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Southwest Pass Outlets Bathymetry and Flow Distribution Assessment

MRG&P Report No. 5 • July 2015

MRG&P
Mississippi River Geomorphology & Potamology Program

Report prepared for the Mississippi River Commission

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Potamology Program

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Southwest Pass Outlets Bathymetry and Flow Distribution Assessment

Data Collection Summary and Analysis

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Final report

Abstract

The Southwest Pass distributary of the Mississippi River is the primary navigable channel connecting the Gulf of Mexico and the Mississippi River. The average expenditure of the U. S. Government on Southwest Pass and the lower Mississippi River dredging has averaged approximately $55 million/year for the previous 5 years. Numerical modeling tools covering this important navigational route are being developed to provide a better understanding of the impact of proposed Mississippi River system changes. Understanding the flow exchange between the Southwest Pass distributary and the surrounding Gulf of Mexico under various river and tide conditions is essential to the development of these analytic modeling tools to be used to predict system response to proposed upriver diversions and dredging templates resulting from navigable channel deepening proposals. The ongoing development of these numerical modeling tools has revealed a data need for bathymetry and velocity information for the four major lateral outlets of the Southwest Pass. Multi-beam channel bed surveys and Acoustic Doppler Current Profiler data were collected over 3 days. The collected data will be used to calibrate the flow exchange and improve the predictive ability of the multidimensional numerical models and the resulting water/sediment ratios at the four lateral outlets.

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Preface

The research documented in this report was conducted as part of the Mississippi River Geomorphology and Potamology (MRG&P) Program. The MRG&P is part of the Mississippi River and Tributaries Program (MR&T) and is managed by the U.S. Army Corps of Engineers (USACE), Mississippi Valley Division (MVD), and Districts. The MRG&P Senior Program Manager was Freddie Pinkard and the Technical Director was Dr. Barbara Kleiss. The MVD Commander was MG Michael C. Wehr. The MVD Director of Programs was Edward Belk.

Mississippi River engineering direction and policy advice were provided by the Mississippi River Commission. The Commission members were MG Wehr, USACE; the Honorable Sam E. Angel; the Honorable R. D. James; the Honorable Norma Jean Mattei, Ph.D.; RDML Gerd F. Glang, National Oceanic and Atmospheric Administration; BG Margaret W. Burcham, USACE; and BG John S. Kem, USACE.

This report was prepared by Steven K. Ayres, P.E., of USACE-New Orleans District. The report was prepared under the general supervision of David A. Ramirez, P.E., Chief, River Engineering Section; Julie Z. LeBlanc, P.E., Chief, Hydraulics & Hydrologic Branch; and John C. Bivona, P.E., Chief, Engineering Division. COL Richard L. Hansen was Commander of New Orleans District. Research in support of the MRG&P was conducted by the U.S. Army Engineer Research and Development Center (ERDC) under the purview of the Coastal and Hydraulics Laboratory (CHL), Vicksburg, MS.

This report would not have been possible without the help of New Orleans District (MVN) and United States Geological Survey (USGS) personnel. In particular, thanks are extended to Michael French (MVN), Jonathan Flowers (MVN), and Garron Ross (USGS). Thanks are also extended to Chustz Surveying Inc. Additionally, thanks are extended to Loren Wehmeyer (ERDC) and Ty Wamsley (ERDC) for providing reviews and suggestions to help improve the final product.

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Unit Conversion Factors

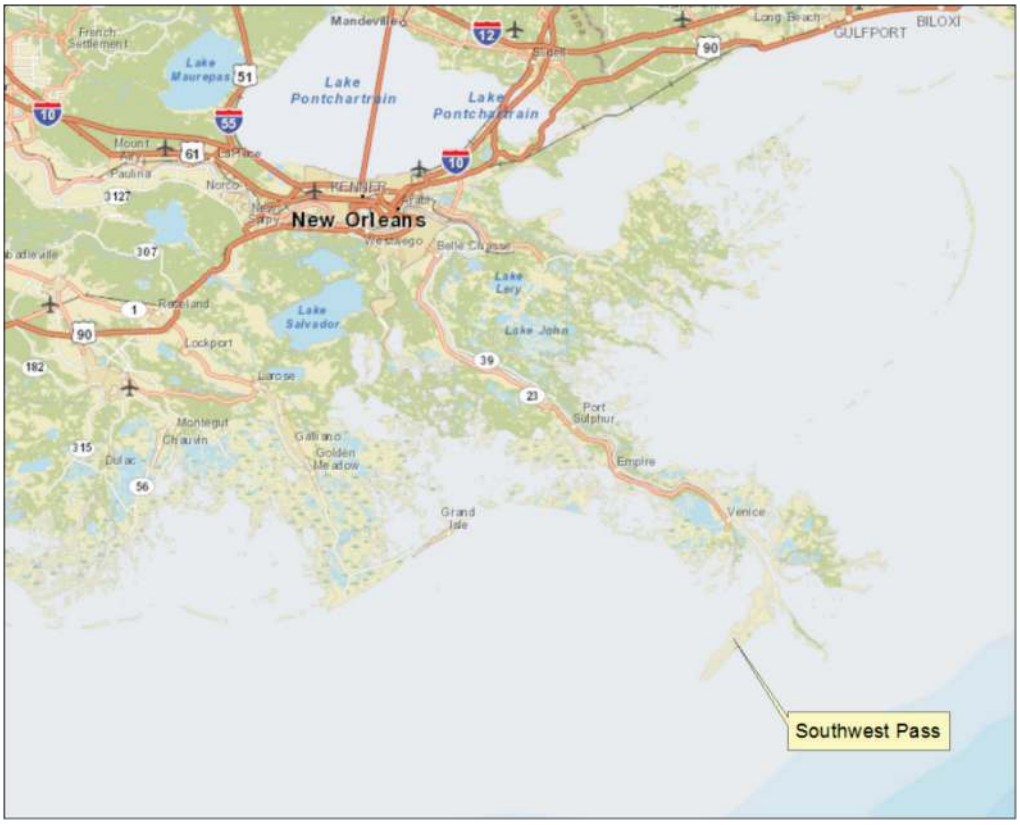
Multiply	By	To Obtain
cubic feet	0.02831685	cubic meters
feet	0.3048	meters
miles (nautical)	1,852	meters
miles (U.S. statute)	1,609.347	meters
square feet	0.09290304	square meters
square miles	2.589998 E+06	square meters
square yards	0.8361274	square meters

1 Introduction

Background

The Southwest Pass distributary is the main navigable channel in the modern Mississippi River delta connecting the lower Mississippi River channel to the Gulf of Mexico (Figure 1). The U.S. Government expends approximately $55 million/year on average for dredging efforts in Southwest Pass and the area around Head of Passes in the lower Mississippi River. The channel is currently maintained to a navigable depth of 45 feet (ft).

Figure 1. Regional map.



Numerical modeling tools covering this important stretch of the navigation route are being developed to study the impact of proposed Mississippi River system changes. An understanding of the flow exchange between the Southwest Pass distributary and the surrounding Gulf of Mexico under various river and tide conditions is essential to the development of these analytic modeling tools that will be used to predict

system response to proposed upriver diversions and dredging templates resulting from navigable channel deepening proposals.

Located along the Southwest Pass channel are four lateral outlets connecting Southwest Pass to the Gulf of Mexico and to various Bays in the Mississippi Delta. Outlets W-1 and W-2 are located on the West side of the channel; Joseph and Burrwood Bayous are located on the East side of the channel (Figure 2).

Figure 2. Southwest Pass lateral outlets.

The flow exchange through these outlets and their entrance[1] width is controlled by rock structures on the Southwest Pass side of the outlets.

Burrwood Bayou has an additional structure that was added in 2004 at the Gulf side of the channel as an emergency measure to prevent avulsion of the channel and improve navigation safety in Southwest Pass near the entrance to Burrwood Bayou. These rock structures are visible in the 2012 imagery displayed here as Figures 3–6.

Figure 3. Outlet W-1 entrance detail.

[1] Henceforth, the entrance to the outlet is defined as the Southwest Pass end of the outlet.

Figure 4. Joseph Bayou entrance detail.

Figure 5. Outlet W-2 entrance detail.

Figure 6. Burrwood Bayou.

Data collection overview

Multi-beam and single-beam surveys were collected at each of the four outlets during June and July 2014. Surveys were concentrated on what was thought to be the main flow paths determined from aerial imagery. Determination of the predominant flow path is complicated by the multiple small channels branching off from the outlet channels as seen in the imagery. Single-beam surveys were collected in areas too shallow for the multi-beam instrumentation to get a more complete coverage of the predominant flow path.

Acoustic Doppler Current Profiler (ADCP) data was collected over a 3-day period from 13–15 May 2014. Cross-section locations were selected upstream and downstream of each outlet in Southwest Pass and in the outlet channel to give a flow budget of the Southwest Pass flow and outlet flow for three different data sets representing various tide conditions.

2 Multi-Beam and Single-Beam Surveys

Data collection methodology

All survey data were collected between 30 June and 17 July 2014 by Chustz Surveying Inc. Topographic data were collected using a Trimble TSC 3, Trimble R8, and a Samsung Galaxy Rugby. The hydrographic data were collected using an Odom Hydrotrac Echo Sounder and a Teledyne RESON SeaBat 7101 multi-beam system. Figures 7–10 show the location of the survey sample points at the four data collection sites.

Figure 7. Outlet W-1 survey samples.

Figure 8. Joseph Bayou survey samples.

Figure 9. Outlet W-2 survey samples.

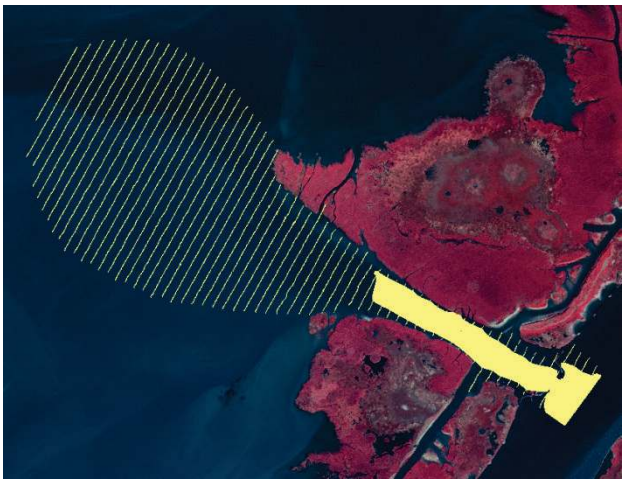


Figure 10. Burrwood Bayou survey samples.

Vertical control for the surveys was established through observation of water level as recorded by the three water level gages in the area located at Head of Passes (gage ID no. 01545), Southwest Pass at River Mile (RM) 7.5 Below Head of Passes (BHP) (gage ID no. 01575), and Southwest Pass at East Jetty (gage ID no. 01670) referenced to NAVD88 (2009.55). Nails were set at each survey site (RM 3.0 BHP, RM 4.5 BHP, RM 9.8 BHP, and RM14.3 BHP) and at the three automatic gage sites. Using a Virtual Reference System (VRS) tied to GULFNet, the nails were surveyed at RM 3.0 BHP and RM 4.5 BHP. Poor cell phone coverage prevented collection of VRS data at the RM 9.8 BHP and RM 14.3 BHP sites. At these sites, the water level was calculated by prorating the water levels at RM 3.0 BHP and RM 4.5 BHP. This information was compared to the water level as

recorded by the automatic gages to establish elevation reference at the two sites without VRS coverage.

