvey San Jacinto River Flooding (presentation)







• Previous Alternatives









• Previous Reservoirs

Watershed	Refrence #	Resevoir Alternatives	Year	Description	Cost (When Proposed)	Size	Wetlands	Percent Developable	Number Tracts of	Benefit	Rank	Notes
	1	East Fork (East San Jacinto No. 1)	1943/1957	Near Cleveland, 5,950 acres underwater	\$2,237,000	5,950 acres	No wetlands impact in Montgomery County	40% developed	1387	Capacity: 107,000 ac- ft		
East Fork	2	East Fork Reservoir (EF-G1)	1985	Near Junction of East Fork and Winters Bayou, reservoir assumes only using 3 of 5' of storage	\$44,300,000	23,000 acres	No wetlands impact in Montgomery County	2%	2645	80%-90% reduction in 100% flow from Montgomery & Liberty Co. (55,000 cfs to <10,000cfs) 9 foot reduction in 100 year flood plain B/C Ratio: .07		
West Fork	3	3 West Fork (San Jacinto No. 4) 1943/1957 Located upstream of Lake Conroe, 2,744 \$700,000 2,744 or even underwater		2,744 acres	No wetlands impact in Montgomery County	<10% developed	35	Capacity: 25,210 ac-ft				
Lake Creek	4	Lake Creek Dam (Combined)	1943/1957	On the upstream of Lake Creek, 6,000 acres underwater	\$2,625,000	Approx. 20000 acres (based on drawing @ 280' line)	2683.08 acres	40% developed	4825			From 1953 report: "The authority has substituted a single dam on Lak eCreek, located approx. 2400 feet upstream from SH 105 crossing of Lake Creek. Its estimated construction of the dam will cost \$2,200,000"
	5	Lake Creek Reservoir	1997	On the lower portion of Lake Creek, would be 80% the size of Lake Conroe	\$275,000,000	16,800 acres	12259 acres	21%	3126			
Spring Creek	6	Spring Creek (Spring Creek No. 1)	1943/1957	At confluence of Spring and Cypress Creeks, 5,500 acres underwater	\$2,600,000	5537 acres	1739 acres	4% developed	229	Capacity 104,000 acre- feet,		Sized based on similar proposed construction as indicated in the 1943/57 reports;
	7	Spring Creek Reservoir 1 (SC-G1)	1985	1,000 ac, near Woodlands at RM 26.42, assumed to have 5' storage above pool	\$6,500,000	1004 acres	101 acres	35% developed	1532	Average 1% reduction in flow with minimal (<0.5*) change in WSEL		Sized based on similar proposed construction as indicated in the 1885 report; reservoir assumed to have 5° of storage volume above pool
	8	Spring Creek Reservoir 2 (SC-G2)	1985	3,643 ac, upstream of Walnut Creek confluence, assumed to have full depth of storage	\$41,000,000	3719 acres	261 acres	23% developed	9607	B/C Ratio=0.09,Average 35% reduction in flow and 3° WSEL reduction		Sized based on similar proposed construction as indicated in the 1985 report;
Cypress Creek	9	Cypress Creek (Spring Creek No. 2)	1943/1957	West of Westfield, 4,180 acres underwater	\$1,500,000	4193 acres	876 acres	30% developed	19288	Capacity 58,520 acre- feet,		Sized based on similar proposed construction as indicated in the 1943/57 reports;







• Previous Reservoirs

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Schedule Update

54 Current Progress
478 Days Remaining
8/12/2019 Completion Date

- Data Collection and Review 93%
- Existing Conditions H&H 44%
- Community Outreach and Education 14%



SAN JACINTO RIVER QUESTIONS?

Study Partners Kickoff Meeting April 8, 2019

Times













MEETING MINUTES

To:	Jing Chen, P.E., CFM	Attendees:	Jing Chen, HCFCD
From:	Terry Barr, P.E., CFM		Dena Green, HCFCD Gary Bezemek, HCFCD
Subject:	San Jacinto Regional Watershed Master Drainage Plan Progress Meeting		Matt Barrett, SJRA Heather Cook, SJRA Diane Cooper, Montgomery County Adam Eaton COH
Meeting Date:	07/10/2019 – 1:30 pm		Terry Barr, Halff Sam Hinojosa, Halff Mike Moya, Halff
Location:	HCFCD, Brookhollow Office		Andrew Moore, Halff
Minutes Date:	07/29/2019 (Revised)		Hector Olmos, FNI Greg Sevcik, Hollaway
AVO No.:	033465.002		Jaine Hayes, Honaway

Item	Description	Action
1.	Introductions	
	Ms. Chen started the meeting.	
2.	Communications and Outreach	
	Sevcik discussed the updates on the communications plan. He stated Hollaway was developing a fact sheet and website for the project. He stated the website would include an interactive map showing the watersheds. He requested an MXD showing the watershed boundaries and stream centerlines.	Halff to provide MXD for map placeholder.
	Cooper stated that SJRA was creating an interactive map and that it could be used in lieu of the SJR study map. Cook stated the SJRA map would include an address search for users to be able to search for the watershed they live and work in. Cooper asked if this website could be used. Cook stated the website was planning to go live in August. Sevcik stated they can put in a placeholder for the map and discuss further once the SJRA website is live.	SJRA and HCFCD to discuss interactive map for website.
	Olmos stated the SJR study website would have updated information regarding the watershed boundaries and stream centerlines based on the new study results. Moya stated it may be better to have one map that is referenced so the public is seeing one result from both agencies.	
	Chen asked when the website would be complete. Sevcik stated the draft will be submitted by August 1 st . He requested a few photos such as aerial photography or photos from the ground to use on the website.	Hollaway to provide draft website.
3.	Activities Conducted This Month	
	Moore stated the initial field survey was complete and that Halff would potentially collect more based on the schedule and budget. Barr stated some channel cross sections may be needed on Luce Bayou as the	

	LiDAR does not include the channel in some areas. Green asked if Fugro had been made aware of the issue and Barr stated they had but did not find any issues with the data.	
	Moore stated the subbasins and hydrologic parameters had been initially calculated for all watersheds. Cooper asked if the BDF would account for larger lots in Montgomery County. Hinojosa stated that the BDF was based on drainage infrastructure and less on development.	
	Moore stated preliminary HEC-HMS models and HEC-RAS models are in final stages of development. He presented flow and water surface elevation comparison results for Lake Creek stating the results were still preliminary and would require refinement during QC and during calibration occurring next month. Cooper mentioned she expected the water surface elevation downstream of Honea Egypt Road to increase. Green mentioned that the upstream flow was quite a bit different from the effective model. Barr stated the models still needed to be refined but the trends show similarities with the effective model.	
	Moore presented the map and decision matrix showing the detention alternatives previously recommended. Green mentioned it would be helpful to have information regarding preliminary cost in today's dollars for discussion. She also mentioned it would be helpful to have smaller alternatives to consider. Chen mentioned the workshop needed to be set up to discuss the alternatives.	HCFCD to set up primary alternatives workshop
4.	Activities Planned Next Month	
	Moore stated the hydrologic and hydraulic models are being completed and submitted for QA/QC to be ready for the August 12 th submittal.	Halff to submit existing conditions
	Bail stated the project is still on schedule.	models and memorandum August 12 th .
5.	Technical Discussion	models and memorandum August 12 th .
5.	Technical Discussion Barr mentioned historical rainfall data would be needed next month to begin calibration. Olmos stated that HCFCD should have the data for the 2017 and 2016 storm events. Barr asked if Halff could go ahead and request the 1994 data from Vieux. Green requested Halff hold off until the new authorization was routed.	models and memorandum August 12 th . Halff to order rainfall data once authorization routed. HCFCD to provide 2016 and 2017 rainfall data.
5.	Technical Discussion Barr mentioned historical rainfall data would be needed next month to begin calibration. Olmos stated that HCFCD should have the data for the 2017 and 2016 storm events. Barr asked if Halff could go ahead and request the 1994 data from Vieux. Green requested Halff hold off until the new authorization was routed. Administrative Discussion	models and memorandum August 12 th . Halff to order rainfall data once authorization routed. HCFCD to provide 2016 and 2017 rainfall data.

	Green stated the consultant logo will only be used in the report.	
7.	General Discussion	
	Bezemek asked what level of confidence we have in the data that would be used to calibrate the models. Barr stated there are several USGS gauges that would be used for calibration. He mentioned Halff can prepare a map showing the calibration data points and the level of confidence for each of the gauges. Hinojosa stated he will reach out to the USGS to meet and discuss their confidence in each of the gauges to be used.	
	Chen requested Halff provide a hard drive to the USACE to get the report and design plan information regarding the sedimentation in the West Fork and Lake Houston. She stated Halff can coordinate with Michael Garske (HCFCD) directly.	Halff to coordinate with USACE.
8.	Ms. Chen concluded the meeting.	

This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not correct, or that any information is missing or incomplete, please contact Halff Associates so that the matter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.





STUDY PARTNERS MONTHLY MEETING AGENDA Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

August 14, 2019 San Jacinto River Watershed Master Drainage Plan HCFCD, Brookhollow

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Progress Meeting				
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	1:30 PM				
			Meeting Stop Time:	3:00 PM				
Agenda								
1.	Introd	uctions						
2.	Communications and Outreach (Hollaway)							
	•	• Project website provide to HCFCD; Go Live soon						
	•	Supporting partner meetings of	er meetings ongoing					
	•	Upcoming public meetings (No	ov/Dec)					
3.	Activit	ies Conducted this Month						
	•	Monthly Study Partners Progre	ess Meeting (07/10/19)					
	•	Started additional survey bridg	es and culverts					
	•	QA/QC of H&H complete, inc	luding External (Halff I	D/FW offices) and FNI Cross QA/QC				
	•	Started working on Draft Exist	ing on Draft Existing H&H Report					
	Completed Alternatives Matrix/Exhibit (pending internal workshop changes)							
	Continue work on Sedimentation and Vegetation Plan							
	Draft project website submitted for comment							
4.	Activit	ies Anticipated Next Month						
	•	Begin Supporting Partners Me	etings					
	•	Complete additional survey of channels and bridges/culverts						
•		Submit Draft Existing H&H Report – 08/12/19						
	•	Begin Calibration effort						
	•	Conduct internal Primary Alter	rnatives Workshop – 08	/07/19				
	•	Conduct Primary Alternatives	Workshop with Study P	Partners – 08/14/19				
	•	Start coordination for Seconda	ry Alternatives (Flood V	Warning)				
	•	Continue work on Sedimentati	on and Vegetation Plan					
5. Techni		nical Discussion						
	None pending Existing H&H Report/Model Review							
6.	Admin	istrative Discussion						
	•	Amendment 1 and Spring Cree	ek Siting Study (Contrac	et options)				
7.	Questi	ons						

SAN JACINTO RIVER SANJAGINTO - Regional Watershed Master Drainage Plan

Study Partners Progress Meeting August 14, 2019









San Jacinto River Basin

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6









Data Collection

- Gage Locations
- High-Water Marks
- Terrain (2018 LiDAR)

[≜]DISTRIC1



Stream: GI C000-00-00 **Field Recon and Survey**



HALFF

OBJECTID

137030_a

Field Grid: N/A

ide of CR 240 between TX-30 and CR

Face of 5' diameter, 4 harrel culvert or

≦DISTRIC1

TX 7707

HMS Subbasin

OBJECTID: Face of 5' diameter, 4 barrel culvert on upst

137030_b side of CR 240 between TX-30 and CR 23

• Watershed Boundaries



• Soils & Percent Impervious (Infiltration Losses)



• BDF Value & Channel Slopes (Clark UH)



HEC-HMS Model

GLC_170

GLC_150A

etc_160

🔒 GLC_150





Meteorologic Models

 100-YEAR ATLAS 14
 2-YEAR ATLAS 14

 25-YEAR ATLAS 14

5-YEAR ATLAS 14 50-YEAR ATLAS 14

500-YEAR ATLAS 14 Control Specifications

Paired Data











Existing Conditions Hydraulics

• FEMA Floodplain



ONTROL

Existing Conditions Hydraulics

• Manning's n-values



Existing Conditions Hydraulics

HEC-RAS Model



Existing Conditions Summary

- New or updated hydrologic and hydraulic models for each basin
- Flows and water surface elevations are generally higher than the effective models
- Calibration is required to determine loss parameters and nvalues







Flooding Hot Spots

• Flood Damage Claim Density



≜DISTRIC1

- Previous Studies
 - 1943 San Jacinto River Master Plan
 - 1957 San Jacinto River Master Plan
 - 1985 Upper San Jacinto River Flood Control Study
 - 1989 South Montgomery County Flood Protection Plan
 - 1997 Lake Creek Reservoir Study
 - 2000 Lake Houston Regional Flood Protection Study
 - 2015 Cypress Creek Overflow Management Plan
 - 2019 Estimate Land Cover Effects on Selected Watersheds
 - 2019 Hurricane Harvey San Jacinto River Flooding (presentation)








Primary Mitigation Alternatives

• Alternatives Matrix

Project	Watershed	Name	Year	Description	Cost (When Proposed)	Location	Size	Wetlands	Percent Developable	Number Tracts of Land	Benefit
1	East Fork	East Fork (East San Jacinto No. 1)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$2,237,000	Near Cleveland	5,950 acres	No wetlands impact in Montgomery County	60%	1387	Capacity: 107,000 ac-ft
2	East Fork	East Fork Reservoir (EF- G1)	1985	Reservoir assumes only using 3 of 5' of storage	\$44,300,000	Near Junction of East Fork and Winters Bayou	29,000 acres	No wetlands impact in Montgomery County	2%	2645	80%-90% reduction in 100Yr flow from Montgomery & Liberty Co. (55,000 cfs to <10,000cfs) 9 foot reduction in 100 year flood plain B/C Ratio: .07
3	West Fork	West Fork (San Jacinto No. 4)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$700,000	Upstream of Lake Conroe	2,744 acres	No wetlands impact in Montgomery County	>90%	35	Capacity: 25,210 ac-ft
4	Lake Creek	Lake Creek Dam (Combined)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.		Upstream portion of Lake Creek	Approx. 20000 acres (based on drawing @ 280' line)	2689.08 acres	60%	4825	
5	Lake Creek	Lake Creek Reservoir	1997	80% the size of Lake Conroe	\$275,000,000	On the lower portion of Lake Creek	16,800 acres	12259 acres	21%	3126	
6	Spring Creek	Spring Creek (Spring Creek No. 1)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$2,600,000	At confluence of Spring and Cypress Creeks	5537 acres	1739 acres	96%	229	Capacity 104,000 acre-feet,
7	Spring Creek	Spring Creek Reservoir 1 (SC- G1)	1985	Assumed to have 5' storage above pool	\$6,500,000	Near Woodlands at RM 26.42	1004 acres	101 acres	5%	1532	Average 1% reduction in flow with minimal (<0.5') change in WSEL
8	Spring Creek	Spring Creek Reservoir 2 (SC- G2)	1985	Assumed to have full depth of storage	\$41,000,000	Upstream of Walnut Creek confluence	3719 acres	261 acres	77%	9607	B/C Ratio=0.09,Average 35% reduction in flow and 3' WSEL reduction
9	Cypress Creek	Cypress Creek (Spring Creek No. 2)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$1,500,000	West of Westfield	4193 acres	876 acres	10%	19288	Capacity 58,520 acre-feet,
10	Caney Creek	Caney Creek (Caney Creek No. 1)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$400,000	Located East of Conroe	850 acres	100 Acres	99%	27	Capacity 6,930 acre-feet
11	Caney Creek	Caney Creek Reservoir (CC- G1)	1985	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$5,700,000	On upper Caney Creek near RM 34.71	677 acres	15 acres	90%	31	B/C=.51, Average 100% flow reduction D/S of reservoir with 14' change in WSEL (at mouth 16% drop in flow and 1.1' drop in WSEL), Reservoir can store all 100-yr runoff upstream
12	Peach Creek	Peach Creek Reservoir 1 (PC- G1)	1985	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event. Assumed to have full depth of storage	\$3,500,000	Located in upstream part of Peach Creek	625 acres	170 acres	92%	49	Capacity 5,350 acre-feet
13	Peach Creek	Peach Creek Reservoir 2 (PC- G2)	1985	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event. Assumed to have full depth of storage	\$8,000,000	Located in upstream part of Peach Creek, above Peach Creek No. 1	1381 acres	20 acres	99%	12	Capacity 2750 acre-feet







Sedimentation and Vegetation

- Sedimentation Data in Report
 - Sediment Measurement Reports (7)
 - Sediment Management Reports (5)
 - Digital Elevation Models (2)
 - Hydraulic Reports (2)
 - Introduction to Sedimentation
 - Peak Discharge Review
 - Sediment Material Size
 - Origin of Sedimentation
 - Sedimentation Rate
 - Historical Sediment Management Recommendations



Schedule Update

54 Current Progress
478 Days Remaining
8/12/2019 Completion Date

- Data Collection and Review 95% (Additional Survey)
- Existing Conditions H&H 90% (Comments, Calibration)
- Primary Mitigation Alternatives 10-15%
- Community Outreach and Education 25%



SAN JACINTO RIVER QUESTIONS?

Study Partners Kickoff Meeting April 8, 2019

Times













MEETING MINUTES

То:	Jing Chen, P.E., CFM	Attendees:	Jing Chen, HCFCD
From:	Terry Barr, P.E., CFM		Rob Lazaro, HCFCD Chuck Gillman SIRA
Subject:	San Jacinto Regional Watershed Master Drainage Plan Progress Meeting		Matt Barrett, SJRA Heather Cook, SJRA Diane Cooper, Montgomery County
Meeting Date:	08/14/2019 – 1:30 pm		Terry Barr, Halff
Location:	HCFCD, Brookhollow Office		Andrew Moore, Halff Hector Olmos FNI
Minutes Date:	08/29/2019 09/22/2019 (Revised)		Corey Stull, FNI Connor Stokes, Hollaway Greg Sevcik, Hollaway
AVO No.:	033465.002		Janice Hayes, Hollaway

Item	Description	Action
1.	Introductions	
	Ms. Chen started the meeting. Mr. Barr provided four (4) USB drives, one for each study partner, that included the Draft Existing Conditions H&H Report.	
2.	Communications and Outreach	
	Mr. Sevcik discussed the updates on the communications plan. He stated the plan is for the website to go live on 8/16/2019. Hollaway is adjusting minor formatting comments. He said the website will not be fully completed by go-live date and will be updated with a full map, photo captions, and frequently asked questions throughout the project. He stated the domain name is sanjacstudy.org.	Holloway to launch website.
	Ms. Cooper asked how the contact form would work and how questions would be spread to all study partners. Mr. Sevcik stated the questions would be routed to HCFCD through Sales Force and HCFCD will spread comments to stakeholders. Ms. Chen stated in previous projects Holloway has compiled all questions and included in a report. Ms. Cooper asked for a way to track questions and responses. She also requested any comments from Montgomery County residents be routed through Montgomery County.	HCFCD and Holloway to coordinate responses with agencies.
	Ms. Chen summarized the supporting partner meetings with Grimes, Walker, Waller, and City of Conroe explaining the study purpose, goals, and progress and requesting any input. Ms. Cooper, Mr. Gillman, and Ms. Cook requested SJRA and Montgomery County be included in any future stakeholder meetings. Ms. Chen stated a second round would be conducted in 2020 and that HCFCD would include all stakeholders in contact with any other partners. She also stated that the study partners	HCFCD to include partners in future meetings.

	would be included on the remaining partner meetings this round.	
	Mr. Sevcik stated that public meetings were beginning to be scheduled. All scheduled public meetings will be held in Harris County with an East/West distribution across the watershed. Mr. Barr stated the scope calls for two sets of meetings, with three meetings each. He mentioned 1 at the end of calibration/selection of alternatives and 1 at the end of the study. Mr. Sevcik requested 45-60 days of preparation for each meeting. He mentioned discussing at the next progress meeting on September 11.	
3.	Activities Conducted This Month	
	Mr. Barr stated that HCFCD had been provided the existing conditions flood hazard assessment report. He stated the results are preliminary and would still need to be calibrated in the next effort. Mr. Moore presented the results of the existing conditions analysis comparing flows through some of the basins. The presentation included a recap of each of the tasks, including data collection (reports, models, survey, etc.), hydrologic modeling, and hydraulic modeling. Several of the report exhibits were included in the presentation to give the study partners an idea of what to expect.	
	Ms. Chen asked when the study team would know if the BDF methodology will work in the steeper terrains. Mr. Moore and Mr. Barr stated that it will be determined during and after calibration.	
	Ms. Chen asked which models were being used for the HCFCD streams and if the new MAAPnext models would be used. Mr. Barr stated that the current effective models are being used as the basis but will be re- calibrated for the selected storm events. Ms. Cooper stated that the Woodlands residents may not trust the results of the existing effective models. Mr. Barr stated the MAAPnext models will not be complete until January/February.	
	Mr. Barr requested any comments from the existing report/models be complete by September 6.	
4.	Activities Planned Next Month	
	Mr. Barr stated calibration is going to occur over the next month as well as starting to combine all the models. He also mentioned that Halff would begin considering the meetings for the secondary alternatives discussion.	
5.	Technical Discussion	
	Mr. Barr requested the GARR data from HCFCD for the 2016 and 2017 storm events. Ms. Chen stated she would request from the flood forecast group. Mr. Barr stated they needed to review the extents to ensure the entire SJR basin is covered. He stated the 1994 data had been requested through Vieux and is expecting it in September. Mr.	Halff to review smaller storm event calibration.

	Bezemek stated they may want to look into a smaller event for low flow calibration.	
6.	Administrative Discussion	
	Ms. Chen discussed the first amendment to the contract which includes budget for the public meetings in Harris County not included in the original scope as well as budget for general technical support to respond to questions. Ms. Cooper and Mr. Gillman stated that their respective boards may not be able to provide additional funds this early in the study. Mr. Gillman stated that SJRA can likely handle outside public meetings without additional budget.	
	Ms. Cooper stated the team needs to have a plan to respond to comments not related to the river study but that some of the questions may not require a response. Mr. Sevcik stated that an address or county box could be added to the comment form to determine where the resident lived to direct to the correct entity.	
	Ms. Chen stated the siting study is currently not listed in the amendment but may be included in the future as contingency.	
7.	General Discussion	
	There was no general discussion as part of the meeting	
8.	Ms. Chen concluded the meeting.	

This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not correct, or that any information is missing or incomplete, please contact Halff Associates so that the matter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.





STUDY PARTNERS MONTHLY MEETING AGENDA Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

September 11, 2019 San Jacinto River Watershed Master Drainage Plan HCFCD, Brookhollow

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Progress Meeting		
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	1:30 PM		
			Meeting Stop Time:	3:00 PM		
Agenda						
1.	Introd	uctions				
2.	Comm	unications and Outreach (Hol	laway)			
	•	Project website has gone live (sanjacstudy.org)			
	•	Study and Supporting Partner meetings ongoing (8 completed; 2 scheduled)				
	•	Upcoming public meetings (Ne	Jpcoming public meetings (Nov/Dec)			
3.	Activit	ies Conducted this Month				
	•	Monthly Study Partners Progress Meeting (08/14/19)				
	•	Started additional survey bridg	es and culverts			
	•	Complete QA/QC of Existing Conditions H&H Models and Report				
•		Submitted Draft Existing H&H Report (08/12/19)				
Conducted Primary Alternatives Workshop (08/14/19)						
	•	Continue work on Sedimentation and Vegetation Plan				
	•	Started Existing Conditions M	odel Calibration			
4.	Activit	ies Anticipated Next Month				
	•	Complete Study and Supportin	g Partners Meetings			
	•	Complete additional survey of	channels and bridges/cu	llverts		
	•	Review Draft Existing H&H R	eport Comments and pr	ovide response (09/25/19)		
	•	Continue Calibration effort; St	art documentation			
	•	Continue Primary Flood Mitig	ation Alternatives Devel	lopment		
	•	Begin Secondary Flood Mitiga	tion Alternatives Devel	opment		
	•	Start coordination for Seconda	ry Mitigation Actions (F	Flood Warning)		
	•	Continue work on Sedimentati	on and Vegetation Plan			
5. Techni		lical Discussion				
	•	Model Calibration discussion				
	•	Updated Alternatives Develop	ment Process (See Mem	0)		
6.	Administrative Discussion					
	•	Amendment for Spring Creek	Siting Study on Commis	ssioners Court (09/10/19)		
7.	Questi	ons				

SAN JACINTO RIVER SANJACINTO - Regional Watershed Master Drainage Plan

Study Partners Progress Meeting September 11, 2019









San Jacinto River Basin

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6









Coordination and Communication

- Coordination
 - Study Partners Meetings (3)
 - Supporting Partners Meeting(5)
 - Additional meetings scheduled



FREQUENTLY ASKED QUESTIONS

- Communications
 - Website has gone live (sanjacstudy.org)
 - Public meeting planning starting
 - Nov/Dec 2019



About The Study

The San Jacinto Regional Watershed Master Drainage Plan (SJMDP) is a comprehensive regional Plan led by local partners including the Harris County Flood Control District (HCFCD), the San Jacinto River Authority (SJRA), Montgomery County, and the City of Houston. The SJMDP is funded jointly with 75 percent from the Federal Emergency Management Agency (FEMA) Hazard Mitigation Planning Program, conveyed through the Texas Department of Emergency Management and 25 percent from the **four local partners**.

Information to be developed includes non-regulatory inundation maps (not intended to replace current effective maps) for the studied streams that show the extent and depth of riverine flooding of the



larger rivers within the watershed for an array of simulated storm events. Additionally, information will be gathered about the number of structures, acres of land, properties, and miles of roadway that are located within the modeled floodplains. Plan results will be used to inform and update Hazard Mitigation Plans for each of the participating partners and to provide guidance on regulations for future growth within the study area.

This watershed-wide effort, kicked off in April 2019, will identify future flood mitigation projects that can be implemented in the near- and longterm to reduce flood risks to people and property throughout the San Jacinto River regional watershed.







Download the Project Fact Sheet

Existing H&H Draft Report

- Submitted to Study Partners on 08/12/19
- Received report comments from SJRA and City of Houston
- Received hydrology comments from HCFCD

SAN JACINTO

REGIONAL WATERSHED MASTER DRAINAGE PLAN



Prepared for: Harris County Flood Control District San Jacinto River Authority Montgomery County City of Houston

DRAFT REPORT

Date of photo: August 29, 2017







- Calibrating to Three (3) Historical Events
 - Hurricane Harvey (2017) In progress
 - Memorial Day (2016) In progress
 - October 1994 After models are combined









- Calibration Adjustments
- Stage
 - Manning's N-value
- Volume
 - Initial Loss (in)
 - Constant Loss (in/hr)
- Peak Flow
 - BDF Value
 - TC+R
- Hydrograph Shape
 - BDF
 - Manning's N-value







• Caney Creek (Harvey 2017)



• Caney Creek (Harvey 2017)



• Peach Creek (Harvey 2017)



• Peach Creek (Harvey 2017)



• Spring Creek (Harvey 2017)











• Spring Creek (Harvey 2017)



• Willow Creek (Harvey 2017)



• Willow Creek (Harvey 2017)



 Jackson Bayou – Gum Gully (Harvey 2017)



• Luce/Tarkington (Harvey 2017)



• Luce/Tarkington (Harvey 2017)



• East Fork SJR (Harvey 2017)



• East Fork SJR (Harvey 2017)



- Work in progress
 - Cypress/Little Cypress Creeks
 - East Fork San Jacinto River
 - Combine models
 - West Fork San Jacinto River (after HEC-RAS models are combined)
 - October 1994 Storm (after HEC-RAS models are combined)











Supporting Partner Meetings

- San Jacinto River Authority
 - Concerned with flooding and impacts to communities (Grogan's Point, MUD 386, Timber Lakes, Kingwood, Lake Houston, etc.)
 - Sedimentation that causes additional flooding or reduces reservoir capacity
- Montgomery County
 - Property Acquisition has been a focus of mitigation efforts
 - Interested in Lake Creek recommendations due to loss of life
 - Flood warning mapping and early detection
 - Additional gages to augment the network
 - Interested in Improved floodplain maps
- City of Houston
 - Including gates on Lake Houston
 - Reduction of flooding in Kingwood
 - Improvements to water quality and concern about impacts on treatment







Primary Flood Mitigation Planning

- Revised Primary Mitigation Planning Procedure
 - Combine HEC-RAS models
 - Simulate models for multiple storm events
 - Run Structural Inventory Tool
 - Identify Damage Centers
 - Select a target frequency
 - Determine high level improvements needed to achieve level of service
- Minor modifications to the alternatives schedule needed
- Final Report submittal dates will remain unchanged







Sedimentation and Vegetation

- Significant Sedimentation Data in Report
 - Measurement Reports
 - Introduction to Sedimentation
 - Sedimentation Rates
 - Historical Sediment Management Recommendations
 - Other data
- Continuing to work on the plan for Sedimentation and Vegetation



Secondary Flood Mitigation Planning

- Setting up meetings with partners to discuss gage network
 - HCFCD
 - SJRA
 - МОСО
 - COH
 - TXDOT
- Recommendations for additional ALERT 2 Rain and Stage gages
- Identify what type of gages are appropriate for the location within the drainage basin





Schedule Update

54 Current Progress
478 Days Remaining
8/12/2019 Completion Date

- Existing Conditions H&H 95% (Comments, Calibration)
- Model Calibration 40-50%
- Primary Mitigation Alternatives 15-20%
- Minor modifications for calibration and flood mitigation planning



SAN JACINTO RIVER QUESTIONS?

Study Partners Kickoff Meeting September 11, 2019

Times












MEETING MINUTES

To:	Jing Chen, P.E., CFM	Attendees:	Jing Chen, HCFCD
From:	Terry Barr, P.E., CFM		Dena Green, HCFCD Gary Bezemek, HCFCD Church Cillman, SIDA
Subject:	San Jacinto Regional Watershed Master Drainage Plan Progress Meeting		Matt Barrett, SJRA Heather Cook, SJRA Diane Cooper, Montgomery County
Meeting Date:	09/11/2019 – 1:30 pm		Terry Barr, Halff Sam Hinojosa, Halff Andrew Moore, Halff
Location:	HCFCD, Brookhollow Office		Corey Stull, FNI
Minutes Date:	09/13/2019		Connor Stokes, Hollaway Greg Sevcik, Hollaway Janice Hayes, Hollaway
AVO No.:	033465.002		Jamee Hayes, Hollaway

Item	Description	Action	
1.	Introductions		
	Ms. Chen started the meeting.		
2.	Communications and Outreach		
	Mr. Barr mentioned that coordination meetings have been held with SJRA, Montgomery County, and the City of Houston. The meeting with HCFCD is schedule for 9/12 and a follow up meeting with Montgomery County is scheduled for 9/13.		
	Mr. Barrett asked if a meeting had been set with Liberty County. Ms. Chen responded that they had not heard from the county and requested that if they had any contacts to reach out to the individuals.	SJRA and HCFCD to follow up with Liberty	
	Mr. Barr mentioned that logistics have started for Public meetings and that the meetings with be in Harris County only. Holloway stated that they were awaiting a PO from the HCFCD and are expecting it in the next few weeks.	County. Hollaway to continue public meeting	
	Ms. Cook stated that SJRA had attended several community meetings and handed out fliers regarding the study. The SJRA has also launched the "Know Your Watershed" website. She mentioned posting a link to the SJRA site from the study website.	preparation. Hollaway to include link to SJRA site.	
3.	Activities Conducted This Month		
	Mr. Barr stated that the draft report had been submitted and that SJRA and the City of Houston had submitted comments. Ms. Cooper stated that she had not had a chance to review. Ms. Chen stated that HCFCD was still compiling comments and should be able to present within the next week. Mr. Barr stated that a revised report would not be submitted, but comments would be included with the ongoing report submittals.		

	He stated that each submittal builds upon the previous ones.	
	Mr. Hinojosa mentioned that Halff had met with the MAAPNext reviewer who provided comments on the hydrologic methodology. He said the comments were minor.	Halff to provide hydrology responses.
4.	Activities Planned Next Month	
	Ms. Chen mentioned that the team would be reviewing the MAAPNext team comments and submitting responses within approximately 2 weeks.	
	Secondary Flood Mitigation Planning	
	Mr. Barr stated that meetings needed to be set up to discuss the gage needs for each entity. Mr. Bezemek suggested what gages would be helpful and how gages can be used for future calibration events.	HCFCD and Halff to setup gage meetings.
	Mr. Barr said the report will include the discussion of the gage needs, exhibits, and recommendations. Ms. Chen mentioned starting with the HCFCD FWS to determine the locations and then request input from the stakeholders.	
5.	Technical Discussion	
	Calibration	
	Mr. Barr mentioned that calibration was in progress for the 2017 and 2016 events. He stated that the 1994 event will be a validation of the combined models.	
	Mr. Moore presented the calibration process and results. Mr. Bezemek requested Halff prepare a confidence analysis in the USGS gages for the events. He mentioned obtaining the rating curves and showing the highest actual measurement to understanding when the flows are extrapolated. He stated that this process was followed on Cypress Creek and led to an adjusted rating curve.	Halff to investigate USGS rating curves.
	Ms. Cooper requested a cross reference with the USGS and NWS gages to show the need for more gages and updates to the rating curves. She also questioned how antecedent moisture conditions affected calibration. Mr. Moore stated that the initial loss factor allowed an adjustment for the antecedent conditions. Mr. Bezemek mentioned that initial loss generally doesn't make a difference in the overall results. Moore confirmed and stated that it affects any early peaks.	
	Mr. Moore stated that the calibration still needed refinement and that the models need to be combined.	
	Study Partners Meeting	
	Mr. Barr presented the different goals from the study from each partner. Ms. Green asked if the City of Houston had any recommendations on how the gates were going to be implemented. Mr. Barr stated that the	

	question was asked and that the City was going to look into the study.	
	Primary Flood Mitigation Planning	Halff to provide
	Mr. Barr presented the alternative primary mitigation planning process. He stated that a memo had been drafted summarizing the new process.	alternative memo.
	Ms. Cooper asked what the differences between the Atlas 14 rainfall and the FEMA effective models. She stated that the report and plan needs to clarify that the AEP storm is based on Atlas 14 rainfall. Mr. Bezemek mentioned showing changes in the floodplains based on the rainfall changes near the flooded areas. Mr. Barrett recommended referencing elevations and flows rather than storm frequency.	Team to consider how to present changes in rainfall.
	Mr. Hinojosa mentioned that the average BLE increase in flow due to the new rainfall was 30% and the base flood elevations increased by one foot. He said that the floodplains did not drastically change throughout the county due to the relief.	
	Mr. Barr stated that the initial pass of the alternative development would help understand the magnitude of the volumes and conveyance systems required. Mr. Stull stated that flooding reduction targets become a rating curve of flows, volumes, and structures reduced.	
	Mr. Barr stated that the process will help identify the solutions that can make a difference early on. The development would guide the direction of alternatives without detailed modeling. He said the benefits will focus on number of structures rather than structure values and focus on the damage centers	
	Ms. Cooper asked how the siting study will play into this study. Mr. Hinojosa stated the siting study will focus on land available for a reservoir. He stated there will be some overlap and discussion between the two studies. Mr. Bezemek stated that a Spring Creek reservoir may or may not benefit much downstream of Spring Creek. Mr. Stull stated the siting study will supplement the overall study to help focus on where detention ponds could be placed throughout the project.	
	Ms. Chen asked how the future conditions will affect the alternatives. Mr. Barr stated that the future conditions will assume the projects are not in place. He stated that the alternatives are developed with future conditions in mind, but focus on current damage areas. Ms. Green said that the analysis will help understand how current policy with future development volumes impact Lake Conroe and Lake Houston.	
	Mr. Barr stated that there is a proposed adjustment to Primary Alternatives schedule to accommodate change in procedure.	
6.	Administrative Discussion	
	Additional Spring Creek Siting Study authorization passed	

	Commissioner's Court on September 10.	
	Alternative memorandum and revised schedule to be provided.	
7.	General Discussion	
	There was no general discussion.	
8.	Ms. Chen concluded the meeting.	

This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not correct, or that any information is missing or incomplete, please contact Halff Associates so that the Mr. Barretter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.





STUDY PARTNERS MONTHLY MEETING AGENDA Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

October 10, 2019 San Jacinto River Watershed Master Drainage Plan HCFCD, Brookhollow

Meeting ca	alled by:	Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Progress Meeting		
Facilitator:		Terry M Barr P.F. CFM	Meeting Start Time	2:00 PM		
			Meeting Start Time:	2.30 PM		
A			Wreeting Stop Time.	5.501 14		
Agenda						
1.	Introd	uctions				
2.	Comm	Communications and Outreach (Hollaway)				
	•	Project website live (sanjacstue	dy.org)			
	•	Study and Supporting Partner	meetings ongoing (10 co	ompleted; 1 scheduled)		
	•	Scheduling upcoming public n	neetings for early Decen	nber		
	•	SJRA to present at Kingwood	meeting and provide up	date on SJRWMDP		
3.	Activit	ies Conducted this Month				
	•	Monthly Study Partners Progre	ess Meeting (09/11/19)			
	•	Responding to existing conditi	ons hydrology commen	ts (MAAPnext team)		
	•	• Provided revised Primary Mitigation Planning Strategy (09/12/19)				
	•	Continue working on Existing Conditions Model Calibration				
	•	Started combining Existing Conditions models				
	•	Meeting with USGS to discuss flow gages on East Fork, Peach, Caney				
	•	Continue work on Sedimentation and Vegetation Plan				
4.	Activities Anticipated Next Month					
	•	Complete additional Supporting Partners Meetings				
	Complete the existing conditions model calibration effort					
	Continue Primary/Secondary Flood Mitigation Alternatives Development					
	Start coordination for Secondary Mitigation Actions (Flood Warning)					
	Continue work on Sedimentation and Vegetation Plan					
	Supporting partner meeting with Grimes County					
5.	Technical Discussion					
	Model Calibration discussion					
	•	Revised Alternatives Development Process				
6.	Administrative Discussion					
	• Amendment for Spring Creek Siting Study Approved/Authorized (09/24/19)			Authorized (09/24/19)		
	• Working with Hollaway on contract for public meeting(s)			g(s)		
7.	Questions					

SAN JACINTO RIVER SANJAGINTO - Regional Watershed Master Drainage Plan

Study Partners Progress Meeting October 10, 2019









San Jacinto River Basin

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6









Coordination and Communication

- Coordination
 - Study Partners Meetings (5)
 - 2nd Montgomery Co. Meeting
 - Supporting Partners Meeting(5)
 - Additional meetings scheduled
 - 2nd Grimes Co. Meeting
- Communications
 - Website has gone live (sanjacstudy.org)
 - Public meeting planning started 09/24
 - Early Dec 2019
 - SJRA to present to Kingwood



FREQUENTLY ASKED QUESTIONS



About The Study

The San Jacinto Regional Watershed Master Drainage Plan (SJMDP) is a comprehensive regional Plan led by local partners including the Harris County Flood Control District (HCFCD), the San Jacinto River Authority (SJRA), Montgomery County, and the City of Houston. The SJMDP is funded jointly with 75 percent from the Federal Emergency Management Agency (FEMA) Hazard Mitigation Planning Program, conveyed through the Texas Department of Emergency Management and 25 percent from the **four local partners**.

Information to be developed includes non-regulatory inundation maps (not intended to replace current effective maps) for the studied streams that show the extent and depth of riverine flooding of the



larger rivers within the watershed for an array of simulated storm events. Additionally, information will be gathered about the number of structures, acres of land, properties, and miles of roadway that are located within the modeled floodplains. Plan results will be used to inform and update Hazard Mitigation Plans for each of the participating partners and to provide guidance on regulations for future growth within the study area.

This watershed-wide effort, kicked off in April 2019, will identify future flood mitigation projects that can be implemented in the near- and longterm to reduce flood risks to people and property throughout the San Jacinto River regional watershed.







- Coordination meeting with USGS JA
 - Direct vs. Indirect Measurements
 - Several streams were measured indirectly during 2017
 - Level of accuracy
 - "Good" +/- 5%
 - "Fair" +/- 8%
 - "Poor" +/- 15%
 - Rating curves are based on all measurements
 - Encouraging use of velocity meters for future gages







USGS Gage Rating Curve Charts JACING







USGS Gage Flow Confidence AN JACING

	Period of Record		
Date	Flow (cfs)	Stage (ft)	
9-Jun-01	36,500	144.89	
17-0ct-94	36,000	144.84	
14-Jul-73	35,000	144.74	
28-Aug-17	21,100	145.07	
1-Apr-45	14,900	141.63	
19-Nov-98	11,200	140.99	
28-May-16	10,700	141.34	
19-Sep-19	9230	140.59	

	Highest Flows Measured		Measurement
Date	Flow (cfs)	Stage (ft)	Method
28-May-16	9,420	140.84	direct
19-Sep-19	9,220	140.59	direct
5-Nov-46	5560	132.91	other
11-Mar-16	4890	138.14	direct
19-Oct-94	4610	136.92	unspecified
10-Jun-01	4440	136.76	unspecified
19-Sep-19	9220	140.59	direct







USGS Gage Flow Confidence AN J/

Stream	Gage	Max. Measured	2017 Flow	Confidence
East Fork		34,000 cfs	108,000 cfs	Mid
East Fork		22,700 cfs	120,000 cfs	Mid
Peach Creek*		77,000 cfs	34,000 cfs	High
Caney Creek		9,400 cfs	21,000 cfs	Low
Lake Creek		51,800 cfs	55,000 cfs	High

*Gage was measured during Imelda at peak flow and rating curve is being revised





• Model Combination









- Calibrating to Three (3) Historical Events
 - Hurricane Harvey (2017) In progress
 - Memorial Day (2016) In progress
 - October 1994 After model is calibrated









- Calibration Adjustments
- Stage
 - Manning's N-value
- Volume
 - Initial Loss (in)
 - Constant Loss (in/hr)
- Peak Flow
 - BDF Value
 - TC+R
- Hydrograph Shape
 - BDF
 - Manning's N-value



• Lake Creek (Harvey 2017)





Time



• Caney Creek (Harvey 2017)



• Caney Creek (Harvey 2017)









• Peach Creek (Harvey 2017)



• Peach Creek (Harvey 2017)









• Spring Creek (Harvey 2017)



• Spring Creek (Harvey 2017)









• Willow Creek (Harvey 2017)



 Jackson Bayou – Gum Gully (Harvey 2017)



• Luce/Tarkington (Harvey 2017)



• Luce/Tarkington (Harvey 2017)






















































• West Fork SJR (Harvey 2017)



• West Fork SJR (Harvey 2017)



• West Fork SJR (Harvey 2017)



• Lake Houston (Harvey 2017)



• Lake Houston (Harvey 2017)



- Work in progress
 - Lake Houston Calibration (2016, 2017)
 - October 1994 Storm after HEC-RAS models are calibrated







Study Partner Meetings

- San Jacinto River Authority
 - Concerned with flooding and impacts to communities (Grogan's Point, MUD 386, Timber Lakes, Kingwood, Lake Houston, etc.)
 - Sedimentation that causes additional flooding or reduces reservoir capacity
- Montgomery County
 - Property Acquisition has been a focus of mitigation efforts
 - Interested in Lake Creek recommendations due to loss of life
 - Flood warning mapping and early detection
 - Additional gages to augment the network
 - Interested in Improved floodplain maps
- City of Houston
 - Including gates on Lake Houston
 - Reduction of flooding in Kingwood
 - Improvements to water quality and concern about impacts on treatment







- Primary and Secondary Alternatives Development
 - Revised Alternatives Evaluation
 - Combine HEC-RAS models
 - Simulate models for multiple storm events
 - Run Structural Inventory Tool
 - Identify Damage Centers
 - Select a target frequency
 - Determine high level improvements needed to achieve level of service
 - Perform Qualitative Analysis
 - Establish Project Ranking Methodology
- Primary and Secondary Alternatives H&H Analysis
 - Includes detailed modeling of the selected alternatives







- Primary and Secondary will run concurrently
- Minor modifications to the alternatives schedule needed
- Final Report submittal dates will remain unchanged



Sedimentation and Vegetation

- Significant Sedimentation Data in Report
 - Measurement Reports
 - Introduction to Sedimentation
 - Sedimentation Rates
 - Historical Sediment Management Recommendations
 - Other data
- Continuing to work on the plan for Sedimentation and Vegetation



- Working on a dialogue with partners to discuss gage network
 - HCFCD (scheduled for 10/21/19)
 - <mark>SJRA (</mark>
 - MOCO (received recommendations)
 - <mark>COH (</mark>
 - USGS (met with staff on 9/27/19)
- Additional ALERT 2 Rain and Stage gage recommendations
- Potentially some new flow gages (USGS)
- Identify what type of gages are appropriate for the location within the drainage basin
- Develop plan for implementation







Schedule Update

54 Current Progress
478 Days Remaining
8/12/2019 Completion Date

- Existing Conditions H&H 98% (Comments, Calibration)
- Model Calibration 75-80%
- Primary Mitigation Planning (Revised Methodology) 15-20%
- Secondary Mitigation Planning (Adjusted Schedule) 10-20%



SAN JACINTO RIVER QUESTIONS?

