## 2.4S.9 Channel Diversions

The following site-specific supplement addresses COL License Information Item 2.18.

### 2.4S.9.1 Historical Channel Diversions

STP 3 & 4 is located adjacent to the Lower Colorado River approximately 16 miles upstream from the Gulf of Mexico in Matagorda County, Texas (Figure 2.4S.9-1). The geologic history of Matagorda County within the last 200,000 years has been studied extensively by different investigators (Reference 2.4S.9-1, 2.4S.9-2, and 2.4S.9-3). The oldest and most prominent geologic formation in Matagorda County is the Beaumont Formation (Figure 2.4S.9-2). The Beaumont Formation is described in Reference 2.4S.9-1 (p. 112-113) as "a regressive or prograding sedimentary geologic unit" that was "probably laid down as an alluvial plain by a paleo-Colorado River. The ancient river's successive meandering courses distributed fluvial and deltaic sediments between the contemporaneous Pleistocene alluvial plains of the paleo-Lavaca and paleo-Navidad Rivers to the southwest and a paleo-Brazos River to the northeast." Early delineations of the Lavaca, Navidad, Colorado, and Brazos rivers are shown in Figure 2.4S.9-3, which is a reproduction of an 1838 map of Texas showing the Rio Colorado, i.e., the Lower Colorado River, and other nearby rivers (Reference 2.4S.9-4). The historical Colorado channel followed the same course as the present day Caney Creek channel, which is referred to as Cane Brake in the map.

Reference 2.4S.9-1 (p. 112) states that the Beaumont Formation was "deposited during a late Pleistocene high sea-level stand similar to that of the present." However, the interglacial period during which the deposition took place is debated. Reference 2.4S.9-1 (p. 112) states that "some investigators place its deposition during the Sangamon [i.e., between 110,000 and 130,000 years ago], a major interglacial stage between the Illinoian [i.e., between 130,000 and 200,000 years ago] and Wisconsin glacial stages [i.e., about 12,000 to 110,000 years ago]. It is possible that the formation was deposited less than 35,000 years BP (before present) in a late intra-Wisconsin high sea-level stand." With respect to the mechanism for deposition, Reference 2.4S.9-1 (p. 112) states that "during the Pleistocene, when the continental glaciers expanded several times, water was transferred from the ocean basins to the largely land-based glaciers and there was a worldwide lowering of sea level. Estimated sea levels below present-day levels range from about 250 to 450 feet. Streams draining into the oceans incised and regraded their channels as they flowed toward a lower, more distant seashore. When the sea level rose in response to periodic melting of the glaciers, the incised channels were flooded, backfilled or alluviated. Subsequently, broad alluvial plains were built along the gulf coast."

The Quaternary geologic history of the paleo-Colorado River has been less well documented upstream of Matagorda County than in Matagorda County. Reference 2.4S.9-2 (p. 1003) states that the Colorado River is "draining the geologically heterogeneous Southern High Plains and Edwards Plateau regions of West Texas. As the channel emerges from a deep canyon at the Balcones Escarpment, the drainage basin narrows considerably, and the lower Colorado River transects the Gulf Coastal Plain for 280 km until discharging into the Gulf of Mexico. On the inner coastal plain, the lower Colorado River flows within a well-defined bedrock valley that transects

Upper Cretaceous carbonates, then progressively younger and less steeply dipping Tertiary siliciclastic rocks."

From the late Quaternary (i.e., between approximately 200,000 years to 35,000 years ago) to the recent present (i.e., approximately 550 years ago), the Colorado River channel occupied the present day Caney Creek channel (Figure 2.4S.9-1, References 2.4S.9-1 and 2.4S.9-2). As stated in Reference 2.4S.9-1 (p. 11), "the flood plain along an abandoned Holocene course of the Colorado River, now occupied by Caney Creek, lies along the northeastern margin of the county." Stratigraphy investigations indicate a recent major avulsion (i.e., the shifting of flow from one channel to another channel) of the Colorado River occurred near Glen Flora, Texas, approximately 500 to 600 years ago (Reference 2.4S.9-2). The previous channel belt (i.e., the previous river channel occupied by the Colorado River before the river avulsed) flowed southeast down the modern day Caney Creek channel and into the eastern end of Matagorda Bay (Figure 2.4S.9-1). The two channels are no longer connected (Figures 2.4S.9-2, 2.4S.9-3). A delineation of the historical Colorado channel is presented in Figure 2.4S.9-1.

The Caney Creek meander belt and geomorphic features are relatively mature compared to the present day Colorado River channel. Reference 2.4S.9-2 (p. 1009-1010) states that "the Caney Creek meander belt was substantially different from the modern channel and suggested that it was a highly sinuous, mature, fully aggraded channel course prior to its abandonment (Figure 2.4S.9-1). Indeed, examination of the Caney Creek meander belt in air photos and in the field shows that a well-defined levee, crevasse splay, and flood basin depositional environments were common to the lower Colorado River when it flowed through the Caney Creek course. Such features did not occur along the lower Colorado River in the bedrock-confined portion of the valley, upstream from the point of avulsion, or in the recently occupied channel farther downstream until the lowermost reaches near the present shoreline." Further, Reference 2.4S.9-2 (p. 1014-1015) states that "avulsion and abandonment of the fully aggraded Caney Creek meander belt, with occupation of the modern lower Colorado channel, most likely occurred in response to near complete filling of the incised valley during the present highstand."

## 2.4S.9.2 Stratigraphic Evidence

Stratigraphic formations along the Colorado River and Caney Creek indicate the river has occupied the recent course near STP 3 & 4 for approximately the last 550 years. Stratigraphic records also indicate that, in an unregulated setting, the most likely zone for future river avulsion is between Eagle Lake and Wharton (Figure 2.4S.9-1). Reference 2.4S.9-2 (p. 1009) states "between Eagle Lake and Wharton, the abandoned Caney Creek meander belt and modern channel occur within a single valley that contains the ELA (i.e., the Eagle Lake Alloformation, which was deposited approximately 20,000 to 14,000 years BP), CBA-1 [i.e., the Columbus Bend Alloformation, which was deposited approximately 12,000 to 5,000 years BP], CBA-2 [i.e., the Columbus Bend Alloformation, which was deposited approximately 5,000 to 1,000 years BP] and floodplain facies from the Caney Creek meander belt and the modern channel" (Figure 2.4S.9-4). Further, "downstream from Wharton, the Caney

Creek and modern channel courses diverge and ultimately discharge into the Gulf of Mexico some 40 km for each other" (Figure 2.4S.9-1). Reference 2.4S.9-2 (p. 1015) states "the influence of base-level change on stratigraphic architecture in the lower Colorado valley extended 90 km upstream from the present highstand shoreline [near Eagle Lake, Texas], but was superimposed on climatically driven episodes of sediment storage or removal. Thus, depositional sequences on coastal plain rivers with large inland drainage basins most likely record interactions between upstream controls on discharge and sediment supply, and base-level controls on stratigraphic architecture and preservation in the geologic record, rather than a strict one-to-one relationship with base-level change *per se*."