Survey results

All of the outlets displayed scour holes of varying degree in size and depth just downstream of their entrances at Southwest Pass. Burrwood Bayou is unique in that it has two scour holes, the largest of which is on the Gulf side of the emergency closure structure which would indicate that the flow through Burrwood Bayou is controlled by the emergency closure structure as intended. Figures 11–18 present survey elevation and scour hole detail for each of the four outlets.

Figure 11. Outlet W-1 bathymetry.

Figure 12. Outlet W-1 scour hole detail.

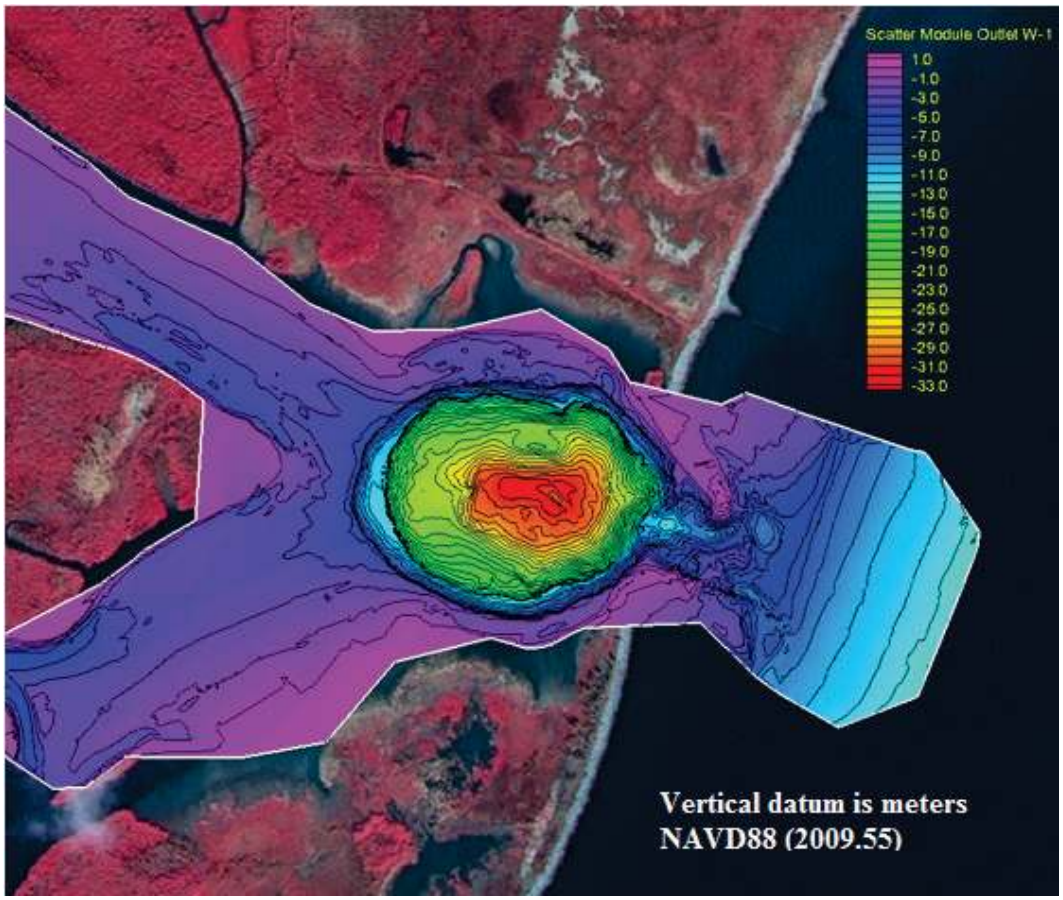


Figure 13. Joseph Bayou bathymetry.

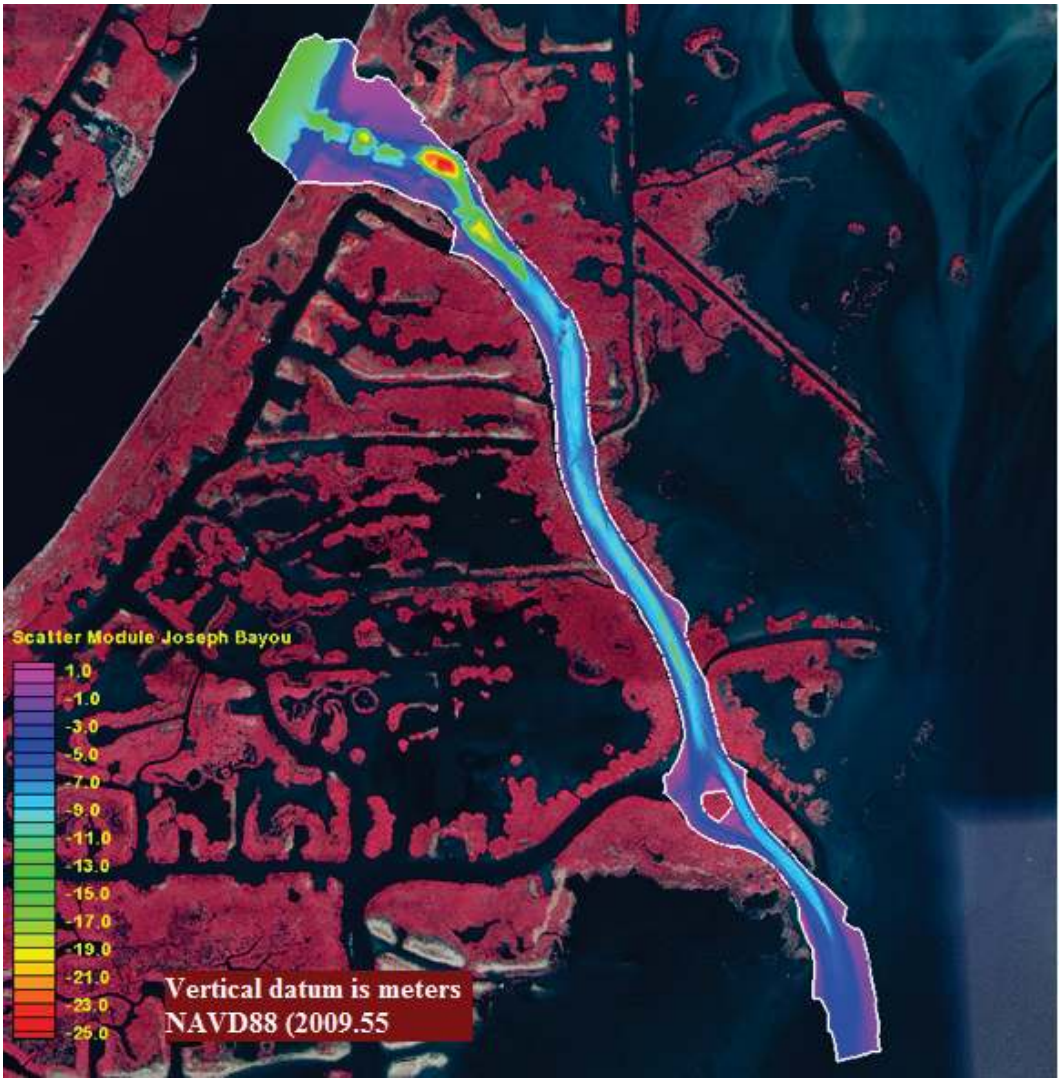


Figure 14. Joseph Bayou scour hole detail.

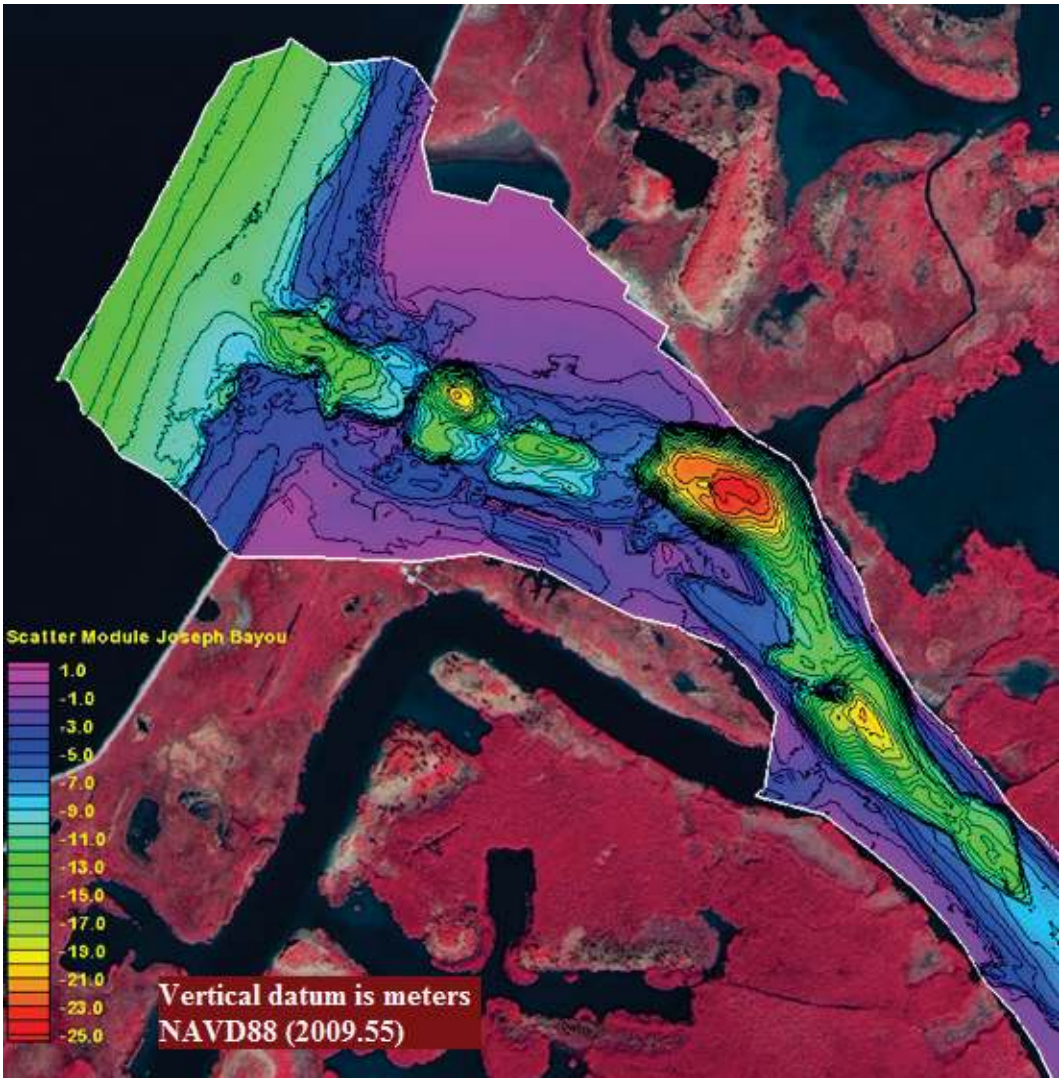


Figure 15. Outlet W-2 bathymetry.

