



MEMORANDUM

Date: December 19, 2007

DAI Job No.: 1615

To: Mr. Scott R. Elmer, P.E.
From: Kevin T. Vogel, P.E., CFM
Craig T. Maske, P.E., CFM
Project: Steady Flow Analysis of Vicksburg Ditch

The purpose of this memorandum is to summarize the results of a steady flow analysis of the Vicksburg Ditch for current and fully developed conditions within the watershed. This memorandum should be considered as an attachment to, or appendix to the final report entitled, **Missouri City Master Drainage Plan Update: Mustang Bayou & Lower Oyster Creek**. We have prepared this document in order to satisfy the formal request made by the Fort Bend County MUD 48 (Jones & Carter, Inc.) in a letter from Mr. Scott Saenger, P.E., dated December 7, 2007. In this letter, the formal request read, "The only additional item we are requesting is that a steady state analysis be completed on the Vicksburg ditch to allow a direct comparison to the previous models (unsteady flow models) for Vicksburg." The following sections discuss the methods, assumptions, and support data used to prepare a steady flow analysis of the Vicksburg ditch. We have also provided a water surface profile comparison of the Vicksburg Ditch using both steady and unsteady flow models.

Background Data & Models Used for the Steady Flow Analysis

Hydrologic and hydraulic models created for the update to the Missouri City Master Drainage Plan were used as the base models for the steady flow analysis. All hydrologic parameters and channel geometry were not changed for the steady flow analysis.

A steady flow HEC-RAS (Version 3.1.3) model of the Vicksburg Ditch was created by deleting all other stream reaches and storage areas within the unsteady HEC-RAS geometry file except for the Vicksburg ditch. The overflow weir into Kitty Hollow Lake located along the Vicksburg ditch was removed from the hydraulic model. The effectiveness of overflow weir to reduce peak runoff rates along the Vicksburg ditch was accounted for within a hydrologic analysis of the flows to Vicksburg Ditch.

A copy of the HEC-HMS model for both the existing and ultimate developed conditions was copied and renamed for the purpose of this study. Both of these new models were modified in the same way, and included the following changes. Multiple junction nodes and a diversion routine were added to these models. A junction node, labeled Vicksburg Channel, was added to combine runoff hydrographs from the VICKS and LSH1 sub-watersheds (Vicksburg and the southern half of Lake Shore Harbor). The combined flow hydrograph was then routed through a diversion routine to determine the extent of the flow hydrograph diverted into Kitty Hollow

Lake, and how much will continue to drain to the south and eventually entering into Lower Oyster Creek south of SH 6. These two resulting hydrographs were sent to created junction nodes Overflow to KH and Culvert to South, respectively.

Method of Analysis

The development of the diversion routine within the HEC-HMS model consisted of creating a steady flow rating curve for the cross-section immediately upstream of the culvert structure controlling the weir. Using normal depth as the downstream boundary condition, a series of flows were applied to the Vicksburg channel in order to determine the computed energy grade elevations at the overflow weir (HEC-RAS Station 23+00). Using a spreadsheet, the resulting Vicksburg ditch rating curve, and the broad-crested weir equation, an inflow-diversion relationship was created. For each of the computed headwater elevations (energy grade elevations) upstream of the control structure, an associated head was computed to use in the weir equation. A weir flow coefficient of 2.65, an average weir length of 240 feet, and a crest elevation of 63.17 (minimum elevation surveyed along the weir structure), was assumed for this analysis. The computed weir flow was added to the culvert flow in order to define the inflow portion of the diversion routine, and the culvert flow used for the diverted flow to the south. These calculations may be found attached to this memorandum. Table 1 shows the inflow-diversion relationship used in the hydrologic model. The "Diversion" column refers to flows that remain in the Vicksburg channel downstream of the weir.

Inflow (cfs)	Diversion (cfs)
0	0
10	10
70	70
103	80
503	90
1199	100
1628	105
2129	110

Computed peak runoff rates from the revised HEC-HMS models were input into the revised HEC-RAS model of the Vicksburg Channel in order to determine flood levels along the ditch during a 100-year storm event for each of the studied conditions. The flows were inserted into a steady flow file within HEC-RAS. The computed peak runoff rate for storm flows not being diverted into Kitty Hollow Lake was used to calculate water surface elevations from the downstream end of the Vicksburg model upstream through the culvert structure controlling the overflow weir. From this point to the cross-section upstream of the Lake Shore Harbor outfall pipe, the computed peak runoff rate for the combined watersheds (VICKS and LSH1) was applied to the stream channel. Upstream of the Lake Shore Harbor outfall pipe, the computed peak runoff rate for the Vicksburg drainage area was applied to the channel and gradually decreased to the most upstream cross-section of the model. Approximately forty percent of the Vicksburg drainage area is able to enter the Vicksburg channel at this location.

Results and Comparison

Hydrologic results of the steady flow analysis are provided in Table 2 below. All hydrologic parameters for sub-areas VICKS and LSH1 remain the same as noted within the final draft of the Missouri City Master Drainage Plan Update. Table 3 compares the steady flow results with the

unsteady results. As shown in Table 3, computed peak runoff rates using a steady flow analysis are within 10% of the unsteady flow results.

