# 2. DREDGE-AND-FILL ACTIVITIES PRIOR TO WORLD WAR II

## 2.1 Nineteenth Century Navigation Projects

### *2.1.1 Inlet stabilization*

Some of the earliest physical alterations of Galveston Bay addressed the most fundamental aspect of navigation, access to the bay. At the close of the War for Southern Independence, the harbor of Galveston was situated on a lateral distributary channel of the flood bar of Bolivar inlet. While the depths in this naturally scoured channel were certainly adequate, shipping was forced to navigate the inner and outer bars of the inlet. The outer bar was the natural ebb bar of the inlet, while the inner bar, located just off the mouth of Galveston channel, was reported to have begun forming in 1866 and was attributed to chain and piling obstructions placed there as a blockade during the war. These bars were highly variable in depth and at that time had been shoaling from reported depths in excess of 30 ft during the 1840's (reports of dubious merit, and, in any event, may have reflected effects of the hurricane of 1837 or the gale of 1842, Frazier, 1921) to depths less than 10 ft, thereby necessitating lightering and the associated expense and hazard. (The early history of Galveston Harbor has been recounted in many sources, and need not be repeated here. See Alperin, 1977, McComb, 1986, and citations therein.)

Dredging was not an option; rather, the entrance channel system had to be protected from littoral drift and maintained by training the tidal currents. From about 1875 through 1897, the Corps of Engineers proceeded with this work, sporadically at times, until the south and north jetties were complete, and the shoreline adjacent to Fort Point was stabilized by a short gabion jetty running out to the inner bar and connecting with the south jetty. The evolving configuration of the Galveston Entrance during the last decade of the nineteenth century is depicted in Fig. 2-1, from Watt (1905). (The 1880-85 harbor and jetty configurations are displayed in Merrill et al., 1886, along with considerable dirty laundry from the controversy with Eads.) As the jetties neared completion, a straightened navigation channel between the jetties was maintained, first by a towed hydraulic dredge, then, in 1895 by the hopper *General C.B. Comstock* (Fig. 2-2). With the completion of the jetties, by about 1897 controlling depths over the bars on the order of 25 ft were attained dependably.

### *2.1.2 Navigation channels*

As soon as settlement began on the periphery of Galveston Bay, shipping was involved, though largely confined to the interior of the bay and its tributaries. Occasional steamboats traversed Galveston Bay to Harrisburg on Buffalo Bayou even before the Texas revolution, and became regular shortly thereafter. The bayshore communities took the necessary steps to ensure access for boat traffic,

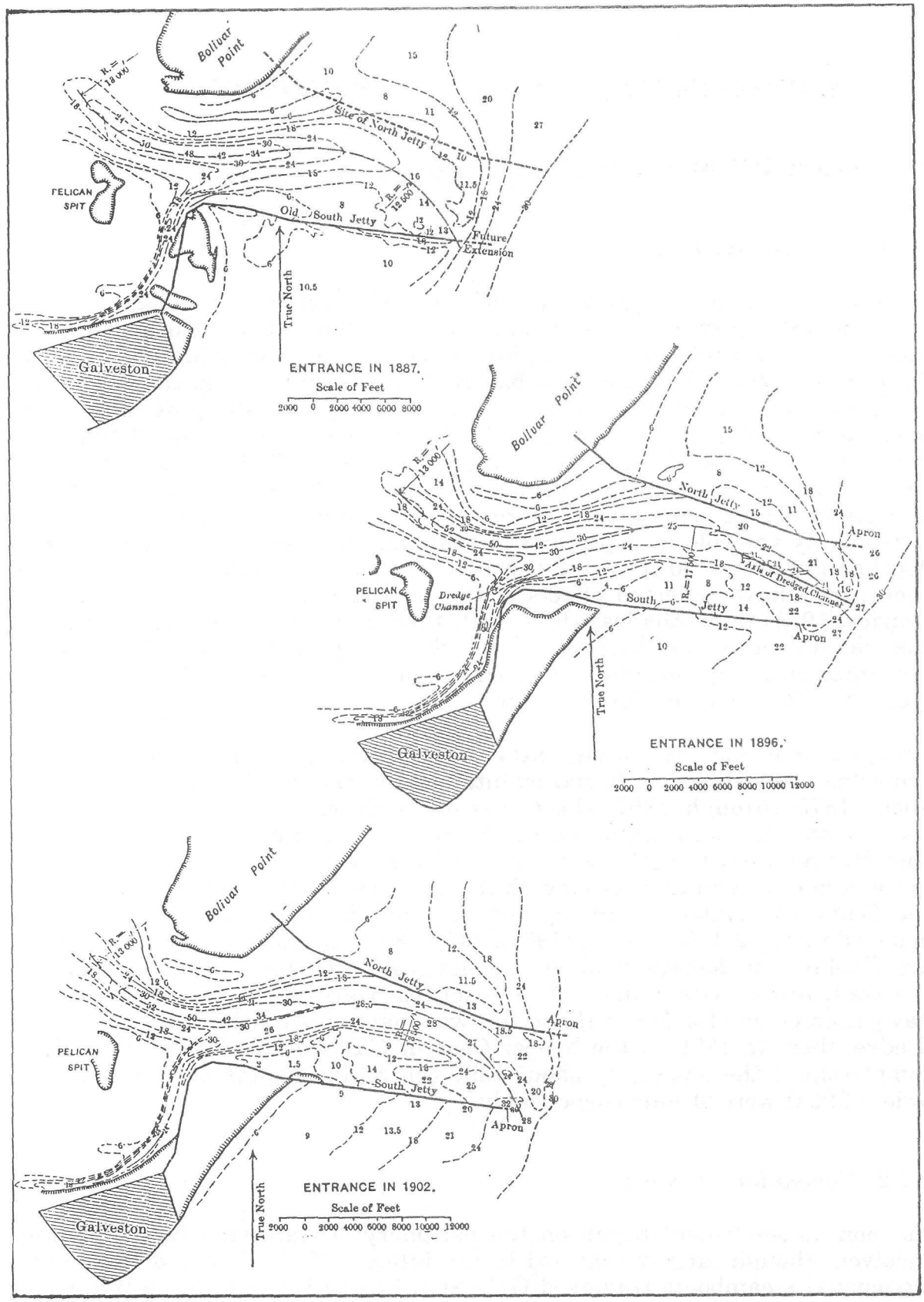


Figure 2-1. Comparative surveys of entrance to Galveston Bay, from Watt (1905)