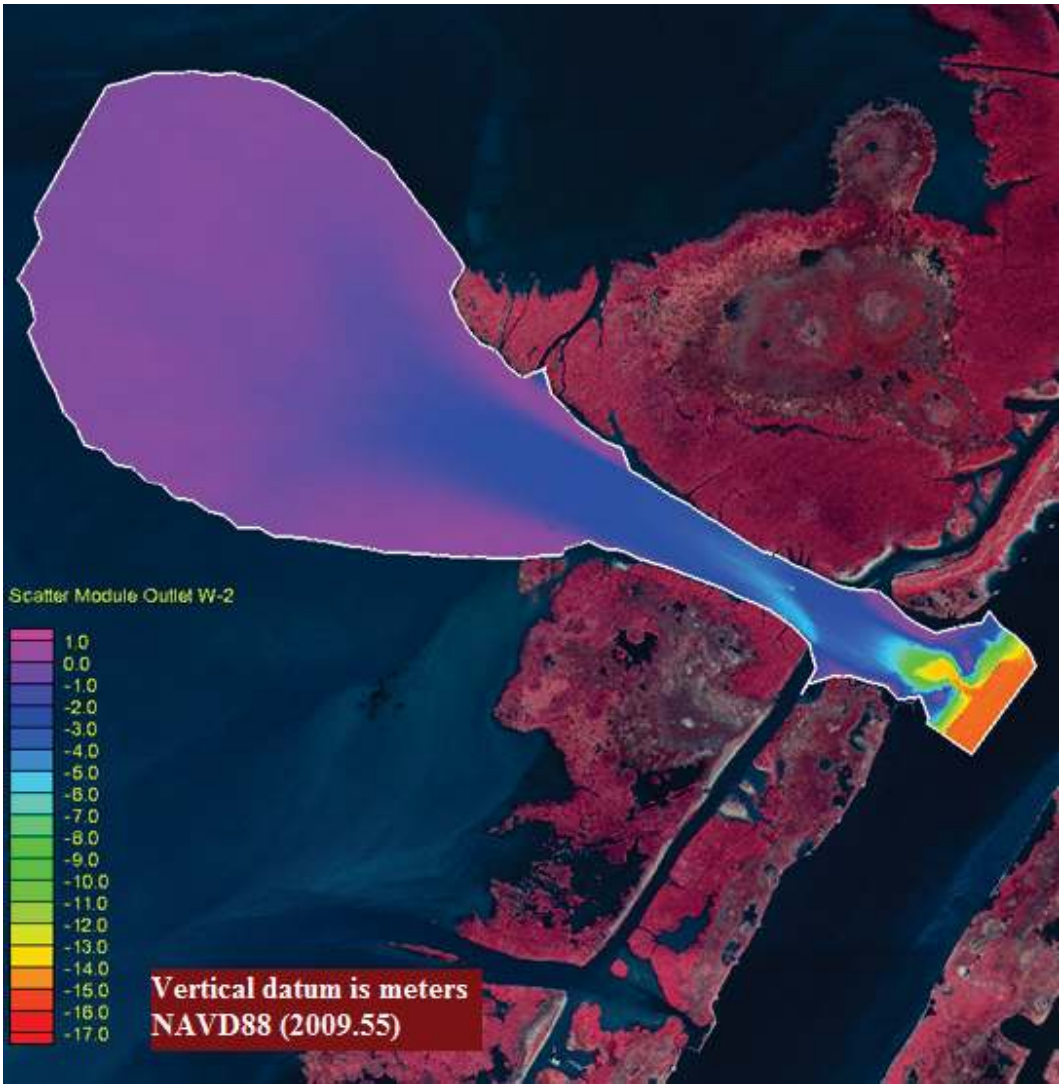


Figure 16. Outlet W-2 scour hole detail.

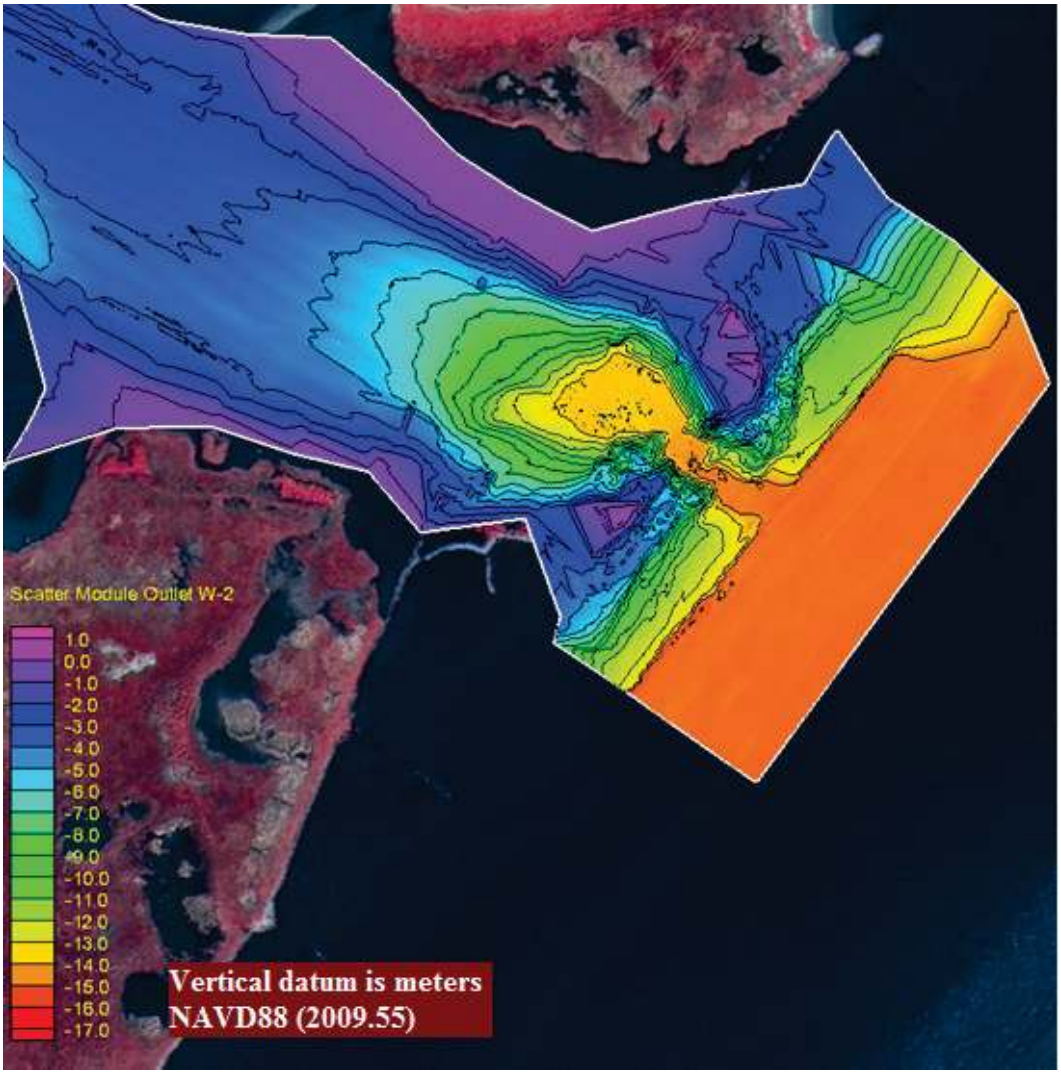


Figure 17. Burrwood Bayou bathymetry.

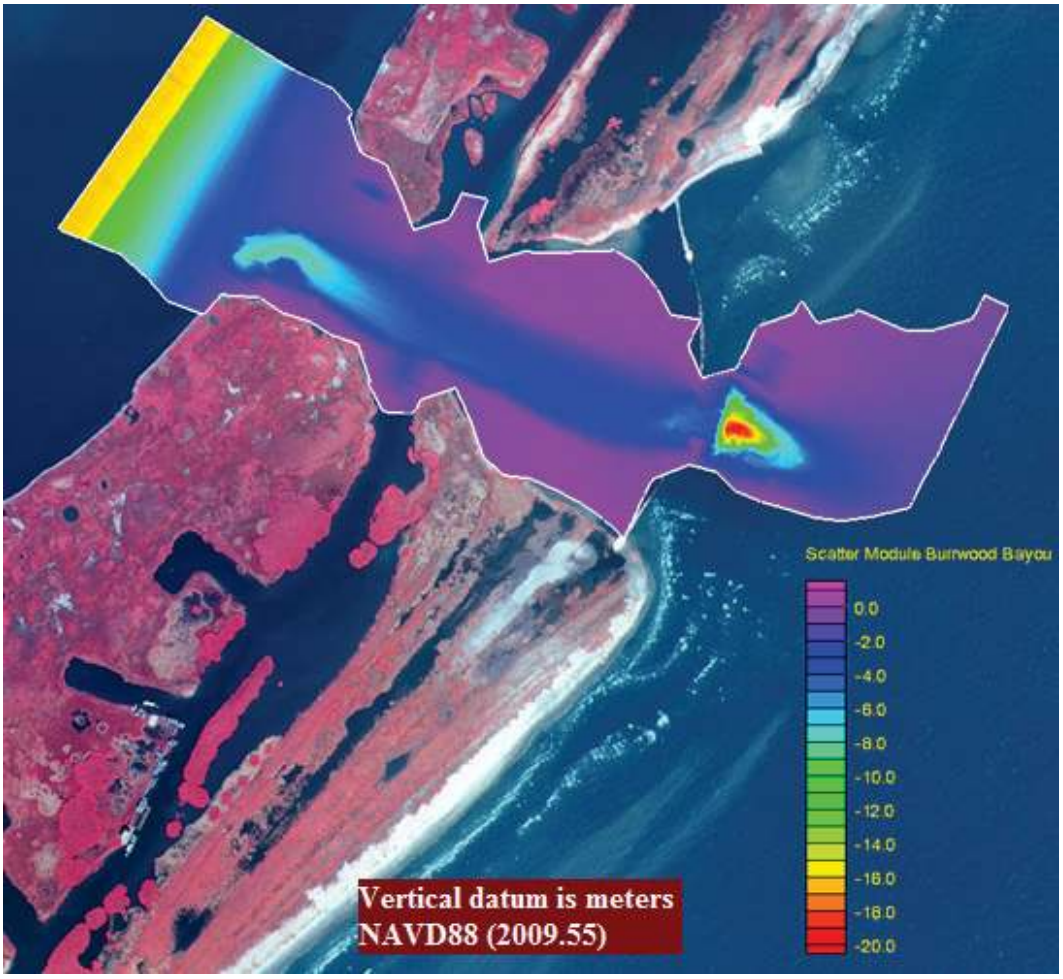
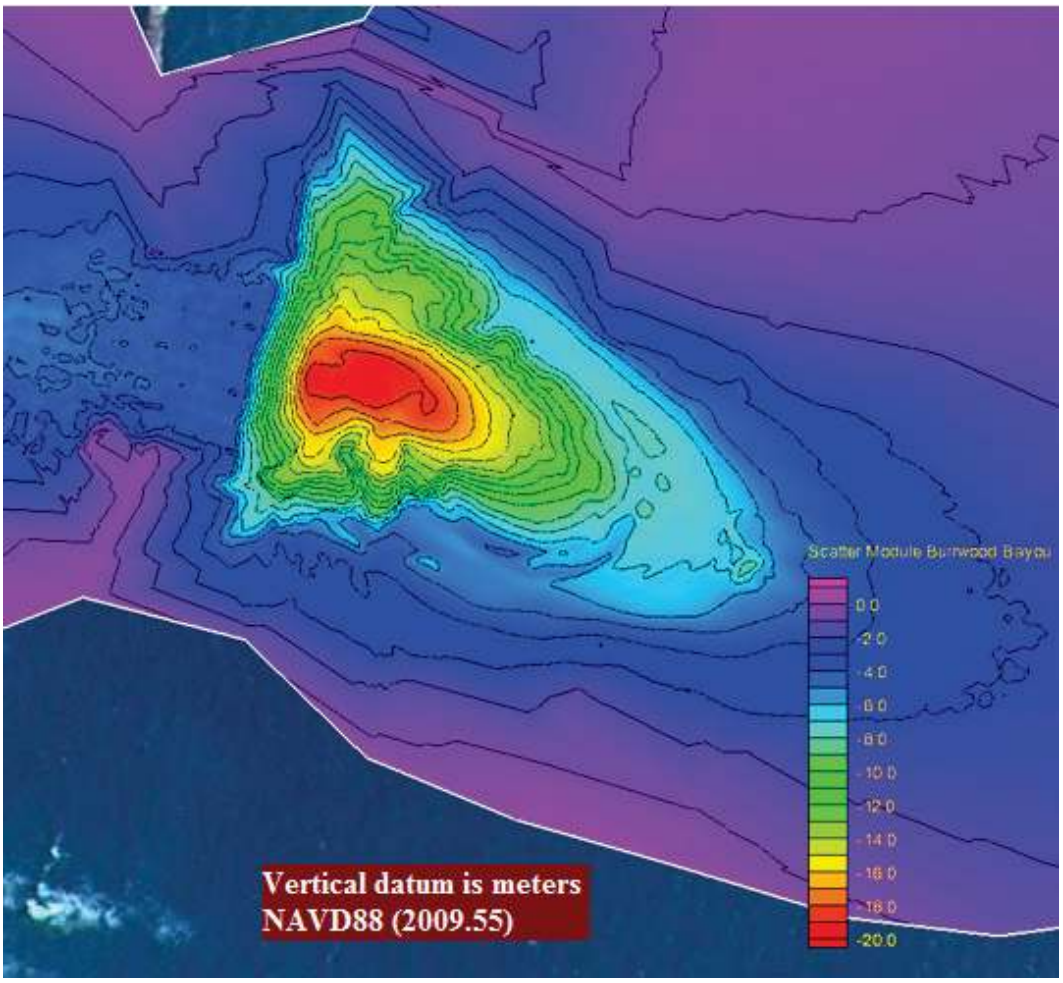