### 2.4S.9.3 Ice Causes

With respect to ice, there is no record of any major river in the State of Texas freezing over at any time in recorded history (Subsection 2.4S.7). Consequently, ice jams that could cause a channel diversion are considered unlikely.

### 2.4S.9.4 Flooding of Site Due to Channel Diversion

#### 2.4S.9.4.1 Geologic Effects

The regional and site-specific geology is discussed in Subsection 2.5S.1. A record of channel diversions due to upstream and above-bank channel changes due to geologic, seismic, or topographic changes, including subaerial landslides and earthquakes, has not been documented above the transition into the Balcones Escarpment, which occurs near Austin, Texas (Reference 2.4S.9-1). As stated on p. 1003 of Reference 2.4S.9-1, "the Colorado River is a large fluvial system […] with its upper reaches and all major tributaries (92% of total area) draining the geologically heterogeneous Southern High Plains and Edwards Plateau regions of West Texas. As the channel emerges from a deep canyon at the Balcones Escarpment, the drainage basin narrows considerably, and the lower Colorado River transects the Gulf Coastal Plain for 280 km until discharging in the Gulf of Mexico." In the vicinity of STP 3 & 4, the region is relatively flat, with less than a one degree average dip in regional geologic units from the location of STP 3 & 4 to the Gulf of Mexico (Subsection 2.5S.1). This low dip indicates a low probability of slope failure along bedding planes (Subsection 2.5S.1). While growth faults are common geologic structures in the Texas Coastal Plain, these faults are non-tectonic gravity-related displacements formed within sediment deposition of the geologic formations. The information presented in Section 2.5S.3 indicates that there are no capable faults in the STP site region. Therefore, it is highly unlikely that surface faulting can occur and cause a slope failure that would lead to channel diversion or surface faulting that would displace landforms and, thereby, cause channel diversion.

#### 2.4S.9.4.2 Land Subsidence from Groundwater Pumping

The groundwater table and land subsidence near STP 3 & 4 are discussed in Subsections 2.4S.12 and 2.5S.1.1 respectively. In the vicinity of Bay City, the measured subsidence for the period of 1918 to 1951 was only 0.12 ft (Reference 2.4S.9-5). Most of the 1918 to 1951 subsidence may be attributed to increased use of groundwater after 1940 (Reference 2.4S.9-5). From 1943 to 1973, the land surface subsided more than 1.5 ft (0.4572 m) due to groundwater withdrawals (Subsection 2.5S.1). More recently, however, land subsidence in Matagorda County has been relatively minimal due to declining groundwater use. Reference 2.4S.9-6 (p. 7) states the groundwater use for Matagorda County as 38,554 acre-feet in 1980, 37,537 acre-feet in 1990, and 14,413 acre-feet in 1997. In 1997, less than 10% of total water use was derived from groundwater sources (Reference 2.4S.9-6, p. 7).

### 2.4S.9.4.3 Floods

Of the various mechanisms that could cause channel diversion, the most likely scenario for a major channel avulsion would be from a large flood, a series or large floods, the failure of upstream dams, or significant sea-level change. In an unregulated setting, the most likely location for a channel diversion on the Colorado River would be between Eagle Lake, Texas, and Wharton, Texas (Figure 2.4S.9-1). However, flows on the Lower Colorado River have been regulated since 1938. For example, since the completion of Lake Buchanan (1937) and Lake Travis (1940), the peak discharge for the Colorado River at Austin (USGS Gauge #08158000) was 47,600 cubic feet per second (cfs) in April 1941 (Figure 2.4S.9-5). A flood that occurred in September 1952 would have produced a flow of over 700,000 cfs had Mansfield dam and Lake Travis not been present. However, Lake Travis has sufficient storage capacity to withhold the entire flood volume. Instead of a potentially disastrous flood, the peak discharge recorded at Austin during this period was only 3720 cfs (Reference 2.4S.9-7).

### 2.4S.9.4.4 Erosion and Channel Diversion due to Coastal Storm Surges

The largest documented hurricane to impact the Texas Coast was Hurricane Carla in 1961 (Subsection 2.4S.5). Reference 2.4S.9-1 (p. 114) states that “Hurricane Carla partly obliterated Matagorda Peninsula in 1961. Erosion effects, however, were soon repaired by shoreline deposition and wind-driven migration of shoreline sediments across the peninsula.” Further, “many scoured washover or storm channels eroded during hurricanes are transverse to the general trend of the peninsula. Almost all are sealed from the gulf by the present-day beach.” Because Hurricane Carla was nearly equivalent to the Probable Maximum Hurricane discussed in Subsection 2.4S.5, hurricane effects are not considered to be a significant mechanism for channel diversion that would impact the safety function at STP 3 & 4.

### 2.4S.9.4.5 Channel Diversion to Upstream Gravel Mining Effects

Sand and gravel mining activities in the Colorado River occur in the vicinity of and immediately downstream of Austin, Texas (Reference 2.4S.9-8). Reference 2.4S.9-8 (p. 883) states that “flooding has caused the river to erode its banks and carve new paths through abandoned pits, effectively altering the river course at several locations in Travis and Colorado counties in Texas.” Reference 2.4S.9-8 notes that gravel mining has led to artificial cutoffs of historical river meanders and localized downstream bank effects. In addition, Reference 2.4S.9-9 notes that “gravel mining without appropriate constraints can lead to severe bed degradation downstream, with the resulting failure of bridges [and] exposure of buried pipelines.” However, severe bed degradation effects in the Lower Colorado River have not been documented. Consequently, gravel mining effects are not considered to be a significant mechanism for channel diversion that would impact the safety function of STP 3 & 4.