Study Partners Kickoff Meeting October 10, 2019

Times













STUDY PARTNERS MONTHLY MEETING AGENDA Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

November 13, 2019 San Jacinto River Watershed Master Drainage Plan HCFCD, Brookhollow

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Progress Meeting		
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	1:30 PM		
			Meeting Stop Time:	3:00 PM		
Agenda						
1.	Introd	uctions				
2.	Comm	Communications and Outreach (Hollaway)				
	•	• Study and Supporting Partner meetings ongoing (11 completed)				
	•	Planning and scheduling upcoming community public meetings in December				
	•	SJRA to present at Kingwood meeting and provide update on SJRWMDP				
3.	Activities Conducted this Month					
	• Monthly Study Partners Progress Meeting (10/10/19)					
	• Responded to existing conditions hydrology comments (MAAPnext team)					
	Submitted Existing Conditions Calibration models and memorandum					
	•	Continue work on Primary Mitigation Actions (Alternatives)				
	•	Continue work on Secondary M	Mitigation Actions (FWS	S Gages)		
	•	Continue work on Sedimentati	on and Vegetation Plan			
4.	Activities Anticipated Next Month					
	•	Provide updated calibration mo	odels (minor adjustment	s)		
	•	Begin work on Future Condition	ons Hydrology			
	•	Continue Primary/Secondary F	Flood Mitigation Alterna	tives Development		
	Provide preliminary recommendations for Secondary Mitigation Acti		Mitigation Actions			
	•	Start working on Other Mitigat	tion Actions (Flood Res	ponse)		
	•	Continue work on Sedimentati	on and Vegetation Plan			
5.	Technical Discussion					
	•	Model Calibration discussion				
	•	Spring Creek Siting Study				
6.	Admin	Administrative Discussion				
	•	Provided a proposal to Hollawa	ay for public meeting(s)			
	•	General assistance item reques	ted			
7.	Questions					

SAN JACINTO RIVER SANJAGINTO - Regional Watershed Master Drainage Plan

Study Partners Progress Meeting November 13, 2019









San Jacinto River Basin

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
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San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6









Coordination and Communication

- Coordination
 - Study Partners Meetings (5)
 - Supporting Partners Meeting(6)
- Communications
 - Website is live and being updated monthly (sanjacstudy.org)
 - Public meetings planned for Dec 2019
 - SJRA presented to Kingwood



FREQUENTLY ASKED QUESTIONS



About The Study

The San Jacinto Regional Watershed Master Drainage Plan (SJMDP) is a comprehensive regional Plan led by local partners including the Harris County Flood Control District (HCFCD), the San Jacinto River Authority (SIRA), Montgomery County, and the City of Houston. The SJMDP is funded jointly with 75 percent from the Federal Emergency Management Agency (FEMA) Hazard Mitigation Planning Program, conveyed through the Texas Department of Emergency Management and 25 percent from the **four local partners**.

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larger rivers within the watershed for an array of simulated storm events. Additionally, information will be gathered about the number of structures, acres of land, properties, and miles of roadway that are located within the modeled floodplains. Plan results will be used to inform and update Hazard Mitigation Plans for each of the participating partners and to provide guidance on regulations for future growth within the study area.

This watershed-wide effort, kicked off in April 2019, will identify future flood mitigation projects that can be implemented in the near- and longterm to reduce flood risks to people and property throughout the San Jacinto River regional watershed.

Download the Project Fact Sheet







- Submitted draft calibration report 11/4/19
 - Will be included as Appendix to the final report
 - Some minor changes due to Time Zone issue
- Analysis of Historical Storms
 - Rainfall Information
 - USGS Gages
- Calibration Process
- Calibration Results
- Existing Conditions Flood Hazard Assessment
- Existing Conditions 100-year Comparisons
- Ongoing update to calibration models







• Lake Houston Results – Harvey 2017







• Lake Houston Results – Memorial Day 2016







• Lake Houston Results – October 1994





• Historical Storm Inundation Exhibits – West Fork



• Historical Storm Inundation Exhibits – Peach Creek



• Frequency Storm Inundation Exhibits – Lake Creek



• Frequency Storm Inundation Exhibits – East Fork



Birthplace of the UNIT

Future Conditions

- Utilizes detailed population projection layer (Urban Core)
 - Brazoria, Fort Bend, Galveston, Harris, and Montgomery Counties
 - Developed as part of the Harris-Galveston Subsidence District's Regional Groundwater Update Project
 - Near-term estimates based on field research
 - Long-term projections utilizing the Small Area Model-Houston
 - Decadal population projections for 2020-2070 at census block level
 - Used to develop water user population projections for the Region H Regional Water Plan
 - <u>https://hgsubsidence.org/science-and-research/</u>
- TWDB population projections (2021 Regional Water Planning)
 - Grimes, Liberty, San Jacinto, Waller, and Walker Counties
 - Less detailed information



Future Conditions



FLOOD FLOOD HARMEDISTRICT





- Primary and Secondary Alternatives Development
 - Revised Alternatives Evaluation
 - Combine HEC-RAS models
 - Simulate models for multiple storm events
 - Run Structural Inventory Tool
 - Identify Damage Centers
 - Select a target frequency
 - Determine high level improvements needed to achieve level of service
 - Perform Qualitative Analysis
 - Establish Project Ranking Methodology
- Primary and Secondary Alternatives H&H Analysis
 - Includes detailed modeling of the selected alternatives







Structural Inventory









Identifying Damage Centers and Target Frequency



Water Surface Elevation Profile

S100-00-0030 Luce Bayou - Water Surface Elevation Profile



- Working on a dialogue with partners to discuss gage network
 - HCFCD (met with staff 10/21/19)
 - MOCO (received gage recommendations)
 - USGS (met with staff on 9/27/19)
 - SJRA (no additional gages requested)
 - COH (will request input)
- Additional ALERT 2 Rain and Stage gage recommendations
- Potentially some new flow gages (USGS)
- Identify what type of gages are appropriate for the location within the drainage basin
- Develop plan for implementation













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Schedule Update

54 Current Progress
478 Days Remaining
8/12/2019 Completion Date

- Existing Conditions H&H 98% (Comments, Calibration)
- Model Calibration 95% (Minor Updates)
- Primary Mitigation Planning (Revised Methodology) 30%
- Secondary Mitigation Planning (Adjusted Schedule) 70%


SAN JACINTO RIVER QUESTIONS?

Study Partners Kickoff Meeting October 10, 2019

Times













MEETING MINUTES

To:	Jing Chen, P.E., CFM	Attendees:	Jing Chen, HCFCD
From:	Terry Barr, P.E., CFM		Dena Green, HCFCD Dimitri Hamilton, HCFCD Beth Walters, HCFCD
Subject:	San Jacinto Regional Watershed Master Drainage Plan Progress Meeting		Matt Barrett, SJRA Jeff Johnson, Montgomery County Terry Barr, Halff
Meeting Date:	11/13/2019 – 1:30 pm		Andrew Moore, Halff
Location:	HCFCD, Brookhollow Office		Corey Stull, FNI Connor Stokes, Hollaway
Minutes Date:	11/19/2019		

AVO No.: 033465.002

Item	Description	Action
1.	Introductions	
	Ms. Chen started the meeting.	
2.	Communications and Outreach	
	 Conner stated the team is coordinating with the precincts to finalize times and dates. Tentative dates are Dec. 16th, 17th, and 19th. The three locations are Kingwood, Huffman, and Spring. Draft public notice has been sent out for review internally. Meetings will be open houses with introduction video. The video draft script will be sent out for review in the next week for approval. Hollaway is developing a "how to participate" handout to describe the meeting to the public and where questions can be answered. Jing stated that HCFCD is expecting to have separate tables for the different partners and wanted to see if they are interested in staffing the table. She requested study partners bring information they would like presented to each meeting. 	Hollaway to provide public notices for review. Hollaway to provide draft script.
3.	Activities Conducted This Month	
	 Barr stated the draft calibration report was submitted at the beginning of the month and was submitted as a technical appendix. He stated that a summary would be included in the next submittal. Dena stated the report and public meeting information should present that the change in floodplain is related to increase in precipitation not necessarily a difference in channel capacity. 	Study partners to provide comments on calibration report.

	Administrative Discussion (cont.)	
	• Cory stated he would reach out to the City Engineer of Liberty to see if there is any new contact for Liberty County. Matt also said that they potentially have a contact for the County and would provide.	FNI and SJRA to provide Liberty County contacts.
6.	Ms. Chen concluded the meeting.	

This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not correct, or that any information is missing or incomplete, please contact Halff Associates so that the matter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.





STUDY PARTNERS MONTHLY MEETING AGENDA Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

January 8, 2020 San Jacinto River Watershed Master Drainage Plan HCFCD, Brookhollow

Meeting ca	alled by:	Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Progress Meeting
Facilitator: Terry M. Barr, P.E., CFM		Meeting Start Time:	1:30 PM	
	Meeting Stop Time: 3:00 PM			
Agenda			<u> </u>	
1.	Introd	uctions		
2.	Comm	unications and Outreach (Hol	laway)	
	•	Community Meetings (Set 1) C	Completed in December	
	•	Woodlands Drainage Task For	ce Meeting (01/28/20)	
3.	Activit	ies Conducted this Month		
	•	Alternatives Workshop No. 2 ((12/11/19)	
	•	Continue updates to calibrated	models	
	•	Continue work on Primary Mit	tigation Actions (Alternation	atives) High Level Analysis
	•	Continue work on Secondary M	Mitigation Actions (FWS	S Gages)
	•	Continue work on Sedimentation and Vegetation Plan		
	•	Worked on Future Conditions hydrology		
	•	• Sensitivity analysis for FFE and higher frequency flooding (2-, 5-year) removal		
4.	Activit	ies Anticipated Next Month		
	•	Meet with MAAPnext (HDR)	to discuss calibration co	omments (01/10/20)
	•	Complete model calibration		
	•	Continue Primary/Secondary Flood Mitigation Alternatives analysis, including sensitivity		
	Start working on Other Mitigation Actions (Flood Response)			
	Submit Future Conditions Hydrology Memorandum			
	Submit Secondary Mitigation Actions Memorandum			
	•	Submit Sedimentation and Veg	getation Memorandum	
5.	Technical Discussion			
	•	Preliminary recommendations	for detailed alternatives	analysis
	•	Release of models to other age	ncies or engineering firm	ns
	Assumptions for Commercial and Industrial land uses for future conditions			
6.	Admin	istrative Discussion		
	•	• Public meeting(s) proposal authorized (Hollaway) – Lump Sum billing?		ump Sum billing?
	Procurement of Liberty and San Jacinto County CAD and property value data			
7.	Questi	ons		

SAN JACINTO RIVER SANJAGINTO - Regional Watershed Master Drainage Plan

Study Partners Progress Meeting January 8, 2020









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Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6









Coordination and Communication

- Coordination
 - Study Partners Meetings (6)
 - Supporting Partners Meeting(7)
- Communications
 - 1st round of public meetings complete
 - Woodlands Drainage Task Force Meeting – January 28th



FREQUENTLY ASKED QUESTIONS









Historical Storm Evaluation

- Responding to comments from HCFCD MAAPnext Review Team (HDR)
- Meeting with HDR to discuss calibration January 10th
- Addressing report comments
- Submit revised models



Birthplace of the UNIT

Future Conditions

- Utilizes detailed population projection layer (Urban Core)
 - Brazoria, Fort Bend, Galveston, Harris, and Montgomery Counties
 - Developed as part of the Harris-Galveston Subsidence District's Regional Groundwater Update Project
 - Near-term estimates based on field research
 - Long-term projections utilizing the Small Area Model-Houston
 - Decadal population projections for 2020-2070 at census block level
 - Used to develop water user population projections for the Region H Regional Water Plan
 - <u>https://hgsubsidence.org/science-and-research/</u>
- TWDB population projections (2021 Regional Water Planning)
 - Grimes, Liberty, San Jacinto, Waller, and Walker Counties
 - Less detailed information





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Land Use Categories	Land Use Descriptions	% Impervious	% Development
Undeveloped	Unimproved, natural, or agricultural	0	0
Residential – Rural Lot	\geq 5 acre ranch or farm	5	0
Residential – Large Lot (Newer)	½ acre new residential neighborhoods, storm sewers or roadside ditches with adequate capacity	25	100
Residential – Large Lot (Older)	> ¼ acre, older neighborhoods with limited capacity roadside ditches	25	50
Residential – Small Lot	≤ ¼ acre	40	100
Schools	Schools with non-paved areas	40	50
Developed Green Areas	Parks or golf courses	15	50
Light Industrial/ Commercial	Office parks, nurseries, airports, warehouses, or manufacturing with non- paved areas	6 5	100
High Density	Commercial, business, industrial, or apartments	85	100
Isolated Transportation*	Highway or major thoroughfare corridors	80	100
Water	Detention basins, lakes, and channels	100	100







Primary Flood Mitigation Planning

Workshop Summary

Damage Centers

- Sensitivity analysis of estimated finished floor elevations

- Comparison of damage centers to actual damages
- Removal of 2-year and 5-year frequency damages
- Incorporate roadway level of service
- Determine reductions in floodplains
- Alternatives
 - Regional detention volumes presented
 - Consideration for local benefits
 - Channelization, tunnels, buyouts, floodplain preservation
 - Impacts of future development and detention regulations







Secondary Flood Mitigation Planning

- Combined all input from stakeholders
- HCFCD, Montgomery County, SJRA, USGS
- Finalizing memorandum for January submittal







Secondary Flood Mitigation Planning



Other Mitigation Alternatives

- Begin setting up emergency protocol meetings
 - Harris County Hydrologic Operations
 - Harris County Office of Emergency Management
 - Montgomery County Office of Emergency management
 - San Jacinto River Authority
 - City of Houston
 - TxDOT
- Communications Plan/Protocol Update
- Identification of Critical Infrastructure
- Identification of Evacuation Routes







Sedimentation

- Total Suspended Solid measurements by USGS and gage locations
- Predicted annual suspended sediment loads per watershed



Sedimentation

Annual suspended sediment load compared to watershed area



Sedimentation

Sand Mining:

- Federal:
 - Regulated under the Mineral Mining and Processing Effluent Guidelines and Standards under 40 CFR Part 436 (Clean Water Act).
- State:
 - Under <u>30 Texas Administrative Code, Chapter 342</u>, APOs are to register with TCEQ. This registration includes an annual renewal, annual fee, and inspection every three years. This act went into effect on September 1, 2012.
 - Mining and reclamation of aggregate pits are not regulated under state law.
 - If operations will affect groundwater, air, or produce hazardous waste the facility will have to obtain permitting including but not limited to, Industrial Multi-Sector General Permits for Stormwater (MSGP), Texas Pollutant Discharge Elimination System Permits (TPDES), and Industrial Hazardous Waste Permits
 - Regulated from a safety aspect under the Texas Department of Transportation (TXDOT)
- Local:
 - No local or municipal regulations pertaining to GSMs were identified. There is speculation that the City of Houston will implement stricter regulation on GSMs within the next few years as a response to Hurricane Harvey





Schedule Update

54 Current Progress
478 Days Remaining
8/12/2019 Completion Date

- Existing Conditions H&H 98% (Comments, Calibration)
- Model Calibration 98% (Discussion with HDR/MAAPnext)
- Primary Mitigation Planning (Revised Methodology) 50%
- Secondary Mitigation Planning (Adjusted Schedule) 90%



SAN JACINTO RIVER QUESTIONS?

Study Partners Progress Meeting January 8, 2020

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MEETING MINUTES

To:	Jing Chen, P.E., CFM	Attendees:	Jing Chen, HCFCD
From:	Terry Barr, P.E., CFM		Rob Lazaro, HCFCD Gary Bezemek, HCFCD
Subject:	San Jacinto Regional Watershed Master Drainage Plan Progress Meeting	ſ	Matt Barrett, SJRA Darren Hess, Montgomery County Adam Eaten, City of Houston
Meeting Date:	1/8/2020 – 1:30 pm		Sam Hinojosa, Halff
Location:	Skype Conference Call		Andrew Moore, Halli Connor Stokes, Hollaway Carrett Johnston, Freese & Nichols
Minutes Date:	1/10/2020		Hector Olmos, Freese & Nichols
AVO No.:	033465.002		

Item	Description	Action
1.	Introductions	
	Ms. Chen started the meeting.	
2.	Communications and Outreach	
	 Conner stated that the team received 87 comments from public meetings and email correspondence. Hollaway is developing a master comment database and grouping comments into categories. He stated that they would begin responding to comments and would request for technical input from the study team. He is working to transcribe all comments and send out comments by 1/15/2020 and would like to have all comments responded by the end of January. Gary asked how the comments would be grouped and distributed since several studies were included on the public meetings. Connor stated that Hollaway would try to filter out by study type. Chen recommended creating a flow chart for the comment response process. 	
3.	Activities Conducted This Month	
	 Sedimentation – The study team has reviewed previous reports to understand the. The team has developed new rating curves to determine the annual suspended sediment loads. Presented exhibit showing the contribution of TSS. Cypress Creek has the highest amount of annual sediment loads. The study will look at the land cover changes over time considering changes from agriculture to developed land. Jing asked if the study will include isolating sedimentation from land use and soil types. George replied that this would not be included but should be investigated in future studies. 	

4.	 George stated that the TSS does not account for dead load (wash load – fine clays, live load - TSS, dead load – tumbles around bottom of channel). Studies in the past have not looked at dead loads so future studies could look into this aspect. Study is looking at the GeoCores developed from the USACE to estimate where the sediment is coming from (dead load, TSS, or wash load). Only one or two consultants are needed for the Woodlands Drainage Task Force update. A presentation is not anticipated for the meeting. Gary recommended an executive briefing agenda and giving them highlights prior to the briefing. Calibration meeting with HDR on 1/10/2020 to discuss final comments on the SJR calibration. Terry asked how the study partners would be sharing models with other entities. Gary recommended HCFCD discuss with study partners before releasing models to others. Matt and Darren requested formal documentation of the requests to follow up with each entity. Gary stated HCFCD would submit a formal request. Garrett discussed the future conditions population estimates and how those are incorporated into the hydrologic parameters including the impervious percentage and BDF. Darren mentioned a large grant was awarded to Patton Village for mitigation improvements. He said he could provide drawings of the potential drainage plans. Hector stated that the impervious percentage presented in the current PCPM impervious values could be low and proposed revising some of the values. Jing requested submitting a new table for review. Matt stated that SJRA would send over a few formal comments on the Alternatives Workshop. He asked if HCFCD or Montgomery County had any damages reported for Tropical Storm Imedia. Jing stated she would contact Harris County and Darren said he could provide damages for Montgomery County. 	HCFCD to submit formal request to study partners. MOCO to provide drawings of mitigation facilities.
	• Completing the secondary mitigation alternatives	
	 Completing the sedimentation analysis Completing the future conditions analysis 	
5.	Administrative Discussion	
	Terry stated he would develop a draft agenda for the emergency coordination meetings to begin setting up meetings.	coordinate emergency protocol meetings.
6.	Ms. Chen concluded the meeting.	

This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not correct, or that any information is missing or incomplete, please contact Halff Associates so that the matter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.





STUDY PARTNERS MONTHLY MEETING AGENDA Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

February 12, 2020 San Jacinto River Watershed Master Drainage Plan HCFCD, Northwest Crossing

Meeting ca	lled by:	Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Progress Meeting
Facilitator:		Terry M Barr P.F. CFM	Meeting Start Time	1·30 PM
Terry W. Bur, T.L., CI		Teny M. Dan, T.E., CI M	Meeting Start Time:	3:00 PM
Agondo			Weeting Stop Time.	5.001 M
Agenda				
1.	Introdu	uctions		
2.	Comm	unications and Outreach (Hol	laway)	
	•	Community Meetings (Set 1)	Completed in December	
	•	Public Meeting Comment Data	abase	
3.	Activit	ies Conducted this Month		
	•	Met with MAAPnext (HDR) to	o discuss calibration cor	nments (01/10/20)
	•	Completed Calibration		
	•	Nearing completion on the Fut	ure Conditions draft me	mo
	Nearing completion on the Sedimentation and Vegetation Plan draft			
	Nearing completion on the Secondary Mitigation Alternatives (FWS Gages) draft memo			
	Modeling Primary Mitigation Alternatives			
4.	Activities Anticipated Next Month			
	•	Nearing completion on the Fut	ure Conditions draft me	mo
	Nearing completion on the Sedimentation and Vegetation Plan draft			
	Nearing completion on the Secondary Mitigation Alternatives (FWS Gages) draft memo			
	Modeling Primary/Secondary Mitigation Alternatives			
	Begin coordination with surrounding counties to discuss emergency management			
5.	Technical Discussion			
	•	Future Conditions results		
	Secondary Mitigation Options results			
	•	Primary Mitigation Alternative	es	
6.	Administrative Discussion			
	•	HCFCD Executive Briefing (0	2/14/20)	
7.	Ouestic	ons		

SAN JACINTO RIVER SANJAGINTO - Regional Watershed Master Drainage Plan

Study Partners Progress Meeting February 12, 2020









San Jacinto River Basin

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6









Coordination and Communication

- Coordination
 - Study Partners Meetings (6)
 - Supporting Partners Meeting(7)
- Communications
 - 1st round of public meetings complete
 - Public Meeting Comment Database



FREQUENTLY ASKED QUESTIONS









Historical Storm Evaluation

- Met with HCFCD MAAPnext Team (HDR) January 10th
- Submitted revised calibrated models
- Addressed the following issues
 - Lake Conroe inflow/outflow
 - Infiltration rates



Birthplace of the UNIT

Future Conditions

- Utilizes detailed population projection layer (Urban Core)
 - Brazoria, Fort Bend, Galveston, Harris, and Montgomery Counties
 - Developed as part of the Harris-Galveston Subsidence District's Regional Groundwater Update Project
 - Near-term estimates based on field research
 - Long-term projections utilizing the Small Area Model-Houston
 - Decadal population projections for 2020-2070 at census block level
 - Used to develop water user population projections for the Region H Regional Water Plan
 - <u>https://hgsubsidence.org/science-and-research/</u>
- TWDB population projections (2021 Regional Water Planning)
 - Grimes, Liberty, San Jacinto, Waller, and Walker Counties
 - Less detailed information





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Methodology Overview

- Aggregated population projections by subbasin
- Assessed currently developed areas to generate two generalized development patterns (suburban, rural)
- Applied development patterns by subbasin to produce future conditions land use data
- Used future conditions land use data to create future conditions hydrologic parameters
- Created hydrologic and hydraulic model runs based on future conditions parameters









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Development Pattern Group Cypress and Spring Lake Houston Cleveland Conroe Generic Development Group Suburban Rural

Type

Rural

Suburban

Development Pa	ttern Area	Transp.	Low Intens.	Med. Intens.	High Intens.	Devel. Open Space
Cypress and Spr	ing	3%	54%	25%	5%	13%
Lake Houston		5%	63%	14%	7%	11%
Cleveland		13%	71%	5%	3%	9%
Conroe		7%	70%	10%	5%	8%
R. Test of the	「大学の語ので	New Co	}	Frank 1	m	A Poort
Future	Devel	opment Pa	attern (Pc	t. of Deve	loped Ar	ea)
Development Type	Transp.	Lov	w N	led.	High	Devel. Open

Intens.

5%

5%

Future Conditions

Develo	opment Pat	tern (Pct. of	f Develope	d Area)	2018		addr 11330 265,0900 addr Current ant Chronien Citt	
nsp.	Low Intens.	Med. Intens.	High Intens.	Devel. Open Space	Population per Developed Acre		crus Atto 00000015315Eu Noon tau Pere (no. 1au ta D.1. Designer Pala	ten 1
%	54%	25%	5%	13%	9.22		PA PROJE DATE CALE PLE NAME PREPAREE	
%	63%	14%	7%	11%	6.3		lan	1
3%	71%	5%	3%	9%	4.05		age F	
%	70%	10%	5%	8%	4.63		ups	
CA.	}	for 1	1 mg	1 Poort	(7)		DISTRIC Ister	
ent Pa	attern (Pc	t. of Deve	loped Ar	ea) P	opulation per	202	ontrol ed Ma ttern	
Lov Intens	v N s. Inte	led. ens. In	High tens.	Devel. Open Space	Future Developed Acre		ARRIS COUNTY FLOOD CO gional Watersh elopment Pal Future Condi	ARIS COUNTY
50%	6 3	80%	5%	10%	10.05		HI Ito Re Dev	H
65%	6 1	5%	5%	10%	6.6		1 Jacin	(S
		e Office se creek					San JACINTO Sa REGIONAL WATERSHED MASTER DRAINAGE PLAN 9	TAN KOW * P





Projected Change in Developed Area, 2018-2070							
Subwatershed	2018 Population	2018 Developed Area (ac)	Change in Population 2018–2070	Area (ac) Req'd for Fut. Dev.	2070 Developed Area		
Lake Creek	28,078	30,264	72,251	10,947	41,211		
Spring Creek	287,039	96,251	510,455	49,180	145,431		
Willow Creek	71,385	25,140	46,827	3,835	28,975		
Cypress Creek	451,660	89,856	138,957	9,564	99,419		
Little Cypress Creek	47,791	17,625	37,562	3,727	21,352		
West Fork	420,196	133,906	593,614	69,166	203,072		
Luce Bayou	8,817	5,669	5,792	673	6,341		
Tarkington Bayou	12,228	10,476	4,852	735	11,211		
Caney Creek	80,492	36,361	182,619	25,285	61,647		
Peach Creek	29,005	18,011	73,295	11,098	29,109		
East Fork	44,042	29,416	23,824	3,401	32,817		
Jackson Bayou	4,377	1,981	1,844	183	2,165		
Gum Gully	11,830	3,519	9,152	911	4,430		







Development Patterns by Subwatershed (2018)									
	Development Pattern (Pct. of Developed Area)								
Subwatershed	Total Area (ac)	Pct. Dev.	Transp.	Low Intens.	Med. Intens.	High Intens.	Devel. Open Space	Avg. Pct. Imp.	Avg. DLU
Lake Creek	211,803	14%	3%	79%	8%	3%	8%	10.1	18.3
Spring Creek	248,160	39%	3%	72%	13%	3%	10%	17.4	42.4
Willow Creek	35,567	71%	6%	51%	15%	4%	24%	27.7	63.1
Cypress Creek	170,789	53%	3%	45%	28%	7%	16%	26.7	54.3
Little Cypress Creek	33,466	53%	5%	49%	16%	3%	27%	20.4	44
West Fork	504,123	27%	7%	66%	13%	6%	8%	19.2	34.8
Luce Bayou	53,728	11%	8%	74%	1%	0%	17%	6.3	13.8
Tarkington Bayou	83,611	13%	16%	72%	5%	2%	5%	5.2	11.9
Caney Creek	139,442	26%	7%	82%	4%	2%	6%	15.3	30.2
Peach Creek	101,496	18%	5%	89%	2%	1%	2%	10.7	21.4
East Fork	264,371	11%	10%	79%	4%	1%	6%	6.5	14.4
Jackson Bayou	4,747	42%	9%	63%	9%	7%	12%	20.6	40.6
Gum Gully	11,846	30%	7%	68%	3%	1%	20%	12.1	30.5
1		Develo	oment Patt	erns by Su	bwatershe	ed (2070)			
			Devel	opment Pat	tern (Pct. of	Developed	Area)		
Subwatershed	Total Area (ac)	Pct. Dev.	Transp.	Low Intens.	Med. Intens.	High Intens.	Devel. Open Space	Avg. Pct. Imp.	Avg. DLU
Lake Creek	211,803	19%	3%	75%	9%	3%	9%	12.4	23.6
Spring Creek	248,160	59%	4%	63%	19%	4%	10%	27.7	63.3
Willow Creek	35,567	81%	5%	50%	18%	4%	22%	32.7	73.1
Cypress Creek	170,789	58%	3%	45%	29%	7%	16%	29.6	60
Little Cypress Creek	33,466	64%	5%	49%	18%	4%	24%	25	53.5
West Fork	504,123	40%	6%	62%	18%	6%	9%	26.4	49.9
Luce Bayou	53,728	12%	7%	72%	3%	1%	16%	6.9	15
Tarkington Bayou	83,611	13%	15%	71%	6%	2%	6%	5.6	12.8
Caney Creek	139,442	44%	6%	73%	11%	3%	7%	22	45.5
Peach Creek	101,496	29%	5%	80%	7%	3%	5%	14.9	31.3
East Fork	264,371	12%	9%	77%	5%	2%	6%	7.3	16.2
Jackson Bayou	4,747	46%	9%	62%	11%	7%	12%	22.7	45
Gum Gully	11,846	37%	7%	64%	9%	2%	18%	16	38.7







Impervious Cover Change



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BDF Change



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Increase in 1% ACE Water Surface Elevations

Summary of Increases in Peak WSE (2018-2070)

Ctas and	100-yr I	ncrease	2-yr Increase		
Stream	Avg (ft)	Max (ft)	Avg (ft)	Max (ft)	
Lake Creek	0	0.5	0	0	
Spring Creek	0.1	1.6	0.2	0.6	
Willow Creek	0	0.1	0.1	0.3	
Cypress Creek	0.1	0.4	0.4	1.7	
Little Cypress Creek	0	0.1	0.1	0.8	
West Fork	0.4	1.1	0.4	1	
Luce Bayou	0	0.2	0	0.2	
Tarkington Bayou	0.1	0.2	0.1	0.2	
Caney Creek	0.1	0.2	0.4	0.8	
Peach Creek	0.1	0.2	0.1	0.4	
East Fork	0	0.2	0	0.3	
Lake Houston Dam	-	0.1	-	0.2	
Jackson Bayou	0	0	0	0.1	
Gum Gully	0	0.1	0.1	0.1	





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Sedimentation Strategy for West Fork San Jacinto River And Spring Creek

- Sedimentation strategies developed using the following
 - Following guidelines of US Army Corps of Engineers and US EPA
 "Regional Sediment Management Plan"
 - Identified sediment sources
 - Potential erosion of land scape (Revised Universal Soil Loss Equation, RUSLE)
 - Erosion of river stream banks and valley walls (stream deflection and LiDAR comparison)
 - Identified sediment depositional areas (LiDAR elevation comparison)
 - Annual suspended sediment loads from each of San Jacinto watershed's seven sub basins
 - Review of deposited sediment sizes of geotechnical cores from Lake Houston
 - Aggregate Production Operations (mapping APO boundaries)
- Over forty sediment strategies mapped on the West Fork and Spring Creek mainstems.
- Opportunities for public-private partnerships identified
- Extension of jurisdictional authority to implement sediment strategies recommended



Sediment Sources

- Evaluated potential erosion of landscape using comparison of 2018 Lidar to older LiDAR data: collected in 2008 (Montgomery County) or collected in 2001 (Harrison County)
- Two analyses were completed comparing recent LiDAR to older LiDAR
 - Stream deviation (the horizonal distance between the mainstem's centerline measured in older LiDAR to the mainstem's centerline measured in recent LiDAR).
 - Change in elevation (the vertical distance between older LiDAR and recent LiDAR)
 - Regions where the older LiDAR elevation is higher are potential areas of sediment loss (example: eroding stream banks)
 - Regions where the older LIDAR elevation is lower are potential areas of sediment deposit (example: sand bars)

Deviation Severity (In Feet)	West Fork San Jacinto River	Spring Creek
Minimal (<30)	38.8%	49.6%
Moderate (30<>60)	18.2%	19.6%
High (60<>90)	13.2%	9.4%
Severe (>90)	29.8%	21.4%

Stream Deviation Findings

- Most of the minimal deviation occurs in the mainstem's headwaters
- Most of the severe deviations occur further downstream







Sediment Sources: Measured Sediment Transport

Updated annual suspended sediment loads for the seven major subwatersheds in the San Jacinto watershed.

		Annual Suspended Sediment Load						
Subwatershed	Drainage		tons/year (tons/sq mi/year)					
Subwatershed	Area (sq. mi)	USGS	Bedient et al.	Brown	FNI			
		1978	1980	2000	2020			
Cypress Creek	324.1		51,600 (159.2)	158,000 (487.5)	189,940 (586.1)			
Spring Creek	437.6	23,400 (53.5)	14,600 (33.4)		131,061 (299.5)			
West Fork San Jacinto River	587.7	36,500 (62.1)	39,700 (67.6)	45,000 (76.6)	64,138 (109.1)			
East Fork San Jacinto River	406.9		14,000 (34.4)		41,371 (101.7)			
Caney Creek	216.7	6,390 (29.5)	27,600 (127.4)		37,981 (175.3)			
Peach Creek	156.2		15,300 (97.9)		8,370 (53.6)			
Luce Bayou	212.8		12,900 (76.6)		18,404 (86.5)			
Total	2,342.0		175,700 (75.0)		491,265 (209.8)			

Finding

1.

2.

ina	Year	Storage in	Years Lapsed	Rate of Loss
Cypress Creek consistently has the largest annual suspended sediment load vet.		Lake Houston (acre-ft)	Since Constructed	(acre-ft/year)
Annual suspended sediment load in acre-feet per vear is	1954	158,553	0	
433-acre feet per year which is a reasonably good	1965	146,769	11	1070
predictor of rate of loss of volume in Lake Houston	1983	130,728	29	960
	1994	136,920	40	540
	2011	126,900	57	555
	2018	128,775	64	465







Overview of Sediment Management Strategies

Various techniques to stop sediments from depositing in area of concern

Protect river streambanks and valley walls

- Restore stream structure and function
- Aggregate mine operation protection

Improved Hydraulic Conveyances

- Increasing the steepness of the riverbed slope
- Increasing the channel's hydraulic radius through a change in a channel's ratio of width to depth
- Decreasing the roughness of the channel

Sediment Bypass Tunnel

 Tunnel that diverts sediment through a tunnel which begins upstream of the area of concern and ends downstream of the Lake Houston dam.

Improve Hydraulic Influence of Lake Houston Dam in area of concern

Dam's backwater effect reduces the West Fork's ability to move sediment through the area of concern

Energy Grade	Shear Power	Stream Power	
Line Slope (ft/ft)	(lb/sq ft)	(lb/ft sec)	1000
0.000179	0.09	0.18	
0.000455	0.14	0.32	N INC
0.000322	0.1	0.2	
0.000013	0	0.01	N N N
0.000004	0	0	
0.000006	0	0	NVX II
	Energy Grade Line Slope (ft/ft) 0.000179 0.000455 0.000322 0.000013 0.000004 0.000006	Energy Grade Shear Power Line Slope (ft/ft) (lb/sq ft) 0.000179 0.09 0.000455 0.14 0.0000322 0.1 0.000013 0 0.000004 0 0.000006 0	Energy Grade Shear Power Stream Power Line Slope (ft/ft) (lb/sq ft) (lb/ft sec) 0.000179 0.09 0.18 0.000455 0.14 0.32 0.000322 0.1 0.2 0.000013 0 0.01 0.000004 0 0

Area of concern







Overview of Sediment Management Strategies: Continued

Various techniques to stop sediments from depositing in area of concern

Sediment trapping

- Either construct an "in-line trap", i.e. a facility that is within the average daily water flow lines or build an "off-line trap", i.e. a facility that is parallel to but outside the average daily flow lines
 - Example of in-line trapping facility





-Examples of off-line trapping facility

- A portion of the river will be deflected into an abandoned aggregate mine pit. Bedload sediment will fall into the deep hole left by an aggregate pit that is no longer in use, and is trapped.
- A portion of the river will be deflected into a side channel, whose hydraulics have been artificially manipulated to reduce the river's power, leading to sediment deposition.







Specific Sedimentation Strategy 1 of 5

1.0-1.25

1.25-1.5

2.0-3.0

>3.0



0 - 0.5

0.5 - 0.75

Streams

Lake Houston Watershed Sub-Basins

Spring Creek Watershed

Protect Upland Soils

Numerous regions bordering both mainstems with high potential of landscape erosion

Map of a region bordering Spring Creek where potential soil loss is high, requiring protection of upland soils







Specific Sedimentation Strategy 2 of 5

Multiple locations to reduce sediment flowing to Lake Houston found in **Spring Creek**

SAN JACINTO

Potential to Reduce	Strategy	Strategy
Sediments Flowing to Lake Houston		Number
	Streambank/valley wall protection	19,23
High	Head cut protection	20
- iigii	Sediment trap	27,25,22
	Stream Restoration	26
	Head cut protection	6,11
Moderate	Sediment trap	13, 16
moderate	Streambank/valley wall protection	10, 18, 28
	Stream restoration	21, 24
	Upland soil protection	1
Lower	Streambank protection	2,3,9,17
Lower	Stream restoration	4, 14
	Sediment trap	5,7,8
Lower	Upland soil protection Streambank protection Stream restoration Sediment trap	1 2,3,9,17 4, 14 5,7,8







Specific Sedimentation Strategy 3 of 5

Multiple locations to reduce sediment flowing to Lake Houston found in Spring Creek

 This is one map from a series of map that depicts potential sediment sources, regions of sediment deposit and stream centerline deviation. Proposed specific sedimentation strategies are also presented.



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Specific Sedimentation Strategy 4 of 5

Multiple locations to reduce sediment flowing to Lake Houston found in West Fork

 This is one map from a series of map that depicts potential sediment sources, regions of sediment deposit and stream centerline deviation. Proposed specific sedimentation strategies are also presented.



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Specific Sediment Source Protection: 5 of 5

This is an example of improving hydraulic conveyance to move sediment through the area of concern in the West Fork









Sedimentation Strategy Recommendations

- Use stream gage data to predict the amount of suspended sediment from different regions within the West Fork and Spring Creek subwatersheds. There are multiple locations where suspended sediment is being measured in these subwatersheds.
- Install new stream gages to measure suspended sediment in Cypress Creek subwatershed to improve the understanding of where in the subwatershed most of its sediments originate.
- Complete a regional sedimentation mitigation plan and develop an annual sediment budget for the San Jacinto watershed, including individual subwatersheds and notable drainage areas within each subwatershed.
- Complete a GIS exercise to quantify potential sediment sources from eroding streambanks and valley walls to determine the percentage of sediments originating from eroding banks versus landscape erosion.



- Damage Centers
 - East Fork SJR, West Fork SJR
 - Peach, Caney, Spring Creeks









- Considering potential watershed mitigation strategies
 - Storage Reservoirs
 - East Fork SJR
 - Caney Creek
 - Peach Creek
 - Lake Creek
 - Spring Creek
 - Channelization
- Modeling various detention volumes and locations

Road& TIN







Secondary Mitigation Planning

- Received input from HCFCD, MCO, USGS, Others
- Considered variety of gage types (Rain, Flow, Stage)
- Flood warning and data for future calibration efforts



Other Mitigation Actions

- Evaluate communications plan/protocol during emergencies
- Identify critical infrastructure and compare to inundation
- Determine expected flood frequency evacuation routes
- Meeting with all Emergency Management Coordinators
 - Completed (Montgomery, Waller, Walker, Grimes, Conroe)
 - Scheduled (Liberty, San Jacinto, Harris, Houston)
 - Workshop (March 12th) to discuss preliminary findings









Schedule Update

54 Current Progress
478 Days Remaining
8/12/2019 Completion Date

- Existing Conditions H&H 100% (Comments, Calibration)
- Model Calibration 100% (Completed calibration update)
- Primary Mitigation Planning (Revised Methodology) 50%
- Secondary Mitigation Planning (Adjusted Schedule) 95%



SAN JACINTO RIVER QUESTIONS?

Study Partners Progress Meeting January 8, 2020

T June













DRAFT MEETING MINUTES

То:	Jing Chen, P.E., CFM	Attendees:	Jing Chen, HCFCD
From:	Terry Barr, P.E., CFM San Jacinto Regional Watershed Master		Matt Barrett, SJRA (via phone) Terry Barr, Halff
Subject:	Drainage Plan Progress Meeting		Andrew Moore, Halff Corv Stull Freese & Nichols
Meeting Date:	2/12/2020 – 1:30 pm		Hector Olmos, Freese & Nichols Garrett Johnston, Freese & Nichols
Location:	Harris County Northwest Crossing		Andrew Swynenberg, Freese & Nichols
Minutes Date:	2/14/2020		
AVO No.:	033465.002		

Item	Description	Action
1.	Introductions	
	Ms. Chen started the meeting.	
2.	Communications and Outreach	
	 Developing public meeting summary report which will be provided to the team for technical responses. Report will be submitted by early next week for the full report. Total of 70 comments from meetings plus another 30 email comments. Second round of meetings scheduled for April/May. Individuals from the meeting stated that notice in local newspapers would be helpful for future meetings. Olmos mentioned using NextDoor or other apps. Mentioned posting on Facebook of local organizations. Chen mentioned keeping Beth Walters involved as she has HOA and other organization contacts. Green asked if we should move locations or change the approach. HCFCD and Hollaway have developed a comment database with standard responses to public meeting comments. 	
3.	Activities Conducted This Month	
	 Completed calibration models and submitted. Revised memorandum will be submitted. Future conditions population changes were based on existing TWDB and HGAC population projections. Green asked if we included the different drainage criteria from the various agencies. Olmos stated that they did include detention rates. Green asked if we could add existing City Limits and communities on the expansion graphs. 	Halff/FNI – Provide updated calibration memo

	 Green asked if we removed obvious areas where development cannot occur such as Lake Houston, Lake Conroe, Katy-Prairie area. Green asked to make sure the old methodology assumptions are matching the new BDF methodology and that the methods are picking up the differences and effectives of development. She mentioned that the parameters that effect TC+R values are not sensitive to small changes in development. Green mentioned that increases on Cypress are surprising due to HCFCD current regulations. Hinojosa and Stull mentioned that volume is likely the contributor. Green mentioned that previous studies showed 1-2 inches increase in water surface elevations. Chen asked if the team had looked at a no detention requirement for the watershed. Barr stated that the team was looking into a no detention solution. Barr said that development location can change the results. Green asked about the assumption of no floodplain fill. Is that a valid assumption and could that change results? She added that Upper Cypress has a higher detention rate in the upper basin. Hinojosa stated that the memorandum for sedimentation include percentage breakdown of sedimentation contributors for each watershed. Chen mentioned that the public is expecting us to tie flooding to sedimentation; however, the scope of the project is not reviewing this claim. Green asked if the HCFCD had received a final report on the benefits of dredging. She asked if we could review the RAS models from the USACE. Recommendation should include further modeling to analyze the options and benefit to flood reduction. 	FNI – Update sedimentation memo to include percentage breakdown of sediment per watershed
4.	Activities Planned Next Month	
	 Completion of future conditions memorandum and study. Meeting with various emergency management officers. Group meeting planned in March for all entities to coordinate together. Are there common steps that could be shared in each of the guidelines. Hinojosa stated that the agencies are beginning to coordinate during disasters. Smaller counties do not have written protocol which may be recommended in the report. 	Halff/FNI – Start working on EMC Workshop materials
5.	Ms. Chen concluded the meeting.	

This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not

correct, or that any information is missing or incomplete, please contact Halff Associates so that the matter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.