Figure 18. Burrwood Bayou scour hole on the Gulf side of the emergency closure structure.



3 ADCP Data

Data collection methodology

ADCP measurements were taken at each site, including measurements in the outflow channels, and upstream and downstream of the outflow channel in Southwest Pass. Each location included measurements conducted under a variety of tide conditions. The measurements were conducted on 13–15 May 2014 using two RDI 600 MHz WorkHorse Rio Grande Broadband ADCP. The Mississippi River flow conditions for the data collection period are shown in Figure 19. Tide conditions at the mouth of Southwest Pass are shown in Figure 20.

Figure 19. Mississippi River discharge conditions during ADCP data collection period.

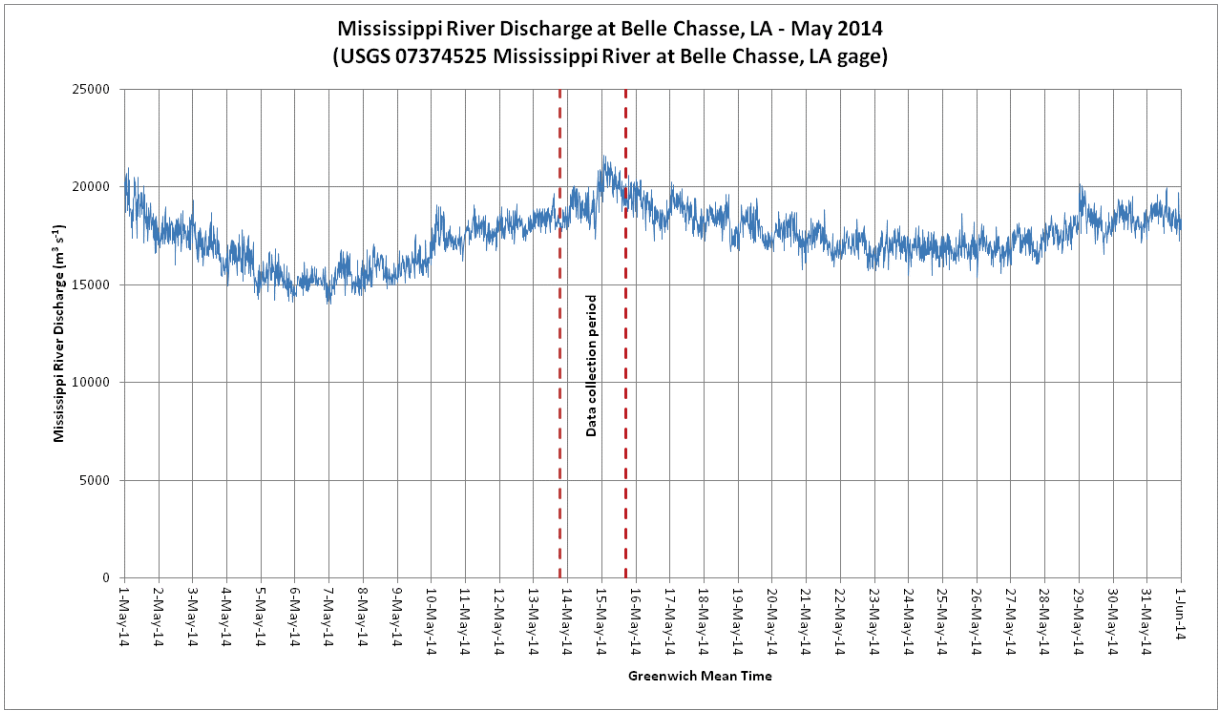
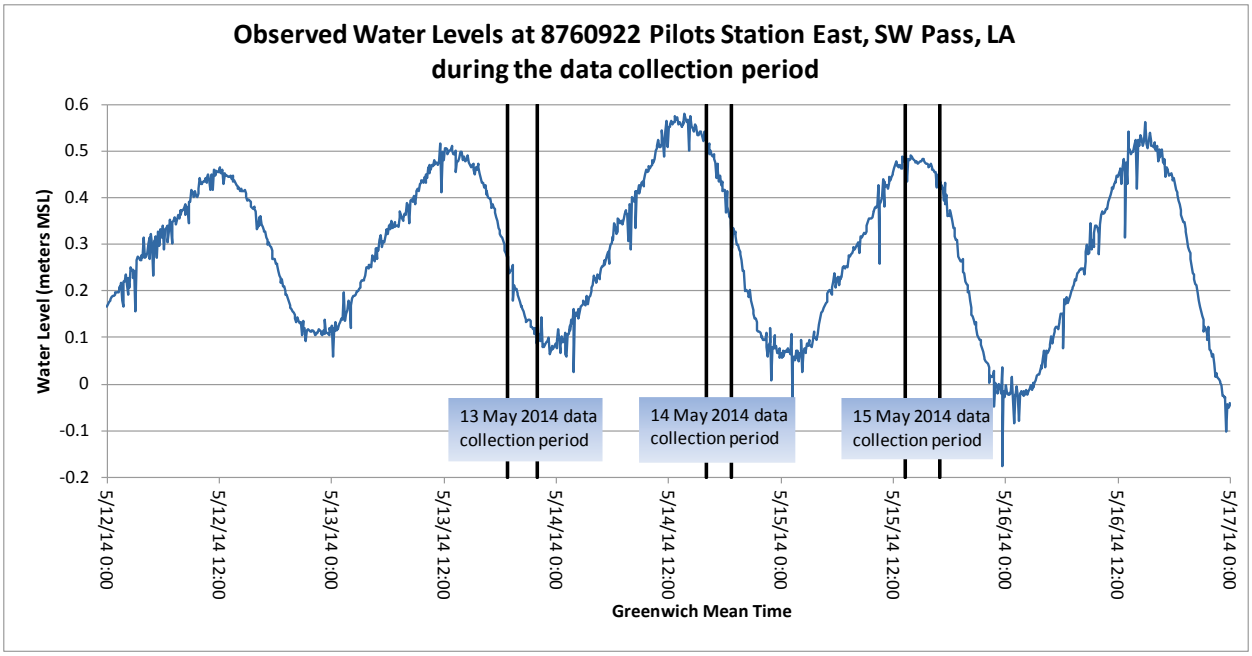


Figure 20. Tide conditions during ADCP measurement periods.



ADCP flow measurement summaries

The ADCP raw data were postprocessed by the Teledyne WinRiver II software. The ADCP data contained samples of stratified flow; therefore, the total flow computed by WinRiver II may represent less flow than the absolute sum of the positive and negative flow. Summary Tables 1–4 present postprocessing results for each data collection site. The total flux column represents the sum of the measured portion of the cross section and the estimates for the unmeasured portions. The delta flux column represents the deviation of the transects' computed flux from the average of all transects at that location and tide condition.

Table 1. ADCP transect summaries for Outlet W-1.

Transect ID	Location of Transect	Tide	Date	Start Time (GMT)	Start Bank	Flux ($m^3 s^{-1}$)						
						Meas.	Top	Bottom	Left	Right	Total	Delta
UULS000	Southwest Pass Upstream of Outlet W-1	Ebb	5/13/2014	21:51:05	Right	5985	691	857	72	44	7649	-4
UULS001	Southwest Pass Upstream of Outlet W-1	Ebb	5/13/2014	21:58:24	Left	6568	768	809	80	43	8268	4
UUSS000	Southwest Pass Upstream of Outlet W-1	Ebb	5/14/2014	18:31:27	Right	4703	533	568	39	21	5865	-6

