

# Flooding Concerns on the Lower Pearl River Near Walkiah Bluff

Amanda L. Roberts, National Weather Service

Walkiah Bluff is located in south Mississippi on the East Pearl River near Wilson Slough and the divergence of the Pearl River into the East and West Pearl Rivers. Approximately 175 residents own homes on or near the East Pearl River near Walkiah Bluff, MS. Flooding often occurs in the Walkiah Bluff area whenever flooding occurs upstream on the Pearl River, thus heightening concerns of local citizens. The Lower Mississippi River Forecast Center (LMRFC) has flood forecasting responsibility in this area, however, Walkiah Bluff is not currently an official forecast point.

Historical data from the period of record was utilized to develop flood forecasting guidance tools for the Walkiah Bluff area. Flood events were analyzed to obtain a better understanding of how Walkiah Bluff reacts in relationship to upstream flooding on the Pearl River at Bogalusa, LA and the Bogue Chitto River at Bush, LA. Assessments were also made regarding how the Pearl River at Pearl River, LA reacts in association with upstream flooding at Walkiah Bluff and Bush.

The effects of the Bogue Chitto River on the crest at Walkiah Bluff, MS are complicated due to numerous sloughs and bayous that interconnect the two channels. It is difficult to accurately interpolate any affects from the Bogue Chitto by utilizing a crest to crest curve for Bogalusa to Walkiah Bluff. However, because the crest at Pearl River, LA is based upon water routed from both Bogalusa and Bush, the LMRFC forecast for Pearl River, LA can be utilized along with the crest to crest curve for Walkiah Bluff to Pearl River, LA to essentially back-forecast the crest at Walkiah Bluff. The results of this study are expected to assist in increasing the accuracy and timeliness of LMRFC flood forecasts for Walkiah Bluff citizens.

## Introduction

Walkiah Bluff is located in Mississippi on the East Pearl River near Wilson Slough and the divergence of the Pearl River into the East and West Pearl Rivers (Figure 1). Approximately 75 residents own raised homes along Parkside Drive, which parallels the East Pearl River near Walkiah Bluff. At least another 100 residents own homes in various nearby neighborhoods, such as the Oak Point Road area (Figure 2). Flooding often occurs in the Walkiah Bluff area whenever flooding occurs upstream on the Pearl River, thus heightening concerns of local citizens. The National Weather Service (NWS) Lower Mississippi River Forecast Center (LMRFC) has agreed to provide guidance on flooding in this area and has developed several tools to assist with such guidance.

## Hydrology of the Pearl River near Walkiah Bluff

The Pearl River forks into the East Pearl River and the West Pearl River approximately 9 miles northwest of Picayune, MS (Figure 3). The East Pearl River flows about 45 miles before emptying into Lake Borgne and also serves as the state boundary between Mississippi and Louisiana. The West Pearl River spans 44 miles before emptying into the Rigolets, which is the main outlet between Lake Ponchartrain and Lake Borgne (U.S. Army Corps of Engineers, New Orleans District 1998).

Wilson Slough and Holmes Bayou are the two main conduits that permit flow from the East Pearl River to empty into the West Pearl River (U.S. Army Corps of Engineers, New Orleans District 1998). Wilson Slough originates about 7 miles west of Picayune, MS and

Holmes Bayou begins about 3 miles southwest of Picayune, MS (Figure 3).

Since the late 19th century, approximately 75% of the low flow in the Pearl River passed through Wilson Slough to the West Pearl River (U.S. Army Corps of Engineers, Vicksburg District, 1989). By 1996, the problem had amplified to the point where almost no flow occurred along the East Pearl River past Wilson Slough during low flow conditions. With funding from the U.S. Army Corps of Engineers (USACOE) and the Mississippi Department of Environmental Quality (MSDEQ), the Walkiah Bluff diversion was constructed in 1999. The diversion, an earthen, trapezoidal weir, was designed to increase discharge and water levels in the East Pearl near Walkiah Bluff and decrease these factors in Wilson Slough and the West Pearl during flow conditions of 1,500 cfs or less. A 50/50 low flow distribution is maintained by this weir (Miller and Payne 1995). According to information received from Charlie McKinnie with the Vicksburg ACOE via email, the top of the weir is 36.1' NGVD 29 and the top of the bank at the weir is 42.65' NGVD 29.