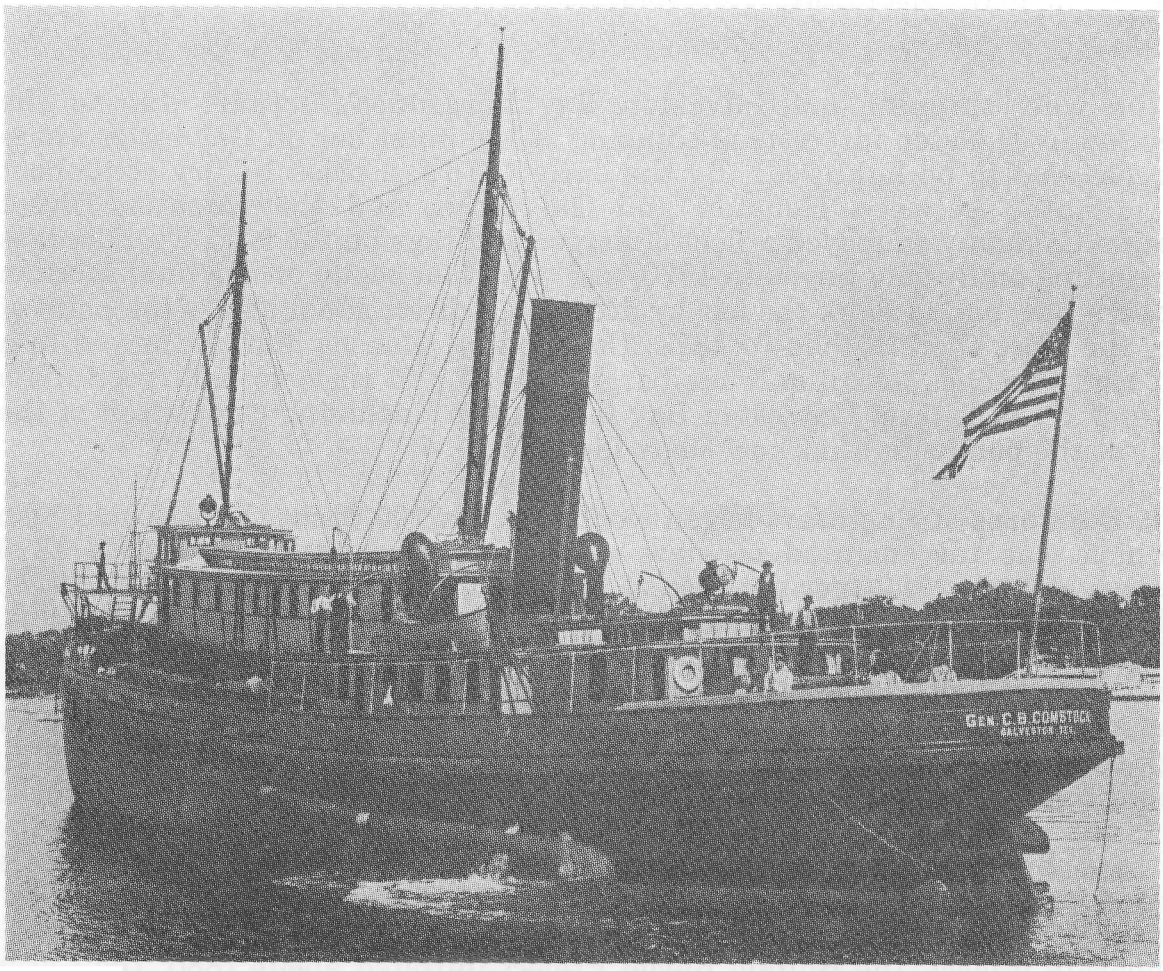


Figure 2-2. Sea-going dredge *Gen. C. B. Comstock*

primarily removal of overhangs and snags. In 1856, the City of Houston began operating a 70-ft dredge to control shoaling along Buffalo Bayou, and contracted the dredge for improving Cloppers Bay (at what is now Morgans Point) and the mouth of the Trinity River (Sibley, 1968). Shipping made frequent passage across the bay from Galveston to Buffalo Bayou, to which the principal impediment was Red Fish Bar (a.k.a. Red Fish Reef), an immense complex of oyster reefs and sand bars that spanned the bay from Eagle Point to Smith Point, through which passage was possible only in a few narrow channels of 4-5 ft depths. These and other dredging activities during the Nineteenth Century are summarized in Table 2-1.

After the war, shipping on Galveston Bay burgeoned, in part due to the interception by Houston interests of shipping at the inner bar off Galveston where the cargoes had to be lightered. By the early 1870's, a brisk luxury steamboat traffic operated between Houston and Galveston, and the Houston Direct Navigation Company employed a fleet of barges and tugs on the bay. Two dredges were operating on Buffalo Bayou in 1870, and work had begun on the final solution to Cloppers Bar, *viz.* to flank the bar by dredging a direct canal across the point of land on the west shore. Then in 1874, Commodore Charles Morgan moved in a fleet of eight dredges and numerous barges, scows and tugs, to enlarge Buffalo Bayou to 9 x 120 ft from Galveston Bay to Houston, including completion of the land cut at the peninsula that now bears his name.

In 1872, the Corps of Engineers began work on a 6 x 100 ft cut through Red Fish Bar, which was incremented in view of Morgan's activity to ultimate 1876 dimensions of 14.5 x 100 over a length of 6100 ft through the bar (Alperin, 1977). Now the natural depths in upper and lower Galveston Bay, on the order of 9 ft, became controlling, and shipping interests began to call for a channel across Galveston Bay of depth 12 ft, then the controlling depth at the outer bar of the inlet. Such a channel would allow the passage of any ship that could make entry through the inlet. In 1876, a 12-ft channel was adopted, the Galveston Bay Ship Channel Project, the routes across upper and lower Galveston Bay were surveyed in 1877, and dredging was begun soon thereafter. The channel, especially in the lower bay, had outrun its economics, however, and appropriations were suspended for 1883-1888, due to lack of use and "lack of permanence" (USA, 1883).

In a separate project, the Buffalo Bayou Project initiated about 1880, the Corps began work on a 12 x 100 ft channel from Sims Bayou (the terminus of the Morgan canal) to White Oak Bayou in Houston. This involved considerable snagging as well as dredging, and progress was frustrated by influxes of silt and logs with each freshet. Further, the waterway was becoming a sump for sewage (ACE, 1896), an apocalyptic omen. Meantime, the federal government had begun the process of acquiring the Morgan canal from Morgans Point to Clinton, final acquisition of which was delayed until 1892 when the federal project to Morgans Point was finally completed (1889) and the Morgan canal evaluated.

Elsewhere in Galveston Bay, traffic to the Trinity River dates back to the 18th Century, in the French trade with Indians in the this area, and the Franciscan mission on the lower Trinity. Lafitte is alleged to have used the labyrinthine

TABLE 2-1

Nineteenth Century dredging in Galveston Bay system, volumes in cubic yards
(Compiled from data of Gilardi, 1942)

| | GALVESTON HARBOR | HOUSTON SHIP CHANNEL | | | | TEXAS CITY CHANNEL | WEST BAY | TRIBUTARIES |
|---|---|---|---|---|---|---|---|---|
| | | *Bay Section* | | *Bayou section* | *notes* | | | |
| | Maint. only | New Work | Maint. | New Work | | | (Channel to Brazos) | |
| 1851-52 | | | | | | | 391100 | |
| 1873 | | 19400 | | | 6x100 channel | | | |
| 1875 | | 20000 | | | thru Redfish & | | | |
| 1876 | | 142800 | | | Cloppers Bars | | | Trinity River |
| 1879 | | 74800 | | | 12 x 100 channel | | | mouth: |
| 1880 | | 628600 | | | Bolivar Roads | | | 22000 |
| 1881 | | | | | to Morgans Cut | | | 25300 |
| 1882 | | 160400 | | 24900 | | | | |
| 1883 | | 801800 | | 187700 | | | | |
| 1884 | 54400 | | | | | | | |
| 1885 | | | | | | | | 23300 |
| 1888 | | 275100 | | 164800 | | | | |
| 1889 | (Jetties | 1259100 | | 65600 | | | | |
| 1890 | underway) | 1684500 | 19800 | 6700 | Improve Morgans | | | Cedar Bayou: |
| 1892 | | | | 54100 | Cut (Fed project) | | | 10400 |
| 1893 | | | 12600 | 23400 | Widen Morgans Cut | | 2900 | |
| 1894 | | | 153400 | 28000 | from 75 to 150 ft | | 8300 | 21000 |
| 1895 | 68100 | | 299300 | 100 | | 1448000* | 10800 | |
| 1896 | 565300 | | 122500 | 36500 | | 973500† | 6300 | |
| 1897 | 806600 | | | | | | | |
| 1898 | 563000 | | | | | *Federal | | Clear Creek: |
| 1899 | 500700 | | | | | †Private | | 16700 |

lower Trinity as an escape route from pursuers. (One of the fascinating pieces of local folklore is that a sunken ship in Miller Lake was scuttled by Lafitte in 1820, while pursued by a revenue cutter. There have been several attempts to raise the ship since it was discovered in 1850. Harry, 1940, notes that application by an Anahuac consortium to the Land Office to try again was pending--handled by its Liberty attorney, Price Daniel. Stokes, 1985, reports that the vessel is still there, totally buried by silt sometime in the 1950's.)

Keelboating had begun in 1824, and by 1834, Anahuac had become a leading port on the river due to its access both to the Texas interior via the Trinity River and the sea via Galveston (Harry, 1940). Vessels followed the river routes to Wallisville and settlements on Old River and Cotton Bayou, including a daily steam packet carrying the U.S. mail. By the last quarter of the Nineteenth Century, the commodity traffic on the lower Trinity from Anahuac to Liberty had become considerable, principally cotton. The year 1871 was the zenith for this trade, in which seventeen steamers were engaged on the Trinity (Stokes, 1985, and references therein). After this, river traffic began to decline due to the competition from railroads. Several sawmills began operations in the 1890's at Anahuac, Cove, Turtle Bayou and Wallisville. Steam tugs were used to tow the logs down the river to these mills (Harry, 1940), and the mail packet continued to run between Anahuac and Liberty.

