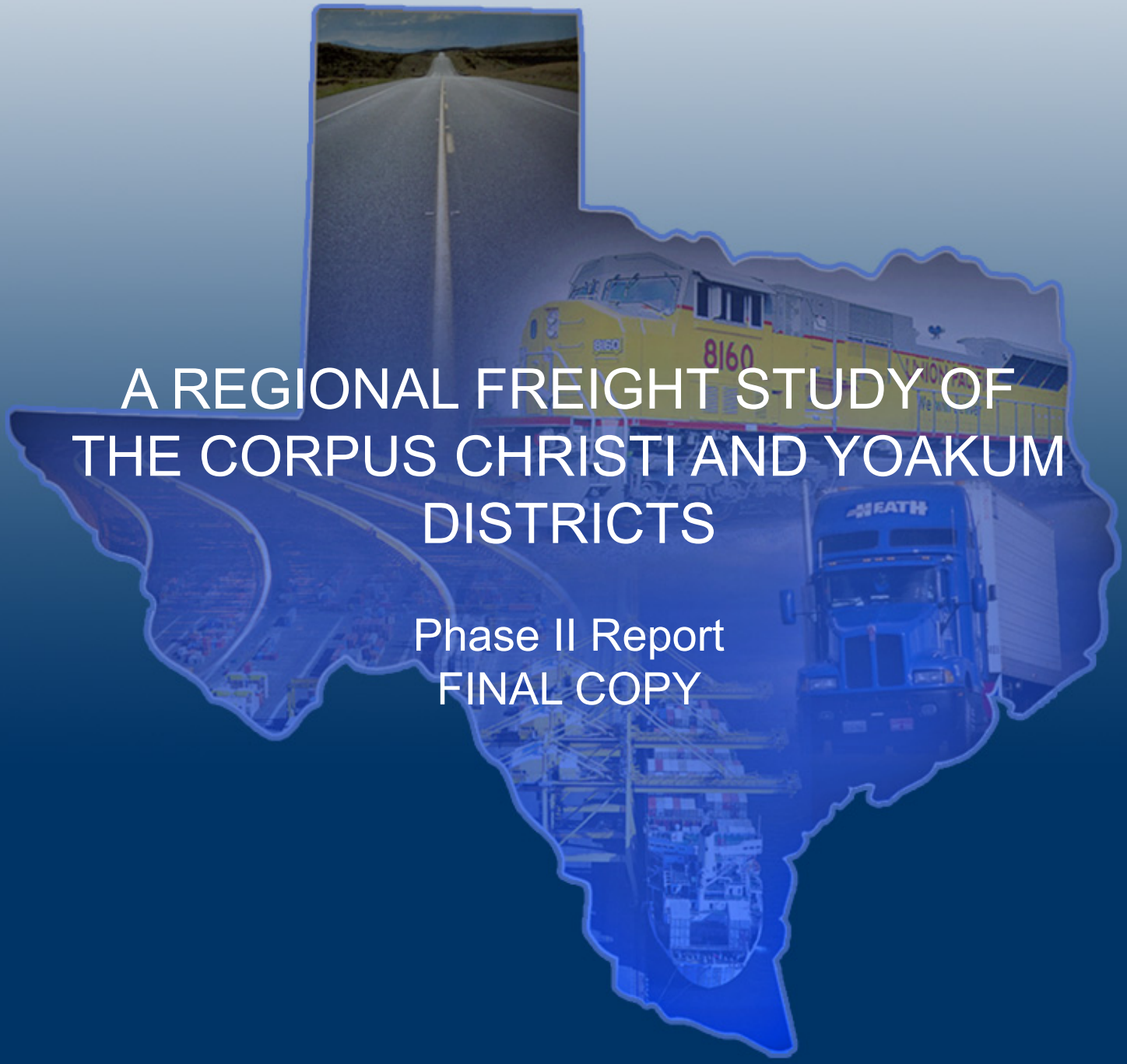

A REGIONAL FREIGHT STUDY OF THE CORPUS CHRISTI AND YOAKUM DISTRICTS

Phase II Report
FINAL COPY

Texas Department of Transportation

JACOBS™

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EXECUTIVE SUMMARY

Analysis of Rail/Roadway Interface Issues

The intersection of a street or highway and an active railroad line creates a number of concerns. While safety concerns are first and foremost, there are several secondary factors that contribute to the desire to eliminate at-grade crossings. Such factors include delays to the traveling public, operational inefficiencies created along the roadway and railway networks, maintenance costs of grade crossing safety equipment, and emissions from idling vehicles. These factors, combined with the obvious undesirable loss of human life and property damage associated with accidents, provide ample justification for the concept that, given a choice, not having an at-grade crossing is preferable to having one.

Unfortunately, economic realities restrict the construction of grade separations. Eliminating an at-grade crossing, either by grade separating or by closure, is expensive and often cost prohibitive. Thus, the benefits associated with eliminating at-grade crossings justify the exercise of identifying candidate grade separation locations for further evaluation.

Methodology

Since there are always going to be more at-grade crossings than available dollars to eliminate those crossings, the process of identifying candidate locations turns into a value engineering exercise. There are over 2,500 public and private at-grade crossings within the Corpus Christi and Yoakum Districts. For obvious reasons it is unrealistic to evaluate each individual crossing to determine costs and benefits associated with grade separations. It is therefore prudent to reduce the number of crossings to be examined in this report from 2,500 to a more manageable number. Accordingly, selection criteria was established to identify which crossings were most likely to achieve favorable cost/benefit ratios.

The first step in the selection criteria process identified those crossings that had an average daily traffic (ADT) of 10,000 or more vehicles. Since virtually all benefits that would result from grade separations relate to the number of vehicles that pass through that crossing, focusing on crossings with higher ADT was a logical first step. The next step in the evaluation process involved calculating an estimated number of vehicles delayed by trains and the amount of time those vehicles were delayed at each of those selected crossings. To accomplish this, the baseline rail model was used to estimate the number of trains per day and the average train velocity for trains passing through the individual crossings. Using the number of trains per day, the average velocity, and an assumed 6,000 foot train length, a total vehicle occupancy time could be calculated for each individual crossing.

The calculated crossing occupancy time was then used to prorate a number of vehicles delayed based on the ADT of that roadway. After performing similar calculations for all crossings with ADTs over 10,000 vehicles, the crossings were sorted by number of vehicles delayed. This process does have some limitations. For example, daily traffic is not uniformly spread across all 24 hours of the day. Since developing hourly traffic volumes for each crossing would have required a detailed traffic engineering exercise, this report assumes that any variations in hourly vehicular traffic would be balanced by variations in hourly train traffic, since both will be affected by what is considered the normal working day. The two variations are considered compensating and would therefore cancel each other out.

The crossing selection criteria is also limited by the reality of actual operating conditions that occur near rail yards. Switching operations in and around these yards result in a significantly elevated number of trains which move at very low speeds. With no way to calculate the individual lengths of each individual switching train, and with no input or feedback from the railroads regarding whether the base-case model accurately depicts operations near rail yards, there was insufficient information to generate a vehicles-delayed number that can be compared to crossings outside the vicinity of rail yards. As such, any crossings in the immediate vicinity of major rail yards that rated in the top 10 were discarded and the next highest crossing was added.

The top rated crossings resulting from this selection process are shown in the table below.

Grade Crossing Locations Identified for Analysis

Street Name	Crossing ID	County	City	Rail Subdivision	Approximate Milepost
Meyers St. (S.H. 36)	023270N (siding) 416484T (main)	Austin	Sealy	BNSF Bay City	0.26 (siding) 135.35 (main)
Avenue F. (S.H. 60)	448744X	Matagorda	Bay City	UP Brownsville	283.80
Rio Grande St. (U.S. 59)	746472J	Victoria	Victoria	UP Port Lavaca (Cuero)	27.50
Park St. (S.H. 44)	793819S	Jim Wells	Alice	Texas Mexican	119.90
Park Ave. (U.S. 77)	435545H	San Patricio	Odem	UP Corpus Christi	132.20
Sinton St. (U.S. 181)	436011U	San Patricio	Sinton	UP Brownsville	162.15
U.S. 90	742771C	Gonzales	Gonzales	Texas Gonzales & Northern	11.02
WB Frontage Rd. (U.S. 77)	764969W	Victoria	Victoria	UP Port Lavaca (Cuero)	31.48
NW Ingleside (S.H. 361)	746288W	San Patricio	Gregory	UP Kosmos	0.06
Esplanade St. (S.H. 87)	746703P	Victoria	Cuero	UP Port Lavaca (Cuero)	54.99

With the 10 target crossings identified above, the rail model developed for the Phase 1 report was used to calculate more accurate occupancy times to be used in the benefits analysis.

<u>Grade Crossing Cost/Benefit Analysis</u>

Each of the selected grade crossings was examined in detail to develop an order of magnitude cost estimate.

In developing the construction cost estimates the following assumptions were made:

- All design concepts should follow standard TxDOT criteria.
- Right-of-way would only be acquired as a last resort.
- Railroad operations can not be interrupted by construction.

The table below shows the individual construction cost estimates for each of the ten crossings. Detailed cost estimates for each crossing can be found in Appendix G. Exhibits showing the conceptual design for these crossings can be found in Appendix H. Descriptions of the individual crossings are found in the paragraphs below.

Estimated Construction Costs for Grade Separations

Street	Crossing ID	Cost
US 90	742771C	$12,700,000.00
US 77 / Park Avenue	435545H	$7,200,000.00
US 77 / WB Frontage Road	764969W	$9,000.00 *
US 59 / Rio Grande St.	746472J	$7,200,000.00
US 183 / Esplanade St.	746703P	$6,900,000.00
SH 36 / Meyers St.	023270N (siding) 416484T (main)	$8,300,000.00
SH 44 / Park St.	793819S	$6,700,000.00
SH 60 / Avenue F	448744X	$8,400,000.00
SH 361 / NW Ingleside	746288W	$8,800,000.00
US 181 / Sinton St.	436011U	$5,600,000.00

** Grade separation not feasible. Cost shown is for crossing closure.*

A benefit-cost analysis was prepared to assess the potential benefits associated with the proposed grade crossings in the Corpus-Yoakum Districts. This analysis includes the benefits to the public and to the railroad companies which operate freight rail lines in these districts. In all, ten grade crossings were considered for review. One of these crossings, US 77 westbound frontage road, has been removed due to the lack of a viable alternative as how to construct a grade separation at this location. In Sealy, two grade crossings exist adjacent to each other at Meyers St. Only the mainline crossing was analyzed at this time. The table below summarizes the estimated benefits to the public and private sectors from the development of these grade separations.

Benefit	Amount
Public	
Value of Time	$2,531,985
Emissions/Fuel	$787,063
Safety	$8,370,607
Reduced Maintenance Costs	--
Hazmat Removal	--
Subtotal	$11,689,656
Private	
Reduced Maintenance Costs	$3,469,347
Safety	$906,190
Subtotal	$4,375,537
Total Benefits (Public + Private)	$16,065,193
Costs	$71,804,239
Benefit/Cost Ratio	0.22

Public Benefits

- The estimation of benefits focused on the following categories, which included: (i) improved time savings for roadway vehicles; (ii) reduced vehicle fuel costs for roadway vehicles; (iii) improved safety; (iv) reduced vehicle emissions; (v) reduced operations and maintenance costs; and (iv) reduction in costs related to the clean-up of hazardous materials. Benefits were discounted at 4.5 percent and a 20-year forecast period was used.

Private Benefits

- The estimation of benefits focused on two main categories, which included: (i) reduced operations and maintenance costs; and; (ii) improved safety conditions. A 4.5 percent discount rate was also used.

The list of crossings identified for potential improvement are shown in the figure below, along with the estimated costs, potential 10 and 20 year benefits, benefit-cost ratio (B/C) and the average daily traffic (ADT) volumes associated with each roadway. These grade crossings are ranked from highest to lowest with respect to the calculated benefits/cost ratio. As an aggregate, the proposed grade separations are estimated to have a B/C ratio of 0.10 and 0.16 over 10 years and 20 years, respectively.

Summary of the Public Benefits for Grade Crossings

Grade Crossing	Crossing Number	ADT	Costs	Benefits 10-Years	B/C Ratio 10-Years	Benefits 20-Years	B/C Ratio 20-Years
NW Ingleside (Hwy. 361)	746288W	13,500	$8,814,073	$2,988,384	0.34	$4,934,355	0.56
Sinton St. (Hwy. 188)	436011U	12,200	$5,624,858	$1,213,289	0.22	$2,039,565	0.36
Avenue F (Hwy. 60)	448744X	14,200	$8,394,270	$1,312,348	0.16	$2,216,937	0.26
Park Ave	435545H	23,000	$7,201,934	$684,677	0.11	$1,311,001	0.18
Rio Grande St. (Hwy. 59)	746472J	18,700	$7,150,988	$195,237	0.03	$332,750	0.05
Park St. (Hwy. 44)	793819S	21,000	$6,726,101	$153,278	0.02	$261,379	0.04
Meyers St.	023270N 416484T	11,600	$8,252,673	$155,780	0.02	$266,001	0.03
Esplanade St. (U.S. 87)	746703P	10,800	$6,897,020	$66,915	0.01	$93,501	0.01
U.S. 90	742771C	14,600	$12,733,507	$133,574	0.01	$227,664	0.02
Total	**N/A**	**N/A**	**$71,795,425**	**$6,947,347**	**0.10**	**$11,683,152**	**0.16**

Recommendations

As illustrated in the table above, only one of the crossings examined in this report were found to have a benefits-cost ratio that exceeded 0.5. However it should be noted that the analysis made focuses purely on determining whether a financial justification for grade separation construction projects can be made. While the results of that analysis does not show that such a financial justification exists, based upon current road and rail traffic patterns, it is recognized that financial considerations may not always be the only criterion used by TxDOT for selecting grade separation projects. As such, the absence of identifying a crossing with a benefits-cost ratio greater than one should not be interpreted as a recommendation to not consider any grade separation projects within the Corpus Christi or Yoakum Districts.

Bottleneck Improvements Evaluation and Modeling

The development of The Base Case Corpus/Yoakum rail simulation model provides a present-day perspective as to how the freight rail network within the Corpus Christi and Yoakum Districts is functioning. Building upon the information learned from the base case simulation, the next steps are to identify improvements that could be made to the rail network to help alleviate congestion at bottleneck points, and to examine how the rail network will handle future growth in freight rail traffic.

The process to accomplish these goals involves estimating what the future growth in freight traffic will be, identifying rail infrastructure improvements to mitigate freight bottlenecks along the network, and using multiple rail simulation models to study the effects of those rail improvements on the network.

Projected Rail Traffic Growth

In order to project how much freight traffic would grow, it was first necessary to forecast how much growth would occur for various commodities that are shipped in and through the Corpus and Yoakum Districts. It is important to examine individual commodities separately, as each commodity will experience a different growth and will be moving along different paths along the rail network. A simple year-by-year growth rate percentage generically applied to all freight will not result in as accurate a model.

The forecasts developed for this Study were derived from a TRANSEARCH database developed by Global Insight (GI). This database contains domestic and U.S.–Mexico commodity flow information for 2003 drawn from existing proprietary, commercial and publicly available data sources and is supplemented by economic forecasting techniques. The database also includes incremental forecasts through the year 2035. Seven separate commodity service types were evaluated using the database, and growth projections determined for each. The service types analyzed included Auto, Coal, Grain, Minerals, Other Commodities, Petrochemicals, and Intermodal.

- Autos and Auto Parts

  The number of carloads transporting motor vehicles and parts is expected to rise dramatically over the next fifteen years. The increase in domestic through traffic moving from west to east through the region is largely due to the growing auto and parts manufacturing industries in Texas and in Mexico.

- Coal

  Coal shipments into the Corpus-Yoakum region are expected to grow by about 30 percent between 2010 and 2035. This is an annual growth rate of approximately 1 percent, which is a reasonable estimation, given moderate economic growth.

- Grain

  The amount of grain entering the Corpus-Yoakum region from the North is predicted to increase by 18 percent. Declining grain shipments from the East and West will be offset by a much larger volume of grain already entering the district from the North.

- Minerals

  The number of carloads carrying minerals into and out of the districts to and from Mexico will increase dramatically over the coming years. This growth will likely be driven by Texas' strong non-metallic mineral extraction industries. Texas is among the top five US states in terms of sand and gravel, aggregate, and crushed stone production and its strong demographic and economic growth are expected to continue fueling demand for these construction materials.

- Petrochemicals

  Petrochemical production is a cornerstone of the Texas economy as a whole and of the Corpus-Yoakum region in particular. The growing population and economy of the United States over the next 15 years is predicted to fuel domestic demand for petrochemicals and contribute to the increasing volume of these products moving by rail in the region.

- Intermodal

  Over the past few decades intermodal containers have grown to become the dominant long-distance shipping method for non-bulk cargo worldwide. The use of intermodal containers reduces the risk of damage and theft of goods and lowers shipping costs by eliminating the need for cargo to be handled when changing modes. As the population and economy of the Corpus-Yoakum region continue to grow, containerized shipments are expected to become increasingly common.

Phase 2 Rail Analyses

The comparison between cases involving present and future freight rail traffic and existing and improved rail network requires four separate model RTC model analyses. These analyses were:

- Base Case: The Base Case simulation was completed in Phase 1 of the study. This analysis reflects the existing rail infrastructure and current freight rail volume. At the time the Base Case simulation of the C-Y network for the Phase 1 report was being developed, the re-opening of the Victoria-Rosenberg line was an unconfirmed rumor. As such it was not included in the Base Case simulation. Now that the Victoria-Rosenberg line is operational, it is necessary to modify the Base Case simulation to account for the KCS trains and their reduced usage of UP track.

- Rail Traffic Controller (RTC) Simulation Case 2: A Rail Traffic Controller (RTC) simulation of the Corpus/Yoakum rail districts that included projected growth traffic through the year 2035 was created using freight growth projections. This analysis did not include any improvements to the rail infrastructure.

- RTC Case 3: Using the results of the Base Case and the Case 2 simulations, rail infrastructure improvements that would likely be necessary to alleviate congestion issues identified in the first two analyses were developed. These improvements were incorporated into the Base RTC network, and run against base levels of traffic, reflecting present day freight volumes, to determine the potential for rail operational improvements associated with the additional track, signal and connections.

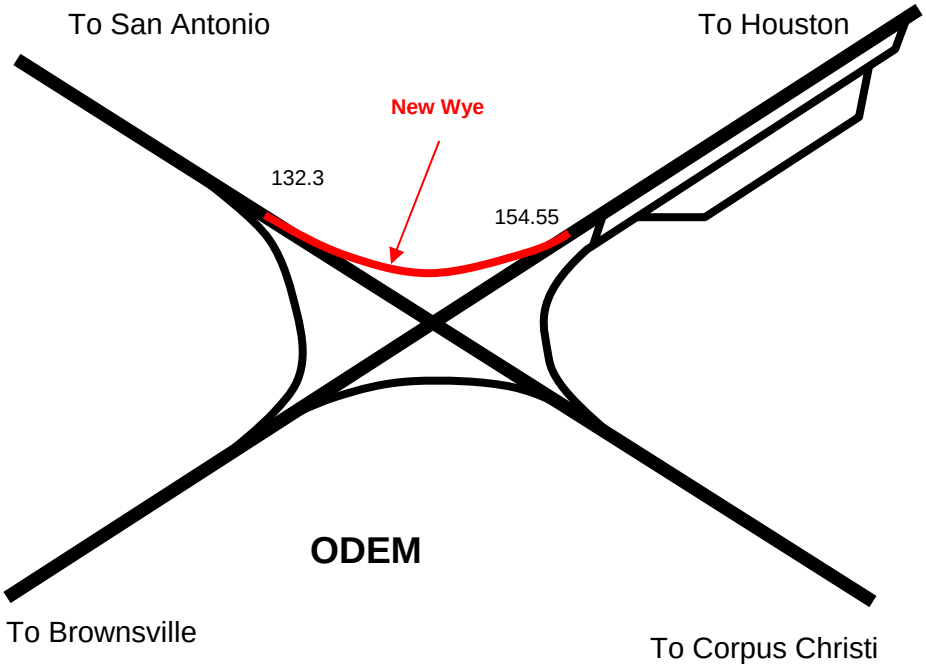
- RTC Case 4: Using the 2035 projected freight volumes developed under Case 2, and the improvements identified under Case 3, a combined simulation reflecting projected growth and projected infrastructure improvements was run.

Rail Infrastructure Improvements

Using the results from the Base Case and the Case 2 simulations, a list of improvements was created to address the rail congestion experienced in those simulations. The improvements were then included in simulation Cases 3 and 4.

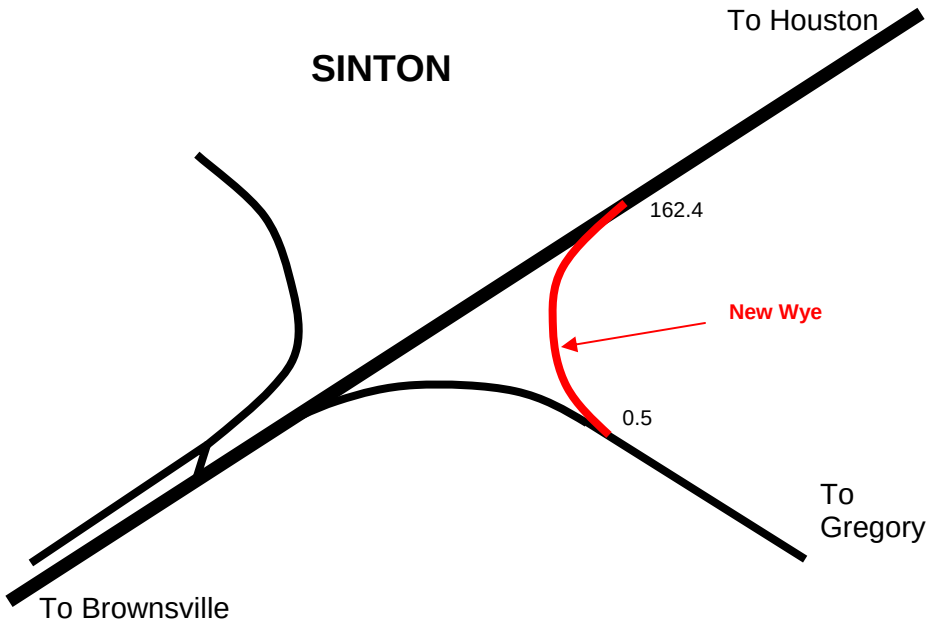
Improvement BA-1:

Connection in the northwest quadrant between the Corpus Christi Subdivision and the Brownsville Subdivisions at Odem. This connection allows trains from San Antonio to turn north towards Bloomington without making a back up move at Odem. CTC was added to the wye at Odem.



Improvement BA-2:

New wye connection at Sinton in northeast quadrant. This connection will allow trains from Houston on the Brownsville Subdivision to operate directly towards Gregory on the Kosmos Subdivision. CTC was added on leg of wye.

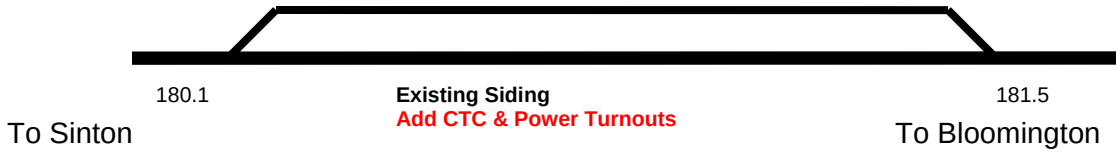


Improvement BA-3:

New siding, MP 171 to 173 Brownsville Subdivision. The siding creates an additional meet-pass point in the middle of a 20 mile stretch of single track. All other sidings on the subdivision are spaced between 10 and 12 miles apart. CTC and turnouts capable of allowing 25 mph movements were included on both ends of the siding.

Improvement BA-4:

Woodsboro siding, MP 180.1 to 181.5 Brownsville Subdivision. Upgrade siding with CTC and 25 mph power turnouts. CTC will increase entrance and exit speed of trains using Woodsboro Siding. This will reduce wait delays to trains meeting or passing at this location.

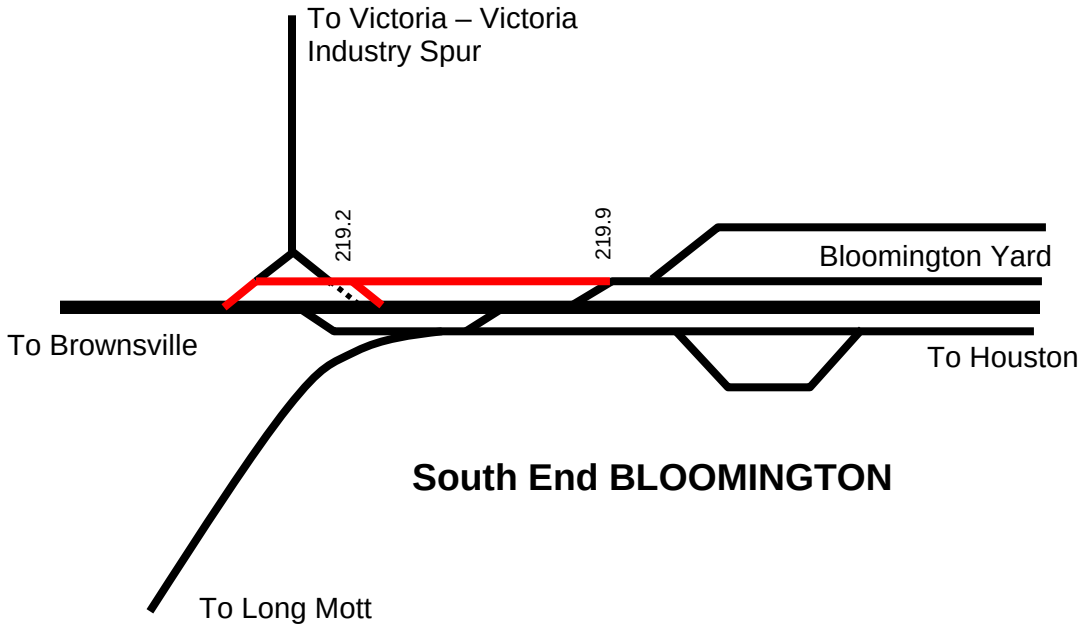


Improvement BA-5:

Greta siding, MP 192.8 to 194.3 Brownsville Subdivision: Upgrade siding with CTC and 25 mph power turnouts. CTC will increase entrance and exit speed of trains using Greta Siding. This will reduce wait delays to trains meeting and passing at this location.

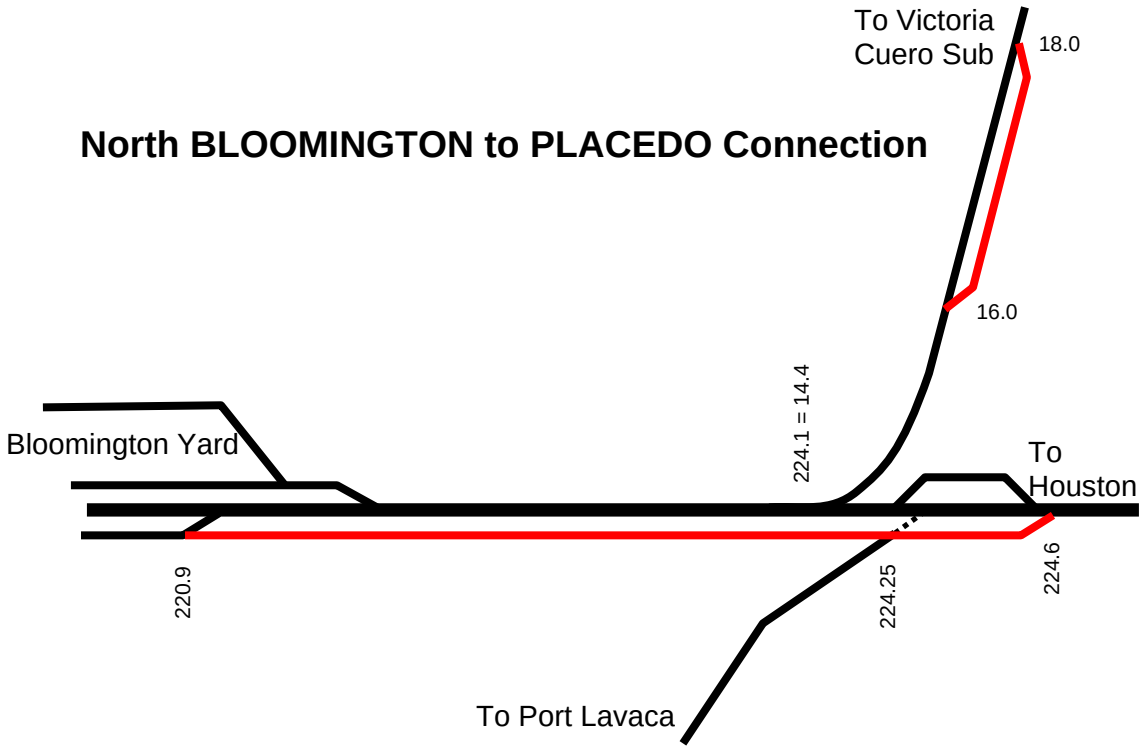
Improvement BA-6:

Extend yard lead from Bloomington Yard to Victoria Industrial Spur, MP 219.2 to 219.9 Angleton Subdivision. This improvement may require a transition to the south side of the existing main track to avoid an industry between the yard and the Industrial Spur. Track connection will allow yard engines working the Victoria Industrial Spur to enter or leave Bloomington Yard without having to enter the main line. This will reduce delays to switch engines or through trains.



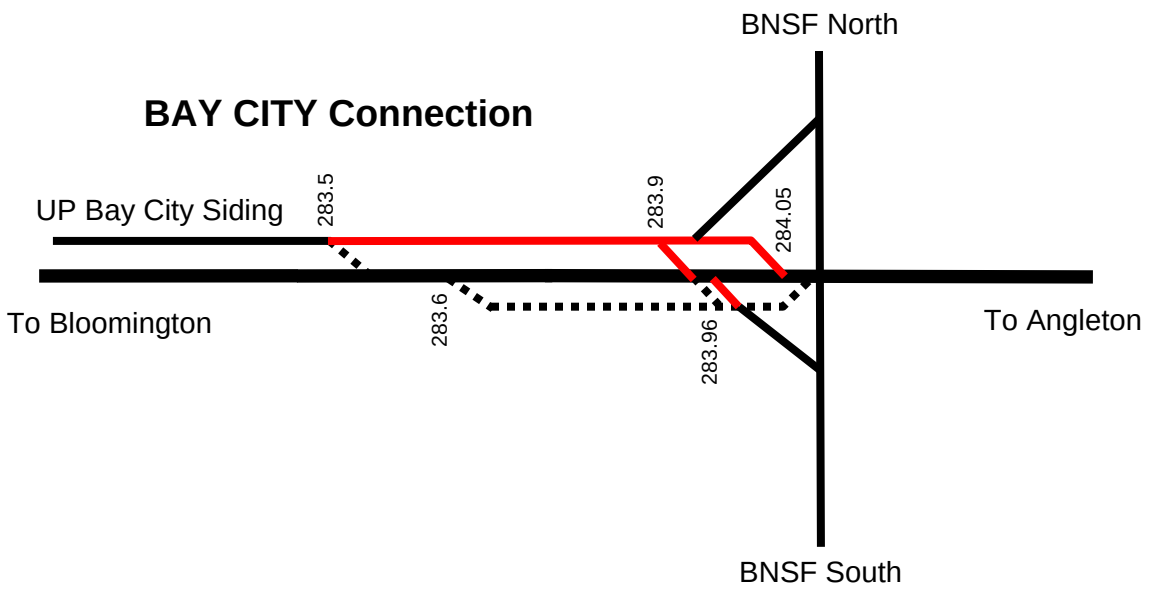
Improvement BA-7:

Second main track Bloomington Yard to Placedo, MP 220.9 to 224.6 Angleton Subdivision. Connections to Port Lavaca Subdivision modified as shown. Track will establish two main tracks from north of Placedo to Bloomington Yard. Additional track will allow trains to move past other trains stopped to change crews or to enter yard. Reconfigured connection at Placedo will allow industry just north of the junction to be served while through trains move around industry track.



Improvement BA-8:

Reconstruct BNSF run around connection track at Bay City to connect into UP's Bay City Siding MP 283.5 to 283.6 Angleton Subdivision. New track becomes CTC siding with connection to BNSF branch line. Old siding limits were MP 282.3 to 283.5; new siding limits are MP 282.3 to 283.9 with connection to BNSF. Longer siding will allow more trains to utilize meet pass capacity. New connection will allow BNSF trains to clear main line when running around train to access BNSF branch line.



Improvement C-1:

New siding MP 16 to MP 18 Cuero Subdivision (between Placedo and Victoria). 25 mph power turnouts, CTC. Siding allows trains coming into Bloomington to be held near Placedo Jct., minimizing the waiting time to proceed through Bloomington Yard. Currently, there is a 26 mile single track stretch between Placedo and Thomaston, which is the first siding west of the junction on the Cuero Subdivision. The location chosen will not only be utilized by UP trains, but KCS trains that use the new route between Rosenberg and Victoria will also have access to this siding.

Improvement G-1:

New siding MP 110.8 to 112.8 Glidden Subdivision. No. 15 power turnouts, 25 MPH, CTC. Siding creates meet pass location in middle of a 20 mile long single track section to reduce meet delay. Average siding spacing on this line is 10 to 12 miles.

Improvement S-1:

New siding MP 85.3 to MP 87.3, Smithville Subdivision. 25 mph power turnouts, CTC. Siding creates a meet pass location between West Point and LCRA coal utility near Fayetteville. This segment is a 27 mile single track segment. The siding was necessary to accommodate LCRA coal trains waiting for access to the LCRA utility.

In addition to the improvements listed above, KCS is currently studying the possibility of constructing a new rail bypass around the city of Victoria. This rail bypass would connect to the Victoria – Rosenberg line east of Victoria, and tie into the Port Lavaca (Cuero) Subdivision south of Victoria. As of the writing of this report, the Victoria bypass is still in a preliminary stage. Estimates as to when construction on the bypass might begin and when the bypass might be operational are not known at this time. Given the preliminary nature of the bypass, this report does not contain a cost estimate for the bypass, nor has this potential improvement been included in any of the rail models.

Results

As previously noted, the Phase 2 analyses include the following cases:

1. Base Case - Existing infrastructure and traffic levels
2. Case 2 - Existing infrastructure and 2035 traffic levels,
3. Case 3 - Improved infrastructure and existing traffic levels
4. Case 4 - Improved infrastructure and 2035 traffic levels

The tables below summarize the delays and average train velocities that are found along the C-Y network's major rail subdivisions for each of the four model runs.

