TEXAS DEPARTMENT OF TRANSPORTATION

Economic Feasibility of Relocating Hazardous Materials Transported by Freight Rail

FOR PUBLIC DISTRIBUTION

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HNTB

Final Report **March 1, 2008**

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EXECUTIVE SUMMARY

Purpose and Need

On June 15, 2007, Governor Rick Perry signed House Bill 160 (HB 160) from the 80th Texas Legislature which directed the Texas Department of Transportation (TxDOT) to conduct a study to determine the economic feasibility of relocating freight trains that carry hazardous materials away from residential areas of the state in municipalities with a population of more than 1.2 million. Municipalities with populations over 1.2 million in the state of Texas consist of the areas inside the city limits of Houston, San Antonio, and the Dallas/Fort Worth Metroplex. This study, presented to the Governor and Texas Legislature on March 1, 2008, includes an evaluation of cost options for the relocation of freight trains from urban residential areas in Houston, San Antonio, and Dallas-Fort Worth.

TxDOT has been conducting freight studies identifying potential rail improvements and alternate alignments in various regions of the state that include Houston, San Antonio, and the Dallas-Fort Worth Metroplex. Building upon the information from these studies, potential relocations, realignments, and improvements to the existing railroad infrastructure have been analyzed to determine which alternatives may reduce the potential of hazardous material exposure to metropolitan residential areas.

The need to study this important issue is exemplified by some of the recent derailments and hazardous material releases that have occurred in the San Antonio region. In May 2004, a derailment near Brackenridge High School injured three people and spilled 5,600 gallons of diesel fuel along the San Antonio River. In June 2004, two freight trains collided southwest of San Antonio in Macdona that resulted in three fatalities and over 40 injuries due to the release of chlorine. Preliminary property damage and environmental clean-up costs were estimated to exceed $7 million.

Despite these high profile incidents, the amount of hazardous material transported by rail is relatively small when compared to other modes of transportation such as truck, pipeline, and waterway. Moreover, the current statewide trend shows a decrease in the number of reported rail incidents involving hazardous material from 154 incidents in 2000 to 83 incidents in 2005.

Confidentiality

This study assesses many factors, including the amount and type of hazardous materials that are transported on specific rail segments. These factors contributed to TxDOT's analysis of the economic feasibility of improvements such as potential relocations, realignments, and improvements to the existing railroad infrastructure. However, some of the factors also necessarily have the effect of assessing the vulnerability of rail segments to acts of terrorism or criminal activity. For that reason, TxDOT has prepared a public version of the study that omits information that would reveal the technical details of particular vulnerabilities. The omitted information is confidential under Texas Government Code Chapter 418.

Methodology

The purpose of this study is to evaluate rail freight movements and operations that transport hazardous materials within Houston, San Antonio, and Dallas-Fort Worth and identify alternative routes and/or alignments to divert or relocate train movements away from residential areas. The impact of hazardous material movements specific to residential areas was measured according to the number of rail carloads transported along a corridor through residential areas within calculated protective action distances for hazardous materials based on the Emergency Response Guide (ERG) published by the U. S. Department of Transportation.

The study analyzes the potential risk to the public by determining a statistical rate of release from a derailed hazardous material freight railcar by rail along each corridor in each metropolitan area. The potential exposure risk caused by a hazardous material release is determined by numerous factors that are often subject to a high degree of variability. The degree of the adverse effect depends upon factors such as the type of hazardous material, the volume of release, population density, location, time of day, and weather conditions.

Houston

Based on analysis of existing freight rail operations, the improvements analyzed to reduce the risk associated with hazardous material carloads moving through residential areas inside Houston are listed below with associated costs:

- Constructing a new rail corridor between Dayton and Cleveland that would reduce the number of BNSF trains that enter central Houston. Includes relocating carload switching operations at New South and Pearland Yards. Estimated Cost - $491 million. (See Figure A)
- Upgrading the condition of track per Federal Railroad Administration (FRA) standards to FRA designated Class 4 track along existing rail lines. Estimated Cost - $35.7 million.

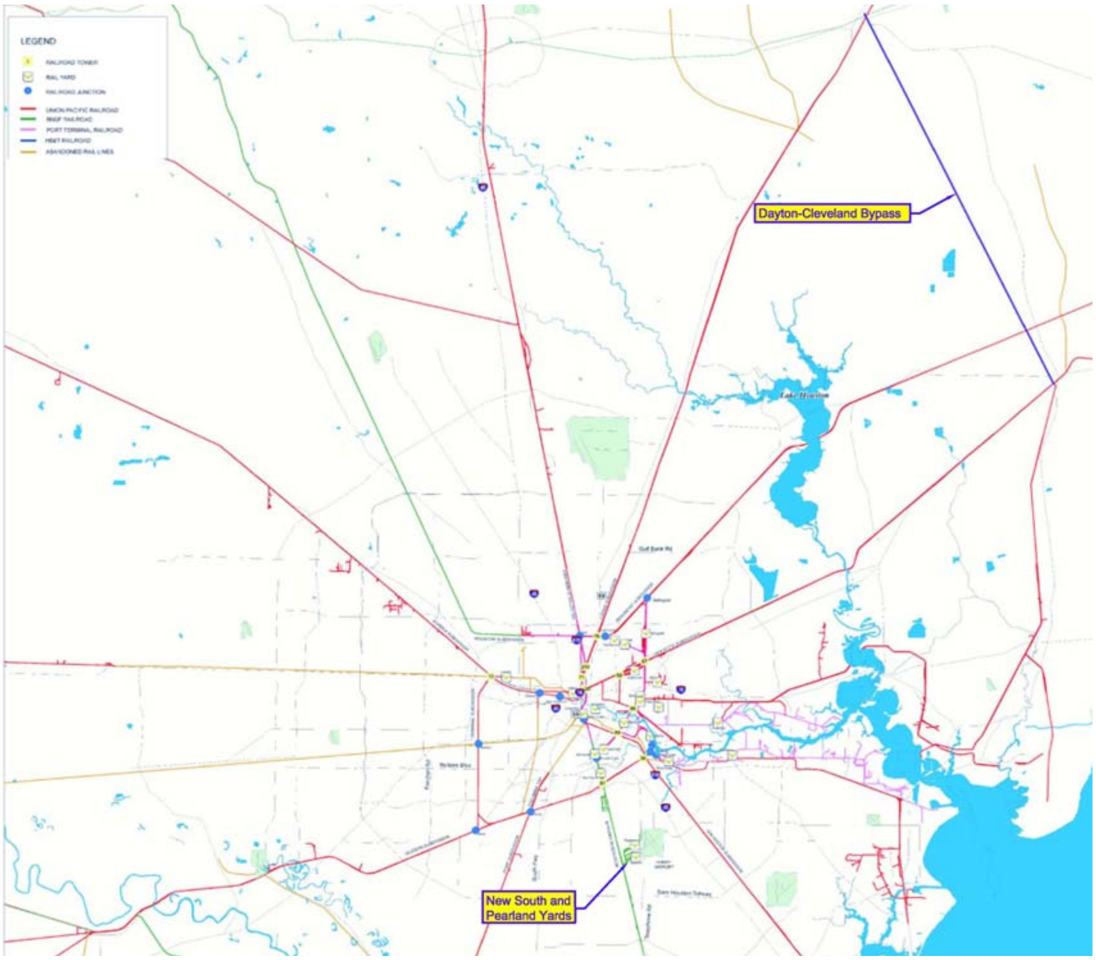

Figure A: Potential New Rail Subdivision between Dayton and Cleveland in the Houston Region

San Antonio

The potential improvements analyzed to reduce hazardous materials transported by rail through residential areas in San Antonio are listed below with associated costs:

- Shifting hazardous materials carloads from Austin Subdivision Mainline 1 to Mainline 2 within San Antonio. Estimated Cost: minimal, yet may impact railroad operations.
- Constructing a new double track rail corridor between Taylor and southwest of San Antonio to bypass San Antonio and other metropolitan areas between San Antonio and Taylor such as New Braunfels, San Marcos, and Austin. Estimated Cost: $2.0 billion. (See Figure B)
- Upgrading the condition of track to FRA designated Class 4 track along existing rail lines. Estimated Cost: $11.3 million.

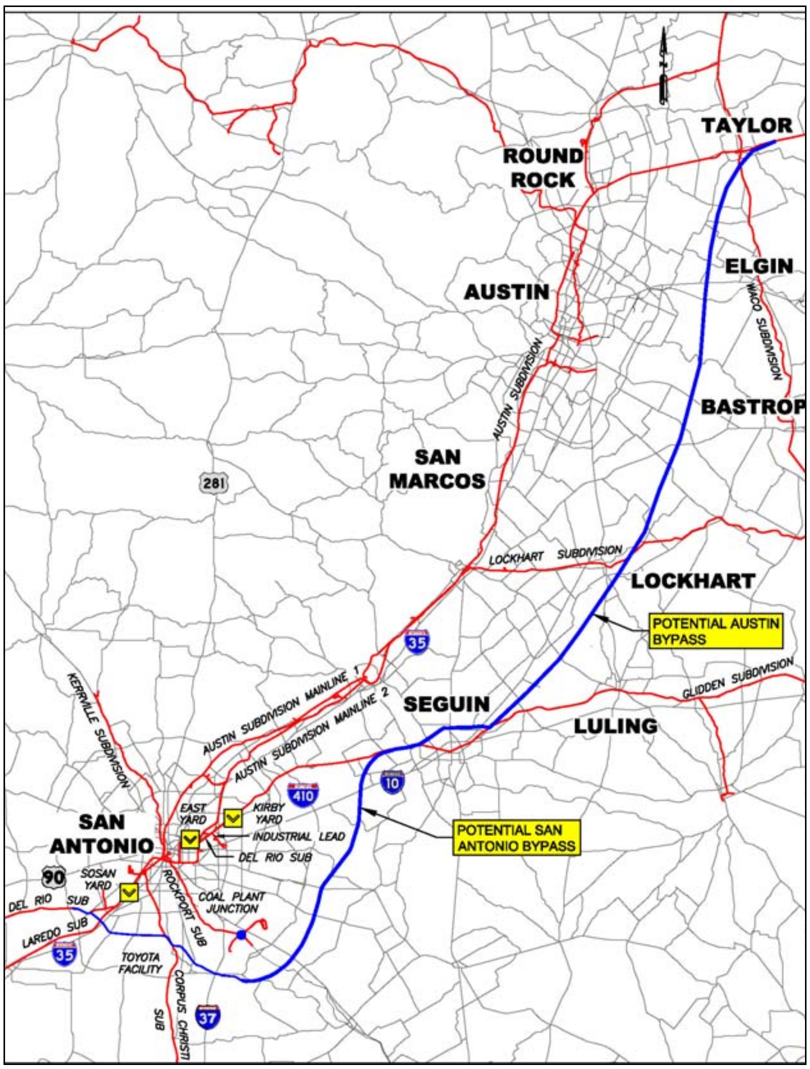

Figure B: Potential San Antonio Rail Bypass

Dallas/Fort Worth

The potential improvements analyzed to reduce hazardous materials transported by rail through residential areas in the Dallas-Fort Worth Metroplex are listed below with associated costs:

- Constructing a 169-mile single track corridor around the Metroplex. Estimated Cost: $1.5 billion. (See Figure C)
- Upgrading the condition of track to FRA designated Class 4 track along existing rail lines. Estimated Cost: $78.6 million.

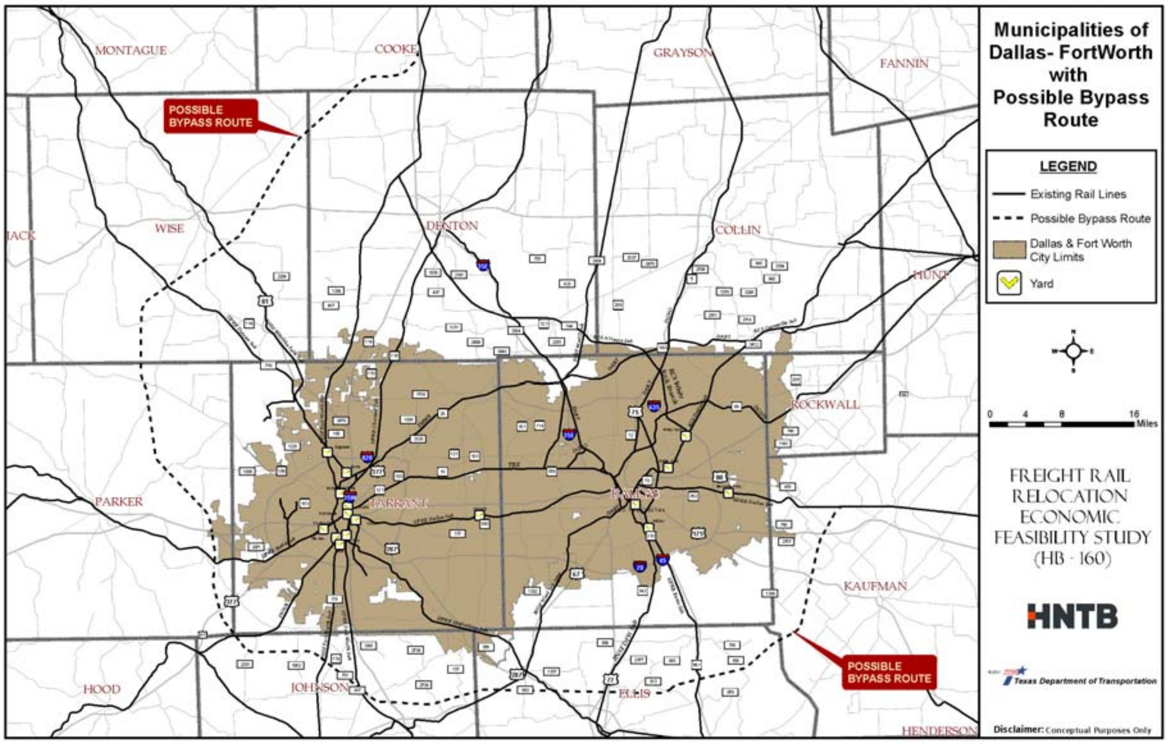

Figure C: Potential Alternate Bypass Route for the Dallas Fort Worth Metroplex

Financing Improvements

This report has not identified funding sources for any of the proposed capital improvements. However, on November 8, 2005, Texas voters approved Proposition 1 which created the Rail Relocation and Improvement Fund. Though not currently funded, this could serve as an effective funding mechanism for the proposed alternatives identified in this study and open the discussion for coordinating public-private partnerships with the railroad companies currently operating in Texas.

Summary

The benefits to the public of rail relocation not only include reducing the overall risk of exposure to transported hazardous material by moving the lines to less densely populated areas, but also include reducing delay times for truck and motor vehicles idling at roadway-rail crossings, improving air quality, and creating the potential to expand existing urban freight rail corridors to provide for passenger rail service and a choice for commuters traveling on congested roadways.

This report should serve as a companion document to the freight studies that have been developed or are currently being developed in various regions of the state. Local and state officials should continue to work with railroad companies to make improvements that benefit the citizens and support the economic development of the state of Texas.

DEFINITION OF TERMS

Absolute Block – A length of track in which no train or engine is permitted to enter while it is occupied by another train or engine.

Automatic Block Signal System (ABS) – A series of consecutive blocks governed by block signals, cab signals or both, actuated by a train, engine or by certain conditions affecting the use of a block.

Bad Order – A piece of rolling stock that needs repair.

Block – A length of track between consecutive block signals or from a block signal to the end of block system limits, governed by block signals, cab signals or both.

Boxcar – An enclosed car used for general service and especially for lading, which must be protected from weather.

Bulk transfer – The transfer of bulk products, such as plastic pellets or liquid sweeteners, from one mode of transportation to another. Bulk transfer permits off-rail shippers and receivers of varied commodities to combine rail's long-haul efficiencies with truck's convenient door-to-door delivery.

Branch Line – A secondary line of a railroad, not the main line

Capacity – General Capacity: Rail demand or volume. Factors affecting capacity for a railroad are numerous, but include, for example, the availability of train crews, locomotives, equipment, and track.

Line or Track Capacity – Maximum number of trains that can operate safely and reliably in each direction over a given segment of track during a given period of time.

Carload – Shipment of not less than five tons of one commodity.

Centralized Traffic Control (CTC) – A traffic control system where train movements are directed through the remote control of switches and signals from a central control point. This system enables trains to pass each other at sidings or interlockings without the need for train crews to stop and manually throw switches. The train operates on the authority of signal indications instead of the authority via timetable or train orders.

Class 1 Railroad – A railroad with annual gross operating revenue of at least $346.8 million in 2006.

Classification – Grouping of railcars in a yard in accordance with train movement requirements, usually by destination.

Classification Yard – A rail yard in which rail cars are classified and grouped in accordance with their movement requirement such as kind, contents, and/or destination.

Container – A large, weatherproof box designed for shipping freight in bulk by rail, truck or steamship. Typically the box resembles a truck trailer, which is lifted onto a flatcar. Most containers are 20, 45, 48 or 53 feet in length.

Containers on Flat Cars (COFC) – Refers to Intermodal shipments where containers are moved on a railroad flat car. The movement is made without the container being mounted on a chassis.

Consist – The make-up of a freight train by types of cars and their contents.

Controlled Point (CP) – A location where switches and/or signals are remotely controlled by a control operator (dispatcher).

Cross-Over – Track that joins two main tracks. When a train moves from one main track to another, it "crosses over."

Cut, to – Separate car(s) from a train.

Diamond – The intersection of normally perpendicular tracks where only one track can be used at a time.

Division – A geographical unit of a railroad, the boundaries of which are designated by railroad timetables.

Double Track (DT) – Two main tracks, on one of which the current of traffic is typically in a specified direction, and on the other typically in the opposite direction.

Drill Track – A track connecting with the ladder track, over which locomotives and cars move back and forth in switching.

Flat Car – A freight car that has a floor without any housing or body above. Frequently used to carry containers and/or trailers, or oversized and odd-shaped commodities.

Grade Crossing – The crossing of highways, roadways, pedestrian walks or combinations of these, with railroad tracks at the same level.

Grade Separation – The separation of a grade crossing by either an underpass or overpass.

Haulage Rights – Rights obtained by one railroad to have its trains operated by another railroad over that railroad's tracks.

Hopper – A rail car with pockets, or hoppers, opening on the underside of the car for unloading bulk commodities.

House Track – A track entering, or along side a freight house. Cars are spotted here for loading or unloading.

Hump – The part of a gravity classification yard (hump yard) in which rail cars that have been pushed up a summit (hill) are cut off while in motion at the top of the hill. Gravity then pulls the rail cars down the hill switching it onto a predetermined track. The weight of the rail car, distance it must travel to the designated track, and it's location within the train that is being made-up, are all taken into consideration so the speed of the car can be adjusted through a series of retarders, or brakes, as the car moves down the hill toward the intended track.

Hump Yard – A yard in which rail cars are classified and forwarded to final destinations. The three components are a receiving yard, a classification yard in which railcars are pushed over a hump to various classification tracks, and a forwarding or departure yard.

Intermodal – Mode of rail transportation that covers the multi-modal transportation of trailers and/or containers by ship, rail, and truck.

Interchange – A track in which various cars are delivered or received from one railroad to another.

Interchange Point – The point at which two or more railroads join. Traffic is passed from one road to another at interchange points.

Interlocking – An arrangement of signal appliances so interconnected that their movements must succeed each other in proper sequence. It may be operated manually or automatically.

Junction – The convergence of two or more railroad lines. Typically a Junction is a Controlled Point as well.

Ladder Track – A diagonal track in a rail yard configuration that typically intersects all tracks, connecting each by means of switches.

Local Train – A train with an assigned crew that works between pre-designated points normally picking up or dropping off railcars to the railroad customer base within the area.

Locomotive – Locomotives are units propelled by any form of energy, or a combination of such units operated from a single control station, used in train or yard service.

Mainline – Primary rail line over which trains operate between terminals. It excludes sidings, and yard and industry tracks.

Manifest – Train made up of mixed railcars (box, tank, piggyback cars, etc.).

Mile Post – A post or sign on a pole each mile along the track that shows the distance from a predefined location such as a major rail terminal.

Multiple Main Tracks – Two or more main tracks, the use of which is designated in the timetable. Two main tracks are commonly referred to as double track. The tracks run parallel and may accommodate traffic in either direction. Typically, on one track the current of traffic is typically in a specified direction, and on the other track(s) typically in the opposite direction.

Piggyback – Slang term for the transportation of a highway trailer on a railroad flat car.

Ramp – Slang term for an intermodal terminal where trailers and containers are lifted onto or off of railcars.

Restricted Speed – The maximum operating speed of a train, not exceeding 20 MPH, which will permit the engineer to stop the train within one half the range of sight; short of other trains, engines, railroad cars, stop signals, derails or switches not properly lined, while concurrently being on the look-out for track infrastructure irregularities such as a broken rail. Train movement through rail yards are typically done at restricted speed.

Right-of-Way – The property owned by a railroad over which tracks have been laid.

Rip Track – A small car repair facility, often a single track in a small yard. Origination of name is derived from "Repair, Inspect, and Paint," however today “Repair in Place” is more applicable.

Running Track – A track, typically not a main track, designated in the timetable upon which movements may be made subject to prescribed signals and rules, or special instructions. Also the name given a track reserved for movement through a yard.

Secondary Track – Any designated track upon which trains or engines may be operated without timetable authority, train orders, or block signals. Also a common name given to tracks on railroad branch lines.

Shortline Railroad – A non-Class I railroad classified as either a regional railroad, local linehaul railroad, or a switching and terminal railroad. Regional railroads are linehaul railroads with at least 350 miles of track and/or revenue of between $40 million and the Class I threshold ($346.8 million). Local linehaul railroads operate less than 350 miles and earn less than $40 million per year. Switching and Terminal railroads perform pick-up and delivery services within a specified area for one or more linehaul railroads.

Siding – A track auxiliary to a main or secondary track for meeting or passing trains. The timetable will indicate stations at which sidings are located.

Single Track – A main track upon which trains are operated in both directions.

Spur Track – A track extending out from the main track that is usually used to serve rail customers.

Storage-in-Transit (SIT) – Bulk commodities, such as plastic pellets and polyvinylchloride powder, are made in vast quantities to minimize the expenses associated with their manufacture. These commodities are customarily loaded into empty railcars known as covered hoppers, and stored at a point (SIT Yard) located between the point of origin and the point of destination to be shipped at a later date.

Stub Track – A form of side track connected to a running track at one end only and protected at the other end by a bumping post or other obstruction.

Subdivision – A portion of a division designated by timetable. Normally the name given to a main track between two locations as specified in the timetable.

Surface Transportation Board (STB) – An independent governmental adjudicatory body administratively housed within the United States Department of Transportation responsible for the economic regulation of interstate surface transportation, primarily for the railroad industry, within the United States. The mission of the STB is to ensure competitive, efficient, and safe transportation services are provided to meet the needs of shippers, receivers, and consumers.

Switching – The movement of freight cars between two nearby locations or trains. This typically involves moving cars within a yard or from specific industry locations to a yard for placement of railcars in a train, or vice versa.

Through Freight Train – An express freight train between major terminals.

Timetable – A written document which establishes the authority for the movement of trains over designated lines of track, subject to the rules established for that track. Typically it describes maximum authorized train speeds for the entire rail line or a portion thereof. The timetable will also include the names and locations of control points for the rail line

Terminal – Railroad facilities established for the handling of passengers or freight, and for the breaking up, making up, forwarding and servicing of trains, and interchanging with other carriers.

Tower – Prior to the centralization and computerization of switching operations, physical structures, called Towers, were erected in locations where the “Tower Operator” could observe and control the movement of trains within a localized area. The towers were complete with manual switching equipment where the operator would physically move levers back and forth controlling the direction of train travel, selection of track the train would occupy, and the signal indication. Today this function typically is done by a dispatcher at a remote location, although the tower designation of that control point, or junction, remains today even though the physical building may no longer exist.

Track Class – Federal Railroad Administration (FRA) designated track condition from class 1 to class 5, with increasing class of track indicating adherence to higher standards based on factors such as spacing of cross-ties, condition of cross-ties, etc.

Trackage Rights – An agreement between railroads where one railroad is authorized to operate its trains, between specific locations, over the tracks owned by another railroad. Typically there is a surcharge for this privilege, and the associated rights are filed with the Surface Transportation Board (STB).

Track Warrant – Track Warrant Control (TWC): A method of traffic control wherein trains are authorized for movement only between specified locations. The form giving a train crew the authority to operate between two locations is called a track warrant.

Trailer on a Flat Car (TOFC) – Refers to intermodal shipments, commonly referred to as “piggy-back.”

Train – An engine or more than one engine coupled, with or without cars, displaying a marker and authorized to operate on a main track.

Trains Spacing – The time spacing in which a terminal/subdivision can handle trains effectively. This could be predicated on the type of method of dispatching authorized for the particular line segment.

Trains Staging – Trains holding at a location awaiting authorization and/or release to move into a terminal.

Trim Lead – Track used to move cars from the sorting tracks (bowl) to the departure yard, where sorted cars are coupled into an outbound train.

Turnout – A section of track with movable rails to divert a train from one track to another. Also referred to as a "switch," although technically the switch is only the moving parts of a turnout. Turnouts are referred to by number. For example, a Number 6 turnout spreads one unit for each six units of travel measured from the point of the frog.

