

A map of Fort Bend County, Texas, showing the watershed boundaries. The map is overlaid on a dark blue background. The text is in a gold, serif font.

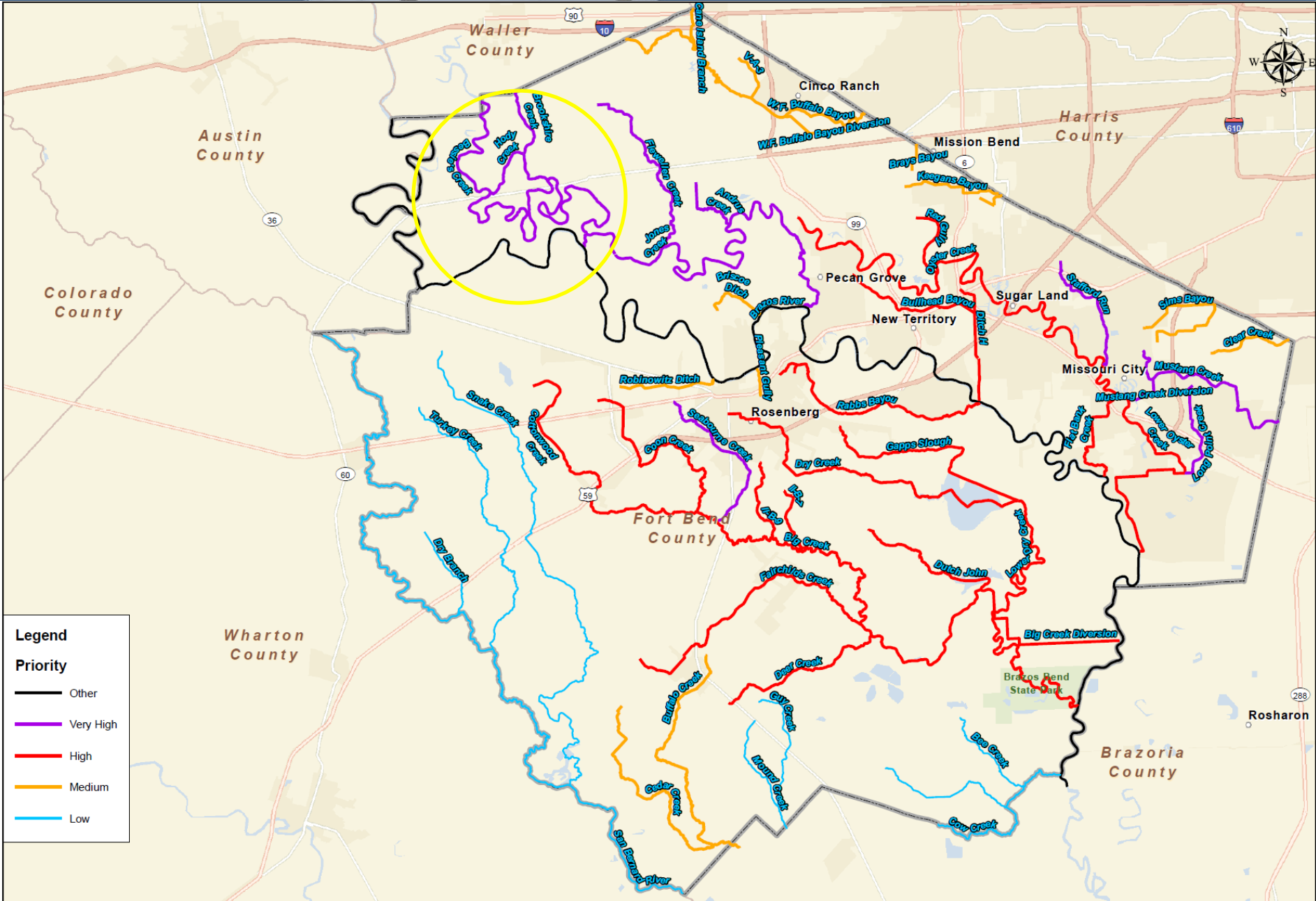
FORT BEND COUNTY WATERSHED STUDY

Bessie's Creek Watershed

Mark Vogler

June 2, 2020

Develop and Update Master Drainage Plans



Overview

- ▣ Based on the draft result of Bessie's Creek study submittal (May 1, 2020)
- ▣ Study consultant: Freese & Nichols, Inc.
- ▣ Hydrology – HEC-HMS 4.3
- ▣ Hydraulic – HRC-RAS 5.07
 - 1D 2D unsteady –flow

MASTER DRAINAGE PLAN FOR FORT BEND COUNTY, TEXAS

Bessie's Creek

May 1, 2020

Prepared for:

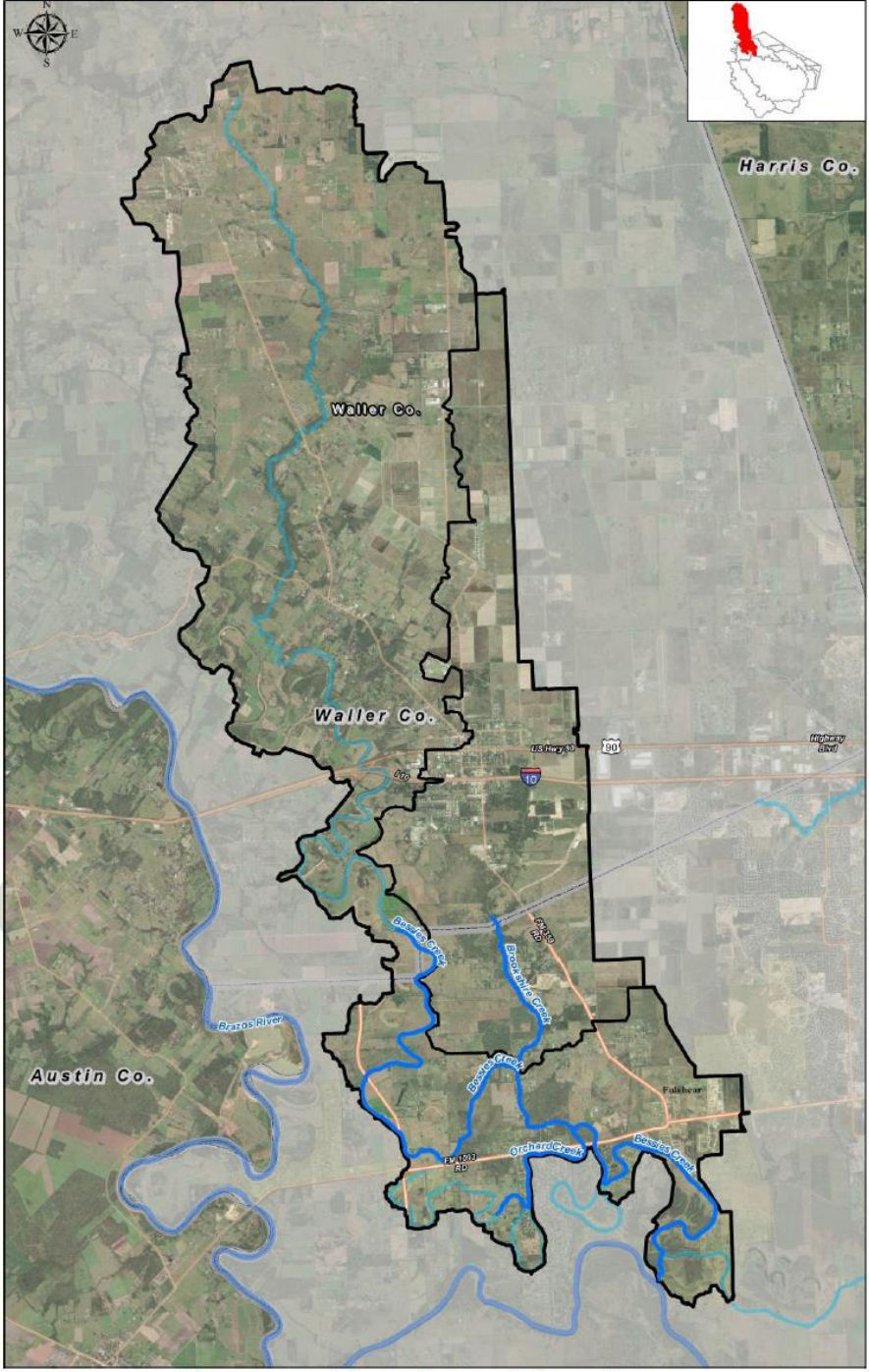
Fort Bend County Drainage District



Prepared by:



FREESE AND NICHOLS, INC.
10497 Town and Country Way, Suite 500
Houston, Texas 77024
713-600-6800



Overview

- ❑ Watershed 106 square miles (29 sqmi in Fort Bend County, 77 sqmi in Waller county)
- ❑ Approximately 18.72 miles long with 6.52 miles of tributaries
- ❑ Study to evaluate existing conditions and future channel sizing for 100yr flow
- ❑ Atlas Rainfall 2-yr, 5-yr, 10-yr, 25-yr, 50-yr, 100-yr and 500-yr storms
- ❑ 1D reaches and 2D area hydraulic model to evaluate the water surface elevation and floodplain
- ❑ NAVD 88