STUDY PARTNERS MONTHLY MEETING AGENDA Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

March 11, 2020 San Jacinto River Watershed Master Drainage Plan SJRA, G&A Division Office

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Progress Meeting				
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	2:00 PM				
			Meeting Stop Time:	3:30 PM				
Agenda								
1.	Introd	Introductions						
2.	Communications and Outreach (Hollaway)							
	•	• Planning for Community Meetings (Set 2) Started – Tentatively scheduled for early July						
	Public Meeting Comment Database							
3.	Activities Conducted this Month							
	• Executive Briefing on 02/14/20							
	Completed Existing H&H Model Calibration							
	Discussed options for the Future Conditions draft memo							
	Continued Modeling Primary/Secondary Mitigation Alternatives							
	Submitted Sedimentation and Vegetation Plan draft							
	Submitted Secondary Mitigation Planning (FWS Gages) draft memo							
	Completed Other Mitigation Actions interviews with various County EMC							
4.	Activities Anticipated Next Month							
	Complete Primary/Secondary Mitigation Alternatives modeling							
	• Start work on cost estimates and benefits of alternatives							
	Provide revised Secondary Mitigation Planning (FWS Gages) memo							
	 Conduct Other Mulgation Actions workshop Start Planning for second round of Community Meetings 							
5.	Technical Discussion							
		Primary Mitigation Alternative	undata					
	•		es upuale					
6.	Administrative Discussion							
	•	N/A						
7.	7. Questions							

SAN JACINTO RIVER SANJACINTO - Regional Watershed Master Drainage Plan

Study Partners Progress Meeting March 11, 2020









San Jacinto River Basin

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6



FLOOD SHARE CONTROL





Coordination and Communication

- Coordination
 - Calibration discussion with J. Terry (HCFCD)
 - Coordination with MAAPnext
 - Woodlands JDTF



FREQUENTLY ASKED QUESTIONS

- Communications
 - Planning for Community Meetings (Set 2) Started
 - Public Meeting Comment
 Database









Historical Storm Evaluation

- Met with HCFCD MAAPnext Team (HDR) January 10th
- Submitted revised calibrated models
- Addressed the following issues
 - Lake Conroe inflow/outflow
 - Infiltration rates
- Revised calibration memo this month









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Future Conditions Updates

50-year Projection

	5		,						
Summary of Increases in Peak WSE (2018-2070)									
Stream	100-yr Increase		2-yr Increase						
Stream	Avg (ft)	Max (ft)	Avg (ft)	Max (ft)					
Lake Creek	0	0.5	0	0	12				
Spring Creek	0.1	1.6	0.2	0.6					
Willow Creek	0	0.1	0.1	0.3					
Cypress Creek	0.1	0.4	0.4	1.7	10				
Little Cypress Creek	0	0.1	0.1	0.8	r				
West Fork	0.4	1.1	0.4	1	3.74				
Luce Bayou	0	0.2	0	0.2	8				
Tarkington Bayou	0.1	0.2	0.1	0.2					
Caney Creek	0.1	0.2	0.4	0.8					
Peach Creek	0.1	0.2	0.1	0.4					
East Fork	0	0.2	0	0.3	355				
Lake Houston Dam	-	0.1	-	0.2					
Jackson Bayou	0	0	0	0.1	3.0				
Gum Gully	0	0.1	0.1	0.1					





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Future Conditions Updates

• Ultimate Development Comparison (in progress)



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Path: H:\STORMWATER\Exhibits\2020-02 Future Conditions Memo\EX 6 - 2020-2070 Population Density Change by Subbasin.mxd

Current Progress

- Identify Damage Centers
- Primary Alternative H&H
- Secondary Alternative H&H
- Future Tasks
- BCA and Project Constraints
- Alternative Funding
- Project Implementation







- Damage Centers
 - East Fork SJR, West Fork SJR
 - Peach, Caney, Spring Creeks







- Primary Mitigation
 - East Fork (National Forest)
 - East Fork (Cleveland)
 - Spring Creek (Walnut Creek)
 - Lake Creek (U/S SH 105)
- Secondary Mitigation
 - Additional Reservoirs (Lake, Spring, Peach, Caney, East)
 - Channelization
 - Sand Mine Conversion
 - Detention Regulations
 - Sedimentation/Dredging
 - Others






Spring Creek

- Est. 25,000 acre-feet
- Walnut Creek Reservoir Alternative
 - 17,000 ac-ft
 - 1,500 acres
 - 43 ft dam
 - 3,000 flooding instances reduction (ex. 8,385)









Spring Creek

- Est. 25,000 acre-feet
- Birch Creek Reservoir Alternative
 - 11,000 ac-ft
 - 1,000 acres
 - 40 ft dam
 - 2,000 flooding instances reduction (ex. 8,385)









Spring Creek

- Est. 25,000 acre-feet
- Mill Creek Reservoir Alternative
 - 11,000 ac-ft
 - 900 acres
 - 50 ft dam
 - 1,400 flooding instances reduction (ex. 8,385)









Alternatives Evaluation – Example Results

Sconorio	Cumulative Number of Flooded Structures					Instances	Denefit
Scenario	500-yr	100-yr	50-yr	25-yr	10-yr	(50-yr Life)	benefit
East Fork – Existing	2,021	1,062	643	431	156	2,850	
East Fork Dam Near FM 945	1 <i>,</i> 593	619	364	231	94	1,708	1,142
Winters Bayou Dam Near East Fork	1,491	594	350	219	89	1,622	1,228
Winters Bayou Dam Near Nebletts Creek	1,631	683	452	264	108	1,933	918
East Fork Channelization A	1,753	771	466	313	118	2,145	705
East Fork Channelization B	1,619	745	457	310	115	2,082	769
East Fork Channelization C	1,554	739	454	311	115	2,066	784

Connection	Cumulative Number of Flooded Structures					Instances	Densett
Scenario	500-yr	100-yr	50-yr	25-yr	10-yr	· (50-yr Life)	Benefit
Spring Creek – Existing	13 <i>,</i> 375	5 <i>,</i> 500	2,519	1,141	385	10,861	
Walnut Creek Dam	11 <i>,</i> 856	3 <i>,</i> 985	1,606	769	243	7,879	2 <i>,</i> 982
Birch Creek Dam	12,421	4,502	1,847	923	290	8,901	1,960
Walnut and Birch Creek Dams	10,886	3 <i>,</i> 089	1,289	609	195	6,532	4,329
Mill Creek Dam	12,472	4,602	2,005	1,022	334	9,449	1,412
						-	







Alternatives Evaluation – Example Results

 "Instances of structural flooding" metric incorporates the probability of 10-year through 500-year frequency events occurring over 50 years

Spring Creek – Reduction in Instances of Structural Flooding (50-yr Project Life)





Lake Creek

- Prelim Est. 150,000 acre feet
- Tributary Reservoirs Alternative
 - 60,000 ac-ft (total)
 - 5,500 acres (total)
 - 35 ft dams
 - 2,000 flooding instances reduction (ex. 7,149*)





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*includes West Fork basin

Lake Creek

- Prelim Est. 150,000 acre feet
- Lake Creek Main Stem Alternative
 - 80,000 ac-ft
 - 6,000 acres
 - 50 ft dam
 - 2,000 flooding instances reduction (ex. 7,149*)











*includes West Fork basin

West Fork (Upstream 59)

- Sand Mine Conversion
 Alternative
 - Southern Crushed Concrete
 - Investigating volumes
- Midreach Channelization
 Alternative
 - 3,000 ft wide
 - 20 miles
 - 1,200 flooding instances reduced (ex. 6,149)





West Fork (Downstream 59)

- Lower Reach Channelization
 Alternative
 - 3,000 ft wide
 - 5 miles
 - 1,200 flooding instances reduced (ex. 6,149)
- Lower Reach Benching Alternative
 - 8,000 ft wide
 - 5 miles
 - 1,400 flooding instances reduced (ex. 6,149)







Caney Creek

- Prelim Est. 40,000 acre feet
- Reservoirs
 - 40,000 ac-ft
 - 4,200 acres
 - 50 ft dam
 - 2,000 flooding instances reduction (ex. 6,194)
- Downstream channelization
 - 400 ft wide channel
 - 40,000 LF



FLOOD SINCONTROL





Peach Creek

- Prelim Est. 40,000 acre feet
- Reservoir
 - 45,000 ac-ft
 - 3,800 acres
 - 40 ft dam
 - 2,000 flooding instances reduction (ex. 4,901)
- Other potential locations
- Downstream channelization
 - In progress



East Fork

- Prelim Est. 100,000 acre feet
- Winters Bayou North Alternative
 - 35,000 ac-ft
 - 2,200 acres
 - 47 ft dam
 - 900 flooding instances reduction (ex. 4,513)









East Fork

- Prelim Est. 100,000 acre feet
- Winters Bayou South Alternative
 - 56,000 ac-ft
 - 3,000 acres
 - 52 ft dam
 - 1,200 flooding instances reduction (ex. 4,513)







East Fork

- Prelim Est. 100,000 acre feet
- East Fork Main Stem Alternative
 - 91,000 ac-ft
 - 3,700 acres
 - 54 ft dam
 - 1,100 flooding instances reduction (ex. 4,513)









East Fork

- Channelization
 - 11 miles prior to Lake Houston
 - 200 ft wide
 - 705 flooding instance reduction
 - 400 ft wide
 - 769 flooding instance reduction
 - 600 ft wide
 - 784 flooding instance reduction











Next Steps

- Finalizing alternative modeling
 - Volumes, Outlets, PMF elevations for reservoirs
- Combination and Regional Solutions
 - Caney Creek near Peach Creek Confluence
 - East Fork near Lake Houston
 - West Fork near Lake Houston
- BCA and Project Constraints
- Alternative Funding
- Project Implementation







Secondary Mitigation Planning

- Received input from HCFCD, MCO, USGS, Others
- Considered variety of gage types (Rain, Flow, Stage)
- Flood warning and data for future calibration efforts



Other Mitigation Actions

- Other Mitigation Action Goals
 - Evaluate communications plan/protocol during emergencies
 - Identify critical infrastructure and compare to inundation
 - Determine expected flood frequency evacuation routes
- Met with all Emergency Management Coordinators
- Workshop (March 11th) to discuss preliminary findings









Schedule Update

54 Current Progress
478 Days Remaining
8/12/2019 Completion Date

- Existing Conditions H&H 100% (Comments, Calibration)
- Model Calibration 100% (Completed calibration update)
- Primary Mitigation Planning (Revised Methodology) 70%
- Secondary Mitigation Planning (Adjusted Schedule) 99%



SAN JACINTO RIVER QUESTIONS?

Study Partners Progress Meeting March 11, 2020

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AVO No.:

033465.002



MEETING MINUTES

To:	Jing Chen, P.E., CFM	Attendees:	Jing Chen, HCFCD
From:	Terry Barr, P.E., CFM		Matt Barrett, SJRA Terry Barr, Halff Sam Hinoiosa Halff
Subject:	San Jacinto River Watershed Master Drainage Plan Progress Meeting		Andrew Moore, Halff Rachel Massey, Hollaway Thomas Mumford Hollaway
Meeting Date:	03/11/2020 – 2:00 pm		Garrett Johnston, Freese & Nichols
Location:	SJRA, G&A Division Office		Hector Olmos, Freese & Nichols Corey Stull, Freese & Nichols
Minutes Date:	03/18/2020		

Item	Description	Action
1.	Introductions	
	Ms. Chen started the meeting.	
2.	Communications and Outreach	
	• Ms. Massey and Mr. Mumford gave and overview of the communications efforts to date. They provided copies of the <i>San Jacinto Regional Watershed Master Drainage Plan Public Meeting Summary Report</i> (Fall 2019), which includes a summary of the meeting attendance and comments at each location. A general overview of the study as well as a summary of the public input was included.	
	• Hollaway also provided a draft schedule for the second set of public meetings to be conducted in July 2020. The schedule included specific dates and responsibilities for the various team members. They also noted that the public meeting located in Tomball for the first round will be moved to the Woodlands for the second round to increase participation. Additional measures will be taken to improve participation, leveraging social media and increased mailers and emails to local groups, including HOA's and groups interested specifically in flooding issues.	Hollaway – provide schedule updates as needed or if there are comments
3.	Activities Conducted This Month	
	• Mr. Moore provided a presentation to the group that reviewed the work performed over the last month. He indicated that the team had met with the MAAPnext lead, Duane Barrett, and addresses the concerns voiced by them. The calibration was completed and the study team is working on updating the memo. The revised memo will be provided by the end of March.	Halff/FNI – submit updated calibration memo

	modeling, which was initially presented in February. Mr. Johnston explained that the original future conditions analysis focused on a 50-year horizon and showed minimal increases in flows and WSEL along the streams. This was primarily a result of the development occurring in the central and lower parts of the watershed and almost none in the outer areas. Halff/FNI are currently looking at an Ultimate Conditions evaluation to determine what a "worst-case scenario" for development might look like. The future conditions memo should be complete by early April.	Halff/FNI – submit updated future conditions memo
•	The majority of the meeting was focused on preliminary results of the Primary and Secondary Alternatives analysis. Mr. Moore gave a brief overview of the tasks completed to date and those that are in progress or upcoming. He reiterated the damage centers that are the focus of the alternatives modeling effort, which include areas along the East Fork SJR, Peach Creek, Caney Creek, West Fork SJR, and Spring Creek. Alternatives are being evaluated on each of these streams as well as on Lake Creek. A breakdown of the "primary" and "secondary" alternatives was included. Primary alternatives are based on those flood reduction measures recommended in previous reports and with minor adjustments. Secondary alternatives include other options, such as additional reservoirs, channelization, sand mine detention, etc. Mr. Barrett mentioned the potential for a Lake Lowering alternative. This is discussed below in the Technical Discussion section.	
•	Mr. Moore started the detailed discussion of the alternatives findings with Spring Creek. He specified that the information provided in the slides for Spring Creek would be the same as slides for the other alternatives. The Spring Creek discussion included three separate reservoirs along Walnut, Birch, and Mill Creeks in Montgomery County. Information such as the approximate volume, acreage, dam height, and expected reduction of flooding instances were included. Mr. Barrett and Ms. Chen asked about the instances of flooding and if they included the lower level (i.e. 2-year, 5-year) storms. Mr. Moore indicated that the instances of flooding did not include the lower level storms because it is not likely that enough flood reduction could be achieved to provide protection. Those structures could potentially be good candidates for a buy-out program. However, in the final BCA calculation, it was agreed that all structures should be included as these structures may still receive benefit from the project and may not be bought out before the project is implemented.	
•	Mr. Moore presented a sample table of the results that will be included in the final report. The table included a summary of	

	 the estimated reduction in flooding instances or "benefits" for each damage center and corresponding alternatives. Mr. Johnston presented graphics that show the reduction of flood instances per river mile. The graphic is based off the same one presented as part of the damage center evaluation and includes a corresponding number of reductions for a given alternative at each river mile. These graphics will be included in the report as well. Given the time constraints, Mr. Moore quickly mentioned the other streams for which the same information is provided. He stated that the presentation will be available on Dropbox for the study partners to review. 	Halff/FNI – upload presentation to Dropbox
4.	Activities Planned Next Month	
	 Complete Primary/Secondary Mitigation Alternatives modeling Start work on cost estimates and benefits of alternatives Provide revised Secondary Mitigation Planning (Gages) memo Continue planning for second round of Community Meetings 	
5.	Technical Discussion	
	• Mr. Barrett mentioned that there was some conversation about modeling the seasonal lake lowering to evaluate its effectiveness as a flood reduction measure and wandered if there had been a resolution. Mr. Barr stated that it is a potential option and the study team had asked HCFCD if it could be included as an alternative. Mr. Hinojosa added that many of the local officials and congressional representative were interested in seeing if this was an effective measure.	
	Ms. Chen asked what would be involved and if it would have a negative impact on the schedule and budget. Mr. Olmos answered that the analysis is relatively simple and could include lowering the starting WSEL in the lake for a variety of options. Using the model developed as part of this study, the impacts could be evaluated all the way to IH-10. Ms. Chen asked the team to provide more specifics on the procedure. Mr. Barrett indicated he would discuss the possibility internally and provide a response to the team.	
	UPDATE: Subsequent to the meeting, the team provided additional information regarding modeling of the lake lowering alternative. Both HCFCD and SJRA indicated that because this was considered a temporary measure, it should not be included in the long-term regional plan as a flood reduction alternative. The study team will not include it moving forward.	

5.	 Administrative Discussion Mr. Barr indicated that the team would discuss the schedule internally and set a date for the Alternatives Workshop. UPDATE: Subsequent to the meeting, the team provided a schedule and prospective Workshop date. The meeting is currently being scheduled for April 27th. 	Halff/FNI determine Alternatives Workshop date.
6.	Ms. Chen concluded the meeting.	

This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not correct, or that any information is missing or incomplete, please contact Halff Associates so that the matter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.





STUDY PARTNERS MONTHLY MEETING AGENDA Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

April 8, 2020 San Jacinto River Watershed Master Drainage Plan Skype Conference Call

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Progress Meeting				
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	1:30 PM				
			Meeting Stop Time:	2:30 PM				
Agenda								
1.	Introdu	ictions						
2.	Comm	Communications and Outreach (Hollaway)						
	•	Planning for Community Meet	ings (Set 2) Started – Te	entatively scheduled for early July				
3.	Activit	ies Conducted this Month						
	•	Submitted updated Calibration	Memo					
	•	Submitted updated Future Con	ditions Memo					
	•	Continued Modeling Primary/S	Secondary Mitigation A	Iternatives				
	•	Started cost estimates and work	kshop fact sheets					
	•	Conducted Spring Creek Siting	g Study workshop					
	•	Working on updated Secondar	y Mitigation Planning (I	FWS Gages) Memo				
	Conducted Other Mitigation Actions workshop							
4.	Activities Anticipated Next Month							
	Complete Primary/Secondary Mitigation Alternatives modeling							
	Conduct Primary Mitigation Workshop							
	Start work on Primary Mitigation Memo							
	Continue work on Spring Creek Siting Study in parallel with Primary Mitigation							
	•	Address comments to the Sedir	mentation and Vegetation	on Memo				
	•	Submit revised Secondary Mit	igation Planning (FWS	Gages) Memo				
	•	Submit Draft Other Mitigation	Actions Memo					
	Continue planning for second round of Community Meetings							
5.	Techni	cal Discussion						
	Discussion of changes to Discharges and Water Surface Elevations							
6.	Administrative Discussion							
	•	N/A						
7.	Questions							

SAN JACINTO RIVER SANJAGINTO - Regional Watershed Master Drainage Plan

Study Partners Progress Meeting April 8, 2020









San Jacinto River Basin

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6



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Coordination and Communication

- Coordination
 - EMC Workshop
 - Spring Creek Siting Workshop
- Communications
 - Planning for Community Meetings (Set 2) Started
 - Public Meeting Comment Database



FREQUENTLY ASKED QUESTIONS









Study Submittals

- Submitted
 - Updated Analysis of Historical Storms (Calibration) Memo
 - Updated Future Conditions Memo
- Upcoming
 - Updated Secondary Mitigation Memo (04/17)
 - Other Mitigation Actions Memo (04/30)
 - Alternative Funding Memo (05/22)
 - Primary Mitigation Memo (06/08)









Current Progress

- Identify Damage Centers
- Primary Alternatives H&H
- Secondary Alternatives H&H
- Cost Estimates
- Benefit Determination
- Fact Sheet Preparation
 Future Tasks
- Alternatives Workshop
- BCA and Project Constraints
- Alternative Funding
- Project Implementation



Spring Creek – Reduction in Instances of Structural Flooding (50-yr Project Life)









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Alternatives Workshop

- Workshop Goals (April 27th)
 - Present alternatives analysis results
 - Discuss project fact sheets including costs, benefits, challenges
 - Consider preferred alternatives and possible combinations
 - Identify a path to implementation
- Workshop Materials
 - Project "fact sheets" (April 20th)
 - Workshop presentation (April 23rd)

Participation by all the study partners is critical so we can have an inclusive discussion and make decisions as a group.



roadway and utilities)







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Primary Mitigation Next Steps

- Complete modeling, cost estimates, etc. for Workshop
- Conduct Alternatives Workshop (April 27th)
- Update/combine alternatives based on recommendations
- Complete funding research and recommendations
- Complete detailed BCA of preferred alternatives
- Identify potential project challenges
- Implementation planning
- Draft study report







Secondary Mitigation Planning

- Received input from HCFCD, MCO, USGS, Others
- Considered variety of gage types (Rain, Flow, Stage)
- Flood warning and data for future calibration efforts







Other Mitigation Actions

- Other Mitigation Action Goals
 - Evaluate communications plan/protocol during emergencies
 - Identify critical infrastructure and compare to inundation
 - Determine expected flood frequency evacuation routes
- Met with all Emergency Management Coordinators
- Workshop (March 11th) to discuss preliminary findings
- Draft memorandum (April 30th)









Schedule Update

54 Current Progress
478 Days Remaining
8/12/2019 Completion Date

- Existing H&H/Calibration 100% (Comments, Calibration)
- Primary Mitigation Planning (Revised Methodology) 80%
- Secondary Mitigation Planning (Adjusted Schedule) 95%
- Other Mitigation Actions (Adjusted Schedule) 75%



Updated Model Results

 Summary of changes from Effective Models to San Jacinto Regional WMDP Models

Watershed	Minimum Flow Change	Maximum Flow Change	Average Flow Change	Average % Change	Minimum Stage Change	Maximum Stage Change
Luce/Tarkington Bayou	-21,616	13,609	2,247	18%	-2.37	3.68
Peach Creek	-23,216	9,963	5,386	20%	-0.39	5.34
Caney Creek	4,496	49,437	13,507	49%	1.1	6.63
East Fork San Jacinto	-3,449	64,343	19,066	2%	0.05	7.90
Lake Creek	12,104	34,980	26,499	67%	3.55	5.14
Spring Creek	-4,981	15,053	5,554	20%	0.39	5.79
Willow Creek	-132	8,936	3,493	53%	0.06	5.00
Cypress Creek	-4,462	7,486	868	6%	-3.09	3.55
Little Cypress	436	8,714	4,429	121%	0.67	3.69
West Fork San Jacinto	-29,803	82,586	8,418	7%	-5.56	3.48
Jackson Bayou	-89	43	-9	-1%	-0.54	2.10
San Jacinto River	55,239	63,914	60,524	24%	-2.22	1.18






SAN JACINTO RIVER QUESTIONS?

Study Partners Progress Meeting April 8, 2020

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MEETING MINUTES

To:	Jing Chen, P.E., CFM	Attendees:	Jing Chen, HCFCD
From:	Terry Barr, P.E., CFM		Beth Walters, HCFCD Dena Green, HCFCD Matt Barratt, SIRA
Subject:	San Jacinto Regional Watershed Master Drainage Plan Progress Meeting		Briana Gallagher, SJRA Chuck Gilman, SJRA Terry Barr, Halff
Meeting Date:	04/08/2020 – 1:30 pm		Sam Hinojosa, Halff Andrew Moore, Halff Connor Stokes, Hollaway
Location:	WebEx Conference Call		Thomas Mumford, Hollaway
Minutes Date:	04/15/2020		Hector Olmos, Freese & Nichols
AVO No.:	033465.002		Adam Eaton, City of Houston Sharon Citino, City of Houston

Item	Description	Action
1.	Introductions	
	Ms. Chen started the meeting.	
2.	Communications and Outreach	
	• Mr. Stokes stated that the summary report from the public meetings is online and available.	
	• Ms. Walters stated that the comment matrix is rolling and would continue to collect responses throughout the project timeframe.	
	• Mr. Stokes stated that they are anticipating public meetings in July with 60 days of preparation beforehand. He stated that . Ms. Walters described that a plan for virtual meetings is being prepared by HCFCD and is being reviewed by management.	
3.	Activities Conducted This Month	
	• Mr. Barr provided an update on the latest study submittals. He stated that Historical Storms memo and Future Conditions were recently submitted. He stated that Other mitigations and Secondary Mitigation would be completed this month.	
	• Mr. Barr covered the topics to discuss at the alternatives workshop. Ms. Chen mentioned that this would be the final workshop and input from all jurisdictions is needed. She added that study partners could invite anyone from their agency needed. Mr. Barr stated that the Fact Sheets would be available April 20 th .	
	• Mr. Barr stated that other mitigation actions workshop was conducted in March and summary minutes were included in the	

	study Dropbox.	
	• Mr. Barrett asked if the Southern Crushed Concrete area would be of value to the project. See Technical Discussion.	
4.	Activities Planned Next Month	
	• Primary Alternatives Workshop April 27 th	
	Completing draft secondary mitigation memorandum	
	• Completing draft other mitigation memorandum	
5.	Technical Discussion	
	• Mr. Barrett asked if the Southern Crushed Concrete area would be of value to the project. Mr. Moore stated that an initial simulation of the area showed only a slight benefit along the West Fork between I-45 and SH-242 for the 100-year storm event. Mr. Barrett asked if there were any reductions for smaller storm events. Mr. Moore stated he would have to look back at the modeling. He also stated that the pond could be used for detention for proposed channel improvements	Halff to provide update on the Southern Crushed Concrete potential project.
6.	Administrative Discussion	Halff/FNI
	• Mr. Barr stated that the draft report would be submitted on July 6 th with 4 weeks of stakeholder review. He stated that the end date of August 31 st is the final deadline for the final report.	determine Alternatives Workshop date.
	• Ms. Chen asked if the June alternative submittal would include the implementation plan. Mr. Barr stated that the June Primary Mitigation would include an implementation plan along with the alternative funding summary.	
7.	Ms. Chen concluded the meeting.	

This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not correct, or that any information is missing or incomplete, please contact Halff Associates so that the matter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.





STUDY PARTNERS MONTHLY MEETING AGENDA Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

May 13, 2020 San Jacinto River Watershed Master Drainage Plan Skype Conference Call

Meeting ca	lled by:	Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Progress Meeting			
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	1:30 PM			
		Meeting Stop Time:		2:30 PM			
Agenda							
1.	Introdu	ictions					
2.	Comm	unications and Outreach (Hol	laway)				
	•	Planning for Community Meet	ings (Set 2) Started – Te	entatively scheduled for early July			
	•	Kingwood Improvements Disc	ussion Meeting – 05/11	/20			
3.	Activit	ies Conducted this Month					
	•	Adjustments to Calibrated Mod	dels – Finalize Existing	Conditions			
	•	Conducted Future Conditions	Meeting - 05/01/20				
	•	Conducted Mitigation Alternat	ives Workshop – 04/27/	/20			
	•	Conducted Sedimentation/Veg	etation Meeting – 05/05	/12			
	•	Submitted Secondary Mitigation	on Planning (FWS Gage	s) Memo – 05/13/20			
	Working on Other Mitigation Actions Memo						
4.	Activities Anticipated Next Month						
	Finalize Primary/Secondary Mitigation Alternatives modeling						
	• Work on Primary Mitigation Memo (Due 06/08)						
	Continue work on Spring Creek Siting Study in parallel with Primary Mitigation						
	Address comments to the Sedimentation and Vegetation Memo						
	•	Submit Draft Other Mitigation	Actions Memo				
	•	Continue planning for second	cound of Community Me	eetings			
5.	Techni	cal Discussion					
	Additional information needed for Kingwood Area						
6.	5. Administrative Discussion						
	Discussion of Draft Report Outline						
7.	Questio	ons					

SAN JACINTO RIVER SANJAGINTO - Regional Watershed Master Drainage Plan

Study Partners Progress Meeting May 13, 2020 - DRAFT









San Jacinto River Basin

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6



DRAFT - 5/13/2020







JRAFT - 5/13/2020

Coordination and Communication

- Coordination
 - Alternatives Workshop (04/27/20)
- Communications
 - Planning for Community Meetings (Set 2)
 - Public Meeting Comment
 Database
 - Kingwood Area Improvements
 Discussion



FREQUENTLY ASKED QUESTIONS









DRAFT - 5/13/2020





Study Submittals

- Submitted
 - Secondary Mitigation Memorandum (05/13)
 - Updated Calibrated Models
- Upcoming
 - Other Mitigation Actions Memo (Late May)
 - Alternative Funding Memo (Early June)
 - Updated Sedimentation/Vegetation Memo (06/12/20)
 - Primary Mitigation Memo (06/08/20)
 - Draft Report (07/13/20)



DRAFT – 5/13/2020

Primary Mitigation Planning

Current Progress

- Preliminary Completion of H&H Models
- Preliminary Benefit Cost Determination
- Preliminary Fact Sheets
- Alternatives Workshop
- Future Tasks
- Finalize H&H Modeling
- Alternative Funding
- Project Implementation
- Submit Alternatives Memo



Spring Creek – Reduction in Instances of Structural Flooding (50-yr Project Life)









Alternatives Workshop

- Workshop (April 27th)
 - Presented alternatives analysis results
 - Discussed project fact sheets including costs, benefits, challenges
 - Consider preferred alternatives and possible combination
 - 38 attendees (HCFCD, SJRA, MCO, COH, H-GAC, USACE)
 - Finalizing workshop minutes for delivery
- Next Step
 - Consider additional projects, combinations or data needed
 - Consider project metrics
 - Follow up with HCFCD ROW
 - Update costs and benefits







DRAFT - 5/13/2020









Secondary Mitigation Planning

- Received input from HCFCD, MCO, USGS, Others
- Updated Secondary Mitigation Memo (05/13/20)
 - 26 Gages recommended (HCFCD Currently installing 5)
 - Approximate installation cost range \$240k \$330k
 - Additional costs for annual maintenance



Other Mitigation Actions

- Other Mitigation Action Goals
 - Evaluate communications plan/protocol during emergencies
 - Identify critical infrastructure and compare to inundation
 - Determine expected flood frequency evacuation routes
- Conducted Emergency Management Workshop (March 11th)
- Working on draft memorandum











Schedule Update

54 Current Progress
478 Days Remaining
8/12/2019 Completion Date

IRAFT - 5/13/2020

- Existing H&H/Calibration 100% (Finalized)
- Primary Mitigation Planning (Workshops Completed) 85%
- Secondary Mitigation Planning (Adjusted Schedule) 100%
- Other Mitigation Actions (Adjusted Schedule) 80%



Draft Report Outline

- Executive Briefing
 - Overall summary of report and recommendations. High level review of project geared toward public officials; Graphical in nature
- Report Narrative
 - More detailed discussion of the process and findings for the various report sections; Limited discussion of technical modeling details
 - 1.0 Project Management
 - 2.0 Data Collection
 - 3.0 Existing Conditions Flood Hazard Assessment
 - 4.0 Analysis of Historical Storms
 - 5.0 Future Flood Risk Planning Assessment
 - 6.0 Primary Flood Mitigation Planning
 - 7.0 Secondary Flood Mitigation Planning
 - 8.0 Other Flood Hazard Mitigation Actions
 - 9.0 Community Outreach and Education







Draft Report Outline

- Detailed Appendices
 - Detailed information for each section including figures, tables, and exhibits. Detailed information regarding each task. Geared toward technical audience: engineers and technical agencies.

Appendix A - Project Management and Coordination (meeting agendas, minutes, etc.)
Appendix B - Data Collection (field observation, survey, previous report summaries)
Appendix C - Existing Conditions Flood Hazard Assessment (technical discussion, results)
Appendix D - Analysis of Historical Storms (detailed calibration memo)
Appendix E - Future Flood Risk Planning Assessment (future conditions memo)
Appendix F - Primary Flood Mitigation Planning (technical discussion, results, BCR, etc.)
Appendix G - Secondary Flood Mitigation Planning (Secondary mitigation memo)
Appendix H - Other Flood Hazard Mitigation Actions (Other mitigation memo, meeting data)
Appendix I - Community Outreach and Education (public meeting info and exhibits)
Appendix J - Digital Data (all digital information)





SAN JACINTO RIVER QUESTIONS?

Study Partners Progress Meeting May 13, 2020 - DRAFT

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STUDY PARTNERS MONTHLY MEETING AGENDA Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

June 10, 2020 San Jacinto Regional Watershed Master Drainage Plan Skype Conference Call

Meeting ca	lled by:	Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Progress Meeting			
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	1:30 PM			
			2:30 PM				
Agenda							
1.	Introdu	uctions					
2.	Comm	unications and Outreach (Hol	laway)				
	•	Planning for Community Meet	ings (Set 2) Started – Te	entatively scheduled for late-July			
	•	SJRA Board Meeting – 07/23/2	20				
	•	Upcoming Stakeholder Briefin	gs in June/July				
3.	Activiti	ies Conducted this Month					
	•	Submitted Primary Mitigation	Alternatives Memo – 06	5/08/20			
	•	Updating Sedimentation/Veget	tation Memo				
	•	Working on Other Mitigation	Actions Memo				
	Conducted Harris County Precinct 1 and 2 Briefings						
4.	Activities Anticipated Next Month						
	Alternatives Funding Memorandum						
	•	Other Mitigation Actions Mem	norandum				
	•	Implementation Planning					
	•	Planning for Stakeholder Brief	ïngs				
	•	Submit Revised Sedimentation	and Vegetation Memo	- 06/26/20			
	•	Draft Report – 07/13/20					
5.	Techni	cal Discussion					
	•	Primary Mitigation Planning M	Iemo Overview				
	• Buyouts						
	Implementation Planning						
6.	Admin	istrative Discussion					
	•	Draft Report Executive Summa	ary				
7.	Questio	ons					
	1						

SAN JACINTO RIVER SANJACINTO - Regional Watershed Master Drainage Plan

Study Partners Progress Meeting June 10, 2020 - DRAFT









San Jacinto River Basin

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6



DRAFT - 6/10/2020

SIRA

Coordination and Communication

- Coordination
 - ROW Discussion 06/05/20
 - SJRA Board Meeting 07/23/20
- Communications
 - Plan Community Meetings (Set 2)
 - HC Precinct 1 Briefing 05/21/20
 - HC Precinct 2 Briefing 05/26/20
 - Late June Briefings
 - HC Precinct 4 Briefing
 - Council Member Dave Martin
 - Congressman Crenshaw
 - State Representative Huberty



FREQUENTLY ASKED QUESTIONS

- July Briefings

- Montgomery County Drainage
 Council
- Kingwood Association Management
- Lake Houston Area Chamber
- Community Activists
 - Bob Rehak
 - Barbara Hillburn







DRAFT - 6/10/2020



- Submitted
 - Primary Mitigation Alternatives Memo (06/08/20)
 - Secondary Mitigation Memorandum
 - Updated Calibrated Models
- Upcoming
 - Updated Sedimentation/Vegetation Memo (06/26/20)
 - Other Mitigation Actions Memo (Late June)
 - Alternatives Funding Memo (Late June)
 - Implementation Memo (Mid-July)
 - Draft Report (07/13/20)
 - Final Report (08/31/20)









JRAFT – 6/10/2020

Primary Mitigation Planning

Current Progress

- Preliminary Completion of H&H Models
- Preliminary Benefit Cost Determination
- Preliminary Fact Sheets
- Alternatives Workshop
- Finalize H&H Modeling
- Submit Alternatives Memo
 Future Tasks
- Alternatives Funding
- Project Implementation



Spring Creek – Reduction in Instances of Structural Flooding (50-yr Project Life)









Alternatives Memorandum

- Intended to be Appendix F in the Draft/Final Report
- Memo Structure
 - Introduction (Goals, Tasks)
 - Damage Center Identification
 - Target Volume Determination
 - Flood Mitigation Alternatives Analysis (Focuses on process and parts)
 - Flood Mitigation Alternatives (Focuses on specific alternatives)
 - Additional Flood Reduction Measures (Policies)
 - Implementation Planning (Considerations moving forward)
 - Appendices (Detailed data developed during the process







Introduction

- Alternatives Analysis Goals
 - Identify areas with high concentrations of significant flood damages
 - Determine project locations that have the highest potential for local and regional mitigation
 - Perform H&H analysis to determine project effectiveness
 - Identify estimated project costs, potential flood reduction benefits, and implementation challenges
 - Develop a path toward plan implementation for the Master Drainage Plan
- Alternatives Tasks
 - Updated version of the plan presented in *Revised Alternatives* Development Process memorandum (October 2019)







Damage Center Identification

- Structural Inventory
 - Data Source, Assumptions, Limitations
 - Summary of Results (Overall, Watershed)
- Damage Center Identification
 - Criteria for Damage Centers (Based on Instances of Flooding per Mile)
 - Summary of Damage Centers (48 Total)
 - Lower San Jac Centers











Target Volume Determination

- Volume Reduction Calculations
- LOS Improvements and Benefits (High-Level Analysis)
- Comparison of Volume and Benefits
- Watershed Mitigation Potential
 - High Potential (Spring, Peach, Caney, East Fork)
 - Moderate Potential (Lake)
 - Low Potential (Luce/Tarkington, Jackson, Willow, Little Cypress, Cypress)

			Estimated Detention Volume Required (acre-ft)								
~	0.2% ACE	99,371	86,429	73,751	57,112	41,941	26,567				
ienc) int	1% ACE	56,396	44,511	33,426	18,455	7,036					
requ	2% ACE	41,378	30,167	19,797	6,597						
gn F orm	4% ACE	28,627	17,856	9,075							
)esiç St	10% ACE	14,937	5,534								
	20% ACE	6,532									
		50%	20%	10%	4%	2%	1%	0.2%			
		ACE	ACE	ACE	ACE	ACE	ACE	ACE			
		Tannat Francisco Diama Frank									







Flood Mitigation Alternatives Analysis

- Primary vs. Secondary
- Previously Recommended Projects
- Project Types
- Opportunities and Challenges
- Project Costs (Including uncertainty)
- Project Benefits



DRAFT - 6/10/2020









Flood Mitigation Alternatives

- Presented by watershed
- All modeled alternatives included
- Overview of Alternatives (Costs vs. Benefits)



San Jacinto River Master Drainage Plan	Combined 1% ACE WSEL Reductions (ft)
Confluence with Lake Creek	-2.38
West Fork I-45	-5.94
West Fork SH99	-1.67
West Fork I-69	-5.07
Lake Houston Parkway*	-0.75
Lake Houston Dam	-0.59
Confluence with Spring Creek	-4.82
Caney Confluence with Peach	-9.74
Caney Confluence with East Fork	-2.82
Confluence with East Fork *	-0.79

* WSEL influenced by Lake Houston Elevation

Additional Flood Reduction Measures

- Floodplain Preservation
- Buyouts

– Should we consider specific recommendations for buyouts?

- Detention Policy
 - Additional Analysis to be done to refine the recommendations







Next Steps

- Alternatives Funding Memo (Some info included in Alts Memo)
- Implementation Planning
 - Finalize Metrics (Historical flooding, current damages, project costs, benefits, funding potential, LMI/SVI)
 - Determine appropriate weighting
 - Project Prioritization
 - Project Phasing
 - Identify the best project(s) to move forward (Feasibility, PER, Design)
- Develop Draft Report
 - Front End Summary
 - Narrative
 - Appendices

	NON-DISASTER FUNDING					DISASTER FUNDING			
Funding Source	PDM*	FMA	FP	CWSRF	NRCS Small Watershed Program (PL-566)	NRCS RCPP	CDBG- MIT	CDBG- DR	HMGP
Funding Agency	FEMA	FEMA	State	EPA	NRCS	NRCS	HUD	HUD	FEMA
Administered by	TDEM	TWDB	TWDB	TWDB	NRCS	NRCS	GLO	GLO & TDA	TDEM
	E	LIGIBLE	PLANNIN	IG ACTIVI	TIES				
Hazard Mitigation Planning									
Planning (H&H studies, alt analysis, BCA)					V				
Engineering Design					V				
	EL	IGIBLE N	ITIGATI	ΟΝ ΑCTIV	ITIES				
Levees, flood walls, or related infrastructure				V					
Regional detention and/or retention basins		Ø		V	V				
Local detention and/or retention basins		V		V	V			V	
Local drainage improvements		Ø		V			V	V	
Local channel conveyance improvements		Ø		V			V	V	
Roadway bridges, culverts, and pipes		V		V		V			
Floodplain development ordinances							V		
Property buyouts or relocations		V		V	V				
Property elevation		V		V	V				
Reconstruction of noncompliant structures				V					
Flood-proofing and/or flood retrofits	V	V		V		V	V		
Flood awareness training and/or education	V		V	V			V		V
Flood warning system				V					







- Executive Summary is intended to be a front end stand-alone document that can be shown to decision makers and the public
- Potential information to be included:
 - Study Background (History, Goals, Info from video)
 - Current Flood Risks (Sources, Historical Damages, Future?)
 - Flood Mitigation Strategies (Projects, Policy, Warning, Response)
 - Implementation (Plan moving forward, Priority projects)
- Graphical in nature and user friendly
- Work with Communications team to prepare







THE STORMWATER MANAGEMENT PROGRAM

The Stormwater Management Program (SWMP) vision, mission, and strategic direction are direct outgrowths and program specific applications of the City's comprehensive vision, mission, strategic goals, and City Values. The Comprehensive City Vision is memorialized and refreshed annually in the Fort Worth Comprehensive Plan. The City Council strategic goals summarize the primary focus areas City leadership has established to accomplish the vision.

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CITY OF FORT WORTH VISION

Fort Worth will be the most livable and best managed City in the country

CITY OF FORT WORTH MISSION

Working together to build a strong community

Ø

- > Make Fort Worth the nation's safest major City
- > Improve mobility and air quality
- Create and maintain a clean and attractive City
- \succ Strengthen the economic base, develop the future workforce and create quality job opportunities

CITY COUNCIL STRATEGIC GOALS

> Promote orderly and sustainable development

CITY VALUES

- Exceptional Customer Experience
- > Accountability
- > Ethical Behavior
- > Diversity
- > Mutual Respect
- Continuous Improvement



STORMWATER MANAGEMENT PROGRAM

The Stormwater Management Program vision, mission, and goals directly contribute to the City's progress toward its comprehensive vision. Stormwater program priorities and strategies are always directed toward that end.

STORMWATER MANAGEMENT VISION

To be commonly recognized as an exceptionally effective and progressive municipal stormwater management program

STORMWATER MANAGEMENT MISSION

Protect people and property from harmful stormwater runoff

STORMWATER MANAGEMENT INITIAL STRATEGIC GOALS

When the SWMP was developed, a very simple, two pronged framework for program goals was established.

Make things better

()

- > Get the drainage system performing as designed (Maintenance and Repair)
- Identify and correct deficiencies in the drainage system (Flood and Erosion Mitigation Capital Improvement Program)
- ➤ Warn of stormwater related hazards

Keep things from getting worse

- > Keep the drainage system performing as designed (Maintenance and Repair)
- > Review Development to ensure no adverse impact (Development Services)



r - 6/10/2020









INITIAL STORMWATER MANAGEMENT PROGRAM OBJECTIVES AND FUNDING

The Stormwater Program was established in conjunction with a Stormwater Utility in 2006. Table 3-2 summarizes the original SWMP fee plan and actual monthly fee schedule by fiscal year. Table 3-1 summarizes stormwater management activities prior to 2006 and the desired outcomes of the established Stormwater Management Program.

> Link to Comprehensive Stormwater Management Program AMEC SWU Reports

INITIAL SWMP OBJECTIVES

PRE-2006	DESIRED
Flood reduction capital projects – over \$500 million backlog	Funded capital program (stable funding source) that reduces backlog in a reasonable timeframe
Reactive maintenance	Proactive, prioritized, scheduled, effective, maintenance program
Incomplete inventory	Complete inventory and condition assessment of facilities
Planning – Limited studies (5% of City) focused only on water quantity issues	Comprehensive master planning – Setting priorities with cost- effective solutions (including water quality issues)
Development Services/Design Standards – 1967 era with limited enforcement	Up-to-date standards that protect from flooding & erosion without slowing growth
Outdated equipment/technology	Up-to-date hardware, software, and field equipment
Public Education primarily limited to water quality issues	Effective education/outreach on all aspects of stormwater issues

SWMP FEE PLAN

	FY07	FY08	FY09	FY10	FY11	FY12-18
Original projected monthly fee per billing unit	\$2.90	\$3.25	\$3.75	\$4.25	\$4.50	Original projection did not go beyond Year 5
Actual monthly fee/ annual budget	\$2.90 / \$10.2M	\$3.20 / \$15.1M	\$3.75 / 19.3M	\$4.75 / \$25.7M	\$4.75 / \$28.1M	\$5.40 /\$39M in FY18

* Billing units are calculated by measuring the hard surface area on a property and dividing by the Equivalent Residential Unit (ERU) of 2,600 square feet to determine the number of billing units on the property.











PROGRAM WIDE STRATEGIES

The following strategic direction is established in response to the identified community needs/priorities and the challenges faced by the overall program, the specific program elements, and the key policy areas.



STRATEGIC DIRECTION

Leverage available resources and opportunities to expand the capacity of the SWMP to meet the established vision and mission

Grant Opportunities

\$

FINANCIAL

To provide potential financial resources for the SWMP, the City will look for, and take advantage of when appropriate, state and federal grant funding for hazard mitigation. This implementation strategy is consistent with the June 2016 Floodplain Management Plan, which includes the mitigation action to "Pursue granst to complete property acquisiton projects". In addition, other mitigation measures, such as drainage improvements, can be partially funded with grants. By pursuing state and federal grants, the City will create opportunities to leverage local funding to plan, develop, and construct projects to mitigate flood and erosion impacts.

The following potential grant sources will continue to be considered by the SWMP:



Federal Emergency Management Agency (FEMA)

Provide substantial federal funding for the purchase of flood-prone homes through FEMA's Flood Mitigation Assistance program (FMA) and the Pre-Disaster Mitigation program (PDM). The Voluntary Buyout policy, once developed, will provide guidance on the circumstances under which these grant funds would be pursued. FEMA currently provide grant funds through the Cooperating Technical Partner program to update regulatory flood maps across the City, as well as producing a variety of flood risk awareness and outreach products.

U.S. Army Corps of Engineers (USACE)

The USACE can provide funding for studies and implementation projects that include planing, analysis, and development of structural (channelization and other drainage features) and non-structural alternatives (such as flood-prone property acquisition) under Section 205 of the 1948 Flood Control Act, and Section 22 of the Water Resources Development Act of 1974, as amended.

Housing and Urban Development (HUD)

The Department of Housing and Urban Development (HUD) administers the federal community Development Block Grant (CDBG) program that can assist with housing, economic development, and measures to reduce damage in future storms. In Texas, the General Land Office (GLO) daministers this part of the

Texas Water Development Board

CDBG program.

Flood Protection Planning Grants provide funds to political subdivisions of the State of Texas for evaluation of structural and nonstructural solutions to flooding problems.

The Flood Mitigation Assistance grant program assists states and communities by providing federal funds for cost-effective measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the National Flood Insurance Program (NFP). The Severe Repetitive Loss grant program, under the FEMA's Hazard Mitigation Assistance Grant Program, provides federal funding to assist states and communities in implementing mitigation measures to reduce or eliminate the long-term risk of flood damage to severe repetitive loss residential structures insured under the NFIP.

The Clean Water State Revolving Fund (Low Interest Loans) provides financial assistance for stormwater projects at belowmarket interest rates.

FORT WORTH STORMWATER MANAGEMENT PROGRAM MASTER PLAN 48



Texas Department of Emergency Management The Hazard Mitigation Grant Program (HMGP) provides post disaster statewide FEMA funding for eligible mitigation projects.









DEVELOPMENT OF THE PLAN

The Southside Area Development Plan (SADP) is an element of the Plan CC Comprehensive Plan. The SADP is intended to provide an analysis of the Southside Area and create strategic recommendations to guide future development. As the community grows, the City should have plans in place to guide the anticipated growth. By understanding development patterns and the impact it has on the community, the City will be better prepared for the future. This plan serves as a guide for City leadership to make regulatory and policy decisions as well as prioritize infrastructure improvements to increase the quality of life.

The Southside Area of Corpus Christi is located south of South Padre Island Drive (SPID), east of the Crosstown Expressway, and is bounded by Oso Creek and Bay to the south and east. The Southside is experiencing most of the recent development in the City, and the growth is anticipated to continue. The SADP was developed through a comprehensive public engagement process that integrated the examination of the existing conditions and the vision of the community.

An Advisory Committee was created to assist in guiding the planning process and provide a representation of the area's residents, business owners, students, and stakeholders. The committee's participation was essential to the development of the final plan. Although the Advisory Committee championed the process, the community was involved throughout the process and participated in multiple engagement events and activities. Residents and stakeholders gave their input regarding the future of the Southside through online surveys and various community engagement events, including a Community Open House and a four-day Community Think Tank. Many of the recommendations identified in this plan are a direct result of the input received, resulting in a community-driven plan.

NARCH 17, 2020

SOUTHSIDE AREA DEVELOPMENT PLAN

WHAT IS MISSING MOST IN THE SOUTHSIDE? 26.9% 18.3% 16.3% 9.6% 7.7% 6.7% 4.8% Parks & Other Mixed-Use RestaurantsShopping Entertainment Office Housing Trails MY FAVORITE PART ARDUIT SOUTHSIDE IS HOW CAN WE ENSURE OUR MELEHROPHOODS THRIVE?





INTRODUCTI

MY VISION FOR SOUTHSIDE IS..

More walking trails and park connecting commercial and neighborhood areas.

Sidewalks lined with

trees and flowers.

Diverse in housing, jobs, entertainment, etc. We don't all need or want to live in the same type of homes/neighborhoods.

os, **11** Improve traffic visibility when entering main to roadways.

> Preserve, protect and enhance Oso Creek.

SOUTHSIDE AREA DEVELOPMENT PLAN March 17, 2020







DRAINAGE UTILITY MASTER PLAN

PUBLIC OUTREACH SURVEY & OBSERVATIONS

The project team engaged with the City's preferred survey provider, Mary Coyne Marketing Communications [NICHC] of Amarillo, to begin the survey effort. The team met with MICHC, provided the public outreach strategy, worked with MICHC and the City to develop questions, and coordinated through the survey process.