Table 2: Results of Steady Flow Hydrologic Analysis		
Node Description	Existing Conditions (cfs)	Ultimate Conditions (cfs)
Sub-Area VICKS	671	1239
Sub-Area LSH1	334	334
Combine Hydrographs	789	1470
Diversion into Kitty Hollow	695	1367
Diversion to the South	94	103

Table 3: Comparison of Hydrologic Results		
Condition	Steady Flow Results (cfs)	Unsteady Flow Results (cfs)
Existing Conditions		
Diversion into Kitty Hollow	695	652
Diversion to the South	94	90
Ultimate Conditions		
Diversion into Kitty Hollow	1367	1263
Diversion to the South	103	118

The results of the steady flow hydraulic analysis are attached to this memorandum and summarize computed water surface elevations for each channel cross-section within the model. Figure 1 below provides a stream profile comparison of the Vicksburg Ditch. Stream profiles for the existing and ultimate developed conditions are shown for both the steady flow and unsteady flow analysis. The computed water surface profile from the steady flow analysis produces slightly higher water surface elevations for portions of Vicksburg ditch starting just upstream of Lake Shore Harbor and extending to the most upstream cross-section. The maximum increase in water surface elevation was 0.28 feet for existing conditions, and 0.67 feet for ultimate conditions. For the portion of Vicksburg ditch between the culvert-weir control structure and Lake Shore Harbor, the steady flow analysis produced lower water surface elevations than the unsteady model. The reason for this decrease is because the maximum water surface elevations computed in the unsteady analysis for this portion of Vicksburg ditch are controlled by maximum water surface elevations within Kitty Hollow Lake and not peak runoff rates within the stream's watershed.