Unit Train – A train composed entirely of one commodity, usually coal or mineral, and usually composed of cars of a single owner and similar design, and usually destined for a single destination.

Universal Crossovers – A pair of crossovers, spaced at a predetermined distance, allowing for the movement of a train from one main track to another, and then return to the original track.

Wye – A track shaped like the letter "Y," but with a connector between the two arms of the "Y." A wye is used to reverse the direction of trains or cars. A train pulls completely through one leg of wye, the switch is thrown and reverses the direction, allowing the movement across the semi-loop track of the wye, and the train is then headed in the opposite direction.

Yard – A system of tracks, other than main tracks and sidings, branching out from a common track. Yards are used typically for switching, making up trains, and/or storing of railcars.

Yard Limits – The location on a main track in which the main track begins to enter a rail yard. This location is typically designated by a yard limit sign placed along the main track, and also is noted in the timetable.

SECTION 1: PURPOSE OF STUDY

The Texas Legislature, as part of the 80th regular session, passed House Bill 160 (H.B. 160) relating to rail relocation and improvement in the state. H.B. 160 states that "the Texas Department of Transportation (TxDOT) shall conduct a study to determine the economic feasibility of relocating freight trains that carry hazardous materials away from residential areas of the state in municipalities with a population of more than 1.2 million. The study must include an evaluation of cost options for the relocation of freight trains from residential areas." A municipality is defined as an administrative entity composed of a clearly defined territory and its population, such as a city, town, or village. Municipalities with populations over 1.2 million in the state of Texas consist of the areas inside the city limits of Houston, San Antonio, and the Dallas/Fort Worth Metroplex.

In this study, all chemicals requiring emergency response in the event of release during transport are considered to be hazardous materials. The U.S. DOT Emergency Response Guide (ERG) includes over 400 individual chemicals assigned to nine separate classifications (e.g., gases, flammable liquids, etc.) requiring the isolation of spill areas by first responders. Each hazardous material has a unique protective action distance according to its chemical composition and reactivity to the environment. For example, gases (e.g., chlorine and carbon monoxide) may have a protective action distance of up to seven miles, whereas toxic and infectious substances (e.g., arsenic and cyanide compounds) have a protective action distance of less than one mile.

The overall concept of the study is to evaluate rail freight movements and operations that transport hazardous materials within the study areas and identify alternative routes and/or alignments to divert or relocate those train movements away from residential areas.

Residential population and land use parcels along each corridor within widths determined from the protective action distances associated with hazardous materials, as discussed in section 4, were included in the study analysis. The analysis of possible alternatives will include an order of magnitude evaluation of costs associated with the reduction of the risk of exposure to hazardous materials.

Project Approach

The scope of this study has been divided into the following tasks:

- Task 1 – Inventory Rail Hazardous Materials Routes and Operations
  - Obtain and review previous rail corridor studies conducted.
  - Analyze appropriate Surface Transportation Board (STB) Waybill data.
  - Establish an inventory of rail infrastructure along hazardous materials transportation routes.
  - Develop a categorized list of rail transported hazardous materials.

  - Populate the Statewide Analysis Model (SAM) with the rail hazardous materials flows.
  - Prepare GIS based maps depicting the existing rail system used for the transport of hazardous materials and any residential areas that are traversed or crossed by the movement of hazardous materials by rail.
- Task 2 – Develop Alternatives for Relocating Rail Hazardous Materials
  - Identify potential alternative routings and improvements that would divert or relocate rail hazardous materials movements from residential areas.
  - Analyze rail corridor demographics and land use adjacent to the corridors.
  - Establish alternative operational improvements, re-alignments, and/or relocation to new corridors for each study area.
- Task 3 – Determination of Economic Feasibility and Cost Analysis
  - Develop an order of magnitude cost estimate for each possible alternative and improvement.
  - Prepare an estimated materials listing necessary for implementing or constructing each alternative and improvement.
  - Compare summary data for possible alternatives and improvements.

SECTION 2: PROJECT BACKGROUND

Historically, many towns and cities established adjacent to the railroads and major truck routes have thrived and have turned into large municipalities over time, and are now faced with the dilemma of having railroad and truck freight operations pass directly through their central business districts. As the municipalities have grown and prospered, so has residential land use adjacent to these modes of operation. Most of the freight transported by trains and trucks are not harmful; however, some of the freight is hazardous materials and is hauled through these same areas. Therefore, truck and rail freight movement through populated areas brings with it a potential exposure to transported hazardous materials (hazmat).

As stated in H.B. 160, the purpose of this study is to “determine the economic feasibility of relocating freight trains that carry hazardous materials away from residential areas of the state in municipalities with a population of more than 1.2 million.” As a result, this study was conducted to inventory existing rail hazardous material routes and operations, develop alternatives for relocating rail hazardous material, and perform a cost analysis to determine the economic feasibility for such alternatives.

The municipalities analyzed consist of Houston, San Antonio, and the Dallas/Fort Worth Metroplex. This section provides an overview of the regional setting for each study area as well as a synopsis of previous studies pertaining to the current operations and potential future development in the rail corridors of each study area. Also included in this section are summaries of federal rules and regulations governing the transportation of hazardous materials, statistical information regarding the safety of hazmat transport by rail versus trucks, descriptions of the different classifications of hazmat, commodity data sources analyzed, and the methodology used in freight forecasting.

Houston

The development of the highway and rail transportation infrastructure in and around the Houston metropolitan area was influenced largely by the growth of the local ports and the geographical layout of Buffalo Bayou, the San Jacinto River, and Galveston Bay. The railroads and roadways were constructed along routes that lead to these areas and the city has grown and expanded along these transportation arteries, creating what is today the nation’s fourth-largest city.[1]

[1] Annual Estimates of the Population for Incorporated Places Over 100,000, Ranked by July 1, 2006 Population: April 1, 2000 to July 1, 2006, United States Census Bureau, Population Division

The railroad history for the area dates back to the middle 19th century, when eleven railroad companies constructed nearly 500 miles of railroad track. By 1890, Houston was recognized as the railroad center of Texas. By the early twentieth century, the port city of Houston had constructed additional railroad infrastructure around what is now the downtown area. Because portions of the original rail network were abandoned and removed over the years and there has not been a significant expansion of the original rail network along with the growth of the region, the railroads serving the Port of Houston are at or near capacity. Approximately 2,200 trains per week travel within the Houston regional rail network, which is comprised of more than 800 miles of mainline tracks and 21 miles of railroad bridges.

Decades of growth along freight routes have left limited right-of-way for expansion not only for the railroads, but also the highway infrastructure. As a result, the Houston region experiences severe congestion and delays for both vehicular and rail traffic and increased safety hazards associated with roadway-rail interfaces. Safety hazards associated with the current congested rail network may include impedance to emergency response vehicles due to blocked grade crossings, hazards to pedestrian traffic across rail lines, and the concentration of high volumes of train traffic in densely populated areas, which leads to increased exposure to train accidents (i.e., derailments) and hazardous materials transport incidents.

San Antonio

San Antonio was founded in 1718 by a Spanish military expedition at the site of a traditional native encampment along a trail through the Texas wilderness while en route to French trading posts in Louisiana. Continuing through the 19th Century, the region was the starting point for the Chisholm Trail and cattle drives to Kansas. Today, San Antonio is at the crossroads of a transportation network that connects the West Coast to the East Coast, and Mexico to Canada.

As of the projected 2005 population estimate based on the 2000 U.S. Census, San Antonio was the second largest city in Texas behind Houston and just ahead of Dallas, and the eighth largest in the United States. The basic framework for San Antonio's transportation network, for both vehicular and rail traffic, however, was laid out many years in advance of the population growth. The railroad lines were constructed between 1877 and 1912, and the groundwork for the interstate and highway system primarily followed U.S. and State Highways that were in existence before 1945. Although transportation initiatives continue to upgrade the network in attempts to meet capacity demands, recent projections show significant increases in population growth to fuel more demand in the future.

The opening of the Toyota facility in south San Antonio will increase the volume of freight rail movements throughout the area once the facility is fully operational. Adding to the anticipated growth in rail traffic that will be experienced resulting from servicing the Toyota facility, the Union Pacific Railroad (UP) has announced plans to construct an intermodal facility in southwest Bexar County that may process over 100,000 trailers and containers annually. Construction is now under way on the $100 million UP railroad facility (near the inland Port of San Antonio) that will increase the railroad's local transporting capacity 2.5 times after it opens in late 2008. Additionally, San Antonio lies within a recently-developed auto-supply corridor that extends from Mexico City to Atlanta. As a result, the rail network in San Antonio is mainly used to service the vehicle manufacturing and automobile parts supply network.

Today's San Antonio roadway infrastructure has a considerable number of locations where roadway congestion is common, especially during periods of peak travel, partly because of the tremendous growth in the movement of freight into and through the San Antonio area.

Recent derailments and hazardous material releases that have occurred in the San Antonio region include a derailment near Brackenridge High School that injured three people and spilled 5,600 gallons of diesel fuel along the San Antonio River in May of 2004. Additionally, two freight trains collided in Macdona in June of 2004 that resulted in three fatalities and over 40 injuries due to the release of chlorine, which is a toxic gas. Preliminary property damage and environmental clean-up costs were estimated to exceed $7 million.

Dallas - Fort Worth

The growth of Dallas began as the city was located at the intersection of roads leading to Austin, Houston, the Red River, and the Gulf Coast. The railroad network was started in 1872 with a line running through Dallas from south to north, creating communities such as Richardson. In 1873, a line was built that ran through Dallas from east to west and established more communities, including Grand Prairie and Mesquite. By 1885, five railroads ran through Dallas County and many communities had been founded along the rail lines.

Organized transportation in Fort Worth began in 1872 as the first westbound stage arrived. By 1900, multiple railroads were operating to and through Fort Worth, forming the rail network. Rail transportation between Dallas and Fort Worth was provided in 1902 by four electric interurban railways, which were phased out in time with the increasing presence of automobiles.

The Dallas-Fort Worth Metroplex is now a dense urban area with international airports, colleges, universities, industries, and businesses that support a thriving economy. The Dallas area has one of the highest concentrations of corporate headquarters in the U.S., such as Texas Instruments, AT&T, Verizon, ExxonMobil, American Airlines, and many other companies of all sizes. The Texas agriculture and livestock industries are based in Fort Worth. The Metroplex is now served by three Class I railroads, two shortline railroads, and two commuter rail lines.

More than ten rail lines now intersect near downtown Fort Worth on the main lines leading to what is known as Tower 55, which is considered a source of problems and delays for both the traveling public and the operating railroads because of the volumes of trains traveling through the location. Additionally, Dallas, Fort Worth, and the surrounding communities now experience many congested locations from the interaction between vehicular travel and freight movement that traverses the region.

Studies

Independent studies have been contracted by TxDOT to identify existing and projected freight transportation operations, bottlenecks, and constraints, with the goal of developing alternative solutions to resolve these transportation infrastructure problems before they become critical in the Houston, San Antonio, and Dallas/Fort Worth regions. The freight study reports will also incorporate pertinent information from various other reports pertaining to freight and passenger rail movements in the study regions. Pertinent information developed for the Houston Region Freight Study, San Antonio Region Freight Study, and Dallas/Fort Worth Region Freight Study has been included in this report.

Federal Rules and Regulations

The federal rules and regulations for the transport of hazardous materials are contained in Title 49 of the Code of Federal Regulations (49 CFR). Sections 171 through 180 of 49 CFR provide regulations as to what materials are considered to pose risk to humans, what materials may be transported, and by what means the materials should be transported and labeled. Section 172.101 provides a table that lists and classifies those materials which are designated as hazardous materials for purposes of transportation and prescribes the requirements for shipping papers, package marking, labeling, and transport vehicle placarding applicable to the shipment and transportation of those hazardous materials. Section 174 prescribes requirements to be observed with respect to the transportation of hazardous materials in or on rail cars.

Additionally, Section 1244 of 49 CFR specifies that each railroad is required to file waybill sample information with the STB for all line-haul revenue waybills terminated on its lines if it terminates at least 4,500 revenue carloads in any of the three preceding years.

The Federal Railroad Administration (FRA) administers a safety program that oversees the movement of hazardous materials across the rail network in the United States. The current FRA hazardous materials safety regulatory program includes the following items:[2]

- Hazardous Materials Incident Reduction Program
- Tank Car Facility Conformity Assessment Program
- Tank Car Owner Maintenance Program Evaluations
- Spent Nuclear Fuel and High-Level Nuclear Waste Program
- Railroad Industrial Hygiene Program
- Rulemaking, Approvals, and Exemptions
- Partnerships in Domestic and International Standards-Related Organizations (e.g., American Association of Railroads - AAR)
- Education, Safety Assurance, Compliance, and Accident Investigation

As part of the safety program , the FRA periodically conducts a National Hazardous Material Audit (the results of which are public) in order to determine the level of compliance of Class I railroads with the federal requirements pertaining to the movement of hazardous materials as contained in 49 CFR, specifically Sections 174.26(a) and (b).[3] The two basic requirements outlined in 49 CFR 174.26 are listed as follows:

- The train crew must have a document that reflects the current position in the train of each rail car containing a hazardous material. The train crew must update the document to indicate changes in the placement of a rail car in the train.
- A member of the crew of a train transporting a hazardous material must have a copy of a document for the hazardous material being transported showing the information required by Section 172 of 49 CFR (i.e. identification number, proper shipping name, hazardous class and/or division, quantity, mass, etc…).

Although it is specified in 49 CFR that the train crew has the above specified information pertaining to the transport of hazardous materials, the railroad dispatching office typically also has hazmat transport data.

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[2] http://www.fra.dot.gov/us/content/337
[3] http://www-tc.pbs.org/wnet/expose/episode202/fraaudit.pdf

Safety Statistics of Hazardous Materials Transportation

Hazardous materials are shipped throughout the U.S. via highways, rail, pipeline, water, and air. The trucking industry continues to remain the dominant mode of freight transport. Approximately 70 percent of the nation's freight tonnage is carried by trucks, far more than by any other mode. In 1998, trucks were reported to account for nearly 43 percent of all hazardous material tonnage shipped in the U.S., while rail accounted for approximately 4 percent of hazardous material tonnage shipments. Pipelines, water, and air transport accounted for the remaining 52 percent of hazardous material tonnage.[4] Table 2-1 lists the shipments and tons shipped for all modes of hazardous material transport in the U.S. for the year 1998.

Mode	No. of Shipments	% by Mode	Tons Shipped	% by Mode
Truck	768,907	93.98	3,709,180	42.94
Rail	4,315	0.53	378,916	4.39
Pipeline	873	0.11	3,273,750	37.90
Water	335	0.04	1,272,925	14.73
Air	43,750	5.35	4,049	0.05
Daily Totals	818,180	100.00	8,638,820	100.00
Annual Totals	298,635,700		3,153,169,300	

Table 2-1: Hazardous Material Shipments and Tons Shipped in the U.S. by Mode[4]

Shipments of hazardous material are defined as deliveries, or trips between the origin and destination of the freight. Shipments may include multiple movements, since movements are defined as transportation from the origin to a point of transfer to another vehicle or delivery to the destination. For example, a freight container may be transported from its point of origin by truck to an intermodal center, transferred to a rail car and hauled to another intermodal center, and then transferred to a truck for final delivery to its destination. The example container's trip consists of only one shipment, but three separate movements. Table 2-2 lists the movements and tons moved for all modes of hazardous material transport in the U.S. for the year 1998.

Mode	No. of Movements	% by Mode	Tons Moved	% by Mode
Truck	1,154,450	91.88	3,794,970	35.27
Rail	12,945	1.03	1,136,748	10.57
Pipeline	873	0.07	3,273,750	30.43
Water	670	0.05	2,545,850	23.66
Air	87,500	6.96	8,098	0.08
Daily Totals	1,256,438	100.00	10,759,416	100.00
Annual Totals	458,599,870		3,927,186,840	

Table 2-2: Hazardous Material Movements and Tons Moved in the U.S. by Mode[4]

[4] Hazardous Material Shipments, The Office of Hazardous Materials Safety, Research and Special Programs Administration, U.S. Department of Transportation, Washington, DC, October 1998.

Movement of hazardous material provides greater insight into hazardous material traffic than shipments alone. For example, total movements as listed in Table 2-2 are 1.54 times (54 percent) greater than numbers of shipments as listed in Table 2-1. In the case of rail, movements are three times (200 percent) greater than shipments, whereas truck movements are 1.5 times (50 percent) greater than shipments. A greater number of movements than shipments indicates increased indirectness of routes, increased travel distances, and more frequent handling, ultimately increasing the risks associated with the transport of hazardous materials.

Table 2-3 shows the number of annual rail carloads transported nationally and in Texas for the year 2005 and the relative percentages of carloads that carry hazardous material.

Number of U.S. Carloads in 2005	32,366,269
U.S. Carloads with Hazmat in 2005	1,750,000
Percentage of Carloads with Hazmat	5.41%
Number of Texas Carloads in 2005	9,742,679
Texas Carloads with Hazmat in 2005	535,847
Percentage of Carloads with Hazmat	5.50%

Table 2-3: Rail Hazardous Material Data
Source: http://www.aar.org/AboutTheIndustry/StateInformation.asp

Various data pertaining to train accidents/incidents including collisions, derailments, and other events causing reportable damage, injuries, or fatalities are reported to the FRA by the operating railroads across the country. Incidents, including those resulting in damage to rail cars transporting hazardous material or causing the release of the hazardous material, must be reported to the FRA if there is reportable damage resulting from the incident above a specified threshold ($6,700 in 2005) or if there are any injuries or evacuations ordered in response to the incident.[5]

Additionally, incidents must be immediately reported to the National Response Center for both rail and truck transport that result in any fatalities, personal injuries, public evacuations, closure of a major transportation artery, and fire, breakage, or spillage of radioactive or infectious materials.[6]

The annual reported number of incidents and property damage resulting from incidents involving hazardous materials is consistently larger for trucks as opposed to rail. The number of reported personal injuries and fatalities resulting from incidents involving hazardous materials is also typically larger for trucks than rail. Table 2-4 summarizes the 2000 through 2005 highway and rail incidents involving hazardous material transported by truck and rail.

[5] Code of Federal Regulations, Title 49, Part 225: Railroad Accidents/Incidents: Reports, Classification, and Investigations
[6] Code of Federal Regulations, Title 49, Part 171.15: Railroad Accidents/Incidents: Immediate Notice of Certain Hazardous Materials Incidents.

	2000 Totals	2001 Totals	2002 Totals	2003 Totals	2004 Totals	2005 Totals
Trucks						
Number of Truck Incidents in the U.S. involving hazmat	15,063	15,806	13,506	13,601	12,977	13,456
Injuries	164	109	118	105	156	175
Fatalities	16	9	8	15	10	24
Property Damage	$40,907,424	$37,738,359	$33,972,178	$39,114,403	$29,235,870	$40,039,279
Number of Truck Incidents in Texas involving hazmat	1,210	1,055	1,035	1,097	1,124	1,267
Injuries	21	16	6	9	11	8
Fatalities	0	2	1	0	0	2
Property Damage	$4,353,278	$3,977,809	$3,510,363	$3,904,839	$3,458,029	$4,306,795
Rail						
Number of Rail Incidents in the United States	3,193	3,240	2,944	3,191	3,605	3,495
Number of Rail Incidents in the U.S. involving hazmat	1,058	899	870	802	753	745
Percentage	0	0	0	0	0	0
Injuries	82	46	14	13	121	692
Fatalities	0	3	1	0	3	10
Property Damage	$16,546,958	$21,247,655	$9,745,140	$4,126,165	$11,635,633	$15,454,556
Number of Rail Incidents in Texas	307	399	372	351	383	437
Number of Rail Incidents in Texas involving hazmat	154	125	126	93	87	83
Percentage	1	0	0	0	0	0
Injuries	23	2	1	2	92	7
Fatalities	0	0	0	0	3	0
Property Damage	$261,160	$7,368,569	$1,256,315	$1,262,120	$5,942,712	$424,500

Table 2-4: 2000-2005 Truck and Rail Hazardous Material Incident Data
Source: U.S. Department of Transportation Office of Hazardous Materials Safety: Hazardous Materials Incident Data

National Freight Rail Statistics

More than 32 million carloads of freight were transported by rail in the U.S. in 2005, of which approximately 1.8 million carried hazardous material.[7] Of the approximately 1.8 million cars classified as hazardous material, 8,596 rail cars were reported to be involved in an incident (i.e., derailment, collisions, impacts, etc), of which 50 cars released hazardous material. This means that approximately 1 out of every 640,000 carloads of freight was involved in an incident that resulted in a release of hazardous material.

Fourteen of the incidents reported in 2005 (either damage to rail cars containing hazardous material or release of hazardous material) resulted in the evacuation of a total of 8,105 people.[8] A total of 745 incidents (not necessarily releases) were reported involving hazardous materials transported by rail, which resulted in 692 injured people and 10 fatalities. The number of reported incidents involving

[7] http://www.aar.org/AboutTheIndustry/StateInformation.asp
[8] Railroad Safety Statistics 2005 Annual Report, Federal Railroad Administration (http://safetydata.fra.dot.gov/officeofsafety/Forms/Default.asp)

hazardous materials has been decreasing annually from 1,058 incidents in 2000 to 745 incidents in 2005.[9] However, statistics such as the number of injuries, rail cars carrying hazardous material, evacuations, and people evacuated vary between each year with no distinct pattern of increase or decrease over time.

Texas Freight Rail Statistics

More than 9.7 million carloads of freight were transported by rail in Texas in 2005.[10] Although not published for the state level, approximately 540,000 carloads are estimated to carry hazardous materials (assuming the national ratio of hazardous material carloads to total carloads applies to Texas as well). In 2005, a reported 2,057 carloads were involved in an incident, of which 11 released hazardous material. This means that approximately 1 out of every 882,000 carloads of freight was involved in an incident that resulted in a release of hazardous material. A total of 83 incidents (not necessarily releases) were reported involving hazardous materials transported by rail, which resulted in 7 injured people, no fatalities, and estimated damages of nearly $425,000.[11] Two of the incidents reported in 2005 (either damage to rail cars containing hazardous material or release of hazardous material) resulted in the evacuation of a total of 600 people.[12] The number of reported incidents involving hazardous materials has decreased from 154 incidents in 2000 to 83 incidents in 2005.

Truck Freight Statistics

As a comparison to rail incident statistics, the following summarizes statistics for trucks. A total of 13,346 incidents, 175 injuries, and 24 fatalities involving hazardous materials transported on highways were reported nationally in 2005. In Texas, 1,267 incidents, 8 injuries, and 2 fatalities involving hazardous materials transported on highways were reported with estimated damages reported to be more than $4.3 million. The incidents involving hazardous materials transported on highways reported in Texas comprise approximately nine percent of the national total for 2005.

The number of incidents and damages reported involving hazardous materials transported on highways is significantly larger than those reported for hazardous materials transported via rail. This may be partly because of the presence of personal vehicles on the same roadways as heavy trucks. Additionally, the number of incidents per tonnage shipped is far lower for rail than highway shipments of freight. Average truck weights as determined from FHWA data were found to be approximately 30 tons (including the weight of the empty truck) as opposed to a typical loaded rail car weight of up to 143 tons.

[9] 2005 Hazardous Materials Incident Data, U.S. Department of Transportation Office of Hazardous Materials Safety (http://hazmat.dot.gov/pubs/inc/data/2005/2005frm.htm)
[10] http://www.aar.org/AboutTheIndustry/StateInformation.asp
[11] 2005 Hazardous Materials Incident Data, U.S. Department of Transportation Office of Hazardous Materials Safety (http://hazmat.dot.gov/pubs/inc/data/2005/2005frm.htm)
[12] Railroad Safety Statistics 2005 Annual Report, Federal Railroad Administration (http://safetydata.fra.dot.gov/officeofsafety/Forms/Default.asp)

Hazardous Material Data Description

The following sections describe the data and tools used to determine existing rail traffic and to forecast the future movement of hazardous materials within the study areas. This information provides the background necessary to evaluate strategies that can minimize the risks of exposure to hazardous materials transported by rail while still accommodating its necessary movement.

Shipments of hazardous materials by rail are reported under two separate classification systems, which are discussed below. One system is strictly concerned with the movement of hazardous materials, while the other considers hazardous materials as a component of the entire spectrum of shipped commodities.

Hazardous Materials Reporting

The State of Texas requires all rail shipments of hazardous materials within state boundaries to be reported by the operating railroads. Carload volume data is submitted by railroad line segment for each railroad operating division and county according to hazardous materials classification requirements prescribed in the 49 CFR, as previously discussed. Each hazard class, or primary hazard code, is listed as follows as it appears in the U.S. Department of Transportation's Emergency Response Guidebook (ERG). This information is conveyed in shipping papers and on rail car placards as guidance for emergency responders in the event of a transport incident involving hazardous materials.