A continual impediment to this traffic was the bar at the mouth of the river (or, more accurately, the bars at the mouths of the river). In addition, the navigability of the river was a strong function of river flow, and the channel itself was frequently hazardous due to bars and snags, including occasional log rafts. Numerous vessels were damaged or sunk, many of which are still on the river bottom (Stokes, 1985). The earliest record of federal aid in removing the bar is 1852 (Harry, 1940). As noted above, Houston's 70-ft dredge was contracted to clear the bar around 1858. This was apparently supported by the state, through an 1856 effort of the Texas Legislature to remove "all serious obstacles" from Texas rivers. After the War, in 1880, a 7 x 85 ft channel was dredged by G.L. Long through the bar and up the river to within four miles of Liberty (Harry, 1940). Records of the Galveston District show dredging of the mouth of the Trinity in 1880, 1881, 1885 and 1894 (Gilardi, 1942).

Not only did the sediment load of the Trinity continually present an impediment to navigation in deposition in the mouth, the entire Trinity delta was in the progress of prograding across upper Trinity Bay, though at a diminishing rate in the Nineteenth Century. The present lobe of the Trinity delta, which isolates Turtle Bay (later Lake Anahuac) from Trinity Bay, appears to be the fifth major main-channel/delta phase in the past 3000 years, and has been prograding across Trinity Bay for the past 600 years (Aten, 1983). Early maps of Trinity Bay, e.g. 1822 and 1825 maps of Stephen F. Austin (see Burch, 1950), show this delta lobe, then known as Browns Flats (Harry, 1940), in much its present configuration, with Turtle Bay as an identifiable geographical feature. The passage from Trinity Bay to Turtle Bay had narrowed to about 200 ft in 1851 (Paine and Morton, 1986), and was still approximately this width in 1895 when the Corps of Engineers performed a baseline survey of the bay.

Around 1860, the first serious rumblings of the idea of a channel to Dallas could be heard (though this was discussed as early as 1848 by Dallas leaders, Keith, 1930). In 1866, the Trinity Slack Water Navigation Company was chartered by the Legislature, with the objective of establishing navigation between Dallas and Galveston. The state authorized a grant of 5000 acres of land to the company for each lock and dam completed on the river (Keith, 1930). Job Boat Number One put in at Dallas in spring of 1868, after seven months in transit from Galveston. The following year, Dallas built a steamboat, the *Sally Haynes*, which began operating on the upper Trinity down to Magnolia (Keith, 1930). Perhaps symbolic of the vision of shipping to Dallas on the Trinity, on its third run down the river the *Sally Haynes* was snagged and foundered.

The idea of a channel to Dallas surfaced again around 1890, and was temporarily squelched by the incursion of railroads and the resulting decline in river trade (Harry, 1940), though it may be that this proposal was a bluff, serving to keep the railroad charges under control (McDonald, 1978). In 1891, sponsored by river-navigation proponents, the steamboat *Dallas* was built to demonstrate feasibility of river navigation. (This study has not sought primary sources for matters relating to the early history of navigation on the river, which would be necessary to resolve the apparent confusion about the precise disposition of *Dallas*. Keith, 1930, describes her as a 64-ft "full-rigged" sternwheeler. Hooks, 1979, refers to her as a snagboat. While both authors agree that she was launched 6 miles downstream from the city, the former states that she navigated the river downstream to Galveston, while the latter asserts that she merely went upstream to Dallas.) Much more important to the vision of shipping on the river was the arrival of the steamboat *H.A. Harvey, Jr.* from Galveston in 1893. Momentum for the navigation project increased then began failing again, when in 1899 Congress authorized a survey of the river from its mouth to Dallas, to determine whether the river warranted improvements.

In addition to the lower Trinity, there was brisk sail- and steam-powered traffic on Cedar Bayou during the latter half of the Nineteenth Century. A shipyard at McGary's landing was operating by the end of the War, and several more began operation afterward. Some minor dredging by the Corps in 1892 and 1894 cleared the bar at the mouth of Cedar Bayou to 5-ft depth, and brush-and-stone jetties were installed to protect the entrance.

In 1855, the Galveston and Brazos Navigation Company completed a 3.5 x 50-ft channel across West Bay to Quintana. This channel snaked through the main tidal distributary on the ebb bar at San Luis Pass, through Mud Island Pass and Folletts Pass, through Christmas Bay (then Oyster Bay), across Rattlesnake Point and through Drum Bay then through the marshes around Swan Lake to connect with Oyster Creek. Ten years later, after the War, the channel was enlarged to 5 x 100 ft and extended a further 7 miles to the Brazos (McComb, 1986). In 1859, Texas dredged a 5-ft cut through the Karankawa Reef complex in West Bay, a passage which was nearly obliterated by the hurricanes of 1875 and 1886 (Alperin, 1977). These canal segments through West Bay to the Brazos were later integrated into planning for the Gulf Intracoastal Waterway, a route for which

was first surveyed in 1873-74, again around 1900, and again in 1905 as the idea for an inland canal began to take hold.

In the final decade of the century, several channel projects were implemented, as a part of the general intensification of shipping in the bay (Table 2-1). In 1895, the Texas City Terminal Company completed a 16 x 100 ft channel from the Galveston Bay Channel just north of Bolivar inlet to the new port at Texas City. In 1899 this channel was taken over by the U.S., and planning was underway for a 25-ft project throughout the bay. In 1894, W.L. Moody opened a small passage through Hannah Reef in East Bay (Gilardi, 1942). The entrance and lower reach of Clear Creek was improved by private interests in the area (Gilardi, 1942).

## 2.2 Twentieth Century Navigation Projects

### *2.2.1 The Houston Ship Channel*

In 1900, a federal channel of nominal 12-ft draft spanned Galveston Bay, from the Bolivar inlet between the jetties, across Red Fish Bar, through the cut at Morgans Point, and up Buffalo Bayou to the city of Houston at White Oak Bayou. This channel was pieced together from several autonomous projects, and the value of a single coordinated project was immediately apparent to both military and private interests. Moreover, the deepening of the bar as a result of the improvements at Bolivar inlet allowed vessels drawing 25-ft to Galveston, which predictably stimulated interest in a deep-draft channel across the bay to Houston. By 1897, Congress had directed surveying and planning for a 25 x 100 ft project from the jetties to Houston. This 58-mile channel plan included extensive rectification and widening in the 9-mile reach from Harrisburg to Houston, and the construction of two suction dredges.

Heretofore, disposal of the spoil was undertaken somewhat cavalierly, usually sidecast in open water or placed in proximity to the project along inland streams. For a 25-ft channel, disposal, as well as minimization of maintenance, became a major concern (Alperin, 1977, and references therein). Part of the project design included identification of suitable spoiling tactics. Moreover, some accommodation was needed for the high rates of siltation in the open bay. Because of the past problems of "deterioration" in the open bay, the channel was to be over-dredged to a width of 150 ft. The bay segment below Red Fish Bar was to be spoiled to the west of the channel. The upper bay segment above Red Fish Bar was more problematic due to the cross-flow from the Trinity, and a dike was recommended to be constructed along the east side of the channel, beyond which spoil would be placed. This dike, discussed further in the next section, would serve the dual purpose of protecting the channel from natural silt transport from Trinity Bay, and containing the spoil.