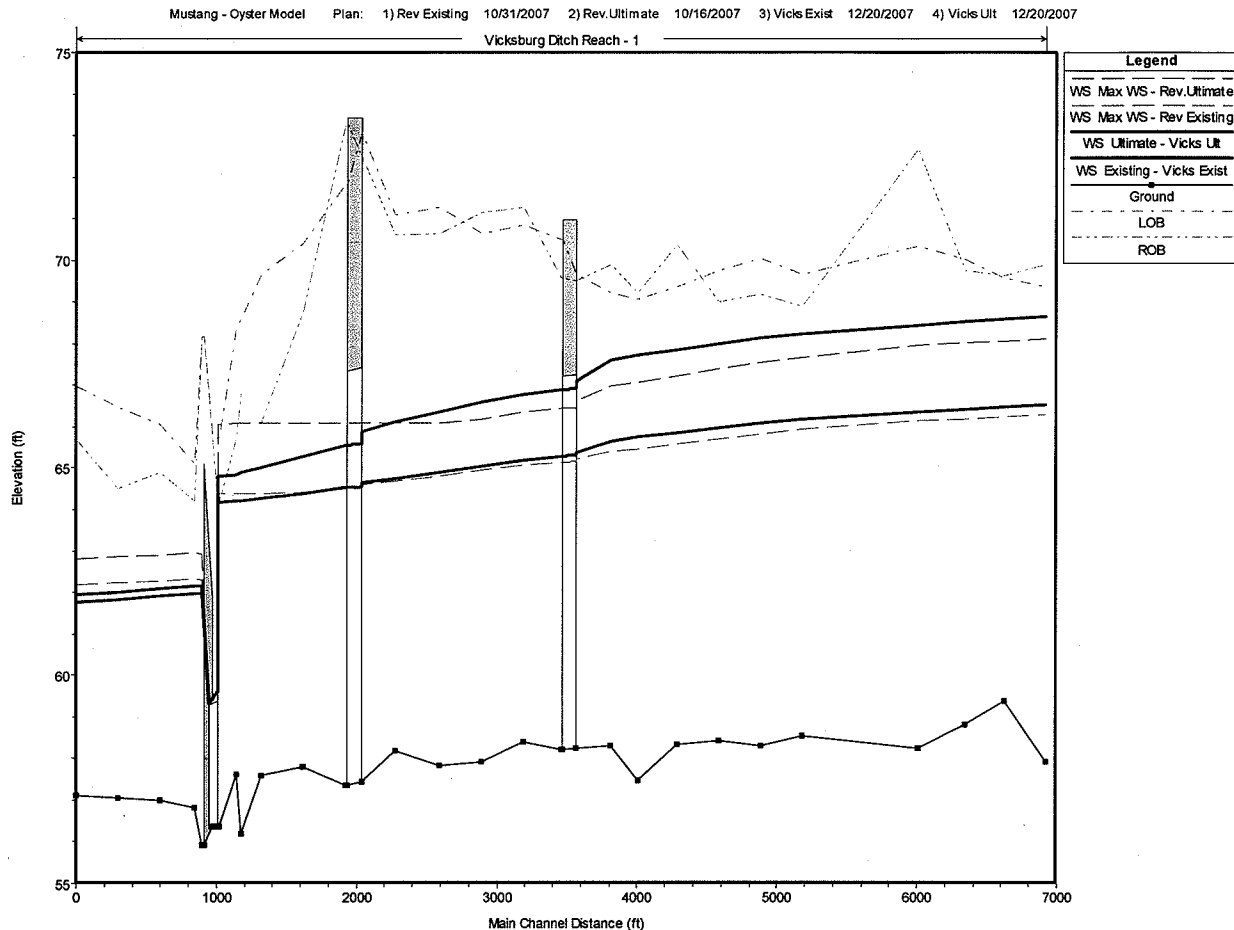


Figure 1: Vicksburg Ditch Profile Comparison

A request to consider a “peak on peak” event for the Vicksburg Ditch was also made by FBC MUD 47. The MUD requested that the steady flow model of Vicksburg Ditch be started at the Kitty Hollow Lake diversion weir assuming that the lake was at its (1%) maximum water surface elevation. This event would be considered highly unlikely because the peaks in Vicksburg Ditch and in Kitty Hollow Lake are approximately 9 to 9.5 hours apart in the design storm event, and, rather than representing a peak-on-peak event, would more appropriately represent two 1% storms occurring back-to-back (another 1% rainfall occurring while Kitty Hollow Lake was still at its maximum water surface), which is an event with a much lower frequency than a 1% annual chance.

Regardless of the likelihood of the event, a model was created in order to show this condition. In order to create the model, the ditch sections downstream of the weir were removed from the model so that the downstream end of the ditch began at the weir. Existing and Ultimate Conditions 1% water surface elevations are shown in the figure below and are compared with the original steady flow profiles. As noted in Figure 2 below, the peak water surface elevations are approximately 0.4 feet higher at the upstream end but remain below the identified bank elevations. Information comparing these elevations in the separate plans is attached to this memorandum.

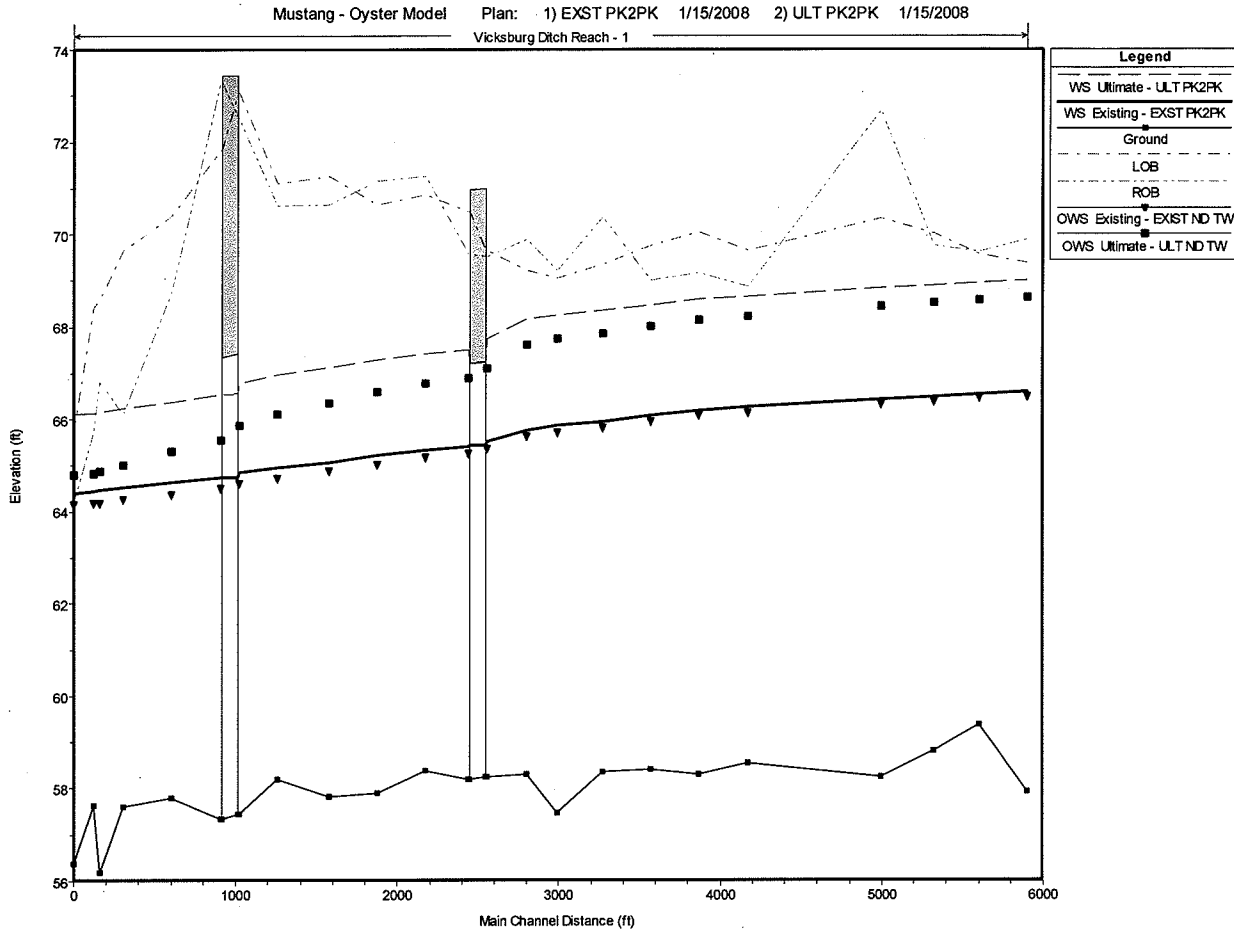


Figure 2: Vicksburg Ditch Profile Comparison – Normal Depth vs. Kitty Hollow Peak Starting Tail-water Conditions

Closing

The results of our steady flow analysis of the Vicksburg ditch are similar to those found using unsteady flow. Water surface elevations are slightly higher, due to the steady flow assumption of coincidental peaks. Given the flat slope of the ditch and the tailwater conditions that can be affected by Kitty Hollow Lake, it is our opinion that the unsteady flow analysis is a more accurate representation of the conditions within the Vicksburg watershed. However, the steady flow analysis shows that 1% existing and ultimate water surface elevations are contained within the channel banks of Vicksburg Ditch.



