U.S. 181 (Harbor Bridge) Feasibility Study

Texas Department of Transportation
Corpus Christi District

June 2003

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Feasibility Study for U.S. 181 (Harbor Bridge)

Nueces County

TEXAS DEPARTMENT OF TRANSPORTATION

Corpus Christi District

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INTRODUCTION

The Texas Department of Transportation (TxDOT) has undertaken a study of the Harbor Bridge (U.S. 181) and the Tule Lake Lift Bridge (Navigation Boulevard) crossings of the Corpus Christi Ship Channel (Channel) to determine whether these crossings are adequate to meet future travel demands. Figure 1 shows the study area.

The study evaluated the crossings required for the two bridges. The red alternative corridor is recommended to replace the current Harbor Bridge. Two alternatives are recommended for replacing the existing Tule Lake Lift Bridge: the low-level alternative with rail and the mid-level alternative without rail.

BACKGROUND AND DESCRIPTION OF THE STUDY AREA

The Harbor Bridge is located on U.S. 181 approximately 0.5 mile north of the U.S. 181 and I-37 interchange. The Harbor Bridge, a six-lane divided highway without shoulders, was built in the 1950s and opened for operation in 1959. It has 138 feet of vertical clearance and is 5,818 feet long. The bridge consists of a combination of pre-stressed concrete beam spans, steel plate girder spans, simple deck truss spans, and continuous truss and suspended tied arch spans.

The Tule Lake Lift Bridge was completed and began operation in 1959. The bridge, which crosses the Channel 3.8 miles west of Harbor Bridge, carries two lanes of vehicular traffic and a single railroad track. Owned by the City of Corpus Christi and operated by the Port of Corpus Christi, Tule Lake Lift Bridge provides 138 feet of vertical clearance, the same as the Harbor Bridge.

PURPOSE OF AND NEED FOR THE PROPOSED IMPROVEMENTS

The need for improvements is defined as deficiencies in the existing structures. The purpose of the improvements is to address future plans for the structures and the areas that they serve. The four major factors affecting the purpose and need for the Harbor Bridge are obsolescence, safety, level of service, and mobility.

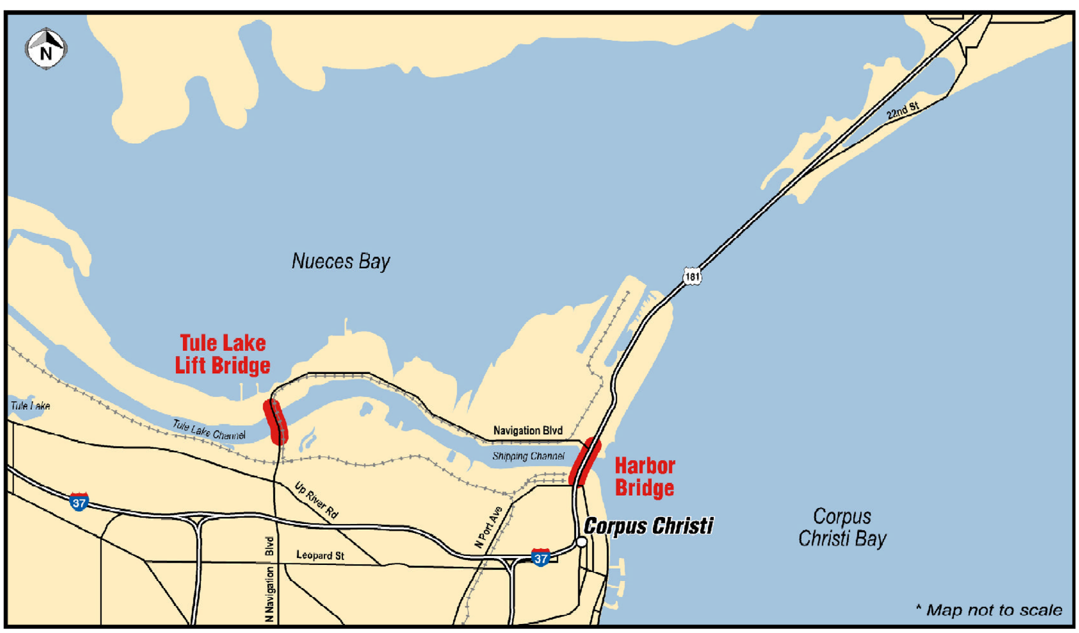


FIGURE 1: STUDY AREA

Harbor Bridge:

- Obsolescence: Rehabilitating/replacing Harbor Bridge would reduce maintenance costs and remove the vertical and horizontal clearance restrictions on the Channel.
- Safety: Constructing the approach roadways to current design criteria, adding shoulders to the bridge, and reducing the conflict points and driver decisions would improve safety.
- Level of Service: Improving the vertical grade and adding travel lanes and shoulders would improve the level of service.
- Mobility: Eliminating the offset alignment between S.H. 286 and U.S. 181, providing better access to local facilities, and improving the connectivity of the highway network would improve mobility.

Tule Lake Lift Bridge:

- Obsolescence: Replacing the Lift Bridge would reduce maintenance and operation costs, and the vertical and horizontal clearance restrictions.
- Safety: Reducing the horizontal and vertical clearances restrictions would improve safety.
- Level of Service: Reducing the number of delays associated with lifting the bridge would improve the level of service.
- Mobility: Maintaining and enhancing the connectivity would positively affect local economic development and would increase mobility.

PUBLIC INVOLVEMENT

During the course of the feasibility study, a public involvement program gave TxDOT and local stakeholders an opportunity to communicate with one another. This program included a public involvement plan (part of the Project Management Plan), three citizens' advisory committee meetings, two public meetings, other meetings, and two newsletters.

CITIZENS' ADVISORY COMMITTEE (CAC)

In response to citizen concerns and out of a desire to gather as much feedback as possible from local stakeholders, TxDOT formed a citizens' advisory committee several months after the feasibility study began. This group included residents of a neighborhood near Harbor Bridge, a number of ministers with churches in that neighborhood, a representative of the Federal Highway Administration, local elected officials; City of Corpus Christi representatives, local business owners, Port of Corpus Christi officials, representatives of civic organizations, and others.

PUBLIC MEETINGS

Two public meetings were held during the feasibility study. The format for these meetings was identical and included an open house, a presentation, and a question and comment period. The meetings were held at the following locations on the dates noted:

- Miller High School: 6 - 8 p.m., November 14, 2002; and
- Oveal Williams Senior Center: 6 - 8 p.m., May 29, 2003.

OTHER MEETINGS

In addition to the CAC and public meetings, TxDOT met informally on April 29, 2003, with stakeholders interested in the Tule Lake Lift Bridge.

NEWSLETTER

To disseminate information about the feasibility study, two newsletters were developed and published.

ALTERNATIVES

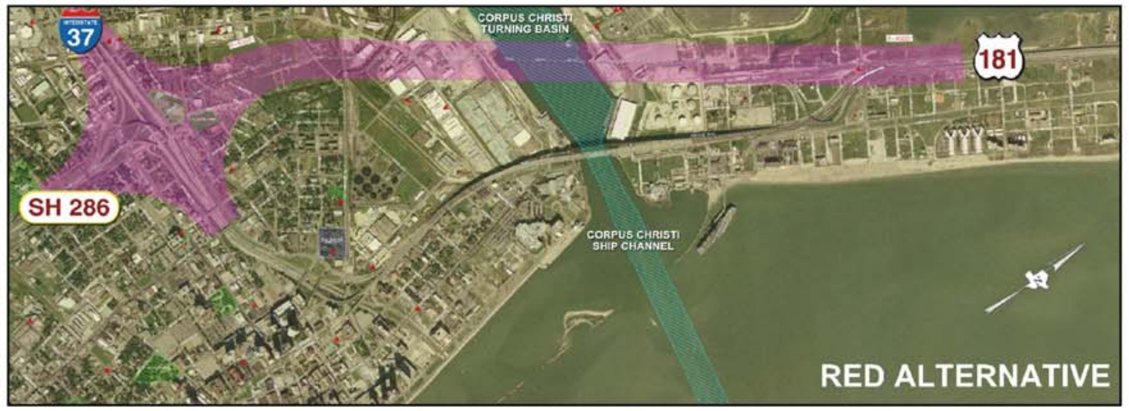
Four Harbor Bridge corridor alternatives were developed based upon the identified need and the comments from the CAC. These four alternatives are shown on the next page of this Executive Summary and were developed using design criteria based on the current TxDOT Design Manual. The proposed alternatives, in addition to the Harbor Bridge (No-Action) Alternative, are:

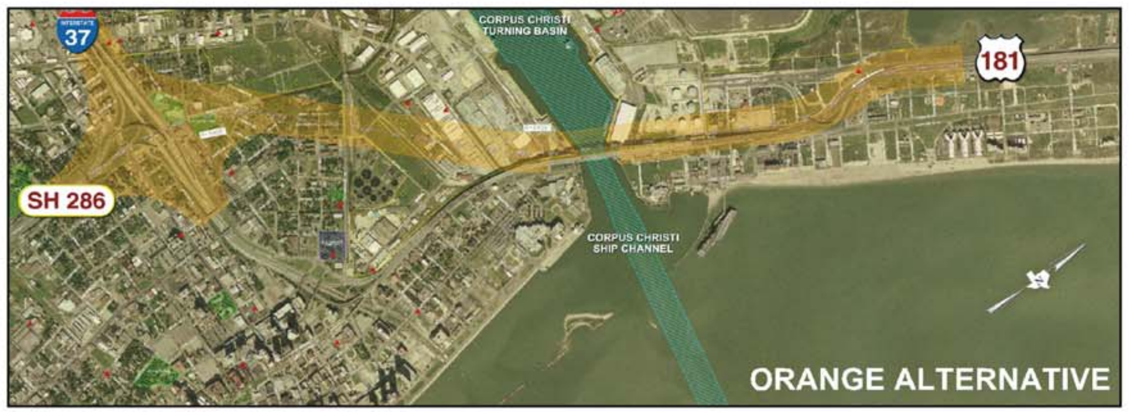
- Red Alternative
- Orange Alternative
- Green Alternative
- Blue Alternative

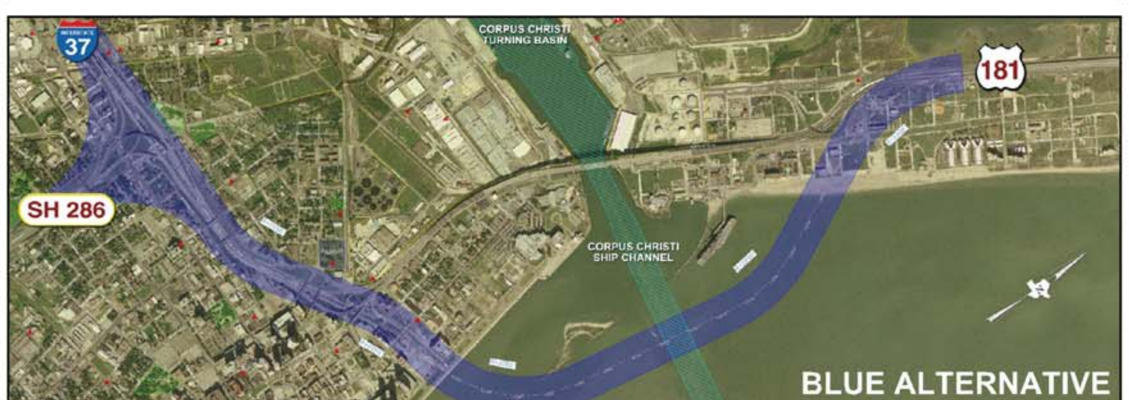
At the first CAC meeting, a tunnel alternative was discussed. The tunnel alternative was eliminated from further consideration for several reasons. The most significant reason, as compared to a bridge alternative, was the significantly higher construction and operation costs without a commensurate increase in traffic service. Another contributing factor would be that trucks carrying hazardous cargo would be prohibited and would have to choose alternate routes.

The proposed alternatives for the Tule Lake Lift Bridge, which are shown on the next page of this Executive Summary, follow the same proposed horizontal alignment, with the exception of the mid-level alternative with rail. For this alternative, there are separate proposed horizontal alignments: one for the highway, and the other for the rail. The rail alignment is

HARBOR BRIDGE ALTERNATIVES





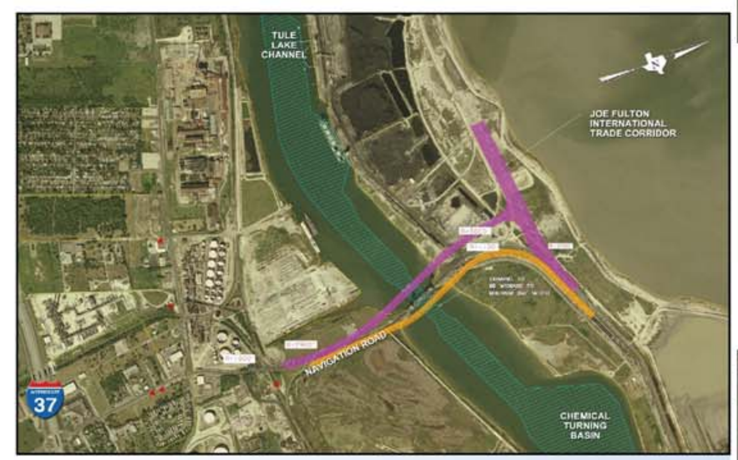


TULE LAKE LIFT BRIDGE ALTERNATIVES

LOW-LEVEL WITH RAIL

LOW-LEVEL WITHOUT RAIL

MID-LEVEL WITH RAIL



MID-LEVEL WITHOUT RAIL

located east of the existing crossing and this bridge would remain in the up position until a train approaches. The proposed alternatives, in addition to the Tule Lake Lift Bridge (No-Action) Alternative, are:

- Low-Level Bridge with Rail
- Low-Level Bridge without Rail
- Mid-Level Bridge with Rail
- Mid-Level Bridge without Rail

EVALUATION CRITERIA

The criteria for evaluating Harbor Bridge alternatives fell into three major categories: traffic/planning, engineering, and environmental/public involvement issues. The criteria for the Tule Lake Lift Bridge fell into the following categories: vehicular and intermodal flow, engineering, and environmental/public involvement issues.

Evaluation criteria were both qualitative and quantitative. The qualitative measures were used to compare the proposed alternatives to the "no-action alternative." The quantitative measures used specific units of measurement as they apply to each alternative.

FEASIBILITY ANALYSIS

ROUTE ALTERNATIVES

TxDOT Travel Demand Model

A critical aspect of the feasibility of the project is an estimation of potential travel demand for Harbor Bridge and Tule

Harbor Bridge

Lake Lift Bridge. The estimates of potential trips using various alternative corridors or configurations influence the ultimate designs of any bridge replacements, both in terms of the number of lanes required to support the traffic crossing the Channel as well as the impacts to the access roadway network.

Traffic Forecasts for Route Alternatives - The future year demand for travel in the corridor is based on the anticipated growth of population and employment in the region as well as potential improvements to the transportation infrastructure. To apply the TxDOT Travel Demand Model developed for the Corpus Christi District for future year conditions, it is necessary to estimate the population, number of households, and employment for each zone in the model. **Table 1** lists the socioeconomic projections for the total region. These estimates are based on approved MPO forecasts for the region. The anticipated traffic and level of service (LOS) conditions for the existing Harbor Bridge are shown in **Table 2.**

TABLE 1: SOCIOECONOMIC GROWTH PROJECTIONS FOR SAN PATRICIO AND NUECES COUNTIES

Socioeconomic	1996	2025	Growth Rate (%/Year)
Population	380,822	543,675	1.24%
Household	137,898	251,508	2.09%
Total Employment	106,707	196,469	2.13%
Basic Employment	34,312	60,719	1.99%
Retail Employment	23,931	45,668	2.25%
Service Employment	48,464	90,082	2.16%

TABLE 2: ESTIMATED TRAFFIC AND LEVEL OF SERVICE BY YEAR

Year	Estimated Conditions	
	Traffic Volume	Level of Service
2001	56,600	C
2025	78,300	D
2035	93,300	D
2045	111,700	E

TABLE 3: ESTIMATED TRAFFIC BY ALTERNATIVE

Location Description	2025 No-Build	Red	Orange	Blue	Green
U.S. 181 at Harbor Bridge	78,300	80,750	80,370	79,710	79,970
Tule Lake Lift Bridge	3,020	2,960	2,980	3,160	3,030
I-37/U.S. 77	51,680	51,290	51,350	52,500	51,480
FM 666 North of FM 3088	5,860	5,860	5,860	5,870	5,860
SH 361 in the vicinity of Port Aransas	9,440	9,460	9,460	9,500	9,450
TOTAL	**148,300**	**150,320**	**150,020**	**150,740**	**149,790**

Future Year Alternative Traffic Estimates - **Table 3** provides a summary of the estimated traffic for each of the Harbor Bridge alternatives, as well as for the Tule Lake Lift Bridge. Traffic estimates for the roadway segments are also included. In addition, the table includes the estimated no-action alternative traffic volumes to facilitate comparisons between the alternatives and the no-build condition. As anticipated, the traffic volumes for each of the alternatives are similar, with all alternatives indicating a slight increase over the no-action condition. This minor increase in total traffic is due to the slight reduction in travel time resulting from the improved design characteristics, in terms of speed and grade, incorporated into each of the alternative alignments.

Harbor Bridge Summary

Harbor Bridge (No-Action) - The no-action alternative assumes that the existing roadway system remains in its current state and that no improvements are constructed. This would not improve the current traffic flow, roadway conditions, Central Buisness District (CBD) access, or community cohesion. It would require continued higher maintenance costs. Additional studies need to provide information about pedestrian/bicycle safety.

Red Alternative - This alternative offers the opportunity to improve the current I-37/SH 286 interchange while still maintaining existing facility access. The new location roadway would remove U.S. 181 through-traffic from the existing roadway, thus alleviating traffic congestion. This alternative completely addresses the offset alignment issue because it provides the most direct connection between S.H. 286 and U.S. 181 on the north side of the ship channel. The only traffic flow issues during construction would be at the I-37/SH 286 interchange and at the tie-in to U.S. 181. Most of the required land for this corridor is currently serving other purposes, resulting in a larger right-of-way purchase than for the other alternatives. This route would have a moderate adverse impact on the CBD, and on the economic and business interests in the area. There is high compatibility with the City of Corpus Christi's future development plans for the local community. This alternative addresses the issue of community cohesion. By removing through-traffic on I-37 and removing the existing control of access, cohesion and mobility for the local traffic would improve on both sides of the current roadway.

Orange Alternative - The orange alternative would provide the opportunity to improve the interchange at I-37/SH 286. The new location roadway would remove U.S. 181 through-traffic from a portion of the CBD, thus alleviating some traffic congestion. This alternative addresses the offset alignment issue by introducing a reverse curve alignment. Traffic flow issues during construction would be at the I-37/SH 286 interchange and from the Channel crossing north to the U.S. 181 tie-in where the alignment parallels the existing roadway. A part of the required land for this corridor is currently serving other purposes, resulting in a larger right-of-way purchase than for the green and blue alternatives. This route would have a moderate adverse impact to the CBD and on the economic and business interests in the area. There is moderate compatibility with the City of Corpus Christi's future development plans for the local community. This alternative addresses the issue of community cohesion. By removing the through-traffic on I-37 and removing the existing control of access, this would provide the local residents with better access to areas on either side of the current roadway.

Green Alternative - The green alternative would improve the existing I-37/SH 286 and I-37/U.S. 181 interchanges but would not improve traffic flow through the CBD. There would be problems with traffic weaving based on the short offset distance between the two interchanges. An estimate has been included for providing braided ramps that help minimize the weaving in this area; however, the traffic flow would be compromised. This alternative meets design criteria, but does not achieve the desirable design criteria. For example, this alternative provides a vertical clearance of only 180 feet; the desirable vertical clearance is 200 feet. There would be significant traffic flow and local access issues along with additional construction cost since this alternative follows the existing roadway. There is high adverse impact on access to the CBD and on the existing economic and business interests in the area. It has low compatibility with the City of Corpus Christi's future development plans for the local community and would cause the most relocations, displacements, and negative impacts to the local neighborhood.

Blue Alternative - This alternative offers the opportunity to improve the current I-37/SH 286 and I-37/U.S. 181 interchanges while still maintaining existing facility access. The new location roadway would remove U.S. 181 through-traffic from the existing roadway, thus alleviating some traffic congestion. This route would not disproportionately affect minority and/or low-income populations in the community due to very little additional new location right-of-way being needed. This alternative would have higher construction cost due to the long bridge structure and ship impact protection needed over Corpus Christi Bay. It would be difficult to maintain traffic flow during construction. There would be adverse impacts on existing economic and business interests in the area. This alternative would not improve access to Corpus Christi's CBD and is not compatible with the City's future development plans for the local community. There would be significant impacts to coastal and aquatic life.

Tule Lake Lift Bridge

Tule Lake Lift Bridge Summary

If rail and highway are both to be maintained at the Tule Lake Lift Bridge location, it is recommended that two bridges be constructed: a mid-level movable bridge that carries highway traffic only and a low-level bridge with rail.

If rail traffic is eliminated from this crossing and only highway traffic is to be maintained across the Tule Lake Channel, it is recommended that a mid-level movable bridge be constructed.

Tule Lake Lift Bridge (No-Action) - The no-action alternative assumes that the existing roadway system remains in its current state and that no improvements are constructed. This would not improve the current traffic flow, roadway or railway conditions, or clearance issues over the Channel and would require continued higher maintenance costs.

Low-Level Bridge with Rail - This alternative would have no impacts on the Joe Fulton International Trade Corridor (Corridor). There should be little difficulty in maintaining traffic flow in the Corridor during construction. The estimated daily amount of time the bridge is inoperable due to ship traffic is approximately four hours. This alternative should not change the emergency service access to the area or access to the inner harbor.

Low-Level Bridge without Rail - This option provides increased navigable clearance based on vehicle grade limits without rail grade limitations. The railroad bridge would be removed and rail traffic would access the area via a new route over land. There would be no impacts on the Corridor and there should be little difficulty in maintaining traffic flow in the Corridor during construction. The estimated daily amount of time the bridge is inoperable due to ship traffic is approximately four hours. This alternative should not change the emergency service access to the area or access to the inner harbor.

Mid-Level Bridge with Rail - This alternative has the highest cost because there would be a new roadway bridge and a separate railway bridge constructed. The roadway bridge would be elevated to provide greater navigable clearance over the Channel when the bridge is in the closed position. This means that the roadway traffic would be disrupted less often due to ship traffic. The estimated daily amount of time the bridge is inoperable due to ship traffic is approximately one hour. The emergency service access to the area and inner harbor access should be improved. There would be construction cost impact to the Corridor of about $3,300,000 to connect with Navigation Boulevard. The difficulty of maintaining traffic flow in the Corridor during construction should be moderate.

Mid-Level Bridge without Rail - For this alternative, the new bridge structure would carry only automobile traffic. The railroad bridge would be removed and rail traffic would access the area via a new route over land. The roadway bridge

Harbor Bridge

would be an elevated structure providing greater clearances over the Channel when the bridge is closed than currently exist. This means that the roadway traffic would be disrupted less often due to ship traffic. The estimated daily amount of time the bridge is inoperable due to ship traffic is approximately one hour. The emergency service access to the area and inner harbor access should be improved. There would be construction cost impact to the Corridor of about $3,300,000 to connect with Navigation Boulevard. The difficulty of maintaining traffic flow in the Corridor during construction should be moderate.

Harbor Bridge approach from the north on U.S. 181

COMPARISON/RECOMMENDATIONS

Four route alternatives were evaluated to identify a recommended corridor crossing for the Harbor Bridge. Two alternatives each, with and without the railroad, were evaluated to identify the recommended alternatives for replacing the existing Tule Lake Lift Bridge.

The ranking of the four alternatives for Harbor Bridge was presented at the CAC meeting for review and comment on April 29, 2003. The Tule Lake Lift Bridge alternatives were presented to the representatives of Channel industrial facilities and local governmental agencies in a meeting on April 29, 2003, and to the presiding officer of the Ship Channel pilots association during a conference call on May 15, 2003. The ranking of the Harbor Bridge and Tule Lake Life Bridge alternatives was presented at a public meeting on May 29, 2003.

Harbor Bridge

The rankings of the four Harbor Bridge alternatives are clustered in two groupings: the red and orange alternatives have a better but similar ranking and the blue and green alternatives have a poorer but similar ranking in the three major categories.

Tule Lake Lift Bridge

In evaluating replacements for the Tule Lake Lift Bridge, the project team grouped the alternatives into two categories: with and without the railroad. The various alternatives have very similar impacts from the standpoint of environmental and public impacts.

RECOMMENDED IMPROVEMENTS

Harbor Bridge

The red alternative corridor is recommended to replace the current Harbor Bridge, to increase the vertical clearance to 200 feet, and to widen the channel to 400 feet. This corridor completely eliminates the offset in alignment between SH 286 and U.S. 181, providing the most flexibility for achieving the desirable design criteria. In addition, the red alternative is the most compatible with the City of Corpus Christi's future development plans.

Tule Lake Lift Bridge

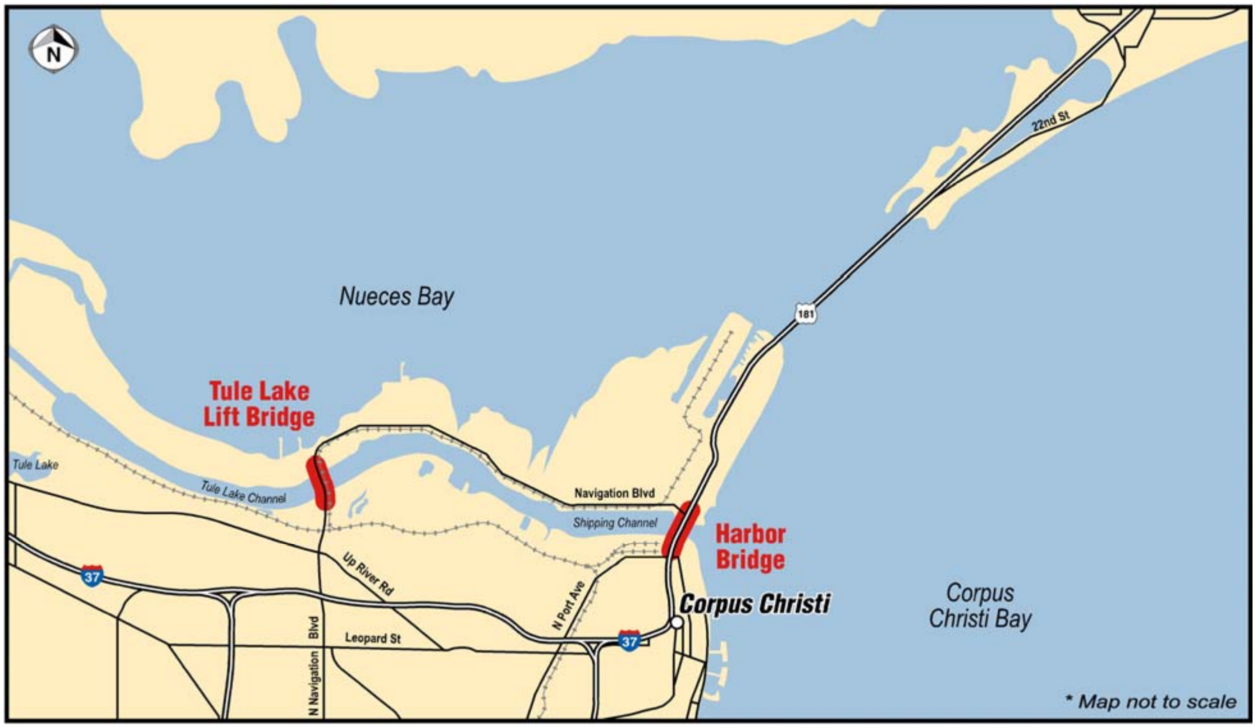
Two alternatives are recommended for replacing the existing Tule Lake Lift Bridge — one incorporating the railroad tracks and the other without provision for a railroad crossing. As with the Harbor Bridge requirements, a 200-foot vertical clearance should also be provided for the Tule Lake Lift Bridge. The two recommended alternatives are the low-level alternative with railroad tracks and the mid-level alternative without provision for the railroad. The low-level bridge should provide a 300-foot channel width, and the mid-level bridge should provide a 350-foot channel width.

Tule Lake Lift Bridge

Section 1.0
INTRODUCTION

The Texas Department of Transportation (TxDOT) has undertaken a study of the Harbor Bridge (U.S. 181) and the Tule Lake Lift Bridge (Navigation Boulevard) crossings of the Corpus Christi Ship Channel (the Channel) to determine whether these crossings are adequate to meet future travel demands. **Figure 1.1-1** shows the study area. This study is being conducted in three phases: the feasibility study, schematic and environmental documentation, and right-of-way map preparation. This report documents the first phase – the feasibility study.

FIGURE 1.1-1
STUDY AREA



The feasibility phase defines the needs and purposes for improvements, identifies alternatives to resolve the needs, identifies environmental and socioeconomic issues, evaluates the alternatives for practicality and resolutions of the defined needs, and makes recommendations for any improvements that solve the needs. In the schematic phase, the recommended improvements will be further defined. This further definition will consist of identifying conflicts, proposing alternative actions, working with interested organizations and groups, developing engineering schematics, preparing environmental documents, and incorporating public feedback. The final phase will be the preparation of right-of-way maps for the preferred alternative.

The two bridge structures are vital components of Corpus Christi's area transportation system. These bridges contribute to the economic well being and growth of the Port of Corpus Christi and the Corpus Christi metropolitan area. Furthermore, because the Port of Corpus Christi has been designated a strategic military port, it must be able to accommodate military vessels.

TxDOT has undertaken this study in response to federal legislation in the Transportation Equity Act for the 21st Century (TEA21). TEA21 specifically designated funds for the study.

1.1 SCOPE OF FEASIBILITY STUDY

The Feasibility Study was made up of the following activities, which are described in this report:

- Determination of the purpose and need to improve the Harbor Bridge and the Tule Lake Lift Bridge.
- Identification of bridge and route alternatives for both bridges.
- Development and use of evaluation criteria for analyzing the various alternatives.
- Use of the Texas Department of Transportation (TxDOT) Travel Demand Model to develop travel demand projections for the bridges.
- Use of alternative route analysis that considers navigational clearances and total costs for each of the bridges.
- Identification of environmental and socioeconomic issues, and other considerations.
- Use of public involvement to identify and work with local stakeholders in developing and evaluating bridge alternatives.
- Development of an implementation plan for the remainder of the bridge project.
- Development of recommended improvements for the Harbor Bridge and Tule Lake Lift Bridge.

Throughout the study, the Harbor Bridge and Tule Lake Lift Bridge alternatives were addressed separately. For clarity, these alternatives also are described independently in this report.

Also, coordination with various state, local, federal agencies occurred throughout the feasibility study. In addition, TxDOT formed a citizens' advisory committee, made up of representative stakeholders with an interest in the future of Harbor Bridge. This group provided valuable input throughout the feasibility study process.

1.2 BACKGROUND AND STUDY HISTORY

The Harbor Bridge is located on U.S. 181 approximately 0.5 mile north of the U.S. 181 and Interstate Highway (IH) 37 interchange. The Harbor Bridge, a six-lane divided highway without shoulders, was built in the 1950s and opened for operation in 1959. Harbor Bridge replaced a bascule bridge that was causing significant traffic delays for the growing Corpus Christi area. It has 138 feet of vertical clearance and is 5,818 feet long. The bridge consists of a combination of pre-stressed concrete beam spans, steel plate girder spans, simple deck truss spans, and continuous truss and suspended tied arch spans.

U.S. 181 provides a direct connection between Corpus Christi's central business district (CBD) and the communities of Portland, Gregory, Ingleside, and Aransas Pass. It was constructed as a freeway. This highway is the only continuous state/federal facility providing a direct connection between downtown Corpus Christi and these northern "suburbs."

The Tule Lake Lift Bridge was completed and began operation in 1959. The bridge, which crosses the Channel 3.8 miles west of Harbor Bridge, carries two lanes of vehicular traffic and a single railroad track. Owned by the City of Corpus Christi and operated by the Port of Corpus Christi, Tule Lake Lift Bridge provides 138 feet of vertical clearance, the same as the Harbor Bridge.

Several studies that address transportation issues in the project area have been conducted in recent years. The Northside Highway and Rail Corridor report, prepared for the Port of Corpus Christi in 1994, recommended creation of what is now called the Joe Fulton International Trade Corridor. This nine-mile highway and rail corridor running along the north side of the Inner Harbor would link I-37 and U.S. 181, serving current and future industrial and waterborne transportation facilities in that area. An environmental assessment was prepared for the JFITC and a FONSI was received in March 2003. The project is anticipated to be award to contract on October 2003.

The Tule Lake Lift Bridge Traffic Management Study, prepared for the Corpus Christi Metropolitan Planning Organization and Nueces County, was completed in 1997. The study report presented an analysis of traffic (maritime, vehicular, and rail) at the bridge and identified strategies to help reduce bridge-related traffic delays. Among the study's recommendations was giving high priority to development of the Joe Fulton International Trade Corridor for mobility and safety reasons.

In addition, a U.S. Army Corps of Engineers, Galveston District, report recently recommended various improvements to the Channel. These include deepening the current channel from 45 feet to 52 feet, and widening the channel across Corpus Christi Bay from 400 feet to 530 feet.

1.3 DESCRIPTION OF STUDY AREA

The geographic area for this Feasibility Study includes the Northside area of Corpus Christi, the Bayfront, and the North Beach area, as well as the industrial areas on the north and south sides of the Tule Lake Lift Bridge. Since the two bridges are independent of one another, the areas surrounding each of these bridges are described separately.

1.3.1 HARBOR BRIDGE

Corpus Christi's CBD is located just south of the U.S. 181 and I-37 interchange. The Northside area of Corpus Christi is just north of the CBD and consists of residential areas surrounded by industrial and Port of Corpus Christi facilities. Land use in this area is mixed. This neighborhood has industrial and commercial facilities, 12 churches, 3 schools, 3 parks, and a cemetery, in addition to residences, and various community facilities such as the Oveal Williams Senior Activity Center, the T.C. Ayers Recreation Center, and the Salvation Army Community Center. The area is home to the Solomon Coles Elementary School, one of the oldest schools in the Corpus Christi Independent School District, and other historical buildings, which are listed in Section 5.

In the past 10 years, the residential population of the Northside area has decreased as industrial activity increased and has encroached on traditional residential areas. To the west of the Northside area, refinery expansion has resulted in the removal of a number of houses.

To the east of the Northside area and south of Harbor Bridge, development is dense. This area has a combination of government buildings, Chamber of Commerce buildings, and the U.S. Courthouse. Theaters, the Bayfront Plaza Convention Center, the Solomon P. Ortiz International Center, Heritage Park, and various museums are also in this area. Various types of new development have been proposed for this area including a new baseball stadium near the Solomon Ortiz Center, and a cruise ship terminal.

Land use in the North Beach Area (east of U.S. 181 and north of Harbor Bridge) also is mixed, with two churches, four parks, and various industrial and commercial properties. Several residential areas and various tourist attractions (e.g. the Texas State Aquarium; various beachfront hotels and restaurants; and the U.S.S. Lexington) are found in this area as well.

1.3.2 TULE LAKE LIFT BRIDGE

Land use in the study area for the Tule Lake Lift Bridge is industrial. The Corpus Christi Public Elevator, owned and operated by the Port of Corpus Christi, is located to the east of the bridge and serves as an export outlet for grain produced in South Texas. Trucks servicing this elevator customarily use the Tule Lake Lift Bridge.

The Port's Bulk Materials Terminal, with its two docks, is located to the west of the bridge. Petroleum coke (generated by nearby CITGO and Flint Hills Refining), barite ore, chrome ore, copper concentrate, and coal all move through this terminal.

In addition, 14 public and private docks are located between the Tule Lake Lift Bridge and the Viola Turning Basin. These docks generate heavy barge traffic; barges exclusively use 5 of the 14 docks.

The Port of Corpus Christi is served by three railroads: the Union Pacific, the Tex-Mex Railway, and the Burlington Northern-Santa Fe. The three railroads transfer railcars from one railroad line to another at the Corpus Christi Terminal Association's Interchange Yard, located on the north side of the channel near the Tule Lake Lift Bridge.

1.4 ORGANIZATION OF THIS DOCUMENT

This document describes the results of the Feasibility Study described above. The Executive Summary included at the beginning of this report was prepared to present a concise description of the study effort and findings. It is also suitable for stand-alone distribution. **Section 2** presents the purpose and need for improving the Harbor Bridge and Tule Lake Lift Bridge. **Section 3** describes various alternatives (including a "No-Build" alternative) for the two bridges and presents the criteria developed to evaluate these alternatives. **Section 4** summarizes the feasibility analysis process, including application of the TxDOT Travel Demand Model and a route analysis for navigational clearances and costs. Environmental considerations related to improving the two bridges are described in **Section 5**. **Section 6** describes the public involvement process associated with this study, and **Section 7** provides an implementation plan including identification of projects and a timetable. Finally, **Section 8** compares the alternatives and recommends improvements.

Section 2.0
PURPOSE AND NEED

2.1 INTRODUCTION

This purpose and need section is subdivided into two parts, one for the Harbor Bridge and the other for the Tule Lake Lift Bridge. This section describes the existing conditions of each bridge, explains the needs (deficiencies) for each structure, and defines the purpose for any improvements proposed for each structure. The purpose and need for each of the two bridges is further explained by addressing four major factors: obsolescence, safety, level of service, and mobility.

2.2 HARBOR BRIDGE

2.2.1 DESCRIPTION

The Harbor Bridge, which opened in 1959, is located on U.S. 181 approximately 0.5 mile north of the U.S. 181 and I-37 interchange. The bridge is a six-lane divided highway without shoulders. Physically protected pedestrian walkways are located on the outside of the main lanes. The Harbor Bridge is 5,818 feet long and consists of a combination of pre-stressed concrete beam spans, steel plate girder spans, simple deck truss spans, and continuous deck truss and suspended tied arch spans. The bridge has a maximum vertical clearance of 138 feet above mean high water.

The Corpus Christi CBD is located just south of the U.S. 181 and I-37 interchange. The Harbor Bridge and U.S. 181 provide a direct connection to the Corpus Christi CBD from the northern suburbs of Portland, Gregory, Ingleside, and Aransas Pass. U.S. 181 was constructed as a freeway in this area and is the only continuous state/federal roadway facility that provides a direct connection between Corpus Christi and the northern suburbs. A six-lane divided highway, U.S. 181 has grade separations throughout the length of the study area except at the Harbor Bridge. U.S. 181 continues north over the Nueces Bay on the Nueces Bay Causeway, which provides a 50-foot vertical clearance for commercial water vessels. There is one connection to U.S. 181 other than by the Harbor Bridge but it is by city/county streets that traverse the Tule Lake Lift Bridge and then interchanges with U.S. 181 north of the Harbor Bridge on North Island.

The Port of Corpus Christi (Port) has most of its facilities in the Inner Harbor District of the Channel. The Channel is 300 feet wide where the Harbor Bridge span is located and connects to the Corpus Christi Bay at the same location. There is direct access to the Port from U.S. 181 north and south of the Harbor Bridge. The Tule Lake Lift Bridge is the only other means of crossing the Channel from north to south.

2.2.2 PURPOSE OF AND NEED FOR THE PROPOSED IMPROVEMENTS

In this section, the need for improvements is defined as deficiencies in existing structures. The purpose of the improvements is to address future plans for the structures and the areas that they serve. The four major factors affecting the purpose and need for the Harbor Bridge are addressed below.

2.2.2.1 Obsolescence

Obsolescence pertains to the design of the existing Harbor Bridge as well as the long-term maintenance of the existing structure and the physical restrictions of the Port facilities. Because the existing Harbor Bridge was constructed of steel in a saltwater environment it requires continuous cleaning and painting to minimize corrosion. More than $12 million has been spent on maintaining the Harbor Bridge in the past 15 years. This does not include the current $5 million contract for structural repairs and the $10.5 million contract scheduled for May 2004 for cleaning and painting. It is reasonable to assume that maintenance cost will continue and will increase at an accelerated manner. Even with good maintenance practices, the joints and connections eventually will deteriorate beyond repair and will have to be replaced. The Harbor Bridge is nearly 50 years old and maintenance costs will accelerate because of its age and continuous exposure to the saltwater environment. It is reasonable to assume that a major rehabilitation of the Harbor Bridge would be required in the next 20 years.

Harbor Bridge

The Port of Corpus Christi currently is restricted from serving certain larger, modern water vessels due to the Harbor Bridge's physical restrictions. The existing Harbor Bridge has a vertical clearance of 138 feet and a span clearance for a 300-foot-wide channel. These clearances restrict the size of vessels that can enter and exit the Channel. Routinely, according to Port personnel, taller vessels must add ballast to leave the Channel after unloading because the vertical clearance is not sufficient for the off-loaded vessels to pass under the Harbor Bridge without the ballast. The photo above shows a vessel passing under the Harbor Bridge.

The restricted vertical clearance also prevents many larger vessels; such as cruise ships and container ships, from entering the Channel. On both sides of the Harbor Bridge, the channel width is 400 feet, and as mentioned previously, the channel width at the Harbor Bridge is 300 feet. This narrowing of the Channel further restricts large ships. Modern ships are being built taller and wider; for the Port to accommodate these larger vessels, current clearance restrictions must be removed.

To address the maintenance and clearance issues described above, the Harbor Bridge needs to be replaced with a new, higher bridge with a longer span that would be designed to be less vulnerable to saltwater corrosion. During the first Citizens' Advisory Committee (CAC) meeting, constructing a tunnel instead of a bridge was discussed in some detail. The tunnel alternative was ruled out of further consideration for several reasons. The reasons included significantly higher construction and annual maintenance cost, restriction of certain vehicles use of the tunnel, and the higher potential of a catastrophic event resulting from a terrorist attack or some other cause.

2.2.2.2 Safety

U.S. 181 at the Harbor Bridge is currently a six-lane facility with no shoulders and steep grades on the approaches to the bridge. U.S. 181 is six lanes as it approaches the Harbor Bridge, but it is divided and has 8-foot shoulders. The lack of shoulders on the Harbor Bridge and bridge approaches does not offer drivers a place to park in case of accidents or vehicle breakdown, thus creating potential obstacles for drivers during heavy traffic periods.

In addition, the horizontal alignment of existing U.S. 181 as it approaches the Harbor Bridge from either end does not meet current freeway design criteria. The photo to the right illustrates what the driver sees when approaching the reverse curve alignment from the north on U.S. 181.The photo below shows entrance and exit connections at the interchange between U.S. 181 and I-37. These connections are short and have horizontal curves that are signed for 35 miles per hour.

Harbor Bridge approach from the north on U.S. 181.

Entrance and exit ramps of Broadway to the CBD are part of the U.S. 181/I-37 interchange.

Currently, the entrance and exit ramps of Broadway to the CBD are part of the U.S. 181/I-37 interchange. As illustrated in the photo to the left, drivers are faced with multiple decisions in a short time period as they descend the steep grade, thus increasing the likelihood of erratic movements and accidents. Because U.S. 181 and I-37 are major highways, many of the drivers who use U.S. 181 are unfamiliar with this non-standard interchange layout. This unfamiliarity also leads to increased driver confusion and tentative movements that increase the likelihood of accidents. From 1997 through 2000, there have been 240 documented accidents in this area. To correct these deficiencies, the interchange of U.S. 181 and I-37 would need to be reconstructed to current design criteria for a freeway-to-freeway connection.

The horizontal and vertical restrictions of the Harbor Bridge also present a safety concern for water vessels entering and leaving the Channel.

Replacing U.S. 181 at the Harbor Bridge with a new approach roadway, as well as the new bridge, would allow the roadway to be widened, the approach roadway vertical and horizontal grades to be flattened, and interchange ramps to be designed to current standards, thus improving the safety of the highway facilities. As mentioned previously, the tunnel alternative had been eliminated from further consideration by the CAC and the project team. The design of the new structure would also be consistent with the size of modern vessels, thus removing the current navigational clearance restrictions.

2.2.2.3 Level of Service

Level of service (LOS) is a measure of the capability of a highway to handle a certain amount of traffic under specific conditions. These conditions include factors such as the number of lanes, whether the roadway is divided or has shoulders or curbs, and vertical and horizontal grades. LOS is also based on the number and type of vehicles that are currently using the facility and how efficiently that facility operates. The best LOS condition is designated as "A" and the worst LOS condition is designated as "F." LOS A reflects conditions where traffic moves without any appreciable delays or problems. LOS F reflects situations where traffic encounters frequent delays with excessive congestion resulting from "stop-and-go" movements normally associated with forced flow conditions.

As mentioned previously, the existing approaches to the Harbor Bridge are steep, with 5 percent grades that exceed the current freeway design standard, which allows for 4 percent grades. About 7 percent of the existing traffic mix is trucks. As they approach Harbor Bridge from either end, these trucks slow down for the horizontal curves, thus making the climb up the five percent grade more difficult. The photo to the right illustrates what the northbound driver sees at the north end of the Harbor Bridge approach. These slower trucks reduce traffic speed during peak traffic periods and adversely affect the LOS of U.S. 181.

South end approach to Harbor Bridge.

To estimate the existing LOS for traffic on the Harbor Bridge, URS obtained observed traffic counts from TxDOT. In 2001, the existing traffic on Harbor Bridge was approximately 47,000 vehicles. To estimate future year traffic, URS used a travel demand model that TxDOT developed for the Corpus Christi MPO. This model forecasted traffic of approximately 78,300 vehicles on the Harbor Bridge for the year 2025, assuming a compounded growth rate of 1.6 percent over the 24-year period. This growth rate was slightly higher than the 1.24 percent growth rate for population, but slightly less than the 2.09 percent annual growth rate in households. To estimate traffic beyond the year 2025, URS adopted an annual growth rate of 2.0 percent and estimated traffic for the year 2035 at approximately 90,300 vehicles, and for the year 2045 approximately 111,700.

Based on the observed traffic counts, URS estimates that the Harbor Bridge traffic experienced LOS "C" conditions in 2001. This LOS is based on the observed truck percentages along with geometric constraints such as the steep grade and restrictions on lateral clearances caused by the absence of roadway shoulders. For the year 2025, the Harbor Bridge would experience LOS "D," with the conditions due to the increased traffic predicted by the model. LOS would further deteriorate to condition "E" by the year 2045.

Replacing Harbor Bridge, as well as constructing a new approach roadway, would allow the roadway to be widened, the approach roadway grades to be flattened, and interchange ramps to be designed to current standards, thus improving the LOS by permitting more traffic to flow better and easier.

2.2.2.4 Mobility

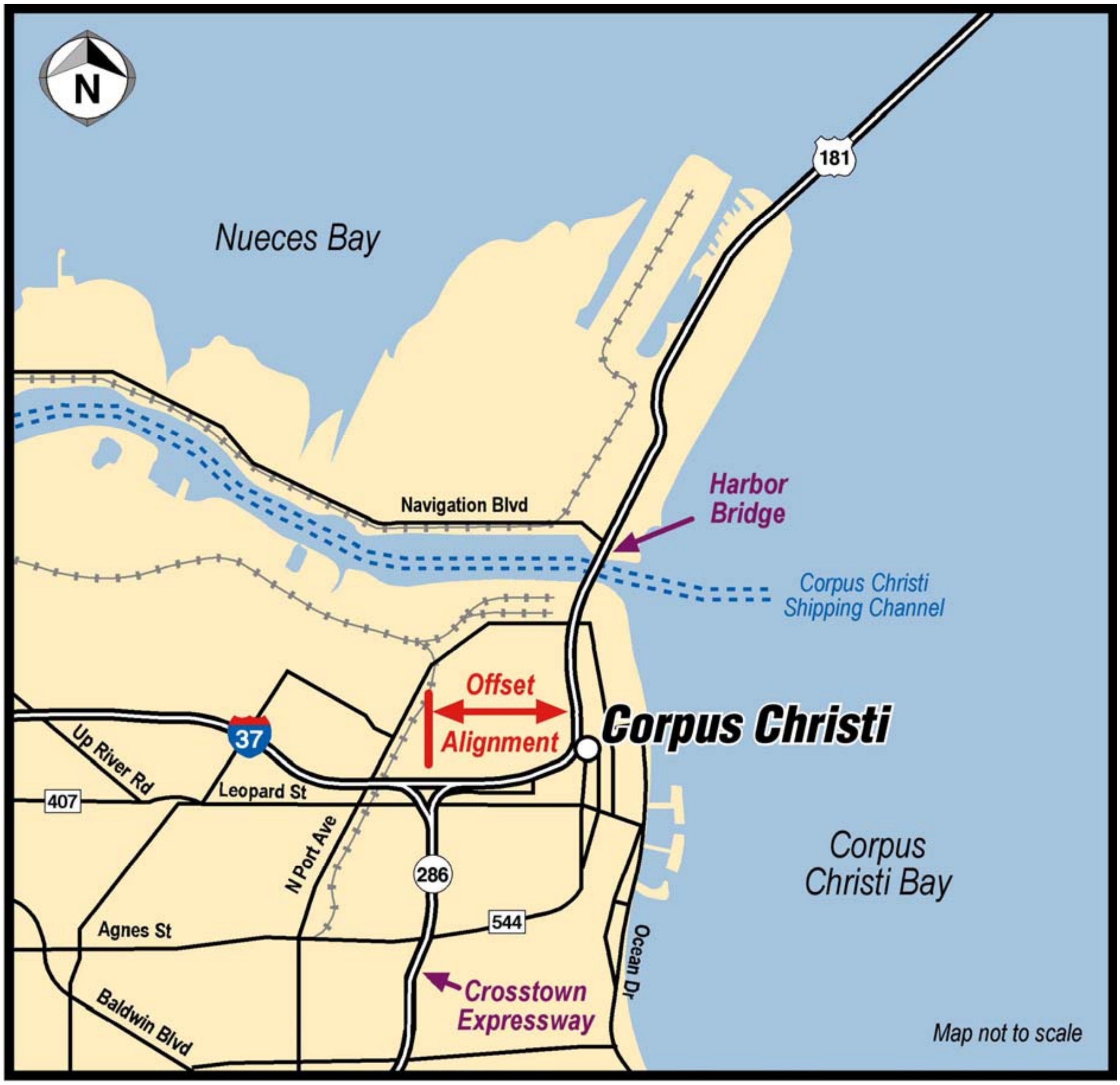
Mobility is defined as the connectivity of the existing transportation system. This transportation system consists of highways [I-37, U.S. 181, and State Highway (SH) 286], city arterials (including Navigation Boulevard, Up River Road, Port Avenue, and Broadway Street), and city streets (including Winnebago Street, Martin Luther King, Peabody Avenue, and Alameda Street). The transportation system provides the traveling public with an assortment of routes to various destinations. In this case, the traveling public includes local drivers as well as commuters, vacationers, business travelers, and others. Not all of these users need the same type of road. The Harbor Bridge and U.S. 181 are freeways designed to move the largest volume of traffic practical with the least amount of delay.