The first phase of this project (dictated by available funds) was begun in 1900, Table 2-2, after the great storm, and consisted of construction of a pile-and-brush dike from Morgans Point to Red Fish Bar and dredging of a 17.5 x 80 ft channel

TABLE 2-2

Houston Ship Channel, pre-1940 new work, cubic yards

| | | |
|---|---|---|
| | *Bay reach* | |
| 1901 | 324687 | 25x100 channel begun |
| 1902 | 2772734 | |
| 1903 | 1220580 | |
| 1904 | 2873380 | 18.5x150 channel completed |
| 1905 | 1566042 | |
| 1914 | 10579566 | 25x150 channel completed |
| 1915 | 3921 | |
| 1921 | 10600000 | |
| 1922 | 5000000 | completed 30x250 channel |
| 1934 | 14334549 | 32x400 project begun |
| 1935 | 11849515 | |
| 1937 | 5615200 | completed 32x400 |
| | *Bayou (inland) reach* | |
| 1903 | 73455 | 25x100 project begun |
| 1904 | 1153178 | |
| 1905 | 1150721 | |
| 1908 | 2390904 | |
| 1909 | 991713 | |
| 1913 | 3853013 | |
| 1914 | 4161497 | |
| 1915 | 180933 | 25x100 channel completed |
| 1917 | 138298 | |
| 1921 | 1462234 | 30x250 project begun |
| 1922 | 4181002 | |
| 1923 | 5711589 | |
| 1924 | 4964303 | |
| 1925 | 2785785 | |
| 1926 | 506034 | |
| 1930 | 20831 | widen channel thru Morgans Point |
| 1932 | 2110124 | |
| 1933 | 3050529 | 32x400 channel begun |
| 1934 | 105199 | |
| 1935 | 2516147 | |
| 1936 | 826307 | |
| 1938 | 5449197 | |
| 1939 | 3751218 | |
| 1940 | 2163000 | |

through the bay. In 1903, dredging was begun to enlarge the channel across the bay to 18.5 x 150 ft. The appearance of the bay around 1905 is shown in Fig. 2-3. In the upper channel in Buffalo Bayou, a series of cutoffs and bend-easings were begun in 1906, and the turning basin at the head of the Long Reach was dredged in 1906-1908. (A 6-mile light-draft channel was dredged upstream from the turning basin to dimensions of 8 x 40 ft.) By 1910, the federal project had achieved 18.5 ft, and in the Rivers and Harbors Act of that year was renamed the Houston Ship Channel. In 1914, dredging was completed to the authorized depth of 25 ft. Maintenance dredging, Table 2-3, now became a matter of routine, and was required virtually every year after 1915.

Once again, the channel had temporarily outrun its economics. In its first year open, there were no sea-going takers, due to apprehension of an unknown channel, the developing war in Europe, and the lack of wharves and warehouses at the port. A "monster celebration" (Alperin, 1977) was planned for August 1915 when the first run of the New York-to-Houston service of Southern Steamship was to be initiated, but the Hurricane of 1915 had other plans. Besides dampening the celebration (pardon), this storm severely damaged two new hydraulic pipeline dredges constructed for channel maintenance, and sank the Corps Galveston District quarterboat, from which dredging operations had been directed (Alperin, 1977). (This is reminiscent of Stilwell's grand celebration of the final spike on the Kansas City, Pittsburg and Gulf at Port Arthur in September 1897, during which a hurricane moved over the city, sending surge-driven waters through the streets, killing at least 10 people and collapsing the new roundhouse. One is also reminded of the crowds drawn to Indianola for the Taylor trial, to be trapped by the great hurricane of 1875. Perhaps Gulf hurricanes have a peculiar malevolence for thronging.)

A new industry motivated the next channel expansion: the appearance of oil tankers in the world fleet after WW I. At that time, petroleum could be moved only by barge on the Houston Ship Channel. New project dimensions of 30 x 250 ft in Galveston Bay and 30 x 150 in the reach above Morgans Point were authorized in 1919 and dredging was completed in 1926 (the bay reaches being completed in 1922, Gilardi, 1942), thereby accommodating tanker traffic into Houston. In the 1930's, the Houston Ship Channel was enlarged again, to 32 x 400 completed (across the bay) in 1937.

### *2.2.2 Other navigation channels*

In close association with the development of the Houston Ship Channel was the creation of a channel to Texas City, Table 2-4. The existing 16-ft channel (see Table 2-8) was obtained by the U.S. government, and included in the 25-ft channel network. This was completed (through a contract to a private dredger) in 1905, and extensive maintenance dredging was needed almost every year for the next decade (Gilardi, 1942). In 1916, dredging was completed on an enlargement to 30 x 300 ft, in association with the construction of the dike, treated separately in the next section. The harbor was dredged to 30 x 800 ft in 1931, and further enlarged in 1934.

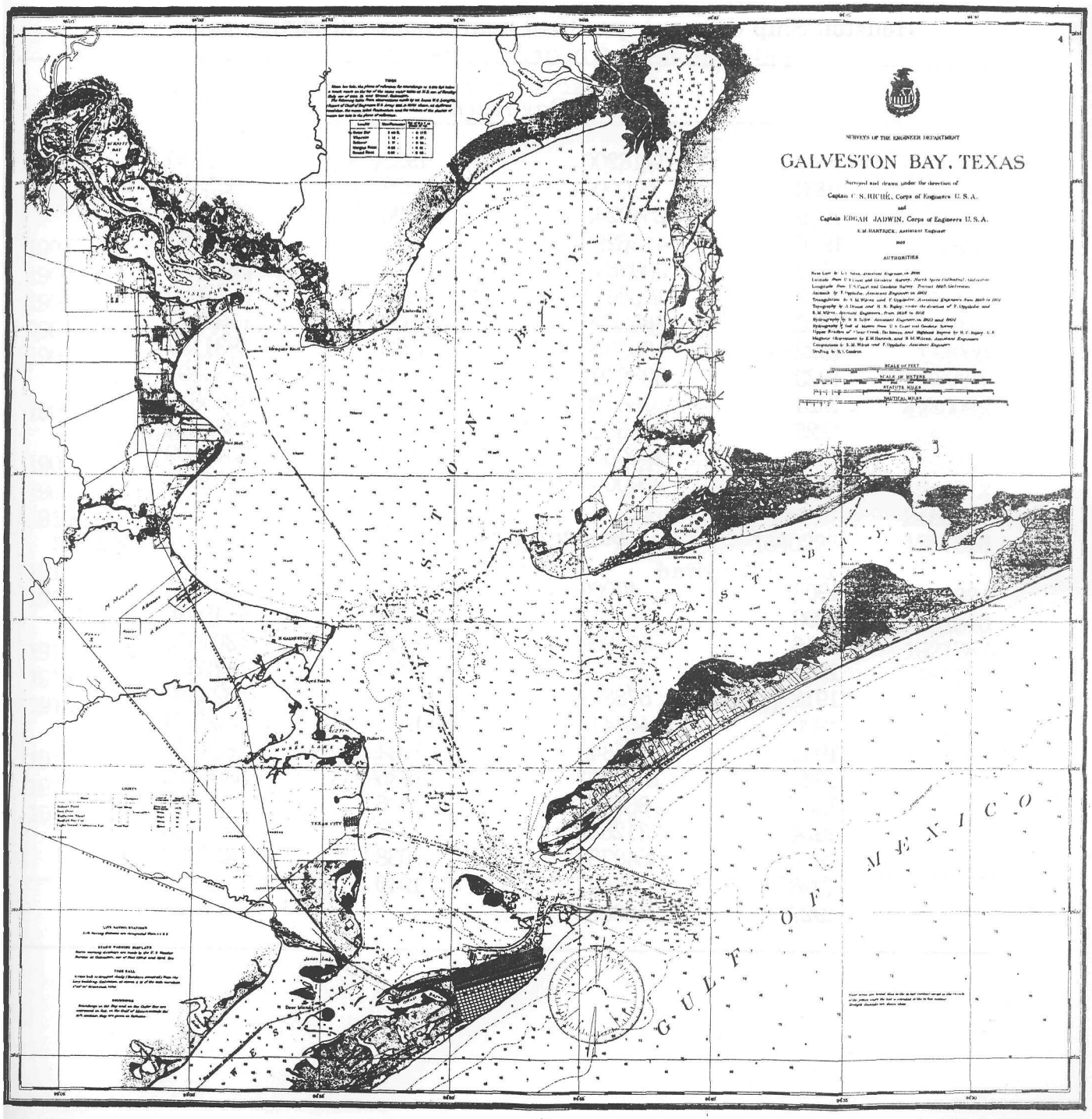


Figure 2-3. Nautical chart of Galveston Bay ca. 1905. Note pile dike extending south from Morgans Point, and Turtle Bay at extreme north end of system.