### Methods

The United States Geological Survey (USGS) owns and maintains two gages near Walkiah Bluff. One gage is located in Mississippi directly above the weir on the Pearl River (NWS ID WSWM6), while the other gage is below the weir just across the state line in Louisiana on Wilson Slough (NWS ID WSWL1). For the purposes of this study, the gage in Mississippi at Walkiah Bluff above Wilson Slough (NWS ID WSWM6) was utilized. The period of record runs from the gage installation date in August of 2006 to present. Historical data from the period of record was utilized to develop flood guidance tools for the Walkiah Bluff area. Flood events were analyzed to obtain a better understanding of how Walkiah Bluff reacts in relationship to flooding on the Pearl River at Bogalusa, LA (NWS ID BXAL1) and the Bogue Chitto River at Bush (NWS ID BSHL1). Assessments were also made regarding how the Pearl River at Pearl River, LA (NWS ID PERL1) reacts in association with flooding at WSWM6 and BSHL1 (Figure 4 and

Table 1).

### Contributions to the Pearl River at Walkiah Bluff, MS Above Wilson Slough

The main contributor of flow at WSWM6 is the water routed down from the mainstem of the Pearl River, however when the Bogue Chitto River provides a significant portion of the flow, it can have considerable effects. Stage data from the USGS gages at BXAL1 and BSHL1 were studied. The amount, timing, and distribution of routed water from these two locations control the shape of the WSWM6 hydrograph. In general, the crest at WSWM6 is directly related to the routed flow from BXAL1.

In addition to the flows from BXAL1, flows from the Bogue Chitto River have some effects on the Pearl. The Bogue Chitto River merges with the Pearl River Navigation Canal between Locks 2 and 3. Below the navigation canal, the Bogue Chitto River flows roughly southward, paralleling the Pearl River to the east and Pearl River canal to the west. There are small sloughs and bayous that connect the Pearl and Bogue Chitto Rivers above Wilson Slough that allow some water to be transferred between the two rivers. The majority of the flow from the Bogue Chitto eventually merges with the West Pearl River near Wilson Slough, downstream of the weir.

If the Bogue Chitto is high compared to the Pearl River, some water from the Bogue Chitto may flow eastward into Wilson Slough and have effects on the flows at WSWM6. During these events, the Bogue Chitto can cause a rise in the tailwater at the weir structure, which lessens the flow through the weir and allows more water down the Pearl River. If the weir structure and closure are overtopped, open river conditions exist on the Pearl and the water level differential between Wilson Slough and the Pearl River is reduced or absent.

Stage forecasts are provided at BXAL1 by LMRFC. To provide information on the expected river levels at Walkiah Bluff, the stages at BXAL1 were compared with stages at WSWM6. The crest to crest

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curve for BXAL1 to WSWM6 branches to the right during high water events when the Bogue Chitto raises the tailwater at the weir (Figure 5). This lessens the flow through the weir and forces more water down the East Pearl. The upper end of the curve branches to the left when there are no significant affects from the Bogue Chitto. Notice the yellow line in Figure 5, indicating the top of the bank at the weir. Regardless of the effects of the Bogue Chitto, once the bank is over-topped, the entire swamp conveys water and requires a larger volume of water to notice an increase in stage. This results in both branches of the curve turning upward once the bank is over-topped.

#### **Contributions to the Pearl River at Pearl River, LA**

The two primary contributors of flow for the West Pearl River at Pearl River are flows from BXAL1 and BSHL1. Generally, the crest height and timing at PERL1 is directly related to the flow routed down from BXAL1 and subsequently, WSWM6.