The manner in which the local street system is connected to U.S. 181 and the Harbor Bridge affects mobility within the project area. The mobility needs of the CBD, the neighborhoods that connect directly to U.S. 181 and I-37 in the project area, the Port and their businesses, and the tourist destinations to the north and south of the Harbor Bridge all must be considered as part of the study of the Harbor Bridge crossing.

Connectivity should provide drivers with a user-friendly, economical, and practical means of continuous traffic movement. The current traffic flow through the I-37/U.S. 181 interchange is confusing, especially for drivers unfamiliar with the Corpus Christi area. For example, traffic moving south to north in Corpus Christi would typically proceed up SH 286 (Crosstown Expressway), merge into I-37, go east for a short distance, then merge again into U.S. 181 going north. This movement has several conflict points, and requires many driver decisions in a relatively short span. **Figure 2.2-1** illustrates the offset between SH 286 and U.S. 181, which is the primary reason why many of these deficiencies exist today.

The Broadway connection, which links U.S. 181 to the CBD, also presents similar conflict points and requires quick driver decisions within a short distance, which contributes to driver confusion and error. Improving the connections to and from U.S. 181, SH 286, and I-37 within the project area will improve mobility for the traveling public.

FIGURE 2.2-1
OFFSET BETWEEN SH 286 AND U.S. 181



2.2.2.5 Summary

U.S. 181 and I-37, as well as the Harbor Bridge, have a number of deficiencies that were analyzed as part of this feasibility study. A number of alternatives were developed to address the purpose and need for resolving obsolescence and safety deficiencies and for improving LOS as well as mobility. The elimination of the offset between U.S. 181 and SH 286 was a prime consideration in developing alternatives. This offset is the primary reason why several of the identified deficiencies exist today. This analysis included evaluation of different locations and types of structures for the Harbor Bridge; analysis of the number and configuration of lanes to be proposed; and analysis of bridge heights, channel widths, and the connections to the local and through transportation network.

2.3 TULE LAKE LIFT BRIDGE

2.3.1 DESCRIPTION

The Tule Lake Lift Bridge (Lift Bridge) is located on Navigation Boulevard in the Port of Corpus Christi Industrial District and provides the only access across the Channel within the Port. The Lift Bridge was opened for public use in 1959 and now serves roadway and railroad traffic. The Lift Bridge has two 12-foot lanes and one set of rails.

From the Harbor Bridge to the Tule Lake Lift Bridge, the Channel width generally is 400 feet, except at the Harbor Bridge where it is 300 feet and at the Lift Bridge where it is 200 feet. The existing vertical clearance is approximately 10 feet. Most of the water traffic requires more than 10 feet of vertical clearance. Thus, the Lift Bridge is raised approximately 25 times a day, disrupting roadway and rail traffic.

Although the City of Corpus Christi owns the Lift Bridge, the Port maintains and operates it. North and south of the Channel, Nueces County owns Navigation Boulevard, which has signals south of the Lift Bridge at the intersection with Up River Road. The Lift Bridge is within the public street system, but mainly serves local business traffic consisting of heavy trucks that are transferring industrial products locally. Other than the Harbor Bridge, the Lift Bridge is the only other means of access to U.S. 181 and points north of Corpus Christi. The Lift Bridge is used for emergency access to the North Island if the Harbor Bridge is inaccessible.

2.3.2 PURPOSE OF AND NEED FOR THE PROPOSED IMPROVEMENTS

In this section, the need for improvements is defined as deficiencies in existing structures. The purpose of the improvements is to address future plans for the structures and the area that they serve. The four major factors affecting purpose and need for the Tule Lake Lift Bridge are addressed below.

2.3.2.1 Obsolescence

Obsolescence pertains to maintenance costs for the existing Lift Bridge, the bridge's structure, and the restrictions that this bridge imposes on Port operations. The Lift Bridge was rehabilitated in the mid 1990s for a total cost of $11.0 million. This rehabilitation was accomplished through two separate contracts. The first was a sandblast and prime coating contract to remove the lead paint. The second was the actual repair and final painting. The Lift Bridge is a steel bridge with motors that lift the traveling platform. This type of structure typically requires more maintenance than other types of bridges, especially in a saltwater environment. The annual operating cost is approximately $1.0 million. It is reasonable to assume that another major rehabilitation of the Lift Bridge will be required approximately every 10 years at a cost in excess of $11 million each time

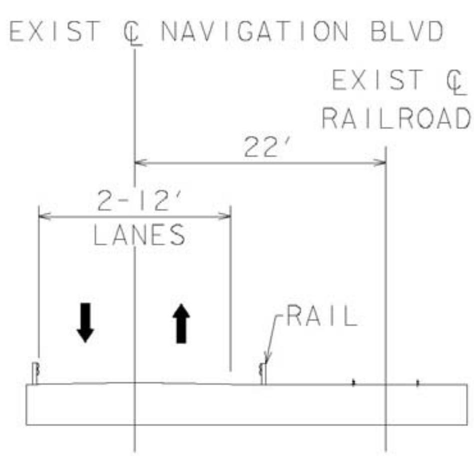
Another obsolescence issue is that the limited clearances of the existing Lift Bridge restricts the Port's ability to operate efficiently. The Lift Bridge's 138-foot vertical clearance and the 200-foot channel width at the bridge constrain the size of vessels that can clear the bridge. The Lift Bridge also has a minimum vertical clearance of less than 10 feet when in the closed position. The Lift Bridge must be raised approximately 25 times a day for all water vessels, including ships, tugboats, and barges. Because larger ships are difficult to stop once they are underway, these vessels will not proceed toward the Lift Bridge until they are certain it is being raised. This adds to the time that vehicular traffic is disrupted.

According to Port personnel, (and similar to Harbor Bridge), the 138-foot vertical clearance of the Lift Bridge routinely requires off-loaded vessels to add ballast to pass under the raised Lift Bridge. The other restriction is the width of the Lift Bridge opening. Channel pilots must guide their vessels, which are up to 165 feet wide, through this narrow opening, which they refer to as "threading the eye of the needle." Water traffic must be closely coordinated to reduce the number of lifts. Eliminating the current clearance restrictions would reduce the lost time and costs of lifting the bridge as well as the physical restrictions that limit the size of water vessels.

2.3.2.2 Safety

The existing Lift Bridge has two lanes of traffic, one in each direction, with no shoulders. Each lane is 12 feet wide. There are no walkways for pedestrian traffic. The railroad has one set of tracks next to the lanes that is separated from the road by a guard rail. **Figure 2.3-1** shows the existing cross section of the Tule Lift Bridge.

FIGURE 2.3-1
TULE LIFT BRIDGE EXISTING CROSS SECTION



Most of the vehicles using the Lift Bridge are heavy trucks. There is no room on the structure for any emergency situations; a disabled vehicle blocks at least one of the two lanes. There is no room for shoulders or additional lanes on the existing bridge. Furthermore, all of the roads leading to the Lift Bridge have two lanes with no defined shoulders. Adding lanes, as appropriate, and shoulders on the Lift Bridge would promote safety for the traveling public.

Tule Lake Lift Bridge

The 200-foot-wide Channel clearance at the Lift Bridge also affects safety. The photo to the right shows a ship passing under the Lift Bridge. Because the ships are up to 165 feet wide, there is very little room for error, and there can be no more than a single vessel near the Lift Bridge at any one time. This presents not only a safety concern but also a costly time delay. A widened channel at the Lift Bridge would promote safety.

2.3.2.3 Level of Service

The Lift Bridge has extended periods of downtime when the bridge is raised for water vessels. This operation causes traffic to back up onto public roads, thereby causing delays on other roadways. Reducing the number of times and the length of time the bridge is lifted will enhance the LOS on the local streets.

Existing traffic volumes for the Lift Bridge are approximately 2,000 vehicles per day, with a substantial percentage being trucks. While the number of trips using the facility is relatively modest, the potential delays encountered by the vehicles are significant. Estimates of delay provided in the Tule Lake Lift Bridge Traffic Management Study indicate that the minimum delay time in response to a bridge opening was eight minutes, with an overall average time of approximately 18 minutes. Historic log data from the bridge operators for 1998 indicated that the bridges opened approximately 25 times a day. With the available data, it is not possible to estimate the number of vehicles encountering these delays. However, for vehicles delayed by a bridge opening, the LOS would be consistent with a failure condition.

The lane and shoulder widths affect the LOS of any roadway. Because of the high percentage of trucks, continuous full width shoulders would improve the bridge's LOS. Trucks have more effect on LOS than a passenger vehicle because of size, speed, and movement. The width of a truck (generally 10 feet) causes a tunnel effect for oncoming vehicles because these vehicles perceive that they have a narrow lane in which to navigate. This tunnel effect causes traffic to slow and be more cautious, which further reduces the LOS of the Lift Bridge.

Bridge openings, as well as the limited vertical and horizontal clearances, also causes delays for water vessels. The time needed to lift the bridge and the frequency of lifting causes costly delays and congestion.

2.3.2.4 Mobility

As mentioned previously, mobility is defined as the connectivity of the existing transportation system. The Lift Bridge is in the Port Industrial District and is located approximately in the middle of the eight-mile-long Channel. Local businesses use the Lift Bridge to transport products from one side of the channel to the other side because they have facilities on both sides. Although the Joe Fulton Trade Corridor eventually will provide access from one side of the Channel to the other (via the Carbon Plant Road connection to I-37), it will involve more driving time for trucks and other vehicles than using the Lift Bridge.

Harbor Bridge and the Lift Bridge provide the only access to the North Island and U.S. 181 north of the Channel. If the Harbor Bridge cannot be used, the Lift Bridge is the only crossing of the Channel.

The Tex-Mex Railway that services the Port facilities uses the Lift Bridge. The Joe Fulton Trade Corridor will also provide an additional rail connection from the west and will provide rail service to Port facilities located on the north side of the channel. With the addition of this new rail service, it may not be necessary to maintain rail service on the Lift Bridge. Therefore, bridge alternatives with and without rail were studied for the new structure in the vicinity of the Lift Bridge.

2.3.2.5 Summary

The existing Lift Bridge has a number of deficiencies that were analyzed as part of this Feasibility Study. A number of alternatives were developed to address the purpose of and need for resolving obsolescence and safety deficiencies and for improving mobility and level of service. Alternatives included different locations and types of structures for the Lift Bridge, analysis of the number of lanes and configuration of lanes, and analysis of bridge heights and channel widths as well as the connections to the local transportation network.

2.4 CONCLUSIONS AND RECOMMENDATIONS

2.4.1 CONCLUSIONS

Both the Harbor Bridge and the Tule Lake Lift Bridge require improvements. The purpose of and need for improvements in both the Harbor Bridge and the Lift Bridge can be summarized in four categories.

Harbor Bridge:

- Obsolescence: Rehabilitating/replacing the Harbor Bridge will reduce maintenance costs and remove the vertical and horizontal clearance restrictions on the Channel.

- Safety: Constructing the approach roadways to current design criteria, adding shoulders to the bridge, and reducing the conflict points and driver decisions will improve safety.

- Level of Service: Improving the vertical grade and adding travel lanes and shoulders will improve the LOS.

- Mobility: Eliminating the offset alignment between S.H. 286 and U.S. 181, providing better access to local facilities, and improving the connectivity of the highway network will improve mobility.

Tule Lake Lift Bridge:

- Obsolescence: Replacing the Lift Bridge will reduce maintenance and operation costs, and the vertical and horizontal clearance restrictions.

- Safety: Reducing the horizontal and vertical clearances restrictions will improve safety.

- Level of Service: Reducing the number of delays associated with lifting the bridge will improve the LOS.

- Mobility: Maintaining and enhancing the connectivity would positively affect local economic development and will increase mobility.

2.4.2 RECOMMENDATIONS

The Harbor Bridge should be improved to provide additional lanes and shoulders and enhanced horizontal and vertical clearances of the Channel. It also should be designed to be less vulnerable to saltwater corrosion. The approach roads of U.S. 181 should be improved to current freeway horizontal and vertical design criteria. The ramps and connections between U.S. 181 and I-37 should be improved to meet design criteria, and the ramps and connections to the CBD and the Port should be improved to reduce driver uncertainty and conflicts. One way to remove these deficiencies is to eliminate the offset between S.H. 286 and U. S. 181.

The Tule Lake Lift Bridge should be improved to provide enhanced horizontal and vertical clearances of the channel. It also should be designed to be less vulnerable to saltwater conditions and to reduce the operating and maintenance costs. The approach roads should be improved to provide additional lanes, as appropriate, and shoulders.

Section 3.0
CORRIDOR ALTERNATIVES AND EVALUATION CRITERIA

3.1 HARBOR BRIDGE ROUTE ALTERNATIVES

Four Harbor Bridge corridor alternatives were developed based upon the identified need described in **Section 2** of this report and comments from the Citzens' Advisory Committee. These alternatives were developed using design criteria based on the current Texas Department of Transportation (TxDOT) Design Manual (see **Appendix A**). Each alternative is described in detail in the following sections. **Figures 3.1-1 through 3.1-4** give an overview of all the alternatives and show the profile view of each alternative.

Criteria were established to evaluate and compare the merits of each alternative. These criteria are summarized in Section 3.3 of this report.

3.1.1 HARBOR BRIDGE (NO-ACTION ALTERNATIVE)

The No-Action Alternative assumes that the existing roadway system remains in its current state and that no improvements are constructed. Maintenance activities, such as utilities, routine maintenance, and painting would continue.

3.1.2 RED ALTERNATIVE

As shown in Figure 3.2-1, the red alternative provides the most direct connection from the existing I-37/SH 286 Interchange to U.S. 181 north of the Channel in the general vicinity of Burleson Street. This alignment extends from the interchange in a northerly direction and curves in a northeasterly direction through a 4,000-foot radius horizontal curve that traverses through the existing Northside neighborhood and Port facilities. It is the western most crossing of all the alternatives, and is approximately 3,000 feet west of the existing Harbor Bridge crossing.

In this alternative, the bridge would cross the 800-foot-wide Corpus Christi turning basin and would require a minimum 1,300-foot-long main span across the channel due to the skew angle between the roadway and the Channel. Four- percent grades on either side of the Channel would provide for the necessary vertical clearance between the bottom of the structure and the water surface. With this profile alignment, the north bridge approach extends 5,190 feet north of the channel centerline and the south approach extends 5,420 feet south of the channel centerline for an overall approach structure length of 10,610 feet. This alternative results in a traditional four legged, multi-level interchange at SH 286 and I-37.

3.1.3 ORANGE ALTERNATIVE

The orange alternative begins at the I-37/SH 286 interchange and runs in a northeasterly direction. Once it passes the interchange, a reverse alignment locates this alternative just to the west and parallel to the existing U.S. 181 alignment just south of the Channel crossing. The orange alternative continues parallel to U.S. 181 until it reaches the existing Burleson Street interchange area. The existing reverse curve alignment in this area is flattened to achieve a more desirable alignment that meets the design criteria. As with the red alternative, 4 percent grades on either side of the Channel are used to provide the desirable vertical clearance between the bottom of the structure and the water surface.

The orange alternative approach structure begins approximately 4,925 feet south of the Channel centerline and ends approximately 5,015 feet north of the channel centerline, resulting in a 10,030-foot long bridge. This alignment crosses the Channel in approximately the same location as the existing Harbor Bridge, thus requiring an approximately 600-foot span with a 200-foot vertical clearance. A standard four legged, multi-level interchange is provided at SH 286 and I-37.

3.1.4 GREEN ALTERNATIVE

The green alternative closely approximates the existing I-37 and U.S. 181 roadways with changes in the alignments to meet the design criteria. Using the maximum vertical grade of 4 percent and a minimum vertical clearance of 180 feet, significantly changes access to the CBD. Direct access from U.S. 181 to upper Broadway is still provided. However, the return move has to be accomplished via Shoreline Boulevard and the west to north entrance ramp to U.S. 181. Mesquite and Chaparral Streets operate as a one-way pair providing direct north-south access between the CBD and the Bayfront area. To preserve this access, the I-37 vertical alignment is grade separated with these two arterials and provides for an at-grade intersection with Shoreline Drive.

The existing ramp access, the exit ramp from U.S. 181 to Power Street and the entrance ramp from Belden Street to U.S. 181, cannot be maintained. The one-way pair structures, Tancahua and Carancahua Street bridges that cross I-37 and connect the Northside neighborhood to the CBD cannot be maintained due to the new vertical alignment of I-37. Access between the Northside neighborhood and the CBD can be accomplished in several different ways, but in all instances, the access will be more circuitous than today. A “T” type interchange is provided at SH 286 and I-37 and because of its proximity to the U.S. 181 and I-37 interchange, the ramp movements between these two interchanges will likely be grade separated.

The approach structure for the green alternative is approximately 9,300 feet long with 4,375 feet of structure located on the south side of the crossing and 4,925 feet located on the north side. A 600-foot-long main span is required to cross the Channel.

3.1.5 BLUE ALTERNATIVE

The blue alternative begins at the western side of the SH 286/I-37 interchange. The alternative closely approximates the existing alignment of I-37 but continues out into Corpus Christi Bay, thus avoiding the existing Northside neighborhood and Port facilities. The alignment turns to the north to provide a perpendicular crossing of the Channel. North of the Channel, the alignment turns to the northwest and returns to the existing U.S. 181 alignment approximately 1,500 feet north of Burleson Street.

At the proposed Channel crossing, the existing 400-foot-wide channel is proposed to be widened to 530 feet and will require a minimum 1,200-foot-long main span. A 5,125-foot approach structure is required for the north approach and 5,225 feet is required for the south approach resulting in an overall structure that is10,350 feet long. Approximately 7,240 feet of bridge would be constructed over water. As with all the other alternatives, 4-percent grades on either side of the channel crossing provide the desired vertical clearance between the bottom of the structure and the water surface. As with the green alternative, a “T” type interchange is provided at SH 286 and I-37.

3.2 TULE LAKE LIFT BRIDGE ROUTE ALTERNATIVES

All four proposed alternatives for the Tule Lake Lift Bridge follow the same horizontal alignment with the exception of the mid-level alternative with rail. For this alternative there are separate horizontal alignments, one for the highway, and the other for the rail. The rail alignment is located east of the existing crossing and this bridge would remain in the up position until a train approaches. An overview of the various Tule Lake Lift Bridge alternatives including profiles are shown on **Figures 3.2-1 through 3.2-4.**

Bulk dock No. 1 is located west of the existing Lift Bridge on the north side of the Channel. Personnel from the Port have indicated that a new bulk dock, bulk dock No. 3, may be located between bulk dock No. 1 and the Lift Bridge. An evaluation should be undertaken to determine if ships could safely dock at bulk dock No. 3 after passing through the Tule Lake Lift Bridge. If they cannot, then an analysis should be performed to determine the best location for bulk dock No. 3. If the preferred location for bulk dock No. 3 is between bulk dock No. 1 and the Lift Bridge, then consideration should be given to locating the Tule Lake Lift Bridge to the east of the existing crossing.

The alternatives are located to the west of, and generally parallel to, the existing alignment, which would allow an alternative to be constructed while maintaining traffic on the existing Lift Bridge. The two mid-level alternatives have an elevated intersection with the proposed Joe Fulton Trade corridor. This elevated intersection is necessitated by the proposed railroad located on the south side and parallel to the trade corridor. In each of these two alternatives, approximately 2,700 feet of the vertical alignment of the trade corridor will need to be adjusted. For the two low-level alternatives, each alternative intersects the Joe Fulton Trade Corridor at-grade.

3.2.1 TULE LAKE LIFT BRIDGE (NO-ACTION)

The no-action alternative assumes that the existing roadway system remains in its current state and that no improvements are constructed. Maintenance activities, such as utilities, routine maintenance, and painting would continue.

3.2.2 LOW- LEVEL BRIDGE WITH RAIL

This alternative replaces the existing single structure with a new comparable structure carrying the roadway traffic and a single railroad track used by the Tex-Mex Railway. The maximum navigable clearance without opening the bridge is approximately 10 feet. Due to railroad restrictions the maximum allowable grade is 0.7 percent. All vessel movements would require the opening of the bridge.

3.2.3 LOW-LEVEL BRIDGE WITHOUT RAIL

This alternative replaces the existing structure with a similar structure for roadway traffic only. The railroad would no longer cross the Channel and the existing bridge would be removed. The maximum navigable clearance without opening the bridge is approximately 10 feet. All significant vessel movements would require the opening of the bridge.

3.2.4 MID-LEVEL BRIDGE WITH RAIL

This alternative includes two separate structures: an elevated roadway movable bridge and a new railway bridge as a separate low-level structure. The navigable clearance for the roadway without opening the bridge is a minimum of 73 feet. The navigable clearance for the railway without opening the bridge is approximately 10 feet. The rail bridge would remain in the open position with a minimum vertical clearance of 73 feet and would be lowered only as required for rail traffic. The rail bridge would be raised to its full height only for large ships. Only large ships would require the opening of the roadway bridge.

3.2.5 MID-LEVEL BRIDGE WITHOUT RAIL

This alternative replaces the existing structure with a new elevated roadway movable bridge and does not include a bridge for the railway. The existing railway structure would be removed. The navigable clearance for the roadway without opening the bridge is a minimum of 73 feet. Only larger ships would require the opening of the bridge.

3.3 EVALUATION CRITERIA

This section describes the criteria that TxDOT and the consulting team used to evaluate and compare the various alternative improvements for the Harbor Bridge and the Tule Lake Lift Bridge. Throughout the study effort, alternatives for the two bridges were addressed separately. Therefore, evaluation criteria were developed to address each structure independently because of the different conditions associated with each.

The criteria for Harbor Bridge fell into three major categories:

- Traffic/planning,
- Engineering, and

- Environmental/public involvement issues.

The criteria for Tule Lake Lift Bridge fell into the following categories:

- Vehicular and intermodal flow,
- Engineering, and
- Environmental/public involvement issues.

Evaluation criteria were both qualitative and quantitative. The qualitative measures were used to compare alternatives and the alternatives with the existing structure - the “no build alternative.” As an example, if an alternative is rated “similar” this means that it is similar to “no action.” The quantitative measures used specific units of measurement as they apply to each alternative.

The criteria used in the evaluations are summarized in **Tables 3.3-1** and **3.3-2**.

TABLE 3.3-1
HARBOR BRIDGE EVALUATION CRITERIA

Criteria	Description of Measure	Unit of Measure
Traffic/Planning		
Adverse impact on existing economic and business interests	A determination of the extent of a particular alternative's impact on economic and business interests	Low, moderate, high
Compatibility with future local development plans	A determination of how compatible an alternative is with the City of Corpus Christi's future development plans for the local community	Low, moderate, high
Impacts to future port operations	A determination of whether an alternative provides the necessary vertical clearance for future Port operations	Yes or no
Access to the central business district	A determination of how an alternative would affect transportation accessibility to Corpus Christi's central business district	Worse, similar, improved
Engineering		
Construction costs	A relative comparison of the estimated construction cost of an alternative	Low, moderate, high
Vertical clearance	The vertical clearance provided at the Channel by each alternative	In feet
Ability to meet design criteria	A determination of whether an alternative can achieve the desirable design criteria	Does not meet, meets, exceeds
Maintenance of traffic during construction	A determination of the difficulty of maintaining traffic flow during construction expected for each alternative	Simple, moderate, complex
Environmental/Public Involvement Issues		
Wetlands/waters of the United States	The number of acres of wetlands/waters of the U.S. that would be impacted by each alternative	In number of acres
Coastal/aquatic issues	A determination of whether an alternative impacts coastal and aquatic life, such as coastal zones, oyster reefs, shrimping, etc.	Minor, moderate, major
Threatened and endangered species	A determination of whether an alternative potentially affects species of potential occurrence and/or known threatened and endangered species sites	Yes or no

TABLE 3.3-1
HARBOR BRIDGE EVALUATION CRITERIA

Criteria	Description of Measure	Unit of Measure
Cultural resources	The number of recorded historical structures and archaeological sites potentially affected by each alternative	Number, by type: • Churches • Civic • Cemeteries
Hazardous materials	Hazardous material sites listed on state and federal databases that are located within the proposed right-of-way or are in proximity to each alternative	Number of sites
Park land	Parks potentially affected (either directly or by constructive use) by each alternative	Number of parks/acreage
Environmental Justice	A determination of whether an alternative disproportionately affects minority and/or low-income populations in the community	Yes or no
Relocations/displacements/neighborhood impacts	The relocations necessary for each alternative	Number, by type: • Business • Industrial • Church • School • Public facilities • Residential
Visual impacts	A determination of the degree to which an alternative alters the local and overall view of the area	Minor, moderate, major

TABLE 3.3-2
TULE LAKE LIFT BRIDGE EVALUATION CRITERIA

Criteria	Description of Measure	Unit of Measure
Vehicular and Intermodal Flow		
Operational delay time	The estimated total daily amount of time the bridge is inoperable due to vessel movements for each alternative	In hours
Public service facility access	A determination of whether an alternative changes emergency service access	Worse, similar, improved
Channel access	A determination of whether an alternative impacts the accessibility of the Inner Harbor	Worse, similar, improved
Adjacent land use	A determination of the alternative's effect on access to and development potential of adjacent land – in linear feet where the fill height exceeds five feet	Number of linear feet where the fill height exceeds five feet
Engineering		
Construction costs	A relative comparison of estimated cost of an alternative	Low, moderate, high
Construction impacts to Joe Fulton Trade Corridor	An estimate of construction costs of altering the Joe Fulton Trade Corridor to connect with Navigation Boulevard.	Low, moderate, high
Maintenance of traffic during construction	A determination of the difficulty of maintaining traffic flow in the Joe Fulton Trade Corridor during construction of each alternative	Simple, moderate, complex
Environmental/Public Involvement Issues		
Wetlands/waters of the United States	The number of acres of wetlands/waters of the U.S. that would be impacted by each alternative	In number of acres
Coastal/aquatic issues	A determination of whether an alternative impacts coastal and aquatic life, such as coastal zones, oyster reefs, shrimping, etc.	Minor, moderate, major
Threatened and endangered species	A determination of whether an alternative potentially affects species of potential occurrence and/or known threatened and endangered species sites	Yes or no

TABLE 3.3-2
HARBOR BRIDGE EVALUATION CRITERIA

Criteria	Description of Measure	Unit of Measure
Cultural resources	The number of recorded historical structures and archaeological sites potentially affected by each alternative	Number, by type: • Churches • Civic • Cemeteries
Hazardous materials	Hazardous material sites listed on state and federal databases that are located within the proposed right-of-way or are in proximity to each alternative	Number of sites
Impacts to structures and existing land uses	A determination of the impacts an alternative has on structures and existing land uses	Number, by type: • Business • Industrial • Church • School • Public facilities • Residential
Impacts to future planned development	A determination of the impacts an alternative has on future planned development	Worse, similar, improved

Section 4.0
FEASIBILITY ANALYSIS

4.1 ROUTE ALTERNATIVES

4.1.1 TXDOT TRAVEL DEMAND MODEL

A critical aspect of the feasibility of the project is an estimation of potential travel demand for Harbor Bridge and Tule Lake Lift Bridge. The estimates of potential trips using various alternative corridors or configurations influence the ultimate designs of any bridge replacements, both in terms of the number of lanes required to support the traffic crossing the Corpus Christ Ship Channel (the Channel) as well as the impacts to the access roadway network. As a result, the capital costs associated with each alternative are related to the magnitude of the anticipated traffic.

The TxDOT Travel Demand Model developed for the Corpus Christi District was used to forecast the traffic for this project. This regional model includes the city of Corpus Christi as well as the remainder of Nueces County and San Patricio County. The model is a comprehensive forecasting system based on a traditional three-step modeling process, and has been validated regionally for the year 1996 using a combination of survey data and traffic count data provided by TxDOT.

The Corpus Christi Model is used extensively throughout the region to forecast demand for a wide range of transportation projects. The future year travel demand generated by the model is based on the amount of socioeconomic growth anticipated to occur by the horizon year. This socioeconomic data includes variables such as population, households, and employment, all of which have been approved for use in the modeling process by the Corpus Christi Metropolitan Planning Organization (MPO).

This section of the report includes a description of how the Corpus Christi Model was developed and validated, and how it is used for this project. The discussion includes a review of the model's performance and validation of the model within the Harbor Bridge corridor. The final subsections provide descriptions of the model’s application and the estimated demand for each of the alternatives.

4.1.1.1 Model Development and Validation

As discussed above, the Corpus Christi Model was validated primarily on a regional basis. Since regional models such as the Corpus Christi Model are applied to individual corridors, it is often necessary to review and adjust elements of the model to improve their ability to replicate observed traffic in the detailed study area. In many cases, this involves relatively minor refinements of the highway network to better represent actual characteristics of the facilities in the corridor.

For this study, the review of the Corpus Christi Model focused on the model's ability to replicate observed traffic volumes on the Harbor Bridge as well as on the Tule Lake Lift Bridge. Also reviewed was the model's replication of observed traffic for potential competing routes, such as the I-37/U.S. 77 Bridge over the Nueces River and SH 361 within Mustang Island. While these routes are well removed from the primary study area, they were reviewed to ensure that the magnitude of traffic estimated by the model was reasonably close to the observed values.

The model was executed for the validation year, 1996, and the results were compared to the values provided by TxDOT. The results of this comparison indicated that the model acceptably replicated the estimates generated by TxDOT for the validation year. The link distances were verified and the number of lanes was reviewed for each roadway section in the corridor.

For this project, the year 2001 was established as the base year. To validate the model for year 2001 conditions, recent traffic counts were obtained from TxDOT. The counts provided by TxDOT were compiled in two formats:

- *District Traffic Maps* - observed values provided in an annual average daily traffic (AADT) format, which reflects adjustments for daily and seasonal variation as well as the percentage of trucks.

- *PCTM Maps* - observed values provided as 24-hour unadjusted axle counts divided by two, resulting in what are commonly referred to as passenger car equivalents. These counts were not adjusted for seasonal variation or percentage of trucks.

From these maps, AADT values were available for all the primary roadways in the corridor. However, the observed traffic count for the Tule Lake Lift Bridge was based on the unadjusted axle counts. Observations in the field indicated that the traffic along Navigation Boulevard in the vicinity of the Tule Lake Lift Bridge is dominated by truck traffic. Using professional judgment, the unadjusted axle count value was revised to reflect the significant level of truck traffic using this roadway.

To validate the model within the corridor for the base year 2001, it was necessary to create a vehicle trip table. TxDOT provided complete model data sets for the years 1996 and 2025. Using these model runs, interpolation techniques were used to estimate the trips for the year 2001. These trips were then assigned to the highway network, which provided estimated traffic volumes for each roadway section in a corridor.

While the results of the roadways were within acceptable tolerances, there was some variation for the Harbor Bridge. The model's slightly higher volume for the Harbor Bridge may be related to several factors, including the economic slowdown and lost traffic resulting from restrictions on vessels entering the Harbor. **Table 4.1-1** provides a listing of roadway segments that form a screenline generally paralleling the Nueces River through the region. These roadway sections included in the screenline are shown in **Figure 4.1-1**.

The table provides a summary of the observed counts as well as the initial and final model estimates provided by the assignment process and subsequent refinements. It should be noted that the differences between the observed counts and final model estimates are generally minimal. Based on the adjusted model estimates, the model was deemed acceptable for use in the project.

TABLE 4.1-1
NUECES RIVER SCREENLINE TRAFFIC COMPARISON SUMMARY

Location Description	2001 Observed Traffic (AADT)	2001 Model Estimates	
		Initial	Adjusted
U.S. 181 at Harbor Bridge	47,000	56,600	56,600
I-37/U.S. 77	37,500	36,800	37,400
FM 666 North of FM 3088	2,000	2,130	2,140
SH 361 in the vicinity of Port Aransas	4,800	4,330	4,330
Tule Lake Lift Bridge	1,690	1,730	1,720

FIGURE 4.1-1
NUECES RIVER SCREENLINE LOCATIONS

4.1.1.2 Traffic Forecasts for Route Alternatives

The future year demand for travel in the corridor is based on the anticipated growth of population and employment in the region as well as potential improvements to the transportation infrastructure. To apply the Corpus Christi Model for future year conditions, it is necessary to estimate the population, number of households, and employment for each zone in the model. The model also requires changes to the highway network in terms of committed projects that would appear in the No-Build Alternative and the physical characteristics of each of the proposed alternative alignments. The following sections of this report describe the preparation of the required model inputs as well as the resultant model forecasts.

Socioeconomic Growth - **Table 4.1-2** lists the socioeconomic projections for the individual counties and the total region. These estimates are the approved MPO forecasts for the region and are incorporated directly into the trip generation component of the Corpus Christi Model. The projected growth rate for population and households is similar in both counties, with anticipated increases in population of less than two percent annually. Household growth is slightly higher at approximately two percent for each county. Employment within each county is projected to increase at more than two percent annually, although San Patricio County is expecting a higher growth rate in retail and service employment, whereas basic employment in Nueces County is anticipated to have the highest annual growth rate. It should be noted that employment growth forecasts tend to be generalized estimates and therefore may not fully reflect major, site-specific employment growth, such as the La Quinta Project, which is directly adjacent to the proposed Harbor Crossing alignments.

For the region as a whole, population growth between the years 1996 to 2025 is projected to compound at an annual rate of 1.24 percent. In contrast, the number of households and total employment was growing at a more rapid rate of 2.09 and 2.13 percent, respectively. Given that the proposed alternatives for the Harbor Bridge involve replacing the existing bridge with a new structure of significant length and vertical clearance, the proposed life cycle for the new facility extends well beyond the typical 20-year design life anticipated for most roadways. Since model-based projections beyond the year 2025 are not available, a growth rate of 2 percent annually was adopted to extrapolate the forecasts beyond the year 2025.

TABLE 4.1-2
SOCIOECONOMIC GROWTH PROJECTIONS

Socioeconomic	1996	2025	Growth Rate (%/Year)
San Patricio County			
Population	65,418	95,302	1.31%
Household	22,589	38,517	1.86%
Total Employment	8,603	15,835	2.13%
Basic Employment	2,469	3,433	1.14%
Retail Employment	1,936	3,997	2.53%
Service Employment	4,198	8,405	2.42%
Nueces County			
Population	315,404	448,373	1.22%
Household	115,309	212,991	2.14%
Total Employment	98,104	180,634	2.13%
Basic Employment	31,843	57,286	2.05%
Retail Employment	21,995	41,671	2.23%
Service Employment	44,266	81,677	2.13%
Total			
Population	380,822	543,675	1.24%
Household	137,898	251,508	2.09%
Total Employment	106,707	196,469	2.13%
Basic Employment	34,312	60,719	1.99%
Retail Employment	23,931	45,668	2.25%
Service Employment	48,464	90,082	2.16%

<u>Future Year No-Build Traffic Estimates</u> - Table 4.1-3 lists the anticipated traffic and level of service (LOS) conditions for the existing Harbor Bridge. The estimated LOS values were derived using the 2000 Highway Capacity Manual (HCM) techniques to approximate conditions for limited access facilities. The LOS techniques provided by the 2000 HCM assume that uninterrupted flow conditions exist, and therefore do not fully account for the substandard alignment and horizontal curvature on the approaches to the Harbor Bridge, particularly the southern approach in Corpus Christi.

TABLE 4.1-3
ESTIMATED TRAFFIC AND LEVEL OF SERVICE BY YEAR

Year	Estimated Conditions	
	Traffic Volume	Level of Service
2001	56,600	C
2025	78,300	D
2035	93,300	D
2045	111,700	E

The year 2025 estimated traffic volumes listed in the table were provided by the Corpus Christi Model. Traffic at 10-year intervals was estimated beyond 2025 using extrapolation techniques with the 2.0 percent assumed growth rate discussed previously. Traffic volumes in year 2025, at 78,300 vehicles, are operating at LOS D conditions. By the year 2035, the existing six-lane bridge would be operating near the upper limit of LOS D. The additional growth beyond 2035 causes LOS E conditions, indicating failure or near failure by the year 2040. In the year 2045, traffic has increased to approximately 111,700 vehicles daily with LOS E conditions. This analysis suggests that the existing six-lane cross section would be inadequate to accommodate the future demand anticipated over the life cycle of the replacement bridge.

4.1.1.3 Alternative Harbor Crossing Alignments

Four alternative alignments were developed for evaluation in this project. All of the alternatives are designed as limited access facilities with alignments that meet the requirements of a 70-mile-per-hour (mph) design speed. These alternatives include a common southern terminus at a reconstructed interchange of I-37 and SH 286. The northern terminus of each alternative rejoins the existing alignment of U.S. 181 in the vicinity of the existing interchange at Burleson Street. The following is a brief description of each alternative:

- **Red Alternative –** This alignment provides the most direct connection from the I-37/SH 286 interchange to the existing alignment north of the crossing. This alignment traverses directly through the Port facilities south of the crossing point.

- **Orange Alternative –** This alignment is similar to the red alternative with a slightly longer distance. The alignment minimizes the impacts to the underlying Port facilities via a more easterly alignment.

- **Blue Alternative –** This alignment alternative has an easterly alignment that extends into the Corpus Christi Bay to avoid impacts to the Port facilities. This alignment has the longest distance among the four alternatives.

- **Green Alternative –** This alignment follows the existing alignment of U.S. 181 and the harbor crossing.

Detailed graphics depicting the alignments of the Harbor Bridge alternatives were provided previously as Figures 3.1-1 through 3.1-4 in **Section 3.2** of this report. Tule Lake Lift Bridge alternatives are shown in Figures 3.2-1 through 3.2-4.

Estimated traffic for the Tule Lake Lift Bridge was also projected for year 2025 under a series of scenarios. The first scenario reflected a "no-build" condition, with the existing bridge and surrounding network unchanged. Traffic volumes for the Tule Lake Lift Bridge were estimated at approximately 3,000 vehicles, nearly twice the existing volume. While rate of growth was significant, volumes at these levels can be accommodated with the existing two-lane cross section. Based on these volumes, the existing capacity of the two-lane section appears to be adequate to support additional traffic growth beyond the year 2025 as well.

Additional scenarios featuring improvements to the surrounding arterial system were also evaluated. Both of these scenarios included a group of projects known as the Joe Fulton International Trade Corridor, which would improve Navigation Boulevard and extend this facility westward to Carbon Plant Road. The objective of this project is to improve access to the industrialized area north of the Tule Lake Channel and to enable a portion of traffic to avoid delays associated with the operation of the lift bridge. The extended roadway, coupled with Carbon Plant Road, provides an alternative access point to I-37 and facilitates the movement of trips with origins and destinations in areas west of the Tule Lake Lift Bridge.

The first travel model scenario included the Joe Fulton International Trade Corridor improvements and retained the existing lift bridge. Under this condition, the traffic on the Lift Bridge was reduced by approximately 600 vehicles, with a corresponding increase of approximately 400 vehicles on Carbon Plant Road, just north of I-37. The second travel model scenario assumed that the Lift Bridge was removed, thereby limiting access to the industrialized area to either the Carbon Plant Road to the west or U.S. 181/Harbor Bridge crossing to the east. With this scenario, traffic on Carbon Plant Road increased by approximately 800, with the remaining traffic diverted to U.S. 181.

4.1.1.4 Future Year Alternative Traffic Estimates

Table 4.1-4 provides a summary of the estimated traffic for each of the Harbor Bridge alternatives, as well as for the Tule Lake Lift Bridge. Traffic estimates for the roadway segments included in the screenline described previously are also included. In addition, the table includes the estimated no-build alternative traffic volumes to facilitate comparisons between the alternatives and the no-build condition. As anticipated, the traffic volumes for each of the alternatives are similar, with all alternatives indicating a slight increase over the No-Build condition. This minor increase in total traffic is due to the slight reduction in travel time resulting from the improved design characteristics, in terms of speed and grade, incorporated into each of the alternative alignments.

TABLE 4.1-4
ESTIMATED TRAFFIC BY ALTERNATIVE

Location Description	2025 No-Build	Red	Orange	Blue	Green
US 181 at Harbor Bridge	78,300	80,750	80,370	79,710	79,970
Tule Lake Lift Bridge	3,020	2,960	2,980	3,160	3,030
I-37/US 77	51,680	51,290	51,350	52,500	51,480
FM 666 North of FM 3088	5,860	5,860	5,860	5,870	5,860
SH 361 in the vicinity of Port Aransas	9,440	9,460	9,460	9,500	9,450
TOTAL	**148,300**	**150,320**	**150,020**	**150,740**	**149,790**

For the Harbor Bridge, the red alternative has a slightly higher value than the other alternatives, which reflects the more direct alignment provided by this alternative. In contrast, the blue alternative, which extends into the Corpus Christi Bay, has a slightly lower volume as a result of the elongated alignment. The traffic estimates for the Tule Lake Lift Bridge exhibit only minimal variation in response to various Harbor Bridge alternatives. This level of variation indicates that most traffic on the Lift Bridge is locally oriented and therefore is insensitive to minor alignment variations in each of the Harbor Bridge alternatives.

4.1.1.5 Recommended Bridge Cross-Sections

The analysis from **Section 4.1.1.2** summarized the level of service for the Harbor Bridge crossing for various horizon years. By the year 2035, the existing six-lane bridge is operating at LOS D with the additional growth beyond 2035 resulting in an unacceptable LOS E condition with the current six-lane cross-section. Given the anticipated life cycle of the proposed bridge, it is recommended that the cross-section of the structure be capable of supporting the anticipated traffic for 2035 and beyond with an acceptable LOS. It is therefore recommended the new bridge be designed with an eight-lane cross-section. **Figure 4.1-2** displays the proposed cross-section for the replacement structure. Although not shown on the proposed cross section, there has been some support to add a pedestrian/bike lane on the structure. As the project development process for Harbor Bridge develops, consideration should be given to adding a pedestrian/bike lane to the Harbor Bridge cross section.

In the case of the Tule Lake Lift Bridge, the existing and projected traffic volumes are easily accommodated with the existing two-lane cross-section. It is recommended that this cross-section be retained in the design of the replacement structure. The proposed cross sections for the new bridge with and without rail are displayed on **Figures 4.1-3 and 4.1-4**.

FIGURE 4.1-2
HARBOR BRIDGE CROSS SECTION

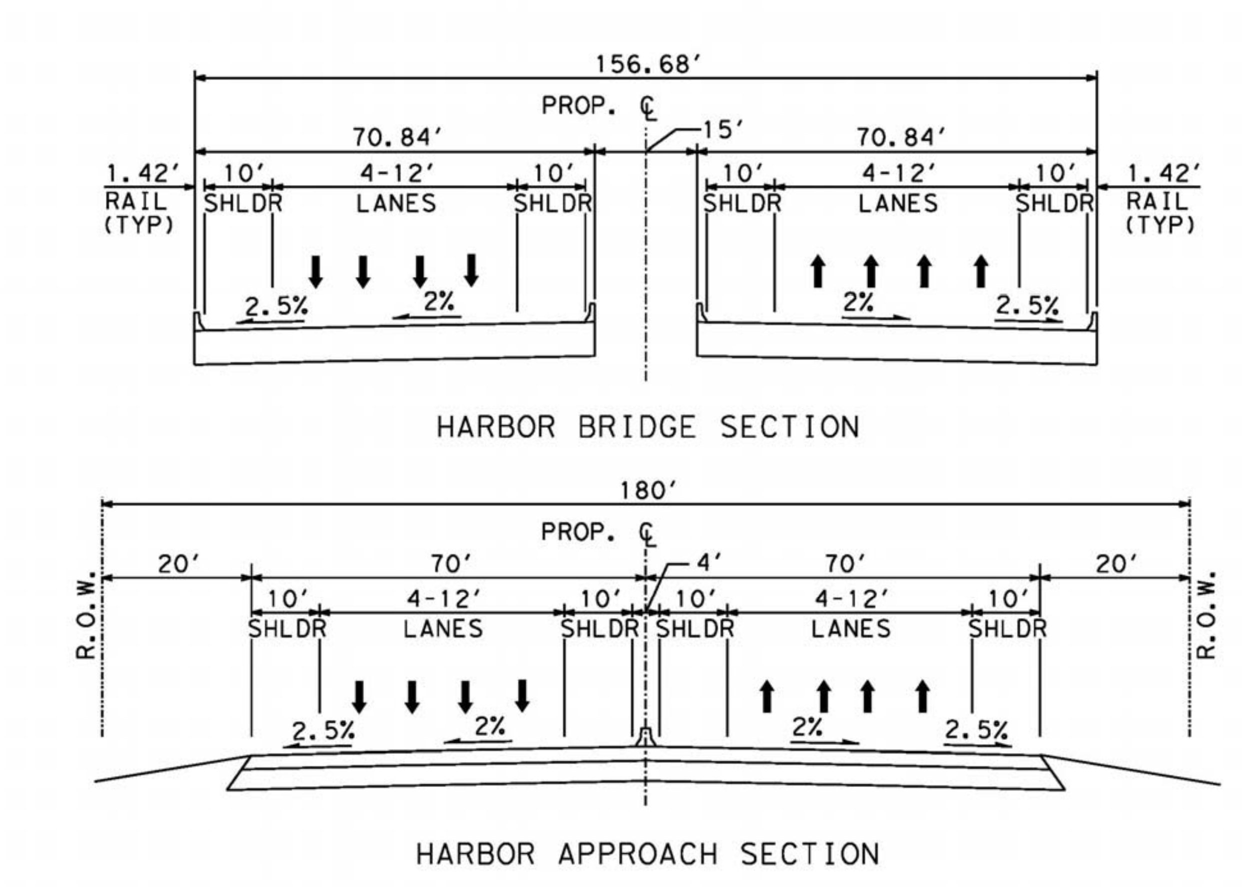
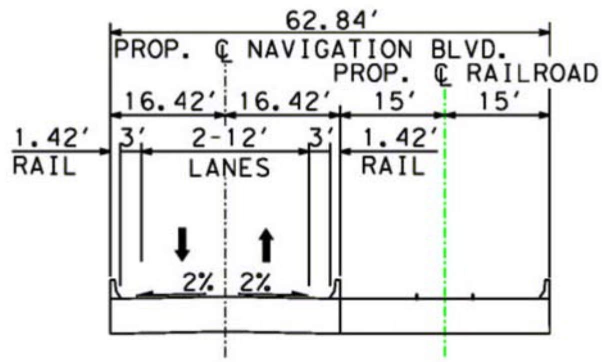
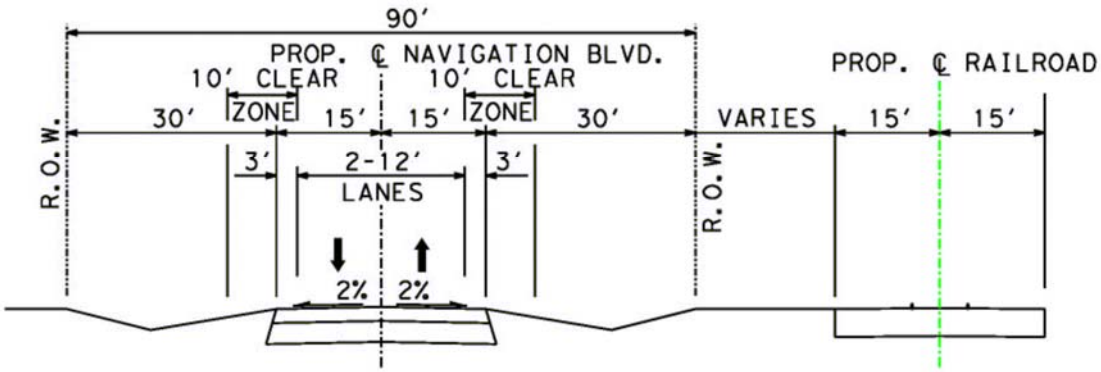


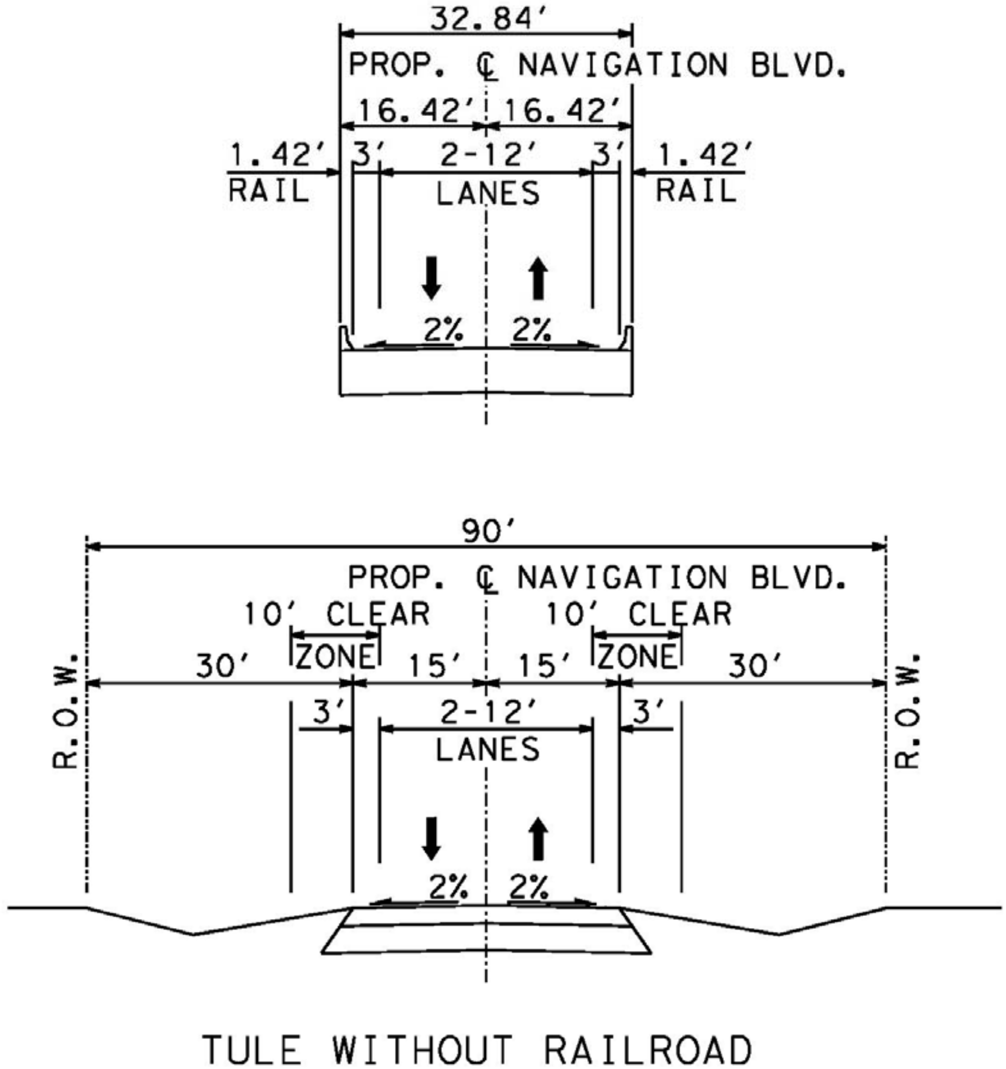
FIGURE 4.1-3
TULE LAKE LIFT BRIDGE WITH RAIL TYPICAL CROSS SECTION





TULE WITH RAILROAD

FIGURE 4.1-4
TULE LAKE LIFT BRIDGE WITHOUT RAIL TYPICAL CROSS SECTION



4.2 BRIDGE ALTERNATIVES

4.2.1 NAVIGATIONAL REQUIREMENTS

Establishing appropriate navigational clearances for a new Harbor Bridge and Tule Lake Lift Bridge is influenced by several factors. The most important of these factors are: 1) trends in merchant vessel size increases over time, 2) navigational constraints at competing ports that may influence future vessel design, and 3) the Port's plans to accommodate the future fleet.