Transect ID	Location of Transect	Tide	Date	Start Time (GMT)	Start Bank	Flux ($m^3 s^{-1}$)						
						Meas.	Top	Bottom	Left	Right	Total	Delta
UUSS001	Southwest Pass Upstream of Outlet W-1	Ebb	5/14/2014	18:39:14	Left	5258	598	643	40	16	6556	6
UUHS000	Southwest Pass Upstream of Outlet W-1	High	5/15/2014	16:42:08	Right	4148	479	547	69	-4	5239	-7
UUHS001	Southwest Pass Upstream of Outlet W-1	High	5/15/2014	16:49:44	Left	4682	574	670	54	18	5998	7
UILS000	Outlet W-1	Ebb	5/13/2014	21:19:45	Right	335	40	107	-5	0	478	-1
UILS001	Outlet W-1	Ebb	5/13/2014	21:25:00	Left	394	57	142	39	-4	627	30
UILS003	Outlet W-1	Ebb	5/13/2014	21:28:56	Right	295	45	77	12	-7	423	-12
UILS004	Outlet W-1	Ebb	5/13/2014	21:32:17	Left	335	65	113	14	6	533	10
UILS005	Outlet W-1	Ebb	5/13/2014	21:37:05	Right	214	21	78	-19	-33	261	-46
UILS006	Outlet W-1	Ebb	5/13/2014	21:41:57	Left	406	42	129	1	-3	574	19
UISS000	Outlet W-1	Ebb	5/14/2014	18:04:19	Right	203	37	63	-15	-16	273	-36
UISS001	Outlet W-1	Ebb	5/14/2014	18:07:51	Left	279	65	82	46	-6	466	8
UISS002	Outlet W-1	Ebb	5/14/2014	18:10:57	Right	206	46	62	28	-7	335	-22
UISS003	Outlet W-1	Ebb	5/14/2014	18:13:27	Left	420	53	160	22	-10	646	50
UISS004	Outlet W-1	Ebb	5/14/2014	18:20:08	Right	225	63	83	58	-1	428	0
UISS005	Outlet W-1	Ebb	5/14/2014	18:22:40	Left	246	65	84	32	1	429	0
UIHS000	Outlet W-1	High	5/15/2014	16:20:51	Right	259	60	80	75	-4	470	-6
UIHS001	Outlet W-1	High	5/15/2014	16:22:49	Left	255	61	78	64	-6	453	-9
UIHS002	Outlet W-1	High	5/15/2014	16:25:02	Right	264	76	96	73	43	553	11
UIHS003	Outlet W-1	High	5/15/2014	16:27:17	Left	288	79	87	21	-5	469	-6
UIHS004	Outlet W-1	High	5/15/2014	16:30:16	Right	269	87	94	89	18	558	12
UIHS005	Outlet W-1	High	5/15/2014	16:32:50	Left	268	66	84	69	-4	484	-3
UDLC000	Southwest Pass Downstream of Outlet W-1	Ebb	5/13/2014	21:12:19	Right	5888	702	723	36	37	7386	2
UDLC001	Southwest Pass Downstream of Outlet W-1	Ebb	5/13/2014	21:19:57	Left	5649	674	693	43	35	7094	-2
UDSC000	Southwest Pass Downstream of Outlet W-1	Ebb	5/14/2014	18:19:14	Right	4593	543	537	28	21	5722	2
UDSC001	Southwest Pass Downstream of Outlet W-1	Ebb	5/14/2014	18:25:22	Left	4393	519	513	25	19	5470	-2

Transect ID	Location of Transect	Tide	Date	Start Time (GMT)	Start Bank	Flux ($m^3 s^{-1}$)						
						Meas.	Top	Bottom	Left	Right	Total	Delta
UDHC000	Southwest Pass Downstream of Outlet W-1	High	5/15/2014	16:22:16	Right	4224	581	509	38	22	5374	6
UDHC001	Southwest Pass Downstream of Outlet W-1	High	5/15/2014	16:28:22	Left	3772	510	443	36	27	4788	-6

Table 2. ADCP transect summaries for Joseph Bayou.

Transect ID	Location of Transect	Tide	Date	Start Time (GMT)	Start Bank	Flux ($m^3 s^{-1}$)						
						Meas.	Top	Bottom	Left	Right	Total	Delta
JULS001	Southwest Pass Upstream of Joseph Bayou	Ebb	5/13/2014	20:49:56	Left	6313	761	788	37	49	7947	6
JULS002	Southwest Pass Upstream of Joseph Bayou	Ebb	5/13/2014	20:56:09	Right	5564	657	691	41	38	6991	-6
JUSS000	Southwest Pass Upstream of Joseph Bayou	Ebb	5/14/2014	17:39:45	Left	4464	517	583	26	92	5682	8
JUSS001	Southwest Pass Upstream of Joseph Bayou	Ebb	5/14/2014	17:49:22	Right	3822	436	483	37	66	4843	-8
JUHS000	Southwest Pass Upstream of Joseph Bayou	High	5/15/2014	15:58:26	Left	4379	521	541	19	62	5522	7
JUHS001	Southwest Pass Upstream of Joseph Bayou	High	5/15/2014	16:05:57	Right	3797	453	496	18	77	4841	-7
JILC000	Joseph Bayou	Ebb	5/13/2014	20:41:26	Right	321	77	75	111	187	772	5
JILC001	Joseph Bayou	Ebb	5/13/2014	20:43:16	Left	377	88	77	101	125	769	4
JILC002	Joseph Bayou	Ebb	5/13/2014	20:46:06	Right	355	82	73	10	133	653	-12
JILC003	Joseph Bayou	Ebb	5/13/2014	20:48:14	Left	306	74	63	79	175	697	-5
JILC004	Joseph Bayou	Ebb	5/13/2014	20:51:46	Right	324	77	72	72	196	741	0
JILC005	Joseph Bayou	Ebb	5/13/2014	20:54:03	Left	306	77	68	103	241	795	8
JISC000	Joseph Bayou	Ebb	5/14/2014	17:50:07	Right	368	86	83	101	78	716	1
JISC001	Joseph Bayou	Ebb	5/14/2014	17:52:59	Left	342	77	72	90	120	700	-1
JISC002	Joseph Bayou	Ebb	5/14/2014	17:55:12	Right	436	93	92	95	115	831	17
JISC003	Joseph Bayou	Ebb	5/14/2014	17:57:44	Left	274	68	59	88	80	568	-20
JISC004	Joseph Bayou	Ebb	5/14/2014	18:00:07	Right	421	93	93	76	112	796	12
JISC005	Joseph Bayou	Ebb	5/14/2014	18:02:28	Left	327	75	72	79	88	641	-10
JIHC000	Joseph Bayou	High	5/15/2014	15:30:57	Right	430	89	88	147	129	882	-1

Transect ID	Location of Transect	Tide	Date	Start Time (GMT)	Start Bank	Flux ($m^3 s^{-1}$)						
						Meas.	Top	Bottom	Left	Right	Total	Delta
JIHC001	Joseph Bayou	High	5/15/2014	15:32:48	Left	403	87	80	120	210	900	1
JIHC002	Joseph Bayou	High	5/15/2014	15:34:22	Right	357	79	76	107	192	811	-9
JIHC003	Joseph Bayou	High	5/15/2014	15:36:20	Left	379	81	76	141	219	896	0
JIHC004	Joseph Bayou	High	5/15/2014	15:38:45	Right	452	99	100	115	181	947	6
JIHC005	Joseph Bayou	High	5/15/2014	15:41:03	Left	410	84	76	108	249	926	4
JDLC000	Southwest Pass Downstream of Joseph Bayou	Ebb	5/13/2014	20:16:54	Left	4927	567	579	43	2	6118	-3
JDLC001	Southwest Pass Downstream of Joseph Bayou	Ebb	5/13/2014	20:23:28	Right	5257	593	618	51	2	6521	3
JDSC000	Southwest Pass Downstream of Joseph Bayou	Ebb	5/14/2014	17:33:07	Left	3453	391	412	36	10	4302	-5
JDSC001	Southwest Pass Downstream of Joseph Bayou	Ebb	5/14/2014	17:38:40	Right	3816	437	472	37	8	4770	5
JDHC000	Southwest Pass Downstream of Joseph Bayou	High	5/15/2014	15:11:44	Left	3061	395	362	26	-2	3841	-4
JDHC001	Southwest Pass Downstream of Joseph Bayou	High	5/15/2014	15:18:35	Right	3308	428	401	32	-4	4164	4

Table 3. ADCP transect summaries for Outlet W-2.

Transect ID	Location of Transect	Tide	Date	Start Time (GMT)	Start Bank	Flux ($m^3 s^{-1}$)						
						Meas.	Top	Bottom	Left	Right	Total	Delta
WULS000	Southwest Pass Upstream of Outlet W-2	Ebb	5/13/2014	20:10:28	Right	4903	681	282	27	12	5906	-6
WULS001	Southwest Pass Upstream of Outlet W-2	Ebb	5/13/2014	20:16:27	Left	5448	749	453	32	34	6717	6
WUSS000	Southwest Pass Upstream of Outlet W-2	Ebb	5/14/2014	17:08:38	Right	3288	421	419	17	8	4153	-10
WUSS001	Southwest Pass Upstream of Outlet W-2	Ebb	5/14/2014	17:15:09	Left	3986	509	503	21	20	5038	10
WUHS001	Southwest Pass Upstream of Outlet W-2	High	5/15/2014	15:29:48	Left	3711	479	471	35	52	4748	6

Transect ID	Location of Transect	Tide	Date	Start Time (GMT)	Start Bank	Flux ($m^3 s^{-1}$)						
						Meas.	Top	Bottom	Left	Right	Total	Delta
WUHS002	Southwest Pass Upstream of Outlet W-2	High	5/15/2014	15:36:49	Right	3200	438	420	16	135	4210	-6
WILS000	Outlet W-2	Ebb	5/13/2014	19:36:50	Left	361	251	144	49	84	889	1
WILS002	Outlet W-2	Ebb	5/13/2014	19:48:02	Right	388	225	96	71	57	837	-5
WILS003	Outlet W-2	Ebb	5/13/2014	19:51:12	Left	421	261	119	52	97	950	8
WILS004	Outlet W-2	Ebb	5/13/2014	19:54:48	Right	367	236	98	70	80	851	-3
WISS000	Outlet W-2	Ebb	5/14/2014	16:44:39	Right	366	199	137	39	73	814	-6
WISS001	Outlet W-2	Ebb	5/14/2014	16:49:14	Left	378	207	144	35	124	889	2
WISS002	Outlet W-2	Ebb	5/14/2014	16:53:52	Right	353	194	128	42	141	858	-1
WISS003	Outlet W-2	Ebb	5/14/2014	16:57:03	Left	447	228	148	29	66	918	6
WIHS000	Outlet W-2	High	5/15/2014	14:25:47	Right	375	169	105	8	129	787	-1
WIHS001	Outlet W-2	High	5/15/2014	14:31:28	Left	394	213	139	9	70	825	4
WIHS002	Outlet W-2	High	5/15/2014	14:35:55	Right	363	190	118	18	65	754	-5
WIHS003	Outlet W-2	High	5/15/2014	14:38:45	Left	389	187	123	18	88	805	2
WDLC000	Southwest Pass Downstream of Outlet W-2	Ebb	5/13/2014	19:43:52	Right	4349	586	611	13	16	5575	2
WDLC001	Southwest Pass Downstream of Outlet W-2	Ebb	5/13/2014	19:51:17	Left	4236	564	549	8	14	5371	-2
WDSC000	Southwest Pass Downstream of Outlet W-2	Ebb	5/14/2014	17:05:00	Right	2961	387	389	-3	18	3751	6
WDSC001	Southwest Pass Downstream of Outlet W-2	Ebb	5/14/2014	17:11:11	Left	2630	343	337	-2	16	3323	-6
WDHC000	Southwest Pass Downstream of Outlet W-2	High	5/15/2014	14:27:48	Right	2939	386	392	24	34	3776	8
WDHC001	Southwest Pass Downstream of Outlet W-2	High	5/15/2014	14:33:04	Left	2538	328	313	25	0	3204	-8

Table 4. ADCP transect summaries for Burrwood Bayou.