- **Brownsville and Angleton Subdivisions (Ricardo to Sweeny)**

Result Statistics

Brownsville Subdivision	Base Case	Case 2	Case 3	Case 4
Delay Ratio	57%	101%	22%	55%
Delay Hrs/Day	40.8	88.2	15.6	47.6
Delay/100 miles	124.1	207.2	48.1	111.8
Velocity	17.5	14.6	22.9	18.9

Result Statistics

Angleton Subdivision	Base Case	Case 2	Case 3	Case 4
Delay Ratio	35%	69%	22%	30%
Delay Hrs/Day	13.9	36.1	8.5	14.6
Delay/100 miles	54.4	106.7	33.1	42.5
Velocity	28.7	23.1	32.5	32.9

- **Corpus Christi Subdivision (Campbellton to Corpus Christi)**

Corpus Christi Subdivision - Results Statistics

Corpus Christi Subdivision	Base Case	Case 2	Case 3	Case 4
Delay Ratio	32%	63%	21%	31%
Delay Hrs/Day	14.4	32.8	9.2	15.6
Delay/100 miles	117.7	236.6	77.7	114.7
Velocity	12.3	9.8	13.6	12.3

- **Cuero Subdivision (Flatonia to Placedo)**

Cuero Subdivision - Results Statistics

Cuero Subdivision	Base Case	Case 2	Case 3	Case 4
Delay Ratio	33%	58%	16%	23%
Delay Hrs/Day	9.8	20.5	2.3	4.1
Delay/100 miles	53.1	93.9	25.8	37.8
Velocity	27.7	23.4	32.1	30.1

- **Flatonia Subdivision (Winchester to Muldoon, Flatonia to Harwood)**

Flatonia Subdivision (east – west) Results Statistics

Flatonia (E-W) Subdivision	Base Case	Case 2	Case 3	Case 4
Delay Ratio	51%	138%	24%	40%
Delay Hrs/Day	5.8	20.4	2.7	5.8
Delay/100 miles	62.1	163.1	29.2	46.6
Velocity	32.6	21.3	39.9	36.6

Flatonia Subdivision (north - south) Results Statistics

Flatonia (N-S) Subdivision	Base Case	Case 2	Case 3	Case 4
Delay Ratio	39%	182%	31%	32%
Delay Hrs/Day	2.9	17.9	2.4	3.2
Delay/100 miles	60.5	285.8	48.3	50.7
Velocity	27.6	3.6	29.2	28.9

- **Glidden Subdivision (Lissie to Flatonia)**

Glidden Subdivision Results Statistics

Glidden Subdivision	Base Case	Case 2	Case 3	Case 4
Delay Ratio	35%	56%	15%	28%
Delay Hrs/Day	12.4	25.5	3.8	9.4
Delay/100 miles	44.4	70.5	18.4	33.6
Velocity	34.8	30.4	42.3	38.7

- **Laredo Subdivision (Matthews to Corpus Christi)**

Laredo Subdivision Results Statistics

Laredo Subdivision	Base Case	Case 2	Case 3	Case 4
Delay Ratio	31%	47%	9%	27%
Delay Hrs/Day	4.3	7.4	1.2	4.2
Delay/100 miles	106.2	156.2	30.1	87.9
Velocity	13.4	12.2	16.2	14.5

- **Smithville Subdivision (Smithville to Katy)**

Smithville Subdivision Results Statistics

Smithville Subdivision	Base Case	Case 2	Case 3	Case 4
Delay Ratio	14%	15%	13%	18%
Delay Hrs/Day	2.9	6.6	4.1	7.8
Delay/100 miles	60.5	44.4	33.6	52.8
Velocity	27.6	17.3	20.7	17.3

Prioritization of Improvements

Based on the results from the model simulation runs and general operational experience, the following prioritization of projects is suggested. It should be noted that this prioritization is based solely on operational considerations. Cost benefit calculations shown later in the report should also be considered when attempts are made to prioritize which improvements might be implemented.

1. Upgrade sidings at Woodsboro and Greta, ***Improvements BA-4 and BA-5***
2. Second track Bloomington to Placedo***, Improvement BA-7***
3. New siding MP 111 Glidden Subdivision, ***Improvement G-1***
4. New siding MP 171 Brownsville Subdivision, ***Improvement BA-3***
5. New leg of the wye at Odem, ***Improvement BA-1***
6. New siding MP 85 Smithville Subdivision, ***Improvement S-1***
7. New siding MP 16 Cuero Subdivision, ***Improvement C-1***
8. New siding and connection to BNSF at Bay City, ***Improvement BA-8***
9. Second track Bloomington to Victoria Industrial Spur, ***Improvement BA-6***
10. New leg of wye at Sinton, ***Improvement BA-2***

Bottleneck Improvements Cost/Benefit Analysis

With potential improvements identified, the next step is to quantify the costs to construct those improvements and the benefits resulting there from. It is important to note that this cost benefit analysis only considers a scenario where all eleven improvements are constructed simultaneously. Thus a single benefits-cost ratio is calculated for the one scenario wherein all of the improvements were made. In order to quantify the effects of an individual improvement, separate RTC model simulations would need to be run on the entire network, with one improvement implemented for each simulation.

The two scenarios considered include a “no-improvements” scenario, representing the existing rail network with no new improvements added, and the “improvements” scenario including the eleven improvements identified earlier in this report. It is important to note that the “no-improvements” scenario does include the new KCS Victoria-Rosenberg line.

Construction Cost Estimates

For each of the eleven improvements identified, a preliminary construction cost estimate was developed using unit cost information for rail construction projects found around the state and from other sources as appropriate.

Rail Improvement Construction Cost Estimates

Improvement	Estimated Cost
Improvement BA-1	$ 2,050,000
Improvement BA-2	$ 3,170,000
Improvement BA-3	$ 6,560,000
Improvement BA-4	$ 2,660,000
Improvement BA-5	$ 2,660,000
Improvement BA-6	$ 6,250,000
Improvement BA-7	$ 16,520,000
Improvement BA-8	$ 8,310,000
Improvement C-1	$ 7,180,000
Improvement G-1	$ 8,280,000
Improvement S-1	$ 8,590,000
TOTAL	**$ 72,230,000**

Benefits Analysis

Unlike the analysis performed earlier in this report regarding grade separations, the quantifiable benefits that result from the improvements to the rail infrastructure are realized primarily by the respective railroad. For this report the benefits have been quantified by measuring the delays resulting from the four RTC simulation models, and then comparing the reduction in delays between the “improvements” scenario and the “no-improvements” scenario.

A dollar value associated with the cost of rail delays was calculated utilizing a value of $320 per hour. This value was derived from utilizing a similar value of $303 per hour as calculated in a similar study prepared for TxDOT back in 2006 and applying a 1.8% annual inflation rate. The $320 value was also adjusted an additional 1.8% annually for inflation over future years of the analysis.

With year by year delay costs calculated for both the “improvements” and “no-improvements” scenarios the next step involved subtracting the delay costs for the “improvements” scenario from the delay costs for the “no-improvements” scenario. This calculation was performed for each year separately giving a year by year cash flow of the savings in delay costs incurred. This cash flow was then reduced into a net present value amount using a discount rate of 9.7%, derived from publicly available financial statements, and that number is used as the cumulative financial benefit realized by adopting the recommended improvements. The table below shows the benefits calculated per major rail subdivision.

Estimated 20yr Benefits

Major Rail Subdivision	Estimated Benefit
Brownsville	$34,815,015
Angleton	$11,875,754
Corpus Christi	$10,227,299
Cuero (Port Lavaca)	$11,850,657
Flatonia (east-west)	$7,596,261
Flatonia (north-south)	$5,483,699
Glidden	$12,655,542
Laredo	$3,663,801
Smithville	($1,404,893)
TOTAL	**$96,763,135**

The negative value calculated for the Smithville Subdivision suggests that the "improvements" scenario results in a worsening operating condition along that subdivision. From this result some might assume that constructing Improvement S-1 would not be justified, as apparently its inclusion would have made operating conditions along the Smithville Subdivision worsen. This assumption would be incorrect. Trains in the existing condition are currently held in delay along the Flatonia Subdivision as there is no place along the Smithville Subdivision for a meet to take place. Adding the new siding along the Smithville Subdivision provides a location such that trains that were delayed on the Flatonia Subdivision can now wait along the Smithville Subdivision, thus providing reduced delays and improved operations along the Flatonia Subdivision.

Noting the approximately $13 million dollars worth of benefits realized along the Flatonia Subdivision, the increase of delay costs experienced along the Smithville Subdivision still results in an overall positive in terms of effect on the entire rail network. This also provides an illustration as to why it is necessary to examine all the rail improvements collectively, as in a rail network changes made in one location can affect conditions long distances away.

The public benefits are associated with the value of time improvements for vehicles waiting at the rail crossings throughout the entire rail network in the Corpus and Yoakum districts. This analysis factored in the number of trains per crossing, average vehicle traffic each crossing, and reduced vehicle delay times as a result of the improvements to the subdivisions.

Public and Private Benefits of the Subdivision Improvements

Benefit	Amount
Public: Value of Time	$2,461,913
Private: Freight Transit Time	$96,763,135
Total	$99,225,048
Costs	**$72,230,000**
Benefit/Cost Ratio	**1.37**

The benefit/cost ratio of 1.37 shown above far exceeds any of the benefit/cost ratios determined from the grade separation analysis, indicating that investment made to the rail infrastructure will provide a better return than investments made into grade separating crossings.

SECTION 7 - ANALYSIS OF RAIL/ROADWAY INTERFACE ISSUES

The intersection of a street or highway and an active railroad line creates a number of concerns. While safety concerns are first and foremost, there are several secondary factors that contribute to the desire to eliminate at-grade crossings. Such factors include delays to the traveling public, operational inefficiencies created along the roadway and railway networks, maintenance costs of grade crossing safety equipment, and emissions from idling vehicles. These factors, combined with the obvious undesirable loss of human life and property damage associated with accidents, provide ample justification for the concept that, given a choice, not having an at-grade crossing is preferable to having one.

Unfortunately, economic realities restrict the construction of grade separations. Eliminating an at-grade crossing, either by grade separating or by closure, is expensive and often cost prohibitive. Thus, the benefits associated with eliminating at-grade crossings justify the exercise of identifying candidate grade separation locations for further evaluation.

Since there are always going to be more at-grade crossings than available dollars to eliminate those crossings, the process of identifying candidate locations turns into a value engineering exercise. The costs associated with eliminating a crossing are quantifiable, as are the benefits, with certain assumptions. By evaluating a number of crossings and developing cost/benefit ratios for each, a prioritization can be given from which informed decisions can be made as to how to best spend limited construction dollars. This section of the report performs such an analysis for certain existing at-grade crossings within the Corpus Christi and Yoakum Districts.

It should be noted that the process of estimating costs and benefits involves several assumptions whose validity may change over time. As such, it is important to note that the dollars, values and estimates presented within this section, and any conclusions drawn there from, represent a good faith effort as to conditions at the time of writing of this report. Fluctuations in construction costs, fuel costs, operating and/or maintenance costs, changes in roadway or railway traffic patterns and other variables could potentially affect the relevance of the recommendations provided herein.

Following is a summary and analysis of grade crossing occupancies for the Texas Department of Transportation's (TxDOT) Corpus Christi and Yoakum Districts Rail Inventory and Analysis. Ten at-grade crossings were identified as potential candidates for crossing protection upgrades or possible grade separation using the selection criteria described below. This section of the report provides the number of occupancies per day and the average total duration of occupancy for each of those crossings. It also describes the crossings and the rail traffic that affect them, and makes recommendations on which crossings should be considered further for possible grade separation.

7.1 METHODOLOGY

7.1.1 Crossing Selection Criteria

As mentioned in Section 6, there are over 2,500 public and private at-grade crossings within the Corpus Christi and Yoakum Districts. For obvious reasons it is unrealistic to evaluate each individual crossing to determine costs and benefits associated with grade separations. Given the rural nature of the district's roadways, the overwhelming majority of 2,500 crossings have limited vehicular traffic anyway, and thus their analyses would never result in a favorable cost/benefit ratio.

Furthermore, the economic constraints facing TxDOT must be recognized. Construction dollars are limited and it is unknown how much money, if any, TxDOT will have available to dedicate to grade separations in the future. With the major metropolitan areas of Houston, Dallas-Fort Worth and San Antonio all having grade crossing issues of their own, it is impractical to assume that construction dollars would be available to grade separate dozens of crossings within the Corpus Christi and Yoakum Districts.

It is therefore prudent to reduce the number of crossings to be examined in this report from 2,500 to a more manageable number. Accordingly, selection criteria was established to identify which crossings were most likely to achieve favorable cost/benefit ratios. Through discussions with TxDOT it was agreed that the ten crossings shown to rate the highest on the selection criteria would be carried through the full evaluation process, including cost/benefit analysis. With an average grade separation costing nearly eight million dollars, selecting ten crossings still provides a large enough sample size to exceed the number of crossings that TxDOT might reasonably expect to grade separate in the near future.

The first step in the selection criteria process identified those crossings that had an average daily traffic (ADT) of 10,000 or more vehicles. Since virtually all benefits that would result from grade separations relate to the number of vehicles that pass through that crossing, focusing on crossings with higher ADT was a logical first step. Thirty-seven crossings with an ADT over 10,000 vehicles were identified based on data taken from the TRACI grade crossing database.

The next step in the evaluation process involved calculating an estimated number of vehicles delayed by trains and the amount of time those vehicles were delayed at each of those selected crossings. To do this, the baseline model discussed in Section 5 of this report was used to estimate the number of trains per day and the average train velocity for trains passing through the individual crossings. Using the number of trains per day, the average velocity, and an assumed 6,000 foot train length, a total vehicle occupancy time could be calculated for each individual crossing.

The calculated crossing occupancy time was then used to prorate a number of vehicles delayed based on the ADT of that roadway. As an example, a crossing with an ADT of 24,000 vehicles with an estimated occupancy of 1 hour would result in 1,000 vehicles experiencing a delay [(24,000 vehicles/day) x 1 hour] / (24 hours/day). After performing similar calculations for all crossings with ADTs over 10,000 vehicles, the crossings were sorted by number of vehicles delayed. The top ten crossings were selected for further analysis.

The top rated crossings resulting from this selection process are shown in the table below.

Table 7-1 Grade Crossing Locations Identified for Analysis

Street Name	Crossing ID	County	City	Rail Subdivision	Approximate Milepost
Meyers St. (S.H. 36)	023270N (siding) 416484T (main)	Austin	Sealy	BNSF Bay City	0.26 (siding) 135.35 (main)
Avenue F. (S.H. 60)	448744X	Matagorda	Bay City	UP Brownsville	283.80
Rio Grande St. (U.S. 59)	746472J	Victoria	Victoria	UP Port Lavaca (Cuero)	27.50
Park St. (S.H. 44)	793819S	Jim Wells	Alice	Texas Mexican	119.90
Park Ave. (U.S. 77)	435545H	San Patricio	Odem	UP Corpus Christi	132.20
Sinton St. (U.S. 181)	436011U	San Patricio	Sinton	UP Brownsville	162.15
U.S. 90	742771C	Gonzales	Gonzales	Texas Gonzales & Northern	11.02
WB Frontage Rd. (U.S. 77)	764969W	Victoria	Victoria	UP Port Lavaca (Cuero)	31.48
NW Ingleside (S.H. 361)	746288W	San Patricio	Gregory	UP Kosmos	0.06
Esplanade St. (S.H. 87)	746703P	Victoria	Cuero	UP Port Lavaca (Cuero)	54.99

It is noted that the process described above does have some limitations. For example, daily traffic is not uniformly spread across all 24 hours of the day. Higher hourly volumes typically occur during the morning and evening rush hours. Developing hourly traffic volumes for each crossing would have required a detailed traffic engineering exercise, which is beyond the scope of this report. Rather, this report assumes that any variations in hourly vehicular traffic would be balanced by variations in hourly train traffic, since both will be affected by what is considered the normal working day. The two variations are considered compensating and would therefore cancel each other out.

The crossing selection criteria is also limited by the reality of actual operating conditions that occur near rail yards. Switching operations in and around these yards result in a significantly elevated number of trains which move at very low speeds. With an assumed 6,000 foot constant train length, this results in skewed occupancy times and inflated vehicles-delayed counts. In reality, not all the trains involved in switching operations will be 6,000 feet long. Some contain only of a handful of rail cars. However, with no way to calculate the individual lengths of each individual switching train, and with no input or feedback from the railroads regarding whether the base-case model accurately depicts operations near rail yards, there was insufficient information to generate a vehicles-delayed number that can be compared to

crossings outside the vicinity of rail yards. As such, any crossings in the immediate vicinity of major rail yards that rated in the top 10 were discarded and the next highest crossing was added.

Of the ten crossings originally identified to have large vehicle delay counts, one crossing was found to have a parallel track with a separate grade crossing identification number immediately adjacent thereto. This crossing occurred along BNSF's Bay City Subdivision at Meyers Street in the city of Sealy. One crossing occurred along the mainline track and the other along an adjacent wye. Since the two crossings were immediately adjacent to each other, thus making it impossible to grade separate one, but not the other, the two crossings were treated as a single crossing. Of the two crossings the mainline track contributed the larger number of trains causing delay, thus that crossing was analyzed in more detail. While, in reality, the total delays at the roadway location would be the combination of the two crossings, only the mainline track was analyzed. If the results of that analysis were to rank this crossing highly in terms of cost/benefit ratio then more attention would be paid to their combined effect.

7.1.2 Rail Occupancy

As discussed in Section 5 of this report, a computer model was developed to simulate a two week long operating period for all trains moving within the Corpus/Yoakum Districts. That model depicts the daily movement of trains and their interactions over a number of rail lines, junctions and yards.

The Rail Traffic Controller (RTC) model was used to develop the simulation. RTC dispatches trains over a defined network, and keeps statistics on the progress of each train as it moves through the network. It has an internal dispatching function that attempts to resolve all conflicts that occur in a simulation by either using available alternate routes (sidings or second tracks) or by delaying trains at points where trains are permitted to meet.

The network is made up of nodes connected by links. The model keeps track of when the head portion of a train enters a node and when the rear end of that train clears that node. A report is generated showing every node that every train operates through over the two week simulation. Such a report was used to develop the grade crossing analysis discussed below.

When the RTC base-case network was originally developed, the specific grade crossings that would eventually be examined as part of the grade crossing analysis were unknown. Normal nodes necessary to accurately represent the rail lines in the Corpus/Yoakum Districts were inserted into the model; nodes such as signals, turnouts and diamonds were entered, as were grades and track speed changes. Nodes representing specific grade crossings were not initially included in the network.

As discussed earlier in this section, part of the second phase of the analyses involved examination of a list of ten crossings that have high daily highway vehicle counts. TxDOT requested occupancy information based on the simulation's results for each of those ten crossings.

Aerial photography, latitude/longitude data, and milepost information for each crossing were used to determine the exact location of the crossing within a given rail subdivision. Those locations were compared with nodes already in the simulation model. The results showed that 6 of the 10 specified crossings had nodes already included in the model within 0.1 mile (approximately 500 feet) of the calculated location, and thus those existing nodes could be used

to monitor grade crossing rail activity. There were no nodes in the model that were within one mile of the calculated station locations for the four remaining crossings.

Two of the crossings that were not included in the network (were not close to nodes already present in the model) were on light density branch lines. One of these crossings is on a branch line near Gonzales, TX, which is operated by short-line carrier Texas Gonzales and Northern (TG&N). This line is at the far end of the network, and no operational information on TG&N operations was available. Research indicated that TG&N interchanges with UP at Harwood, TX on the Flatonia Subdivision, however, there was no information as to how many times per week or what time of day this interchange occurs. Since most short-lines only operate a limited number of interchange trains per day, it was not considered necessary to include this operation in the original simulation. For purposes of the crossing evaluations it was assumed that two round-trip trains per day operate along this line.

The second crossing along a light density branch line that was not near a node in the model occurred where an industry spur track crosses a major highway and connects to Union Pacific Railroad's (UP) Kosmos Subdivision near Gregory, TX. Approximately four trains per day operated over the Kosmos Subdivision (2 in each direction) in the simulation, and they did not pose a capacity issue. Because of this light level of traffic, local industry rail traffic was not included in the simulations.

The remaining two crossings that did not have nodes within a reasonable distance for analysis purposes were both located on UP's Port Lavaca (Cuero) Subdivision between Flatonia and Victoria. One crossing was approximately five miles north of Victoria, and the second was in Cuero, TX.

These two crossings presented a minor issue that had to be resolved before being able to analyze the occupancies during the simulation. Two new nodes were inserted at the appropriate mileposts to capture operations through the area of the crossings. This was accomplished using data taken from the TxDOT crossing list.

An important factor in the modeling effort was the recognition that traffic on the Port Lavaca (Cuero) Subdivision is expected to change over the next two years from that which was modeled in the base simulation. Kansas City Southern (KCS) Railway currently uses the Port Lavaca Subdivision to run approximately six trains a day between Laredo, Corpus Christi and Houston via trackage rights on UP, and those trains were modeled in the base case running over this route.

Between the time of final writings of the Phase 1 and Phase 2 reports, construction of the KCS line was completed and became operational. KCS trains that previously ran on UP trackage rights between Rosenberg and Victoria are now relocated to the new line, significantly reducing the traffic levels operating on the northern end of the Port Lavaca Subdivision. However, at the time the rail model was being developed no operational information regarding the effects of the addition of the new KCS line to the network was available.

To address this scenario, new nodes were added into a later simulation that rerouted all KCS trains from the Port Lavaca (Cuero) Subdivision to the new KCS route. The only trains that remained on the Port Lavaca (Cuero) Subdivision were then captured at the new crossing nodes.

The later simulation network also included modifications that had been identified as potential improvements (new sidings, wyes, etc.) that would alleviate congestion that was identified in the Base Case simulation. The additional capacity that resulted from those improvements, coupled with the addition of the new KCS line improved many of the operations on the Angleton, Brownsville and Corpus Christi Subdivisions. The reduced delay increased train speeds, which in turn shortened the duration of grade crossing occupancies.

Detailed review of the two simulation outputs indicated that Port Lavaca Subdivision operations experienced little change in operating speeds due to these capacity improvements; a comparison of operating speeds at the crossings' mileposts found there was less than a 0.1 mile per hour difference between cases. However, the rerouting of KCS trains did significantly change the number of trains that operated over the Port Lavaca Subdivision, and that, in turn, had an impact on the grade crossing analysis.

Because the capacity improvements included in the second simulation had an impact on operating speeds and delays for trains on the Angleton, Brownsville and Corpus Christi Subdivisions, that simulation was used to analyze only the crossings that will be affected by the KCS reroutes. All other crossings were analyzed using the Base Case simulation results. The table below indicates which simulation was used for each crossing analyzed in the study.

Table 7-2 Grade Crossing Occupancies

Crossing Number	Street Name	City	Average Occupancies per Day	Average Duration of Occupancy (minutes)	Minutes per Day Crossing is Blocked	Notes
023270N (note 1)	Meyers	Sealy	9.4	2.8	26.0	Base simulation
448744X	Hwy. 60	Bay City	23.0	2.5	57.3	Base simulation
746472J	Hwy. 59	Victoria	4.6	4.6	21.6	Case 2 sim
793819S	Hwy. 44	Alice	6.7	1.9	12.8	Base simulation
435545H	Park Ave.	Odem	6.8	4.6	31.4	Base simulation
436011U	Hwy. 188	Sinton	21.2	2.4	51.5	Base simulation
742771C (note 2)	Hwy. 90	Gonzales	4.0	2.5	10.0	Not included in simulation
764969W	Hwy. 77 access	Victoria	4.6	2.7	12.3	Case 2 sim
746288W (note 2)	Hwy. 361	Gregory	4.0	2.5	10.0	Not included in simulation
746703P	Hwy. 87	Cuero	4.6	1.8	8.1	Case 2 sim

Notes:

1. Includes parallel track, crossing 416484T
2. Branch line not included in simulation. Assumed 4 occupancies and 30 minutes of blockage.

It must be noted that the Minutes per Day Crossing is Blocked result does not represent the time grade crossing protection systems are activated. While information was provided regarding the presence of flashers, gates and flashers, or no protection, activation and clearing times for those devices was not available. It is estimated that for each crossing that has electronic grade crossing protection, approximately 40 seconds should be added to each occupation to reflect the actual time the crossing is not available to highway traffic.

7.1.3 Analysis of Results

The following section reviews each crossing addressed by the study and provides a brief discussion of the result of the grade crossing analysis relevant to said crossing. While each crossing description provides information as to whether or not a crossing might warrant further grade crossing consideration, cost-benefit calculations that appear later in this report provide more accurate information in that regard.

Highway 60 in Bay City

This crossing is located just west of a connection where BNSF trains depart from UP's Angleton Subdivision to enter BNSF's Bay City Subdivision. Because of the configuration of the BNSF/UP connection, BNSF must run around their train before entering their own trackage (this also occurs when the train reenters UP trackage). This run around move creates additional grade crossing occupancies; this in addition to the multiple UP through trains that operate through Bay City. The run around BNSF movements are generally slow speed movements (longer occupancies); the UP movements are at higher speeds, but are more frequent.

This crossing experienced the greatest number of minutes of blockage throughout the day of any crossing in the Corpus/Yoakum Districts. The high highway vehicle counts combined with the number of occupancies and total minutes of delays created at this crossing could justify further consideration for a grade separation project.

Highway 188 in Sinton

Highway 188 crosses UP's Brownsville Subdivision just north of the connection to UP's Kosmos Subdivision. All UP, BNSF and KCS trains moving between Houston/Bloomington and Laredo, Brownsville, and Corpus Christi cross at this location. Normal train speed in this area is approximately 50 mph, but delays around Sinton created some movements that were as slow as 10 mph through the crossing. Potential growth of traffic moving between Houston and the Corpus Christi area would aggravate the number and duration of blockages at this crossing.

The crossing had the second highest total minutes of blockage per day for the Corpus/Yoakum Districts. The level of blockage combined with high vehicle counts might also make this crossing a candidate for grade separation consideration.

Meyers St. in Sealy

UP operates some trains from Houston toward Smithville by running them north on BNSF's Galveston Subdivision between Rosenberg and Sealy, and from there, continuing to UP's Smithville Subdivision via a connection at Sealy. The crossing in question is located across the Smithville Subdivision main track (and the adjacent connecting wye track) just west of BNSF's

Galveston Subdivision. Meyers St. runs parallel to the Galveston Subdivision and does not cross BNSF's main track, thus only UP trains impacted this crossing.

At this location, the Smithville Subdivision is running east – west between Smithville and Katy, TX. The wye track at Sealy is parallel to the Smithville Subdivision main track at the Meyers Street crossing. Trains operating on the Smithville Subdivision to or from Katy pass over this crossing along with trains coming from Rosenberg that are turning towards Smithville.

Because of curvature of the wye track, and the adjacent BNSF Galveston Subdivision diamonds, UP trains operate at approximately 20 miles per hour over this crossing. This relatively slow speed increases the total minutes the crossing is blocked each day. The slow speed of trains establishes the basis for why this crossing should receive further consideration for a grade separation project.

As stated earlier, depending on the results of the cost/benefit calculations for the mainline crossing, it may be appropriate to consider the effects of both crossings at this location. If those results do not define this crossing as justifying a possible grade separation, then no further study will be warranted. Only the mainline tracks were analyzed; however, the wye track which is adjacent to the mainlines would further contribute to delays at this crossing.

Park Avenue in Odem

This crossing is located just west of the intersection of UP's Brownsville Subdivision and UP's Corpus Christi Subdivision. Park Avenue crosses the Corpus Christi Subdivision, and runs parallel to the Brownsville Subdivision.

Because of complex track work at this location, many Corpus Christi Subdivision trains in the simulation had to stop or proceed slowly across the diamonds. This increased the number of minutes Park Avenue was blocked in the Base simulation. In future simulations, a configuration change at Odem is being recommended that would reduce the length of time this crossing is blocked. If such modifications are made, this crossing is not recommended for further grade separation study. If the configuration changes at Odem are not accepted or funded, then this crossing could also be considered for separation if the cost-benefit ratio calculation justifies doing so.

Highway 44 in Alice

This crossing is located on the southeast side of Alice on KCS's Laredo Subdivision. BNSF and KCS trains move through this crossing as they travel between Corpus Christi, Houston and Laredo.

The crossing is a relatively high speed crossing, with trains averaging 47 mph. While there is potential for significant growth of train traffic on this line because of KCS's new routing between Victoria and Rosenberg, the trains speeds help minimize the total time the crossing is (or will be) blocked. There are currently no sidings or other impediments that have the potential to slow trains down through this area. Therefore, it is unlikely that the amount of delay to highway users would justify a grade separation.

Highway 59, and Highway 77 Access Road in Victoria

These two crossings are located approximately 4 miles apart just north of Victoria on UP's Cuero Subdivision. Trains in the simulation operated over both of these crossings at approximately 40 mph.

Following the relocation of KCS traffic to their own routes, only 4 trains per day (approximate) will then operate over these crossings. That volume of trains is not expected to justify a grade separation at either location.

Highway 87 in Cuero

This crossing is located in the middle of Cuero. Trains operated over this crossing at approximately 40 mph in the simulations.

Following the relocation of KCS traffic to their own route, the remaining trains that will operate over the line are not expected to justify a grade separation at this location.

Highway 90 in Gonzales

As described previously, this crossing was not included in the model because of the light density of traffic and the lack of information regarding operations on the TG&N. It is estimated that this crossing would be affected by TG&N traffic up to four times per day: one interchange train moving from Gonzales to Harwood and returning to Gonzales, and possibly one switch engine serving customers north of the Hwy 90 crossing.

Assuming the track speed is 10 mph in this area (common for light density branch operations), a 30 car train (e.g. UP interchange train) would take approximately 2.5 minutes to clear the crossing. Industry switchers would likely be shorter and require less time. Therefore, it is estimated that this crossing is blocked for a total of less than 10 minutes per day, a duration of blockage unlikely to justify a grade separation.

Highway 361 in Gregory

Also mentioned previously, this crossing is an industrial spur connecting to the Kosmos Subdivision near Gregory. Aerial photographs indicate the plant is in production, and this report assumed a maximum of 10 cars entering and leaving the plant per day.

Track speed for industrial spurs usually does not exceed 10 mph. Based on the configuration of the tracks in the industry, it is estimated that cars must first be pulled from the plant prior to new cars being spotted into the plant. Such moves would likely lead to four occupancies per day during a short time period when the plant was being served. It is estimated that with a local train handling this number of cars, the crossing would not be blocked for more than 10 minutes during any day. As with many of the crossings analyzed, this level of blockage would likely not justify considering a grade separation for this crossing.

7.2 GRADE CROSSING COST/BENEFIT ANALYSIS

7.2.1 Construction Cost Estimates

Each of the selected grade crossings was examined in detail to develop an order of magnitude cost estimate.

In developing the construction cost estimates the following assumptions were made:

- All design concepts should follow standard TxDOT criteria.
- Right-of-way would only be acquired as a last resort.
- Railroad operations can not be interrupted by construction.

The table below shows the individual construction cost estimates for each of the ten crossings. Detailed cost estimates for each crossing can be found in Appendix G. Exhibits showing the conceptual design for these crossings can be found in Appendix H. Descriptions of the individual crossings are found in the paragraphs below.

Table 7-3 Estimated Construction Costs for Grade Separations

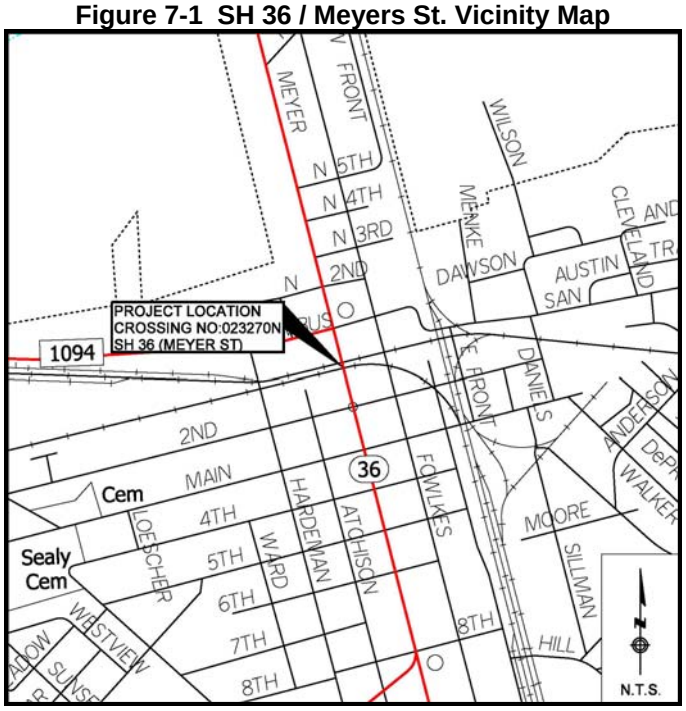
Street	Crossing ID	Cost
US 90	742771C	$12,700,000.00
US 77 / Park Avenue	435545H	$7,200,000.00
US 77 / WB Frontage Road	764969W	$9,000.00 *
US 59 / Rio Grande St.	746472J	$7,200,000.00
US 183 / Esplanade St.	746703P	$6,900,000.00
SH 36 / Meyers St.	023270N (siding) 416484T (main)	$8,300,000.00
SH 44 / Park St.	793819S	$6,700,000.00
SH 60 / Avenue F	448744X	$8,400,000.00
SH 361 / NW Ingleside	746288W	$8,800,000.00
US 181 / Sinton St.	436011U	$5,600,000.00

** Grade separation not feasible. Cost shown is for crossing closure. See below for discussion.*

SH 36 / Meyers Street

The BNSF railroad currently owns and operates the Galveston Subdivision which is traversed by SH 36 (Meyer Street) within the vicinity of Sealy, Texas in Austin County. At this location, the railroad consists of two tracks running West-East between 2nd Street and FM 1094 (Columbus Road). The figure below depicts the general location of the project.

Figure 7-1 SH 36 / Meyers St. Vicinity Map



Existing Crossing

SH 36 crosses the tracks at grade and is controlled by advanced warning signs and flashing gates. Pavement markings consist of stop lines and railroad crossing symbols. SH 36 is classified as rural other principal arterial and consists of four approximate twelve foot lanes with a two-way left turn lane. The existing crossing is shown in the picture below.

Figure 7-2 SH 36 / Meyers St. Existing Conditions

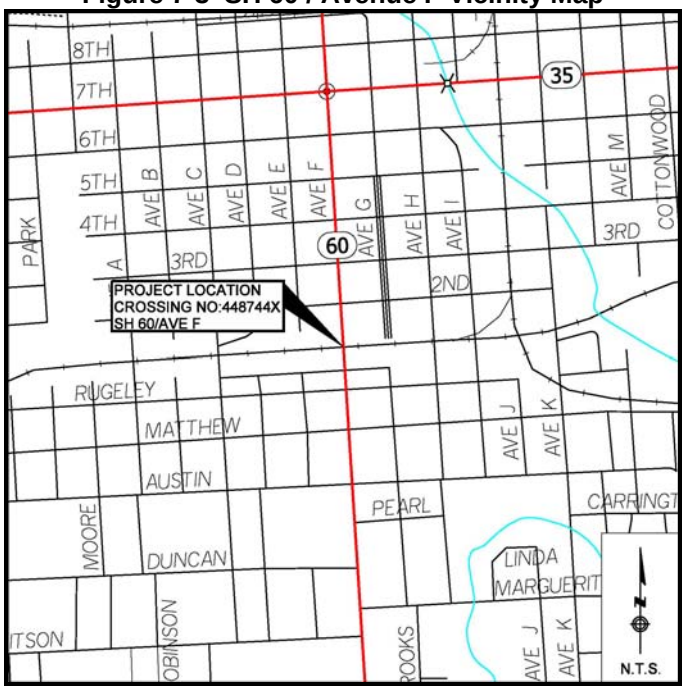
Proposed Improvements

The proposed improvements at SH 36 and BNSF's Galveston Subdivision tracks include a grade separated crossing with four twelve foot lanes. Two two-way frontage roads with turnarounds will be included in the proposed improvements; therefore, additional right-of-way will need to be acquired. An exhibit illustrating the limits of the proposed improvements can be found in Appendix H.