Generally, the flow contributed by the Bogue Chitto River is much less than that from the Pearl River. The most prevalent affect that water from BSHL1 has on PERL1 is that it causes the initial rise in the PERL1 hydrograph prior to the arrival of the routed water from WSWM6. Because of this, the secondary rise generated by water from WSWM6 drives the flood crest at PERL1 (Figure 6). The travel time from BSHL1 to PERL1 ranges from slightly less than a day and a half to two days, with longer travel times associated with large scale events (Figure 7).

#### **Results**

The effects of the Bogue Chitto on the crest at WSWM6 are complicated. It is difficult to accurately interpolate any affects from the Bogue Chitto by utilizing the crest to crest curve for BXAL1 to WSWM6. Because the crest at PERL1 is based upon water routed from both BXAL1 and BSHL1, the LMRFC forecast for PERL1 can be utilized along with the crest to crest curve for WSWM6 to PERL1 to essentially back-forecast the crest at WSWM6.

A list of corresponding historical crests for BSHL1, BXAL1, WSWM6 and WSWL1 has been developed in an effort to give citizens an idea of what to expect based on historical data (Table 2).

#### **Conclusions**

In most cases, the crest at WSWM6 can be expected to occur slightly less than a day and a half prior to the PERL1 crest, however events with a long, broad crest may take as long as 2 days. The user is encouraged to take into consideration the magnitude of the flood event when determining the travel time, as this will also assist in establishing the general shape of the hydrograph. Historically, the Walkiah Bluff hydrograph strongly mimics that of BXAL1, but additional rises have also been noted when water from the Bogue Chitto causes a rise in the tailwater at the weir or when the weir is overtopped. As a reminder, a significant difference is noted in the response of the river when the top of the bank at the weir is overtopped (42.65' NGVD 29). If a crest for WSWM6 is anticipated to be above this level, the user should keep in mind that the river will become more of an open river system, the water will spread beyond the channel, and a greater volume of water is needed in order to see a significant rise in stage.

#### **References**

- Miller, A. C., and Payne, B. S. (1997). "Effects of water diversions of freshwater mussels in the Pearl River near Walkiah bluff, Mississippi and Louisiana, 1995," Technical Report EL-97-22, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.
- U.S. ARMY CORPS OF ENGINEERS. 1989. "Lower Pearl River Basin Flow Distribution, Mississippi and Louisiana," United States. Army. Corps of Engineers. Vicksburg District.
- U.S. ARMY CORPS OF ENGINEERS. 1998. Water resources development in Louisiana. U.S. Army Corps of Engineers, New Orleans District. 191 pp.