Class 1 – Explosives (e.g., dynamite, rockets)

- Division 1.1 Explosives with a mass explosion hazard
- Division 1.2 Explosives with a projection hazard
- Division 1.3 Explosives with predominately a fire hazard
- Division 1.4 Explosives with no significant blast hazard
- Division 1.5 Very insensitive explosives with a mass explosion hazard
- Division 1.6 Extremely insensitive articles

Class 2 – Gases (e.g., chlorine, carbon monoxide, ammonia)

- Division 2.1 Flammable gases
- Division 2.2 Non-flammable, non-toxic gases
- Division 2.3 Toxic gases

Class 3 – Flammable liquids and combustible liquids (e.g., alcohol, gasoline)

Class 4 – Flammable solids; spontaneously combustible materials; and dangerous when wet materials/water re-active substances (e.g., magnesium phosphide)

- Division 4.1 Flammable solids
- Division 4.2 Spontaneously combustible materials
- Divisions 4.3 Water-reactive substances/Dangerous when wet materials

Class 5 – Oxidizing substances and organic peroxides (e.g., chlorine dioxide)

- Division 5.1 Oxidizing substances

- Division 5.2 Organic peroxides

Class 6 – Toxic substances and infectious substances (e.g., arsenic)
- Division 6.1 Toxic substances
- Division 6.2 Infectious substances

Class 7 – Radioactive materials (e.g., non-weapons grade uranium)

Class 8 – Corrosive substances (e.g., sulfuric acid, hydrochloric acid)

Class 9 – Miscellaneous hazardous materials/products, substances organisms

Commodity Reporting
The CFR also prescribes a reporting system for all commodities shipped by rail, including hazardous materials, through the submission of waybills, which describe the disposition of freight and are used by the railroads as the authority to move shipments and to determine freight charges and interline settlements. According to 49 CFR Part 1244 – Waybill Analysis of Transportation Property – Railroads, each railroad must file waybill sample information with the STB at sampling rates dependent upon whether authenticated copies of waybill samples are filed (the manual system) or computerized tape records of waybill samples are filed (the computerized system). In recent years, approximately 99 percent of waybills filed with the STB were submitted under the Machine Readable Input (MRI) method. Sampling rates of computerized tape records such as MRI are prescribed in Part 1244.4 of the CFR, and are based on the number of carloads reported on each waybill and are listed in Table 2-5. In contrast to the hazardous materials classification system, railroad waybills document commodity type according to the Standard Transportation Commodity Classification (STCC) code system published by the American Association of Railroads (AAR).

Carloads on Waybill	Sampling Rate
1-2	1/40
3-15	1/12
16-60	1/4
61-100	1/3
101+	1/2

Table 2-5: Sampling Rate of Waybill Data

The formats for the classification systems described above were used to report the amount of hazardous material transported through residential areas along each rail corridor within the study areas. The data was sorted into railroad subdivisions and line segments so that the total number of carloads carrying hazardous materials within municipality boundaries for Houston, San Antonio, and Dallas-Fort Worth could be summarized in graphical and tabular format. The impact of hazardous material movements specific to residential areas, as defined by each municipality, was also measured according to the number of rail carloads transported through residential land use areas within the protective action distances, as prescribed in the ERG, for each railroad subdivision. Protective action distances define areas of potential exposure, where exposure includes any required emergency response action ranging from instructing the public to remain indoors, to isolating a hazard area, and to requiring the evacuation of an area.[13]

Freight Model Forecasting

The Texas Statewide Analysis Model (SAM) was used as the primary tool used to forecast the future movement of rail freight. SAM is a travel demand modeling package developed for and used by TxDOT to analyze the movement of people and freight throughout the state, and consists of a family of interrelated models that generate passenger trip estimates and freight tonnage flows for highway, aviation, railroad, and waterway facilities. Maps and data produced by SAM are particularly useful in planning regional transportation system improvements and addressing future needs and priorities.

SAM was originally developed using base year (1998) transportation planning data to validate the adequacy of the model in estimating passenger flows by travel mode. In urban areas, transportation data from existing urban models were incorporated into the model. In the remaining rural areas, national and state travel survey and demographic data (population, employment, and other socioeconomic factors) were used to prepare travel estimates, which were then compared to traffic counts. SAM freight models were used to develop estimates of freight flow.

Based on the availability of hazardous materials rail data for the year 2005, SAM was used in this study to identify corridor-specific growth patterns over a 20-year period (to 2025). These general growth rates were then applied to the 2005 hazardous materials movement data in order to predict its future impact on the Houston, San Antonio, and Dallas-Fort Worth areas.

Model Calibration

The transportation and travel survey data necessary for freight modeling is less comprehensive than that for passenger modeling. SAM freight models used in this study were developed using survey data primarily from the following three sources:

- Reebie Transearch Database – This 1998 survey data includes a sample of all Texas freight movements (within, to, from, and through the State), but does not include freight movements between Texas and Mexico.
- Wharton Economic Forecasting Associates (WEFA) – Similar to the Reebie data, the WEFA data included only intra-U.S. flows and did not include freight movements between Texas and Mexico.
- Latin America Trade Transportation Study (LATTS) – This study collected data from the DRI/Mercer World Sea Trade Service (WSTS), which integrates

[13] 2004 Emergency Response Guide, Research and Special Programs Administration, U.S. Department of Transportation.

world trade databases and economic/trade models to produce historical data and forecasts of freight movements around the world and includes freight movements between Texas and Mexico.

These three reports (Reebie, WEFA, and LATTS) contained survey data of base year and projected future year commodity movements for areas within the U.S. as well as outside the country. This data showed the amount of commodity tonnages that were going to and from various areas. In addition, county demographic information that provided the overall tonnage growth within each Texas county was provided. The county demographic data and the survey information from the three reports were used to calibrate freight trip generation equations. These resulting equations were used to determine the commodity tonnages going into and out of each county within Texas.

Trip Generation

Trip generation is the process of converting the interaction of people and worksites into trips. This process provides results in the form of auto trips, truck trips, and of particular importance to this study, tons of commodities. All trip generation estimates for the freight model were developed at the county level since Reebie freight data is reported as county-level freight origins and destinations. More specifically, the trip generation model applies equations that relate variables for employment types and special freight handling facilities to tonnages produced or attracted to individual counties.

Since freight transportation demand growth is affected by changes in employment and worker productivity, the predictive equations base freight movements on dynamic economic events. The resulting estimates were then compared to 1998 Reebie control total data in order to iteratively adjust equation parameters until reasonable freight tonnage estimates by commodity and movement type were obtained.

Mode Choice and Assignment

The statewide, county-level freight flow tonnage estimates are allocated among highway, rail, and waterway transportation using a mode choice model. While rail and waterborne movements were assigned to their respective networks at the county level, the highway freight tonnage estimates were disaggregated to even smaller geographic areas, called traffic analysis zones, prior to being assigned to the road network.

Growth Rate

The STB data set provided rail carload information for the base year (2005). For the purpose of this study, the primary use of SAM was to project the base year growth in commodity movements to the forecast year of 2025. Since the STB hazmat statistics are for 2005, this growth rate was adjusted to represent a 20-year increase in shipped commodities, from 2005 to 2025.

SECTION 3: EXISTING HAZARDOUS MATERIALS ROUTES AND OPERATIONS

This section is intended to supplement and provide guidance in determining the existing and projected future movement of hazardous materials by rail within the municipal limits for Houston, San Antonio, and Dallas-Fort Worth.

Houston

Track and Structures

The Houston region serves as one of the country's largest freight centers, servicing trains, trucks, air, and ships. Nearly 250 miles of mainline track and more than 370 at-grade roadway-railroad crossings are located within the city of Houston. Houston is served by three Class I railroads, consisting of UP, BNSF, and KCS, as well as shortline railroads such as the Houston Belt & Terminal (HB&T) and the Port Terminal Railroad Association (PTRA). The volume of freight that is shipped into and out of the Houston region requires a number of major terminals that provide the capability to transfer freight to and from the railroads. Terminals are facilities established for the handling of passengers or freight, and for the breaking up, making up, forwarding, and servicing of trains, and interchanging with other carriers. The following is a list of the major terminals located within the Houston region:

- American Yard
- Basin Yard
- BNSF Intermodal Hub
- BNSF SIT Yard
- Booth Yard
- Congress Yard
- Dallerup Yard
- East Belt Yard
- Englewood Yard & Intermodal
- Eureka Yard
- Glass Yard
- Hardy Yard
- Lloyd Yard
- Manchester Yard
- MK Yard
- Mykawa Yard
- Navigation Yard
- New South Yard
- Old South Yard
- Pasadena Yard
- Pearland Yard & Intermodal
- Pierce Yard & Intermodal
- PTRA North Yard
- Settegast Yard & Intermodal

The major terminals (rail and intermodal yards), junctions, and rail line subdivisions inside of Loop 610 are shown in Figure 3-1.

Figure 3-1: Houston Railroad Network

The existing rail lines are typically referred to as subdivisions in this report and are listed in Table 3-1 with their associated/adjacent highway corridors or locations in the Houston region.

Railroad Subdivision	Highway Corridor/ Location
UP Angleton	SH 35 South
UP Baytown	IH 10 East
UP Beaumont	Lake Houston/ Huffman
HB&T East Belt	Downtown East
UP Eureka	U.S. 290
BNSF Galveston	SH 6
UP Galveston	IH 45
UP Glidden	U.S. 90A
BNSF Houston	SH 249/ FM 1774
UP Lafayette	U.S. 290 East/ Liberty
UP Lufkin	U.S. 59
BNSF Mykawa	SH 35
UP Navasota	Kuykendahl/ Hwy 149
UP Palestine	Hardy Toll Road
UP Popp	FM 521
PTRA Subdivisions	Port of Houston/ Houston Ship Channel
UP Strang	La Porte Hwy/ Pasadena Fwy
UP Terminal	Bellaire/ Memorial Park/ IH 10
HB&T West Belt	Downtown West

Table 3-1: Houston Subdivisions and Associated Highway Corridors/ Locations

The existing rail lines in the Houston area are owned and operated by the UP, BNSF, PTRA, and the HB&T railroads, with other railroads such as the KCS having track usage rights. Table 3-2 summarizes the track, bridge, and grade crossing inventories for the Houston railroad subdivisions and industrial leads.

Railroad Subdivision Name	Mainline Track (mi)	Number of Grade Crossings	Number of Bridges	Transports Hazmat
UP Baytown	7.11	20	3	Yes
UP Beaumont	7.01	4	7	Yes
UP Clinton Ind. Lead	5.90	0	2	Data not Available
UP Columbia Tap	2.50	0	1	Data not Available
UP Dart Ind. Lead	1.32	1	0	Data not Available
UP Eureka	10.44	17	9	Yes
UP Katy Eureka Ind. Lead	1.75	1	4	Data not Available
UP Galveston	19.44	53	17	Yes
UP Glidden	17.25	22	8	Yes
UP Lufkin	13.46	22	8	Yes
UP Palestine	13.28	1	8	Yes
UP Popp Ind. Lead	5.28	25	3	Yes
UP Strang	9.84	29	8	Yes
UP Terminal	45.38	58	21	Yes
PTRA Clinton	4.41	6	3	Data not Available
PTRA North Shore	13.25	25	2	Data not Available
PTRA Manchester	4.47	4	3	Data not Available
PTRA Carnegie	3.47	6	1	Data not Available
HB&T East Belt	22.49	24	9	Yes
HB&T West Belt	17.66	26	20	Yes
BNSF Houston	15.06	23	6	Yes
BNSF Mykawa	6.10	7	2	Yes
Total:	246.87	374	145	

Table 3-2: Houston Track and Bridge Inventory Summary

Existing Freight Rail Operations

Approximately 2,200 trains per week (more than 300 per day) travel within the Houston region comprised of Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties.

Of the trains in the Houston regional network, less than five percent operate completely through the region without having to stop in Houston to pick up or drop off rail cars. Almost half (48 percent) of all the trains in the network are local trains and rail yard engines. The freight trains in the Houston region carry freight cars coming into, or leaving, the Houston, Dayton, Baytown, Bayport, and Beaumont industrial complexes. The freight carried on these trains is mostly for local business, and since it is shipped in carloads, must be sorted by destination (customer) at one or more of the major Houston yards. Most of the trains carry chemicals, and/or heavy bulk commodities like coal, grain, and rock/aggregate. This heavy industrial cargo accounts for about 84 percent of Houston's rail activity.

Within the Houston region, the railroads provide rail service to more than 900 customers. Although not a direct indication of the location of each and every customer within Houston's IH-610 loop, Figure 3-2 shows the general locations, excluding those that are along the ship channel or the Port areas, of existing industry and spur tracks that connect to the main tracks that could serve rail customers.

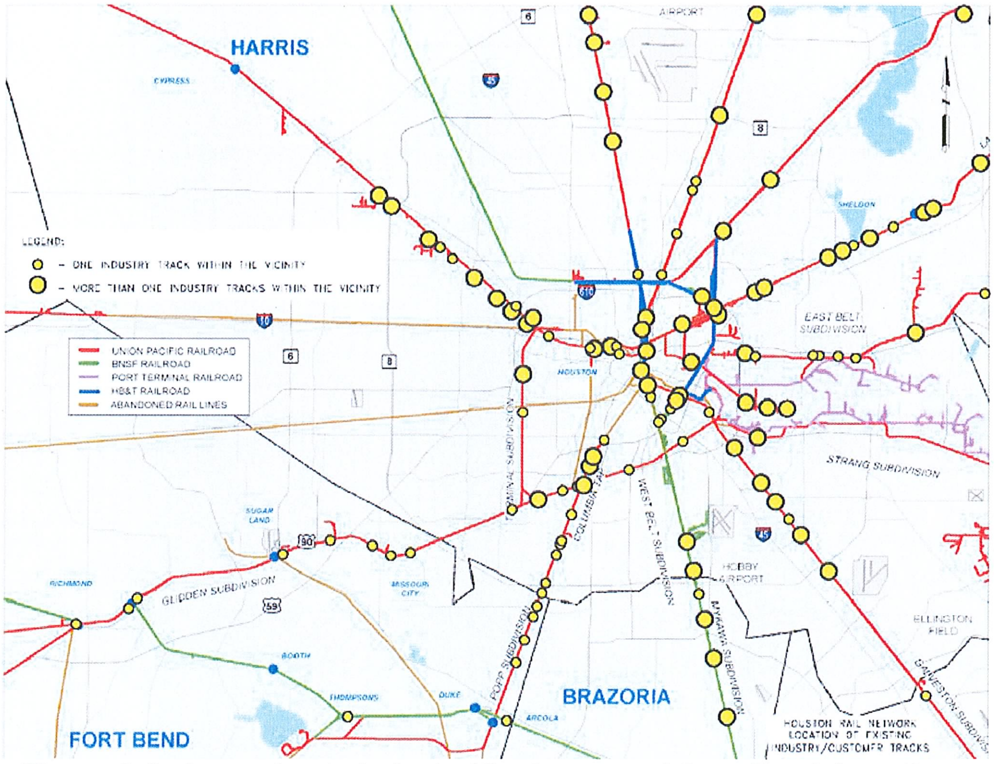

Figure 3-2: Approximate Industry/Customer and Spur Track Locations

Hazardous Material Movement Trends

Projections from SAM yielded a 3.9 percent annual growth rate per year for the Houston region; this growth rate was used to estimate the number of carloads carrying hazardous materials in 2025. Figures 3-3 and 3-4 illustrate the carloads currently handled and projected carloads in the city of Houston. Separate (and full-size) maps of each subdivision are provided in Appendix C, which also include areas of residential land use.

Confidential

Confidential

Figure 3-3: 2005 Hazardous Material Movement within the City of Houston

Confidential

Figure 3-4: 2025 Hazardous Material Movement within the City of Houston

Hazardous Material Movement by Classification

Table 3-3 lists the relative percentages of hazardous material classifications out of all hazardous material carloads transported in Houston. Radioactive material carloads were not included in the analysis of this study due to the unavailability of data. Additionally, no explosives were shown to be moved along any subdivisions in Houston.

Hazardous Material Classification	Percentage of Hazardous Material Carloads
Explosives	Confidential
Gases	
Flammable and Combustible Liquids	
Flammable Solids	
Oxidizing Substances and Organic Peroxides	
Toxic/ Infectious Substances	
Radioactive Materials	
Corrosive Substances	
Misc. Hazardous	
Total	

Table 3-3: Percentages of Carloads by Hazardous Material Classification in Houston

Residential Exposure to Hazardous Materials Moved by Rail

The impact of hazardous material movements specific to residential areas in Houston was measured according to the number of rail carloads transported through residential land use areas within of the protective action distances for hazardous materials as specified in the ERG along each railroad subdivision. Table 3-4 lists the estimated number of residents, determined from 2000 US Census data, within protective action distances (see section 4) along each rail subdivision that transports hazardous material. The total number of residents shown in the table includes residents that are counted on more than one rail subdivision due to overlapping protective action distances between subdivisions.

Subdivision	Protective Action Distance (miles)	Estimated Number of Residents
UP Baytown	1.91	39,800
UP Beaumont	1.96	22,000
HB&T East Belt	1.91	89,600
UP Eureka	1.97	44,200
UP Galveston	1.70	80,200
UP Glidden	1.83	140,100
BNSF Houston	1.85	93,400
UP Lafayette	2.06	5,600
UP Lufkin	1.40	54,400
BNSF Mykawa	1.88	37,500
UP Palestine	1.87	51,800
UP Popp	2.12	27,800
UP Strang	1.71	67,500
UP Terminal	1.97	166,000
HB&T West Belt	1.87	90,000
Total	**-**	**1,009,900**

Table 3-4: Estimated Residential Population within Protective Action Distance Corridor Widths along Rail Subdivisions in Houston

Hazardous Material Findings Summary

- Hazardous material rail carloads tonnage is projected to more than double by 2025. This is based on an assumption that the tonnage of hazardous materials transported will grow at the same rate as all other tonnage, which is expected to double by 2025.
- [Confidential]
- [Confidential]

San Antonio

Track and Structures

The city of San Antonio includes more than 120 miles of mainline tracks, nearly 250 at-grade roadway-railroad crossings, and three active rail yards: Kirby Yard, East Yard, and SoSan Yard. Kirby Yard (located near Randolph Air Force Base) includes fueling and auto unloading facilities and handles the majority of domestic autos destined for San Antonio and the Rio Grande River Valley. East Yard, located east of IH-35 just north of Pine Street, is used primarily as a staging area to serve UP's San Antonio region customer base (approximately 350 customers) and also serves as an intermodal facility. SoSan Yard is located in the southwestern region of San Antonio, near the Port Authority of San Antonio, and serves as the hub for all international traffic, from the Ports of Los Angeles and Long Beach as well as Mexico.

The existing rail lines are listed in Table 3-5 with their associated/adjacent highway corridors in San Antonio and are shown in Figure 3-5.

Railroad Subdivision	Highway Corridor/ Location
Austin Mainline 1	Downtown North/ FM 2252
Austin Mainline 2	IH 35 North/ N. Pan Am Expy
Camp Stanley Industrial Lead	IH 10 North
Corpus Christi	U.S. 281
Del Rio	Macdona Lacoste Rd
Glidden	FM 1976/ SH 78
Kerrville	IH 10 North/ McDermott Fwy
Laredo	IH 35 South
Rockport	SH 122/ CR 128

Table 3-5: San Antonio Railroad Subdivisions and Highway Corridors/ Locations

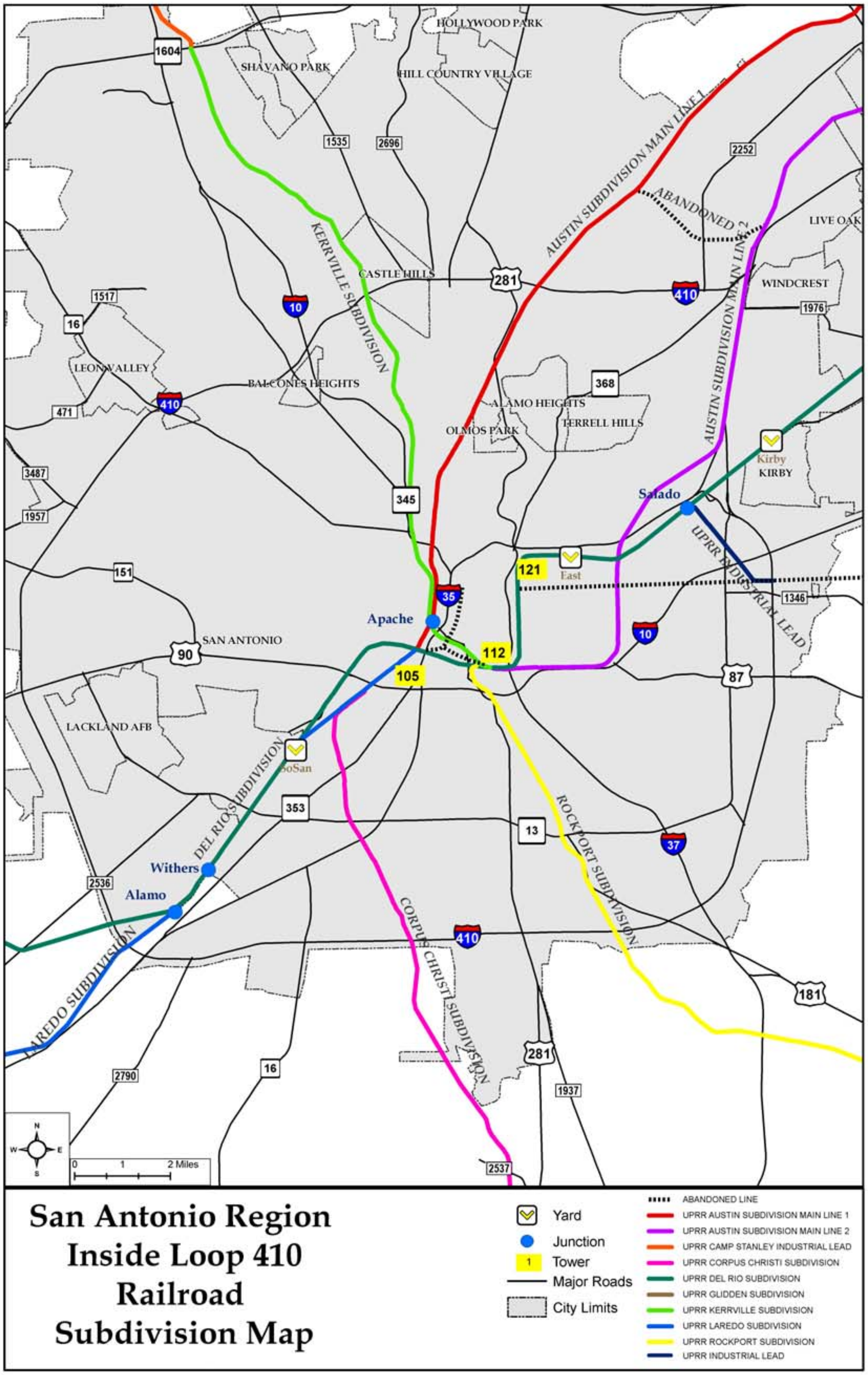

Figure 3-5: San Antonio Rail Network

The existing rail lines in the San Antonio area are owned by the UP. Table 3-6 summarizes the track and bridge inventories for the railroad subdivisions and industrial leads in the San Antonio region.

Railroad Subdivision Name	Mainline Track (mi)	Number of Grade Crossings	Number of Bridges	Transports Hazmat
UP Austin M.L. #1	19.23	49	20	Yes
UP Austin M.L. #2	19.58	19	9	Yes
UP Camp Stanley Ind.	2.00	7	4	Yes
UP Corpus Christi	10.88	18	7	Yes
UP Del Rio	33.08	38	24	Yes
UP Glidden	1.10	2	3	Yes
UP Kerrville	15.00	62	26	Yes
UP Laredo	8.63	18	4	Yes
UP Rockport	10.51	34	16	Data Not Available
Total:	120.01	247	113	

Table 3-6: San Antonio Track and Bridge Inventory Summary

Existing Freight Rail Operations

There are five major rail lines owned and operated by UP, with over 420 miles of single track mainline in the San Antonio area and three active rail yards in the region (Kirby Yard, East Yard, and SoSan Yard), each having functions independent of the other. A fourth yard, in the Macdona area, will soon be constructed to the southwest of San Antonio to handle intermodal freight movement into San Antonio to and from Mexico and the West Coast ports.

It is estimated that approximately 70 to 75 percent of the trains moving into/out of San Antonio perform operations such as dropping off or picking up rail cars, maintenance services, fueling, and crew changes at SoSan Yard, located near the Port Authority of San Antonio (formerly Kelly USA). East Yard is primarily used as an industrial service yard for local and regional customers. Therefore, north-south trains terminating in San Antonio typically do so at East Yard, located north of the Alamo Dome and the Amtrak Station. Kirby Yard, located east of San Antonio near Kirby, is a crew change point as well as an in-line fueling facility. Kirby Yard is also equipped for unloading auto racks and provides some local service.

The San Antonio region rail network includes 2,890 trains per 28-day period, which equates to an average of more than 100 trains per day, including those projected to service the new Toyota Facility south of the city.

Although not a direct indication of the location of each and every customer within San Antonio's IH-410 loop, Figure 3-6 shows the general locations of existing industry and spur tracks that connect to the main tracks that could serve rail customers. In comparison to a Terminal network such as in the Houston region, there are relatively few customers located in the downtown area.