Table 8. Existing Conditions Results at Key Locations

Stream	Location	100-Year		500-Year	
		WSEL*	Flow**	WSEL*	Flow**
		(ft)	(cfs)	(ft)	(cfs)
Bessie's Creek	Fort Bend County Line	115.16	5,866	115.70	7,763
	US Hunt Rd. Bridge	114.83	5,262	115.16	5,806
	DS Hunt Rd. Bridge	114.79	5,262	115.13	5,806
	US Dam 4	114.77	5,262	115.11	5,796
	DS Dam 4	114.52	5,262	114.84	5,796
	US FM 1489 Rd. Bridge (North)	114.33	5,036	114.67	5,441
	DS FM 1489 Rd. Bridge (North)	114.00	5,036	114.70	5,441
	US Dam 3	113.98	5,036	114.69	5,441
	DS Dam 3	113.71	5,036	114.43	5,441
	US FM 1489 Rd. Bridge (South)	113.61	5,110	114.30	6,194
	DS FM 1489 Rd. Bridge (South)	113.58	5,110	114.26	6,194
	US Dam 2	113.44	5,077	114.11	5,963
	DS Dam 2	113.14	5,077	113.81	5,963
	US Private Crossing 7	110.73	5,240	112.45	6,167
	DS Private Crossing 7	110.73	5,240	112.45	6,167
	DS Brookshire Creek Confluence	110.43	9,990	112.22	13,911
	Bessies Creek Choke Point	109.56	9,633	111.51	13,427
	US FM 1093 Bridge	104.70	9,802	107.69	13,400
	DS FM 1093 Bridge	104.47	9,802	107.33	13,400
	Oxbow	101.88	9,805	104.91	13,474
	US James Ln Bridge	99.35	9,813	102.76	13,467
	DS James Ln Bridge	98.71	9,813	102.19	13,467
	US Fulshear Trace Bridge	96.39	9,851	100.14	13,525
	DS Fulshear Trace Bridge	96.47	9,851	100.24	13,525
	Brazos River	89.73	10,146	94.13	14,055

Existing Conditions Hydrology Results at Key Locations

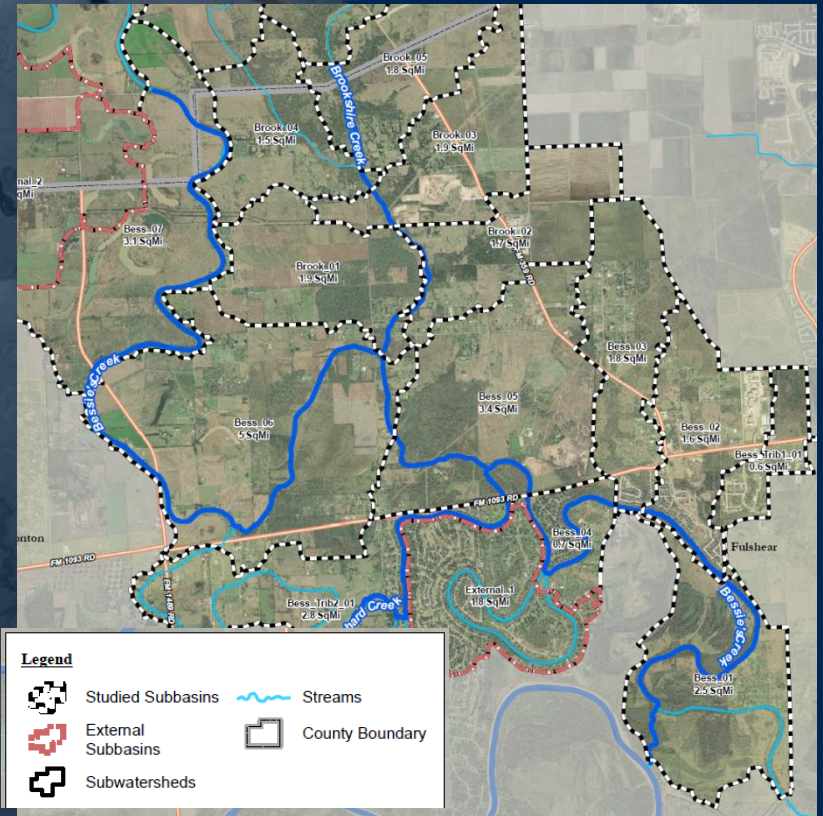
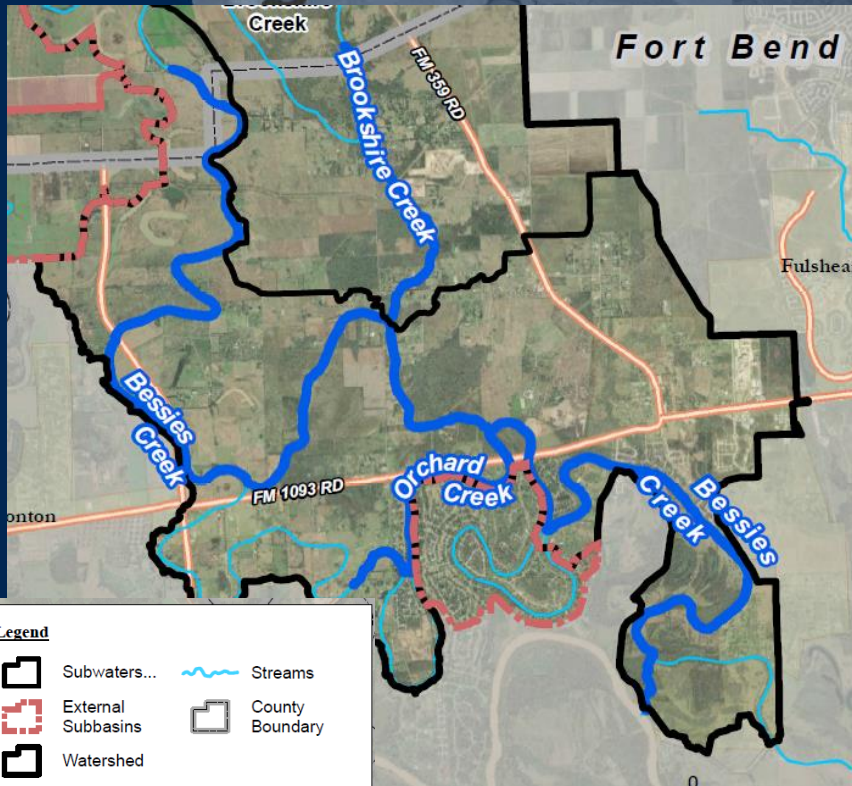
Stream	Location	100-Year		500-Year	
		WSEL*	Flow**	WSEL*	Flow**
		(ft)	(cfs)	(ft)	(cfs)
Brookshire Creek	Fort Bend County Line	117.33	4,592	118.35	6,876
	US Pecan Hill Rd. Bridge	114.77	4,493	115.78	6,765
	DS Pecan Hill Rd. Bridge	114.36	4,496	115.29	6,765
	US Pool Hill Rd. Bridge	113.93	6,858	114.84	10,955
	DS Pool Hill Rd. Bridge	113.05	6,858	114.03	10,955
	US Hunt Rd. Bridge	111.99	7,401	113.28	11,812
	DS Hunt Rd. Bridge	111.50	7,401	112.98	11,812
	US Rogers Rd. Bridge	110.83	7,124	112.63	10,970
	DS Rogers Rd. Bridge	110.74	7,124	112.55	10,970
	Orchard Creek	US Bowser Rd. Culvert	107.44	363	109.65
DS Bowser Rd. Culvert		106.71	363	109.60	747
US Waltham Rd. Culvert		106.43	233	109.42	-718
DS Waltham Rd. Culvert		106.43	233	109.43	-718
US Weston Rd. Culvert		106.43	280	109.43	-724
DS Weston Rd. Culvert		106.42	280	109.43	-724
US Bessie's Creek Confluence		106.40	409	109.31	1,472

*Water surface elevations reported are from HEC-RAS cross sections

**Flows determined from profiles lines in RAS Mapper drawn across the HEC-RAS 1D/2D model extents

**Negative flows indicate water flowing from downstream to upstream

Bessie's Creek Watershed



Hydrology Parameter – Atlas 14 Rainfall

Table 1. Rainfall Distribution used in this Drainage Master Plan (Fort Bend County)

Duration	Rainfall Depth (in)						
	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr	500 yr
5 min	0.59	0.73	0.84	1.00	1.13	1.26	1.57
15 min	1.19	1.46	1.69	2.00	2.25	2.50	3.11
1 hr	2.26	2.78	3.22	3.83	4.30	4.80	6.20
2 hr	2.83	3.53	4.19	5.16	5.99	6.91	9.45
3 hr	3.17	4.00	4.82	6.08	7.19	8.47	12.00
6 hr	3.77	4.86	5.97	7.72	9.33	11.20	16.30
12 hr	4.40	5.79	7.20	9.41	11.40	13.80	20.50
1 day	5.09	6.82	8.55	11.20	13.70	16.50	24.50

Table 2. Rainfall Distribution used in this Drainage Master Plan (Waller County)

Duration	Rainfall Depth (in)						
	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr	500 yr
5 min	0.56	0.69	0.80	0.94	1.05	1.16	1.43
15 min	1.13	1.38	1.59	1.87	2.08	2.29	2.82
1 hr	2.13	2.61	3.00	3.54	3.94	4.36	5.58
2 hr	2.65	3.33	3.93	4.78	5.45	6.20	8.52
3 hr	2.96	3.79	4.53	5.64	6.54	7.57	10.80
6 hr	3.51	4.59	5.62	7.18	8.51	10.10	14.80
12 hr	4.09	5.42	6.73	8.76	10.50	12.60	18.70
1 day	4.72	6.32	7.93	10.50	12.80	15.40	22.40