**Table 1. Select gages in the Lower Pearl River basin.**

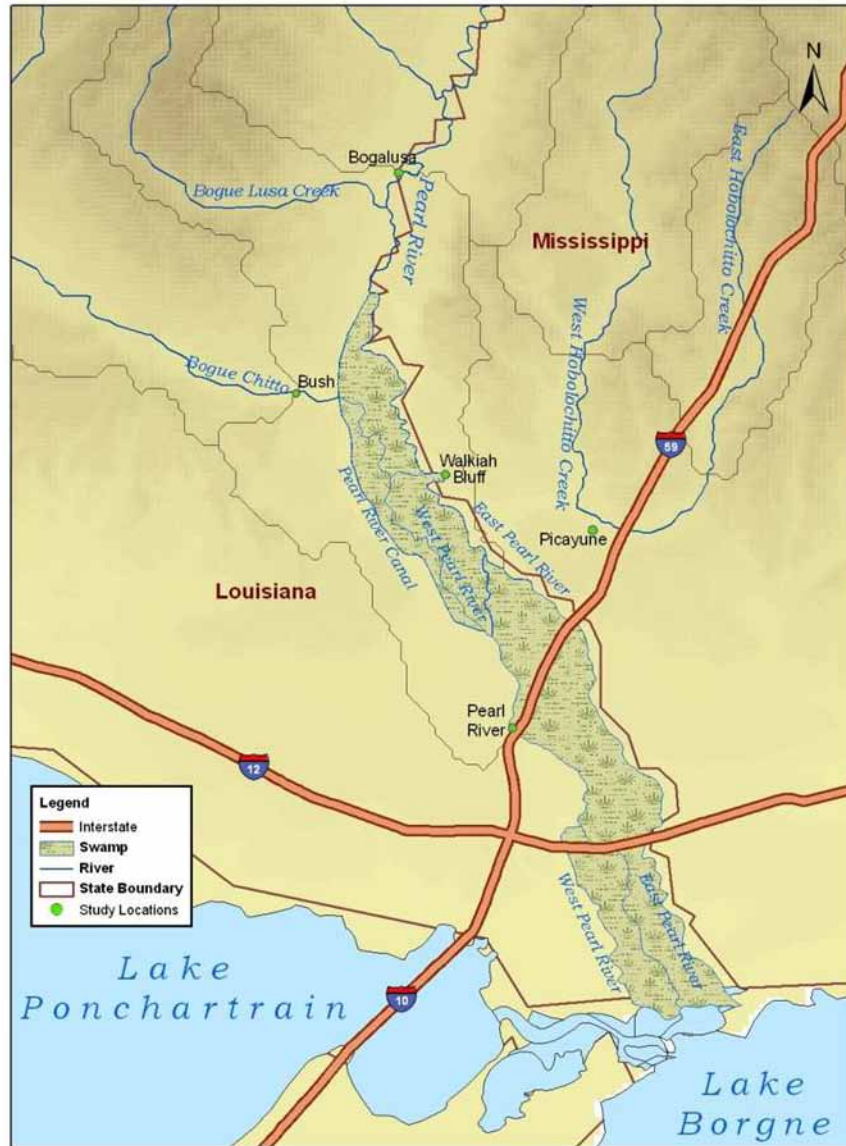
| <b>National Weather Service<br/>Gage ID</b> | <b>River Name</b>            | <b>Gage Location</b>                   | <b>Gage Datum<br/>(NGVD29)</b> |
|---------------------------------------------|------------------------------|----------------------------------------|--------------------------------|
| BXAL1                                       | Pearl River                  | Near Bogalusa, LA                      | 55.0'                          |
| FRNL1                                       | Bogue Chitto River           | Near Franklinton, LA                   | 123.81'                        |
| PPBL1                                       | Pearl River                  | Pool's Bluff (6 mi. south of Bogalusa) | 0.0'                           |
| PRTL1                                       | Pearl River Navigation Canal | Near Sun, LA (at Lock #3)              | 0.0'                           |
| BSHL1                                       | Bogue Chitto River           | Bush, LA                               | 44.25'                         |
| PRDL1                                       | Pearl River Navigation Canal | Near Sun, LA (at Lock #2)              | 0.0'                           |
| WSWM6                                       | Pearl River                  | Above Weir at Walkiah Bluff, MS        | 0.0'                           |
| WSWL1                                       | Pearl River                  | Below Weir at Walkiah Bluff, LA        | 0.0'                           |
| MNLM6                                       | West Hobolochitto Creek      | McNeil, MS                             | 55.64'                         |
| CREM6                                       | East Hobolochitto Creek      | Carrier, MS                            | 62'                            |
| PRUL1                                       | Pearl River Navigation Canal | Near Pearl River, LA (at Lock #1)      | 0.0'                           |
| PERL1                                       | Pearl River                  | Pearl River, LA                        | -0.05'                         |
| SIVL1                                       | Pearl River                  | Indian Village near Slidell, LA        | N/A                            |
| EPCM6                                       | Pearl River                  | East Pearl at CSX Rail Road            | 0.0'                           |