## 2.4S.9.5 Human-Induced Changes of Channel Diversion

### 2.4S.9.5.1 Colorado River Delta

The geomorphology of the Lower Colorado River since the late 17th century was largely governed by the occurrence and subsequent removal of a major log jam blocking the river near Wharton, Texas. Reference 2.4S.9-3 (p. 100) states “the earliest historical reference to a raft of logs in the Colorado River was made in 1690 when the Matagorda Bay area was mapped by Spanish explorers headed by Captain Francisco de Llanos. Deposition of the modern delta must have begun after 1690 because the Spaniards were able to ascend some 10 or 15 miles of the eastern channel of the Colorado River, which is about at the head of the tidewater. Had there been deltation at the mouth of the river, it is unlikely that they could have gotten their sailing ships into the river. The Spaniards discovered a log raft (i.e., debris jam) in the western channel and had to turn back and exit by another channel. This raft was mentioned by William Selkirk in 1824, the first surveyor in the area (Reference 2.4S.9-1). Reference 2.4S.9-1 (p. 115) states that “in 1824, the downstream edge of the raft was about 46 miles in length and entered Wharton County. Unsuccessful and poorly funded efforts to destroy the raft persisted until 1925, when a narrow pilot channel was blasted through the raft. A major flood on the Colorado River in 1929 carried substantial parts of the raft into Matagorda Bay and silted up the mouth of the river channel. The municipality of Matagorda and the surrounding lowlands were then subjected to periodic flooding. During the flood of 1935, the major flow of the Colorado River was almost diverted into Tres Palacios Creek and Tres Palacios Bay, one of the arms of Matagorda Bay.” Reference 2.4S.9-3 (p. 103) states “the last major flood occurred in 1935, when considerable water from the Colorado River found its way into the head waters of Tres Palacios Creek in Wharton County. If left alone, the Colorado River would have diverted itself again and Tres Palacios Creek might be now the main channel of the Colorado River.” Further, “concurrent dam building and flood control measures in the upper Colorado watershed greatly reduced the danger of flooding in the Colorado lowlands.”

The removal of the log raft led to the development of the Colorado River delta near Matagorda (Figure 2.4S.9-6). The development of the delta eventually separated East Matagorda Bay from Matagorda Bay. In 1908, the delta spanned 45 acres. In 1929, a large flood flushed much of the raft into Matagorda Bay, and silted up the mouth of the channel, splitting the bay into East Matagorda Bay and Matagorda Bay. The acreage of the delta increased to 3470 acres in 1933, 4890 acres in 1936, 7098 acres in 1941, and 7200 acres in 1953 (Reference 2.4S.9-3, Figure 2.4S.9-7). In 1936, a channel was cut through the peninsula to relieve flooding, and the Colorado River discharged directly into the Gulf of Mexico. Since 1941, Mansfield Dam and Buchanan Dam have trapped most of the coarse sediment in the Colorado River. Consequently, the delta has been in a recessive mode (Reference 2.4S.9-1).

### 2.4S.9.5.2 Channel Stabilization and Efficiency

Constructed channels often define channel efficiency in terms of the channel cross-section that “gives the maximum discharge, Q, for a specified flow area, A,” which is known as the most efficient hydraulic section (Reference 2.4S.9-10, p. 235). However, in natural channels, channel efficiency refers to the effective ability of the channel to move both water and sediment over a wide range of flows and grain sizes, respectively. Reference 2.4S.9-11 (p. 168) states that “rivers with erodible boundaries flow in self-formed channels that, when subject to relatively uniform controlling conditions, are expected to show a consistency of form, or average geometry, adjusted to transmit the imposed water and sediment discharges.” The adjustment of the local channel form is a function of the shear stress relative to sediment supply.

With respect to sediment transport, erosion, deposition and longitudinal profile impacts due to Lake Buchanan and Lake Travis, Reference 2.4S.9-9 (p. 7) states that “the installation of a dam on a river typically blocks the downstream delivery of all but the finest sediment, creating a pattern of bed aggradation upstream. The dam raises base level, i.e., the downstream water surface elevation to which the river upstream must adjust, forcing upstream-migrating deposition.” Further, Reference 2.4S.9-9 (p. 8) states that “the cutoff of sediment at a dam often induces bed degradation, as the river mines itself to replace the lost load. Bed degradation rarely continues unabated. Even small amounts of coarse, erosion resistant material in the substrate tend to concentrate on the bed surface as the bed degrades, eventually limiting the process through the formation of a static armor.”

A considerable number of channel efficiency improvements were completed by the United States Army Corps of Engineers (USACE) south of Bay City in connection with the navigation project authorized by Congress under Section 7 of the Rivers and Harbors Act of August 8, 1917. Dredging was carried out between river mile 22 and the Gulf Intracoastal Waterway. This dredging stabilized the river planform (i.e., the lateral footprint of the channel) (Reference 2.4S.9-7). The dredged material was deposited along both banks of the river and the spoil areas were enclosed by embankments, limiting alluvial channel meander changes. A considerable portion of the abandoned river channel north of the STP 3 & 4 and in the vicinity of Selkirk Island was filled in shortly after 1917. Hence, shifting of the Colorado River channel near the project site is unlikely (Reference 2.4S.9-7).

In the vicinity of the site, natural levees have been developed along both banks of the Colorado River. Near the highway bridge FM 521 bridge crossing at river mile 16, the elevation of the levee is approximately 20 ft. Based on historical data collected by the USACE, a flood of 75,000 cfs would overtop the west bank near the site for existing channel and flood plain conditions. The natural levee reaches an elevation of 25 ft approximately 2 miles upstream from FM 521. At this point the discharge required to overtop the levee under previous conditions was also approximately 75,000 cfs. Past backwater studies indicate that the bankfull capacity in the vicinity of STP 3 & 4 has increased to approximately 100,000 cfs, due in part to the dredging of a 14-foot-deep channel with a 100-ft width for a distance of 15.5 miles above the Gulf Intracoastal Waterway (Reference 2.4S.9-7).

Numerous relict Colorado River channels have also been documented from the Tres Palacios River west of the Colorado River to Caney Creek east of the Colorado River (Reference 2.4S.9-1, Figure 2.4S.9-1). For example, three miles downstream from Wharton, Texas, a west branch of the Colorado River formerly diverted flows south to

Matagorda Bay (Figures 2.4S.9-8 and 2.4S.9-9). Access to the west branch from the main river course was terminated when dredge spoil was used to fill in the connection in 1917 (Reference 2.4S.9-7). During flood stage, the west branch still conveys some of the overbank flows. The two branches isolate an island known as Wild Cow Island (Figure 2.4S.9-8). Throughout Wild Cow Island, there are indications of abandoned river courses (Reference 2.4S.9-1). To the east of the present Colorado River channel, Dick Island and Selkirk Island are formed by abandoned river courses (Figures 2.4S.9-8, 2.4S.9-9), some of which have also been blocked or filled by dredge spoil (Reference 2.4S.9-7).

### 2.4S.9.5.3 ~~2.4S.9.5~~ Potential of Future Channel Migration and Impact

The formation and evolution of an avulsion-dominated delta floodplain in which the Lower Colorado River flows is a complex process (Reference 2.4S.9-12). Reference 2.4S.9-13 (p. 711) states that “at present, little evidence is available on avulsion rates, avulsion frequencies, and inter-avulsion periods of aggrading fluvial systems over time scales of millennia.” A river avulsion occurs with the rapid transfer of flow from the current channel to a new flow pathway. Studies of avulsion have noted several recurring characteristics, including persistent avulsion locations, the duration of inter-avulsion periods (i.e., the period of activity between channel belts), and avulsion frequency (Reference 2.4S.9-13). In a study of another avulsion-dominated river system, persistent avulsion zones occurred in areas with a large difference in topographic elevation between the former flow course and the new flow course (Reference 2.4S.9-13). Avulsion frequency has also been found to increase with increasing sedimentation rates that build or lead to aggradation of the channel relative to an adjacent flow course (Reference 2.4S.9-14).