TABLE 2-3

Houston Ship Channel, pre-1940 maintenance dredging, cubic yards

*Bay reach*

| | | | |
|---|---|---|---|
| 1904 | 1118200 | 1928 | 1993520 |
| 1908 | 500000 | 1929 | 1695353 |
| 1909 | 2540249 | 1930 | 6988651 |
| 1916 | 4136264 | 1931 | 345727 |
| 1917 | 3907841 | 1932 | 5876615 |
| 1918 | 1763401 | 1933 | 27800 |
| 1920 | 2653596 | 1934 | 198417 |
| 1922 | 1000000 | 1935 | 1831197 |
| 1923 | 3382408 | 1936 | 2834601 |
| 1924 | 166000 | 1937 | 3863642 |
| 1925 | 2575600 | 1938 | 1308011 |
| 1926 | 2000000 | 1939 | 3043509 |
| 1927 | 3000000 | 1940 | 3901056 |

*Bayou (inland) reach*

| | | | |
|---|---|---|---|
| 1908 | 40000 | 1928 | 2234116 |
| 1909 | 185247 | 1929 | 4049010 |
| 1916 | 497809 | 1930 | 4301615 |
| 1917 | 725773 | 1931 | 1479557 |
| 1918 | 578874 | 1932 | 1328894 |
| 1920 | 464417 | 1933 | 95574 |
| 1921 | 2157849 | 1934 | 624384 |
| 1922 | 1202481 | 1935 | 3398220 |
| 1923 | 865424 | 1936 | 1031560 |
| 1924 | 2312632 | 1937 | 450043 |
| 1925 | 3640788 | 1938 | 488687 |
| 1926 | 2355567 | 1940 | 47416 |
| 1927 | 3160380 | | |

TABLE 2-4

Texas City Channel, pre-1940 federal dredging, cubic yards

| *Year* | *New work* | *Maintenance* | *Year* | *New work* | *Maintenance* |
|---|---|---|---|---|---|
| 1901 | 815060 | | 1919 | | 580886 |
| 1902 | 967100 | | 1920 | | 584992 |
| 1903 | 1105330 | | 1921 | | 625494 |
| 1904 | 683657 | | 1922 | | 795816 |
| 1905 | 584970 | | 1924 | 127890 | 154900 |
| | Drake & Stratton contract complete 5/05 | | 1925 | | 2225531 |
| 1906 | | 698222 | 1926 | | 4240082 |
| | dredged to 25' by Texas City Trans. Co | | 1927 | | 55700 |
| 1908 | | 1001147 | 1928 | | 2395556 |
| 1909 | | 273284 | 1929 | | 1940272 |
| 1910 | | 527000* | 1930 | | 2450361 |
| | 30x200 chnl cnctg Tx Cty Term. Co. whrf | | 1931 | 1840225 | 1287536 |
| 1911 | 1109318 | 234000* | | harbor 30'x800' | |
| 1912 | | 225176 | 1932 | | 1001834 |
| | begin 30'x300' channel | | 1933 | | 2931810 |
| 1913 | 70157 | 1155278 | 1935 | | 1921382 |
| 1914 | 464693 | 676579 | 1937 | 1846051 | 980015 |
| 1915 | 3638869 | 352519 | | 34' channel | |
| | 30' channel complete | | 1939 | | 1062839 |
| 1916 | 2524192 | 429530 | 1940 | | 1424642 |
| 1917 | | 665940 | | | |
| 1918 | | 1177140 | *Estimated | | |

In 1900, Galveston Channel was approximately 30 x 1200 ft in dimension to about 51st street. This channel was extended at 30 x 700 ft to 56th St. in 1909, and further widened to 1000 ft in 1913. The portion of the channel to 43rd St. was deepened to 32 ft in 1929 and 34 ft in 1937. The harbor channel (i.e., the inner and outer bar channels between the jetties) was enlarged to 35 x 800 ft "experimentally" (Gilardi, 1942) in 1922, and maintained at that depth thereafter. The successive operations in Galveston Channel are summarized in Tables 2-5 (federal) and 2-6 (private).

Meanwhile, the idea of an inland canal, which had been floated (pardon) since 1818 (Sibley, 1968), gathered momentum with the creation in 1905 of the Interstate Inland Waterway League, an organization that evolved into the modern Gulf Intracoastal Canal Association. As a federal project, the Corps completed dredging segments of a 5 x 40 ft inland canal by 1909, including, in Galveston Bay, the old canal through Karankawa Reef from West Bay to the Brazos. The connection with the upper coast was finally completed in 1934 with the segment from East Bay to Sabine Lake. Also, with this part of the project, the older strategy of running a canal from bay to bay was replaced with that of a landlocked channel paralleling the coast (Alperin, 1977), so that the East Bay segment was actually dredged through Bolivar Peninsula paralleling its longitudinal axis. The Gulf Intracoastal Waterway was finally enlarged to a 9 x 100 ft canal by 1942, along with various feeder and service channels.

Several minor channels were dredged in the early 20th Century, especially to make navigable some of the tributaries conflowing with Galveston Bay, summarized in Tables 2-7 (federal) and 2-8 (private). For example, the lower reach of Bastrop Bayou was authorized in 1907 for a 4 x 100 ft channel and was dredged to 4 x 60 ft within the next few years. This channel has not been maintained since 1927. Similarly, the last dredging work on the 4 ft channel in Oyster Bayou was in 1911. The abandoned original route of the GIWW at Drum Bay is still apparent in the physiography of this area, though it has not been dredged since the early part of the century.

The Trinity River from Liberty to the communities on the lower delta and Turtle Bay continued to be heavily used. As the rice industry grew, barging of rice relied upon the river channels and transport across the bay. The lumber industry made particular use of the main river channel for the transport of logs by tugs. The 1915 hurricane virtually destroyed the lumber mills, and when the industry re-built, the river was supplanted by trucks for movement of timber. On the other hand, there was increasing river traffic in association with oil development, and at the opening of WW II, the Texas Gulf Sulphur Company was constructing facilities on Lake Miller, north of Wallisville, to mine a large sulphur dome. The Anahuac Channel, from 6-ft water in Trinity Bay to the port at Anahuac, was dredged to dimensions 6 x 80 ft in 1905 (Harry, 1940, Gilardi, 1942). A nearly parallel channel about 500 ft to the west was dredged to the same dimensions, connecting 6-ft water in Trinity Bay with the main channel of the river. These short channels proved to be high-maintenance, requiring dredging approximately every two years.

TABLE 2-5
Dredging in Galveston Channel, pre-1940, federal projects, cubic yards

| *Year* | *New work* | *Maintenance* | *notes* | *Year* | *New work* | *Maintenance* | *notes* |
|---|---|---|---|---|---|---|---|
| 1902 | | 127497 | Maintain 30 x | 1922 | | 1320671 | |
| 1903 | | 330608 | 1200 channel | 1923 | | 1795125 | |
| 1904 | | 1993153 | through Inner | 1924 | | 3095194 | |
| 1905 | | 343977 | Bar to 51st | 1925 | | 1709195 | |
| 1906 | | 587634 | | 1926 | | 3220502 | |
| 1907 | 733337 | 404981 | 30x700 chnl | 1927 | | 5321682 | |
| 1908 | 1632387 | 385922 | 51st to 56th | 1928 | | 5270804 | |
| 1909 | 700330 | 158257 | | 1929 | 4514824 | 148637 | Complete 32 ft |
| 1910 | 138091 | 2185651 | 30x1000 chnl | 1930 | | 2848873 | channel to |
| 1911 | 196985 | 943998 | 51st to 57th | 1931 | | 2034580 | 43rd |
| 1912 | 5510865 | 1539606 | | 1932 | | 3681451 | |
| 1913 | 1097060 | | | 1934 | | 4724644 | |
| 1914 | 1165959 | 44377 | | 1935 | | 888818 | |
| 1915 | | 1792658 | | 1936 | | 3172162 | |
| 1916 | | 1007774 | | 1937 | 192160 | 384321 | 34 ft channel |
| 1917 | | 2130067 | | 1938 | 847565 | 3246741 | complete to |
| 1918 | | 1226155 | | 1939 | | 827750 | 43rd |
| 1920 | | 272911 | | 1940 | | 3646400 | |
| 1921 | | 1002408 | | | | | |

TABLE 2-6
Dredging in Galveston Channel, pre-1940, by private interests, cubic yards

| | | | |
|---|---|---|---|
| 1902 | 262680 | 1921 | 459133 |
| 1903 | 591708 | 1922 | 474822 |
| 1904 | 304521 | 1923 | 462395 |
| 1905 | 264725 | 1924 | 653307 |
| 1906 | 442895 | 1925 | 191148 |
| 1907 | 489050 | 1926 | 447112 |
| 1908 | 571217 | 1927 | 400775 |
| 1909 | 499277 | 1928 | 314715 |
| 1910 | 238543 | 1929 | 681537 |
| 1911 | 189786 | 1930 | 321544 |
| 1912 | 296731 | 1931 | 702540 |
| 1913 | 329069 | 1932 | 407199 |
| 1914 | 575963 | 1933 | 300713 |
| 1915 | 567718 | 1934 | 412444 |
| 1916 | 442345 | 1935 | 146030 |
| 1917 | 419094 | 1936 | 476081 |
| 1918 | 235028 | 1937 | 453698 |
| 1919 | 585227 | 1938 | 407583 |
| 1920 | 550653 | 1939 | 273829 |
| | | 1940 | 287901 |