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AUSTIN
DALLAS
HOUSTON
THE WOODLANDS

December 7, 2007

TO: KEVIN VOGEL

Mr. Scott Elmer, P.E.
Director of Public Works City of Missouri City
1522 Texas Parkway
Missouri City, Texas 77489

Re: Kitty Hollow Lake Model

Dear Mr. Elmer:

On October 31, 2007 we attended a technical meeting at your office where Dodson & Associates presented their technical revisions to the drainage analysis in response to our previous concerns about the DRAINAGE PLAN. The engineering consultants from Fort Bend MUDs 47 (Marvin Zahradnik and John Grounds) and 48 (Jones & Carter) were in attendance with you, your consultant (Dodson) and Fort Bend County Drainage District representatives. In the meeting we discussed our previous concerns and your response. The primary revisions were based on the unsteady state modeling in HEC-RAS.

In the meeting, we requested the models for review and received them on November 1, 2007. Our review of the models for Kitty Hollow Lake and the adjacent watercourses found that the analysis appears to adequately represent the interaction of Kitty Hollow Lake and its adjacent watercourses and in particular the Vicksburg ditch. The only additional item we are requesting is that a steady state analysis be completed on the Vicksburg ditch to allow a direct comparison to the previous models for Vicksburg.

We have discussed the modeling and this request with John Grounds and are in concurrence with the technical aspects of the modeling to be included in the revised report.

We believe you and your consultant have taken every effort to address our comments and concerns and provided adequate responses to the issues. It is our understanding that the additional work will be incorporated into a revised report for distribution.

Should you have any questions, or require additional information, please call Chris Argo or myself at (713) 777-5337.

Sincerely,

Scott C. Saenger, P.E.

SCS/cba/ras

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cc: Mr. Jon Grounds, P.E. – Grounds Anderson, L.L.C
Mr. Marvin Zahradnik, P.E. – Fort Bend County MUD No. 47 Engineer
Ms. Robin Bobbitt – Johnson Radcliffe Petrov & Bobbitt PLLC
Board of Directors – Vicksburg Joint Powers

Weir Cross-Section

Stat (ft)	Eleva (ft)
0	65.19
7	63.17
48	63.6
108	63.32
173	63.25
240	63.25
248	64.25

Weir Data

C	2.65	
Crest Elv	63.17	ft
Length	240	ft

Culvert Flow

Q (cfs)	EG (ft)
10	59.1
70	62.66
80	63.28
90	63.92
100	64.61
105	64.96
110	65.33
115	65.71
120	66.09
123	66.33
125	66.49
130	66.56
135	66.56

Head (ft)	Flow (cfs)
0	0.00
0	0.00
0.11	23.20
0.75	413.09
1.44	1099.01
1.79	1523.13
2.16	2019.01
2.54	2574.59
2.92	3173.45
3.16	3572.63
3.32	3847.37
3.39	3969.69
3.39	3969.69

Q Total (cfs)

10.00
70.00
103.20
503.09
1199.01
1628.13
2129.01
2689.59
3293.45
3695.63
3972.37
4099.69
4104.69

Diversion Rating Curve

DI (cfs)	DQ (cfs)
10	10
70	70
103	80
503	90
1199	100
1628	105
2129	110
2690	115
3293	120
3696	123
3972	125
4100	130
4105	135

HEC-RAS Output for Current Conditions

River: Vicksburg Ditch		Reach: Reach - 1					
Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)
Reach - 1	2300	PF 1	10	56.37	59.1	56.95	59.1
Reach - 1	2300	PF 2	70	56.37	62.64	57.94	62.66
Reach - 1	2300	PF 3	80	56.37	63.25	58.06	63.28
Reach - 1	2300	PF 4	90	56.37	63.9	58.18	63.92
Reach - 1	2300	PF 5	100	56.37	64.58	58.29	64.61
Reach - 1	2300	PF 6	105	56.37	64.94	58.33	64.96
Reach - 1	2300	PF 7	110	56.37	65.3	58.37	65.33
Reach - 1	2300	PF 8	115	56.37	65.68	58.43	65.71
Reach - 1	2300	PF 9	120	56.37	66.06	58.48	66.09
Reach - 1	2300	PF 10	123	56.37	66.3	58.51	66.33
Reach - 1	2300	PF 11	125	56.37	66.46	58.52	66.49
Reach - 1	2300	PF 12	130	56.37	66.56	58.56	66.56
Reach - 1	2300	PF 13	135	56.37	66.56	58.61	66.56