I-ICI-IC conducted the survey during June 2018. The survey was conducted by telephone and continued until it reached 300 Amarillo residential customers and 100 Amarillo commercial customers. Questions included a variety of topics, including demographic information, general understanding of stormwater management, general understanding of the role of the stormwater program, financial responsibility for stormwater improvements, preferred messaging type, and identification of flooding problem areas.



 EDUCATION: The survey results suppor a need for the Drainage Utility to educate the public about the makeup of the drainage system in the City of Amarillo and the role of the Drainage Utility in reducing flood risk.



FINANCIAL RESPONSIBILITY: Nearly hal respondents believe there should be wared cost between the City and the veloper for installation of new rastructure relative to new velopment.



DRAINAGE UTILITY MASTER PLAN

CAPITAL IMPROVEMENT PROJECT PROGRAM

The project team endeavored to develop an objective process to determine how best to prioritize the current list of stormwater CIPs and allow prioritization of future CIPs. The following steps were used to prioritize CIPs and to develop 5-Year CIP plan options.

- Identify and understand previously developed CIPs (1993 Storm Water / laster Plan, 2011 Drainage Utility Study, 2014 Tee Anchor Lake (Laster Drainage Plan).
- Perform 2D rapid assessment to identify flooding hot-spot locations on a city-wide scale.
- Prioritize CIPs utilizing a uniform and objective approach to scoring so that each project is evaluated based on the same metrics.
- Review top tier CIPs in more detail to determine if the projects were reasonable, if they were contingent on other City projects, and if they would need to be phased (and how).
- 6 Update estimates of probable cost for each top tier project.
- Bevelop 5-year CIP plan options based on the top tier projects including a drainage utility rate increase evaluation.

RAPID ASSESSMENT

The rapid assessment is a highlevel analysis tool that was prepared for the 2019 D/JP to identify flooding hot-spot locations on a city-wide scale. Rain-on-mesh HEC-RAS 2D modeling was applied across the entire City to identify lowlving areas that are prone to flooding. The results of the rain-on-the-mesh modeling, in conjunction with emergency response and drainage complaint data, allow for determination of high risk flood area.



CIP PRIORITIZATION

Nine (9) evaluation criteria categories with relative importance based on weight were established as shown on page at right. As a group, staff and consultants participated in an activity involving binary comparisons of the importance of one criterion relative to another. This process resulted in rankings of most important to least important, but also allowed for the placement of a weighted multiplier to be applied to each project score, reflecting the importance of that criteria.






Schedule Update

54 Current Progress
478 Days Remaining
8/12/2019 Completion Date

IRAFT - 6/10/2020

- Existing H&H/Calibration 100% (Finalized)
- Primary Mitigation Planning (Workshops Completed) 95%
- Secondary Mitigation Planning (Adjusted Schedule) 100%
- Other Mitigation Actions (Adjusted Schedule) 85%



SAN JACINTO RIVER QUESTIONS?

Study Partners Progress Meeting June 10, 2020 - DRAFT

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MEETING MINUTES

То:	Jing Chen, P.E., CFM	Attendees:	Jing Chen, HCFCD
From:	Terry Barr, P.E., CFM		Matt Barrett, SJRA Terry Barr Halff
Subject:	San Jacinto Regional Watershed Master Drainage Plan Progress Meeting		Sam Hinojosa, Halff Rachel Massey, Holloway Rosaura Martinez, Holloway
Meeting Date:	06/10/2020 – 1:30 pm		Hector Olmos, Freese & Nichols Adam Faton, City of Houston
Location:	Skype Conference Call		Addin Eaton, City of Houston
Minutes Date:	06/11/2020		

AVO No.: 033465.002

Item	Description	Action
1.	Introductions	
	Ms. Chen started the meeting.	
2.	Communications and Outreach	
	• Terry mentioned the upcoming coordination meetings with the SJRA Board. He stated that future public meetings appear to be slated for late July. The team had coordinated with HC Precincts 1 and 2 as well as the HCFCD ROW team. There are several stakeholder briefings planned for June/July.	
	• Jing stated that there were several (9) stakeholder meetings schedule including: HC Precinct 4, Councilman Martin, State Rep. Huberty, Congressman Crenshaw, the Lake Houston Area Chamber of Commerce, the Kingwood Association Management, Community Activists Barbara Corbin and Bob Rehak, and the Montgomery County Drainage Council. Jing asked if the briefings could be added to the slide.	Halff – Add Stakeholder Meetings to the slides
3.	Activities Conducted This Month	
	• Terry stated that the primary alternatives memo was submitted on Monday, June 8 th . He stated that the sedimentation, other mitigation, and alternatives funding will be submitted in late June. The draft report will be submitted July 13 th .	
	• Jing asked that the final deliverable be added to the slide showing the final report.	Halff – Add Final Report date to the
	• Terry stated that the primary alternatives memorandum was submitted and that future tasks include the alternatives funding and project implementation. He stated that implementation will include the list of projects and what is the first project that	Shues

	should be evaluated	
	should be explored.	
	• Terry summarized the primary alternative memorandum submittal and the information presented.	
	• Terry summarized the flood mitigation analysis. He mentioned that the team reviewed the previous projects and modeled the ones that showed ability to reduce flooding.	
	• Terry stated that the memo includes information for each project. The narrative section includes the detailed information needed to pursue the project. He said the fact sheets provide a high-level view of the projects.	
	• Jing asked if the memorandum would include a per watershed comparison of the improvements. Terry stated that it would be included in the report, but that the combined improvements show that information for each watershed other than the West Fork. He stated it would be included in the draft report.	Halff/FNI – Include combination of projects in each watershed
	• Terry stated that the report does not specifically recommend buyouts for particular areas, but the projects recommended are not focused on removing structures from the frequent storm events (2-year, 5-year) and these structures may be good candidates for buyouts.	Halff/FNI - Include benefits per watershed.
	• Jing stated that Darren Hess (MOCO) asked if buyouts would be included in the recommendation. Terry stated it could be but would like those thoughts from the study partners.	
4.	Activities Planned Next Month	
	• Terry stated the alternatives funding memorandum would include additional funding information from that presented in the primary alternatives memo. He stated the metrics would include flooding, damages, benefits, costs, funding, and social vulnerability/LMI areas.	
	• Terry stated that the report executive summary would be a stand-alone document focused on providing a comprehensive summary that is more user-friendly to non-engineers. He stated that the goal is to summarize the study and focus on the implementation of the projects. Dena agreed that this would be an important part of the messaging.	
	• Hector stated that the front-end document would be a good opportunity to answer the frequently asked questions.	
	• Jing asked when the executive summary would be complete. Terry stated it would be submitted with the draft report. Jing indicated that it would be a good idea to work on the Executive Summary document at the same time as developing the materials and message for the stakeholder and public meetings.	Halff/FNI – Start working on developing the Executive Summary

	Terry agreed that these two objectives should share a consistent message and be developed in parallel.	
5.	 Technical Discussion Terry stated that he would like input on both the buyouts and detention policy on the language presented and if more information would be needed. Jing stated that Precincts 1 and 2 were interested in the detention policy recommendation. 	Study Partners - Review detention and buyout sections and provide feedback.
5.	 Administrative Discussion Terry asked that the stakeholders provide comments on the primary mitigation memo as soon as possible. Terry asked if hard copies of the report needed to be printed. Jing stated that she would look into the requirements and ask stakeholders if they needed hard copies of the draft report. 	Partners to provide comments. HCFCD to determine submittal requirements.
6.	Ms. Chen concluded the meeting.	2

This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not correct, or that any information is missing or incomplete, please contact Halff Associates so that the matter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.





STUDY PARTNERS MONTHLY MEETING AGENDA Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

July 8, 2020 San Jacinto Regional Watershed Master Drainage Plan Teams Conference Call

Meeting ca	lled by:	Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Progress Meeting
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	1:30 PM
			Meeting Stop Time:	3:00 PM
Agenda				
1.	Introdu	uctions		
2.	Comm	unications and Outreach (Hol	laway)	
	•	Planning for Community Meet	ing No. 2 – Scheduled f	For August 13th
	•	SJRA Board Meeting - 07/23/	20	
	٠	Upcoming Stakeholder Briefin	gs in July/Aug	
3.	Activit	ies Conducted this Month		
	•	Submitted Revised Sedimentat	ion/Vegetation Memo	
	•	Submitted Other Mitigation Ad	ctions Memo	
	•	Work on Draft Report and Exe	cutive Summary	
	٠	Conducted Harris County Prec	inct 3 Briefings	
4.	Activit	ies Anticipated Next Month		
	•	Submit Draft Report - 07/13/2	0	
	•	Work on Final Report and Exe	cutive Summary	
	•	Conduct COH Briefing		
	•	Conduct Harris County Precine	ct 4 Briefing	
	•	Conduct HCFCD Executive B	riefing	
	•	Conduct Stakeholder Briefings	5	
5.	Techni	cal Discussion		
	•	Implementation Planning and	Project Prioritization	
6.	Admin	istrative Discussion		
	•	Draft Report Executive Summ	ary	
7.	Questions			
7.	• Questie	Draft Report Executive Summ	ary	

SAN JACINTO RIVER SANJACINTO - Regional Watershed Master Drainage Plan

Study Partners Progress Meeting July 8, 2020 - DRAFT









San Jacinto River Basin

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6



DRAFT - 7/8/2020

SIRA

JRAFT - 7/8/2020

Coordination and Communication

- Coordination
 - ROW Discussion 06/05/20
 - SJRA Board Meeting 07/23/20
- Communications
 - Plan Community Meeting No. 2
 - HC Precinct 3 Briefing 06/30/20
 - July/August Briefings
 - HC Precinct 4 Briefing
 - Council Member Dave Martin
 - Congressman Crenshaw
 - State Representative Huberty
 - Montgomery County Drainage Council
 - Kingwood Association Management
 - Lake Houston Area Chamber
 - Community Activists (Bob Rehak, Barbara Hillburn)



FREQUENTLY ASKED QUESTIONS







DRAFT - 7/8/2020





Study Submittals

- Submitted
 - Primary Mitigation Alternatives Memo (06/08/20)
 - Secondary Mitigation Memorandum
 - Updated Calibrated Models
 - Updated Sedimentation/Vegetation Memo (06/26/2020)
 - Other Mitigation Actions (07/06/2020)
- Upcoming
 - Alternatives Funding and Implementation (07/13/20)
 - Draft Report (07/13/20)
 - Final Report (08/31/20)



Implementation

- Metrics
 - Historical Damages Number of historically flooded structures based on the watershed
 - Predicted Damages Number of instances of flooding per watershed based on a 50-year project life
 - Flooding Instance Reduction Number of instances of flooding removed by the project
 - Structures Removed Number of structures removed from the 1% ACE floodplain
 - BCR Benefit Cost Ratio of the project
 - Roadway Total depth of reduction of WSELs along modeled roadways for all frequency storm events
 - SVI Average SVI of structures benefitted by project
 - LMI Average LMI of structures benefitted by project
 - Cost Total cost of project





JRAFT - 7/8/2020







Implementation

- Project Scoring
- Metrics are weighted based on priority
- Projects are assigned a score of 0 – 4 based on quartile compare to other projects
- Example: Walnut Creek
 Detention removes 1,296
 structures from the 1% ACE.
 This project removes the most
 of all projects so receives a 4.0
 as a score.

Metric	Assigned Weight
Historical Damages	10%
Predicted Damages	15%
Instance Reduction	20%
Structures Removed	20%
BCR	10%
Roadway	10%
SVI	10%
LMI	10%
Cost	5%

Implementation

• Project Scoring

												100	while a
			Watershed	Watershed		Structures							
			Historical	Predicted	Instance	Removed						Cost	Total
		Cost (\$M)	Damages ¹	Damages ¹	Reduction ²	from 1% ACE ²	BCR ⁴	Roadway	SVI	LMI⁵	Cost	RAW	Score
		0%	10%	10%	20%	20%	10%	5%	10%	10%	5%		100%
	Walnut Creek	97.2–132.1	2.0	3.0	3.0	4.0	4.0	1.0	1.0	0.0	3.0	1.0	2.60
Coring	Birch Creek	81.6–121.6	2.0	3.0	2.0	3.0	3.0	1.0	0.0	1.0	3.0	0.0	2.10
Shung	DC2-200 Channel	53.6–203.6	2.0	3.0	0.0	0.0	3.0	0.0	1.0	0.0	3.0	1.0	1.05
	I-45 Channel	81.2–231.2	2.0	3.0	3.0	4.0	4.0	2.0	0.0	1.0	2.0	2.0	2.60
	Caney Creek Detention	98.0–163.0	0.0	0.0	1.0	2.0	3.0	1.0	1.0	1.0	2.0	2.0	1.25
Lake	Little Caney Creek	98.0–128.0	0.0	0.0	0.0	1.0	2.0	2.0	2.0	1.0	3.0	0.0	0.95
	Garret's Creek Detention	107.0–131.0	0.0	0.0	2.0	2.0	2.0	3.0	1.0	2.0	2.0	1.0	1.55
	Walker Creek Detention	201.0-218.0	1.0	1.0	1.0	0.0	1.0	3.0	3.0	3.0	1.0	3.0	1.30
Peach	SH 105 Detention	356.0-433.0	1.0	1.0	3.0	1.0	0.0	3.0	3.0	3.0	0.0	4.0	1.75
	I-69 Channel	161.0–311.0	1.0	1.0	4.0	2.0	3.0	4.0	3.0	3.0	1.0	3.0	2.55
	Detention at FM 1097	105.0–131.0	2.0	2.0	2.0	1.0	1.0	4.0	4.0	4.0	3.0	1.0	2.25
Caney	Detention at SH 105	179.0–208.0	2.0	2.0	4.0	3.0	2.0	3.0	4.0	4.0	1.0	2.0	3.00
	US 69 Channelization	194.0–209.0	2.0	2.0	2.0	3.0	1.0	2.0	2.0	2.0	1.0	3.0	2.05
East Fork	Winter's Bayou Dam	134.0–166.6	3.0	1.0	3.0	2.0	2.0	2.0	3.0	3.0	2.0	2.0	2.40
Nost Fork	River Plantation Channel	148.0-538.0	4.0	4.0	1.0	1.0	1.0	0.0	2.0	2.0	1.0	3.0	1.75
VESLFOIR	Kingwood Benching	818.0-848.0	4.0	4.0	1.0	3.0	0.0	1.0	2.0	2.0	0.0	4.0	2.05









DRAFT - 7/8/2020

Implementation

• Project Ranking

Rank	Project	Score	Cost
1	Caney - Detention at SH 105	3.00	179.0–208.0
2	Spring - Walnut Creek	2.60	97.2–132.1
3	Spring - I-45 Channel	2.60	81.2 - 231.0
4	Peach - I-69 Channel	2.55	161 - 311
5	East Fork - Winter's Bayou Dam	2.40	134.0–166.6
6	Caney - Detention at FM 1097	2.25	105.0–131.0
7	Spring - Birch Creek	2.10	81.6–121.6
8	Caney - US 69 Channelization	2.05	194.0 - 209
9	West Fork - Kingwood Benching	2.05	818.0 - 848.0
10	Peach - SH 105 Detention	1.75	356.0-433.0
11	West Fork - River Plantation Channel	1.75	148.0 - 593
12	Lake - Garret's Creek Detention	1.55	107.0–131.0
13	Peach - Walker Creek Detention	1.30	201.0–218.0
14	Lake - Caney Creek Detention	1.25	98.0–163.0
15	Spring - DC2-200 Channel	1.05	53.6 - 203
16	Lake - Little Caney Creek	0.95	98.0–128.0







DRAFT - 7/8/2020

Implementation

• Project Ranking - Adjusted

Rank	Project	Score	Cost
1	Caney - Detention at SH 105	3.00	179.0–208.0
2	Spring - Walnut Creek	2.60	97.2–132.1
3	Spring - I-45 Channel	2.60	81.2 - 231.0
4	East Fork - Winter's Bayou Dam	2.40	134.0–166.6
5	Caney - Detention at FM 1097	2.25	105.0–131.0
6	Spring - Birch Creek	2.10	81.6–121.6
7	Caney - US 69 Channelization	2.05	194.0 - 209
8	West Fork - Kingwood Benching	2.05	818.0 - 848.0
9	Peach - SH 105 Detention	1.75	356.0-433.0
10	Peach - I-69 Channel	2.55	161 - 311
11	West Fork - River Plantation Channel	1.75	148.0 - 593
12	Lake - Garret's Creek Detention	1.55	107.0–131.0
13	Peach - Walker Creek Detention	1.30	201.0–218.0
14	Lake - Caney Creek Detention	1.25	98.0–163.0
15	Spring - DC2-200 Channel	1.05	53.6 - 203
16	Lake - Little Caney Creek	0.95	98.0–128.0





Draft Report Outline

- Executive Briefing
 - Overall summary of report and recommendations. High level review of project geared toward public officials; Graphical in nature
- Report Narrative
 - More detailed discussion of the process and findings for the various report sections; Limited discussion of technical modeling details
 - 1.0 Project Management
 - 2.0 Data Collection
 - 3.0 Existing Conditions Flood Hazard Assessment
 - 4.0 Analysis of Historical Storms
 - 5.0 Future Flood Risk Planning Assessment
 - 6.0 Primary Flood Mitigation Planning
 - 7.0 Secondary Flood Mitigation Planning
 - 8.0 Other Flood Hazard Mitigation Actions
 - 9.0 Community Outreach and Education







Draft Report Outline

- Detailed Appendices
 - Detailed information for each section including figures, tables, and exhibits. Detailed information regarding each task. Geared toward technical audience: engineers and technical agencies.

Appendix A - Project Management and Coordination (meeting agendas, minutes, etc.)
Appendix B - Data Collection (field observation, survey, previous report summaries)
Appendix C - Existing Conditions Flood Hazard Assessment (technical discussion, results)
Appendix D - Analysis of Historical Storms (detailed calibration memo)
Appendix E - Future Flood Risk Planning Assessment (future conditions memo)
Appendix F - Primary Flood Mitigation Planning (technical discussion, results, BCR, etc.)
Appendix G - Secondary Flood Mitigation Planning (Secondary mitigation memo)
Appendix H - Other Flood Hazard Mitigation Actions (Other mitigation memo, meeting data)
Appendix I - Community Outreach and Education (public meeting info and exhibits)
Appendix J - Digital Data (all digital information)



JRAFT - 7/8/2020

Executive Summary

- Outline
 - San Jacinto Regional Watershed Master Drainage Plan
 - San Jacinto River Watershed
 - Development in Watershed
 - Watershed Flood History
 - Sources of Flooding
 - Flood Damage Areas
 - Future Flooding Potential
 - Flood Reduction in the Upper San Jacinto River Watershed
 - Public Outreach
 - Data Collection and Review
 - Existing Conditions
 - Recommended Projects
 - Policy Recommendations
 - Flood Warning and Response
 - Project Implementation
 - Frequently Asked Questions







Schedule Update

54 Current Progress
478 Days Remaining
8/12/2019 Completion Date

IRAFT - 7/8/202

- Existing H&H/Calibration 100% (Finalized)
- Primary Mitigation Planning (Workshops Completed) 95%
- Secondary Mitigation Planning (Adjusted Schedule) 100%
- Other Mitigation Actions (Adjusted Schedule) 95%







STUDY PARTNERS MONTHLY MEETING AGENDA

Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

August 11, 2020 San Jacinto Regional Watershed Master Drainage Plan Teams Conference Call

Meeting ca	alled by:	Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Progress Meeting
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	1:30 PM
			Meeting Stop Time:	3:00 PM
Agenda				
1.	Introd	uctions		
2.	Comm	unications and Outreach (Hol	laway)	
	•	Final review of meeting plan 0	08/13/20	
	•	Lake Houston Recovery Task	Force – 08/13/20	
	•	Upcoming Stakeholder Briefin	gs in July/Aug	
3.	Activit	ies Conducted this Month		
	•	Submitted Draft Report and Ex	kecutive Summary	
	•	Working on updates to Draft R	Report and Executive Su	mmary based on comments
	•	Community Meeting planning		
4.	Activit	ies Anticipated Next Month		
	•	Submit Final Report – 08/31/2	0	
	•	Conduct Community Meeting		
	•	Conduct Stakeholder Meetings	3	
5.	Techni	cal Discussion		
	•	Community Meeting Presentat	ion	
	•	Questions related to review co	mments	
6.	Admin	istrative Discussion		
	•	Additional Stakeholder Meetin	igs	
	•	Final Report discussion		
	•	TDEM submittal and review re	equirements	
	•	Next Steps for the San Jac Stud	dy	
7.	Questi	ons		

Appendix A.4

Supporting Partners Meetings





Grimes County

August 7, 2019 San Jacinto River Watershed Master Drainage Plan HCFCD, Brookhollow

Meeting ca	lled by:	Jing Chen, P.E., CFM	Type of Meeting:	Supporting Partners Meeting	
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	8:30 AM	
			Meeting Stop Time:	9:30 AM	
Agend	а				
1.	Attend	lees (See attached sign in sh	eet)		
	•	Terry Barr, Halff Associates, I	nc.		
	•	Jing Chen, HCFCD			
	•	Gary Bezemek, HCFCD			
	•	David Lilly, Grimes County Er	nergency Manager		
	•	Joe Fauth, Grimes County Ju	dge		
2.	Study	Overview			
	•	Jing introduced the study, hig	shlighting that the San J	acinto Regional Watershed Master	
		Urainage Plan (SJRWIVIDP) IS 1	funded by a FEMIA HIMG	P grant and includes a partnership of	
		nurnose of the study is to pro	wide consistently mode	led and manned baseline conditions	
		data and inundation mapping	for the San Jacinto wat	tershed. The study team is contacting	
		major stakeholder communit	ies, collecting informati	on to inform this planning effort, and	
		will distribute results within t	he watershed once plar	nning is complete for communities to	
		consider incorporate results a	and update their HMPs.		
	•	Terry provided an overview o	f the study goals and ol	ojectives:	
		 Assess basin vulnerat a reliable baseline co 	pility – Update H&H mo nditions model	deling for the basin and calibrate to set	
		 Primary Mitigation Pl 	anning – Look at structi	aral improvements and drainage policy	
		 Secondary Mitigation 	ı Planning – Focus on ga	ges and flood warning capability	
		 Other Mitigation Acti 	ons – Focus on commu	nication between jurisdictions and	
		identification of flood	led infrastructure	on charing information with the public	
		as well as decision m	and Education – Focus	isdictions	
	•	Terry provided an overview o	if the study schedule		
	•	Terry provided an overview o	f the Community Outre	ach efforts and mentioned the	
		website, which is <u>www.sanja</u>	<u>cstudy.org</u> .		
3.	Input f	rom Local Jurisdiction			
	This po	ortion of the meeting included	a conversation about ar	nticipated growth in the area, current	
	draina	ge criteria, flood history and ho	ot spots, and mitigation	alternatives.	
	•	They are expecting significant	t growth in the SH249 c	orridor up to SH105 over the next 10	
	years; Major developers are already looking at the area				

	•	Todd Mission is poised for growth; Economic and growth planning are needed
	•	Grimes/Montgomery County have several proposed developments and they are trying to
		get ahead of future development
	•	Along Mill Creek, there is significant flooding at the Grimes County line; they are
		considering buyouts in those areas
	•	There is not any flood data available or good modeling in that area; All of Grimes County
		mapping are Zone A, so there is no detailed H&H modeling
	•	Drainage Criteria
		• Floodplain Ordinance applicable to developments in the floodplain
		 Takes an aggressive approach (overall goal is No Adverse Impact)
		• Outside flood zone there are currently no detention requirements (Subdivision
		Regulations are only enforcement mechanism)
		• Any criteria for Todd Mission?
		• Unaware of Atlas 14 and no plans to implement it; HCFCD agreed to send a link to
		Atlas 14 data to the County. Data was subsequently sent on 8/7/19.
	•	Talking with USACE about adding gages so they are open to adding some (FWS, Emergency
		efforts, Etc.)
	•	HCFCD is encouraging jurisdictions to use the information developed in the San Jac WMDP
		to update their respective Hazard Mitigation Plans (HMP). Grimes Co. is currently updating
		their HMP.
	•	Consider Mill/Lake Creek as a gauge location. Reach out to D. Lilly for more specific
		information.
	•	Judge Fauth – Requested that we reiterate the study timeline.
	•	Jing – Wrapped up the meeting
	•	David – Mill Creek near Grimes County line is one of their most impacted areas.
	•	Professor George Allen (Texas A&M) – Merit Hydro (KBTX)
	•	Judge – Appreciated our involvement and our sharing the information with them
	•	Consider gages up in the upper reaches. Currently some HCFCD gages (Stage Only)
	•	Our Spring Creek MAAPnext modeling will include a 1D model of Mill Creek in that area
I I	1	





Waller County

August 9, 2019 San Jacinto River Watershed Master Drainage Plan HCFCD, Brookhollow

Meeting ca	lled by:	Jing Chen, P.E., CFM	Type of Meeting:	Supporting Partners Meeting		
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	2:00 PM		
			Meeting Stop Time:	3:00 PM		
Agend	а					
1.	Attendees (See attached sign in sheet)					
	•	Terry Barr, Halff				
	•	Andrew Moore, Halff				
	•	Jing Chen, HCFCD				
	•	Gary Bezemek, HCFCD				
	•	Yancy Scott, Waller County E	ngineer			
2.	Study	Overview				
	•	Jing introduced the study, hig	hlighting that the San Ja	acinto Regional Watershed Master		
		Drainage Plan (SJRWMDP) is funded by a FEMA HMGP grant and includes a partnership of				
HCFCD, SJRA, Montgomery County, and the City of			ounty, and the City of H	ouston. She also stated that the		
	purpose of the study is to provide consistently modeled and mapped baseline condi					
	uata and inundation mapping for the San Jacinto Watershed. The study team is contactil					
	will distribute results within the watershed once planning is complete for communities to					
	consider incorporate results and update their HMPs.					
	 Terry provided an overview of the study goals and objectives: 			ojectives:		
	 Assess basin vulnerability – Update H&H modeling for the basin and calibrat 			deling for the basin and calibrate to set		
a reliable baseline conditions model						
		 Primary Mitigation Pl 	anning – Look at structu	ural improvements and drainage policy		
		 Secondary Mitigation 	Planning – Focus on ga	ges and flood warning capability		
		• Other Mitigation Actions – Focus on communication between jurisdictions and				
		identification of flooded infrastructure				
		• Community Outreach and Education – Focus on sharing information with the public				
as v		as well as decision ma	f the study schedule	isalctions		
	•	Terry provided an overview o	f the Community Outre	ach efforts and mentioned the		
		 remy provided an overview of the community Outreach efforts and mentioned the website, which is www.saniacstudy.org. 				
-		· · · · · · ·	<u> </u>			
3.	Input f	rom Local Jurisdiction				
	This po	his portion of the meeting included a conversation about anticipated growth in the area, current				
drainage criteria, flood history and hot spots, and mitigation alternatives.			alternatives.			

The County Fire Marshal is the Emergency Management Coordinator and in charge of the	
Hazard Mitigation Plan (HMP); The County Engineer is the Floodplain Manager and can	
provide input to update the county HMP	
Per the HGAC 2040 Plan, development is expected along the US290 corridor and along	
FM1488 between Magnolia and Hempstead.	
 Along FM1488 there is quite a bit of development, including 3-4 planned developments 	
(MUDs) that encompass about 2000 ac.	
There is quite a bit of flooding in Clear Creek Forest	
The Waller County Strategic Plan was updated in 2018 and is on their website	
Drainage criteria is part of the Subdivision Regulations and requires that developers	
demonstrate no increase at the point of release (No Adverse Impact)	
The drainage criteria may be updated in the future when planning and development	
regulations are updated.	
The City of Waller uses Harris County regulations and Waller County may change at some	
point to follow a similar pattern; they have had a detention criteria since the 2000's	
Flooding History	
County has some maps for Tax Day/Memorial Day/Harvey (FEMA Claims)	
 No Hwill program, resident information only South of EM 1488 to Spring (Prushy, Three mile, Walnut, Pirch) 	
 South of FM 1488 to Spring (Brushy, Three-Inne, Walnut, Birch) Development in many areas right up to the creeks 	
 EIRM Maps (fairly accurate) but there are still some areas with Zone A 	
 Minimal CIP/Maintenance ability outside of county road ROW, which is limiting 	
• Are MID's responsible for maintenance of their channels?	
 FM 1488 Regularly floods (2017) 	
 County is considering drainage districts by watershed, but politics may slow that down 	
 Some new gages to be installed or have recently been installed 	
City of Waller participated in Upper Cypross Study, Braining View has may or may not have	.r
• City of Waller participated in Opper Cypress Study. Frame view has may of may not have t	л
enforce detention requirements. Evalvio drains into cypress creek.	
 Interested in detention; Waller Co. thinks they don't have statutory authority to require 	
detention for sites	





City of Conroe

August 13, 2019 San Jacinto River Watershed Master Drainage Plan Conroe City Hall

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Supporting Partners Meeting		
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	10:00 AM		
			Meeting Stop Time:	11:00 AM		
Agend	a					
1.	Attend	lees (See attached sign in she	eet)			
	•	Terry Barr, Halff				
	•	Andrew Moore, Halff				
	•	Jing Chen, HCFCD				
•		Gary Bezemek, HCFCD				
	•	Mike Legoudes, Conroe Fire				
	•	Christy Bryant, Conroe EMS				
	•	Anne Tran, City of Conroe Flo	odplain Management			
	•	Norm McGuire, City of Conroe	e Public Works			
	•	Cams Bogert, City of Conroe	City Engineer			
	•	Ann Colina, City of Conroe Flo	oodplain Management			
2. Study Overview						
	•	Jing introduced the study, hig	hlighting that the San J	acinto Regional Watershed Master		
		Drainage Plan (SJRWMDP) is f	funded by a FEMA HMC	SP grant and includes a partnership of		
HCFCD, SJRA, Montgomery County, and the City of Houston. She also stated th		louston. She also stated that the				
		purpose of the study is to pro	vide consistently mode	eled and mapped baseline conditions		
		data and inundation mapping	for the San Jacinto wa	tershed. The study team is contacting		
		major stakenoider communit	les, collecting informati	on to inform this planning effort, and		
		will distribute results within t	ne watersned once plai	ining is complete for communities to		
	•	Terry provided an overview o	f the study goals and ol	hiertives		
	•	\sim Assess basin vulnerat	vility — Undate H&H mo	deling for the basin and calibrate to set		
		a reliable baseline co	nditions model			
		 Primary Mitigation Pl 	anning – Look at struct	ural improvements and drainage policy		
		 Secondary Mitigation 	Planning – Focus on ga	ages and flood warning capability		
		 Other Mitigation Acti 	ons – Focus on commu	nication between jurisdictions and		
		identification of flood	led infrastructure	-		
		 Community Outreach 	and Education – Focus	on sharing information with the public		
		as well as decision ma	akers in the affected jur	risdictions		
	•	Terry provided an overview o	f the study schedule			
	•	Terry provided an overview o	f the Community Outre	ach efforts and mentioned the		
		website, which is <u>www.sanjac</u>	<u>cstudy.org</u> .			

3.	Input from Local Jurisdiction
	This portion of the meeting included a conversation about anticipated growth in the area, current
	drainage criteria, flood history and hot spots, and mitigation alternatives.
	• The City of Conroe currently regulates with the FEMA model (Halff model)
	There is currently an internal discussion about which model to use for regulating
	They City does not currently plan on using Atlas 14 rainfall
	• They did not have too many issues with Hurricane Harvey but did have some flooding with the Tax Day 2016 storm
	• They City is growing very rapidly in all sectors at all boundaries and internally.
	 They have the ability to annex ETJ areas by providing utilities (N/W)
	• The City is expected to double in size in 20 years (Metro Study done for their WWMP)
	 Not too many issues with criteria except that there is a disconnect between the City of
	Montgomery County with respect to Atlas 14
	Conroe would like more updated FEMA maps
	 Current TDWB Study was finalized this month and could be LOMR'd
	Hurricane Harvey impacts were limited to flooding caused by the Lake Conroe dam releases
	The Tax Day storm resulted in more flash flooding in town
	October 1994 storm had localized stream flooding and a berm breached at the sewer plant
	Inere are currently gages at SH 105 & IH-45 that they utilize, but the SH 105 gage does not
	provide much useful information. What about putting a gage at FW 2854?
	Confide stall are working to convince the City Council that gages are needed and could possible loverage TMDR funding
	 The study team asked about any additional studies in the area. They City indicated that we
	already have most of their studies (Little Canev?)
	 Flood hotspots are at FM 2854. IH-45, residential neighborhoods along the West Fork;
	during Harvey – 1 lane blocked at SH105 and FM 2854 was not passable.
	• Are there any plans available for the FM 2854 TXDOT improvements? They will look
	• The City would like to help any way they can but can't commit to maintaining additional
	channels that have been improved
	They currently maintain improved channels within their jurisdiction, but not unimproved
	channels
	 The biggest challenges to projects that they face are ownership/maintenance
	 Which benchmarks were used for survey? FEMA does not regularly maintain benchmarks.
	The TSARP benchmarks are being updated as part of the MAAPnext effort.
	Gary discussed the Harris County Flood Warning System and the MAAPnext program
	• Jing – consider partnerships for programs (grants, projects)
	 Buyouts – Many people took out a second mortgage to fix homes, so there is a concern that
	the buyout will not cover those additional costs, making buyouts unattractive to
	lieu of an actual buyout program, they may not issue permits to rebuild in flood damaged
	areas. Gary provided a brief overview of buyout program in Harris County
	areas. Gary provided a brief overview of buyout program in marris county.





Walker County

August 13, 2019 San Jacinto River Watershed Master Drainage Plan Bleyl Engineering, Conroe

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Supporting Partners Meeting	
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	11:30 AM	
			Meeting Stop Time:	1:00 PM	
Agend	a				
1.	Attend	lees (See attached sign in she	eet)		
	•	Terry Barr, Halff			
	•	Andrew Moore, Halff			
	•	Jing Chen, HCFCD			
	•	Gary Bezemek, HCFCD			
	•	Ryan Londeen, Bleyl Enginee	ring		
	•	Steffanie Deloss, Bleyl Engine	eering		
	•	Andrew Isbell, Walker County	Planning and Developr	nent Director	
2.	Study	Overview			
	•	Jing introduced the study, hig	hlighting that the San Ja	acinto Regional Watershed Master	
		Drainage Plan (SJRWMDP) is f	funded by a FEMA HMG	P grant and includes a partnership of	
	HCFCD, SJRA, Montgomery County, and the City of Houston. She also stated that the				
		purpose of the study is to provide consistently modeled and mapped baseline conditions			
	maior stakeholder communities, collecting information to inform this planning effort, and				
		major stakenoider communit	les, collecting informati	on to inform this planning erfort, and	
	consider incorporate results and update their HMPs.		ining is complete for communities to		
	 Terry provided an overview of the study goals and objectives: 		niectives.		
 Assess basin vulnerability – Undate H&H modeling for the basin vulnerability – Unda		deling for the basin and calibrate to set			
		a reliable baseline co	nditions model		
		• Primary Mitigation Pl	anning – Look at structu	ural improvements and drainage policy	
		 Secondary Mitigation 	Planning – Focus on ga	ges and flood warning capability	
		 Other Mitigation Acti 	ons – Focus on commu	nication between jurisdictions and	
		identification of flood	led infrastructure		
		 Community Outreach 	and Education – Focus	on sharing information with the public	
		as well as decision ma	akers in the affected jur	isdictions	
	•	Terry provided an overview o	f the study schedule		
	•	Terry provided an overview o	f the Community Outre	ach efforts and mentioned the	
	website, which is <u>www.sanjacstudy.org</u> .				
3.	Input f	rom Local Jurisdiction			
	This po	ortion of the meeting included	a conversation about ar	nticipated growth in the area, current	
drainage criteria, flood history and hot spots, and mitigation altern		alternatives.			

•	There are over 1,000 lots under development in the watershed (West Fork) and more going
	into Caney Creek (Texas Grand Ranch); Also I-45 commercial district (3000 Ac.) Large lots.
٠	Walker County (WCO) has a detention criteria but does not currently use Atlas 14
•	Would be interested in the modeling that comes out of the study
•	WCO is experiencing development pressure from Houston and Sam Houston S.U.
•	In many of the new development there are "No Build" easements along floodplains, most
	of which are Zone A and are buffered (25-50 ft)
•	If WCO is going to implement change, they feel like they need to do soon since it is starting
	to develop rapidly
•	City of Huntsville has water contracts (ETJ), but floodplain permitting is county's
	responsibility.
•	Most development is between the West Fork Main stem and I-45.
•	Mr. Isbell indicated he could provide any models that they have from development to study
	team.
•	The WCO detention criteria not great but they are working on new subdivision regulations
	to strengthen the county's ability to prevent adverse impacts; this is expected to be ready
	in the next 30 days. WCO currently only look pre- vs. post-development discharge rates.
	Smaller lots (< 1 ac) are not regulated.
•	Harris Co. has different regulations than other counties; There are currently no statures
	that allow enforcement of drainage criteria; maybe floodplain permitting; A drainage
	conveyance easement is not currently required, only a note on the plat indicating
	preserving drainage conveyance
•	A big part of flood mitigation is the regulatory aspect; the earlier the better
•	WCO needs to develop BFE's in the floodplain (currently Zone A); Need FEMA approved
	detailed studies for major developments.
•	The San Jac study models potentially use our data as "Best Available" for Zone A regulation
•	WCO currently allows a max 1 ft rise within the development property boundary but they
	would prefer a "No Rise" criteria
•	Mr. Barr asked what mitigation actions they would like to see? WCO indicated that Lake
	Conroe is currently their detention.
•	WCO does not currently have traffic studies or a master plan; Their population growth
	estimates (HGAC) are likely underestimating the actual growth. They work with TXDOT
	Bryan District.
•	The Trinity River is not studied in detail south of the D/FW Metroplex
•	Most of WCO's flooding is in the Trinity River basin. Not many issues in the SJR Basin
•	Steam gages would be of interest to WCO, particularly in the Wildwood Shores
	neighborhood; WCO is considering using a FEMA grant to get some gages
•	WCO is interested in seeing the information that comes out of this study.
•	WCO asked how we are handling Atlas 14 for the study? The study team is using the
	average depth for each watershed.
•	Walker County has had some issues with BLE accuracy and has concerns about the public
	seeing the data and coming back at FEMA/others.
•	How are we modeling Lake Conroe (In=Out; Per criteria; no release) Max elevation should
	be considered. Can lake ops be a potential alternative? They hope that we can identify
	future studies/mapping needs.
•	Interested in staying informed about and possibly participating in the regulatory discussion
	that could be a part of the alternatives analysis.





San Jacinto River Authority

August 26, 2019 San Jacinto River Watershed Master Drainage Plan SJRA Woodlands Office

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Meeting
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	1:00 PM
			Meeting Stop Time:	2:00 PM
Agend	a			
1.	Attend	ees (See attached sign in she	eet)	
	•	Terry Barr, Halff		
	•	Andrew Moore, Halff		
	•	Jing Chen, HCFCD		
	•	Both Walters HCECD		
		Matt Barrett, SIRA Engineerir	na	
	•	Chuck Gilman, SJRA Director	of Flood Management	
	•	Heather Cook, SJRA Commu	nications	
	•	Michael Reedy, Freese & Nich	nols	
2.	2. Study Overview			
	 Study Overview Jing introduced the study, highlighting that the San Jacinto Regional Watershed Master Drainage Plan (SJRWMDP) is funded by a FEMA HMGP grant and includes a partnership of HCFCD, SJRA, Montgomery County, and the City of Houston. She also stated that the purpose of the study is to provide consistently modeled and mapped baseline condition data and inundation mapping for the San Jacinto watershed. The study team is contactin major stakeholder communities and collecting information to inform this planning effort The results will be distributed throughout the watershed once planning is complete for communities to consider incorporating the results and updating their HMPs. Terry provided an overview of the study goals and objectives: Assess basin vulnerability – Update H&H modeling for the basin and calibrate to a reliable baseline conditions model Primary Mitigation Planning – Look at structural improvements and drainage po Secondary Mitigation Planning – Focus on gages and flood warning capability Other Mitigation Actions – Focus on communication between jurisdictions and identification of flooded infrastructure Community Outreach and Education – Focus on sharing information with the pu as well as decision makers in the affected jurisdictions Terry provided an overview of the study schedule Terry provided an overview of the Community Outreach efforts and mentioned the website, which is <u>www.sanjacstudy.org</u>. 		Acinto Regional Watershed Master P grant and includes a partnership of ouston. She also stated that the led and mapped baseline conditions ershed. The study team is contacting nation to inform this planning effort. hed once planning is complete for d updating their HMPs. ojectives: deling for the basin and calibrate to set aral improvements and drainage policy ges and flood warning capability nication between jurisdictions and on sharing information with the public isdictions ach efforts and mentioned the	

3.	Input from Local Jurisdiction		
	This portion of the meeting included a conversation about anticipated growth in the area, current drainage criteria, flood history and hot spots, and mitigation alternatives.		
	 The study presents an opportunity for Montgomery County (MCO) and partnering agencies to reduce flood risk from the upper reaches through Lake Houston. SJRA expressed concerns related to flooding across the entire San Jacinto Basin, but historically have had more public input from residents in Grogan's Point, MUD 386 (Woodlands), Timber Lakes/ Timber Ridge, Kingwood, and Lake Houston. There has not been as much public input from the east side residents. SJRA would like to provide guidance to local communities. Chuck stated that the drainage criteria and subdivision regulations are within the purview of the cities and counties within the watershed; SJRA has no enforcement authority but supports the efforts of Montgomery County. Jing asked if SJRA is concerned about erosion in the major rivers. Chuck stated that the SJRA is more concerned about sedimentation and the impacts on reservoir capacity and flooding. With respect to public outreach, Cook stated SJRA is working on a "Know Your Watershed" website. SJRA has partnered with HCFCD to study the feasibility of sand traps in the San Jacinto River Watershed. Planting/stabilization may be one option to help to reduce erosion. SJRA has a substantial network of ALERT gages but they rely on Montgomery County to 		
	 perform road closures and evacuations. Cook asked how the public was going to be made aware of the new study website. Jing stated she would check with Hollaway on the process. Cook recommended a partnership in relaying information to the public. 		



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STUDY PARTNERS MEETING NOTES

Montgomery County

August 26, 2019 San Jacinto River Watershed Master Drainage Plan SJRA Woodlands Office

Meeting called by		Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Meeting	
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	3:00 PM	
			Meeting Stop Time:	4:00 PM	
Agend	а				
1.	Attend	lees (See attached sign in she	eet)		
	•	Terry Barr, Halff			
	•	Andrew Moore, Halff			
	•	Jing Chen, HCFCD			
	•	Gary Bezemek, HCFCD			
	•	Beth Walters, HCFCD			
	•	Michael Reedy, Freese and N	lichols		
	•	Darren Hess, Montgomery Co	ounty Emergency Manag	ger	
2	Study	Overview			
2.	olddy	ling introduced the study high	hlighting that the San I	acinto Regional Watershed Master	
	•	Drainage Plan (SIRWMDP) is f	incroduced the study, highlighting that the San Jacinto Regional Watershed Master have Plan (SIRW/MDP) is funded by a FEMA HMGP grant and includes a partnership of		
	HCECD SIRA Montgomery County and the City of Houston. She also stated the		ouston. She also stated that the		
	purpose of the study is to provide consistently modeled and mapped baseline conditions				
	data and inundation mapping for the San Jacinto watershed. The study team is contacting				
	major stakeholder communities, collecting information to inform this planning effort, and				
		will distribute results within t	he watershed once plar	nning is complete for communities to	
	consider incorporate results and update their HMPs.				
	 Terry provided an overview of the study goals and objectives: 		ojectives:		
	 Assess basin vulnerability – Update H&H modeling for the basin and calil 		deling for the basin and calibrate to set		
		a reliable baseline co	nditions model		
		 Primary Willigation Pr Secondary Mitigation 	Dianning – LOOK at Structt	arai improvements and drainage policy	
		 Other Mitigation Acti 	ons – Focus on commu	pication between jurisdictions and	
		identification of floor	led infrastructure		
		 Community Outreach 	and Education – Focus	on sharing information with the public	
as well as decision makers in the af		akers in the affected jur	isdictions		
	•	Terry provided an overview o	f the study schedule		
	•	Terry provided an overview o	f the Community Outre	ach efforts and mentioned the	
		website, which is <u>www.sanjac</u>	<u>cstudy.org</u> .		
3.	Input f	rom Local Jurisdiction			
	This po	ortion of the meeting included a	a conversation about ar	nticipated growth in the area. current	
	draina	ge criteria, flood history and ho	ot spots, and mitigation	alternatives.	