As mentioned in Chapter 2, the alternative of constructing a tunnel instead of a high level bridge was eliminated from further consideration. Both the project team and the Citizens' Advisory Committee eliminated the tunnel alternative. There were several reasons for eliminating a tunnel alternative. When compared to a bridge alternative, the tunnel alternative has significantly higher construction and maintenance costs and requires certain vehicles, such as those transporting hazardous material, to find alternate routes. The most compelling reason for eliminating the tunnel alternative from further consideration was because the tunnel alternative has a higher total cost without commensurate increase in traffic benefit.

Naturally, the desire is to provide navigational clearances that will not hinder waterborne commerce, present or future. This desire is complicated by the fact that merchant ship navigation requirements cannot be predicted beyond a decade, as not much is known about new ship designs and orders that may occur beyond that time. Meanwhile, bridges are expected to serve for 50 to 75 years. Harbor Bridge is an appropriate real-world illustration of this complication. When it was permitted (1954) and opened to traffic (1959), the bridge provided adequate clearance for the types of vessels that entered the Channel. It was also more-or-less average height among the bridges built over major ship channels during that era. However, nearly 50 years later, it is inarguably restrictive for the larger vessels of today.

The approach used in this study evaluated the three factors noted previously to establish an appropriate bridge clearance. This clearance is based on available information from the present and the predictable short-term future, and on a rational evaluation of additional clearance height that would take into account long-term trends and developments.

4.2.1.1 Existing Conditions at the Port of Corpus Christi

Currently, two bridges cross the Channel. The Harbor Bridge at the mouth of the Channel provides 138 feet of vertical clearance over a 300-foot-wide channel, known as Industrial Canal, with a high-level fixed span bridge. The Tule Lake Lift Bridge, located approximately 3.75 miles west of the Harbor Bridge, provides 138 feet of vertical clearance in the full, opened lift position over a 200-foot-wide channel known as Tule Lake Channel.

The Channel originates in the open waters of the Gulf of Mexico at the minus 47-foot contour line. At that point, the channel is dredged to a depth of 47 feet and a width of 700 feet. Approximately 0.5 miles east of the pass between Mustang Island and San Jose Island, the channel narrows to 600 feet. Once the channel enters Redfish Bay, the depth decreases to 45 feet and narrows to 500 feet to a point immediately west of the La Quinta Junction, where it narrows again to 400 feet. At the Harbor Bridge crossing, the channel remains at 45 feet in depth and 400 feet in width until just west of the Chemical Turning Basin, where it narrows to 300 feet. The channel remains at 45 feet deep and 300 feet wide through the Tule Lake Lift Bridge and west to its terminus at the Viola Turning Basin. A channel deepening improvement project is currently in development.

Table 4.2-1 summarizes the types of vessels (ships), number of vessels per type, and frequency of vessels per type that called on the Port's Inner Harbor District facilities during the 2001 calendar year.

TABLE 4.2-1
VESSEL TYPES (SHIPS) CALLING ON THE PORT OF CORPUS CHRISTI
INNER HARBOR DISTRICT, 2001

Vessel Type	Number of Vessels per Type[1]	Percentage by Type	Frequency of Vessels per Type	Percentage by Type
Bulk Carrier	44	11.1%	118	11.1%
Bulk/Container Carrier	7	1.8%	19	1.8%
General Dry Cargo Ship	4	1.0%	6	<1.0%
General Dry Cargo/Container Ship	9	2.3%	17	1.6%
General Dry Cargo/Container Ship with Refrigerated Capacity	1	<1.0%	2	<1.0%
General Dry Cargo/Container Ship with Roll-on/Roll-off Capacity	1	<1.0%	2	<1.0%
General Dry Cargo/High Lift Vessel	1	<1.0%	2	<1.0%
General Dry Cargo/Pallets Carrier	1	<1.0%	2	<1.0%
Chemical Carrier	12	3.0%	31	2.9%
Liquefied Gas Carrier	5	1.3%	7	<1.0%
Liquefied Gas Carrier/Chemical Carrier	1	<1.0%	2	<1.0%
Ore/Bulk/Oil	45	11.4%	98	9.2%
Ore/Oil	1	<1.0%	2	<1.0%
Cargo Vessel with Refrigerated Capacity	4	1.0%	5	<1.0%
Semi-Submersible Deck Cargo with Roll-on/Roll-off Capacity	2	<1.0%	3	<1.0%
Bitumen Carrier	1	<1.0%	2	<1.0%
Oil and Oil Products Tanker	211	53.4%	652	61.3%
Oil and Oil Products/Chemical Tanker	40	10.1%	87	8.2%
Oil and Oil Products/Chemical/Molasses Tanker	4	1.0%	5	<1.0%
Vehicle Carrier (other than Roll-on/Roll-off)	1	<1.0%	2	<1.0%
TOTAL	395	[2]	1064	[2]

Sources: Port of Corpus Christi Authority (PCCA) Vessel Activity Log 2001.
Jane's Book of Merchant Ships 1999-2000.

[1] Based on individual vessels (ships) as appearing on PCCA Vessel Activity Log 2001.

[2] Does not equal 100% due to rounding.

Table 4.2-2 summarizes the vessel (ship) movements under the Tule Lake Lift Bridge during 2001. Telephone interviews with Ray Harrison, Port Vessel Traffic Control Chief, indicate that almost every vessel movement past the Tule Lake Lift Bridge requires an opening cycle.

Mr. Harrison stated that the Tule Lake Lift Bridge was capable of variable opening heights at the discretion of the bridge tender. Additionally, telephone interviews with John Sulbar, Corpus Christi Terminal Railroad (CCTR), revealed that an average of 2 to 6 trains cross the Tule Lake Lift Bridge daily, which equated to approximately 78,000 rail cars in 2001.

Barge traffic under the Tule Lake Lift Bridge is not reflected in Table 4.2-2. In 2001, 5,692 barges called the Inner Harbor and a conservative estimate would be that 50 percent or 2,846 passed under the Tule Lake Lift Bridge.

TABLE 4.2-2
ANNUAL, MONTHLY, AND DAILY VESSEL (SHIP) MOVEMENTS AT TULE LAKE LIFT BRIDGE 2001*

Variable	Inbound[4]	Outbound[4]
Total Movements (976)	485	491
Average Month [1]	40	41
Average Week [2]	9	9
Average Day [3]	1	1
Peak Month	46	49
Low Month	36	34
Peak Week	15	14
Low Week	6	4
Peak Day	5	5
Low Day	0	0

Source: PCCA Vessel Activity Logs 2001.
[1] Total movements divided by 12.
[2] Total movements divided by 52.
[3] Total movements divided by 365.
[4] Rounded.
* Does not include barge, tug, or tow movements.

4.2.1.2 Characteristics of Vessels

The following sections describe the characteristics and present, near-term, and long-term trends of vessels likely to visit the Port of Corpus Christi as well as those vessels in markets targeted by the Port.

Characteristics of the Merchant Fleet - The world's overall merchant shipping fleet comprises a number of specialized fleets of vessel types designed to carry specific cargoes (e.g., containers, bulk cargo, roll-on/roll-off [Ro-Ro], passenger cruise ships). Each of these individual specialized fleets in turn comprises vessels of varying sizes (and, therefore, differing air draft requirements). One observation is clear, however; the historical trend has been toward larger vessels in all categories. This trend is especially marked in cruise ships and container ships. The very largest of the present bulk carriers will probably not be surpassed in size by future vessels.

This evaluation of the characteristics of the merchant fleet included a survey of empirical data relative to the existing and planned (on-order) fleet, with particular emphasis on those vessels serving the Gulf of Mexico and south Atlantic Ocean range. In addition, the evaluation includes speculation about long-term trends in merchant vessel size and the issues influencing those trends, particularly at the Port of Corpus Christi.

Present and Near-Term Characteristics of Merchant Vessels - A survey was conducted among owner/operators of merchant vessels in the Gulf of Mexico and South Atlantic Ocean range. Once the geographic scope of the inventory was set, a data search was conducted using industry literature, the Internet, and telephone interviews. A literature review was performed of Jane's Book of Merchant Ships 1999-2000, Lloyd's List, Port of Corpus Christi Port Activity Logs for 1999, 2000, and 2001, and the SH 87 Bolivar Bridge Feasibility Study Fleet Inventory. Data were collected on over 40 cargo lines (including bulk, petroleum, chemical, and Ro-Ro), 20 cruise lines, and 7 port authorities. Data were also collected on present ship building activity and planned orders at 31 international shipyards.

A survey questionnaire was developed (see **Appendix B**) for cargo and cruise line owners that inquired about basic information related to general ship dimensions such as draft, beam, air draft, and cargo or passenger capacity. Questions in the survey related to the existing size and total number of vessels and largest vessels (beam and air draft) in the fleets. **Table 4.2-3** provides a summary of the largest vessels reported in the fleet, based on information from the activities detailed above from the most active providers of cargo and cruise movements.

Over 70 questionnaires were distributed as of the week of August 5, 2002. A total of 16 responses were received. Additionally, seven responses were received via e-mail and telephone conversations. Therefore, to date approximately 30 percent of the questionnaires have been completed. As noted in **Table 4.2-3**, many owner/operators are reluctant to make to fleet projections beyond 5 to 7 years; therefore, much of the information gained from the survey is based on vessels currently ordered or currently under construction.

TABLE 4.2-3
CARGO AND CRUISE OWNER/OPERATORS
LARGEST VESSELS AS OF 2002
GULF OF MEXICO AND SOUTH ATLANTIC OCEAN RANGE

Owner/ Operator Name	Type	Total Number in Fleet[1]	Max Size Vessel and Draft	As of 2002		Projected Maximums		
				Max. Air Draft (ft)	Max. Beam (ft)	Max. Air Draft (ft)	Max. Beam (ft)	Projected Year of Service[3]
CARGO VESSELS								
Alstom	TK ULCC	1	554,000 dwt 93.8 ft	195.0	206.7	2	2	2
Americana	BC	1	56,000 dwt 47.3 ft	180.0	108.5	2	2	2
Daewoo	TK ULCC	1	442,000 dwt (sister ships) 80.4 ft	200.0	223.1	200.0	223.1	2004 (Hellespont Fairfax and Tara)
Delmas Vieliheux	BC	1	33,000 dwt 27.9 ft	114.8	98.4	2	2	2
Hyundai	TK VLCC	1	250,000 dwt 70.7 ft	163.5	195.0	2	2	2
Maersk Sea-Land	CT	1	104,750 dwt 47.5 ft	165.0	148.0	2	2	2

TABLE 4.2-3 (CONTINUED)
CARGO AND CRUISE OWNER/OPERATORS
LARGEST VESSELS AS OF 2002
GULF OF MEXICO AND SOUTH ATLANTIC OCEAN RANGE

Owner/ Operator Name	Type	Total Number in Fleet[1]	Max Size Vessel and Draft	As of 2002		Projected Maximums		
				Max. Air Draft (ft)	Max. Beam (ft)	Max. Air Draft (ft)	Max. Beam (ft)	Projected Year of Service[3]
CRUISE VESSELS								
Carnival Cruise Line	CR	15	2,904 passengers 47.5 ft	208.0	127.3	[2]	[2]	[2]
Celebrity Cruises	CR	4	1,950 passengers 26.0 ft	180.5	105.9	[2]	[2]	[2]
Cunard Cruise Line	CR	2	2,620 passengers 32.0 ft	171.0	105.0	204.0	148.0	2004 (Queen Mary 2)
Norwegian Cruise Line	CR	5	2,224 passengers 31.5 ft	170.6	108.0	[2]	[2]	[2]
Princess Cruises	CR	6	2,600 passengers 29.5 ft	177.0	153.0	[2]	[2]	[2]
Royal Caribbean Cruise Line	CR	8	3,114 passengers 29.0 ft	207.0	157.5	[2]	[2]	[2]
MILITARY VESSELS								
Nimitz Class Aircraft Carriers	MIL	8	97,000 dwt 44.0 ft	215.0[4]	133.0	215.0[4]	133.0	2006 (USS Ronald Reagan)
Ticonderoga Class Cruisers	MIL	27	10,000 dwt 18.2 ft	120.0	55.0	[2]	[2]	[2]

Sources: Harbor Bridge Fleet Inventory Questionnaire.
SH 87 Feasibility Study, URS Corporation.

1 Fleet sizes are difficult to determine due to vessel rotations and responses to market demands and needs; therefore, many providers were unable to provide a defined number.

2 No specific information available at this time.

3 Based on responses from mailed questionnaires, e-mailed requests, and telephone conversations.

4 Does not include communications tower on bridge tower that is hinged.

TK = Tanker (ULCC = Ultra Large Crude Carrier, VLCC = Very Large Crude Carrier); BC = Bulk Cargo; CT = Container; CR = Cruise; MIL = Military; dwt = dead weight tons (measure of a vessel's total cargo capacity).

The analysis of the data collected in the survey was focused on determining the vertical navigational clearances necessary to allow for the safe and efficient passage of the maximum number of vessels currently in service, planned, and those reasonably projected to be in service in the Gulf of Mexico and South Atlantic Ocean range. Based on telephone interviews and mailed surveys with cargo owner/operators, it is difficult to determine the size (number of vessels) of the fleet of cargo vessels in the Gulf of Mexico and South Atlantic Ocean range because of vessel movements and reactions to market demands and needs. Also, in many cases air draft was not provided due to load and ballast variables. Daewoo currently operates the vessel Ultra Large Crude Carrier (ULCC) with the greatest air draft and beam at 200.0 feet and 223.1 feet, respectively. However, this vessel drafts 80.4 feet and could not enter the Port when fully loaded. However, a partially loaded ULCC could enter the port.

The cargo industry is responding to market demands and needs by developing larger vessels. However, data collected from interviews with Hyundai and Samsung, the two most active owner/operators in 2001 in the Channel, indicate that they are not anticipating ordering any new vessels with more than a 130-foot air draft or 165-foot beam.

The current cruise fleet of approximately 560 vessels has an average air draft of 131.3 feet and an average beam of 71.2 feet. The tallest, or greatest air draft, vessel in the cruise ship fleet is operated by Star Clipper Cruises at 226.0 feet. This vessel is the Star Clipper and is a five-mast sailing cruise ship, which remains exclusively in the eastern Caribbean and is, therefore, not an issue in the Channel. Carnival Cruise Lines operates the next tallest cruise vessel, the Carnival Destiny, at 208.0 feet. The greatest current beam is 157.5 feet, found on the Royal Caribbean Cruise Lines' Voyager of the Seas.

For military vessels, the Navy's highest vessels are the aircraft carriers. For example, the *Nimitz* class carriers require 215 feet vertical clearance and are the largest warships in the world. Other U.S. Navy aircraft carriers include the *Enterprise*, the *John F. Kennedy*, and two *Kitty Hawk* class vessels. None of the Navy's carriers are presently deployed in the Gulf of Mexico. All U.S. homeports for carriers are on the Atlantic or Pacific Coasts.

The Navy vessels' air draft requirements drop significantly, with three cruisers of the *Ticonderoga* class at homeport Pascagoula, Mississippi, requiring 120 feet of vertical clearance. Other Navy vessels with homeports on the Gulf of Mexico, and vertical requirements under 120 feet, are *Avenger* class Mine Countermeasure Ships and *Osprey* class Coastal Mine Hunters, approximately 20 of which are based at Ingleside, Texas, in Corpus Christi Bay.

The existing 138-foot Harbor Bridge has precluded the Port of Corpus Christi from securing contracts with various branches of the armed services for layberths and supply/troop deployments. Al Speight, the Port's Manager of Industrial Development, stated during a telephone interview that vertical clearance requirements for layberth contracts were 142 feet and 165 feet for the most recent deployment of troops and supplies for the war in Iraq. Mr. Speight added that if the Port of Corpus Christi had met these requirements, the Port would have secured the contracts.

Long-term Trends in Merchant Fleet Vessel Designs - The information gained from the survey of the merchant fleet provides important, but incomplete, data to be used in determining appropriate bridge clearances for the long-term future. Additional evaluation should be made of trends and needs beyond the five-to-seven year horizon covered by the survey. Long-term trends are discussed below, organized by merchant vessel type.

Long-term Trends in Cruise Ships - Among the vessels that require the highest air draft clearance per deadweight are the cruise ships. This trend is related to the industry's desire to carry more passengers (larger vessels, generally) and to provide more outside cabin views (higher profiles, specifically). In the highly competitive cruise ship market, such amenities are important.

Within the industry, it is anticipated that the cruise ship business will continue to grow into and beyond the foreseeable future. Evidence of this can be found in the details of the recently announced merger of Carnival Corporation and P&O Princess Cruises PLC. According to business news reports, Princess had fought off Carnival's approaches for almost a year, until a deal was struck that would allow Princess shareholders to retain an interest. Associated Press quotes the Princess chief executive as saying, "This is important to us given the growth potential of the cruise industry." Apparently it was important since the decision requires Princess to pay a $62.5-million penalty for breaking off an on-going merger with Royal Caribbean.

The tallest planned cruise vessels are becoming larger to satisfy the demand and needs of the cruise market, as discussed above. Many cruise lines are moving toward maximizing the number of cabins with outside views and private balconies. However, due to the dynamics of the global marketplace, no cruise line contacted stated that they operate with planning horizons beyond 10 to 12 years. Cunard Cruise Lines (Queen Mary 2) indicated in a telephone conversation that the cruise industry has an "unofficial" vertical limit of 215 feet based on the "safe" clearance of the Verrazano Narrows Bridge in New York Harbor.

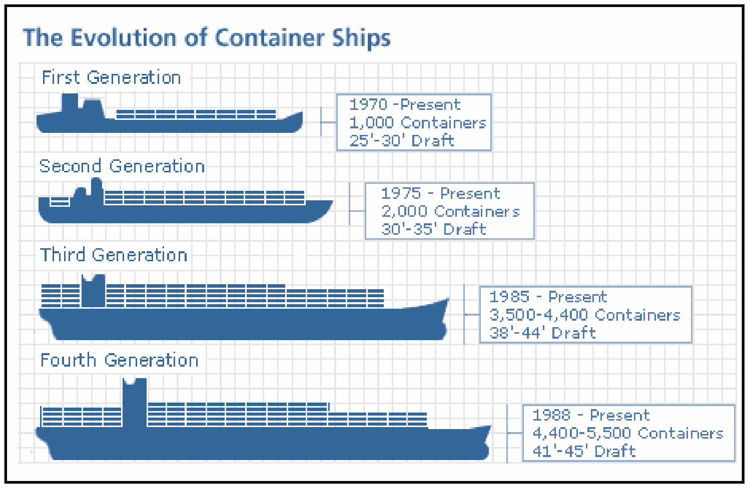
The tallest planned cruise vessels are 207.0 feet. One has been completed and two are currently under construction at the Kvaerner Masa-Yards Turku New Shipyards in Turku, Finland, for Royal Caribbean Cruise Lines as part of the new Voyager-class. The same Voyager-class will also have the greatest beam at 157.5 feet.

As indicated by the Port and noted in the June 2002 issue of *SeaTrade Cruise Review,* Carnival, Celebrity, Costa, Crystal, Cunard, Royal Caribbean, and Norwegian Cruise Lines have placed over $13 billion in new vessel orders. However, as stated previously, the cruise industry has a "self-imposed" limit to the overall vertical dimension of new vessels based on safe clearance requirements for New York Harbor..

With the brisk activity in new ship orders and the optimism about continued growth within the industry, it can be anticipated that the long-term future will include many new large cruise ship designs.

Long-term Trends in Container Ships - Within the past quarter century, general cargo has increasingly been transported in container ships. Ports have planned and built highly mechanized container terminals to accommodate the specialized handling requirements of containers. The results have been remarkable overall efficiencies, compared to past methods for shipping and handling general cargoes. As containerized freight has become the trend, the specialized merchant fleet to carry containers has rapidly evolved to larger and larger vessel capacities. An evaluation of this trend is presented in recent research by a coalition of ports and port users in the Pacific Northwest. The illustration below, taken from that work, depicts how the large container ships of today evolved rapidly through four generations.

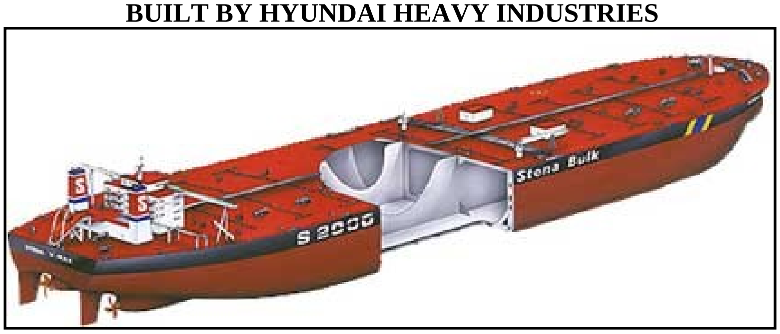
The evolution of container ship design is particularly applicable to this discussion of merchant ship vertical clearance requirements because container ships present relatively higher profiles than other cargo vessels of similar deadweight tonnage. Container ships typically carry boxes stacked on deck, with the control bridge superstructure built high enough to provide line-of-sight over the stacked boxes. However, as stated previously in this section, 215 feet of air draft is considered an industry standard for the upper range of vessel development based on the need and desire to serve specific markets, specifically New York Harbor.



Source: Columbia River Channel Coalition, October 2002

Long-Term Trends in Bulk Carriers - The vessels of the bulk cargo carrier fleet are further specialized for carrying different cargoes (e.g., dry bulk, petroleum, chemicals, ore). The most important bulk cargo to the Port of Corpus Christi is petroleum product. The present top end of that specialized fleet is represented by the ULCCs, which are generally defined as those over 320,000 dwt. The largest of these reaches over 550,000 dwt, of which four were built by Chantiers de l'Atlantique. It is not likely that additional ULCCs that large will be constructed in the future. The orders for the last of these mega-giants were made before the oil crisis of 1973 and the last one was delivered in 1979.

CONCORDIA MARITIME'S NEWEST VLCC, BUILT BY HYUNDAI HEAVY INDUSTRIES



Source: *Marinetalk* website

Today, and probably in the future, the largest super tankers being built are in the Very Large Crude Carrier (VLCC) range (200,000-320,000 dwt). Examples are recently launched VLCCs built by Hyundai Heavy Industries for Concordia Maritime, a Stena company. The design for these 315,000 dwt vessels uses an exceptionally wide beam (almost 230 feet), allowing a relatively shallow-draft hull form and providing 30 percent higher loading capacity per draft than conventional designs. The exceptionally wide beam requires dual rudders and dual engines, which the vessel's designer also touts as a safety feature.

Long-Term Trends in Military Vessels – An evaluation of the long-term future for Navy vessels (and Corpus Christi's ability to attract those vessels) is particularly difficult because of the nature of military strategizing. Ongoing Navy strategy does not depend on particularly large Navy vessels in homeports on the Gulf of Mexico. If this trend continues, clearance requirements for Navy vessels at Corpus Christi will not be a determining factor in establishing the top of the bridge clearance height envelope.

4.2.1.3 Merchant Vessels Likely to Call the Future Port of Corpus Christi

The discussion above has summarized what is known and what can be speculated about the future fleet of merchant vessels that may operate in the Gulf of Mexico and the South Atlantic Ocean range. For this Feasibility Study, the additional questions to answer are, "What vessel types will the Port of Corpus Christi likely attract?" and "What bridge vertical clearance will allow them to pass?"

A number of considerations influence the answer to this question. They include plans for improvements and developments at the port, the port-selection decision process by vessel owners/operators, and conditions and constraints at competing ports. Each of these considerations is discussed below.

Future Plans at the Port of Corpus Christi - At the Port of Corpus Christi, as at most commercial harbors, port managers and developers have plans and programs that could change the characteristics of merchant shipping navigation needs in the harbor. For this reason, it is important to evaluate present-day and long-term Port conditions.

The Port has indicated to TxDOT that any new bridges should allow for the safe and efficient passage of all vessels currently calling on the Port as well as those reasonably assumed calling on the Port in the year 2050 and beyond. This includes the Port's intention to continue to market bulk and liquid cargo shipping interests and cruise lines to the newly completed terminal just west of the Harbor Bridge. To accommodate these future plans, the Port has requested the evaluation of a 400-foot horizontal clearance.

Discussions with the Port identified cargo ships in the Channel as bulk, liquid, and chemical vessels. Cruise vessels, however infrequent in the Port, are actively being marketed for the newly constructed cruise terminal immediately west of the Harbor Bridge and the smaller vessels in the world's fleet are being targeted.

During the 1990s, the Port constructed a multi-purpose cargo dock at a cost of more than $20 million. This facility is "specifically designed to handle containers," according to a Port source. It is designed for 55 feet of water, is installed with container crane rails, and can accommodate an uncommonly high deck load of 1,500 pounds per square foot (psf). According to the Port source, container line companies have indicated an interest in locating an operation at the Port, but the existing bridge vertical clearance is a hindrance.

The Port is aggressively undertaking a diversification program to create jobs and stimulate the regional economy. This diversification program has targeted various new market areas not currently calling on the Port due to the existing vertical restriction at the Harbor Bridge. Many of the targeted markets may be located west of the existing Tule Lake Lift Bridge, for example layberths for naval ships, shipbuilding yards, ship repair (naval and commercial), coal import/export terminals, large oil tanker docks (250,000+ dwt), container yards, and offshore module fabrication and construction. Other markets that are focusing on the area east of the Tule

Lake Lift Bridge include cruise ships, an automobile import terminal, and chilled fruit warehouses.

Targeted development west of the Tule Lake Lift Bridge is a function of two significant infrastructure improvement projects currently underway with the Port of Corpus Christi:

1. ***Joe Fulton International Trade Corridor* –** This $50 million intermodal project will open over 1,000 acres of land and 4 miles of Channel frontage for new port projects and targeted markets. Currently, more than one quarter of the Channel cannot be developed because it lacks road and rail access. This project will construct a new industrial roadway along the north side of the Channel to connect U.S. 181 and I-37, covering a total distance of over 11 miles. Seven miles of new railroad track connecting the north side of the channel to the Union Pacific main line west of the Channel will be constructed. This project is currently in final design, and construction is scheduled to begin in 2003 and be completed in 2007.

2. ***Channel Improvement Project* –** This is a $200 million channel improvement project that will provide much needed improvements to the current Channel. The main part of the project will include deepening the current channel from 45 to 52 feet. It will also include widening the channel across the bay from 400 to 530 feet. Other features will include a 1.5-mile extension to the La Quinta Channel and construction of barge shelves across Corpus Christi Bay. This project will maintain the Port of Corpus Christi's status as having the deepest water on the Gulf of Mexico and therefore provide for more heavily loaded ships to enter the port and increase safety for all commercial vessel traffic. The major benefit to deepening the channel to 52 feet will be the reduction of the average number of lightering trips (from five to three trips) required to unload a VLCC ship offshore. With the 52-foot channel project completed, the VLCC's will be able to lighter up to 52 feet and enter the Inner Harbor with a larger volume of oil. By reducing the number of lightering operations, the probability for accidents/spills is greatly reduced.

With a 52-foot channel depth, the Port will enjoy an advantage over all other Gulf of Mexico and southeastern U.S. ports. This advantage can be important, particularly in attracting and accommodating the unusually large bulk carrier vessels. With the 52-foot channel project complete, the VLCC's will be able to lighter up to 52 feet and come into the Port's Inner Harbor carrying a large load of oil. This will further necessitate the need for a higher bridge.

If port managers' and developers' plans are realized, the potential exists for Corpus Christi to serve vessel types and sizes that do not presently call on the port. Of course, a number of factors determine port-of-choice. Different port users have different criteria. Navy port selections are based on military strategy. Cruise ship port selections are based on proximity to cruise destinations (to a lesser extent, they are also based on the efficiency of travel from the market area to the port). Cargo port selections are influenced heavily by distance and intermodal service to/from the hinterland.

Other Factors Influencing Merchant Vessel Size - An important influence on the ultimate size of merchant vessels is the operating restrictions imposed by channel depths and clearances at many major ports. That is, vessel design typically avoids dimensions that would preclude the vessel from calling on major port facilities, particularly at ports that specialize in the cargo type for which the vessel is designed. These include air draft clearances, as well as channel depths.

At many locations, clearances under major bridges will remain the same for many years since the bridges at those ports are relatively recently built and can be expected to remain in place for some time. Examples in the Gulf of Mexico and South Atlantic can be found at Savannah, Charleston (under construction), Houston (planned), Jacksonville, and Tampa. **Table 4.2-4** provides a summary of existing and planned bridge vertical clearances at more than 20 major U.S. and world ports. As can be seen from the data, clearances above 205 feet are rare.

Channel depths also have an important limiting influence on merchant ship dimensions. The utility of a vessel is severely restricted if it is designed with an operating draft so deep that its port choices are limited. As with vertical clearances discussed above, the existing channel depths at many ports are likely to remain the same for many years to come. Channels depths at many ports are now at their cost-effective limit; others are now at their environmentally acceptable maximum depth. While the cost-effectiveness criteria may change in the future, the environmental criteria can only be expected to become more severe.

Table 4.2-5 presents a summary of channel depths and vertical clearance restrictions at a number of world-ranking ports. **Table 4.2-6** provides similar data for the major Gulf of Mexico and U.S. south Atlantic ports.

TABLE 4.2-4
COMPARISON OF VERTICAL CLEARANCES (AIR DRAFT)
FOR BRIDGES CROSSING ACTIVE SHIPPING CHANNELS

Location	Bridge Name	Crossing	Vertical Clearance	
			lw	Hw
Jacksonville, FL	Dame Point	St. Johns River	162	161
Savannah, GA	Talmadge	Savannah River	186	184
Charleston, SC	Grace Memorial	Cooper River	155	150
Charleston, SC	Under Construction	Cooper River	192	187
Sandy Point, MD	William P. Lane Memorial	Chesapeake Bay	188	187
Staten Island/ Brooklyn, NY	Verrazano Narrows	New York Harbor	232	229
Baltimore, MD	Outer Harbor Crossing	Patapsco River	--	185
New Orleans, LA	Judge William Seeber	Mississippi River	160	156
New Orleans, LA	Huey P. Long	Mississippi River	153	133
Galveston Bay, TX[1]	Bolivar Bridge	Houston Ship Channel	220[1]	216[1]
Tampa, FL	Sunshine Skyway	Tampa Bay	177	175
Los Angeles, CA	Vincent Thomas	Long Beach Harbor	190	185
Long Beach, CA	Heim	Long Beach Harbor	167	163
San Diego, CA	Coronado Bay	San Diego Bay	199	195
San Francisco/ Oakland, CA	Golden Gate	San Francisco	238	232
Tacoma, WA	Tacoma Narrows	Puget Sound – Narrows	170	159

TABLE 4.2-4 (CONTINUED)
COMPARISON OF VERTICAL CLEARANCES (AIR DRAFT)
FOR BRIDGES CROSSING ACTIVE SHIPPING CHANNELS

Location	Bridge Name	Crossing	Vertical Clearance	
			lw	Hw
Quebec, Canada	Quebec Road	St. Lawrence River	--	150
Sydney, Australia	Sydney Harbor	Sydney Harbor	--	172
Panama Canal Zone	Thatcher	Panama Canal	--	201
Honshu-Shikoku, Japan	Honshu	Akashi Straits	--	220
Zealand/ Funen, Denmark	Great Belt East Bridge	Great Belt	--	213
Hong Kong	Ting Kau	Rambler Channel	--	203

Sources: U.S. Coast Guard Bridge Data for U.S. and Foreign Waterway Crossings.
World Bridges of Denmark, November 1996.
Ting Kau – Hong Kong.

[1] Currently in preliminary design.

lw = low water hw = high water

TABLE 4.2-5
WORLD AND U.S. PORT RANKINGS[1]

Port	World Ranking	U.S. Ranking	Channel Depth		Existing Vertical Restriction	Cargo Volume Total (Short Tons)
			Existing	Planned		
Singapore	1	n/a	[2]	[2]	none	359,246,000
Rotterdam	2	n/a	72 ft	-	none	334,574,000
S. Louisiana	3	1	47 ft	-	135 lw/133 hw	214,342,000
Shanghai	4	n/a	38 ft	41 ft	none	206,132,000
Hong Kong	5	n/a	[2]	[2]	203 hw	196,112,000
Houston	8	2	40 ft	45 ft	178 lw/175 hw	191,419,265
New York/ New Jersey	11	3	40 ft	45 ft	232 lw/229 hw	138,669,879
New Orleans	25	4	45 ft	-	135 lw/133 hw	90,768,449
Corpus Christi	29	5	45 ft	52 ft	140 lw/138 hw	83,124,950

Source: U.S. Army Corps of Engineers, Navigation Data Center, www.iwr.usace.army.mil/ndc/wcsc
portfocus.com

[1] Only eastern seaboard and gulf coastal ports included.

[2] At Singapore and Hong Kong, cargoes are accommodated at various and separate facilities with differing depths.

TABLE 4.2-6
U.S. PORT RANKINGS
GULF OF MEXICO AND SOUTHEASTERN UNITED STATES

Port	World Ranking (1999)	U.S. Ranking (2000)	Channel Depth		Existing Vertical Restriction	Cargo Volume Total (Short Tons)
			Existing	Planned		
S. Louisiana	3	1	47 ft	-	135 lw/133 hw	214,342,000
Houston	8	2	40 ft	45 ft	178 lw/175 hw[1] 138 lw/135 hw[2] 138 lw/135 hw[3]*	191,419,265
New Orleans	25	4	45 ft	-	135 lw/133 hw	90,768,449
Corpus Christi	29	5	45 ft	52 ft	140 lw/138 hw	83,124,950
Baton Rouge	37	9	45 ft	-	135 lw/133 hw	65,631,084
Texas City	n/a	10	40 ft	45	none*	61,585,891
Plaquemines	38	11	45 ft	-	137 lw/135 hw	59,910,084
Lake Charles	n/a	13	40 ft	-	135 lw/133 hw	55,517,891
Mobile	n/a	14	40 ft [4]	-	none	54,156,967
Tampa	n/a	18	38 ft	41 ft	177 lw/175 hw	46,460,327
Pt. Everglades	n/a	31	44 ft	-	none	22,500,201
Charleston	n/a	34	45 ft [5]	45 ft [5]	155 lw/150 hw	21,081,838
Jacksonville	n/a	36	38 ft	41 ft	162 lw/161 hw	19,701,277
Savannah	n/a	37	42 ft	48 ft	186 lw/184 hw	19,670,923

Source: U.S. Army Corps of Engineers, Navigation Data Center, www.iwr.usace.army.mil/ndc/wcsc. portfocus.com

[1] Fred Hartman Bridge.

[2] Jeese Jones Memorial Bridge (aka Houston Ship Channel Bridge).

[3] Sherman Bridge.

[4] 45 feet waterward of the I-10 tunnels.

[5] Currently being deepened to 45 feet.

* Proposed Bolivar Bridge has a planned 220-ft vertical clearance.

While the Port of Corpus Christi hopes to grow its business in many areas, it may be difficult for the Port to attract the largest cruise ships from their Florida homeports in Miami, Fort Lauderdale, and Cape Canaveral. However, Corpus Christi plans to take advantage of the Port's proximity to “new, off-the-beaten path destinations in Mexico.” If long-term success is achieved in this endeavor, then larger and larger cruise ships can be expected at Corpus Christi, possibly with air draft requirements in the 200-foot range.

In the category of containerized freight, the port's capability to attract this type of business is unrestricted if the bridge vertical clearance issue is removed. The planned channel deepening to 52 feet should be a major advantage in this regard since it will allow the larger container ships to call the port.

As mentioned previously, petroleum bulk carriers represent by far the most significant vessel types at the Port of Corpus Christi and they can be expected to remain the same in the future. The channel deepening and removal of bridge clearance restrictions will allow ever-larger vessels to enter the port, whereas they presently require lightering operations.

4.2.1.4 Recommendation

The minimum vertical clearance for both the Harbor Bridge and Tule Lake Lift Bridge should be set at 200 feet. The following sections discuss the reasoning and potential implications of this recommendation to set the minimum vertical clearance at the Harbor Bridge at 200 feet with 400 feet of horizontal clearance.

Due to the engineering constraints related to the active rail crossing at the Tule Lake Lift Bridge, it is recommended that a swing bridge be considered to achieve unlimited vertical clearance. Providing a 200-foot operational vertical clearance with a new lift bridge (similar to the existing bridge) would require a world record span and height for a lift bridge. However, the final decision of which bridge is most appropriate and cost-effective will be dealt with in the next phase of this study. Considerations related to the selection of the most appropriate movable design are discussed in the next section.

4.2.2 HARBOR BRIDGE

4.2.2.1 Navigational Clearances

Port of Corpus Christi sources have indicated that the Harbor Bridge clearance height should accommodate at least 95 percent of all vessels carrying the types of cargoes that the port presently serves or plans to serve in the future. This includes an expanded cruise ship business, continuation of petroleum product as a major cargo, containerized freight, bulk ore, military layberths, and auto carriers, among others.

Given the data and information discussed above, it is likely that the vessels that require the highest vertical clearance at the Harbor Bridge site are the cruise ships. A bridge clearance height of 200 feet would accommodate approximately 98 percent of the present cruise ship fleet serving the U.S. If a bridge clearance of 200 feet is to be provided, the horizontal alignment may be adjusted to a location that would place the present cruise ship terminal seaward of the bridge. In that case, unlimited vertical clearance would be provided to the present cruise ship terminal. New cruise ship facilities could be developed in Channel for vessels not requiring more than the clearance provided at the Harbor Bridge.

Bulk carriers of a size that would require 200 feet vertical clearance (ULCCs and VLCCs) would be restricted by their deep draft, even given the planned harbor deepening to 52 feet. Therefore, it is not anticipated that these vessels would control the desirable bridge height. In the scenario in which the large bulk carrier would be lightered to a depth that it could enter the harbor, its air draft requirement would increase. Still, it is not anticipated that the largest bulk carrier that could be accommodated by the channel depth would require more than the 200-foot vertical clearance, even in the lightered condition.

Containerized freight carriers are another important vessel type in the determination of bridge clearance because of their relatively high profile per deadweight. However, it is not anticipated that a significant number of those vessels would ever require a clearance higher than 200 feet since that would preclude them from using well-developed containerized freight facilities at locations such as Savannah, Charleston, and Long Beach.

Military vessels likely to call at Channel facilities do not include the *Nimitz*-class aircraft carriers. Since the military vessels anticipated to call do not have high air draft requirements, it is not anticipated that military ships will figure in setting the appropriate bridge clearance height.

With 200 feet recommended as the proposed vertical clearance, it can be anticipated that the new Harbor Bridge will not impede any of the Port's plans for future growth in targeted markets.

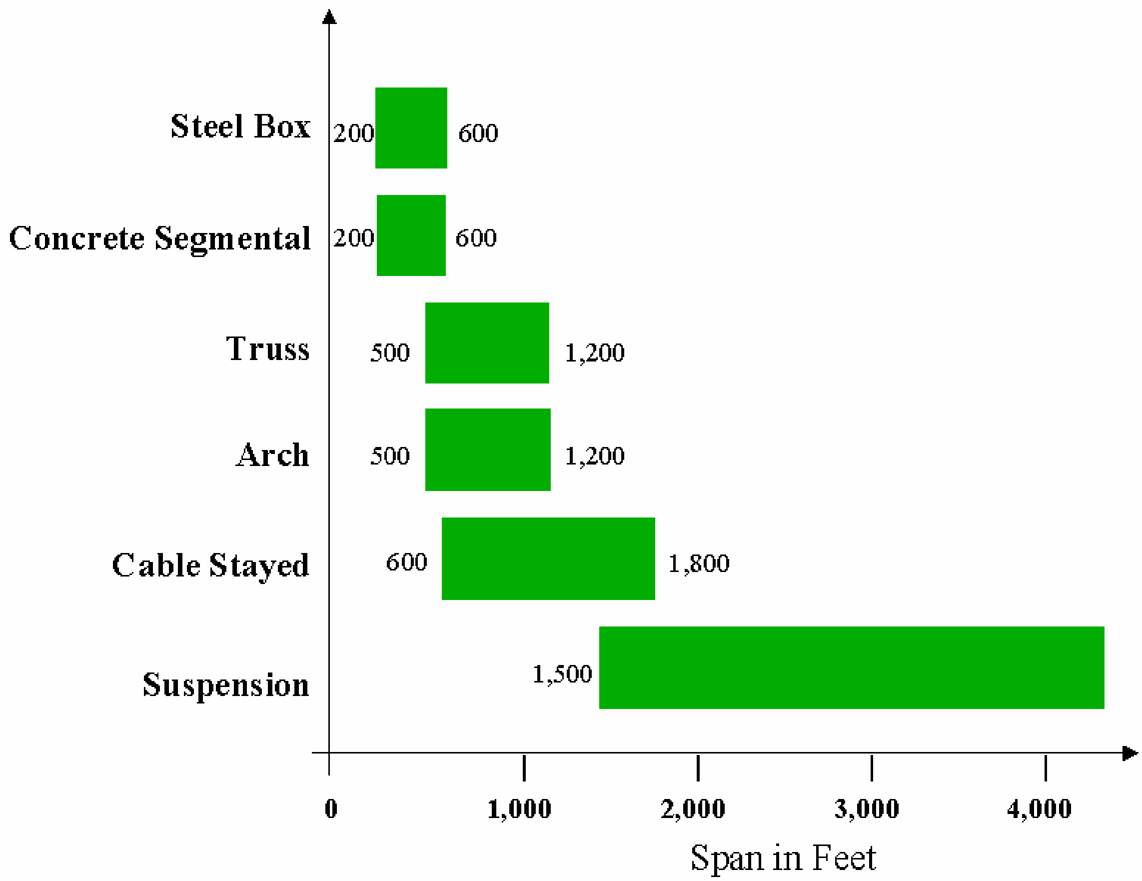
4.2.2.2 Total Costs

Structure Alternatives - Although the selection of recommended structure types for the Harbor Bridge study is beyond the scope of this feasibility report, assumptions must be made as to span arrangements and structure types to allow for comparative costing of the various route alternatives.

The structure for each of the corridors can be divided into four general regions: low-level approach, mid-level approach, high-level approach, and main span unit. It is assumed that the bridge begins and ends when the profile grade line is 20.0 feet above the existing ground line. For the purposes of this study, the low-level approach structure is defined as that portion of the crossing with a profile grade elevation between 20.0 feet and 50.0 feet above existing ground line. The mid-level approach is defined as that portion of the structure with a profile grade elevation between 50.0 feet and 120.0 feet above existing ground line. The high-level approach region is defined to include the remaining portion of the approaches that are bounded by the mid-level approaches and the main span unit. Finally, the main span unit is centered about the shipping channel, providing the necessary horizontal and vertical clearances.

In general, as the profile grade elevation increases, the optimum span length would also increase. As a result, the low-level approaches may consist of short span structures in the range of 100 to 150 feet, while the high-level approaches would require intermediate to long span structures with spans in the range of 150 to 300 feet. The main span unit would have the longest span and varies between the different route alternates from a minimum of 600 feet for the green and orange alternatives, 1200 feet for the blue alternative and 1300 feet for the red alternative. **Figure 4.3-1** depicts the range of different bridge types as a function of span length. This graphic was developed by the Federal Highway Administration (FHWA).

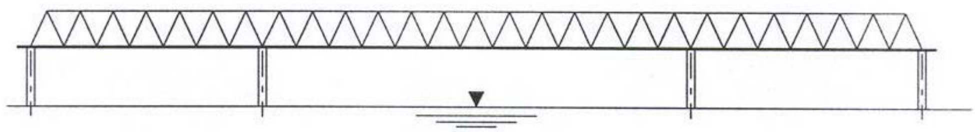
FIGURE 4.3-1
APPLICATION OF BRIDGE TYPE BY SPAN RANGE



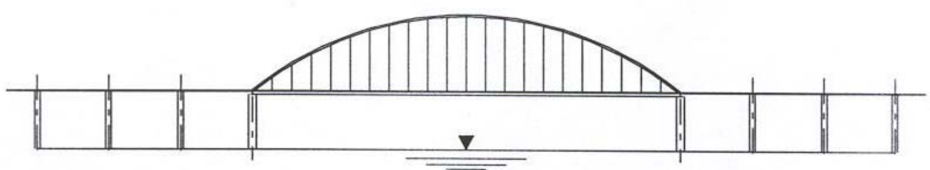
Reference: Walter Podolny, Jr., Cable-Stay Bridges State-of-the-Art in the United States, from the conference proceedings – A Seminar Series on Cable-Stayed Bridges, October 17-18, 1994, Miami, Florida

As can be seen in **Figure 4.3-1**, there is typically more than one type of structure possible for a given span length. A more detailed discussion of appropriate bridge types together with estimated unit prices follows.

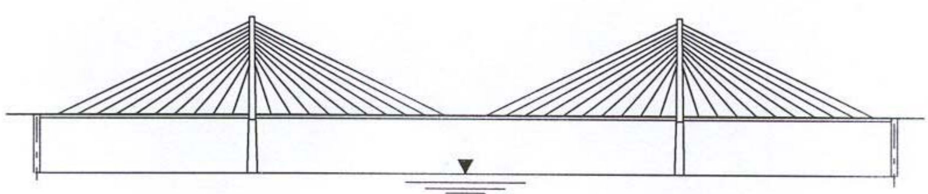
FIGURE 4.3-2
BRIDGE TYPES



TRUSS BRIDGE



TIED-ARCH BRIDGE



CABLE STAYED BRIDGE

<u>Main Span Unit</u> - The orange and green alternatives cross the Channel at a slight skew angle where the navigational channel width is at the narrowest, 300 feet. The main span length for both of these alignments was set at 600 feet in an effort to place the piers on land to avoid vessel impact protection costs. As can be seen in **Figure 4.3-1**, with a span main span length of 600 feet, there are several feasible bridge types, including: steel truss, tied arch, and cable-stayed structures. Illustrations of these bridge types are shown in **Figure 4.3-2**. The steel box and concrete segmental girder type bridges would not be considered feasible due to the significant structural depth required below the profile grade line and the impact this would have on the vertical clearance requirements.

The red alternative crosses the Channel farther inland over the Corpus Christi Turning Basin. The width of the turning basin is 800 feet and the red alternative crosses at a significant skew angle to the channel. The main span length for the red alternative was set at 1,300 feet, which places the piers and associated vessel impact protection systems outside the channel, but not completely on land. To place the main piers completely on land, the main span length would need to be increased to approximately 1,600 feet, which creates a more expensive structure than the 1,300-foot main span including the vessel impact protection system. Again, as can be seen in **Figure 4.3-1**, with a main span length of 1,300 feet, there are several feasible bridge types including: steel truss, tied arch, and cable-stayed structures. Illustrations of these bridge types are shown in **Figure 4.3-2**. The 1,300-foot main span length would require vessel impact protection systems around both main piers adjacent to the channel.

The blue alternative crosses the Channel in a perpendicular direction out in the relatively open water of the Corpus Christi Bay where the maintained channel width is currently 400 feet. There are plans to widen the Channel to 530 feet in the future at the location of the blue alignment. The main span length of the blue alternative was set at 1,200 feet to provide sufficient clearance out in the open water of the bay for the 530-foot shipping channel, waterline footings, plus vessel impact protection systems. Again, as can be seen in **Figure 4.1-1**, with a main span length of 1,200 feet, there are several feasible bridge types including: steel truss, tied arch, and cable-stayed structures. Illustrations of these bridge types are shown in **Figure 4.1-1**. The 1,200-foot main span length would require vessel impact protection systems around both the main piers adjacent to the channel, and several of the approach span piers on both sides of the main span unit.

For the purposes of developing comparative cost estimates, a cable-stayed alternative is assumed. This bridge type was chosen because there are a number of recent cable-stayed structures in the United States from which historical unit pricing can be derived. **Table 4.3-2** includes the cost, span, and geographic location of several North American long span bridge projects, most of which are cable-stayed.

The square-foot unit price of these projects is adjusted for inflation by using the *Engineering News Record* construction cost index and adjusted geographically by the 1999 Means Heavy Construction Cost Data location index. A plot of the adjusted unit prices as a function of span length is shown in **Figure 4.3-3**. For 600-foot, 1,200-foot, and 1,300-foot main span lengths a unit cost of approximately $190, $260, and $270 per square foot is estimated, respectively.