SH 60 / Avenue F

The Union Pacific Railroad Co. currently owns and operates the Angleton Subdivision which is traversed by SH 60 (Avenue F) within the vicinity of Bay City, Texas in Matagorda County. At this location, the railroad consists of one main track running West-East between 1st Street and 2nd Street. The figure below depicts the general location of the project.

Figure 7-3 SH 60 / Avenue F Vicinity Map



Existing Crossing

SH 60 crosses the track at grade and is controlled by advanced warning signs and flashing gates. Pavement markings consist of stop lines and railroad crossing symbols. SH 60 is classified as urban other principal and consists of four approximate twelve foot lanes. A photograph of the existing crossing is not available.

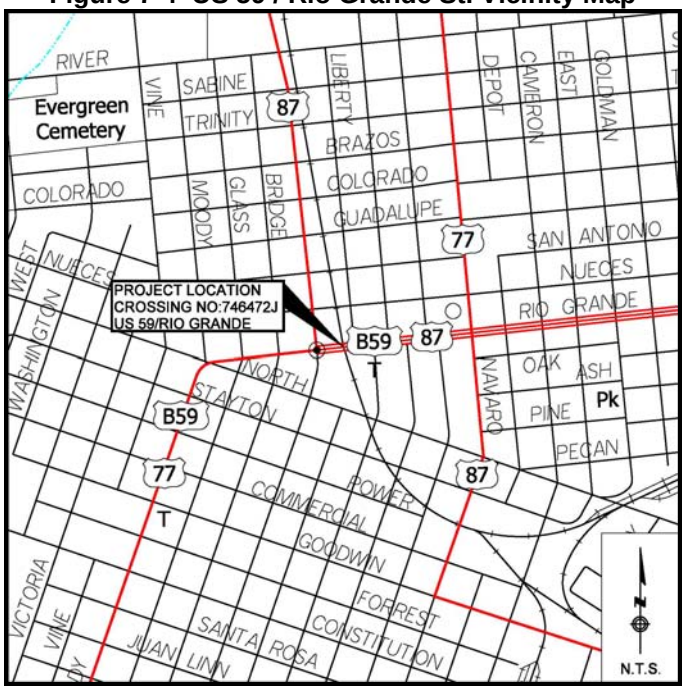
Proposed Improvements

The proposed improvements at SH 60 and Union Pacific's Angleton Subdivision track include a grade separated crossing with four twelve foot lanes. Two two-way frontage roads will be included in the proposed improvements; therefore, additional right-of-way will need to be acquired. An exhibit illustrating the limits of the proposed improvements can be found in Appendix H.

US 59 / Rio Grande Street

The Union Pacific Railroad Co. currently owns and operates the Port Lavaca (Cuero) Subdivision which is traversed by US 59 (Rio Grande Street) within the vicinity of Victoria, Texas in Victoria County. At this location, the railroad consists of one main track running North-South between Main Street and Liberty Street. The general location of the project is depicted in the figure below.

Figure 7-4 US 59 / Rio Grande St. Vicinity Map



Existing Crossing

US 59 crosses the track at grade and is controlled by advanced warning signs and flashing gates. Pavement markings consist of stop lines and railroad crossing symbols. US 59 is classified as urban other principal and consists of four approximate twelve foot lanes. An exhibit of the existing crossing is shown in the picture below.

Figure 7-5 US 59 / Rio Grande St. Existing Conditions

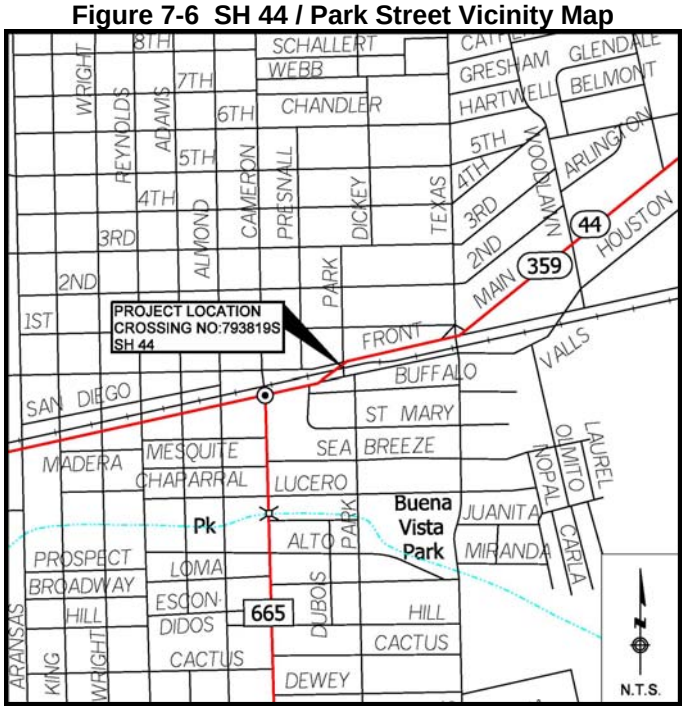
Proposed Improvements

The proposed improvements at US 59 and Union Pacific's Cuero Subdivision main track include a grade separated crossing with four twelve foot lanes. An exhibit illustrating the limits of the proposed improvements can be found in Appendix H.

SH 44 / Park Street

The Kansas City Southern Railway Co. currently owns and operates the Laredo Subdivision which is traversed by SH 44 within the vicinity of Alice, Texas in Jim Wells County. At this location, the railroad consists of one main track running West-East between East Main Street and East Front Street. Figure 1 depicts the general location of the project.

Figure 7-6 SH 44 / Park Street Vicinity Map



Existing Crossing

SH 44 crosses the tracks at grade and is controlled by traffic signals, advanced warning signs, and flashing gates. Pavement markings consist of stop lines and railroad crossing symbols. SH 44 is classified as urban other principal and consists of four approximate twelve foot lanes with a concrete median. An exhibit of the existing crossing is shown in Figure 2.

Figure 7-7 SH 44 / Park Street Existing Conditions

Proposed Improvements

The proposed improvements at SH 44 and Kansas City Southern's Laredo Subdivision main track include a grade separated crossing with four twelve foot lanes. Two two-way frontage roads will be included in the proposed improvements; therefore, additional right-of-way will need to be acquired. An exhibit illustrating the limits of the proposed improvements can be found in Appendix H.

US 77 / Park Avenue

The Union Pacific Railroad Co. currently owns and operates the Corpus Christi Subdivision which is traversed by US 77 (Park Avenue) within the vicinity of Odem, Texas in San Patricio County. At this location, the railroad consists of two tracks running North-South between Borden Street and Humphries Street. The figure below depicts the general location of the project.

Figure 7-8 US 77 / Park Avenue Vicinity Map

Existing Crossing

US 77 crosses the tracks at grade and is controlled by advanced warning signs. Pavement markings consist of stop lines and railroad crossing symbols. US 77 is classified as rural other principal arterial and consists of four approximate twelve foot lanes with a two-way left turn lane. An exhibit of the existing crossing is shown in the figure below.

Figure 7-9 US 77 / Park Avenue Existing Conditions

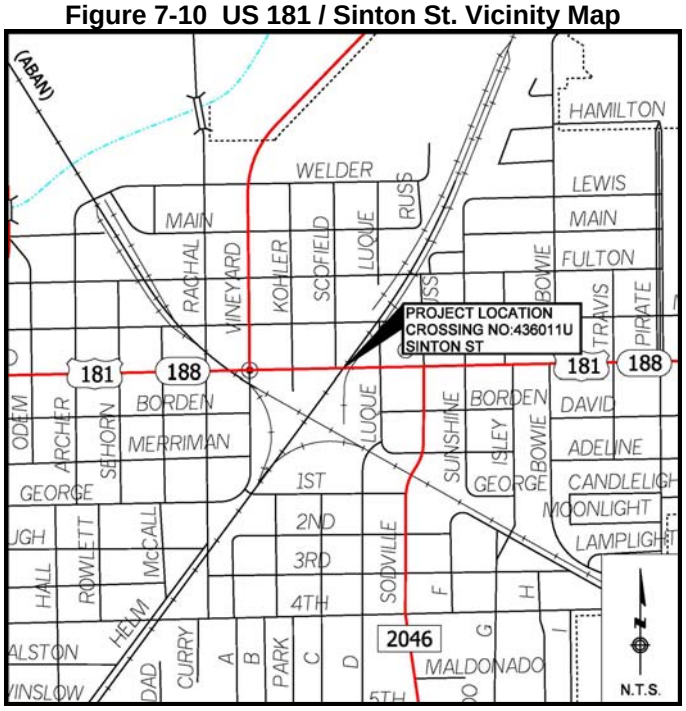
Proposed Improvements

The proposed improvements at US 77 and Union Pacific's Co Christ Subdivision tracks include a grade separated crossing with four twelve foot lanes and five foot sidewalks. An exhibit illustrating the limits of the proposed improvements can be found in Appendix H.

US 188 / Sinton Street

The Union Pacific Railroad Co. currently owns and operates the Brownsville Subdivision which is traversed by Sinton Street within the vicinity of Sinton, Texas in San Patricio County. At this location, the railroad consists of one main track running North-South between Scofield Avenue and Luque Street. The vicinity map shown in the figure below depicts the general location of the project.

Figure 7-10 US 181 / Sinton St. Vicinity Map



Existing Crossing

Sinton Street crosses the track at grade and is controlled by advanced warning signs and flashing gates. Pavement markings consist of stop lines and railroad crossing symbols. Sinton Street is classified as urban other principal and consists of four approximate twelve foot lanes with five foot sidewalks. A picture of the existing crossing is shown below.

Figure 7-11 US 181 / Sinton St. Existing Conditions

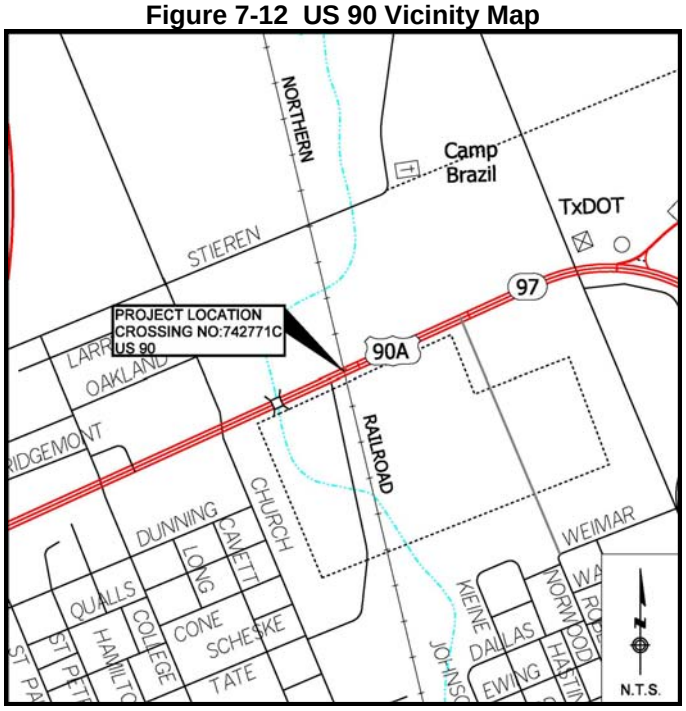
Proposed Improvements

The proposed improvements at Sinton and Union Pacific's Brownsville Subdivision main track include a grade separated crossing with four twelve foot lanes and five foot sidewalks. An exhibit illustrating the limits of the proposed improvements can be found in Appendix H.

US 90

The Texas Gonzales & Northern railroad currently owns and operates a rail line which is traversed by US 90 within the vicinity of Gonzales, Texas in Gonzales County. At this location, the railroad consists of one main track running North-South between Tate Street and Johnson Street, as shown in the figure below.

Figure 7-12 US 90 Vicinity Map



Existing Crossing

US 90 crosses the track at grade and is controlled by advanced warning signs and flashing gates. Pavement markings consist of stop lines and railroad crossing symbols. US 90 is classified as urban other principal and consists of four approximate twelve foot lanes with ten foot shoulders and an one-hundred foot grassy median. The picture below shows the existing crossing.

Figure 7-13 US 90 Existing Conditions

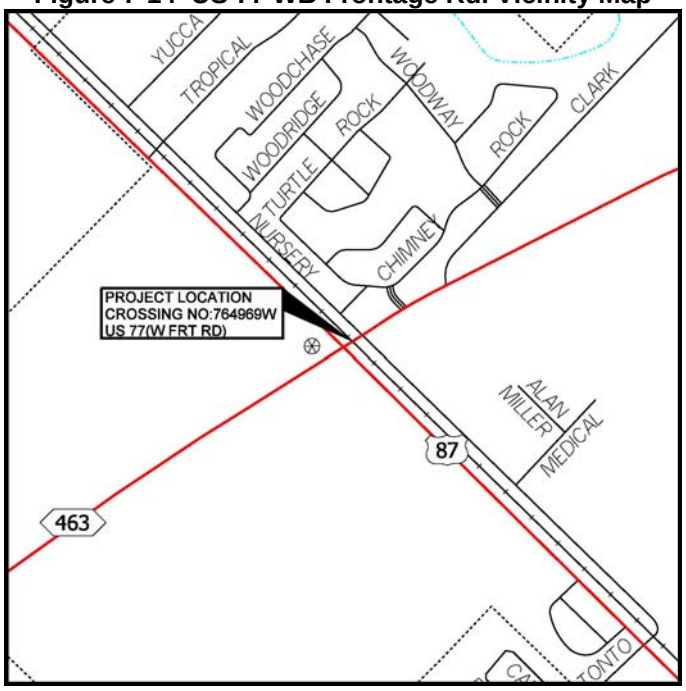
Proposed Improvements

The proposed improvements at US 90 and Union Pacific's Flatonia Subdivision main track include a grade separated crossing with four twelve foot lanes, ten foot shoulders, and concrete traffic barrier. Two one-way frontage roads with turnarounds will be included in the proposed improvements. An exhibit illustrating the limits of the proposed improvements can be found in Appendix H.

US 77 Westbound Frontage Road

The Union Pacific Railroad Co. currently owns and operates the Port Lavaca (Cuero) Subdivision which is traversed by US 77 north of Victoria, Texas in Victoria County. At this location, the railroad consists of one main track running North-South between US 87 and Nursery Drive. The general location of the project is shown in the figure below.

Figure 7-14 US 77 WB Frontage Rd. Vicinity Map



Existing Crossing

The mainlanes of US 77 are grade separated over the existing track. Westbound and eastbound frontage roads cross the track at grade and are controlled by traffic signals, advanced warning signs, and flashing gates. Pavement markings consist of stop lines and railroad crossing symbols. The frontage roads of US 77 are classified as rural major collectors and consist of two approximate twelve foot lanes with no shoulder. An exhibit of the existing crossing is shown in the picture below.

Figure 7-15 US 77 WB Frontage Rd. Existing Conditions

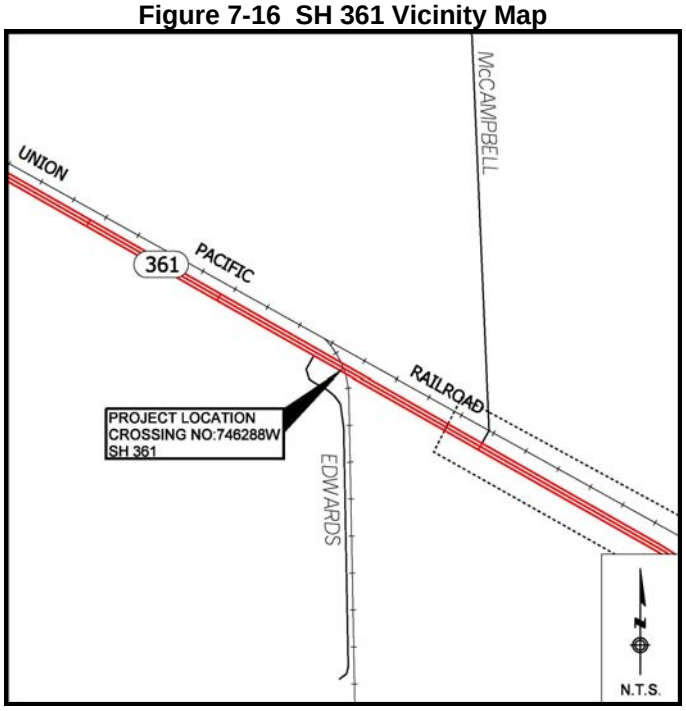
Proposed Improvements

Upon a detailed examination of this particular crossing it was determined that a grade separation at this location would not be feasible. Just north of the crossing is a subdivision connection and it is not geometrically feasible to construct a grade separation that could both provide adequate clearance above the rail line and connect to the existing subdivision entrance. To construct a grade separation at this location would effectively cut off the subdivision. Additionally, just south of the crossing is an intersection between the US 77 westbound frontage road and US 87. If a grade separation were constructed, it would be impossible to connect the elevated US 77 WBFR with US 87 without a complicated major interchange. Since such an interchange would cost in the tens of millions of dollars and cause significant disruptions to railway and roadway traffic, this was not felt to be a realistic alternative. As such, a "no-build" recommendation is given for this location and this crossing is removed from any further cost/benefit analysis.

SH 361 / Ingleside Drive

The Union Pacific Railroad Co. currently owns and operates the Kosmos Subdivision which is traversed by SH 361 west of Ingleside, Texas in San Patricio County. At this location, the railroad consists of one main track running North-South between Edwards Road and McCampbell Road. The figure below depicts the general location of the project.

Figure 7-16 SH 361 Vicinity Map



Existing Crossing

SH 361 crosses the tracks at grade and is controlled by advanced warning signs. Pavement markings consist of stop lines only. SH 361 is classified as rural major collector and consists of four approximate twelve foot lanes, ten foot shoulders, and a thirty foot grassy median. An exhibit of the existing crossing is shown below.

Figure 7-17 SH 361 Existing Conditions

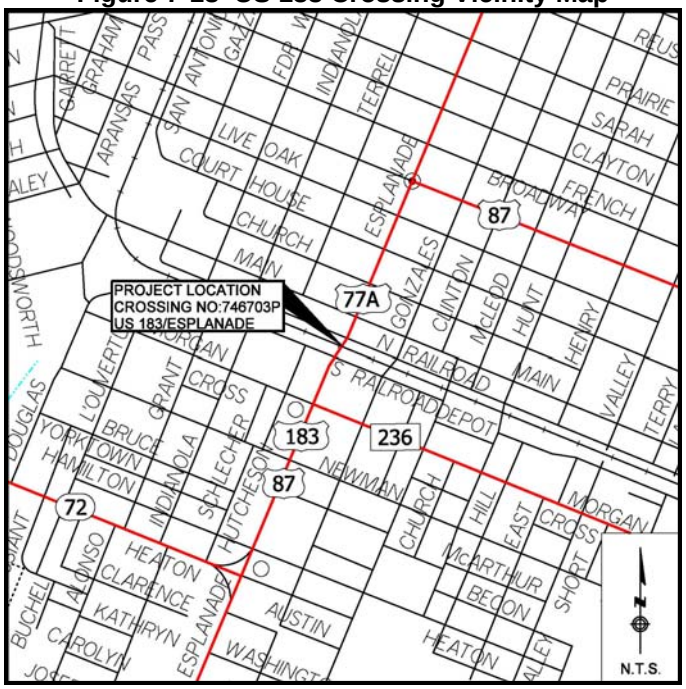
Proposed Improvements

The proposed improvements at SH 361 and Union Pacific's Sealy Subdivision main track include a grade separated crossing with four twelve foot lanes, ten foot shoulders, and concrete traffic barrier. The proposed improvements will also include extending the existing roadway south of SH 361 to allow access to businesses and Edwards Road. Therefore, additional right-of-way will need to be acquired. An exhibit illustrating the limits of the proposed improvements can be found in Appendix H.

US 183 / Esplanade Street

The Union Pacific Railroad Co. currently owns and operates the Cuero Subdivision which is traversed by US 183 (Esplanade Street) within the vicinity of Cuero, Texas in De Witt County. At this location, the railroad consists of one main track running West-East between North Railroad Street and South Railroad Street. The figure below depicts the general location of the project.

Figure 7-18 US 183 Crossing Vicinity Map



Existing Crossing

US 183 crosses the track at grade and is controlled by advanced warning signs and flashing gates. Pavement markings consist of stop lines and railroad crossing symbols. US 183 is classified as urban other principal and consists of four approximate twelve foot lanes. A picture of the existing crossing is shown below.

Figure 7-19 US 183 Crossing Existing Condition

Proposed Improvements

The proposed improvements at US 183 and Union Pacific's Cuero Subdivision track include a grade separated crossing with four twelve foot lanes. Two two-way frontage roads will be included in the proposed improvements; therefore, additional right-of-way will need to be acquired. An exhibit illustrating the limits of the proposed improvements can be found in Appendix H.

7.2.2 Benefit-Cost Analysis

A benefit-cost analysis was prepared to assess the potential benefits associated with the proposed grade crossings in the Corpus-Yoakum Districts. This analysis includes the benefits to the public and to the railroad companies which operate freight rail lines in these districts. In all, ten grade crossings were considered for review. As mentioned previously, one of these crossings, US 77 westbound frontage road, has been removed due to the lack of a viable alternative as how to construct a grade separation at this location. In Sealy, two grade crossings exist adjacent to each other at Meyers St. Only the mainline crossing was analyzed at this time. Table 7-4 summarizes the estimated benefits to the public and private sectors from the development of these grade separations.

Table 7-4 Summary of the Public and Private Benefits of Grade Separations

Benefit	Amount
Public	
Value of Time	$2,531,985
Emissions/Fuel	$787,063
Safety	$8,370,607
Reduced Maintenance Costs	--
Hazmat Removal	--
Subtotal	$11,689,656
Private	
Reduced Maintenance Costs	$3,469,347
Safety	$906,190
Subtotal	$4,375,537
Total Benefits (Public + Private)	$16,065,193
Costs	$71,804,239
Benefit/Cost Ratio	0.22

7.2.2.1 Methodology

Public Benefits

The estimation of benefits focused on the following categories, which included: (i) improved time savings for roadway vehicles; (ii) reduced vehicle fuel costs for roadway vehicles; (iii) improved safety; (iv) reduced vehicle emissions; (v) reduced operations and maintenance costs; and (iv) reduction in costs related to the clean-up of hazardous materials. Benefits were discounted at 4.5 percent and a 20-year forecast period was used. The general methodology and source data used for estimating each of these parameters is described below.

- *Improved Time Savings.* For each railroad crossing, the potential time savings for roadway vehicles was calculated as a function of the most recent ADT for each crossing, average number of occupancies, average number of minutes per occupancy, the number of minutes per day that each crossing is blocked, and value of time to motorists. ADT data was subdivided into auto ADT and truck ADT based on historical patterns for each crossing. Occupancy and delay data was derived through a rail model simulation model. Value of time was divided into auto and truck drivers. For autos, the value of time of $20.64 was estimated by using the average hourly wage rate in the Corpus Christi area in 2008 and an average auto-occupancy. For trucks, the value of time of $13.70 was based on the wage rate for truck drivers in the region.

- *Reduced Vehicle Fuel Costs*. This was calculated as a function of the aggregate amount of time that autos and trucks have been delayed multiplied by fuel costs in the $/gallon for each railroad crossing. Using forecast data prepared by the Energy Information Administration (EIA) within the U.S. Department of Energy, a $3.01/gallon for regular unleaded was used to estimate this benefit.

- *Improved Safety.* Potential safety benefits were estimated from recent accident/incident reports prepared by the Federal Railroad Administration (FRA) for each railroad crossing. The safety benefits represent the monetized value established by the National Highway

Traffic Safety Administration (NHTSA) for the value of life, value of injury, and value of property damage.

- *Reduced Emissions.* The estimated value of potential emissions reductions were based on the amount of Nitrogen Oxide (NO_x), Volatile Organic Compounds (VOC), and Carbon Monoxide (CO) emitted by trucks and autos per minute of idling as well as the amount of Particulate Matter (PM) emitted by idling trucks, only. These figures were drawn from the U.S. Environmental Protection Agency (EPA). These amounts were then multiplied at the cost per ton for each emission type based on values estimated by the EPA and/or used in other freight studies prepared for Caltrans and the Colorado Department of Transportation (CDOT).

- *Reduced Maintenance Costs.* It is the responsibility of the railroad companies to maintain the signals as well as the surface at the crossing. Moreover, the railroad companies must supply the crossbucks. As a result, there is no public benefit associated with the reduction of signalization maintenance costs as a result of the proposed improvements.

- *Hazmat.* The Office of Safety Analysis within the Federal Railroad Administration (FRA) found that there were no incidents of hazardous materials released from railroad operations in the 21 counties from 2000 to 2009. Consequently, there is no public benefit from these proposed improvements associated with the removal and clean-up of hazardous materials.

Private Benefits

The estimation of benefits focused on two main categories, which included: (i) reduced operations and maintenance costs; and; (ii) improved safety conditions. A 4.5 percent discount rate was also used. The general methodology and source data used for estimating each of these parameters is described below.

- *Reduced Operations and Maintenance Costs.* At the present time, the private railroad companies incur the costs of operating and maintaining railroad signals at the crossings under consideration. By eliminating these signals, the railroad would experience an annual decrease of $266,710 in O&M costs or approximately $26,671/signal. This includes the O&M costs associated with the signals, ROW, telephone and radio systems, and supporting facilities. This benefit translates in approximately $3.5 million in cost savings to the railroad companies for the entire forecast period.

- *Improved Safety.* Railroad companies incur liabilities associated with accidents along their respective rail lines, including incidents that occur at road/rail crossings. Although the FRA does not report any incidents relating to collisions along the mainline or due to signal failures in the Corpus Christ and Yoakum districts, there have been 18 accidents in the most recent 20 years at the 10 grade crossings under study. These accidents have resulted in 1 fatality and 6 injuries during this period. Using financial data collected from the UPRR, it is estimated that, on average, each incident costs the railroad company about $77,400 per year in settlement and court costs. In this manner, the railroad company would save close to $900,000 as a result of the proposed grade separations during the 20-year forecast period.

7.2.2.2 Analysis of the Grade Crossings

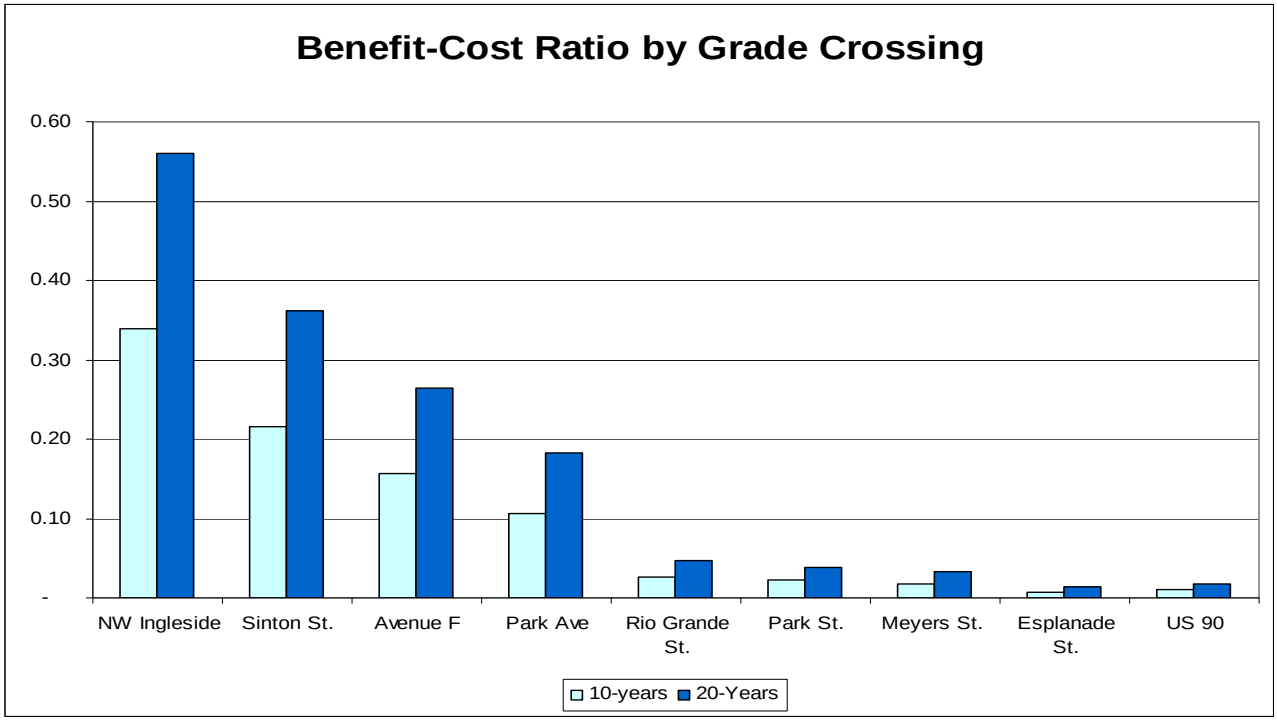
In the absence of major safety issues, the largest benefits from these proposed investments were related to the improved time savings for autos and trucks. In particular, time savings provided over 70 percent of the total benefits for nearly half of the crossing for which benefits could be calculated. It should be noted that none of the grade crossings that were examined provided a benefit-cost ratio greater than 1. The Table 7.5 and Figure 7-20 below illustrate the corresponding 10-year and 20-year benefit-cost ratios.

The list of crossings identified for potential improvement are shown in the figure below, along with the estimated costs, potential 10 and 20 year benefits, benefit-cost ratio (B/C) and the average daily traffic (ADT) volumes associated with each roadway. These grade crossings are ranked from highest to lowest with respect to the calculated benefits/cost ratio. As an aggregate, the proposed grade separations are estimated to have a B/C ratio of 0.10 and 0.16 over 10 years and 20 years, respectively.

Table 7-5 Summary of the Public Benefits for Grade Crossings

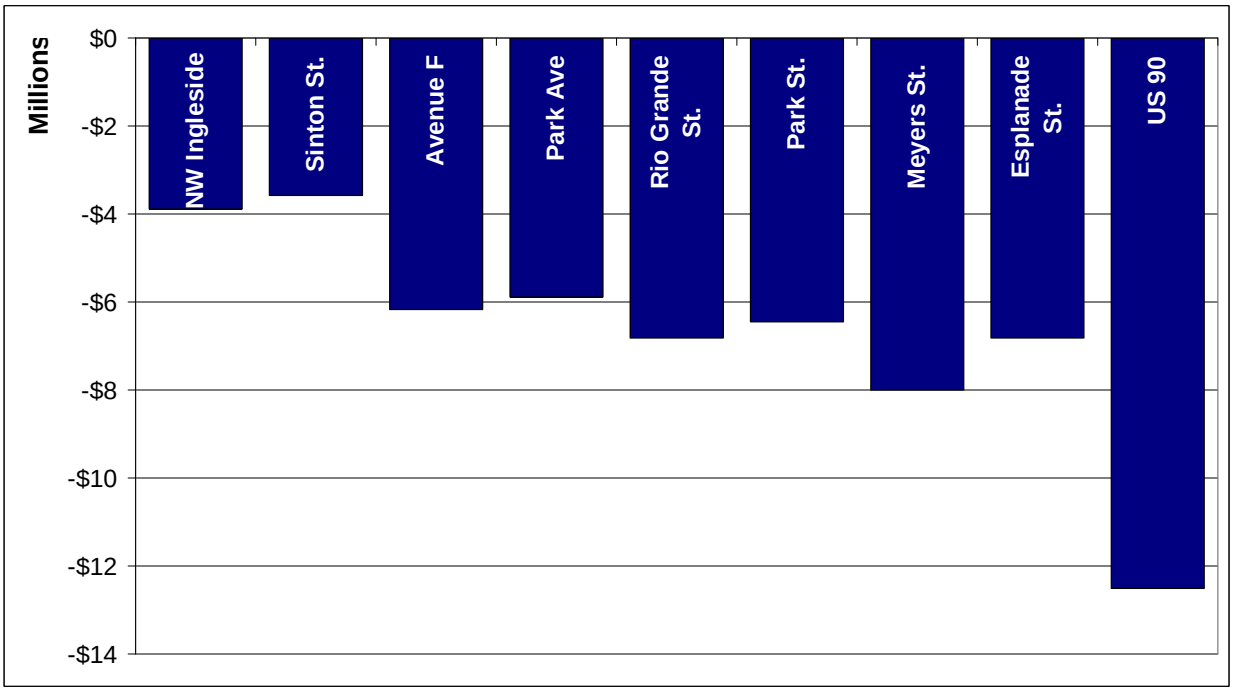
Grade Crossing	Crossing Number	ADT	Costs	Benefits 10-Years	B/C Ratio 10-Years	Benefits 20-Years	B/C Ratio 20-Years
NW Ingleside (Hwy. 361)	746288W	13,500	$8,814,073	$2,988,384	0.34	$4,934,355	0.56
Sinton St. (Hwy. 188)	436011U	12,200	$5,624,858	$1,213,289	0.22	$2,039,565	0.36
Avenue F (Hwy. 60)	448744X	14,200	$8,394,270	$1,312,348	0.16	$2,216,937	0.26
Park Ave	435545H	23,000	$7,201,934	$684,677	0.11	$1,311,001	0.18
Rio Grande St. (Hwy. 59)	746472J	18,700	$7,150,988	$195,237	0.03	$332,750	0.05
Park St. (Hwy. 44)	793819S	21,000	$6,726,101	$153,278	0.02	$261,379	0.04
Meyers St.	023270N 416484T	11,600	$8,252,673	$155,780	0.02	$266,001	0.03
Esplanade St. (U.S. 87)	746703P	10,800	$6,897,020	$66,915	0.01	$93,501	0.01
U.S. 90	742771C	14,600	$12,733,507	$133,574	0.01	$227,664	0.02
Total	**N/A**	**N/A**	**$71,795,425**	**$6,947,347**	**0.10**	**$11,683,152**	**0.16**

Figure 7-20 Benefit/Cost Ratios by Crossing



Nearly all of the grade crossings studied had a difference of least $4 million between the potential costs and benefits. The difference between the estimated costs and benefits for each grade crossing is depicted in the figure below. Table 7-21 summarizes the difference between the costs and benefits for each grade crossing under consideration.

Figure 7-21 Value of Differential Value between Costs and Benefits



Finally, it should be highlighted that safety issues form an important component of the estimated benefits for the following five crossings:

- Avenue F (448744X) in Bay City;
- US 77/Park Avenue (435545H) in Odem;
- Sinton St. (436011U) in Sinton
- Westbound frontage road of U.S. 77 (764969W) in Victoria;
- NW Ingleside/Hwy. 361 (746288W) in Ingleside.

In particular, the NW Ingleside crossing has had 5 accidents and 1 fatality during the previous 20 years. The second most dangerous crossing was at Sinton St. which had 3 accidents and 0 fatalities during this same period. Thus, while the cost/benefit ratio for any one crossing might be less than some given standard, factors such as safety can sometimes provide added justification for grade separating a crossing.

7.3 RECOMMENDATIONS

As illustrated in the previous subchapter, only one of the crossings examined in this report were found to have a benefits-cost ratio that exceeded 0.5. However it should be noted that the analysis made focuses purely on determining whether a financial justification for grade separation construction projects can be made. While the results of that analysis does not show that such a financial justification exists, based upon current road and rail traffic patterns, it is recognized that financial considerations may not always be the only criterion used by TxDOT for selecting grade separation projects. As such, the absence of identifying a crossing with a benefits-cost ratio greater than one should not be interpreted as a recommendation to not consider any grade separation projects within the Corpus Christi or Yoakum Districts. Instead, it is the intent of this section to provide the financial data and recommend that any consideration for grade separation projects within the two districts begin with those crossings showing the highest benefits-costs ratios. It should also be noted that significant changes to traffic patterns along the roadways or railways could affect the results found herein and cause the selected crossings to rate more favorably.