•	Several master planned communities are in progress and will be completed in the near
	future. They are all over Montgomery County, not just in one area. Approx. 20,000 new
	rooftops are expected in the southern portion of the county.
•	There is an item on the agenda related to the detention policy and the allowance for an
	impact analysis to demonstrate that no detention is needed. Not sure how detention item
	will play out but they are still interested in looking at that alternative.
•	Much of the urban flooding is along Stewart and Alligator Creeks
•	Montgomery County is focusing on property acquisition: they are boning to see 300+
_	buyouts.
•	Interested in the study results and recommendations for Lake Creek; There has been a
	history of loss of life during major flooding events at low water crossings.
•	They are also interested in early warning/detection along Lake Creek; The creek generally
	rises quickly but has a slow decent, so near flash flooding conditions followed by lengthy
	flooding period.
•	The Fast Fork at the county line floods a lot (Plum Grove).
•	Most of the state roads close during major rainfall events.
•	They are looking at buyouts in Patton Village
•	Montgomery County would also like to see gages outside of MOCO so that they can get
	better warning for flood conditions in their jurisdiction. Focus on unland areas with sparse
	gage coverage especially on the east side
•	MOCO preference would be to focus just on gages not road closure arms, which are more
	expensive and were not approved when previously presented
•	MOCO will send road closure information for the study team's use
	Lise of the National Forest for detention is of interest to MOCO
	MOCO does not believe the surrent flood mans are very assurate. The flood plains are
· ·	either too small or some area not included at all
•	The EOM relies on notifications from SIRA to alert them and then they start to make
	notifications.
•	How can we help to improve this process? Would a shared network be beneficial? MOCO
	mentioned that having a better idea of response times from one area to the next would
	help them make decisions about road closures and, if needed, evacuations.
•	How can we share this information most efficiently?
	• The HGAC system ties the counties together, but each county has their own
	notification systems.
	 They currently leverage Web EOC activity boards
	 HCFWS can send alerts – MOCO would like something similar.
	• What would they like to see? Rainfall? Elevations? Channel status? Response
	times? Flooded crossings?
	• They would like to see warnings go to the EOC rather than to the public all the time.
	The public can get worn out with alerts during a major event and may ignore the
	notifications.
•	MOCO is responsible for everyone but (Conroe. Shennandoah) but the entities have good
	communication.
•	They have a few locations called Instant Command Center (Regional EOC-like).





San Jacinto County

August 27, 2019 San Jacinto River Watershed Master Drainage Plan HCFCD, Brookhollow

Meeting ca	lled by:	Jing Chen, P.E., CFM	Type of Meeting:	Supporting Partners Meeting		
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	10:30 AM		
			Meeting Stop Time:	11:30 AM		
Agend	a					
1.	Attend	lees (See attached sign in she	eet)			
	•	Terry Barr, Halff Associates, I	nc.			
•		Jing Chen, HCFCD				
•		Gary Bezemek, HCFCD				
•		David Brandon, San Jacinto County Commissioner, Precinct 3				
	•	Laddie McAnally, San Jacinto	County Commissioner,	Precinct 1		
	•	Dena Green, HCFCD				
	•	Heather Cook, SJRA				
	•	Matt Barrett, SJRA				
2.	Study	Overview				
	•	 Jing introduced the study, highlighting that the San Jacinto Regional Watershed Master Drainage Plan (SJRWMDP) is funded by a FEMA HMGP grant and includes a partnership of HCFCD, SJRA, Montgomery County, and the City of Houston. She also stated that the purpose of the study is to provide consistently modeled and mapped baseline conditions data and inundation mapping for the San Jacinto watershed. The study team is contacting major stakeholder communities, collecting information to inform this planning effort, and will distribute results within the watershed once planning is complete for communities to consider incorporate results and update their HMPs. Terry provided an overview of the study goals and objectives: Assess basin vulnerability – Update H&H modeling for the basin and calibrate to set a reliable baseline conditions model Primary Mitigation Planning – Look at structural improvements and drainage policy Secondary Mitigation Planning – Focus on gages and flood warning capability Other Mitigation Actions – Focus on communication between jurisdictions and identification of flooded infrastructure Community Outreach and Education – Focus on sharing information with the public as well as decision makers in the affected jurisdictions Terry provided an overview of the study schedule Terry provided an overview of the Community Outreach efforts and mentioned the website, which is <u>www.sanjacstudy.org</u>. 				
3.	Input f	rom Local Jurisdiction				
	This portion of the meeting included a conversation about anticipated growth drainage criteria, flood history and hot spots, and mitigation alternatives.		iticipated growth in the area, current alternatives.			

•	Inundation data in the San Jacinto County (SJCO) is limited since Livingston is used for water
	supply and inundation around the lake is not recorded.
•	Mr. Brandon monitors rainfall and flood concerns in Grimes County to see what potential
	flooding may occur later in San Jacinto Co.
•	Their evacuation routes are very limited since most roads are flooded
•	They have noticed a dramatic difference in storms and resultant flooding due to
	sedimentation over the past several decades, particularly on Peach Creek and the East Fork.
•	Luce Bayou at US 59 is a major problem because it acts as a giant Levee; Harvey was worse
	than the October 1994 storm with tremendous flooding along US 59 corridor.
•	There is only 1 gage in San Jacinto Co. (Peach Creek)
•	Most of their roads underwater (SH 150, FM 945, FM 2025) by as much as 10-15 ft.
•	Dammed up vegetation on major/minor streams broke through and caused problems D/S
	during Hurricane Harvey.
•	Tarkington Bayou at US 59 is biggest area of concern.
•	Floods from 2004 to current (2016/2017) have had more impact at Cleveland.
•	Mr. Brandon follows the "flood wave" and can tell by condition of one area what potential
	conditions are downstream and when flooding may occur.
•	There are some written records about HWM but no survey data.
•	Creekwood Subdivision homes flooded during Harvey.
•	There was significant East Fork flooding during Harvey as well (Harvey Shaw Rd, FM 1945)
•	Large tracts are being subdivided/developed; Development is starting to get more dense
	and the number of permit requests to SJCO has tripled
•	US 190 going to be a loop at some point in the future.
•	Does SJCO have a development or drainage policy?
	 Currently minimal but being worked on. Submitted NOI for drainage study (FEMA
	BLE; County is completely Zone A (unstudied)
	 Limited enforcement capability (subdivision regs)
	 2017 Adopted NFIP changes (2ft above BFE)
•	Most county roads are old forest roads that were dedicated to SJCO; Title 3 funds are
	provided for the maintenance of those roads.
•	Project team asked about the potential for providing detention in the National Forest
	 Mr. Brandon indicated that a dam was recommended for the East fork (DAM C)
	many years ago – Martin Dyess Park
	 Mr. McAnally was not sure if we could dam through the National Forest (tree
	health, road access, property) – Eagles, woodpeckers
	• We would need to talk to the National Forest Service Lufkin HQ
	 I errain could be problematic because the area is hillier than Harris Count
	 Inere may be come flatter areas that could provide sufficient storage Describe the trible based on the storage
	 Possibly but it is large tract farmland; might be more conductive to storage (peach,
	boggy, gum) Look at terrain dataset.
•	ivir. Brandon revealed that Peach Creek was formed by an earthquake in 1922
•	Study team asked about the SCJO wish list – if you could change authority, what would help
	most?
	 Duilding codes would help SJCO manage development more efficiently. More limited ability to regulate DV's (DV parks)
	 very influed ability to regulate KV S (KV parks) Deeple weit until lest minute to succuste
1	• People wait until last minute to evacuate.

 As far as Emergency Management, SJCO has an EOC, rescue boats, deuces (large trucks for which NEC)
from the NFS)
 SJCO works with TXDOT and has started dialogue to raise some of the roads.
SJCO has issues with mandatory evacuations in the urban areas (other jurisdictions) that
clog roadways. The county's current policy is to stay in place.
TRA communicates well during events.
What kind of communication would you like? Better communication from neighboring counties: more gauges
counties, more gauges.
• Gages would be beneficial at: East Fork at SH 150; Winters Bayou at SH 150; Along SH 105
near FM 1725; the type of gage (rain, stage, flow) needed depends on location.
 TXDOT (10-20 years) is looking to elevate bridges at SH 150 and FM 945 S. This could
potentially be leveraged in the long term for flood storage. Is there existing development in
these areas?
 \$12M road expansion of SH 150 from FM 945 to FM 1097
• Flood wave travel time is 1 day from SH 150 to next major road (??) on Winters Bayou.




STUDY PARTNERS MEETING NOTES

City of Houston

September 6, 2019 San Jacinto River Watershed Master Drainage Plan Skype Conference Call

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Meeting		
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	1:30 PM		
			Meeting Stop Time:	2:30 PM		
Agend	а					
1.	Attend	ees (See attached sign in sh	eet)			
	•	Terry Barr, Halff				
	•	Sam Hinojosa, Halff				
	•	Andrew Moore, Halff				
	•	Jing Chen, HCFCD				
	•	Gary Bezemek, HCFCD				
	•	Michael Reedy, Freese & Nich	1015			
	•	Cory Stull, Freese & Nichols	Marke Planning Donarts	nont		
	•		works Planning Departi	nent		
2.	Study	Overview				
	•	Jing introduced the study, hig Drainage Plan (SJRWMDP) is the HCFCD, SJRA, Montgomery Co purpose of the study is to pro- data and inundation mapping major stakeholder communit will distribute results within the consider incorporate results at Terry provided an overview of Assess basin vulnerate a reliable baseline co Primary Mitigation Pl Secondary Mitigation Pl Secondary Mitigation Other Mitigation Activity identification of flood Community Outreach as well as decision ma Terry provided an overview of website, which is <u>www.sanjac</u>	hlighting that the San Ja funded by a FEMA HMG ounty, and the City of He ovide consistently mode g for the San Jacinto wat ies, collecting information he watershed once plan and update their HMPs. If the study goals and ob oility – Update H&H mod nditions model anning – Look at structure Planning – Focus on ga ons – Focus on communited infrastructure in and Education – Focus akers in the affected jur if the study schedule if the Community Outree cstudy.org.	acinto Regional Watershed Master P grant and includes a partnership of ouston. She also stated that the led and mapped baseline conditions cershed. The study team is contacting on to inform this planning effort, and ming is complete for communities to ojectives: deling for the basin and calibrate to set ural improvements and drainage policy ges and flood warning capability nication between jurisdictions and on sharing information with the public isdictions ach efforts and mentioned the		

3.	Input from Local Jurisdiction		
	This portion of the meeting included a conversation about anticipated growth in the area, current		
	drainage criteria, flood history and hot spots, and mitigation alternatives.		
	 Kingwood area is currently built out and they are not anticipating much development downstream of the lake. Adam stated he can look into any studies of population growth in that area. 		
	 Looking for an update to the drainage criteria for the City. Currently the planning group is considering requiring both the City IDM and the Atlas 14 rainfall based on the HCFCD criteria for their drainage evaluations. 		
	• What is the current status of the Lake Houston gates? Is the City of Houston wanting		
	modeling done as part of this study?		
	 The gates appear to be moving toward a design phase, which will include detailed analysis of the configuration, costs, and benefits. 		
	• KIT looking into a hydrodynamic model to determine any potential impacts. The		
	City didn't see flooding on the lake during Hurricane Harvey, except around the channels leading into the lake.		
	 COH has determined that the flooding in Kingwood was a result of the flooding along the channels, not the backwater from Lake Houston. 		
	• Any changes to the lake need to consider the new 400 MGD treatment plant		
	Houston Water is interested in how flood mitigation alternatives may impact the		
	lake with an eye toward the treatment processes and water quality.		
	• Would the City be interested in looking at pre-release of the lake? Adam will check into the		
	need for the City. Sam stated that looking into the gate operations will be needed. He		
	asked for any information that is available as part of previous studies.		
	Gary stated that many of the detention on the small channels that feed into Lake Houston		
	may have some timing impacts on the lake, but not volume impacts. Is the City interested		
	in reviewing the detention regulations for Lake Houston?		
	 Jing requested 4 reports from the City regarding dredging and sedimentation operations. 		
	Mike stated that all of these reports would be beneficial for the study. The reports		
	requested include the following:		
	 USACE 2018 West Fork San Jacinto River Emergency Dredging (I-69 to Lake Houston); 		
	nttps://www.swg.usace.army.mii/Portals/26/EM/190415_Post%20Harvey%20Dred		
	- HEC-RAS Model		
	- Plans & Specs		
	- Pre & Post Construction Surveys		
	 Dredged Material Disposal Site Locations & Conveyance Corridors 		
	- Dredging logs or Lessons Learned		
	2. TWDB Contract No. R1248011430 with U.S. Army Corps of Engineers, Fort Worth		
	District, 2011 and Report - Planning Assistance to States (?).		
	3. Report on Sedimentation of Lake Houston, San Jacinto River, Harris County, Texas,		
	Houston, Lexas, January 1966, Ambursen Engineering Corporation.		
	4. USACE individual permit number SWG-2018-00916 application by City of Houston		
	tor disposal of future dredged material, dated April 1, 2019.		
	 Mike also stated that the City had packaged a submittal to FEMA that included benefit cost information which would also be helpful to understand the benefits. Adam stated that he 		

		has not been able to find the permit application. Mike stated that CWA may have the
		Information.
	•	address the fleeding issue and recommend a solution or will it be conducted in the gate
		study? Sam stated that the study should include the gates but will also look into the
		reduction flooding on the West Fork. The intent of the San Jacinto study is not necessarily
		to evaluate gate sizing and entimization on Lake Houston, but additional gates can be
		accounted for
	•	How certain the City is that they will receive the federal funding for the gates? Gary stated
	·	that if the gates are tied to federal funding, then the benefit cost will have to be positive to
		receive the funding
	•	Adam stated he is not sure of far unstream residents would notice the impacts of the gates
	•	Gary stated that the study should identify how Kingwood flooded in historical events. The
		partners should coordinate with the gate study to understand the new gate study.
	•	Mike stated that the gate study will look into a BCR analysis based on several gate scenarios
		but it will be completed after this study. He stated that the team could make some
		assumptions based on what we know of the Lake Houston gates. Terry stated that any
		assumptions would have to be clearly identified in the report.
	•	Adam stated that the City is looking for any kind of reduction in flooding through Kingwood,
		no specific areas have higher priority than others.
	•	What do you see as a success for this study? Houston Water wants to make sure there are
		no major operation changes to the Lake Houston including sedimentation and quality. The
		City relies heavily on the gages coming into the lake to understand how to adjust the water
		treatment process.
	•	What are the City's Flood Mitigation goals? To make Kingwood happy by addressing their
		needs; there is a lot of political pressure in that area, so we want to make sure that we are
		addressing that community
	•	Gary asked how big of an issue sedimentation and bacteria are. Adam indicated that
		improvements to the water quality would be seen as beneficial. Any increase in turbidity
		(sedimentation) would not be beneficial for the City. Proposed mitigation options that are
		recommended as part of the study may require a study of the future water quality to
		understand how the processes would be impacted.
	•	Jing asked for the status of the mouth bar dredging. Adam stated he was not sure at the
	_	moment but would look into the status.
	•	Jing stated that the Drait Existing H&H model review should be completed by 9/9/2019
		with the report by the end of that week. She stated that HDR is reviewing the BDF
4	0	
4.	Summ	ary of Questions for City of Houston
	•	What is the current status of the Lake Houston gates? Is the City of Houston wanting
		modeling done as part of this study?
	•	would the City be interested in looking at pre-release of the lake?
	•	Is the City interested in reviewing the detention regulations for Lake Houston?
	•	What does the City see as a success for this study?
	•	What are the City's Flood Mitigation goals?
	•	What is the status of the Mouth Bar dredging?
	-	WHAT IS THE STALAS OF THE WOALT OF ALCHENE:





STUDY PARTNERS MEETING NOTES

Harris County Flood Control District

September 12, 2019 San Jacinto River Watershed Master Drainage Plan HCFCD, Brookhollow

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Meeting
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	11:00 AM
			Meeting Stop Time:	12:00 PM
Agend	a			
1.	Attend	lees (See attached sign in she	eet)	
	•	Terry Barr, Halff		
	•	Sam Hinojosa, Halff		
	•	Andrew Moore, Halff		
	•	Cory Stull, FNI		
	•	Hector Olmos, FNI		
	•	Jing Chen, HCFCD		
	•	Gary Bezemek, HCFCD		
	•	Matt Zeve, HCFCD		
	•	Ataul Hanan, HCFCD		
	•	Dena Green, HCFCD		
2.	Study	Overview		
	•	Terry introduced the meeting jurisdiction. He summarized t	and the purpose for col he purpose of the study	lecting goals and input from each local v and the study deliverables.
3.	Input f	rom Local Jurisdiction		
	This po drainag	ortion of the meeting included a ge criteria, flood history and hot	conversation about ant spots, and mitigation a	ticipated growth in the area, current lternatives.
	•	Terry introduced the meeting jurisdiction	and the purpose for col	lecting goals and input from each local
	•	Matt stated the goals should in seek funding, 3) Cooperating drainage criteria for the water	nclude 1) Educating the with surrounding counti shed.	e public, 2) coming up with a project to les, and 4) determining a consistent
	•	Matt stated that the focus sho agencies and that the focus s wide updates to drainage crite	uld be on the plan to ac hould be on which proje eria	dvocate to the public and governmental acts reduce flooding and watershed
	•	Gary expressed interest in kn calibration efforts for the basin watershed.	owing what future gage n noting the lack of gage	s would have be beneficial for future es in the upper reaches of the
	•	Matt requested that progress supporting partners to keep a	updates be prepared ar Il entities involved in the	nd sent to both study partners and project.
	•	Sam asked for the district's re there is a potential project for existing gates only as the proj	commendation for mod increasing the gate cap posed gates will be mod	eling the Lake Houston gates since bacity. Matt recommended modeling the deled and optimized in a future study.

 Matt requested the study recommend a project(s) to be used for the State Flood Plan. Terry mentioned that dual use facilities achieve higher scoring. Matt mentioned looking into potential water supply or recreation as potential dual use facilities for the flood control reservoirs. Matt requested the study provide a one pager on the recommended project(s). He recommended the study team be involved on the State Flood Plan and coordinate with Saul Nuccitelli to understand what the state will be looking for concerning potential projects.
• Gary mentioned that some entities are wanting new maps. Matt mentioned that one goal can be developing a policy for new mapping. Ataul mentioned that HCFCD could host a workshop to discuss funding opportunities for creating new maps. Gary mentioned that the study could show the change in floodplain due to the new Atlas 14 rainfall.





STUDY PARTNERS MEETING NOTES Montgomery County

September 13, 2019 San Jacinto River Watershed Master Drainage Plan Montgomery County Engineering

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Study Partners Meeting
Facilitator:		Sam Hinojosa, P.E., CFM	Meeting Start Time:	9:30 AM
			Meeting Stop Time:	11:30 AM
Agend	la			
1.	Attend	lees (See attached sign in sh	leet)	
	•	Sam Hinojosa, Halff		
	•	Andrew Moore, Halff		
	•	Jing Chen, HCFCD		
	•	Gary Bezemek, HCFCD		
	•	Beth Walters, HCFCD		
	•	Jeff Johnson, Montgomery C	ounty	
	•	Diane Cooper, Montgomery	County	
2.	Study	Overview		
	•	Sam introduced the study, h	ighlighting that the San .	lacinto Regional Watershed Master
		Drainage Plan (SJRWMDP) is	funded by a FEMA HMC	SP grant and includes a partnership of
		HCFCD, SJRA, Montgomery C	County, and the City of H	ouston. He stated that the purpose of
		the study is to provide consis	stently modeled and ma	pped baseline conditions data and
		inundation mapping for the s	San Jacinto Watersned.	ne study team is contacting major
		distribute results within the	meeting information to i	niorm this planning erfort, and will
		consider incorporate results	and undate their HMPs	
		Sam provided an overview o	f the study goals and oh	iectives:
		• Assess hasin vulnera	hility – Undate H&H mo	deling for the basin and calibrate to set
		a reliable baseline co	onditions model	
		 Primary Mitigation P 	lanning – Look at struct	ural improvements and drainage policy
		 Secondary Mitigation 	n Planning – Focus on ga	ges and flood warning capability
		 Other Mitigation Act 	ions – Focus on commu	nication between jurisdictions and
		identification of floo	ded infrastructure	
		 Community Outreac 	h and Education – Focus	on sharing information with the public
		as well as decision m	akers in the affected jui	risdictions
	•	Sam provided an overview o	f the study schedule	
3.	Input f	rom Local Jurisdiction		
	This po	ortion of the meeting included	a conversation about a	nticipated growth in the area, current
	draina	ge criteria, flood history and h	ot spots, and mitigation	alternatives.
	•	Jeff stated that the county w	anted to minimize flood	ling for public safety concerns. He
		stated that the study should	have a concrete set of r	ecommendation for flood control

	dams. He stated that the projects should have actual costs for publication to the general
	public and local officials. Diane added that frequency and amount of overtonning of roads
	would be
•	leff mentioned that justification for the proposed flood mitigation projects would be
•	beneficial for future implementation. He stated that getting public huw in for the plan
	would helptor the ability to access public funding
	Diana montioned that having accurate flood models will be a success for the preject. She
•	Diane mentioned that having accurate flood models will be a success for the project. She
	stated that the study should show the new Atlas 14 extents and identify potential drainage
	issues throughout the county. Gary mentioned having comparisons to the existing
	floodplain to show where the floodplain may especially be outdated.
•	Diane stated that the final product should include an implementation plan that could be
	referenced in the event of a future disaster and public funding is available.
•	Jeff stated that having a comprehensive gage network would be indispensable for public
	warning during storm events. He stated that the public needs a simple place to go to learn
	and reference during an event. Diane added that public education for reading and
	understanding the National Weather Service dataset would be beneficial.
•	Diane stated that it would be helpful if the study recommended future study for the
	tributaries to the main streams as these are not currently updated mapping in the county.
•	Diane stated that Darren Hess had a dataset of the flooded roads throughout the county.
	She also stated that the County had records of the impacted homes for the recent storm
	events.
•	Diane stated that the engineer's office has a high interest in updating the FEMA maps and
	models, however funding is limited. Gary stated that new maps would be beneficial to
	ensuring new development is not located within potential floodplains. Diane stated that
	the maps in East County needed refinement.
•	Jeff stated that any policy recommendations would need to have significant engineering
	backing in order to be implemented in the county. He stated that policy changes are likely
	needed throughout the region.
•	Diane stated that the new FEMA regulations and insurance rates proposed could alter the
	perception of large-scale projects and make them more appealing.
•	Sam asked if the county had any high-water marks. Jeff and Diane stated they were not
	aware of any.
•	Jeff stated that developers have to show no adverse impact for anything over 15,000 sq ft.
•	Diane showed the Montgomery County Flood Story Map showing the structures inundated
	in major storm events. She stated that the man only showed the residential structures
	She also stated that the numbers are likely low as renters do not typically report flooding in
	the homes
-	Diane recommended "moving the Hurricane Harvey event" around the San Jacinto River
•	basin to determine how the storm would have affected the basin if it had taken a different
	noth. She recognized that this effort was not part of the scope of work but should be
	path. She recognized that this enort was not part of the scope of work but should be
	The meeting was concluded
•	me meeting was concluded.





SUPPORTING PARTNERS MEETING NOTES

Grimes County

October 15, 2019 San Jacinto River Watershed Master Drainage Plan Skype Call

Meeting calle by:	d Jing Chen, P.E., CFM	Type of Meeting:	Supporting Partners Meeting	
Facilitator:	Sam Hinojosa, P.E., CFM	Meeting Start Time:	11:00 AM	
		Meeting Stop Time:	12:00 PM	
Agenda				
1. /	Attendees (See attached sign in sl	heet)		
	Sam Hinojosa, Halff Associa	tes, Inc.		
	Andrew Moore, Halff Association	ates, Inc.		
	Jing Chen, Harris County Florence	ounty Flood Control District		
	Matt Barrett, San Jacinto Riv	ver Authority		
	Harry Walker, Grimes Count	y Road and Bridge Engir	neer	
	David Lilly, Grimes County E	mergency Manager		
2. 5	Study Overview			
	 Jing introduced the study, his Drainage Plan (SJRWMDP) is HCFCD, SJRA, Montgomery (purpose of the study is to pr data and inundation mappin major stakeholder communi will distribute results within consider incorporate results Sam provided an overview of Assess basin vulnera Creek is being updat and simulating Atlas effective mapping. Primary Mitigation F and drainage policy Secondary Mitigation Other Mitigation Activity identification of floot Community Outread as well as decision n Sam provided an overview of meetings will be open house project. 	ighlighting that the San J is funded by a FEMA HMG County, and the City of H rovide consistently mode of for the San Jacinto wat ities, collecting informati the watershed once plan and update their HMPs. of the study goals and ob ability – Update H&H mo ted in Grimes County. Ca a 14 rainfall information. Planning – Look at structu in Planning – Focus on ga tions – Focus on commun- oded infrastructure. Iden the and Education – Focus nakers in the affected jur of the study schedule f the public meetings wit e/expo style summarizing dy team is meeting with the	acinto Regional Watershed Master acinto Regional Watershed Master approximation of the second states of the second states of the second states of the second states of the study team is contacting on to inform this planning effort, and noting is complete for communities to jectives: deling for the basin. Hydrology of Lake alibrating base models to historical data Goals do not include updating FEMA ural improvements to reduce flood risk ages and flood warning capability nication between jurisdictions and atify funding sources on sharing information with the public risdictions thin Harris County. She stated the g the different components of the supporting partners to obtain input and	

	• Sam and Jing provided an overview of the Community Outreach efforts and mentioned the website, which is <u>www.sanjacstudy.org</u> .
3.	Input from Local Jurisdiction This portion of the meeting included a conversation about anticipated growth in the area, current drainage criteria, flood history and hot spots, and mitigation alternatives.
	 Harry stated that the county does not have studied base flood elevations and asked whether this study will provide base flood elevations. Sam and Jing stated that elevations would be available for the main creeks that are being studied. He stated that hydraulic models for the tributaries of the main creek are not being developed for this study. David asked if the USACE was identifying potential sites for detention/retention reservoirs. He also asked if they are a major player in study? Sam stated that the USACE would possibly take the recommendations of the study done and perform a feasibility study. Any large reservoirs to be constructed would likely need federal funding and oversight. David asked if there any reservoirs or large detention basins are proposed in Grimes County. Sam stated that basins had yet to be identified, but that there is potential on Lake Creek. David mentioned that land may be available in the upper end of the Spring Creek watershed along Mill Creek. He mentioned that there are buyouts being conducted in this area near Todd Mission (Mill Creek Subdivision). Harry stated the SH249 corridor is hot spot for potential development. Currently plan for retention is inline in the center of the roadway. Harry stated the County is interested in developing new criteria especially for detention. Harry is currently modifying subdivision regulations and can share new data when it is revised. Harry stated that there is not currently a plan to adopt Atlas 14, but it can be considered as part of the new regulations.





SUPPORTING PARTNERS MEETING NOTES

Liberty County

November 22, 2019 San Jacinto River Watershed Master Drainage Plan HCFCD, Brookhollow

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Supporting Partners Meeting	
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	2:00 PM	
			Meeting Stop Time:	3:00 PM	
Agend	а				
1.	1. Attendees (See attached sign in sheet)				
	Terry Barr, Halff Associates, Inc.				
	Jing Chen, HCFCD				
	David Douglas, Liberty County				
	•	Rachael Todd, Halff Associate	s, Inc.		
	•	Cory Stull, Freese & Nichols, I	nc.		
2.	Study	Overview			
	•	Jing introduced the study, hig	hlighting that the San J	acinto Regional Watershed Master	
		Drainage Plan (SJRWMDP) is f	unded by a FEMA HMG	P grant and includes a partnership of	
	HCFCD, SJRA, Montgomery County, and the City of Houston. She also stated that the				
	purpose of the study is to provide consistently modeled and mapped baseline conditions				
	major stakeholder communities, collecting information to inform this planning effort. and				
	will distribute results within the watershed once planning is complete for communities to				
	consider incorporate results and update their HMPs.				
	 Terry provided an overview of the study goals and objectives: 				
	 Assess basin vulnerability – Update H&H modeling for the basin and calibrate a reliable baseline conditions we del 				
	a reliable baseline conditions model				
	 Primary Mitigation Planning – Look at structural improvements and drainage pol Secondary Mitigation Planning – Focus on gages and flood warning capability 				
	 Other Mitigation Actions – Focus on communication between jurisdictions and 				
	identification of flooded infrastructure				
	 Community Outreach and Education – Focus on sharing information with t 			on sharing information with the public	
	as well as decision makers in the affected jurisdictions				
	Terry provided an overview of the study schedule Terry provided an evention of the Community Outproch offects and reactions of the				
	 Terry provided an overview of the Community Outreach efforts and mentioned the website, which is www.sanjacstudy.org 				
~		· · · · · · · ·	<u></u> <u></u>		
3.	Input f	rom Local Jurisdiction			
	This po	ortion of the meeting included a	a conversation about ar	nticipated growth in the area, current	
	uraina	se chiena, houd history and ho	it spots, and mitigation	anematives.	
 David oversees FEMA mitigation and coordinates grants/permits for Liberty Co 			ints/permits for Liberty County (LC)		

 Crysta Beasley is the Emergency Management Coordinator for LC
• LJA in Beaumont is LC's consulting engineer rather than a LC having a county engineer.
David provided the following names and contact information to help HCFCD with LC
drainage criteria and previous studies.
 Alan Sims, LJA Beaumont
 Toby Davis, LJA Beaumont
• Currently there are no detailed studies for most of the streams in LC with most of the area
unmapped. Current BLE models are based on the old rainfall, and LC has plans to adopt
Atlas 14 rainfall. FEMA BFE's in the area are sporadic with approximately 3-4 miles
between BFE's. Although LC has requirements for building in the floodplain, these BFE's
prove difficult to manage. No current "one-rule" applies to all development, each
development must prove no impact.
• LC is ready to see long term solutions and implementation plans. From SJRWMDP the
Primary Flood Hazard Mitigation Improvements – structural improvements and policy
improvements. There is currently 1 gage on Luce Bayou, and LC is open to more for
Secondary Flood Hazard Mitigation.
• LC is putting together a Liberty County Drainage District. This will be funded separately
through a special district fee rather than through property taxes.
• Other judges from surrounding counties (8) are interested in a regional drainage study and
plan – Liberty, Chambers, Jasper, Jefferson, Hardin, etc. More focused near the Sabine
River.
• Areas of interest include: Cedar Bayou, Plum Grove, River Ranch (south of Dayton),
developments south of Cleveland. LC is getting a lot of interest from heavy industry –
mostly rail related development.
Potential projects include:
\circ Cedar Bayou: major detention south of Dayton, improvements on west side of LC
 Luce & Tarkington: cleaning out channels and detention





SUPPORTING PARTNERS MEETING NOTES

Liberty County

December 3, 2019 San Jacinto River Watershed Master Drainage Plan HCFCD, Conference Call

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Supporting Partners Meeting			
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	10:30 AM			
			Meeting Stop Time:	11:30 AM			
Agend	la						
1.	Attend	lees (via Conference Call)					
	•	Terry Barr, Halff Associates					
	•	Jing Chen, HCFCD					
	•	Gary Bezemek, HCFCD					
•		Matt Barrett, SJRA					
	•	Cory Stull, FNI					
• Al		Allen Sims, LJA Engineering	Allen Sims, LJA Engineering				
	•	Manuel Mendoza, LJA Engine	ering				
•		Dawn Filcher, LJA Engineering	5				
John Groui		John Grounds, LJA Engineerin	rounds, LJA Engineering				
	Andrew Moore, Halff Associates						
2.	Study Overview						
	Jing introduced the study, highlighting that the San Jacinto Regional Watershed Maste						
	Drainage Plan (SJRWMDP) is funded by a FEMA HMGP grant and includes a partnershi						
	HCFCD, SJRA, Montgomery County, and the City of Houston. She also stated that the						
purpose of the study is to provide consistently modeled and mapped baseline co			eled and mapped baseline conditions				
data and inundation mapping for the San Jacinto watershed. The study t		tershed. The study team is contacting					
		will distribute results within the watershed once planning is complete for communities to					
		consider incorporate results a	and update their HMPs.				
 Terry provided an overview of the study goals and objective 		bjectives:					
		 Assess basin vulnerability – Update H&H modeling for the basin and calibrate to set 					
		a reliable baseline co	nditions model				
		• Primary Mitigation Pl	anning – Look at struct	ural improvements and drainage policy			
		 Secondary Mitigation 	Planning – Focus on ga	ages and flood warning capability			
		• Other Mitigation Acti	ons – Focus on commu led infrastructure	nication between jurisdictions and			
		 Community Outreach 	and Education – Focus	s on sharing information with the public			
		as well as decision ma	akers in the affected ju	risdictions			
	•	Terry provided an overview o	f the study schedule				
	•	Terry provided an overview o	f the Community Outre	each efforts and mentioned the			
		website, which is www.sanjad	<u>cstudy.org</u> .				

3.	Input from Local Jurisdiction		
	This portion of the meeting included a conversation about anticipated growth in the area, current drainage criteria, flood history and hot spots, and mitigation alternatives.		
	 LJA currently serves as the County Engineer for Liberty County. Most of the current develop is in the Plum Grove region. Allen stated development is anticipated along new Grand Parkway alignment. Allen stated new drainage criteria has been approve by Commissioner's Court and LJA will provide. The criteria does not include Atlas 14 rainfall as it was not available at the time of approval. 		
	 Allen stated that new criteria added a no negative impact requirement and information regarding how detention volumes should be calculated. The new criteria mimics Chambers County drainage criteria and Hays County subdivision rules. Allen stated that adopting a watershed wide drainage policy would help with maintaining consistency. 		
	 Dawn mentioned that the Plum Grove area has had flooding as of recent. She stated they are also looking into flooding issues in Precinct 3 (northwest). She stated that the Plum Grove development may be receiving adverse flows from the adjacent developments. 		
	 Allen stated that the County is currently interested in starting a countywide drainage district. Upon creation of the district, they may be interested in updating the FEMA maps depending on funding. The county is expecting a vote in May for the district. He stated that there are several drainage districts that maintain a portion of the channels. Cory stated that the County has new maps in the Trinity basin. Allen stated that the drainage district would take over maintenance of open channels and a master drainage study would be conducted to determine the improvements needed in the County. 		
	 Allen is interested in adding gages throughout the watershed and county. Dawn stated that she would be interested in more rain gages upstream of the county. She stated that the County could do an agreement with the HCFCD or USGS to implement and maintain the new gages. Allen stated that large regional detention would be beneficial to the County. Jing stated 		
	that future meetings would include preliminary alternative recommendations.		

Appendix A.5

Technical Meetings



H&H METHODOLOGY MEETING AGENDA

March 19, 2019 Upper San Jacinto River Regional Flood Mitigation Plan Harris County Flood Control District

Facilitator: Terry Barr Meeting Start Time: 10:00 AM Agenda Internation Internation					
Facilitator: Terry Barr Meeting Start Time: 10:00 AM Meeting Stop Time: 11:30 AM Agenda 1. Terrain Information					
Meeting Stop Time: 11:30 AM Agenda 1. Terrain Information 1.					
Agenda 1. Terrain Information					
1. Terrain Information					
 Survey will be taken at selected bridge/culverts and cross sections (II.D) 					
Is the 2018 LiDAR available?	•				
Will any dredging survey be available for the San Jacinto River? Lake Houston Spillway	r?				
Is there recent bathymetric data for Lake Houston and/or Lake Conroe available?					
• Horizontal datum (Central Vs. South Central Zone)?					
2. Hydrology					
• Will Atlas 14 rainfall zones be determined? Do HCO, MCO, COH, SJRA agree?					
• The intent is to use the BDF methodology to calculate TC&R parameters					
 Weighted methodology vs. Step-wise; Is there a preference? 					
 Minimal alteration to HCFCD models for Spring, Cypress, etc. (III.A.1.c); Is there 	• Minimal alteration to HCFCD models for Spring, Cypress, etc. (III.A.1.c); Is there a				
preferred basin size for the remainder of the study area?	preferred basin size for the remainder of the study area ? Scope identifies Initial & Constant as loss method: Is that flexible? (III Δ 1 d)				
3. Hydraulics					
New models based on most current LiDAR datasets with structure and cross section sur	vey				
Topography for HCFCD streams will not be updated per the scope (III.B.1.b)					
4. Future Conditions					
Currently no detention requirements along the East and West Fork corridors					
 Should future conditions consider some detention requirements? Should that he one of the mitigation strategies that we consider? 					
 Should that be one of the mitigation strategies that we consider: How do we account for future development detention using BDF? 					
5. Benefit-Cost Analysis					
• For the FEMA BCA Toolkit, the intent is it to leverage external GIS tools to populate the					
necessary data fields; confirm that this is acceptable.					
b. Questions					



14800 St. Mary's Lane, Ste. 160 Houston, TX 77079-2943 (713) 588-2450 Fax (281) 310-5259

MEETING MINUTES

То:	Jing Chen, P.E., CFM	Attendees:	Gary Bezemek, HCFCD
From:	Terry Barr, P.E., CFM		Dena Green, HCFCD Ataul Hannan, HCFCD
Subject:	Upper San Jacinto River Regional Flood Mitigation Plan – Methodology Discussion	Crai Terr San	Craig Maske, HCFCD Terry Barr, Halff Sam Hinojosa, Halff Andrew Moore, Halff
Meeting Date:	03/19/2019 – 10:00 am		Mike Moya, Halff Hector Olmos Freese & Nichols
Location:	HCFCD, Brookhollow Office		Cory Stull, Freese & Nichols
Minutes Date:	3/22/2019 (Revised 3/29/2019)		

AVO No.: 033465.002

Item	Description	Action
1.	Meeting Introduction	None
	Ms. Chen kicked off the meeting with a brief introduction. The meeting agenda and schedule were provided to the group (See attached agenda for reference). Mr. Barr discussed the intent of the meeting, which was to inform HCFCD about specific methodologies that will be used for the San Jacinto study and to ask questions relating to the approach. The original scope was prepared in early 2018 and since then there have been changes in the rainfall data, terrain data, and preferred methodologies. The intent of the Halff/FNI team is to develop models that are consistent with the MAAPnext products that will be developed in the coming year. The meeting order generally followed the questions provided on the attached agenda.	
2.	Terrain Information	
	Mr. Barr indicated that survey will be taken at limited locations and that the remainder of the modeling will be developed based on the most recent LiDAR, which will be provided by HCFCD.	
	LiDAR Data and Projections	
	Per HCFCD, the 2018 LiDAR DEM should be ready within the next week or so, the LAS may lag behind that. The projection discrepancy between Harris County and the areas to the north was discussed. For the MAAPnext study, a projection of NAD83 State Plane South Central was requested; however, Central and UTM15 projections for the datasets created a bit of confusion as to what is being delivered. Depending on the data delivered, some stitching of the datasets may be needed. Ms. Green indicated that HCFCD will check into the status of the terrain and the coverage and projection that will be provided. The major concern amongst the group was that models developed in different projections will not be able to be combined. However, if the models are developed in the same projection, they will not be in the standard projection used by their respective jurisdictions. Both Halff and HCFCD agreed that the modeling procedure will depend on the LiDAR projection. Subsequent discussions with HCFCD indicated that the LiDAR will be delivered in one contiguous	HCFCD – Provide full LiDAR coverage data in State Plane South Central projection Halff/FNI – Evaluate the data and make a recommendation for the model development



	dataset with a State Plane South Central projection and will include the 2018 LiDAR as well as portions of pre-2018 LiDAR in parts of Montgomery and the surrounding counties.	
	Dredging, Bathymetric, and Spillway Survey	
	Survey data for the recent dredging of the San Jacinto River, the Lake Houston Spillway, and bathymetric data of Lakes Houston and Conroe was requested. HCFCD indicated that the dredging survey may be available through the USACE and that they would request the data.	HCFCD – Check with USACE for dredging survey
	HCFCD also indicated that they have pre-dredging survey data, which may prove helpful during the calibration effort. Halff agreed to check with the TWDB for data related to the lake bathymetry. With respect to the lake Houston Spillway, Mr. Olmos indicated that using the LAS data or	Halff – Check with TWDB for Lake Bathymetry
	construction drawings of the recent improvements may provide adequate information for the Lake Houston spillway. FNI agreed to check with CWA for available survey.	FNI – Check with CWA for survey of Lake Houston Spillway
3.	Hydrology	
	Atlas 14 Rainfall Data	
	Since the scope development, the release of Atlas 14 rainfall data has occurred, resulting in a significant increase in 24-hour rainfall depths for the region. HCFCD has updated the regions for Harris County. Currently Montgomery County has established a single depth of 16.1" for their 24-hour, 1% AEP storm. No information was available for the surrounding counties. HCFCD indicated that they are interested in the flow coming across the county line and that varying the rainfall across the watershed might provide more realistic results. Halff suggested pulling Atlas 14 depths at several locations within each major tributary watershed and developing an average for each watershed. Halff agreed to look at the depth information and provide a recommendation to HCFCD. It should be noted that a 24-hour rainfall event will be used for the Frequency Storms; however, the model run time will need to be several days to allow all flows to be routed and the lakes to reach their peaks and start to descend. Calibration storms will use historical rainfall data and the duration will depend on the data.	Halff/FNI – Provide a recommendation for Atlas 14 rainfall depths in Montgomery and surrounding counties
	BDF Methodology	
	Halff/FNI recommended using the BDF methodology for Clark UH parameters, specifically the Step-Wise methodology given the limited amount of development in much of the watershed. Harris County watersheds will not be updated with the new parameters. Mr. Bezemek expressed concern with the use of BDF in the basin due to steeper slopes, indicating that the older methodology provided good results. Mr. Maske indicated that the slope adjustment factors provided good returns for the Spring Creek basin. Mr. Hannan recommended that Halff/FNI run some tests using BDF and see how it compares to the older methodology. The primary adjustment method would be slope factors.	Halff/FNI – Run tests on BDF methodology and provide a recommendation
	Basin Size	
	A maximum or minimum basin size for the hydrologic model was also discussed. The basins would be developed with the augmented flood	



	warning system in mind, so basin breaks would occur at major roadways and where tributaries enter. The Halff/FNI team will work to develop basins that are of a consistent size as much as possible. Given the mostly undeveloped conditions in the upper reaches of the basin, some of the subbasins may be larger than those in the developed areas. HCFCD indicated that there was no specific requirement for basin sizes and the BDF methodology works well across basins of varying sizes.	Halff/FNI – Share preliminary basin delineation with HCFCD to ensure agreement
	Loss Rate Methods The original scope called for the Initial & Constant (I&C) method to be used. The initial thought for the hydrology was to move toward Green & Ampt (G&A) for all the hydrology to maintain consistency across the model. Mr. Bezemek pointed out that the data for G&A may be limited in Montgomery and the surrounding counties. In addition to the limited data, Mr. Bezemek also pointed out that there is limited flexibility in the parameter adjustments without going outside the normal parameter ranges, which could hinder the calibration effort. Mr. Hinojosa suggested that the team leverage the I&C method for the areas outside Harris County and maintain the G&A parameters for the Harris County Basins (Spring, Cypress, etc.). Mr. Barr asked if there was any concern about using varying methodologies across the model. The group generally agreed that the different methods were appropriate for specific areas in the basin, but HCFCD will communicate any changes in methodology to TDEM/FEMA if the recommended approach requires a revision to the scope. The methodology will be discussed with TDEM at the study partners kickoff on April 8 th . Mr. Stull and Mr. Hinojosa both indicated that modeling they have seen in the area using the I&C methodology has worked well with calibrations efforts.	HCFCD – Communicate changes in methodology to TDEM/FEMA if the recommended approach requires revision to the scope
4.	 Hydraulics Mr. Barr indicated that when the study was scoped in early 2018, it was based on the current terrain dataset. Per the scope, new models will be based on the most current LiDAR data for that watershed and the existing Harris County models (Spring, Cypress, Willow, Little Cypress, Jackson) will not be updated for the study. 2018 LiDAR Data The effective Harris County models were developed using the 2001 LiDAR. As such the terrain data is nearly 20 years old. There has been some development in the area; however, there are also pockets that remain unchanged. Mr. Hannan suggested comparing the terrain datasets (2001 and 2018) to determine the changes. HCFCD is developing an adjustment for the new GEOID12B. The current effective models will be used with major changes due to development or major drainage improvements added to the models. Cross sections will not be recut using the new terrain for the effective models. Mr. Hinojosa suggested considering where the damages are highest and where projects may be recommended. It may be beneficial to update the terrain in those areas where a project will be recommended to provide a better comparison. The project team needs to consider this internally and make a recommendation to HCFCD. 	Halff/FNI – Review modeling and the location of potential projects to determine terrain adjustment needs for hydraulic models



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5.	Future Conditions	
	Mr. Barr asked about the development of future conditions parameters and the detention criteria in Montgomery and the surrounding counties. The current MCO criteria allows for the engineer to prove no-impact on the receiving stream to avoid detention. Mr. Barr asked what should be assumed for detention in MCO and the surrounding area. If the area is developed without the benefit of detention, there is concern that will impact the lakes (Conroe, Houston) and the surrounding areas, such as Kingwood. In addition, Mr. Stull asked what should be assumed for future conditions. The growth projections to be performed by FNI use a 50-year horizon; however, there may still be areas that area not developed at the end of that timeframe.	Halff/FNI – Review population projections and establish a methodology
	Mr. Bezemek suggested that we consider full development to determine what impact detention might have on the basin, including the lakes. He indicated that some areas might benefit from detention while others may not see much difference with or without detention. Mr. Barr suggested that this evaluation be one of the potential flood reduction alternatives.	
	Mr. Maske asked about future conditions parameters using BDF. Mr. Stull indicated that the percent impervious would be increased based on the projected development. In addition, the project team will look at BDF for existing developed areas and determine an appropriate BDF for areas that are projected to develop in the future.	
6.	FEMA BCA	
	Mr. Barr indicated that the benefit-cost analysis will be done using FEMA BCA per the scope. The amount of data related to specific properties may be limited. Given the scale of the study, FFE will be estimated using the LiDAR data and some flat elevation increase to be determined. Property values will be based on County Appraisal District (CAD) data for the respective counties. The project team intends to utilize GIS tools to perform the damage calculations and then enter the data into FEMA BCA. Ms. Green suggested that the project team develop a specific methodology and present to TDEM at the study partners kickoff meeting in April. Ms. Chen mentioned that the LiDAR data may include building footprints per her conversation with Brian Edmonson (MAAPnext). Subsequent to the meeting, it was confirmed that the 2018 LiDAR does include building footprints. HCFCD GIS department is looking at pre-2018 LiDAR pieces to consider deriving building footprint data for the areas in the SE and SW corners of the current 2018 LiDAR coverage. In that case, the structure location data should be relatively easy to establish. The project team will check structure locations against recent aerial imagery to ensure correctness.	Halff/FNI – Develop a methodology for BCA data development and present to HCFCD and TDEM
7.	Model Calibration	
	Mr. Bezemek asked if specific storms have been identified for calibration. Mr. Barr indicated that Hurricane Harvey was to be included as well as the October 1994 storm. Mr. Stull and Mr. Olmos indicated that the 2015 and 2016 storms were to be included. Mr. Hannan suggested that whatever storms are used they need to have good coverage of the basin. The project team agreed to look at gage data	Halff/FNI – Provide a recommendation for storms to be used during the



	and determine what storms were appropriate. Depending on the coverage, different storms may be used in different parts of the basin. However, it is important to note that using different storms in different parts of the basin will not provide accurate values at Lake Houston, since all the watersheds flow through it.	calibration process.
8.	Ms. Chen concluded the meeting.	