Consequently, before the construction of Lake Buchanan, Lake Travis and other upstream reservoirs, the potential for a channel diversion in an unregulated setting would be higher, especially if the sea level were to decline. However, upstream reservoirs have significantly attenuated large floods and trapped all but the finest sediment loads. In conjunction, the Lower Colorado River has had significant levees constructed along its length that has stabilized the river planform.

The above review of the evidences and potential causes of channel diversions in the Colorado River indicates that there is little likelihood that major channel diversions impacting the safety facilities and function of STP 3 & 4 would occur. Specifically, flooding events in the order of a probable maximum flood (PMF) at the STP site discussed in Section 2.4S.2 as a result of channel diversions is considered improbable. Similarly, interruption of the non-safety water supply to the STP Reservoir Makeup Pumping Facility located on the west bank of the Colorado River as a result of channel migration is considered unlikely.

### 2.4S.9.6 References

2.4S.9-1 “Soil Survey of Matagorda County, Texas,” Hyde, H. W. 2001, United States Department of Agriculture and Natural Resources Conservation Service.

2.4S.9-2 “Late Quaternary Sedimentation, Lower Colorado River, Gulf Coastal Plain of Texas,” Geological Society of America Bulletin 106: 1002-1016, Blum, M. D. and S. Valastro, Jr. 1994.

2.4S.9-3 “Historical Deltation of the Colorado River, Texas” Deltas in Their Geologic Framework, Houston Geological Society, p. 99-105, Wadsworth, Jr., A. H. 1966.

2.4S.9-4 “An Illustrated Atlas, Geographical, Statistical, and Historical, of the United States and the Adjacent Countries,” Bradford, T. G. 1838.

2.4S.9-5 “Ground-Water Resources of Matagorda County, Texas,” Report No. 91, Texas Water Development Board, March 1969.

2.4S.9-6 “Aquifers of the Gulf Coast of Texas,” Report 365, Texas Water Development Board, February 2006.

2.4S.9-7 “STPEGS Updated Final Safety Analysis Report, Units 1 and 2,” Revision 13.

2.4S.9-8 “Impacts of Sand and Gravel Mining on Physical Habitat of the Colorado River and Tributaries, Central Texas,” Transactions of the Gulf Coast Association of Geological Societies, p. 883-890, Saunders, G. P. 2002.

2.4S.9-9 “Transport of Gravel and Sediment Mixtures” ASCE Manual 110, Sediment Engineering, Chapter 3, Parker, G., 2007 (in press). Draft available at http://cee.uiuc.edu/people/parkerg/manual_54.htm, accessed June 21, 2007.

2.4S.9-10 “Open-Channel Flow,” Chaudhry, M. H., 1993.

2.4S.9-11 “Fluvial Forms and Processes,” Knighton, D. 1998.

2.4S.9-12 “A Genetic Classification of Floodplains.” Geomorphology 4: 459-486, Nanson, G. C. and Croke, J. C. 1992.

2.4S.9-13 “Middle and Late Holocene Avulsion History of the River Rhine (Rhine-Meuse Delta, Netherlands),” Geology 22: 711-714, Törnqvist, T. 1994.

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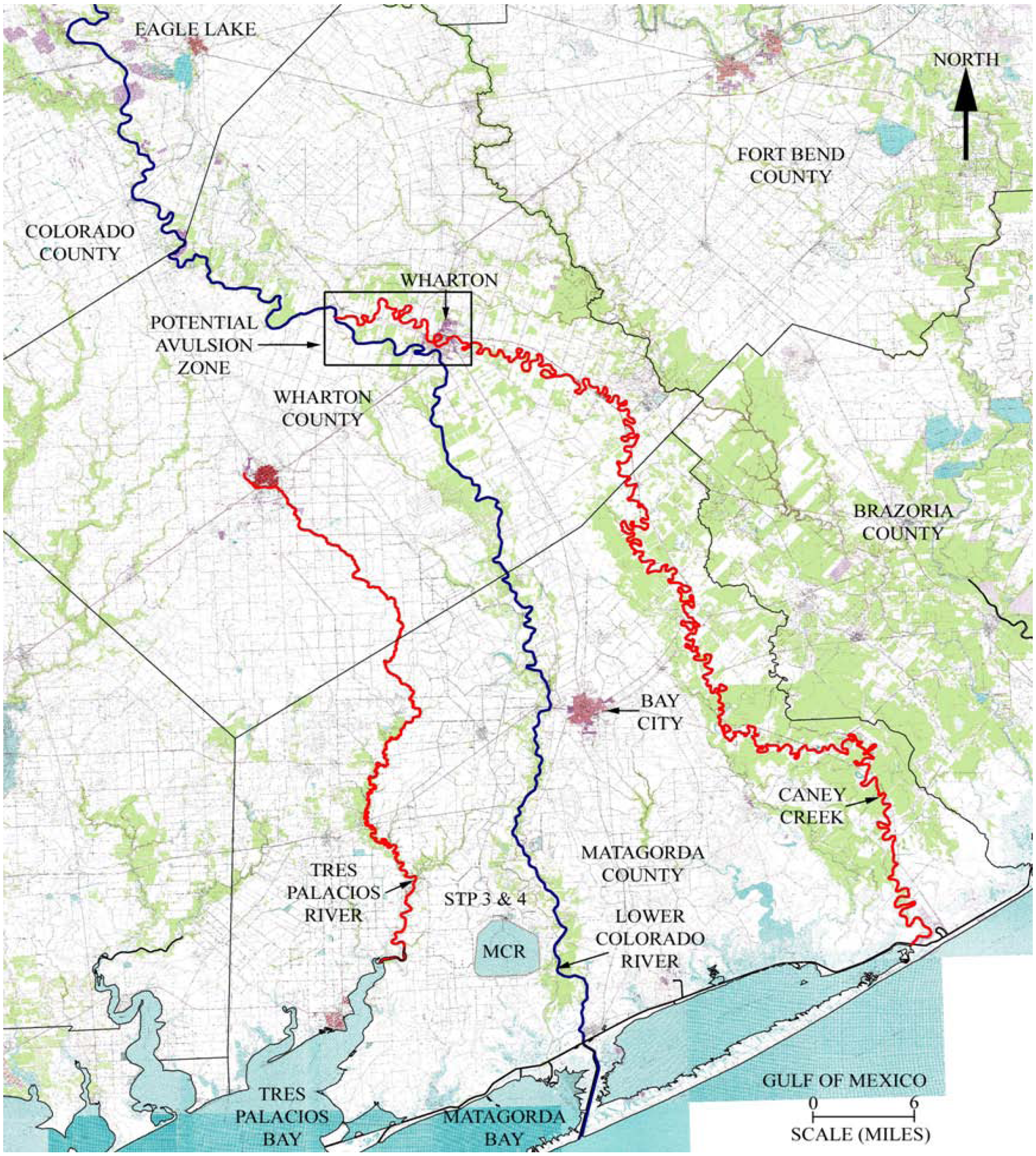