SECTION 8 - BOTTLENECK IMPROVEMENTS EVALUATION AND MODELING

The development of The Base Case Corpus/Yoakum rail simulation model provides a present-day perspective as to how the freight rail network within the Corpus Christi and Yoakum Districts is functioning. Building upon the information learned from the base case simulation, the next steps are to identify improvements that could be made to the rail network to help alleviate congestion at bottleneck points, and to examine how the rail network will handle future growth in freight rail traffic.

The process to accomplish these goals involves estimating what the future growth in freight traffic will be, identifying rail infrastructure improvements to mitigate freight bottlenecks along the network, and using multiple rail simulation models to study the effects of those rail improvements on the network.

8.1 PROJECTED TRAFFIC GROWTH

In order to project how much freight traffic would grow, it was first necessary to forecast how much growth would occur for various commodities that are shipped in and through the Corpus and Yoakum Districts. It is important to examine individual commodities separately, as each commodity will experience a different growth and will be moving along different paths along the rail network. A simple year-by-year growth rate percentage generically applied to all freight will not result in as accurate a model.

The forecasts developed for this Study were derived from a TRANSEARCH database developed by Global Insight (GI). This database contains domestic and U.S.–Mexico commodity flow information for 2003 drawn from existing proprietary, commercial and publicly available data sources and is supplemented by economic forecasting techniques. The database also includes incremental forecasts through the year 2035. A variety of information is provided in this dataset, including movements by weight (in tons), value (in 2003 dollars), commodity (4-digit Standard Transportation Classification Code [STCC]), movement type (inbound, outbound, and through traffic) and for rail movements, whether the move occurred via carload or intermodal unit.

8.1.1 2035 Train Forecasts

As described in the Phase I report for this Study, a Rail Traffic Controller model (RTC) was developed, validated, and used to generate a baseline of number of trains per day (year 2010) in the Corpus Christi and Yoakum Districts. To develop train forecasts, the TRANSEARCH database was utilized to determine the percent growth between 2010 and 2035 for various commodities. This growth factor was then applied to the baseline volumes in the RTC model to establish forecasted trains per day, each train carrying a specific commodity. In order to accomplish this, two assumptions were made, as described below:

Assumption 1- Origin and Destination of Rail Trips

One of the data sources used to develop the TRANSEARCH database was the Surface Transportation Board's Waybill Sample data, a highly confidential source of nationwide railroad flows. As this source contains confidential information, oftentimes details that could be tied to any "insider secrets" are removed, and in the case of this database the rail carrier name was withheld. Therefore, in order to generate growth projections, data was categorized by shipment origin and destination.

Using the Corpus Christi and Yoakum districts as reference points, origins and destinations were determined to come to/from either the North, South (in U.S.), South (in Mexico), East, West (in U.S.), or West (in Mexico). Trains traveling completely internal to the Districts and trains traveling through without stopping in the Districts were also identified.

Assumption 2- Train Service Type

The baseline RTC model contains information on train service type for today. In order to develop future forecasts, data was required to be categorized by the same set service types so that appropriate growth could be applied to each. This is important, as not all train service types grow at the same level, nor does each service type travel through each region. The service types analyzed included Auto, Coal, Grain, Minerals, Other Commodities, Petrochemicals, and Intermodal. Each of these train types can be tied to a set of commodities found in the TRANSEARCH database which have been defined as follows:

- Autos/Auto Parts: defined as STCC 4 (4-digit Standard Transportation Commodity Code) groups 3710 – Motor Vehicles Or Equipment, 3711 – Motor Vehicles, 3712 Passenger Motor Car Bodies, 3713 – Motor Bus Or Truck Bodies, 3714 – Motor Vehicle Parts Or Accessories;

- Coal: defined as STCC 4 groups 1111 – Anthracite, 1121 – Bituminous Coal, and 1122 – Lignite;

- Grain: defined as STCC 4 group 0113 – Grain;

- Minerals: defined as STCC 4 groups 1400 through 1492, which includes stone, gravel, sand, clay and other nonmetallic minerals, and 3211 through 3299, which encompass cement, brick, tile, clay, concrete products, plaster, stone and other nonmetallic mineral products;

- Petrochemicals: defined as the STCC 4 groups 1300 through 1320 – Crude Petroleum and Natural Gas, 2801 through 2899 – Chemicals, and 2901 to 2991, which include refined petroleum, asphalt, and other petroleum and coal products;

- Other Commodities: defined as those belonging to all other STCC 4 commodity groups – broadly defined as all non-grain farm products, forest products, fish/marine products, metallic ores, ordnance and accessories, food, tobacco, textiles, apparel, lumber, furniture/fixtures, paper products, printed matter, chemicals, rubber/plastics, leather, clay/concrete/glass/stone, metals, machinery, electronics, instrumentation, other non-auto related transportation equipment, miscellaneous manufactured products, scrap materials, mail, hazardous materials, empty containers, and other miscellaneous freight; and

- Intermodal: defined as STCC 4 group 4611 – Freight All Kinds, this is the commodity classification normally associated with intermodal traffic.

8.1.2 Results

The subchapters below discuss the trends in commodity growth forecasted for the Study Area. Detailed summary tables showing specific percentages of growth, as well as origin and destination, can be found in Appendix I.

8.1.2.1 Commodity Growth Patterns

The analysis indicates an overall growth rate of approximately 40 percent for rail commodities moving into, out of, through, and within the Corpus-Yoakum region. The following sections describe in more detail some of the key factors and trends that may be driving this growth.

The tables found in Appendix I provide a summary of the percent change calculated between 2010 and 2035 for all commodity types. In some cases strong growth was identified (e.g., auto/auto parts from Mexico to the U.S.) and in some cases a decline was shown (e.g., minerals from the U.S. to Mexico). These percentages were then applied to appropriate trains in the present-day RTC network to generate future traffic.

8.1.2.2 Autos and Auto Parts

The number of carloads transporting motor vehicles and parts is expected to rise dramatically over the next fifteen years. The increase in domestic through traffic moving from west to east through the region is largely due to the growing auto and parts manufacturing industries in Texas and in Mexico. Toyota began manufacturing pickup trucks in San Antonio in 2003 and this factory, in addition to the many parts suppliers in the state, will contribute to the continuing growth of this sector.

The large increase in auto parts moving into and out of Mexico is likely due to growth in Mexico's auto manufacturing sector. Mexico is currently one of the top fifteen auto manufacturing countries, with factories owned by Ford, Honda, and others[1]. It is likely that parts made in the US may go into Mexico for assembly and then return and vice versa. The increasingly global economy and lowered trade restrictions between the US and Mexico indicate that this trend is likely to continue.

8.1.2.3 Coal

Coal shipments into the Corpus-Yoakum region are expected to grow by about 30 percent between 2010 and 2035. This is an annual growth rate of approximately 1 percent, which is a reasonable estimation, given moderate economic growth. The slight drop in the amount of coal bound for Mexico moving through the district is most likely due to Mexico shifting towards coal from other sources that does not pass through the district. One possibility is that Mexico may begin importing more coal from Wyoming, which does not pass through the Corpus-Yoakum district en route. Wyoming produces 38% of all coal produced in the United States[2] and it is likely that it will gain market share in the future.

8.1.2.4 Grain

While it would appear that the overall amount of that grain entering the district is declining, given the 60 percent drop in the amount of grain coming into the district from the East and a 28 percent drop in the amount of grain entering the district from the West, this is not the case. While the amount of grain entering the Corpus-Yoakum region from the North is predicted to increase by only 18 percent, this will offset declining grain shipments from the East and West of the region due to the much larger volume of grain already entering the district from the North.

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[1] International Organization of Motor Vehicle Manufacturers, http://OICA.net

[2] Wyoming Mining Association, www.wma-minelife.com

The decline in the amount of grain moving through the district from East to West is most likely also a result of the increasing grain production of the northern states. Grain Shipments from Jim Wells County into Mexico are likely decreasing for the same reason—northern grain producers gaining market share.

8.1.2.5 Minerals

While the number of carloads carrying minerals into and out of the districts to and from Mexico will increase dramatically over the coming years, many of the most dramatic increases, shown in the corresponding table in Appendix I, result from very small 2010 carload volumes. In most cases these large percentage increases represent less than 100 carloads in 2035. However, the 558% increase in east to west through traffic destined for Mexico represents a large total number of carloads. This growth will likely be driven by Texas' strong non-metallic mineral extraction industries. Texas is among the top five US states in terms of sand and gravel, aggregate, and crushed stone production[3] and its strong demographic and economic growth are expected to continue fueling demand for these construction materials.

8.1.2.6 Other Commodities

The growth in carloads carrying other goods is not surprising given the growing population and economy. Of particular interest is the dramatic growth in the number of train cars moving into and out of Mexico. Cross-border trade has been growing since the passage of NAFTA and that trend is expected to continue in the future.

8.1.2.7 Petrochemicals

Texas is the largest crude oil producing state in the US and is home to four of the ten largest refineries in the country[4]. Petrochemical production is a cornerstone of the Texas economy as a whole and of the Corpus-Yoakum region in particular. The growing population and economy of the United States over the next 15 years is predicted to fuel domestic demand for petrochemicals and contribute to the increasing volume of these products moving by rail in the region.

The drastic growth in the number of petrochemical carloads bound for Mexico may indicate an increasing demand in the country for fertilizer and fuel. However, a portion of Mexico's demand for petrochemicals may also be due to a growing petrochemical industry—many of the inputs used in the production of petrochemicals are other petrochemicals. This would explain the generally increasing volumes of petrochemicals moving across the border in both directions.

8.1.2.8 Intermodal

Over the past few decades intermodal containers have grown to become the dominant long-distance shipping method for non-bulk cargo worldwide. The use of intermodal containers reduces the risk of damage and theft of goods and lowers shipping costs by eliminating the need for cargo to be handled when changing modes. As the population and economy of the Corpus-Yoakum region continue to grow, containerized shipments are expected to become increasingly common.

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[3] Tepordei, Valentin. Aggregate Production Continues Torrid Pace. *Rock Products*, August 1, 2005. www.rockproducts.com

[4] Energy Information Administration, www.eia.doe.gov

8.2 CORPUS CHRISTI, YOAKUM DISTRICTS PHASE 2 ANALYSES

The comparison between cases involving present and future freight rail traffic and existing and improved rail network requires four separate model RTC model analyses. These analyses were:

- Base Case: The Base Case simulation was completed in Phase 1 of the study. This analysis reflects the existing rail infrastructure and current freight rail volume.
- Rail Traffic Controller (RTC) Simulation Case 2: A Rail Traffic Controller (RTC) simulation of the Corpus/Yoakum rail districts that included projected growth traffic through the year 2035 was created using freight growth projections. This analysis did not include any improvements to the rail infrastructure.
- RTC Case 3: Using the results of the Base Case and the Case 2 simulations, rail infrastructure improvements that would likely be necessary to alleviate congestion issues identified in the first two analyses were developed. These improvements were incorporated into the Base RTC network, and run against base levels of traffic, reflecting present day freight volumes, to determine the potential for rail operational improvements associated with the additional track, signal and connections.
- RTC Case 4: Using the 2035 projected freight volumes developed under Case 2, and the improvements identified under Case 3, a combined simulation reflecting projected growth and projected infrastructure improvements was run.

Simulation cases 2 through 4 (RTC Case 2 through 4) were completed in December, 2008. This report will describe the growth that was created in the model and the infrastructure improvements that are believed to be necessary to accommodate that growth. It will also review the results of the three simulations in the same areas that were specified in the initial analysis.

Each flow was broken down by commodity type, so growth could be assigned to the most likely train type that would handle that commodity.

The projections were broken into the following commodities:

1. Autos/auto parts
2. Intermodal
3. Coal
4. Grain
5. Minerals
6. Other merchandise
7. Petrochemical products

As an example of how projections were made, growth was developed for petrochemical traffic between the West, North and East that terminated and/or originated in Nueces County. Major rail facilities were identified in each county that were likely to receive that traffic, and assigned it to trains serving those facilities.

Freight growth by corridor within the Corpus Christi and Yoakum Districts was determined by two separate sets of projections. The first set of projections identified projected car count growth between the counties and each origin, destination and through corridor. The second set identified the projected growth percentage over the 25 year span in the same corridors.

The two data sets were used to develop the growth plan for the Case 2 and 4 simulations. Using the car count document, concentration was focused on the corridors that showed the largest car flows between any origin and destination. Flows greater than 500 cars per years were analyzed, while flows of less than that many cars per year were not. While the smaller flows are important, it is believed they would likely become incremental traffic on trains running in the specific corridors and would be accounted for in that manner.

Once those corridors were identified, the growth projection percentages for all traffic types running on a specific train type were taken and a weighted average of growth was created. For example, for a Houston to Corpus Christi train growth projection, if the data showed 5,000 cars from the east going to Corpus that was estimated to equate to 80% growth, and it showed 10,000 cars from the north going to Corpus that was estimated to equate to 10% growth, a weighted average of 33% growth was calculated for that train type in that corridor. The weighted growth projection was then slightly modified to account for traffic that would fill out existing trains.

After the calculation was completed, the growth percentage was applied to the number of trains of that type that were run in the Base Case. In the preceding example, the 33% growth would have been reduced by 6.6% to account for traffic that would be "absorbed" by existing trains. The remaining 26.4% was then multiplied by the number of trains from the Base Case, and the result was the number of trains that were added to the 2030 simulations in that corridor and direction. All estimates were rounded off to the nearest whole train to avoid dealing with partial trains.

An equal number of returning trains were also added to the simulation to account for the return of rail equipment to the origin area.

This method adequately projected train growth in the majority of the corridors that had been identified in the Base Case. However, there were some traffic flows that were not available in the growth data. When one of these flows was encountered, a more generic growth percentage was utilized and compounded over the 20 years to determine the growth of traffic in the corridor. The generic percentages were commodity specific and had been supplied by railroads in other studies.

8.2.1 Updated Base Case: Addition of KCS Victoria-Rosenberg Line

Several references have been made throughout the Phase 1 report about the rail line between Victoria and Rosenberg owned by KCS. Between the writings of the Phase 1 and Phase 2 reports, construction of this line has been completed. As this line is now in use, it is having a significant affect on the freight rail network by allowing KCS trains to leave UP track at Victoria, thus no longer using the Glidden Subdivision and the Port Lavaca Subdivision between Victoria and Flatonia.

At the time the Base Case simulation of the C-Y network for the Phase 1 report was being developed, the re-opening of the Victoria-Rosenberg line was an unconfirmed rumor. As such it was not included in the Base Case simulation. Now that the Victoria-Rosenberg line is operational, it is necessary to modify the Base Case simulation to account for the KCS trains and their reduced usage of UP track. To accomplish this, a “stub out” was added to the model network at Victoria to simulate the Victoria-Rosenberg line. This “stub out” was then handled in the same manner as rail lines which cross Study Area boundaries. KCS trains would originate or disappear from the simulation network at that point. It is necessary to treat the Victoria-

Rosenberg line in this manner due to the absence of track charts or construction plans that would be needed in order to accurately include the new line into the existing rail network.

8.3 INFRASTRUCTURE IMPROVEMENTS

Using the results from the Base Case and the Case 2 simulations, a list of improvements was created to address the rail congestion experienced in those simulations. The improvements were then included in simulation Cases 3 and 4.

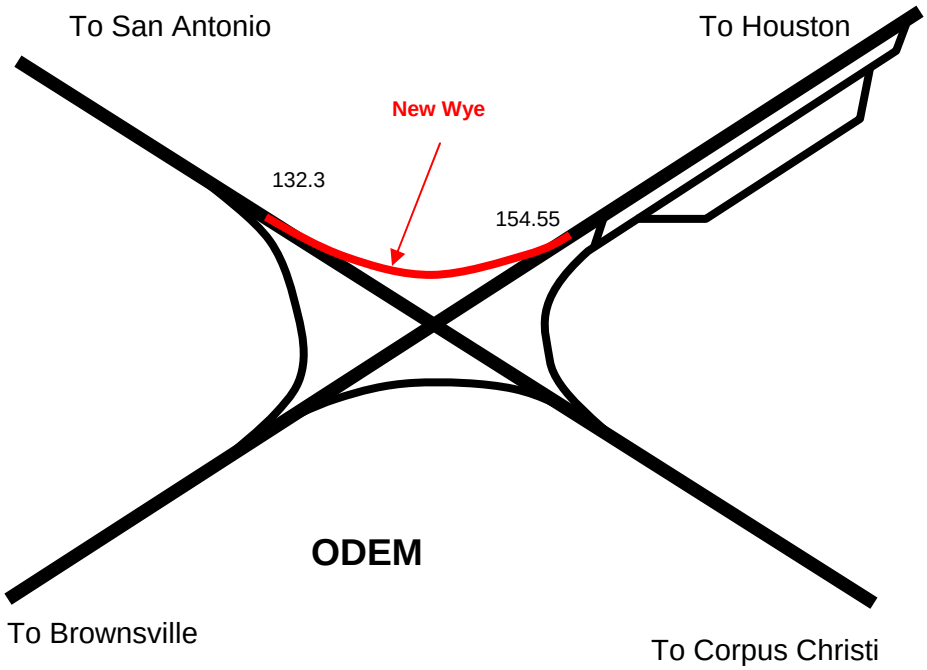
Following is a brief description of all improvements that have been developed for Phase 2 of the Corpus Christi/Yoakum rail analysis. For each improvement, a brief description is provided with estimated mileposts and subdivisions of the improvement. Also provided are brief descriptions of what issues the improvement were designed to correct. All congestion issues were based on the results of the Base Case Corpus/Yoakum simulation that was completed in April, 2008.

Improvements are not shown in priority order.

8.3.1 Brownsville and Angleton Subdivisions

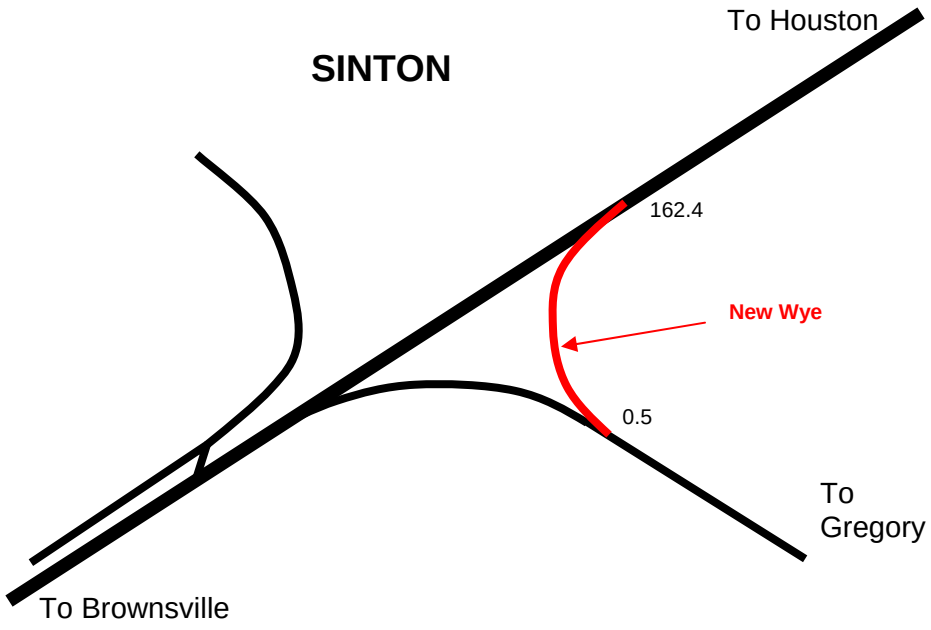
Improvement BA-1:

Connection in the northwest quadrant between the Corpus Christi Subdivision and the Brownsville Subdivisions at Odem. This connection allows trains from San Antonio to turn north towards Bloomington without making a back up move at Odem. CTC was added to the wye at Odem.



Improvement BA-2:

New wye connection at Sinton in northeast quadrant. This connection will allow trains from Houston on the Brownsville Subdivision to operate directly towards Gregory on the Kosmos Subdivision. CTC was added on leg of wye.

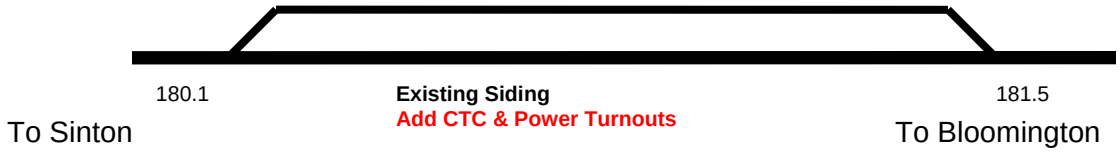


Improvement BA-3:

New siding, MP 171 to 173 Brownsville Subdivision. The siding creates an additional meet-pass point in the middle of a 20 mile stretch of single track. All other sidings on the subdivision are spaced between 10 and 12 miles apart. CTC and turnouts capable of allowing 25 mph movements were included on both ends of the siding.

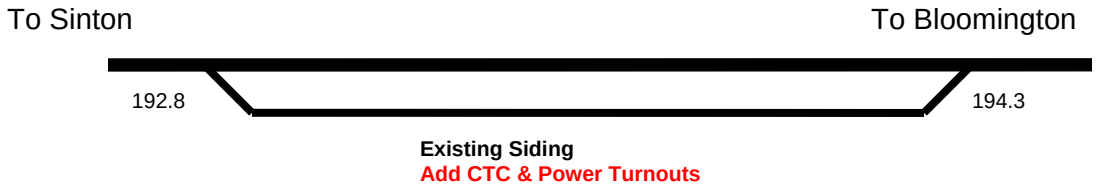
Improvement BA-4:

Woodsboro siding, MP 180.1 to 181.5 Brownsville Subdivision. Upgrade siding with CTC and 25 mph power turnouts. CTC will increase entrance and exit speed of trains using Woodsboro Siding. This will reduce wait delays to trains meeting or passing at this location.



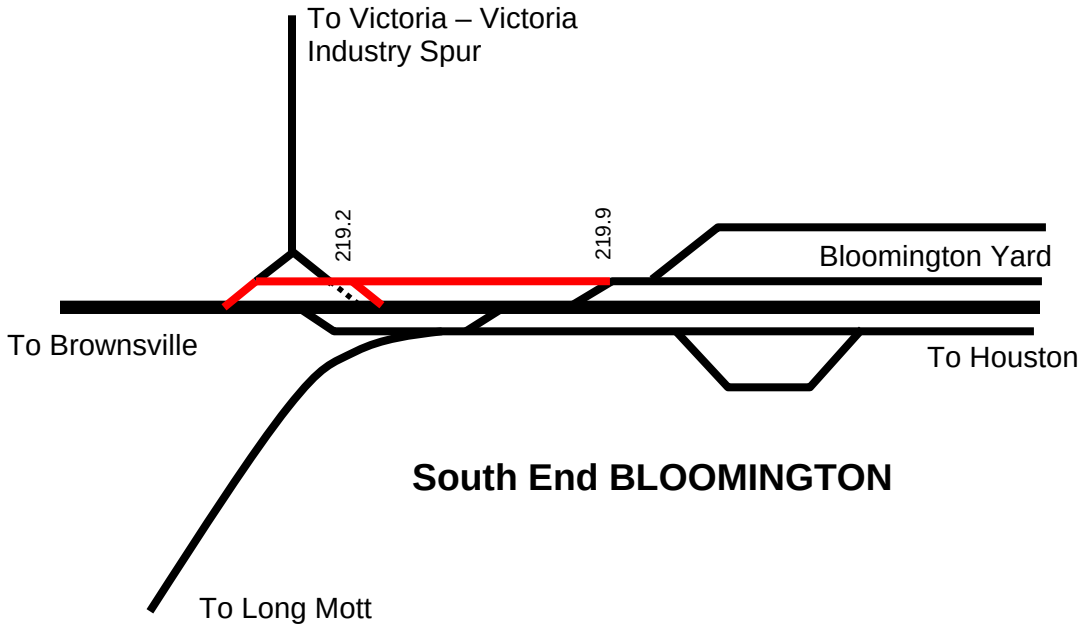
Improvement BA-5:

Greta siding, MP 192.8 to 194.3 Brownsville Subdivision: Upgrade siding with CTC and 25 mph power turnouts. CTC will increase entrance and exit speed of trains using Greta Siding. This will reduce wait delays to trains meeting and passing at this location.



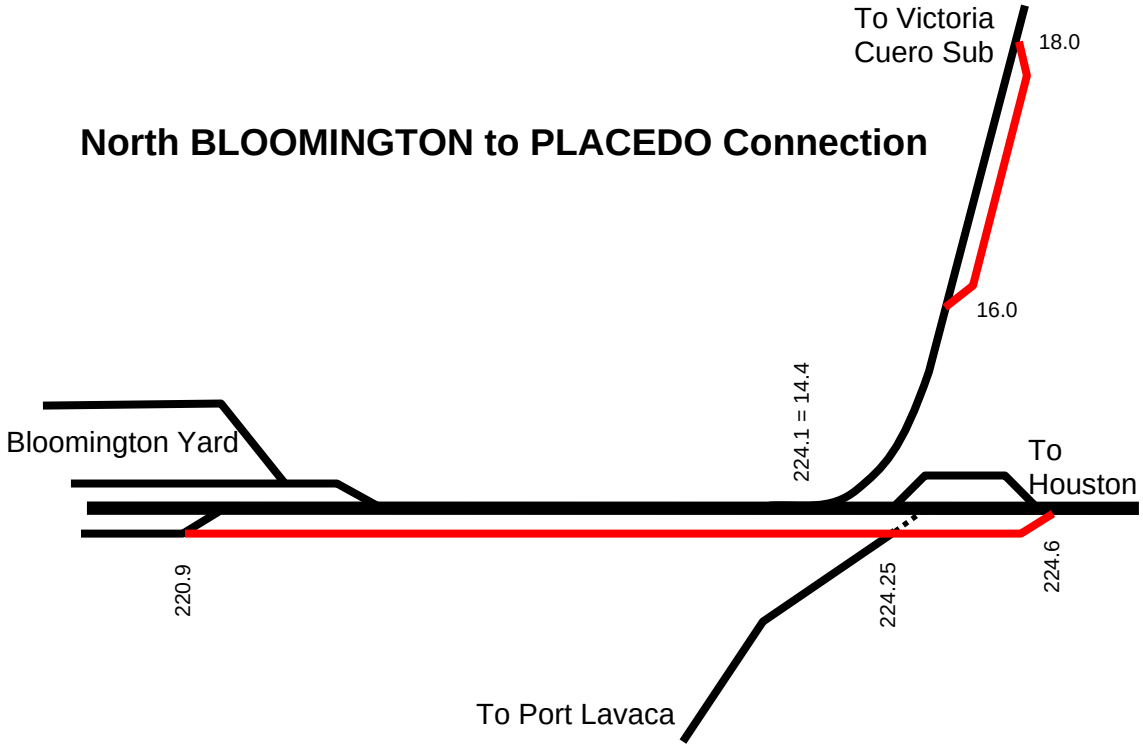
Improvement BA-6:

Extend yard lead from Bloomington Yard to Victoria Industrial Spur, MP 219.2 to 219.9 Angleton Subdivision. This improvement may require a transition to the south side of the existing main track to avoid an industry between the yard and the Industrial Spur. Track connection will allow yard engines working the Victoria Industrial Spur to enter or leave Bloomington Yard without having to enter the main line. This will reduce delays to switch engines or through trains.



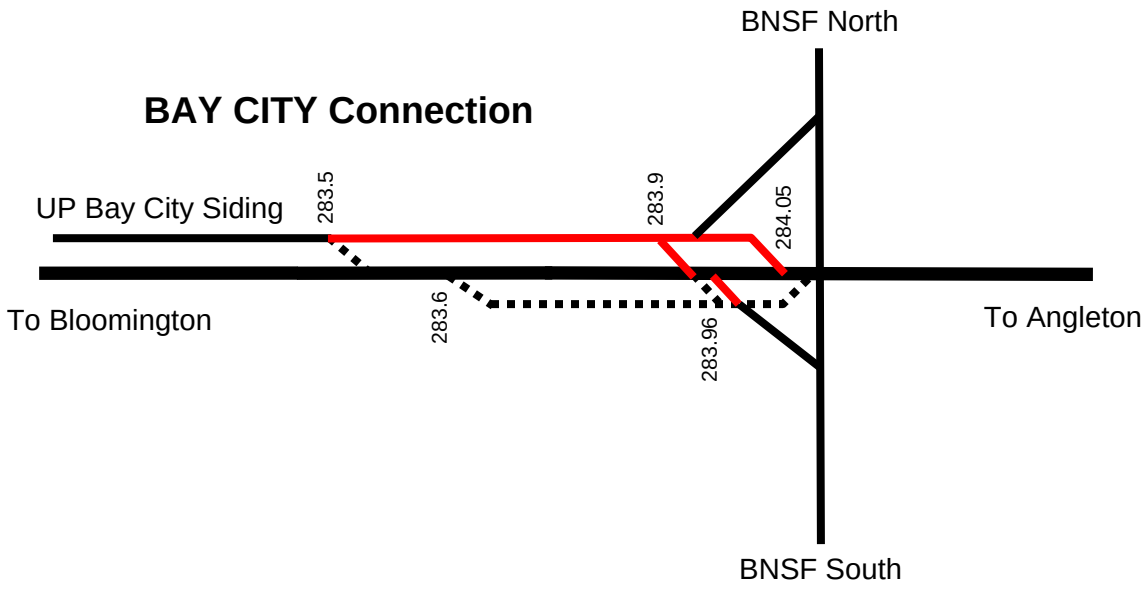
Improvement BA-7:

Second main track Bloomington Yard to Placedo, MP 220.9 to 224.6 Angleton Subdivision. Connections to Port Lavaca Subdivision modified as shown. Track will establish two main tracks from north of Placedo to Bloomington Yard. Additional track will allow trains to move past other trains stopped to change crews or to enter yard. Reconfigured connection at Placedo will allow industry just north of the junction to be served while through trains move around industry track.



Improvement BA-8:

Reconstruct BNSF run around connection track at Bay City to connect into UP's Bay City Siding MP 283.5 to 283.6 Angleton Subdivision. New track becomes CTC siding with connection to BNSF branch line. Old siding limits were MP 282.3 to 283.5; new siding limits are MP 282.3 to 283.9 with connection to BNSF. Longer siding will allow more trains to utilize meet pass capacity. New connection will allow BNSF trains to clear main line when running around train to access BNSF branch line.



8.3.2 Port Lavaca (Cuero) Subdivision

Improvement C-1:

New siding MP 16 to MP 18 Cuero Subdivision (between Placedo and Victoria). 25 mph power turnouts, CTC. Siding allows trains coming into Bloomington to be held near Placedo Jct., minimizing the waiting time to proceed through Bloomington Yard. Currently, there is a 26 mile single track stretch between Placedo and Thomaston, which is the first siding west of the junction on the Cuero Subdivision. The location chosen will not only be utilized by UP trains, but KCS trains that use the new route between Rosenberg and Victoria will also have access to this siding.

8.3.3 Glidden Subdivision

Improvement G-1:

New siding MP 110.8 to 112.8 Glidden Subdivision. No. 15 power turnouts, 25 MPH, CTC. Siding creates meet pass location in middle of a 20 mile long single track section to reduce meet delay. Average siding spacing on this line is 10 to 12 miles.

8.3.4 Smithville Subdivision

Improvement S-1:

New siding MP 85.3 to MP 87.3, Smithville Subdivision. 25 mph power turnouts, CTC. Siding creates a meet pass location between West Point and LCRA coal utility near Fayetteville. This segment is a 27 mile single track segment. The siding was necessary to accommodate LCRA coal trains waiting for access to the LCRA utility.

8.3.5 KCS Victoria Bypass

In addition to the improvements listed above, KCS is currently studying the possibility of constructing a new rail bypass around the city of Victoria. This rail bypass would connect to the Victoria – Rosenberg line east of Victoria, and tie into the Port Lavaca (Cuero) Subdivision south of Victoria. Bypassing Victoria would allow KCS trains to make connections between the Victoria – Rosenberg line and the Cuero Subdivision at much higher velocities, as the number of at-grade crossings encountered along the bypass would be significantly lower than the number currently encountered passing through town. Fewer trains passing through Victoria would also reduce motorist delays within the city. The corresponding reduction in rail traffic along the Cuero Subdivision could also provide operational benefits to UP and any of the train operations that they conduct within city limits.

As of the writing of this report, the Victoria bypass is still in a preliminary stage. KCS is believed to have examined potential bypass routes, though one has not yet been selected[5]. Issues relating to environmental clearance, right of way acquisition and funding have not yet been resolved. As such, estimates as to when construction on the bypass might begin and when the bypass might be operational are not known at this time.

Even though a potential date for completion of the bypass not known, this potential improvement to the Corpus-Yoakum rail network deserves mention in this report as there is significant interest from both KCS and state and local governments in seeing this project move forward. Given the preliminary nature of the bypass, this report does not contain a cost estimate for the bypass, nor has this potential improvement been included in any of the rail models.

8.4 OPERATIONAL MODIFICATIONS

The only major modification that was made in all the subsequent simulations involved KCS trains moving between Rosenberg and Victoria. In the Base Case, these trains were all routed on UP's Glidden Subdivision to Flatonia, where they entered UP's Cuero Subdivision to Victoria and Placedo (and returned by the same routing). In all subsequent cases, these trains were assumed to operate via the new line that KCS between Rosenberg and Victoria. This removed all KCS trains from the UP Glidden Subdivision, as well as most of the Cuero Subdivision. KCS trains continued to operate on the Cuero Subdivision between Victoria and Placedo.

Shortly after Phase 2 was begun, it was noticed UP had changed its subdivision designations from those that were used in the first phase of the study. In the Base Case, documents obtained during the Phase 1 data gathering indicated the Flatonia Subdivision ran between San Antonio and Flatonia, then proceeded north through West Point, ultimately ending at Hearne, TX. Subsequent documents indicated the Flatonia Subdivision was replaced by the Giddings Subdivision between Hearne and West Point and the Cuero Subdivision between West Point

[5] Victoria Advocate: Rail Bypass Plans Moving Slower Than Expected, November 2, 2009

and Flatonia. Additionally, the Glidden Subdivision was extended west of Flatonia to Kirby near San Antonio, eliminating the Flatonia Subdivision in its entirety.

There was also a minor adjustment to the Brownsville Subdivision; in the earlier documents, the north end of the subdivision was shown at Barge Canal (south of Bloomington). The newer documents indicated that the Brownsville Subdivision now extends to Bloomington. The Angleton Subdivision begins at Bloomington and extends north.

It is the opinion of the authors of this report that these changes should not be reflected in this report because it would confuse the comparisons with the Base Case. Therefore, the subdivision boundaries remain the same in this report as were designated in the Phase 1 report.

8.5 RESULTS

As previously noted, the Phase 2 analyses include the following cases:

5. Base Case - Existing infrastructure and traffic levels
6. Case 2 - Existing infrastructure and 2035 traffic levels,
7. Case 3 - Improved infrastructure and existing traffic levels
8. Case 4 - Improved infrastructure and 2035 traffic levels

As stated earlier growth projections were made for the period 2010-2035 years. Thus modeling efforts used data at years 2035 to simulate tail movement at that year. Cost/benefits calculations that are presented later in tie report will be established for years 2010 and 2030 to make this report consistent with other similar studies that TxDOT is performing.

The following sections describe the results of the three new simulations. They also compare those results with the Base Case statistics that were developed in Phase 1 of this study. Because of the results of the Phase 2 simulation, there was a slight modification of the measurements used in these cases as compared to the numbers reported in the initial simulation and report. The following is a brief description of those changes.