This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not correct, or that any information is missing or incomplete, please contact Halff Associates so that the matter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.





MEETING NOTES

September 27, 2019 San Jacinto River Watershed Master Drainage Plan USGS Office, Shenandoah

Meeting called b	by: Terry M. Barr, P.E., CFM	Type of Meeting:	USGS Calibration Meeting	
Facilitator:	Andrew Moore, P.E., CFM	Meeting Start Time:	11:00 AM	
		Meeting Stop Time:	1:00 PM	
Agenda				
1. Att	endees			
	• Terry Barr, Halff Associates,	Inc.		
	• Sam Hinojosa, Halff Associat	Sam Hinojosa, Halff Associates, Inc.		
	Andrew Moore, Halff Associa	tes, Inc.		
	Hector Olmos, Freese & Nich	iols, Inc.		
	• Cory Stull, Freese & Nichols,	Inc.		
	Jason Pollender, USGS			
	David Brown, USGS			
2. Ga	ge and Measurement Discussion			
	 e and Measurement Discussion Hinojosa introduced the meeting presenting an overview of the study and purpose of the meeting. The general purpose was to collect information for how the USGS collects and publishes stage and flow measurements and to discuss the results of the calibration effort. Moore presented the gage locations where background information on gauges would be helpful for calibration on Peach Creek, Caney Creek, and the East Fork San Jacinto (EFSJR). Pollender presented the process of data collection for flows and water surface elevations during Hurricane Harvey on the EFSJR. He stated that the peak flow was estimated through indirect measurement. Peak flows on Peach Creek and Caney Creek were also estimated through indirect measurements. Pollender stated that 26 indirect measurements were taken during Harvey due to inability to access the streams. Pollender and Brown described how indirect measurements are obtained. Generally, hydraulic models are developed along the reach of the stream within the vicinity of the gauge. Flows are applied in the model until the water surface elevations match high water marks. The flow producing the matching elevations is used for the measurement. The resultant flow is compared to the rating curve. For Harvey, the estimated flow on Peach Creek was the highest estimated flow in the history of measurements. Brown stated that indirect measurements generally have a +/- 20% accuracy. Pollender described the process for obtaining direct measurements. These measurements are obtained with sonar during the storm event. A "Good" measurement is +/- 5% accuracy, a "Fair" measurement is +/- 8% accuracy, and a "Poor" measurement is greater 			

sandy areas may interfere with the measurements. However, the measurements can be
corrected with consideration to material.
Pollender presented the process for developing and updating the gauge rating curves. The
direct or indirect measurements are collected and stored in a program as points that are
used to make adjustments to the curves. Moore asked which points were used in the rating
curve development. Pollender stated that most data measurement points were used
depending on the quality or if they were flagged as significant outliers. Pollender showed
that the rating curves had not changed significantly in the recent updates.
Pollender indicated that the backup information provided with each of the gages and rating
curves could be provided but needed to be requested.
Pollender discussed several gages that are relevant to the San Jacinto study and Moore
provided the Halff/FNI modeling results for comparison:
\circ East Fork San Jacinto @ US59 (08070000) showed a Q of 108,000 (~15% error); the
adjusted elevation measurement was within 0.05' of the original; a measurement
was taken during Hurricane Imelda
\circ East Fork San Jacinto @ FM1485 (08070200) had an indirect measurement using a
1D HEC-RAS model
 Peach Creek @ FM2090 (08071000) Harvey measurement will likely be revised,
putting the estimated flows closer the Halff modeling
\circ Caney Creek @ FM2090 (08070500) may have a potential datum issue that
requires adjustment; Halff requested the records for datum adjustments; gages are
currently on NGVD 1929 and need to be adjusted to Geoid 12B
 Pollender stated that the Hurricane Harvey flows for Peach Creek were going to be re-
evaluated and adjusted as needed based on the Tropical Storm Imelda flow measurements.
He also stated that the measurements are taken at the upstream end of I-59, not at the
actual gage location.
 Brown stated that they now have capabilities to measure flows through reservoirs with
accuracy and may be measuring flows in Lake Houston in the future.
Brown stated that the USGS has a list of potential future gauge locations throughout the
watershed and can provide to Halff. These gauges were desired for varying reasons: flood
warning, rainfall measurements, flow measurements, water quality, etc. Not all the gauges
were desired for USGS specific reasons.
Hinojosa stated that Halff would reviewed the measurement types for each gauge and send
a list to the USGS to confirm the quality and confidence of the measurements.
Brown indicated that the USGS is encouraging the use of velocity meters for gages to local
jurisdictions, which make flow measurements more reliable and easier to obtain
Brown stated that a new area/capacity relationship for Lake Houston would be available on
10/21/19.

Project Overview Presentation

October 2019

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN



The San Jacinto Regional Watershed Master Drainage Plan is:

A comprehensive regional study led by local partners to **identify future flood mitigation projects** that can be implemented in the near- and long-term with the **purpose of reducing flood risks** to people and property throughout the San Jacinto River regional watershed.



Master Drainage Plan Study Area

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6



The goals of the San Jacinto Regional Watershed Master Drainage Plan are to:

- Identify the region's vulnerabilities to flood hazards using Atlas 14 rainfall
- **Develop** approaches to enhance public information and flood level assessment capabilities during a flood disaster event
- **Evaluate** flood mitigation strategies to improve community resilience
- **Provide** a comprehensive Flood Mitigation Plan



Plan Objectives

Primary Flood Mitigation Planning

- Stormwater Detention
- Buyouts
- Channel Conveyance
- Drainage Policy
- Secondary Flood Mitigation Planning

 Flood Assessment/Warning
- Other Mitigation Actions
- Community Outreach & Education







Information to be developed includes:

- Non-regulatory inundation maps of the streams in the study area
- Numbers of structures, acres of land, properties, and miles of roadway located in the inundated area
- Hazard Mitigation Plan -Study data can be incorporated into existing plans



Identify Vulnerabilities

Update Existing H&H Models

- Current Terrain
- Atlas 14 Rainfall
- BDF Methodology
- Calibrate to Historical Storms
 - Harvey (2017)
 - Memorial Day (2016)
 - October 1994
 - Imelda (2019)
- Damage Centers



Improve Flood Assessment

- Review existing FWS
- Meet with stakeholders
 - HCFCD
 - USGS
 - SJRA
 - Montgomery County
- Identify potential additions
 - Gage type (flow, stage, rain)
 - Gage Locations



Evaluate Mitigation Strategies

Primary Alternatives

- Leverage previous reports
- Detailed H&H Analysis

Secondary Alternatives

- Structural and Policy Ideas
- Develop & Analyze additional strategies

Sedimentation and Vegetation

- Sedimentation Rates
- Historical Sediment Management **Recommendations**



servoir

#13



Public Outreach/Education

- Public Meetings (6)
- Project Website
 www.sanjacstudy.org
- Presentation Material
- Partner Meetings
 - Study Partners
 - Supporting Partners



About The Study

The San Jacinto Regional Watershed Master Drainage Plan (SJMDP) is a comprehensive regional Plan led by local partners including the Harris County Flood Control District (HCFCD), the San Jacinto River Authority (SJRA), Montgomery County, and the City of Houston. The SJMDP is funded jointly with 75 percent from the Federal Emergency Management Agency (FEMA) Hazard Mitigation Planning Program, conveyed through the Texas Department of Emergency Management and 25 percent from the **four local partners**.

Information to be developed includes non-regulatory inundation maps (not intended to replace current effective maps) for the studied streams that show the extent and depth of riverine flooding of the

larger rivers within the watershed for an array of simulated storm events. Additionally, information will be gathered about the number of structures, acres of land, properties, and miles of roadway that are located within the modeled floodplains. Plan results will be used to inform and update Hazard Mitigation Plans for each of the participating partners and to provide guidance on regulations for future growth within the study area.

This watershed-wide effort, kicked off in April 2019, will identify future flood mitigation projects that can be implemented in the near- and longterm to reduce flood risks to people and property throughout the San Jacinto River regional watershed.

Download the Project Fact Sheet



Major Project Milestones

- Existing Hydrology & Hydraulics
Analysis and Calibration CompleteFall 2019Primary Alternatives Analysis
CompleteWinter 2019Vegetation and Sediment Control
Analysis CompleteJanuary 2020
 - Draft Report Complete

Final Report Complete

Fall 2020

Summer 2020



Contact Us

- Harris County Flood Control District

 Jing Chen,
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- San Jacinto River Authority

 Matt Barrett, mbarrett@sjra.net
- Montgomery County
 - Darren Hess, darren.hess@mctx.org
- City of Houston
 - Adam Eaton, adam.eaton@houstontx.gov







MEETING AGENDA Harris County Flood Control District

May 12, 2020 San Jacinto River Watershed Master Drainage Plan Microsoft Teams Meeting

Meeting ca	alled by:	Jing Chen, P.E., CFM	Type of Meeting:	Kingwood Discussion		
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	11:30 AM		
			Meeting Stop Time:	12:30 PM		
Agenda						
1.	Introd	uction				
	•	Kingwood Questions				
	~					
2.	Currei	nt Kingwood Flooding				
	•	Flood Claims	1			
	•	West Fork and East Fork Profi	les			
	•	inundation Mapping				
3.	Limita	tions to Kingwood Improvem	ents			
	•	Lake Houston Backwater (Inur	ndation, Profiles)			
4.	Recap of Recommended Projects					
	Potential Projects and Combined Alternatives					
	WSEL Reductions Structural Flood Damage Deductions					
	•	Structural Flood Damage Redu	ictions			
5.	Kingwood Benefits					
	•	Reductions in Flooded Structu	res			
6.	Additi	onal Alternatives to Consider				
	•	Lake Houston Lowering (Sepa	rate study)			
	•	Levee Protection				
	•	Buyouts of frequently flooded	areas			
7.	Kingw	ood Messaging				
	•	Communicating the Benefits				
	•	Communicating the Limitation	IS			
Delivering the Message						

SAN JACINTO RIVER SANJAGINTO - Regional Watershed Master Drainage Plan

Kingwood Discussion May 12, 2020 - DRAFT








San Jacinto River Basin

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6



2

DRAFT - 5/11/2012

SIRA

Kingwood Questions

- How does flooding currently affect Kingwood?
- How does the current plan benefit Kingwood?
- What are the limitations of the current plan?
- What are some alternative ideas to address flooding?
- How to we want to communicate the benefits and limitations?







Current Flooding



Kingwood West Fork/Lake Houston

G103-00-00 West Fork San Jacinto Water Surface Elevation Profile







Kingwood East Fork



GEF-00-03 East Fork Water Surface Elevation Profile

Harvey WSE







Current Flooding

Inundation Area Structures									
Event	Structures								
2-year	1								
5-year	5								
10-year	29								
25-year	84								
50-year	275								
100-year	1,001								
500-year	2,335								









Current Flooding



DRAFT - 5/11/2012

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Lake Houston

- Influence of Lake Houston extends from the dam to Lake Houston Parkway.
- Upstream of Lake Houston Parkway, the West Fork controls



Kingwood West Fork/Lake Houston



Stream station above confluence with Interstate 10 (feet)

10

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San Jacinto Regional WMDP



San Jacinto Regional WMDP

- Plan Cost: \$3.1B \$3.5B
- Total Mitigation: 250,000 acre-feet
- Overall Plan Benefits: \$677 M
- BCR: 0.19 0.22

Watershed	Damages, Existing (\$M)	Damages, Combined Alts (\$M)	Benefit (\$M)
Spring	466.6	163.8	302.8
Willow	112.2	86.6	25.6
Cypress	213.2	211.6	1.6
Little Cypress	30.9	30.8	0.1
East Fork	101.4	56	45.5
West Fork	269.7	132.7	137
Lake Creek	10.1	3.2	6.9
Peach	113.1	27.9	85.3
Caney	135.6	63.8	71.9
Luce	14.6	14	0.5
Total	1467.4	790.4	677.2







Kingwood Area Benefits

- Highest WS reduction U/S of W. Lake Houston Pkwy
- Lake Houston controls lower reaches
- 58% Reduction in instances of flooding
- Most East Fork structures no longer in 100-year IA



South For





Kingwood Area Benefits



Event	Numbers for Structural Flooding (Sta. 1300+00 to 1750+00)									
Event	Existing Proposed		Reduction	% Reduction						
25-year	70	11	59	84%						
50-year	315	56	259	82%						
100-year	1,157	359	798	69%						
500-year	2,333	1,952	381	16%						
Instances of Flooding	1,469	611	858	58%						
Damages (\$M)	\$118.4	\$53.8	\$64.6	55%						







Kingwood Additional Options

- Lake Houston Dam Improvements
 - Reduction of peak water surface elevation at dam has influence up to W. Lake Houston Parkway
 - Lowering would result in WSEL decreases to W. Lake Houston Pkwy
- This study does **NOT** include evaluation of dam operations or lowering (gates, etc.)



Kingwood Additional Options

- Kingwood Levee (Concept not evaluated in detail)
 - East Fork near Caney Creek to West Fork at I-59
 - 14 miles in length
 - Max WSEL increase 0.25 feet
 - 13,000 acre feet of mitigation to offset impacts



DRAFT - 5/11/2012







Star Y

Kingwood Additional Options

- Buyouts within frequency floodplains (current market value)
 - 500-year: \$1.2 Billion
 - 100-year: \$579 Million
 - 50-year: \$72 Million
 - 25-year \$14 Million

Kingwood Messaging

- Communicating the BenefitsSAN JACI
- Communication the Limitations
- Delivering the Message







19

Kingwood Detention

 Approximate volumes located in Kingwood to achieve lower water surface elevations

	West Fork (I-69)	East Fork (Conf. w/ Caney)	Lake Houston (Dam)						
100-Year Volume Needed to Achieve Lower WSEL (acre-fe									
10-year	520,000	270,000	800,000						
25-year	280,000	460,000							
50-year	90,000	60,000	165,000						
	Reductions in	100-year WSEL (ft)							
10-year	9.0	6.5	5.6						
25-year	5.5	4.5	3.0						
50-year	2.5	2.2	1.5						





Appendix A.6

Primary Alternatives Workshops





PRIMARY ALTERNATIVES WORKSHOP AGENDA

Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

August 14, 2019 San Jacinto River Watershed Master Drainage Plan HCFCD, Brookhollow

Meeting ca	lled by:	Jing Chen, P.E., CFM	Type of Meeting:	Primary Alternatives Workshop
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	3:00 PM
		•	Meeting Stop Time:	4:30 PM
Agenda				
1.	Works	hop Goals (2 Min)		
	•	Review previously identified in	mprovements	
	•	Discuss opportunities and cons	straints	
	•	Introduce project ranking meth	odology	
	•	Select primary alternatives for	detailed evaluation	
2.	Previo	usly Identified Alternatives (1	5 Min)	
	•	Master Plan for Full-Scale Dev	velopment of the San Jac	cinto River (1943, 1957)
	•	San Jacinto Upper Watershed I	Drainage Improvement a	and Flood Control Planning (1985)
	•	Comprehensive Flood Protection	on Plan for Southern Mo	ontgomery County (1989)
	•	Lake Creek Reservoir Report (1997)	
	•	Regional Flood Protection Stud	dy for Lake Houston Wa	atershed Program (2000)
	•	Spring Creek & West Fork – E	stimating Land Cover E	Effects on Selected Watersheds (2019)
3.	Potent	ial Project Challenges (3 Min)		
	•	Property Acquisition (Level of	Development, Number	of Parcels)
	•	Site Conflicts (Environmental,	Transportation, Utilities	s, Hazmat, Oil/Gas Well, etc.)
	•	Operations & Maintenance		
4.	Potent	ial Project Opportunities (5 m	in)	
	•	Ability to reduce flood damage	es	
		• How many damage cer	nters may benefit?	
		• Drainage area to project	ct vs. total drainage area	l
	•	Opportunity to improve sedime	entation issues	
	•	Opportunity for ancillary uses		
5.	Select	Primary Alternatives (50 min))	
	•	Removed alternatives that are	infeasible or already cor	nstructed
	•	Identify alternatives that may b	e feasible and/or benefi	cial
	•	Select Four (4) alternatives to a	develop	

5.	Project Ranking Methodology Introduction (10 min)										
	Establish Criteria										
	Determine Weighting Factors										
	Establish Scoring Process										
	Determine Rankings										
7.	Recap & Questions (5 min)										

SAN JACINTO RIVER SANJAGINTO - Regional Watershed Master Drainage Plan

Primary Alternatives Workshop August 14, 2019









Workshop Goals

Primary Mitigation Planning: Recommend action strategies to reduce or eliminate long-term flood risk to people and property. The flood risk reduction strategies will be prioritized and will likely include large regional detention facilities, channel conveyance improvements, vegetation and sedimentation removal, and property buy-outs. The action strategies will be provided to the local communities to update their respective Hazard Mitigation Plans.

- Review previously identified improvements
- Discuss opportunities and constraints
- Introduce project ranking methodology
- Select primary alternatives for detailed evaluation



Previously Identified Alternatives

- 1943 San Jacinto River Master Plan
- 1957 San Jacinto River Master Plan
- 1985 Upper San Jacinto River Flood Control Study
- 1989 South Montgomery County Flood Protection Plan
- 1997 Lake Creek Reservoir Study
- 2000 Lake Houston Regional Flood Protection Study
- 2015 Cypress Creek Overflow Management Plan
- 2019 Estimate Land Cover Effects on Selected Watersheds
- 2019 Hurricane Harvey San Jacinto River Flooding (presentation)



Previously Identified Alternatives



Previously Identified Alternatives



Project	Watershed	Name	Year	Description	Cost (When Proposed)	Location	Size	Wetlands	Precentage Developed	Number Tracts of Land	Benefit
1	East Fork	East Fork (East San Jacinto No. 1)	1943/ <mark>1</mark> 957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$2,237,000	Near Cleveland	5,950 acres	1534 acres	20%	1387	Capacity: 107,000 ac-ft
2	East Fork	East Fork Reservoir (EF- G1)	1985	Reservoir assumes only using 3 of 5' of storage	\$44,300,000	Near Junction of East Fork and Winters Bayou	29,000 acres	1548 acres	12%	2645	80%-90% reduction in 100Yr flow from Montgomery & Liberty Co. (55,000 cfs to <10,000cfs) 9 foot reduction in 100 year flood plain B/C Ratio: .07
3	West Fork	West Fork (San Jacinto No. 4)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$700,000	Upstream of Lake Conroe	2,744 acres	1116 acres	1%	35	Capacity: 25,210 ac-ft
4	Lake Creek	Lake Creek Dam (Combined)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.		Upstream portion of Lake Creek	Approx. 20000 acres (based on drawing @ 280' line)	3848 acres	10%	4825	
5	Lake Creek	Lake Creek Reservoir	1997	80% the size of Lake Conroe	\$275,000,000	On the lower portion of Lake Creek	16,800 acres	7461 acres	25%	3126	
6	Spring Creek	Spring Creek (Spring Creek No. 1)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$2,600,000	At confluence of Spring and Cypress Creeks	5537 acres	1117 acres	5%	229	Capacity 104,000 acre-feet,
7	Spring Creek	Spring Creek Reservoir 1 (SC- G1)	1985	Assumed to have 5' storage above pool	\$6,500,000	Near Woodlands at RM 26.42	1004 acres	102 acres	14%	1532	Average 1% reduction in flow with minimal (<0.5') change in WSEL
8	Spring Creek	Spring Creek Reservoir 2 (SC- G2)	1985	Assumed to have full depth of storage	\$41,000,000	Upstream of Walnut Creek confluence	3719 acres	407 acres	23%	9607	B/C Ratio=0.09,Average 35% reduction in flow and 3' WSEL reduction
9	Cypress Creek	Cypress Creek (Spring Creek No. 2)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$1,500,000	West of Westfield	4193 acres	151 acres	84%	19288	Capacity 58,520 acre-feet,
10	Caney Creek	Caney Creek (Caney Creek No. 1)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$400,000	Located East of Conroe	850 acres	87 acres	19%	27	Capacity 6,930 acre-feet
11	Caney Creek	Caney Creek Reservoir (CC- G1)	1985	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$5,700,000	On upper Caney Creek near RM 34.71	677 acres	16 acres	13%	31	B/C=.51, Average 100% flow reduction D/S of reservoir with 14' change in WSEL (at mouth 16% drop in flow and 1.1' drop in WSEL) Reservoir can store all 100-yr runoff upstream
12	Peach Creek	Peach Creek Reservoir 1 (PC- G1)	1985	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event. Assumed to have full depth of storage	\$3,500,000	Located in upstream part of Peach Creek	625 acres	142 acres	33%	49	Capacity 5,350 acre-feet
13	Peach Creek	Peach Creek Reservoir 2 (PC- G2)	1985	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event. Assumed to have full depth of storage	\$8,000,000	Located in upstream part of Peach Creek, above Peach Creek No. 1	1381 acres	22 acres	0%	12	Capacity 2750 acre-feet
14	Stewart Creek	Stewart Creek (Stewart Creek No. 1)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$175,000	At the edge of Conroe	301 acres	12 acres	3%	11	Capacity 2,400 acre-feet









Project	Watershed	Name	Year	Description	Cost (When Proposed)	Location	Size	Wetlands	Precentage Developed	Number Tracts of Land	Benefit
15	Caney Creek	CC-E	1985	Modify the bridge(s) to be less hydraulically restrictive	Not Calculated	Sycamore Drive R.M. 12.31	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth c 0.4 feet immediately upstream of bridges, B/C: 0.00
15	Caney Creek	CC-E	1985	Modify the bridge(s) to be less hydraulically restrictive	Not Calculated	Fire Tower Road R.M. 13.45	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth of 0.6 feet immediately upstream of bridges, B/C: 0.00
16	East Fork	EF-B	1985	Replace the Existing Channel with a large grass lined channel for the entirety of the watershed	\$48,700,000	Between Harris County and San Jacinto County Line	Width Upstream: 480 Feet, Width Downstream: 530 Feet, Depth 20 Feet	2259 acres	3%	884	B/C: 0.07
16	East Fork	EF-D	1985	Remove debris, and vegetation along the banks of the channel to increase hydraulic efficiency.	\$3,400,000	Along the East Fork	N/A	N/A	N/A	N/A	About 0.1 Foot reduction in 100 Year flood plane, B/C: 0.03
17	East Fork	EF-E2	1985	Modify the bridge(s) to be less hydraulically restrictive	\$3,000,000	Highway 105 bridge near Cleveland	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth of 1.2 feet immediately upstream of bridges, B/C: 0.03
18	East Fork	EF-E1	1985	Modify the bridge(s) to be less hydraulically restrictive	\$3,000,000	FM1485 Bridge near Harris County line	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth of 1.6 feet immediately upstream of bridges, B/C: 0.08
19	Lake Creek	LC-B	1985	Replace the Existing Channel with a large grass lined channel for the entirety of the watershed	\$126,000,000	R.M. 43.3 to R.M. 0.0	Depth Upstream: 22 Feet, Depth Downstream: 31 Feet, Width Upstream: 260 Feet, Width Downstream: 670 Feet	2949 acres	2%	329	B/C: <0.001
19	Lake Creek	LC-D	1985	Remove debris, and vegetation along the banks of the channel to increase hydraulic efficiency.	\$3,100,000	Along Lake Creek	N/A	N/A	N/A	N/A	≤0.3 Foot reduction in 100 Year flood plane, B/C: 0.0
20	Peach Creek	PC-B	1985	Replace the Existing Channel with a large grass lined channel for the entirety of the watershed	\$37,500,000	R.M. 40.4 to R.M. 0.0	Width Upstream: 100 Feet, Width Downstream: 450 Feet, Depth Upstream: 10 Feet, Depth Downstream: 20 Feet	815 acres	5%	664	B/C: 0.33
20	Peach Creek	PC-D	1985	Remove debris, and vegetation along the banks of the channel to increase hydraulic efficiency.	\$4,300,000	Along Peach Creek	N/A	N/A	N/A	N/A	Average 0.5 Foot reduction in 100 Year flood plane, Up to a 1.3 foot reduction. B/C: 0.04
21	Peach Creek	PC-E	1985	Modify the bridge(s) to be less hydraulically restrictive	Not Calculated	Appian Way R.M. 5.2	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth of 0.4 feet immediately upstream of bridges, B/C: 0.00
21	Peach Creek	PC-E	1985	Modify the bridge(s) to be less hydraulically restrictive	Not Calculated	Unnamed Road R.M. 7.1	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth of 1.2 feet immediately upstream of bridges, B/C: 0.00
21	Peach Creek	PC-E	1985	Modify the bridge(s) to be less hydraulically restrictive	Not Calculated	FM2090 R.M. 9.4	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth c 0.6 feet immediately upstream of bridges, B/C: 0.00
22	Spring Creek	SC-B	1985	Replace the Existing Channel with a large grass lined channel for the entirety of the watershed	\$190,800,000	R.M. 48.2 to R.M. 0.0	Width Upstream: 200 Feet, Width Downstream: 500 Feet, Upstream Depth: 14 Feet, Downstream Depth: 35 Feet	795 acres	3%	386	B/C: 0.03

FLOOD SINUAR CONTROL







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Project	Watershed	Name	Year	Description	Cost (When Proposed)	Location	Size	Wetlands	Precentage Developed	Number Tracts of Land	Benefit
22	Spring Creek	SC-D	1985	Remove debris, and vegetation along the banks of the channel to increase hydraulic efficiency.	\$4,700,000	Along Spring Creek	N/A	N/A	N/A	N/A	About 1 Foot reduction in 100 Year flood plane, B/C: 0.14
23	Spring Creek	SC-E2	1985	Modify the bridge(s) to be less hydraulically restrictive	\$19,000,000	Missouri pacific RR R.M. 13.17	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth o 0.2 feet immediately upstream of bridges, B/C: 0.00
24	Spring Creek	SC-E1	1985	Modify the bridge(s) to be less hydraulically restrictive	\$10,000,000	Huffsmith Conroe Road RM 35.44, Missouri Pacific RR R.M. 37.28, Chicago and Pacific RR at R.M. 38.54	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth o 0.8 feet immediately upstream of bridges, B/C: 0.00
25	Spring Creek	SC-E3	1985	Modify the bridge(s) to be less hydraulically restrictive	Not Calculated	Missouri pacific RR R.M. 13.17, and I-45 spans at R.M. 16.83 and 16.89	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth o 0.5 feet immediately upstream of bridges, B/C: 0.00
26	West Fork	WF-B	1985	Replace the Existing Channel with a large grass lined channel for the entirety of the watershed	\$137,000,000	Lake Conroe to Harris County	Depth: 30 Feet, Upstream Width: 500 Feet, Downstream Width: 600 Feet	1216 acres	4%	354	B/C: 0.40
26	West Fork	WF-D	1985	Remove debris, and vegetation along the banks of the channel to increase hydraulic efficiency.	\$5,700,000	Along The West Fork	N/A	N/A	N/A	N/A	≤1 Foot reduction in 100 Year flood plane
27	West Fork	WF-C1	1985	Replace the existing West Fork channel section with a grass lined channel, with the bottom of the current channel as the bottom of the new channel, for the length of Critical Area 1	\$8,600,000	Critical Area 1	N/A	179 acres	8%	35	B/C: 0.03
27	West Fork	WF-D1	1985	Desnag channel sections for critical area 1	\$270,000	Critical Area 1	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth ≤0.6, B/C: 0.00
28	West Fork	WF-C2	1985	Replace the existing West Fork channel section with a grass lined channel, with the bottom of the current channel as the bottom of the new channel, for the length of Critical Area 2	\$17,300,000	Critical Area 2	N/A	97 acres	25%	34	B/C: 0.31
28	West Fork	WF-D2	1985	Desnag channel sections for critical area 2	\$530,000	Critical Area 2	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth ≤0.6, B/C: 0.31
29	West Fork	WF-C3	1985	Replace the existing West Fork channel section with a grass lined channel, with the bottom of the current channel as the bottom of the new channel, for the length of Critical Area 3	\$31,200,000	Critical Area 3	N/A	125 acres	14%	216	B/C: 0.93
29	West Fork	WF-D3	1985	Desnag channel sections for critical area 3	\$1,100,000	Critical Area 3	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth ≤0.6, B/C: 2.5
30	West Fork	WF-C4	1985	Replace the existing West Fork channel section with a grass lined channel, with the bottom of the current channel as the bottom of the new channel, for the length of Critical Area 4	\$8,800,000	Critical Area 4	N/A	147 acres	29%	87	B/C: 0.75





Project	Watershed	Name	Year	Description	Cost (When Proposed)	Location	Size	Wetlands	Precentage Developed	Number Tracts of Land	Benefit
30	West Fork	WF-D4	1985	Desnag channel sections for critical area 4	\$270,000	Critical Area 4	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth ≤0.6, B/C: 2.3
31	West Fork	WF-C5	1985	Replace the existing West Fork channel section with a concrete lined channel, with the bottom of the current channel as the bottom of the new channel, for the length of Critical Area 3	\$370,000,000	Critical Area 3	N/A	125 acres	14%	87	Channel reduction of flood depth by 5.5 feet in critical area 3, with a minor increase in depth downstream, B/C: 0.1
32	West Fork	WF-E	1985	Modify the bridge(s) to be less hydraulically restrictive	\$18,500,000	Atchinson	N/A	N/A	N/A	N/A	1.2 Foot reduction in 100 Year flood plane, B/C: 0.085
33	Caney Creek	CC-B	1985	Replace the Existing Channel with a large grass lined channel for the entirety of the watershed	\$73,000,000	R.M. 46.1 to R.M. 0.0	Width Upstream: 200 Feet, Width Downstream: 460 Feet, Depth Upstream: 14 Feet, Depth Downstream: 30 Feet	663 acres	4%	829	B/C: 0.09
33	Caney Creek	CC-D	1985	Remove debris, and vegetation along the banks of the channel to increase hydraulic efficiency.	\$7,400,000	Along Caney Creek	N/A	N/A	N/A	N/A	About 2.7 Foot reduction in 100 Year flood plane, B/C: 0.08
34	West Fork	West Fork (San Jacinto No. 1)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$925,000	At confluence with Lake Creek	3,890 acres	1,738 acres	14%	370	Capacity: 33,525 ac-ft
	Caney Creek	CC-F25	1985	Purchase all property within the 25-yr floodplain	\$1,900,000	Along Caney Creek		N/A			B/C: 2.7
	Caney Creek	CC-F100	1985	Purchase all property within the 100-yr floodplain	\$4,600,000	Along Caney Creek		N/A			B/C: 1.20
	East Fork	EF-F25	1985	Purchase all property within the 25-yr floodplain	\$3,400,000	Along the East Fork		N/A			B/C: 0.81
	East Fork	EF-F100	1985	Purchase all property within the 100-yr floodplain	\$4,500,000	Along the East Fork		N/A			B/C: 0.77
so.	Lake Creek	LC-F25	1985	Purchase all property within the 25-yr floodplain, which is the same as the 100-yr floodplain.	\$1,300,000	Along Lake Creek		N/A			B/C: 0.09
Buyout	Peach Creek	PC-F25	1985	Purchase all property within the 25-yr floodplain	\$6,200,000	Along Peach Creek		N/A			B/C: 1.9
ш	Peach Creek	PC-F100	1985	Purchase all property within the 100-yr floodplain	\$9,500,000	Along Peach Creek		N/A			B/C: 1.3
	Spring Creek	SC-F25	1985	Purchase all property within the 25-yr floodplain	\$6,300,000	Along Spring Creek		N/A			B/C: 0.84
	Spring Creek	SC-F100	1985	Purchase all property within the 100-yr floodplain	\$18,000,000	Along Spring Creek		N/A			B/C: 0.36
	West Fork	WF-F25	1985	Purchase all property within the 25-yr floodplain	\$62,000,000	Along The West Fork		N/A			B/C: 0.76
	West Fork	WF-F100	1985	Purchase all property within the 100-yr floodplain	\$97,000,000	Along The West Fork		N/A			B/C: 0.57

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Opportunities and Challenges

- Opportunities
 - Ability to reduce flood damages
 - How many damage centers may benefit?
 - Drainage area to project vs. total drainage area
 - Opportunity to improve sedimentation issues
 - Opportunity for ancillary uses
- Challenges
 - Property Acquisition (Level of Development, Number of Parcels)
 - Site Conflicts (Environmental, Transportation, Utilities, Hazmat, Oil/Gas Well, etc.)
 - Operations & Maintenance







Alternatives Removed

- Removed alternatives that are infeasible or already constructed
 - 7 (Spring Creek) Extensive Development
 - 9 (Cypress Creek) Extensive Development
 - 14 (Stewart Creek) Not along studied channel
 - 15,17,18,21,23,24,25,32 (Multiple Bridges) Isolated Impact
 - 26 (West Fork) In Lake Conroe; Isolated Impact







Select Primary Alternatives

- Removed alternatives that are infeasible or already constructed
- Identify alternatives that may be feasible and/or beneficial
- Select Four (4) alternatives to develop















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mill

Project Ranking Methodology


Establish & Weight Criteria

- Potential Criteria
 - Reduction in Flood Levels
 - BCR (Financials for project)
 - Development Potential
 - Environmental Constraints
 - Project Completion Risks
 - Long Term Risks
 - Citizen Satisfaction
 - ROW Needs
 - Population Benefitted
 - Maintenance Needs
 - Others?



		1	2	3	4	5	6			
	Criteria	D1-Regulatory Risk	D2 - Capacity	S1 - Safest City	D3 - Capital Replacement	D4 - Efficiency/Sust ainability	T1- Citizen/Custom er Satisfaction	Sum	Rank	Weight
1	D1 - Regulatory Risk		2.00	2.00	2.00	2.00	2.00	10.00	1	0.17
2	D2 - Capacity	2.00		2.00	2.00	2.00	2.00	10.00	1	0.17
3	S1 - Safest City	2.00	2.00		2.00	2.00	2.00	10.00	1	0.17
4	D3 - Capital Replacement	2.00	2.00	2.00		2.00	2.00	10.00	1	0.17
5	D4 - Efficiency/Sustainability	2.00	2.00	2.00	2.00		2.00	10.00	1	0.17
6	T1-Citizen/Customer Satisfaction	2.00	2.00	2.00	2.00	2.00		10.00	1	0.17







Project Scoring Metrics



≜DISTRIC1

SAN JACINTO RIVER QUESTIONS?

Study Partners Kickoff Meeting April 8, 2019

Times









SAN JACINTO

REGIONAL WATERSHED MASTER DRAINAGE PLAN

PRIMARY MITIGATION PLANNING ALTERNATIVES MATRIX

8/14/2019

Project	Watershed	Name	Year	Description	Cost (When Proposed)	Location	Size	Wetlands	Precentage Developed	Number Tracts of Land	Benefit	Current Feasibility Notes
1	East Fork	East Fork (East San Jacinto No. 1)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$2,237,000	Near Cleveland	5,950 acres	1534 acres	20%	1387	Capacity: 107,000 ac-ft	Small pockets of residential rural development in this area. Reservoir permit in Sam Houston National Forest is unlikely.
2	East Fork	East Fork Reservoir (EF-G1)	1985	Reservoir assumes only using 3 of 5' of storage	\$44,300,000	Near Junction of East Fork and Winters Bayou	29,000 acres	1548 acres	12%	2645	80%-90% reduction in 100Yr flow from Montgomery & Liberty Co. (55,000 cfs to <10,000cfs) 9 foot reduction in 100 year flood plain B/C Ratio: .07	Reservoir permit in Sam Houston National Forest is unlikely.
3	West Fork	West Fork (San Jacinto No. 4)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$700,000	Upstream of Lake Conroe	2,744 acres	1116 acres	1%	35	Capacity: 25,210 ac-ft	Reservoir permit in Sam Houston National Forest is unlikely.
4	Lake Creek	Lake Creek Dam (Combined)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.		Upstream portion of Lake Creek	Approx. 20000 acres (based on drawing @ 280' line)	3848 acres	10%	4825		Review small pockets of residential development and overlap with Sam Houston National Forest.
5	Lake Creek	Lake Creek Reservoir	1997	80% the size of Lake Conroe	\$275,000,000	On the lower portion of Lake Creek	16,800 acres	7461 acres	25%	3126		Feasibility compared to 1997 appears largely unchanged.
6	Spring Creek	Spring Creek (Spring Creek No. 1)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$2,600,000	At confluence of Spring and Cypress Creeks	5537 acres	1117 acres	5%	229	Capacity 104,000 acre-feet,	Area surrounding reservoir boundary is highly developed. Review reservoir boundary.
7	Spring Creek	Spring Creek Reservoir 1 (SC-G1)	1985	Assumed to have 5' storage above pool	\$6,500,000	Near Woodlands at RM 26.42	1004 acres	102 acres	14%	1532	Average 1% reduction in flow with minimal (<0.5') change in WSEL	Area is now developed.
8	Spring Creek	Spring Creek Reservoir 2 (SC-G2)	1985	Assumed to have full depth of storage	\$41,000,000	Upstream of Walnut Creek confluence	3719 acres	407 acres	23%	9607	B/C Ratio=0.09,Average 35% reduction in flow and 3' WSEL reduction	Reservoir is now partially developed. Review boundary.
9	Cypress Creek	Cypress Creek (Spring Creek No. 2)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$1,500,000	West of Westfield	4193 acres	151 acres	84%	19288	Capacity 58,520 acre-feet,	Area is now developed.
10	Caney Creek	Caney Creek (Caney Creek No. 1)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$400,000	Located East of Conroe	850 acres	87 acres	19%	27	Capacity 6,930 acre-feet	Feasibility compared to 1943/1957 appears largely unchanged.
11	Caney Creek	Caney Creek Reservoir (CC-G1)	1985	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$5,700,000	On upper Caney Creek near RM 34.71	677 acres	16 acres	13%	31	B/C=.51, Average 100% flow reduction D/S of reservoir with 14' change in WSEL (at mouth 16% drop in flow and 1.1' drop in WSEL), Reservoir can store all 100-yr runoff upstream	Small residential rural developments. Review reservoir boundary.
12	Peach Creek	Peach Creek Reservoir 1 (PC-G1)	1985	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event. Assumed to have full depth of storage	\$3,500,000	Located in upstream part of Peach Creek	625 acres	142 acres	33%	49	Capacity 5,350 acre-feet	Reservoir permit in Sam Houston National Forest is unlikely.
13	Peach Creek	Peach Creek Reservoir 2 (PC-G2)	1985	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event. Assumed to have full depth of storage	\$8,000,000	Located in upstream part of Peach Creek, above Peach Creek No. 1	1381 acres	22 acres	0%	12	Capacity 2750 acre-feet	Reservoir permit in Sam Houston National Forest is unlikely.
14	Stewart Creek	Stewart Creek (Stewart Creek No. 1)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$175,000	At the edge of Conroe	301 acres	12 acres	3%	11	Capacity 2,400 acre-feet	There is development just downstream of reservoir location that was built around the year 2000. Area where reservoir is located remains undeveloped.
15	Caney Creek	CC-E	1985	Modify the bridge(s) to be less hydraulically restrictive	Not Calculated	Sycamore Drive R.M. 12.31	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth of 0.4 feet immediately upstream of bridges, B/C: 0.00	Feasibility compared to 1985 appears largely unchanged.
15	Caney Creek	CC-E	1985	Modify the bridge(s) to be less hydraulically restrictive	Not Calculated	Fire Tower Road R.M. 13.45	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth of 0.6 feet immediately upstream of bridges, B/C: 0.00	Feasibility compared to 1985 appears largely unchanged.
16	East Fork	EF-B	1985	Replace the Existing Channel with a large grass lined channel for the entirety of the watershed	\$48,700,000	Between Harris County and San Jacinto County Line	Width Upstream: 480 Feet, Width Downstream: 530 Feet, Depth 20 Feet	2259 acres	3%	884	B/C: 0.07	Feasibility compared to 1985 appears largely unchanged. Channel width may be restricted in some locations due to development.
	•	•	•	-		•	•		•	•		



SAN JACINTO

REGIONAL WATERSHED MASTER DRAINAGE PLAN

PRIMARY MITIGATION PLANNING ALTERNATIVES MATRIX

8/14/2019

Project	Watershed	Name	Year	Description	Cost (When Proposed)	Location	Size	Wetlands	Precentage Developed	Number Tracts of Land	Benefit	Current Feasibility Notes
16	East Fork	EF-D	1985	Remove debris, and vegetation along the banks of the channel to increase hydraulic efficiency.	\$3,400,000	Along the East Fork	N/A	N/A	N/A	N/A	About 0.1 Foot reduction in 100 Year flood plane, B/C: 0.03	Feasibility compared to 1985 appears largely unchanged.
17	East Fork	EF-E2	1985	Modify the bridge(s) to be less hydraulically restrictive	\$3,000,000	Highway 105 bridge near Cleveland	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth of 1.2 feet immediately upstream of bridges, B/C: 0.03	Feasibility compared to 1985 appears largely unchanged.
18	East Fork	EF-E1	1985	Modify the bridge(s) to be less hydraulically restrictive	\$3,000,000	FM1485 Bridge near Harris County line	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth of 1.6 feet immediately upstream of bridges, B/C: 0.08	Feasibility compared to 1985 appears largely unchanged.
19	Lake Creek	LC-B	1985	Replace the Existing Channel with a large grass lined channel for the entirety of the watershed	\$126,000,000	R.M. 43.3 to R.M. 0.0	Depth Upstream: 22 Feet, Depth Downstream: 31 Feet, Width Upstream: 260 Feet, Width Downstream: 670 Feet	2949 acres	2%	329	B/C: <0.001	Feasibility compared to 1985 appears largely unchanged.
19	Lake Creek	LC-D	1985	Remove debris, and vegetation along the banks of the channel to increase hydraulic efficiency.	\$3,100,000	Along Lake Creek	N/A	N/A	N/A	N/A	≤0.3 Foot reduction in 100 Year flood plane, B/C: 0.0	Feasibility compared to 1985 appears largely unchanged.
20	Peach Creek	РС-В	1985	Replace the Existing Channel with a large grass lined channel for the entirety of the watershed	\$37,500,000	R.M. 40.4 to R.M. 0.0	Width Upstream: 100 Feet, Width Downstream: 450 Feet, Depth Upstream: 10 Feet, Depth Downstream: 20 Feet	815 acres	5%	664	B/C: 0.33	Feasibility compared to 1985 appears largely unchanged. Permitting through Sam Houston National Forest may be an issue.
20	Peach Creek	PC-D	1985	Remove debris, and vegetation along the banks of the channel to increase hydraulic efficiency.	\$4,300,000	Along Peach Creek	N/A	N/A	N/A	N/A	Average 0.5 Foot reduction in 100 Year flood plane, Up to a 1.3 foot reduction. B/C: 0.04	Feasibility compared to 1985 appears largely unchanged. Permitting through Sam Houston National Forest may be an issue.
21	Peach Creek	PC-E	1985	Modify the bridge(s) to be less hydraulically restrictive	Not Calculated	Appian Way R.M. 5.2	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth of 0.4 feet immediately upstream of bridges, B/C: 0.00	Feasibility compared to 1985 appears largely unchanged.
21	Peach Creek	PC-E	1985	Modify the bridge(s) to be less hydraulically restrictive	Not Calculated	Unnamed Road R.M. 7.1	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth of 1.2 feet immediately upstream of bridges, B/C: 0.00	Feasibility compared to 1985 appears largely unchanged.
21	Peach Creek	PC-E	1985	Modify the bridge(s) to be less hydraulically restrictive	Not Calculated	FM2090 R.M. 9.4	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth of 0.6 feet immediately upstream of bridges, B/C: 0.00	Feasibility compared to 1985 appears largely unchanged.
22	Spring Creek	SC-B	1985	Replace the Existing Channel with a large grass lined channel for the entirety of the watershed	\$190,800,000	R.M. 48.2 to R.M. 0.0	Width Upstream: 200 Feet, Width Downstream: 500 Feet, Upstream Depth: 14 Feet, Downstream Depth: 35 Feet	795 acres	3%	386	B/C: 0.03	Feasibility compared to 1985 appears largely unchanged.
22	Spring Creek	SC-D	1985	Remove debris, and vegetation along the banks of the channel to increase hydraulic efficiency.	\$4,700,000	Along Spring Creek	N/A	N/A	N/A	N/A	About 1 Foot reduction in 100 Year flood plane, B/C: 0.14	Feasibility compared to 1985 appears largely unchanged.
23	Spring Creek	SC-E2	1985	Modify the bridge(s) to be less hydraulically restrictive	\$19,000,000	Missouri pacific RR R.M. 13.17	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth of 0.2 feet immediately upstream of bridges, B/C: 0.00	Feasibility compared to 1985 appears largely unchanged.
24	Spring Creek	SC-E1	1985	Modify the bridge(s) to be less hydraulically restrictive	\$10,000,000	Huffsmith Conroe Road RM 35.44, Missouri Pacific RR R.M. 37.28, Chicago and Pacific RR at R.M. 38.54	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth of 0.8 feet immediately upstream of bridges, B/C: 0.00	Feasibility compared to 1985 appears largely unchanged.
25	Spring Creek	SC-E3	1985	Modify the bridge(s) to be less hydraulically restrictive	Not Calculated	Missouri pacific RR R.M. 13.17, and I-45 spans at R.M. 16.83 and 16.89	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth of 0.5 feet immediately upstream of bridges, B/C: 0.00	Feasibility compared to 1985 appears largely unchanged.
26	West Fork	WF-B	1985	Replace the Existing Channel with a large grass lined channel for the entirety of the watershed	\$137,000,000	Lake Conroe to Harris County	Depth: 30 Feet, Upstream Width: 500 Feet, Downstream Width: 600 Feet	1216 acres	4%	354	B/C: 0.40	Feasibility compared to 1985 appears largely unchanged. Channel width may be restricted in some locations due to development. Permitting along Sam Houston National Forest may be an issue.