Hydrology Parameter

▣ Loss Method - Green Ampt

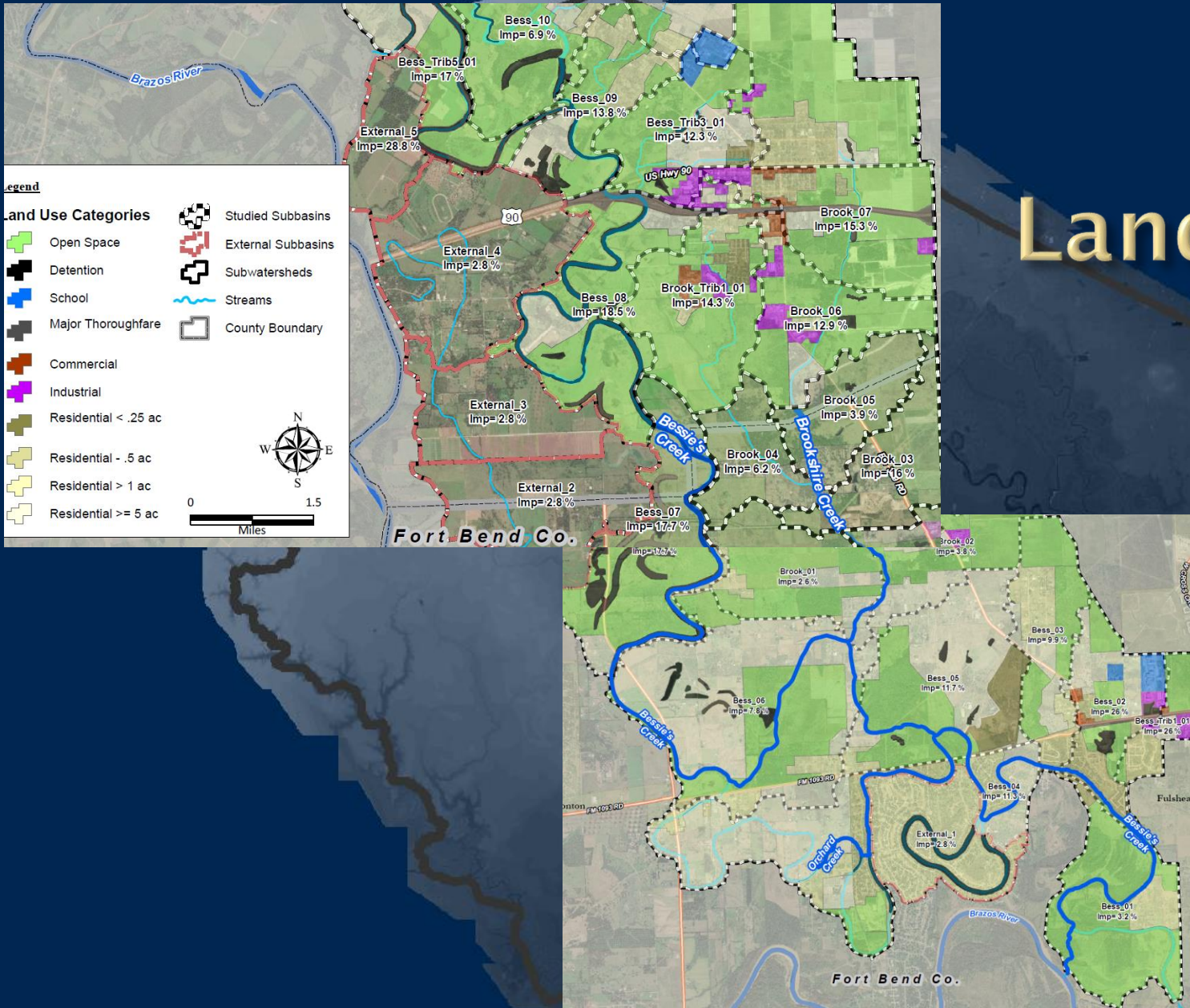
Table 3. Green and Ampt Loss Parameters Developed for Fort Bend County

Zone	Initial Canopy Storage (%)	Max Canopy Storage (in)	Crop Coefficient	Initial Loss (in)	Saturated Content	Suction (in)	Hydraulic Connectivity (in/hr)
Zone 1	0	0.1	1	0.075	0.46	12.45	0.024

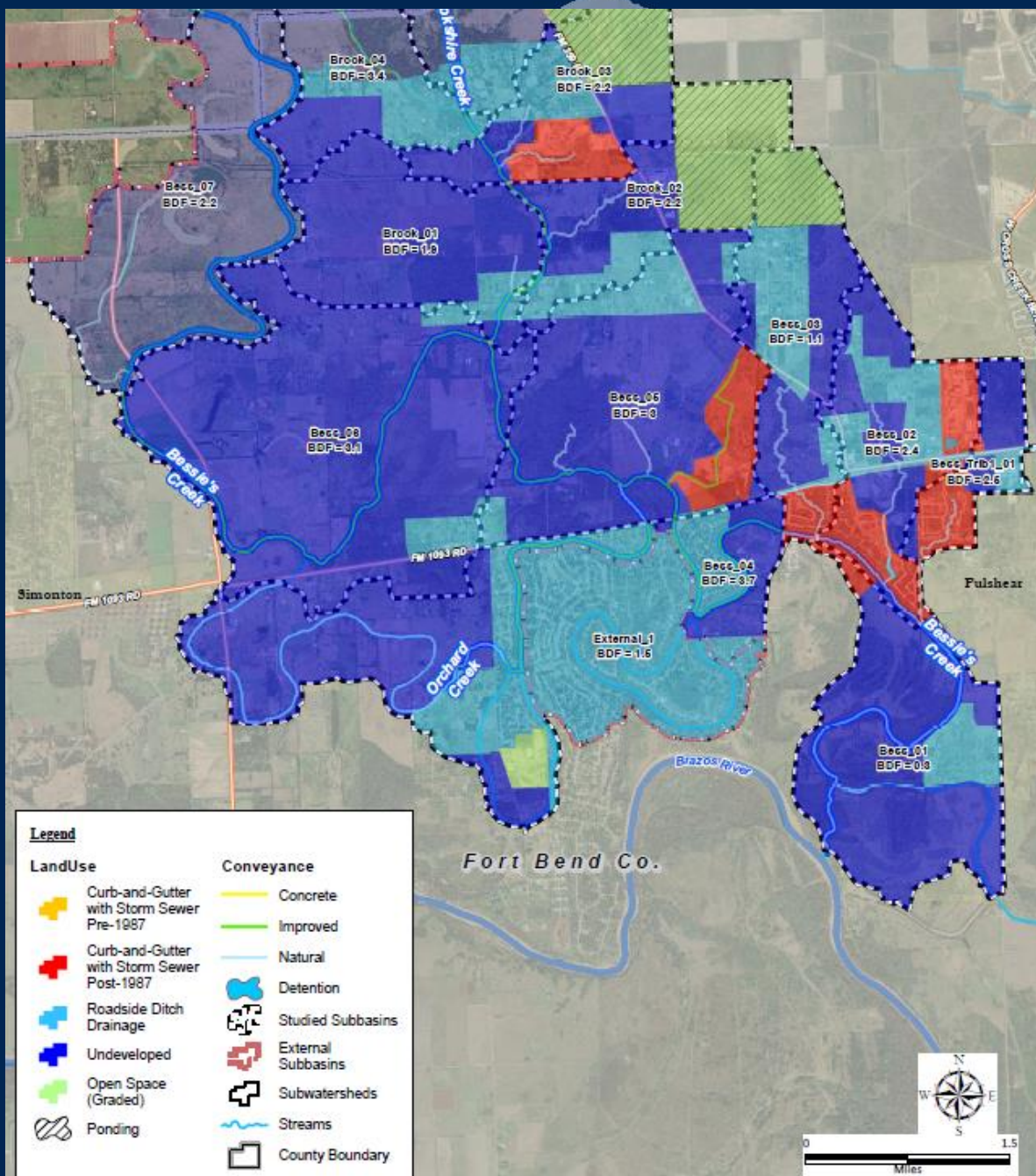
▣ Transform Methods

- ▣ Basin Development Factor (BDF) method to determine the Clark Unit Hydrograph parameters

Land use



BDF Calculations



Hydraulic Parameter 2-D Roughness Coefficients

Table 5. 2D Manning's n Values

Land Use	Manning's n Values
Default value	0.06
Barren Land	0.20
Cultivated Crops	0.17
Forest	0.25
Low Intensity	0.16
Medium Intensity	0.18
High Intensity	0.03
Open Space	0.06
Open Water	0.01
Pasture	0.22
Wetlands	0.08

Table 6. Manning's n Value Override Regions

Region	Manning's n Values
Region 1	0.04
Brookshire Wetland	0.08
Orchard Wetland	0.065
Orchard Wetland 2	0.065
Orchard Wetland 3	0.06
Channel 1	0.065
Oxbow	0.08
Oxbow 2	0.08
Lake	0.01
Lake 2	0.02
Twinwood Wetland	0.08
Twinwood Wetland 2	0.08
Fence	0.3