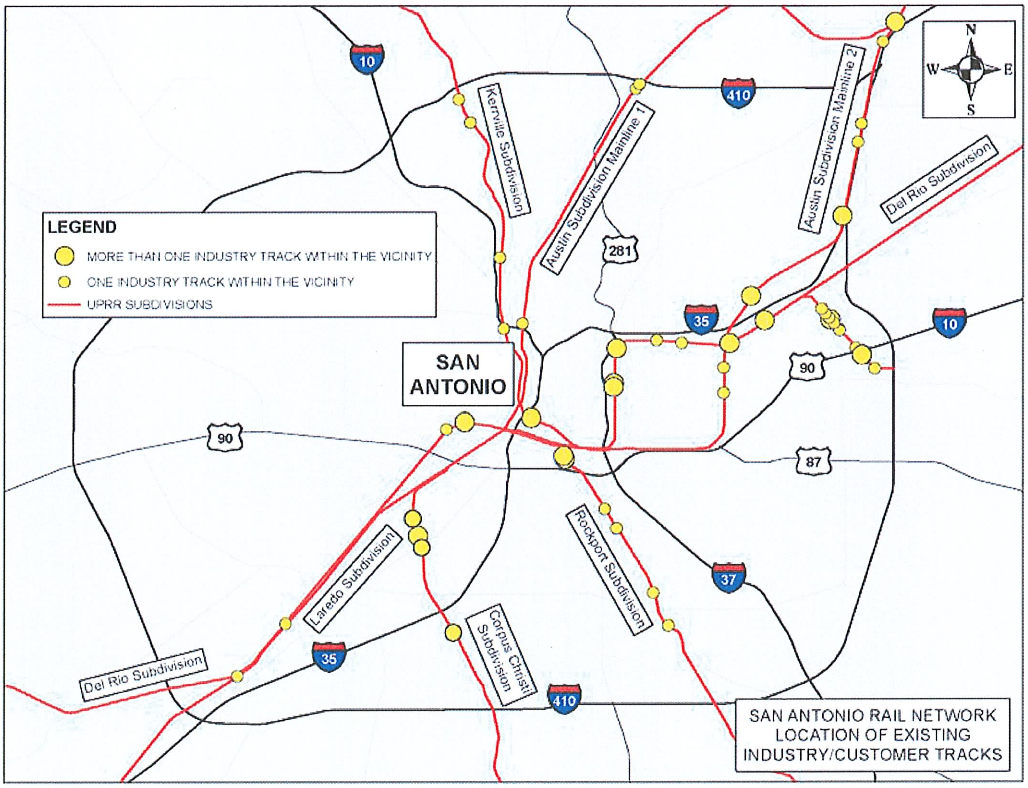

Figure 3-6: Approximate Industry/Customer and Spur Track Locations

Hazardous Material Movement Trends

UP and BNSF are the primary freight rail operators in the San Antonio area. BNSF does not serve the local customers in the area, but rather operates through-traffic on the UP owned tracks through trackage rights agreements. Projections from SAM yielded a 2.0 percent annual growth rate per year for the San Antonio region; this growth rate was used to estimate the number of carloads carrying hazardous materials in 2025. In cases of double track mainlines, such as Austin Subdivision Mainlines 1 and 2, the volume of hazardous materials shipped on the lines was distributed according to the relative percentage of average train counts on the respective lines.

Figures 3-7 and 3-8 illustrate the carloads in 2005 and projected carloads in 2025 containing hazardous materials. Separate maps of each subdivision are provided in Appendix C, which show areas of residential land use.

Confidential

Confidential

Figure 3-7: 2005 Hazardous Material Movement within the City of San Antonio

Confidential

Figure 3-8: 2025 Hazardous Material Movement within the City of San Antonio

Hazardous Material Movement by Classification

Table 3-7 lists the relative percentages of hazardous material classifications out of all hazardous material carloads transported in San Antonio. Radioactive material carloads were not included in the analysis of this study due to the unavailability of data.

Hazardous Material Classification	Percentage of Hazardous Material Carloads
Explosives	Confidential
Gases	
Flammable and Combustible Liquids	
Flammable Solids	
Oxidizing Substances and Organic Peroxides	
Toxic/ Infectious Substances	
Radioactive Materials	
Corrosive Substances	
Misc. Hazardous	
Total	

Table 3-7: Percentages of Carloads by Hazardous Material Classification in San Antonio

Residential Exposure to Hazardous Materials Moved by Rail

As with the other study areas, the impact of hazardous material movements specific to residential areas in San Antonio was measured according to the number of rail carloads transported through residential land use areas within protective action distances for hazardous materials. Table 3-8 lists the estimated number of residents, determined from 2000 US Census data, within the identified protective action distances along each rail subdivision that transports hazardous material. The total number of residents shown in the table includes residents that are counted on more than one rail subdivision due to overlapping protective action distances between subdivisions.

Subdivision	Protective Action Distance (miles)	Estimated Number of Residents
Austin Mainline 1	1.63	123,800
Austin Mainline 2	1.63	101,200
Corpus Christi	1.64	51,000
Del Rio	1.79	134,400
Glidden	1.91	8,100
Kerrville	1.57	127,200
Laredo	2.09	64,800
Total	-	**610,500**

Table 3-8: Estimated Residential Population within Protective Action Distance Corridor Widths along Rail Subdivisions in San Antonio

Hazardous Material Findings Summary

- Hazardous material rail carloads tonnage is projected to increase by 48 percent by 2025.
- [Confidential]
- [Confidential]

Dallas-Fort Worth Metroplex

Track and Structures

The Dallas-Fort Worth Metroplex's infrastructure includes nearly 400 miles of mainline tracks and more than 600 at-grade roadway-railroad crossings. Additionally, the Metroplex is home to the BNSF headquarters and Network Operations Center, BNSF Intermodal and Carload Transportation Center at Alliance Airport, UP Centennial Yard (one of UP's largest freight classification facilities), the UP Arlington Auto Facility (serves General Motors), the UP Mesquite Auto Facility (serves Chrysler, Ford, and Nissan), the UP Miller Yard (handles traffic from the Port of Houston), and many other large rail yards and facilities. The Class I railroads serving the region consist of the UP, BNSF, and the KCS. The shortline and commuter railroads serving the region include the Dallas Area Rapid Transit (DART), the Dallas, Garland, and Northeastern Railroad (DGNO), the Fort Worth and Western Railroad (FWWR), and the Trinity Rail Express (TRE).

The existing rail lines are listed in Table 3-9 with their subdivision names and associated/adjacent highway corridors or locations in the Dallas-Fort Worth region are shown in Figure 3-9.

Railroad Subdivision	**Highway Corridor/ Location**
UP Baird Subdivision	IH 20 West
UP Choctaw Subdivision	U.S. 377 North
UP Dallas Subdivision	IH 30/ Tom Landry Hwy
UP Duncan Subdivision	U.S. 287 North/ SH 718
UP Ennis Subdivision	IH 45 South
UP Everman Industrial Lead	Downtown Ft. Worth South
UP Ft. Worth Subdivision	IH 35W (south of Ft. Worth)
UP Midlothian Subdivision	U.S. 287 South
BNSF DFW Subdivision	IH 45 South/ SH 342
BNSF Ft. Worth Subdivision	SH 174 South/ SH 156 North
BNSF Madill Subdivision	University of Dallas
BNSF Ward Industrial Spur	U.S. 67
BNSF Wichita Falls Subdivision	U.S. 287 North/ U.S. 81
KCS Alliance Subdivision	Lake Dallas
KCS White Rock Subdivision	IH 635 (Northeast Downtown Dallas)
DART	Downtown Dallas
DGNO	Northeast of Dallas
FWWR	U.S. 377 South, Ft. Worth, Carrollton
TRE	SH 121/ Trinity Blvd/ Rock Island Rd

Table 3-9: DFW Subdivisions and Associated Highway Corridors/ Locations

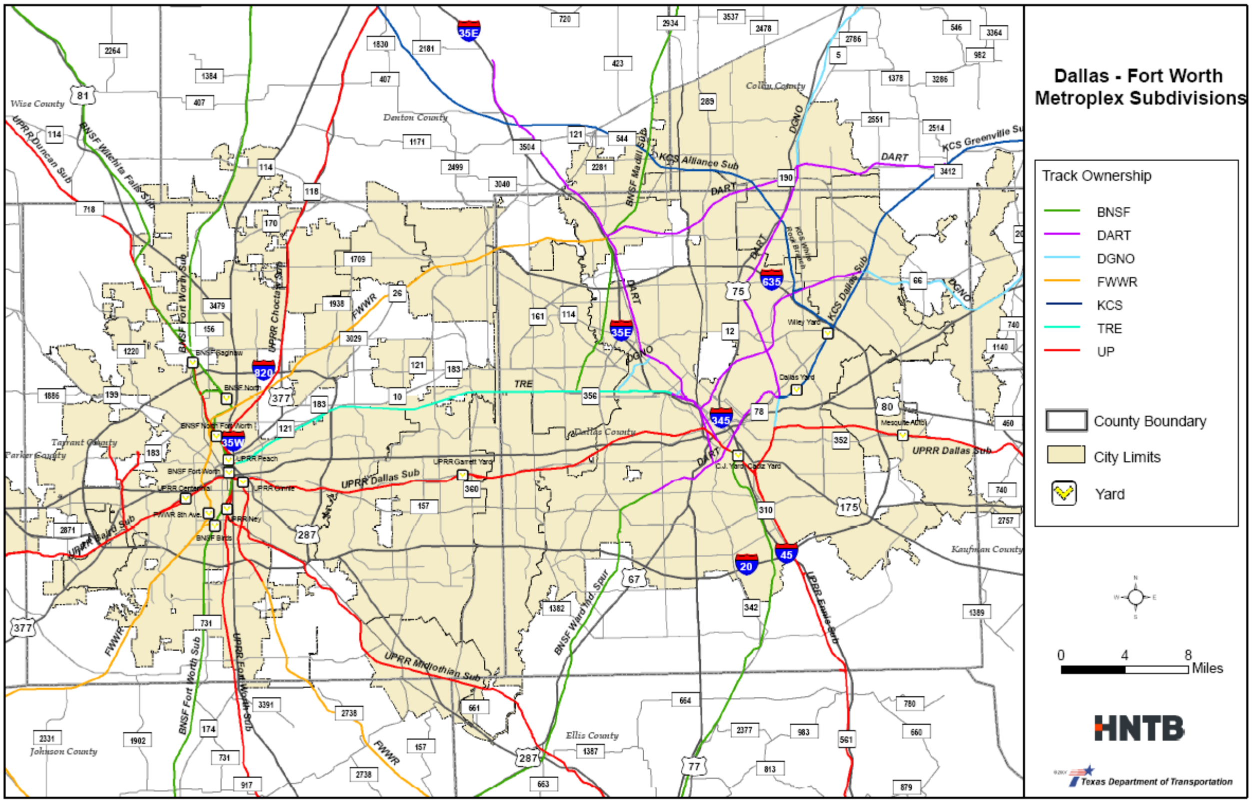

Figure 3-9: DFW Rail Network

The existing rail lines in the Metroplex area are owned and operated by the UP, BNSF, KCS, DGNO, FWWR, TRE, and DART. Table 3-10 summarizes the track and bridge inventories for the Dallas-Fort Worth Metroplex railroad subdivisions and industrial leads.

Railroad Subdivision Name	Mainline Track (mi)	Number of Grade Crossings	Number of Bridges	Transports Hazmat
KCS Alliance	28.98	30	42	Yes
UP Baird	5.6	14	4	Yes
UP Choctaw	18.3	36	24	Yes
KCS Dallas	21.23	30	32	Yes
UP Dallas	88.97	113	66	Yes
BNSF DFW	11.43	17	19	Data Not Available
FWWR Dublin	8.66	14	4	Yes
UP Duncan	16.26	36	6	Yes
UP Ennis	4.8	8	7	Yes
UP Everman Industrial	6.92	14	8	Data Not Available
BNSF Fort Worth	30.8	59	26	Yes
UP Fort Worth	13	35	10	Yes
FWWR Fort Worth	30.83	60	26	
BNSF Madill	17.09	11	8	Yes
UP Midlothian	20.5	41	12	Yes
TRE	33.8	31	29	Yes
BNSF Ward Industrial	4.1	7	5	Data Not Available
KCS White Rock	10.9	28	9	Yes
BNSF Wichita Falls	18.24	30	17	Yes
Total:	390.41	614	354	

Table 3-10: Dallas-Fort Worth Track and Bridge Inventory Summary

Existing Freight Rail Operations

The Dallas-Fort Worth Metroplex is a dense urban area with international airports, colleges and universities, and industries and businesses that support a thriving economy. The Dallas area has one of the highest concentrations of corporate headquarters in the U.S., and is home to large corporate operations for Texas Instruments, AT&T, Verizon, ExxonMobil, American Airlines, and many other companies of all sizes. The Texas agriculture and livestock industries are based in Fort Worth. The Metroplex is now served by three Class I railroads (UP, BNSF, and the KCS), two shortline railroads (DGNO and FWWR), and two commuter rail lines (DART and TRE) for a total of more than 1500 miles of mainline track.

The region is home to the BNSF headquarters and Network Operations Center (NOC), BNSF Intermodal and Carload Transportation Center (at Alliance Airport), UP Centennial Yard (which is one of UP's largest freight classification facilities), the UP Arlington Auto Facility (which serves General Motors), the UP Mesquite Auto Facility (which serves Chrysler, Ford, and Nissan), the UP Miller Yard (which handles traffic from the Port of Houston), and many other large rail yards and facilities. Fort Worth is also home to what is known as the busiest at-grade rail intersection in the country, Tower 55, which experiences typical daily train volumes of more than 100 freight and passenger trains. More than ten rail lines intersect in downtown Fort Worth near what is known as Tower 55 (as shown in Figure 3-10), which is considered a source of problems and delays for both the traveling public and the operating railroads.

Also located in the region are significant air cargo facilities such as DFW International Airport, which handles nearly 900,000 U.S. tons of cargo each year, and the Fort Worth Alliance Airport, which handled 171,090 metric tons in 2002.

Although not a direct indication of the location of each and every customer within the Dallas-Fort Worth Metroplex, Figure 3-11 shows the general locations of existing industry and spur tracks that connect to the main tracks that could serve rail customers.

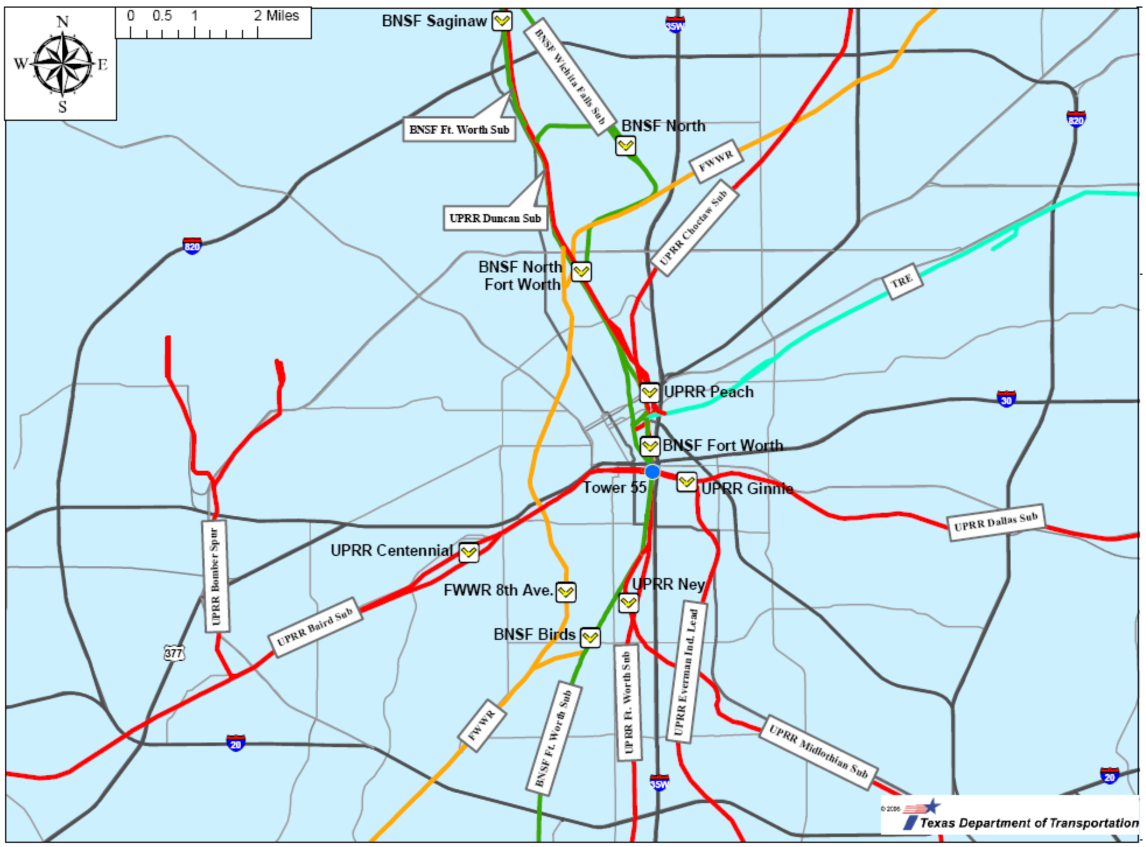

Figure 3-10: Existing Rail Network in Downtown Fort Worth (Tower 55)

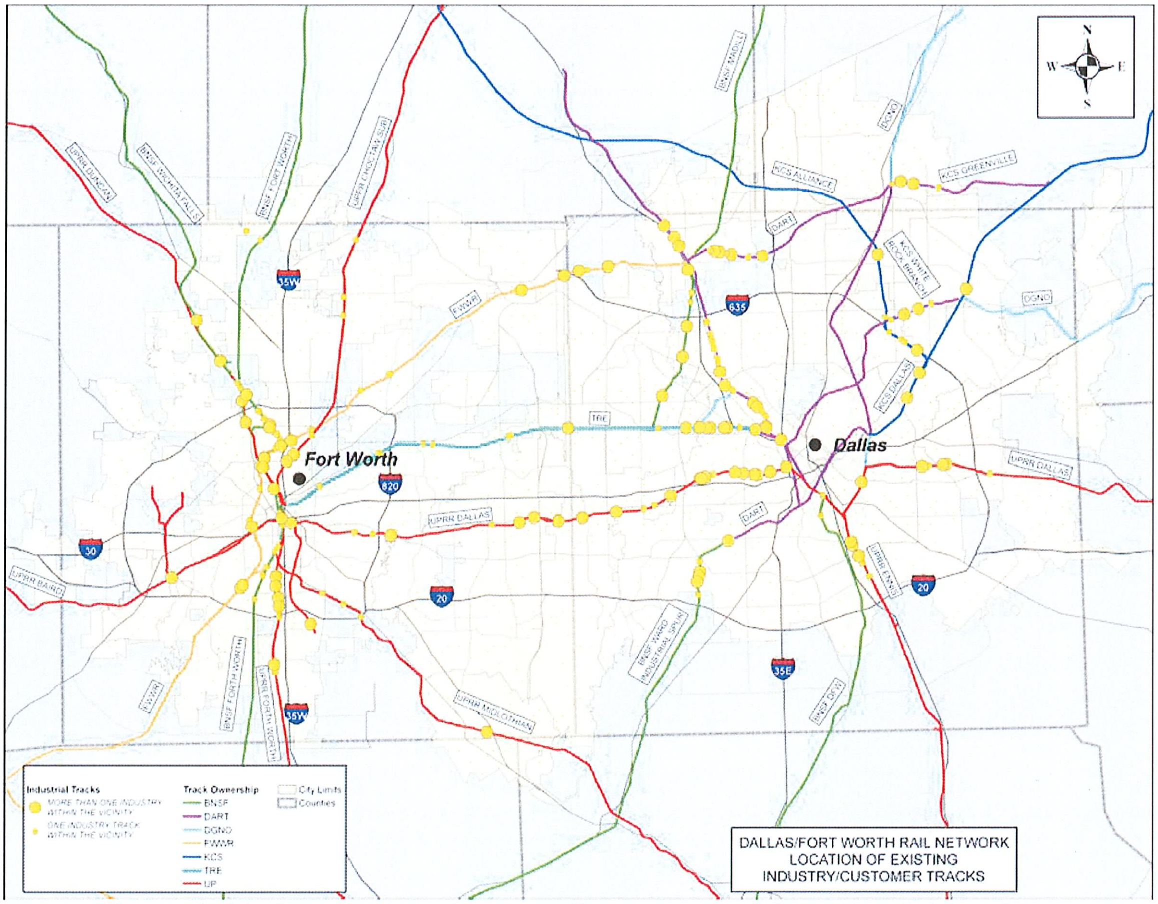

Figure 3-11: Approximate Industry/Customer and Spur Track Locations

Hazardous Material Movement Trends

The UP, BNSF and KCS are the primary freight operators for the Dallas-Fort Worth Metroplex, although the DGNO and FWWR also operate freight. The freight operators of the region, such as UP, BNSF, and the DGNO, also transport freight (including hazardous materials) on the TRE passenger line from Dallas to Fort Worth. Based on the 2005 STB data, twelve subdivisions carry hazardous materials in Dallas-Fort Worth. Projections from SAM yielded a 2.5 percent annual growth rate in the Dallas-Fort Worth region, this growth rate was used to estimate the number of carloads carrying hazardous materials in 2025. Figures 3-12 and 3-13 illustrate the carloads handled in 2005 and projected carloads in 2025 in Dallas-Fort Worth. Separate maps of each subdivision are also provided in Appendix C, which also show areas of residential land use along each rail line.

Confidential

Confidential

Figure 3-12: 2005 Hazardous Material Movement within Dallas-Fort Worth

Confidential

Figure 3-13: 2025 Hazardous Material Movement within Dallas-Fort Worth

Hazardous Material Movement by Classification

Table 3-11 lists the relative percentages of hazardous material classifications out of all hazardous material carloads transported in Dallas-Fort Worth. Radioactive material carloads were not included in the analysis of this study due to the unavailability of data. Additionally, less than 0.02 percent of hazardous material carloads moved along subdivisions in Dallas-Fort Worth were shown to contain explosives.

Hazardous Material Classification	Percentage of Hazardous Material Carloads
Explosives	**Confidential**
Gases	
Flammable and Combustible Liquids	
Flammable Solids	
Oxidizing Substances and Organic Peroxides	
Toxic/ Infectious Substances	
Radioactive Materials	
Corrosive Substances	
Misc. Hazardous	
Total	

Table 3-11: Percentages of Carloads by Hazardous Material Classification in Dallas-Fort-Worth

Residential Exposure to Hazardous Materials Moved by Rail

The impact of hazardous material movements specific to residential areas was measured according to the number of rail carloads transported through residential land use areas within protective action distances for hazardous materials along each railroad subdivision. Based on the classification system of the ERG, residential exposure levels vary depending on the type of hazardous material. Table 3-12 lists the estimated number of residents, determined from 2000 US Census data, within the identified protective action distances along each rail subdivision that transports hazardous material. The total number of residents shown in the table includes residents that are counted on more than one rail subdivision due to overlapping protective action distances between subdivisions.

Subdivision	Protective Action Distance (miles)	Estimated Number of Residents
KCS Alliance	2.00	224,400
UP Baird	1.60	22,200
UP Choctaw	1.78	73,200
UP Dallas	1.58	260,400
BNSF DFW	2.15	46,300
DGNO	1.64	382,800
UP Duncan	2.03	38,900
UP Ennis	1.78	13,300
UP Fort Worth	1.82	59,700
BNSF Fort Worth	1.77	101,100
FWWR	1.80	276,500
KCS Greenville/Dallas	2.00	90,900
BNSF Madill	1.80	95,000
UP Midlothian	1.77	57,400
TRE	1.95	177,700
KCS White Rock	2.00	110,100
BNSF Wichita Falls	1.62	33,900
Total	**-**	**2,063,800**

Table 3-12: Estimated Residential Population within Protective Action Distance Corridor Widths along Rail Subdivisions in Dallas-Fort Worth

Hazardous Material Findings Summary

- Hazardous material rail carloads tonnage is projected to increase by more than 63 percent by 2025.
- [Confidential]
- [Confidential]

SECTION 4: RISK ANALYSIS AND DISCUSSION

This section describes the method of analyzing the impacts of transporting hazardous materials within metropolitan areas. The degree to which the movement of these materials might have an adverse effect on the public depends upon the actual occurrence of a release of hazardous material from a rail tank car or other container into the environment. The effects of this type of incident then depend upon factors such as the location and size of the release, the type of hazardous material, the time of day at which the release occurs, and the population density near the point of release.

Hazardous materials may be shipped without incident and have no adverse effect on the public. In order to analyze the impacts of rail-transported hazardous materials, the likelihood of a train accident that results in a spill or release must be estimated. Since the circumstances that might be involved in a release are not known beforehand, these estimates are based on statistics from previous rail accidents in the U.S.