Transect ID	Location of Transect	Tide	Date	Start Time (GMT)	Start Bank	Flux ($m^3 s^{-1}$)						
						Meas.	Top	Bottom	Left	Right	Total	Delta
BULS000	Southwest Pass Upstream of Burrwood Bayou	Ebb	5/13/2014	18:50:49	Left	4021	801	191	65	-9	5070	7
BULS001	Southwest Pass Upstream of Burrwood Bayou	Ebb	5/13/2014	18:57:48	Right	3478	738	87	82	4	4389	-7
BUSS000	Southwest Pass Upstream of Burrwood Bayou	Ebb	5/14/2014	16:00:51	Left	2442	379	356	73	-5	3244	11
BUSS002	Southwest Pass Upstream of Burrwood Bayou	Ebb	5/14/2014	16:09:08	Right	1822	317	302	102	37	2579	-11
BUHS000	Southwest Pass Upstream of Burrwood Bayou	High	5/15/2014	13:35:22	Left	2797	438	452	72	90	3849	11
BUHS002	Southwest Pass Upstream of Burrwood Bayou	High	5/15/2014	14:02:41	Right	2302	361	343	72	38	3116	-11
BILC000	Burrwood Bayou	Ebb	5/13/2014	19:12:33	Right	163	67	47	66	44	387	9
BILC001	Burrwood Bayou	Ebb	5/13/2014	19:16:36	Left	115	50	34	28	37	263	-26
BILC002	Burrwood Bayou	Ebb	5/13/2014	19:22:13	Right	209	116	69	27	10	431	21
BILC003	Burrwood Bayou	Ebb	5/13/2014	19:25:30	Left	168	92	54	19	10	343	-4
BISC000	Burrwood Bayou	Ebb	5/14/2014	16:36:07	Right	228	110	72	6	7	422	11
BISC001	Burrwood Bayou	Ebb	5/14/2014	16:40:49	Left	173	76	49	15	8	322	-15
BISC002	Burrwood Bayou	Ebb	5/14/2014	16:43:33	Right	224	103	67	23	9	426	12
BISC003	Burrwood Bayou	Ebb	5/14/2014	16:47:20	Left	188	84	56	14	6	349	-8
BIHC000	Burrwood Bayou	High	5/15/2014	13:42:46	Right	264	144	85	49	14	555	10
BIHC001	Burrwood Bayou	High	5/15/2014	13:46:00	Left	217	115	67	36	13	447	-11
BIHC002	Burrwood Bayou	High	5/15/2014	13:47:51	Right	264	142	83	49	14	553	9
BIHC003	Burrwood Bayou	High	5/15/2014	13:50:56	Left	216	116	69	48	15	464	-8
BDLC000	Southwest Pass Downstream of Burrwood Bayou	Ebb	5/13/2014	18:45:15	Left	3085	502	456	42	30	4114	-8
BDLC001	Southwest Pass Downstream of Burrwood Bayou	Ebb	5/13/2014	18:53:48	Right	3597	583	560	19	28	4787	8
BDSC001	Southwest Pass Downstream of Burrwood Bayou	Ebb	5/14/2014	16:08:17	Left	1744	310	257	28	7	2345	-10

Transect ID	Location of Transect	Tide	Date	Start Time (GMT)	Start Bank	Flux ($m^3 s^{-1}$)						
						Meas.	Top	Bottom	Left	Right	Total	Delta
BDSC002	Southwest Pass Downstream of Burrwood Bayou	Ebb	5/14/2014	16:22:18	Right	2141	362	325	22	7	2857	10
BDHC000	Southwest Pass Downstream of Burrwood Bayou	High	5/15/2014	13:23:52	Left	1799	350	286	23	17	2475	-15
BDHC001	Southwest Pass Downstream of Burrwood Bayou	High	5/15/2014	13:30:42	Right	2451	470	402	30	26	3379	15

Southwest Pass flow distribution

The measured flow distribution in Southwest Pass is summarized in Tables 5–7 along with the corresponding tide condition shown in Figures 21–23. It was found that the four outlets carry approximately 48% of the total Southwest Pass flow for a high-tide condition and 5,619 $m^3 s^{-1}$ total discharge. During ebb tide conditions, the outlets carried 31% and 38% of the total Southwest Pass discharges of 7,958 $m^3 s^{-1}$ and 6,210 $m^3 s^{-1}$, respectively.

Table 5. Southwest Pass flow distribution for an ebb tide condition on 13 March 2014.

The ADCP measurements summarized in this table were conducted on 13 March 2014 between 1845 and 2200 GMT.	Average Transect Flow $m^3 s^{-1}$	Portion of Total Southwest Pass Flow %	Portion of Southwest Pass Flow at the Outlet %
Southwest Pass Upstream of Outlet W-1	7958	100.0	
Outlet W-1	483	6.1	6.1
Southwest Pass Downstream of Outlet W-1	7240	91.0	
Southwest Pass Upstream of Joseph Bayou	7469	93.8	
Joseph Bayou	738	9.3	9.9
Southwest Pass Downstream of Joseph Bayou	6319	79.4	
Southwest Pass Upstream of Outlet W-2	6311	79.3	
Outlet W-2	882	11.1	14.0
Southwest Pass Downstream of Outlet W-2	5473	68.8	
Southwest Pass Upstream of Burrwood Bayou	4729	59.4	
Burrwood Bayou	356	4.5	7.5
Southwest Pass Downstream of Burrwood Bayou	4450	55.9	
Four Outlets total percentage for this tide condition		30.9	

Figure 21. Tide conditions during 13 May 2014 data collection period.

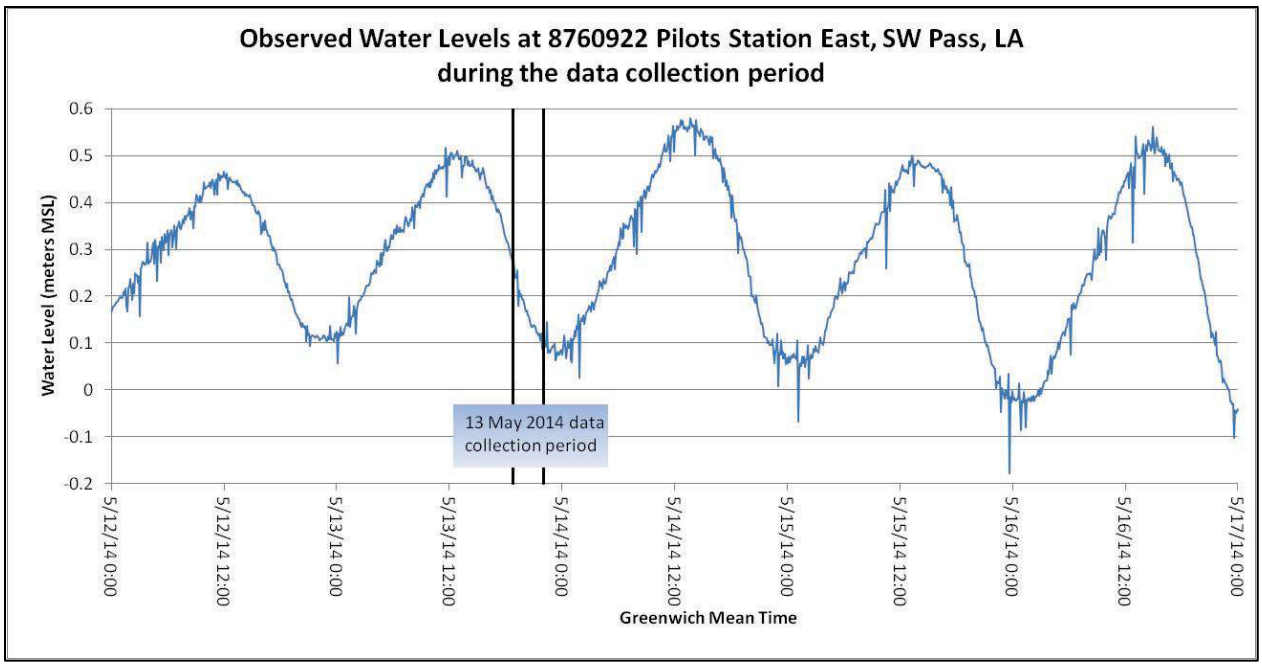


Table 6. Southwest Pass flow distribution for an ebb tide condition on 14 March 2014.

The ADCP measurements summarized in this table were conducted on 14 March 2014 between 1600 and 1845 GMT.	Average Transect Flow $m^3 s^{-1}$	Portion of Total Southwest Pass Flow %	Portion of Southwest Pass Flow at the Outlet %
Southwest Pass Upstream of Outlet W-1	6210	100.0	
Outlet W-1	429	6.9	6.9
Southwest Pass Downstream of Outlet W-1	5596	90.1	
Southwest Pass Upstream of Joseph Bayou	5263	84.7	
Joseph Bayou	709	11.4	13.5
Southwest Pass Downstream of Joseph Bayou	4536	73.0	
Southwest Pass Upstream of Outlet W-2	4596	74.0	
Outlet W-2	870	14.0	18.9
Southwest Pass Downstream of Outlet W-2	3537	57.0	
Southwest Pass Upstream of Burrwood Bayou	2912	46.9	
Burrwood Bayou	380	6.1	13.0
Southwest Pass Downstream of Burrwood Bayou	2601	41.9	
Four Outlets total percentage for this tide condition		38.4	

Figure 22. Tide conditions during 14 May 2014 data collection period.

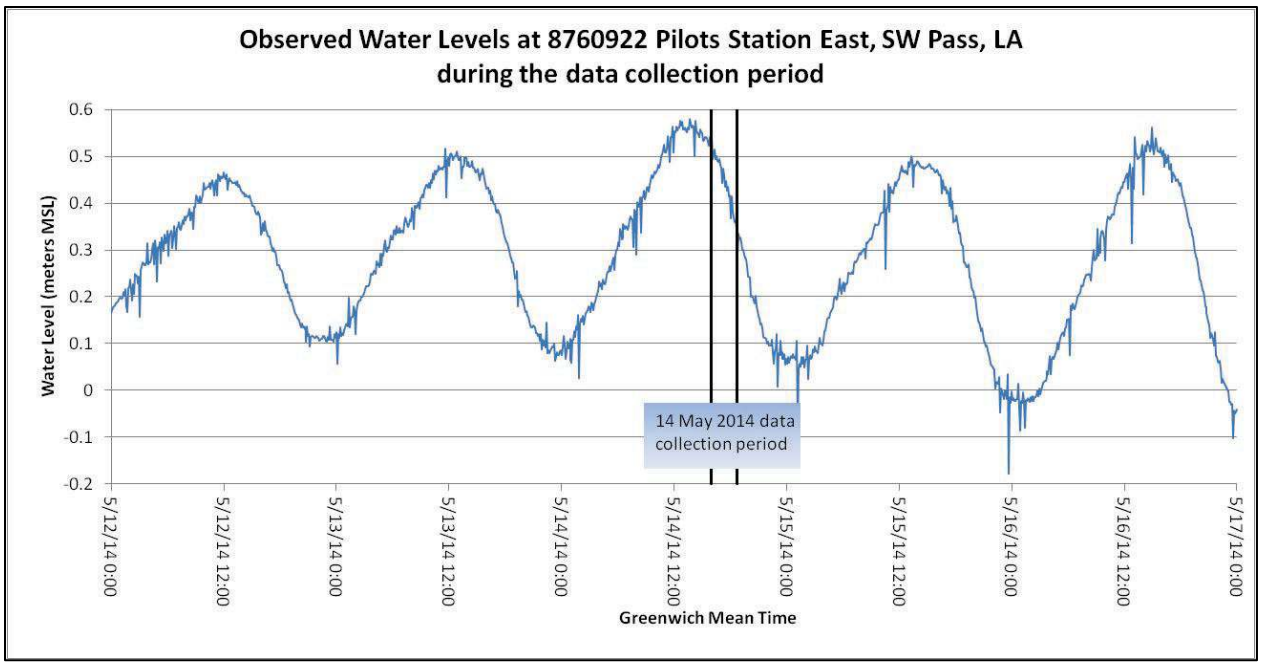
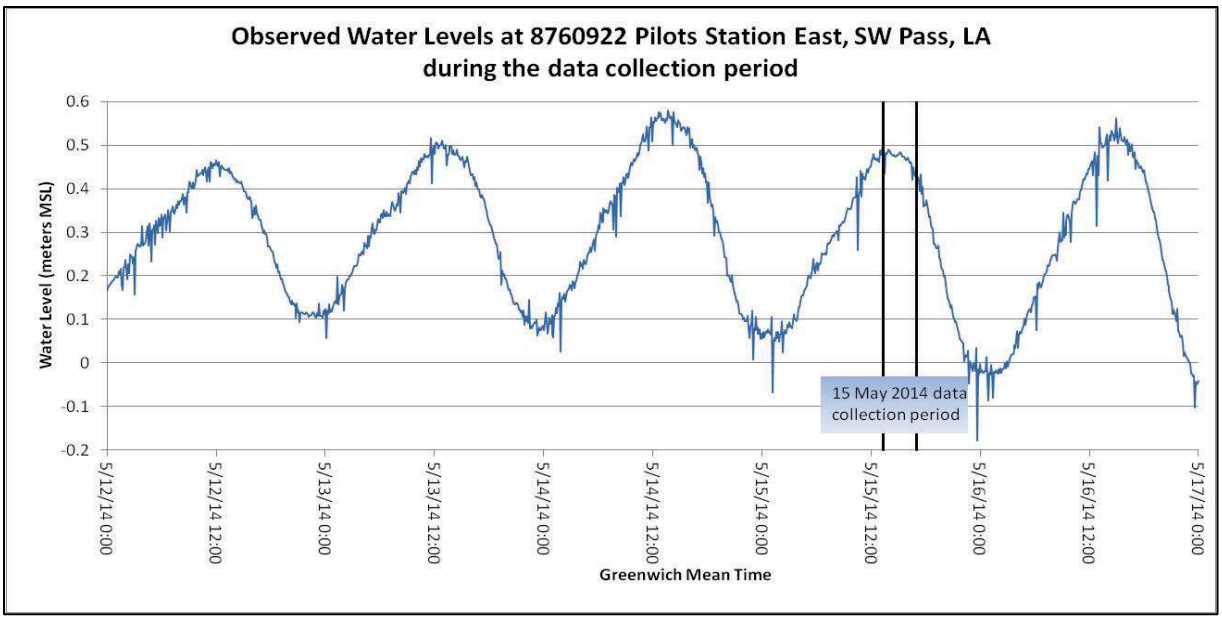