Analysis Results

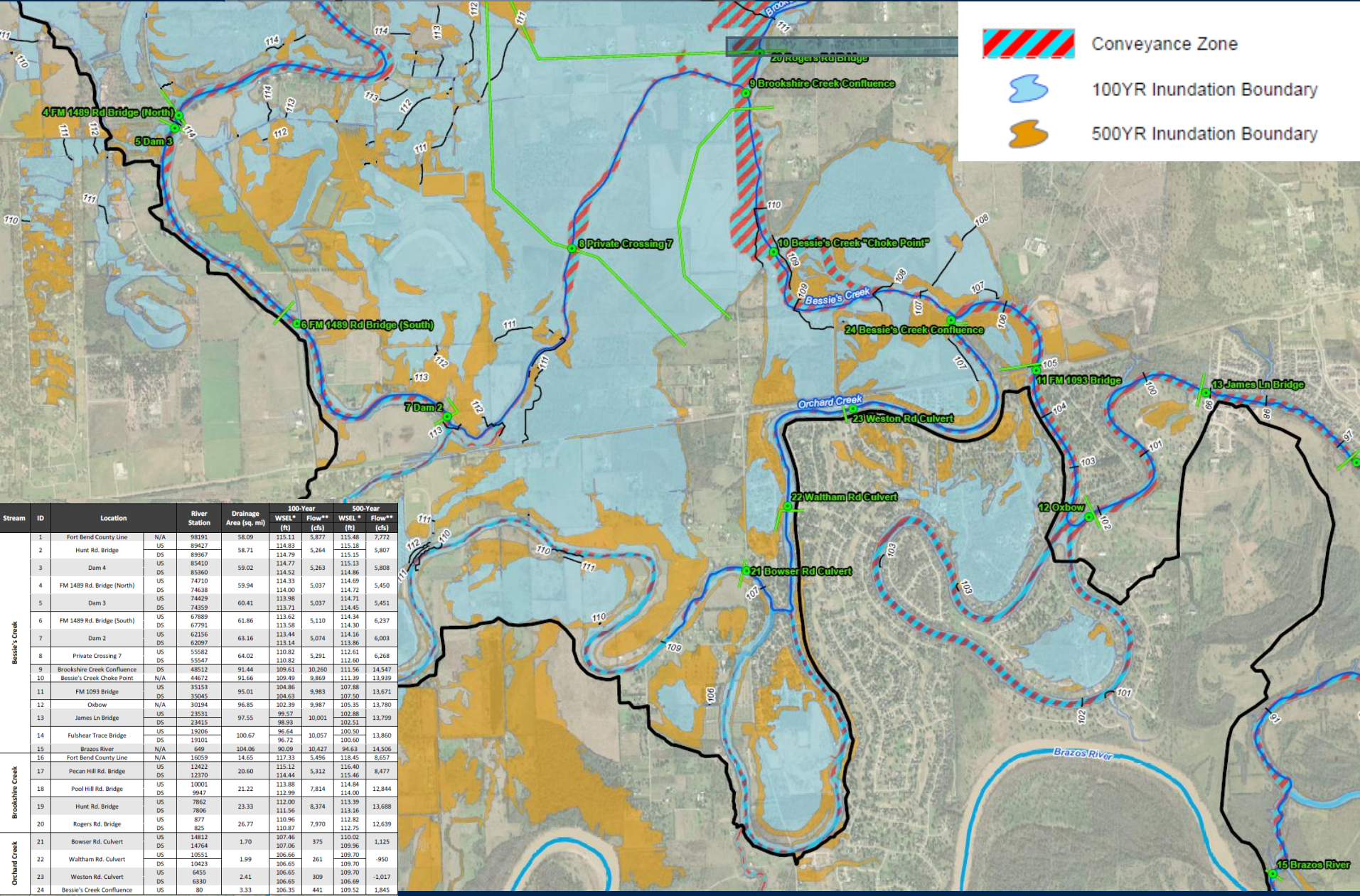
Table 9. Existing Conditions Results at Key Locations




Stream	ID	Location	River Station	Drainage Area* (sq.mi)	2-Year		5-Year		10-Year		25-Year		50-Year		100-Year		500-Year		
					WSEL* (ft)	Flow** (cfs)	WSEL* (ft)	Flow** (cfs)	WSEL* (ft)	Flow** (cfs)	WSEL* (ft)	Flow** (cfs)	WSEL* (ft)	Flow** (cfs)	WSEL* (ft)	Flow** (cfs)	WSEL* (ft)	Flow** (cfs)	
Bessie's Creek	1	Fort Bend County Line	N/A	98191	58.09	111.33	1,563	112.00	2,347	112.98	3,138	114.17	4,289	114.74	5,037	115.11	5,877	115.48	7,772
	2	Hunt Rd. Bridge	US	89427	58.71	111.28	1,505	111.90	2,249	112.84	3,036	113.98	4,061	114.51	4,663	114.83	5,264	115.18	5,807
			DS	89367		111.25		111.85		112.77		113.88		114.46		114.79		115.15	
	3	Dam 4	US	85410	59.02	111.25	1,505	111.86	2,249	112.79	3,032	113.91	4,060	114.46	4,663	114.77	5,263	115.13	5,808
			DS	85360		111.11		111.68		112.58		113.69		114.22		114.52		114.86	
	4	FM 1489 Rd. Bridge (North)	US	74710	59.94	111.07	1,512	111.61	2,265	112.49	3,041	113.54	4,048	114.05	4,572	114.33	5,037	114.69	5,450
			DS	74638		110.58		111.12		112.00		113.06		113.56		114.00		114.72	
	5	Dam 3	US	74429	60.41	110.57	1,512	111.10	2,265	111.98	3,041	113.04	4,048	113.55	4,573	113.98	5,037	114.71	5,451
			DS	74359		108.32		110.42		111.70		112.76		113.27		113.71		114.45	
	6	FM 1489 Rd. Bridge (South)	US	67889	61.86	108.27	1,520	110.37	2,275	111.65	3,036	112.69	4,068	113.19	4,630	113.62	5,110	114.34	6,237
			DS	67791		108.26		110.36		111.64		112.67		113.16		113.58		114.30	
	7	Dam 2	US	62156	63.16	108.20	1,520	110.30	2,275	111.56	3,033	112.56	4,061	113.03	4,615	113.44	5,074	114.16	6,003
			DS	62097		107.93		110.06		111.33		112.30		112.75		113.14		113.86	
	8	Private Crossing 7	US	55582	64.02	105.56	1,517	107.77	2,249	108.74	2,921	109.47	3,829	110.09	4,545	110.82	5,291	112.61	6,268
			DS	55547		105.53		107.77		108.74		109.47		110.09		110.82		112.60	
9	Brookshire Creek Confluence	DS	48512	91.44	104.47	2,661	106.27	3,876	107.45	5,053	108.78	6,985	109.70	8,564	110.58	10,260	112.46	14,547	
10	Bessie's Creek "Choke Point"	N/A	44672	91.66	102.65	2,656	104.27	3,848	105.50	4,936	107.28	6,766	108.58	8,260	109.61	9,869	111.56	13,939	
11	FM 1093 Bridge	US	35153	95.01	98.17	3,012	99.51	4,163	100.63	5,242	102.36	7,097	103.66	8,603	104.86	9,983	107.88	13,671	
		DS	35045		98.00		99.34		100.47		102.20		103.50		104.63		107.50		
12	Oxbow	N/A	30194	96.85	95.26	3,008	96.73	4,163	97.95	5,242	99.82	7,093	101.19	8,600	102.39	9,987	105.35	13,780	
13	James Ln Bridge	US	23531	97.55	91.11	3,060	92.75	4,174	94.20	5,248	96.48	7,099	98.15	8,611	99.57	10,001	102.88	13,799	
		DS	23415		90.35		92.03		93.48		95.80		97.49		98.93		100.51		102.51
14	Fulshear Trace Bridge	US	19206	100.67	87.46	3,206	89.32	4,217	90.82	5,272	93.23	7,128	95.08	8,657	96.64	10,057	100.50	13,860	
		DS	19101		87.23		89.27		90.82		93.29		95.15		96.72		100.60		
15	Brazos River	N/A	649	104.06	79.94	3,598	82.14	4,767	83.83	5,788	86.08	7,312	88.24	8,931	90.09	10,427	94.63	14,506	
Brookshire Creek	16	Fort Bend County Line	N/A	16059	14.65	115.27	1,207	115.87	1,764	116.15	2,327	116.53	3,396	116.88	4,371	117.33	5,496	118.45	8,657
	17	Pecan Hill Rd. Bridge	US	12422	20.60	112.18	1,174	112.91	1,762	113.39	2,324	114.06	3,293	114.57	4,207	115.12	5,312	116.40	8,477
			DS	12370		111.74		112.50		112.96		113.55		114.44		115.46			
	18	Pool Hill Rd. Bridge	US	10001	21.22	110.68	1,343	111.74	2,204	112.38	3,068	113.01	4,582	113.45	6,010	113.88	7,814	114.84	12,844
			DS	9947		110.15		110.97		111.64		112.20		112.59		112.99		114.00	
	19	Hunt Rd. Bridge	US	7862	23.33	109.21	1,457	109.98	2,188	110.71	3,192	111.24	4,768	111.59	6,417	112.00	8,374	113.39	13,688
			DS	7806		109.05		109.85		110.48		110.90		111.17		111.56		113.16	
	20	Rogers Rd. Bridge	US	877	26.77	105.19	1,759	107.07	2,302	108.09	3,046	109.30	4,616	110.11	6,185	110.96	7,970	112.82	12,639
DS			825	105.10		106.77		107.87		109.14		110.02		110.87		112.75			

Orchard Creek	21	Bowser Rd. Culvert	US	14812	1.70	106.66	52	107.00	109	107.13	162	107.26	235	107.36	297	107.46	375	110.02	1,125
			DS	14764		100.58		102.07		103.17		104.69		105.90		107.06		109.96	
	22	Waltham Rd. Culvert	US	10551	1.99	100.47	69	102.03	-96	103.14	-133	104.58	172	105.57	223	106.66	261	109.70	-950
			DS	10423		100.45		102.01		103.11		104.60		105.55		106.65		109.70	
23	Weston Rd. Culvert	US	6455	2.41	100.45	107	102.01	103	103.11	134	104.60	194	105.55	256	106.65	309	109.70	-1,017	
		DS	6330		100.40		101.93		103.06		104.60		105.55		106.65		109.69		
24	Bessie's Creek Confluence	US	80	3.33	99.71	-194	101.11	-260	102.24	-344	103.92	-428	105.17	-438	106.35	441	109.52	1,845	