**Figure 2.4S.9-1 STP 3 & 4 Relative to the Current Colorado River Channel (Dark Blue Line) and Relict Channels of the Colorado River Delta Plain (Red Lines)**

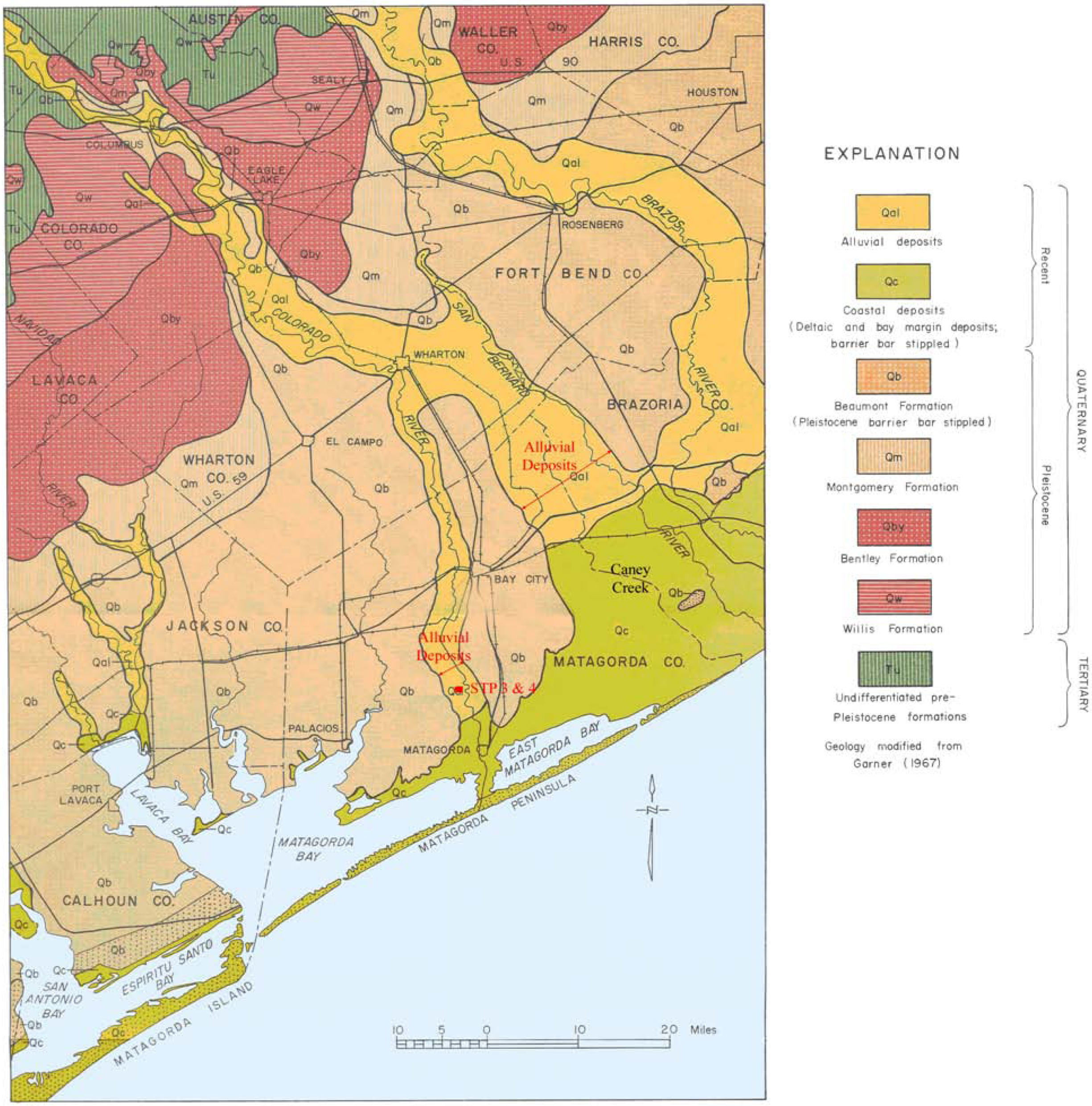


**Figure 2.4S.9-2 Quaternary and Tertiary Deposits of the Colorado River, From Near Columbus, Texas to the Gulf of Mexico**


**Figure 2.4S.9-3 1838 Map of Texas Showing the Rio Colorado (i.e., the Lower Colorado River) Between the Rio-La Vaca and Rio Navidad Rivers to the West and the Rio Brazos to the East**