TABLE 4.3-1
HISTORICAL PRICES FOR LONG SPAN BRIDGES IN NORTH AMERICA

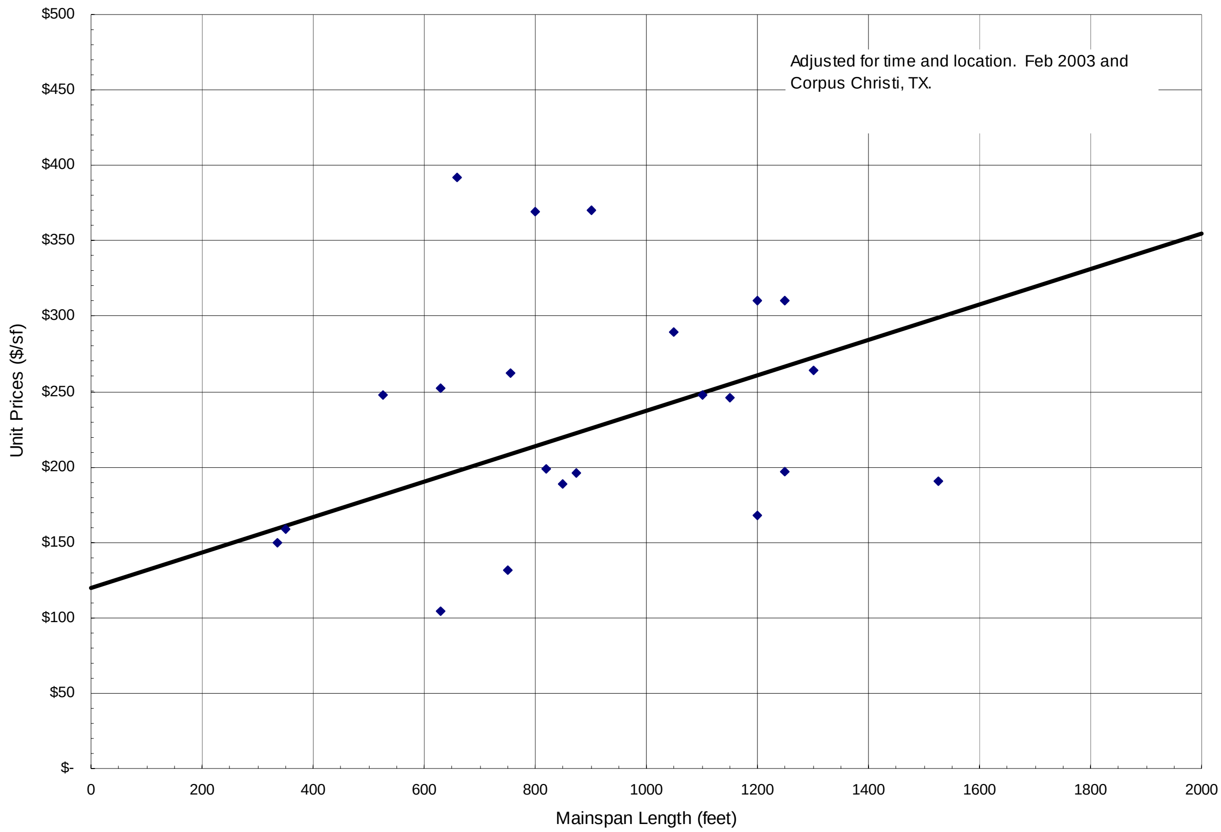
Structure[1]	Location	Date Bid	Bid Price (million)	Main Span Length (ft.)	Total Length (ft.)	Deck Width (ft.)	Deck Area (sf)	ENR Index	Geographic Index	Raw Unit Cost (sq.ft.)	Time Adjusted Cost (sq.ft.)	Time + Loc. Adjusted Cost (sq.ft.)
Sunshine Skyway	Tampa, FL	1982	$ 71.1	1200	4000	95	380,000	3825	84.2	$187.11	$324.80	$310.53
East Huntington	Huntington, WV	1981	$ 19.3	900	1808	46.5	84,072	3471	95.5	$229.57	$439.16	$370.18
Annacis	Vancouver, BC	1984	$ 45.7	1525	2724	105	286,020	4146	108.2	$159.78	$255.89	$190.38
Dame Point	Jacksonville, Fl.	1984	$ 47.0	1300	2600	105	273,000	4146	84.1	$172.16	$275.72	$263.92
Cochrane	Mobile, AL	1985	$ 32.0	800	1600	82	131,200	4228	83.4	$243.90	$383.04	$369.73
Fred Hartman	Baytown, TX	1987	$ 50.0	1250	2214	156	345,384	4406	89.3	$144.77	$218.17	$196.67
Talmadge	Savannah, GA	1987	$ 25.7	1100	2040	75	153,000	4406	82.3	$167.97	$253.14	$247.61
James River	Richmond, VA	1988	$ 11.8	630	1230	128	157,440	4519	85.1	$74.95	$110.13	$104.17
Weirton-Steubenville	Steubenville, OH	1988	$ 30.0	820	1965	92	180,780	4732	94.4	$165.95	$232.86	$198.57
Acosta[2]	Jacksonville, Fl.	1989	-	630	-	-	-	4615	84.1	$183.00	$263.30	$252.03
Burlington	Burlington, IA	1990	$ 28.8	660	1245	84.33	104,991	4732	79.0	$274.31	$384.91	$392.22
C&D Canal	Delaware	1991	$ 24.6	750	1650	127.25	209,963	4835	98.4	$117.16	$160.90	$131.63
Taylor Southgate[3]	Cincinnati, OH	1991	$ 25.9	850	2000	81	162,000	4896	92.5	$159.88	$216.83	$188.70
Clark Bridge	Alton, IL	1991	$ 34.9	756	1360	108	146,880	4835	100.1	$237.61	$326.31	$262.42
Foss Waterway	Tacoma, WA	1994	$ 17.0	350	-	-	102,531	5408	103.4	$165.80	$203.58	$158.49
Sydney Lanier	Brunswick, GA	1996	$ 54.3	1250	2496	79.5	198,432	5719	82.3	$273.65	$317.71	$310.77
Maysville	Maysville, KY	1997	$ 37.0	1050	2100	58.5	122,850	5825	95.5	$301.18	$343.32	$289.40
Cape Girardeau	Cape Girardeau,MO	1997	$ 50.8	1150	2086	93.83	195,729	5826	96.8	$259.54	$295.80	$245.99
Lower Buffalo[5]	West Virginia	1997	$ 18.0	525	1850	38.7	71,595	5765	94.0	$251.41	$289.57	$247.99
Owensboro	Owensboro, KY	1997	$ 27.1	1200	2197	75.16	165,127	5826	89.8	$164.12	$187.05	$167.68
17th Street[4]	Atlanta, GA	2001	$ 18.0	336	830	137	113,710	6390	88.4	$158.30	$164.49	$149.79
U.S. Grant	Portsmouth, OH	2001	$ 25.9	875	1685	70	117,950	6286	95.5	$219.84	$232.22	$195.75

ENR Construction Cost Index (Feb 2003) = 6640
Base Geographic Index (Corpus Christi) = 80.5

Notes:

1. All bridges are cable-stayed unless noted otherwise.
2. Segmental concrete CIP.
3. Parallel chord truss.
4. Steel box girder.
5. Steel plate girder.

FIGURE 4.3-3
HISTORICAL PRICES FOR LONG SPAN BRIDGES IN NORTH AMERICA



The unit costs shown above are a first cost and are not adjusted to take into account any life cycle costs.

Approach Structures - The low-level approach structures would most likely be constructed of short span structures with spans in the range 100 to 150 feet. Candidate superstructure types include prestressed concrete beams, post-tensioned concrete systems including both boxes and beams, and steel girders. Substructure units may consist of either pile bents or rigid frame piers.

The mid- and high-level approach structures would consist of intermediate-to-long span structures. Superstructures may include prestressed concrete beams, both conventional and/or post-tensioned drop in spans, concrete boxes, and steel girders. Substructure units would be rigid frame piers and would most likely require mid-height bracing due to their height.

TxDOT has a large historical record of unit prices for the low-level approach type of structure. It is proposed to assume a price of $60 per square foot for the low-level approaches. For the mid-level approach structures, it is proposed to assume a price of $90 per square foot, while a price of $140 per square foot is proposed for the high-level approaches. These prices are developed from the September 1999 report prepared by the American Segmental Bridge Institute entitled "Cost of Concrete Segmental Bridges over Water, Cable-Stayed Bridges, and Viaducts" with additional updates in the year 2001. As with the main span unit, no allowance for life cycle costs are included in the approach unit prices. The proposed unit prices reflect the potential that additional aesthetic requirements would be placed on the Harbor Bridge due to its proximity to the downtown Corpus Christi area.

Vessel Impact Protection Costs - All four of the route alternatives cross the Channel at various locations. The piers for the orange and green alternatives are placed completely out of the water and, therefore, would not be subject to vessel impacts and would not require impact protection systems. However, the blue and red alternatives have piers in the water and would be subject to potential vessel impact forces and require supplementary vessel impact protection systems.

The blue alternative is located in the relatively open water of the Corpus Christi Bay, which means that, in addition to the main span piers, several of the approach span piers would be vulnerable to impact forces from errant vessels. The magnitude of the vessel impact forces to be resisted by the main span and approach span piers would be determined based on a probability analysis of vessels leaving the channel. The magnitude of the vessel impact loadings would therefore be the greatest at the piers immediately adjacent to the channel since they would have a greater probability of being struck, and would decrease at the pier locations away from the channel.

The red alternative is located over the confined water of the Corpus Christi Turning Basin and, although the main span piers are located outside of the turning basin, they are still located in the water and, therefore, are subject to vessel impact forces.

In general, the magnitude of the vessel impact forces would most likely be too large for the piers to resist by themselves, in an economical manner. Instead, supplemental protection structures would be required and would typically consist of either dolphins or island structures used either separately or in combination.

Determination of the magnitude of the vessel impact forces and the design of the protection systems is beyond the scope of this Feasibility Study. To estimate the vessel impact protection costs, an estimate has been made as to the number of piers that would require protection. For the red alternative, it has been assumed that four dolphins would be required to protect each of the main span piers, for a total of eight dolphins. For the blue alternative, it was assumed that dolphins would be required at the main span and along the approach spans to protect 3,000 feet of bridge length, centered about the Channel. The approach span piers in the water, but outside this 3,000-foot region, would require additional strengthening to resist smaller vessel impact forces.

For the red alternative, the costs of the individual dolphins were derived from the average cost of those provided for the Sunshine Skyway Bridge constructed in Tampa, Florida, adjusted for time. For the blue alternative, the entire vessel impact protection system was derived from the full bid price for the dolphin system provided for the Sunshine Skyway Bridge, also adjusted for time.

Summary - The probable unit construction costs for the bridge alternatives have been estimated based primarily on historical unit prices of similar type structures. The historical prices have been consistently adjusted to account for both inflation and geographic factors.

The probable construction costs for the various alternatives are tabulated in **Table 4.3-5**. These prices include only the costs of the bridge between touch-down points at both ends and do not include costs associated with right-of-way acquisitions, retaining walls, life-cycle elements, removal of the existing structure, and contingency. The costs assumed an out-to-out structure width of 142 feet.

TABLE 4.3-2
SUMMARY COSTS FOR HARBOR BRIDGE ALTERNATIVES

Alignment	Total Bridge Length	Low-Level Approach Length	Mid-Level Approach Length	High-Level Approach Length	Total Main Span Unit Length	Vessel Impact Protection System Cost	Estimated Total Bridge Cost
Red	10,610 ft	1,480 ft	3,370 ft	3,260 ft	2,500 ft	$10,000,000	$226,33,7000
Orange	10,030 ft	1,670 ft	3,100 ft	4,110 ft	1,150 ft	$0	$166,580,000
Green	9,300 ft	1,650 ft	3,050 ft	3,450 ft	1,150 ft	$0	$152,650,000
Blue	10,350 ft	1,410 ft	3,030 ft	3,510 ft	2,400 ft	$48,000,000	$288,800,000
Unit Prices		$60/sf	$90/sf	$140/sf	$190/sf, $260/sf or $270/sf	-	-

4.2.2.3 Harbor Bridge Summary

Harbor Bridge (No-Action) - The no-action alternative assumes that the existing roadway system remains in its current state and that no improvements are constructed. This would not improve the current traffic flow, roadway conditions, CBD access, or community cohesion and it would require continued higher maintenance costs. Additional studies need to provide information about pedestrian/bicycle safety.

Red Alternative - This alternative offers the opportunity to improve the current I-37/SH 286 interchange while still maintaining existing facility access. The new location roadway would remove U.S. 181 through traffic from the existing roadway, thus alleviating traffic congestion. This alternative completely addresses the offset alignment issue because it provides the most direct connection between S.H. 286 and U.S. 181 on the north side of the Channel. The only traffic flow issues during construction would be at the I-37/SH 286 interchange and at the tie-in to U.S. 181. Most of the required land for this corridor is currently serving other purposes, resulting in a larger right-of-way purchase than for the other alternatives. This route would have a moderate adverse impact on the CBD, and on the economic and business interest in the area. There is high compatibility with the City of Corpus Christi's future development plans for the local community. This alternative addresses the issue of community cohesion. By removing the through traffic on I-37 and removing the existing control of access, cohesion and mobility for the local traffic would improve on both sides of the current roadway.

Orange Alternative - The orange alternative would provide the opportunity to improve the interchange at I-37/SH 286. The new location roadway would remove U.S. 181 through-traffic from a portion of the central business district, thus alleviating some traffic congestion. This alternative addresses the offset alignment issue by introducing a reverse curve alignment. Traffic flow issues during construction would be at the I-37/SH 286 interchange and from the Channel crossing north to U.S. 181 tie-in where the alignment parallels the existing roadway. A part of the required land for this corridor is currently serving other purposes, resulting in a larger right-of-way purchase than for the green and blue alternatives. This route would have a moderate adverse impact to the CBD and on the economic and business interest in the area. There is moderate compatibility with the City of Corpus Christi's future development plans for the local community. This alternative addresses the issue of community cohesion. By removing the through-traffic on I-37 and removing the existing control of access, this would provide the local residences with better access to areas on either side of the current roadway.

Green Alternative - The green alternative would improve the existing I-37/SH 286 and I-37/U.S. 181 interchanges but would not improve traffic flow through the CBD. There would be problems with traffic weaving based on the short offset distance between the two interchanges. An estimate has been included for providing braided ramps that help minimize the weaving in this area; however, the traffic flow would be compromised. This alternative meets design criteria, but does not achieve the desirable design criteria. For example, this alternative only provides a vertical clearance of 180 feet; the desirable vertical clearance is 200 feet. There would be significant traffic flow and local access issues along with additional construction cost since this alternative follows the existing roadway. There is high adverse impact on access to the CBD and on the existing economic and business interest in the area. It has low compatibility with the City of Corpus Christi's future development plans for the local community and would cause the most relocations, displacements, and negative impacts to the local neighborhood.

Blue Alternative - This alternative offers the opportunity to improve the current I-37/SH 286 and I-37/U.S. 181 interchanges while still maintaining existing facility access. The new location roadway would remove U.S. 181 through-traffic from the existing roadway, thus alleviating some traffic congestion. This route would not disproportionately affect minority and/or low-income populations in the community due to very little additional new location right-of-way being needed. This alternative would have very high construction cost due to the long bridge structure needed over Corpus Christi Bay. It would be very difficult to maintain traffic flow during construction. There would be adverse impacts on existing economic and business interest in the area. This alternative would not improve access to Corpus Christi's CBD and is not compatible with the City's future development plans for the local community. There would be significant impacts to coastal and aquatic life and would require acquisition of a substantial acreage of state-owned submerged lands managed by the General Land Office.

4.2.3 TULE LAKE LIFT BRIDGE

4.2.3.1 Navigational Clearances

As discussed previously, the Port is aggressively pursuing multiple target markets with the intention of potentially utilizing the future Joe Fulton International Trade Corridor west of the existing Tule Lake Lift Bridge. Similar to the Harbor Bridge, the new Tule Lake Lift Bridge should accommodate at least 95 percent of all vessels carrying the types of cargoes that the port presently serves or plans to serve in the future. This includes continuation of petroleum product as a major cargo, containerized freight, bulk ore, military layberths, prefabrication of oil platforms and modular units, auto carriers, and even cruise ships if the Corpus Christi market expands to that extent.

Requirements for bulk carriers (ULCCs and VLCCs), containerized freight carriers, and military vessels would be similar to those discussed in **Section 4.2.2.1**. However, as discussed in **Section 4.2.1.2,** other physical dimensions (e.g., draft, beam, overall length) may be limiting criteria in the western reaches of the Channel, whereas safe maneuvering of these vessels inbound and outbound may become questioned. With 200 feet recommended as the lower range of the proposed vertical clearance and unlimited vertical clearance for the upper range (based on use of a swing span), it can be anticipated that the new Tule Lake Lift Bridge will not impede any of the Port's plans for future growth in targeted markets.

4.2.3.2 Total Costs

The general objective of a new Tule Lake Lift Bridge (Navigation Boulevard) is to replace the maintenance-prone existing bridge. Consideration is being given to eliminating the crossing and, if that is not feasible, then eliminating the rail traffic at this crossing. In the event rail traffic is eliminated, only highway traffic need be provided for on a new bridge.

Highway needs can be met by providing two 12-foot lanes and appropriate shoulders. Although 10-foot shoulders may be recommended on the approach roadway, the cost of providing such wide shoulders on a major movable bridge could be prohibitive. Therefore, for the purpose of this Feasibility Study, the cross-section of the bridge roadway is assumed to include two 3-foot-wide shoulders and two 1.42-foot-wide traffic barriers in addition to the lanes. Rail needs can be met with a single track. A width of 20 feet plus a 5-foot-wide maintenance walkway is assumed for the rail.

Minimum vertical and horizontal clearances for a replacement bridge or bridges have been preliminarily established at 300 feet horizontal and 200 feet vertical for the movable span open (raised). The existing Tule Lake Lift Bridge features a vertical lift main span that provides 200 feet of horizontal clearance in the channel, 10 feet of vertical clearance in the closed position, and 138 feet of vertical clearance in the fully raised position. For mid-level concepts, the minimum vertical clearance with the bridge in the closed position is 73 feet, which is adequate for most tug and barge combinations to pass under without opening the bridge and matches the U.S. Coast Guard minimum vertical clearance for the Intracoastal Waterway in Texas.

The new Tule Lake Lift Bridge would be located in an extremely aggressive (saltwater) environment. Therefore, consideration must be given during bridge type selection and design to materials that are less susceptible to corrosion.

<u>**Movable Bridge Options**</u> - Bridge alternatives that span the channel and do not provide the required vertical clearance between high water and the low member of the structure require a movable channel span to allow vessels to pass. Although many types of movable bridges have

been constructed in the past 200 years, including significant variations on those types, three distinct movable bridge types have demonstrated sufficient success to warrant consideration at this location. These three types, the swing bridge, vertical lift bridge, and bascule bridge are given consideration in this study. The following discussion provides a brief introduction to these types and summarizes the basic characteristics, advantages, and disadvantages.

Swing Bridges – Swing spans consist of a movable span, which pivots about a vertical axis to provide the required span opening and clearance to navigation traffic. Swing spans are typically symmetrical or balanced about the center pivot; although a number of types have unequal spans (termed bobtail swing spans) that are counterweighted on the shorter span to balance the weight of the longer span. Swing spans are typically operated by machinery located on the span that drives a pinion that engages a circular rack attached to the pivot pier. Some newer bridges use a pair of hydraulic slewing cylinders for span operation.

Swing spans are typically the lowest cost movable span for narrow bridges (two-lane highway and single- or double-track rail) spanning channels with widths of 65 feet or less. Their economy diminishes for wide bridges since the pivot point must be moved further away from the edge of the channel to provide clearance. The pivot of the swing span is generally considered a navigation hazard since the span pivots horizontally toward navigation traffic. For this reason, swing spans require a more substantial fender system to protect the open span from vessel impact and/or an increased horizontal clearance. Where large vessels are present, these additional protection requirements can add significant cost in the form of dolphins or cellular cofferdams. Despite these disadvantages, swing spans have been constructed over channels more than 200 feet wide and double-swing spans have been constructed to span over channels up to 400 feet wide. Most notable of these is the George P. Coleman Bridge in Yorktown, Virginia, that has twin 500-foot swing spans over a 450-foot wide channel.

If two parallel bridges are to be constructed, one for highway and one for rail, separation of the bridges would be required to accommodate operational clearances. A swing bridge requires horizontal clearance adjacent to the bridge into which the swing span superstructure may swing.

Vertical Lift Bridge - A vertical lift span consists of a simple span, lifted vertically to provide the required clearance. This configuration allows for lengthy movable spans in excess of 500 feet long that can span channels over 450 feet wide. Counterweights are usually provided to balance the weight of the lift span and minimize the operating loads. The lift span dead load is supported by wire ropes, which pass over sheaves at the top of towers and connect to the counterweights. The towers are supported on piers at each end of the movable span.

Because the counterweights are located overhead, a dry pit for the counterweight travel is not required with this scheme; thus, a waterline pier can be used, potentially reducing construction costs or eliminating the need for cofferdam construction. Span operation is either provided through operating ropes, if the drive machinery is located on the lift span, or independent synchronized drives that actuate the counterweight sheaves, in the case of a tower drive (i.e., the drive machinery is located on the top of the towers.)

Vertical lift bridges require the most complex and costly machinery of the three most common movable bridge types. Counterweight ropes and sheaves also lead to the most expensive operation and maintenance costs. For this reason, vertical lift bridges are only economical where long spans and/or relatively short lifts are required.

A major disadvantage of this bridge type is that a vertical lift span scheme restricts the vertical clearance of the channel (i.e., the scheme does not provide unlimited vertical clearance as do other movable span types). Large vertical lift bridges that provide up to 140 feet of vertical clearance are not uncommon. However, a vertical lift bridge providing 200 feet of vertical clearance would be a unique solution.

Vertical lift towers are typically an expensive element of the lift span, especially when the towers are tall and steel is used in the construction. Load shoes for the lift span would be located directly below the main girders at the ends of the span. Therefore, there would be no live load carried by the counterweight ropes since this load is directly transferred through the load shoes to the Pier (or lower element of the tower).

Bascule Bridges - Bascule spans consist of a leaf (or two leaves) that pivots about a horizontal axis. Each leaf is usually balanced by a counterweight to reduce the loads required to operate the span. A bascule span consisting of one leaf, opening towards one side of the channel is called a single-leaf bascule. If a pair of leaves is used, one opening to either side of the channel, the bridge is referred to as a double-leaf bascule. Unlike vertical lift bridges, bascule bridges can provide unlimited vertical clearance for navigation traffic.

Double-leaf bascule spans introduce concerns of excessive deflection and rotation at the tips of the leaves under heavy rail traffic due to the cantilevered configuration. Therefore, single-leaf arrangements are typically favored for rail bridges. The single-leaf provides a simple span for live load with the bridge in the lowered position.

In general, single-leaf bascule bridges are preferred for spanning channels up to 120 feet wide and where there are alternative traffic routes or limited marine traffic. Single-leaf bascule bridges have been constructed to span channels up to 200 feet wide. However it must be considered that in the closed position, a single-leaf bascule acts as a simple span for live load, whereas a double-leaf bascule functions as a pair of cantilevers pinned at the center. This difference in structural arrangements makes the single leaf less susceptible to deflection and vibration, thereby providing a smooth ride for traffic. A single-leaf bascule is generally less expensive to construct than a double-leaf because only one bascule pier (the large pier that supports the leaf, machinery, and counterweight) is required rather than two. Similarly, single-leaf bascules require less maintenance because they have fewer moving parts and do not require span locks.

Double-leaf bascule bridges are common for spanning channels of less than 180 feet, although they have been constructed over channels more than 250 feet wide. Double-leaf bascule bridges require span locks (also called center locks) that pin the two leaves together in the center so that live loads do not produce a deck discontinuity that would be unsafe to traffic. The major advantage of a double-leaf configuration is that it offers greater operational flexibility during maintenance. If a mechanical or electrical component of a single-leaf bascule is removed for service, the leaf cannot be operated. If the channel must remain open to vessels, the bridge must be serviced while fixed in the open position, closed to vehicles. On the other hand, one leaf of a double-leaf bascule can be serviced in the closed position while the other leaf remains in service, opening half a channel for vessels to pass.

Highway Movable Span Deck System - Selection of the type of deck system on a movable span is a critical design decision. Bridge roadway deck type, and the resulting weight, has a major influence on the size of counterweight required. This is especially true on a bascule bridge where weight added to the leaf typically requires that three times as much weight be added to the counterweight. The lightest deck systems are steel grid decks that range from 18 to 25 psf. These systems have the added advantage of allowing some wind to pass through, thereby reducing the wind force that must be overcome by the operating machinery. The disadvantages of open grating are increased tire noise, less skid resistance after the steel wears smooth, and no protection of the supporting structure from roadway debris.

Solid deck types used on movable bridges typically include filled steel grid decks (50 psf), orthotropic decks (45 psf), and exodermic decks (64 psf). Fiber reinforced polymer (FRP) deck systems (35 psf) are a relatively new closed deck system that could also be considered. The added dead load of these systems can be somewhat offset through reductions in the mass of the supporting structure, achieved by making the deck composite with the structure. A composite solid deck provides protection of the structure from roadway debris and corrosion that can result from it. For the purposes of this study, it is assumed that the new bridge would have a solid deck type for the roadway.

Operational Issues - Several key operational issues must be addressed in evaluating movable bridge types and configurations. Site conditions or constraints often dictate the resolution of these issues. Other operational issues are resolved simply by meeting a preference of the owner or operating agency. The following are some key issues with regard to a new Tule Lake Lift Bridge:

- A highway or combination highway/rail bridge at this site would normally remain in the closed or lowered position to allow mostly uninterrupted vehicular use and be raised to allow passage of vessels. Reportedly, vessels pass through the channel that require the existing bridge to be raised at a rate of about 25 times per day. For a new bridge constructed on a vertical profile similar to the existing rail, one would anticipate about the same number of operations.

- An independent highway bridge could be constructed at a higher profile than the existing bridge. This mid-level profile would allow the highway bridge to remain in the closed position for passage of vessels not requiring a significant vertical clearance. It is estimated that all but large ships could pass under a bridge with 73 feet of clearance in the closed position. With records indicating only two ship passages through the channel per day, a mid-level highway bridge would only open approximately twice per day.

- A rail bridge could normally be left in the open position and lowered to allow trains to pass over the river. The current number of trains crossing the Tule Lake Lift Bridge is two to six per day. Therefore, a separate railroad bridge could be normally left in the open position and lowered two to six times per day. A vertical lift bridge left partially open, such that it provides 73 feet of clearance, could be lowered for trains and raised to the full open position for ships. Note that a bridge normally left in the open position would be subject to higher design wind loads than a bridge left normally closed.

Operating and Maintenance Costs - Operating and maintenance costs consist of the following primary types of expenses:

- **Bridge Operator:** This cost covers the labor and overhead to provide bridge operators (also called bridge tenders) for all times that the bridge is scheduled for operation or maintenance. Bridge operators must have adequate skills and training to operate the bridge safely under varying conditions of traffic and weather. If possible, bridge operators should also be trained to perform routine maintenance and to understand the basic principles of the bridge operating equipment. The costs for bridge operators vary depending upon skill level and the times for which the bridge operator is on duty.

- **Utilities:** Utility costs include fees for electric, phone, and water and sewer. Dedicated data phone lines would be required for remote operation. Electrical power usage for movable bridges is relatively small as the equipment is operated intermittently.

- **Routine or Scheduled Maintenance:** Routine maintenance includes cost for labor, materials, and equipment to provide normal maintenance operations, such as lubricating machinery, changing lubrication and hydraulic system filter and breather elements, minor cleaning and painting, replacement of minor wear elements, replacement of limit switches, relays, and other small electrical components, etc.

- **Painting:** The structural steel coating or paint system would require replenishment or replacement periodically.

- **Unscheduled Repairs:** Unscheduled repairs include correction of deficiencies that require skills or equipment not possessed by local maintenance forces. This would include replacement of major components such as motors, pumps, programmable logic controllers (PLC's) or bearing bushings.

- **Rehabilitation:** If more than a few major components are in need of repair, a rehabilitation contract would be required to implement such corrective action. Historically, well-designed and constructed movable bridges would last 25 years or more before a major rehabilitation contract is required. After the initial rehabilitation, additional rehabilitation may be required at more frequent intervals as mechanical equipment becomes older and electrical equipment becomes obsolete. Historically, the cost for movable bridge rehabilitation is between 10 and 30 percent of the cost of initial construction.

This cost and frequency of major rehabilitation can vary significantly depending upon the quality of initial construction and maintenance.

Maintenance costs presented in this report include bridge operators, utilities, routine maintenance, and painting. Unscheduled repairs and rehabilitation costs are not included in the estimated O&M costs..

In general, the differences between O&M costs for various types of movable bridges are small compared to the overall costs. Historic cost records by the Florida Department of Transportation (owners of more than 100 movable bridges) indicate average annual O&M costs of $120,000, including minimum wage bridge operators (about $10.00 per hour.) This includes operator and maintenance personnel direct salaries and consumable maintenance supplies (lubrication) only and does not include overhead.

For the purpose of estimating O&M costs for a new Tule Lake Lift Bridge the following rates were assumed:

- Bridge Operators = $15.00 per hour
- General Labor = $15.00 per hour
- Mechanical Technicians = $100 per hour for 3-person crew
- Electrical Technicians = $80 per hour for 2-person crew

Number of Bridges - The requirements for a highway crossing and a rail crossing can be substantially different. For example, typical maximum grade requirements would limit the track profile grade to one similar to the existing bridge. This low track profile produced an existing bridge with a vertical clearance of only 10 feet in the closed position. On the other hand, the profile grade of an independent highway bridge could be increased significantly by using 4 percent grades or more to produce a mid-level profile.

Single Bridge Concept: In this concept, a single bridge is constructed that carries both highway and rail. Because the bridge carries rail, it must be built on a low profile. Therefore, the bridge must open for all but the smallest of vessels.

Twin Bridge Concept: In this concept, the highway bridge is separated and raised to a mid-level profile that reduces the number of times the bridge is required to open for a vessel. It is assumed that the number of train crossings is limited and rail is carried on a separate low-level bridge. This results in construction of two bridges rather than one. In the two-bridge scenario, the highway bridge would be a normally closed bridge that would open only for larger vessels. The rail bridge would be a normally open bridge that would be closed only when a train required passage.

General Movable Span Options - The vertical clearance requirement of 200 feet can be accommodated by any of the three most common movable bridge types. For a swing or bascule bridge, unlimited vertical clearance is provided. For a vertical lift bridge, 200 feet is practical, although the maximum range for existing bridges of this type is about 140 feet. Pushing the vertical clearance requirement to 200 feet on a lift bridge would have a significant impact on the cost and operating cycle time. Furthermore, it would push the bridge beyond the current limits of proven designs.

The horizontal clearance requirement of a 300-foot channel is just beyond the maximum range for existing bascule bridges. The widest bascule bridge in service provides only 262 feet of horizontal channel clearance (Galata Bridge in Istanbul, Turkey). The widest channel ever spanned by a bascule bridge was only 295 feet, by a rolling lift bridge constructed over the Tennessee River in 1916. These long bascule bridges are of the double-leaf configuration. The largest single leaf bascule bridges provide clear channel widths in the range of 200 feet. A bascule bridge is therefore not considered a viable option for this site.

Swing spans typically do not provide channels wider than about 150 feet. However, two rather unique double swing bridges provide wider channels. The George P. Coleman Bridge in Yorktown, Virginia, is a double swing span with 500 feet between pivot piers that provides 450 of horizontal clearance and the Spokane Street Swing Bridge in Seattle, Washington is a double concrete swing span with 480 feet between pivot piers. Therefore, a double swing bridge is a viable concept for this site.

Vertical lift bridges are the most common movable bridge type for spanning channels in excess of 150 feet. There are many examples of vertical lift bridges with span lengths of over 300 feet and several with spans over 400 feet. Therefore, a vertical lift bridge is a viable concept for this site.

With the information given, it appears that there are two movable span types worthy of further consideration for the new Tule Lake Lift Bridge:

- Vertical Lift Bridge
- Double Swing Bridge

Low-Level Bridge with Rail - This concept is best suited for a single vertical lift bridge that provides for both rail and highway on one structure. The overall width of the structure would be about 63 feet. The additional cost of providing separate structures is not warranted if both are to remain on low profiles. Assuming that the bridge crosses perpendicular to the channel, the required main span for a vertical lift bridge providing 300 feet of horizontal clearance would be about 360 feet. This provides clearance between the end of the lift span and the channel for foundations and fendering. Since this bridge carries both highway and rail, the profile is limited to the maximum grade of the track. The profile would therefore remain similar to the existing bridge, resulting in a vertical clearance of about 10 feet above mean high water in the closed position.

To provide 200 feet of vertical clearance, the lift span would need to be raised 190 feet. At a typical rate of 50 feet per minute, and allowing for acceleration and deceleration ramping, the lift (or lower) operation would take about 4 minutes. Including operation of signals and gates, the total cycle time to raise and lower the bridge would be about 10 minutes plus the time for the vessel(s) to pass.

The most practical superstructure type for a lift bridge of this size is a through truss. This provides a lightweight structural system with a minimal effective structure depth. The low structure depth allows the track profile to remain low and reduces both the cost and impact associated with raising the approach roadway/rail.

Even given the use of a through truss, the top of the lift span towers would need to be about 250 feet high above the water to raise the lift span to its required height.

Low-Level Bridge without Rail - This concept is also best suited for a single vertical lift bridge. The low profile of the roadway does not provide adequate structure depth for a concrete double swing bridge. A through truss double swing bridge could be used but the operating machinery would be positioned low to the water and exposed to an extremely aggressive saltwater environment.

The overall width of the highway-only structure would be about 33 feet. Once again, the required main span for a vertical lift bridge providing 300 feet of horizontal clearance would be about 360 feet. Since this bridge carries only highway traffic, the profile can be raised slightly to allow small vessels to pass without opening and to provide greater protection from salt spray. For the purpose of evaluating a low-level concept as distinctly different from a mid-level concept it is assumed that the clearance for this concept is only raised to provide 25 feet in the closed position. At this level no additional significant impacts to the approach roadways result.

To provide 200 feet of vertical clearance, the lift span would need to be raised 175 feet. At this lift, the time of operation would not be significantly different than for the low-level combination highway/rail bridge. The through truss superstructure and tower heights would also be similar.

Mid-Level Bridge with Rail - It is not practical to raise the rail profile to a mid-level crossing due to limited space and maximum track grade restrictions. Therefore, this concept requires two separate bridges. A vertical lift bridge similar to that described for the low-level bridge with highway and rail would best serve the rail bridge. The width of the structure would be reduced to 30 feet since it would only provide for a single track and maintenance access.

The mid-level highway bridge could be either a vertical lift bridge or a concrete double swing bridge. The width of either would be approximately 33 feet. As with the other concepts, the vertical lift bridge would require a span of approximately 360 feet. However, unlike the other concepts, the deck level would be raised to about 90 feet above the water at the center of the channel. This would provide about 80 feet of clearance in the closed position and reduce the lift to open the bridge to only 120 feet. This bridge would only open for large ships. Allowing for acceleration and deceleration ramping, the lift (or lower) operation would take just under three minutes. Including operation of signals and gates, the total cycle time to raise and lower the bridge would be about seven minutes plus the time for the vessel(s) to pass.

A double swing span could be of either concrete or steel construction. A steel bridge would require extensive maintenance painting, as would the vertical lift concepts. A concrete double swing span offers added stiffness as well as the low maintenance associated with modern concrete. Therefore, the concrete double swing bridge is presented for comparison with the vertical lift concept.

The minimum main span length for a double swing bridge providing a 300-foot channel would be about 360 feet. However, in discussions with the Channel pilots association, they recommended that the channel width for the swing span concept be increased to 350 feet to offset the additional length through the bridge created by the open swing span and associated pier protection. The resulting minimum double swing span length between pivot points is 410 feet. The safe speed of the bridge is limited by the need to control the large inertia of the massive concrete superstructure. This span would be about 15 percent smaller than the Spokane Street Bridge, which requires 2.5 minutes to rotate 45 degrees. Since the Tule Lake Lift Bridge would need to rotate 90 degrees, an opening/closing time of about 4 minutes is to be expected. This would result in a total cycle time of about 9 minutes plus the time for the vessel(s) to pass.

Another issue presented by the double swing span concept is that the open swing span and associated pier protection also presents a potential restriction to planned terminal access. In particular, planned development of a new bulk terminal on the northwest corner of the bridge could be impacted. As a result, consideration should be given in the next phase of the project to evaluate the location of this new bulk terminal and new bridge alignment to the east of the existing bridge.

The concrete swing span superstructure at Spokane Street is a variable depth cast-in-place segmental concrete box girder with a depth at the pier of about 30 feet. In addition, the pivot mechanism, a large diameter lift/turn hydraulic cylinder and paired slewing cylinders, requires a pier height of about 20 feet between the foundation and the superstructure to house it. To utilize this type of structure, the profile grade of the bridge (and rail) would need to be raised by at least 50 feet. This is less than the proposed profile for the mid-level bridge. With the mid-level profile raising the deck to approximately 90 feet above the water at the center of the channel and a maximum structure depth of 25 feet at the edge of the channel, the mid-level concrete double swing bridge would provide a minimum of 65 feet of vertical clearance at the edge of the 350 foot wide channel and approximately 89 feet of clearance at the center of the channel. With some minor adjustment of the profile, the requirement for 73 feet of clearance for a 300-foot-wide channel can be achieved.

A double swing span at this location would require a 90-degree opening angle. This would significantly impact the selection and cost of the drive system. If a pair of tandem slewing cylinders, similar to the Spokane Street Bridge, cannot be configured to work, a more expensive gear drive system (ring gear and pinion) would be required.

In the open position the swing spans would parallel the channel and the tips would be extended from the pivot pier towards approaching vessels. Span protection, in the form of protective dolphins or heavy fendering, would be required to prevent vessel impact with the open swing spans.

Mid-Level Bridge without Rail - This concept is identical to the highway structure for the mid-level bridge with highway and rail. Since rail is eliminated, only the highway bridge is required. Once again, the recommended concept is the concrete double swing bridge.

In a conversation with the Ship Pilots Association, the presiding officer requested that the minimum channel width be increased 50 feet to 350 feet for the double swing bridge alternative.

This additional 50 feet in width was requested because when the swing opens completely, the spans form a "vertical wall for about 350 feet". This vertical wall requires the ship pilots to maintain a straight alignment for a significant distance as the vessel passes through a crossing. This additional 50 feet provides an error of margin for the ship pilots as they navigate through the crossing and deal with cross winds and shifting ballast.

Common Elements - It is assumed for the purposes of estimating bridge construction and maintenance costs that bridge control is by way of a Programmable Logic Controller (PLC) based control system. Operation is primarily from a local bridge tenders facility although remote operation could be used. Both local PLC control and local manual control are provided. Traffic control equipment includes two traffic signals, four traffic gates, two barrier gates, span locks, four rail locks, advance train warning signals, and railroad interface equipment. Backup power is assumed to be provided for all concepts by way of an auxiliary generator.

Cost Estimates - Cost estimates were prepared for the purpose of comparing concepts. Costs are for construction of the movable span and approach spans. Historical movable bridge square foot costs are not useful in this exercise because the costs vary extensively from bridge to bridge based upon site specific requirements and because the new Tule Lake Lift Bridge pushes the limits of the application. Therefore, the cost estimates developed herein are based upon conceptual level quantities and historic quantity unit prices rather than square foot costs. Dolphins for ship impact protection are included for all concepts. These estimates do not account for specific site geotechnical conditions. Costs assume competent subsurface conditions exist for support of a major bridge.

TABLE 4.4-1
TULE LAKE LIFT BRIDGE REPLACEMENT COST ESTIMATES

Concept	Initial Construction Estimate[1]	Annual Maintenance Estimate[2]	Life-Cycle Cost Estimate[3,4,5]
Low-Level Bridge with Rail	$ 67.1 million	$ 472,000	$76.8 million
Low-Level Bridge without Rail	$ 49.9 million	$ 290,000	$56.3 million
Mid-Level Bridge with Rail	$ 94.6 million	$ 551,000	$106.6 million
Mid-Level without Rail	$ 54.7 million	$ 205,000	$60.1 million

1 Construction cost estimates include major bridge elements plus a 20% contingency to account for mobilization, miscellaneous elements, and unknowns.
2 Annual maintenance costs include bridge operations, routine maintenance, and painting.
3 Life-Cycle costs are present values.
4 Life-Cycle costs are based upon a 7% discount rate and 75 years of service life.
5 Life-Cycle costs include costs for rehabilitation at ages 30 and 60 for a cost of 30% of initial construction.

4.2.3.3 Tule Lake Lift Bridge Summary

If rail and highway are both to be maintained at the Tule Lake Lift Bridge location, it is recommended that two bridges be constructed: a mid-level movable bridge that carries highway traffic only and a low-level rail-only vertical lift bridge.

If rail traffic is eliminated from this crossing and only highway traffic is to be maintained across Tule Lake, it is recommended that a mid-level movable bridge be constructed.

Tule Lake Lift Bridge (No-Action) - The no-action alternative assumes that the existing roadway system remains in its current state and that no improvements are constructed. This would not improve the current traffic flow, roadway or railway conditions or clearance issues over the Channel and would require continued higher maintenance costs.

Low-Level Bridge with Rail - This alternative would have no impacts on the Joe Fulton International Trade Corridor. The construction cost estimate for this moveable bridge including approach roadway work is approximately $75,700,0000. There should be little difficulty in maintaining traffic flow in the Corridor during construction. The estimated daily amount of time the bridge is inoperable due to ship traffic is approximately four hours. This alternative should not change the emergency service access to the area or access to the inner harbor.

Low-Level Bridge without Rail - The construction cost for this option including approach roadway work is approximately $56,700,000. This option provides increased navigable clearance based on vehicle grade limits without rail grade limitations. The railroad bridge would be removed and rail traffic would access the area via a new route over land. There would be no impacts on the Joe Fulton International Trade Corridor and there should be little difficulty in maintaining traffic flow in the Corridor during construction. The estimated daily amount of time the bridge is inoperable due to ship traffic is approximately four hours. This alternative should not change the emergency service access to the area or access to the inner harbor.

Mid-Level Bridge with Rail - The construction estimate for this option including approach roadway work is approximately $105,300,000. This alternative has the highest cost because there would be a new roadway bridge and a separate railway bridge constructed. The roadway bridge would be elevated to provide greater navigable clearance over the Channel when the bridge is in the closed position. This means that the roadway traffic would be disrupted less often due to ship traffic. The estimated daily amount of time the bridge is inoperable due to ship traffic is approximately one hour. The emergency service access to the area and inner harbor access should be improved. There would be construction cost impact to the Joe Fulton International Trade Corridor of about $3,300,000 to connect with Navigation Boulevard. The difficulty of maintaining traffic flow in the Corridor during construction should be moderate.

Mid-Level Bridge without Rail - The construction estimate for this option including approach roadway work is approximately $58,700,000. The new bridge structure would carry only automobile traffic. The railroad bridge would be removed and rail traffic would access the area via a new route over land. The roadway bridge would be an elevated structure providing greater clearances over the Channel when the bridge is closed than currently exist. This means that the roadway traffic would be disrupted less often due to ship traffic. The estimated daily amount of time the bridge is inoperable due to ship traffic is approximately one hour. The emergency service access to the area and inner harbor access should be improved. There would be construction cost impact to the Joe Fulton International Trade Corridor of about $3,300,000 to connect with Navigation Boulevard. The difficulty of maintaining traffic flow in the Corridor during construction should be moderate.

Section 5.0
ENVIRONMENTAL CONSIDERATIONS

A number of environmental considerations were evaluated with regard to the construction of a new Harbor Bridge, as well as construction of a replacement for the existing Tule Lake Lift Bridge. Pertinent resource categories related to the human and natural environment were investigated to evaluate the magnitude of potential environmental constraints associated with the various route alternatives. A brief discussion of baseline conditions is provided for appropriate categories that could constrain certain alternatives.

Quantitative comparisons of potential impacts are discussed, where appropriate, along with a qualitative discussion of the degree of constraint associated with various route alternatives. This preliminary evaluation of environmental considerations is based primarily on existing, published information supplemented with limited field reconnaissance and agency input. Site-specific investigations such as field wetland delineations, endangered species presence/absence surveys, hazardous material site assessments, and noise modeling would be conducted during a subsequent National Environmental Policy Act (NEPA) document preparation phase. Similarly, a detailed evaluation of impacts associated with specific roadway alignments was beyond the scope of this feasibility study, as was an evaluation of secondary and cumulative impacts. Quantitative impact discussions for the Harbor Bridge study corridors are focused on a 600-foot corridor width, which may tend to exaggerate potential impacts, based on the potential for avoidance measures to be built into an actual alignment with lesser width requirements.

Potential environmental constraints associated with various resource categories are illustrated on **Plate 1** (see Map Pocket) for the Harbor Bridge project and on **Figure 5.1-1** for the Tule Lake alternatives and are discussed in the following sections.

5.1 SOCIAL/ECONOMIC IMPACT AND COMPATIBILITY WITH EXISTING LAND USES

5.1.1 SOCIAL/ECONOMIC CONDITIONS

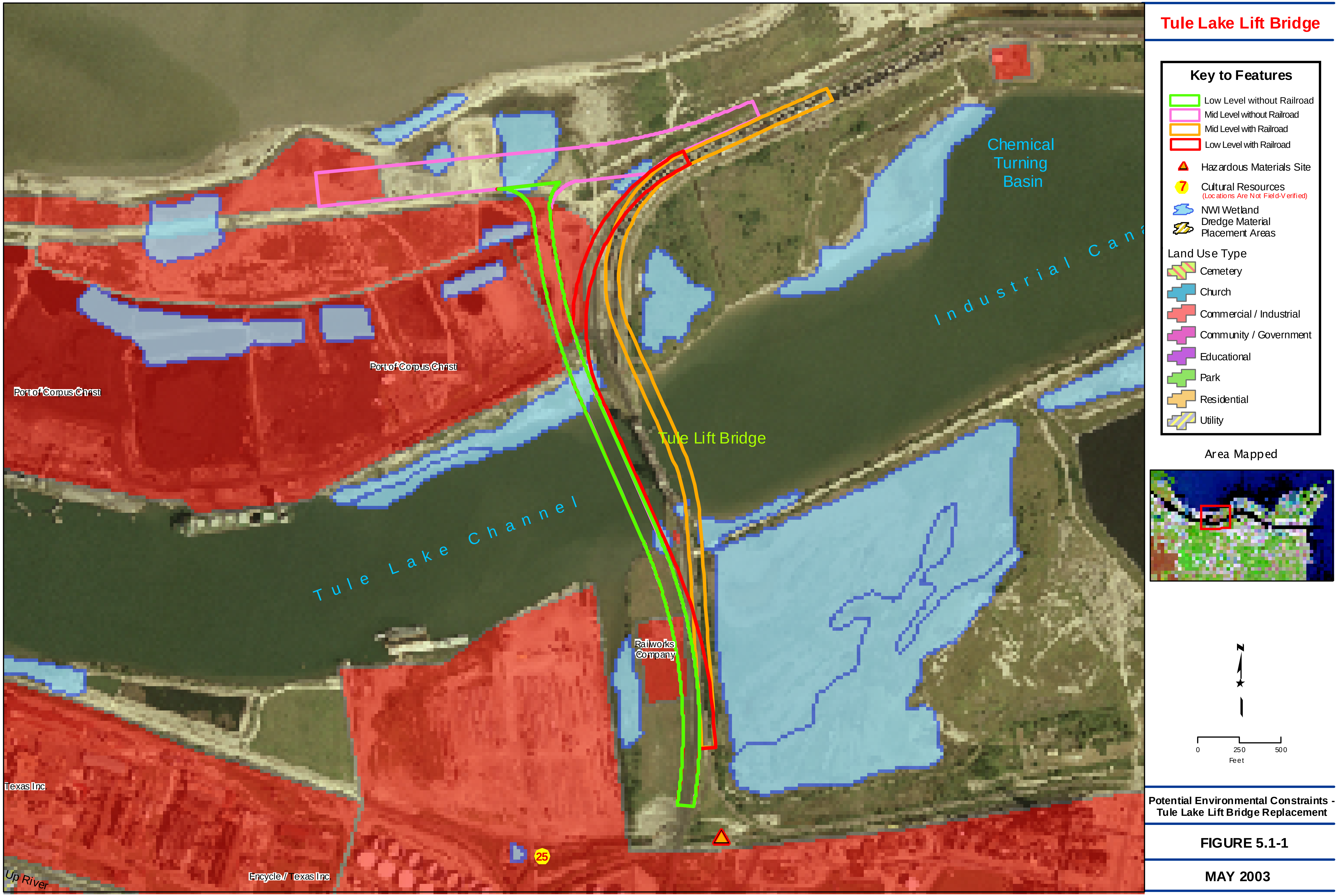
This section provides an overview of socioeconomic characteristics within the project study area. With respect to population, ethnicity, income, poverty, and employment data, the study area is composed of portions of Nueces County and the City of Corpus Christi as well as portions of eight U.S. census tracts. Data collected by the U.S. Census Bureau for 2000 allow for analysis of the racial and ethnic compositions of the project area. These data are discussed below. **Tables 5.1-1** and **5.1-2** show 2000 Census data for the counties, cities, and census tracts in the project area.

As **Table 5.1-1** shows, the populations of both Nueces County and the City of Corpus Christi were more ethnically diverse than the State of Texas in 2000. White and Black or African American persons formed smaller percentages of the total population in these two areas than they did statewide, and Hispanic or Latino persons formed a larger percentage of the population. White persons comprised 37.7 percent and 38.5 percent of the population in the county and city, respectively, compared to 52.4 percent in the state. The county and city also had lower percentages of Black or African American persons (4.1 percent and 4.5 percent, respectively) than the state (11.3 percent). On the other hand, Hispanic persons comprised 55.8 percent and 54.3 percent of the population in the county and city, respectively, compared to 32.0 percent in the state. All other ethnic groups comprised 1 percent or less of the county and city's total population. See **Table 5.1-1.**

TABLE 5.1-1
OVERVIEW OF RACE AND ETHNICITY CHARACTERISTICS FOR THE NATION, STATE OF TEXAS, NUECES COUNTY AND CITY OF CORPUS CHRISTI

	United States	Texas	Nueces County	City of Corpus Christi
Total:	281,421,906	20,851,820	313,645	277,454
White alone	194,552,774	10,933,313	118,178	106,901
Percentage	69.1%	52.4%	37.7%	38.5%
Black or African American alone	33,947,837	2,364,255	12,718	12,404
Percentage	12.1%	11.3%	4.1%	4.5%
American Indian and Alaska Native alone	2,068,883	68,859	933	822
Percentage	0.7%	0.3%	0.3%	0.3%
Asian alone	10,123,169	554,445	3,458	3,382
Percentage	3.6%	2.7%	1.1%	1.2%
Native Hawaiian and Other Pacific Islander alone	353,509	10,757	136	125
Percentage	0.1%	0.1%	0.0%	0.0%
Some other race alone	467,770	19,958	308	296
Percentage	0.2%	0.1%	0.1%	0.1%
Population of two or more races:	4,602,146	230,567	2,963	2,787
Percentage	1.6%	1.1%	0.9%	1.0%
Hispanic or Latino	35,305,818	6,669,666	174,951	150,737
Percentage	12.5%	32.0%	55.8%	54.3%

Source: U.S. Bureau of the Census, 2000.