+ Drainage areas based on drainage area delineations, but location may be impacted by overflows/diversions
 *Water surface elevations reported are from HEC-RAS cross sections
 **Flows determined from profiles lines in RAS Mapper drawn across the HEC-RAS 1D/2D model extents
 ***Negative flows indicate water flowing from downstream to upstream

Bessie's Creek Inundation Map



-  Conveyance Zone
-  100YR Inundation Boundary
-  500YR Inundation Boundary

Stream	ID	Location	River Station	Drainage Area (sq. mi)	100-Year		500-Year		
					WSEL* (ft)	Flow** (cfs)	WSEL* (ft)	Flow** (cfs)	
Bessie's Creek	1	Fort Bend County Line	N/A	98191	58.09	115.11	5,877	115.48	7,772
	2	Hunt Rd. Bridge	US	89427	58.71	114.83	5,264	115.18	5,807
	3	Dam 4	US	85410	59.02	114.77	5,263	115.13	5,808
			DS	85360	59.02	114.52	5,263	114.86	5,808
	4	FM 1489 Rd. Bridge (North)	US	74710	59.94	114.33	5,037	114.69	5,450
			DS	74638	59.94	114.00	5,037	114.72	5,450
	5	Dam 3	US	74429	60.41	113.98	5,037	114.71	5,451
			DS	74359	60.41	113.71	5,037	114.45	5,451
	6	FM 1489 Rd. Bridge (South)	US	67889	61.86	113.62	5,110	114.34	6,237
			DS	67791	61.86	113.38	5,110	114.30	6,237
	7	Dam 2	US	62256	63.16	113.44	5,074	113.86	6,003
			DS	62097	63.16	113.14	5,074	113.86	6,003
	8	Private Crossing 7	US	55582	64.02	110.82	5,291	112.61	6,268
			DS	55547	64.02	110.82	5,291	112.60	6,268
	9	Brookshire Creek Confluence	US	48512	91.44	109.61	10,260	111.56	14,547
			DS	44672	91.66	109.49	9,869	111.39	13,939
	10	Bessie's Creek "Choke Point"	US	35153	95.01	104.86	9,983	107.88	13,671
			DS	35045	95.01	104.63	9,983	107.50	13,671
	11	FM 1093 Bridge	US	30194	96.85	102.39	9,987	105.35	13,780
			DS	29531	97.55	99.57	10,001	102.88	13,799
	12	Oxbow	US	23415	97.55	98.93	10,001	102.51	13,799
			DS	19206	96.64	96.64	10,057	100.50	13,860
	13	Fulshear Trace Bridge	US	19101	96.72	96.72	10,060	100.60	13,860
			DS	549	104.06	90.09	10,427	94.63	14,506
14	Fort Bend County Line	US	16059	14.65	117.33	5,496	118.45	8,657	
		DS	12422	20.60	115.12	5,312	116.40	8,477	
15	Pecan Hill Rd. Bridge	US	12370	20.60	114.44	5,312	115.46	8,477	
		DS	10001	21.22	113.88	7,814	114.84	12,844	
16	Pool Hill Rd. Bridge	US	9947	21.22	112.99	7,814	114.00	12,844	
		DS	825	26.77	110.87	7,970	112.75	12,639	
17	Hunt Rd. Bridge	US	7862	23.93	112.00	8,374	113.39	13,688	
		DS	7806	23.93	111.56	8,374	113.16	13,688	
18	Rogers Rd. Bridge	US	877	26.77	110.96	7,970	112.82	12,639	
		DS	825	26.77	110.87	7,970	112.75	12,639	
19	Bowser Rd. Culvert	US	14812	1.70	107.46	375	110.02	1,125	
		DS	14764	1.70	107.06	375	109.96	1,125	
20	Waltham Rd. Culvert	US	10551	1.99	106.66	261	109.70	950	
		DS	10423	1.99	106.65	261	109.70	950	
21	Weston Rd. Culvert	US	6455	2.41	106.65	309	109.70	-1,017	
		DS	6330	2.41	106.65	309	109.69	-1,017	
22	Bessie's Creek Confluence	US	80	3.33	106.35	441	109.52	1,845	
		DS	80	3.33	106.35	441	109.52	1,845	

15 Brazos River

Stream	ID	Location		River Station	Drainage Area (sq. mi)	100-Year		500-Year	
						WSEL*	Flow**	WSEL*	Flow**
						(ft)	(cfs)	(ft)	(cfs)
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	2	Hunt Rd. Bridge	US	89427	58.71	114.83	5,264	115.18	5,807
			DS	89367		114.79		115.15	
	3	Dam 4	US	85410	59.02	114.77	5,263	115.13	5,808
			DS	85360		114.52		114.86	
	4	FM 1489 Rd. Bridge (North)	US	74710	59.94	114.33	5,037	114.69	5,450
			DS	74638		114.00		114.72	
	5	Dam 3	US	74429	60.41	113.98	5,037	114.71	5,451
			DS	74359		113.71		114.45	
	6	FM 1489 Rd. Bridge (South)	US	67889	61.86	113.62	5,110	114.34	6,237
			DS	67791		113.58		114.30	
	7	Dam 2	US	62156	63.16	113.44	5,074	114.16	6,003
			DS	62097		113.14		113.86	
	8	Private Crossing 7	US	55582	64.02	110.82	5,291	112.61	6,268
			DS	55547		110.82		112.60	
9	Brookshire Creek Confluence	DS	48512	91.44	109.61	10,260	111.56	14,547	
10	Bessie's Creek Choke Point	N/A	44672	91.66	109.49	9,869	111.39	13,939	
11	FM 1093 Bridge	US	35153	95.01	104.86	9,983	107.88	13,671	
		DS	35045		104.63		107.50		
12	Oxbow	N/A	30194	96.85	102.39	9,987	105.35	13,780	
13	James Ln Bridge	US	23531	97.55	99.57	10,001	102.88	13,799	
		DS	23415		98.93		102.51		
14	Fulshear Trace Bridge	US	19206	100.67	96.64	10,057	100.50	13,860	
		DS	19101		96.72		100.60		
15	Brazos River	N/A	649	104.06	90.09	10,427	94.63	14,506	
Brookshire Creek	16	Fort Bend County Line	N/A	16059	14.65	117.33	5,496	118.45	8,657
	17	Pecan Hill Rd. Bridge	US	12422	20.60	115.12	5,312	116.40	8,477
			DS	12370		114.44		115.46	
	18	Pool Hill Rd. Bridge	US	10001	21.22	113.88	7,814	114.84	12,844
			DS	9947		112.99		114.00	
19	Hunt Rd. Bridge	US	7862	23.33	112.00	8,374	113.39	13,688	
		DS	7806		111.56		113.16		
20	Rogers Rd. Bridge	US	877	26.77	110.96	7,970	112.82	12,639	
		DS	825		110.87		112.75		
Orchard Creek	21	Bowser Rd. Culvert	US	14812	1.70	107.46	375	110.02	1,125
			DS	14764		107.06		109.96	
	22	Waltham Rd. Culvert	US	10551	1.99	106.66	261	109.70	-950
			DS	10423		106.65		109.70	
	23	Weston Rd. Culvert	US	6455	2.41	106.65	309	109.70	-1,017
DS			6330	106.65		106.69			
24	Bessie's Creek Confluence	US	80	3.33	106.35	441	109.52	1,845	

Existing
Conditions
100yr WSE
at Key
Locations

Model Verification

Stream	Location		2014 CLOMR		2015 FEMA	2020 MDP				2020 MDP - 2014 CLOMR					2020 MDP - 2015 FEMA		
			100-Year		100-Year	Avg. 25-Year & 50-Year		100-Year		Avg 25- 50-Yr vs 100-Yr			100-Yr vs 100-Yr				
			WSEL	Flow	WSEL	WSEL	Flow	WSEL	Flow	WSEL	Flow	Flow	WSEL	Flow		Flow	WSEL
			(ft)	(cfs)	(ft)	(ft)	(cfs)	(ft)	(cfs)	(ft)	(cfs)	(%)	(ft)	(cfs)		(%)	(ft)
Bessie's Creek	Brookshire Creek Confluence	DS	108.72	8,000	110.50	109.10	7,936	110.40	10,344	0.38	-64	-1%	1.68	2,344	29%	-1.41	
	Bessie's Creek "Choke Point"	N/A	107.65	8,000	109.50	108.21	7,673	109.79	9,969	0.55	-328	-4%	2.14	1,969	25%	-1.30	
	Orchard Creek Confluence	DS	105.36	8,411	108.20	104.69	7,701	106.47	9,805	-0.67	-710	-8%	1.11	1,394	17%	-3.51	
	FM 1093 Bridge	US	104.44	8,452	106.00	103.17	7,673	104.99	9,969	-1.28	-780	-9%	0.55	1,517	18%	-2.84	
	Oxbow	N/A	102.92	8,452	102.00	100.24	8,017	102.14	10,122	-2.68	-435	-5%	-0.78	1,670	20%	-1.76	
	James Ln Bridge	US	102.08	8,452	101.50	97.54	8,031	99.73	10,139	-4.54	-421	-5%	-2.35	1,687	20%	-3.96	
	Fulshear Trace Bridge	US	101.21	8,662	101.50	94.41	8,087	96.82	10,199	-6.80	-576	-7%	-4.39	1,537	18%	-7.09	
	Brazos River	N/A	96.65	8,944	101.50	87.50	8,374	90.39	10,680	-9.15	-570	-6%	-6.26	1,736	19%	-14.00	