Source: Modified from Reference 2.4S.9-4

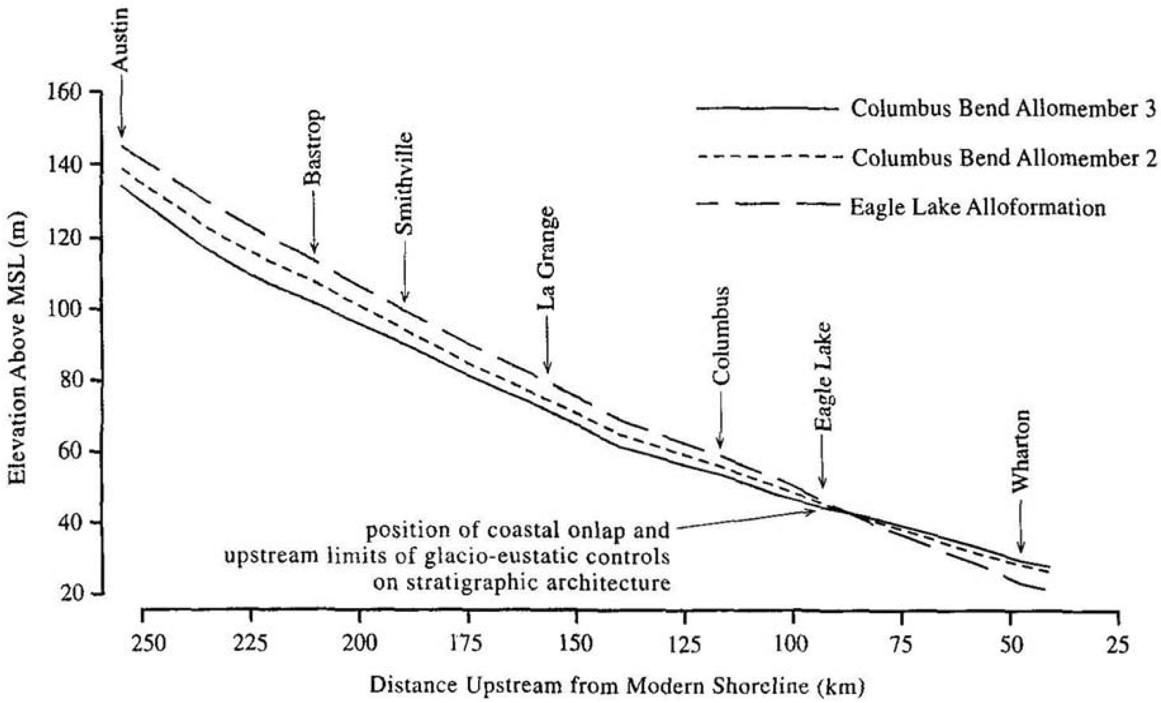


**Figure 2.4S.9-4 Longitudinal Profiles for the Lower Colorado River Relative to Mean Sea Level (MSL)**

Source: Reference 2.4S.9-2, p. 1015

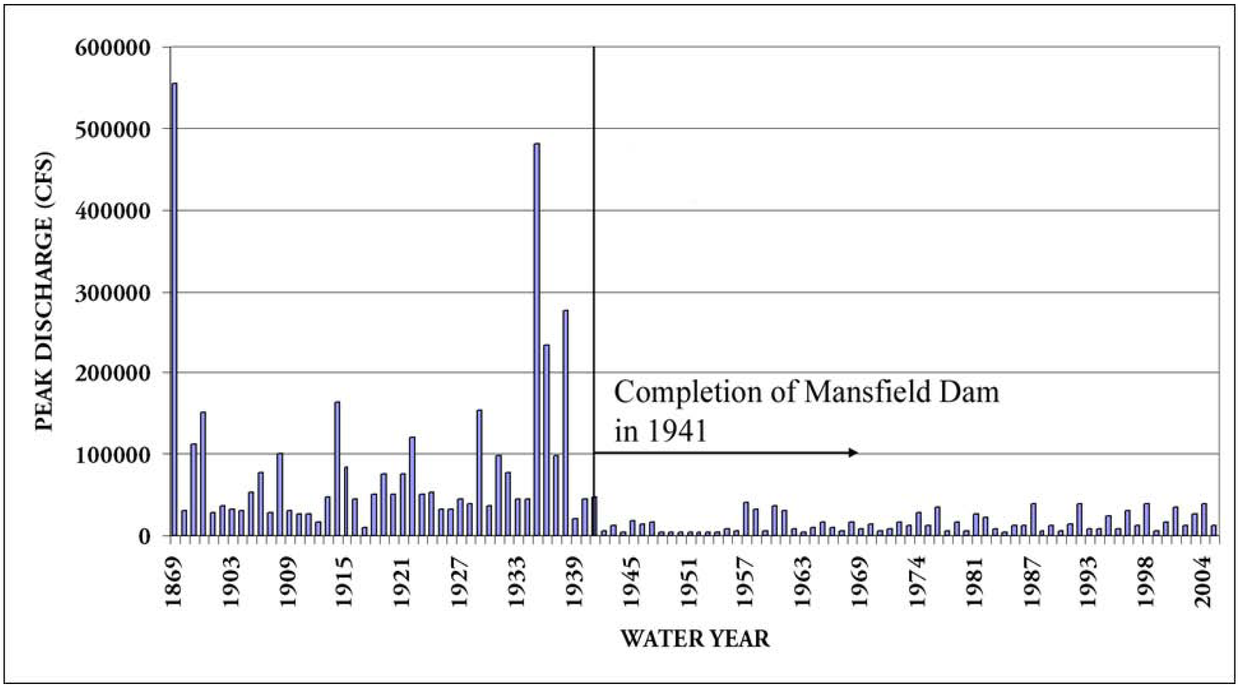


**Figure 2.4S.9-5 Peak Discharge Versus Water Year for the Colorado River at Austin, Texas (USGS #08158000) Before and After the Completion of Mansfield Dam and Lake Travis**

Note: The flow record includes all historical peaks in the USGS database from water year of 1863 to 2006