Table 7. Southwest Pass flow distribution for a high-tide condition on 15 March 2014.

The ADCP measurements summarized in this table were conducted on 15 March 2014 between 1320 and 1700 GMT.	Average Transect Flow $m^3 s^{-1}$	Portion of Total Southwest Pass Flow %	Portion of Southwest Pass Flow at the Outlet %
Southwest Pass Upstream of Outlet W-1	5619	100.0	
Outlet W-1	498	8.9	8.9
Southwest Pass Downstream of Outlet W-1	5081	90.4	
Southwest Pass Upstream of Joseph Bayou	5181	92.2	
Joseph Bayou	894	15.9	17.2
Southwest Pass Downstream of Joseph Bayou	4003	71.2	
Southwest Pass Upstream of Outlet W-2	4479	79.7	
Outlet W-2	793	14.1	17.7
Southwest Pass Downstream of Outlet W-2	3490	62.1	
Southwest Pass Upstream of Burrwood Bayou	3482	62.0	
Burrwood Bayou	505	9.0	14.5
Southwest Pass Downstream of Burrwood Bayou	2927	52.1	
Four Outlets total percentage for this tide condition		47.9	

Figure 23. Tide conditions during 15 May 2014 data collection period.



Velocity profiles

Using the WinRiver II postprocessing software, velocity profiles were extracted from the raw data, and a few examples are shown here. It is evident from the velocity data that a saltwater wedge was present in Southwest Pass at the time the ADCP data was collected. The most upstream, cross-section velocity plot of data collected in Southwest Pass on 13 May displays a uniform velocity profile (Figures 24 and 25). However, on the same day, the most upstream advance of the wedge is evident in the plots around the Joseph Bayou outlet (Figures 26–29). A fully stratified flow situation is evident in the data taken upstream of the Burrwood Bayou outlet on 15 May as seen in Figures 30 and 31.

Figure 24. Southwest Pass Upstream of Outlet W-1, 13 May 2014 cross-section plot.

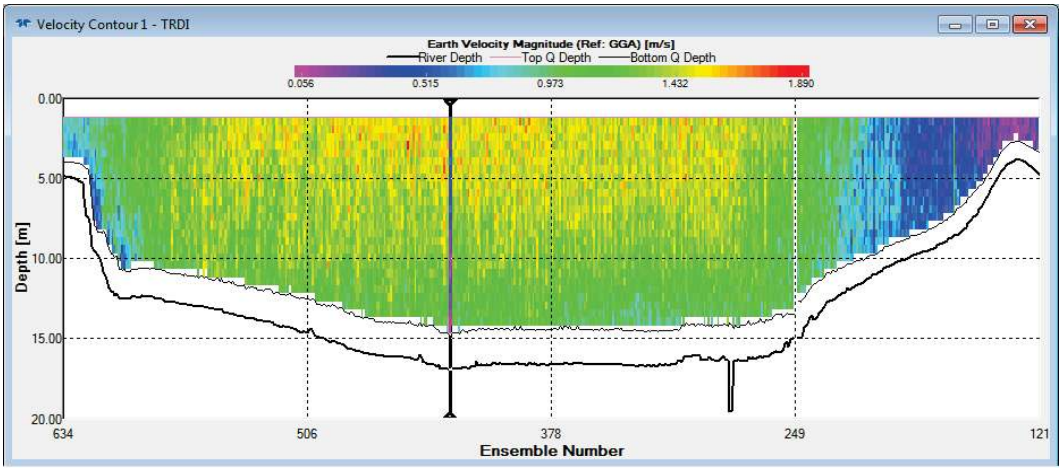


Figure 25. Southwest Pass Upstream of Outlet W-1, 13 May 2014 velocity profile.

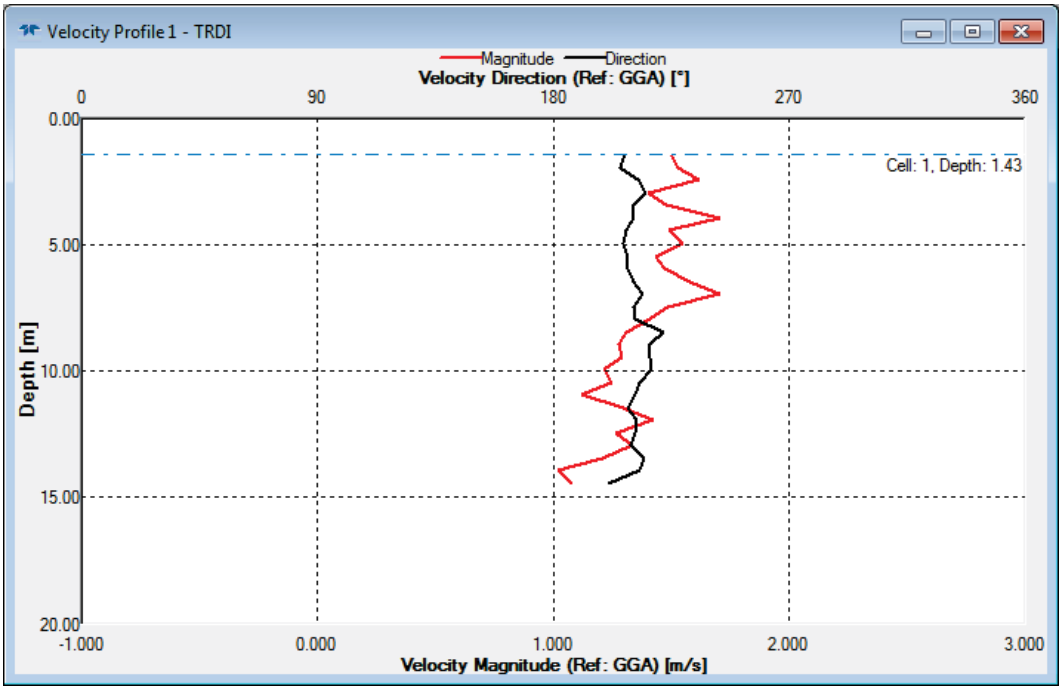


Figure 26. Southwest Pass Upstream of Joseph Bayou, 13 May 2014 cross-section plot.

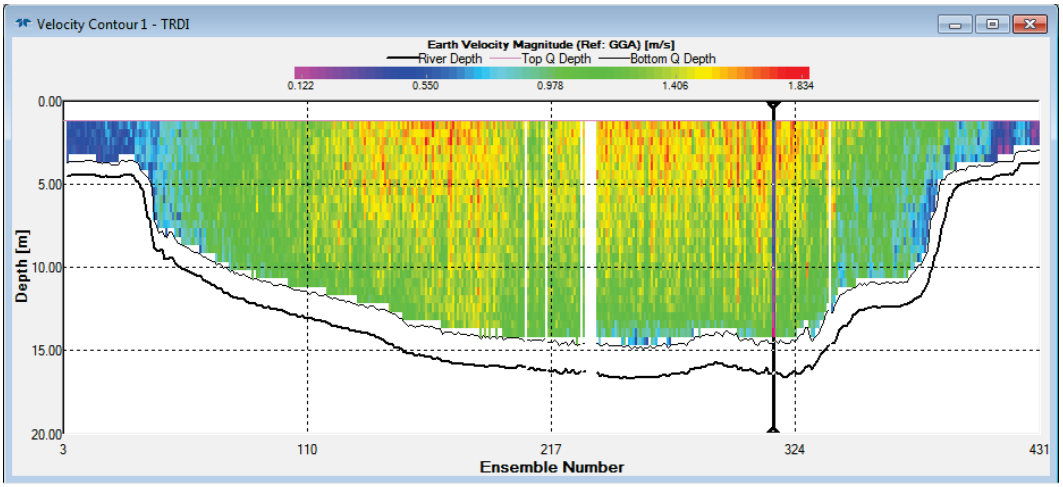


Figure 27. Southwest Pass Upstream of Joseph Bayou, 13 May 2014 velocity profile.