itch	Reach: Reach - 1	Profile: Max WS						Existing	Ultimate
	Reach	River Sta	Profile	Plan	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Difference (ft)	Difference (ft)
	Reach - 1	1283.313	Max WS	Rev Existing	89.72	57.11	62.19		
	Reach - 1	1283.313	Max WS	Rev.Ultimate	117.47	57.11	62.82		
	Reach - 1	1283.313	Existing	Vicks Exist	94	57.11	61.76	-0.43	-0.88
	Reach - 1	1283.313	Ultimate	Vicks Ult	103	57.11	61.94		
	Reach - 1	1581.721	Max WS	Rev Existing	89.72	57.06	62.23		
	Reach - 1	1581.721	Max WS	Rev.Ultimate	117.47	57.06	62.86		
	Reach - 1	1581.721	Existing	Vicks Exist	94	57.06	61.83	-0.4	-0.85
	Reach - 1	1581.721	Ultimate	Vicks Ult	103	57.06	62.01		
	Reach - 1	1878.148	Max WS	Rev Existing	89.73	56.99	62.29		
	Reach - 1	1878.148	Max WS	Rev.Ultimate	117.47	56.99	62.91		
	Reach - 1	1878.148	Existing	Vicks Exist	94	56.99	61.92	-0.37	-0.81
	Reach - 1	1878.148	Ultimate	Vicks Ult	103	56.99	62.1		
	Reach - 1	2129.785	Max WS	Rev Existing	89.74	56.81	62.33		
	Reach - 1	2129.785	Max WS	Rev.Ultimate	117.47	56.81	62.95		
	Reach - 1	2129.785	Existing	Vicks Exist	94	56.81	61.98	-0.35	-0.78
	Reach - 1	2129.785	Ultimate	Vicks Ult	103	56.81	62.17		
	Reach - 1	2180.874	Max WS	Rev Existing	89.74	55.92	62.31		
	Reach - 1	2180.874	Max WS	Rev.Ultimate	117.47	55.92	62.92		
	Reach - 1	2180.874	Existing	Vicks Exist	94	55.92	61.98	-0.33	-0.76
	Reach - 1	2180.874	Ultimate	Vicks Ult	103	55.92	62.16		
	Reach - 1	21	Diversion Culver		Culvert				
	Reach - 1	2292.567	Max WS	Rev Existing	89.86	56.37	64.39		
	Reach - 1	2292.567	Max WS	Rev.Ultimate	117.48	56.37	66.07		
	Reach - 1	2292.567	Existing	Vicks Exist	94	56.37	64.17	-0.22	-1.28
	Reach - 1	2292.567	Ultimate	Vicks Ult	103	56.37	64.79		
	Reach - 1	2300	Max WS	Rev Existing	89.86	56.37	64.39		
	Reach - 1	2300	Max WS	Rev.Ultimate	117.48	56.37	66.07		
	Reach - 1	2300	Existing	Vicks Exist	94	56.37	64.17	-0.22	-1.28
	Reach - 1	2300	Ultimate	Vicks Ult	103	56.37	64.79		
	Reach - 1	2426.166	Max WS	Rev Existing	64.54	57.63	64.39		
	Reach - 1	2426.166	Max WS	Rev.Ultimate	-50.21	57.63	66.09		
	Reach - 1	2426.166	Existing	Vicks Exist	789	57.63	64.2	-0.19	-1.26
	Reach - 1	2426.166	Ultimate	Vicks Ult	1470	57.63	64.83		
	Reach - 1	2460.764	Max WS	Rev Existing	103.74	56.2	64.39		
	Reach - 1	2460.764	Max WS	Rev.Ultimate	0.2	56.2	66.09		
	Reach - 1	2460.764	Existing	Vicks Exist	789	56.2	64.22	-0.17	-1.2
	Reach - 1	2460.764	Ultimate	Vicks Ult	1470	56.2	64.89		
	Reach - 1	2500			Lat Struct				
	Reach - 1	2602.869	Max WS	Rev Existing	162.62	57.6	64.39		
	Reach - 1	2602.869	Max WS	Rev.Ultimate	90.22	57.6	66.09		
	Reach - 1	2602.869	Existing	Vicks Exist	789	57.6	64.28	-0.11	-1.07
	Reach - 1	2602.869	Ultimate	Vicks Ult	1470	57.6	65.02		
	Reach - 1	2899.453	Max WS	Rev Existing	654.03	57.81	64.43		
	Reach - 1	2899.453	Max WS	Rev.Ultimate	90.22	57.81	66.09		
	Reach - 1	2899.453	Existing	Vicks Exist	789	57.81	64.4	-0.03	-0.79
	Reach - 1	2899.453	Ultimate	Vicks Ult	1470	57.81	65.3		
	Reach - 1	3211.06	Max WS	Rev Existing	659.24	57.34	64.52		
	Reach - 1	3211.06	Max WS	Rev.Ultimate	90.23	57.34	66.09		
	Reach - 1	3211.06	Existing	Vicks Exist	789	57.34	64.53	0.01	-0.53
	Reach - 1	3211.06	Ultimate	Vicks Ult	1470	57.34	65.56		
	Reach - 1	3	Lake Shore Harbo		Culvert				
	Reach - 1	3322.115	Max WS	Rev Existing	661.26	57.44	64.61		
	Reach - 1	3322.115	Max WS	Rev.Ultimate	95.65	57.44	66.1		
	Reach - 1	3322.115	Existing	Vicks Exist	789	57.44	64.64	0.03	-0.22
	Reach - 1	3322.115	Ultimate	Vicks Ult	1470	57.44	65.88		
	Reach - 1	3558.066	Max WS	Rev Existing	662.92	58.2	64.68		
	Reach - 1	3558.066	Max WS	Rev.Ultimate	95.65	58.2	66.1		
	Reach - 1	3558.066	Existing	Vicks Exist	789	58.2	64.75	0.07	0.02