Potential Environmental Constraints - Tule Lake Lift Bridge Replacement

FIGURE 5.1-1

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As **Table 5.1-2** shows, all of the study area census tracts, except Tracts 1 and 3, are comprised primarily of minority persons; these tracts have a lower percentage of White persons than the City of Corpus Christi (38.5 percent). **Figure 5.1-2** shows the locations of the census tracts. All but two of the tracts (Tracts 1 and 7) have higher percentages of Black persons than Corpus Christi (4.5 percent), and half of the tracts have a higher percentage of Hispanic or Latino persons than the city (54.3 percent).

TABLE 5.1-2
OVERVIEW OF RACE AND ETHNICITY CHARACTERISTICS
FOR STUDY AREA CENSUS TRACTS

	Census Tract 1	Census Tract 3	Census Tract 4	Census Tract 5	Census Tract 6	Census Tract 7	Census Tract 8	Census Tract 11
Total	441	922	1,813	1,730	7,142	3,983	4,407	2,003
White Alone	311	545	113	69	1,033	1,303	1,032	127
Percentage	70.5%	59.1%	6.2%	4.0%	14.5%	32.7%	23.4%	6.3%
Black or African American alone	7	47	883	766	442	135	289	98
Percentage	1.6%	5.1%	48.7%	44.3%	6.2%	3.4%	6.6%	4.9%
American Indian and Alaska Native alone	0	3	8	5	26	8	5	7
Percentage	0.0%	0.3%	0.4%	0.3%	0.4%	0.2%	0.1%	0.3%
Asian alone	25	9	0	0	46	7	12	5
Percentage	5.7%	1.0%	0.0%	0.0%	0.6%	0.2%	0.3%	0.2%
Native Hawaiian and Other Pacific Islander alone	0	0	1	0	3	2	1	0
Percentage	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%
Some other race alone	1	2	0	3	8	9	4	0
Percentage	0.2%	0.2%	0.0%	0.2%	0.1%	0.2%	0.1%	0.0%
Population of two or more races	5	7	16	15	49	29	19	4
Percentage	1.1%	0.8%	0.9%	0.9%	0.7%	0.7%	0.4%	0.2%
Hispanic or Latino	92	309	792	872	5,535	2,490	3,045	1,762
Percentage	20.9%	33.5%	43.7%	50.4%	77.5%	62.5%	69.1%	88.0%

Source: U.S. Census Bureau, 2000.

As **Table 5.1-3** shows, population growth in both Nueces County and the City of Corpus Christi has slowed over the past 30 years. Both the county and the city grew during each decade between 1970 and 2000, but the growth rate decreased with each decade. The state population also grew from 1970 to 2000, but it grew the most between 1970 and 1980 (27.1 percent).

TABLE 5.1-3
HISTORICAL POPULATION TRENDS FOR THE STATE OF TEXAS, NUECES COUNTY AND THE CITY OF CORPUS CHRISTI, 1970-2000

Year	State of Texas	Nueces County	City of Corpus Christi
1970	11,196,730	237,544	204,525
Percent Change 1970-1980	27.1%	12.9%	13.4%
1980	14,229,191	268,215	231,999
Percent Change 1980-1990	19.4%	8.5%	11.0%
1990	16,986,510	291,145	257,453
Percent Change 1990-2000	22.8%	7.7%	7.8%
2000	20,851,820	313,645	277,454

Sources: Texas Almanac, 1997.
U.S Census Bureau, 1990, 2000.

Both the Texas Water Development Board (TWDB) and the Texas State Data Center (TSDC) anticipate increased growth in Nueces County in the future. The highest growth estimate shown in **Table 5.1-4** was produced by the TSDC's 1.0 Migration Scenario, which anticipates that the county's population will increase from 313,645 persons in 2000 to 472,520 persons in 2030, an increase of 50.7 percent. The TSDC's 0.5 Migration Scenario produced the smallest growth estimate of 34.4 percent (increasing from 313,645 persons in 2000 to 421,507 persons in 2030). TSDC uses census data from 2000 as the basis for its population projections, when the population in Nueces County was 313,645 persons. The TWDB uses 1990 census data as its base; however, it is anticipated that TWDB's projections will be updated in the future to reflect 2000 census data.

TABLE 5.1-4
POPULATION PROJECTIONS FOR NUECES COUNTY, TEXAS

Year	Texas Water Development Board	Texas State Data Center	
	Most Likely Growth Scenario	0.5 Migration Scenario	1.0 Migration Scenario
2000	332,581	313,645	313,645
2010	374,552	352,073	364,482
2020	422,288	389,686	421,298
2030	470,779	421,507	472,520

Source: Texas Water Development Board, 2000. Texas State Data Center, 2000.

Based on data from the U.S. Census Bureau for 2000, economic indicators show that residents of Nueces County and the City of Corpus Christi were slightly more likely than the other residents of the State of Texas to live in poverty in 2000. The county and the city had higher percentages of persons living below poverty (18.2 percent and 17.3 percent, respectively), than the state (15.4 percent).

In addition, residents of Nueces County and Corpus Christi had lower median household incomes than residents of the state. Median household income was $35,959 for Nueces County in 1999, compared to $36,414 in Corpus Christi and $39,927 in Texas. It was still well above the poverty guideline of $18,400 in 2003 for a family of four (**Table 5.1-5**).

TABLE 5.1-5
OVERVIEW OF PROJECT AREA INCOME AND POVERTY RATES

	Median Household Income (1999)	Percentage of Persons Living Below Poverty (2000)
State of Texas	$39,927	15.4%
Nueces County	$35,959	18.2%
City of Corpus Christi	$36,414	17.6%

Source: U.S. Bureau of the Census, 2000.

Government employment provides the foundation for the Nueces County economy. According to the Corpus Christi Chamber of Commerce, the largest employers in the county are the Corpus Christi Naval Air Station, the Ingleside Naval Station, the Christus Spohn Health System, and the Corpus Christi Army Depot. Other major employers in Nueces County and the City of Corpus Christi include Bay Inc. (industrial construction), HEB, and Columbia Health Care Corporation.

From 1996 to 2000, overall employment in Nueces County increased by 5.7 percent (Texas Workforce Commission, 1996-2000). During that time, six employment sectors in the county experienced growth and five experienced declines. The two fastest growing sectors of the economy were "State Government" and "Transportation, Communications and Public Utilities," which experienced employment increases of 21.4 percent and 17.2 percent, respectively. Regarding absolute numbers of new jobs, the "Services & Other" and "Trade" sectors provided much of the new employment opportunities, adding 6,361 and 1,729 jobs respectively. Conversely, the "Local Government" and "Mining" sectors lost 938 and 918 jobs, respectively (**Table 5.1-6**).

TABLE 5.1-6
SECOND QUARTER EMPLOYMENT BY INDUSTRY FOR NUECES COUNTY, 1996-2000

	1996	1997	1998	1999	2000	% Change 1996-2000
Agriculture	1,077	1,115	1,094	1,030	1,176	9.2%
Mining	2,125	2,020	2,152	1,816	1,628	-23.4%
Construction	11,910	10,960	11,018	11,322	12,048	1.2%
Manufacturing	10,887	10,500	10,311	10,078	9,969	-8.4%
T.C.P.U.*	6,172	6,177	6,511	6,639	7,234	17.2%
Trade	32,381	33,006	33,640	34,130	34,110	5.3%
F.I.R.E.**	5,906	5,949	5,886	5,670	5,848	-1.0%
Services & Other	37,547	41,316	43,438	43,841	43,908	16.9%
State Government	3,582	3,735	4,156	4,268	4,347	21.4%
Local Government	17,893	16,773	16,901	16,996	16,955	-5.2%
Federal Government	5,609	5,895	5,488	5,394	5,603	-0.2%
Total Employment	135,089	137,446	140,595	141,184	142,826	5.7%

Source: Texas Workforce Commission. *Covered Employment and Wages by Industry and County – Second Quarter, 1996-2000.*

* Transportation, Communication and Public Utilities.

** Finance, Insurance and Real Estate.

The unemployment rate in Nueces County has generally been higher than in the state as a whole. Both the state and the county's unemployment rates declined between 1996 and 2001. The county's rate declined more than the state's, although it was still higher in Nueces County in 2001 (5.7 percent) than in the state (4.9 percent). Since December 2002, the unemployment rate in Nueces County was lower than in the state (**Table 5.1-7**).

TABLE 5.1-7
LABOR FORCE TRENDS IN NUECES COUNTY, 1996-2001

Year	State of Texas Unemployment Rate	Nueces County Unemployment Rate	Nueces County Civilian Labor Force
1996	5.6%	8.4%	148,179
1997	5.4%	7.8%	147,498
1998	4.8%	6.8%	146,252
1999	4.6%	6.6%	146,070
2000	4.2%	6.3%	144,369
2001	4.9%	5.7%	144,506
2002	6.3%	6.1%	148,816

Source: Texas Workforce Commission. *Texas Civilian Labor Force Estimates Actual – Not Seasonally Adjusted, 1996-2002.*

5.1.1.2 Economic Impacts of the Port of Corpus Christi

Seaport activity impacts local, state, and regional economies by generating direct and indirect jobs, revenue, and taxes. The Port of Corpus Christi is the fifth largest port in the United States and acts as a hub for international trade. The greater economic impact of the port was measured by examining the number of jobs created, business revenue generated, and the amount of state and local taxes produced by port activities.

Seaport activity at the Port of Corpus Christi generated 31,000 jobs in 1995 (including direct, indirect, induced, and related jobs) and these jobs resulted in $1.1 billion in total personal income. In 1995, port-related activities generated $1 billion in business revenue, $66.3 million in state and local taxes, and $18 million in U.S. Customs revenue.

5.1.2 EXISTING LAND USES

This section provides a regional and site-specific description of land use in the project area. A summary of land cover and land use for Nueces County is included in **Table 5.1-8**. Existing land use in the project vicinity is mixed, consisting of commercial properties, single and multi-family residential areas, oil and gas production facilities, industrial facilities, public facilities, parks, religious facilities, museums, and undeveloped land (**Plate 1**).

Land use in the northern portion of the project area surrounding Industrial Canal and south to I-37 is primarily industrial, with oil and gas processing facilities comprising the majority of the land use. However, just north of I-37 near the interchange with SH 358 (South Padre Island Drive), there are two religiously affiliated schools, a church, and two large residential areas.

The remainder of the project area is composed of fewer industrial facilities and a larger concentration of residential, educational, community, and religious facilities. The most densely developed portion of the project area is located just east of the Crosstown Expressway (Loop 286), both north and south of I-37. Within this area, there are 12 religious facilities, 3 schools, 3 parks, a cemetery, and numerous government buildings.

TABLE 5.1-8
LAND COVER AND LAND USE FOR NUECES COUNTY (1997)

Land Cover/Land Use	Coverage %
Other	0.00%
Cropland cultivated	44.78%
Cropland non-cultivated	0.00%
Pastureland	5.37%
Rangeland	8.07%
Forest land	0.00%
Minor Land Cover	4.79%
Urban Built up	12.21%
Rural	1.43%
Water-small-streams*	0.39%
Water-census-streams**	22.4%
Federal lands	0.37%
Conservation Reserve	0.19%
Total area	700,100 acres

* < 660 feet wide and water bodies <40 acres est.
** >= 660 feet wide and water bodies >= 40 acres est.
Source: Natural Resources Conservation Service,
U.S. Department of Agriculture, 1997.

East of U.S. 181 and north of Harbor Bridge, land use is also mixed with two churches, four parks, and a number of industrial and commercial facilities. There are also a few residential areas interspersed with patches of undeveloped land. The Texas State Aquarium is located in this area, directly adjacent to U.S. 181 on the southeastern corner of Corpus Christi Bay. East of U.S. 181 and south of Harbor Bridge, development is fairly dense. There are a number of government buildings including a fire station, Chamber of Commerce buildings, and the U.S. Courthouse. Heritage Park, the Convention Center, and a number of museums are all located adjacent to U.S. 181 and south of the Harbor Bridge.

5.1.2.1 Section 4(f) of the Department of Transportation Act

Section 4(f) of the Department of Transportation Act of 1966, as amended, provides for the protection of certain lands affected by transportation projects. Section 4(f) states that the Secretary of Transportation may not approve any program or project that requires the use of land from a publicly owned park, recreational area, or wildlife and waterfowl refuge of national, state, or local significance (as determined by the official having jurisdiction thereof) or any significant historic site, unless there is no feasible and prudent alternative to the use of such land and the proposed action includes all possible planning to minimize harm.

The potential use of a Section 4(f) property may be either direct or indirect. Direct use is typically considered to include the acquisition of property or the modification or relocation of facilities. Indirect impacts from a proposed action may also adversely affect a Section 4(f) site. Such impacts might include changes in access, visual impacts, increased noise levels, and other similar effects. If indirect impacts are substantial, they are considered "constructive uses" which are described in 23 CFR Part 771.135(p) (2):

> *"Constructive use occurs when the transportation project does not incorporate land from a Section 4(f) resource, but the project's proximity impacts are so severe that the protected activities, features, or attributes that qualify a resource for protection under section 4(f) are substantially impaired. Substantial impairment occurs only when the protected activities, features or attributes of the resources are substantially diminished."*

There are six publicly owned parks located within the study area: T.C. Ayers Park, Artesian Park, Heritage Park, Dr. H. J. Williams Memorial Park, Catamaran Sail Park, and Lovenskiold Park. All known parkland in the project area is illustrated on **Plate 1** (see Map Pocket). In addition, a number of structures listed on the National Register of Historic Places (NRHP) are located within the study area.

5.1.2.2 Section 6(f) of the Land and Water Conservation Fund Act

Section 6(f) of the Land and Water Conservation Fund Act requires that recreational facilities that receive U.S. Department of Interior (DOI) funding under the Land and Water Conservation Fund Act, as allocated by the Texas Parks and Wildlife Department (TPWD), may not be converted to non-recreational uses unless approval is received from the Director of the National Park Service and from TPWD. Section 6(f) properties could be affected by the project alternatives, and are discussed in **Section 5.1.3**. A preliminary review of the six publicly owned parks located within the study area reveals that none of these parks qualify as a Section 6(f) property. During the preparation of the environmental document during the next phase of this project, another review of these publicly owned parks should be conducted to confirm their status.

5.1.3 POTENTIAL IMPACTS

5.1.3.1 U.S. 181 Harbor Bridge Issues

Social/Economic - There are a number of potential social and economic impacts that could result from the construction of the Harbor Bridge. The bridge would become the dominant visual feature in the project area. Residents with an uninterrupted view of the water may consider the blue alternative corridor intrusive. The most substantial social impacts could be to community cohesion, neighborhood travel patterns, and school/church/community facility continuity, depending on the chosen design and route of the roadway facility. The red alternative alignment corridor could displace as many as five public facilities, including a Corpus Christi low-income public housing complex, a senior center, and a health center. The orange alternative alignment corridor could displace four public facilities, and the green alternative alignment corridor could displace nine public facilities, one school, and four churches. The blue alternative alignment corridor could displace six public facilities, one school, and two churches.

In addition, census data suggest that there may be relocation effects in areas where minority or low-income populations exist in percentages greater than the county and state averages. The green alternative corridor would encompass the largest number of potential residential relocations (111), followed by the orange (87), red (71), and blue (39) (**Table 5.1-9**). Since the required relocations for all four alternatives would impact primarily minority residents, environmental justice issues may have to be considered. To address potential environmental justice concerns, TxDOT should continue to proactively identify potentially affected groups and individuals, communicate with those residents through a variety of traditional and non-traditional media, and make every effort to involve those residents in all future aspects of the project planning process. Involvement of a Citizen's Advisory Committee during this feasibility study has been a useful endeavor and could serve as a model for future project related outreach.

The potential positive impacts associated with the project include improved access to commercial and industrial areas, upgrading of the Port's ability to accommodate larger vessels in the future, and opportunity to enhance planned economic development within the study area.

Existing Land Uses - Impacts to existing land uses could involve the relocation of residences, displacement of businesses, increased noise levels at adjacent receivers, impacts to parkland, and potential impacts to oil and gas facilities. In addition, secondary development should be addressed during subsequent project development phases. Potential relocations and displacements within each of the four 600-foot corridors evaluated are summarized in **Table 5.1-9**.

TABLE 5.1-9
POTENTIAL RELOCATIONS/DISPLACEMENTS

	Alternative			
	Red	**Orange**	**Green**	**Blue**
Business	3	6	52	36
Industrial	14	30	23	0
Church	0	0	4	2
School	0	0	1	1
Public facilities.	5	4	9	6
Residential	71	87	111	39

Note: Quantities are within a 600-foot corridor.

Section 4(f)/6(f) Issues - All of the alternatives could impact publicly owned parks in the project area. The red and orange alternative corridors each encompass, and could potentially impact, two parks (T.C. Ayers Park ball fields and swimming pool), a total of 7.13 acres of parkland. The green alternative could impact portions of three parks (T.C. Ayers Park, Lovenskiold Park and Heritage Park), a total of 1.76 acres of parkland. The blue alternative could impact four parks (T.C. Ayers Park, Lovenskiold Park, and two parks located near the county courthouse). All alternatives would likely impact T.C. Ayers Park, located north of I-37; the blue and green alternative alignments would impact only the south side of the park, but the red and orange alternatives would impact the entire park, including the ball fields and swimming pool.

Future NEPA analyses would likely require a formal Section 4(f) and 6(f) evaluation in order to identify potential avoidance options and, if avoidance is infeasible, identify potential replacement options. This exercise would be an appropriate time to involve affected residents in the process of identifying compensatory solutions for project related impacts.

5.1.3.2 Tule Lake Lift Bridge Issues

Social and economic effects would be minimal for all of the Tule Lake Lift Bridge alternatives considered. No residential relocations and only one business displacement would be required. No neighborhoods would be impacted, and no environmental justice issues are anticipated. No parkland would be impacted.

5.2 WETLANDS/WATERS OF THE U.S.

5.2.1 EXISTING CONDITIONS

Wetlands are transitional areas between terrestrial and aquatic systems that are defined according to three criteria: 1) the presence of hydrophytic vegetation, 2) hydric soil characteristics, and 3) wetland hydrology. Wetlands are afforded protection under the Clean Water Act (CWA) with regulatory enforcement responsibility delegated to the U.S. Army Corps of Engineers (USACE).

In addition to the jurisdictional wetlands defined above, the CWA regulates impacts to other waters of the United States. The term "waters of the United States" has broad meaning and incorporates both deepwater aquatic habitats and special aquatic sites, including wetlands, as listed below:

a. The territorial seas with respect to the discharge of fill material.

b. Coastal and inland waters, lakes, rivers, and streams that are navigable waters of the United States, including their adjacent wetlands.

c. Tributaries to navigable waters of the United States, including adjacent wetlands.

d. Interstate waters and their tributaries, including adjacent wetlands.

e. All other waters of the United States not identified above, such as lakes, intermittent streams, prairie potholes, and other waters that are not a part of a tributary system to interstate waters or navigable waters of the United States, the degradation or destruction of which could affect interstate commerce. A recent Supreme Court ruling found that many wetlands that are not adjacent to navigable waters (isolated wetlands) are not, in fact, subject to USACE jurisdiction.

This section generally describes the project area's wetland resources as interpreted through U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps and limited field investigations. The NWI maps are not based upon and do not necessarily correspond with wetlands as delineated using USACE guidelines, but they are a useful first tool in determining the likely presence and approximate boundaries of wetland features in an area. Wetland habitat within the broad project area can be broken into three main categories: nontidally influenced high marsh, tidally influenced low marsh, and sub-tidal waters. Dominant vegetation within the high and low marshes is similar, and consists of cordgrasses (*Spartina* spp.), seashore saltgrass (*Distichlis spicata*), saltwort (*Batis maritima*), and dropseed (*Sporobolus* spp.). Associated intertidal areas are dominated by black mangrove (*Avicennia germinans*) and bushy sea-ox-eye (*Borrichia frutescens*). Sub-tidal waters are dominant within the study area and include the permanently inundated channels of the Gulf Intracoastal Waterway (GIWW), the Corpus Christi Channel, as well as open bay bottom in Corpus Christi Bay.

A field visit was made to the project area to examine and confirm the occurrence of various features and communities identified on NWI maps, but no formal field determination or delineation of wetlands was conducted for this feasibility study. Emergent wetlands identified on the NWI maps are illustrated on **Plate 1** and **Figure 5.1-1**.

5.2.2 EFFECTS ON WETLANDS/WATERS OF THE U.S.

Construction of any of the proposed alternatives could result in impacts to wetlands and subtidal waters. These impacts would be associated with the need to place fill material and piers in areas containing wetlands and bay bottom habitats. Potential impacts to wetlands and waters of the U.S. are described below and in **Table 5.2-1**.

5.2.2.1 Harbor Bridge

All route alternatives would result in direct impacts to wetlands and other waters of the U.S. The red alternative corridor would potentially impact approximately 7.51 acres of emergent wetlands and cross approximately 1,502 linear feet of open water. The orange alternative corridor would potentially impact approximately 3.53 acres of emergent wetlands and cross approximately 651 linear feet of open water. The green alternative corridor would impact approximately 3.53 acres of emergent wetlands and cross approximately 651 linear feet of open water. The blue alternative corridor would impact approximately 3.69 acres of emergent wetlands and cross approximately 7,190 linear feet of open water.

5.2.2.2 Tule Lake Lift Bridge

All route alternatives would result in direct impacts to wetlands and/or other waters of the U.S. The two low-level alternatives and the mid-level alternatives without railroad would cross approximately 1,037 linear feet of open water (the ship Channel). The mid-level alternative with railroad would have a total length of 1,956 feet, with the railway bridge crossing approximately 919 linear feet of open water, and the roadway bridge crossing approximately 1,037 linear feet of open water. The four corridors evaluated would potentially impact between 0.07 and 0.80 acres of emergent wetlands illustrated in **Table 5.2-1**.

TABLE 5.2-1
POTENTIAL WETLAND/WATER OF THE U.S. EFFECTS

Alternative	NWI Wetlands (Acre)	Waters of the U.S. (Acre)	Total (Acre)
Harbor Bridge - Red Corridor	7.51	18.62	26.13
Harbor Bridge - Orange Corridor	3.53	8.98	12.51
Harbor Bridge - Green Corridor	3.53	8.98	12.51
Harbor Bridge - Blue Corridor	3.69	100.36	104.1
Tule Lake – Low-Level without railroad	0.55	2.27	2.82
Tule Lake – Low-Level with railroad	0.74	2.71	3.45
Tule Lake – Mid-Level with railroad	0.07	1.53	1.60
Tule Lake – Mid-Level without railroad	0.80	3.64	4.44

5.3 AQUATIC RESOURCES

5.3.1 FISHERIES

The major fisheries in and around the Corpus Christi Bay System are commercial shrimping, fin fishing, shellfishing, and recreational fishing. These industries contribute nearly $1 billion to the Gulf Coast economy annually (USDOC, 1994). Commercial and recreational fishing in the Corpus Christi Bay alone contribute more than $350 million per year to the local economy (American Oceans Campaign, 1996). In the 1990s most of the commercial fisheries in Texas experienced some amount of decline, while some have crashed severely, in part due to destruction of important nursery habitat, nonpoint source pollution, and channelization of floodwaters.

Nationwide, one in five Americans over the age of six spend on average $1,200 a year on sport-fishing-related items such as equipment, licenses, and travel. The nation's annual spending on recreational fishing totaled $42 billion in 2001, and supports more than 1 million jobs (or about 1 percent of the U.S. civilian labor force). In Nueces and San Patricio counties alone there are over 12,000 registered recreational boats (USFWS, 2001). The Corpus Christi Chamber of Commerce estimates that port-related companies employed approximately 50,000 people in the Corpus Christi area in 2001 (Corpus Christi Chamber of Commerce, 2003).

The Texas shrimp industry landed over 84 million pounds or $187 million worth of shrimp in 1998 (NMFS, 2000), making it one of the most valuable seafood industries in the United States (TPWD, 2000). Brown, white, and pink shrimp (family Penaeidae) are caught in shrimping trawls after migrating at maturity from nursery estuaries to deep bay waters or to the open water of the Gulf of Mexico. Shrimp of minor commercial value, making up less than 20 percent of total annual catch, include the seabob, rock shrimp, royal red shrimp, and others. Live shrimp are also used for bait by the sport fishing industry. In 1995, the state legislature passed limited entry legislation, restricting the number of shrimping licenses, in order to improve the health and stabilize the size of the shrimp population in Texas waters.

The fin fish (mostly black drum fish or flounder) and crabbing industries also began limited entry and license buyback programs in 1999 and 1997, respectively, to prevent overfishing and to promote economic stability for fishermen. Over 90 different crabs live in Texas waters, but the blue crab (*Callinectes sapidus*) is the most common edible crab. It is the most economically important in Texas, bringing in over $4 million in 1998. Blue crabs grow to maturity in an estuary's muddy bottom, and after mating to females move to saltier areas of the bay or into the Gulf, while the females remain. Crabs are caught with traps, trawls, or trotlines, and the annual catch ranged from 6.9 to 11.7 million pounds between the years 1977 and 1989.

Fin fish resources are of great value to the project area economy due to recreational and commercial harvest. Recreational fishing occurs throughout the project area, particularly in Nueces Bay, the shallow shorelines of Corpus Christi Bay, and the shallow coves and flats behind Mustang Island. Nearby Aransas Bay, Upper Laguna Madre, and Baffin Bay are also popular fishing locations. The most important recreational species harvested in the project area are redfish (*Sciaenops ocellatus*), southern flounder (*Paralicthys lethostigma*), black drum (*Pogonias cromis*), spotted seatrout (*Cynoscion nebulosus*), Atlantic croaker (*Micropogonias undulatu*), and blue crab (*Callinectes sapidus*).

5.3.3 SEAGRASS BEDS

Seagrass beds serve as critical nursery habitat for numerous species, including fish and shellfish, which are of commercial and recreational importance. It is estimated that 98 percent of commercial landings in the Gulf waters of Texas are dependent on seagrass beds. Hydrologic functions of seagrasses include the stabilization of coastal sedimentation and erosion processes, in addition to indicating water quality and ecosystem health. Texas has approximately 235,000 acres of seagrasses, primarily in the Laguna Madre (Pulich et al., 1997). Five genera of seagrasses (not true grasses) occur along the Texas Gulf Coast (*Halodule*, *Thalassia*, *Syringodium, Halophila*, and *Ruppia*). No seagrasses are known to occur within the project area.

5.3.4 OYSTER REEFS

There are a few scattered reefs of the Eastern oyster (*Cassostrea virginica*) in Corpus Christi Bay (Pulich et al., 1997). The Corpus Christi National Estuary Report (CCNEP-06C, 1996) found most oyster reefs in Corpus Christi Bay to be dead, but did find living oyster reefs in Nueces Bay and the intertidal zone. No oyster reefs are known to occur within the project area.

5.3.5 ESTUARIES

Estuaries are defined as semi-enclosed coastal bodies of water having saltwater inflow and being diluted by freshwater inflow. Estuarine habitat is used for shelter, cover, and nursery and spawning grounds by many commercially and recreationally important species including fish, shrimp, crabs, oysters, and clams. In addition, many bird, reptile, and mammal species utilize estuarine habitat. Texas has approximately 560,000 acres of estuarine wetlands, about 10 percent of the total estuarine habitat in the U.S. Estuarine wetlands in Texas sustained a net loss of about 60,000 acres (a 9.5 percent decrease) in the last 40 years (Moulton et. al, 1997). The Corpus Christi Bay System includes 25 bays and saltwater bayous, covering an area of 600 square miles.

Fresh water inflows to the saltwater of Corpus Christi Bay create unique brackish or low salinity ecosystems. Estuarine habitats include salt marsh, tidal freshwater marsh, seagrass, mangrove, oyster reef, and shallow open water bottom. Fisheries of the Gulf coast are highly dependent on these habitats, which are responsible for 20 to 70 percent (depending on the species) of the commercial fishery production in Texas.

Estuarine habitats receive nonpoint pollution (sediment and nutrient loaded runoff), which can cause the water to be murky, lacking sufficient oxygen to support life and oysters and resulting in inedible fish. Discharged water from chemical industry and municipal treatment plants can contain concentrated organic chemicals and matter, petroleum byproducts, heavy metals, nutrients, and heat. Turbidity or lack of water clarity prevents light penetration and effects the production of the most basic elements of the estuary food web.

Freshwater inflow, however, is critical in maintaining a healthy estuary by providing needed nutrients and sediments in manageable amounts, salinity dilution, and providing season cycles and flood patterns for aquatic organisms. Oysters depend on freshwater to defend marine predators and disease. The system’s primary sources of freshwater are the San Antonio, Mission, Aransas, and Nueces Rivers, and the Lake Corpus Christi and Choke Canyon Reservoirs, that affect the quality and timing of freshwater input. Freshwater usage by agricultural and urban and industrial users leaves only a small percentage of the total freshwater output for the estuary. Urban development along coastal fringe land and constructed bulkheads can alter the location where freshwater are input to the bay, and estuarine ecosystems in these urbanized areas are often less capable of or not adapted to dealing with that input.

5.3.6 AQUATIC COMMERCE

The Corpus Christi Bay system contributes to the local economy directly through revenue from recreation and tourism as well as fisheries and seafood industries. Approximately 2.8 million people visit the city of Corpus Christi each year. The average total economic output from tourism in the city is $1.3 billion per year. In 1986, the most recent year for which data are available, sport fishing in just the Corpus Christi and Aransas bays contributed $246 million to the local economy (American Oceans Campaign, 1996).

In 1994, the market value for all commercial fin fish and shellfish in the Gulf Coast area was $806 million (USDOC, 1994). Many of these commercially valuable species rely on Corpus Christi Bay for survival during some portion of their life cycles.

The Port of Corpus Christi, the deepest port in the Gulf of Mexico, supports many commercial activities in the local area. In 2002, the port's top 10 commodities included various oil and gasoline products, bauxite ore, and slop and slurry. A total of 6,860 ships or barges used the port in 2001 and transported 87,035,957 tons of material.

5.3.7 EFFECTS ON AQUATIC RESOURCES

5.3.7.1 Harbor Bridge

In general, if construction of any of the proposed routes results in more or deeper dredging of the Ship Channel or the bay bottom, it could adversely impact the water quality of the bay. If dredging must occur, the dredged material should be placed somewhere of benefit, such as a near shore open water area that could be made into a shallow bottom wetland that could benefit a number of organisms. The blue alternative corridor would have the highest potential for negative impacts due to its length and protrusion out into Corpus Christi Bay. The other options would essentially involve construction of a bridge over a perpendicular, linear feature (the Ship Channel).

None of the route alternatives would directly impact known seagrass beds or oyster reefs.

5.3.7.2 Tule Lake Lift Bridge

Comparable impacts would be anticipated in association with all of the Tule Lake options. The disturbed nature of the bridge location (the channel is periodically dredged for maintenance) results in a fairly low quality aquatic resource. Nevertheless, efforts should be undertaken throughout the project planning process to identify construction methods that minimize the potential for water quality degradation.

5.4 WATER QUALITY ISSUES

5.4.1 SURFACE WATER

5.4.1.1 Existing Conditions

Regional Surface Water - The Corpus Christi Bay System encompasses approximately 600 square miles of bay and estuary. The average depth of the bay is eight feet. The Nueces River Basin is the regional watershed, covering 11,000 square miles and portions of 12 counties. The system's primary sources of surface water are the San Antonio, Mission, Aransas, and Nueces rivers, and the Lake Corpus Christi and Choke Canyon reservoirs.

Surface water features near the immediate project area include the Nueces River, Rincon Bayou, Tule Lake, and the Tule Lake/Corpus Christi Ship Channel (Channel). The Ship Channel is a navigation channel that connects harbor facilities at Corpus Christi and Aransas Pass. In April 2003 the USACE published a Final Environmental Impact Statement and Feasibility Report (USACE, 2003) for deepening and widening the channel in response to increased shipping activity. Tule Lake is located just south of the Channel and drains into the channel. It is approximately 1 mile long and 0.25 mile wide at its broadest point. Little information exists on the ecological condition of the area.

5.4.1.2 Surface Water Impacts

Impacts to surface water features can be grouped into two categories: short-term and long-term. Short–term impacts are those typically associated with construction activities. Long-term impacts are those that last for at least the life of the project.

Highway construction activities have the potential to adversely affect water quality, especially close to river and stream crossings. Such activities, if not properly controlled, can cause an increase in turbidity and sediments that are potentially damaging to delicate aquatic ecosystems. Potentially harmful construction activities include land clearing operations, roadway preparation with heavy machinery, and other construction related operations.

Long-term project impacts on adjacent waters may include effects on both water quantity and quality. The placement of fill into jurisdictional waters (including adjacent wetlands) would require a permit under the CWA. If the project requires channelization or other modification of a body of water, regulatory coordination with the U.S. Fish and Wildlife Service (USFWS) under the Fish & Wildlife Coordination Act is required. These requirements are discussed further in **Section 5.10**.

Long-term highway-related water quality impacts might include a decrease in water quality due to non-point source pollutants such as oil, grease, and sediments from motor vehicles. TxDOT is currently operating under a Memorandum of Agreement (MOA) with the Texas Commission on Environmental Quality (TCEQ) regarding efforts to minimize non-point source pollution from roadways. Pollution associated with highway-related secondary development could further decrease the quality of aquatic and wetland ecosystems. Water quality effects may occur in places where bridges are improved to accommodate increased traffic volumes, as well as where new bridges are built. Since both of the projects being evaluated involve the replacement of existing bridges, the primary potential for changes to water quality would occur during construction.

5.4.2 GROUNDWATER

5.4.2.1 Existing Conditions

The major source of groundwater in the project area is the Gulf Coast Aquifer. This aquifer extends along the Texas coastal plain from the Sabine River in the east to western Starr County in south Texas and extends approximately 100 miles inland. The Gulf Coast Aquifer is a complex system of interbedded sands and shales extending to a maximum depth of 2,600 feet.

The net sand thickness of the aquifer ranges from 200 feet to more than 1,000 feet. Yields of high capacity wells average about 1,500 gallons per minute (gpm) but may locally produce up to 3,200 gpm. The quality of water in the aquifer ranges from fresh to slightly saline. Over much of the area dissolved solids are less than 500 milligrams per liter (mg/l). According to reports and maps produced by the TWDB no water supply wells occur within the project area, including domestic, stock tank, and observation wells.

Subsidence is a major groundwater concern for the project area and much of the Gulf Coast. Subsidence is occurring as a result of overpumping the Gulf Coast aquifer. Much of the groundwater usage has been replaced by surface water sources to halt further subsidence. The resulting decrease in groundwater withdrawal will also help remedy the problem of saltwater intrusion into the fresh water aquifer.

5.4.2.2 Groundwater Impacts

No substantial impact to the quality or quantity of groundwater in the project area would be expected due to the construction of any of the discussed alternatives. Consistent with the recommendation of the TCEQ, the Corpus Christi District should ensure that, prior to initiation of construction, drill holes resulting from core sampling on-site and down-gradient of the site be plugged from the bottom of the hole to the top of the hole, in order to prevent water or contaminants from entering the subsurface environment. In addition, any private, unrecorded water wells that occur within the proposed right-of-way should be plugged utilizing currently accepted methods in order to protect groundwater.

5.5 HAZARDOUS MATERIAL IMPACTS

Known hazardous material sites generally are identified through the due diligence process that will be described in **Section 5.10.7**. Hazardous material sites typically require some form of notification, identification, or registration with a regulatory agency. A large number of these sites show up on multiple agency databases. Database research companies obtain and maintain these records.

An initial review of information gathered from numerous environmental databases by Environmental Data Resources (EDR) revealed 494 agency hazardous material sites within a 2-mile radius of the existing Harbor Bridge. Of the 494 sites identified, approximately 240 are individual sites that store, use, or have had a release of hazardous materials. These include 58 Resource Conservation and Recovery Act (RCRA)-regulated sites generally identified as using, storing, or having a release of hazardous materials, 71 leaking underground storage tank sites generally identified as having known releases of hazardous materials (typically motor fuel), and 121 underground storage tank sites generally identified as storing hazardous materials (motor fuel). Hazardous material sites not identified in the initial assessment, EDR report or other database listings will require identification through due diligence processes as described in **Section 5.10.7**.

Regulations that address releases of hazardous materials to the environment are enforced by the TCEQ, the Texas General Land Office (GLO), the U.S. Coast Guard, the Texas Railroad Commission (TRC), TxDOT, and the U.S. Department of Transportation (USDOT). The location of a hazardous material release (ground surface, water body, subsurface, groundwater, etc.) and the facility/owner status (industrial facility, gas station owner, oil producing company, etc.) essentially dictates which state or federal enforcement agency will be involved. For example, an oil release to Corpus Christi Bay would be the initial responsibility of the GLO and the U.S. Coast Guard, with the TCEQ and TRC having the responsibility for enforcing remediation standards after the initial spill response. Releases from underground fuel storage tanks are primarily managed by the TCEQ, as are industrial hazardous waste release sites. Ultimately, most hazardous material impacts are going to be the responsibility of the TCEQ, who implements and enforces the Clean Water Act (CWA), Clean Air Act (CAA), RCRA, and the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS).

Numerous remediation programs for addressing hazardous material impacts are in place at the TCEQ and TRC. These programs allow landowners or responsible parties to mitigate hazardous material releases by providing cleanup standards, risk assessment, and legal programs. These programs include, but are not limited to, the following:

- TCEQ Texas Risk Reduction Program (TRRP)
- TCEQ Spill Response Rules (30 TAC 327)
- TCEQ Brownfields Program
- TCEQ Texas Voluntary Cleanup Program
- TCEQ Superfund Program
- TCEQ Underground Storage Tank Program
- TCEQ Innocent Owner/Operator Program
- TRC Rule 8 Water Protection

- TRC Rule 91 Oil Spill Cleanup

All releases of hazardous materials require immediate response to ensure protection to human health and the environment. Acquisition or assumption of hazardous material release sites may include short and/or long term and costly remediation and/or risk evaluation. Hazardous material release sites should be identified and avoided where possible using standard industry techniques for due diligence as described in **Section 5.10.7**.

5.6 FLOODPLAINS/DRAINAGE

5.6.1 EXISTING CONDITIONS

Floodplains are defined by Executive Order 11988, Floodplain Management, as "the relatively flat areas adjoining the inland and coastal waters, including floodprone areas of offshore islands, including at a minimum, that area subject to a one percent or greater chance of flooding in any given year, i.e., those areas which would be inundated by a 100-year flood."

A large portion of the project area is located within areas mapped on the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Maps (FIRM) as occurring within the 100-year floodplain. FEMA administers the National Flood Insurance Program (NFIP). This program mandates that development projects that create an increase of more than one foot in the base flood elevation or encroach upon any regulatory floodway require an engineering study quantifying these effects plus the notification of all affected parties.

5.6.2 EFFECTS ON FLOODPLAINS

All of the bridge alternatives would traverse areas within the 100-year floodplain, as identified by FEMA. The amount of fill placed within floodplain areas would be dependent upon the ultimate span length, roadway width and design, and method of structural protection.

Since this project would encroach on the 100-year floodplain, it should be evaluated with respect to the following: the level of flooding risk; effects on beneficial floodplain values; the extent to which the project may support incompatible floodplain development; and measures to minimize floodplain impacts and to preserve beneficial floodplain values. The floodplain assessment should state whether the county or other local jurisdiction is a participant in the NFIP and should be included in the NEPA document.

Executive Order 11988, "Floodplain Management" requires federal agencies to avoid actions, to the extent practicable, which will result in the location of facilities in floodplains and/or affect floodplain values. If the project is approved for further study, hydraulic studies will be carried out to ensure that the project would not increase base flood elevations to a level that would violate applicable floodplain regulations and ordinances.

5.7 COASTAL ZONE ISSUES

5.7.1 TEXAS COASTAL MANAGEMENT PROGRAM

Between 1989 and 1995, Texas established the Coastal Coordination Council (CCC) pursuant to the Coastal Zone Management Act of 1972. The CCC published rules and established the Texas Coastal Management Program (TCMP) in 1997. The TCMP is based primarily on the Coastal Coordination Act of 1991. The TCMP set up rules to protect certain coastal natural resources and required that certain proposed actions within the boundary of the TCMP be consistent with the goals and policies of the TCMP, including fill and dredging activities.

The entire Corpus Christi Bay system is within the boundary of the TCMP. Sections of Mustang Island are included in the Coastal Barrier Resource System's list of designated Coastal Barrier Resources; however, none of these designated areas fall within the project area.

5.8 ECOLOGICAL RESOURCES/THREATENED AND ENDANGERED SPECIES

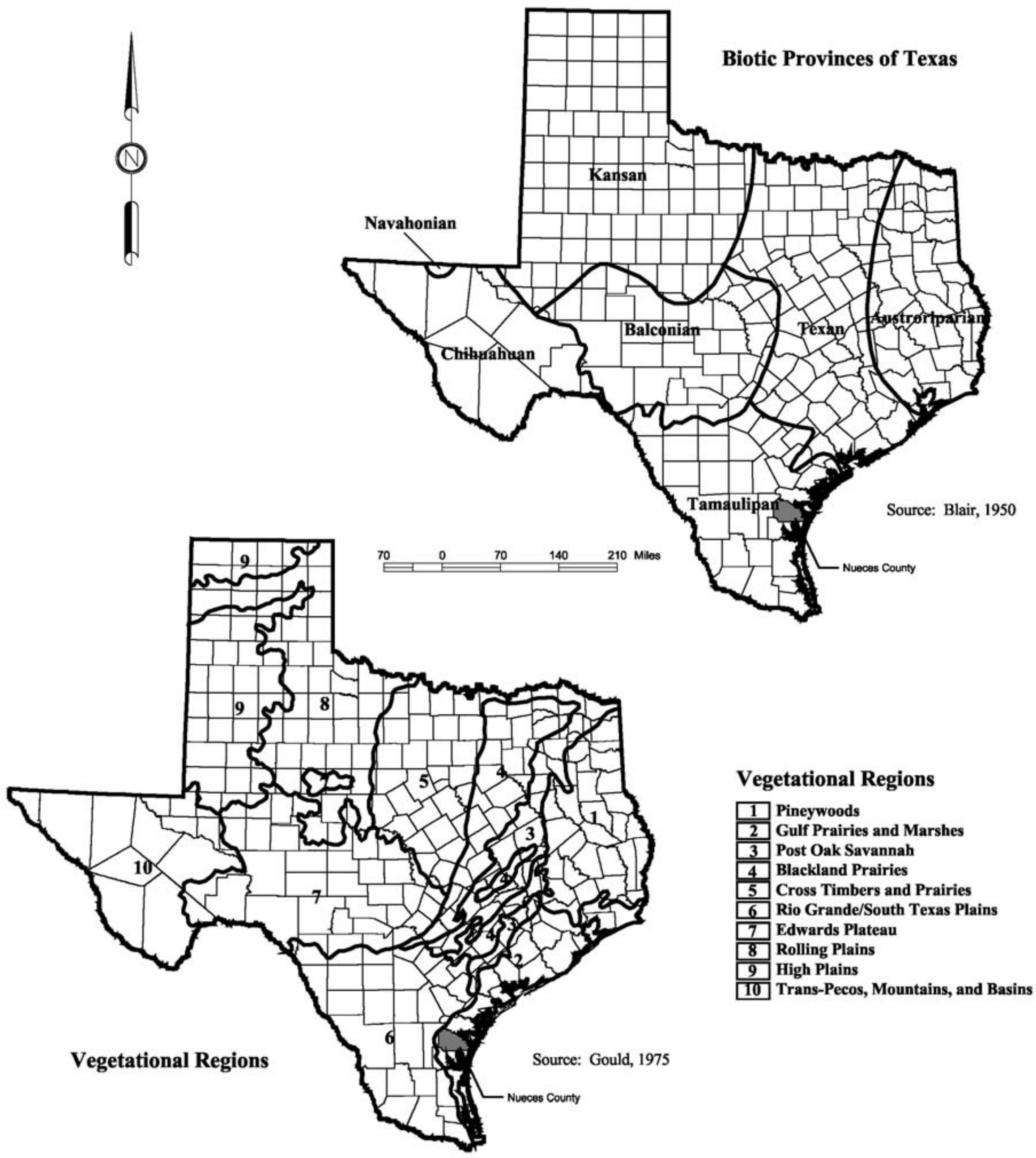
This section addresses regional and site-specific aspects of the U.S. 181 Harbor Bridge project area's ecological resources. Potential impacts associated with the preliminary route alternatives are also discussed. The following sections deal with the vegetation, terrestrial wildlife, and threatened or endangered resources in the region and local area.

5.8.1 VEGETATION

5.8.1.1 Existing Vegetation

This section provides a regional and site-specific description of terrestrial vegetation for the U.S. 181 Harbor Bridge project. The project lies within the Gulf Prairies and Marshes Vegetation Area of Texas (Gould, 1975). This vegetation area extends in an arc along the Coastal Bend and occupies approximately 9.5 million acres. Marshes represent approximately 500,000 of the 9.5 million acres, with prairies occupying the remainder of this vegetation area in Texas. The Marsh Area is limited to narrow belts of low wet marsh interspersed with dunes adjacent to the coast. The Gulf Prairies and Marshes Vegetation Area is a nearly level, slowly drained plain less than 150 feet above mean sea level. The project location, in relation to the Vegetation Areas of Texas, is illustrated in **Figure 5.8-1**. Because the project area occurs in a bay setting, the discussion of the Gulf Prairies and Marshes Vegetation Area presented below focuses on coastal communities.

FIGURE 5.8-1
VEGETATIONAL REGIONS AND BIOTIC PROVINCES OF TEXAS



Gulf Marsh vegetation community composition varies according to salinity regimes within the habitat. Typical emergent Gulf Marsh plants include sedges (*Carex* spp. and *Cyperus* spp.), rushes (*Juncus* spp.), cordgrass (*Spartina* spp.), saltwort (*Batis maritima*), glasswort (*Salicornia* spp.), seashore saltgrass (*Distichlis spicata*), sea ox-eye daisy (*Borrichia frutescens*), bulrush (*Scirpus* spp), dropseed (*Sporobolus* spp.), common reed (*Phragmites australis*), marshmillet (*Zizaniopsis miliacea*), and maidencane (*Panicum hemitotum*). Aquatic forbs common in the Gulf Marshes are pepperweeds (*Lepidium* spp.), smartweeds (*Polygonum* spp.), docks (*Rumex* spp.), bushy seedbox (*Ludwigia alternifolia*), pennyworts (*Hydrocotyle* spp.), narrowleaf cattail (*Typha domingensis*), spiderworts (*Tradescantia* spp.), and duckweed (*Lemna* spp.). Salty soils of sand and mudflat communities of the Gulf Prairie and Marsh Vegetation Area support a unique assemblage of halophytic species. Common herbaceous and woody plants of this community type include spikesedges (*Eleocharis* spp.), fimbries (*Fimbristylis* spp.), glassworts, sea rockets (*Cakile* spp.), maritime saltwort (*Batis maritima*), morning glories (*Ipomoea* spp.), and sea ox-eye daisy (*Leucanthemum vulgare*) (Hatch et al., 1990).

Subtidal marine algae are found in moderate numbers within the estuaries. Typical algal species include *Acetabularia* spp., *Cladophora* spp., *Dictyota* spp., *Ectocarpus* spp. and *Giffordia* spp. These species typically prefer shell debris or other similar substratum for attachment and are not known for prolonged survival on sands or mud sediments.

The majority of Nueces County has been cleared for agriculture or urban land uses. McMahan et al. (1984) note that mesquite-blackbrush brush occurs along the Atascosa River in the northern part of the county. Also, a mesquite-granjeno (*Celtis pallida*) vegetation assemblage begins south of Oso Bay, in the southeastern portion of the county, and extends south to northern Willacy, Hidalgo, and Starr Counties and southwest to eastern Jim Hogg County.

5.8.1.2 Effects on Vegetation

Roadway improvement projects have the potential to adversely impact plant and animal life either directly, through destroying individuals during construction or operation, or indirectly, through disturbance or impairment of terrestrial wetland or aquatic habitats. Potential wetlands affects are discussed in **Section 5.2**. The nature of terrestrial impacts will generally depend on the amount and quality of vegetation affected by a project. In general, the study area is highly developed, with industrial and residential uses predominating. In developed areas, remnant patches of vegetation can be a locally important resource, particularly for migratory bird species.

Vegetation impacts would occur as areas within and adjacent to the roadway right-of-way are cleared during construction. Minimal vegetation clearing in conjunction with reseeding of adjacent areas with native grasses and shrubs immediately following the completion of construction activities would limit soil erosion and reestablish stable vegetative communities.

While a majority of the bridge corridors would primarily cross open water, small tracts of vegetated land near the touch down points and throughout the project corridor could be disturbed. These areas, including parkland, undeveloped tracts, and residential yards, can be important habitats for local wildlife and "fallout areas" used by neotropical songbirds during migration. Efforts to minimize impacts to project area vegetation should be emphasized during project planning.

5.8.2 WILDLIFE

5.8.2.1 Existing Wildlife

Nueces County falls within the northeastern portion of the Tamaulipan biotic province as delineated by Blair (1950). **Figure 5.8-1** illustrates the project location in relation to the biotic provinces of Texas. The immediate project area is on the coastal periphery of the Tamaulipan province, which may influence faunal communities to a great extent. Another consideration is the isolated nature of the project area in relation to terrestrial wildlife communities.