TABLE 2-7

Federal dredging in Galveston Bay system, pre-1940
Smaller projects, cubic yards

Port Bolivar Channel

| | | | | | |
|---|---|---|---|---|---|
| 1908 | 247998 | 1919 | 9444 | 1930 | 97171 |
| 1909 | 269929 | 1920 | 409647 | 1931 | 254666 |
| 1910 | 462415 | 1921 | 149246 | 1932 | 96446 |
| 1911 | 391058 | 1922 | 137603 | 1933 | 202180 |
| 1912 | 791277 | 1923 | 179754 | 1934 | 142660 |
| 1913 | 490710 | 1924 | 165913 | 1935 | 147440 |
| 1914 | 728713 | 1925 | 165608 | 1936 | 134829 |
| 1915 | 344571 | 1926 | 175464 | 1938 | 115467 |
| 1916 | 315334 | 1927 | 282738 | 1939 | 124432 |
| 1917 | 188600 | 1928 | 83885 | 1940 | 96583 |
| 1918 | 271968 | 1929 | 279692 | | |

West Galveston Bay

| | | | |
|---|---|---|---|
| 1906 | 33653 | 1921 | 200000 |
| 1907 | 23001 | 1922 | 25000 |
| 1908 | 165406 | 1924 | 7159 |
| 1909 | 123986 | 1926 | 10275 |
| 1910 | 388311 | 1928 | 100000 |
| 1914 | 540000 | 1930 | 100000 |
| 1915 | 94800 | 1931 | 100000 |
| 1916 | 8396 | 1933 | 2117123 |
| 1917 | 32277 | 1934 | 50000 |
| 1918 | 5000 | | |

Chocolate Bayou

| | |
|---|---|
| 1909 | 98904 |
| 1911 | 46968 |
| 1920 | 214691 |

| | Dickinson Bayou | Clear Creek | Cedar Bayou | East Bay Bayou |
|---|---|---|---|---|
| 1905 | | | 119851 | |
| 1908 | 47811 | 80083 | 100708 | |
| 1909 | 127247 | | 9375 | 5773 |
| 1910 | | | | 6692 |
| 1911 | 85067 | 127231 | 8922 | 7616 |
| 1915 | 156957 | 212785 | 67858 | |
| 1918 | 59111 | 10166 | | |
| 1921 | 23750 | 42188 | | |
| 1923 | | 51111 | | |
| 1924 | 45000 | | 136431 | |
| 1925 | | 54637 | | |

| | Dickinson Bayou | Clear Creek | Cedar Bayou |
|---|---|---|---|
| 1926 | | 22895 | 117142 |
| 1928 | | | 132023 |
| 1930 | | 107348 | 387261 |
| 1931 | 300000 | | |
| 1932 | | | 237000 |
| 1933 | | | 257244 |
| 1934 | | 14217 | |
| 1935 | | | 286216 |
| 1936 | | 51004 | |
| 1937 | | | 374851 |
| 1940 | 230616 | | 310813 |

TABLE 2-7

(continued)

| | Anahuac Channel | Trinity River Mouth | Turtle Bayou | Double Bayou | | Anahuac Channel | Turtle Bayou | Double Bayou |
|---|---|---|---|---|---|---|---|---|
| 1903 | | | | 13348 | 1923 | 67096 | | 55621 |
| 1905 | 119401 | 58077 | | 80480 | 1924 | 139836 | | 71901 |
| 1906 | 24555 | | | 71008 | 1925 | 71844 | | 64583 |
| 1908 | 162928 | 23989 | | 54994 | 1926 | 132141 | | 108185 |
| 1909 | | | | 63917 | 1927 | 115058 | | 89716 |
| 1910 | 35717 | 10979 | | | 1928 | 63908 | | |
| 1911 | | | 79125 | 40816 | 1929 | 111633 | | 67035 |
| 1912 | 45200 | | | | 1930 | 183596 | 350943 | 116354 |
| 1915 | 89226 | | | 70944 | 1932 | 100761 | | 53823 |
| 1916 | | | 116900 | | 1934 | 151365 | | 58057 |
| 1917 | 156019 | | | 48926 | 1936 | 139004 | | 50261 |
| 1918 | | | 37232 | | 1938 | 380444 | | |
| 1920 | 146724 | | | 73441 | 1940 | 201694 | | |
| 1921 | 9405 | | 127308 | 46662 | | | | |

TABLE 2-8
Private dredging in Galveston Bay, pre-1940, cubic yards
(Compiled from data of Gilardi, 1942)

| | | | | | |
|---|---|---|---|---|---|
| | Double Bayou | | | | |
| 1906 | 18000 | | | | |
| | Bastrop Bayou | | | | |
| 1906 | 1790 | | Port Bolivar | | |
| | Texas City Channel | 1909 | 50000 | 1922 | 54370 |
| 1906 | 2245000 | 1911 | 130947 | 1924 | 70000 |
| 1913 | 14815 | 1912 | 171908 | 1926 | 66000 |
| | Texas City Turning Basin | 1913 | 131815 | 1927 | 53154 |
| 1926 | 26800 | 1914 | 211700 | 1930 | 69380 |
| 1939 | 48993 | 1915 | 78200 | 1933 | 67954 |
| | Clear Creek | 1916 | 92402 | 1935 | 49603 |
| 1907-08 | 41000 | 1917 | 140557 | 1937 | 53964 |
| | Turtle Bay | 1919 | 230316 | 1938 | 14519 |
| 1918 | 23148 | 1920 | 200 | | |
| | Turtle Bayou | | | | |
| 1921 | 15000 | | | | |

A 4 x 50 ft project from the entrance of Turtle Bay (Browns Pass) to Turtle Bayou was authorized in 1902, completed in 1911 and redredged several times, the last being 1930. (In the Nineteenth Century, Browns Pass referred to the easternmost channel of the Trinity bird's foot, opposite Anahuac. In the early Twentieth Century, when Middle Pass began to be maintained as the preferred entrance to the river, the name came to be applied to the entrance of Turtle Bay, though some maps show it still attached to the delta distributary. Recent location maps of the Corps apply the name to Middle Pass.) In 1936, Turtle Bay was permanently blocked by a bulkhead and lock, to protect its water for irrigation purposes (see Section 2.3.4). Occasional traffic from Galveston Bay through Turtle Bay is recorded afterward, e.g. 1936 and 1939 (Harry, 1940), but the federal project in Turtle Bay was formally abandoned in March 1937 (Gilardi, 1942). In 1939, Stanolind Oil dredged a small barge channel further up Turtle Bayou (Harry, 1940), but this has little relevance for Galveston Bay since Turtle Bay was now isolated from the bay.

The Old River Rice and Irrigating Company began constructing canals to supply irrigation water to rice crops in western Chambers County around 1901, and water from Old River was used for irrigation for the first time in 1905 (Harry, 1940). A rice warehouse was built on Cedar Bayou at Needle Point, and barges freighted the rice from there to Galveston and Houston. This company was generally more successful than those near Anahuac because of the reduced threat of salt intrusion. But it too suffered from the occasional "salt year," when bay salinities would intrude up Old River, and a sequence of bad years in the early 1920's drove the company into receivership in 1924. The Barbers Hill Canal Company bought the canal rights in 1926, and installed a pipeline to the Trinity River to insure the supply of freshwater. The Cedar Bayou channel, protected by small jetties at its mouth in Galveston Bay (see Section 2.1.2 above), continued to be important for the transport of rice and other commodities by barge. This channel was improved to 4-6 ft depths in 1905, and enlarged to 10 x 100 from the Houston Ship Channel to river mile 11 in 1930, with frequent maintenance thereafter.