This study discusses the potential risk to the public by determining a statistical rate of release of transporting hazardous materials by rail along each corridor in each metropolitan area. Risk is also measured as the potential for public exposure in a residential area to a release of hazardous materials, where exposure includes any required emergency response action ranging from instructing the public to remain indoors, to isolating a hazard area, to requiring the evacuation of an area.[1]

Hazardous Material Risk Factors

The variability in current rail operating conditions and demographic patterns on each rail corridor represent uncertainties in the circumstances involved in a release of hazardous material. Therefore, predicting the likelihood of an incident that leads to the release of hazardous material must rely on historical data that describes the tendency for these events to occur. Figure 4-1 illustrates how each of these factors, described in sections that follow, are incorporated into the determination of the residential area's risk of exposure to hazardous materials.

[1] 2004 Emergency Response Guide, Research and Special Programs Administration, U.S. Department of Transportation.

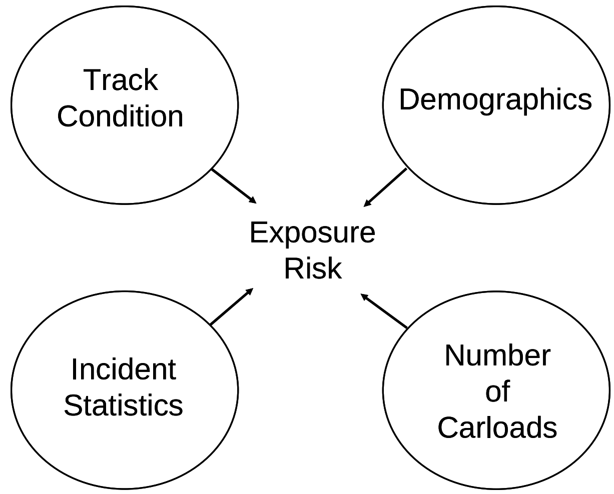

Figure 4-1: Determinants of Hazardous Material Exposure Risk

Incident Statistics

The Federal Railroad Administration (FRA) reports that the majority of serious events involving train derailments or train collisions that results in the release of hazardous materials or harm to rail passengers have been associated with track conditions and human factors.[2] Figure 4-2 shows how track condition and human factors together make up almost 72 percent of these high-risk train accidents. Incidents caused by human factors may be the result of error on the part of railroad locomotive crew or precipitated by the actions of motorists at highway-rail grade crossings. Figure 4-2 also shows that signal and equipment failures together comprise 14 percent of rail incidents that pose harm to the public.

While information available for this study does not allow for the resolution of problems associated with human performance on private railroads, the effects of track condition can be examined using 1992-2001 train accident data that has been compiled by the FRA Office of Safety. The data from this time period showed that 346 out of 377 (92 percent) of hazardous material releases on Class I and non-Class I railroads were due to derailments.[3]

[2] National Rail Safety Action Plan Progress Report 2005-2007, Federal Railroad Administration, U.S. Department of Transportation, May 2007.
[3] Anderson, R.T. and Barkan, C.P.L., Railroad Accident rates for Use in Transportation Risk Analysis, Transportation Research Record, No. 1863, National Research Council, Washington, D.C., 2004, pp. 88-98.

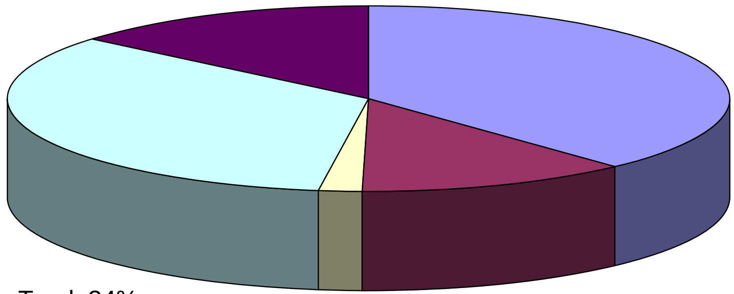

Figure 4-2: 2001-2006 Causes of Non-Grade Crossing Train Accidents

Derailment Statistics

Table 4-1 lists the maximum allowable train speed for freight rail service according to each FRA track class. Since the FRA bases track class on specific track standards (e.g., number of good rail ties per defined length, consistency of track gauge, etc.) that relate to maximum allowable train speeds, records of maximum train speeds on each rail corridor can be used to infer track conditions without conducting an extensive and costly field inventory. This table also lists the FRA-compiled accident rates for each track class in terms of cars derailed per billion freight car miles traveled.[4] One billion freight car miles is equivalent to a 100-car train traveling 100,000 times over a corridor distance of 100 miles. These statistics exclude incidents involving highway-rail grade crossing accidents and, thus, reflect the potential for track and operating conditions at each FRA track class (which may involve human factors) to cause a derailment. Derailments per billion freight car miles traveled during the 1992-2001 period are listed in Table 4-1 according to FRA track class and associated maximum track speed.

Performance Measure	FRA Track Class				
	1	2	3	4	5
Maximum Track Speed (mph)	10	25	40	60	80
Cars Derailed per Billion Freight Car Miles	3979	726	300	77	42

Table 4-1: Relationship of Track Speed and Derailment Rate to FRA Track Class

Table 4-1 represents statistics collected nationwide, and provides no indication of when or where an accident involving a derailment will actually occur. Non-derailment related hazardous material incidents are primarily attributable train collisions and highway-rail grade crossing accidents. Since 92 percent of hazardous material releases are associated with derailments, determining the potential for hazardous material incidents within the municipal areas of this study focus on the relationship between track condition to railcar derailments (i.e., the major cause of

[4] Anderson, R.T. and Barkan, C.P.L., Railroad Accident rates for Use in Transportation Risk Analysis, Transportation Research Record, No. 1863, National Research Council, Washington, D.C., 2004, pp. 88-98.

releases) since events such as highway-rail grade crossing accidents are highly dependent upon the unique conditions of each incident.

Hazardous Material Release

Table 4-2 lists the risk of a hazardous material release per freight car derailments. This table also describes a cause/effect relationship between higher average train speeds and the probability of release following a derailment (i.e., release rates increase with higher speeds at derailment), which can be expected since higher speeds at derailment generate greater impact forces.

Probability	FRA Track Class				
	1	2	3	4	5
Hazmat Releases per Freight Cars Derailed	0.2%	0.5%	0.8%	0.8%	0.9%
Average Speed at Derailment (mph)	8.7	17.7	26.3	33.6	37.0

Table 4-2: Probability of Release following a Derailment per FRA Track Class

The combined information in Tables 4-1 and 4-2 provide the information necessary for determining the expected frequency of hazardous material releases, based on nationwide rail derailment data. Table 4-3 lists this rate as expected releases per billion railcar miles traveled. For example, based on FRA statistics, hazardous materials transported by rail on class 2 track could be expected to experience 4 releases per billion freight car miles traveled. Figure 4-3 plots the expected releases listed in Table 4-3 for each track class, illustrating how there is not a significant decrease in release frequencies from class 4 to class 5 track while release frequency drops significantly as track class increases from class 1 to class 4.

Frequency of Occurrence	FRA Track Class				
	1	2	3	4	5
Hazmat Releases per Billion Freight Car Miles*	8	4	2	1	0

* Decimals are rounded to the nearest whole number (class 5 release rate is actually 0.4)

Table 4-3: Hazardous Material Release Frequency per FRA Track Class

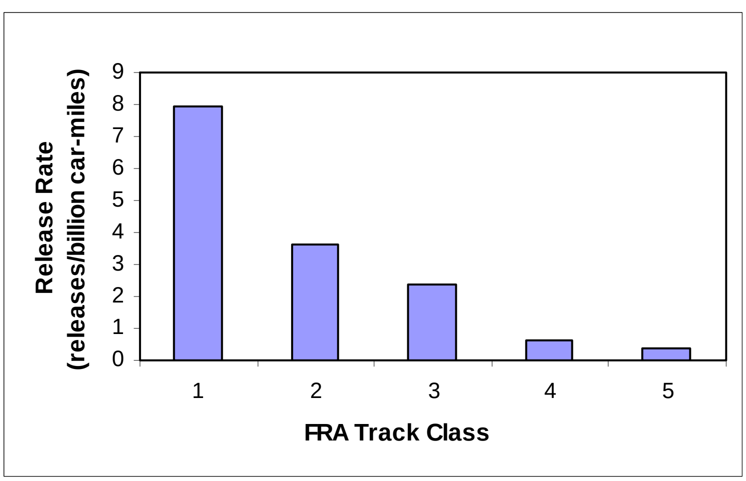

Figure 4-3: Rates of Hazmat Release by FRA Track Class

Determining the expected frequency of hazardous material releases (Table 4-3) from nationwide accident statistics provides a critical component to estimating the risk of exposure to populations. Since these statistics are compiled according to track class, knowledge of the classes of track as discussed in section 5 allows for the potential of a release to be assigned to each corridor.

Exposure to Residential Areas

Given that at any particular time, there is a risk (albeit small) of an incident occurring that results in the release of hazardous material, the number of people expected to be exposed at any point along each subdivision can be calculated based on protective action distances. This study uses 2000 U.S. Census blocks, with population density reported as people per square mile, to determine the number of inhabitants along each rail corridor within the protective action distance for the corridor. Given the variability in population densities among U.S. Census blocks, a weighted average population density was used to represent the numbers of people potentially affected within a defined study limit (based on protective action distance) on each corridor, as shown in Figure 4-4.

The total geographic area likely to be exposed in the event of a release of hazardous material is governed by the chemical and physical properties of the material that escapes into the environment from a railcar, the size of the chemical release, and the time at which the chemical is released. These areas are defined by protective action distances of each hazardous material listed in the ERG, which are the result of atmospheric models that consider:

- Hazardous material type (i.e., chemical name)
- Large (greater than 5% of a car's contents) or small spill (5% or less of a cars contents), where a typical tank car might have a 16,000-gallon capacity
- Time of day (daylight hours or nighttime)

The potential impact area of a hazardous material release is a rectangular area consisting of a width and a length equal to an ERG protective action distance (see Figure 4-4) that is representative of the unique composition of hazardous materials being transported on each corridor. Potential impact areas are then converted to potential numbers of persons exposed to a release using the weighted average population densities described above.

Effectiveness of Re-Allocating Rail Movements by Time-of-Day

The list of hazardous materials provided in the ERG shows that protective action distances can be much greater for nighttime spills than for daytime spills. For example, the ERG protective action distance for a large spill of anhydrous hydrogen chloride is 2.2 miles for instances when the spill occurs during the day and 6.5 miles when the spill occurs at night. These measures are the result of modeling thousands of hypothetical releases varying in release amount and atmospheric conditions. In each case, the rate of emission and downwind dispersion of vapors produced from liquids pooled on the ground, gases released directly from containers, and water-reactive chemicals spilled in water were calculated using a database of historic atmospheric conditions. Separate calculations of the emission and dispersion of vapors were made for daytime and nighttime conditions since reduced levels of atmospheric mixing occur at night, thus lessening the dispersion of hazardous vapor plumes.[5]

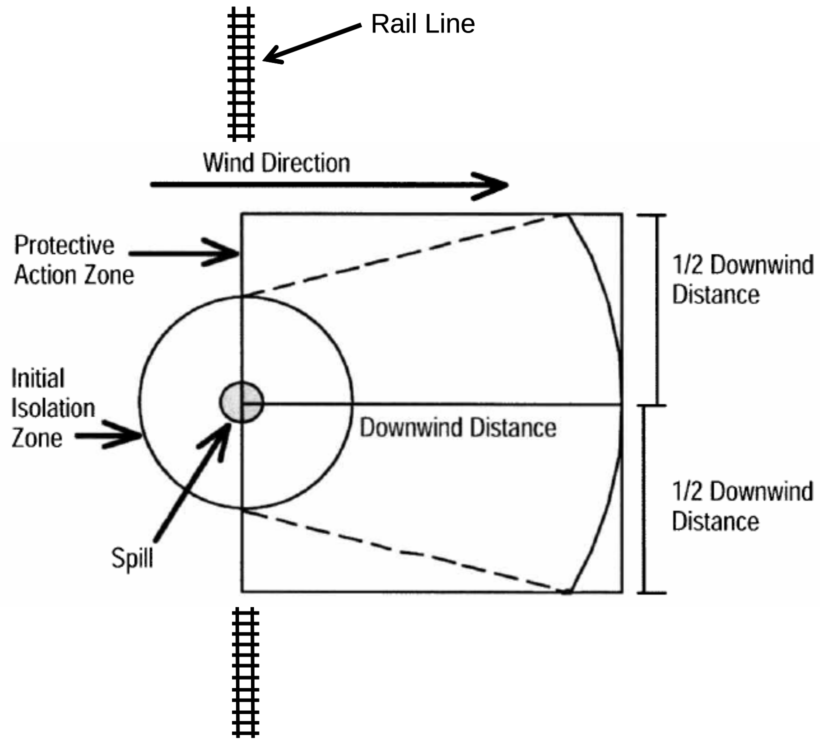

Figure 4-4: Example of Population Density Variation along Rail Corridors

Considering that each of the potential impact areas calculated in this study are based on the assumption that rail movements of hazardous materials are uniformly distributed over 24 hours (50 percent during the day and 50 percent at night), any reallocation of daytime movements of hazardous materials to nighttime movements would increase the size of the impact area since protective action distances are larger for nighttime spills. This impact should be given consideration in the event that the implementation of commuter rail service within a municipal area includes plans to shift existing daytime freight rail service to nighttime operations in order to accommodate daytime commuter service.

In summary, the occurrence and effects on a residential area depend upon a series of simultaneous events. First, a specific train must contain hazardous material cargo. Then, not only must the train experience a derailment, but the derailment must involve one or more hazardous material cars containing a substance requiring at least a modest protective action distance. This derailment must also be of a nature that causes the hazardous material car to release its contents. Yet, in order

[5] 2004 Emergency Response Guidebook Protective Action Distance Factors to Consider, available at: http://environmentalchemistry.com/yogi/hazmat/erg/ProtectiveFactors.html.

to have significant impact, the release must occur in a populated area. While this study shows that hazardous materials are moved throughout the municipal areas of Houston, San Antonio, and Dallas-Fort Worth on a regular basis, available statistics allude to a very low probability of events occurring that would necessitate protective action and potential risk of exposure to residential areas of those cities.

SECTION 5: ALTERNATIVES AND ECONOMIC FEASIBILITY FOR RELOCATING HAZARDOUS MATERIALS

As stated previously, the purpose of this study is to determine the economic feasibility of relocating freight trains that carry hazardous materials away from residential areas of the state in municipalities with a population of more than 1.2 million. It is through an understanding of the movement of hazardous rail freight that each region can develop ways to minimize risks to the population while still accommodating necessary freight movement. This report is intended to provide the Texas Legislature and officials within the Houston, San Antonio and Dallas/Fort Worth areas a description of freight rail movements of hazardous materials and an examination of infrastructure projects that have the potential to mitigate the public's risk of exposure to these substances.

The findings presented herein are based on 2005 transportation and 2000 census data, and present economic feasibility as a relative comparison among potential projects based on their ability to reduce the risk of exposure to hazardous materials to the residential population per investment dollar. Governing agencies may choose to pursue these analyses in greater detail or initiate discussions with the private sector concerning the possible implementation of specific projects.

An analysis was performed to identify improvements, including possible rail bypass routes, for the cities of Houston, San Antonio, and Dallas-Fort Worth and estimate the amount of hazardous materials that would shift from existing rail lines to the identified possible rail routes. The existing 2005 and projected 2025 hazardous material movements along existing rail lines without any improvements are discussed in section 3 with maps included in Appendix C, and the projected hazardous material movements after the incorporation of identified improvements and alternative routes are shown in Appendix D. Examples of improvements identified in this report are listed as follows:

- Adding a mainline track to facilitate the rerouting of hazardous material carloads to existing rail subdivisions with reduced residential exposure
- Relocating through-freight rail traffic onto new alignments (bypass routes) in conjunction with relocating rail yard and/or intermodal facilities
- Improvements to existing track (increase track class)

Some improvements, such as possible rail bypasses, can play a significant role in addressing the public's transportation needs by lessening congestion and providing track capacity for commuter rail service. However, the issue of protecting the public against releases of hazardous materials must address the existing locations of certain industries that handle hazardous materials. Therefore, it is possible that the risk of exposure would not be entirely eliminated or may be transferred to another mode of transport.

Methodology

The percentages of hazardous material cargo that may be shifted from existing rail lines to possible bypass routes were derived from analysis of current rail movements and operations. It was assumed that the same percentage projected for the total number of trains that may be shifted to possible bypass routes could be applied to the projected carloads of hazardous materials.

The percent shift of each individual hazardous material classification (i.e., gases, flammable liquids, etc…) from existing lines to the possible bypass routes could not be projected with a high level of accuracy based on the available data; therefore, the shift analyzed is for the total volume of hazardous materials of all classifications.

Economic feasibility, in the case of hazardous materials, is measured by the effectiveness of an infrastructure investment to reduce the risk of exposure to the public. This assessment examines two types of investment:

1. Rail bypass (or possible re-route) and/or yard relocation that allows for hazardous materials to be rerouted.
2. Track infrastructure upgrades that would likely reduce the potential for a release of hazardous material on existing routes.

Houston

Identified Improvements

Analysis of the existing freight rail operations reveals that the traffic is predominantly local business, for local customers and is not capable of being re-directed to bypass routes around Houston. Additionally, operational changes such as rerouting hazardous material carloads from one existing subdivision to another subdivision are not included as recommendations in this study due to the local service requirements along existing lines. Consequently, rail improvements such as rail yard relocations, rail line consolidations, and improvements to existing track conditions were investigated to relocate hazardous material traffic away from residential areas.

The improvements determined to be most beneficial in reducing the risk associated with hazardous material carloads moving through residential areas inside Houston are listed below with associated costs (detailed cost estimates are provided in Appendix A):

- Dayton to Cleveland Bypass – New rail corridor between Dayton and Cleveland would reduce the number of BNSF trains that enter central Houston. Estimated Cost - $296 million.
- Relocate carload switching operations at New South and Pearland Yards. Estimated Cost - $195 million.
- Upgrading the class of track along existing rail lines to class 4. Estimated costs vary by subdivision and are shown in Table 5-10.

Dayton-Cleveland Bypass

The possible bypass route analyzed consists of a new rail corridor with approximately 32 miles of track between Cleveland, Texas (at a crossing with the UP Lufkin Subdivision and the BNSF Conroe Subdivision) and Dayton, Texas (at a connection with the UP Baytown and Lafayette Subdivisions), as shown in Figure 5-1. In addition to reducing delay on existing rail lines in Houston, the potential Dayton to Cleveland bypass coupled with the New South and Pearland Yard relocations would potentially remove hazardous materials transported by rail from existing subdivisions in Houston to a possible bypass route located outside of the city.

The estimated cost of the Dayton to Cleveland alternative route includes an approximate 32-mile single track corridor located to the northeast of Houston for an approximate cost of $296 million. In addition to the new track and required right-of-way, the estimated cost also includes the following items:

- connections to the UP Lufkin and Lafayette Subdivisions
- grade separations with the UP Beaumont and BNSF Conroe Subdivisions
- eleven active grade crossing warning devices
- four grade separations at roadway-railroad crossings
- three sidings located at 10-mile intervals (these sidings would provide a location to set-off a car to allow the train to proceed to its destination or a location for one train to wait while another train passes)
- two train car safety detection devices (hot box and dragging equipment detectors) located at 20-mile intervals
- centralized traffic control signalization (to allow for computerized train movement in either direction)

Trains that could be rerouted to this alignment include BNSF through-trains operating between Beaumont or points east, and points west/northwest of Houston such as Temple and/or Teague. Trains that originate or terminate at Dayton, conveying traffic to or from Dayton, and which would not have to work at any other point in the Houston terminal, also were directed to this alignment provided that they had access. To gain such access, other new connections would be required in the northeast quadrants at Conroe, between the BNSF Conroe Subdivision and the UP Palestine Subdivision; and at Dobbin, between the BNSF Houston Subdivision and the BNSF Conroe Subdivision.

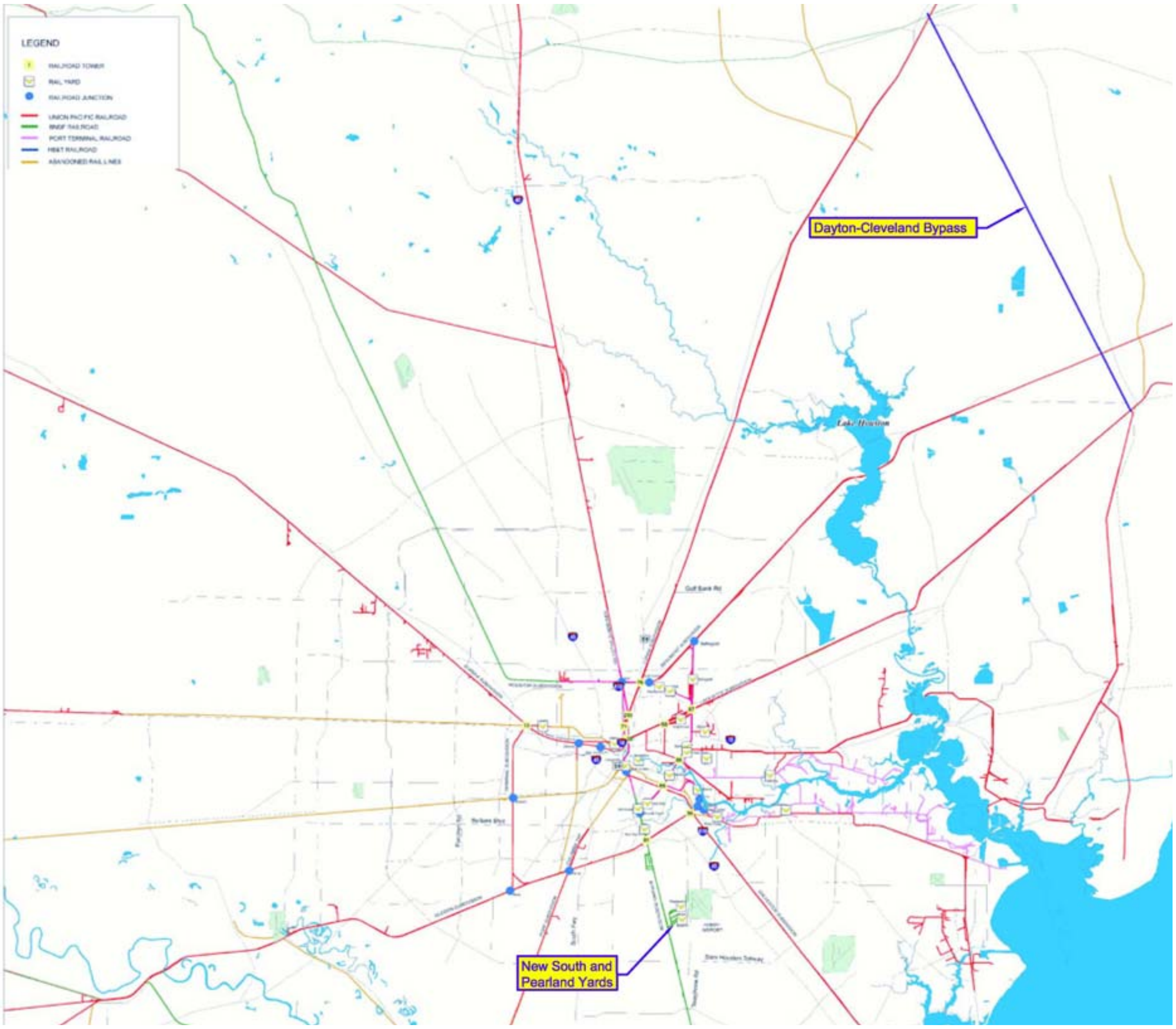

Figure 5-1: Dayton-Cleveland Corridor
(note: bypass route shown is for conceptual purposes only)

Relocate Carload Switching Operations

The Cleveland to Dayton connection was analyzed in conjunction with the relocation of current BNSF carload switching operations to a site not yet determined. By utilizing their existing network, a large number of BNSF trains would not need to enter into the heart of the Houston area rail network. Trains serving their customer base such as the Houston Light and Power facility at Thompson, Texas would remain. This relocation would free up capacity on existing rail lines and enhance movement capabilities on other existing rail corridors within the region. A relocation site for the yard operations has not yet been identified; however, studies are underway to investigate locations south, north, and northeast of Houston.

Currently, the BNSF intermodal, auto, and carload operations take place at either Pearland on the BNSF Mykawa Subdivision or New South Yard on the West Belt Subdivision. Trains inbound from Temple or Teague must take the long way around to get to either facility, while trains being prepared for departure often occupy the main track preventing the passage of additional trains.

BNSF Pearland Intermodal Facility and Mykawa Yard are located on the BNSF Mykawa Subdivision near the Houston Hobby Airport. The Pearland Intermodal Facility occupies over 80 acres of land and handles receiving and distribution of automobiles. Mykawa Yard primarily handles the classification and storage of freight cars. The BNSF Gulf Division, which includes the Mykawa Subdivision, is nearing capacity in terms of meeting merchandise operations demand. Relocating the facilities at Pearland and Mykawa to a location which could accommodate a larger facility would consolidate these operations.

BNSF New South Yard is located immediately north of the Griggs/Long/Mykawa intersection, which is frequently occupied by vehicular traffic traveling in all directions and crossing both the UP Glidden Subdivision and the BNSF Mykawa Subdivision. New South Yard is a major classification yard with a carload switching facility. Photo 5-1 shows the south end of New South yard under existing conditions.