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**Table 2. Historical crests for the Bogue Chitto at Bush, LA, the Pearl River at Bogalusa, LA, the Pearl River at Walkiah Bluff, MS, and Wilson Slough at Walkiah Bluff, LA**

| <b>Bogue Chitto at Bush Crest Date</b> | <b>Bogue Chitto at Bush Crest</b> | <b>Pearl River at Bogalusa Crest Date</b> | <b>Pearl River at Bogalusa Crest</b> | <b>Pearl River at Walkiah Bluff Crest Date</b> | <b>Pearl River at Walkiah Bluff Crest</b> | <b>Wilson Slough at Walkiah Bluff Crest Date</b> | <b>Wilson Slough at Walkiah Bluff Crest</b> |
|----------------------------------------|-----------------------------------|-------------------------------------------|--------------------------------------|------------------------------------------------|-------------------------------------------|--------------------------------------------------|---------------------------------------------|
| 10/30/2006                             | 11.29                             | 10/29/2006                                | 18.8                                 | 10/31/2009                                     | 36.2                                      | No Gage                                          | No Gage                                     |
| 2/4/2007                               | 7.15                              | 2/5/2007                                  | 17.47                                | 2/7/2009                                       | 37.5                                      | No Gage                                          | No Gage                                     |
| 2/26/2008                              | 9.05                              | 2/29/2008                                 | 20.53                                | 3/2/2009                                       | 40                                        | No Gage                                          | No Gage                                     |
| 3/8/2008                               | 11.19                             | 3/9/2008                                  | 20.23                                | 3/11/2008                                      | 39.8                                      | No Gage                                          | No Gage                                     |
| 4/6/2008                               | 4.46                              | 4/10/2008                                 | 16.84                                | 4/12/2008                                      | 36.2                                      | No Gage                                          | No Gage                                     |
| 5/17/2008                              | 8.29                              | 5/22/2008                                 | 18.23                                | 5/24/2008                                      | 38                                        | No Gage                                          | No Gage                                     |
| 9/7/2008                               | 12.86                             | 9/8/2008                                  | 18.42                                | 9/8/2008                                       | 37.98                                     | 9/8/2008                                         | 34.0                                        |
| 12/15/2008                             | 10.41                             | 12/19/2008                                | 20.75                                | 12/21/2008                                     | 40.2                                      | 12/21/2008                                       | 36.4                                        |
| 1/10/2009                              | 10.07                             | 1/13/2009                                 | 20.65                                | 1/15/2009                                      | 40.2                                      | 1/14/2009                                        | 36.4                                        |
| 2/15/2009                              | 7.65                              | 2/18/2009                                 | 18.88                                | 2/20/2009                                      | 38.05                                     | 2/19/2009                                        | 33.2                                        |
| 3/18/2009                              | 8.33                              | 3/21/2009                                 | 20.28                                | 3/23/2009                                      | 39.5                                      | 3/24/2009                                        | 35.0                                        |
| 3/31/2009                              | 17.5                              | 3/31/2009                                 | 21.99                                | 4/1/2009                                       | 44.62                                     | 4/1/2009                                         | 44.4                                        |
| 4/17/2009                              | 12.48                             | 4/16/2009                                 | 20.35                                | 4/18/2009                                      | 39.92                                     | 4/18/2009                                        | 37.2                                        |
| 10/19/2009                             | 9.55                              | 10/19/2009                                | 20.23                                | 10/21/2009                                     | 39.71                                     | 10/21/2009                                       | 34.9                                        |
| 11/3/2009                              | 6.43                              | 11/4/2009                                 | 17.36                                | 11/6/2009                                      | 37.14                                     | 11/6/2009                                        | 31.2                                        |
| 12/18/2009                             | 14.29                             | 12/20/2009                                | 21.13                                | 12/21/2009                                     | 42.77                                     | 12/21/2009                                       | 41.6                                        |

Figure 1. Lower Pearl River basin.