In the Phase 1 report, Delay Ratio and Delay per 100 Miles were calculated using only Slowing Delay, Switch Delay and Stop Delay. These three delays are the only delays included in the Elapsed Runtime statistic that RTC provides; this statistic is used to develop Delay Ratio.

In the Phase 2 results, however, in addition to Slowing, Switch and Stop Delay, Origin Delay was added to Elapsed Runtime to calculate Delay Ratio. Origin Delay is the time between when a train is scheduled to enter the network and when it is actually able to enter the network. For example, if a train is scheduled to enter the network at Sweeney at 1100, and cannot enter until 1200, then one hour of Origin Delay is recorded.

RTC records Origin Delay, but it is not included in the Elapsed Runtime of a train. In the Base Case, this was acceptable because no comparisons were being made to other simulations that involved operational or network modifications. However, as Phase 2 cases were simulated, it became obvious that Origin Delay had to be accounted for.

The primary driver of this change was the Case 2 (2035 growth, no improvements) simulation. When Case 2 was completed, it was noted that many trains experienced high levels of Origin Delay. Further, a comparison of statistics from Case 2 with the Base Case that did not include Origin Delay created an inaccurate perspective of what was actually occurring across the network. Therefore, it was decided to go back and recalculate the delay statistics of the Base Case and Case 2, including Origin Delay, in those calculations. Origin Delay was also included

into the Case 3 and Case 4 simulation results as well, to create equitable comparisons between all results.

The value of Origin Delay is a function of the network that is used in a simulation. For example, if the line segments being studied are many miles away from the endpoints of the network, origin delay is not a significant concern in the results. However, when the end points of a network coincide with the area being analyzed (as with the Corpus/Yoakum network), then Origin Delay becomes meaningful to comparative results. Experience with RTC has found that on occasions when a network is congested, the model will attempt to get trains off the network before it will allow other trains to enter. When this occurs, Origin Delay must be included to get a candid evaluation of the delays associated with the traffic and infrastructure. A summary of the results of each of the four modeling cases is presented below for each of the various subdivisions that were analyzed.

8.5.1 Brownsville and Angleton Subdivisions (Ricardo to Sweeny)

The tables below compare the Delay Ratio (DR), the Delay Hours per Day (DHr), the Delay per 100 miles (D/100) and the velocity of traffic on the Angleton and Brownsville Subdivisions for the four simulation cases that were completed.

Table 8-1 Result Statistics

Brownsville Subdivision	Base Case	Case 2	Case 3	Case 4
Delay Ratio	57%	101%	22%	55%
Delay Hrs/Day	40.8	88.2	15.6	47.6
Delay/100 miles	124.1	207.2	48.1	111.8
Velocity	17.5	14.6	22.9	18.9

Table 8-2 Result Statistics

Angleton Subdivision	Base Case	Case 2	Case 3	Case 4
Delay Ratio	35%	69%	22%	30%
Delay Hrs/Day	13.9	36.1	8.5	14.6
Delay/100 miles	54.4	106.7	33.1	42.5
Velocity	28.7	23.1	32.5	32.9

Per the tables above, the Angleton and Brownsville Subdivisions experienced increased DR, DHr and D/100 when growth was applied and no infrastructure improvements were included in the model. This was not surprising given the delays that occurred on these subdivisions in the Base simulation. Using DR as one criterion, it is believed that the Case 2 simulation results would not be acceptable to the railroads using any portion of these two subdivisions.

It should be noted that to get the model to complete its Case 2 simulation, crew changes at Bloomington had to be reduced from 30 minutes in the Base Case to 10 minutes in Case 2. With a full thirty minutes of dwell for each train changing crews, the backups around

Bloomington Yard became so great that the model could not find a resolution. Even after reducing the dwells to 10 minutes, the model had to run an extremely high number of iterations to find a solution. The length of the crew changes were not changed in any other simulation case.

In Case 3, all delay statistics decreased as compared to the Base Case. As described previously, this simulation included all the infrastructure mitigation to the network however it did not include any growth trains. With the additional double track, sidings, connections and signaling upgrades, train movements over the two subdivisions were far more fluid than in either of the two previous cases.

In Case 4, when traffic growth was added to the infrastructure improvements, the results indicated that the statistics returned to near Base Case values. All statistics except DHr showed improvement in Case 4 as compared to the Base Case, which is a goal of any simulation analysis that is developing new network infrastructure.

The increase in DHr can be explained. DHr is the average number of hours of delay per day that were present in the simulation. There were more trains in the Case 4 simulation than in the Base Case, so the delay hours should naturally increase. When those hours are normalized by mileage operated or by the sum of unimpeded run time hours, the results show improvement in Case 4.

Table 8-3 Delays Greater than 30 Minutes (D>30)

Brownsville -	Delays Greater than 30 Minutes			
Angleton Subdivision	Base Case	Case 2	Case 3	Case 4
Ricardo - Robstown	10	32	5	18
Odem - Sinton	74	136	38	75
Woodsboro - Greta	51	128	19	92
Inari - Bloomington - Keeran	101	174	24	107
Vanderbilt - Sweeny	47	71	26	31

Table 8-4 Total Delay Hours for Delays Greater than 30 Minutes (T30)

Brownsville -	Delay Hours			
Angleton Subdivision	Base Case	Case 2	Case 3	Case 4
Ricardo - Robstown	10.1	57.5	4.3	26.2
Odem - Sinton	93.3	190.1	35.6	91.5
Woodsboro - Greta	67.4	161.7	16.7	98.6
Inari - Bloomington - Keeran	121.4	221.1	17.5	105.1
Vanderbilt - Sweeny	39.1	63.9	19.2	22.4

The tables above compare Delays Greater than 30 Minutes (D>30) and Total Hours of Delay for Delays Greater than 30 Minutes (T30) for the four simulation cases. A comparison of segments between cases provides insight into which network improvements had the greatest impact on rail movement fluidity. For comparison purposes, Case 2 has little value because the

subdivisions already were approaching capacity in the Base Case. The additional traffic clearly pushed these segments into a situation that would not be acceptable to the railroads using the routes.

Case 3 results and the list of improvements provide the best indication of how the changes in the network helped traffic flow. As can be seen in Table 3, there was some improvement between Ricardo and Robstown, however, there were no infrastructure modifications made in that area. The improvement experienced was primarily because of infrastructure additions north of this location and the improved flow that they created.

Odem to Sinton experienced a significant decrease in D>30 and T30 in Case 3 as compared to the Base Case. This improvement was focused around the new leg of the wye at Odem, Improvement BA-1. The improvement allowed trains coming from the west end of the Corpus Christi Subdivision to turn directly to the north at Odem in Case 3; in the Base Case, these trains had to pull east towards Corpus Christi and then back up to the south before heading north. This back up move created many major delays around a junction that is heavily used by UP, BNSF and KCS trains moving towards Brownsville, Laredo and Corpus Christi.

Woodsboro to Greta also experienced a significant decrease in D>30 and T30. The new siding at MP 171 (Improvement BA-3) and the improved signaling system/power turnouts at Woodsboro and Greta (Improvements BA-4 and BA-5) were responsible for this improvement. Traffic had the ability to meet/pass in a much more efficient manner in Case 3 than in the Base Case, which cleared up many of the delays experienced in the previous simulation.

The new double track connections at Bloomington Yard to the south (to the Victoria Industrial Spur) and north (to Placedo) were primarily responsible for the improvements experienced between Inari and Keeran. These improvements are designated Improvements BA-6 and BA-7 respectively. Even though KCS trains utilized their own route to Victoria in this simulation, all of the KCS trains continued to move through Bloomington as they did in the Base Case. The new double track and connections improved flow for all traffic running through the area; crew changes and trains entering the yard no longer blocked through movements (KCS and BNSF trains) which led to the reduction in D>30 and T30.

Case 4 clearly demonstrated the impact of growth traffic on the Angleton/Brownsville subdivision. As can be seen in Table 3, the absolute number of delays greater than 30 minutes increased as compared with the Base Case statistics when the additional traffic was added to the network. However, Table 4 shows that even while the number of major delays increased, in three of the segments, the total hours of delay decreased. This indicates that while the higher traffic levels did create additional delays, the severity of the delays was not as great. This is the main reason why the overall statistics shown in Tables 1 and 2 indicated an improvement for Case 4 as compared to the Base Case.

8.5.2 Corpus Christi Subdivision (Campbellton to Corpus Christi)

Table 8-5 below illustrates the delay metrics for the Corpus Christi Subdivision.

Table 8-5 Corpus Christi Subdivision - Results Statistics

Corpus Christi Subdivision	Base Case	Case 2	Case 3	Case 4
Delay Ratio	32%	63%	21%	31%
Delay Hrs/Day	14.4	32.8	9.2	15.6
Delay/100 miles	117.7	236.6	77.7	114.7
Velocity	12.3	9.8	13.6	12.3

Similar to the previous descriptions, Table 8-5 indicates that when traffic growth and infrastructure improvements are both included in the simulation (Case 4), the results approach those that were found in the Base Case. Case 2 and Case 3 again show a significant degradation and improvement respectively as compared to the Base Case.

Table 8-6 Delays Greater than 30 Minutes

Corpus Christi Subdivision	Delays Greater than 30 Minutes			
	Base Case	Case 2	Case 3	Case 4
Campbellton - Mathis	39	45	33	42
Hubert - Viola	28	56	17	20
Corpus Christi	8	8	6	4

Table 8-7 Total Hours Delay for Delays Greater than 30 Minutes

Corpus Christi Subdivision	Delay Hours			
	Base Case	Case 2	Case 3	Case 4
Campbellton - Mathis	58.2	72.9	39.3	51.7
Hubert - Viola	48.7	95.6	23.5	32.4
Corpus Christi	8.2	9.2	7.0	4.4

Tables 8-6 and 8-7 support the findings that the improvements around Odem have a positive impact on the Corpus/Yoakum network. Since no improvements were made on the Corpus Christi Subdivision west of Odem, it is not unexpected that there was little change in the performance between Campbellton and Mathis in Case 4 as compared to the Base Case. However, with the new connection at Odem (Improvement BA-1), the improvement that was experienced between Hubert and Viola and around Corpus Christi is obvious in Case 4. Again, this is primarily because the trains that had to make a back up move at Odem to go north on the Brownsville Sub could make a direct move to the north with the new leg of the wye. This improved the operation of not only the Corpus Christi Subdivision to Brownsville Subdivision trains, but also for other traffic using the Odem connection that had to wait while the backup move was being performed by other trains.

It should be noted that there was significant traffic growth that originated, terminated or moved through Corpus Christi in Case 4. Even with this additional traffic, D>30 and T30 were both

lower in Case 4 than they were in the Base Case. This confirms that the modifications around Odem affected other traffic that did not utilize the new leg of the wye.

8.5.3 Cuero Subdivision (Flatonia to Placedo)

The model results for delays along the Cuero Subdivision are found in Table 8-8 below.

Table 8-8 Cuero Subdivision - Results Statistics

Cuero Subdivision	Base Case	Case 2	Case 3	Case 4
Delay Ratio	33%	58%	16%	23%
Delay Hrs/Day	9.8	20.5	2.3	4.1
Delay/100 miles	53.1	93.9	25.8	37.8
Velocity	27.7	23.4	32.1	30.1

Once again, Table 8-8 portrays the same pattern of results for the Cuero Subdivision that has been seen in the previous subdivision results. The magnitude of increased DR and D/100 from Case 2 is somewhat less than on other subdivisions; however that would be expected with the rerouting of KCS trains between Victoria and Rosenberg on the new line that is being constructed.

Growth traffic and infrastructure improvements in Case 4 again created simulation results that were slightly better than Base Case results. As mentioned previously, this was a goal for the improvements included into Cases 3 and 4.

Table 8-9 Delays Greater than 30 Minutes

Cuero Subdivision	Delays Greater than 30 Minutes			
	Base Case	Case 2	Case 3	Case 4
Flatonia - Adel	16	1	4	7
Adel - Thomaston	16	33	2	3
Thomaston - Placedo	15	6	1	2

Table 8-10 Total Delay Hours for Delays Greater than 30 Minutes

Cuero Subdivision	Delay Hours			
	Base Case	Case 2	Case 3	Case 4
Flatonia - Adel	20.7	0.5	3.0	7.6
Adel - Thomaston	25.6	50.9	5.9	4.9
Thomaston - Placedo	16.3	38.3	0.7	1.5

The tables above clearly show the impact of removing KCS traffic from the Cuero Subdivision in the Phase 2 simulation cases. The only anomaly to this result was in Case 2 between Adel and

Thomaston. In that case, the D>30 and the T30 both significantly increased, even with less trains running on the subdivision.

The reason for this increase in Case 2 was the congestion between Placedo and Bloomington. Thomaston and Adel are the only sidings on the Cuero Subdivision; when a train had to meet an opposing train, the meet had to occur at Thomaston or Adel. Many times the model held the south bound train for a northbound train, which was delayed around Bloomington because of congestion. This led to increased D>30.

There was still UP traffic growth on the Cuero Subdivision in Cases 2 and 4. Coleto Creek coal trains, Corpus Christi grain trains, and Bloomington merchandise trains did replace some of the KCS trains that were relocated because of the new Victoria - Rosenberg routing.

The new siding between Placedo and Victoria, Improvement C-1, also improved operations in Case 4. All UP and KCS trains (and growth) utilized this section of railroad in Case 4, yet the segment still showed improvement in D>30 and T30. The reduced distance from Bloomington/Placedo to a meet pass point for opposing Cuero Sub trains made the route more fluid, which reduced the number of major delays that occurred.

8.5.4 Flatonia Subdivision (Winchester to Muldoon, Flatonia to Harwood)

Tables 8-11 and 8-12, found below, clearly indicate that without some infrastructure improvements, the Flatonia Subdivision (as defined in this study) would likely experience delays that would not be acceptable to the railroads. In Case 2, DR exceeds 100% of the unopposed run time for trains in the simulation, which would be so costly in actual operation that it would not be tolerated.

Table 8-11 Flatonia Subdivision (east – west) Results Statistics

Flatonia (E-W) Subdivision	Base Case	Case 2	Case 3	Case 4
Delay Ratio	51%	138%	24%	40%
Delay Hrs/Day	5.8	20.4	2.7	5.8
Delay/100 miles	62.1	163.1	29.2	46.6
Velocity	32.6	21.3	39.9	36.6

Table 8-12 Flatonia Subdivision (north - south) Results Statistics

Flatonia (N-S) Subdivision	Base Case	Case 2	Case 3	Case 4
Delay Ratio	39%	182%	31%	32%
Delay Hrs/Day	2.9	17.9	2.4	3.2
Delay/100 miles	60.5	285.8	48.3	50.7
Velocity	27.6	3.6	29.2	28.9

In Case 4, DR and D/100 both return to values that are somewhat less than Base Case results. The additional sidings that were created on the Glidden and Smithville Subdivisions are responsible for this improvement.

Table 8-13 Delays Greater than 30 Minutes

Flatonia Subdivision	Delays Greater than 30 Minutes			
	Base Case	Case 2	Case 3	Case 4
Winchester - Muldoon	7	59	13	12
Flatonia - Harwood	28	50	5	16

Table 8-14 Total Hours of Delay for Delays Greater than 30 Minutes

Flatonia Subdivision	Delay Hours			
	Base Case	Case 2	Case 3	Case 4
Winchester - Muldoon	6.0	139.7	15.9	11.3
Flatonia - Harwood	31.7	69.1	5.2	9.8

Results in Tables 8-13 and 8-14 reflect the changes in operations associated with the infrastructure improvements that were made in the network around the Flatonia Subdivision. As previously described, no actual improvements were made to the subdivision, however two improvements were made adjacent to it. Each had an impact on the subsequent simulation results.

One of the largest, repetitive delays on the north - south Flatonia Sub involved LCRA coal trains. The loaded trains entered the Flatonia Subdivision near Giddings and turned to the east at West Point to access the LCRA plant that is near Fayetteville on the Smithville Subdivision. The loaded trains frequently had to stop in Winchester siding on the Flatonia Subdivision because there is currently no siding between West Point and the LCRA plant that can accommodate a coal train. In the simulations, when a loaded train entered the network, if a coal train was still in the LCRA facility or ready to leave it to the north, the loaded train had to be held at Winchester.

Holding a train at Winchester removed the only siding on the north - south Flatonia Subdivision that was north of West Point in the simulation. When a coal train was waiting in that siding, no other meets could occur between north-south Flatonia traffic and Smithville Subdivision traffic that was turning north at West Point. This led to some conflicts in the Base Case, but many additional conflicts once growth was applied.

In subsequent cases with traffic growth, this issue was aggravated by the projected growth of LCRA coal traffic. In the Base Case, five coal trains per week were included in the model; in the growth cases, up to 13 trains per week were included. This level of coal traffic increased the likelihood that a meet between coal trains would occur, which led to the large increases in D>30 and T30 seen in the Case 2 results.

When Case 3 was initially run, no siding was included on the Smithville Subdivision to correct these conflicts. The Base Case volume of trains did not warrant the siding, and it was left out.

However, the changes in operations associated with other network improvements created the realization that some modification had to be made in this location to accommodate future growth.

The new siding at MP 87 of the Smithville Subdivision was added in Case 4 to create a new meet pass location for LCRA (and other) trains on the Smithville Subdivision. The siding shortened a 24 mile stretch of single track between West Point and Fayetteville. It also allowed LCRA trains to advance from the Flatonia Subdivision to the Smithville Subdivision if they were meeting an opposing train between West Point and Fayetteville.

The ability to move LCRA trains from the Flatonia Subdivision onto the Smithville Subdivision had a positive impact on Flatonia Subdivision statistics. It did not totally return the statistics to Base Case levels, however this is understandable because of the amount of growth trains that were added to the Flatonia Subdivision based on growth projections. While many LCRA trains experienced decreased delays on the Flatonia Subdivision, other traffic including that moving towards San Antonio countered those decreases.

The Flatonia east west traffic experienced similar improvement when a new siding was introduced on the Glidden Subdivision at MP 111. The 20 mile stretch of single track in the Base Case and Case 2 created a number of longer delays at Flatonia to accommodate east west traffic meets. The inclusion of the siding, in conjunction with the relocation of KCS traffic, allowed the Flatonia Subdivision to show positive results in Cases 3 and 4. When sidings are evenly spaced (by running time) on a single track subdivision, train operations generally become more fluid than when there is uneven spacing or large gaps between sidings.

8.5.5 Glidden Subdivision (Lissie to Flatonia)

The Glidden Subdivision also experienced results that were slightly better than Base results in the Case 4 simulation. As described previously, the main reasons for this improvement was the relocation of KCS traffic to its own route between Rosenberg and Victoria and the inclusion of a new siding at MP 111 that evened out siding spacing on the subdivision. While growth of traffic between San Antonio and Houston made up for the removal of KCS trains, the overall impact of the operational change and the infrastructure improvement compensated for the projected growth.

Table 8-15 Glidden Subdivision Results Statistics

Glidden Subdivision	Base Case	Case 2	Case 3	Case 4
Delay Ratio	35%	56%	15%	28%
Delay Hrs/Day	12.4	25.5	3.8	9.4
Delay/100 miles	44.4	70.5	18.4	33.6
Velocity	34.8	30.4	42.3	38.7

Table 8-16 Delays Greater than 30 Minutes

Glidden Subdivision	Delays Greater than 30 Minutes			
	Base Case	Case 2	Case 3	Case 4
Lissie - Ramsey	10	37	1	3
Glidden - Flatonia	40	73	10	37

Table 8-17 Total Delay Hours for Delays Greater than 30 Minutes

Glidden Subdivision	Delay Hours			
	Base Case	Case 2	Case 3	Case 4
Lissie - Ramsey	10.9	40.5	0.9	2.6
Glidden - Flatonia	36.7	85.1	10.3	33.7

The relocation of KCS trains is very evident between Lissie and Ramsey in Tables 16 and 17. No improvements were made in this area, however D>30 and T30 decreased significantly in Cases 3 and 4.

The improvement in operations was not as great between Glidden and Flatonia. This is partly because of additional north - south Flatonia Subdivision growth traffic that was included into the model in the 2030 cases, and partly because of BNSF traffic coming from the west that turned north at Flatonia. Both of these traffic groups blocked east west traffic when making the movements through Flatonia, which in turn affected through traffic. However, even with the growth projected on this segment of the network, the operations between Glidden, Flatonia and Harwood (on the Flatonia Subdivision) were more fluid than Base Case operations. The new siding at MP 111 contributed to this result.

8.5.6 Laredo Subdivision (Matthews to Corpus Christi)

No improvements were made to the Laredo Subdivision in any of the subsequent simulations. Growth traffic was applied based on the projections that were performed.

The improvement in operating statistics in Case 4 reflects the improvement in traffic fluidity on the Brownsville Subdivision north of Robstown. With less congestion in that segment of the network, trains flowed more smoothly on the Laredo Subdivision. Traffic "bunched up" in the Base Case because of congestion issues around Odem. Adding the new wye at Odem (Improvement BA-1) resulted in less congestion on the Brownsville Subdivision and allowed the traffic on the Laredo Subdivision to remain spaced in the later simulations which led to improved operational statistics.

Table 8-18 Laredo Subdivision Results Statistics

Laredo Subdivision	Base Case	Case 2	Case 3	Case 4
Delay Ratio	31%	47%	9%	27%
Delay Hrs/Day	4.3	7.4	1.2	4.2
Delay/100 miles	106.2	156.2	30.1	87.9
Velocity	13.4	12.2	16.2	14.5

Table 8-19 Delays Greater than 30 Minutes

Laredo Subdivision	Delays Greater than 30 Minutes			
	Base Case	Case 2	Case 3	Case 4
Matthews - Aqua	16	10	4	5
Aqua - Robstown	16	27	2	17
Robstown - Corpus	15	12	1	13

Table 8-20 Total Delay Hours for Delays Greater than 30 Minutes

Laredo Subdivision	Delay Hours			
	Base Case	Case 2	Case 3	Case 4
Matthews - Aqua	7.0	10.9	1.6	10.4
Aqua - Robstown	25.3	34.7	10.2	17.1
Robstown - Corpus	6.4	18.9	2.3	19.7

The more even flow of traffic can be seen between Matthews and Aqua in Tables 8-19 and 8-20. Where there were major delays in the Base Case, the delays decreased in Case 4, even though growth trains were included in the simulation. The ability to keep the trains spaced (because of improvements on the Brownsville Subdivision north of Robstown) allowed the model to minimize longer delays.

Between Aqua and Robstown and Robstown and Corpus, the Case 4 delay numbers were very similar to Base Case numbers. However, the Case 4 numbers included the growth traffic, indicating that in reality, the Case 4 network was running better than the Base network in this area. The overall traffic statistics confirm this, as they were less in Case 4 than in the Base Case (Table 18).

The at-grade crossing and junction at Robstown was the main reason that there were major delays between Aqua and Corpus Christi. As train traffic increased, there were more opportunities for conflicts at this location. Even though the trains remained spaced more evenly, two trains could not occupy the crossing at the same time, leading to some of the delays.

8.5.7 Smithville Subdivision (Smithville to Katy)

The relatively static level of DR and D/100 reflects the single directional nature of the Smithville Subdivision for most traffic. While there are some meets on this line, they are minimal compared to other lines in this network.

The introduction of a siding at MP 87 in Case 4 allowed the model to shift some of the delays that occurred on the Flatonia Subdivision to the Smithville Subdivision. In previous cases, the model held trains away from the Smithville Subdivision because of the limited locations where a meet could take place. Once a new siding was included, the model used the siding for some of those meets. This explains why the DR and the D/100 increased in Case 4 when compared with Case 2, where traffic growth was included but no infrastructure were changed.

Table 8-21 Smithville Subdivision Results Statistics

Smithville Subdivision	Base Case	Case 2	Case 3	Case 4
Delay Ratio	14%	15%	13%	18%
Delay Hrs/Day	2.9	6.6	4.1	7.8
Delay/100 miles	60.5	44.4	33.6	52.8
Velocity	27.6	17.3	20.7	17.3

Table 8-22 Delays Greater than 30 Minutes

Smithville Subdivision	Base Case	Case 2	Case 3	Case 4
Smithville - West Point	1	0	0	0
West Point - Sealy	14	8	20	26
Sealy - Katy	0	0	0	0

Table 8-23 Total Delay Hours for Delays Greater than 30 Minutes

Smithville Subdivision	Delay Hours			
	Base Case	Case 2	Case 3	Case 4
Smithville - West Point	0.5	0	0.0	0
West Point - Sealy	24.6	20.6	24.1	61.5
Sealy - Katy	0.0	0	0.0	0

Tables 8-22 and 8-23 portray how the model changed the meet locations between Case 2 and Case 4. In Case 2, there were very few delays on the subdivision, even with the projected growth in traffic. Many of the trains that were meeting other trains were held on the Flatonia Subdivision or on BNSF's Galveston Subdivision because of limited locations to meet on the Smithville Subdivision. In Case 4, however, once a longer siding was included on the line, the model had the ability to use it and the sidings at Fayetteville, New Ulm and Cat Springs to allow

meets. New Ulm and Cat Springs are both relatively short sidings (5,500 feet), so most of the meets occurred at Fayetteville and the new MP 87 siding.

Additionally, there are no sidings between Sealy and Katy. This led to further delays between West Point and Sealy because when the model had a train that was operating to Katy while there was already a train between Sealy and Katy, the model had to hold the first train west of Sealy until the train east of Sealy departed. In actuality, there may be tracks that a short local train or a smaller rock train could clear to east of Sealy, however such tracks would fall outside of the Study Area boundaries and therefore could not be included in the model.

8.5.8 Prioritization

Based on the results from the model simulation runs and general operational experience, the following prioritization of projects is suggested. It should be noted that this prioritization is based solely on operational considerations. Cost benefit calculations shown later in the report should also be considered when attempts are made to prioritize which improvements might be implemented.

11. Upgrade sidings at Woodsboro and Greta, ***Improvements BA-4 and BA-5***
12. Second track Bloomington to Placedo***, Improvement BA-7***
13. New siding MP 111 Glidden Subdivision, ***Improvement G-1***
14. New siding MP 171 Brownsville Subdivision, ***Improvement BA-3***
15. New leg of the wye at Odem, ***Improvement BA-1***
16. New siding MP 85 Smithville Subdivision, ***Improvement S-1***
17. New siding MP 16 Cuero Subdivision, ***Improvement C-1***
18. New siding and connection to BNSF at Bay City, ***Improvement BA-8***
19. Second track Bloomington to Victoria Industrial Spur, ***Improvement BA-6***
20. New leg of wye at Sinton, ***Improvement BA-2***

The order of these projects could change depending on circumstances. For instance, if a new intermodal facility is built near Gregory, the leg of the wye at Sinton would become a higher priority than listed. Similarly, if movements from the Corpus Christi Subdivision to Gregory are short term movements, then the wye at Odem would become a lesser priority.

The list developed attempts to balance the needs of multiple subdivisions with the level of delay experienced in the simulations. It would take multiple additional simulations to test each project separately to develop a robust cost/benefit analysis for the overall network.

Table 8-24 Train Growth Percentages by Identified Corridor

Between		Autos	Coal	Grain	IM	Merch/ Petrochem	Minerals
Campbellton	Robstown						5%
Campbellton	Rockport						0%
Giddings	Bloomington					31%	
Giddings	Corpus					168%	
Giddings	Katy						22%
Giddings	LCRA		160% *				
Giddings	San Antonio				37%		
Giddings	Victoria		29%				
Houston	Bloomington					11%	
Houston	Brownsville	100%		67%		53%	
Houston	Corpus					87%	
Houston	Laredo	125%		23%		20%	
Houston	San Antonio	160%			37%		6%
San Antonio	Corpus			-25%			
Temple	Galveston			22%			
Temple	Houston				37%		

* Growth shown is higher than projected growth. This was because the numbers of trains in the Base Case were less than actual volumes.

SECTION 9 - BOTTLENECKS IMPROVEMENTS COST/BENEFIT ANALYSIS

The previous section of this report identified potential improvements that could be made to the existing rail infrastructure to remove bottlenecks and improve freight movements through the Corpus Christi and Yoakum Districts. It is the purpose of this section to attempt to quantify the costs to construct those improvements and the benefits resulting there from.

It is important to note that this cost benefit analysis only considers a scenario where all eleven improvements are constructed simultaneously. Thus a single benefits-cost ratio is calculated for the one scenario wherein all of the improvements were made. Note, too, that changes made at one location on a rail network can have far reaching effects on other portions of the network, even if not in close proximity to the location where an individual improvement is made. In order to quantify the effects of an individual improvement, separate RTC model simulations would need to be run on the entire network, with one improvement implemented for each simulation.

The two scenarios considered include a “no-improvements” scenario, representing the existing rail network with no new improvements added, and the “improvements” scenario including the eleven improvements identified earlier in this report. It is important to note that the “no-improvements” scenario does include the new KCS line.

9.1 CONSTRUCTION COST ESTIMATES

For each of the eleven improvements identified, a preliminary construction cost estimate was developed using unit cost information for rail construction projects found around the state and from other sources as appropriate. The cost estimates include preliminary quantity estimates for all track work, signal work, structures, drainage, utilities and right-of-way, as well as associated costs for the “intangible” costs associated with design, construction management and mobilization. Given the extremely preliminary nature of these estimates a 20% contingency is also included in the final cost.

A summary of the individual construction costs for each improvement can be found in the table below. Detailed estimates can be found in Appendix J.

Table 9-1 Rail Improvement Construction Cost Estimates

Improvement	Estimated Cost
Improvement BA-1	$ 2,050,000
Improvement BA-2	$ 3,170,000
Improvement BA-3	$ 6,560,000
Improvement BA-4	$ 2,660,000
Improvement BA-5	$ 2,660,000
Improvement BA-6	$ 6,250,000
Improvement BA-7	$ 16,520,000
Improvement BA-8	$ 8,310,000
Improvement C-1	$ 7,180,000
Improvement G-1	$ 8,280,000
Improvement S-1	$ 8,590,000
TOTAL	**$ 72,230,000**

9.2 BENEFITS ANALYSIS

Unlike the analysis performed earlier in this report regarding grade separations, the quantifiable benefits that result from the improvements to the rail infrastructure are realized primarily by the respective railroad. For this report the benefits have been quantified by, first, measuring the delays resulting from the four RTC simulation models, and then comparing the reduction in delays between the "improvements" scenario and the "no-improvements" scenario.

The delays encountered along the various subdivisions between the Base Case simulation and the Case 2 simulation was compared. With the Base Case simulation representing current traffic levels on an un-improved network (but including the new KCS line) and the Case 2 simulation representing 2035 traffic levels on the un-improved network, a linear interpolation between the corresponding delays provides a year by year value representing the cumulative delays that RTC estimates would be experienced over the Corpus-Yoakum network for the next 25 years. A dollar value associated with the cost of these delays was calculated utilizing a value of $320 per hour as the cost to the railroads of one hour of delay in present day time. This value was derived from utilizing a similar value of $303 per hour as calculated in a similar study prepared for TxDOT back in 2006 and applying a 1.8% annual inflation rate. The $320 value was also adjusted an additional 1.8% annually for inflation over all the years of the analysis.

The next step in the benefits analysis involved performing similar calculations for the "improvements" scenario, which is a comparison between the Case 3 simulation representing present day traffic on an improved Corpus-Yoakum network and the Case 4 simulation representing 2035 traffic on the improved network. As with the comparison between Base Case and Case 2, Delay values were interpolated for the intermediate years and dollar amounts associated with cost of delay were developed from those numbers.

With year by year delay costs calculated for both the "improvements" and "no-improvements" scenarios the next step involved subtracting the delay costs for the "improvements" scenario from the delay costs for the "no-improvements" scenario. This calculation was performed for each year separately giving a year by year cash flow of the savings in delay costs incurred. This cash flow was then reduced into a net present value amount using a discount rate of 9.7%, derived from publicly available financial statements, and that number is used as the cumulative financial benefit realized by adopting the recommended improvements. The table below shows the benefits calculated per major rail subdivision.

Table 9-2 Estimated 20yr Benefits

Major Rail Subdivision	Estimated Benefit
Brownsville	$34,815,015
Angleton	$11,875,754
Corpus Christi	$10,227,299
Cuero (Port Lavaca)	$11,850,657
Flatonia (east-west)	$7,596,261
Flatonia (north-south)	$5,483,699
Glidden	$12,655,542
Laredo	$3,663,801
Smithville	($1,404,893)
TOTAL	**$96,763,135**

The negative value calculated for the Smithville Subdivision suggests that the "improvements" scenario results in a worsening operating condition along that subdivision. From this result some might assume that constructing Improvement S-1 would not be justified, as apparently its inclusion would have made operating conditions along the Smithville Subdivision worsen. This assumption would be incorrect. As discussed previously in Section 8.5.7, trains in the existing condition are currently held in delay along the Flatonia Subdivision as there is no place along the Smithville Subdivision for a meet to take place. Adding the new siding along the Smithville Subdivision provides a location such that trains that were delayed on the Flatonia Subdivision can now wait along the Smithville Subdivision, thus providing reduced delays and improved operations along the Flatonia Subdivision. Noting the approximately $13 million dollars worth of benefits realized along the Flatonia Subdivision, the increase of delay costs experienced along the Smithville Subdivision still results in an overall positive in terms of effect on the entire rail network. This also provides an illustration as to why it is necessary to examine all the rail improvements collectively, as in a rail network changes made in one location can affect conditions long distances away.

9.3 PUBLIC AND PRIVATE BENEFITS

Unlike the analysis performed earlier in this report for grade separations where ten separate calculations were performed, the cost benefit analysis for the rail infrastructure improvements is relatively simpler. The public benefits are associated with the value of time improvements for vehicles waiting at the rail crossings throughout the entire rail network in the Corpus and Yoakum districts. This analysis factored in the number of trains per crossing, average vehicle traffic each crossing, and reduced vehicle delay times as a result of the improvements to the subdivisions.

With respect to the private benefits, there is only one scenario to examine—a comparison between the "improvements" and "no improvements" conditions. This estimate was derived from the value of train delay hour, delay costs for the entire rail network, and the value of the proposed improvements on train speeds along the network. Table 9-3 below is summary of the public and private benefits as well as the estimated total costs for the rail infrastructure improvements.

Table 9-3 Public and Private Benefits of the Subdivision Improvements

Benefit	Amount
Public: Value of Time	$2,461,913
Private: Freight Transit Time	$96,763,135
Total	$99,225,048
Costs	**$72,230,000**
Benefit/Cost Ratio	**1.37**

The benefit/cost ratio of 1.37 shown above far exceeds any of the benefit/cost ratios determined from the grade separation analysis, indicating that investment made to the rail infrastructure will provide a better return than investments made into grade separating crossings.

APPENDIX F – CONSTRUCTION COST ESTIMATES

PROJECT NAME/STREET NAME
US 183/ Esplanade St

PROJECT LIMITS
From Morgan St to Courthouse St

COUNTY
De Witt

TXDOT DISTRICT
Yoakum

SCOPE/ASSUMPTIONS
Construct bridge over UPRR tracks and add frontage roads.