Cost Analysis

Table 11. – Existing 100-Year Level of Service Channel Improvements

Segment	Extents	Description/Configuration	ROW Required (acres)	Estimated Construction Cost
Bessie's 1	Private Crossing near Simonton Brookshire Rd to Dam 2 near FM 1093	- Channel Length = 2.93 mi long - Channel longitudinal slope = 0.0004 - Flowline Adjustment = None - Side Slope = 4:1 - Average Top Width = 340 ft - Channel bottom width = 220 ft – 235 ft - Maintenance Berm = 60 ft, 30 ft on each side	122	\$44,113,614
Bessie's 2	Dam 2 near FM 1093 to Brookshire Creek confluence near Pool Hill Rd	- Channel Length = 2.84 mi long - Channel longitudinal slope = 0.0003 - Flowline Adjustment = None - Side Slope = 4:1 - Average Top Width = 440 ft - Channel bottom width = 295-340 ft - Maintenance Berm = 60 ft, 30 ft on each side	154	\$65,458,848
Bessie's 3	Brookshire Creek confluence near Pool Hill Rd to Orchard Creek Confluence	- Channel Length = 1.91 mi long - Channel longitudinal slope = 0.00017 - Flowline Adjustment = None - Side Slope = 4:1 - Average Top Width = 570 ft - Channel bottom width = 440ft -- 455ft - Maintenance Berm = 60 ft, 30 ft on each side	129	\$61,961,173
Bessie's 4	Orchard Creek Confluence to FM 1093	- Channel Length = 0.66 mi long - Channel longitudinal slope = 0.0010 - Flowline Adjustment = None - Side Slope = 4:1 - Average Top Width = 440 ft - Channel bottom width = 305ft - Maintenance Berm = 60 ft, 30 ft on each side	36	\$15,105,773

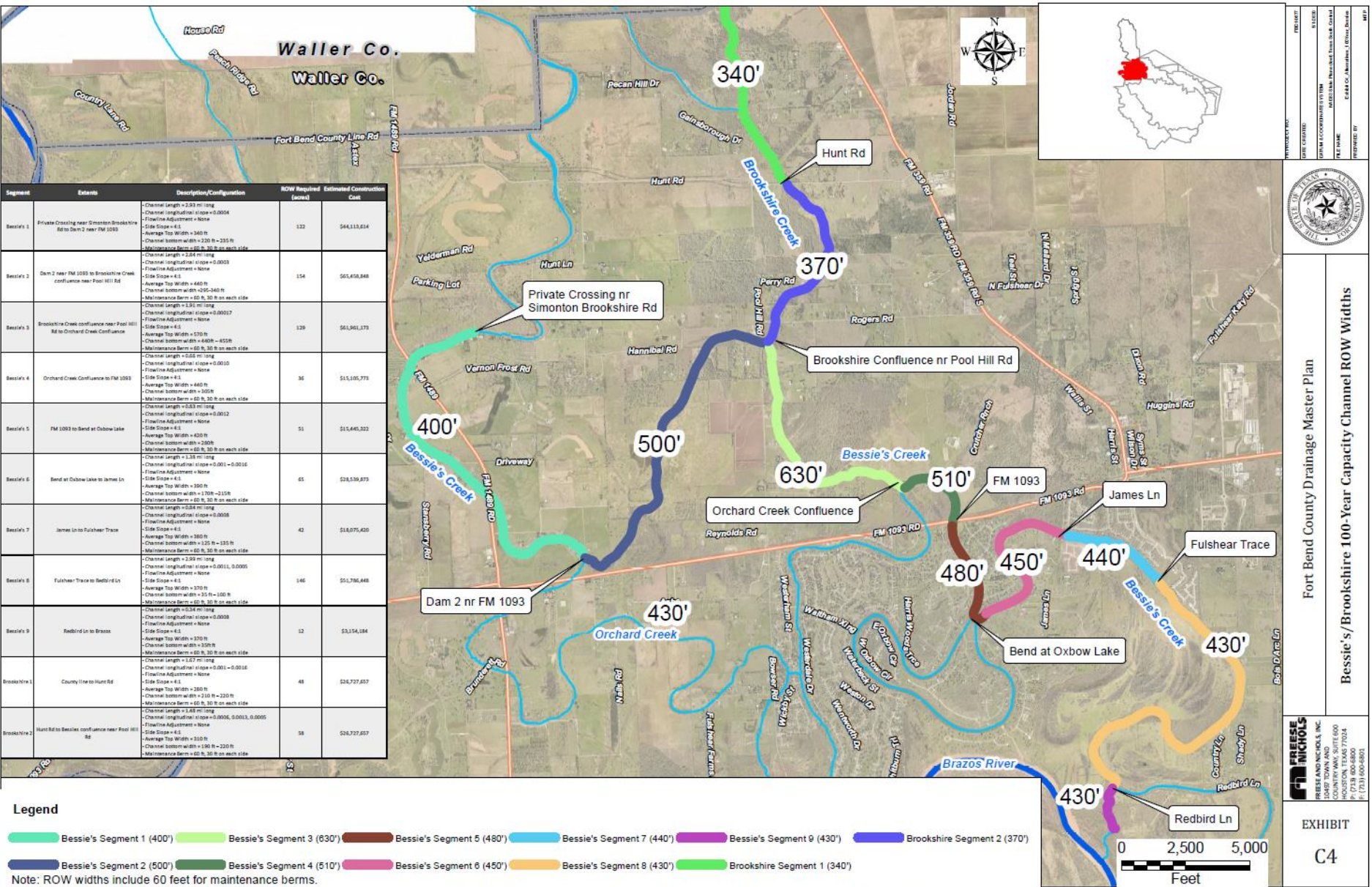
Table 12. – Existing 100-Year Level of Service Channel Improvements

Segment	Extents	Description/Configuration	ROW Required (acres)	Estimated Construction Cost
Bessie's 5	FM 1093 to Bend at Oxbow Lake	- Channel Length = 0.83 mi long - Channel longitudinal slope = 0.0012 - Flowline Adjustment = None - Side Slope = 4:1 - Average Top Width = 420 ft - Channel bottom width = 280ft - Maintenance Berm = 60 ft, 30 ft on each side	51	\$15,445,322
Bessie's 6	Bend at Oxbow Lake to James Ln	- Channel Length = 1.38 mi long - Channel longitudinal slope = 0.001 – 0.0016 - Flowline Adjustment = None - Side Slope = 4:1 - Average Top Width = 390 ft - Channel bottom width = 170ft --215ft - Maintenance Berm = 60 ft, 30 ft on each side	65	\$28,539,873
Bessie's 7	James Ln to Fulshear Trace	- Channel Length = 0.84 mi long - Channel longitudinal slope = 0.0008 - Flowline Adjustment = None - Side Slope = 4:1 - Average Top Width = 380 ft - Channel bottom width = 125 ft – 135 ft - Maintenance Berm = 60 ft, 30 ft on each side	42	\$18,075,420
Bessie's 8	Fulshear Trace to Redbird Ln	- Channel Length = 2.99 mi long - Channel longitudinal slope = 0.0011, 0.0005 - Flowline Adjustment = None - Side Slope = 4:1 - Average Top Width = 370 ft - Channel bottom width = 35 ft – 100 ft - Maintenance Berm = 60 ft, 30 ft on each side	146	\$51,786,448

Table 11. – Existing 100-Year Level of Service Channel Improvements

Segment	Extents	Description/Configuration	ROW Required (acres)	Estimated Construction Cost
Bessie's 9	Redbird Ln to Brazos	- Channel Length = 0.34 mi long - Channel longitudinal slope = 0.0008 - Flowline Adjustment = None - Side Slope = 4:1 - Average Top Width = 370 ft - Channel bottom width = 35ft ft - Maintenance Berm = 60 ft, 30 ft on each side	12	\$154,184
Brookshire 1	County line to Hunt Rd	- Channel Length = 1.67 mi long - Channel longitudinal slope = 0.001 – 0.0016 - Flowline Adjustment = None - Side Slope = 4:1 - Average Top Width = 280 ft - Channel bottom width = 210 ft – 220 ft - Maintenance Berm = 60 ft, 30 ft on each side	48	\$26,727,657
Brookshire 2	Hunt Rd to Bessie's confluence near Pool Hill Rd	- Channel Length = 1.48 mi long - Channel longitudinal slope = 0.0006, 0.0013, 0.0005 - Flowline Adjustment = None - Side Slope = 4:1 - Average Top Width = 310 ft - Channel bottom width = 190 ft – 220 ft - Maintenance Berm = 60 ft, 30 ft on each side	58	\$26,727,657

Bessie's/Brookshire 100-Year Capacity Channel ROW Widths



PROJECT: Fort Bend County Drainage Master Plan
 DATE CHARGED: 5/1/2020
 DATE APPROVED: 5/1/2020
 DRAWN BY: J. [Name]
 CHECKED BY: [Name]
 APPROVED BY: [Name]

STATE OF TEXAS
 COUNTY OF WALLER

Fort Bend County Drainage Master Plan
 Bessie's/Brookshire 100-Year Capacity Channel ROW Widths

EXHIBIT
 C4

PRESE AND NICHOLS, INC.
 15457 TOWN AND
 COUNTRY BLVD
 HOUSTON, TEXAS 77054
 P: (713) 900-8800
 F: (713) 900-8901

Alternative Analysis – Diversions

All diversion locations were evaluated with channels of 100-foot bottom width, 3 to 1 side slopes, and varying depths. The reduction in water surface elevation as a result of the diversion channels is summarized in Table 13 below.