Reach - 1	3558.066	Ultimate	Vicks Ult	1470	58.2	66.12		
Reach - 1	3877.001	Max WS	Rev Existing	633.97	57.83	64.8		
Reach - 1	3877.001	Max WS	Rev.Ultimate	92.57	57.83	66.1		
Reach - 1	3877.001	Existing	Vicks Exist	671	57.83	64.9	0.1	0.26
Reach - 1	3877.001	Ultimate	Vicks Ult	1239	57.83	66.36		
Reach - 1	4172.941	Max WS	Rev Existing	606.47	57.91	64.95		
Reach - 1	4172.941	Max WS	Rev.Ultimate	1103.17	57.91	66.17		
Reach - 1	4172.941	Existing	Vicks Exist	671	57.91	65.05	0.1	0.42
Reach - 1	4172.941	Ultimate	Vicks Ult	1239	57.91	66.59		
Reach - 1	4474.405	Max WS	Rev Existing	578.44	58.4	65.07		
Reach - 1	4474.405	Max WS	Rev.Ultimate	1051.64	58.4	66.36		
Reach - 1	4474.405	Existing	Vicks Exist	671	58.4	65.19	0.12	0.42
Reach - 1	4474.405	Ultimate	Vicks Ult	1239	58.4	66.78		
Reach - 1	4739.578	Max WS	Rev Existing	553.79	58.21	65.14		
Reach - 1	4739.578	Max WS	Rev.Ultimate	1006.39	58.21	66.43		
Reach - 1	4739.578	Existing	Vicks Exist	671	58.21	65.29	0.15	0.46
Reach - 1	4739.578	Ultimate	Vicks Ult	1239	58.21	66.89		
Reach - 1	9 Vicksburg Bridge			Culvert				
Reach - 1	4853.178	Max WS	Rev Existing	553.79	58.25	65.22		
Reach - 1	4853.178	Max WS	Rev.Ultimate	1006.39	58.25	66.63		
Reach - 1	4853.178	Existing	Vicks Exist	671	58.25	65.38	0.16	0.48
Reach - 1	4853.178	Ultimate	Vicks Ult	1239	58.25	67.11		
Reach - 1	5095.294	Max WS	Rev Existing	531.35	58.32	65.4		
Reach - 1	5095.294	Max WS	Rev.Ultimate	965.54	58.32	66.97		
Reach - 1	5095.294	Existing	Vicks Exist	671	58.32	65.66	0.26	0.64
Reach - 1	5095.294	Ultimate	Vicks Ult	1239	58.32	67.61		
Reach - 1	5289.216	Max WS	Rev Existing	513.27	57.48	65.47		
Reach - 1	5289.216	Max WS	Rev.Ultimate	932.43	57.48	67.07		
Reach - 1	5289.216	Existing	Vicks Exist	537	57.48	65.75	0.28	0.67
Reach - 1	5289.216	Ultimate	Vicks Ult	991	57.48	67.74		
Reach - 1	5568.561	Max WS	Rev Existing	486.94	58.35	65.58		
Reach - 1	5568.561	Max WS	Rev.Ultimate	884.68	58.35	67.22		
Reach - 1	5568.561	Existing	Vicks Exist	537	58.35	65.85	0.27	0.64
Reach - 1	5568.561	Ultimate	Vicks Ult	991	58.35	67.86		
Reach - 1	5869.236	Max WS	Rev Existing	458.61	58.42	65.71		
Reach - 1	5869.236	Max WS	Rev.Ultimate	833.27	58.42	67.39		
Reach - 1	5869.236	Existing	Vicks Exist	537	58.42	65.98	0.27	0.62
Reach - 1	5869.236	Ultimate	Vicks Ult	991	58.42	68.01		
Reach - 1	6166.936	Max WS	Rev Existing	430.6	58.31	65.82		
Reach - 1	6166.936	Max WS	Rev.Ultimate	782.41	58.31	67.54		
Reach - 1	6166.936	Existing	Vicks Exist	403	58.31	66.1	0.28	0.62
Reach - 1	6166.936	Ultimate	Vicks Ult	743	58.31	68.16		
Reach - 1	6467.022	Max WS	Rev Existing	402.36	58.54	65.93		
Reach - 1	6467.022	Max WS	Rev.Ultimate	731.1	58.54	67.68		
Reach - 1	6467.022	Existing	Vicks Exist	403	58.54	66.18	0.25	0.56
Reach - 1	6467.022	Ultimate	Vicks Ult	743	58.54	68.24		
Reach - 1	7291.603	Max WS	Rev Existing	324.68	58.24	66.15		
Reach - 1	7291.603	Max WS	Rev.Ultimate	590.37	58.24	67.96		
Reach - 1	7291.603	Existing	Vicks Exist	403	58.24	66.36	0.21	0.5
Reach - 1	7291.603	Ultimate	Vicks Ult	743	58.24	68.46		
Reach - 1	7621.412	Max WS	Rev Existing	293.01	58.83	66.19		
Reach - 1	7621.412	Max WS	Rev.Ultimate	532.84	58.83	68.01		
Reach - 1	7621.412	Existing	Vicks Exist	403	58.83	66.41	0.22	0.51
Reach - 1	7621.412	Ultimate	Vicks Ult	743	58.83	68.52		
Reach - 1	7902.004	Max WS	Rev Existing	266.37	59.37	66.23		
Reach - 1	7902.004	Max WS	Rev.Ultimate	484.41	59.37	68.06		
Reach - 1	7902.004	Existing	Vicks Exist	268	59.37	66.48	0.25	0.53
Reach - 1	7902.004	Ultimate	Vicks Ult	496	59.37	68.59		
Reach - 1	8203.587	Max WS	Rev Existing	266.58	57.92	66.28		
Reach - 1	8203.587	Max WS	Rev.Ultimate	485.42	57.92	68.12		
Reach - 1	8203.587	Existing	Vicks Exist	268	57.92	66.52	0.24	0.52
Reach - 1	8203.587	Ultimate	Vicks Ult	496	57.92	68.64		