Photo 5-1: Mykawa Subdivision at New South Yard (looking north)

The ancillary benefits to the relocation of carload switching operations at existing BNSF facilities to a location outside of the Houston Metroplex may include:

- Reducing the volume of BNSF trains within the immediate region by routing trains destined for New South and Mykawa Yards around the city, which improves safety and air quality in the dense urban areas
- Allowing for additional uses on the existing rail line, such as commuter rail

The Dayton-Cleveland route was shown to benefit both the private and public sectors by reducing train traffic in the east end of Houston. The relocation of carload switching operations that currently take place at New South and Pearland (Mykawa) Yards may ultimately increase the benefits of this improvement. Analysis of hypothetical cases in which carload switching is relocated outside of Houston in addition to constructing the new Dayton-Cleveland corridor has shown that there may be a reduction in the number of trains operating on the BNSF Houston, HB&T East Belt, UP Terminal, and HB&T West Belt subdivisions ranging from six to 15 percent, depending on the subdivision.

Upgrading Class of Track

Table 5-1 and Figure 5-2 show the mileage of each track class that comprises the rail corridors within Houston under existing conditions. Actual track classes at any future time depend upon the degree of infrastructure maintenance or improvement relative to the amount of wear associated with daily rail operations. This table was prepared by associating the maximum train speeds provided in railroad timetables to their respective track classes. The FRA track class defines maximum allowable train speeds. The frequency of releases per car miles traveled increases as the class of track decreases.

Subdivision	Corridor Composition by Track Class (miles)				
	1	2	3	4	5
Baytown		7.11			
Beaumont				7.01	
East Belt		11.21			
Eureka			10.44		
Galveston			19.44		
Glidden					17.25
Houston			15.06		
Lafayette				1.00	
Lufkin				13.46	
Mykawa				6.06	
Palestine				6.64	
Popp			5.28		
Strang			9.84		
Terminal East				9.06	
Terminal West				13.59	
West Belt		9.16			
Total	0.00	27.48	60.06	56.82	17.25
Releases per Billion Car Miles (see Table 4-3)	8	4	2	1	0

Table 5-1: Track Conditions of Rail Corridors in Houston

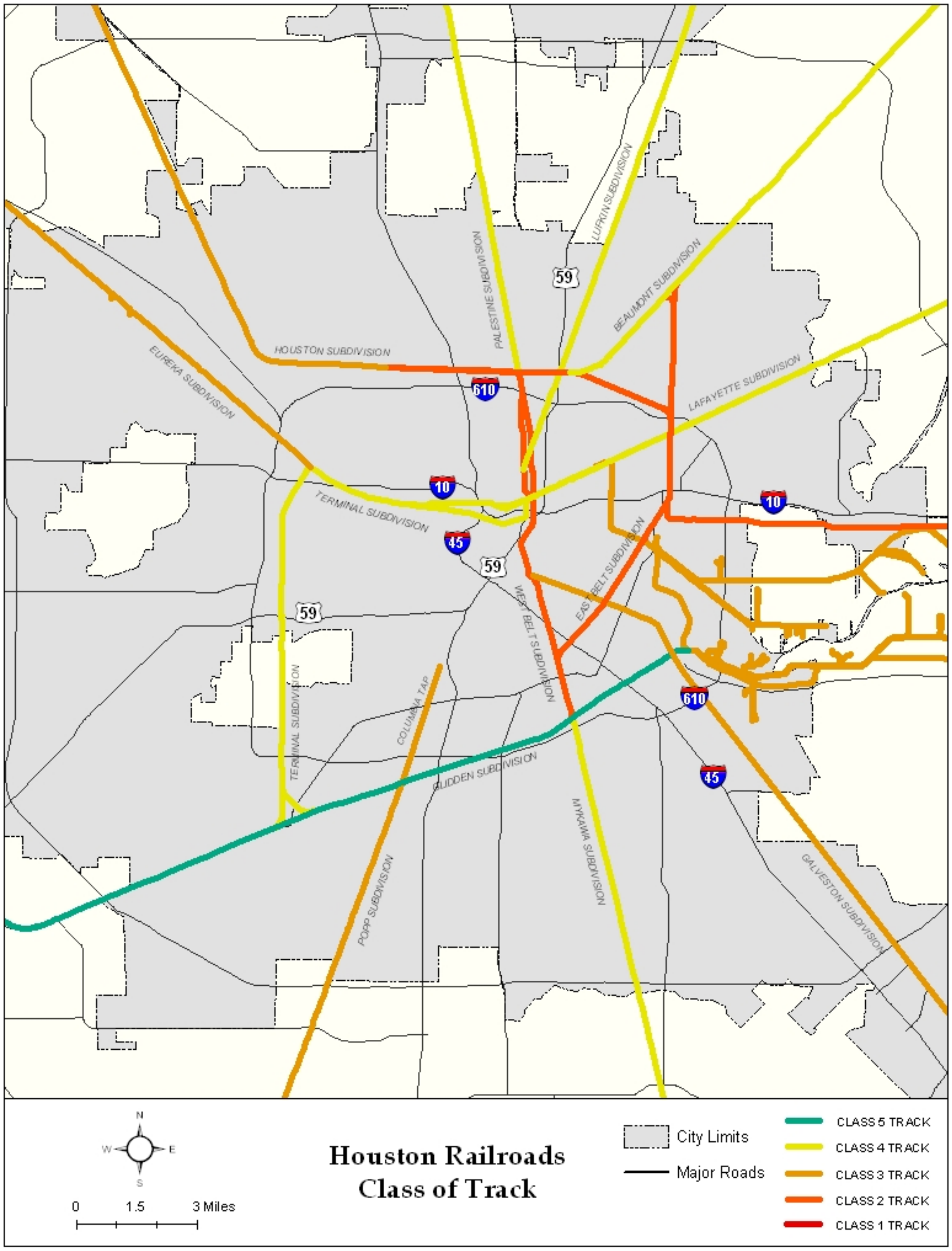

Figure 5-2: Track Conditions of Rail Corridors in Houston

Impacts to Hazardous Material Movement

The percentage of rail cars traveling along the possible bypass route that would carry hazardous materials was estimated based on the total number of trains determined to be potentially able to be rerouted to the bypass. A projected average percentage of hazardous cargo moving along existing subdivisions within the city was used to estimate the percentage of rail cars that would carry hazardous materials along the possible bypass route.

The comparative analysis between build and no-build scenarios of a bypass shows that the number of carloads carrying hazardous materials on six of the twelve subdivisions within the study area would be reduced by varying percentages. However, the number of trains along the BNSF Conroe subdivision, which is located approximately 40 miles north of Houston and runs primarily east-west between Silsbee and Somerville through Conroe and Cleveland, would increase by approximately 22 percent. Table 5-2 and Figure 5-3 illustrate the projected percentages of change in carloads carrying hazardous materials by subdivision resulting from the possible bypass route and relocated yard operations.

All freight is estimated to be reduced along existing by the same percentages of reduction in hazardous materials listed in the Table 5-2. The reduction of freight on existing lines has benefits to the public (in addition to the reduction of hazardous materials movement through residential areas) such as reduced delay, emissions, noise, and accidents at roadway-rail crossings along existing rail lines.

Railroad Subdivision	**2005 Annual Carloads of Hazardous Materials**	**2005 Annual Carloads of Hazardous Materials with Bypass**	**Estimated Change in Annual Carloads of Hazardous Materials**
UP Baytown	**Confidential**		0%
UP Beaumont			0%
BNSF Conroe			22%
HB&T East Belt			-12%
UP Eureka			0%
UP Galveston			0%
UP Glidden			-3%
BNSF Houston			-8%
UP Lafayette			-2%
UP Lufkin			0%
BNSF Mykawa			0%
UP Palestine			0%
UP Strang			0%
UP Terminal (east segment)			-6%
UP Terminal (west segment)			-6%
HB&T West Belt			-15%
Possible Bypass Route			N/A

Table 5-2: Estimated Change of 2005 Hazardous Material Movement Resulting from the Possible Bypass and Yard Relocations

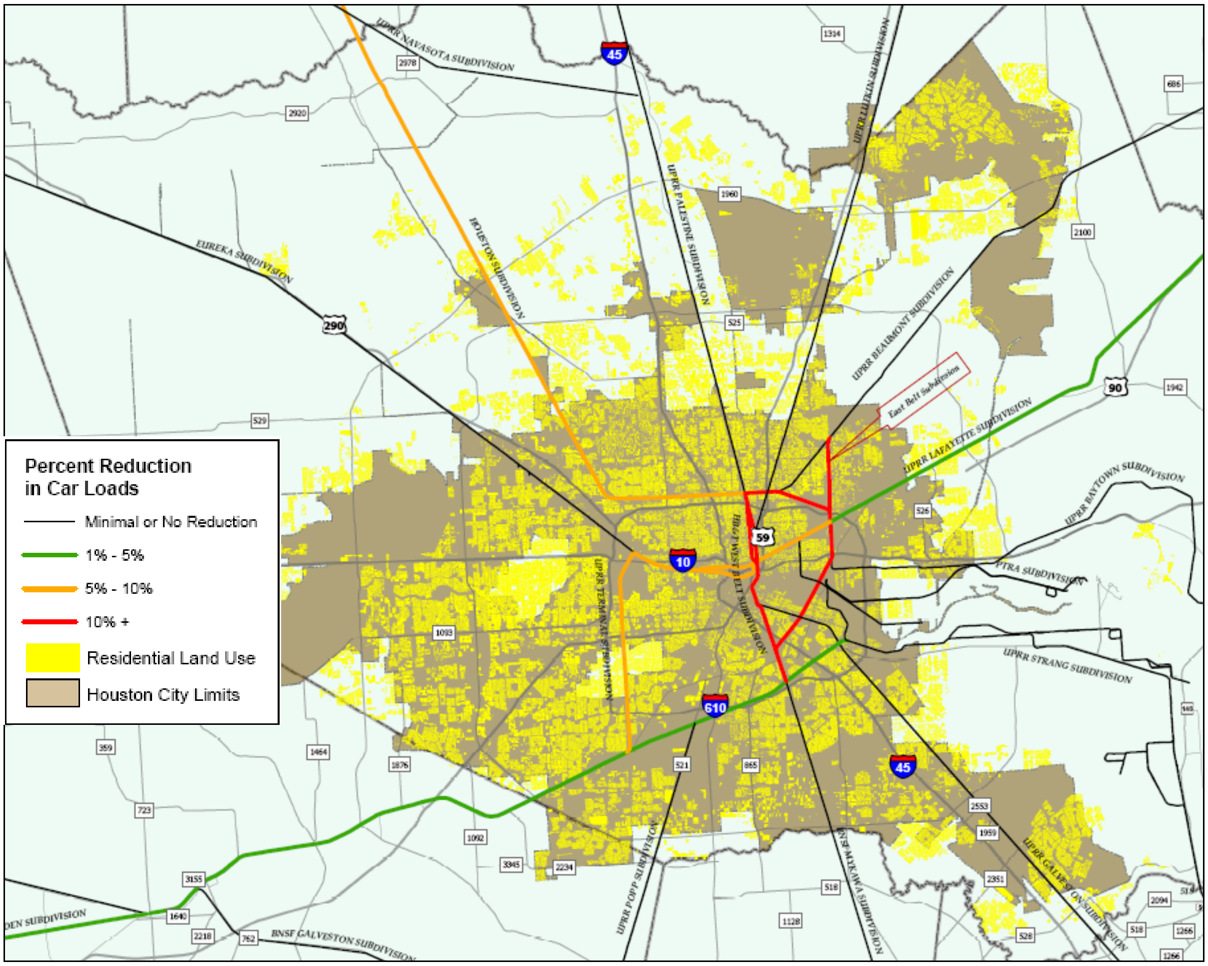

Figure 5-3: Estimated Reduction in Annual Carloads of Hazardous Materials Resulting from Possible Bypass and Relocated Yard Operations

The estimated number of residents, as shown in Table 5-3 and previously discussed in section 3, was calculated as the residential population along each rail corridor within the city limits of Houston and within a corridor width as defined by the calculated protective action distances (as described in section 4) for hazardous materials. Residential data shown in the following table as well as in the maps in Appendix C are derived from 2000 US Census data, and were not projected for the future year due to the lack of available data pertaining to regional residential growth rates at the census block level.

Railroad Subdivision	Estimated Number of Residents (2000)	Estimated Change in 2005 Annual Carloads of Hazardous Materials Due to Bypass
UP Baytown	39,800	**Confidential**
UP Beaumont	22,000	
BNSF Conroe	51,800*	
HB&T East Belt	89,600	
UP Eureka	44,200	
UP Galveston	80,200	
UP Glidden	140,100	
BNSF Houston	93,400	
UP Lafayette	5,600	
UP Lufkin	54,400	
BNSF Mykawa	37,500	
UP Palestine	51,800	
UP Popp	27,800	
UP Strang	67,500	
UP Terminal	166,000	
HB&T West Belt	90,000	
Subtotal (Existing Network)	**1,009,900**	
Possible Bypass Route	9,700	
Total	**1,019,600**	

Table 5-3: Estimated Residential Exposure to Hazardous Materials within Houston and Changes in Hazardous Materials Carloads Due to the Possible Bypass
(*population shown for BNSF Conroe Subdivision is for limits between Silsbee and Somerville, Texas)

While the estimated number of residents potentially impacted by the hazardous cargo movement does not decrease, the amount of hazardous cargo projected to travel in close proximity to the residential areas along the existing subdivisions within the city of Houston decreases overall by approximately seven percent, for a total of approximately   annual carloads in 2005. However, hazardous material carloads are projected to be increased by   annual carloads on the BNSF Conroe Subdivision.

In summary, the following conclusions were made regarding the impact of the possible Dayton-Cleveland rail corridor and relocated operations at New South and Pearland/ Mykawa Yards on the movement of hazardous materials through Houston:

- The largest percentages of reduction of projected hazardous material carloads occur along the HB&T West Belt (15 percent) and the HB&T East Belt (12 percent) Subdivisions with the identified improvements.
- Hazardous material carloads are not projected to be significantly impacted on the Baytown, Beaumont, Galveston, Lufkin, Mykawa and Palestine Subdivisions with the construction of the identified improvements.

- The total number of rail carloads carrying hazardous material on the existing rail subdivisions in Houston is projected to be reduced by approximately seven percent resulting from the identified improvements.
- The possible bypass route affects a relatively smaller residential population than existing routes.

San Antonio

Identified Improvements

The potential improvements analyzed to reduce hazardous materials transported by rail through residential areas in San Antonio are listed below with associated costs (detailed cost estimates are provided in Appendix A):

- Shifting hazardous materials carloads from Austin Subdivision Mainline 1 to Mainline 2 within San Antonio. Estimated Cost: minimal.
- Constructing a new double track rail corridor between Taylor and southwest of San Antonio to bypass San Antonio as well as other metropolitan areas between San Antonio and Taylor such as New Braunfels, San Marcos, and Austin. Estimated Cost: $2.0 billion.
- Upgrading the class of track along existing rail lines to class 4. Estimated costs vary by subdivision and are shown in Table 5-11.

Shifting Rail Operations Between Existing Rail Subdivisions

Analysis of current local service requirements and locations of rail customers that may receive carloads of hazardous material within San Antonio shows that up to 55 percent of hazardous materials carloads may potentially be re-routed from Austin Subdivision Mainline 1 to Mainline 2 within San Antonio, thereby consolidating hazmat transport within the city. Additionally, there are fewer residents along Mainline 2 than Mainline 1, as shown in Table 5-4. Hazardous material carload traffic may also potentially be consolidated on the Del Rio and Laredo Subdivisions southwest of downtown; however, such a consolidation would not change the risks or potential consequences associated with the hazmat transport due to the close proximity of the two lines.

Subdivision	2005 Annual Carloads of Hazardous Materials	Estimated Number of Residents
Austin Mainline 1	Confidential	123,800
Austin Mainline 2		101,200
Corpus Christi		51,000
Del Rio		134,400
Glidden		8,100
Kerrville		127,200
Laredo		64,800

Table 5-4: Estimated Residential Exposure to Hazardous Materials in San Antonio

Possible Bypass Route

A significant volume of the rail freight moving into and/or out of San Antonio does not originate or terminate there; but is only in San Antonio to be switched or classified into another train destined elsewhere, or for movement onto another mainline that traverses the San Antonio area. Therefore, an alternative to reroute hazardous material away from the residential areas in San Antonio is to construct a bypass route around the city. The concept provides for the relocation of through-freight rail services to a possible new route from Taylor to the southwest portion of San Antonio, as shown in Figure 5-4.

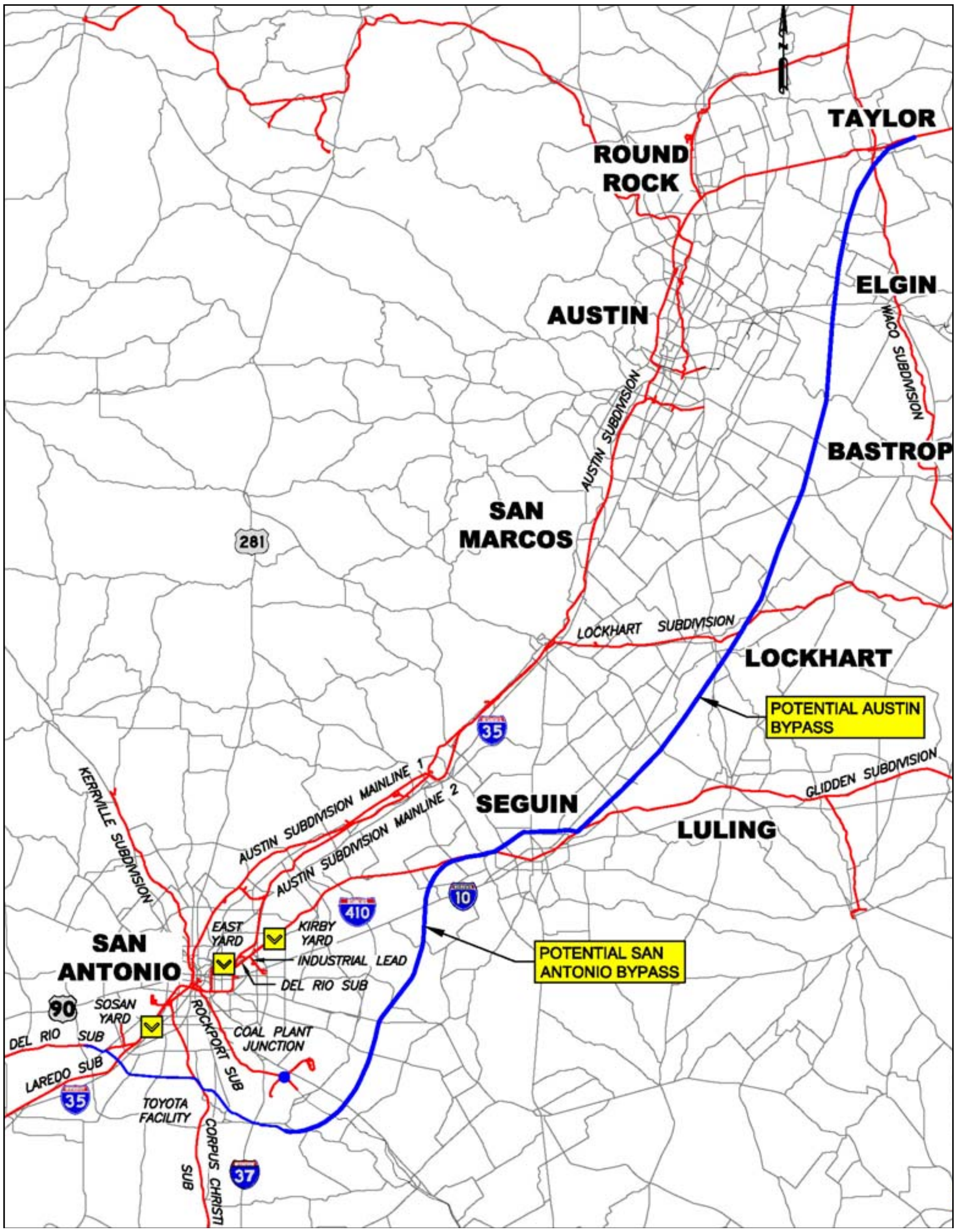

Figure 5-4: San Antonio Region Railroad Subdivision Locations
(note: possible bypass route shown is for conceptual purposes only)

The potential Taylor to San Antonio bypass would remove hazardous materials carloads from existing subdivisions in San Antonio to a bypass route located outside of the city. The estimated cost of the possible bypass route includes an approximate 142-mile double track (class 4) corridor between Taylor and southwest of San Antonio near Macdona, for an estimated cost of $2 billion. In addition to the new track and right-of-way, the estimate also includes the following items:

- mainline connections to the Laredo, Del Rio, Corpus Christi, Rockport, Glidden, and Austin Subdivisions
- 102 active grade crossing warning devices and 23 grade separations At roadway-railroad crossings
- fourteen sidings located at 10-mile intervals (these sidings would provide a location to set-off a car to allow the train to proceed to its destination)
- seven train car safety detection devices (hot box and dragging equipment detectors) located at 20-mile intervals
- centralized traffic control (to allow for computerized train movement in either direction on either track)
- control points with universal crossovers at 20-mile intervals
- a new freight yard facility at Marion to remove local freight switching operations from the San Antonio area

While the possible bypass route would reduce the number of hazardous material carloads through San Antonio, additional public benefits associated with the relocation of through-freight rail services in the corridor could include:

- Reductions in vehicular delays and improved safety at highway-rail grade crossings,
- Improvements to air quality resulting from reductions in vehicular idling and reduced locomotive operations,
- Reductions in fuel usage for vehicular traffic,
- Improvements in economic development opportunities, and
- Possible implementation of commuter rail services in the existing corridor.

The relocation of through-freight traffic to the San Antonio bypass route would require the construction of new yard facilities for the classification and sorting of rail cars on the new route. Constructing one facility toward the western end of the conceptual San Antonio bypass may optimize efficiencies; potentially at or near UP's new intermodal facility located between the Del Rio and Laredo Subdivisions just off I-35. This location could serve as a main line fueling facility and crew exchange point for through-freight operations and handle typical mechanical department operations for that area. Another yard facility may be necessary on the eastern end of the alignment, potentially near Marion and could be used for train make-up for the San Antonio area, which could reduce traffic entering East Yard for that same purpose. Marion could provide the operational logistics as a staging area for local trains, a crew exchange point and a locomotive fueling facility. Located northeast of

San Antonio, mixed freight trains could be routed to this location, reducing traffic through the city, with freight cars separated for local delivery.

Upgrading Class of Track

Table 5-5 and Figure 5-5 show the mileage of each track class that comprises the rail corridors within San Antonio under existing conditions. This table was prepared by associating the maximum train speeds provided in railroad timetables to their respective track classes. The FRA track class defines maximum allowable train speeds. The frequency of releases per railcar miles traveled increases as the class of track decreases.