SAN JACINTO

REGIONAL WATERSHED MASTER DRAINAGE PLAN

PRIMARY MITIGATION PLANNING ALTERNATIVES MATRIX

8/14/2019

Project	Watershed	Name	Year	Description	Cost (When Proposed)	Location	Size	Wetlands	Precentage Developed	Number Tracts of Land	Benefit	Current Feasibility Notes
26	West Fork	WF-D	1985	Remove debris, and vegetation along the banks of the channel to increase hydraulic efficiency.	\$5,700,000	Along The West Fork	N/A	N/A	N/A	N/A	≤1 Foot reduction in 100 Year flood plane	Feasibility compared to 1985 appears largely unchanged.
27	West Fork	WF-C1	1985	Replace the existing West Fork channel section with a grass lined channel, with the bottom of the current channel as the bottom of the new channel, for the length of Critical Area 1	\$8,600,000	Critical Area 1	N/A	179 acres	8%	35	B/C: 0.03	Feasibility compared to 1985 appears largely unchanged.
27	West Fork	WF-D1	1985	Desnag channel sections for critical area 1	\$270,000	Critical Area 1	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth ≤0.6, B/C: 0.00	Feasibility compared to 1985 appears largely unchanged.
28	West Fork	WF-C2	1985	Replace the existing West Fork channel section with a grass lined channel, with the bottom of the current channel as the bottom of the new channel, for the length of Critical Area 2	\$17,300,000	Critical Area 2	N/A	97 acres	25%	34	B/C: 0.31	Feasibility compared to 1985 appears largely unchanged.
28	West Fork	WF-D2	1985	Desnag channel sections for critical area 2	\$530,000	Critical Area 2	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth ≤0.6, B/C: 0.31	Feasibility compared to 1985 appears largely unchanged.
29	West Fork	WF-C3	1985	Replace the existing West Fork channel section with a grass lined channel, with the bottom of the current channel as the bottom of the new channel, for the length of Critical Area 3	\$31,200,000	Critical Area 3	N/A	125 acres	14%	216	B/C: 0.93	Feasibility compared to 1985 appears largely unchanged.
29	West Fork	WF-D3	1985	Desnag channel sections for critical area 3	\$1,100,000	Critical Area 3	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth ≤0.6, B/C: 2.5	Feasibility compared to 1985 appears largely unchanged.
30	West Fork	WF-C4	1985	Replace the existing West Fork channel section with a grass lined channel, with the bottom of the current channel as the bottom of the new channel, for the length of Critical Area 4	\$8,800,000	Critical Area 4	N/A	147 acres	29%	87	B/C: 0.75	Feasibility compared to 1985 appears largely unchanged.
30	West Fork	WF-D4	1985	Desnag channel sections for critical area 4	\$270,000	Critical Area 4	N/A	N/A	N/A	N/A	Reduction of 100 year flood depth ≤0.6, B/C: 2.3	Feasibility compared to 1985 appears largely unchanged.
31	West Fork	WF-C5	1985	Replace the existing West Fork channel section with a concrete lined channel, with the bottom of the current channel as the bottom of the new channel, for the length of Critical Area 3	\$370,000,000	Critical Area 3	N/A	125 acres	14%	87	Channel reduction of flood depth by 5.5 feet in critical area 3, with a minor increase in depth downstream, B/C: 0.1	Feasibility compared to 1985 appears largely unchanged.
32	West Fork	WF-E	1985	Modify the bridge(s) to be less hydraulically restrictive	\$18,500,000	Atchinson	N/A	N/A	N/A	N/A	1.2 Foot reduction in 100 Year flood plane, B/C: 0.085	Feasibility compared to 1985 appears largely unchanged.
33	Caney Creek	CC-B	1985	Replace the Existing Channel with a large grass lined channel for the entirety of the watershed	\$73,000,000	R.M. 46.1 to R.M. 0.0	Width Upstream: 200 Feet, Width Downstream: 460 Feet, Depth Upstream: 14 Feet, Depth Downstream: 30 Feet	663 acres	4%	829	B/C: 0.09	Feasibility compared to 1985 appears largely unchanged. Permitting along Sam Houston National Forest may be an issue.
33	Caney Creek	CC-D	1985	Remove debris, and vegetation along the banks of the channel to increase hydraulic efficiency.	\$7,400,000	Along Caney Creek	N/A	N/A	N/A	N/A	About 2.7 Foot reduction in 100 Year flood plane, B/C: 0.08	Feasibility compared to 1985 appears largely unchanged. Permitting along Sam Houston National Forest may be an issue.
34	West Fork	West Fork (San Jacinto No. 1)	1943/1957	Creation of a reservoir at the described location, with the intent of managing water release during a specific storm event.	\$925,000	At confluence with Lake Creek	3,890 acres	1,738 acres	14%	370	Capacity: 33,525 ac-ft	Some small pockets of development near reservoir location. Review reservoir boundary.
35	East Fork	East Fork Reservoir		Downstream of Cleveland								Replaces infeasible alternative from above
36	Lake Creek	Lake Creek Reservoir		Upstream portion of Lake Creek outside Sam Houston National Forest								Replaces infeasible alternative from above



SAN JACINTO REGIONAL WATERSHED

ASTER DRAINAGE PLAN

PRIMARY MITIGATION PLANNING ALTERNATIVES MATRIX 8/14/2019

Number Cost (When Precentage Wetlands Project Watershed Year Description Size Name Location Tracts of Developed Proposed) Land Peach Creek 37 Peach Creek Downstream of Sam Houston National Forest Reservoir Caney Creek CC-F25 1985 Purchas all property within the 25-yr floodplain. \$1,900,000 Along Caney Creek N/A CC-F100 Caney Creek 1985 Purchas all property within the 100-yr floodplain. \$4,600,000 Along Caney Creek N/A EF-F25 East Fork 1985 Purchas all property within the 25-yr floodplain. \$3,400,000 Along the East Fork N/A East Fork EF-F100 1985 Purchas all property within the 100-yr floodplain. \$4,500,000 Along the East Fork N/A Purchas all property within the 25-yr floodplain; Lake Creek LC-F25 1985 \$1,300,000 Along Lake Creek N/A Same as the 100-yr floodplain. Buyouts PC-F25 Peach Creek 1985 Purchas all property within the 25-yr floodplain. \$6,200,000 Along Peach Creek N/A Peach Creek PC-F100 1985 Purchas all property within the 100-yr floodplain. \$9,500,000 Along Peach Creek N/A SC-F25 Spring Creek 1985 Purchas all property within the 25-yr floodplain. \$6,300,000 Along Spring Creek N/A SC-F100 Spring Creek 1985 Purchas all property within the 100-yr floodplain. \$18,000,000 Along Spring Creek N/A West Fork WF-F25 1985 Purchas all property within the 25-yr floodplain. \$62,000,000 Along The West Fork N/A WF-F100 West Fork 1985 Purchas all property within the 100-yr floodplain. \$97,000,000 Along The West Fork N/A



Benefit	Current Feasibility Notes
	Replaces infeasible alternative from above
B/C: 2.7	
B/C: 1.20	
B/C: 0.81	
B/C: 0.77	
B/C: 0.09	
B/C: 1.9	
B/C: 1.3	
B/C: 0.84	
B/C: 0.36	
B/C: 0.76	
B/C: 0.57	





MEETING MINUTES

To:	Jing Chen, P.E., CFM	Attendees:	Jing Chen, HCFCD
	_		Gary Bezemek, HCFCD
From:	Terry Barr, P.E., CFM		Jonathan Holley, HCFCD
C1 *4-	Users Constants Disco Designal		Myron Jones, HCFCD
Subject:	Upper San Jacinto River Regional		KOD Lazaro, HCFCD
	Flood Mitigation Plan – Primary		Dena Green, HCFCD
	Alternatives Workshop		Jeremy Ratcliff, HCFCD
			Chuck Gilman, SJRA
Meeting Date:	08/14/2019 – 3:00 pm		Matt Barrett, SJRA
0	-		Heather Cook, SJRA
Location:	HCFCD, Brookhollow Office		Diane Cooper, Montgomery County
			Darren Hess, Montgomery County
Minutes Date:	08/30/2019		Adam Eaton, COH
			Terry Barr, Halff
AVO No.:	033465.002		Sam Hinojosa, Halff
			Andrew Moore, Halff
			Hector Olmos, FNI
			Corev Stull, FNI
			Greg Sevcik, Hollaway
			Connor Stokes Hollaway
			Janice Haves Hollaway
			Jamee Hayes, Hollaway

Item	Description	Action
1.	Introductions	
	Ms. Chen started the meeting.	
2.	Workshop Goals	
	Mr. Barr summarized the workshop goals. He mentioned that the previous alternatives had been explored and Halff is developing a ranking system matrix to summarize the options. He summarized the potential opportunities and constraints that are currently being weighed.	
3.	Previously Identified Alternatives	
	Mr. Moore summarized the previous alternatives that had been explored through historical studies. He mentioned that options ranged from large reservoirs, to channel improvements, to localized de-snagging and sedimentation removal. He stated that benefit cost ratios of previous alternatives were very low due to the lack of development within the watershed.	
4.	Primary Alternative Discussion	
	Mr. Barr presented the maps and matrices summarizing the previous alternatives. He stated that locations of reservoirs were preliminary and based on descriptions and limited figures from the reports.	
	Ms. Cooper asked what the base data for the complaint hot spots included. Mr. Hinojosa stated that it was FEMA loss data for Harris	

County and observed flooding from Montgomery County for the 2016 and 2017 events.	
Mr. Hinojosa stated that the damages occur along Cypress Creek, Spring Creek and Kingwood in Harris County while damages are sparse in Montgomery County with centers around River Plantation, McDade Estates, and Caney Creek near I-59.	
Mr. Hinojosa discussed the potential for a Lake Creek reservoir. Mr. Bezemek stated that you could easily remove the hydrology to see what happens downstream. He asked how it would help population centers. Mr. Hinojosa stated that there are not a significant number of centers along Lake Creek but the volume could impact the Lake Houston area.	Halff to conduct high level volume review of alternatives.
Mr. Hinojosa discussed the potential for an East Fork Reservoir in the Sam Houston National Forest. He asked whether there would be potential for impounding water in the national forest. Mr. Holley stated the USACE has done a study on the impact of temporary impoundment on vegetation. He stated they have not noticed a big change in a vegetated state on the two Harris County reservoirs due to recent flooding. He stated that forested lands can coexist with floodplains.	Halff to continue to investigate impoundment in the national forest.
Mr. Hinojosa discussed how a Spring Creek reservoir will be included in the alternative discussion even though it had not been proposed in the past. He stated that the conservancy may pose a challenge with creating a reservoir along the main stem, but smaller basins can also be looked at for potential detention.	
Mr. Hinojosa stated that smaller basins on Caney and Peach Creeks may prove to help out the volumes and flows at Lake Houston. He stated that these creeks have flatter terrain so there is less land depth for a large reservoir, but smaller ones could generate enough volume. He said that development is currently sparse through the watersheds, but development is growing in the region.	
Mr. Bezemek stated that previous studies along Cypress Creek are being updated with the new terrain and new model techniques. He stated that the updates are reviewing mitigation along the tributaries and larger detention to reduce flows downstream. He stated one option is rice field detention which includes building berms along current rice fields to reduce runoff during a storm event. He stated the reports will be complete by the end of 2019.	HCFCD to provide Cypress Creek report when complete
Mr. Hinojosa stated that there is potential for alternatives on Luce and Tarkington Bayous but large reservoirs may be challenging due to the flat terrain.	
Mr. Gilman asked if the alternatives would include the proposed gates for Lake Houston. He stated that the City had received a grant for studying the gates as a separate effort. Mr. Bezemek recommended modeling with a lower water surface elevation to show the impact of improved gates.	Halff to determine if changes to gate configuration should be modeled

	 Mr. Barrett asked how many land-owners correlate to the number of parcels in the spreadsheet. He stated that ROW acquisition process could potentially be simplified if multiple parcels are owned by the same entity. One example where that could occur is in the national forest. Ms. Cooper stated she had provided new developments being constructed in Montgomery County and it could be used for potential damage centers and future conditions modeling. She stated that development will occur in Montgomery County. Ms. Cooper asked if Halff had obtained any flooding damages from Cleveland. Hinojosa stated that they had not obtained that information yet but would enquire. Ms. Green asked how future conditions will impact the alternatives. Mr. Hinojosa stated that volumes and flows will likely change due to development and that it would be reviewed as part of the process. 	Halff to include landowners in matrix. Halff to request damage data from surrounding counties.
4	Ms. Chen concluded the meeting.	

This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not correct, or that any information is missing or incomplete, please contact Halff Associates so that the matter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.



PRIMARY ALTERNATIVES WORKSHOP

HCFCD, City of Houston, Montgomery County, SJRA August 14, 2019



Name	Organization	Phone Number	Email
Terry Barr TB	Halff Associates, Inc.	(713) 588-2451	tbarr@halff.com
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Jing Chen JC	HCFCD	(713) 684-4264	jing.chen@hcfcd.hctx.net
Matt Barett	SJRA	936 588 7177	mbarrett@sjra.net
Chuck Gulman	STRA	936-588-1111	Cgilman @ Sira.net
Hatu Olmos	FUT	713-600-6856	her preese com
Figure Gooper	Montgenery Co	936-338-8111	Diane. Cooper O Mctx. ora
Jonathan Hollay	HOFCB	346-286-4155	jonathan hollar heted hete net
GARY BEZEMEK	HEFED	713 684 4000	gary bezemekehefed . netr. net
Myran Jones	HEFED	346-286-4056	maron inese hated het v. net
LARREN HESS	Moula Co GHSEM	936,523 3900	darren-hessemate.org
JANICE PAYES	Hollaway	713-868-4100	JANICE @ hollawayenv. com
for itzak	HUFU	713-624-4027	robert. lazer old hered. org
Adam Eston	Cott	832 395 3082	Adam. Exten Charbontz-gov
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Jereny asterity	HCFCP	(71) 689-4005	even, rate it 42 held . sty
yory Still	FNI	(712)600-6809	Cory. Stull & Freese. com

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ALTERNATIVES WORKSHOP NO. 2 AGENDA

Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

December 11, 2019 San Jacinto River Watershed Master Drainage Plan HCFCD, Brookhollow

Meeting ca	alled by:	Jing Chen, P.E., CFM	Type of Meeting:	Alternatives Workshop No. 2					
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	1:00 PM					
			Meeting Stop Time:	4:00 PM					
Agenda									
1.	Introd	uctions, Agenda, Purpose (5 m	nin)						
2.	Works	hop Goals (2 min)							
	•	Review and provide input on d	amage center identifica	tion					
	•	Prioritization of damage center	f damage centers						
	•	Provide feedback on magnitud	e and type of projects						
	•	Determine ranking metrics list							
3.	Altern	atives Evaluation Process (3 m	nin)						
	•	Combine HEC-RAS models for	or all streams						
	•	Run models for frequency stor	m events						
	•	Develop the Structural Invento	ry Tool						
	•	Identify "Damage Centers"							
	•	Select a Target Frequency							
	•	Determine Improvements need	ed to achieve the desire	ed level of service					
	•	Qualitative Analysis							
	•	Ranking Methodology							
4.	Calibr	ation Discussion (10 min)							
	•	Combined Models							
	•	Calibration							
	•	HDR Discussion							
5.	Freque	ency Analysis (20 min)							
	•	Analysis Results							
	•	Watershed Volume Sensitivity							
5.	Struct	ural Inventory (10 min)							
2.	•	Process and Inventory Develop	oment						
	•	Flooded Structure Statistics							

7.	Damage Center Identification (30 min)
	Identification Process
	Damage Center Locations (Maps)
	Questions for Study Partners
	Break (10 min)
8.	Target Frequency Discussion (30 min)
	Flood Risk Reduction Volumes
	Volume Calculation Process
	 Determining Volumes
	 Volume Differences by Frequency
	 Benefits Determination
	• Issues with Selecting a "Target Frequency"
9.	Potential Improvements (30 min)
	Total Volume Needs and Locations
	Volume required vs. Structures Removed
	 100-Year Level of Service
	 Most Cost-Effective Level of Service
	Study Partner Input
10.	Project Metrics (25 min)
	Ranking Methodology
	Study Partner Input
11.	Closing Remarks and Questions (5 min)

SAN JACINTO RIVER SANJAGINTO - Regional Watershed Master Drainage Plan

Primary Alternatives Workshop December 11, 2019 - DRAFT









Workshop Goals

- Review and provide input on damage center identification
- Prioritization of damage centers
- Provide feedback on magnitude and type of projects
- Determine ranking metrics list









Alternatives Evaluation Process

- Combine HEC-RAS models for all streams
- Run models for frequency storm events
- Develop the Structural Inventory Tool
- Identify "Damage Centers"
- Select a Target Frequency
- Determine Improvements needed to achieve the desired level of service
- Qualitative Analysis
- Ranking Methodology







DRAFT - 8/26/2020

DRAFT - 8/26/2020

Combined Models

- Submitted draft calibration report and models 11/4/19
- Continued updates including the Lake Conroe elevation and Memorial Day 2016
- Initial Review discussions with HDR
 - Some gages match very well
 - Some gages did not match flow/stage as well
 - Confidence in some flow gages discussed with USGS
 - Initial loss seemed high for some of the watersheds





DRAFT - 8/26/2020

100-year inflow volumes to Lake Houston







• 100-year flow hydrograph comparisons











- Watershed Volume Sensitivity
- Table shows 100-year WSEL reduction at Lake Houston as a result of removing entire watershed from model
- Lake Houston 100-year = 51.73'

WSEL Reduction	Luce Bayou	East Fork	Caney Creek	Peach Creek	Lake Creek	Spring Creek	Cypress Creek
I-59	0	0	-0.01	-0.01	-1.26	-2.8	-0.63
East Fork	-0.06	-1.62	-2.49	-1.83	-0.01	-0.05	-0.05
FM 1960	-0.49	-0.65	-0.65	-0.48	-0.59	-1.2	-0.24
Lake Houston Dam	-0.42	-0.56	-0.56	-0.41	-0.5	-1.04	-0.2

- Watershed Volume Sensitivity
- Table shows 100-year WSEL reduction at Lake Houston as a result of removing entire watershed from model
- US59 and Lake Houston 100-year Example



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Structural Inventory

- Identified structures near floodplains
- Assigned finished floor elevations based on terrain + 6-inches









Structural Inventory

DRAFT - 8/26/2020

• Structures identified within frequency floodplains

Storm Event	Luce	East Fork	Caney	Peach	West Fork	Lake Creek	Spring	Cypress
2yr	5	20	139	77	58	16	50	12
5yr	19	103	289	293	223	31	269	94
10yr	34	236	546	505	624	49	644	250
25yr	68	523	1,078	789	1,399	89	1,324	638
50yr	96	828	1,497	1,086	2,227	154	2,524	1,345
100yr	184	1,247	2,023	1,315	4,979	205	5,669	2,910
500yr	369	2,120	4,124	1,838	10,298	333	11,982	8,750





- Identification Process
 - "hotspots" based on structures within floodplain
 - Tabulated structures at risk of flooding per frequency event
 - Tabulated instances of flooding based on a 50-year project

Spring Creek – Structures at Risk of Flooding



- Identification Process
 - "hotspots" based on structures within floodplain
 - Tabulated structures at risk of flooding per frequency event
 - Tabulated instances of flooding based on a 50-year project

Spring Creek – Instances of Structural Flooding (50-yr Project Life)



Identification Process

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- "hotspots" based on structures within floodplain
- Tabulated structures at risk of flooding per frequency event
- Tabulated instances of flooding based on a 50-year project

Spring Creek – Instances of Structural Flooding (50-yr Project Life)



SILLA CONTROL VICE TO REVERTE

• Map of Damage Centers (47 total)









- Luce Bayou; Tarkington Bayou
 - Very flat terrain, not much relief
 - Minimal flood damages
 - Improvements upstream would likely help overflow into Cedar, not Lake Houston
 - Smaller % of volume being contributed by Luce/Tarkington Bayous
 - 0-0.5' reduction in Lake Houston (Low Sensitivity)





- East Fork San Jacinto River
 - Large availability of undeveloped land
 - Slightly steeper; More relief
 - Contributes large % of volume into Lake Houston
 - Damages within the watershed are relatively low
 - Winters Bayou plays a significant role in drainage
 - 0.5-1.6' reduction downstream (High Sensitivity)











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- Peach Creek; Caney Creek
 - Relatively high number of damages
 - Undeveloped land available
 - Confluence near Kingwood
 - Combines into significant portion of the East Fork
 - 1.0-4.0' reduction downstream (High Sensitivity)

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Damage Centers

West Fork San Jacinto

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- Previous study indicates limited opportunity near Conroe
- Possible improvements at River Plantation
- Limited space due to development
- Minimal benefit upstream of Lake Conroe
- Much higher volume needed
- Detention needed along Lake Creek







- Lake Creek
 - Relatively small number of damages
 - Limited development in the upper watershed
 - History of consideration for detention project
 - Potential local and West Fork benefits
 - 0.5-1.2' reduction downstream (Moderate Sensitivity)



Lake Greek







- Spring Creek
 - Availability of undeveloped land upstream
 - Slightly steeper; More relief
 - Contributes large % of volume into Lake Houston
 - Significant damages within the watershed
 - Siting study is a focus in the watershed
 - 1.0-2.8' reduction downstream
 (High Sensitivity)









- Cypress Creek; Little Cypress Creek; Willow Creek
 - Limited land availability for large projects in much of the watershed area
 - Projects being developed as part of separate HCFCD efforts
 - Projects in Upper Cypress would influence the overflow, not Lake Houston
 - Small volume contributions from Willow and Little Cypress

e 110

 0.2-0.6' reduction downstream (Low Sensitivity)

290

Little Cypress

Cypress Creek







- Jackson Bayou
 - Very limited detention possibilities due to size
 - Outfalls downstream of Lake Houston; no upstream benefits
 - Small fraction of flow into San Jacinto; minimal improvement
 - Being investigated through Watershed Planning Study
 - Potential channel conveyance project (No Sensitivity to Lake Houston)









Higher Priority Centers








Damage Centers

- Map of roadways inundated
 - Color coded based on frequency overtopped









Damage Centers

- Questions for Study Partners AN JACIN
 - Are there other Damage Centers that need to be included for other reasons than those presented?
 - Are there other factors that could change the current priority?
 - Which Damage Centers will need to be addressed with a project no matter the BCA?









- Goal is to determine high level detention volumes needed
 throughout the watershed
- Select "target frequency" based on no or minimal structures flooding in the damage center
- Calculate detention volume needed to reduce greater storm
 events to a lower frequency
- Calculate estimated total volume needed for each watershed
- Optimization will occur during modeling









- Target Frequency
 - Selected a target frequency based on profiles showing potentially inundated structures
 - DC_J100_002

DRAFT









- Volume calculation process
 - Hydrograph subtraction per damage center
 - Calculated volume needed for various frequencies







- Volume calculation process
 - Hydrograph subtraction per damage center
 - Calculated volume needed for various frequencies



Volume calculation process

- Hydrograph subtraction per damage center
- Calculated volume needed for various frequencies
- Determined reduction in potentially impacted structures

	Existin	g conditions	1829	946	498	271	100	43	9	2717	Flood in	stances (5	0-yr)
			Cu	mulative	e numb	er of flo	oded st	tructure	S				
Start	Target	Vol, ac-ft	500yr	100yr	50yr	25yr	10yr	5yr	2yr	Benefit	B/V	Incr. V	Incr. B
500yr	100yr	78,745	946	498	271	100	43	9	0	1638	21	78,745	1638
500yr	50yr	123,390	498	271	100	43	9	0	0	2298	19	44,645	660
500yr	25yr	168,485	271	100	43	9	0	0	0	2568	15	45,095	269
500yr	10yr	219,495	100	43	9	0	0	0	0	2671	12	51,011	103
500yr	5yr	257,190	43	9	0	0	0	0	0	2704	11	37,694	33
500yr	2yr	289,914	9	0	0	0	0	0	0	2715	9	32,724	11
100yr	50yr	20,639	1829	498	271	100	43	9	0	1462	71	20,639	1462
100yr	25yr	52,374	1829	271	100	43	9	0	0	2032	39	31,736	570
100yr	10yr	96,786	1020	100	10	<u> </u>	<u></u>	Û	0	2256	23	44,411	224
100yr	5yr	127,434	1829	43	9	0	0	0	0	2325	18	30,648	69
100yr	2yr	163,114	1829	9	0	0	0	0	0	2347	14	35,680	22





- Volume calculation process
 - Hydrograph subtraction per damage center
 - Calculated volume needed for various frequencies
 - Determined reduction in potentially impacted structures





- Volume required versus structures removed from floodplain
- Target frequency is the 100-year frequency storm event

Stream	Volume Required	Benefit	Volume Per Benefit		
Luce Bayou	87,000	780	112		
East Fork SJR	1.6 M	4,569	350		
Caney Creek	89,000	1,487	60		
Peach Creek	214,000	8,480	25		
West Fork SJR	4.3 M	9,948	432		
Lake Creek	232,000	705	329		
Spring Creek	458,256	10,915	42		
Cypress Creek	128,332	4,812	27		
*Addicks Reservoir capacity 204,500 acre-feet and 26 sq. miles					
ET 8/26/2020					





- Volume required versus structures removed from floodplain
- Target frequency varies based on anticipated benefit

Stream	Volume Required	Benefit	Volume Per Benefit	
Luce Bayou	7,713	653	12	
East Fork SJR	500,000	3,653	137	
Caney Creek	25,373	1,257	20	
Peach Creek	65,687	7,030	9	
West Fork SJR	1.8 M	8,329	216	
Lake Creek	79,619	595	134	
Spring Creek	132,302	9,331	14	
Cypress Creek	128,332	3,962	32	
*Addicks Reservoir capacity 204,500 acre-feet and 26 sq. miles				





• Volume required for prioritized damage centers

Stream	Max Beneficial Volumes	Volume Required	Benefit	Volume Per Benefit
East Fork SJR	25 Yr	393,000	3,187	123
Caney Creek	10 Yr	50,000	1,421	35
Peach Creek	10 Yr	121,000	7,958	15
West Fork SJR	10-25 Yr	1.1 M	5,270	209
Spring Creek	25 Yr	160,000	9,674	17

*Addicks Reservoir capacity 204,500 acre-feet and 26 sq. miles







Watershed Mitigation Potential

High Potential

- Spring Creek (Benefits in watershed; Potential reduction downstream)

- East Fork (Major Lake Houston contributor; Available open space)
- Peach/Caney Creek (Available open space; Benefits in watershed)
- Moderate Potential
 - Lake Creek (Available open space; large portion of West Fork, Limited benefits in the Lake Creek watershed)
- Low Potential
 - Cypress Creek (Limited open space; Other HCFD efforts; Overflow)
 - Willow Creek/Little Cypress Creek (Small contribution; Limited space)
 - Luce/Tarkington Bayou (Limited damages; Smaller contribution; Flat)
 - Jackson Bayou (Very small contribution; Downstream of Lake Houston)

West Fork (Limited open space; High volume; Benefits in watershed)
 DRAFT - 8/26/2020



- Initial volume estimates show significant volume may be needed for the 100-year storm event
- What types of projects should be considered?
 - Detention
 - Buyout
 - Channelization
 - Other
- What about policy considerations?
 - Detention
 - Floodplain Preservation







Ranking Methodology

Metrics from Scope of Work:

- Reduction in structural flooding
- Project Cost
- Design Life
- Maintenance
- Feasibility
- Constructability
- Public Benefit
- Public Safety
- Multi use
- Environmental Constraints







Ranking Methodology

Other Metrics to Consider

- Reduction in road flooding
- Community/Agency favor
- Erosion Control
- Impact to water quality
- Multi-function
- Implementation schedule

Input from Stakeholders: Is there anything missing?







SAN JACINTO RIVER QUESTIONS?

Primary Alternatives Workshop December 11, 2019 - DRAFT

T June













MEETING MINUTES

To:	Jing Chen, P.E., CFM	Attendees:	Jing Chen, HCFCD
From:	Terry Barr, P.E., CFM		Jonathan Holley, HCFCD
Subject:	Upper San Jacinto River Regional Flood Mitigation Plan – Alternatives Workshop No. 2		Matt Barrett, SJRA Terry Barr, Halff Andrew Moore, Halff Johnny Kim Halff
Meeting Date:	12/11/2019 – 1:00 pm		Hector Olmos, FNI
Location:	HCFCD, Northwest Crossing Office		Garrett Johnston, FNI Adam Eaton, COH Chuck Gilman SIBA (phone)
Minutes Date:	12/19/2019		Chuck Oliman, SJKA (phone)
AVO No.:	033465.002		

Item	Description	Action
1.	Introductions, Agenda, Purpose	
	Mr. Barr introduced the meeting.	
	There was a discussion concerning the public meeting exhibits. The 100- year event will be presented instead of the Harvey event to be less "Harvey-centric". Also, volumes will be reported instead of flows. Line weights will be removed to avoid confusion with a floodplain map. The pie chart showing volumes will be retained. The West Fork watershed could be split into two at Lake Conroe. Cumulative drainage area may also be included on the map if beneficial.	Halff to upload the revised exhibit onto the Dropbox by 12/12.
	Mr. Barr asked if there would be any issues with showing the calibrated inundation map from Harvey. All agreed to put "DRAFT" on all exhibits for the public meeting, as the analysis is unfinished.	
	Ms. Chen asked about the status of the sedimentation report. Mr. Stull stated they are on track to submit a draft in January. This includes a literature review, update, and synthesis of existing data, including data received from USACE.	
2.	Workshop Goals	Halff to set up a
	Mr. Barr presented the workshop goals.	Montgomery
	Ms. Green stated that the workshop attendees should brief others in their respective organizations about the outcomes of this workshop. A separate briefing for Montgomery County may be provided if needed.	County.
3.	Alternatives Evaluation Process	
	Mr. Barr presented the alternatives evaluation process, with each step being discussed in detail during the remainder of the workshop.	

4.	Calibration Discussion	
	Mr. Moore presented an update on the calibration effort. The HEC-RAS models have been combined into one. The combined model will be fine-tuned further but is approximately 90% complete. Draft calibration report and models were submitted to HCFCD on 11/4/19.	
	Mr. Moore talked with Mr. Duane Barrett (HDR) on 12/6/19. Mr. Barrett did not have a chance to do a full review of the calibrated model at that time but commented on discrepancies between gauge readings and model results. Mr. Moore said there are known issues with certain gauge readings. A meeting is scheduled with HDR on 12/17/19 to review comments on the calibrated model.	
5.	Frequency Analysis	
	The frequency analysis was presented. The "Lake Conroe" hydrograph on Slide 6 does not include dam operations and should be labeled "West Fork" instead. Mr. Barrett stated that the West Fork peak could potentially be reduced and the timing may be delayed after dam operations are included.	
	The figure shows that proposing a reservoir on just one of the watersheds could not solve the regional problem. Mr. Bezemek recommended adding the combined hydrograph to the figure to provide perspective on hydrograph timing. The combined hydrograph may need to be on a different scale or secondary axis so as not to "flatten" the other hydrographs.	
	Entire watersheds were removed from the combined model one at a time to test the sensitivity of each watershed's contribution. The scenario where Spring Creek is removed from the model shows the most significant reductions including 2.8 ft at US59 and more than 1 ft at the Lake Houston dam For perspective, Mr. Olmos explained that if an alternative was sought that would reduce Lake Houston stage by three feet, the alternative would be substantial. and likely not feasible from a cost perspective.	
	Ms. Chen asked if regional ponds would be modeled for the upcoming Spring Creek workshop. Mr. Stull said the analysis would be similar to this high-level exercise, and that they would consider the impact to damage centers. Mr. Barr stated that an alternative in Spring Creek may be recommended as a regional option.	
6.	Structural Inventory	
	FNI presented an update on the structural inventory. Finished floor elevations were assigned based on the terrain plus six inches. On the first pass, many structures were within the 2-year inundation. Google Street View spot checks revealed that many of these structures were built on	

	 piers. Whole neighborhoods were identified in this way as raised on piers for the following iterations of the analysis. Ms. Green stated a six-inch adjustment could potentially be too low. She suggested rerunning the analysis for other adjustments (e.g., 1 foot) to test the sensitivity. The results could be included in the data tables. Mr. Stull said they can add in a sensitivity check for FFEs. Mr. Johnston stated another adjustment was made in the Cypress Creek watershed because of the Inverness Forest Levee system. For the neighborhood protected by the levee, the FFEs were assigned to the levee height. Ms. Chen asked if the study team's structural inventory tool was the same format as HCFCD's structural inventory tool. Mr. Stull explained that this process was created ad hoc for this study, but the nature of the tool is the same as HCFCD's. It is comprised of a spreadsheet that is linked to GIS data. 	FNI to perform sensitivity check for FFE adjustments.
7.	Damage Center Identification	Ms. Chen to follow up with
	The table on Slide 10 shows the number of structures with FFE below the water surface elevation of each frequency storm event. Mr. Johnston presented the figures on Slides 11 through 13, which boil the number of structures at risk of flooding down to one number: the statistically expected "instances of flooding" over a 50-year project life. Each damage center was identified based on "instances of flooding" per river mile. Mr. Stull stated that this analysis can be extended to include appraisal district structure values and depth-damage curves. Mr. Moore stated that BCA will eventually be included after the modeling and analysis. The following discussion took place concerning the damage centers for each watershed:	Bruce (HCFCD) for Imelda flooding complaint data.
	Luce Bayou / Tarkington Bayou: Ms. Chen stated that the "Huffman analysis" recommended a detention pond in this watershed.	
	EFSJR: Mr. Moore stated that one regional pond on just EFSJR may not be a solution since Winters Bayou (tributary of EFSJR) also has a large drainage area.	
	Peach Creek / Caney Creek: Ms. Green said that they get a lot of calls from Splendora. Mr. Moore said that Montgomery County Precinct 2 Commissioner was interested in this study because they have known drainage issues.	
	WFSJR: Mr. Moore said a previous Halff study showed that the channel improvements required to reduce the damage center between Conroe and Lake Conroe was cost prohibitive. Mr. Olmos mentioned that though Kingwood spans both EFSJR and WFSJR, it is currently shown as separate damage centers.	
	Lake Creek: It was found that many watershed studies from the past mention a regional pond on Lake Creek. This will likely be a proposed alternative.	

Spring Creek: Spring Creek has the highest concentration of damaged structures. Mr. Bezemek asked if the structural inventory is backed up by historical complaints. Mr. Moore said that historical complaints are available for comparison and that structural flooding for Montgomery County is available online. Mr. Bezemek said to verify that the damage numbers here are correct.

Cypress/Little Cypress/Willow Creek: Mr. Bezemek stated that the Frontier Program on Little Cypress Creek should provide relief to the local damage centers there. Mr. Olmos said that the Frontier projects may not help much further downstream of the confluence of Cypress Creek and Little Cypress Creek. Mr. Holley said dredging Cypress Creek would be very costly.

Jackson Bayou: This watershed is downstream of Lake Houston Dam and will have no upstream benefits.

General Comments: Mr. Bezemek said that damage center rings could be color-coded for future exhibits. He also said the damage center rings are useful information for future locally driven projects.

Ms. Green stated that there needs to be more clarity on what benefit there is to reducing the volume into Lake Houston. It makes it seem as though Lake Houston is the focus.

Mr. Bezemek said that the metric for determining damage centers may be adjusted by filtering out the 2-year, 5-year, and maybe 10-year damage incidents ("hopelessly deep in the floodplain") to see if any damage centers disappear or are significantly changed. He also suggested that the damage centers that didn't "make the cut" could be retained on the map in a different color, just so the public does not wonder why the study missed a known damage center. Otherwise, a note can be included about the filtering process.

Ms. Chen said this narrative (explaining each watershed) would be helpful in the report.

Mr. Eaton mentioned that the most downstream WFSJ damage center on Slide 23 will be of value to the Lake Houston gates project. According to the structural inventory, there are approximately 2,500 instances of flooding over a 50-year period within that damage center.

The legend on Slide 24 should be renamed from "None" to "less than 2-year."

Ms. Green said that the relative severity of each damage center should be checked again after the FFE sensitivity analysis is completed.

Mr. Bezemek mentioned drainage tunnels as a potential alternative. For example, could it be used to take water off of Cypress Creek? Mr. Stull said a narrative could be provided about certain potential projects that may help locally, but not considered for this study. Ms. Green said however that if there are a lot of local damages, a potential local

	alternative could still be proposed that may not have a regional impact. Ms. Green cautioned not to discount a potential solution just because some other entity may work on those solutions.	
	Mr. Moore asked the workshop participants if there was anything that the study has missed so far. Ms. Green asked about Atascosita. Mr. Bezemek commented that while the typical metric for ranking flood projects is based on structural risk, road closures and navigability of roads may need to be factored into the metric. Ms. Chen asked if the Harvey and Imelda flooding complaint layers could be overlain on the damage center map.	
8.	Target Frequency	
	The flood risk reduction volumes were discussed. The flood risk reduction volumes were estimated for each damage center based on approximate hydrograph volume differences that could be provided by detention. Mr. Moore said some checks were made with the estimated volume in the model for Spring Creek. Mr. Olmos noted that these calculated volumes would need to be located within the immediate vicinity of each damage center to provide full benefit. It was acknowledged that one project could benefit more than one damage center.	
	The "benefit" (y-axis) on Slide 31 refers to instances of flooding over a 50-year period. Ms. Chen asked how the target frequency will be determined. The optimal benefit curves are provided for each damage center and can be used to help determine a target detention frequency for each individual damage center.	
	Mr. Bezemek said it may never make sense in this regional study to alleviate flood risk for a structure that floods in the 2-year and thus suggested that deep flooding should perhaps be filtered out. Shallow flooding may see more benefit from a regional perspective. Mr. Bezemek suggested cutting out the 2-year, 5-year, and potentially 10-year structures from this analysis. Mr. Olmos said that once the data is coupled with the economics, BCA could be calculated for buyouts. HCFCD typically uses grants to help with buyouts.	
	Ms. Chen said that in urbanized areas, FFEs should be adjusted by closer to 12 inches instead of 6 inches. Mr. Stull said that each subdivision usually uses the same foundation type, so sampling of the more-frequently flooded structures is likely sufficient to make a determination at the subdivision level. Date of construction and associated criteria could be used to infer individual FFEs, but this data is not readily available for the entire study area.	
	Compared to other watersheds, Peach and Spring Creek watersheds particularly seem to not require as much volume to get a good amount of benefit. Mr. Barrett asked if the benefits calculated for the various watersheds are limited to that watershed or if benefits are determined in the receiving watersheds (i.e. Benefits on the West Fork from storage on Lake Creek). Mr. Moore said these benefits are calculated only for the	

	respective damage centers. And Mr. Barr noted that there could still be further benefits downstream.	
	Mr. Bezemek asked if the study has produced floodplains for all storm frequencies. A: Yes, at least in raw form.	
	Mr. Bezemek said an alternative way of showing benefit would be to show shrinkages in floodplain.	
	Mr. Barrett asked if an alternative on WFSJR ever looks feasible. Mr. Johnston said those benefit curves are generally flatter and all require large volumes.	
	Mr. Bezemek said we need to be able to incorporate transit LOS in the overall project ranking metric.	
	Mr. Barrett indicated that the study team will need to carefully explain this methodology in future reports as it is complex and difficult to understand. The tables show a significant amount of data and context will need to be provided.	
9.	Potential Improvements	
	Mr. Bezemek commented that the term "low potential" could be changed to "not a regional solution". Local and regional benefits could be differentiated, but we need to reinforce that regional benefits will be the scope of this analysis.	
	Mr. Bezemek said diversions and parallel channels are some things that HCFCD does but may not be valid in other areas. HCFCD is currently doing a study on Upper Cypress and considering building berms on their big properties. A bypass could work if there are a cluster of homes.	
	Mr. Bezemek said another policy is to bar development in the floodplain. HCFCD sees floodplain preservation as pursuing buyouts to keep a floodplain undeveloped.	
	Ms. Green asked if the study team has the necessary data to estimate a future condition. She assumes that the effective criteria for each jurisdiction would be consulted. For example, if the criteria requires detention, then detention should be included in future conditions. Montgomery County drainage criteria allows for zero detention if the timing of the hydrograph allows. Mr. Moore is considering estimating a future condition with and without detention, as Montgomery County was very interested in that. Mr. Moore said that Montgomery County staff is interested in getting rid of the loophole, but the commissioner does not want to get rid of something if it makes sense. It may be better for people not to detain, depending on where you are in the watershed. The project team will assume future conditions without detention in Montgomery County in order to reflect current interpretation of the rules. Future conditions with stricter detention regulation could be investigated as one	

 plan for an executive briefing later. Executive briefing would require about an hour and should include Matt Zeve, Alan Black, and Russ Poppe. Ms. Green said that the large-scale projects can be an incentive for other partners to join. Funding from the state's "Rainy Day" fund could potentially be used to fund some of these local projects. Closing Remarks and Questions 	10.	Project Metrics The following question was asked: Are we successful in this if we end up proposing huge projects that will never get built? Mr. Barr said that when working on master drainage plans, the goal is generally to propose a range of potential project scales, including costly projects with high benefit and more affordable projects with lower benefit. Mr. Bezemek said the study partners should have further discussion on this topic. Is HCFCD OK if the number one project is a multi-billion dollar project? Ms. Green said the scope began by imagining those large-scale projects that they would have to target funding for, but things might be changing now. This is a question that needs to be run by HCFCD executives.	Halff to send memo and exhibits. Aim to have executive briefing as quickly as possible (early February), and Ms. Green and Ms. Chen to check in with their executives before then. Study
11. Closing Remarks and Questions		Ms. Green suggested giving minutes with exhibits to executives, and to plan for an executive briefing later. Executive briefing would require about an hour and should include Matt Zeve, Alan Black, and Russ Poppe. Ms. Green said that the large-scale projects can be an incentive for other partners to join. Funding from the state's "Rainy Day" fund could	partners to have answers to the study team by mid-January.
The workshop was adjourned	11.	Closing Remarks and Questions	

This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not correct, or that any information is missing or incomplete, please contact Halff Associates so that the matter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.



ALTERNATIVES WORKSHOP NO. 2

HCFCD, City of Houston, Montgomery County, SJRA December 11, 2019



Name	Organization	Phone Number	Email
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ALTERNATIVES WORKSHOP NO. 3 AGENDA

Study Partners: HCFCD, City of Houston, Montgomery County, SJRA

April 27, 2020 San Jacinto Regional Watershed Master Drainage Plan WebEx Conference Call

Meeting called by:		Jing Chen, P.E., CFM	Type of Meeting:	Alternatives Workshop No. 3	
Facilitator:		Terry M. Barr, P.E., CFM	Meeting Start Time:	1:00 PM	
			Meeting Stop Time:	3:30 PM	
Agenda					
1.	Introd	roductions, Agenda, Purpose			
	•	Basin Overview			
	•	San Jacinto Basin Mitigation S	trategies		
2.	Workshop Goals				
	•	• Present mitigation planning results and receive feedback on projects, combinations & metrics			
	Review damage center identification and target volumes				
	Present flood reduction alternatives (Location, configuration, costs, benefits, constraint)			ration, costs, benefits, constraints)	
	•	Identify most effective alternat	ives and potential comb	inations	
	•	Discuss metrics and project pri	oritization		
3.	Existin	ting Conditions Modeling Recap			
	•	Existing Conditions Model (20	017/2018 LiDAR, Atlas	14 Volume 11 Rainfall)	
	•	Model Calibration/Validation			
4.	Alternatives Evaluation Recap				
	•	Damage Center Recap			
	•	Flood Reduction Volume Reca	ıp		
	•	Previously Recommended Pro	jects		
	•	Watershed Mitigation Potentia	1		
5.	Flood 3	Reduction Projects Summary			
	•	Summary of Project Location			
	•	Fact Sheet Overview			
	•	Summary of Project Information	on		
	•	Cost Uncertainty			
6.	Spring Creek				
	•	Overview of Potential Projects			
	•	Most Effective Project Discuss	sion		
7.	Lake C	Creek			
	•	Overview of Potential Projects			

	Most Effective Project Discussion			
8.	Caney Creek			
	Overview of Potential Projects			
	Most Effective Project Discussion			
	BREAK (10 min)			
9.	Peach Creek			
	Overview of Potential Projects			
	Most Effective Project Discussion			
10.	East Fork San Jacinto			
	Overview of Potential Projects			
	Most Effective Project Discussion			
11.	West Fork San Jacinto			
	Overview of Potential Projects			
	Most Effective Project Discussion			
12.	San Jacinto Regional WMDP			
	Overview of Potential WMDP Projects			
	Low to Moderate Income (LMI) Areas			
	Potential Project Combinations			
	Watershed Implementation Approach vs. Combined Regional Approach			
	Additional Flood Mitigation Measures			
	• Buyouts			
	Study Partner Input			
13.	Implementation			
	Potential Ranking Metrics			
	Implementation Steps			
	• Study Partner Input			
14.	Study Deliverables Schedule			
	Preliminary Mitigation Planning Memo (June 8 th)			
	• Draft Report (July 13 th)			
	• Final Report (August 31st)			
15.	Closing Remarks and Questions			

SAN JACINTO RIVER SANJACINTO - Regional Watershed Master Drainage Plan

Alternatives Workshop No. 3 April 27, 2020 - DRAFT









San Jacinto River Basin

- 75% HMGP Funded
- 25% Local Funded

Stream Name	Stream Length (Miles)
West Fork San Jacinto River	61.4
East Fork San Jacinto River	73.2
San Jacinto River	16.3
Lake Creek	58.9
Cypress Creek	60.5
Little Cypress Creek	20.8
Spring Creek	69.6
Willow Creek	19.8
Caney Creek	49.3
Peach Creek	53.5
Luce Bayou	10.8
Tarkington Bayou	36.9
Jackson Bayou	4.6
Total	535.6



2

DRAFT - 5/13/2020

San Jacinto Flood Mitigation Strategies

- Primary Flood Mitigation Planning (Flood Reduction)
 - Primary Alternatives Based on previously identified solutions
 - Secondary Alternatives Developed additional flood reduction projects
 - Develop cost estimates
 - Evaluate potential benefits
 - Identify implementation path and challenges
- Secondary Flood Mitigation Planning (Flood Warning)
 - Coordinate with HCFCD, MCO, SJRA, TXDOT, USGS, NWS
 - Recommend locations for additional FWS gages
- Other Mitigation Actions (Flood Response)
 - Coordinate with agencies responsible for Emergency Management
 - Provide recommendations for updated communications protocols
 - Identify potential flooding of roadways and critical infrastructure





Workshop Goals

- Present primary mitigation planning results and receive feedback on projects, combinations, and metrics
- Recap damage center identification and target volumes
- Present flood reduction alternatives (Location, configuration, costs, benefits, constraints)
- Identify effective alternatives and potential combinations
- Discuss metrics and the path toward project prioritization







Workshop Questions

- Projects:
 - Are the projects we have looked at appropriate for the study?
 - Are there any other projects that we should have considered?
- Costs
 - Are cost assumptions appropriate and reasonable?
 - Is there anything else we should consider or revise?
- Implementation
 - What project implementation approach is preferred?
 - What metrics are important for prioritizing projects?