HEC-RAS Reach	River: Vicksburg Ditch River Sta	Profile	Reach: Reach - 1 Plan	Profile: Existing Q Total (cfs)	W.S. Elev (ft)	Existing Difference	Ultimate Difference
Reach - 1	8203.587	Existing	Vicks Exist	268	66.52		
Reach - 1	8203.587	Ultimate	Vicks Ult	496	68.64		
Reach - 1	8203.587	Ultimate	ULT PK2P	496	69	0.08	0.36
Reach - 1	8203.587	Existing	EXST PK2	268	66.6		
Reach - 1	7902.004	Existing	Vicks Exist	268	66.48		
Reach - 1	7902.004	Ultimate	Vicks Ult	496	68.59		
Reach - 1	7902.004	Ultimate	ULT PK2P	496	68.96	0.07	0.37
Reach - 1	7902.004	Existing	EXST PK2	268	66.55		
Reach - 1	7621.412	Existing	Vicks Exist	403	66.41		
Reach - 1	7621.412	Ultimate	Vicks Ult	743	68.52		
Reach - 1	7621.412	Ultimate	ULT PK2P	743	68.9	0.08	0.38
Reach - 1	7621.412	Existing	EXST PK2	403	66.49		
Reach - 1	7291.603	Existing	Vicks Exist	403	66.36		
Reach - 1	7291.603	Ultimate	Vicks Ult	743	68.46		
Reach - 1	7291.603	Ultimate	ULT PK2P	743	68.84	0.08	0.38
Reach - 1	7291.603	Existing	EXST PK2	403	66.44		
Reach - 1	6467.022	Existing	Vicks Exist	403	66.18		
Reach - 1	6467.022	Ultimate	Vicks Ult	743	68.24		
Reach - 1	6467.022	Ultimate	ULT PK2P	743	68.67	0.09	0.43
Reach - 1	6467.022	Existing	EXST PK2	403	66.27		
Reach - 1	6166.936	Existing	Vicks Exist	403	66.1		
Reach - 1	6166.936	Ultimate	Vicks Ult	743	68.16		
Reach - 1	6166.936	Ultimate	ULT PK2P	743	68.6	0.1	0.44
Reach - 1	6166.936	Existing	EXST PK2	403	66.2		
Reach - 1	5869.236	Existing	Vicks Exist	537	65.98		
Reach - 1	5869.236	Ultimate	Vicks Ult	991	68.01		
Reach - 1	5869.236	Ultimate	ULT PK2P	991	68.48	0.1	0.47
Reach - 1	5869.236	Existing	EXST PK2	537	66.08		
Reach - 1	5568.561	Existing	Vicks Exist	537	65.85		
Reach - 1	5568.561	Ultimate	Vicks Ult	991	67.86		
Reach - 1	5568.561	Ultimate	ULT PK2P	991	68.36	0.11	0.5
Reach - 1	5568.561	Existing	EXST PK2	537	65.96		
Reach - 1	5289.216	Existing	Vicks Exist	537	65.75		
Reach - 1	5289.216	Ultimate	Vicks Ult	991	67.74		
Reach - 1	5289.216	Ultimate	ULT PK2P	991	68.26	0.12	0.52
Reach - 1	5289.216	Existing	EXST PK2	537	65.87		
Reach - 1	5095.294	Existing	Vicks Exist	671	65.66		
Reach - 1	5095.294	Ultimate	Vicks Ult	1239	67.61		
Reach - 1	5095.294	Ultimate	ULT PK2P	1239	68.17	0.12	0.56
Reach - 1	5095.294	Existing	EXST PK2	671	65.78		
Reach - 1	4853.178	Existing	Vicks Exist	671	65.38		
Reach - 1	4853.178	Ultimate	Vicks Ult	1239	67.11		
Reach - 1	4853.178	Ultimate	ULT PK2P	1239	67.75	0.14	0.64
Reach - 1	4853.178	Existing	EXST PK2	671	65.52		
Reach - 1	4796.529	Vicksburg Bridge	Culvert				
Reach - 1	4739.578	Existing	Vicks Exist	671	65.29		
Reach - 1	4739.578	Ultimate	Vicks Ult	1239	66.89		
Reach - 1	4739.578	Ultimate	ULT PK2P	1239	67.5	0.14	0.61
Reach - 1	4739.578	Existing	EXST PK2	671	65.43		
Reach - 1	4474.405	Existing	Vicks Exist	671	65.19		
Reach - 1	4474.405	Ultimate	Vicks Ult	1239	66.78		
Reach - 1	4474.405	Ultimate	ULT PK2P	1239	67.44	0.15	0.66
Reach - 1	4474.405	Existing	EXST PK2	671	65.34		