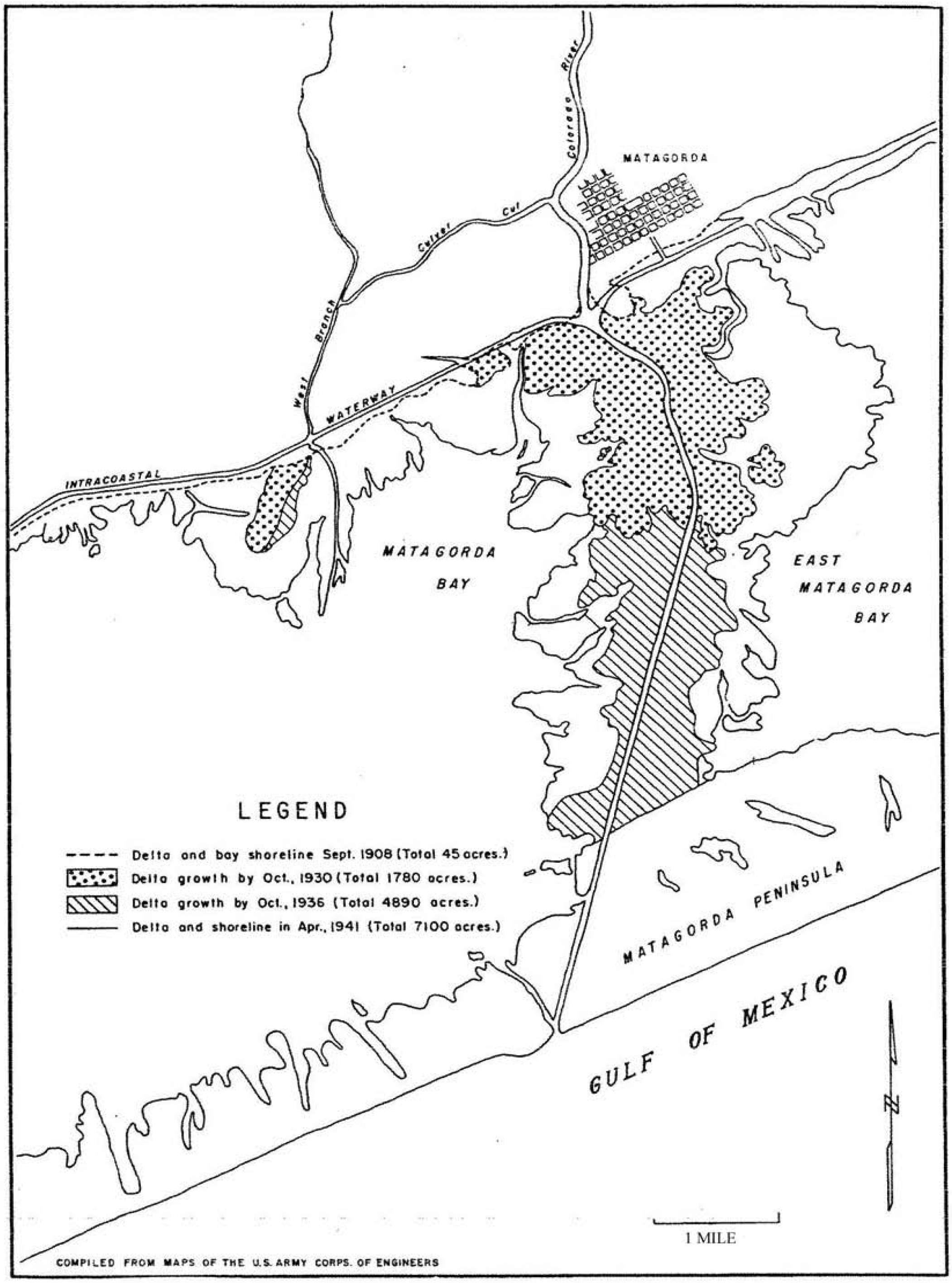


**Figure 2.4S.9-6 Successive Growth Stages of the Modern Delta of the Colorado River, Texas**

Source: Figure 2 of Reference 2.4S.9-3 [p. 101]

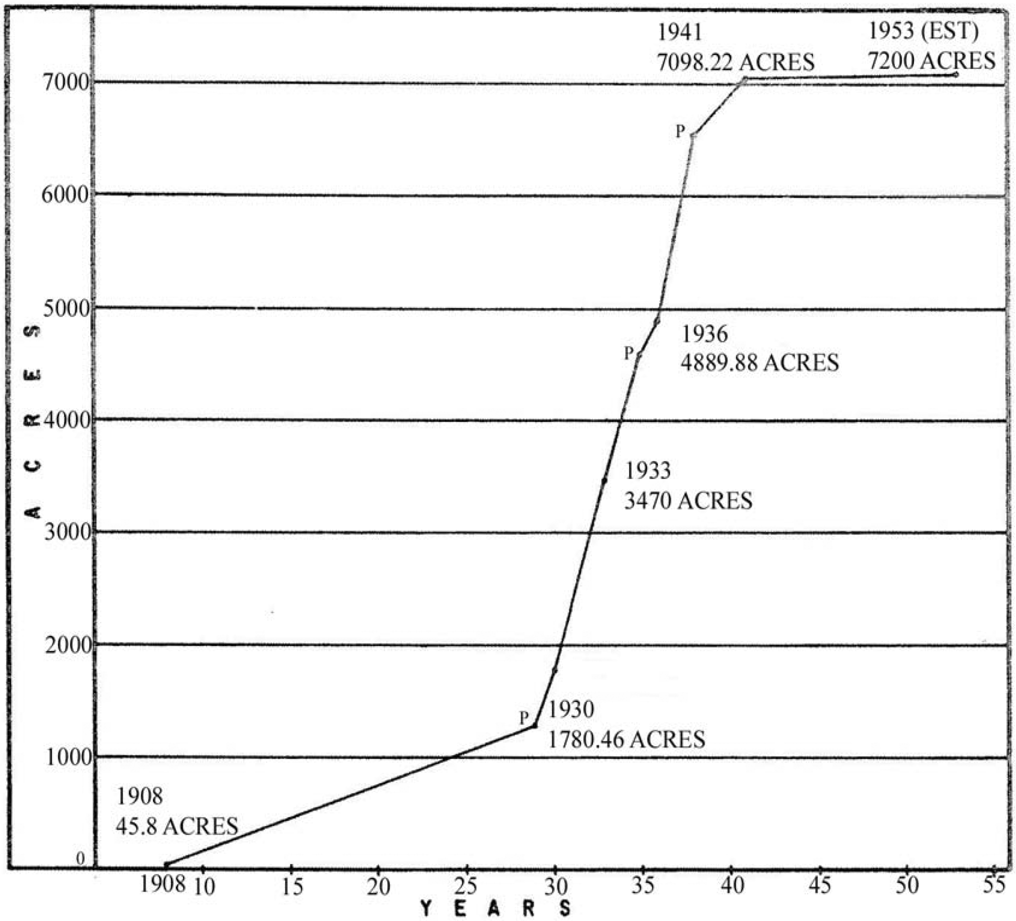


**Figure 2.4S.9-7 Graphic Representation of the Growth of the Colorado River Delta in Acres by Years**

Note: Points marked “P” are postulated for flood years
Source: Modified from Figure 4 of Reference 2.4S.9-3 [p. 105]