The most common and widespread small mammals within the Tamaulipan biotic province include the Mexican ground squirrel (*Spermophilus mexicanus*), hispid pocket mouse (*Perognathus hispidus*), Merriam's pocket mouse (*P. merriami*), short-tailed grasshopper mouse (*Onychomys leucogaster*), white-footed mouse (*Peromyscus leucopus*), hispid cotton rat (*Sigmodon hispidus*), southern plains woodrat (*Neotoma micropus*), and eastern cottontail (*Sylvilagus floridanus*). Sandy substrates support populations of eastern moles (*Scalopus aquaticus*) and Ord's kangaroo rat (*Dipodomys ordii*). The South Texas pocket gopher *(Geomys personatus*) is endemic to the sandy soils of this province.

Larger mammals common to the province include the Virginia opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), nine-banded armadillo (*Dasypus novemcinctus*), bobcat (*Felis rufus*), coyote (*Canis latrans*), gray fox (*Urocyon cinereargentus*), striped skunk (*Mephitis mephitis*), gulf coast hog-nosed skunk (*Conepatus leuconotus*), white-tailed deer (*Odocoileus virginiana*), javelina (*Tayassa tajacu*), and wild pig (*Sus scrofa*).

According to Blair (1950), 6 of the 36 species of snakes known from the Tamaulipan province rarely occur in other provinces of the state and four of these are limited to the Matamoran district to the south. The other two, the Texas indigo (*Drymarchon corais erebennus*) and South Texas ground snake (*Sonora semiannulata taylori*) occur throughout the province. Dixon (1987) documents occurrences of *S. taylori* in prairie habitat of counties to the northeast in the Texas biotic province. The most common snakes of the province include the western coach whip (*Masticophis flagellum testaceus*), Texas glossy snake (*Arizona elegans arenicola*), blotched water snake (*Nerodia erythrogaster transversa*), diamondback water snake (*N. rhombifera rhombifera*), checkered garter snake (*Thamnophis marcianus marcianus*), Gulf Coast ribbon snake (*Thamnophis proximus orarius*), western diamondback rattlesnake (*Crotalus atrox*), and the previously mentioned Texas indigo snake. Common lizards of the Tamaulipan biotic province are the Texas banded gecko (*Coleonyx brevis*), Texas spiny lizard (*Sceloporus olivaceous*), eastern fence lizard (*Sceloporus undulatus*), Texas horned lizard (*Phrynosoma cornutum*), and Texas spotted whiptail (*Cnemidophorus g. gularis*). Lizard species restricted to the Tamaulipan biotic province include the mesquite lizard (*Sceloporus gramicus*), the blue spiny lizard (*S. cyanogenys*), the rosebelly lizard (*S. variabilis marmoratus*), the four-lined skink (*Eumeces t. tetragrammus*), and the keeled earless lizard (*Holbrookia p. propinqua*) (Blair, 1950; Dixon, 1987).

Only two salamander species are found in the Tamaulipan province. Two subspecies of tiger salamander recognized by Dixon (1987) occur there as well as in other Texas biotic provinces. These are the barred and eastern tiger salamanders (*Ambystoma t. tigrinum* and *A. t. mavortium*).

The other Tamaulipan salamander is the black-spotted newt (*Notophthalmus meridionalis*). The only other urodele representative of the province is the Rio Grande lesser siren (*Siren intermedia texana*) (Blair, 1950; Dixon, 1987).

Wildlife habitat in the immediate vicinity of the project area is typical of that which occurs in a coastal urban setting, where bird life is a very prominent component of the local biota. The project area provides habitat for upland avian species and the bay system supports high numbers of waterfowl, wading birds, and shorebirds.

Birds commonly observed utilizing the wetland areas in the vicinity of the project include reddish egrets (*Egretta rutescen*), snowy egrets (*Egretta thula*), cattle egrets (*Casmerodios albus*), osprey (*Pandion haliaentus*), cormorants (*Phalacrocorax* spp.), redheads (*Aythya americana*), oyster catchers (*Haematopus* spp.), willets (*Catoptrophorus semipalmatus*), Roseate spoonbills (*Ajaja ajaja*), Northern pintails (*Anas acuta*), Blue-winged teals (*Anas discons*), Least terns (*Sterna antillarum*), Great blue heron (*Ardea herodias*), and several gull species (*Larus* spp.). Common upland birds of the study area include, American kestrel (*Falco sparverius*), killdeer (*Charadrius vociferus*), rock dove (*Columba livia*), mourning dove (*Zenaida macroura*), flycatchers (*Tyrannus* and *Empidonax* spp.), Northern mockingbird (*Mimus polyglottos*), and house sparrow (*Passer domesticus*).

5.8.2.2 Effects on Wildlife

Project area wildlife resource impacts would occur primarily during the project's construction phase. Despite the urban nature of the project area, construction activities could directly or indirectly affect a variety of wildlife species present within the study area. Some small, sessile species could be killed by heavy machinery during right-of-way clearing. Construction during breeding and nesting season may destroy or disturb active bird nests.

All migratory birds in the U.S. are protected by federal statute, the Migratory Bird Treaty Act of 1916 (16 USC §§ 703-711). Migratory birds are protected from harassment, capture, possession, trade or sale, injury, and taking (killing) by this legislation. Habitat protection is not explicitly included in this statute.

5.8.3 THREATENED AND ENDANGERED SPECIES

5.8.3.1 Existing Threatened and Endangered Species

A list of sensitive species of potential occurrence in Nueces County provided by the Wildlife Diversity Program of the TPWD indicates that 18 federally listed/proposed listed endangered or threatened species occur or have historically occurred in Nueces County. Of these, seven are bird species, two are mammals, and five are sea turtle species (**Table 5.8-1**). The mountain plover, an upland bird species, is proposed for listing as threatened. Additionally, a number of birds, reptiles, mammals, and plant species that are considered rare but are not currently federally protected, or are state-listed, are also noted on the Nueces County list. Life histories for each of the federally listed endangered and threatened species of potential occurrence in Nueces County are included below.

TABLE 5.8-1
RARE, THREATENED, AND ENDANGERED SPECIES OF POTENTIAL OCCURRENCE IN NUECES COUNTY, TEXAS

Common Name	Scientific Name	Status	
		USFWS[1]	**TPWD[2]**
AMPHIBIANS			
Sheep Frog	*Hypopachus variolosus*		T
Black-Spotted Newt	*Notophthalmus meridionalis*		T
South Texas Siren (Large Form)	*Siren Sp 1*		T
REPTILES			
Loggerhead Sea Turtle	*Caretta caretta*	T	T
Green Sea Turtle	*Chelonia mydas*	T	T
Leatherback Sea Turtle	*Dermochelys coriacea*	E	E
Hawksbill Sea Turtle	*Eretmochelys imbricata*	E	E
Texas Tortoise	*Gopherus berlandieri*		T
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	E	E
Texas Diamondback Terrapin	*Malaclemys terrapin littoralis*		
Southern Earless Lizard	*Holbrookia lacerata*		
Keeled Earless Lizard	*Holbrookia propinqua*		
Texas Horned Lizard	*Phrynosoma cornutum*		T
Texas Scarlet Snake	*Cemophora coccinealLineri*		T
Texas Indigo Snake	*Drymarchon corais erebennus*		T
Mexican Milk Snake	*Lampropeltis triangulum*		
Northern Cat-Eyed Snake	*Leptodeira septentrionalis*		
Gulf Saltmarsh Snake	*Nerodia clarkii*		
MAMMALS (Excluding Whales)			
Ocelot	*Felis pardalis*	E	E
Jaguarundi	*Felis yagouaroundi*	E	E
Gulf Coast Hog-Nosed Skunk	*Conepatus leuconotus texensis*	C	
Atlantic Spotted Dolphin	*Stenella frontalis*		T
Rough-Toothed Dolphin	*Steno bredanensis*		T
BIRDS			
Brown Pelican	*Pelecanus occidentalis*	E	E
Reddish Egret	*Egretta rufescens*		T
White-Faced Ibis	*Plegadis chihi*		T
Wood Stork	*MycteriaaAmericana*		T
Whooping Crane	*Grus americana*	E	E
Masked Duck	*Oxyura dominica*		
Bald Eagle	*Haliaeetus leucocephalus*	T	T
White-Tailed Hawk	*Buteo albicaudatus*		T
Aplomado Falcon	*Falco femoralis septentrionalis*	E	E
Peregrine Falcon	*Falco peregrinus*	DL	
American Peregrine Falcon	*Falco peregrinus anatum*	DL	E
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	DL	T
Northern Jacana	*Jacana spinosa*		
Piping Plover	*Charadrius melodus*	T	T
Mountain Plover	*Charadrius montanus*	PT	
Snowy Plover	*Charadrius alexandrinus*		
Eskimo Curlew	*Numenius borealis*	E	E
Long-Billed Curlew	*Numenius americanus*		
Coastal Least Tern	*Sterna antillarum*		

TABLE 5.8-1 (CONTINUED)
RARE, THREATENED, AND ENDANGERED SPECIES OF POTENTIAL OCCURRENCE IN NUECES COUNTY, TEXAS

Common Name	Scientific Name	Status	
		USFWS[1]	TPWD[2]
Interior Least Tern	*Sterna antillarum athalassos*	E	E
Sooty Tern	*Sterna fuscata*		T
Black Skimmer	*Rhyncops niger*		
Ringed Kingfisher	*Ceryle torquata*		
Northern Beardless-Tyrannulet	*Camptostoma imberbe*		T
Rose-Throated Becard	*Pachyramphus aglaiae*		T
Loggerhead Shrike	*Lanius ludovicianus migrans*		
Texas Botteri's Sparrow	*Aimophila botteri texana*		T
FISH			
Opossum Pipe Fish	*Microphis brachyurus*		T
Texas Pipe Fish	*Syngnathus affinis*		
PLANTS			
Short-Fruited Spikerush	*Eleocharis brachycarpa*		
Lila De Los Llanos	*Anthericum chandleri*		
Plains Gumweed	*Grindelia oolepis*		
South Texas Ambrosia	*Ambrosia cheiranthifolia*	E	E
Black Lace Cactus	*Echinocereus reichenbachii albertii*	E	E
Welder Machaeranthera	*Psilactis heterocarpa*		
Elmendorf's Onion	*Allium elmendorfii*		
Texas Windmill Grass	*Chloris texensis*		
Slender Rush-Pea	*Hoffmannseggia tenella*	E	E
Roughseed Sea-Purslane	*Sesuvium trianthemoides*		
Tharpe's Rhododon	*Rhododon angulatus*		

Definition of Terms for Federally Listed Species of Potential Occurrence in Nueces Counties, Texas:
"Blank" denotes rare species, or species of concern.
[1] USFWS: United States Fish and Wildlife Service.
E Endangered (in danger of extinction throughout all or a significant portion of its range).
T Threatened (likely to become endangered within the foreseeable future).
T S/A Threatened for similarity of appearance.
P Proposed for listing as Threatened and Endangered and under consideration by the Secretary of the Interior.

[2]TPWD: Texas Parks and Wildlife Department.
E Listed as Endangered in the State of Texas.
T Listed as Threatened in the State of Texas.
NL Not Listed.

Sources:

50 CFR Part 17. January 6, 1989. Endangered and Threatened Wildlife and Plants; Animal Notice of Review. Department of the Interior. Fish and Wildlife Service.
50 CFR Part 17.11 and 17.12. April 15, 1990. Endangered and Threatened Wildlife and Plants; Animal Notice of Review. Department of the Interior. Fish and Wildlife Service.
31 T.A.C. 65.171-177. December 28, 1987. Regulation for Taking, Possessing, Transporting, Exporting, Processing, Selling, or Offering for Sale, or Shipping Endangered Species.
31 T.A.C. 65.181-65. February 10, 1988. Regulation for Taking, Possessing, Transporting, Exporting, Processing, Selling, or Offering for Sale, or Shipping Endangered Species.
Texas Parks and Wildlife Department. Texas Biological and Conservation Data System, Computerized Special Species and Natural Community Occurrences, Nueces Co.

<u>Reptiles</u> - U.S. law protects all sea turtles because numbers in most populations are declining. The primary reasons for population decline in these species are over-hunting, accidental entanglement and drowning in trawling nets used by shrimp trawlers and commercial fishing vessels, and the destruction of nesting sites. Five sea turtles that inhabit the Gulf of Mexico are listed as threatened or endangered by the USFWS.

Green Sea Turtle - Threatened - The Green Sea Turtle is a large, generally brown turtle named for its greenish body fat. Green Sea Turtle ranges throughout the Atlantic, Pacific, and Indian Oceans, and it forages on seagrasses and algae that grow in shallow waters. Exploitation of the nesting grounds by human interference and pollution poses the greatest threat to these turtles. In addition, people hunt the turtles for food, further contributing to their declining populations. Green Sea turtles are occasional visitors to the Texas coast.

Loggerhead Sea Turtle - Threatened - Loggerhead Sea Turtles are reddish brown in color and have characteristically large heads. These carnivorous turtles are capable of living in a variety of environments including brackish waters of coastal lagoons and river mouths. They were historically harvested for their meat and fat. The greatest threat to these animals is entanglement in large shrimp trawl nets. The major nesting beaches are primarily along the Atlantic coast from North Carolina to Florida. These turtles are an occasional visitor to the Texas coast.

Hawksbill Sea Turtle - Endangered - The Hawksbill Sea Turtle is a brown turtle with brightly colored thick scutes covering the carapace. These carnivorous turtles live in offshore waters and are common where reef formations are present. Degradation of nesting grounds by human interference and pollution poses the greatest threat to these turtles. The population of Hawksbill Sea Turtles is also declining because individuals are harvested for their “tortoise shell,” which is used to make jewelry. These turtles are typically found in tropical areas but are occasional visitors to the Texas coast.

Kemp's Atlantic Ridley Sea Turtle - Endangered - Kemp’s Atlantic Ridley Sea Turtles are yellow and olive in color. These turtles are the smallest of the Atlantic turtles and have achieved the nickname of “bastard turtle” because of the erroneous belief that the species is a hybrid between the Loggerhead and Green Turtles. Exploitation of the nesting grounds by human and non-human predation and industrial pollution poses the greatest threat to these turtles. These turtles are occasional visitors to the south Texas coast.

Leatherback Sea Turtle - Endangered - The Leatherback Sea Turtle is the largest of all living turtles. This carnivorous turtle feeds predominately on jellyfish, squid, fish, and floating seaweed. These pelagic turtles are a rare visitor to the Texas coast and move into shallow water only during reproductive season. The most serious threat to the Leatherback is disturbance of its nesting grounds. Ingestion of plastic bags and other plastic wastes are another cause of mortality.

<u>Mammals</u> - Two endangered feline species, the ocelot (*Leopardus pardalis*) and the jaguarundi (*Herpailurus yagouaroundi*), are documented as potentially occurring in Nueces County. The largest resident population of ocelots in Texas is in the eastern Lower Rio Grande Valley on and around the Laguna Atascosa National Wildlife Area. No verifiable documentation of a resident jaguarundi population in Texas exists and the only verified specimen or sightings have occurred along the Texas-Mexico border. Optimal ocelot habitat consists of dense thornshrub communities with greater than 95 percent horizontal cover in the lowest layer (Tewes, 1991). The level of information on jaguarundi habitat preferences is scarce and very little field research has been completed to date for this species. Tewes and Schmidly (1987) report jaguarundi utilization of chaparral, primary and secondary forests, grasslands, and savannahs. These species are not expected to occur within the project area.

Birds - A brief life history and status for avian species federally listed as threatened or endangered is provided in the following paragraphs.

Piping Plover - Threatened in Wintering Areas, Endangered in Breeding Grounds - The piping plover (*Charadrius melodus*) is a small, ringed (dark narrow breast band) plover which breeds from south-central Canada, the Great Lakes, across the northern great plains regions and coastally from Newfoundland to Virginia. This species primarily winters coastally from South Carolina south to Texas and Florida. Migration to breeding grounds generally takes place between early March and mid-May. The piping plover returns from breeding grounds quickly with migration to the south typically occurring between late July and late October (Oberholser, 1974). Migration is a staggered event for this species and stragglers are irregularly documented along the Texas coast in June and July. It is important to note that, although this species does not breed in the project area, it is possible for individuals to be present nearly year-round. Census work reported by Haig and Plissner (1993) demonstrate that the Texas Gulf Coast harbors the largest percentage of individual wintering birds (1,904 out of a total of 3,451, or 55 percent). Haig and Plissner (1993) cite Mustang Island and Redfish Bay Islands in Nueces County as major wintering sites, accounting for 8.1 percent and 2.4 percent of the total census, respectively. The USFWS (1994) identifies essential breeding and winter habitat for the piping plover throughout its range, based upon data generated in the 1991 international census (Haig and Plissner, 1992). Coastal portions of all Texas Counties between Galveston and Cameron are considered essential habitat. There is historical data of piping plovers utilizing the area adjacent to U.S. 181 just north of the Harbor Bridge touch-down area near Portland. Migration to and from breeding grounds may be said to occur between March and October, and lowest numbers are present in the project area in June and July.

Piping Plover

Brown Pelican - Endangered - The brown pelican (*Pelecanus occidentalis*) is a large, dark water bird known to inhabit seacoasts and islands of the Pacific and Atlantic coasts. This species has suffered from harassment by fishermen, who view the birds as competitors, and DDT-induced egg-thinning. Between 1950 and 1960, the estimated population of these birds declined from 595 to zero, based on Christmas Bird Counts (Oberholser, 1974). They have since undergone a substantial recovery with 619 breeding pairs documented in the central and upper portions

Brown Pelican

of the coast in recent years (Yantis, 1990). Nueces County and the central coastal bend of Texas represents the heart of the brown pelican breeding population for the state. In 1990, TPWD reported 500 breeding pairs utilizing one rookery site in Nueces County (well outside the study area), and their numbers are increasing substantially.

Whooping Crane - Endangered - The whooping crane (*Grus americana*) is North America's tallest bird, with a standing height of 1.5 m (5 ft) or more. The bird is a large, white crane with a dagger-like, yellow bill, and with reddish skin on the crown that is darker on the face and lower jaw. The whooping crane's tail plumes form a sort of bustle. In flight, the long extended black legs and neck as well as black-tipped wings are characteristic. The whooping crane ranges from Wood Buffalo National Park in southern Mackenzie and northern Alberta south to North Dakota, Iowa, and the central coastal prairie in Texas and southwest Louisiana. In Texas, whooping cranes winter at Aransas National Wildlife Refuge and Matagorda and St. Joseph's Islands in Aransas, Calhoun, and Matagorda Counties (Oberholser, 1974). Although the whooping crane is not known to use the bay near the project area, Oberholser (1974) documents winter and spring specimens from Nueces County.

Bald Eagle - Threatened, Proposed Delisted - The bald eagle (*Haliaeetus leucocephalus*) ranges over much of the U.S., Canada, British Columbia, and Labrador. This eagle is primarily a fishing species and prefers habitat associated with large bodies of water. In Texas, wintering and nesting activity occurs mainly near large, freshwater impoundments with standing timber located in or around the water (Oberholser, 1974). Mitchell (personal communication, 1994) cites Victoria County as the nearest locality for nesting or wintering activity on a regular basis.

Eskimo Curlew - Endangered - The Eskimo curlew (*Numenius borealis*) has been near extinction for most of this century. This bird stands about 14 inches in height and feeds on wild fruits and insects. The Eskimo curlew breeds on barren tundra of the northwestern American Arctic and migrates to its wintering grounds on the pampas of Argentina via Labrador and the coastal U.S. Incomplete records of its presence in Texas are almost all from spring migration to the U.S. Great Plains, where individuals stop en route to the breeding grounds. Oberholser (1974) cites one spring specimen taken in Nueces County in 1877. There has been no recent documentation of this species in the project vicinity.

Interior Least Tern - Endangered - The interior race of the least tern (*Sterna antillarum athalassos*) is federally listed as endangered but the coastal race (*Sterna antillarum*) does not have federal or state protective status. There is no discernible morphological difference between the races of least tern. Instead, the race distinctions are based on geographic differences in breeding site selection. This small tern nests in colonies between May and July on barren to sparsely vegetated sandbars, lake and reservoir shorelines, sand and gravel pits, and dike field sandbar islands. There is a lack of wintering data for least terns in general; however, they are known from along the Central American coast and northern South American coast (from Venezuela to northeastern Brazil) in winter (USFWS, 1990). Least terns commonly utilize the general project area (considered within the coastal race). The known interior race breeding localities closest to the project area are at Falcon Lake in Starr and Zapata Counties.

<u>Plants</u> - Brief life history and status descriptions for the two federally listed endangered plant species found in Nueces County, the slender rush-pea (*Hoffmannseggia tenella*) and the South

Texas ambrosia (*Ambrosia cheiranthifolia*) follow. These descriptions are abbreviated from Poole and Riskind (1987).

Slender Rush-Pea - Endangered - This Gulf prairie and marsh species is a short (3-6 inches) perennial with twice compound leaves on stalks up to five inches in length (3-7 divisions, with 5-6 pairs of leaflets). Blooms are salmon or orange in color and set from February to June. The slender rush-pea is typically found on clay soils along creeks in association with buffalo grass, speargrass, mesquite, and prickly pear.

South Texas Ambrosia - Endangered - South Texas ambrosia, a member of the aster family, is a herbaceous, erect, silvery to grayish-green, rhizomatous perennial plant, 0.3-1.0 feet tall. Its simple leaves are usually opposite on the lower portion of the plant and alternate above.

South Texas ambrosia grows at low elevations in open clay-loam to sandy-loam prairies and savannas. Much of the original native habitat for South Texas ambrosia has been converted to agricultural fields, improved pastures, or urban areas. Many savanna areas have been cleared and planted to nonnative grasses, such as buffelgrass (*Cenchrus ciliaris*), which out-compete and eventually displace much of the native vegetation. Other potential prairie habitat may now be invaded by thorny shrub and tree species as a result of fire suppression or overgrazing. South Texas ambrosia does not appear to survive intensive plowing, blading, or disking; however, some lesser soil disturbance may enhance its growth. South Texas ambrosia has been verified recently from eight populations, four in Nueces County, three in Kleberg County, and one overlapping both counties in Texas.

5.8.3.2 Effects on Threatened and Endangered Species

Shoreline habitats in the vicinity of the touch down points for all bridge routes could potentially be habitat for the piping plover. However, this is unlikely given the disturbed nature of the area. Nevertheless, the area's suitability as habitat would need to be evaluated following acquisition of right-of-entry during the NEPA stage. The various bridge route alternatives may cause impacts to the endangered brown pelican and to other species not on the endangered species list because of potential vehicular mortality and construction-related impacts to potential habitat. The preferred bridge alternative would be constructed as an elevated structure and elevated causeways have been known to cause problems for brown pelicans at other locations. Vehicles have killed brown pelicans that landed in the roadway on other bridges on the Texas coast. Each of the proposed bridge structures would require construction activity within several different types of habitat, including vegetated uplands and open water/bay bottom. However, the potential for encountering endangered species issues, based on currently available information, appears to be low for all alternative corridors. See **Section 5.10** for a discussion of required coordination for protected species and habitat issues.

5.9 CULTURAL/HISTORIC RESOURCES

5.9.1 INTRODUCTION

A preliminary research assessment was conducted regarding the potential for cultural resources within the area of potential effect of the proposed corridor alignments that were evaluated for this study. Research focused on identification of previously recorded archeological sites, State

Archeological Landmarks (SALs), properties listed on the NRHP, Texas Historical Markers, and other historic properties. Research was conducted at the Texas Archeological Research Laboratory (TARL) and the Texas Historical Commission (THC) for this study.

Numerous archaeological surveys have been conducted in the vicinity of the proposed alignment corridors, including surveys that identified anomalies on the bay floor that were further studied during diving investigations. This type of survey has generally been conducted prior to dredging activity associated with the Ship Channel. A description of recorded cultural resources within the study area is provided below.

5.9.1.1 Recorded Cultural Resource Sites Within the Study Area

The following is a list of recorded cultural resources located within the project area. During research for this study, eight archaeological sites, eight properties listed on the NRHP, and twenty-four properties bearing Official State Historical Markers (OSHM) were located. Sources consulted for this information include archive files at the Texas Archeological Resource Laboratory, the Texas Historical Commission, and the Texas Historic Sites Atlas Online. The location of these cultural resources have not been field checked for this project, and therefore may not be precisely mapped. Locations of NRHP listed properties and OSHMs are illustrated on **Plate 1.**

1. **Julius Lichtenstein House –** location depicted on Historic Sites Atlas, but this location is believed to be inaccurate. See #30.
2. **Broadway Bluff Improvements –** National Register. The Broadway Bluff Improvement is a cast concrete structure extending six blocks from Interstate Highway 37 and Mann Street to Upper Broadway and Mesquite Streets. Retaining walls, stairways, roadways, balustrades, and landscaping comprise the Improvement located on a forty-foot bluff separating uptown and downtown Corpus Christi. In spite of a few alterations and additions, there is no significant change in either its function or overall physical appearance since completed in 1931.
3. **Old Nueces County Courthouse –** National Register. One of the oldest remaining buildings in the city. Built in neo-classical style.
4. **Old Bayview Cemetery/ Thomas S. Parker –** Historical Markers. One marker commemorates the oldest federal military cemetery in Texas, founded in 1845. Another marker for Thomas S. Parker is in the cemetery.
5. **Solomon Coles School –** Historical Marker. Black school founded in 1878 by Solomon Coles, a former slave who earned a bachelors and masters degrees from Yale. The school moved to present location in 1893.
6. **Guaranty Title Company –** Historical Marker. Marker commemorates 1926 building, home of one of the first and oldest land abstract and title companies in Texas.
7. **Artesian Park, Sulphur Well –** Historical Marker. Earliest public park in Texas. Founded in 1854 when Kinney deeded the well site and surrounding

land in honor of significant early campsite for General Zachary Taylor and his troops (among them three future presidents- Taylor, Pierce and Grant).

8. **Corpus Christi Caller-Times –** Historical Marker. Site of local newspaper offices. Begun as *Corpus Christi Caller* in 1883. The *Caller-Times* has been published on this site since 1935.

9. **Corpus Christi Lighthouse –** Historical Marker**.** Built in 1857. Used as a powder magazine during Civil War, and partially damaged when boys set fire to it to keep it from being captured by federal troops. Abandoned in 1870s and dismantled in 1878.

10. **Salt Mill –** Historical Marker. One of the earliest industries in Corpus Christi was a mill erected at this site by Captain John Anderson (1813-1898), a Swedish-born seafarer who brought his family to Texas in 1852. Anderson built a house here in the 1850s, when this property was on the waterfront.

11. **Captain Enrique Villareal & the Rincon del Oso Land Grand –** Historical Marker. Marker text commemorates Villareal, a soldier, colonist, Indian fighter, and explorer. Captain Enrique Villarreal at one time held title to most of the land that now constitutes Nueces County.

12. **St. Patrick's Church/Corpus Christi Cathedral –** Historical Marker. The Corpus Christi Cathedral is the second structure to serve as cathedral for the Diocese of Corpus Christi. It replaced Saint Patrick's, the church which had become the cathedral when the city was elevated to a Diocesan seat in 1912. After a fire destroyed St. Patrick's Church in 1938, the cornerstone for the Corpus Christi Cathedral was laid in 1940.

13. **Centennial House –** Historical Marker. Built by Forbes Britton in 1849-1850. Britton ranched, was a partner in shipping firm of Britton, Mann and Yates, and helped form first company to obtain a deep-water channel for the city. He served from 1857-61 in the Texas senate.

14. **Kinney's Trading Post –** Historical Marker. The marker commemorates H.L. Kinney, who helped found Corpus Christi around 1838. He established a fort and trading post around which the city grew. The building, enclosed by a stockade, contained his home, store, and quarters for armed men.

15. **Lonestar Fair –** Historical Marker. Organized by H.L Kinney in 1851-52 in order to stimulate the local economy and recruit men to Carbajal's army to 'liberate' northern Mexico.

16. **Home of Felix Von Blucher –** Historical Marker. Marker text commemorates family land of German native Anton Felix Hans Hellmuth von Blucher (1819-1879).

17. **LULAC –** Historical Marker. One of the most influential American political groups of the twentieth century, the League of United Latin American Citizens, was founded in Corpus Christi on this site in 1929.

18. **Kelsey Church –** Historical Marker. The original church was established in 1872. The present church was built on the same site in 1948.

19. **Britton-Evans House –** National Register. Built in 1850, this was one of the first permanent residences to be built along the old Corpus Christi bluff.

20. **Church of the Good Shepard –** National Register. Built in the 1870s.

21. **Richard King House –** National Register. The 1928 Richard Ring House is a 2-story Italian Renaissance influenced dwelling, roughly L-shaped, with a hipped roof.

22. **First Methodist Church of Corpus Christi –** Historical Marker. Marker commemorates the history of the church and its various buildings over time.

23. **First Presbyterian Church of Corpus Christi –** Historical Marker. Marker text commemorates the history of the Presbyterian Church and its various buildings over time. Present building was complete in 1930.

24. **Hebrew Rest Cemetery –** Historical Marker. This burial ground was established in 1875 to serve the pioneer Jewish settlers of Corpus Christi, 55 years before the formal organization of a Jewish congregation in the area.

25. **Matthew Dunn Homesite –** Historical Marker. Marker commemorates former homesite of Mathew Dunn, early Corpus Christi settler.

26. **Theodore Merchant Homesite –** Historical Marker. Marker text commemorates prominent farmer and civic leader of turn of the century.

27. **Nueces County Courthouse of 1914 –** RTHL, Historical Marker. Second county courthouse. Built next to original courthouse and finished in 1914.

28. **Corpus Christi –** Historical Marker- Commemorates the founding of county in 1846.

29. **Guggenheim House –** National Register. Turn of the century Queen Anne style residence of a prominent local merchant, Simon Guggenheim.

30. **Julius Lichtenstein House –** National Register. The Lichtenstein House, a turn of the century one-story frame dwelling in a transitional Colonial Revival/Queen Anne style, is typical of middle-class housing at the turn of the century. Moved from its original location nine blocks south of its current site in 1929, the Lichtenstein House has been at 1617 North Chaparral Street for over half a century; its original location at 715 North Chaparral was covered by the Art Deco Ritz Theatre about 1930.

31. **Charlotte Sidbury House –** National Register. Built in 1893 by Charlotte Sidbury, a prominent female businesswoman, and her husband. The picturesque Sidbury House, in Corpus Christi's bayfront area, is a two-story, asymmetrical residence decorated in the elaborate Eastlake style. The house was used as a rent house and moved to its present location. Also near site is Sidbury-Savage house, built in 1875 and occupied by Charlotte Sidbury until her death. The Sidbury-Savage house is a RTHL.

32. **41NU253 –** Recorded in 1988 by Jim Warren, this area was reported to be the site of Zachary Taylor’s headquarters and possibly quartermasters stores, and entrenchments during the war with Mexico in 1845. Investigators conducted

backhoe tests, shovel tests and used metal detectors but found no evidence to substantiate local claims. This site was not recommended for NRHP or SAL eligibility.

33. **41NU251 –** No information about this site.

34. **41NU260 –** Located in a vacant lot is an historic site that has been covered with construction fill. The site consisted of an historic trash pit with a concentration of glass bottles that dated to the late 19th century. The site was tested and no further work was recommended.

35. **41NU175 –** The site was recorded in 1979 by Malcom Johnson based on a 1950s report. A canister shot was reportedly found by an acquaintance of the recorder on this site.

36. **41NU174 –** The site was recorded in 1979 by Malcom Johnson based on a 1950s report. An arrow point and a plain silver ring were discovered in a flowerbed in front of a residential home. It was reported that a scatter of chert flakes and cobbles was nearby.

37. **John Dunn Homesite –** Historical Marker. Built in 1889

38. **31NU176 –** This shell midden was found strewn across a plowed agricultural field. The site was recorded in 1979 by Malcom Johnson. The site was surface collected during the 1950s. Artifacts collected included Late Prehistoric arrow points and Late Archaic dart points, welk gouges, and other stone debris tools.

39. **Kovner-Bobys Homestead –** RTHL, Historical Marker. Built in 1851 of native lumber.

40. **41NU177 –** The site was recorded in 1979 by Malcom Johnson. An expansive site, this site covers several acres, but the densest concentration of the site appears to be near the eastern end. Reportedly, the site consists of a scatter of lithic debitage, tools and projectile points, burned clay, and various types of shell all surface collected during the 1950s. No recommendations were made for the site.

41. **41NU158 –** Several flakes, flake tools, burned bone, baked clay nodules, and shell were observed at this site. The site covers an extensive area overlooking Tule Lake. Further testing was recommended to more accurately define the boundaries of the site.

5.9.2 POTENTIAL CULTURAL RESOURCE IMPACTS

5.9.2.1 Harbor Bridge

Several NRHP properties and OSHMs occur within the green and blue alternative bridge corridors (four and seven properties, respectively). In addition, all of the corridors could impact numerous historic-age residential structures in neighborhoods throughout the study area.

Once a preferred alternative is selected, a complete pedestrian survey of areas not previously surveyed with subsurface probing should be conducted to locate archeological sites in undisturbed areas if federal funds are to be used in this project. Additionally, an Historic Structure Survey should be conducted to document all of the buildings that lie within the path of the alternative and to evaluate specific impacts on a case-by-case basis. Additionally, a survey of inundated areas may be required to ensure that no unrecorded sites exist in Corpus Christi Bay itself, particularly if the blue corridor alternative is selected for the Harbor Bridge. Specific attention should be given to shipwrecks and sites buried on terraces along inundated streambeds. The type and amount of work required should be coordinated by TxDOT-Environmental Affairs Division (TxDOT-ENV) with the THC-Division of Antiquities Protection as outlined in their Programmatic Agreement, but in accordance with Section 106 of the National Historic Preservation Act of 1966 and Chapter 26 of the Texas Historical Commission's Rules of Practice and Procedure for the Antiquities Code of Texas. Additionally, once an Historic Structures Survey has been conducted, TxDOT-ENV should undertake eligibility determinations if any of the identified structures are determined to be potentially eligible for listing on the NRHP.

5.9.2.2 Tule Lake Lift Bridge

No recorded historic or archaeological resources are known from the vicinity of the Tule Lake Lift Bridge project area.

5.10 REGULATORY COMPLIANCE, PERMITTING, AND POTENTIAL MITIGATION ISSUES

Coordination with various federal and state resource and regulatory agencies will be required prior to approval of a Harbor Bridge route alternative as well as a Tule Lake replacement alternative. In some cases, permits may also be required. This section identifies the resource and regulatory agencies with which coordination may be required during advanced project development. This section also lists potential mitigation activities that may be required as a result of coordination or permit conditions.

The proper timing for resolution of regulatory compliance questions is during preparation of a compliance document. NEPA requires that an Environmental Assessment (EA) be prepared to determine the significance of impacts associated with major federal actions on the human and natural environment. A Finding of No Significant Impact (FONSI) would allow a project to move forward, while potentially significant impacts would require the preparation of an Environmental Impact Statement to address project alternatives and consequences. A major bridge such as the Harbor Bridge could involve preparation of an EIS; however, recent project experience indicates a willingness on the part of the FHWA and TxDOT to attempt to resolve project issues, even for large projects, with an EA. A less controversial project like the Tule Lake bridge replacement is typically processed with an EA, or potentially as a Categorical Exclusion. The NEPA process provides a framework within which regulatory compliance, permitting, and potential mitigation issues would be addressed, as described below.

5.10.1 CULTURAL RESOURCES

Regulatory Compliance: All TxDOT highway projects fall under the purview of Section 106 of the National Historic Preservation Act (1992, as amended), and also the provisions of the Texas Antiquities Code (TAC). Under Section 106, Federal Agencies are required to take into account the effect that the proposed undertaking will have on any historic properties that are eligible or potentially eligible for the NRHP, and that are located within the Area of Potential Effect of the project. In this case the project is federally funded ultimately by the Federal Highway Administration, and therefore falls under federal regulatory compliance statutes, and also is managed by TxDOT, and thus is subject to the tenets of the Texas Antiquities Code (TAC). Under the TAC, any archeological or historic resources located on lands owned or controlled by state agencies, or any local or regional municipality, may be considered as a State Archeological Landmark (SAL), and before any ground breaking on such localities can be conducted, coordination regarding the preservation or recording of such sites must take place with the Texas Historical Commission (THC).

In order to determine the potential for impacts to cultural resources, TxDOT will be required to consult with the THC regarding an agreed-upon APE as well as the scope of a cultural resource survey within the selected alternative's right-of-way.

Potential Mitigation: Potential measures for mitigating impacts to historic and archeological sites include:

- Detailed data recovery and documentation;
- Preservation of a site in place (avoidance);
- Appropriate planning and design considerations that maintain the visual and aesthetic character of the resource, or other criterion for eligibility; and
- Providing for the regular maintenance and surveillance of a historic property to lessen its deterioration and loss from vandalism and neglect.

Appropriate mitigation measures would be identified following consultation between TxDOT, FHWA, THC, and the State Historic Preservation Officer (SHPO).

5.10.2 WATER QUALITY AND WETLANDS

Regulatory Issues: Wetlands and/or other waters of the U.S. occur throughout the study area, providing aquatic and wetland habitat for wildlife as well as serving as important flood control features and recharge pathways for local aquifers. Impacts to wetlands, such as those resulting from roadway construction activities, are subject to the jurisdiction of the USACE under Section 404 of the CWQ (33 USC § 1344), which regulates the discharge of dredged or fill material into waters of the U.S.

Wetland permitting is carried out under the regulatory authority of the USACE. Projects that exceed the acreage limits of the USACE's Nationwide Permit Program or are located in a high quality wetland area (as determined by the USACE) must apply for an individual permit.

Individual permits require notification of the public and adjacent landowners, regulatory review, project avoidance documentation and submittal of detailed project and mitigation plans that are not typically required under NWPs. Individual permits are typically utilized for projects involving large wetland acreages, tidally influenced projects, projects in navigable waters (such as the Harbor Bridge and the Tule Lake bridge) and controversial proposals.

All of the bridge route alternatives would require a Section 404 permit. A 404 permit application submitted to the USACE would be processed jointly with the TCEQ, which must certify that a project conforms to Section 401 of the CWA regarding state water quality certifications. In addition, the Texas Pollutant Discharge Elimination System (TPDES) requires that a Notice of Intent be submitted to the TCEQ if the proposed project disturbs more than five acres of naturally vegetated area (to be reduced to one-acre threshold in 2003).

Potential Mitigation: Wetlands appear to occupy relatively small acreages within the route alternative corridors due to the steep drop-offs into the open bay bottom shipping lanes. A field wetland delineation will be required. Construction of any of the bridge alternatives may result in mitigation for placement of fill in waters of the U.S. This mitigation may be as simple as minimization of the impact by adding retaining walls to reduce the footprint of the approach road to the new bridge, or using specialized construction techniques. Mitigation may be more substantial if the resource agencies or the Corps of Engineers require that the amount of area of tidal water be replaced by dredging an upland area of the same size to allow tidal inundation. Mitigation for all alternatives would typically be in the form of avoidance where possible, followed by on-site restoration of disturbed areas where impacts are unavoidable. In addition, it is possible that restoration of other off-site but similar wetlands will be required by the USFWS, TPWD or National Marine Fisheries Service in order for the Corps of Engineers to issue the Section 404 permit. Any cost estimates for the bridge should include funding to pay for the mitigation.

Because of the ecological importance of wetlands along the Gulf Coast, the best mitigation strategy is to avoid wetlands wherever possible. By choosing corridor alternatives that cross or abut the fewest numbers of wetlands, potential impacts can be minimized. Short-term construction impacts can be minimized through the use of erosion control measures such as temporary settling pits, dikes, and berms. Some long-term impacts to water quality associated with oil, grease, and sediment runoff from increased traffic may be unavoidable where bridges are widened or where new bridges are built. Construction and regular maintenance of settling ponds (where required) may minimize these potential impacts.

Where project impacts to wetlands appear to be unavoidable, Executive Order 11990 requires preparation in the environmental document of a "Wetland Finding for the Preferred Alternative," which should be supported by the following information: (1) a reference to Executive Order 11990; and (2) an explanation why there are no practicable alternatives to the measures to minimize harm to wetlands.

In cases where wetlands are filled during construction, the USACE requires compensatory mitigation. The exact area of wetlands to be impacted by roadway construction would be identified during later investigations via a field wetland delineation, to be confirmed by the USACE.

5.10.3 NAVIGATION

Regulatory Issues: All possible alternatives for construction of a new Harbor Bridge or Tule Lake Lift Bridge would require coordination with the U. S. Coast Guard under Section 9 of the Rivers and Harbors Act of 1899 because the project will involve placement of a structure over navigable waters of the United States. The new bridge structure, which will require work in navigable waters, will also need a permit under Section 10 of the Rivers and Harbors Act for placement of supports and protective devices (such as fenders and dolphins constructed around bridge piers).

Potential Mitigation: Section 9 and Section 10 permits are not likely to result in mitigation per se, but during project coordination, the Corps of Engineers and the Coast Guard will likely recommend design and safety criteria that must be included in the construction plans for the replacement bridge.

5.10.4 THREATENED/ENDANGERED SPECIES

Regulatory Issues: Section 7 of the Endangered Species Act requires that federal agencies consult with the USFWS or in certain instances the National Marine Fisheries Service (NMFS) if a major federal action, such as construction of a bridge, may harm threatened or endangered species. Two federally listed species, the piping plover and the brown pelican, likely occur in the project vicinity. Early project coordination with the USFWS could result in a number of project-related recommendations, such as the need for presence/absence surveys, population monitoring, or recommended avoidance and minimization design strategies.

Potential Mitigation: During the preparation of the NEPA document, informal consultation regarding impacts to listed species should be initiated with the USFWS. Potential mitigation measures associated with threatened and endangered species are mandated to focus on avoidance options. If preliminary project planning indicates that species of potential occurrence could be affected by proposed improvements, an intensive, site-specific effort to establish the presence or absence of listed species is typically required. If it is determined that a proposed project may affect listed species, coordination with the USFWS is typically required to develop avoidance and/or mitigation options.

If impacts to listed species or protected habitats are unavoidable, a number of potential mitigation measures may be negotiated. Endangered species mitigation efforts have historically entailed a broad range of approaches, depending upon the project's relative impact and the species involved. Examples of mitigation efforts (always considered only after avoidance options are exhausted) include:

- Acquiring, preserving and/or enhancing occupied compensatory habitat;
- Collecting additional scientific data regarding the species of concern;
- Creating replacement habitat;
- Donating funds to consolidated conservation efforts;

- Transplanting plants found within the project impact zone, minimal vegetation clearing and reseeding of areas adjacent to the roadway with native grasses as quickly as possible following completion of activities to reduce soil erosion and reestablish vegetative communities; and

- Incorporating design modifications (such as wildlife crossing culverts) into project design.

TxDOT and the USFWS would negotiate any required mitigation during subsequent, compliance-oriented stages of project development.

Particularly with regard to the brown pelican, recent bridge projects along the Texas coast have encountered conflicts that required design considerations. The South Padre Island to Port Isabel Causeway in Cameron County design encountered numerous problems with wind shear forcing pelicans and other shore birds down onto the pavement surface, resulting in vehicular collisions and bird fatalities. Mitigation measures have included signage, reduced speed limits, and lighting and railing design modifications intended to make the causeway less attractive to perching birds. Similar measures could conceivably be required for a U.S. 181 Harbor Bridge that would be much taller than the existing bridge.

5.10.5 TEXAS COASTAL MANAGEMENT PROGRAM (TCMP)

Regulatory Compliance: The project area for both proposed bridges is within the boundary of the TCMP and is, therefore, subject to the goals and policies of that program as stated in 31 TAC Sections 501 - 506. The proposed project will be required to be reviewed by TxDOT to ensure that the project's impacts to Coastal Natural Resource Areas (CNRA) are handled in a manner consistent with the goals and policies of the TCMP.

Potential Mitigation: The TCMP does not require specific mitigation or protection of CNRAs beyond that required by existing federal and state statutes. Therefore, no unique mitigation will be required under the TCMP goals and policies but TxDOT will need to ensure that the construction of the bridge is consistent with the goals and policies of the TCMP.

5.10.6 SOCIAL/ECONOMIC/LAND USE ISSUES

Regulatory Compliance: If any proposed alternative results in the relocation of homes or businesses, relocation efforts must be consistent with the requirements of the Civil Rights Act of 1968, the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, and the Housing and Urban Development Act of 1974. To ensure adequate public knowledge of the relocation program, the services and benefits available must be discussed at the public meetings and hearing to be held as part of the proposed project; presented in a brochure which is available in both English and Spanish; and announced in the news media and through posted notices.

In compliance with Executive Order 12898, "Environmental Justice," the U.S. Department of Transportation FHWA has promulgated its Final Environmental Justice Strategy and Proposed

Order (Fed. Reg. Vol. 60, No. 125, June 29, 1995, p. 33897), which requires the agency to determine whether a proposed action will have an adverse impact on minority or low income populations; if so, whether that impact is disproportionate; and, if so, whether measures to avoid, minimize or compensate are practicable. Because the census tracts in the vicinity of the Harbor Bridge corridors are composed of minority and low-income residents, the potential exists for environmental justice issues to arise. TxDOT should be encouraged to continue its proactive public outreach program during the NEPA phase in order to communicate with affected communities and address these issues before they become problematic.

Potential Mitigation: If relocations are necessary, qualified displacees must be provided with Relocation Assistance Program benefits that are intended to assist the displacee in purchasing or renting comparable replacement housing.

From a regional perspective, several mitigation measures can be employed to minimize impacts to neighborhoods and visual resources. These include the following:

- Landscape screening on road side with tree/shrub plantings and other beautification measures;
- Management of materials, equipment, and noise during construction phase;
- Revegetation following construction;
- Design and location of road lighting fixtures with sensitivity to adjacent residential areas and potential wildlife habitat areas;
- Construction of noise walls and other noise mitigation structures (if determined to be necessary pursuant to the formal environmental compliance process);

Specific mitigation measures for each roadway segment should be designed and implemented as required by future environmental compliance efforts pursuant to this feasibility study.

5.10.7 HAZARDOUS MATERIALS

Regulatory Compliance: Regulations pertaining to hazardous materials encountered during roadway planning are minimal. A majority of the activities associated with hazardous materials are analogous to due diligence on the part of TxDOT in order to avoid, whenever possible, acquiring property which may contain hazardous materials and subsequent legal liability.

Potential Mitigation: The potential mitigation measures discussed in this section focus on the impacts associated with various project alternatives and their possible interactions with existing industrial material sites. Potential impacts range from expensive land acquisitions and hazardous material clean-ups to relatively inexpensive avoidance measures.

Information pertaining to potential hazardous material site locations within the study corridor is intended to assist TxDOT transportation planners in identifying avoidance and minimization options during subsequent regulatory compliance efforts. If potential hazardous material sites are located within the right-of-way of the preferred alternative alignment, an iterative approach to impact assessment and potential mitigation planning is typically taken. Prior to right-of-way acquisition, the following phases can occur:

- **Phase I –** A Phase I Environmental Site Assessment (ESA) is typically performed on land acquisition tracts with a potential for hazardous material contamination in order to exercise due diligence prior to acquiring property (and accompanying liability). This phase typically involves a review of historical aerial photography, deed research, a review of recorded site information and an on-site inspection. If potential hazardous material contamination is indicated, a second phase of investigations may be required;
- **Phase II –** A Phase II investigation typically involves invasive data collection, such as sampling of soil, groundwater, or other existing media in order to determine the actual presence and extent of potential contamination. If potentially harmful levels of contaminants are present, a third phase can be required;
- **Phase III –** Phase III efforts involve actual mitigation of existing contamination. This may include removal of contaminated soil or hazardous materials, remediation of contaminated groundwater or soil, or some combination of these approaches using a number of innovative strategies.

Construction phase mitigation may be required if hazardous materials are encountered during construction activities. Residential and commercial relocations may involve asbestos removal, utility relocations may encounter PCBs in older transformers, or hydrocarbon contamination may be discovered. These and other instances of contamination may be encountered during highway construction.

5.10.8 ECOLOGICAL RESOURCES

Regulatory Issues: Ecological resources are subject to adverse impacts from roadway expansion, and may require some type of mitigation.

Projects that involve modification of water bodies including impoundments, relocation, channel deepening or modification, or filling may require coordination with the USFWS under the Fish & Wildlife Coordination Act. Wetland and aquatic habitat impacts may be subject to the USACE regulatory and mitigation requirements (i.e., avoidance, minimization, and compensation).

Potential Mitigation – Mitigation issues related to high value, unregulated habitats are covered in a Memorandum of Understanding (MOU) between TxDOT and TPWD. This MOU generally encourages avoidance as the primary mitigation preference, but where avoidance is impossible, it prescribes an assessment of existing vegetation, usually by sampling, and then the compensatory planting of equivalent species on equivalent acreage, usually within the proposed roadway's right-of–way or on adjacent natural areas. In the past, the MOU has focused on high value areas such as riparian corridors, mature woodland vegetation, and prairie remnants. Coordination with TPWD regarding potential mitigation would be expected during the NEPA compliance process.

Section 6.0
PUBLIC INVOLVEMENT

During the course of the feasibility study, a public involvement program gave TxDOT and local stakeholders an opportunity to communicate with one another. This program included a public involvement plan (part of the Project Management Plan), three citizens' advisory committee meetings, two public meetings, other meetings, and two newsletters. (A complete record of the meetings, comment forms, and media coverage is included in the separate document, *Compendium of Public Involvement*.)

6.1 CITIZENS' ADVISORY COMMITTEE

In response to citizen concerns and out of a desire to gather as much feedback as possible from local stakeholders, TxDOT formed a citizens' advisory committee several months after the feasibility study began. This group included residents of a neighborhood near Harbor Bridge; a number of ministers with churches in that neighborhood; a representative of the Federal Highway Administration; local elected officials; City of Corpus Christi representatives; local business owners; Port of Corpus Christi officials;, representatives of civic organizations; and others. An attendance list for each of the Citizens Advisory Committee (CAC) meetings is included in *Compendium of Public Involvement.*

In concert with TxDOT, a list of people to be invited to the CAC meeting was developed. Many of these individuals had attended an earlier, informal meeting with TxDOT to discuss issues associated with the Harbor Bridge. A group of local ministers requested that meeting and encouraged their congregations to attend. In addition to these stakeholders, names of other people representing all aspects of the community were added to the list.

This CAC did not have formal bylaws or a formal mission. Rather, the intent was to form a fluid group that would allow neighborhood and other stakeholder concerns to surface and to address these concerns and requests for further information as quickly and completely as possible. All CAC meetings were open to the public.

The CAC met three times at the Oveal Williams Senior Center (1414 Martin Luther King Dr., Corpus Christi):

- June 27, 2002;
- September 19, 2002; and
- April 29, 2003.