At the opening of the Twentieth Century, the railroads had supplanted the river traffic on the lower Trinity (except downstream from Liberty). Nevertheless, the prospects for a channel to Dallas improved considerably with Congressional authorization for clearing the river. Dallas residents also contributed to the effort (Hooks, 1979), and by 1910 the river had been cleared 80 miles downriver from Dallas, and the construction of locks had begun. This was a 6-ft project, with navigable depths to be maintained by a system of 37 locks and dams down to Galveston Bay. By 1917, seven of these had been completed, but these were widely separated, so a navigation pool was not achieved (Williams et al., 1930, USCE, 1962). The scale of the project and the difficulty of maintenance led to its abandonment in 1922, except for the channel to Liberty. In May 1933, Comm. Hatfield navigated the river to Fort Worth and back to Galveston Bay in the small *Texas Steer*, and again in 1938 with eight Sea Scouts (Harry, 1940), but this appears to have been the last gasp of river traffic to the inland areas. In 1941, yet another federal study conceived a plan for a 9-ft channel to Fort Worth, but only

the deepening of the channel to Liberty could be justified economically at the time (USCE, 1962).

### *2.2.3 The Dikes*

The problem of siltation ("deterioration") of dredged channels crossing the open bay was confronted since the 12-ft Galveston Bay Channel of the last century. This was obviously related to silt-loaded currents crossing the channel, so an equally obvious solution was to protect the channel by a structure on the upcurrent side. This approach led to the construction of two extensive dikes in the open waters of Galveston Bay.

The first was a part of the 25-ft project for the Galveston Bay Channel, begun in 1901. The initial construction was a 60,000 ft dike of timber pilings and brush extending from Morgans Point south along the eastern side of the channel. This work was completed in 1902, using 500,000 linear feet of timber and 6000 cords of brush (Gilardi, 1942). Spoil was placed on the eastern side of this structure, beginning the spoil bank to be later named Atkinson Island. Apparently, this structure was plagued with deterioration, and in 1910, 11,500 ft was replaced with creosoted piles on an experimental basis (Gilardi, 1942). The storm of 1911 destroyed all but the uppermost 7,500 ft. However, the spoil bank here, Atkinson Island, had now stabilized to continue to provide the same protective function as the old brush dike.

The Texas City Channel was laid nearly perpendicular across a natural scour channel north of Pelican Island known as Half Moon Channel, probably maintained by currents associated with northers (though perhaps part of the astronomical tidal ebb flow). In fact, there was some debate that the Galveston Bay Channel (later, the Houston Ship Channel) should pass through Galveston Channel, then around the west side of Pelican Island and along Half Moon Channel, to take advantage of the naturally scoured depths (Gilardi, 1942). With sediment-laden currents regularly sweeping across Texas City Channel, the resulting high rate of siltation led to authorization of a timber pile dike along the north side of the channel, completed in 1915. This structure extended 28,200 ft out into Galveston Bay, and required 950,000 linear feet of timber pilings, which were covered with a clay mound to discourage borers. While it definitely reduced siltation in the channel, maintenance on the structure was expensive, and several alternatives were experimented with in the 1920's, including mud shell, pontoons and sheet pile bulkheads. In 1931-34 a rubble mound dike was constructed, creating the present Texas City Dike configuration.

## 2.3 Non-navigation projects

### *2.3.1 Galveston*

One of the greatest dredge-and-fill activities of the early part of this century was that of the grade elevation of the city of Galveston following the 1900 storm. This

entailed the mining and transport of great quantities of sand from the western segments of the island to the northern, which was accomplished by pipeline slurry over a period of seven years, completed in 1910. This activity is notable in the present context from two standpoints. First, large borrow areas were created, which have become a permanent part of the back-island morphology, most important of which is Offatts Bayou, an enlargement of a previously existing channel cutting part way into the island, probably a relict tidal distributary. Offatts Bayou was later used for borrow in the construction of Fort Crockett, in 1907 and 1909 (Gilardi, 1942), Table 2-9, and has continued to serve as a borrow area to the present day. Second, this was apparently the first use in Texas of large-capacity self-propelled hopper dredges (Walden, 1990).

One of the dredges brought to the project by Goedhart and Bates, the 233-ft *Galveston*, was later (1909) acquired by the Corps and used for maintenance dredging in the Galveston harbor channels. *Galveston* was built in 1904 at the Maryland Steel Company of Sparrows Point, to 39 ft beam and 15 ft draft (loaded), with hopper capacity of 1400 cu yds and a pumping plant that could pump 1350 cu yds in 45 mins. (A diagram of the dredge is shown in Fowler, 1914.) Originally used in the New Orleans and Mississippi delta waterways, in 1906 the dredge was moved to Quebec, where she dredged the St. Lawrence channel below Quebec (Prelini, 1912). Since 1909 it was in continuous service in Galveston Bay. This venerable old dredge was driven against the North Jetty during the July 1943 hurricane where she foundered, in sight of her namesake city (Alperin, 1977, McComb, 1986).

During the early Twentieth Century, major federal filling projects were performed in the Galveston area, as summarized in Table 2-9. Access to the island from the mainland was facilitated by bridges. By 1900, four bridges spanned West Bay in the vicinity of Virginia Point, three for railroads and one for wagons (McComb, 1986). The last (designed by H.C. Ripley) was constructed of concrete pilings on 80-ft centers and steel-arch spans, but unfortunately did not survive the great storm. A new combined causeway was completed in 1912, comprised of concrete arches on 70-ft spans, functioning as railroad and vehicle viaduct as well as aqueduct.

### *2.3.2 Tributaries*

This study is concerned primarily with Galveston Bay, and therefore does not address in any detail the dredge-and-fill activities within the watershed. These are, however, considerable. In this low, marshy area of the Texas coast, dredging and filling are *sine qua non* for development of cities and industrial sites, as well as conversion of the land to ranching and agriculture. A substantial amount of wetlands conversion has occurred due to these activities, which are analyzed and quantified in a separate project of GBNEP (White et al., 1992).

Flooding in the area, especially in the city of Houston, in the 1920's and 1930's, led to implementation of flood control measures, including construction of levees, rectification of drainageways, and construction of reservoirs. Most of this work,

TABLE 2-9

Borrow dredging for Federal filling projects, pre-1940, cubic yards
(Exclusive of initial Galveston Seawall & grade raising)

| | Galveston seawall (from West Bay) | Quarantine Station | Pelican Island | Fort Crockett (from West Bay) | Texas City Dike | GIWW bulkhead at Bolivar Peninsula |
|---|---|---|---|---|---|---|
| 1904 | | | 243564 | | | |
| 1905 | | | 565138 | | | |
| 1906 | | | 100000 | | | |
| 1907 | | | | 995691 | | |
| 1909 | | | | 251587 | | |
| 1912 | | 465980 | | | | |
| 1915 | | | | | 3172000 | |
| 1916 | | | | | 2222429 | |
| 1917 | | | | | 643094 | |
| 1922 | 7995 | | | | 259744 | |
| 1923 | 135071 | | | | 413205 | |
| 1924 | | | | | 1182486 | |
| 1925 | 1106228 | | | | 616399 | |
| 1926 | | | | | 728233 | |
| 1927 | | | | | 2437659 | |
| 1928 | | | | | 225000 | |
| 1929 | | | | | 1627056 | |
| 1930 | | 350943 | | | 1445787 | |
| 1931 | | | | | 586457 | |
| 1934 | | | | | | 212030 |
| 1935 | | | | | | 454611 |

though initiated prior to WW II, has continued to the present. An example is the Buffalo Bayou Flood Control Plan for Houston, including Barker and Addicks Reservoirs. A more recent example is the floodwater diversion channel of Highland Bayou which debouches into Jones Bay about 7,000 ft down the shore from the natural mouth of the bayou.

### *2.3.3 The shell dredging industry*

The origins of the commercial use of shell lie in its utility as a building material, especially for roads, and date to the late Nineteenth Century (Doran, 1965). The copious quantities of both oyster and clam shell in Galveston Bay made it a ready source for such "reef" shell. By 1905, a steam-powered mudshell dredge was operating, and in 1911 the Texas Game, Fish and Oyster Commission was authorized to regulate commercial sand and shell removal (Kerr, ca. 1970, Benefield, 1976).

The growth of the reef shell industry was stimulated about 1916, when Lonestar Cement (Portland Cement Company) began operations on the Channel, using shell as the raw material for cement. This required the adoption of a rotary kiln to avoid compaction (Kerr, ca. 1970), a type of kiln which had come to dominate the U.S. cement industry since 1900 (Lesley, 1905, who does not list shell among the raw materials for cement). In 1928, there were three cement factories in the world using "mudshell," of which two were in Houston (and the third in California, TGFOC, 1928). In the late 1920's, raw shell began to be used as a supplement in poultry feed, especially to facilitate eggshell formation. Shellbuilder and Mayo Shell began operations in 1931 and 1933, respectively (Kerr, ca. 1970).