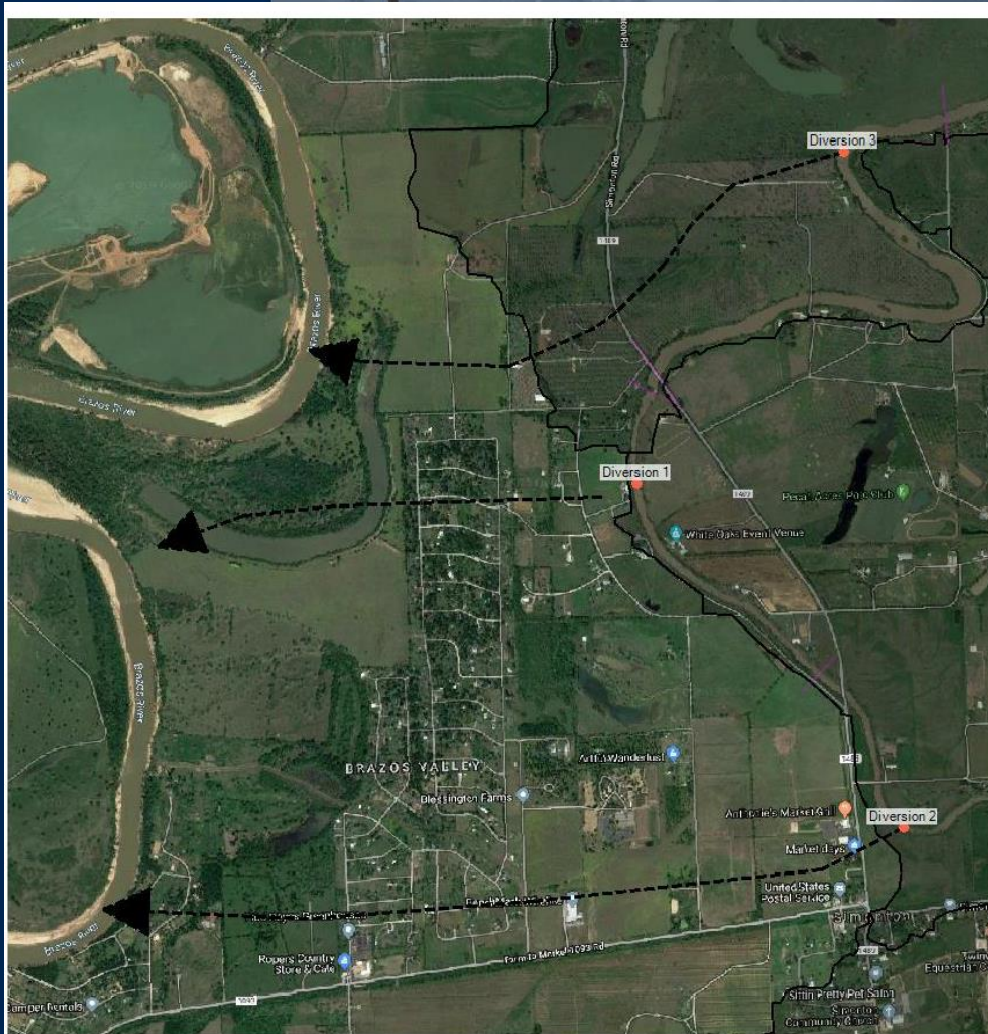


Figure 2 - Diversion Locations

Table 13. – Diversion Channel Results

Diversion	Profile Location	WSE Reduction
Diversion 1	DS Confluence Brookshire & Bessie's	0.83
	Bessie's "Choke Point"	1.04
	US FM 1093 at Bessie's	1.00
	DS Confluence Orchard & Bessie's	1.13
Diversion 2	DS Confluence Brookshire & Bessie's	0.83
	Choke Point	1.04
	US FM 1093 at Bessie's	1.00
	DS Confluence Orchard & Bessie's	0.96
Diversion 3	DS Confluence Brookshire & Bessie's	0.20
	Choke Point	0.38
	US FM 1093 at Bessie's	0.27
	DS Confluence Orchard & Bessie's	0.24

Environmental Assessment

- Potential Encroachment
- Threatened and Endangered Species
- Cultural Resources/Archaeology
- Other Environmental Concerns

Table 15. – Potential Pipeline Encroachments

Pipeline Owner	Pipeline
Trunkline Gas Company, LLC	Edna Discharge
Naturla Gas P/L/Co of Amer LLC	Gulf Coast Mainline #1 Gulf Coast Mainline #2
Tennessee Gas Pipeline Company	18E - 100 Randon TGP 100 SYSTEM 100-1 TGP 100 SYSTEM 100-2 TGP 100 SYSTEM 100-3
Kinder Morgan Texas Pipeline LLC	Rancho La Grange-Genoa Junction
Dow Pipeline Company	KS

Table 14. – Potential Encroachment into existing Wetlands

Segment	Extents	Wetlands Encroached
Bessie's 2	Dam 2 near FM 1093 to Brookshire Creek Confluence	0.28 ac of Freshwater Forrested/ Shrub Wetland
Bessie's 5	FM 1093 to Bend at Oxbow Lake	1.21 ac of Freshwater Forrested/ Shrub Wetland
Bessie's 7	James Ln to Fulshear Trace	1.10 ac of Freshwater Forrested/ Shrub Wetland
Brookshire 1	County Line to Hunt Road	0.52 ac of Freshwater Forrested/ Shrub Wetland

Table 16. – Potential Wastewater Outfall Encroachments

Segment	Extents	Wastewater Outfalls
Bessie's 3	Brookshire Creek Confluence to Orchard Creek Confluence	Land Tejas Company LTD Outfall
Brookshire 1	County Line to Hunt Road	Fulshear Lakes WW Outfall

BESSIE'S CREEK SEGMENT-1 COST ESTIMATE

BESSIE'S CREEK - SEGMENT 1

EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE

PRIVATE CROSSING NEAR SIMONTON BROOKSHIRE ROAD TO DAM 2

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
LAND ACQUISITION					
1	Total area (122 acres)	1	LS	\$ 3,500,873	\$3,500,873
GENERAL CIVIL					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 595,890.00	\$595,890
3	Clearing and Grubbing	121	AC	\$ 6,500	\$786,500
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 354,545.00	\$354,545
5	Stormwater Pollution Prevention Plan	30,910	LF	\$ 7.50	\$231,825
6	Turf Est. - Hydroseeding w/ Mulch	590,480	SY	\$ 0.50	\$295,240
NEW CONSTRUCTION					
7	Excavation & Off-site Disposal	993,150	CY	\$ 12.00	\$11,917,800
MISC COSTS					
8	Wetland Mitigation	-	AC	\$ 100,000.00	\$0
9	Stream Mitigation	15,455	LF	\$ 1,000.00	\$15,455,000
10	Utility and Pipeline Adjustment	3	EA	\$ 500,000.00	\$1,500,000
11	Minor Roadway Channel Crossing Adjustment	1	EA	\$ 500,000.00	\$500,000
12	Major Roadway Channel Crossing Adjustment	2	EA	\$ 1,000,000.00	\$2,000,000
LAND ACQUISITION SUBTOTAL:					\$3,500,873
GENERAL CIVIL SUBTOTAL:					\$2,264,000
NEW CONSTRUCTION SUBTOTAL:					\$11,917,800
MISC COSTS:					\$19,455,000
OPINION OF PROBABLE CONSTRUCTION COST					\$37,138,000
ENGINEERING				15%	\$2,127,270.0
CONSTRUCTION MGMT				8%	\$1,134,544.0
CONTINGENCY				10%	\$3,713,800.0
PROJECT TOTAL					\$44,113,614

NOTES:

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN
 CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING

BESSIE'S CREEK SEGMENT-2 COST ESTIMATE

BESSIE'S CREEK - SEGMENT 2 EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE DAM 2 NEAR FM 1093 TO BROOKSHIRE CREEK CONFLUENCE

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
LAND ACQUISITION					
1	Total area (154 acres)	1	LS	\$ 2,187,475	\$2,187,475
GENERAL CIVIL					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 1,490,611.80	\$1,490,612
3	Clearing and Grubbing	152	AC	\$ 6,500	\$988,000
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 843,298.66	\$843,299
5	Stormwater Pollution Prevention Plan	30,016	LF	\$ 7.50	\$225,120
6	Turf Est. - Hydroseeding w/ Mulch	745,360	SY	\$ 0.50	\$372,680
NEW CONSTRUCTION					
7	Excavation & Off-site Disposal	2,484,353	CY	\$ 12.00	\$29,812,236
MISC COSTS					
8	Wetland Mitigation	0.28	AC	\$ 100,000.00	\$28,000
9	Stream Mitigation	15,008	LF	\$ 1,000.00	\$15,008,000
10	Utility and Pipeline Adjustment	-	EA	\$ 500,000.00	\$0
11	Minor Roadway Channel Crossing Adjustment	1	EA	\$ 500,000.00	\$500,000
12	Major Roadway Channel Crossing Adjustment	1	EA	\$ 1,000,000.00	\$1,000,000
LAND ACQUISITION SUBTOTAL:					\$2,187,475
GENERAL CIVIL SUBTOTAL:					\$3,919,710
NEW CONSTRUCTION SUBTOTAL:					\$29,812,236
MISC COSTS:					\$16,536,000
OPINION OF PROBABLE CONSTRUCTION COST					\$52,455,000
ENGINEERING				15%	\$5,059,792.0
CONSTRUCTION MGMT				8%	\$2,698,555.7
CONTINGENCY				10%	\$5,245,500.0
PROJECT TOTAL					\$65,458,848