At each of these meetings, a brief presentation was made on the status of the feasibility study and the CAC members were then given an opportunity to respond. Each of the three meetings is summarized below.

June 27, 2002

During the first meeting, a facilitator divided 39 members of the CAC into three groups and created an interactive environment in which CAC members could voice their concerns about what a replacement of the Harbor Bridge would mean for the local community. Each group was asked to respond to several questions:

- What is your vision for the project?
- What is your vision for the community?
- What other concerns do you have?
- What should be covered in future meetings?

The groups' responses can be grouped into the following themes:

- Support livable, united neighborhoods;
- Maintain a distinctive, signature structure;
- Use durable materials;
- Revitalize the community;
- Ensure safety (shoulders, curves); and
- Maintain history and heritage.

In addition, CAC members wanted TxDOT to consider their input when planning a subsequent public meeting. They requested information on the City of Corpus Christi's development plans for the Northside, as well as any plans that the Corpus Christi Independent School District or the Corpus Christi Housing Authority might have for this area of town. CAC members wanted TxDOT to compile and evaluate the issues that had been raised at the meeting and report back to them at the next meeting. They requested another CAC meeting in the early fall 2002 and a public meeting later that fall.

September 19, 2002

At the second CAC meeting, TxDOT invited representatives from the City of Corpus Christi's Planning Department, the Corpus Christi Independent School District, and the Corpus Christi Housing Authority to provide information and to be available to answer questions. TxDOT updated the CAC on the status of the feasibility study and presented the four alternative corridor alignments. Again the facilitator was on hand to help the group summarize its thoughts and concerns at the end of the meeting. Twenty-eight CAC members attended the meeting.

The CAC members showed a particular interest in the development plans, including rezoning of the Northside, described by the City of Corpus Christi, as well as the possibility that Corpus

Christi Independent School District (CCISD) might close Solomon Coles Elementary School. More than one individual expressed concerns about each of these topics.

In general, the primary issues that CAC members noted were the following:

- Bridge safety,
- Continued opportunities for public input,
- Timeframe for bridge replacement,
- Cost-effectiveness of bridge replacement,
- Maintenance of historical sites in the area, and
- Improvement of the aesthetics of the neighborhood with landscaping.

At this meeting, CAC members indicated that they were pleased with TxDOT's use of such a committee to share information and obtain community input, especially before making any final plans for Harbor Bridge. They also expressed their appreciation that information was being presented in a manner that a lay person could understand.

CAC members made it clear that they wanted the public meeting to cover all the topics that had been covered in their committee meetings.

April 29, 2003

The final CAC meeting for the feasibility study began with a presentation on the ranked Harbor Bridge corridor alternatives. It was followed by a group discussion of the alternatives. This meeting was not facilitated but followed a similar format to the first two meetings—a presentation followed by a group discussion. Twenty-six CAC members were in attendance.

At the meeting, the ranking of the alternative corridors was presented and the evaluation criteria used to perform this ranking was explained. When the presentation was over, CAC members asked the following questions:

- If the number-one ranked alternative were selected, how would people have access to the downtown?
- How would the new bridge corridor affect the widening of Staples and Port Avenues?
- The city (of Corpus Christi) is talking about rezoning the Northside, CCISD is planning to close Coles Elementary, and you're talking about a new bridge. Are you all talking to each other?
- Will the number one-ranked alternative go over the top of the proposed new ball stadium?

- Will building a new bridge affect the Corpus Christi Ship Channel?
- How will TxDOT handle right-of-way acquisition?

TxDOT also requested ideas from the CAC members on how the upcoming public meeting could be better advertised so as to attract as many participants as possible. Members suggested having the meeting at the Oveal Williams Center because it is a convenient location for neighborhood residents. They also recommended using the city's automated telephone dialing system for meeting notification; contacting 12 ministers with churches in the project area; and inviting households by zip code.

The minutes for the three meetings are included in **Appendix C** of this document.

6.2 PUBLIC MEETINGS

Two public meetings were held during the feasibility study. The format for these meetings was identical and included an open house, a presentation, and a question and comment period. The meetings were held at the following locations on the dates noted:

- Miller High School: 6 - 8 p.m., November 14, 2002; and
- Oveal Williams Senior Center: 6 - 8 p.m., May 29, 2003.

6.2.1 MEETING PUBLICITY

Meeting publicity for the first public meeting included the following (see *Compendium of Public Involvement* for this project for copies of the ads, flyers, media advisories, community calendar notices, and media coverage):

- An invitation letter was mailed to everyone on the CAC mailing list.
- A 3x5-inch ad was placed in the *Corpus Christi Caller-Times* and the *Portland News*. The ad in each paper ran twice within one week of the meeting date.
- Meeting notices were distributed to radio and television stations as well as to the *Corpus Christi Caller-Times* for their community calendars.
- Media advisories were sent to the local media (newspaper, radio, and television to inform them of the public meeting and to encourage them to attend.
- A reporter from the *Caller-Times* was personally contacted with information about the feasibility study and the public meeting. She subsequently interviewed TxDOT representatives.

The day of the public meeting, the *Caller-Times* ran a lead story on the Harbor Bridge and the public meeting. The following morning they ran a follow-up story on the meeting. Copies of these stories are included in *Compendium*. All three local network television TV stations attended the meeting and ran stories on the 10 p.m. news the night of the meeting. A complete list of all the media outlets to which information was sent can be found in **Appendix C**.

Meeting publicity for the second public meeting included the following (see *Compendium of Public Involvement* for this project for copies of the ads, flyers, community calendar notices, media advisories, and media coverage):

- An invitation letter was mailed to everyone on the CAC mailing list.
- David Casteel sent a cover letter and newsletter to a list of elected officials.
- An invitation notice and flyer were sent to 11 ministers of churches in the Northside neighborhood
- A (3 X 5-inch) ad was placed in the *Corpus Christi Caller-Times* and the *Portland News*. The ad in each paper ran twice within one week of the meeting date.
- Meeting notices were distributed to radio and TV stations as well as to the *Corpus Christi Caller-Times* for their community calendars.
- Media advisories were sent to the local media (newspaper, radio, and TV) to inform them of the public meeting and to encourage them to attend.
- A reporter from the *Caller-Times* was personally contacted with information about the feasibility study and the public meeting. She attended the public meeting and subsequently interviewed TxDOT representatives.

The morning after the public meeting, the *Caller*-Times ran a story on the public meeting. All three local network TV stations attended the meeting and ran stories on the 10 p.m. news the night of the meeting. A complete list of all the media outlets to which information was sent can be found in **Appendix C**.

6.2.2 MEETING FORMAT

Each of the public meetings had the same format—a half-hour open house followed by a presentation and comment period (for another hour-and-a-half). During the open house, which took place during the first one-half hour of the meeting, the public had the opportunity to review a number of displays illustrating the study area and the various alternatives. TxDOT staff representatives and consultant team members were available to describe the displays and answer any questions. After the open house, a presentation was given to describe the study scope and process, and to outline the various alternatives. At the conclusion of the presentation, speakers were invited to state their questions and comments (see meeting transcripts in the Compendium). Below is a summary of each of the meetings.

6.2.3 MEETING SUMMARY – NOVEMBER 14, 2002

A total of 54 residents and 5 local government officials signed in at the November 14 meeting at Miller High School. The open house portion of the meeting sparked lively input regarding the alternative corridor that extends into the Bay and returns to land at approximately the site of the new Federal Courthouse.

The comment period that followed the presentation drew relatively few comments that fell into the following categories:

- Concerns about the capacity of a new bridge to meet future traffic demand,
- Concerns about the corridor alternative that extends out over the Bay and its impact on the Federal Courthouse, and
- General issues associated with neighborhood relocations associated with the alternative corridors.

TxDOT did not receive any additional written comments after the meeting.

6.2.4 MEETING SUMMARY – MAY 29, 2003

A total of 31 residents, 2 local government officials, and 2 elected officials signed in at the May 29 meeting at the Oveal Williams Center. The open house portion of the meeting lasted for 30 minutes and was followed by the formal presentation at 6:30. Overall, the meeting did not generate a large number of comments. The verbal comments during the meeting were as follows:

- How many lanes will the new Harbor Bridge have?
- If we go with the preferred alternative (the Red alternative), what will happen to the approach to Shoreline Blvd?
- All truck traffic does not need to go into downtown Corpus Christi on Highway 37. I hope that consideration will be given to routing truck traffic through San Patricio County where there is ample open land. This should redirect traffic away from Highway 37 and ease congestion.
- What about the issue of eminent domain as it relates to this project?

6.3 OTHER MEETINGS

In addition to the CAC and public meetings, TxDOT met informally on April 29, 2003, with stakeholders interested in the Tule Lake Lift Bridge. A list of the stakeholders invited to this meeting as well as complete meeting minutes may be found in **Appendix C**.

At this meeting, background information was presented on the feasibility study and the alternative configurations for the Tule Lake Lift Bridge were explained. Most of the comments from the individuals at the meeting were questions about the bridge configurations and how they would affect operations.

One of the meeting participants suggested a meeting with the local channel pilots' group to get its reaction to any possible changes in the bridge configuration. On May 15, a conference call was held with Rick Casas, the Presiding Officer for the Aransas-Corpus Christi Pilots, to discuss any issues the ship pilots may have regarding the Tule Lake Lift Bridge alternatives. There were two issues; the first regarding the High-level alternative with railroad. Since this alternative requires two structures instead of one, the Presiding Officer indicated that this alternative was least desirable of the alternatives presented. The other issue concerned the High-level alternative without railroad. Since this alternative will likely be a "double swing" movable structure, the channel width should be increased to 350 feet. The reason for this increase is because in the open position the bridge forms a "450 foot vertical wall" and the ship pilots need this additional width to navigate through this crossing.

6.4 NEWSLETTER

To disseminate information about the feasibility study, two newsletters were developed and published. The format for each was four pages of black and white text, and graphics. The first issue of the newsletter contained articles on the following topics:

- Feasibility study background and status,
- Alternative corridors (including their preferential rankings),
- Key role of the CAC,
- Advertisement for the public meeting, and
- Mailing list form.

The newsletter included a map of the four corridor alternatives for Harbor Bridge that indicated the ranking of the alternatives. The ranking of the Tule Lake Lift Bridge alternatives was explained but not illustrated.

The mailing list for the newsletter was developed by combining the mailing list for the CAC and Tule Lake Lift Bridge Stakeholder meeting with the names of households in three zip codes in the project area: 78401, 78407, and 78402. In addition, the Port of Corpus Christi provided one of their mailing lists and some of the names on this list were used as well. In all, approximately 2100 copies of the May newsletter were distributed. In addition, newsletters were made available at the public meeting on May 29.

The second issue of the newsletter (June 2003) contained articles on the following topics:

- Summary of the Final Feasibility Report
- Summary of the final public meeting (May 29)
- Description of the next stages in the project
- Mailing list form.

The mailing list for this issue of the newsletter was expanded to include the names of people who attended the public meeting.

A copy of both issues of the newsletter may be found in **Appendix C**.

Section 7.0
IMPLEMENTATION PLAN

As part of the Feasibility Study, plans have been developed for implementing the recommended Harbor Bridge alternative and the two Tule Lake Lift Bridge alternatives. These plans are based on several assumptions. First, since funding for these improvements is very difficult to predict, it is assumed that the funding will become available sequentially rather than all at one time. For the Harbor Bridge Corridor project, this means implementing two separate projects in sequence. This assumption is based on the fact that most of the construction cost for each project is greater than the District's annual letting volume, and, therefore, it was not considered reasonable to fund both of these projects concurrently. In the case of the Tule Lake Lift Bridge, where two alternatives are recommended, it has been assumed that the scope and schedule duration for each work activity is the same for the two recommended alternatives; therefore, only one schedule is presented.

7.1 PROJECT IDENTIFICATION

Once the Feasibility Study is complete, it is recommended that the Harbor Bridge and Tule Lake Lift Bridge be developed as separate projects on independent schedules. The reason for separating the Tule Lake Lift Bridge and the Harbor Bridge into two projects is because the development of the two projects are no longer dependent on the other to function as proposed. These two projects have independent utility.

The next phase of the Harbor Bridge project - the schematic development and environmental documentation - should be developed as a single project. However, once the project receives environmental clearance, it is recommended that the development of these two projects be divided into two projects with separate project development schedules. This recommendation is preliminary because the final recommendation to separate the projects is determined at the completion of the NEPA process. During the development of the NEPA process, new information could be developed or discovered requiring the Harbor Bridge project be divided differently than what is recommended in this study.

It is recommended that the Harbor Bridge project be divided as follows: the first, the design and construction of the S.H. 286/I-37 Interchange, and the second, the design and construction of the high-level bridge/approach structures. The design and construction of these two projects require significantly different skills rarely found within a single organization. Furthermore, the magnitude of the construction costs dictates that this project be divided.

Construction of the interchange would take place before construction of the high-level bridge/approach structures because interchange improvements would increase the level of service for three legs of the interchange even before the high-level bridge/approach structures are complete. Also, this project is not dependent on the high-level bridge/approach structures project to function independently. During the public and Citizens' Advisory Committee meetings, the public expressed a desire for right-of-way acquisition to begin as soon as possible. At the completion of the NEPA phase, right-of-way acquisition may begin. Acquisition could begin on the high-level bridge at that time even though construction of this project may not begin for several years, thus addressing the public's desire for early acquisition of right-of-way. Construction contractors who wish to bid the High Level/Approach Structures project should be pre-qualified because of the highly specialized nature of the high level/approach structures construction project.

The Tule Lake Lift Bridge project can be developed as a single project throughout the entire project development phase. As with the Harbor Bridge High Level Bridge project, the design and construction of the movable bridge is very specialized, particularly if the concrete "double swing" structure is built to replace the Tule Lake Lift Bridge. Contractors wishing to bid the replacement structure should also be pre-qualified to ensure that the low bidder is qualified to construct the new Tule Lake Lift Bridge.

7.2 IMPLEMENTATION SCHEDULE

In developing the implementation schedules for both the Harbor Bridge corridor and the Tule Lake Lift Bridge, several additional assumptions were made. For the Harbor Bridge corridor, an Environmental Assessment (EA) may be acceptable to address all the environmental impacts, and agency and public concerns. However, for the purposes of developing the duration of the environmental documentation, it was assumed that an Environmental Impact Statement (EIS) would be required. Nonetheless, it is recommended that TxDOT proceed with processing the environmental document as an EA for several reasons. First, public support of the project is high with no organized opposition identified to date. A high level of public support can influence the type of environmental document required to receive clearance. Second, the public wants these complex, urban highway projects implemented on an accelerated schedule. If there is an opportunity to reduce the time required to process the environmental document, then it should be taken. In the case of the Tule Lake Lift Bridge, an EA should provide the appropriate detail to receive environmental clearance.

The implementation schedules for Harbor Bridge and Tule Lake Lift Bridge are shown respectively in **Figures 7.2-1** and **7.2-2**. The time required for the surveying and mapping effort for the right-of-way and construction plans preparation is included in the respective plan's preparation work activity. The time required to prepare the necessary permits is also included.

A review of the two schedules reveals that the right-of-way plans, utility adjustment plans, and the preparation of the Plans, Specifications and Estimates (PS&E) are all scheduled to start at the same time. This provides an early emphasis on the right-of-way and utility adjustment requirements confirming those needs identified in the schematic development phase. These schedules also reflect that the adjustment of utilities occurs after the right-of way is acquired. It is understood that it may be more economical to adjust certain utilities after construction has begun. If this is necessary, it is usually identified in the early stages of the PS&E preparation.

For both the Harbor Bridge and Tule Lake Lift Bridge schedules, six months was assumed as the minimum time needed to send the plans to Austin for final review, advertising, and awarding of the contract. Because of the need to sequentially schedule the beginning of construction for the two projects identified in the Harbor Bridge corridor program, advertising and award time for the high level/approach structure project is significantly longer than six months. This is also because the PS&E for this project is scheduled to begin concurrently with the design of the interchange. This allows for these plans to be "placed on the shelf" and, if money becomes available sooner than anticipated, the actual construction could begin at an earlier date.

FIGURE 7.2-1
IMPLEMENTATION SCHEDULE
HARBOR BRIDGE CORRIDOR

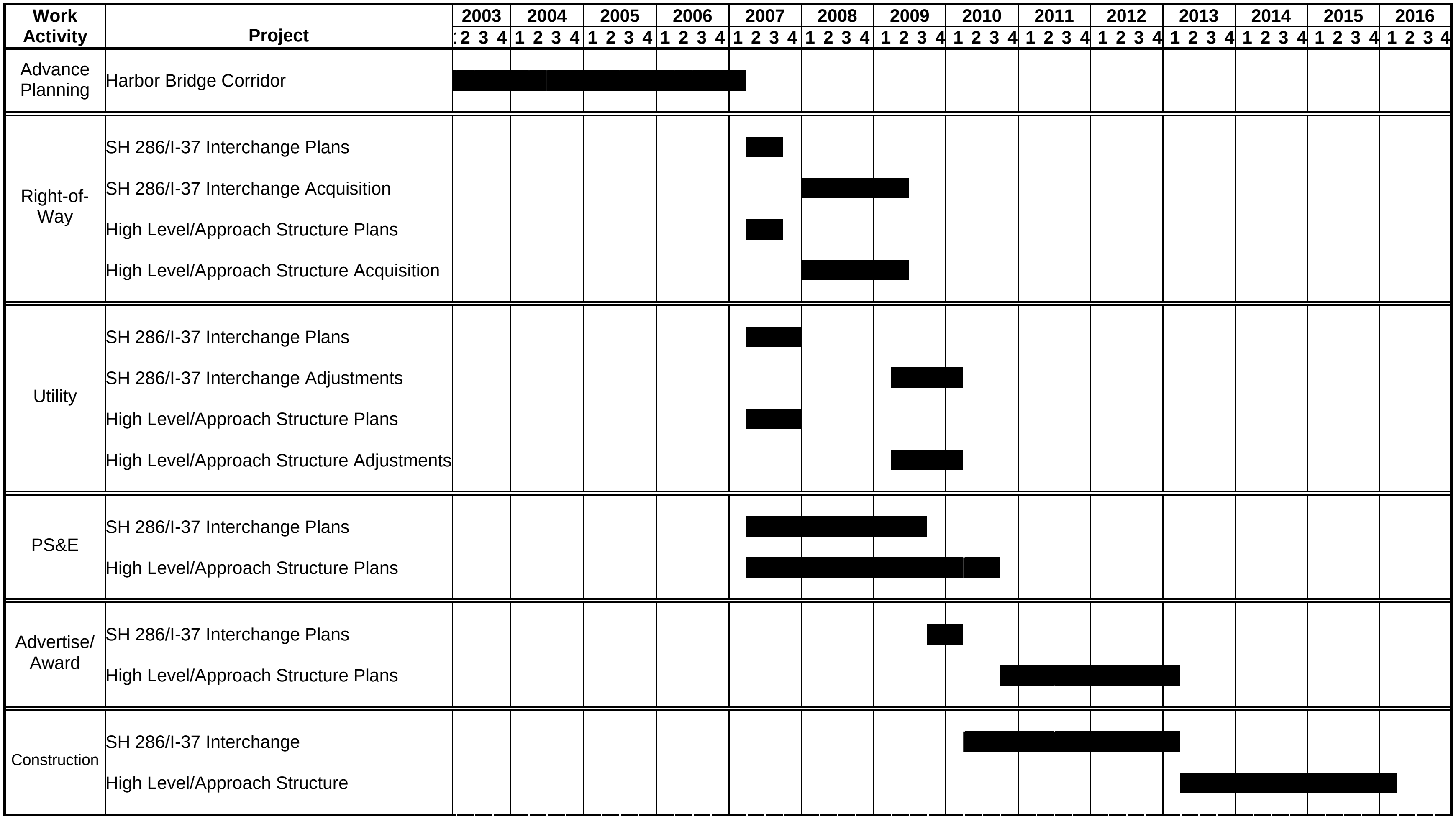
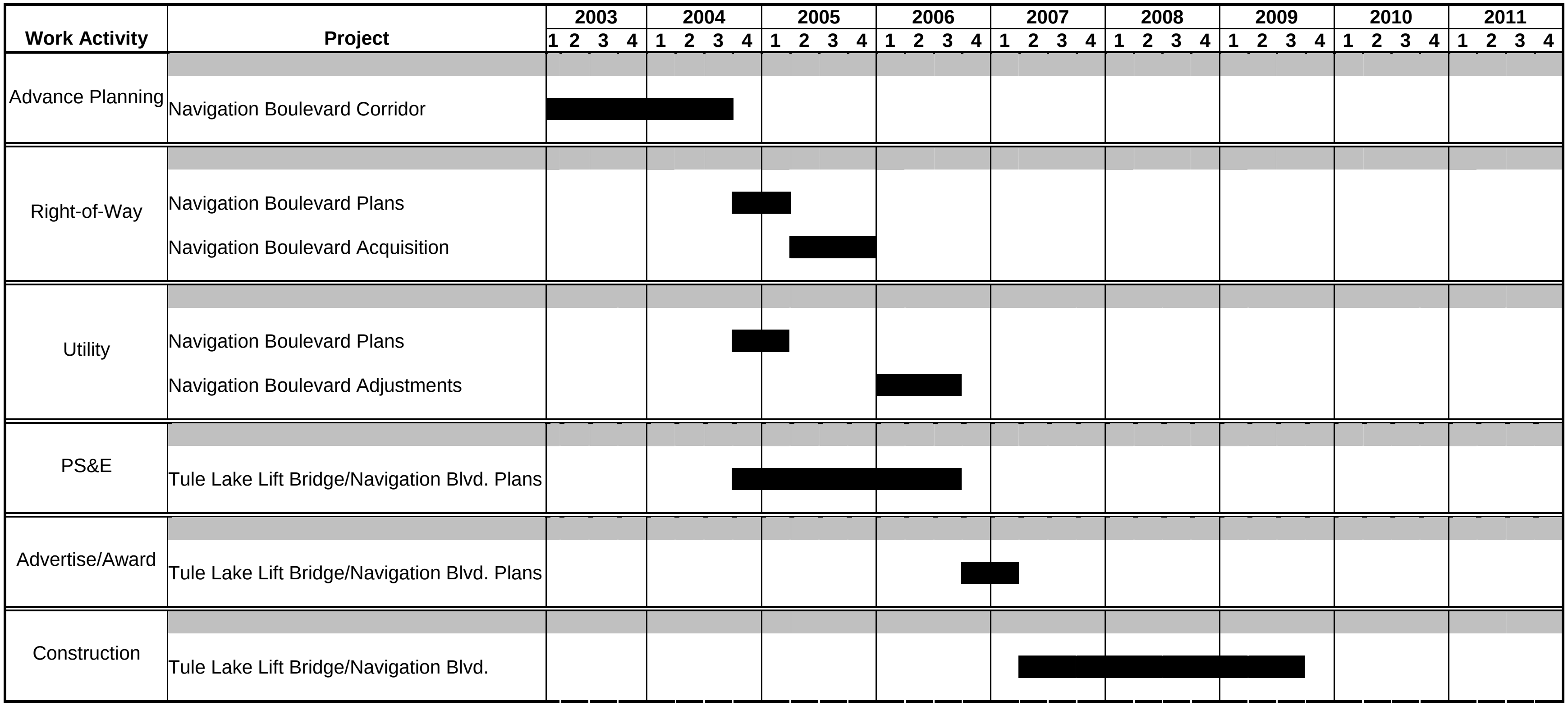


FIGURE 7.2-2
IMPLEMENTATION SCHEDULE
TULE LAKE LIFT BRIDGE



Section 8.0
COMPARISON/RECOMMENDATIONS

Four route alternatives were evaluated to identify a recommended corridor crossing for the Harbor Bridge. Two alternatives each, with and without the railroad, were evaluated to identify the recommended alternatives for replacing the existing Tule Lake Lift Bridge. The project team conducted a joint evaluation of the Harbor Bridge and Tule Lake Lift Bridge alternatives using the evaluation criteria described in Section 3..

The ranking of the four alternatives for Harbor Bridge was presented to the Citizens Advisory Committee (CAC) for its review and comment on April 29, 2003. The Tule Lake Lift Bridge alternatives were presented to the representatives of Ship Channel industrial facilities and local governmental agencies in a meeting on April 29, 2003, and to the presiding officer of the Ship Channel pilots association during a conference call on May 15, 2003. The ranking of the Harbor Bridge and Tule Lake Life Bridge alternatives was presented at a public meeting on May 29, 2003.

8.1 EVALUATION PROCESS

The process of evaluating the various alternatives for Harbor Bridge and the Tule Lake Lift Bridge took place in three steps:

- Development of evaluation criteria;
- Evaluation of each alternative using these criteria; and
- Ranking of each alternative.

Separate evaluations were conducted for the Harbor Bridge alternatives and the Tule Lake Lift Bridge alternatives. For the Harbor Bridge alternatives, the evaluation criteria were divided into three major categories: Traffic/Planning, Engineering, and Environmental/Public Involvement. For the Tule Lake Lift Bridge alternatives, the evaluation criteria were divided into three major categories: Vehicular and Intermodal Flow, Engineering, and Environmental/Public Involvement.

Evaluation criteria (as shown in **Tables 8.1-1 and 8.1-2**) included both qualitative and quantitative measures. Task leaders with expertise in each of the major evaluation criteria categories led the evaluation of alternatives in his/her respective area with significant input from project team members. On the basis of the group evaluation, each task leader then recommended to the team a ranking for each alternative in each of the evaluation criteria areas.

For qualitative criteria, the ranking was color coded (as shown on the tables) to reflect the ranking value. Relative negative or undesirable evaluations were denoted by red; neutral or moderate attributes were shown as yellow; and positive or desirable findings were shown as green. In the case where a quantitative measure was used to rank the alternative, units of measurement are given. The following sections describe in more detail the ranking of the Harbor Bridge and Tule Lake Lift Bridge alternatives.

8.1.1 HARBOR BRIDGE

As shown in **Table 8.1-1,** the rankings of the four Harbor Bridge alternatives are clustered in two groupings: the red and orange alternatives have a better but similar ranking and the blue and green alternatives have a poorer but similar ranking in the three major categories. In the Environmental/Public Involvement category, the blue alternative has the highest number of acres of wetlands/waters of the United States impacted, and the green alternative has the highest number of relocations/displacements. The blue and green alternatives have the highest number of recorded historical sites potentially affected and the highest number of hazardous sites located within the corridor. The red and orange alternatives are similar for this major category with the red alternative receiving a better ranking because of fewer numbers of relocations/displacements than the orange.

In the Traffic/Planning category, the green and the blue alternatives rank lower than the red and orange alternatives. Again, the red and the orange alternatives are similar, but the red alternative ranks higher than the orange because the former is more compatible with future development planned by the City of Corpus Christi. In particular, the City has identified the location of a proposed baseball stadium site east of the red alternative and adjacent to and east of the proposed cruise terminal. Both the orange and green alternatives act as barriers between the beachfront area with its museums, convention center, Heritage Square, etc. and the cruise terminal and new stadium. All of these facilities are located to the east of the red alternative allowing all the amenities to be joined together rather than be separated. In addition, the red alternative acts as barrier/buffer between these existing and planned people-oriented facilities and the port/industrial facilities. This compatibility of the red alternative with local future development plans is considered significant.

In the Engineering major category, the blue and green alternatives fare poorly. The blue alternative’s estimated construction costs are the highest of all the alternatives. The red alternative is estimated to have construction costs higher than the orange alternative because of the longer span required to cross the Ship Channel with the red alternative. The green alternative provides less air draft than the other three alternatives - 180 feet of air draft versus 200 feet of air draft for the others. The Port considers 200 feet of air draft an absolute minimum. The red alternative provides more flexibility in achieving the desirable design criteria and provides the most direct route, thereby completely eliminating the offset between the existing S.H. 286 and U.S, Highway 181 alignments described in Section 2.

TABLE 8.1-1
HARBOR BRIDGE ALTERNATIVES EVALUATION

Evaluation Criteria *Criteria address the entire 600-foot wide corridors		Alternatives: Red	Orange	Green	Blue
Environmental/Public Involvement Issues					
Wetlands/waters of the United States The number of acres of wetlands/waters of the U.S. that would be impacted by each alternative	Number of acres (wetland/US waters/total)	7.51/18.62/ 26.13	3.53/8.98/ 12.51	3.52/8.98/ 12.5	3.69/100.36/ 104.1
Coastal/aquatic issues A determination of whether an alternative impacts coastal and aquatic life, such as coastal zones, oyster reefs, shrimping, etc.	Major (red) / Moderate (yellow) / Minor (green)	Minor (green)	Minor (green)	Minor (green)	Major (red)
Threatened and endangered species A determination of whether an alternative potentially affects species of potential occurrence and/or known threatened and endangered species sites	Yes (red) / No (green)	No (green)	No (green)	No (green)	No (green)
Cultural resources The number of recorded historical structures and archaeological sites potentially affected by each alternative	Churches	0	0	0	0
	Civic	0	0	4	7
	Cemeteries	0	0	0	0
Hazardous materials Hazardous material sites listed on state and federal databases which are located within the proposed right-of-way or are in proximity to each alterantive	Number of Sites	1	1	3	2
Park land Parks potentially affected (either directly or by constructive use) by each alternative	Number of Parks/Acres	2 / 7.13	2 / 7.13	3 / 1.76	4 / 2.04
Environmental Justice A determination of whether an alternative disproportionately affects minority and/or low-income populations in the community	Major (red) / Moderate (yellow) / Minor (green)	Major (red)	Major (red)	Major (red)	Minor (green)
Relocations/displacements/neighborhood impacts The relocations necessary for each alternative	Business	3	6	52	36
	Industrial	14	30	23	0
	Church	0	0	4	2
	School	0	0	1	1
	Public fac.	5	4	9	6
	Residential	71	87	111	39
Visual impacts A determination of the degree to which an alternative alters the local and overall view of the area	Major (red) / Moderate (yellow) / Minor (green)	Moderate (yellow)	Moderate (yellow)	Minor (green)	Major (red)

TABLE 8.1-1 (CONTINUED)
HARBOR BRIDGE ALTERNATIVES EVALUATION

Evaluation Criteria		Red	Orange	Green	Blue
Traffic / Planning					
Adverse impact on existing economic and business interests A determination of the extent of a particular alternative's adverse impact on economic and business interests	Red: High Yellow: Moderate Green: Low	Yellow	Yellow	Red	Red
Compatibility with future local development plans A determination of how compatible an alternative is with the City of Corpus Christi's future development plans for the local community	Red: Low Yellow: Moderate Green: High	Green	Yellow	Red	Red
Impacts to future port operations A determination of whether an alternative provides necessary air draft for future Port operations	Red: No Green: Yes	Green	Green	Green	Green
Access to the central business district A determination of how an alternative would affect transportation accessibility to Corpus Christi's central business district	Red: Worse Yellow: Similar Green: Improved	Yellow	Yellow	Red	Red
Engineering					
Construction costs A relative comparison of the estimated cost of an alternative	Red: High Yellow: Moderate Green: Low	Yellow	Green	Green	Red
Air draft The vertical clearance provided the Ship Channel by each alternative	In feet	200'	200'	180'	200'
Ability to meet design criteria A determination of whether an alternative can achieve the desirable design criteria	Red: Doesn't Meet Yellow: Meets Green: Exceeds	Green	Yellow	Red	Yellow
Maintenance of traffic during construction A determination of the difficulty of maintaining traffic flow during construction expected for each alternative	Red: Complex Yellow: Moderate Green: Simple	Yellow	Yellow	Red	Red

8.1.2 TULE LAKE LIFT BRIDGE

In evaluating replacements for the Tule Lake Lift Bridge, the project team grouped the alternatives were into two categories: with and without the railroad. A review of **Table 8.1-2** reveals that the various alternatives have very similar impacts from the standpoint of environmental and public impacts. Several individuals at the Tule Lake Lift Bridge stakeholder meeting indicated that the alternative with two bridges is less desirable because an additional structure creates a potential additional hazard.

A review of the engineering criteria reveals that the mid-level bridge without the railroad has essentially the same estimated construction cost as the low-level alternative, but provides more vertical clearance, reducing the number of daily openings by a significant number. It does require the highway portion of Joe Fulton International Trade Corridor to be elevated so that Navigation Boulevard would be grade separated and the proposed railroad placed in the Corridor. The estimated construction costs for the low-level alternative with the railroad are significantly lower than for the mid-level alternative with the railroad because two bridges are required for the mid-level option, one for Navigation Boulevard and the other for the railroad. For this alternative, the railroad alignment would be different from Navigation Boulevard and would remain in the "up position" at least as high as Navigation Boulevard, and only be lowered when the trains cross the Ship Channel.

A review of the Vehicular and Intermodal Flow criterion reveals that the alternatives that include the railroad would cause significantly more delay to traffic traveling along Navigation Boulevard because the number of bridge openings would essentially be the same as today. The two mid-level alternatives have a greater adverse impact on adjacent land use than the low-level alternative because direct access to adjacent property would be restricted when the fill height along Navigation Boulevard exceeds five feet.

8.2 RECOMMENDED IMPROVEMENTS

Recommended improvements for both Harbor and the Tule Lake Lift Bridges are described in this section of the report. These recommendations are based upon technical analysis as described earlier in the report as well as on comments received from the project Citizens' Advisory Committee, the maritime industry, ship pilots who navigate the Ship Channel, and the public. The recommended improvements for each alternative are presented below.

TABLE 8.1-2
TULE LAKE LIFT BRIDGE ALTERNATIVES EVALUATION

Evaluation Criteria		Alternatives			
Environmental/Public Involvement Issues		Low Level with RR	Low Level w/o RR	Mid Level with RR	Mid Level w/o RR
Wetlands/waters of the United States The number of acres of wetlands/waters of the U.S. that would be impacted by each alternative	Number of acres (wetlands/US waters/total	1.16/7.00/8.16	1.16/7.00/8.16	1.16/7.00/8.16	1.16/7.00/8.16
Coastal/aquatic issues A determination of whether an alternative impacts coastal and aquatic life, such as coastal zones, oyster reefs, shrimping, etc.	Major / Moderate / Minor	Minor	Minor	Minor	Minor
Threatened and endangered species A deterimination of whether an alternative potentially affects species of potential occurrence and/or known threatened and endangered species sites	Yes / No	No	No	No	No
Cultural resources The number of recorded historical structures and archaeological sites potentially affected by each alternative	Churches	0	0	0	0
	Civic	0	0	0	0
	Cemeteries	0	0	0	0
Hazardous materials Hazardous material sites listed on state and federal databases which are located within the proposed right-of-way or are in proximity to each alterantive	Number of Sites	0	0	0	0
Impacts to structures and existing land uses A determination of the impact of alternatives on structures	Business	1	1	1	1
	Industrial	0	0	0	0
	Church	0	0	0	0
	School	0	0	0	0
	Public fac.	0	0	0	0
	Residential	0	0	0	0
Impacts to future planned development A determination of the impacts an alternative has on future planned development	Worse / Similar / Improved	Improved	Improved	Improved	Improved

TABLE 8.1-2 (CONTINUED)
TULE LAKE LIFT BRIDGE ALTERNATIVES EVALUATION

Evaluation Criteria		Alternatives: Low level with RR	Low level w/o RR	Mid level with RR	Mid level w/o RR
Engineering					
Construction costs A relative comparison of the estimated cost of an alternative	Red: High Yellow: Moderate Green: Low	Yellow	Green	Red	Green
Construction impacts to Joe Fulton Corridor An estimate of construction costs of altering Joe Fulton Corridor to connect with Navigation Boulevard	In 2003 dollars	$0	$0	$3,300,000	$ 3,300,000
Maintenance of traffic during construction A determination of the difficulty of maintaining traffic flow in the Joe Fulton corridor during construction of each alternative	Red: Complex Yellow: Moderate Green: Simple	Green	Green	Yellow	Yellow
Vehicular and Intermodal Flow					
Operational delay time The estimated total daily amount of time the bridge is inoperable due to vessel movements for each alternative	In hours	4	4	0.5	0.5
Public service facility access A determination of whether an alternative changes emergency service access	Red: Worse Yellow: Similar Green: Improved	Yellow	Yellow	Green	Green
Ship channel access A determination of whether an alternative impacts the accessibility of the inner harbor	Red: Worse Yellow: Similar Green: Improved	Yellow	Yellow	Green	Green
Adjacent land use A determination of the alternative's effect on access to and development potential of adjacent land -- in linear feet where the fill height exceeds five feet	In linear feet	0	2400'	5200'	5200'

8.2.1 HARBOR BRIDGE

The red alternative corridor is recommended to replace the current Harbor Bridge. This corridor completely eliminates the offset in alignment between SH 286 and U.S. 181, providing the most flexibility for achieving the desirable design criteria. In addition, the red alternative is the most compatible with the City of Corpus Christi's future development plans.

This alternative is located to the west of the proposed new stadium and cruise terminal allowing these two important facilities to become a part of the existing beachfront development, convention center area, and CBD. The alternative also would serve as a barrier between the newly developed Northside people-oriented area and the Port and industrial facilities located to the west of the red alternative. While the red alternative requires a longer bridge span resulting in a higher estimated construction cost than the green and orange alternatives, the benefits from better compatibility with future local development and elimination of the offset outweigh the added cost.

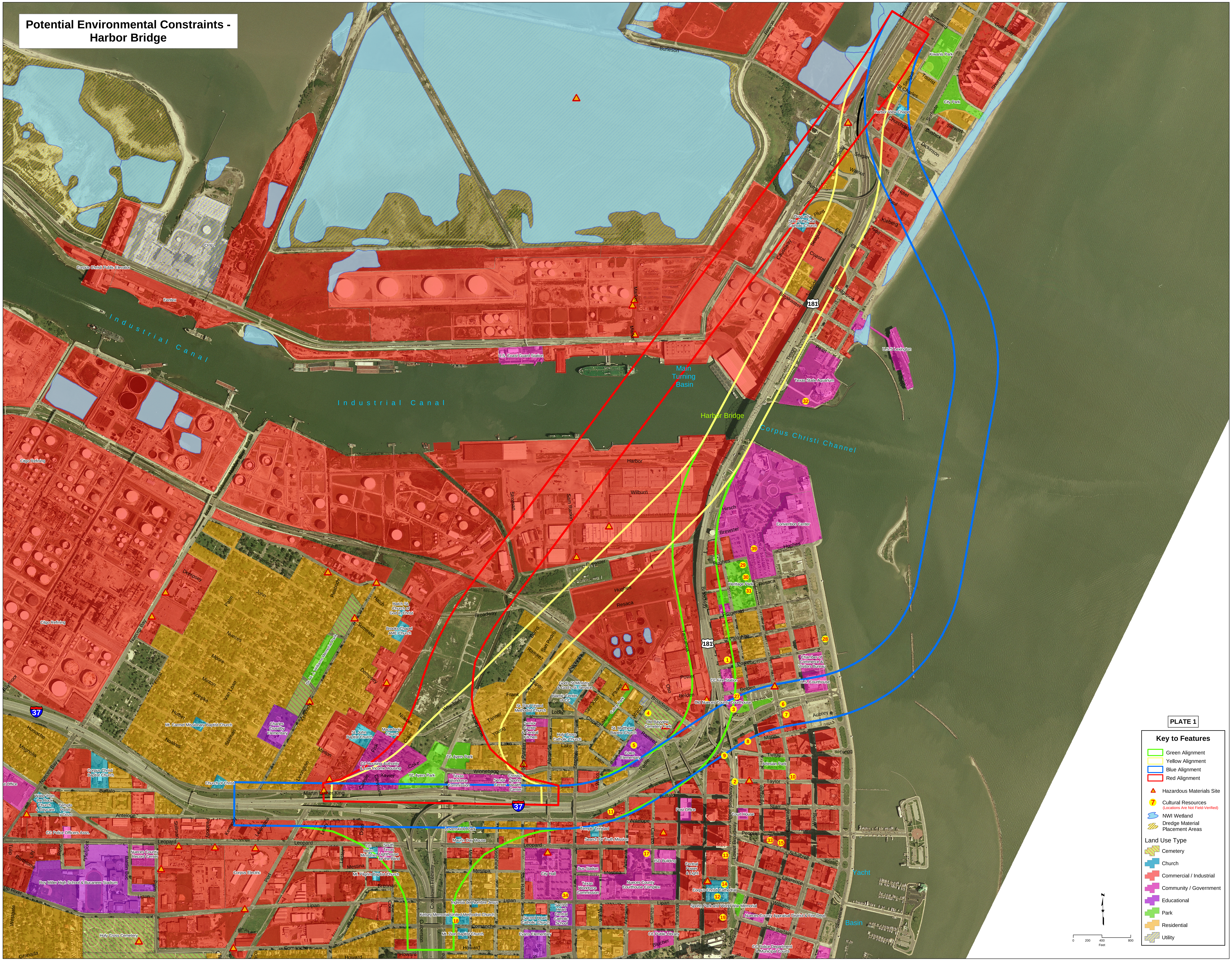
The green and blue alternatives have significantly greater adverse environmental impacts, and the blue alternative has the greatest construction cost. The green alternative does not address the offset issue. Both the blue and green alternatives continue to form a barrier between the CBD and the beachfront area and the Northside, which is considered undesirable. The orange alternative was ranked higher than both the green and blue alternatives but lower than the red alternative. The orange alternative was ranked lower than the red alternative because it is located to the east of the cruise terminal and the site of the new baseball stadium, and therefore would form a barrier between these two facilities and other existing beachfront and downtown development. In addition, its reverse curve alignment reduces the flexibility in detailed design options.

8.2.2 TULE LAKE LIFT BRIDGE

Two alternatives are recommended for replacing the existing Tule Lake Lift Bridge — one incorporating the railroad tracks and the other without provision for a railroad crossing. The two recommended alternatives are the low-level alternative with railroad tracks and the mid-level alternative without provision for the railroad.

The low-level alternative with the railroad crossing was selected primarily based on estimated cost. The mid-level alternative with railroad requires two structures, one for Navigation Boulevard and the other a separate railroad bridge. As previously described, the railroad crossing is a vertical lift structure with the bridge left in the "up position" until a train needs to cross the Channel. These two structures result in an estimated construction cost for the mid-level alternative with the railroad bridge of approximately two times the low-level alternative. There is no substantial difference in the environmental impacts for the two alternatives, with the mid-level alternative disrupting a larger area of the natural environment because of the two structures required versus one structure for the low-level alternative. Also, maritime users of the Ship Channel prefer the low-level alternative with the railroad crossing because there is only one structure as compared to two structures required for the mid-level alternative with railroad. The recommended alternative with the railroad crossing is a low-level vertical lift structure that provides a clear channel width of 300 feet and 200 feet in the "up position."

The mid-level alternative without a railroad crossing of the channel is the recommended alternative. This alternative was selected because it reduces the number of openings by approximately 90 percent as compared to the low-level alternative and has essentially the same construction cost. There is no substantial difference in the environmental impacts for the two alternatives. The mid-level alternative would have an adverse impact on access to adjacent property because of the fill height that restricts direct access to the adjacent property. However, this adverse impact to adjacent property does not outweigh the benefits of a substantial reduction in the number of openings provided by the mid-level alternative. A concrete, mid-level "double-swing" movable structure providing a 350-foot clear channel width is the recommended alternative without the railroad crossing. This additional channel width is provided in response to the ship pilots' request to mitigate the "vertical wall" effect when the swing bridge is in the open position.


Potential Environmental Constraints - Harbor Bridge
Industrial Canal
Main Turning Basin
Harbor Bridge
Corpus Christi Channel
PLATE 1
Key to Features
Green Alignment
Yellow Alignment
Blue Alignment
Red Alignment
Hazardous Materials Site
Cultural Resources
(Locations Are Not Field-Verified)
NWI Wetland
Dredge Material Placement Areas
Land Use Type
Cemetery
Church
Commercial / Industrial
Community / Government
Educational
Park
Residential
Utility

Date Month XX, 2002

HARBOR BRIDGE
GEOMETRIC DESIGN ELEMENTS
MULTILANE URBAN HIGHWAY

A. Traffic

Exist/Design Year AADT 47,000 Year 2001

Design Year AADT 68,700 Year 2025

B. Design Speed, Alignment and Grades:

Design Elements	Exist Conditions	Prop Design Criteria	Values from Applicable Design Guidelines
Design Speed	50 mph	70 mph	Table 3-17
Min Horiz Radius	N/A	3405’	Table 2-3
Max Grade	5 %	4 %	Table 2-9
Min Grade	N/A	0.0 %	Pg. 2-38

Functional Classification Principal arterial

Is superelevation required? Yes Chart used Table 2-6 Rate 6 %

C. Proposed Typical Section

1. Transverse Dimensions (all dimensions from Fig. 3-12 unless otherwise noted)
   a. Proposed median width: 24’ (including shoulders)
   b. Number of Lanes: Lane Width:
      1. Proposed 8 12’
   c. Shoulders:
      1. Inside width 10’
      2. Outside width 10’
   d. Right of way:
      1. Usual width: 180’ (Table 2-11)
   e. Bridge Width:
      1. Usual width: 141.68’
2. Cross slopes:
   a. Roadway : 2% (2.5% outside lane)
   b. Outside Shoulder: 2.5%

MULTILANE URBAN HIGHWAY

3. Clear Zone Criteria:
   a. Channel Width:
      Corpus Christi Ship Channel: 400’
   b. Vertical Under Bridge Main Span: 200’
   c. Channel Depths: Min 45’ (52’ future Corps of Engineers depth)

TULE LAKE LIFT BRIDGE
GEOMETRIC DESIGN ELEMENTS
MULTILANE URBAN STREET WITH RAIL

A. Traffic
Exist/Design Year AADT 1,690 Year 2001
Design Year AADT 3,020 Year 2025

B. Design Speed, Alignment and Grades:

Design Elements	Exist Conditions	Prop Design Criteria	Values from Applicable Design Guidelines
Design Speed	Varies	40 mph	Table 3-1
Min Horiz Radius	N/A	4010’	Table 2-4
Min Sag K	N/A	250	UPR STD 0016
Min Crest K	N/A	125	UPR STD 0016
Max Grade	N/A	0.7 %	MoKan MIS
Min Grade	N/A	0.0 %	Pg. 2-38

Functional Classification Collector
Is superelevation required? No Chart used N/A Rate N/A

C. Proposed Typical Section
1. Transverse Dimensions (all dimensions from Table 3-1 unless otherwise noted)
   a. Proposed median width: N/A
   b. Number of Lanes: Lane Width:
      1. Proposed 2 12’
   c. Shoulders:
      1. Inside width N/A
      2. Outside width 3’
   d. Right of way:
      1. Usual width: 90’ (Table 2-11)
   e. Bridge Width:
      1. Usual width: 62.84’
2. Cross slopes:
   a. Roadway: 2%
   b. Outside Shoulder: 2%

MULTILANE URBAN STREET

3. Clear Zone Criteria:
   - a. Channel Width:
     Corpus Christi Ship Channel: 300’ Min. (350’ Mid Level)
   - b. Vertical Under Bridge Main Span: 200’
   - c. Channel Depths: Min 45’ (52’ future Corps of Engineers depth)

Date Month XX, 2002

TULE LAKE LIFT BRIDGE
GEOMETRIC DESIGN ELEMENTS
MULTILANE URBAN STREET WITHOUT RAIL

A. Traffic
Exist/Design Year AADT 1,690 Year 2001
Design Year AADT 3,020 Year 2025

B. Design Speed, Alignment and Grades:

Design Elements	Exist Conditions	Prop Design Criteria	Values from Applicable Design Guidelines
Design Speed	Varies	40 mph	Table 3-1
Min Horiz Radius	N/A	4010’	Table 2-4
Max Grade	N/A	6 %	Table 2-9
Min Grade	N/A	0.0 %	Pg. 2-38

Functional Classification Collector
Is superelevation required? No Chart used N/A Rate N/A

C. Proposed Typical Section
1. Transverse Dimensions (all dimensions from Table 3-1 unless otherwise noted)
   a. Proposed median width: NA
   b. Number of Lanes: Lane Width:
      1. Proposed 2 12’
   c. Shoulders:
      1. Inside width N/A
      2. Outside width 3’
   d. Right of way:
      1. Usual width: 90’ (Table 2-11)
   e. Bridge Width:
      1. Usual width: 32.84’
2. Cross slopes:
   a. Roadway: 2%
   b. Outside Shoulder: 2%

MULTILANE URBAN STREET

3. Clear Zone Criteria:
   a. Channel Width:
      Corpus Christi Ship Channel: 300’ Min. (350’ Mid Level)
   b. Vertical Under Bridge Main Span: 200’
   c. Channel Depths: Min 45’ (52’ future Corps of Engineers depth)

APPENDIX B
VESSEL SURVEY QUESTIONNAIRE

1.	**NAME OF COMPANY:**

2.	**NAME OF CONTACT:**

3.	**PHONE NUMBER:**

4.	**FAX NUMBER:**

5.	**E-MAIL ADDRESS:**

6.	**MAILING ADDRESS (*PLEASE PROVIDE AN ADDRESS THAT CAN RECEIVE AN OVERNIGHT DELIVERY*):**

7.	**VESSEL FUNCTIONS AND GENERAL CARGO TYPES:**

7A.	**MOST FREQUENTED DOCKING FACILITY USED AT PCCA:**

8.	**NUMBER OF VESSELS CURRENTLY (2002) SERVICING THE GULF OF MEXICO AND/OR ATLANTIC OCEAN:**

9.	**NAME OF THE LARGEST VESSEL(S) SERVICING THE GULF OF MEXICO AND/OR ATLANTIC OCEAN:**

9A.	**VERTICAL CLEARANCE REQUIREMENTS ABOVE THE WATER LINE OR MOLDED DEPTH:**

9B.	**BEAM:**

10.	**PROJECTED SIZE OF LARGEST VESSEL(S) IN FLEET (2010 – 2050) (IMPERIAL UNITS PLEASE)**

2010	**(A) LENGTH OVERALL (LOA)**
	(B) BEAM
	(C) DEADWEIGHT TONNAGE (DWT)
	(D) MAX LOADED WATER DRAFT
	(E) MAX LOADED AIR DRAFT
	(F) MAX UNLOADED AIR DRAFT
	(G) MOLDED DEPTH (FROM THE BOTTOM OF THE KEEL TO THE HEIGHT POINT)

2020	**(A) LENGTH OVERALL (LOA)**
	(B) BEAM
	(C) DEADWEIGHT TONNAGE (DWT)
	(D) MAX LOADED WATER DRAFT
	(E) MAX LOADED AIR DRAFT
	(F) MAX UNLOADED AIR DRAFT
	(G) MOLDED DEPTH (FROM THE BOTTOM OF THE KEEL TO THE HEIGHT POINT)

APPENDIX B (CONTINUED)
VESSEL SURVEY QUESTIONNAIRE

2030	**(A) LENGTH OVERALL (LOA)**
	(B) BEAM
	(C) DEADWEIGHT TONNAGE (DWT)
	(D) MAX LOADED WATER DRAFT
	(E) MAX LOADED AIR DRAFT
	(F) MAX UNLOADED AIR DRAFT
	(G) MOLDED DEPTH (FROM THE BOTTOM OF THE KEEL TO THE HEIGHT POINT)

2040	**(A) LENGTH OVERALL (LOA)**
	(B) BEAM
	(C) DEADWEIGHT TONNAGE (DWT)
	(D) MAX LOADED WATER DRAFT
	(E) MAX LOADED AIR DRAFT
	(F) MAX UNLOADED AIR DRAFT
	(G) MOLDED DEPTH (FROM THE BOTTOM OF THE KEEL TO THE HEIGHT POINT)

2050	**(A) LENGTH OVERALL (LOA)**
	(B) BEAM
	(C) DEADWEIGHT TONNAGE (DWT)
	(D) MAX LOADED WATER DRAFT
	(E) MAX LOADED AIR DRAFT
	(F) MAX UNLOADED AIR DRAFT
	(G) MOLDED DEPTH (FROM THE BOTTOM OF THE KEEL TO THE HEIGHT POINT)

13.	**ADDITIONAL COMMENTS:**

MEETING MINUTES

TxDOT Harbor Bridge/Tule Lake Lift Bridge Feasibility Study
Harbor Bridge Citizens' Advisory Committee Meeting
April 29, 2003

Important Notice
The Harbor Bridge Public Meeting will take place on **May 29** rather than on May 22, as discussed in the CAC meeting. Meeting particulars are as follows:

Event: Harbor Bridge Feasibility Study Public Meeting
Place: Oveal Williams Senior Activity Center
Time: 6 – 8 p.m., Thursday, May 29, 2003
Agenda: Open house and public meeting to discuss the recommended corridor alternatives for Harbor Bridge and Tule Lake Lift Bridge

The Harbor Bridge Citizens' Advisory Committee met on April 29, 2003 with 26 members in attendance. The agenda for this meeting covered the following topics:

- Feasibility study update/status
- Evaluation criteria and evaluation process
- Recommended Harbor Bridge corridors
- Recommended Tule Lake Lift Bridge corridors
- May public meeting
- Project funding and timeline
- Meeting summary and wrap-up.