DATE
29-Jan-09

Pay Item	Description	Unit	Qty	Unit Cost	Est. Cost
110	Excavation	CY	4,005	$10.00	$40,050.00
132	Embankment	CY	39,071	$11.00	$429,781.00
247	Flexbase (12")	CY	5,128	$40.00	$205,120.00
260	Lime	TON	748	$100.00	$74,800.00
260	Lime Treat (Flex Base)	SY	15,384	$0.32	$4,922.88
260	Lime Treat (Subgrade)(6")	SY	15,384	$1.30	$19,999.20
316	Aggregate	CY	140	$50.00	$7,000.00
316	Asphalt	GAL	4,615	$3.30	$15,229.50
340	Hot Mix (4")	TON	3,454	$80.00	$276,320.00
423	Retaining Wall	SF	40,025	$40.00	$1,601,000.00
450	Rail	LF	3,202	$130.00	$416,260.00
xxx	Bridge	SF	3,022	$75.00	$226,650.00
xxx	Drainage	LS	1	$100,000.00	$100,000.00
514	Permanent Concrete Traffic Barrier	LF		$60.00	$0.00
531	Sidewalks	LF		$35.00	$0.00
644	Signs	EA	20	$500.00	$10,000.00
658	Pavement Markings	LF	7,087	$1.50	$10,630.50
xxx	Illumination	LS	1	$50,000.00	$50,000.00
xxx	Signals	LS	2	$100,000.00	$200,000.00
	Barricading	LS		3.0%	$110,632.89
	Mobilization	LS		11.0%	$405,653.94
	Preparation of Right of Way	LS		3.0%	$110,632.89
	Contingency	LS		15.0%	$647,202.42
				Construction Total	**$4,961,885.22**
	Environmental	LS		6.0%	$297,713.11
	Engineering (Planning and PS&E)	LS		15.0%	$744,282.78
	Right of Way	LS		5.0%	$248,094.26
	Utilities	LS		3.0%	$148,856.56
	CE&I	LS		10.0%	$496,188.52
				Project Grand Total Estimated Cost	**$6,900,000.00**

PROJECT NAME/STREET NAME
US 90

PROJECT LIMITS
From Church St to CR 239A (Seydler St)

COUNTY
Gonzales

TXDOT DISTRICT
Yoakum

SCOPE/ASSUMPTIONS
Construct bridge over UPRR tracks and add frontage roads.

DATE
29-Jan-09

Pay Item	Description	Unit	Qty	Unit Cost	Est. Cost
110	Excavation	CY	28,764	$10.00	$287,640.00
132	Embankment	CY	67,363	$11.00	$740,993.00
247	Flexbase (12")	CY	19,771	$40.00	$790,840.00
260	Lime	TON	2,883	$100.00	$288,300.00
260	Lime Treat (Flex Base)	SY	59,313	$0.32	$18,980.16
260	Lime Treat (Subgrade)(6")	SY	59,313	$1.30	$77,106.90
316	Aggregate	CY	539	$50.00	$26,950.00
316	Asphalt	GAL	17,794	$3.30	$58,720.20
340	Hot Mix (4")	TON	13,022	$80.00	$1,041,760.00
423	Retaining Wall	SF	39,550	$40.00	$1,582,000.00
450	Rail	LF	3,164	$130.00	$411,320.00
xxx	Bridge	SF	18,704	$75.00	$1,402,800.00
xxx	Drainage	LS	1	$100,000.00	$100,000.00
514	Permanent Concrete Traffic Barrier	LF	1,785	$60.00	$107,100.00
531	Sidewalks	LF		$35.00	$0.00
644	Signs	EA	20	$500.00	$10,000.00
658	Pavement Markings	LF	45,338	$1.50	$68,007.00
xxx	Illumination	LS	1	$50,000.00	$50,000.00
xxx	Signals	LS		$100,000.00	$0.00
	Barricading	LS		3.0%	$211,875.52
	Mobilization	LS		11.0%	$776,876.90
	Preparation of Right of Way	LS		3.0%	$211,875.52
	Contingency	LS		15.0%	$1,239,471.78
				Construction Total	**$9,502,616.97**
	Environmental	LS		6.0%	$570,157.02
	Engineering (Planning and PS&E)	LS		15.0%	$1,425,392.55
	Right of Way	LS		0.0%	$0.00
	Utilities	LS		3.0%	$285,078.51
	CE&I	LS		10.0%	$950,261.70
				Project Grand Total Estimated Cost (Rounded)	**$12,700,000.00**

PROJECT NAME/STREET NAME
US 77/ Park Ave

PROJECT LIMITS
From Baylor St to Rachal St

COUNTY
San Patricio

TXDOT DISTRICT
Corpus Christi

SCOPE/ASSUMPTIONS
Construct bridge over UPRR tracks.

DATE
29-Jan-09

Pay Item	Description	Unit	Qty	Unit Cost	Est. Cost
110	Excavation	CY	1,345	$10.00	$13,450.00
132	Embankment	CY	46,458	$11.00	$511,038.00
247	Flexbase (12")	CY	4,389	$40.00	$175,560.00
260	Lime	TON	640	$100.00	$64,000.00
260	Lime Treat (Flex Base)	SY	13,167	$0.32	$4,213.44
260	Lime Treat (Subgrade)(6")	SY	13,167	$1.30	$17,117.10
316	Aggregate	CY	120	$50.00	$6,000.00
316	Asphalt	GAL	3,950	$3.30	$13,035.00
340	Hot Mix (4")	TON	2,991	$80.00	$239,280.00
423	Retaining Wall	SF	39,500	$40.00	$1,580,000.00
450	Rail	LF	3,160	$130.00	$410,800.00
xxx	Bridge	SF	7,200	$75.00	$540,000.00
xxx	Drainage	LS	1	$100,000.00	$100,000.00
514	Permanent Concrete Traffic Barrier	LF		$60.00	$0.00
531	Sidewalks	LF	3,400	$35.00	$119,000.00
644	Signs	EA	20	$500.00	$10,000.00
658	Pavement Markings	LF	7,601	$1.50	$11,401.50
xxx	Illumination	LS	1	$50,000.00	$50,000.00
xxx	Signals	LS	1	$100,000.00	$100,000.00
	Barricading	LS		3.0%	$118,946.85
	Mobilization	LS		11.0%	$436,138.45
	Preparation of Right of Way	LS		3.0%	$118,946.85
	Contingency	LS		15.0%	$695,839.08
				Construction Total	**$5,334,766.28**
	Environmental	LS		6.0%	$320,085.98
	Engineering (Planning and PS&E)	LS		15.0%	$800,214.94
	Right of Way	LS		1.0%	$53,347.66
	Utilities	LS		3.0%	$160,042.99
	CE&I	LS		10.0%	$533,476.63
				Project Grand Total Estimated Cost (Rounded)	**$7,200,000.00**

PROJECT NAME/STREET NAME
US 77 (W FRT RD)

PROJECT LIMITS
At UPRR Crossing

COUNTY
Victoria

TXDOT DISTRICT
Yoakum

SCOPE/ASSUMPTIONS
Close existing at grade crossing at US 77 W Frontage Rd.

DATE
29-Jan-09

Pay Item	Description	Unit	Qty	Unit Cost	Est. Cost
110	Excavation	CY		$10.00	$0.00
132	Embankment	CY		$11.00	$0.00
247	Flexbase	CY		$40.00	$0.00
260	Lime	TON		$100.00	$0.00
260	Lime Treat (Flex Base)	SY		$0.32	$0.00
260	Lime Treat (Subgrade)	SY		$1.30	$0.00
316	Aggregate	CY		$50.00	$0.00
316	Asphalt	GAL		$3.30	$0.00
340	Hot Mix	TON		$80.00	$0.00
423	Retaining Wall	SF		$40.00	$0.00
450	Rail	LF		$130.00	$0.00
xxx	Bridge	SF		$75.00	$0.00
xxx	Drainage	LS		$100,000.00	$0.00
514	Permanent Concrete Traffic Barrier	LF		$60.00	$0.00
531	Sidewalks	LF		$35.00	$0.00
644	Signs	EA	10	$500.00	$5,000.00
658	Pavement Markings	LF		$1.50	$0.00
xxx	Illumination	LS		$50,000.00	$0.00
xxx	Signals	LS		$100,000.00	$0.00
	Barricading	LS		3.0%	$150.00
	Mobilization	LS		11.0%	$550.00
	Preparation of Right of Way	LS		3.0%	$150.00
	Contingency	LS		15.0%	$877.50
				Construction Total	**$6,727.50**
	Environmental	LS		6.0%	$403.65
	Engineering (Planning and PS&E)	LS		15.0%	$1,009.13
	Right of Way	LS		0.0%	$0.00
	Utilities	LS		0.0%	$0.00
	CE&I	LS		10.0%	$672.75
	Project Grand Total Estimated Cost (Rounded)				**$9,000.00**

PROJECT NAME/STREET NAME
US 59/ Rio Grande St

PROJECT LIMITS
From Bridge St to Wheeler St

COUNTY
Victoria

TXDOT DISTRICT
Yoakum

SCOPE/ASSUMPTIONS
Construct bridge over UPRR tracks.

DATE
29-Jan-09

Pay Item	Description	Unit	Qty	Unit Cost	Est. Cost
110	Excavation	CY	0	$10.00	$0.00
132	Embankment	CY	38,670	$11.00	$425,370.00
247	Flexbase (12")	CY	3,094	$40.00	$123,760.00
260	Lime	TON	7,518	$100.00	$751,800.00
260	Lime Treat (Flex Base)	SY	9,281	$0.32	$2,969.92
260	Lime Treat (Subgrade)(6")	SY	9,281	$1.30	$12,065.30
316	Aggregate	CY	84	$50.00	$4,200.00
316	Asphalt	GAL	2,784	$3.30	$9,187.20
340	Hot Mix (4")	TON	2,116	$80.00	$169,280.00
423	Retaining Wall	SF	40,550	$40.00	$1,622,000.00
450	Rail	LF	3,244	$130.00	$421,720.00
xxx	Bridge	SF	3,017	$75.00	$226,275.00
xxx	Drainage	LS	1	$100,000.00	$100,000.00
514	Permanent Concrete Traffic Barrier	LF		$60.00	$0.00
531	Sidewalks	LF		$35.00	$0.00
644	Signs	EA	20	$500.00	$10,000.00
658	Pavement Markings	LF	5,480	$1.50	$8,220.00
xxx	Illumination	LS	1	$50,000.00	$50,000.00
xxx	Signals	LS		$100,000.00	$0.00
	Barricading	LS		3.0%	$118,105.42
	Mobilization	LS		11.0%	$433,053.22
	Preparation of Right of Way	LS		3.0%	$118,105.42
	Contingency	LS		15.0%	$690,916.72
				Construction Total	**$5,297,028.20**
	Environmental	LS		6.0%	$317,821.69
	Engineering (Planning and PS&E)	LS		15.0%	$794,554.23
	Right of Way	LS		1.0%	$52,970.28
	Utilities	LS		3.0%	$158,910.85
	CE&I	LS		10.0%	$529,702.82
				Project Grand Total Estimated Cost (Rounded)	**$7,200,000.00**

PROJECT NAME/STREET NAME
Sinton St

PROJECT LIMITS
From Vineyard St to Sodville St

COUNTY
San Patricio

TXDOT DISTRICT
Corpus Christi

SCOPE/ASSUMPTIONS
Construct bridge over UPRR tracks.

DATE
29-Jan-09

Pay Item	Description	Unit	Qty	Unit Cost	Est. Cost
110	Excavation	CY	0	$10.00	$0.00
132	Embankment	CY	38,170	$11.00	$419,870.00
247	Flexbase (12")	CY	3,054	$40.00	$122,160.00
260	Lime	TON	445	$100.00	$44,500.00
260	Lime Treat (Flex Base)	SY	9,161	$0.32	$2,931.52
260	Lime Treat (Subgrade)(6")	SY	9,161	$1.30	$11,909.30
316	Aggregate	CY	83	$50.00	$4,150.00
316	Asphalt	GAL	2,748	$3.30	$9,068.40
340	Hot Mix (4")	TON	2,089	$80.00	$167,120.00
423	Retaining Wall	SF	34,350	$40.00	$1,374,000.00
450	Rail	LF	2,748	$130.00	$357,240.00
xxx	Bridge	SF	4,583	$75.00	$343,725.00
xxx	Drainage	LS	1	$100,000.00	$100,000.00
531	Sidewalks	LF	2,902	$35.00	$101,570.00
644	Signs	EA	10	$500.00	$5,000.00
658	Pavement Markings	LF	4,353	$1.50	$6,529.50
xxx	Illumination	LS	1	$50,000.00	$50,000.00
xxx	Signals	LS		$100,000.00	$0.00
	Barricading	LS		3.0%	$93,593.21
	Mobilization	LS		11.0%	$343,175.11
	Preparation of Right of Way	LS		3.0%	$93,593.21
	Contingency	LS		15.0%	$547,520.29
				Construction Total	**$4,197,655.54**
	Environmental	LS		6.0%	$251,859.33
	Engineering (Planning and PS&E)	LS		15.0%	$629,648.33
	Right of Way	LS		0.0%	$0.00
	Utilities	LS		3.0%	$125,929.67
	CE&I	LS		10.0%	$419,765.55
				Project Grand Total Estimated Cost (Rounded)	**$5,600,000.00**

PROJECT NAME/STREET NAME
SH 361

PROJECT LIMITS
At UPRR Crossing

COUNTY
San Patricio

TXDOT DISTRICT
Corpus Christi

SCOPE/ASSUMPTIONS
Construct bridge over UPRR tracks and extend existing roadway.

DATE
29-Jan-09

Pay Item	Description	Unit	Qty	Unit Cost	Est. Cost
110	Excavation	CY	9,448	$10.00	$94,480.00
132	Embankment	CY	63,892	$11.00	$702,812.00
247	Flexbase (12")	CY	9,835	$40.00	$393,400.00
260	Lime	TON	1,434	$100.00	$143,400.00
260	Lime Treat (Flex Base)	SY	29,506	$0.32	$9,441.92
260	Lime Treat (Subgrade)(6")	SY	29,506	$1.30	$38,357.80
316	Aggregate	CY	268	$50.00	$13,400.00
316	Asphalt	GAL	8,852	$3.30	$29,211.60
340	Hot Mix (4")	TON	6,608	$80.00	$528,640.00
423	Retaining Wall	SF	37,500	$40.00	$1,500,000.00
450	Rail	LF	3,000	$130.00	$390,000.00
xxx	Bridge	SF	11,142	$75.00	$835,650.00
xxx	Drainage	LS	1	$100,000.00	$100,000.00
514	Permanent Concrete Traffic Barrier	LF	1,621	$60.00	$97,260.00
644	Signs	EA	20	$500.00	$10,000.00
658	Pavement Markings	LF	17,772	$1.50	$26,658.00
xxx	Illumination	LS	1	$50,000.00	$50,000.00
xxx	Signals	LS		$100,000.00	$0.00
	Barricading	LS		3.0%	$148,881.34
	Mobilization	LS		11.0%	$545,898.25
	Preparation of Right of Way	LS		3.0%	$148,881.34
	Contingency	LS		15.0%	$870,955.84
				Construction Total	**$6,677,328.08**
	Environmental	LS		6.0%	$400,639.68
	Engineering (Planning and PS&E)	LS		15.0%	$1,001,599.21
	Right of Way	LS		0.5%	$33,386.64
	Utilities	LS		0.5%	$33,386.64
	CE&I	LS		10.0%	$667,732.81
				Project Grand Total Estimated Cost (Rounded)	**$8,800,000.00**

PROJECT NAME/STREET NAME
SH 60/ Ave F

PROJECT LIMITS
From Matthews St to 3rd St

COUNTY
Matagorda

TXDOT DISTRICT
Yoakum

SCOPE/ASSUMPTIONS
Construct bridge over UPRR tracks and add frontage roads.

DATE
29-Jan-09

Pay Item	Description	Unit	Qty	Unit Cost	Est. Cost
110	Excavation	CY	6,083	$10.00	$60,830.00
132	Embankment	CY	44,442	$11.00	$488,862.00
247	Flexbase (12")	CY	6,597	$40.00	$263,880.00
260	Lime	TON	962	$100.00	$96,200.00
260	Lime Treat (Flex Base)	SY	19,790	$0.32	$6,332.80
260	Lime Treat (Subgrade)(6")	SY	19,790	$1.30	$25,727.00
316	Aggregate	CY	180	$50.00	$9,000.00
316	Asphalt	GAL	5,937	$3.30	$19,592.10
340	Hot Mix (4")	TON	4,404	$80.00	$352,320.00
423	Retaining Wall	SF	40,000	$40.00	$1,600,000.00
450	Rail	LF	3,200	$130.00	$416,000.00
xxx	Bridge	SF	11,702	$75.00	$877,650.00
xxx	Drainage	LS	1	$100,000.00	$100,000.00
644	Signs	EA	20	$500.00	$10,000.00
658	Pavement Markings	LF	7,955	$1.50	$11,932.50
xxx	Illumination	LS	1	$50,000.00	$50,000.00
xxx	Signals	LS	1	$100,000.00	$100,000.00
	Barricading	LS		3.0%	$134,649.79
	Mobilization	LS		11.0%	$493,715.90
	Preparation of Right of Way	LS		3.0%	$134,649.79
	Contingency	LS		15.0%	$787,701.28
				Construction Total	**$6,039,043.17**
	Environmental	LS		6.0%	$362,342.59
	Engineering (Planning and PS&E)	LS		15.0%	$905,856.48
	Right of Way	LS		5.0%	$301,952.16
	Utilities	LS		3.0%	$181,171.30
	CE&I	LS		10.0%	$603,904.32
				Project Grand Total Estimated Cost (Rounded)	**$8,400,000.00**

PROJECT NAME/STREET NAME
SH 44

PROJECT LIMITS
From Cameron St to Texas Blvd

COUNTY
Jim Wells

TXDOT DISTRICT
Corpus Christi

SCOPE/ASSUMPTIONS
Construct bridge over UPRR tracks and add frontage roads.

DATE
29-Jan-09

Pay Item	Description	Unit	Qty	Unit Cost	Est. Cost
110	Excavation	CY	3,925	$10.00	$39,250.00
132	Embankment	CY	40,646	$11.00	$447,106.00
247	Flexbase (12")	CY	5,214	$40.00	$208,560.00
260	Lime	TON	760	$100.00	$76,000.00
260	Lime Treat (Flex Base)	SY	15,643	$0.32	$5,005.76
260	Lime Treat (Subgrade)(6")	SY	15,643	$1.30	$20,335.90
316	Aggregate	CY	142	$50.00	$7,100.00
316	Asphalt	GAL	4,693	$3.30	$15,486.90
340	Hot Mix (4")	TON	3,493	$80.00	$279,440.00
423	Retaining Wall	SF	37,400	$40.00	$1,496,000.00
450	Rail	LF	2,992	$130.00	$388,960.00
xxx	Bridge	SF	6,444	$75.00	$483,300.00
xxx	Drainage	LS	1	$100,000.00	$100,000.00
514	Permanent Concrete Traffic Barrier	LF		$60.00	$0.00
644	Signs	EA	40	$500.00	$20,000.00
658	Pavement Markings	LF	8,221	$1.50	$12,331.50
xxx	Illumination	LS	1	$50,000.00	$50,000.00
xxx	Signals	LS	0	$100,000.00	$0.00
	Barricading	LS		3.0%	$109,466.28
	Mobilization	LS		11.0%	$401,376.37
	Preparation of Right of Way	LS		3.0%	$109,466.28
	Contingency	LS		15.0%	$640,377.75
				Construction Total	**$4,909,562.74**
	Environmental	LS		6.0%	$294,573.76
	Engineering (Planning and PS&E)	LS		15.0%	$736,434.41
	Right of Way	LS		3.0%	$147,286.88
	Utilities	LS		3.0%	$147,286.88
	CE&I	LS		10.0%	$490,956.27
				Project Grand Total Estimated Cost (Rounded)	**$6,700.000.00**

PROJECT NAME/STREET NAME
SH 36 (Meyer St)

PROJECT LIMITS
From Main St to 2nd St

COUNTY
Austin

TXDOT DISTRICT
Yoakum

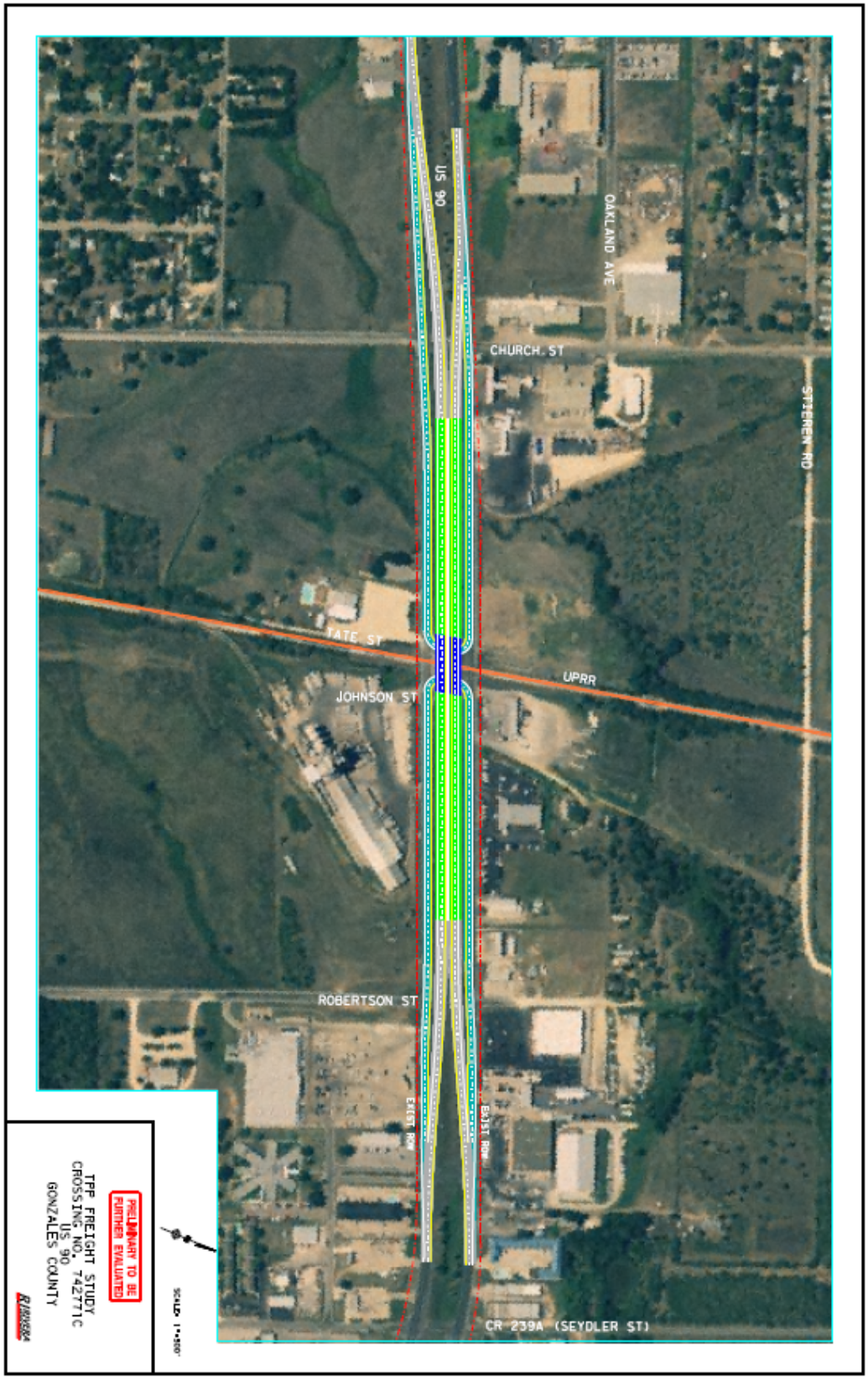
SCOPE/ASSUMPTIONS
Construct bridge over UPRR tracks and add frontage roads.

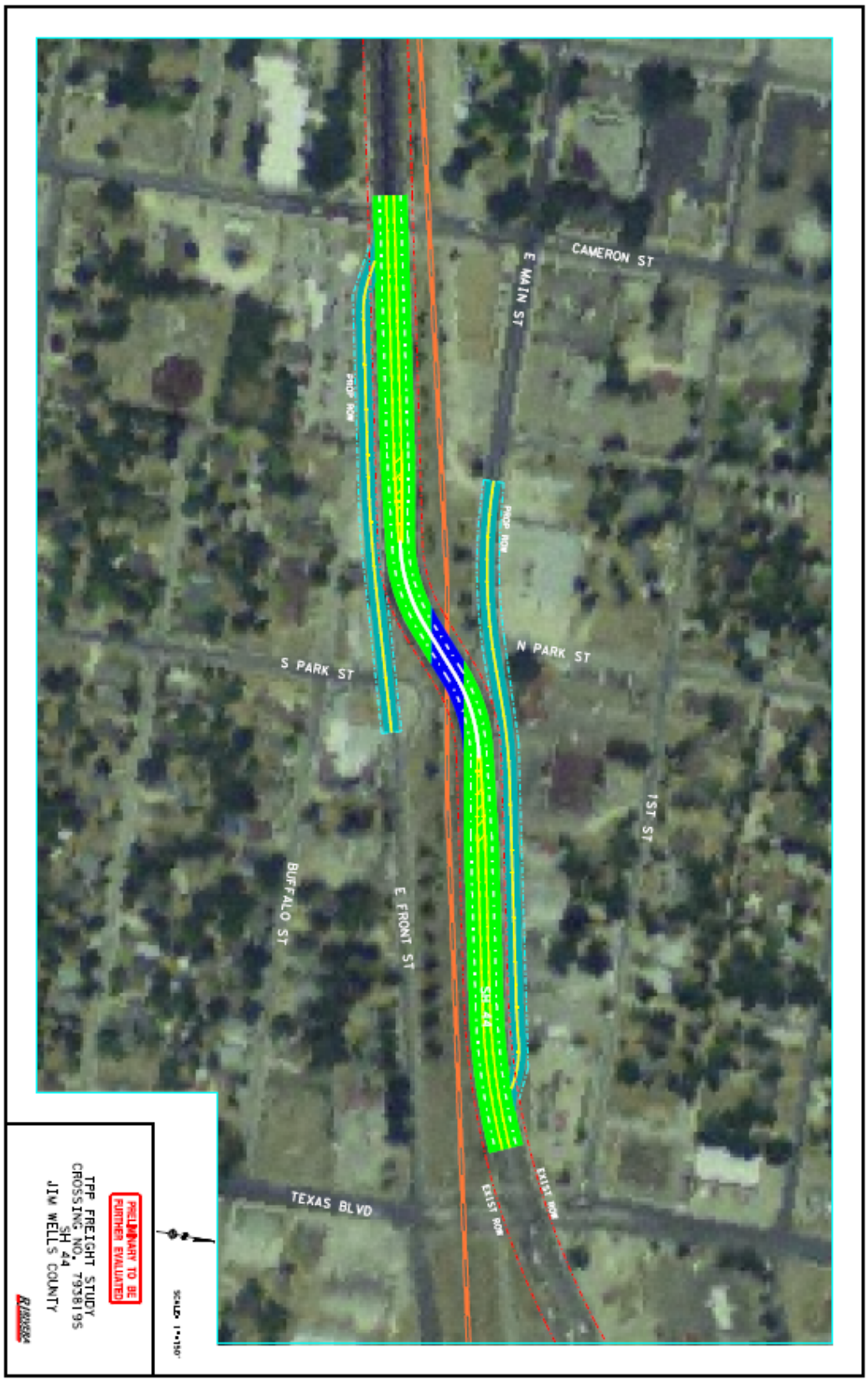
DATE
29-Jan-09

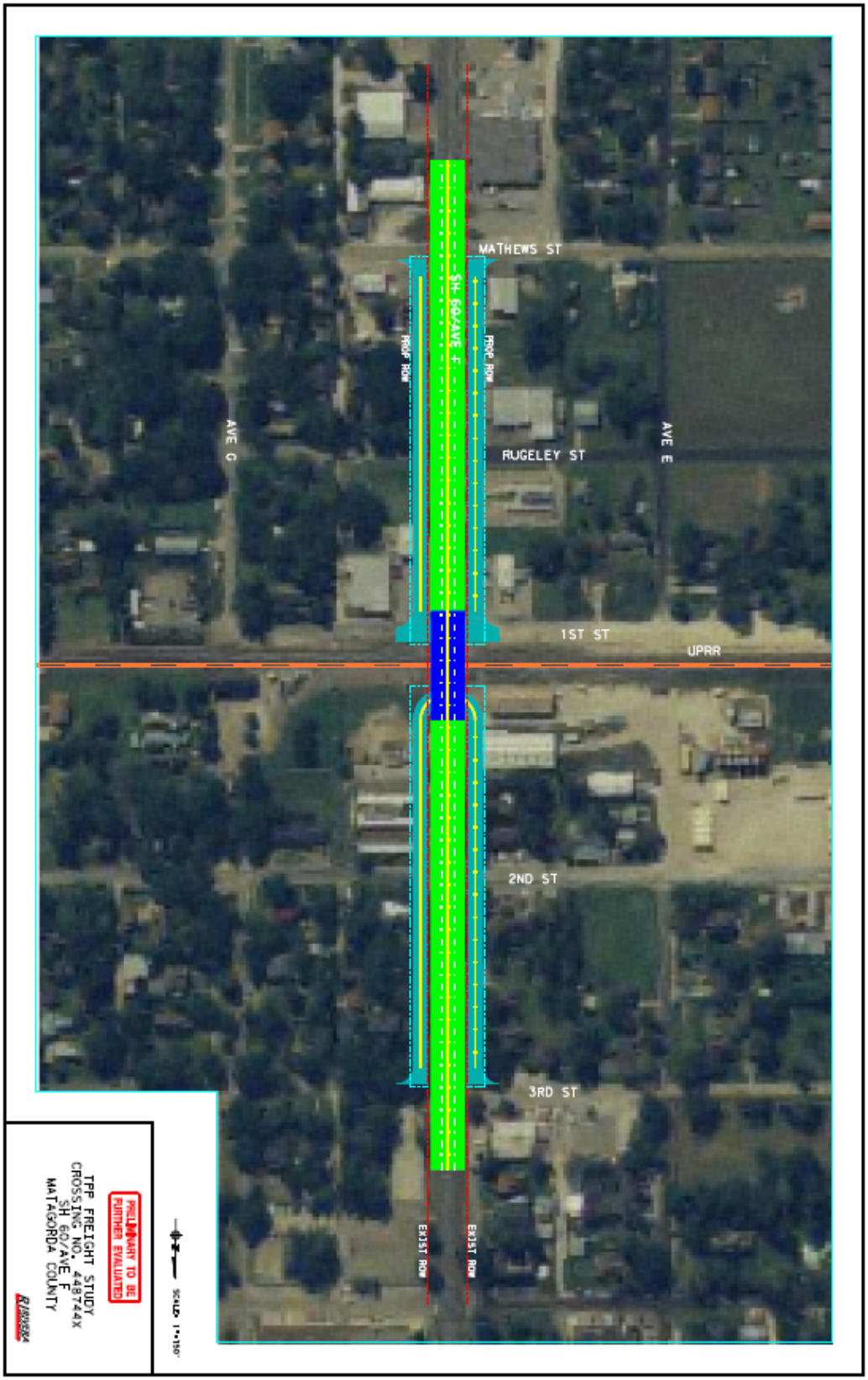
Pay Item	Description	Unit	Qty	Unit Cost	Est. Cost
110	Excavation	CY	7,909	$10.00	$79,090.00
132	Embankment	CY	37,033	$11.00	$407,363.00
247	Flexbase (12")	CY	6,917	$40.00	$276,680.00
260	Lime	TON	1,009	$100.00	$100,900.00
260	Lime Treat (Flex Base)	SY	20,752	$0.32	$6,640.64
260	Lime Treat (Subgrade)(6")	SY	20,752	$1.30	$26,977.60
316	Aggregate	CY	189	$50.00	$9,450.00
316	Asphalt	GAL	6,226	$3.30	$20,545.80
340	Hot Mix (4")	TON	4,605	$80.00	$368,400.00
423	Retaining Wall	SF	40,000	$40.00	$1,600,000.00
450	Rail	LF	3,200	$130.00	$416,000.00
xxx	Bridge	SF	11,000	$75.00	$825,000.00
xxx	Drainage	LS	1	$100,000.00	$100,000.00
644	Signs	EA	20	$500.00	$10,000.00
658	Pavement Markings	LF	10,283	$1.50	$15,424.50
xxx	Illumination	LS	1	$50,000.00	$50,000.00
xxx	Signals	LS	1	$100,000.00	$100,000.00
	Barricading	LS		3.0%	$132,374.15
	Mobilization	LS		11.0%	$485,371.87
	Preparation of Right of Way	LS		3.0%	$132,374.15
	Contingency	LS		15.0%	$774,388.76
				Construction Total	**$5,936,980.46**
	Environmental	LS		6.0%	$356,218.83
	Engineering (Planning and PS&E)	LS		15.0%	$890,547.07
	Right of Way	LS		5.0%	$296,849.02
	Utilities	LS		3.0%	$178,109.41
	CE&I	LS		10.0%	$593,698.05
				Project Grand Total Estimated Cost (Rounded)	**$8,300,000.00**

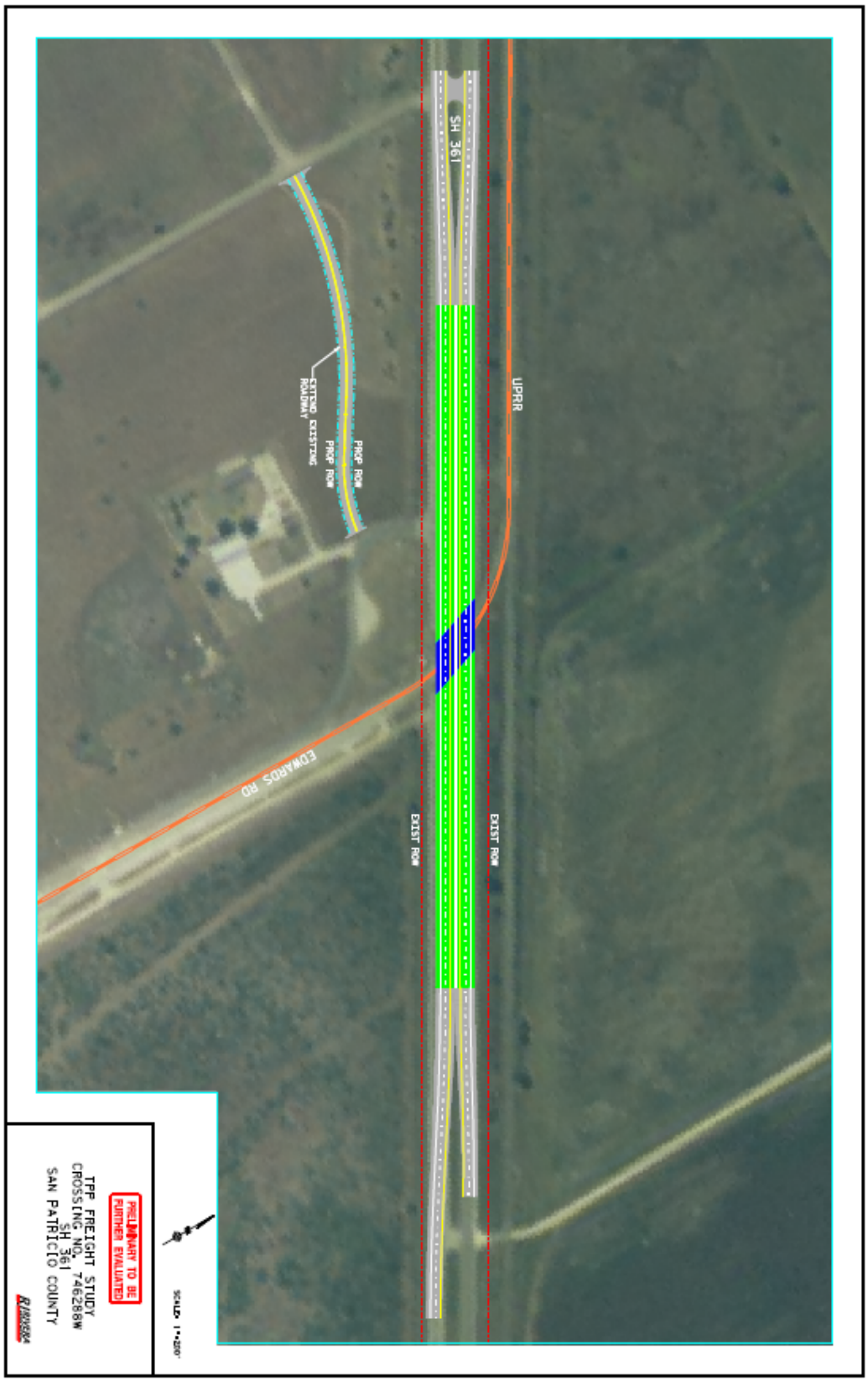
APPENDIX G – GRADE SEPARATION EXHIBITS

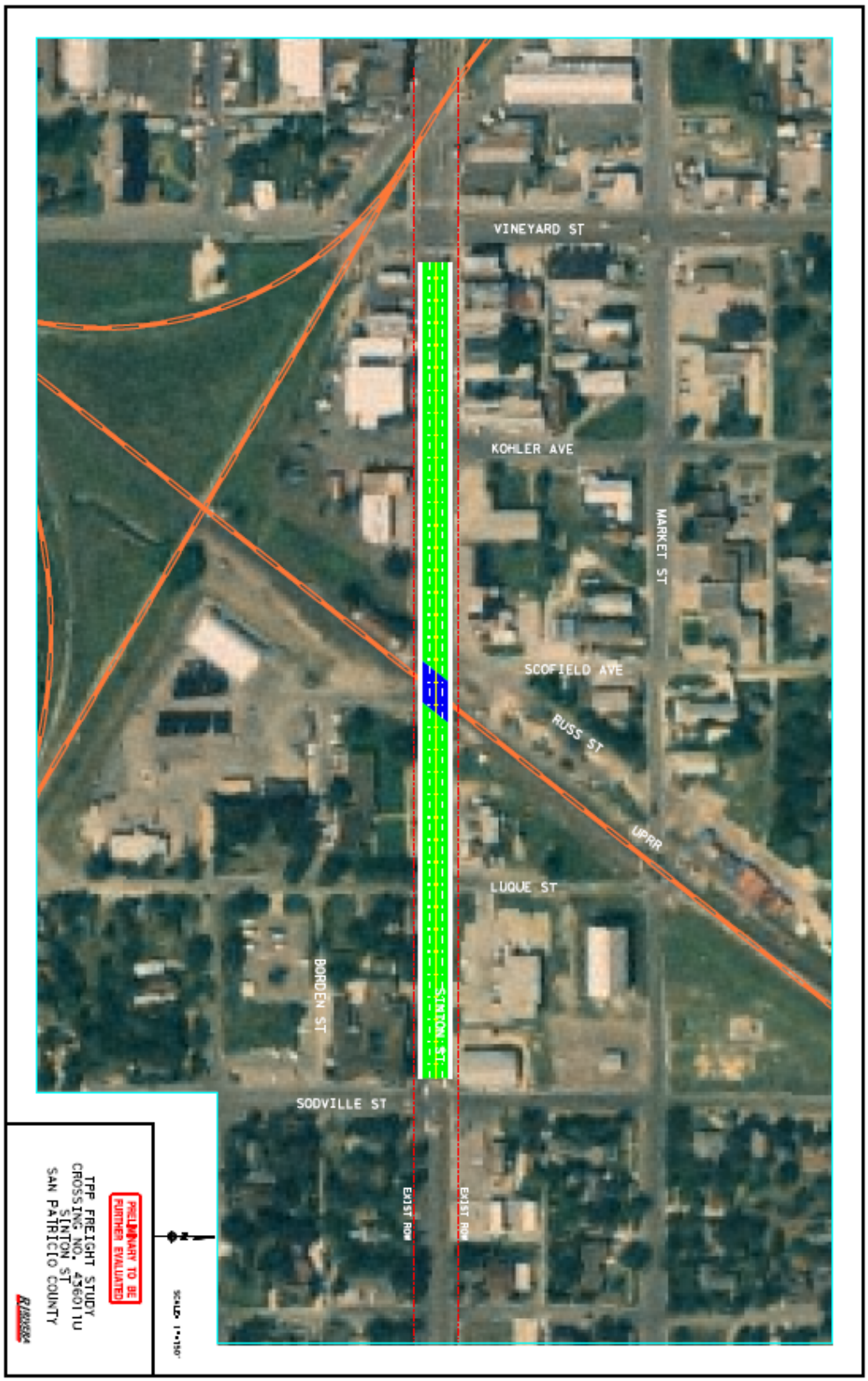
The following pages show the conceptual designs for grade separations at the ten crossings studied in this report.