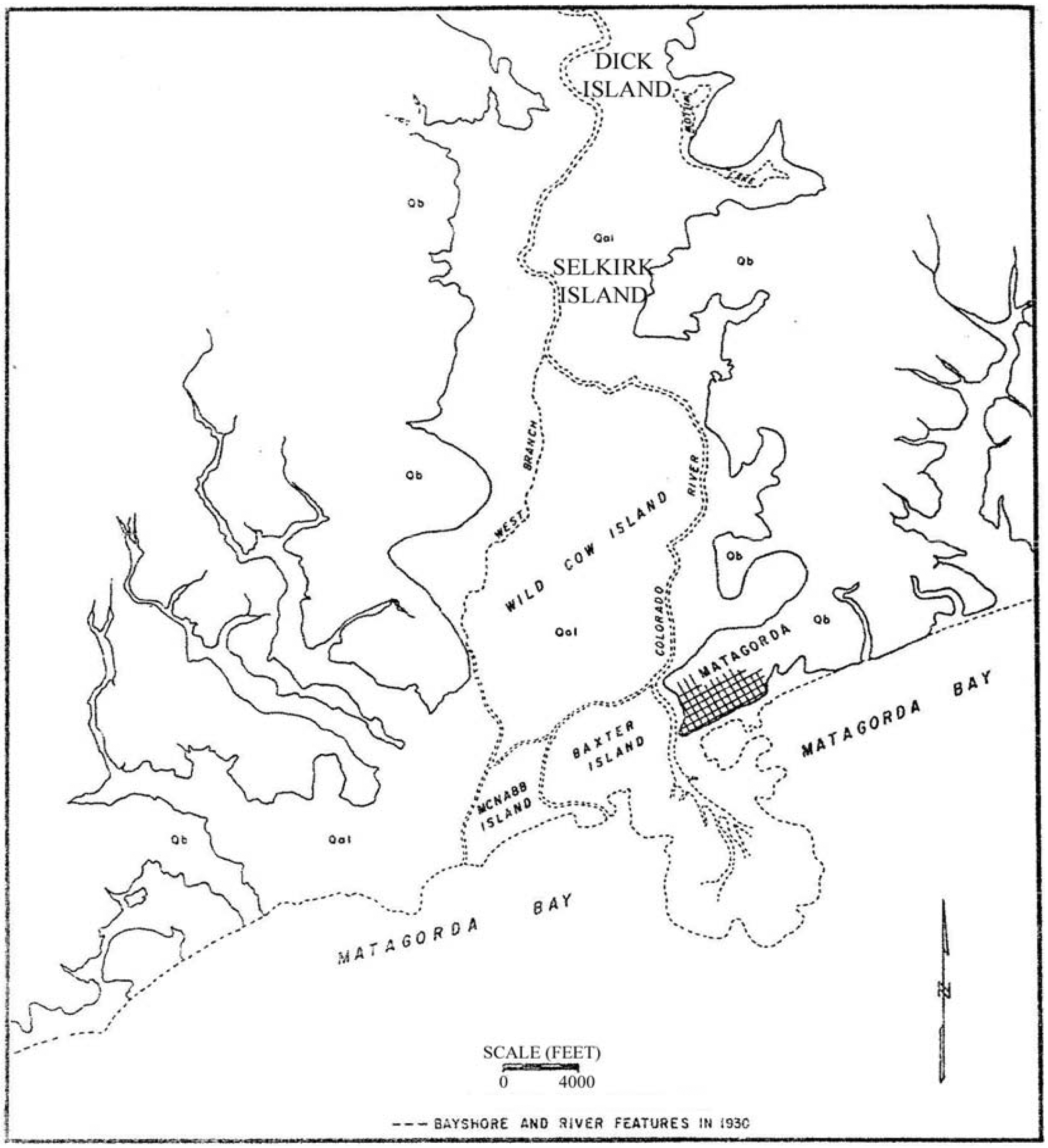


**Figure 2.4S.9-8 Historical Estuary Occupied by the Colorado River After Abandoning the Caney Creek Area (Solid Line) and the Estuary After Being Filled with Sediments in 1930 (dashed line) (modified from Fig. 3 of Reference 2.4S.9-3 [p. 103]**

Source: Modified from Fig. 3 of Reference 2.4S.9-3 [p. 103]

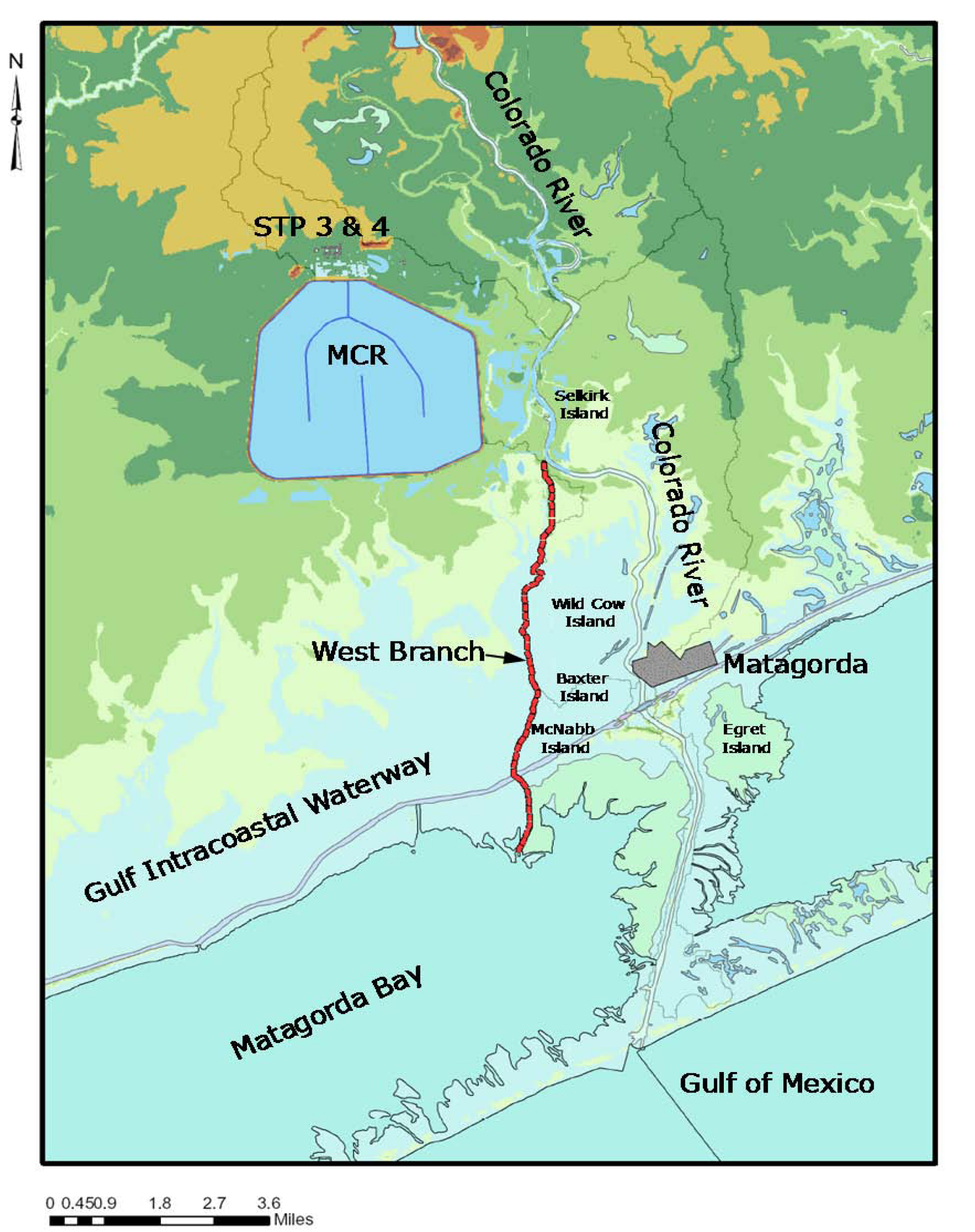


**Figure 2.4S.9-9 Plan View of West Branch of the Lower Colorado River, Wild Cow Island, Baxter Island, and McNabb Island Near Matagorda, Texas**