Review of CAC Recommendations from Previous Meetings
The meeting began with a review of the CAC members' wishes for a new Harbor Bridge. The desired characteristics of a new bridge area are as follows:

- Maintain the distinctive, "signature" quality of the current Harbor Bridge;
- Result in skyline worthy structure;
- Support livable, united neighborhoods;
- Revitalize the local community;
- Use durable materials that will result in a long lasting structure;
- Provide adequate width for current and future traffic;
- Make the bridge more user friendly with bike lanes and pedestrian walkways;
- Ensure safety (provide shoulders and remove sharp approach curves); and
- Provide adequate navigational clearances.

Feasibility Study Status
The next topic was the current status of the Harbor Bridge/Tule Lake Lift Bridge Feasibility Study.

Various portions of the study have been completed, including the Purpose and Need Study; the Fleet Survey (to determine required clearances for vessels traveling beneath the two bridges); and the Travel Demand Study (to determine future vehicle travel demand for the bridges). Public involvement activities, including three meetings (including tonight's meeting) of the CAC and a public meeting, have taken place. Preliminary alternative corridors have been identified and ranked for Harbor Bridge. In addition, alternative configurations have been identified and evaluated for the Tule Lake Lift Bridge.

The Feasibility Study is now in its final stages and scheduled for completion by June 30. During this time, a recommended corridor alternative will be identified for Harbor Bridge and a recommended configuration will be identified for Tule Lake Lift Bridge.

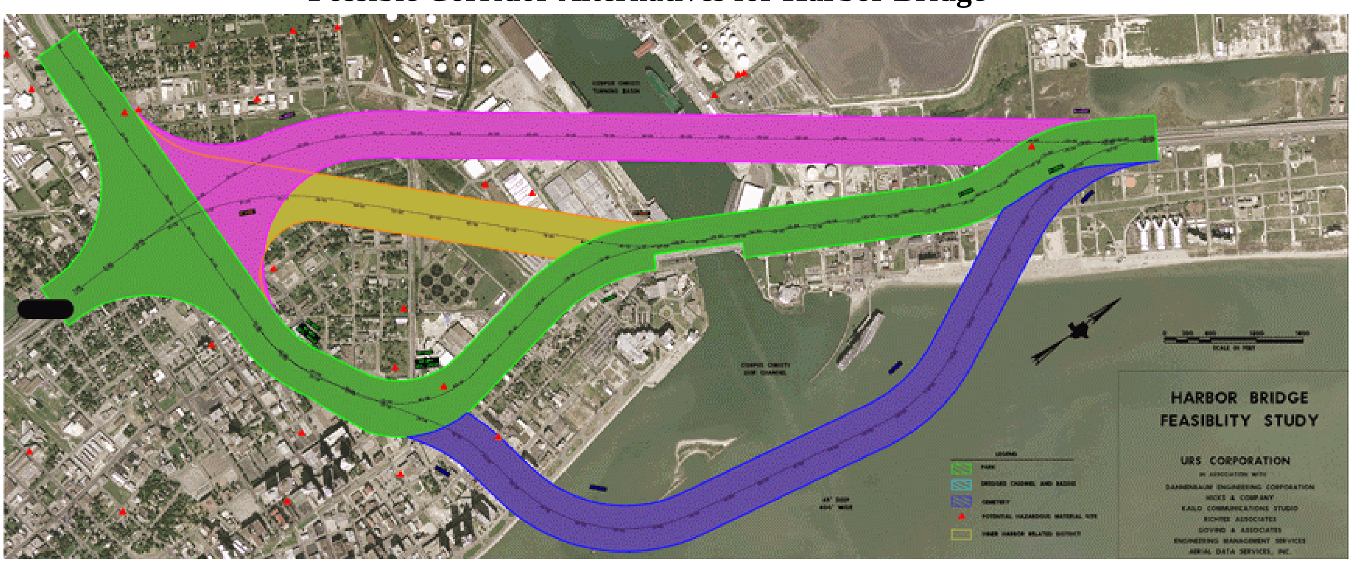
Additional public involvement activities will take place as well. These activities include the distribution of a newsletter and a public meeting, scheduled for May 29. The final Feasibility Study report will be completed by June 30.

Evaluation Criteria and Evaluation Process – Harbor Bridge

For the Feasibility Study, a set of criteria was developed to evaluate each of the alternative corridors for the Harbor Bridge. These evaluation criteria fell into three categories:

- Environmental/Public involvement issues;
- Traffic and planning; and
- Engineering.

Possible Corridor Alternatives for Harbor Bridge



Each of the alternatives shown above was evaluated and then ranked. The top ranked alternative was the "red" corridor (at the top of the picture). It was ranked number one for the following reasons:

- It will have less of an environmental impact than the other alternatives.
- It will meet the desired design criteria.
- It is highly compatible with future development plans for the area.
- It resolves the "offset" alignment between U.S. 181 and the Crosstown Expressway.

The number two-ranked alternative was the "orange" corridor, second from the top in the figure above. This corridor received the number two ranking for the following reasons:

- It meets design criteria.
- This alternative is moderately compatible with future development plans.

The third ranked alternative corridor is the "blue" route, which is the corridor that extends out into Corpus Christi Bay. It received this ranking because of the following reasons:

- It has a higher impact on coastal/aquatic life.
- This corridor would have a higher visual impact than the other alternatives.
- This corridor would create a barrier between the neighborhood and the central business district.
- It would create a barrier between the central business district and the beachfront area.

Finally, the lowest ranked alternative corridor was the "green," which is in approximately the same area as the current Harbor Bridge (including approaches from north and south). This alternative was ranked lowest for these reasons.

- More relocations are required for this corridor than for the red and orange alternatives.
- This alternative will have a high adverse effect on local business/economic interests.

- It is not very compatible with future development plans for the community.
- It reduces access to the central business district.
- This corridor does not address the offset alignment between the Crosstown Expressway and U.S. 181

Evaluation Criteria and Evaluation Process – Harbor Bridge

Evaluation criteria were developed to evaluate four configurations for the Tule Lake Lift Bridge—low level with railroad and without railroad, and mid-level with and without railroad.

The evaluation process worked just as it did with Harbor Bridge although the evaluation criteria categories were slightly different:

- Environmental/Public involvement issues;
- Engineering; and
- Vehicular and intermodal flow.

Upcoming Public Meeting

TxDOT presented its plans for a public meeting on the feasibility at the end of May and requested input from CAC members. CAC members requested that the meeting be held at Oveal Williams Center or Miller High School.

Committee members also were asked about how public meeting attendance could be increased. Ron Massey of the City of Corpus Christi suggested use of the city's auto dial system to remind people of the meeting. Waunell Madison recommended that TxDOT notify the 12 ministers with churches in the project area of the meeting.

It was also recommended that the upcoming newsletter (including a meeting notification) be sent to residents and businesses in several local zip codes including the Northside and North Beach areas.

Funding Issues and Project Timeline

The Harbor Bridge project will be funded in two phases. During the first phase, interchange improvements associated with the bridge would be completed. During the second phase, the actual bridge would be built.

The advantage of using such this phased approach is that the project can move forward more quickly, right-of-way can be acquired sooner, and the community can come to an agreement on the new bridge before all of the funding for the entire project is available.

Following is the anticipated timeline for completing project activities.

- Complete feasibility study – Summer 2003
- Prepare Environmental Assessment (EA) – Fall 2003 to Summer 2004
- Public involvement continued – Summer 2004
- If the EA and Finding of No Significant Impact (FONSI) are adequate, then the project would be cleared to proceed – Summer 2006.
- If not, then prepare Draft Environmental Impact Statement (EIS) followed by Record of Decision (ROD)
    - Prepare document – Fall 2004 to Spring 2005
    - Public involvement – Throughout
    - Clearance/ROD – Spring 2008
- Prepare Right-of-Way (ROW) Map – Spring 2008 to Fall 2008
- Acquire ROW – Fall 2008 to Summer 2010

- Develop construction plans for Phase I – Fall 2008 to Summer 2010
- Build Phase I – 2010 to 2013
- Develop construction plans for Phase II – 2008 to 2012
- Build Phase II – After 2013 (approximately 3 to 4 years to build)

CAC Input and Questions

Question: If the number one ranked alternative is selected, how would people have access to the downtown?

The existing approaches to the Harbor Bridge would become a boulevard that would provide access to the central business district.

Question: The city is talking about widening Staples and Port Avenues. How would the new bridge corridor affect this plan?

The new alignment would provide a ramp to the downtown; it would also provide a direct connection between the high traffic routes of U.S. 181 and the Crosstown Expressway.

Question: The city is talking about rezoning the Northside, CCISD is planning to close Coles Elementary, and you are talking about a new bridge. Are you all talking with one another?

Bill Kelly responded that any city zoning changes will accommodate the new bridge location. The school district is considering the zoning changes and is communicating with TxDOT about the bridge feasibility study. TxDOT is actively working with the city, CCISD, and other local entities in conducting this feasibility study.

Question: Will the number one ranked alternative go over the top of the proposed new ballpark?

This alternative corridor will not pass over the location of the ballpark.

Question: Will building a new bridge affect the Corpus Christi Ship Channel?

No foundations will be built in the Channel itself.

Question: How will ROW acquisition be handled?

A TxDOT representative responsible for ROW issues will be at the public meeting on May 29.

This was the final CAC meeting for the Harbor Bridge/Tule Lake Lift Bridge Feasibility Study. We thank you for all of your time and ideas that have contributed to making this a better project.

TxDOT Harbor Bridge/Tule Lake Lift Bridge Feasibility Study
Tule Lake Lift Bridge Stakeholders Meeting
April 29, 2003

A meeting of Tule Lake Lift Bridge stakeholders was held on April 29, 2003, in Corpus Christi. In attendance were the following:

Richard Faris
Logistics Coordinator
Equistar

Captain Pat Newman
Manager, Marine Assurance
Valero Marketing and Supply Company

Greg Sheldon
Loss Control Supervisor
Valero Marketing and Supply Company

Christopher Nelson
Division Chief
Refinery Terminal Fire Company

Andy Cunningham
Flint Hills Resources

Frank Brogan
Port of Corpus Christi

Brian Wood, TxDOT
Victor Vourcos, Tx DOT

Dave Johnston, URS
Nancy Gates, URS
Jim Phillips, URS
Carol Scott, Kailo Communications Studio
Vern Hegwood, Dannenbaum Engineering

The agenda for this meeting covered the following topics:

1. Overview and current status TxDOT Harbor Bridge/Tule Lake Lift Bridge Feasibility Study
2. Development of alternatives for Harbor Bridge and Tule Lake Lift Bridge
3. Detailed explanation of alternatives for Tule Lake Lift Bridge
4. Upcoming public meeting on project: May 29 at the Ortiz Center.

Overview and Status of TxDOT's Feasibility Study

In 2001, TxDOT, Corpus Christi District began a Feasibility Study that addresses the need to replace the Tule Lake Lift Bridge and the Harbor Bridge. This study includes the following components:

- An determination of the purpose and need for replacement of the Tule Lake Lift Bridge and Harbor Bridge.
- A vessel survey to determine the number and types of ships that are now using and are expected to using the Ship Channel in the future.
- A traffic demand study to evaluate whether future travel demand crossing the Ship Channel exceeds the current capacity of the two bridges
- An identification and evaluation of alternatives to the existing bridges. For Tule Lake Lift Bridge, four alternative configurations have been identified. In the case of the Harbor Bridge, four alternative corridors have been identified and ranked.
- Public involvement to identify and work with local stakeholders in developing and evaluating bridge alternatives.
- Selection of recommended alternatives for the bridges. This selection does not commit TxDOT to a course of action.

The Feasibility Study is scheduled for completion on June 30 of this year. The next stage of the project will be schematic development and environmental documentation to evaluate the recommended alternatives in greater detail. Public involvement will continue to be a key component of this stage of the project as the environmental impacts of the alternatives are identified and evaluated and the bridge design process begins.

Development of Alternatives for Harbor Bridge and Tule Lake Lift Bridge

Four alternative corridor alignments have been identified for Harbor Bridge. These alternatives have been ranked using evaluation criteria that fall into three categories:

- Environmental/Public involvement issues;
- Traffic and planning; and
- Engineering.

There are four possible configurations for the Tule Lake Lift Bridge: low level bridge with and without railroad and mid-level bridge with and without railroad. The City of Corpus Christi owns the Tule Lake Lift Bridge, which is operated and maintained by the Port of Corpus Christi.

One of the issues associated with developing configurations for the Tule Lake Lift Bridge has to do with the UP railroad. The railroad currently uses this bridge crossing but would not necessarily have to do this in the future because it could be routed around the end of the Ship Channel. The decision whether to include a railroad crossing is a local decision, not TxDOT’s. Therefore, the possible configurations include bridges with and without a railroad crossing.

In the mid-level configuration without the railroad, the bridge would be high enough that it would not need to open for barges and tugs, only for ships. With the railroad crossing, a separate railroad bridge would parallel the vehicle bridge and would remain in the open position until a train approached the bridge. The channel width would be increased to 300 feet and the channel depth to 52 feet (in a separate channel-dredging project). A 200-foot vertical clearance would be available with the mid-level bridge in the closed position.

A double-swing design is envisioned for the mid-level bridge. This design provides unlimited vertical clearance in the open position and requires concrete construction, which is easier to maintain. On the downside, the heavy concrete structure takes longer to operate than a conventional steel lift bridge.

In the low-level configuration, the bridge would have to open each time a vessel approaches.

Public Involvement Activities

Last summer TxDOT established a citizens advisory committee (CAC) of stakeholders with an interest in the future of Harbor Bridge and Tule Lake Lift Bridge. The committee has met three times; all meetings were open to the public. As the Feasibility Study has progressed, the CAC has provided valuable input for the development of bridge alternatives. A public meeting was held in November and a second such meeting will take place on May 29 from 6 –8 p.m. at the Oveal Willliams Center.

Meeting Followup:

Distribute meeting minutes to those in attendance and those invited
Contact the Channel Pilot’s Association for a follow-up meeting with them since pilots have a strong interest in bridge configuration.

Tule Lake Bridge Stakeholder meeting list

Tuloso Midway ISD
Dr. Karen Rue
apeterson@tmisd.esc2.net

Flint Hills Resources
Andy Cunningham
PO Box 2608
Corpus Christi, TX 78403

CITGO Corpus Christi Refinery
David Dear
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TxDOT Harbor Bridge/Tule Lake Bridge Feasibility Study
Citizen's Advisory Committee Meeting
September 19, 2002

The agenda for the meeting covered the following:

- Feasibility study update/status
- Presentation of development plans for project area
- Presentation of bridge types
- Discussion of possible corridors
- Discussion of upcoming meetings

TxDOT representative, Bryan Wood, opened the meeting with an introduction and an update on the Harbor Bridge Feasibility Study.

Thus far in the project, a purpose and need memo has been completed to identify the need for replacement of the Harbor Bridge and the Tule Lake Lift Bridge. Data have been gathered to identify constraints (e.g., environmental) that might affect bridge replacement. Public involvement activities are underway, including these citizens' advisory committee meetings. A fleet survey that will be used to determine navigational clearances is being reviewed by TxDOT. In addition, a travel demand tech memo is being completed to determine future travel demand across the Corpus Christi Ship Channel. Finally, some preliminary conceptual corridor alignments have been developed and are being presented here tonight.

Ron Stuckey reviewed the process that TxDOT uses in addressing right-of-way (ROW) issues. He commented on the use of ROW maps and the data used in appraising properties (market value comps, cost to replace, income (i.e., from rental property)

Ron Massey, Assistant City Manager for the City of Corpus Christi, reported to the group on the city's plans in the project area. The objective of the Northside Plan, which is due to be completed in draft form in November 2002, is to rezone properties in the Hillcrest and Washington Coles areas from residential to non-residential. Various committee members questioned Ron about the idea of rezoning the project area, in particular how that might affect residents who choose to remain in the area.

The Hillcrest area is being considered for a Research Technology Park District, and would serve as a buffer between heavy industry to the west and areas to the east. The Washington Coles area is being considered for mixed land use/zoning that would bring together the Bayfront Arts and Science Park and the neighborhood.

The draft plan will be presented to neighborhood ministers, and will be the subject of Planning Commission public hearings in December 2002 and January 2003, and city council public hearings in February 2003. If the plan and zoning districts are adopted, the city would begin the rezoning process in the spring of 2003. In the meantime, the city is working with other local and state entities to identify ways of easing the transition from residential to non-residential zoning. Michael Gunning, Corpus Christi's Director of Planning, also attended to answer questions from the group. Comments from the group included the following:

- Doesn't rezoning before people move out put the cart before the horse?
- We need to help people get out rather than be stuck there after rezoning.

Ron also discussed the closure of the Broadway wastewater treatment plant, which has been recommended by the Corpus Christi City Council.

Benito Reyes from the Corpus Christi Independent School District discussed the district's master plan, which will look at the needs of the entire district. This plan will not be ready until next year. Thus far, CCISD has not made any decisions regarding consolidation of schools and is waiting to see the results of TxDOT's feasibility study for Harbor Bridge. A concern was raised by the group that the name of Simon Coles continue to be used even if that school eventually closes.

Richard Franco of the Corpus Christi Housing Authority presented a brief overview of the housing authority's plans. The Housing Authority has no specific plans for the Leathers Housing Project, although the agency does plan to build 1000 units (not specifically in the Harbor Bridge area) in the next five years.

David Johnston of URS, the feasibility study consultant, presented photos of various possible bridge designs (examples from across the U.S. and abroad) for the committee's information. He also then presented some possible alignments for the Harbor Bridge and Tule Lake Lift Bridge for the committee to look at and consider.

Scott Elliff, the meeting facilitator helped the committee summarize the meeting by asking committee members to complete the following sentences.

I'm really pleased to see…

- That you are talking to the community before finalizing anything
- TXDOT responded to our requests for information for this meeting
- Attractive bridge designs
- We didn't talk about a tunnel
- Great turnout
- Good refreshments
- Good drawings
- Use of layman's language
- That we're taking school issues under consideration
- Attendance and enrollment aren't the only factors the school district is considering in thinking about closing schools
- There will be other opportunities for public participation

I’m still concerned about…

- Which bridge design will win out
- Decision-making process on rezoning needs to include property owners
- Will the bridge be high enough?
- Bridge security
- Safety from barge accidents
- Issue of cost effectiveness—for *whom?*
- Timeframe—when are we really going to be talking to folks seriously about this?

I’m still wondering…

- If we can get the money, and when?
- Why does it take seven years to move the wastewater plant?
- About this area still maintaining some beauty and landscaping once a bridge is built
- Maintaining historical sites in the area

Finally the committee provided some input regarding the public meeting:

- Need large venue—Selena Auditorium?
- 6:00 p.m. – 7:30 p.m. Start promptly.
- Cover everything that the Advisory Group has seen so far:
  - ✓ The need for the new bridge
  - ✓ Corridors, with advantages and disadvantages
  - ✓ Bridge designs—fewer than were shown tonight, and show them compatible with each of the corridor options

TxDOT Harbor Bridge/Tule Lake Lift Bridge Feasibility Study
Summary of Citizen's Advisory Committee Meeting
June 27, 2002

Common Themes

- Support livable, united neighborhoods
- Maintain distinctive, signature structure
- Use durable materials
- Revitalize community
- Ensure safety (shoulders, curves)
- Maintain history and heritage

Vision for the Bridge -- CAC member ideas

Visual:
- Visually "sensational"—appealing, attractive, distinctive…not like the causeway, or just "functional"
- Should be a new "icon" for Corpus Christi
- Lighted bridge for "Sparkling City"

Construction materials:
- Use durable materials suitable for this environment
- Long-term solution in durable construction materials

Configuration:
- Adequate vertical and horizontal clearance
- Eliminate the big bend by the Courthouse/Take out dangerous curves
- Improve safety
- Open up streets in the area (e.g., Winnebago) that used to connect to downtown
- Include message signs to advise folks of upcoming hazards
- Some see a tunnel, others see a bridge
- Aid in evacuating the City in time of need
- Provide HOV lane, bus lane
- Provide sidewalks, bike lanes and other accommodations for various modes of transportation
- Should be as wide as possible and provide space for cars that break down – shoulders

Location:
- Location should be compatible with Port operations
- Should provide access to all of the recreational facilities, hotels
- Maintain historical points—do not lose the history
- Ease traffic flow into main streets

- Align with current interchanges
- Save the old Courthouse/Tear the Courthouse down

Miscellaneous:
- Not be a toll bridge—open to all people

Vision for the community - CAC member ideas

Neighborhood Preservation:
- If the bridge ties to the Crosstown Expressway, concern about living under ramp bridges, and issues related to that
- Heritage in area needs to be considered—St. Paul's and Holy Cross churches are nearly 100 years old
- Tear down some houses, but preserve historic areas, such as Harlem Theatre, churches, Unity Chapel, Bayview Cemetery
- Port Avenue would become very important
- Support neighborhood objectives
- Maintain or increase property values
- Maintain access to neighborhoods
- Keep community together (community cohesion)
- Maintain neighborhood beauty, Maintain park facilities
- Improve the area—make it more "livable"-- landscaping needed

Development Issues:
- Opportunity for growth—businesses near off-ramps—the City as a whole should experience economic growth—property values would grow
- Identify opportunities for re-development
- Funds would be available in relation to the project to improve housing, making the community more livable—community renewal
- Unite the Coles area with downtown and beachfront
- Develop vacant lots—could be developed as a tourist pathway connecting with downtown
- Bridge could keep commercial traffic away from downtown
- If you tear something down, put something new in its place
- Enhancement of Central Business District
- Timing of construction—impact to vessel traffic

Other issues or concerns

Relocation:

- Right of Way—what are the State's legal rights to acquire property at a cost different from what the owner wants to receive?

- When I-37 was built, the state took a real interest in helping folks relocate—want to see that again
- Need to consider needs of renters

Traffic Flow:
- Connection to the Fulton Corridor
- What happens to Concrete Street?
- Address traffic congestion
- Parking for new baseball field--how will this affect area?
- Access from bridge to downtown, uptown, bayfront
- Access to attractions—good signage needed
- Impact of demolition on vessel traffic

Environmental/Safety:
- Environmental issues (gas lines, impact on community as a whole)
- Noise from development
- Truck spills from accidents
- Terrorist activity
- Proximity to refineries—danger of explosions
- Security—barge accidents
- Security to base of structure—ownership and access

Alternatives and Ideas

- No tunnel
- No bridge over bay
- Research bridges in our Sister Cities—duplicate or replicate other structures
- Look at bridges in Phoenix and St. Louis
- Consider 1984 Hialco planning document, City's Northside Development Plan
- Hold on to the Napoleon's Hat icon
- Where will the money come from?

Considerations for Future Meetings

- Contact CCISD to hear about their plans
- Hear about churches' plans and their discussions with the City
- Present the input of the Advisory Committee at this meeting to the future Public Meeting
- Be prepared to present the status of the City's Northside Development Plan
- Hear from the Housing Authority
- Analyze tonight's issues and concerns, and bring information to next meeting
- Need Port presence and representation from City of Portland
- Bring real estate / appraisal folks

- Consider waiting until bridge height and other specs are available
- Need to be able to feed back some information from the study
- Show some of the “unfavorable” alternatives and why they were determined to be unfavorable
- How would the bridge relocation impact other transportation plans?

MEDIA OUTLETS FOR MEETING PUBLICITY

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PO Box 331486
Corpus Christi, TX 78463

Phone: 361-884-8890
Fax: 361-884-8891

Community Calendar and PSA Announcements were sent to the following:

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PO Box TV-10
Corpus Christi, TX 78403-3199
Contact: Carol Rostohar
Prefers: Fax- 361-884-8111

KIII- Channel 3
PO Box 6669
Corpus Christi, TX 78466-6669
Contact: Heidi Garcia

KRIS- Channel 6
PO Box 840
Corpus Christi, TX 78403-0840
Contact: Jay Sanchez

KORO- Channel 28
PO Box 2667
Corpus Christi, TX 78403-2667
Contact: Claire Arrendondo

Corpus Christi Caller Times
PO Box 9136
Corpus Christi, TX 78469-9136
Contact: Cynthia Wilson
Prefers: e-mail – wilsonc@caller.com

KEYS-AM
Po Box 9757
Corpus Christi, TX 78469-9757
Contact: John Gifford
Prefers: Fax- 361-882-9767

KEDT-FM
4455 S.P.I.D. #38
Corpus Christi, TX 78411-4481
Contact: Stewart Jacoby
Prefers: Fax 361-855-3877

KFTX-FM
1520 South Port Ave.
Corpus Christi, TX 78405-2106
Contact: Austin Daniels
Prefers: e-mail- AustinKFTX@swbell.net

KLTG-FM
PO Box 898
Corpus Christi, TX 78403-0898
Contact: Bert Clark
Prefers: e-mail- bertc@thbeach965.com

KPUS-FM
826 S.P.I.D.
Corpus Christi, TX 78416-2506
Contact: Alecia Buller
Prefers: Fax- 361-225-3047

Texas Radio
94.7
701 Benys Rd
Corpus Christi TX 78408
Contact: Dave Avery
FAX: 299-0400

South Texas Informer
PO BOX 271383
Corpus Christi TX 78427
Contact: Beverly Winters
FAX: 808-9606

Padre Island Moon
14493 SPID
Corpus Christi TX 78411
Contact: Mike Ellis
FAX: 949-9625

Flour Bluff Sun
PO BOX 18268
Corpus Christi TX 78480
Contact: Marie Speer
FAX: 939-8553

Portland News
101 Cedar Dr #G
Portland TX 78374
Contact: Kathleen Muller
FAX: 643-1400

NEWSLETTERS

NEWS from the Bridge

A Newsletter from the
Texas Department of Transportation
Corpus Christi District
July 2003

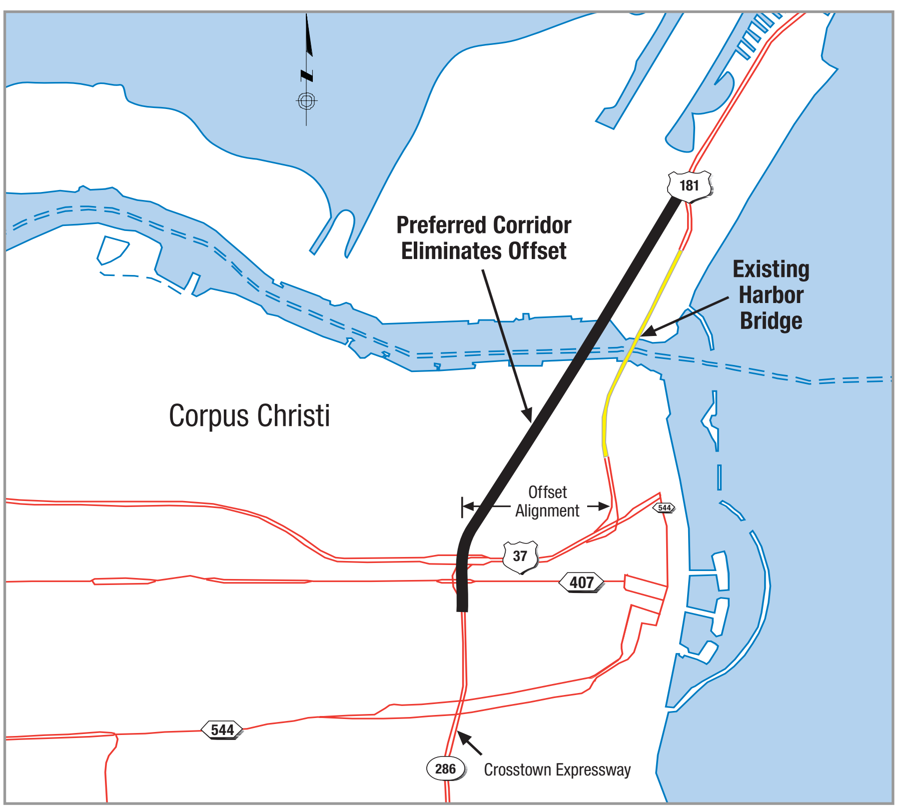
Feasibility Study on Harbor Bridge and Tule Lake Lift Bridge Recommends Corridor for a New Harbor Bridge

A recently completed Feasibility Study has identified a preferred corridor location for a new Harbor Bridge and two preferred configurations for the Tule Lake Lift Bridge. The study incorporated a technical review and evaluation of four possible alternative corridors for the Harbor Bridge, as well as input from the public.

TxDOT conducted the Feasibility Study to determine if the Harbor Bridge and Tule Lake Lift Bridge were in need of replacement. As nearly 50-yr-old steel bridges over salt water, both are experiencing increasing maintenance costs as they age. As larger ships begin entering the Corpus Christi Ship Channel, they will require higher clearances than those now offered by the two bridges. Furthermore, the Harbor Bridge presents safety concerns associated with its steep slope, sharp curves, and lack of shoulders.

The Feasibility Study, which began in late 2001, consisted of the following activities:

- A determination of the purpose and need for replacement of the Harbor Bridge and the Tule Lake Lift Bridge.
- A vessel survey to determine the number and types of ships that are now using and are expected to use the Ship Channel in the future.
- A traffic demand study to evaluate whether future travel demand crossing the Ship Channel exceeds the current capacity of the two bridges.
- An identification and evaluation of alternatives to the existing bridges. In the case of the Harbor Bridge, four alternative corridors have been identified and ranked. For Tule Lake Lift Bridge, four alternative configurations have been identified.
- Public involvement to identify and work with local stakeholders in developing and evaluating bridge alternatives.



The preferred corridor for the Harbor Bridge would eliminate the offset alignment between the Crosstown Expressway and U.S. 181.

Continued on page 2

Feasibility Study (cont.)

More complete information on the study was provided in the previous issue of this newsletter, which was distributed in May. Throughout the Feasibility Study process, input from the public was a key component. A Citizens' Advisory Committee was formed early in the study as a means of communicating with interested individuals and organizations. This group, which met three times, offered many ideas, opinions, and concerns, and helped TxDOT form a vision of what a new Harbor Bridge should offer.

Four Harbor Bridge Alternative Corridors Evaluated

In the study, four route alternatives were evaluated for the Harbor Bridge. As described in the last issue of the newsletter, one alternative follows the current route of the bridge. Another follows the path of the current bridge but then continues out into Corpus Christi Bay, avoiding the existing Northside neighborhood and Port facilities. A third alternative is an extension of the Crosstown Expressway but returns to an alignment parallel to the existing Harbor Bridge across the Corpus Christi Ship Channel.

The fourth and preferred corridor alternative (as shown on page 1) provides the most direct connection between the existing IH37/SH286 (Crosstown Expressway) intersection and U.S. 181 north of the Ship Channel. This corridor is approximately 3000 feet west of the existing Harbor Bridge. Although the preferred corridor is about 600 feet wide, the actual path of the bridge and its approaches would be less than half of that width.

In evaluating the alternatives, the project team also used input from the Citizens' Advisory Committee established for this project, from citizens at the public meetings, and from the maritime industry and the ship pilots who navigate the Ship Channel.

Preferred Corridor Offers Several Advantages

The preferred alternative corridor offers several advantages over the other three alternatives. First, it completely eliminates the offset (see figure) alignment between the Crosstown Expressway and U.S. 181. For a driver, the offset has meant making a series of turns in driving from the Crosstown Expressway to U.S. 181 or from the other direction. The alternative would allow a driver to go straight down U.S. 181, across the bridge and onto the Crosstown Expressway or vice versa.

Another advantage of the preferred alternative corridor is that it offers more flexibility in designing a new bridge that meets design criteria. In other words, it will enable a new bridge to be built without the extreme curves and steep approaches of the existing Harbor Bridge, which will enhance safety. In addition pedestrian and bicycle lanes could be included.

Finally, the preferred alternative is the most compatible alternative with the City of Corpus Christi's future development plans. This corridor is located to the west of the proposed new stadium and cruise terminal. Such a configuration would allow these two facilities to become part of the existing beachfront development, convention center area, and Corpus Christi's central business district. It would also serve as a barrier between the people-oriented areas of the Northside, and the Port and industrial facilities located to the west of this corridor.

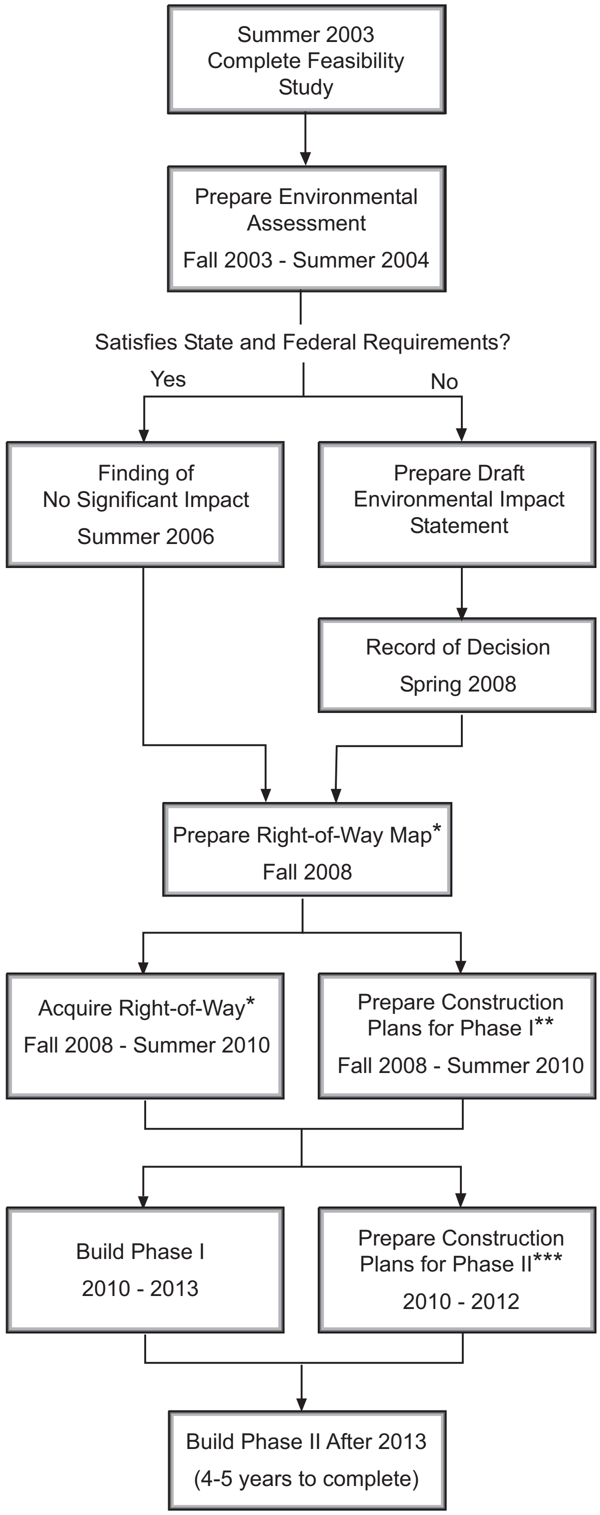
The other alternatives were ranked lower than the preferred corridor for various reasons including greater adverse environmental impacts and incompatibility with future local development.

Two Preferred Tule Lake Lift Bridge Configurations Identified

The Feasibility Study also identified two configurations for replacing the Tule Lake Lift Bridge; one configuration would accommodate the railroad tracks and the other would only serve cars and trucks. An evaluation of four potential configurations—two with a railroad crossing and two without-revealed no significant differences among the four as far as environmental and public impacts are concerned. The recommended alternatives are a low-level bridge with a railroad crossing or a mid-level bridge without the railroad. The key factor in evaluating the low-level alternatives was cost. In the case of the mid-level bridge, the preferred alternative would significantly reduce the number of times the bridge would have to open in a day.

The next stage in the bridge replacement process is to conduct a more detailed analysis of the environmental impacts of the preferred alternatives. As shown on the timeline, the entire process of bridge replacement will last at least 15 years.

Anticipated Project Activities Through Construction of the Harbor Bridge



* If project receives a FONSI, this process would begin in Fall 2006
** Interchange improvements at tie-in to I-37
*** New bridge across Ship Channel

May 29 Public Meeting Highlights Preferred Replacements for Two Bridges

On May 29, 2003, TxDOT held its second public meeting on the Harbor Bridge/Tule Lake Lift Bridge Feasibility Study. This meeting, held at the Oveal Williams Senior Center, gave TxDOT an opportunity to present the results of the feasibility study and listen to comments from the public.

Representatives of TxDOT and the Feasibility Study consultant, URS Corporation, discussed study results and recommendations, and described the timeline for upcoming activities related to the two bridges. The preferred corridor alternative for the Harbor Bridge and the preferred configurations for Tule Lake Lift Bridge were described and shown on displays that meeting attendees were able to look at before and after the presentation.

About 35 people attended the public meeting and a few individuals asked questions or offered information. The questions ranged from the number of lanes that a new Harbor Bridge would have (projected to be four lanes in each direction) to how the approach to Shoreline Blvd would be handled if the preferred corridor were chosen (a boulevard approach may be used).

In preparing the final Feasibility Study report, TxDOT considered all comments received at the meeting as well as those that were mailed in later.

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Victor Vourcos
TxDOT Corpus Christi
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fax: 361-808-2407
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NEWS from the Bridge

A Newsletter from the
Texas Department of Transportation
Corpus Christi District
May 2003

TxDOT's Feasibility Study for Harbor Bridge/Tule Lake Lift Bridge Replacement Now Underway

Harbor Bridge is nearly 50 years old and is showing its age. As a steel structure over salt water, it requires more and more maintenance every year. Furthermore, the bridge presents safety concerns. Designed for four lanes of traffic, the bridge now carries six lanes without shoulders. Its steep slope and sharp curves have resulted in numerous traffic accidents on the bridge itself. And, as increasingly larger ships enter the Corpus Christi Ship Channel, it has become more and more difficult for ships to pass under this bridge with 138 feet of clearance above the water.

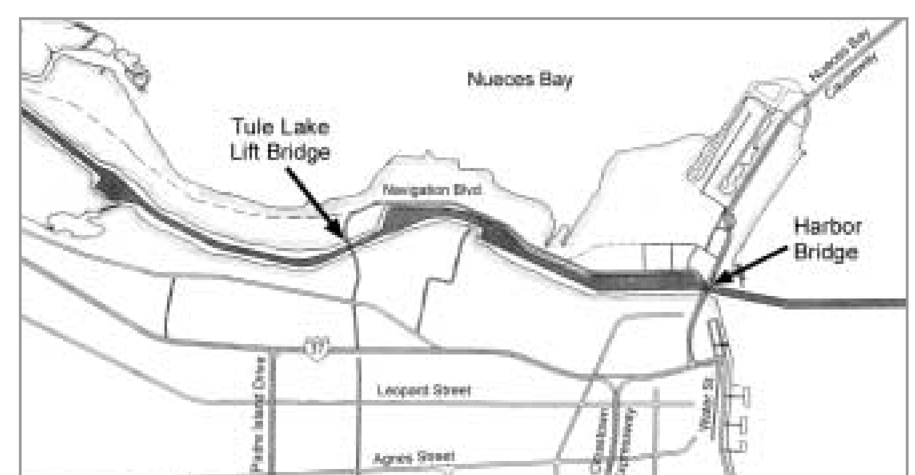
Further up the channel, the Tule Lake Lift Bridge, also built in the late 1950s, is another steel bridge that is experiencing increasing maintenance costs. Furthermore, the bridge must be opened 20 - 24 times a day, and has navigational clearances that limit ship size.

Feasibility Study Underway

The Texas Department of Transportation, Corpus Christi District is conducting a feasibility study to look at whether these two bridges should be replaced. With an initial $4 million dollars from the federal government, TxDOT wanted to look at various alternatives to the existing bridges; find out what the local community (including citizens, local government, businesses, etc,) thinks of these alternatives; and develop an implementation plan for proceeding with the recommended alternative.

The advantages of replacing the bridges are many. Higher and wider bridges would reduce traffic congestion for vehicles and ships, and would accommodate both current and future shipping needs. Pedestrian and bicycle lanes can be added. New bridges would improve safety by reducing the number and severity of accidents. Finally, new bridges would provide economic benefits for the City of Corpus Christi.

Continued on page 2



Public Meeting to be Held on May 29

You are invited to an Open House and Public Meeting on

Corridor Alternatives for Harbor Bridge and Configurations for Tule Lake Lift Bridge

Thursday, May 29, 2003
Open House: 6 - 6:30 p.m.
Public Meeting: 6:30 - 8 p.m.
Oveal Williams Senior Center
1414 Martin Luther King Dr.
Corpus Christi, TX

For more information, call Victor Vourcos at TxDOT at 361-808-2378

TxDOT's Feasibility Study (cont.)

The Feasibility Study will be completed early this summer. The study, conducted for TxDOT by the URS Corp. consultant team, consists of these activities:

- A determination of the purpose and need for replacing the Harbor Bridge and the Tule Lake Lift Bridge.
- A vessel survey to determine the number and types of ships that are now using and are expected to use the Ship Channel in the future.
- A traffic demand study to evaluate whether future travel demand crossing the Ship Channel exceeds the current capacity of the two bridges
- An identification and evaluation of alternatives to the existing bridges. In the case of the Harbor Bridge, four alternative corridors have been identified and ranked. For Tule Lake Lift Bridge, four alternative configurations have been identified.
- Public involvement to identify and work with local stakeholders in developing and evaluating bridge alternatives.

The Feasibility Study will recommend a corridor alternative for the Harbor Bridge and configurations for the Tule Lake Lift Bridge with and without the railroad crossing.

Feasibility Study First Step in Longer Process

The Feasibility Study is step one in a process that ultimately may take several years to complete. The next step is to prepare an Environmental Assessment (EA) or Environmental Impact Statement (EIS). This involves a more detailed evaluation of how an alternative location and specific routes for the Harbor Bridge would affect the environment, including cultural resources, biological resources, historical structures, and neighborhood relationships, as well as the air, water, and land. Also during this phase of the project, a preliminary layout of the bridge and associated roadways will be prepared.

After the EA phase, the project may be cleared by the Federal Highway Administration (in a document called a Finding of No Significant Impact) and other federal agencies, or it may require the more detailed environmental study—an EIS—for final approval (called a Record of Decision). A final go-ahead for the project is projected for summer 2006 at the earliest and summer 2008 at the latest.

At that point, TxDOT will begin the Right-of-Way (ROW) process, which consists of creating a ROW map and actual acquisition of property. This process will take at least two years and will be followed by development of construction plans and actual construction.

If the project is approved and TxDOT has funding in place, the agency plans to build the new bridge in two phases. During the first phase, the approaches, connections to other highways, and other roads associated with the new bridge would be built. During the second phase, the actual bridge itself would be constructed.

CAC

Citizens Advisory Committee Plays Valuable Role in Feasibility Study

Since public involvement is so important in determining the future of Corpus Christi's bridges, TxDOT formed a Citizens' Advisory Committee (CAC) shortly after the Feasibility Study began. Membership on the committee was open to anyone with an interest in the study and a willingness to donate three evenings of time.

Committee members include many residents of Corpus Christi's Northside neighborhoods, ministers with churches in the neighborhood, members of civic organizations; local business owners and Chamber of Commerce representatives; local government representatives and elected officials; school district representatives; and individuals from the Port of Corpus Christi and the Federal Highway Administration.

The goal of the CAC was to offer the community an opportunity for a timely exchange of information with TxDOT. The committee met in June 2002, September 2002, and April 2003. As the Feasibility Study progressed, CAC members had opportunities to learn about project status and to react to study findings and identification of issues.

From the beginning, CAC members have provided valuable input to TxDOT in many areas. For instance, they have shared their ideas about what a replacement for Harbor

Continued on page 3

CAC

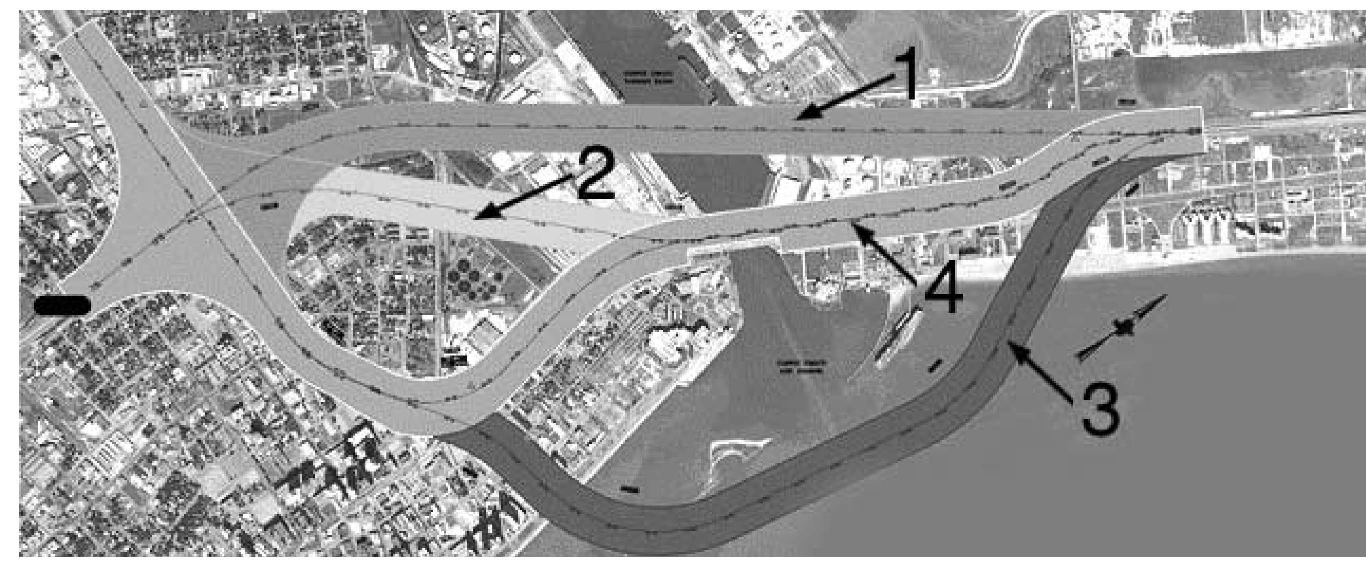
Citizens Advisory Committee (cont.)

Bridge should offer (e.g., a signature structure, the ability to bicycle and walk, etc.) and what the advantages and disadvantages of various corridor alternatives might be. CAC members have also provided valuable insights into where and when public meetings should be held, as well as how best to reach out to the wider community with study information.

The CAC serves as a complement to the public meetings that are also an integral part of the Feasibility Study. The first public meeting for the project was held in November 2002 and the second is planned for May 29 (see page 1).

Although the CAC for the Feasibility Study has now completed its work, TxDOT is open to the idea of using this type of committee to enhance public involvement as the next phase of development begins (EA or EIS).

Study Identifies Corridor Alternatives for Harbor Bridge and Possible Configurations for Tule Lake Lift Bridge



TxDOT's Feasibility Study has identified and evaluated four corridor alternatives for Harbor Bridge and four possible configurations for the Tule Lake Lift Bridge. To evaluate the alternative corridors shown above for Harbor Bridge, TxDOT developed three categories of evaluation criteria: environmental/public involvement; traffic/planning; and engineering.

The alternatives shown above are labeled according to the ranking they were assigned after the evaluation process was completed. For study purposes, the corridors shown are much wider than the actual anticipated path of the bridge and associated roads.

The number-one ranked alternative was assigned that rating because it has a lower environmental impact; achieves more desirable design criteria; is more compatible with future development plans; and would provide a smoother transition between U.S. 181 and the Crosstown Expressway.

The Tule Lake Lift Bridge configurations include options for low- and mid-level bridges with and without the railroad crossing immediately adjacent to the location of the current bridge. The recommended alternatives are a mid-level, double-swing bridge without the railroad crossing or the low-level crossing with the railroad. Additional information on these alternatives will be available at the upcoming public meeting.

TxDOT welcomes your ideas and opinions on these alternatives and on the Tule Lake Lift Bridge configurations. Come to the public meeting on May 29 and let us know what you think.