STIEREN RD
OAKLAND AVE
US 90
CHURCH ST
TATE ST
UPRR
JOHNSON ST
ROBERTSON ST
EXIST ROW
EXIST ROW
CR 239A (SEYDLER ST)
PRELIMINARY TO BE FURTHER EVALUATED
TPF FREIGHT STUDY
CROSSING NO. 742771C
US 90
GONZALES COUNTY

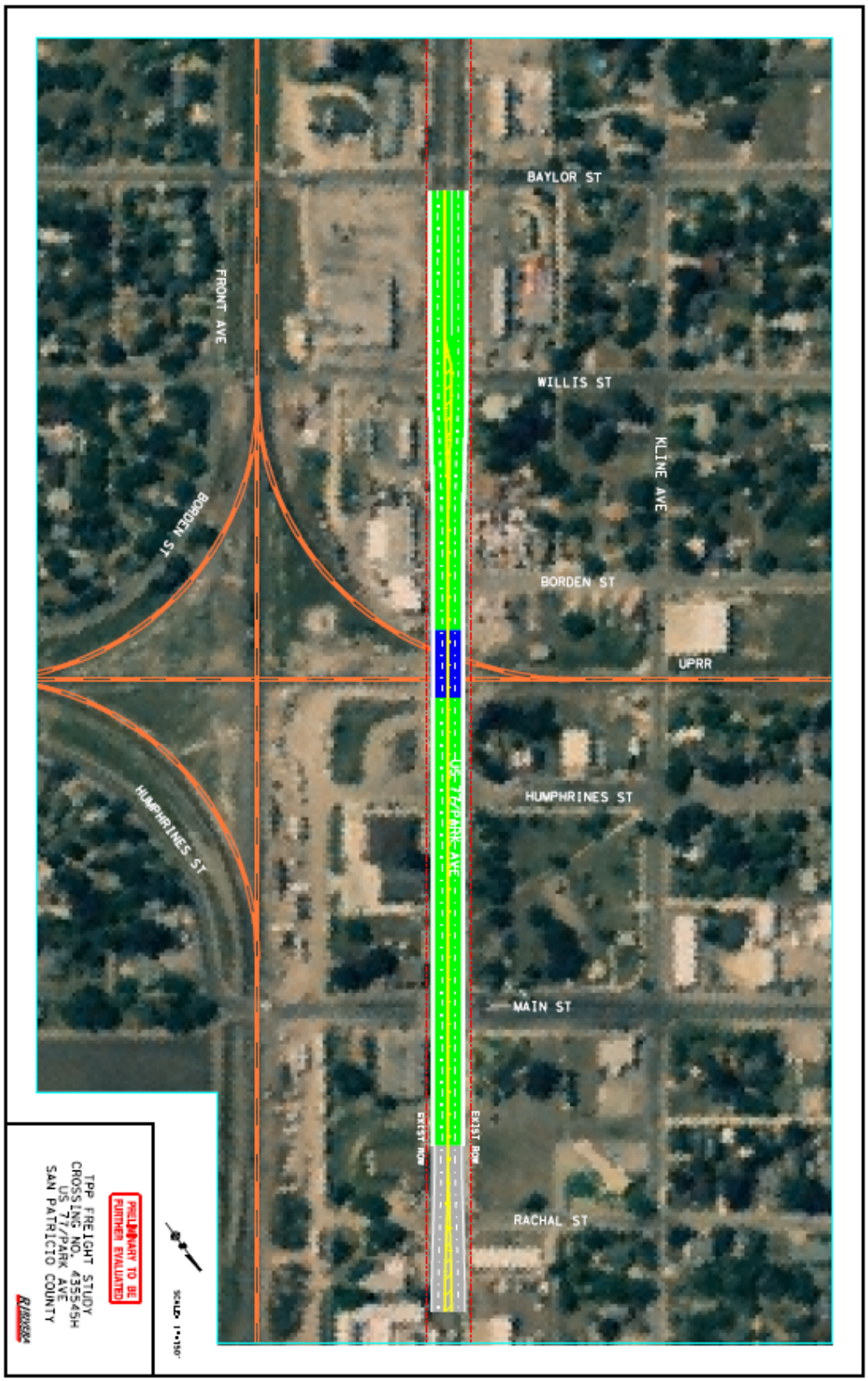

CAMERON ST
E MAIN ST
PROP ROW
PROP ROW
N PARK ST
S PARK ST
1ST ST
BUFFALO ST
E FRONT ST
SH 44
EXIST ROW
EXIST ROW
TEXAS BLVD
SCALE: 1"=150'
PRELIMINARY TO BE FURTHER EVALUATED
TPF FREIGHT STUDY
CROSSING NO. 793819S
SH 44
JIM WELLS COUNTY

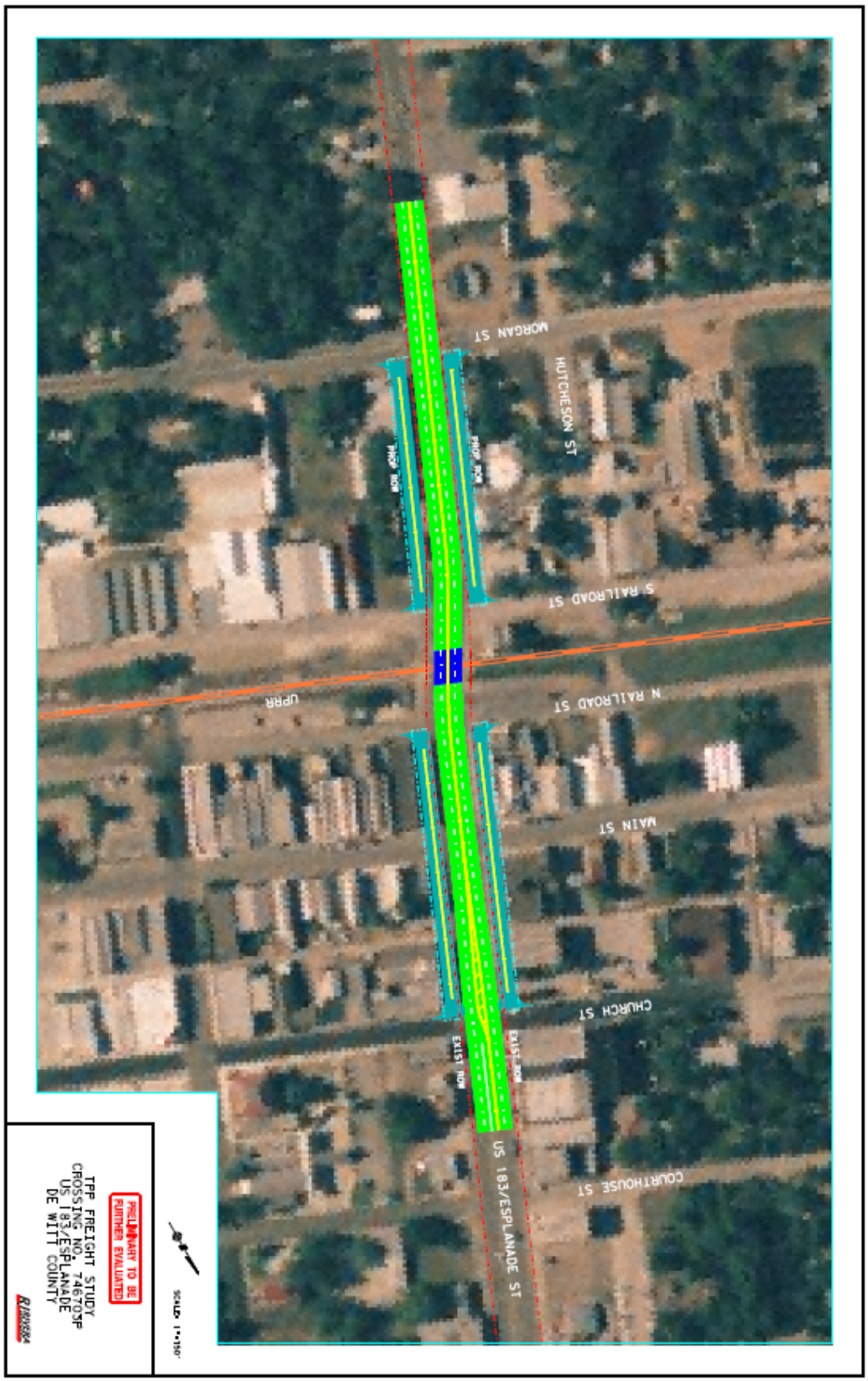

MATHEWS ST
SH 60/AVE F
PROP ROW
PROP ROW
AVE G
RUGELEY ST
AVE E
1ST ST
UPRR
2ND ST
3RD ST
EXIST ROW
EXIST ROW
SCALE: 1"=150'
PRELIMINARY TO BE FURTHER EVALUATED
TPF FREIGHT STUDY
CROSSING NO. 448744X
SH 60/AVE F
MATAGORDA COUNTY

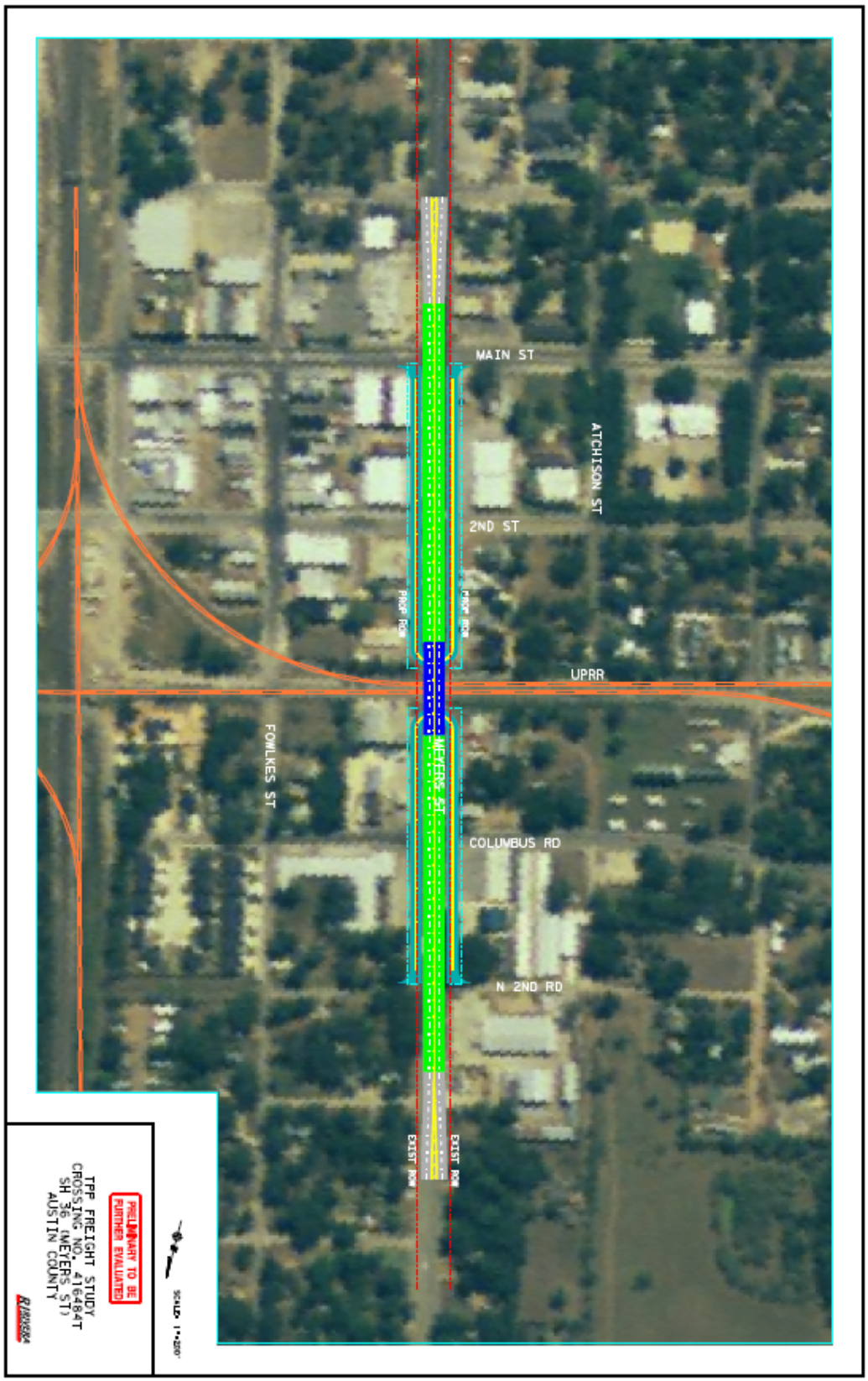

UPRR
EXIST ROW
EXIST ROW
SH 361
PROP ROW
PROP ROW
EXTEND EXISTING ROADWAY
EDWARDS RD
SCALE: 1"=200'
PRELIMINARY TO BE FURTHER EVALUATED
TPF FREIGHT STUDY
CROSSING NO. 746288W
SH 361
SAN PATRICIO COUNTY


VINEYARD ST
KOHLER AVE
MARKET ST
SCOFIELD AVE
RUSS ST
UPRR
LUQUE ST
BORDEN ST
SINTON ST
SODVILLE ST
EXIST ROW
EXIST ROW
PRELIMINARY TO BE FURTHER EVALUATED
TPF FREIGHT STUDY
CROSSING NO. 436011U
SINTON ST
SAN PATRICIO COUNTY
SCALE: 1"=150'

EXIST ROW
EXIST ROW
NORTH ST
BRIDGE ST
N MAIN ST
MAIN ST
UPRR
LIBERTY ST
NUECES ST
WILLIAMS ST
US 59/RIO GRANDE ST
DE LEON ST
WHEELER ST
US 77 (N NAVARRO ST)
SCALE: 1"=150'
PRELIMINARY TO BE FURTHER EVALUATED
TPF FREIGHT STUDY
CROSSING NO. 746472J
US 59/RIO GRANDE
VICTORIA COUNTY


BAYLOR ST
WILLIS ST
KLINE AVE
BORDEN ST
UPRR
HUMPHRINES ST
US 77/PARK AVE
MAIN ST
RACHAL ST
EXIST ROW
EXIST ROW
FRONT AVE
BORDEN ST
HUMPHRINES ST
SCALE: 1"=150'
PRELIMINARY TO BE FURTHER EVALUATED
TPP FREIGHT STUDY
CROSSING NO. 435545H
US 77/PARK AVE
SAN PATRICIO COUNTY


COURTHOUSE ST
US 183/ESPLANADE ST
EXIST ROW
EXIST ROW
CHURCH ST
MAIN ST
N RAILROAD ST
UPRR
S RAILROAD ST
PROP ROW
PROP ROW
HUTCHESON ST
MORGAN ST
SCALE: 1"=150'
PRELIMINARY TO BE FURTHER EVALUATED
TPF FREIGHT STUDY
CROSSING NO. 746703P
US 183/ESPLANADE
DE WITT COUNTY


MAIN ST
ATCHISON ST
2ND ST
PROP ROW
PROP ROW
UPRR
MEYERS ST
FOWLKES ST
COLUMBUS RD
N 2ND RD
EXIST ROW
EXIST ROW
SCALE: 1"=200'
PRELIMINARY TO BE FURTHER EVALUATED
TPF FREIGHT STUDY
CROSSING NO. 416484T
SH 36 (MEYERS ST)
AUSTIN COUNTY

APPENDIX H – RAIL FREIGHT PROJECTION TABLES

Table 1 - Percent Change in Autos/Auto Parts Carloads 2010 to 2035

Origin/Destination Counties	Frm North	Frm South	Frm South (Mexico)	Frm East	Frm West	Frm West (Mexico)	To North	To South	To South (Mexico)	To East	To West	To West (Mexico)
Kleberg												
Nueces						273.90%						126.10%
San Patricio						273.90%						
Jim Wells												
Live Oak						273.90%						126.10%
Aransas												
Calhoun						273.90%						126.10%
Victoria						273.90%						
DeWitt/Lavaca												
Jackson/Matagorda						273.90%						126.10%
Wharton/Colorado						273.90%						
Fayette												
Karnes												
Gonzales						273.90%						
Through Traffic												
North to South												
North to South (Mexico)		126.10%										
South to North		127.70%										
South to North (Mexico)		273.90%										
West to South												
South to West												
East to South		-51.10%										
East to South (Mexico)		126.10%										
South to East		98.80%										
South to East (Mexico)		273.90%										
East to West												
East to West (Mexico)		126.10%										
West to East		160.60%										
West to East (Mexico)		273.90%										

Table 2 - Percent Change in Coal Carloads 2010 to 2035

Origin/Destination Counties	Frm North	Frm South	Frm South (Mexico)	Frm East	Frm West	Frm West (Mexico)	To North	To South	To South (Mexico)	To East	To West	To West (Mexico)
Kleberg												
Nueces												
San Patricio												
Jim Wells												
Live Oak												
Aransas												
Calhoun												
Victoria					29.2%							
DeWitt/Lavaca												
Jackson/Matagorda												
Wharton/Colorado												
Fayette					32.2%							
Karnes												
Gonzales												
Through Traffic												
North to South												
North to South (Mexico)												
South to North												
South to North (Mexico)												
West to South												
South to West												
East to South												
East to South (Mexico)		-6.1%										
South to East												
South to East (Mexico)												
East to West												
East to West (Mexico)		-6.1%										
West to East												
West to East (Mexico)												

Table 3 - Percent Change in Number of Grain Carloads 2010 to 2035

Origin/Destination Counties	Frm North	Frm South	Frm South (Mexico)	Frm East	Frm West	Frm West (Mexico)	To North	To South	To South (Mexico)	To East	To West	To West (Mexico)	To Nueces
Kleberg													
Nueces	17.6%			-60.2%	-27.5%			-36.7%				-62.9%	-45.10%
San Patricio													
Jim Wells												-75.6%	
Live Oak													
Aransas													
Calhoun													
Victoria													
DeWitt/Lavaca													
Jackson/Matagorda													
Wharton/Colorado													
Fayette													
Karnes													
Gonzales													
Through Traffic													
North to South		69.9%											
North to South (Mexico)													
South to North													
South to North (Mexico)													
West to South													
South to West													
East to South		23.9%											
East to South (Mexico)													
South to East													
South to East (Mexico)													
East to West		-76.6%											
East to West (Mexico)													
West to East													
West to East (Mexico)													

Table 4 - Percent Change in Number of Mineral Carloads 2010 to 2035

Origin/Destination Counties	Frm North	Frm South	Frm South (Mexico)	Frm East	Frm West	Frm West (Mexico)	To North	To South	To South (Mexico)	To East	To West	To West (Mexico)
Kleberg					25.1%	-40.8%						
Nueces	42.3%		89.3%		-5.9%	94.7%		4.1%	-15.5%	181.8%	36.7%	104.4%
San Patricio	44.4%		-24.0%	8.6%	-12.5%	-19.6%			-15.5%			-11.7%
Jim Wells				-60.1%								
Live Oak				-54.8%		296.3%						755.7%
Aransas												
Calhoun					29.6%	280.1%						605.1%
Victoria					-11.0%	280.1%			-15.5%			-12.3%
DeWitt/Lavaca					-2.9%	280.1%						
Jackson/Matagorda	4.0%		19.8%		-2.6%	21.4%				80.9%		238.1%
Wharton/Colorado					67.3%	280.1%	-61.0%			-53.4%		
Fayette				-46.1%		280.1%						
Karnes												
Gonzales					-4.3%	280.1%				114.1%		
Through Traffic												
North to South		-8.3%										
North to South (Mexico)		136.0%										
South to North												
South to North (Mexico)		280.1%										
West to South		0.3%										
South to West		116.6%										
East to South		9.9%										
East to South (Mexico)		75.3%										
South to East		7.3%										
South to East (Mexico)		82.9%										
East to West		33.9%										
East to West (Mexico)		558.1%										
West to East		6.2%										
West to East (Mexico)		89.8%										

Table 5 - Percent Change in Other Commodity Carloads 2010 to 2035

Origin/Destination Counties	Frm North	Frm South	Frm South (Mexico)	Frm East	Frm West	Frm West (Mexico)	To North	To South	To South (Mexico)	To East	To West	To West (Mexico)	To Nueces	To Calhoun
Kleberg						164.3%								
Nueces	96.7%		172.1%	97.5%	310.5%	145.4%			77.2%	95.2%	84.5%	39.5%	-45.1%	
San Patricio				11.3%		111.9%				16.9%	-27.4%	10.9%		
Jim Wells						163.9%			35.8%		44.8%	35.8%		
Live Oak			172.1%			158.0%			137.4%			90.6%		
Aransas						172.1%								
Calhoun	19.9%			21.3%		155.6%			157.8%	-56.9%	-16.2%	102.6%		
Victoria			56.3%	101.3%		56.9%		67.0%	35.8%	-8.0%	95.7%	36.7%	24.8%	18.0%
DeWitt/Lavaca						158.7%						130.9%		
Jackson/Matagorda				50.8%		142.3%			129.3%	0.0%	48.7%	39.0%		
Wharton/Colorado						158.4%	70.2%		35.8%	132.1%		35.8%		
Fayette	71.0%			-46.1%	85.5%	157.9%								
Karnes						158.2%								
Gonzalez	74.2%			85.9%		154.4%								
Goliad												125.7%		
Bee						172.1%								
Through Traffic														
North to South		59.7%												
North to South (Mexico)		123.5%												
South to North		59.8%												
South to North (Mexico)		158.8%												
West to South		66.4%												
South to West		134.7%												
East to South		34.1%												
East to South (Mexico)		142.9%												
South to East		90.7%												
South to East (Mexico)		163.2%												
East to West		122.0%												
East to West (Mexico)		117.5%												
West to East		153.30%												
West to East (Mexico)		145.80%												

Table 6 - Percent Change in Number of Petrochemical Carloads 2010 to 2035

Origin/Destination Counties	Frm North	Frm South	Frm South (Mex.)	Frm East	Frm West	Frm West (Mex.)	To North	To South	To South (Mex.)	To East	To West	To West (Mex.)	To Nueces	To Calhoun	To Victoria	To DeWitt/Lavaca	To Jackson/Matagorda
Kleberg						13.6%											
Nueces	23.0%		13.6%		-25.2%	19.3%	4.0%	32.5%	248.1%	2.6%	37.8%	47.3%	151.5%				
San Patricio	-30.4%	8.5%	25.8%			38.2%	-53.2%		-51.6%	-47.7%	-52.4%	-51.6%		-36.1%			
Jim Wells						13.6%											
Live Oak			13.6%			23.8%		175.0%	-9.9%	51.2%	165.7%	-6.4%					
Aransas																	
Calhoun	29.4%		13.6%	80.8%	167.7%	13.6%	-2.9%	25.5%	471.6%	-2.5%	-1.0%	255.4%	21.9%	6.2%	-7.9%	-28.8%	
Victoria	-3.6%		13.6%			19.9%	-51.6%	-24.5%		-46.5%	-49.5%	-50.2%					
DeWitt/Lavaca						13.6%											
Jackson/Matagorda	62.3%		13.6%	-61.3%		13.6%	-24.1%	7.7%	-9.9%	-20.8%	-3.2%	-12.7%	4.6%	-8.8%	-21.0%		-19.5%
Wharton/Colorado						13.6%											
Fayette						13.6%											
Karnes																	
Gonzalez	22.2%					13.6%											
Through Traffic																	
North to South		-3.4%															
North to South (Mexico)		9.2%															
South to North																	
South to North (Mexico)		21.4%															
West to South		20.0%															
South to West		37.6%															
East to South		6.7%															
East to South (Mexico)		512.1%															
South to East		31.4%															
South to East (Mexico)		35.0%															
East to West		-2.5%															
East to West (Mexico)		307.5%															
West to East		45.2%															
West to East (Mexico)		45.8%															

Table 7. Percent Change in Number of Intermodal Units (2010 and 2035)

Origin/Destination Counties	Frm North	Frm South	Frm South (Mexico)	Frm East	Frm West	Frm West (Mexico)	To North	To South	To South (Mexico)	To East	To West	To West (Mexico)
Kleberg												
Nueces				171.8%							82.8%	
San Patricio												
Jim Wells												
Live Oak												
Aransas												
Calhoun												
Victoria												
DeWitt/Lavaca												
Jackson/Matagorda												
Wharton/Colorado												
Fayette												
Karnes												
Gonzales												
Through Traffic												
North to South												
North to South (Mexico)												
South to North												
South to North (Mexico)												
West to South		309.7%										
South to West		245.6%										
East to South		220.9%										
East to South (Mexico)												
South to East		200.1%										
South to East (Mexico)												
East to West												
East to West (Mexico)												
West to East												
West to East (Mexico)												

APPENDIX I – RAIL IMPROVEMENT CONSTRUCTION COST ESTIMATES

Improvement BA-1				
Odem, Texas				
Item	**Quantity**	**Units**	**Unit Price**	**Estimated Cost**
Trackwork				
Install #10 ML Power Turnout	2	EA	$300,000.00	$600,000.00
Construct New Track & Trackbed	711	TF	$200.00	$142,111.11
At-Grade Street Crossing	60	LF	$280.00	$16,800.00
Subtotal I				**$758,911.11**
Signal Work				
Relocate Active Warning Devices at Public Crossing	1	LS	$200,000.00	$200,000.00
CTC	1	LS	$160,000.00	$160,000.00
Subtotal II				**$360,000.00**
Structures				
None				$0.00
Subtotal III				**$0.00**
Drainage				
Perforated crossing drain	80	LF	$40.00	$3,200.00
24" CMP	40	LF	$175.00	$7,000.00
Subtotal IV				**$10,200.00**
Earthwork				
Clearing and Grubbing	0.9	Acre	$10,000.00	$9,000.00
Erosion Control	1500	LF	$6.00	$9,000.00
Seeding and Mulching	0.8	Acre	$2,500.00	$2,000.00
Cuts and Fills	150	CY	$25.00	$3,750.00
Subtotal V				**$23,750.00**
Utilities	1	LS	2.00%	$23,057.22
SW3P	1	LS	1.00%	$11,528.61
Right of Way				
Acquire Occupied Property	0.6	Acre	$300,000.00	$180,000.00
Demolish Existing 1-Story Structure	1800	SF	$9.00	$16,200.00
Relocate Mobile Facilities	1	LS	$50,000.00	$50,000.00
Subtotal VI				**$280,785.83**
Subtotal All Above Costs				**$1,433,646.94**
Contractor Mobilization	1	LS	5.00%	$71,682.35
Design Engineering and Permitting	1	LS	10.00%	$143,364.69
Construction Management	1	LS	8.00%	$114,691.76
Contingency	1	LS	20.00%	$286,729.39
Total Project Cost				**$2,050,115.13**
Total Project Cost (Rounded)				**$2,050,000.00**

Improvement BA-2				
Sinton, Texas				
Item	**Quantity**	**Units**	**Unit Price**	**Estimated Cost**
Trackwork				
Install #10 ML Power Turnout	2	EA	$300,000.00	$600,000.00
Construct New Track & Trackbed	979	TF	$200.00	$195,722.22
At-Grade Street Crossing	90	LF	$280.00	$25,200.00
Subtotal I				**$820,922.22**
Signal Work				
Relocate Active Warning Devices at Public Crossing	2	LS	$200,000.00	$400,000.00
CTC	1	LS	$180,000.00	$180,000.00
Subtotal II				**$580,000.00**
Structures				
None				$0.00
Subtotal III				**$0.00**
Drainage				
Perforated crossing drain	150	LF	$40.00	$6,000.00
24" CMP	60	LF	$175.00	$10,500.00
Subtotal IV				**$16,500.00**
Earthwork				
Clearing and Grubbing	1.4	Acre	$10,000.00	$14,348.03
Erosion Control	2500	LF	$6.00	$15,000.00
Seeding and Mulching	1.2	Acre	$2,500.00	$3,000.00
Cuts and Fills	150	CY	$25.00	$3,750.00
Subtotal V				**$36,098.03**
Utilities	1	LS	2.00%	$29,070.41
SW3P	1	LS	1.00%	$14,535.20
Right of Way				
Acquire Occupied Property	1.9	Acre	$300,000.00	$570,000.00
Demolish Existing 1-Story Structure	4500	SF	$9.00	$40,500.00
Remove Existing Track	300	LF	$20.00	$6,000.00
Relocation Expenses	1	LS	$100,000.00	$100,000.00
Subtotal VI				**$760,105.61**
Subtotal All Above Costs				**$2,213,625.86**
Contractor Mobilization	1	LS	5.00%	$110,681.29
Design Engineering and Permitting	1	LS	10.00%	$221,362.59
Construction Management	1	LS	8.00%	$177,090.07
Contingency	1	LS	20.00%	$442,725.17
Total Project Cost				**$3,165,484.98**
Total Project Cost (Rounded)				**$3,170,000.00**

Improvement BA-3				
Cranell, Texas				
Item	**Quantity**	**Units**	**Unit Price**	**Estimated Cost**
Trackwork				
Install #15 ML Power Turnout	2	EA	$400,000.00	$800,000.00
Construct New Track & Trackbed	10230	TF	$200.00	$2,046,000.00
At-Grade Street Crossing	16	LF	$280.00	$4,480.00
Subtotal I				**$2,850,480.00**
Signal Work				
CTC	1	LS	$1,000,000.00	$1,000,000.00
Subtotal II				**$1,000,000.00**
Structures				
None				$0.00
Subtotal III				**$0.00**
Drainage				
Perforated crossing drain	30	LF	$40.00	$1,200.00
24" CMP	0	LF	$175.00	$0.00
Subtotal IV				**$1,200.00**
Earthwork				
Clearing and Grubbing	12.1	Acre	$10,000.00	$121,000.00
Erosion Control	10600	LF	$6.00	$63,600.00
Seeding and Mulching	9.7	Acre	$2,500.00	$24,250.00
Cuts and Fills	15600	CY	$25.00	$390,000.00
Subtotal V				**$598,850.00**
Utilities	1	LS	2.00%	$89,010.60
SW3P	1	LS	1.00%	$44,505.30
Right of Way				
Acquire Occupied Property		Acre	$300,000.00	$0.00
Demolish Existing 1-Story Structure		SF		$0.00
Remove Existing Track		LF	$20.00	$0.00
Relocation Expenses		LS		$0.00
Subtotal VI				**$133,515.90**
Subtotal All Above Costs				**$4,584,045.90**
Contractor Mobilization	1	LS	5.00%	$229,202.30
Design Engineering and Permitting	1	LS	10.00%	$458,404.59
Construction Management	1	LS	8.00%	$366,723.67
Contingency	1	LS	20.00%	$916,809.18
Total Project Cost				**$6,555,185.64**
Total Project Cost (Rounded)				**$6,560,000.00**