At this time, shell was still a minor industry, whose fortunes waxed and waned. The turning point for the industry was in 1929, when a process for manufacturing lime from shell was devised, relying on the rotary-kiln technology, thereby opening markets for plaster, mortar, waste treatment, water softening and many other uses (markets which were temporarily stunted by the Depression). The Haden Lime Company began operating a 50,000 ton/yr plant on the Channel at Greens Bayou, but economic problems in the 1930's forced its sale to Nyotex in 1941 (Kerr, ca. 1970). Dry ice production from soda ash began about 1934, creating an additional market for lime products. Lime from reef shell began to be used in pulp manufacture, through creation of calcium hypochlorite used in the bleaching process, which, according to Kerr (ca. 1970), revitalized harvesting of cut-over forests in East Texas for paper mills about 1937. In 1941, Dow established its magnesium plants near Freeport, a further market for reef-shell lime.

Thus by WW II, reef shell had become a basic raw material for a major component of the growing chemical industry in the Galveston Bay area. The ability to secure this raw material from such a nearby source was central to the economics of these industries. The dredging of shell responded in kind, varying with the economic vagaries of the market. Capt. W. D. Haden built a steam-powered dredge in 1905, and the first hydraulic dredge was introduced in 1912

(Kerr, ca. 1970). (The Haden dredge is described as an "orange-peel dipper dredge" by Kerr, ca. 1970, which of course cannot be. It was probably a grapple dredge with an orange-peel bucket.) Parker Brothers and Company, was founded in 1924 by Capts. Charlie, Bill, George, Bob and Briscoe Parker (*Bay City Tribune*, 1982), and became the dominant producer in Galveston Bay and along the Texas coast (Kerr, ca. 1970). The trends in shell production are shown in Fig. 2-4, for the coast as a whole (from Kerr, ca. 1970) and for Galveston Bay (from Gilardi, 1942). During the early 1940's, production more than doubled its pre-WW II rates, a consequence of the new markets for reef-shell lime, and a harbinger of the boom in shell dredging that was to come. Cumulatively, about 50 x $10^6$ cu yds had been removed from Galveston Bay by 1940.

### *2.3.4 Closure of Turtle Bay*

About 1900, rice production became large-scale in the upper Trinity Bay vicinity. The first major irrigator was Hankamer-Stowell Canal Company (later Farmers Canal Company), which began excavating canals from Turtle Bay in 1899, but the Lone Star Canal Company was only a few years behind it, moving water from Turtle Bay in 1903. Between hurricanes and "salt-water years," when salinity would intrude into Turtle Bay from Galveston Bay, the crop was inconsistent. Trinity River Irrigation District No. 1 was established in 1911, primarily to deal with the salt intrusion problem. Bonds were passed and a bulkhead and barrier built across the mouth of Turtle Bay about 1915, just in time to be taken out by the 1915 hurricane. The bulkhead was not re-built, and the problem of salt intrusion returned. Moreover, when salt intrusion did not occur, it was usually because of flooding on the Trinity which was even more devastating to the rice crop. Farmers Canal ceased operation in 1925 and Lone Star became inactive during 1927-1931 (Harry, 1940). Devers took over the Farmers waterways in 1927, and began pumping directly from the Trinity River to avoid the salt intrusion risk.

About 1931, Trinity River Irrigation District No. 1 began reconstruction of the salt-water-barrier bulkhead at the entrance to Turtle Bay. In 1935, while this reconstruction was underway, oil was discovered at Turtle Bayou and Monroe City, which seemed to galvanize the opposition to the barrier. Objections to closing Turtle Bay were lodged by Stanolind Oil, Parker Brothers, several towing companies, and a logging company. The authority of the District to close Turtle Bay was derived from a provision in a 1902 act of Congress declaring Turtle Bay nonnavigable, despite the federal channel project in Turtle Bay and the record of vessel traffic. The decision ultimately rested with the War Department, who resolved it in 1936 by allowing the Irrigation District 60 days to complete work on the barrier, including locks and dams (Harry, 1940). This was accomplished, and Turtle Bay, now Lake Anahuac, was isolated from the Galveston Bay system.

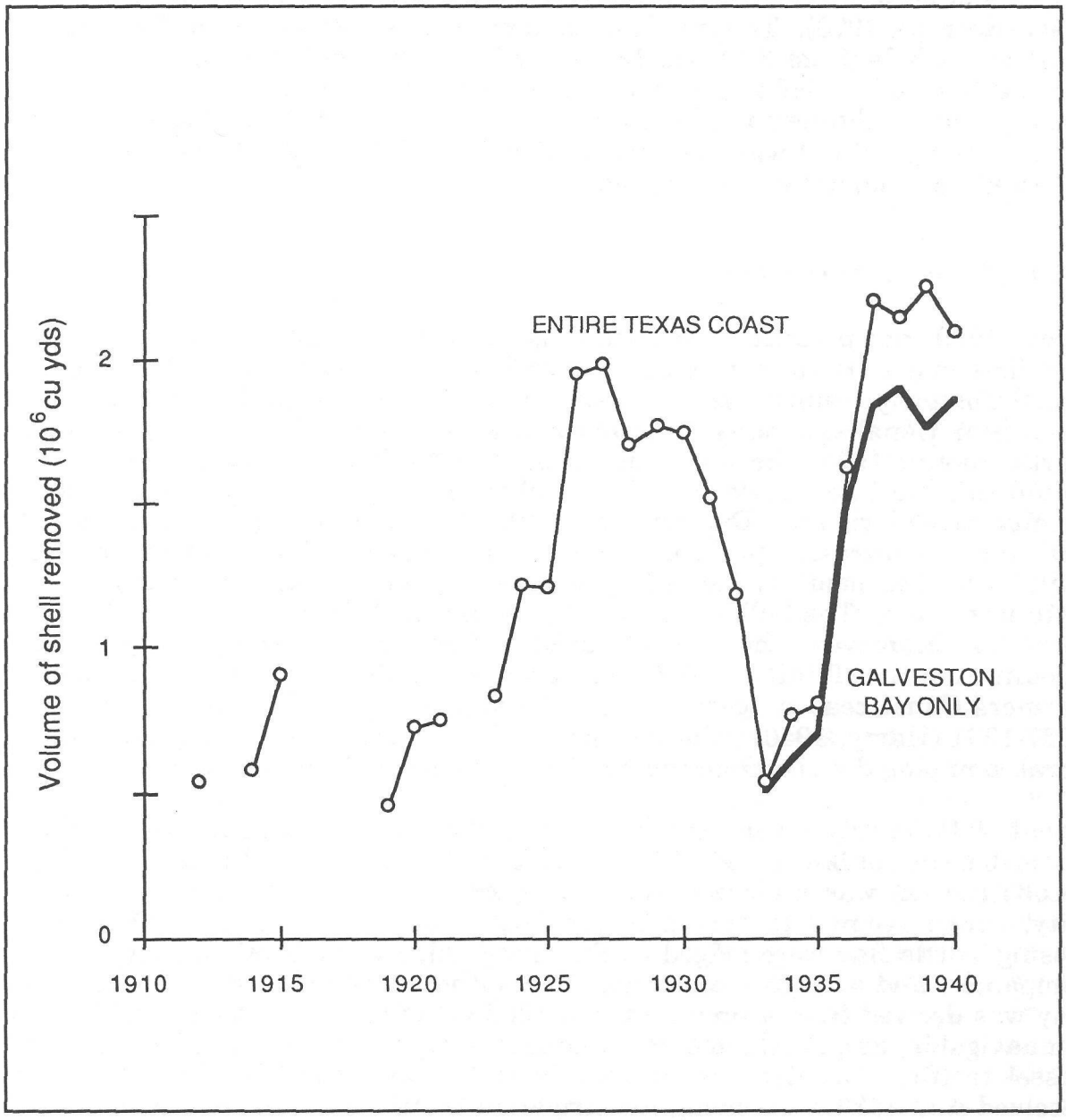


Fig. 2-4 Shell volume removed from Galveston Bay, pre-1940 (Data of Texas Game, Fish & Oyster Commission, compiled by Gilardi, 1942, and Kerr, ca. 1970)