Reach - 1	4172.941	Existing	Vicks Exist	671	65.05		
Reach - 1	4172.941	Ultimate	Vicks Ult	1239	66.59		
Reach - 1	4172.941	Ultimate	ULT PK2P	1239	67.3	0.17	0.71
Reach - 1	4172.941	Existing	EXST PK2	671	65.22		
Reach - 1	3877.001	Existing	Vicks Exist	671	64.9		
Reach - 1	3877.001	Ultimate	Vicks Ult	1239	66.36		
Reach - 1	3877.001	Ultimate	ULT PK2P	1239	67.14	0.18	0.78
Reach - 1	3877.001	Existing	EXST PK2	671	65.08		
Reach - 1	3558.066	Existing	Vicks Exist	789	64.75		
Reach - 1	3558.066	Ultimate	Vicks Ult	1470	66.12		
Reach - 1	3558.066	Ultimate	ULT PK2P	1470	66.98	0.2	0.86
Reach - 1	3558.066	Existing	EXST PK2	789	64.95		
Reach - 1	3322.115	Existing	Vicks Exist	789	64.64		
Reach - 1	3322.115	Ultimate	Vicks Ult	1470	65.88		
Reach - 1	3322.115	Ultimate	ULT PK2P	1470	66.79	0.21	0.91
Reach - 1	3322.115	Existing	EXST PK2	789	64.85		
Reach - 1	3265.263	Lake Shore Harbo	Culvert				
Reach - 1	3211.06	Existing	Vicks Exist	789	64.53		
Reach - 1	3211.06	Ultimate	Vicks Ult	1470	65.56		
Reach - 1	3211.06	Ultimate	ULT PK2P	1470	66.54	0.21	0.98
Reach - 1	3211.06	Existing	EXST PK2	789	64.74		
Reach - 1	2899.453	Existing	Vicks Exist	789	64.4		
Reach - 1	2899.453	Ultimate	Vicks Ult	1470	65.3		
Reach - 1	2899.453	Ultimate	ULT PK2P	1470	66.39	0.23	1.09
Reach - 1	2899.453	Existing	EXST PK2	789	64.63		
Reach - 1	2602.869	Existing	Vicks Exist	789	64.28		
Reach - 1	2602.869	Ultimate	Vicks Ult	1470	65.02		
Reach - 1	2602.869	Ultimate	ULT PK2P	1470	66.24	0.24	1.22
Reach - 1	2602.869	Existing	EXST PK2	789	64.52		
Reach - 1	2460.764	Existing	Vicks Exist	789	64.22		
Reach - 1	2460.764	Ultimate	Vicks Ult	1470	64.89		
Reach - 1	2460.764	Ultimate	ULT PK2P	1470	66.17	0.25	1.28
Reach - 1	2460.764	Existing	EXST PK2	789	64.47		
Reach - 1	2426.166	Existing	Vicks Exist	789	64.2		
Reach - 1	2426.166	Ultimate	Vicks Ult	1470	64.83		
Reach - 1	2426.166	Ultimate	ULT PK2P	1470	66.14	0.25	1.31
Reach - 1	2426.166	Existing	EXST PK2	789	64.45		
Reach - 1	2300	Existing	Vicks Exist	94	64.17		
Reach - 1	2300	Ultimate	Vicks Ult	103	64.79		
Reach - 1	2300	Ultimate	ULT PK2P	1470	66.1	0.23	1.31
Reach - 1	2300	Existing	EXST PK2	789	64.4		
Reach - 1	2292.567	Existing	Vicks Exist	94	64.17		
Reach - 1	2292.567	Ultimate	Vicks Ult	103	64.79	n/a	n/a
Reach - 1	2259.321	Diversion Culver	Culvert				
Reach - 1	2180.874	Existing	Vicks Exist	94	61.98		
Reach - 1	2180.874	Ultimate	Vicks Ult	103	62.16	n/a	n/a
Reach - 1	2129.785	Existing	Vicks Exist	94	61.98		
Reach - 1	2129.785	Ultimate	Vicks Ult	103	62.17	n/a	n/a
Reach - 1	1878.148	Existing	Vicks Exist	94	61.92		
Reach - 1	1878.148	Ultimate	Vicks Ult	103	62.1	n/a	n/a
Reach - 1	1581.721	Existing	Vicks Exist	94	61.83		
Reach - 1	1581.721	Ultimate	Vicks Ult	103	62.01	n/a	n/a
Reach - 1	1283.313	Existing	Vicks Exist	94	61.76		
Reach - 1	1283.313	Ultimate	Vicks Ult	103	61.94	n/a	n/a