Improvement BA-4				
Woodsboro, Texas				
Item	**Quantity**	**Units**	**Unit Price**	**Estimated Cost**
Trackwork				
Install #15 ML Power Turnout	2	EA	$400,000.00	$800,000.00
Realign Existing Siding	300	TF	$45.00	$13,500.00
At-Grade Street Crossing		LF	$280.00	$0.00
Subtotal I				**$813,500.00**
Signal Work				
CTC	1	LS	$1,000,000.00	$1,000,000.00
Subtotal II				**$1,000,000.00**
Structures				
None				$0.00
Subtotal III				**$0.00**
Drainage				
Perforated crossing drain	0	LF	$40.00	$0.00
24" CMP	0	LF	$175.00	$0.00
Subtotal IV				**$0.00**
Earthwork				
Clearing and Grubbing	0.0	Acre	$10,000.00	$0.00
Erosion Control	0	LF	$6.00	$0.00
Seeding and Mulching	0.0	Acre	$2,500.00	$0.00
Cuts and Fills	0	CY	$25.00	$0.00
Subtotal V				**$0.00**
Utilities	1	LS	0.00%	$0.00
SW3P	1	LS	0.00%	$0.00
Right of Way				
Acquisition	0.5	Acre	$100,000.00	$50,000.00
Demolish Existing 1-Story Structure		SF		$0.00
Remove Existing Track		LF		$0.00
Relocation Expenses		LS		$0.00
Subtotal VI				**$50,000.00**
Subtotal All Above Costs				**$1,863,500.00**
Contractor Mobilization	1	LS	5.00%	$93,175.00
Design Engineering and Permitting	1	LS	10.00%	$186,350.00
Construction Management	1	LS	8.00%	$149,080.00
Contingency	1	LS	20.00%	$372,700.00
Total Project Cost				**$2,664,805.00**
Total Project Cost (Rounded)				**$2,660,000.00**

Improvement BA-5				
Greta, Texas				
Item	**Quantity**	**Units**	**Unit Price**	**Estimated Cost**
Trackwork				
Install #15 ML Power Turnout	2	EA	$400,000.00	$800,000.00
Realign Existing Siding	300	TF	$30.00	$9,000.00
At-Grade Street Crossing		LF	$280.00	$0.00
Subtotal I				**$809,000.00**
Signal Work				
CTC	1	LS	$1,000,000.00	$1,000,000.00
Subtotal II				**$1,000,000.00**
Structures				
None				$0.00
Subtotal III				**$0.00**
Drainage				
Perforated crossing drain	0	LF	$40.00	$0.00
24" CMP	0	LF	$175.00	$0.00
Subtotal IV				**$0.00**
Earthwork				
Clearing and Grubbing	0.0	Acre	$10,000.00	$0.00
Erosion Control	0	LF	$6.00	$0.00
Seeding and Mulching	0.0	Acre	$2,500.00	$0.00
Cuts and Fills	0	CY	$25.00	$0.00
Subtotal V				**$0.00**
Utilities	1	LS	0.00%	$0.00
SW3P	1	LS	0.00%	$0.00
Right of Way				
Acquisition	0.5	Acre	$100,000.00	$50,000.00
Demolish Existing 1-Story Structure		SF		$0.00
Remove Existing Track		LF		$0.00
Relocation Expenses		LS		$0.00
Subtotal VI				**$50,000.00**
Subtotal All Above Costs				**$1,859,000.00**
Contractor Mobilization	1	LS	5.00%	$92,950.00
Design Engineering and Permitting	1	LS	10.00%	$185,900.00
Construction Management	1	LS	8.00%	$148,720.00
Contingency	1	LS	20.00%	$371,800.00
Total Project Cost				**$2,658,370.00**
Total Project Cost (Rounded)				**$2,660,000.00**

Improvement BA-6				
Bloomington, Texas				
Item	**Quantity**	**Units**	**Unit Price**	**Estimated Cost**
Trackwork				
Install #10 ML Power Turnout	5	EA	$300,000.00	$1,500,000.00
Install #15 ML Power Turnout	1	EA	$400,000.00	$400,000.00
Remove Ex. #10 Turnout	2	EA	$40,000.00	$80,000.00
Construct New Track & Trackbed	4262	TF	$200.00	$852,400.00
Realign Existing Siding	500	TF	$45.00	$22,500.00
At-Grade Street Crossing	30	LF	$280.00	$8,400.00
Subtotal I				**$2,863,300.00**
Signal Work				
Relocate Active Warning Devices at Public Crossing	1	LS	$200,000.00	$200,000.00
Interlock and Signal Siding	1	LS	$750,000.00	$750,000.00
Subtotal II				**$950,000.00**
Structures				
Br. 219.80	55	TF	$4,800.00	$264,000.00
Subtotal III				**$264,000.00**
Drainage				
Perforated crossing drain	0	LF	$40.00	$0.00
24" CMP	0	LF	$175.00	$0.00
Subtotal IV				**$0.00**
Earthwork				
Clearing and Grubbing	5.5	Acre	$10,000.00	$55,000.00
Erosion Control	5000	LF	$6.00	$30,000.00
Seeding and Mulching	3.3	Acre	$2,500.00	$8,250.00
Cuts and Fills	900	CY	$25.00	$22,500.00
Subtotal V				**$115,750.00**
Utilities	1	LS	2.00%	$83,861.00
SW3P	1	LS	1.00%	$41,930.50
Right of Way				
Acquisition	0.5	Acre	$100,000.00	$50,000.00
Demolish Existing 1-Story Structure		SF		$0.00
Remove Existing Track		LF		$0.00
Relocation Expenses		LS		$0.00
Subtotal VI				**$175,791.50**
Subtotal All Above Costs				**$4,368,841.50**
Contractor Mobilization	1	LS	5.00%	$218,442.08
Design Engineering and Permitting	1	LS	10.00%	$436,884.15
Construction Management	1	LS	8.00%	$349,507.32
Contingency	1	LS	20.00%	$873,768.30
Total Project Cost				**$6,247,443.35**
Total Project Cost (Rounded)				**$6,250,000.00**

Improvement BA-7				
Bloomington, Texas				
Item	**Quantity**	**Units**	**Unit Price**	**Estimated Cost**
Trackwork				
Install #15 ML Power Turnout	1	EA	$400,000.00	$400,000.00
Install #10 ML Power Turnout	1	EA	$300,000.00	$300,000.00
Relocated #10 ML Turnout	1	EA	$75,000.00	$75,000.00
Construct New Track & Trackbed	25000	TF	$200.00	$5,000,000.00
Realign Existing Siding	450	TF	$45.00	$20,250.00
At-Grade Street Crossing	124	LF	$280.00	$34,720.00
Subtotal I				**$5,829,970.00**
Signal Work				
Relocate Active Warning Devices at Public Crossing	2	LS	$200,000.00	$400,000.00
Install Electric Locks and Derails at Turnout	3	EA	$30,000.00	$90,000.00
Relocate Signal Equipment	1	LS	$100,000.00	$100,000.00
Signal Control for New Siding and Interlockings	1	LS	$1,850,000.00	$1,850,000.00
Subtotal II				**$2,440,000.00**
Structures				
Br. 221.4	108	LF	$4,800.00	$518,400.00
Br. 222.3	54	LF	$4,800.00	$259,200.00
Br. 223.0	54	LF	$4,800.00	$259,200.00
Subtotal III				**$1,036,800.00**
Drainage				
Perforated crossing drain	200	LF	$40.00	$8,000.00
24" CMP	0	LF	$175.00	$0.00
Subtotal IV				**$8,000.00**
Earthwork				
Clearing and Grubbing	29.1	Acre	$10,000.00	$291,000.00
Erosion Control	25300	LF	$6.00	$151,800.00
Seeding and Mulching	23.3	Acre	$2,500.00	$58,250.00
Cuts and Fills	37500	CY	$25.00	$937,500.00
Subtotal V				**$1,438,550.00**
Utilities	1	LS	2.00%	$215,066.40
SW3P	1	LS	1.00%	$107,533.20
Right of Way				
Acquisition	4.8	Acre	$100,000.00	$480,000.00
Demolish Existing 1-Story Structure		SF		$0.00
Remove Existing Track		LF		$0.00
Relocation Expenses		LS		$0.00
Subtotal VI				**$802,599.60**
Subtotal All Above Costs				**$11,555,919.60**
Contractor Mobilization	1	LS	5.00%	$577,795.98
Design Engineering and Permitting	1	LS	10.00%	$1,155,591.96
Construction Management	1	LS	8.00%	$924,473.57
Contingency	1	LS	20.00%	$2,311,183.92
Total Project Cost				**$16,524,965.03**
Total Project Cost (Rounded)				**$16,520,000.00**

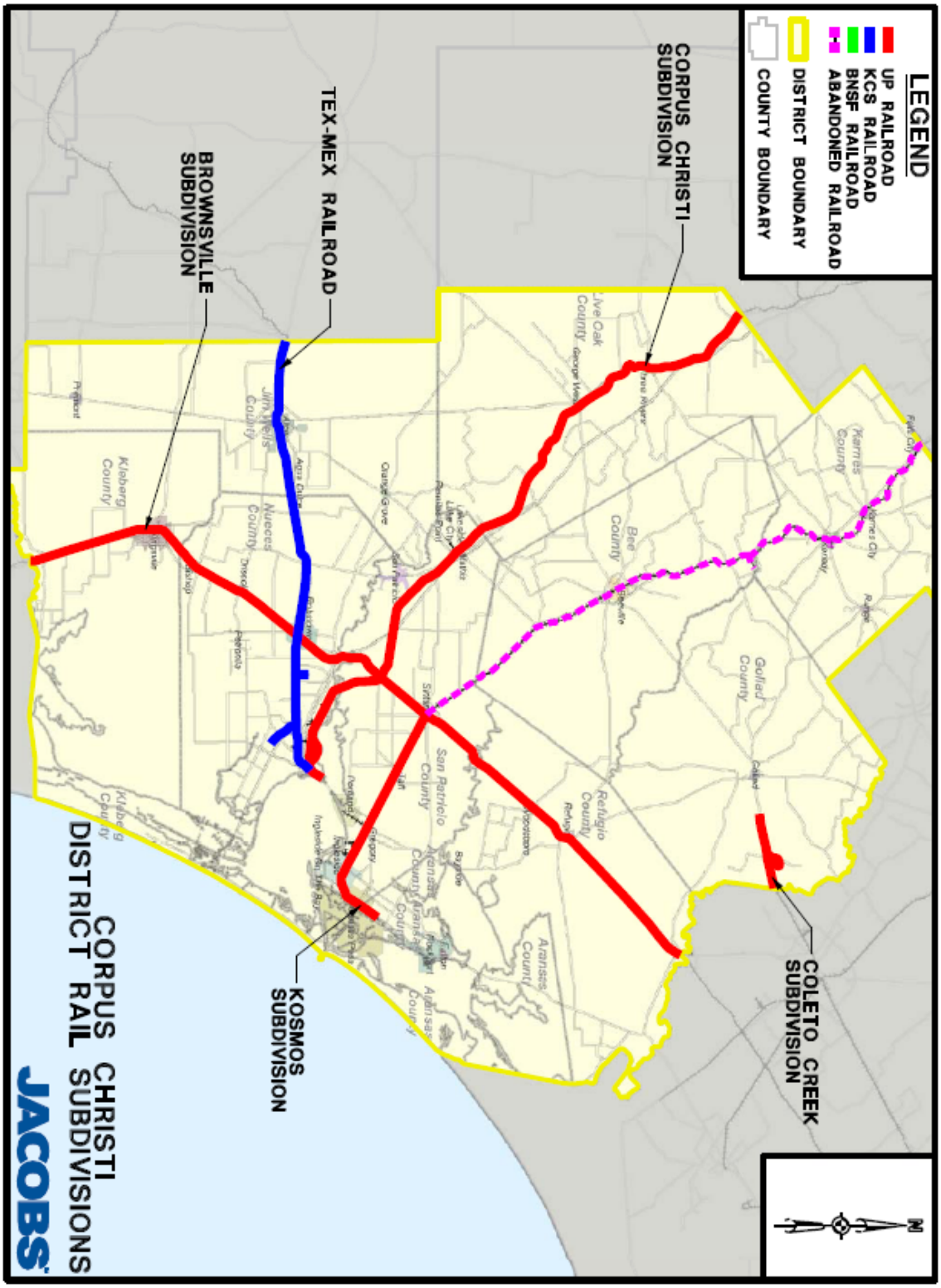
Improvement BA-8				
Bay City, Texas				
Item	**Quantity**	**Units**	**Unit Price**	**Estimated Cost**
Trackwork				
Install #15 ML Power Turnout	1	EA	$400,000.00	$400,000.00
Install #10 ML Power Turnout	4	EA	$300,000.00	$1,200,000.00
Remove #10 Turnout	6	EA	$40,000.00	$240,000.00
Remove Existing Siding	2400	LF	$20.00	$48,000.00
Construct New Track & Trackbed	3300	TF	$200.00	$660,000.00
At-Grade Street Crossing	210	LF	$280.00	$58,800.00
Subtotal I				**$2,606,800.00**
Signal Work				
Relocate Active Warning Devices at Public Crossing	10	LS	$200,000.00	$2,000,000.00
Install Electric Locks and Derails at Turnout	2	EA	$30,000.00	$60,000.00
CTC	1	LS	$600,000.00	$600,000.00
Subtotal II				**$2,660,000.00**
Structures				
None		LF		$0.00
Subtotal III				**$0.00**
Drainage				
Perforated crossing drain	300	LF	$40.00	$12,000.00
24" CMP	0	LF	$175.00	$0.00
Subtotal IV				**$12,000.00**
Earthwork				
Clearing and Grubbing	4.2	Acre	$10,000.00	$42,000.00
Erosion Control	3700	LF	$6.00	$22,200.00
Seeding and Mulching	3.4	Acre	$2,500.00	$8,500.00
Cuts and Fills	5500	CY	$25.00	$137,500.00
Subtotal V				**$210,200.00**
Utilities	1	LS	2.00%	$109,780.00
SW3P	1	LS	1.00%	$54,890.00
Right of Way				
Acquisition - In-town Right-of-Way	0.8	Acre	$200,000.00	$160,000.00
Subtotal VI				**$324,670.00**
Subtotal All Above Costs				**$5,813,670.00**
Contractor Mobilization	1	LS	5.00%	$290,683.50
Design Engineering and Permitting	1	LS	10.00%	$581,367.00
Construction Management	1	LS	8.00%	$465,093.60
Contingency	1	LS	20.00%	$1,162,734.00
Total Project Cost				**$8,313,548.10**
Total Project Cost (Rounded)				**$8,310,000.00**

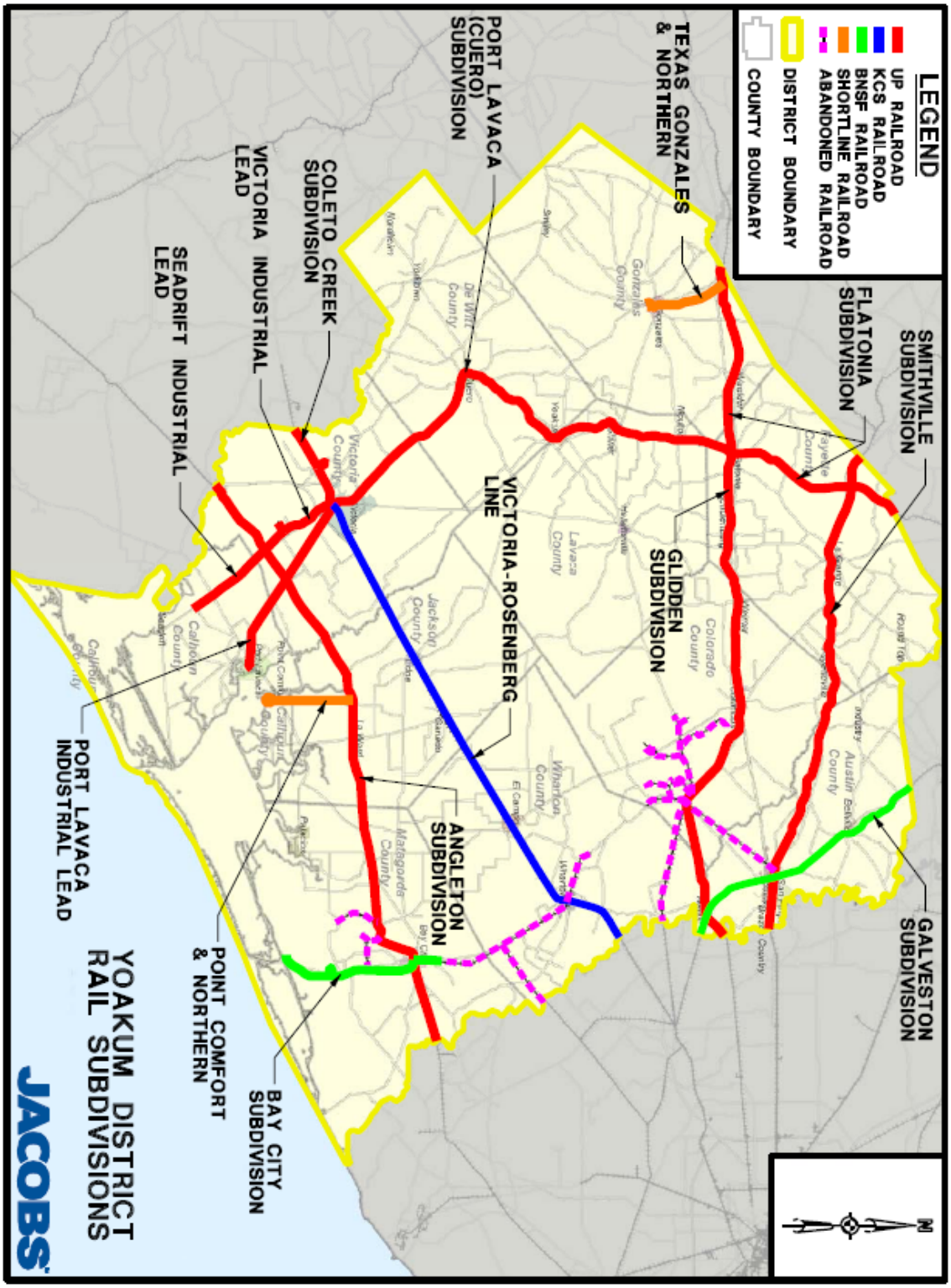
Improvement C-1				
DaCosta, Texas				
Item	**Quantity**	**Units**	**Unit Price**	**Estimated Cost**
Trackwork				
Install #15 ML Power Turnout	2	EA	$400,000.00	$800,000.00
Construct New Track & Trackbed	10230	TF	$200.00	$2,046,000.00
At-Grade Street Crossing	64	LF	$280.00	$17,920.00
Subtotal I				**$2,863,920.00**
Signal Work				
Relocate Active Warning Devices at Public Crossing	2	LS	$200,000.00	$400,000.00
CTC	1	LS	$1,000,000.00	$1,000,000.00
Subtotal II				**$1,400,000.00**
Structures				
None				$0.00
Subtotal III				**$0.00**
Drainage				
Perforated crossing drain	100	LF	$40.00	$4,000.00
Extend Culverts	60	LF	$175.00	$10,500.00
Subtotal IV				**$14,500.00**
Earthwork				
Clearing and Grubbing	12.1	Acre	$10,000.00	$121,000.00
Erosion Control	10600	LF	$6.00	$63,600.00
Seeding and Mulching	9.7	Acre	$2,500.00	$24,250.00
Cuts and Fills	15600	CY	$25.00	$390,000.00
Subtotal V				**$598,850.00**
Utilities	1	LS	2.00%	$97,545.40
SW3P	1	LS	1.00%	$48,772.70
Right of Way				
Acquire Occupied Property		Acre	$300,000.00	$0.00
Demolish Existing 1-Story Structure		SF		$0.00
Remove Existing Track		LF	$20.00	$0.00
Relocation Expenses		LS		$0.00
Subtotal VI				**$146,318.10**
Subtotal All Above Costs				**$5,023,588.10**
Contractor Mobilization	1	LS	5.00%	$251,179.41
Design Engineering and Permitting	1	LS	10.00%	$502,358.81
Construction Management	1	LS	8.00%	$401,887.05
Contingency	1	LS	20.00%	$1,004,717.62
Total Project Cost				**$7,183,730.99**
Total Project Cost (Rounded)				**$7,180,000.00**

Improvement G-1				
Engle, Texas				
Item	**Quantity**	**Units**	**Unit Price**	**Estimated Cost**
Trackwork				
Install #15 ML Power Turnout	2	EA	$400,000.00	$800,000.00
Construct New Track & Trackbed	10230	TF	$200.00	$2,046,000.00
At-Grade Street Crossing	110	LF	$280.00	$30,800.00
Subtotal I				**$2,876,800.00**
Signal Work				
Relocate Active Warning Devices at Public Crossing	1	LS	$200,000.00	$200,000.00
CTC	1	LS	$1,000,000.00	$1,000,000.00
Subtotal II				**$1,200,000.00**
Structures				
Br. 112.88	44	LF	$4,800.00	$211,200.00
Br. 112.38	45	LF	$4,800.00	$216,000.00
Br. 111.49	64	LF	$4,800.00	$307,200.00
Subtotal III				**$734,400.00**
Drainage				
Perforated crossing drain	150	LF	$40.00	$6,000.00
Extend Culverts	180	LF	$175.00	$31,500.00
Subtotal IV				**$37,500.00**
Earthwork				
Clearing and Grubbing	12.1	Acre	$10,000.00	$121,000.00
Erosion Control	10600	LF	$6.00	$63,600.00
Seeding and Mulching	9.7	Acre	$2,500.00	$24,250.00
Cuts and Fills	15600	CY	$25.00	$390,000.00
Subtotal V				**$598,850.00**
Utilities	1	LS	2.00%	$108,951.00
SW3P	1	LS	1.00%	$54,475.50
Right of Way				
Acquisition	1.8	Acre	$100,000.00	$180,000.00
Subtotal VI				**$343,426.50**
Subtotal All Above Costs				**$5,790,976.50**
Contractor Mobilization	1	LS	5.00%	$289,548.83
Design Engineering and Permitting	1	LS	10.00%	$579,097.65
Construction Management	1	LS	8.00%	$463,278.12
Contingency	1	LS	20.00%	$1,158,195.30
Total Project Cost				**$8,281,096.40**
Total Project Cost (Rounded)				**$8,280,000.00**

Improvement S-1				
Wendt, Texas				
Item	**Quantity**	**Units**	**Unit Price**	**Estimated Cost**
Trackwork				
Install #15 ML Power Turnout	2	EA	$400,000.00	$800,000.00
Construct New Track & Trackbed	10230	TF	$200.00	$2,046,000.00
At-Grade Street Crossing	120	LF	$280.00	$33,600.00
Subtotal I				**$2,879,600.00**
Signal Work				
Relocate Active Warning Devices at Public Crossing	3	LS	$200,000.00	$600,000.00
CTC	1	LS	$1,000,000.00	$1,000,000.00
Add Detector on Siding - MP 85.70	1	EA	$100,000.00	$100,000.00
Subtotal II				**$1,700,000.00**
Structures				
Br. 86.80	99	LF	$4,800.00	$475,200.00
Subtotal III				**$475,200.00**
Drainage				
Perforated crossing drain	160	LF	$40.00	$6,400.00
Subtotal IV				**$6,400.00**
Earthwork				
Clearing and Grubbing	12.1	Acre	$10,000.00	$121,000.00
Erosion Control	10600	LF	$6.00	$63,600.00
Seeding and Mulching	9.7	Acre	$2,500.00	$24,250.00
Cuts and Fills	15600	CY	$25.00	$390,000.00
Subtotal V				**$598,850.00**
Utilities	1	LS	2.00%	$113,201.00
SW3P	1	LS	1.00%	$56,600.50
Right of Way				
Acquisition	1.8	Acre	$100,000.00	$180,000.00
Subtotal VI				**$349,801.50**
Subtotal All Above Costs				**$6,009,851.50**
Contractor Mobilization	1	LS	5.00%	$300,492.58
Design Engineering and Permitting	1	LS	10.00%	$600,985.15
Construction Management	1	LS	8.00%	$480,788.12
Contingency	1	LS	20.00%	$1,201,970.30
Total Project Cost				**$8,594,087.65**
Total Project Cost (Rounded)				**$8,590,000.00**

APPENDIX J – MISCELLANEOUS EXHIBITS

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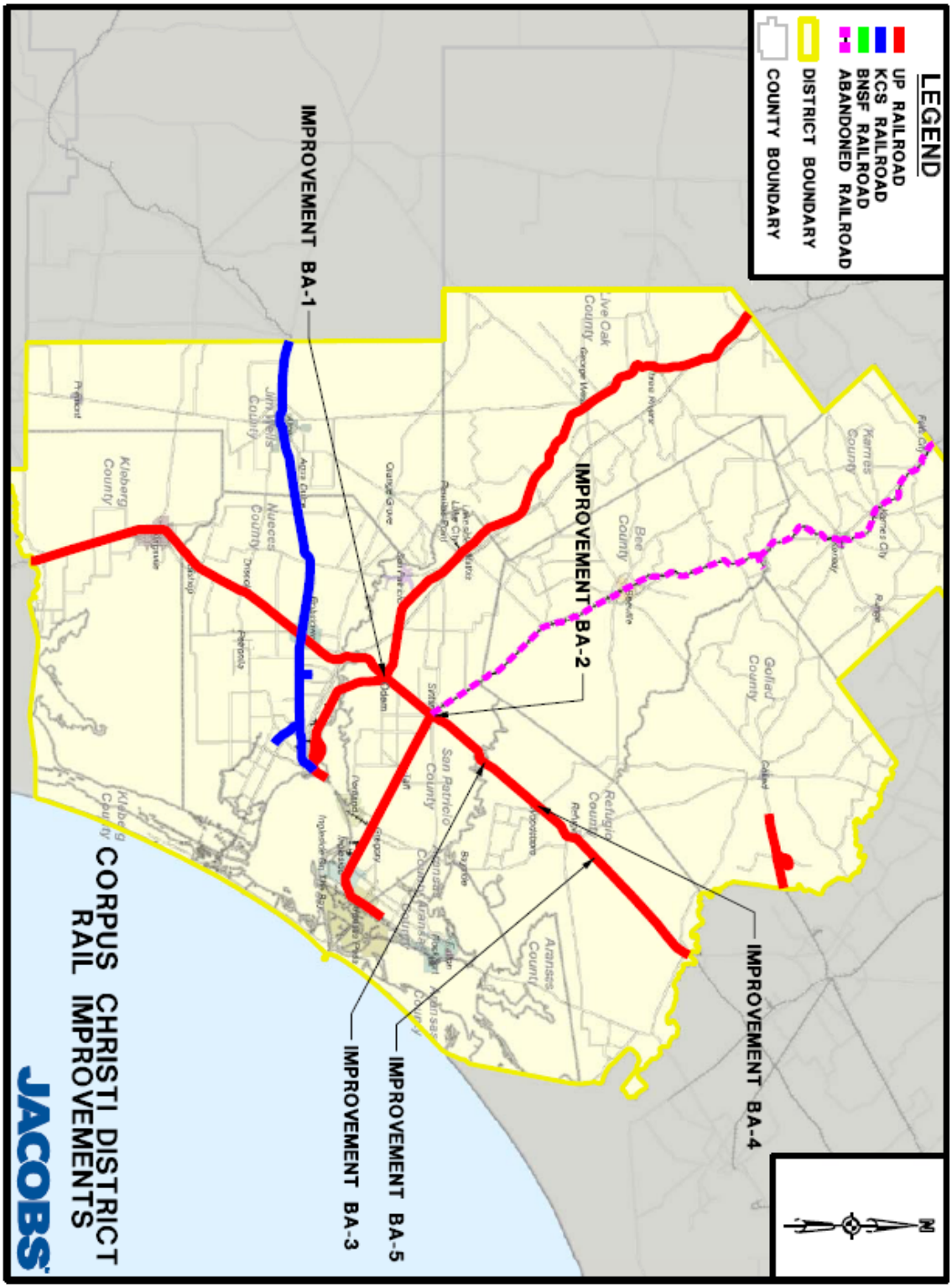
KCS RAILROAD
BNSF RAILROAD
SHORTLINE RAILROAD
ABANDONED RAILROAD
DISTRICT BOUNDARY
COUNTY BOUNDARY
SMITHVILLE SUBDIVISION
FLATONIA SUBDIVISION
GALVESTON SUBDIVISION
TEXAS GONZALES & NORTHERN
GLIDDEN SUBDIVISION
PORT LAVACA (CUERO) SUBDIVISION
VICTORIA-ROSENBERG LINE
COLETO CREEK SUBDIVISION
VICTORIA INDUSTRIAL LEAD
ANGLETON SUBDIVISION
SEADRIFT INDUSTRIAL LEAD
POINT COMFORT & NORTHERN
BAY CITY SUBDIVISION
PORT LAVACA INDUSTRIAL LEAD
YOAKUM DISTRICT RAIL SUBDIVISIONS
JACOBS
Gonzales County
Lavaca County
Colorado County
Fayette County
Austin County
Wharton County
Jackson County
Matagorda County
Victoria County
Calhoun County
Refugio County
Goliad County
Bee County
Karnes County
Wilson County
Dewitt County
Lavaca County
Gonzales
Cuero
Yoakum
Shiner
Moulton
Hallettsville
Weimar
Columbus
Rosenberg
Richmond
Wharton
Angleton
Victoria
Port Lavaca
Point Comfort
Calhoun
Palacios
Bay City
Edna
Ganado
Inez
Yorktown
Karnes City
Kenedy
Goliad
Refugio
Sinton
Mathis
Beeville
Pettus
Pleasanton
Poteet
Floresville
Stockdale
Seguin
Luling
Gonzales
Flatonia
Schulenburg
Fayetteville
La Grange
Hallettsville
Shiner
Yoakum
Cuero
Victoria
Port Lavaca
Point Comfort
Palacios
Bay City
Angleton
Rosenberg
Richmond
Wharton
Columbus
Weimar
Eagle Lake
Sealy
Brenham
Giddings
Smithville
Bastrop
Elgin
Taylor
Hutto
Round Rock
Austin
Bellville
Sealy
Hempstead
Waller
Prairie View
Hempstead
Brenham
Navasota
Bryan
College Station
Caldwell
Lockhart
San Marcos
Kyle
Buda
Dripping Springs
Wimberley
Blanco
Johnson City
Fredericksburg
Boerne
Comfort
Kerrville
Ingram
Hunt
Center Point
Bandera
Medina
Pipe Creek
Hondo
Castroville
Devine
Jourdanton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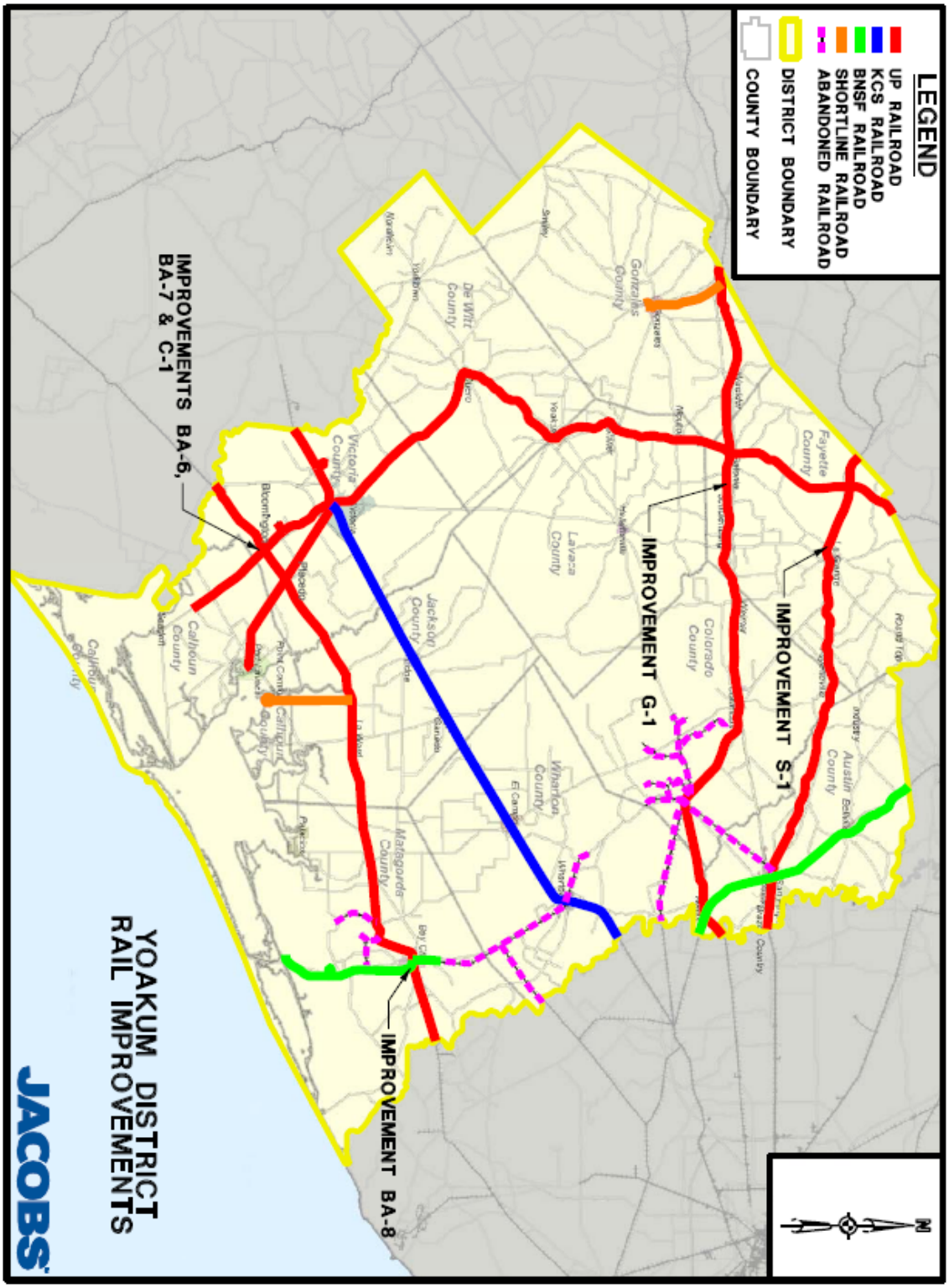
BNSF RAILROAD
ABANDONED RAILROAD
DISTRICT BOUNDARY
COUNTY BOUNDARY
IMPROVEMENT BA-1
IMPROVEMENT BA-2
IMPROVEMENT BA-3
IMPROVEMENT BA-4
IMPROVEMENT BA-5
CORPUS CHRISTI DISTRICT
RAIL IMPROVEMENTS
JACOBS
Live Oak County
Bee County
Karnes County
Goliad County
Refugio County
Aransas County
San Patricio County
Nueces County
Jim Wells County
Kleberg County
N


LEGEND
UP RAILROAD
KCS RAILROAD
BNSF RAILROAD
SHORTLINE RAILROAD
ABANDONED RAILROAD
DISTRICT BOUNDARY
COUNTY BOUNDARY
IMPROVEMENT S-1
IMPROVEMENT G-1
IMPROVEMENT BA-8
IMPROVEMENTS BA-6, BA-7 & C-1
Fayette County
Austin County
Colorado County
Gonzales County
Lavaca County
Wharton County
Jackson County
Matagorda County
Victoria County
DeWitt County
Calhoun County
YOAKUM DISTRICT
RAIL IMPROVEMENTS
JACOBS