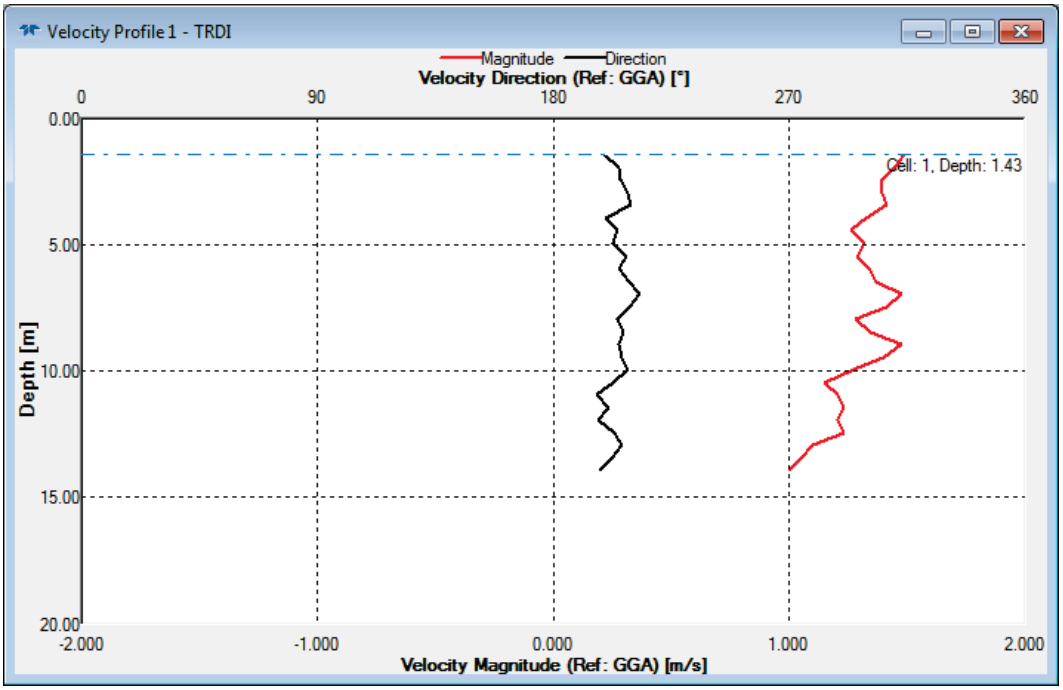


Figure 28. Southwest Pass Downstream of Joseph Bayou, 13 May 2014 cross-section plot.

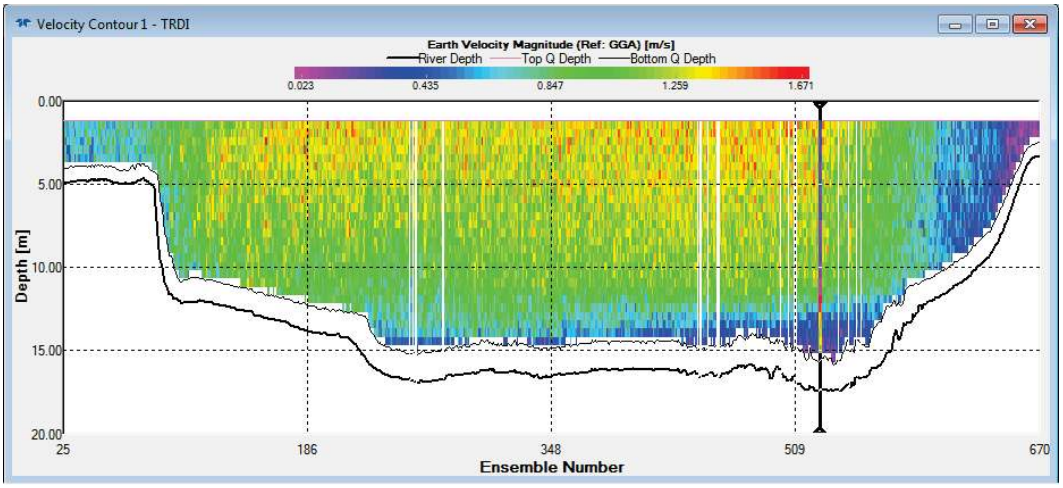


Figure 29. Southwest Pass Downstream of Joseph Bayou, 13 May 2014 velocity profile.

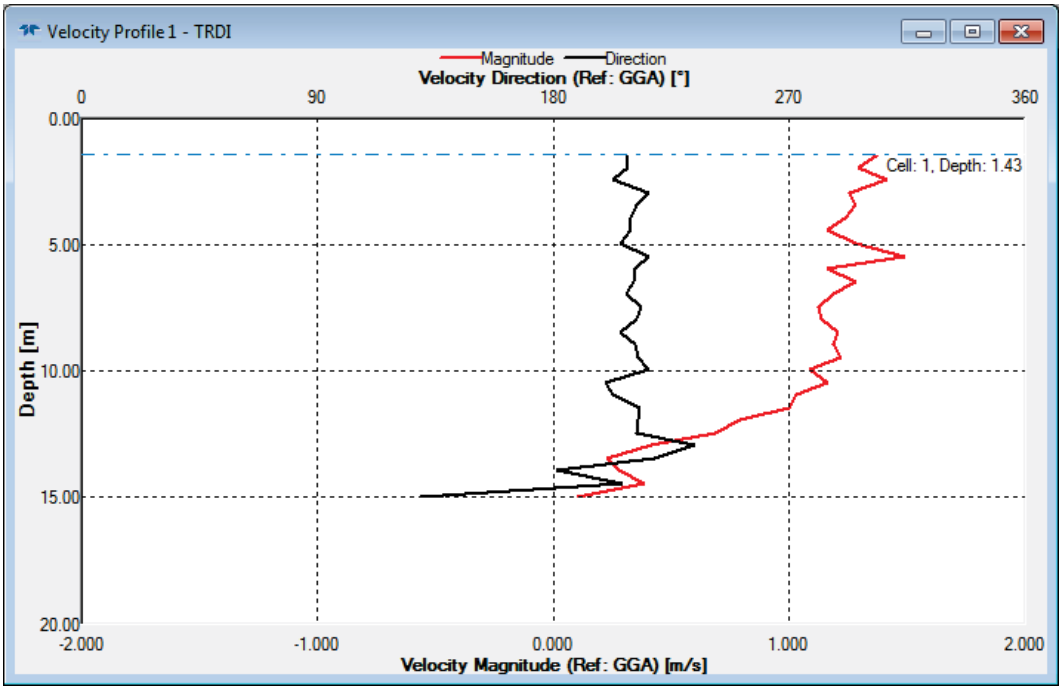


Figure 30. Southwest Pass Upstream of Burrwood Bayou, 15 May 2014 cross-section plot.

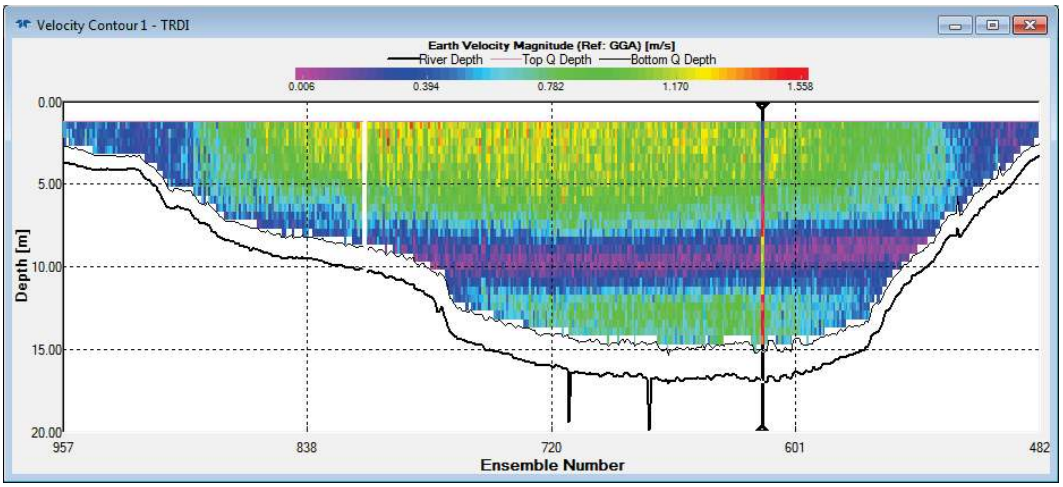
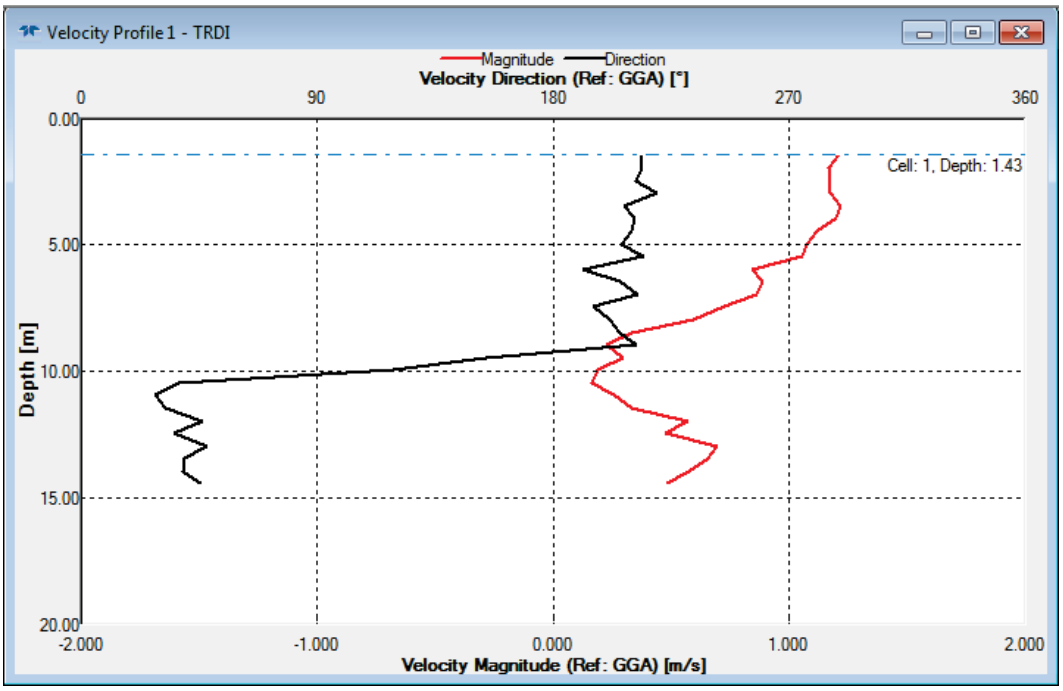


Figure 31. Southwest Pass Upstream of Burrwood Bayou, 15 May 2014 velocity profile.



4 Summary

The data collected for this study show that given certain tide conditions and Mississippi River discharge, the four lateral outlets along Southwest Pass are capable of diverting almost half of the flow entering Southwest Pass from the lower Mississippi River channel as seen in the ADCP data set collected on 15 March 2014. Therefore, the impact of these lateral outlets on Southwest Pass flow and sedimentation dynamics must be considered in any model study that includes Southwest Pass in its domain. The loss of stream power along the channel due to the diversion of water through the outlets is likely a primary driver of resulting shoaling patterns in Southwest Pass. The flow stratification evident in the velocity profiles indicates that flocculation due to salinity would also contribute to the sedimentation characteristics observed in Southwest Pass.

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14. ABSTRACT

The Southwest Pass distributary of the Mississippi River is the primary navigable channel connecting the Gulf of Mexico and the Mississippi River. The average expenditure of the U.S. Government on Southwest Pass and the lower Mississippi River dredging has averaged around $55 million/year for the previous 5 years. Numerical modeling tools covering this important stretch of the navigation route are being developed to help gain a better understanding of the impact of proposed Mississippi River system changes. An understanding of the flow exchange between Southwest Pass distributary and the surrounding Gulf of Mexico under various river and tide conditions is essential to the development of these analytic modeling tools that will be used to predict system response to proposed upriver diversions and dredging templates resulting from navigable channel deepening proposals. The ongoing development of these numerical modeling tools have revealed a data need for bathymetry and velocity information for the four major lateral outlets of the Southwest Pass. Multi-beam channel bed surveys and Acoustic Doppler Current Profiler data was collected over a 3-day period. The collected data will be used to calibrate the flow exchange and improve the predictive ability of the multi-dimensional numerical models and the resulting water/sediment ratios at the four lateral outlets.

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