5







Existing Conditions Modeling

- Developed Comprehensive Model
- Limited Updates to M3 Models
- Hydrology
 - Atlas 14 Rainfall (varies by watershed)
 - Updated Watershed Delineation
 - Soils, % Impervious, BDF (TC+R)
 - HEC-HMS Model Development
- Hydraulics
 - Updated cross section geometry
 - New/updated bridges and culverts
 - Reviewed and adjusted n-values
 - Developed unsteady RAS models





6





Analysis of Historical Storms

- Historical Storms
 - Memorial Day (2016)
 - Hurricane Harvey (2017)
 - TS Imelda (2019)
 - October 1994
- Leveraged Gage Adjusted Radar Rainfall (GARR) Data
- USGS Gages (Used 22/25)
 - Met with USGS
 - Peach Creek Adjustment
 - Gage Summary in Report
- Calibration Report Submitted









Alternatives Evaluation Recap

- Evaluate flood damages using the Structural Inventory Tool
- Identify "Damage Centers"
- Determine volume reduction for a range of LOS improvements
- Compare reduction volumes to potential benefits
- Estimate preliminary target volumes for each damage center
- Consider previously identified projects
- Develop new potential projects
- Select watersheds with highest potential for improvements







Damage Center Recap

- Run models for frequency storm events
- Develop the Structural Inventory Tool
- Identify Damage Centers





9

Damage Center Recap


Flood Risk Reduction Volumes

- Volume Reduction
 - Extract hydrographs from models at damage centers for frequency events
 - Calculated volume difference for frequency ranges (i.e 100-yr to 10-yr)







Flood Reduction Volume Recap

- Volume for LOS Improvement Ranges
 - Prepared table of volume differences for a range of LOS improvements
 - Determine reductions in potentially impacted structures for each volume

	Based on Hydrograph												
	Difference in Volumes (ac-ft)												
500vr	28	9 91/1	257 1	90	210	105	1	68,485	5	123,39	0	78,745	
100yr	16	3,114	127,4	34	96	5,786		52,374	4	20,63	9		
50yr	11	3,143	83,5	38	54	1,781		17,82	1				
25yr	74	4,866	47,8	375	22	2,771							
10yr	3	6,503	13,4	48		-							
5vr	14	4,164											
2vr		.,											
-1.	2yr	5y	r	1	0yr		25yr		50	/r	10	0yr	500yr
	Existin	g condition	1829	946	498	271	100	43	9	2717 6	i bool	nstances (5	0-vr)
	Exiotin	5 contactions	1023	510	150	272	100	10	5	27271	locali		<u> </u>
			Cui	mulativ	e numb	er of flo	oded s	tructure	S				
Start	Target	Vol, ac-f	500yr	100yr	50yr	25yr	10yr	5yr	2yr	Benefit	B/V	Incr. V	Incr. B
500yr	100yr	78,745	946	498	271	100	43	9	0	1638	21	78,745	1638
500yr	50yr	123,390	498	271	100	43	9	0	0	2298	19	44,645	660
500yr	25yr	168,485	271	100	43	9	0	0	0	2568	15	45,095	269
500yr	10yr	219,495	100	43	9	0	0	0	0	2671	12	51,011	103
500yr	5yr	257,190	43	9	0	0	0	0	0	2704	11	37,694	33
500yr	2yr	289,914	9	0	0	0	0	0	0	2715	9	32,724	11
100yr	50yr	20,639	1829	498	271	100	43	9	0	1462	71	20,639	1462
100yr	25yr	52,374	1829	271	100	43	9	0	0	2032	39	31,736	570
100yr	10yr 💻		1020	100			- U			2256	23	44,411	224
100yr	5yr	127,434	1829	43	9	0	0	0	0	2325	18	30,648	69
100yr	2yr	163,114	1829	9	0	0	0	0	0	2347	14	35,680	22





Flood Risk Reduction Volumes

- Comparison of Volumes to Benefits
 - Plot volumes vs. potential benefits
 - Look for point where curves start to flatten
 - Estimate preliminary target volume for the given damage center







Previously Recommended Projects

- Reviewed previous reports and master plans
 - 1943 San Jacinto River Master Plan
 - 1957 San Jacinto River Master Plan
 - 1985 Upper San Jacinto River Flood Control Study
 - 1989 South Montgomery County Flood Protection Plan
 - 1997 Lake Creek Reservoir Study
 - 2000 Lake Houston Regional Flood Protection Study
 - 2015 Cypress Creek Overflow Management Plan
 - 2019 Estimate Land Cover Effects on Selected Watersheds
 - 2019 Hurricane Harvey San Jacinto River Flooding (presentation)







Previously Recommended Projects

- Considered 34 Previously Recommended Projects
 - 1943/1957 San Jacinto River Master Plan
 - 1985 Upper San Jacinto River Flood Control Study









Watershed Mitigation Potential

- Higher Potential
 - Spring Creek (Benefits in watershed; Potential reduction downstream)
 - East Fork (Major Lake Houston contributor; Available open space)
 - Peach/Caney Creek (Available open space; Benefits in watershed)
- Moderate Potential
 - Lake Creek (Available open space; large contributing area to West Fork, Limited benefits in the Lake Creek watershed)
- Lower Potential
 - Cypress Creek (Limited open space; Other HCFD efforts; Overflow)
 - Willow Creek/Little Cypress Creek (Small contribution; Limited space)
 - Luce/Tarkington Bayou (Limited damages; Smaller contribution; Flat)
 - Jackson Bayou (Very small contribution; Downstream of Lake Houston)
 - West Fork (Limited open space; High volume; Benefits in watershed)

Flood Reduction Projects Summary









Project Information

- Approximate location
- **General Objective**
- How the project functions
- Immediate Downstream **Frequency Benefit**

The immediate downstream frequency benefit shows the incremental LOS improvement resulting from the project. The reduction listed (i.e. 100-year to 50-year) means that the 100-year flow/elevations are now close to the 50-year flow/elevations. This is consistent with the target volume determination that was presented at Workshop 2.

Project Location Map

The project location is identified by the magenta shape (Detention) or line (Channel) and includes an inset for general location.

Improvement Specifications

Provides approx. information for:

- Dam acreage (100-yr and PMF)
- Storage volume (100-year)
- Volume of Excavation (channel) or Embankment (detention)
- Dam height and length

SAN JACINTO REGIONAL WATERSHED MASTER DRAINAGE PLAN



SPRING CREEK DETENTION - Walnut Creek (DRAFT)

LOCATION: Approximately 10 miles U/S of Spring Creek on Walnut Creek

OBJECTIVE: Reduce flooding in Spring Creek

HOW IT WORKS: Captures runoff inline

IMMEDIATE DOWNSTREAM FREQUENCY BENEFIT: Incremental reduction in 100-year (Atlas 14) WSEL



IMPROVEMENT SPECIFICATIONS PROPOSED RESERVOIR

COSTS

- Design/Construction Cost \$41M
- . Environmental Cost - \$7M
- ROW Cost \$43M \$72M
- TOTAL COSTS \$91M \$120M
- 20-Year Escalation Cost \$138M-\$183M

BENEFITS

OPPORTUNTIES AND CHALLENGES POTENTIAL PARTNERS

FEMA, USACE, TXDOT, HCFCD, SJRA, MOC The Woodlands Township, City of Tomball TWDB, GLO

REQUIRED REAL ESTATE

- 39 parcels within PMF
- 30 parcels within 100-year WSEL

DESKTOP ENVIRONMENTAL MITIGATION

 5.4 acres of potential wetlands 760 linear feet of NHD streams

RELOCATIONS/RECONSTRUCTION

- 1 Utility to be relocated
- 0.19 miles of Roads (PMF)
- 0.1 miles of Roads (at 100-yr event)

Benefits

- Reduction in structures flooded and instances of flooding
- General location of improvements
- Extent of WSEL reductions > 0.5'
- Roadway improvements
- Net Present Value Benefits based on structural damage reduction
- Benefit Cost Ratio (BCR) based on 2020 estimated costs

Opportunities/Challenges Potential partners for projects

- FEMA/USACE (If BCR > 1.0)
- GLO (Areas with LMI) •
- TWDB (Potential FIF)
- Local Agencies

Real Estate (100-yr & PMF inundation)

Environmental Mitigation potential impacts to streams and wetlands at the proposed embankments.

Estimated Relocation or Reconstruction of roads and utilities.

Project Costs

- Planning level summary of the design/construction costs
- Estimated environmental mitigation for wetlands and streams
- Estimated ROW cost has been provided for 100-year and PMF scenarios (Range of costs)
- Cost escalation factor to estimate the cost for the same project in 20years.

Flood Reduction Projects Summary

Watershed	Project Type	General Location	Estimated Costs (\$M)	Present Value Benefit (\$M)	Benefit-Cost Ratio (BCR)
Spring Creek	Detention	Walnut Creek 10 miles U/S of Spring Creek	91 - 120	123	1.02 - 1.35
Spring Creek	Detention	Mill Creek 10 miles U/S of Spring Creek	96 - 126	81.6	0.65 - 0.85
Spring Creek	Detention	Birch Creek 10 miles U/S of Spring Creek	77 - 117	82.6	0.70 - 1.07
Spring Creek	Bench	I-45 to 3 miles D/S of Riley Fuzzell	81	145.3	1.79
Spring Creek	Bench	Between Gosling Road and I-45	123	82.6	0.66
Spring Creek	Bench	DC2-200 U/S of I-45	59	53	0.89
Spring Creek	Bench	DC2-500 U/S Kuykendahl Rd. to Willow Creek	142	70.3	0.49
Lake Creek	Detention	Caney Creek 0.3 miles North of SH 105	98 - 163	34	0.21 - 0.35
Lake Creek	Detention	Little Caney Creek 1.1 miles U/S of Lake Creek	98 - 128	27.6	0.22 - 0.28
Lake Creek	Detention	Garrett's Creek 0.74 miles U/S of Lake Creek	107 - 131	35.4	0.27 - 0.33
Lake Creek	Detention	Lake Creek Mainstem 0.6 miles U/S of SH105	187 - 264	61.8	0.15 - 0.22
Peach Creek	Detention	Peach 12 miles U/S of New Caney @ SH105	299 - 428	57	0.13 - 0.19
Peach Creek	Detention	Peach/Walker 19 miles U/S of New Caney	203 - 222	68	0.30 - 0.33
Peach Creek	Channel	Peach Creek D/S of I-59	180	75.9	0.42
Caney Creek	Detention	Caney Creek 1.0 miles U/S of FM 1097	104 - 131	19.8	0.15 - 0.19
Caney Creek	Detention	Caney Creek 1.9 miles U/S of SH 105	177 - 207	26.3	0.13 - 0.15
Caney Creek	Channel	Caney Creek D/S of US-69 to the East Fork	140	75.9	0.54
East Fork	Detention	Winters Bayou Nebletts 2 miles U/S Cleveland	128 - 176	39.8	0.15 - 0.20
East Fork	Detention	Winters Bayou 5 miles U/S of Cleveland	132 - 163	44.2	0.26 - 0.33
East Fork	Detention	East Fork 10 miles U/S of Cleveland near FM945	138 - 141	34.3	0.15 - 0.16
East Fork	Bench	East Fork FM 1485 to Luce Bayou	326	24.9	0.08
West Fork	Channel	West Fork from I-45 to SH 242	148	33.8	0.22
West Fork	Channel	West Fork from I-45 to 3.2 miles D/S of SH 242	179	30.3	0.15
West Fork	Channel	West Fork D/S of I-59	722	67	0.09
West Fork	Bench	West Fork D/S of I-59	818	55.6	0.07







Cost Uncertainty

- Construction Pricing
 - Construction priced vary depending on economic conditions, availability of materials, access, etc.
 - 30% Contingency included on construction unit costs
 - Utility relocation accounted for but requires more detailed information
- ROW Acquisition
 - Cost estimates assume 2.5 x Market Value for parcels
 - Assumed full parcels is acquired if > 20% inundation
 - Range of parcels considers 100-yr vs. PMF inundation limits
- Environmental
 - Actual wetlands coverage vs. NWI data
 - Mitigation via bank vs. Mitigation in place
 - Quality of wetlands and degree of aquatic resource loss









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Spring Creek

- Most Effective Projects
 - Birch Creek Detention
 - Walnut Creek Detention
 - Channel Improvements from I-45 to Riley Fuzzell
- Total Cost: \$249M \$318M
- Spring Creek WSEL Reduction (Watershed & Basin-wide)

Regional Project Reductions

1% ACE WSEL Reductions (ft)				
Walnut Det.	Birch Det.	Chl. D/S of I-45		
-0.16	-0.1	0.12		
-0.12	-0.12	-0.12		
-0.16	-0.16	-0.16		
-0.11	-0.11	-0.11		
	1% A Walnut Det. -0.16 -0.12 -0.16 -0.11	1% ACE WSEL Reduction Walnut Det. Birch Det. -0.16 -0.1 -0.12 -0.12 -0.16 -0.16 -0.11 -0.11		

Spring Creek Reductions

Spring Creek Combined	1% ACE WSEL		
Improvements	Reductions (ft)		
SH249	-2.53		
Kuykendahl	-1.96		
Gosling	-1.45		
I-45	-6.65		
Riley Fuzzell	-6.61		





Spring Creek

Instances of Structural Flooding (50-yr)					
Existing Proposed Reduction % Reduction					
6,744	2,555	4,189	62%		

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Lake Creek

- Most Effective Projects
 - Garrett's Creek Detention
 - Little Caney Creek Detention
 - Caney Creek Detention
- Total Cost: \$303M \$422M
- Lake Creek WSEL Reduction

Regional Project Reductions

Lake Creek	1% ACE WSEL Reductions (ft)				
Improvements	Garrett's Det.	Little Caney Det.	Caney		
Confluence with West Fork	-0.63	-0.58	-1.6		
West Fork I-45	-0.48	-0.44	-1.31		
West Fork SH99	-0.56	-0.56	-1.37		
West Fork I-69	-0.15	-0.16	-0.64		
Lake Houston Parkway	-0.14	-0.15	-0.39		
Lake Houston Dam	-0.09	-0.11	-0.38		

Lake Creek Reductions

Lake Creek Combined Improvements	1% ACE WSEL Reductions (ft)
SH 105	-4.5
FM 149	-3.63
Superior Road	-3.32
Splendora Ranch (Fish Crk)	-4.7







Instances of Structural Flooding (50-yr)					
Existing Proposed Reduction % Reduction					
230	73	157	68%		

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Caney Creek

Proj. No.	Project Type	General Location	Estimated Costs (\$M)	Present Value Benefit (\$M)	Benefit-Cost Ratio (BCR)	2
15	Detention	Caney Creek 1.0 miles U/S of FM 1097	104 - 131	19.8	0.15 - 0.19	
16	Detention	Caney Creek 1.9 miles U/S of SH 105	177 - 207	26.3	0.13 - 0.15	
17	Channel	Caney Creek D/S of I-69 to the East Fork	140	47	0.34	
1 11	26 2	-31 1/F-h	and a		1	

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Caney Creek

- Most Effective Projects
 - Mainstem detention upstream of SH105
 - Mainstream detention upstream of FM1097
 - Channel Improvements from US59 to East Fork Confluence
- Total Cost: \$421M \$478M
- Caney Creek WSEL Reduction (Watershed & Basin-wide)

Regional Project Reductions

Caney Creek	1% ACE WSEL Reductions (ft)				
Improvements	SH 105 Det.	FM 1097 Det.	Chl. D/S of I-69		
Confluence with Peach	-0.79	-0.37	-4.66		
Confluence with East Fork	-0.55	-0.42	-0.08		
Confluence with West Fork	-0.08	-0.05	-0.17		
West Fork I-69	-0.05	-0.02	-0.1		
Lake Houston Parkway	-0.04	-0.02	-0.15		
Lake Houston Dam	-0.01	0.00	0.01		

Caney Creek Reductions

Caney Creek Combined	1% ACE WSEL
Improvements	Reductions (ft)
SH 105	-6.94
FM 2090	-4.64
HWY 242	-2.46
I-69	-15.59
FM 1485	-12.1







Caney Creek

Instances of Structural Flooding (50-yr)					
Existing Proposed Reduction % Reduction					
2,680	997	1,683	63%		

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Incr. Existing Incr. Benefit —Cumul. Existing —Cumul. Proposed

River Mile

Peach Creek



Proj.

No.

Project

Туре

General Location

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Estimated

Costs (\$M)

Present Value

Benefit (\$M)

Benefit-Cost

Ratio (BCR)







Peach Creek

- Most Effective Projects
 - Mainstem detention upstream of SH105
 - Mainstream detention upstream of FM1097
 - Channel Improvements from US59 to East Fork Confluence
- Total Cost: \$682M \$830M
- Peach Creek WSEL Reduction (Watershed & Basin-wide)

Regional Project Reductions

Peach Creek	1% ACE WSEL Reductions (ft)		
Improvements	SH 105 Det.	Walker Det.	Chl. D/S of I-69
Confluence with Caney	-1.02	-0.56	0.02
Confluence with East Fork	0.23	0.01	0.05
Confluence with West Fork	0.13	0.06	-0.09
Lake Houston Dam	0.08	0.03	-0.08
Lake Houston Parkway	0.05	0.02	-0.04
I-69	0.00	0.00	0.00

Peach Creek Reductions

Peach Creek Combined	1% ACE WSEL	
Improvements	Reductions (ft)	
SH 105	-3.76	
FM 2090	-5.39	
169	-13.88	
Roman Forest	-10.75	
FM 1485	-1.38	







Peach Creek

Instances of Structural Flooding (50-yr)				
Existing Proposed Reduction % Reduction				
2,363	542	1,821	77%	

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East Fork SJR

- Most Effective Projects
 - Mainstem detention upstream of SH105
 - Mainstream detention upstream of FM1097
 - Channel Improvements from US59 to East Fork Confluence
- Total Cost: \$458M \$489M
- East Fork SJR WSEL Reduction (Watershed & Basin-wide)

Regional Project Reductions

East Fork	1% ACE WSEL Reductions (ft)	
Improvements	Winters Det.	Chl. D/S FM1485
Confluence with Caney	0.08	-1.67
Confluence with West Fork	-0.50	0.02
Lake Houston Dam	-0.37	0.01
Lake Houston Parkway	-0.30	0.01
I-69	0.00	0.00

East Fork Reductions

East Fork Combined	1% ACE WSEL	
Improvements	Reductions (ft)	
FM 945	-0.02	
SH 105	-2.16	
I-69	-1.96	
FM 2090	-2.39	
FM 1485	-9.74	







East Fork SJR

Instances of Structural Flooding (50-yr)				
Existing Proposed Reduction % Reduction				
1,994	1,063	931	47%	

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East Fork – Benefit Summary (50-yr Project Life)







West Fork San Jacinto

- Most Effective Projects
 - West Fork Channelization from I-45 to SH242
 - West Fork Channelization downstream of US59
- Total Cost: \$966M
- West Fork SJR WSEL Reduction (Basin-wide)

Regional Project Reductions

West Fork	1% ACE WSEL Reductions (ft)	
Improvements	Upper WF 750	Bench D/S of I-69
Confluence with West Fork	-0.17	
West Fork I-45	-3.07	
West Fork SH99	0.13	
West Fork I-69	0.05	-2.34
Lake Houston Parkway	0.05	0.06
Lake Houston Dam	0.02	0.04







West Fork SJR

Instances of Structural Flooding (50-yr)				
Existing Proposed Reduction % Reduction				
4,033	1,928	2,105	52%	

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West Fork – Benefit Summary (50-yr Project Life)



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San Jacinto Regional WMDP



Low to Moderate Income (LMI) Areas









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San Jacinto Regional WMDP

- Combined projects show increased local and regional benefits
- Current modeled combinations
 - Spring Creek: Walnut Detention, Birch Detention, I-45 to Riley Fuzzell
 - Lake Creek: Caney Detention, Little Caney Detention, Garrett's Detention
 - East Fork: Winters Detention, Lower East Fork Channel Improvements
 - Caney Creek: SH105 and FM1097 Detention, Channel D/S of I-69
 - Peach Creek: SH 105 and Walker Detention, Channel D/S of I-69
 - Full Combined Model: Ultimate Flood Reduction Improvements







San Jacinto Regional WMDP

- Plan Cost: \$3.1B \$3.5B
- Overall Plan Benefits: \$677 M
- BCR: 0.19 0.22

Watershed	Damages, Existing (\$M)	Damages, Combined Alts (\$M)	Benefit (\$M)
Spring	466.6	163.8	302.8
Willow	112.2	86.6	25.6
Cypress	213.2	211.6	1.6
Little Cypress	30.9	30.8	0.1
East Fork	101.4	56	45.5
West Fork	269.7	132.7	137
Lake Creek	10.1	3.2	6.9
Peach	113.1	27.9	85.3
Caney	135.6	63.8	71.9
Luce	14.6	14	0.5
Total	1467.4	790.4	677.2







Kingwood Area Benefits

- Highest reduction U/S of W. Lake Houston Pkwy
- Lake Houston controls lower reaches
- 58% Reduction in instances of flooding
- Most East Fork structures no longer in 100-year FP









Kingwood Area Benefits







Watershed vs. Regional Approach

Project Implementation

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Watershed Approach

- Prepare plan based on completing full watersheds
- Prioritize watersheds based on maximum regional benefit
- Spring Creek has highest benefit as a watershed

Items to consider

- Social vulnerability
- Low to Moderate Income Areas
- Metrics besides "benefits"

Input from Stakeholders: Which approach do you think is the most effective?

Consider individual projects in all

Prioritize projects based on

Identify top 5-10 projects to

Regional Approach

maximum benefit

watersheds

implement







Additional Regional Measures

- Detention Policy
 - Detention associated with local development provides critical mitigation, but the regional benefits associated with local detention are highly dependent on the location and timing of development
 - 2070 modeling indicated limited detention impact, but development was centered on the urban core lower in the basin (1-2% volume increase)
 - Ultimate development along the basin outer boundaries shows a higher increase in runoff volume (>5%); detention impact may increase
 - Detention **DOES** have an impact on local flooding issues
- Floodplain Preservation
 - Losses to floodplain storage could negatively impact downstream areas
 - Future Conditions modeling does not include floodplain fill
 - Approx. market value of all flooded structures in the 100-year ~ \$3B






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Buyouts

- Structures currently located in the 2-, 5-year floodplains may see some benefits, but will continue to flood
- Removed from the instances of flooding for damage centers
- Maintained in the BCR calculations
- Generally a higher BCR on buyouts than structural projects
- Best option may be to buyout structures in this category







Buyouts

• Summary of structures and expected damages in each watershed that flood in the 5-year event

Buyouts - Structures Flooding in 5-yr Event						
Watershed	Count	Market Value	Mkt Value * 1.25 Existing NPV 50-yr damage BC		BCR	
Spring	87	12,184,636	15,230,795	80,537,873	5.3	
Willow	43	13,197,517	16,496,896	30,707,624	1.9	
Cypress	31	12,790,373	15,987,966	55,385,994	3.5	
Little Cypress	13	2,468,448	3,085,560	11,513,834	3.7	
East Fork	34	4,083,750	5,104,688	21,596,467	4.2	
West Fork	10	1,412,655	1,765,819	6,244,840	3.5	
Lake Creek	3	519,100	648,875	2,390,871	3.7	
Peach	71	7,536,240	9,420,300	44,668,723	4.7	
Caney	82	7,288,986	9,111,233	56,872,257	6.2	
Luce	5	583,203	729,004	2,845,449	3.9	
Tarkington	60	6,657,070	8,321,338	45,279,121	5.4	
Jackson Bayou	2	518,533	648,166	1,529,131	2.4	
Gum Gully	1	211,015	263,769	1,514,652	5.7	
	442	69,451,526	86,814,408	361,086,836	4.2	

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Project Metrics

Metrics from Scope of Work:

- Reduction in structural flooding
- Project Cost
- Design Life
- Maintenance
- Feasibility
- Constructability
- Public Benefit
- Public Safety
- Multi-function
- Environmental Constraints

Other Metrics to Consider:

- Social Vulnerability
- Low to Moderate Income
- Reduction in road flooding
- Community/Agency favor
- Erosion Control
- Impact to water quality
- Implementation schedule

Input from Stakeholders: Is there anything missing? Which are preferred?





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Birthplace of the Tust

Project Metrics

Recommended Metrics and Weight

Reduction in Structural Flooding	25%
Project Cost	20%
Funding potential	10%
Long Term Maintenance	10%
Constructability	15%
Transportation Improvement	10%
Erosion Control	5%
Implementation Schedule	5%

Input from Stakeholders: Is weighting appropriate? Other items to use in prioritization?

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Implementation Planning

- Identify projects to be included in MDP
- Finalize modeling of individual selected projects
- Prioritize projects (Watershed or Regional Approach)
 - Select and weight metrics based on study partner input
 - Update project costs and benefits
 - Gather information on the selected metrics
 - Perform project prioritization
- Develop project phasing plan based on priority
 - Model projects cumulatively (i.e. Project 1, Project 1 & 2,...All projects) to ensure no negative impacts
 - Update environmental and cultural data, update utility information, ROW
 - Identify potential funding sources depending on criteria (BCR, LMI, etc.)
- Move forward with Feasibility, Preliminary Engineering, Design





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Study Deliverables Schedule

- Preliminary Mitigation Planning Memo (June 8th)
- Draft Report (July 13th)
- Final Report (August 31st)



SAN JACINTO RIVER QUESTIONS?

Primary Alternatives Workshop April 27, 2020 - DRAFT

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ALTERNATIVES WORKSHOP MINUTES

То:	Jing Chen, P.E., CFM	Attendees:	See attached list
From:	Terry Barr, P.E., CFM		
Subject:	Upper San Jacinto River Regional Flood Mitigation Plan – Alternatives Workshop No. 3		
Meeting Date:	04/27/2020 – 1:00 pm		
Location:	WebEx Conference Call		
Minutes Date:	05/05/2020		
AVO No.:	033465.002		

Item	Description	Action
1.	Introductions, Agenda, Purpose	
	Mr. Barr introduced the study team and began the meeting.	
2.	Workshop Goals	
	Mr. Barr presented the workshop goals.	
	 Present primary mitigation planning results and receive feedback on projects, combinations, and metrics Recap damage center identification and target volumes Present flood reduction alternatives (Location, configuration, costs, benefits, constraints) Identify effective alternatives and potential combinations Discuss metrics and the path toward project prioritization 	
3.	Existing Conditions Modeling Recap	
	Mr. Barr presented the existing conditions modeling recap which included an analysis of historical storms. The team developed a comprehensive model of the San Jacinto River basin, which included updated hydrologic and hydraulic models for streams outside of HCFCD jurisdiction. For those streams with HCFCD M3 models, minor modifications were made to account for development since the model adoption. The HEC-HMS models were updated to include Atlas 14 Volume 11 rainfall and to incorporate the Basin Development Factor (BDF) methodology for non- M3 models. All HEC-RAS models were converted to unsteady in order to account for volume and timing.	
	Model Calibration	
	(2017) and Memorial Day (2016). Gage Adjusted Radar Rainfall (GARR) data was run in the USGS and HCFCD gage information was used as a	

	basis for comparison to the modeled data. Adjustments were made to the hydrologic and hydraulic model to bring the modeled stages, flows, and volumes within the acceptable tolerances. More detailed information is available in the Calibration memorandum submitted to HCFCD in April 2020	
4.	Alternatives Evaluation Recap	
	Mr. Barr presented the alternatives evaluation recap which included damage centers, flood risk reduction volumes, previously recommended projects, and watershed mitigation potential.	
	Damage Center Identification Mr. Barr provided an overview of the damage center identification process, which utilized the HCFCD Structural Inventory tool to identify flooded structures for a range of frequency rainfall events. Based on a combination of structures flooded and the frequency of expected flooding, the study team calculated the "instances of flooding" expected for each river mile on each major stream. Using this information, the team identified several "damage centers". These centers were used to guide where expected damages were the highest and where projects should potentially be located to achieve maximum benefit. Major damage centers were identified along Spring Creek, Peach Creek, Caney Creek, East Fork and West Fork SJR.	
	Flood Reduction Target Volumes	
	Rather than focus on arbitrarily setting a target frequency for reduction, the study teams approach looked at a range of volume targets for level of service (LOS) increases (i.e. how much detention volume would it take to lower 100-year flows to 10-year flows, etc.) This was run for the full complement of storms from the 2- to 500-year events. Using this information, the team determined the reduction in instances of flooding (benefits) associated with each volume. The volume and benefits were plotted and used to determine the target volume that provides the most relative benefit before a point of diminishing returns was reached and additional volume provided minimal increase in benefits. Once these target volumes were determined, the team started to look at projects.	
	Previously Recommended Projects	
	Per the study scope, the team considered projects that were recommended in previous reports. Mr. Barr explained that the team looked at numerous documents that had been prepared dating back to 1943, which recommended a variety of projects. In particular, the 1943 and 1957 San Jacinto River Master Plans (they were nearly identical in recommendations), as well as the 1985 Upper San Jacinto River Flood Control Study, provided numerous projects for consideration. The study team evaluated the efficacy of 34 projects in those studies. Many of them are infeasible due to current development or other factors, including the fact that many more propagad as water any hypersection with a limited	

	amount of flood reduction benefit. Several of the larger reservoirs, including locations on Lake Creek, East Fork, Peach Creek and Caney Creek were included with some modifications to the size and configuration. Several additional alternatives were evaluated, including channel conveyance improvements and other detention locations.	
	Mr. Bezemek asked if there was any consideration of coupling water supply with the proposed detention basins as was done with several of the projects in the older studies. The addition of water supply to the projects could provide additional funding opportunities and benefits. Mr. Stull stated that there may be limited potential for a dual use reservoir, but that it was not included in the alternatives modeling – volume can generally be used for detention or water supply purposes, but not both.	
	Watershed Mitigation Potential	
	Mr. Barr briefly discussed the findings of the high-level analysis of each watershed. Based on a qualitative evaluation of volume in each of the watersheds, the team determined which watersheds show the most potential for providing benefits, but within their respective watersheds and further downstream. The watersheds with the highest mitigation potential included Spring Creek, East Fork SJR, Peach Creek, and Caney Creek. Lake Creek provided moderate potential, but it contributes a significant portion of the total West Fork drainage area.	
	Several of the watersheds were classified as having lower mitigation potential and were not considered for flood reduction projects. Willow Creek and Little Cypress Creek did not have a large enough contributing area to have a significant impact on the downstream flooding. Luce/Tarkington Bayous had very limited damages and provided a smaller contribution to the overall watershed. Jackson Bayou is very small and confluences with the San Jacinto River downstream of Lake Houston, making it impossible to address flooding issues upstream of the Lake. Cypress Creek is a significant contributor; however, there are other planning efforts being considered, there is limited open space downstream of the overflow, and efforts upstream of the overflow would not have an impact on flood conditions downstream.	
5.	Flood Reduction Projects Summary	
	Mr. Barr presented the flood reduction projects summary. The proposed projects are located throughout the basin along the 6 streams identified for potential improvements (Spring, Lake, West Fork, East Fork, Peach, Caney) and include both channel conveyance improvements and detention projects. Mr. Barr included an overview of the Project Fact Sheet, which includes the following information for each project:	
	 General project information Project location map Project specifications Cost breakdown 	

- Opportunities/Challenges/Potential Partners
- Project Benefits

Mr. Barr discussed some of the factors that create potential cost uncertainties for the projects discussed. Among these uncertainties were construction pricing changes, ROW acquisition needs and cost multiplier above current market value, and environmental impacts, permitting, and mitigation. In particular, the current ROW acquisition multiplier of 2.5 could be considered too conservative and may be reduced with input from HCFCD ROW acquisition staff. There were several questions relating to the fact sheets and cost uncertainty that were discussed, which related to the ROW needs.

Mr. Barr reiterated that the costs/benefits were still preliminary and subject to change as the configurations, costs, and benefits were refined.

Mr. Barr opened a discussion for feedback regarding ROW acquisition. Ms. Green asked to clarify the distinction between 100-YR and PMF cost estimates. Mr. Barr explained that this provides a cost range and a buffer for how much property might need to be acquired. Mr. Hannan asked to keep the range for future entities to make decisions.

Mr. Bezemek asked who the owner of these projects would be, would it be a current stakeholder or a new entity. Furthermore, Mr. Bezemek asked how maintenance would occur and who would be responsible. Mr. Barr explained the need to consider who could potentially own each project. Mr. Bezemek asked if maintenance is included in the benefit cost for BCR. Mr. Barr explained that the BCR does not include maintenance at this time. As implementation planning is started and the cost estimates are updated, it would be considered.

Ms. Green asked about the berm elevations and whether they were designed for the 100-year, PMF or something else. Mr. Barr explained that the berm elevations were set such that the 100-year elevation was below the spillway and was controlled by the primary outfall. Flow above the 100-year event would outfall via a spillway, up to and including the PMF. This was done with TCEQ dam permitting in mind, as it will require the structure to pass the PMF. Ms. Green asked if the detention basins include freeboard. Mr. Olmos explained that freeboard was considered and, in many cases, the PMF freeboard was 3-3.5 ft to top of dam to account for wave run-up. Ms. Green mentioned that USACE released guidance related to reservoirs and may include information about ROW and easements.

With respect to the discussion of buying property up to the 100-year elevation vs. the PMF, Ms. Green asked about the possibility of an easement outside of the 100-year elevation properties as a potential cost savings measure. Mr. Bezemek said that purchasing easement to restrict development, would be a possibility, but would likely still cost 90% of the property value, so there may not be much in the way of cost savings.

6.	 Spring Creek Mr. Barr discussed project details for the Spring Creek watershed. Out of 4 total projects evaluated, 3 were considered most effective: Birch Creek Detention Walnut Creek Detention Channel Improvements from I-45 to Riley Fuzzell The estimated total cost of the projects ranged from \$249M - \$318M. The total cumulative benefits within the Spring Creek watershed are approximately \$300M. 	
7.	 Lake Creek Mr. Barr discussed project details for the Lake Creek watershed. Out of 7 total projects evaluated, 3 were considered most effective: Garrett's Creek Detention Little Caney Creek Detention Caney Creek Detention The estimated total cost of the projects ranged from \$303M - \$422M. The total cumulative benefits within the Lake Creek watershed are approximately \$7M, with most of the benefits accruing in the West Fork watershed downstream. 	
8.	 Caney Creek Mr. Barr discussed project details for the Caney Creek watershed. Out of 3 total projects evaluated, 3 were considered most effective: Caney Creek Detention at FM1097 Caney Creek Detention at SH105 Channel Improvements D/S of US59 to East Fork Confluence The estimated total cost of the projects ranged from \$421M - \$478M. The total cumulative benefits within the Caney Creek watershed are approximately \$75M. 	
9.	 Peach Creek Mr. Barr discussed project details for the Peach Creek watershed. Out of 3 total projects evaluated, 3 were considered most effective: Peach Creek Detention at SH105 Peach Creek Detention at Walker Creek U/S of New Caney Channel Improvements D/S of US59 The estimated total cost of the projects ranged from \$682M - \$830M. The total cumulative benefits within the Caney Creek watershed are approximately \$84M. 	
10.	East Fork San Jacinto	

	 Mr. Barr discussed project details for the East Fork of San Jacinto watershed. Out of 4 total projects evaluated, 2 were considered most effective: Winters Bayou U/S of Cleveland Channel Improvements D/S of FM1485 to Luce Bayou Confluence The estimated total cost of the projects ranged from \$458M - \$489M. The total cumulative benefits within the East Fork watershed are approximately \$55M. 	
11.	West Fork San Jacinto	
	Mr. Barr discussed project details for the West Fork of San Jacinto watershed. Out of 4 total projects evaluated, 2 were considered most effective:	
	 Channel Improvements from I-45 to FM242 Channel Improvements D/S of US59 	
	The estimated total cost of the projects is \$966M. The total cumulative benefits within the East Fork watershed are approximately \$145M.	
12.	San Jacinto Regional WMDP	
	Mr. Barr presented an overview of San Jacinto Regional WMDP. The overall map indicated that the "most effective" projects were located throughout the basin and included both channel improvement and detention projects. Mr. Barr also presented information about the project coverage as compared to the Low to Moderate Income (LMI) areas. Several of the projects on the east side of the basin (Peach, Caney, East Fork) have the potential to benefit LMI areas, which may make them eligible for CDBG funding through the GLO.	
	Project Combinations and Cost	
	Mr. Barr briefly discussed the combinations of projects, indicating that project combinations had been modeled for each of the watersheds as well as an overall combined model for all the proposed projects. He indicated that additional combinations can be considered once the projects are selected. Mr. Barr presented the total estimated project costs, which range between approximately \$3.1B and \$3.5B, depending on the ROW and environmental factors. Mr. Barr reiterated that these costs will be refined as the team moves into the implementation stage.	
	Kingwood Area Benefits	
	Mr. Barr discussed the potential benefits of projects in the Kingwood area specifically, which include a 58% decrease in the instances of flooding. There is a nearly 70% decrease in the number of structures at risk from flooding during a 100-year event and more than 80% reduction for flooding during less frequent events. It was noted that Lake Houston controls the water surface elevations (WSE) below Lake Houston Parkway, limiting the potential WSE reductions in that area unless the	

lake elevation is reduced. This study does not include an investigation of options to reduce Lake Houston WSE.	
Watershed vs. Regional Approach	
Mr. Hinojosa presented two potential approaches for moving forward with the MDP, one which focused on prioritizing watersheds and completing all projects in a watershed before moving to the next priority watershed. In the case of this study, Spring Creek provided the most overall benefit. The second option looked at each project on its own and prioritizing projects based on metrics, independent of the watershed in which it is located. While the highest BCR projects were in Spring, other projects can provide significant benefit, even if their BCR is lower. In most cases, the lower BCR is a function of limited development, particularly on the east side of the basin. Mr. Hinojosa solicited input from the group regarding the watershed vs. regional approaches.	
Mr. Barrett explained that the funding source and potential partners would be a significant factor in driving the projects and implementation and that a regional approach would provide the most variety of partnerships. He asked if the team had considered evaluating the combined project costs and benefits similar to the target volume determination, using the point of inflection to identify the most cost- beneficial path forward. Mr. Barrett suggested that if funding cannot be secured for an entire project, it would help to research to see if funding is available for a portion of a project.	
Mr. Stull recommended having "anchor" projects which have the most advantageous BCR and adding smaller project for LMI areas or other areas as funding permits. Ms. Green preferred the approach of identifying funding first and determining the first few projects that will provide the most benefit. She suggested that developing a roadmap for the communities for the future of the region would be a good approach. Furthermore, Ms. Green explained that securing funding for the watershed approach may pose a challenge. Mr. Eaton agreed that a regional approach makes the most sense and that the team needs to consider cumulative benefits when selecting the projects to be implemented. The general consensus among the group was that the regional approach is the best option.	
Additional Regional Measures	TT 1001 1
Mr. Barr discussed additional regional flood mitigation measures, which included evaluating detention policy for jurisdictions in the San Jacinto basin and the possibility of flood preservation policies. Need to determine what is the combination of buyouts plus structural measures.	Halff look at combinations of alternatives with buyouts
Buyouts	
Ms. Green asked if the structures that flood during the 2-YR and 5-YR were scattered or located in close proximity (clustered). Mr. Johnston explained that there are some clusters of structures, but they are generally spread out. Ms. Green explained that it is most cost effective	

	for buyouts to be clustered and reduces the impact buyouts have on communities. Intermittently purchasing properties can degrade the character of a neighborhood. Ms. Green and Mr. Maske asked if RL/SRL information is available for the buyout structures. Mr. Johnston explained that information regarding the structures can be reviewed. Mr. Barr mentioned that the structures are available for Harris County but need to be confirmed. <i>FEMA Mapping vs. Updated with Atlas 14</i> Mr. Bezemek asked if there are any comparisons to the current FEMA maps. Filling in the Atlas 14 floodplain could affect results if the maps are not updated or adopted based on the new information. A key first step would be to update the floodplain mapping based on the Atlas 14 models. It is important that the mapping information in potential buyout areas is up to date so that there is a good sense of actual at-risk properties. Ms. Chen mentioned that HCFCD could facilitate a workshop to help communities navigate the FEMA mapping process. Mr. Hannan explained that a positive outcome of the San Jac study would be adopting the modeling as "best available".	Halff compare repetitive loss structures to modeling data and determine if they are benefitting from the proposed projects. HCFCD reach out to surrounding counties to offer assistance.
13.	Implementation	
	Potential Ranking Metrics	
	A discussion regarding the project metrics was opened by Mr. Barr, who provided a list of potential considerations. These included costs, benefits, maintenance, constructability, among others. Additional metrics, such as social vulnerability, low to moderate income area benefits, and reductions in road flooding were also included. Mr. Bezemek asked how the outlined project metrics compared with FEMA metrics. The team should consider aligning project metrics with FEMA metrics to determine if eligible for FEMA funded opportunities.	Halff update metrics to include O&M include O&M in project costs
	Mr. Barrett explained that funding potential, maintenance, and which agency will lead the project are important considerations. The viability of operations and maintenance would largely depend on which jurisdiction is responsible.	
	Mr. Bezemek commented that the Harris County watershed planning studies have focused recent studies on areas with the worst flooding. This includes weighting structures with roads based on historical flooding. Considerations would include constructability and primary damages. Once the areas are identified, then consider other metrics as this would help to focus improvements in areas of historical flooding.	
	Ms. Chen commented that erosion control and channel damage weights should be higher for watersheds that contribute more erosion to Lake Houston. Considerations could include how the structural improvements would tie in with the sedimentation recommendations to reduce sedimentation into Lake Houston.	Halff consider how erosion and sedimentation could be added to the project weight

	Mr. Bezemek commented that different sources of funding may require different metrics and weights. Selecting hard numbers and ranking	
	metrics may limit funding opportunities. Current rankings may not	
	include future grant funding depending on the language. May need to	
	sources. Mr. Barr replied that projects need to be prioritized with	Halff look at
	funding sources and availability in mind. Mr. Barrett suggested two sets	potential funding
	of criteria to rank the projects, reductions in structural flooding and then	options for the
	everything else. Mr. Eaton explained that funding potential may need to	recommended
	be a secondary consideration as funding availability and sources can change over the years. Ranking a small set of metrics first may provide	projects
	more flexibility. Mr. Olmos suggested incorporating rankings for	
	projects based on LMI area, areas of improvement, and inclusion of	
	multiple jurisdictions which could improve possibility for funding. Mr.	
	Barrett explained that LMI and multi-jurisdictional areas are funding criteria for several sources including the TWDB FIF. Ms. Chen said	
	TxDOT may have new bridges constructed on some of the roadways,	
	which could tie into some of the proposed flood reduction projects.	
	Implementation Planning	
	Mr. Barr presented the implantation planning details including steps:	
	• Identify projects to be included in the MDP	
	• Finalize modeling of the individual projects	
	 Prioritize projects Develop project phasing plan 	
	 Move forward with feasibility, preliminary engineering, design 	
	Ms. Chen explained that HCECD that can provide high level	HCFCD reach out
	presentation to the study partners in June if they are interested. Ms.	to study partners
	Green reminded the group that while the project costs appear daunting,	to offer briefings
	the data developed as part of the analysis provides very helpful	
	information including mapping, models, identification of hazards, etc.	
14.	Study Deliverables Schedule	
	• Preliminary Mitigation Planning Memo (June 8 th)	
	• Draft Report (July 13 th)	
	• Final Report (August 31st)	
15.	Closing Remarks and Questions	
	The workshop was adjourned.	
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This concludes the Meeting Minutes. Our goal is to provide a complete and accurate summary of the proceedings of the subject meeting in these minutes. If you feel that any of the items listed above are not correct, or that any information is missing or incomplete, please contact Halff Associates so that the matter can be resolved, and a correction issued if necessary. These minutes will be assumed to be correct and accepted if we do not hear from you within ten (10) calendar days from your receipt.



PRIMARY MITIGATION PLANNING WORKSHOP

HCFCD, City of Houston, Montgomery County, SJRA

April 27, 2020



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