Subdivision	Corridor Composition by Track Class (miles)				
	1	2	3	4	5
Austin 1				19.10	
Austin 2				19.00	
Corpus Christi			10.88		
Del Rio					22.00
Glidden					1.10
Kerrville		17.00			
Laredo				9.00	
Total	0.00	17.00	10.88	47.10	23.10
Releases per Billion Car Miles (see Table 4-3)	8	4	2	1	0

Table 5-5: Track Conditions of Rail Corridors in San Antonio

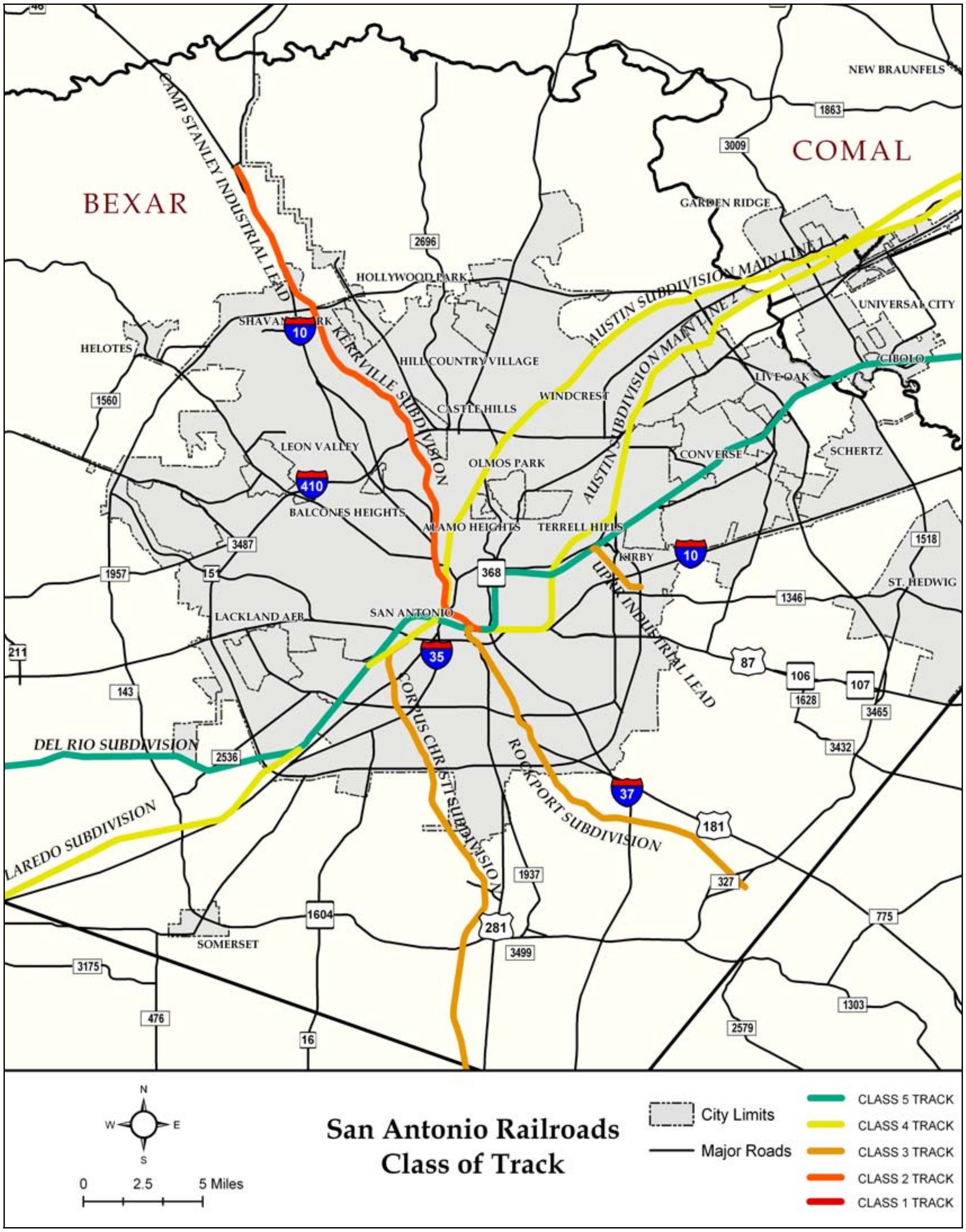

Figure 5-5: Track Conditions of Rail Corridors in San Antonio

Impacts to Hazardous Material Movement

Table 5-6 and Figure 5-6 illustrate the projected change in 2005 annual carloads carrying hazardous materials by subdivision resulting from the possible bypass route. The comparative analysis between build and no-build scenarios of a bypass shows that varying percentages of the number of carloads on eight of the nine rail subdivisions in San Antonio would shift to the possible bypass route. The only subdivision that shows no projected shift of carloads to the possible bypass route was the Kerrville Subdivision, since it serves local customers northwest of the city. All other freight is estimated to be reduced on the existing subdivisions by the same percentages of reduction in hazardous materials listed in Table 5-5.

<table>
<tr><th>Railroad Subdivision</th><th>2005 Annual Carloads of Hazardous Materials</th><th>2005 Annual Carloads of Hazardous Materials with Bypass</th><th>Estimated Change in Annual Carloads of Hazardous Materials</th></tr>
<tr><td>Austin Mainline 1</td><td colspan="2" rowspan="8">Confidential</td><td>-59-69%
(depending on location)</td></tr>
<tr><td>Austin Mainline 2</td><td>-75-94%
(depending on location)</td></tr>
<tr><td>Corpus Christi</td><td>-67%</td></tr>
<tr><td>Del Rio</td><td>-85%</td></tr>
<tr><td>Glidden</td><td>-12-64%
(depending on location)</td></tr>
<tr><td>Kerrville</td><td>0%</td></tr>
<tr><td>Laredo</td><td>-85%</td></tr>
<tr><td>Possible Bypass Route</td><td>N/A</td></tr>
</table>

Table 5-6: Change in 2005 Hazardous Material Movement due to the Possible Bypass Route

The largest projected shifts in terms of percentages occur along the Laredo, Del Rio, and Austin Subdivisions. The bypass route is projected to result in a reduction of hazardous material movement on the Laredo Subdivision between downtown San Antonio and Gessner of 85 percent, while the Austin Subdivision Mainline 2 between Garden Ridge (located northeast of San Antonio in Comal County) and downtown San Antonio is projected to have 94 percent of hazardous material traffic shift to the possible bypass route. Another segment along the Austin Subdivision Mainline 2 between San Marcos and Garden Ridge is estimated to experience a shift of approximately 75 percent of carloads carrying hazardous materials off of the existing line and onto the bypass. The Del Rio Subdivision between downtown San Antonio and Macdona is projected to experience a reduction of 85 percent, for a total shifted number of carloads carrying hazardous materials of nearly ,. These segments run parallel to the possible bypass route and carry traffic through the heart of the city.

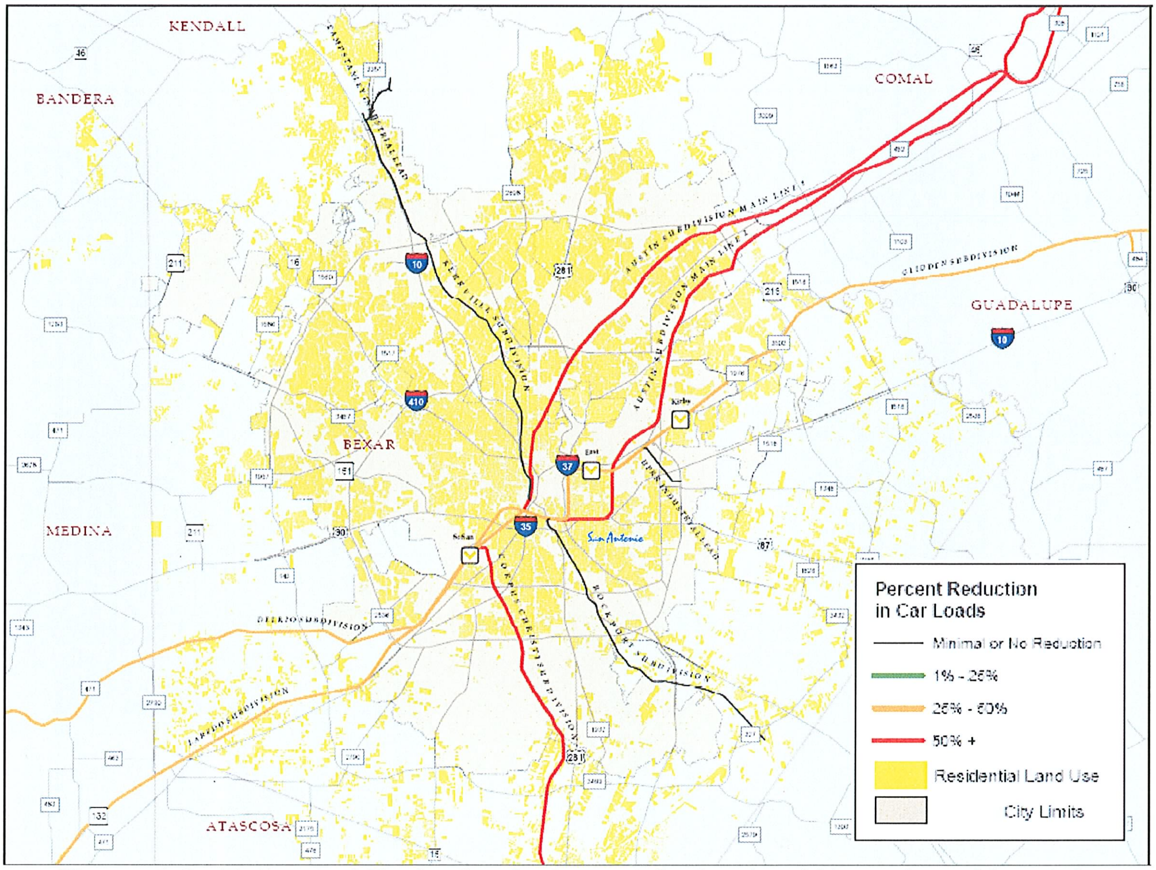

Figure 5-6: Estimated Reduction in Annual Carloads of Hazardous Materials Resulting from Possible Bypass

The estimated number of residents, as shown in Table 5-7 and discussed in section 3, was calculated as the residential population along each rail corridor within the city limits of San Antonio and within a corridor width as defined by the protective action distances for hazardous materials. The residential land use along each subdivision is shown in the maps in Appendix C.

The estimated number of residents along the existing railroad subdivisions are shown only within the city limits of San Antonio, while the residential population estimated along the possible bypass route is located along the entire corridor, which extends beyond the city limits. The total number of residents impacted by the relocation of freight trains to the possible bypass route would be higher than presented in the table, since the existing subdivision demographics are only shown for the San Antonio municipal limits. The possible bypass route would reduce hazardous material movements within the existing corridor between Taylor and Macdona and would therefore have a greater positive impact due to the fact that volumes would be reduced through New Braunfels, San Marcos, Buda, Kyle, Austin, Pflugerville, Round Rock, and Hutto, to Taylor. These areas are not within the municipal limits of San Antonio, and therefore not part of the scope of this study.

Railroad Subdivision	Estimated Number of Residents (2000)	Estimated Change in 2005 Annual Carloads of Hazardous Materials Due to Bypass
Austin Mainline 1	123,800	Confidential
Austin Mainline 2	101,200	
Corpus Christi	51,000	
Del Rio	134,400	
Glidden	8,100	
Kerrville	127,200	
Laredo	64,800	
Subtotal (Existing Network)	**610,500**	
Possible Bypass Route	33,800	
Total	**644,300**	

Table 5-7: Estimated Residential Exposure to Hazardous Material within San Antonio and Changes in Hazardous Materials Carloads Due to the Possible Bypass

While the estimated total number of residents potentially impacted by the hazardous cargo movement increases with the addition of the possible bypass route, the amount of hazardous cargo traveling in close proximity to the densely populated residential areas along the existing subdivisions within the city of San Antonio is projected to decrease by approximately 50 percent.

The following conclusions were made regarding the impact of the identified bypass route on the movement of hazardous materials through San Antonio:

- The largest percentages of projected carloads shifting from existing rail lines to the possible bypass route occurs between Garden Ridge and downtown San Antonio along the Austin Subdivision Mainline 2 and the Del Rio Subdivision between downtown San Antonio and Macdona as well as the segment along the Laredo Subdivision between downtown San Antonio and Gessner.
- The total number of rail carloads carrying hazardous material on the existing rail subdivisions in San Antonio is projected to be reduced by approximately 50 percent and shifted to the possible bypass route.

Dallas-Fort Worth

Identified Improvements

The improvements analyzed for the Dallas-Fort Worth study area consist of upgrading the class of track on existing rail lines to class 4 track (discussed in further detail later in this section) as well as a possible bypass route. The Regional Transportation Council of the North Central Texas Council of Governments (NCTCOG), the metropolitan planning organization (MPO) for the region, along with multiple other regional public and private organizations have stated the region's support of the development of a new outer loop/ rail bypass of the Dallas-Fort Worth Metroplex.

For the purposes of routing hazardous material away from residential areas, a possible bypass route was developed for this study that connects to the UP Dallas Subdivision southeast of Dallas, loops around the Metroplex to the south, and then connects to the BNSF Fort Worth Subdivision north of Fort Worth. The alignment in this study does not include a segment to the northeast of Dallas, since the train volumes and hazardous material carloads on the rail lines northeast of the Metroplex are significantly lower that other lines in the study area. It was therefore determined that the cost to benefit comparison would not warrant detailed study of the northeast segment of the loop.

The possible Dallas-Fort Worth bypass includes an approximate 169-mile single track corridor around the Metroplex for an estimated cost of $1.5 billion. In addition to the new track and right-of-way, the cost estimate includes the following items:

- mainline connections to the UP Dallas Subdivision in the northeast and the BNSF Fort Worth Subdivision in the north
- at-grade crossing diamonds where the bypass would traverse the UP Ennis, BNSF DFW, UP Midlothian, BNSF Ward Industrial Spur, UP and BNSF Fort Worth, FWWR, and Wichita Falls Subdivisions
- 103 active grade crossing warning devices, 45 road crossing locations with cross bucks, and 38 grade separations at roadway-railroad crossings
- sixteen sidings located at 10-mile intervals (these sidings would provide a location to set-off a car to allow the train to proceed to its destination or a location for one train to wait while another train passes)
- train car safety detection devices (hot box and dragging equipment detectors) located at 20-mile intervals
- centralized traffic control to allow for computerized train movement in either direction

This alignment would re-route through-trains currently traveling through the congested residential and downtown areas of Dallas and Fort Worth (e.g., Tower 55) onto the bypass and outside of the Metroplex. However, service to local customers along existing rail subdivisions must be maintained. The possible bypass, as shown in Figure 5-7, would have connections with the existing rail lines with the highest volumes of hazardous material carloads, such as the UP Dallas Subdivision, UP Midlothian Subdivision, UP Fort Worth Subdivision, UP Baird Subdivision, the FWWR, the UP Duncan Subdivision, the BNSF Wichita Falls Subdivision, and the BNSF Fort Worth Subdivision.

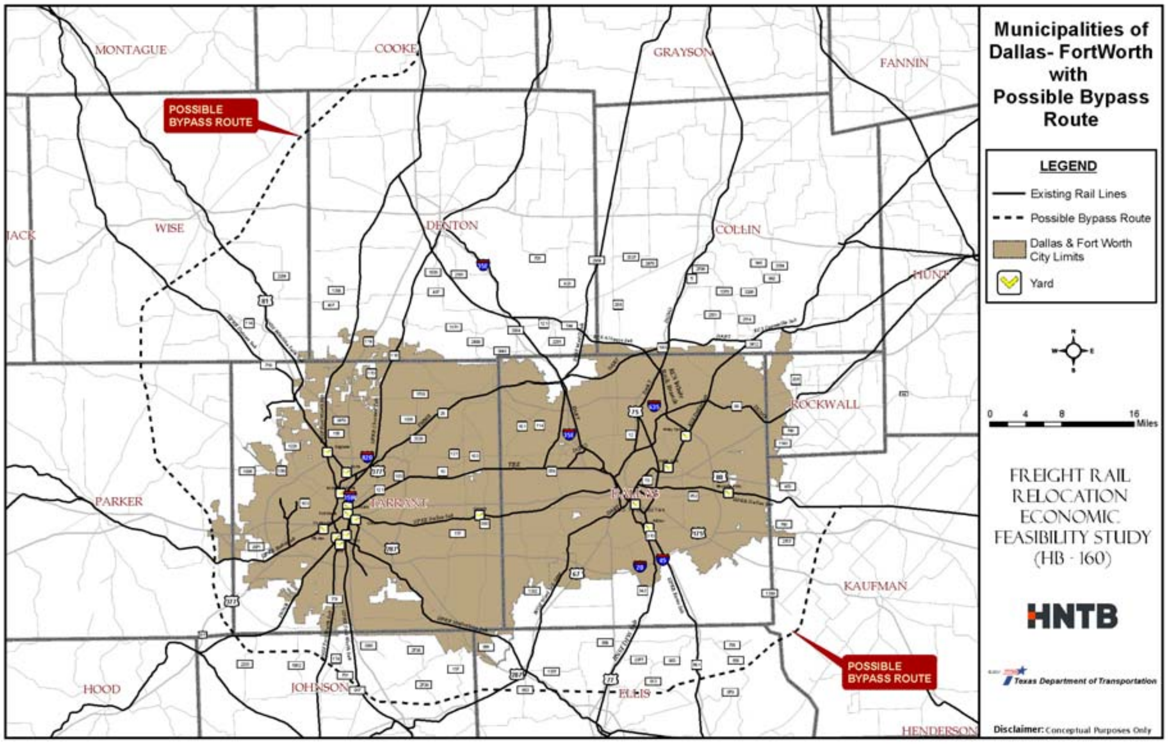

Figure 5-7: 2005 Hazardous Material Movement within Dallas-Fort Worth

Upgrading Class of Track

Table 5-8 and Figure 5-8 show the mileage of each track class that comprises the rail corridors within Dallas-Fort Worth under existing conditions. This table was prepared by associating the maximum train speeds provided in railroad timetables to their respective track classes. The FRA track class defines maximum allowable train speeds. The frequency of releases per railcar miles traveled increases as the class of track decreases.

Subdivision	Corridor Composition by Track Class (miles)				
	1	2	3	4	5
Alliance			21.42		
Baird				5.60	
Choctaw				18.65	
Dallas				54.25	
DFW			11.43		
DGNO	73.42				
Duncan			13.66		
Ennis				4.80	
Fort Worth (UP)				13.03	
Fort Worth (BNSF)				30.80	
FWWR	1.84	37.63			
Greenville/Dallas (KCS)				11.53	
Madill				17.09	
Midlothian				20.50	
TRE			2.84	30.96	
White Rock		10.90			
Wichita Falls				18.24	
Total	75.26	48.53	49.35	225.45	0.00
Releases per Billion Car Miles (see Table 4-3)	8	4	2	1	0

Table 5-8: Track Conditions of Rail Corridors in Dallas-Fort Worth

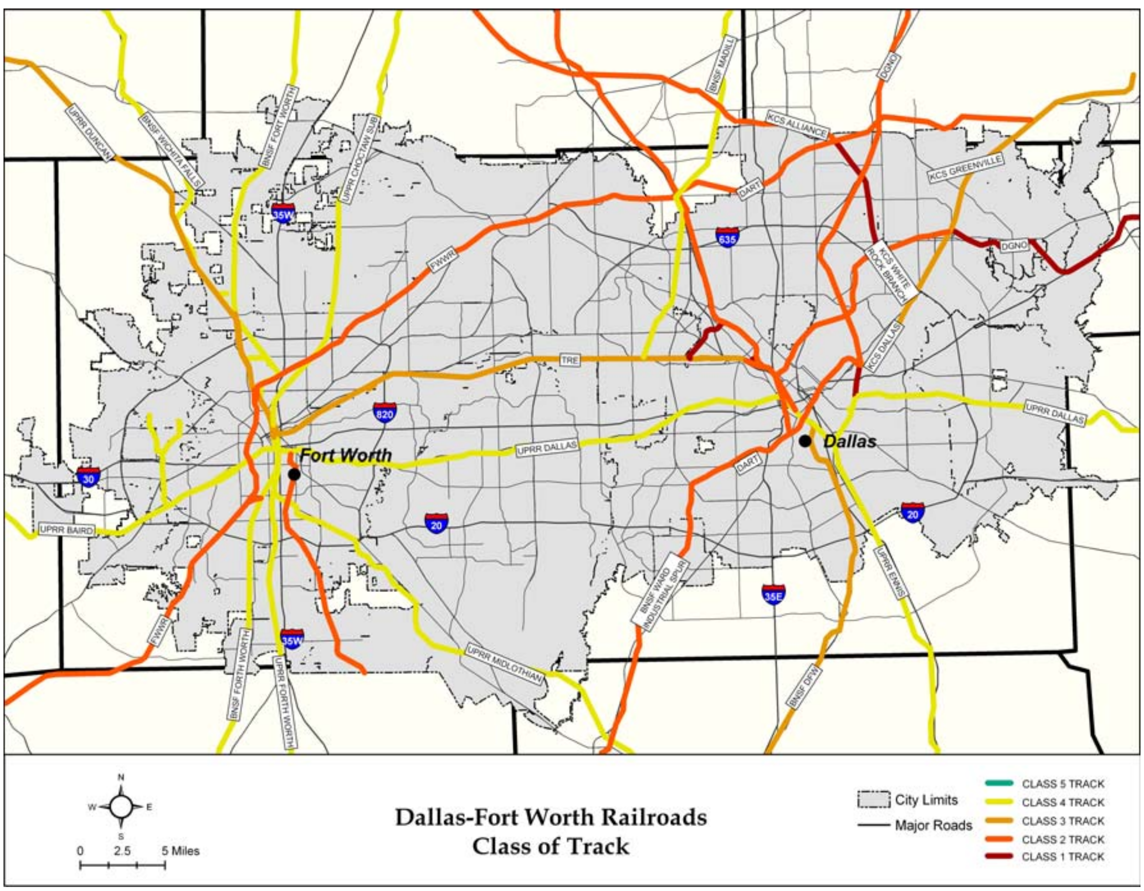

Figure 5-8: Track Conditions of Rail Corridors in Dallas-Fort Worth

Impacts to Hazardous Material Movement

An independent study of the Dallas-Fort Worth region is currently underway; however, because the study has not yet been completed to the same level as similar studies for the Houston and San Antonio regions, comprehensive data pertaining to railroad operations in the Dallas-Forth Worth region is not yet available.[1] As a result, two scenarios of percentage shifts from existing rail lines to the bypass were analyzed. The two scenarios consist of an estimated shift of 10 percent of hazardous material carloads from all existing rail lines within the municipality limits to the bypass as well as an estimated 25 percent shift.

The 10 and 25 percentage shifts were selected for analysis based on analysis of STB Waybill data as well as analysis of the locations of existing customers within the Dallas-Fort Worth Metroplex that may receive hazardous materials carloads. This analysis identified approximate volumes of hazardous material carloads that may be able to be potentially rerouted to a bypass. The analysis showed that between 10 and 25 percent of hazardous material carloads may be able to be shifted from existing lines to a bypass around the Metroplex.

The hazardous material carload distribution resulting from the possible bypass route within the Dallas-Fort Worth Metroplex limits for the two scenarios analyzed are shown in Figures 5-10 and 5-11 for the year 2005. Figure 5-9 shows the existing rail network hazardous material carload projections for the year 2005, without the construction of the possible bypass route.

Confidential

Figure 5-9: 2005 Hazardous Material Movement within DFW without Bypass

[1] Dallas-Fort Worth Region Freight Study Phase I, dated February 27, 2007.

Confidential

Figure 5-10: 2005 Hazardous Material Movement within the DFW with a 10 Percent Shift to the Bypass

Confidential

Figure 5-11: 2005 Hazardous Material Movement within the DFW with a 25 Percent Shift to the Bypass

The estimated number of residents, as shown in Table 5-9 and discussed in section 3, was calculated as the residential population along each rail corridor within the city limits of the Dallas-Fort Worth Metroplex and within a corridor width as defined by the calculated protective action distances for hazardous materials. The estimated residential population along the existing railroad subdivisions is shown only within the city limits of the Dallas-Fort Worth Metroplex, while the residential population estimated along the possible bypass route is located along the entire corridor, which extends beyond the municipality limits.

Railroad Subdivision	**Estimated Number of Residents (2000)**	**2005 Annual Carloads of HazMat w/ 10% Shift to Bypass**	**2005 Annual Carloads of HazMat w/ 25% Shift to Bypass**
KCS Alliance	224,400	**Confidential**	
UP Baird	22,200		
UP Choctaw	73,200		
UP Dallas	260,400		
DGNO	382,800		
UP Duncan	38,900		
UP Ennis	13,300		
UP Fort Worth	59,700		
BNSF Fort Worth	101,100		
FWWR	276,500		
KCS Greenville/Dallas	90,900		
BNSF Madill	95,000		
UP Midlothian	57,400		
TRE	177,700		
KCS White Rock	110,100		
BNSF Wichita Falls	33,900		
Subtotal (Existing Network)	**2,063,800**		
Alternate Bypass Route	92,300		
Total	**2,156,100**		

Table 5-9: Estimated Residential Exposure to Hazardous Material within Dallas-Fort Worth and Changes in Hazardous Materials Carloads Due to the Possible Bypass

While the estimated total number of residents potentially impacted by the hazardous cargo movement increases with the addition of the possible bypass route, the amount of hazardous cargo traveling in close proximity to the residential areas along the existing subdivisions within the Metroplex was analyzed for assumed reductions of 10 and 25 percent.

Economic Analysis of Improvements

Derailment statistics presented in section 4 showed that the release rate of hazardous materials reach a minimum expected rate beginning at FRA track class 4 (see Figure 4-3). Track improvements are, therefore, evaluated assuming that corridors having existing track classes below class 4 are upgraded to class 4. Table 5-10 lists the existing and upgraded track class and incident exposure for each subdivision in the Houston area. Since the release rate of hazardous materials from rail cars is a function of track classes (see Table 4-3), this table also lists the expected change in releases for each corridor following track upgrades to class 4 (see Tables 4 through 6 in Appendix B for calculations). The capital cost of upgrading track, shown in Table 5-10, is estimated at $0.49 million per mile to upgrade from class 1 to class 4, and $0.41 million per mile to upgrade from either class 2 or 3 to class 4.

Subdivision	Residential Exposure (people)	FRA Track Class		Change in Annual Releases	Percent Decrease in Annual Releases	Capital Cost ($ million)
		Existing	Upgraded			
Baytown	11,800	2	4	-0.006	75%	2.92
Beaumont	5,400	4	4	0.000	0%	0.00
East Belt	15,100	2	4	-0.051	75%	4.58
Eureka	8,300	3	4	-0.001	50%	4.26
Galveston	7,000	3	4	-0.007	50%	7.94
Glidden	14,500	5	5	0.000	0%	0.00
Houston	11,500	3	4	-0.004	50%	6.15
Lafayette	10,900	4	4	0.000	0%	0.00
Lufkin	5,600	4	4	0.000	0%	0.00
Mykawa	12,200	4	4	0.000	0%	0.00
Palestine	14,600	4	4	0.000	0%	0.00
Popp	11,200	3	4	-0.001	50%	2.16
Strang	10,900	3	4	-0.005	50%	4.02
Terminal East	15,800	4	4	0.000	0%	0.00
Terminal West	14,400	4	4	0.000	0%	0.00
West Belt	18,700	2	4	-0.035	75%	3.74

Table 5-10: Houston Reductions in Releases following Track Upgrades

Table 5-11 lists the existing and upgraded track class for each subdivision in the San Antonio area. Since most of the corridors in San Antonio are comprised of either class 4 or 5 track, only the Corpus Christi and Kerrville subdivisions would require improvements.