NOTES:

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING

BESSIE'S CREEK SEGMENT-3 COST ESTIMATE

BESSIE'S CREEK - SEGMENT 3 EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE BROOKSHIRE CREEK CONFLUENCE TO ORCHARD CREEK CONFLUENCE

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
LAND ACQUISITION					
1	Total area (129 acres)	1	LS	\$ 4,382,645	\$4,382,645
GENERAL CIVIL					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 1,468,893.00	\$1,468,893
3	Clearing and Grubbing	129	AC	\$ 6,500	\$838,500
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 824,323.15	\$824,323
5	Stormwater Pollution Prevention Plan	20,156	LF	\$ 7.50	\$151,170
6	Turf Est. - Hydroseeding w/ Mulch	624,360	SY	\$ 0.50	\$312,180
NEW CONSTRUCTION					
7	Excavation & Off-site Disposal	2,448,155	CY	\$ 12.00	\$29,377,860
MISC COSTS					
8	Wetland Mitigation	-	AC	\$ 100,000.00	\$0
9	Stream Mitigation	10,078	LF	\$ 1,000.00	\$10,078,000
10	Utility and Pipeline Adjustment	3	EA	\$ 500,000.00	\$1,500,000
11	Minor Roadway Channel Crossing Adjustment	1	EA	\$ 500,000.00	\$500,000
12	Major Roadway Channel Crossing Adjustment	-	EA	\$ 1,000,000.00	\$0
LAND ACQUISITION SUBTOTAL:					\$4,382,645
GENERAL CIVIL SUBTOTAL:					\$3,595,066
NEW CONSTRUCTION SUBTOTAL:					\$29,377,860
MISC COSTS:					\$12,078,000
OPINION OF PROBABLE CONSTRUCTION COST					\$49,434,000
ENGINEERING				15%	\$4,945,938.9
CONSTRUCTION MGMT				8%	\$2,637,834.1
CONTINGENCY				10%	\$4,943,400.0
PROJECT TOTAL					\$61,961,173

NOTES:

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING

BESSIE'S CREEK SEGMENT-4 COST ESTIMATE

BESSIE'S CREEK - SEGMENT 4 EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE ORCHARD CREEK CONFLUENCE TO FM 1093

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
LAND ACQUISITION					
1	Total area (36 acres)	1	LS	\$ 878,947	\$878,947
GENERAL CIVIL					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 285,309.60	\$285,310
3	Clearing and Grubbing	35	AC	\$ 6,500	\$227,500
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 163,029.66	\$163,030
5	Stormwater Pollution Prevention Plan	6,938	LF	\$ 7.50	\$52,035
6	Turf Est. - Hydroseeding w/ Mulch	174,240	SY	\$ 0.50	\$87,120
NEW CONSTRUCTION					
7	Excavation & Off-site Disposal	475,516	CY	\$ 12.00	\$5,706,192
MISC COSTS					
8	Wetland Mitigation	-	AC	\$ 100,000.00	\$0
9	Stream Mitigation	3,469	LF	\$ 1,000.00	\$3,469,000
10	Utility and Pipeline Adjustment	1	EA	\$ 500,000.00	\$500,000
11	Minor Roadway Channel Crossing Adjustment	-	EA	\$ 500,000.00	\$0
12	Major Roadway Channel Crossing Adjustment	1	EA	\$ 1,000,000.00	\$1,000,000
LAND ACQUISITION SUBTOTAL:					\$878,947
GENERAL CIVIL SUBTOTAL:					\$814,994
NEW CONSTRUCTION SUBTOTAL:					\$5,706,192
MISC COSTS:					\$4,969,000
OPINION OF PROBABLE CONSTRUCTION COST					\$12,369,000
ENGINEERING				15%	\$978,177.9
CONSTRUCTION MGMT				8%	\$521,694.9
CONTINGENCY				10%	\$1,236,900.0
PROJECT TOTAL					\$15,105,773

NOTES:

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING

BESSIE'S CREEK SEGMENT-5 COST ESTIMATE

BESSIE'S CREEK - SEGMENT 5 EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE FM 1093 TO BEND AT OXBOW LAKE

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
LAND ACQUISITION					
1	Total area (51 acres)	1	LS	\$ 1,160,932	\$1,160,932
GENERAL CIVIL					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 295,873.20	\$295,873
3	Clearing and Grubbing	51	AC	\$ 6,500	\$331,500
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 172,676.34	\$172,676
5	Stormwater Pollution Prevention Plan	8,816	LF	\$ 7.50	\$66,120
6	Turf Est. - Hydroseeding w/ Mulch	246,840	SY	\$ 0.50	\$123,420
NEW CONSTRUCTION					
7	Excavation & Off-site Disposal	493,122	CY	\$ 12.00	\$5,917,464
MISC COSTS					
8	Wetland Mitigation	1.21	AC	\$ 100,000.00	\$121,000
9	Stream Mitigation	4,408	LF	\$ 1,000.00	\$4,408,000
10	Utility and Pipeline Adjustment	-	EA	\$ 500,000.00	\$0
11	Minor Roadway Channel Crossing Adjustment	-	EA	\$ 500,000.00	\$0
12	Major Roadway Channel Crossing Adjustment	-	EA	\$ 1,000,000.00	\$0
LAND ACQUISITION SUBTOTAL:					\$1,160,932
GENERAL CIVIL SUBTOTAL:					\$989,590
NEW CONSTRUCTION SUBTOTAL:					\$5,917,464
MISC COSTS:					\$4,529,000
OPINION OF PROBABLE CONSTRUCTION COST					\$12,597,000
ENGINEERING				15%	\$1,036,058.0
CONSTRUCTION MGMT				8%	\$552,564.3
CONTINGENCY				10%	\$1,259,700.0
PROJECT TOTAL					\$15,445,322

NOTES:

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING

BESSIE'S CREEK SEGMENT-6 COST ESTIMATE

BESSIE'S CREEK - SEGMENT 6 EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE BEND AT OXBOW LAKE TO JAMES LN

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
LAND ACQUISITION					
1	Total area (65 acres)	1	LS	\$ 3,789,303	\$3,789,303
GENERAL CIVIL					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 519,495.00	\$519,495
3	Clearing and Grubbing	65	AC	\$ 6,500	\$422,500
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 297,399.27	\$297,399
5	Stormwater Pollution Prevention Plan	14,546	LF	\$ 7.50	\$109,095
6	Turf Est. - Hydroseeding w/ Mulch	315,163	SY	\$ 0.50	\$157,582
NEW CONSTRUCTION					
7	Excavation & Off-site Disposal	865,825	CY	\$ 12.00	\$10,389,900
MISC COSTS					
8	Wetland Mitigation	-	AC	\$ 100,000.00	\$0
9	Stream Mitigation	7,273	LF	\$ 1,000.00	\$7,273,000
10	Utility and Pipeline Adjustment	-	EA	\$ 500,000.00	\$0
11	Minor Roadway Channel Crossing Adjustment	1	EA	\$ 500,000.00	\$500,000
12	Major Roadway Channel Crossing Adjustment	-	EA	\$ 1,000,000.00	\$0
LAND ACQUISITION SUBTOTAL:					\$3,789,303
GENERAL CIVIL SUBTOTAL:					\$1,506,071
NEW CONSTRUCTION SUBTOTAL:					\$10,389,900
MISC COSTS:					\$7,773,000
OPINION OF PROBABLE CONSTRUCTION COST					\$23,458,000
ENGINEERING				15%	\$1,784,395.6
CONSTRUCTION MGMT				8%	\$951,677.7
CONTINGENCY				10%	\$2,345,800.0
PROJECT TOTAL					\$28,539,873

NOTES:

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING

BESSIE'S CREEK SEGMENT-7 COST ESTIMATE

BESSIE'S CREEK - SEGMENT 7 EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE JAMES LN TO FULSHEAR TRACE

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
LAND ACQUISITION					
1	Total area (42 acres)	1	LS	\$ 3,378,398	\$3,378,398
GENERAL CIVIL					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 306,349.20	\$306,349
3	Clearing and Grubbing	42	AC	\$ 6,500	\$273,000
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 176,263.03	\$176,263
5	Stormwater Pollution Prevention Plan	8,838	LF	\$ 7.50	\$66,285
6	Turf Est. - Hydroseeding w/ Mulch	203,280	SY	\$ 0.50	\$101,640
NEW CONSTRUCTION					
7	Excavation & Off-site Disposal	510,582	CY	\$ 12.00	\$6,126,984
MISC COSTS					
8	Wetland Mitigation	1.10	AC	\$ 100,000.00	\$110,000
9	Stream Mitigation	4,419	LF	\$ 1,000.00	\$4,419,000
10	Utility and Pipeline Adjustment	-	EA	\$ 500,000.00	\$0
11	Minor Roadway Channel Crossing Adjustment	-	EA	\$ 500,000.00	\$0
12	Major Roadway Channel Crossing Adjustment	-	EA	\$ 1,000,000.00	\$0
LAND ACQUISITION SUBTOTAL:					\$3,378,398
GENERAL CIVIL SUBTOTAL:					\$923,537
NEW CONSTRUCTION SUBTOTAL:					\$6,126,984
MISC COSTS:					\$4,529,000
OPINION OF PROBABLE CONSTRUCTION COST					\$14,958,000
ENGINEERING				15%	\$1,057,578.2
CONSTRUCTION MGMT				8%	\$564,041.7
CONTINGENCY				10%	\$1,495,800.0
PROJECT TOTAL					\$18,075,420

NOTES:

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING



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