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**Figure 2. Aerial photography of the Walkiah Bluff area (courtesy of ESRI). Red outlines indicate residential areas frequently affected by flooding.**

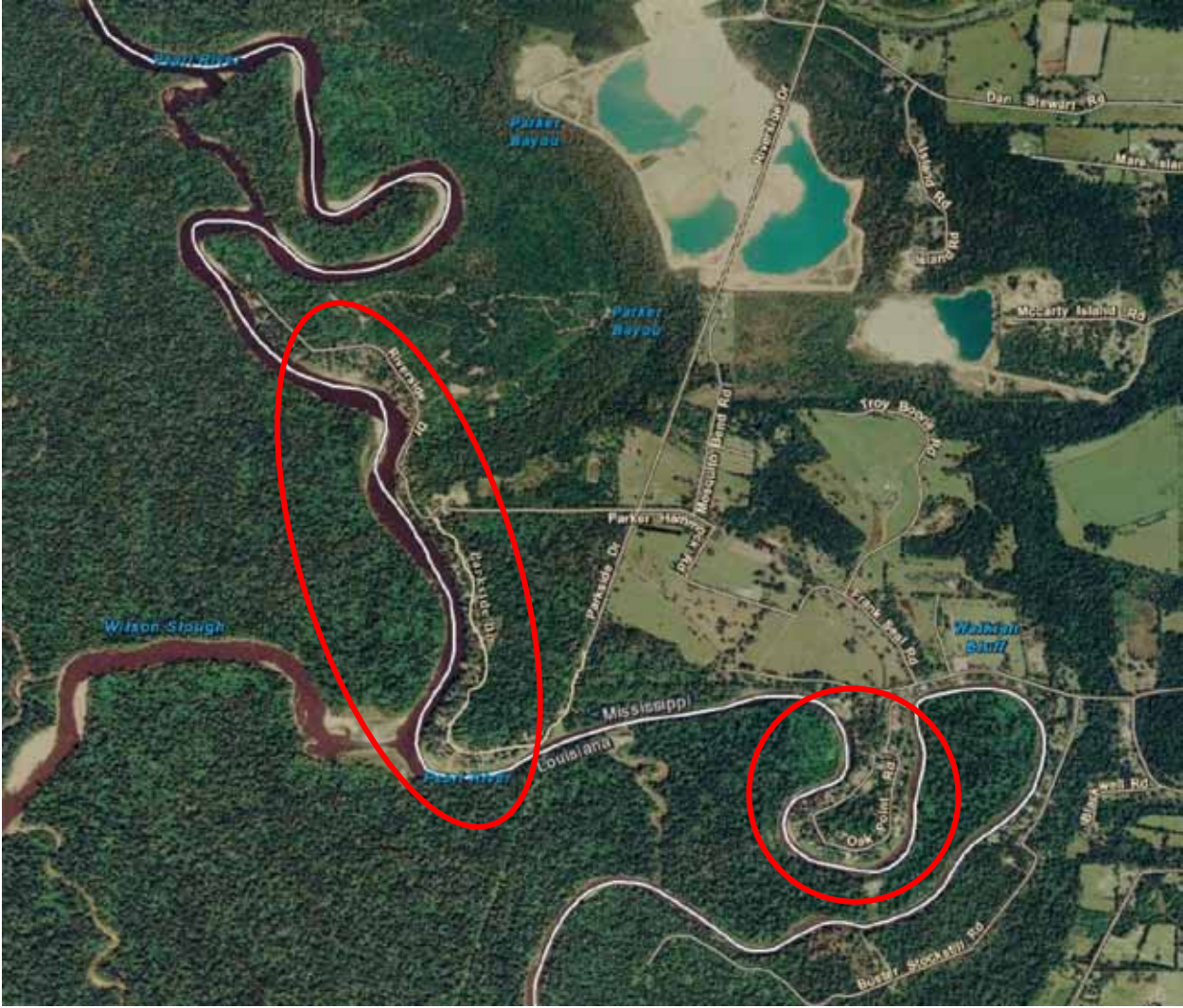
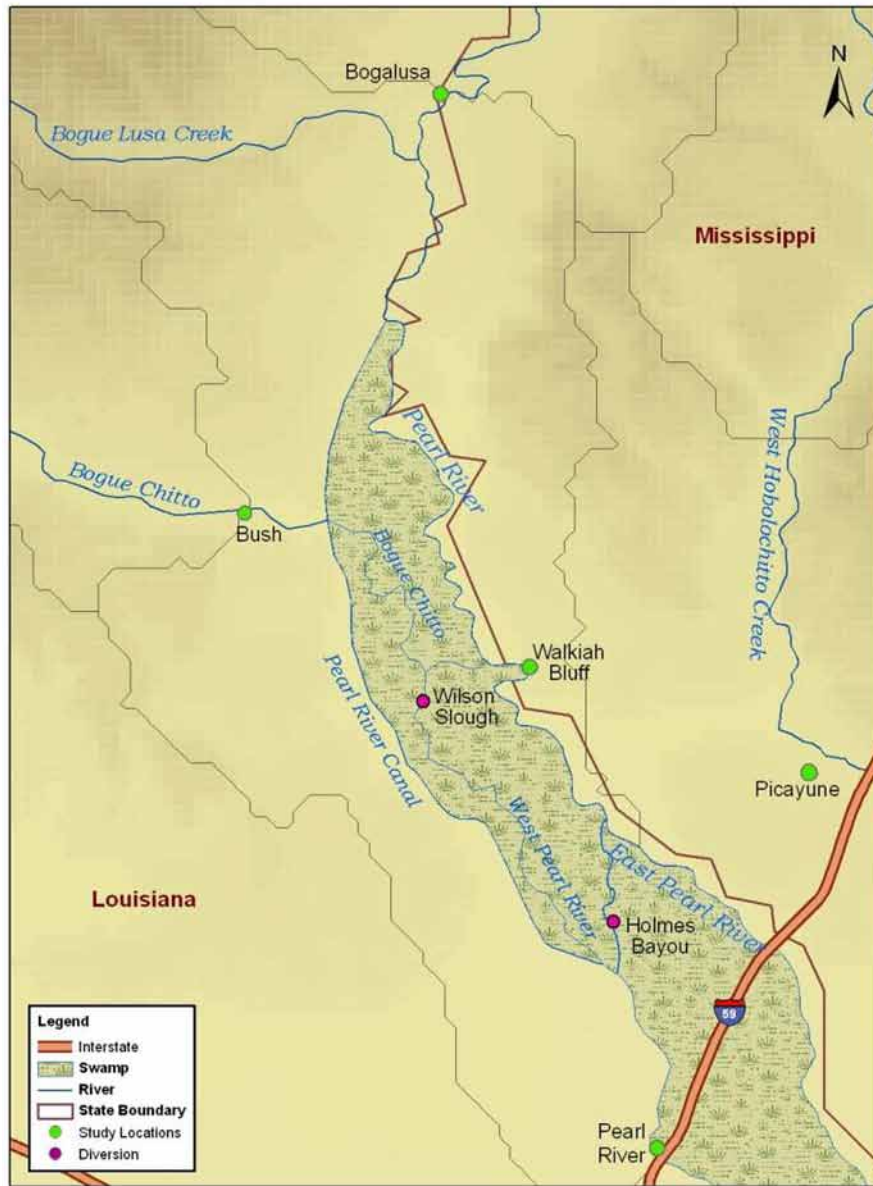