Subdivision	Residential Exposure (people)	FRA Track Class		Change in Annual Releases	Percent Decrease in Annual Releases	Capital Cost ($ million)
		Existing	Upgraded			
Austin 1	10,600	4	4	0.000	0%	0.00
Austin 2	8,700	4	4	0.000	0%	0.00
Corpus Christi	7,700	3	4	-0.002	50%	4.44
Del Rio	10,900	5	5	0.000	0%	0.00
Glidden	14,000	5	5	0.000	0%	0.00
Kerrville	11,800	2	4	-0.004	75%	6.94
Laredo	15,100	4	4	0.000	0%	0.00

Table 5-11: San Antonio Reductions in Release Rates following Track Upgrades

Table 5-12 lists the improvements necessary in the Dallas-Fort Worth area in order to comply with class 4 standards. Since the DGNO is a lengthy class 1 corridor, a substantial investment is required to upgrade conditions to class 4.

Subdivision	Residential Exposure (people)	FRA Track Class		Change in Annual Releases	Percent Decrease in Annual Releases	Capital Cost ($ million)
		Existing	Upgraded			
Alliance	18,300	3	4	-0.003	50%	8.75
Baird	6,300	4	4	0.000	0%	0.00
Choctaw	7,000	4	4	0.000	0%	0.00
Dallas	7,600	4	4	0.000	0%	0.00
DFW	8,700	3	4	-0.001	50%	4.67
DGNO	8,500	1	4	-0.039	88%	35.94
Duncan	5,800	3	4	-0.003	50%	5.58
Ennis	4,900	4	4	0.000	0%	0.00
Fort Worth (UP)	8,300	4	4	0.000	0%	0.00
Fort Worth (BNSF)	6,400	4	4	0.000	0%	0.00
FWWR	12,600	2	4	-0.009	75%	16.27
Greenville/Dallas (KCS)	13,800	4	4	0.000	0%	0.00
Madill	10,000	4	4	0.000	0%	0.00
Midlothian	5,000	4	4	0.000	0%	0.00
TRE	10,300	4	4	-0.002	0%	0.00
White Rock	17,700	2	4	-0.003	75%	7.45
Wichita Falls	3,000	4	4	0.000	0%	0.00

Table 5-12: Dallas-Fort Worth Reductions in Release Rates following Track Upgrades

The effects of a rail bypass in each municipality are presented in Tables 5-13 through 5-15. The capital costs shown in these tables are not assumed to be completely allocated to reducing the risks associated with hazardous materials. A rail bypass could also eliminate a vast number of train-vehicle conflicts at existing grade crossings, provide capacity for commuter rail operations, and improve the efficiency of freight movements throughout a region.

Table 5-13 lists impact of shifting hazmat carloads from existing corridors in Houston to the bypass, indicating that carloads would be reduced from the urban area. In Table 5-14, hazardous materials on the existing San Antonio rail network are shown to be reduced by carloads and Table 5-15 indicates that a bypass in Dallas-Fort Worth would reduce hazardous materials on the existing rail network by carloads. Tables 5-13 through 5-15 show that a significant number of carloads will remain on existing corridors even with the construction of rail bypasses. In each case, a maximum reduction in exposure to hazardous materials could be achieved by upgrading existing track where needed for local operations and constructing a rail bypass to lessen the need for hazardous materials passing through densely populated municipal areas on the existing network.

Subdivision	Residential Exposure (people)	Annual Hazmat Carloads with Bypass (Cost = $296 million)		
		Existing	New	Change
Baytown	11,800			
Beaumont	5,400			
East Belt	15,100			
Eureka	8,300			
Galveston	7,000			
Glidden	14,500			
Houston	11,500			
Lafayette	10,900			
Lufkin	5,600		**Confidential**	
Mykawa	12,200			
Palestine	14,600			
Popp	11,200			
Strang	10,900			
Terminal East	15,800			
Terminal West	14,400			
West Belt	18,700			
Bypass	600			

Table 5-13: Houston Changes in Hazmat Carloads due to a Bypass

Subdivision	Residential Exposure (people)	Annual Hazmat Carloads with Bypass (Cost = $2.0 billion)		
		Existing	New	Change
Austin 1	10,600			
Austin 2	8,700			
Corpus Christi	7,700			
Del Rio	10,900		**Confidential**	
Glidden	14,000			
Kerrville	11,800			
Laredo	15,100			
Proposed Bypass	400			

Table 5-14: San Antonio Changes in Hazmat Carloads due to a Bypass

Subdivision	Residential Exposure (people)	Annual Hazmat Carloads with Bypass (Cost = $1.5 billion)		
		Existing	New	Change
Alliance	18,300	Confidential		
Baird	6,300			
Choctaw	7,000			
Dallas	7,600			
DFW	8,700			
DGNO	8,500			
Duncan	5,800			
Ennis	4,900			
Fort Worth (UP)	8,300			
Fort Worth (BNSF)	6,400			
FWWR	12,600			
Greenville/Dallas (KCS)	13,800			
Madill	10,000			
Midlothian	5,000			
TRE	10,300			
White Rock	17,700			
Wichita Falls	3,000			
Proposed Bypass	1,000			

Table 5-15: Dallas-Fort Worth Changes in Hazmat Carloads due to a Bypass

SECTION 6: CONCLUSIONS

The exposure of hazardous materials within a municipality is determined by several factors that are often subject to a high degree of variability. The physical and chemical composition of each hazardous material identified in the U.S. Department of Transportation's Emergency Response Guide contributes to a unique set of characteristics that determine how the material will behave when released into the environment. In addition to the potential for hazardous materials to behave differently from one another, variability in the behavior of a specific hazardous material exists according to atmospheric conditions that prevail at the time of release. The degree to which a release can affect the environment is further influenced by the volume of hazardous material actually released subsequent to a derailment or train collisions.

The majority of serious hazardous material incidents are, in fact, the result of derailments or train collisions. Of these accidents, the greatest number of hazardous material releases is associated with the derailment of rail cars, which directly correlates to track condition, train speed at derailment, and composition of the car. Due to the variability in size, strength, and protective features of hazardous material cars on the rail network, the integration of national derailment statistics with documented track conditions provided the most efficient approach to predicting releases within the municipalities of Texas.

Exposure to hazardous materials has been presented as a likelihood of release (release rate) according to the existing track condition of each rail corridor, and contrasted to the number of people that could be exposed if a release were to occur. Each corridor has been characterized by existing hazardous material carload volumes in order to evaluate the effects of proposals to relocate or reroute substantial numbers of these movements. The concept of relocating or rerouting hazardous materials is supported by the strategy to transfer carloads from densely populated to less densely populated areas, thus minimizing the effects of a release in the event that an incident occurs.

Rerouting of cars on existing infrastructure avoids notable public expense but could reduce the efficiency with which the railroad industry serves its customer base, and could add to grade crossing conflicts that currently exist. Rail relocations to new corridors requires a significant investment of capital, and may best be rationalized as part of a greater effort to reduce train-vehicle accidents at existing grade crossings, provide capacity for planned commuter rail service, and promote the efficient movement of freight through regions of the state.

Improving existing rail infrastructure has been investigated as an alternative to rerouting or relocating the movement of hazardous materials since national statistics show that release rates are highly influenced by track condition. Track upgrades are essentially a compromise between the low-cost but less than optimal rerouting of trains carrying hazardous materials and the high-cost of achieving substantial reductions in exposure through the construction of possible bypasses.

While, this study provides a comparison of improvements and their potential effects in reducing the risk of exposure to residents in close proximity to rail lines, the identified improvements may also provide additional benefit to the State and its citizens in the form of improved safety, reduced congestion, improved air quality, and economic development opportunities.

APPENDIX A: COST ESTIMATES

Houston Alternate Route

Item	Quantity	Units	Unit Price	Estimated Cost
Crossings				
New Active Warning Devices at Public Crossings: Gates, Flashers, Bells and Road Surface	11	EA	$ 300,000.00	$ 3,300,000
Grade Separations (roadway over) - 4 total	1	LS	$ 50,000,000.00	$ 50,000,000
Subtotal I				**$ 53,300,000**
Trackwork (note: meets FRA track class 4 requirements)				
Install #24 concrete ML turn-outs	2	EA	$ 250,000.00	$ 500,000
Install #15 concrete siding turn-outs	3		$ 200,000.00	$ 600,000
Construct New ML Track- (32.48 miles)	171,494	TF	$ 200.00	$ 34,298,800
Construct New ML set out tracks Track- (3 locations@3000')	9,000	TF	$ 200.00	$ 1,800,000
Subtotal II				**$ 37,198,800**
Signal Work				
Install New Hot Box Detectors/Dragging Equipment Detectors	2.00	EA	$ 250,000.00	$ 500,000
Install CTC	32.48	MI	$ 1,000,000.00	$ 32,480,000
Subtotal III				**$ 500,000**
Structures				
Construct New Single Track Railroad Bridges	3,286	LF	$ 4,000.00	$ 13,144,000
Subtotal III				**$ 13,144,000**
Drainage				
Proposed Small Drainage Structures along new North Corridor (Assumed 2-36" CMP @ 60' per mile)	1,949	LF	$ 500.00	$ 974,500
Subtotal IV				**$ 974,500**
Subtotal (I + II + III + IV)				**$ 105,117,300**
Utilities				
Relocation Allowance for New ML Track	1.00	LS	1%	**$ 1,051,173**
Stormwater Pollution Prevention Plan	1	LS	1%	**$ 1,051,173**
Earthwork				
Clearing and Grubbing	394.00	AC	$ 2,000.00	$ 788,000
Erosion Control Silt Fence/Hay Bales - (32.48 miles)	342,989	LF	$ 3.00	$ 1,028,967
Seeding and Mulching	394	AC	$ 2,500.00	$ 985,000
Cuts and Fills	952,747	CY	$ 100.00	$ 95,274,700
Subtotal V				**$ 98,076,667**
Right of Way Acquisition				
New Corridor	394	AC	$4,000	$ 1,576,000
Subtotal VI				**$ 1,576,000**
Subtotal (all above costs)				$ 206,872,313
Contractor Mobilization	1	LS	5%	$ 10,343,616
Design Engineering and Permitting	1	LS	10%	$ 20,687,231
Construction Management	1	LS	8%	$ 16,549,785
Contingency	1	LS	20%	$ 41,374,463
Total Construction Cost				$ 295,827,408

The costs shown in this estimate represent an estimate of probable costs prepared in good faith and with reasonable care. HNTB has no control over the costs of construction labor, materials, or equipment, nor over competitive bidding or negotiating methods and does not make any commitment or assume any duty to assure that bids or negotiated prices will not vary from this estimate.

Austin/San Antonio Bypass (includes new Marion Yard)

Item	Quantity	Units	Unit Price	Estimated Cost
Crossings				
New Active Warning Devices at Public Crossings: Gates, Flashers, Bells and Road Surface	102	EA	$ 300,000.00	$ 30,600,000
Grade Separations (roadway over) - 23 total	1	LS	$235,400,000.00	$ 235,400,000
Subtotal I				**$ 266,000,000**
Trackwork (note: meets FRA track class 4 requirements)				
Install #24 concrete ML turn-outs	28	EA	$ 250,000.00	$ 7,000,000
Install #15 concrete siding turn-outs	22		$ 200,000.00	$ 4,400,000
Install #9 yard turn-outs	6		$ 100,000.00	$ 600,000
Construct New ML Double Track- (142 miles)	1,499,520	TF	$ 200.00	$ 299,904,000
Construct New ML set out tracks Track- (14 locations@3000')	42,000	TF	$ 200.00	$ 8,400,000
Construct new Marion siding and yard tracks	64,560	TF	$ 150.00	$ 9,684,000
Construct Marion Yard facilities	1	LS	$ 1,000,000.00	$ 1,000,000
Install new double track crossing diamonds	10.00	EA	$ 250,000.00	$ 2,500,000
Subtotal II				**$ 333,488,000**
Signal Work				
Install New Interlockings (universal cross-overs)	5.00	EA	$ 1,000,000.00	$ 5,000,000
Install New Hot Box Detectors/Dragging Equipment Detectors	7.00	EA	$ 250,000.00	$ 1,750,000
Install CTC	142.00	MI	$ 1,000,000.00	$ 142,000,000
Subtotal III				**$ 6,750,000**
Structures				
Construct New Double Track Railroad Bridges	31,434	LF	$ 8,000.00	$ 251,472,000
Subtotal III				**$ 251,472,000**
Drainage				
Proposed Small Drainage Structures along new North Corridor (Assumed 2-36" CMP @ 60' per mile)	8,520	LF	$ 500.00	$ 4,260,000
Subtotal IV				**$ 4,260,000**
Subtotal (I + II + III + IV)				**$ 861,970,000**
Utilities				
Relocation Allowance for New ML Track (142 miles)	1.00	LS	1%	**$ 8,619,700**
Stormwater Pollution Prevention Plan	1	LS	1%	**$ 8,619,700**
Earthwork				
Clearing and Grubbing	1,721.00	AC	$ 2,000.00	$ 3,442,000
Erosion Control Silt Fence/Hay Bales - (142 miles)	1,499,520	LF	$ 3.00	$ 4,498,560
Seeding and Mulching	1,721	AC	$ 2,500.00	$ 4,302,500
Cuts and Fills	4,891,333	CY	$ 100.00	$ 489,133,300
Subtotal V				**$ 501,376,360**
Right of Way Acquisition				
New Corridor	1721	AC	$4,000	$ 6,884,000
Subtotal VI				**$ 6,884,000**
Subtotal (all above costs)				$ 1,387,469,760
Contractor Mobilization	1	LS	5%	$ 69,373,488
Design Engineering and Permitting	1	LS	10%	$ 138,746,976
Construction Management	1	LS	8%	$ 110,997,581
Contingency	1	LS	20%	$ 277,493,952
Total Construction Cost				$ 1,984,081,757

The costs shown in this estimate represent an estimate of probable costs prepared in good faith and with reasonable care. HNTB has no control over the costs of construction labor, materials, or equipment, nor over competitive bidding or negotiating methods and does not make any commitment or assume any duty to assure that bids or negotiated prices will not vary from this estimate.

Dallas/Fort Worth Alternate Route Bypass

Item	Quantity	Units	Unit Price	Estimated Cost
Crossings				
New Active Warning Devices at Public Crossings: Gates, Flashers, Bells and Road Surface	103	EA	$ 300,000.00	$ 30,900,000
Crossing Warning Device - cross bucks	45	EA	$ 5,000.00	$ 225,000
Grade Separations (roadway over) - 38 total	1	LS	$ 379,000,000.00	$ 379,000,000
Subtotal I				**$ 410,125,000**
Trackwork (note: meets FRA track class 4 requirements)				
Install #24 concrete ML turn-outs	2	EA	$ 250,000.00	$ 500,000
Install #15 concrete siding turn-outs	16		$ 200,000.00	$ 3,200,000
Construct New ML Single Track- (169 miles miles)	892,320	TF	$ 200.00	$ 178,464,000
Construct New ML set out tracks Track- (16 locations@3000')	48,000	TF	$ 200.00	$ 9,600,000
Install new single track crossing diamonds	8.00	EA	$ 250,000.00	$ 2,000,000
Subtotal II				**$ 193,764,000**
Signal Work				
Install New Hot Box Detectors/Dragging Equipment Detectors	8.00	EA	$ 250,000.00	$ 2,000,000
Install CTC	169.00	MI	$ 1,000,000.00	$ 169,000,000
Subtotal III				**$ 2,000,000**
Structures				
Construct new single track railroad bridges	23,374.00	LF	$ 4,000.00	$ 93,496,000
Subtotal III				**$ 93,496,000**
Drainage				
Proposed Small Drainage Structures along new North Corridor (Assumed 2-36" CMP @ 60' per mile)	3,380	LF	$ 500.00	$ 1,690,000
Subtotal IV				**$ 1,690,000**
Subtotal (I + II + III + IV)				**$ 701,075,000**
Utilities				
Relocation Allowance for New ML Track (169 miles)	1.00	LS	1%	**$ 7,010,750**
Stormwater Pollution Prevention Plan	1	LS	1%	**$ 7,010,750**
Earthwork				
Clearing and Grubbing	2,048.00	AC	$ 2,000.00	$ 4,096,000
Erosion Control Silt Fence/Hay Bales - (169 miles)	1,784,640	LF	$ 3.00	$ 5,353,920
Seeding and Mulching	2,048	AC	$ 2,500.00	$ 5,120,000
Cuts and Fills	3,304,889	CY	$ 100.00	$ 330,488,900
Subtotal V				**$ 345,058,820**
Right of Way Acquisition				
New Corridor	2048	AC	$5,000	$ 10,240,000
Subtotal VI				**$ 10,240,000**
Subtotal (all above costs)				$ 1,070,395,320
Contractor Mobilization	1	LS	5%	$ 53,519,766
Design Engineering and Permitting	1	LS	10%	$ 107,039,532
Construction Management	1	LS	8%	$ 85,631,626
Contingency	1	LS	20%	$ 214,079,064
Total Construction Cost				$ 1,530,665,308

The costs shown in this estimate represent an estimate of probable costs prepared in good faith and with reasonable care. HNTB has no control over the costs of construction labor, materials, or equipment, nor over competitive bidding or negotiating methods and does not make any commitment or assume any duty to assure that bids or negotiated prices will not vary from this estimate.

APPENDIX B: RAIL CORRIDOR CHARACTERISTICS

RAIL CORRIDOR CHARACTERISTICS

Houston Subdivision	Length (mi)	Density (pop/mi^2)	Protective Action Dist. (mi)	Exposure Area (mi^2)	Residential Exposure (people)
Baytown	7.11	2937.24	2.01	4.03	11800
Beaumont	7.01	1605.14	1.84	3.39	5400
East Belt	11.21	4185.87	1.90	3.60	15100
Eureka	10.44	2148.96	1.97	3.88	8300
Galveston	19.44	2421.12	1.70	2.90	7000
Glidden	17.25	4426.85	1.81	3.27	14500
Houston	15.06	3354.95	1.85	3.42	11500
Lafayette	1.00	2730.85	2.00	3.98	10900
Lufkin	13.46	2895.89	1.40	1.95	5600
Mykawa	6.06	3290.38	1.92	3.70	12200
Palestine	6.64	4168.52	1.87	3.50	14600
Popp	5.28	2486.84	2.12	4.48	11200
Strang	9.84	4006.73	1.65	2.71	10900
Terminal East	9.06	3721.15	2.06	4.23	15800
Terminal West	13.59	3721.15	1.97	3.88	14400
West Belt	9.16	5250.74	1.89	3.55	18700
Proposed Bypass	33.60	152.15	1.92	3.67	600

Table 1: Rail Corridor Lengths and Population Densities for Houston Subdivisions.

San Antonio Subdivision	Length (mi)	Density (pop/mi^2)	Protective Action Dist. (mi)	Exposure Area (mi^2)	Residential Exposure (people)
Austin 1	19.10	3977.80	1.63	2.66	10600
Austin 2	19.00	3267.49	1.63	2.66	8700
Corpus Christi	10.88	2856.11	1.64	2.70	7700
Del Rio	22.00	3418.46	1.79	3.19	10900
Glidden	1.10	3841.36	1.91	3.65	14000
Kerrville	17.00	4753.25	1.57	2.48	11800
Laredo	9.00	3435.91	2.09	4.39	15100
Proposed Bypass	142.29	131.28	1.81	3.28	400

Table 2: Rail Corridor Lengths and Population Densities for San Antonio Subdivisions.

DFW Subdivision	Length (mi)	Density (pop/mi^2)	Protective Action Dist. (mi)	Exposure Area (mi^2)	Residential Exposure (people)
Alliance	21.42	5238.15	1.87	3.50	18300
Baird	5.60	2483.15	1.59	2.54	6300
Choctaw	18.65	2205.41	1.78	3.17	7000
Dallas	54.25	3039.57	1.58	2.49	7600
DFW	11.43	1884.96	2.15	4.61	8700
DGNO	73.42	3184.70	1.64	2.68	8500
Duncan	13.66	1404.28	2.03	4.11	5800
Ennis	4.80	1560.85	1.78	3.16	4900
Fort Worth (UP)	13.03	2521.32	1.82	3.31	8300
Fort Worth (BNSF)	30.80	1859.23	1.85	3.42	6400
FWWR	39.49	3897.63	1.80	3.23	12600
Greenville/Dallas (KCS)	11.53	3942.73	1.87	3.49	13800
Madill	17.09	3089.67	1.80	3.24	10000
Midlothian	20.50	1578.52	1.77	3.15	5000
TRE	33.80	2697.69	1.95	3.81	10300
White Rock	10.90	5049.16	1.87	3.50	17700
Wichita Falls	18.24	1145.49	1.62	2.64	3000
Proposed Bypass	162.91	328.58	1.78	3.16	1000

Table 3: Rail Corridor Lengths and Population Densities for Dallas-Fort Worth Subdivisions.

Subdivision	Annual Rail Traffic (car-miles) [millions]	FRA Track Class		Hazmat Release Rate (releases/car-mile) [reported in millionths]			Change in Annual Releases
		Existing	Upgraded	Existing	Upgraded	Change	
Baytown	2.05	2	4	0.004	0.001	-0.003	-0.006
Beaumont	8.68	4	4	0.001	0.001	0.000	0.000
East Belt	17.08	2	4	0.004	0.001	-0.003	-0.051
Eureka	0.95	3	4	0.002	0.001	-0.001	-0.001
Galveston	7.03	3	4	0.002	0.001	-0.001	-0.007
Glidden	10.67	5	5	0.000	0.000	0.000	0.000
Houston	4.15	3	4	0.002	0.001	-0.001	-0.004
Lafayette	0.75	4	4	0.001	0.001	0.000	0.000
Lufkin	2.52	4	4	0.001	0.001	0.000	0.000
Mykawa	2.66	4	4	0.001	0.001	0.000	0.000
Palestine	4.18	4	4	0.001	0.001	0.000	0.000
Popp	0.51	3	4	0.002	0.001	-0.001	-0.001
Strang	5.35	3	4	0.002	0.001	-0.001	-0.005
Terminal East	14.37	4	4	0.001	0.001	0.000	0.000
Terminal West	4.95	4	4	0.001	0.001	0.000	0.000
West Belt	11.46	2	4	0.004	0.001	-0.003	-0.035

Table 4: Car Volumes, Track Class, and Release Rates for Houston Subdivisions.

Subdivision	Annual Rail Traffic (car-miles) [millions]	FRA Track Class		Hazmat Release Rate (releases/car-mile) [reported in millionths]			Change in Annual Releases
		Existing	Upgraded	Existing	Upgraded	Change	
Austin 1	8.70	4	4	0.001	0.001	0.000	0.000
Austin 2	3.09	4	4	0.001	0.001	0.000	0.000
Corpus Christi	2.40	3	4	0.002	0.001	-0.001	-0.002
Del Rio	17.11	5	5	0.000	0.000	0.000	0.000
Glidden	0.52	5	5	0.000	0.000	0.000	0.000
Kerrville	1.32	2	4	0.004	0.001	-0.003	-0.004
Laredo	6.00	4	4	0.001	0.001	0.000	0.000

Table 5: Car Volumes, Track Class, and Release Rates for San Antonio Subdivisions.

Subdivision	Annual Rail Traffic (car-miles) [millions]	FRA Track Class		Hazmat Release Rate (releases/car-mile) [reported in millionths]			Change in Annual Releases
		Existing	Upgraded	Existing	Upgraded	Change	
Alliance	3.12	3	4	0.002	0.001	-0.001	-0.003
Baird	1.86	4	4	0.001	0.001	0.000	0.000
Choctaw	6.21	4	4	0.001	0.001	0.000	0.000
Dallas	29.20	4	4	0.001	0.001	0.000	0.000
DFW	1.04	3	4	0.002	0.001	-0.001	-0.001
DGNO	5.34	1	4	0.008	0.001	-0.007	-0.039
Duncan	2.77	3	4	0.002	0.001	-0.001	-0.003
Ennis	1.45	4	4	0.001	0.001	0.000	0.000
Fort Worth (UP)	3.66	4	4	0.001	0.001	0.000	0.000
Fort Worth (BNSF)	15.70	4	4	0.001	0.001	0.000	0.000
FWWR	2.87	2	4	0.004	0.001	-0.003	-0.009
Greenville/Dallas (KCS)	1.68	4	4	0.001	0.001	0.000	0.000
Madill	3.11	4	4	0.001	0.001	0.000	0.000
Midlothian	3.57	4	4	0.001	0.001	0.000	0.000
TRE	12.92	4	4	0.001	0.001	0.000	-0.002
White Rock	0.99	2	4	0.004	0.001	-0.003	-0.003
Wichita Falls	6.97	4	4	0.001	0.001	0.000	0.000

Table 6: Car Volumes, Track Class, and Release Rates for Dallas-Fort Worth Subdivisions.

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