Figure 3. Pearl River divergence.





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Figure 4. Gage locations in the lower Pearl River basin (NEW gage IDs).



**Figure 5. Crest to crest curve for Bogalusa, LA to Walkiah Bluff, MS on the the Pearl River. Purple markers indicate events with a heavy contribution from the Bogue Chitto River near Bush, LA.**

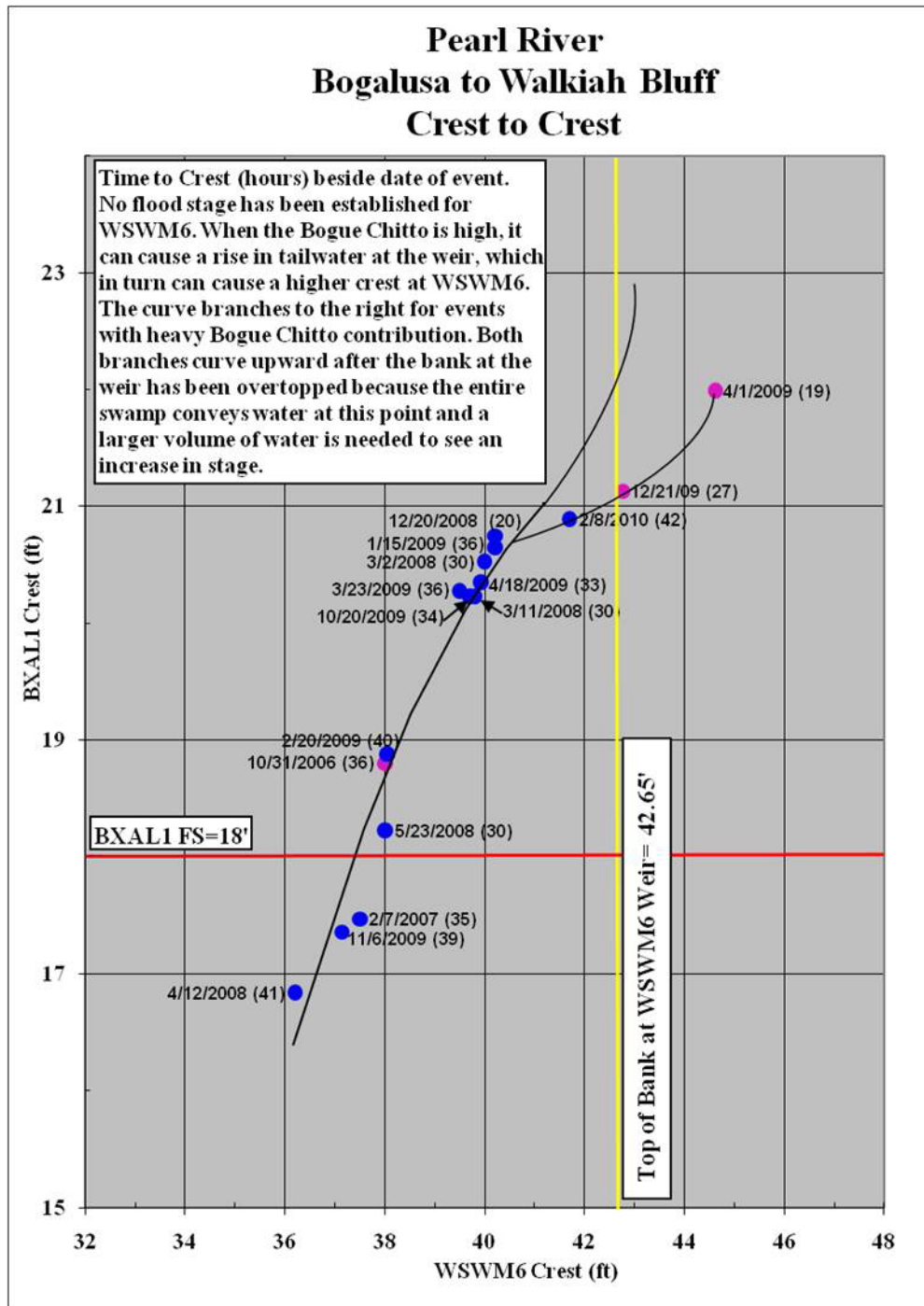


Figure 5. Crest to crest curve for Bogalusa, LA to Walkiah Bluff, MS on the the Pearl River. Purple markers indicate events with a heavy contribution from the Bogue Chitto River near Bush, LA

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Figure 6. Historical hydrographs indicating the hydrologic contributors at Pearl River, LA on the Pearl River (NWSID PERL1).



Figure 7. Crest to crest curve for Walkiah Bluff, MS to Pearl River, LA on the Pearl River.

