Regional Goods Movement Profile

H-GAC Regional Goods Movement Study

submitted to

Houston-Galveston Area Council

submitted by

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Executive Summary

The H-GAC region is home to a number of regionally and nationally significant freight hubs, gateways, and corridors and its businesses depend on efficient freight transportation to remain competitive. This report, one in a series of reports for the H-GAC Regional Goods Movement Study, provides a profile of key freight facilities that are critical to the region's economy. The profile documents the supply of freight transportation infrastructure and services by providing modal inventories of the highway, rail, port, air cargo and pipeline networks. In addition to the inventory of physical infrastructure, service providers, operational conditions, and modal challenges are discussed. The information in this report will be used to conduct the regional goods movement needs assessment.

What Comprises the H-GAC Regional Freight Transportation System?

The regional freight transportation system is multimodal and is comprised of:

- More than 24,000-lane miles of roadways carrying more than 465 million tons of goods annually. This includes 21 Federally designated intermodal connectors and 38 designated hazardous material routes which carry more than 150 million tons of hazardous materials annually;

- Three Class I railroads – UP, BNSF and KCS – operating nearly 1,000 miles of track in the region, with 829 miles of main track, 123 miles of siding track, and 47 miles of yard track and carrying more than 150 million tons of local freight annually;

- Four deepwater ports, including the Ports of Houston, Freeport, Galveston and Texas City, and the Gulf Intracoastal Waterway System which handle more than 145 million tons of freight;

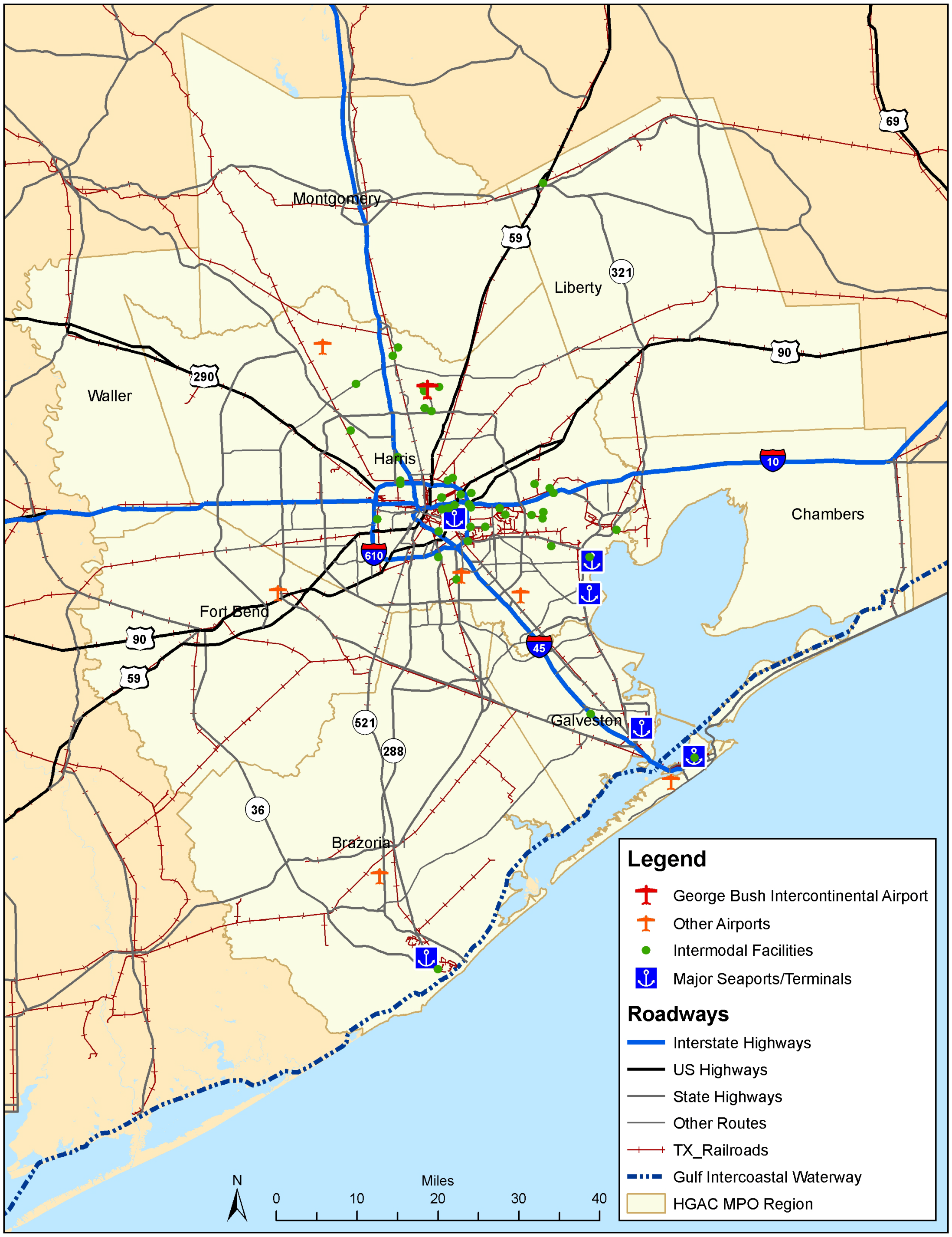
- Two major air cargo facilities at George Bush Intercontinental Airport (IAH) that handle more than 800,000 pounds of air freight annually; and

- Approximately 21,500 miles of pipelines that carry more than 445 million tons of freight annually.

While significant portions of the non-highway freight system have been developed and evolved based on private sector investment, the public sector has an interest in making sure infrastructure continues to provide for efficient goods movement because of its direct impact on the region's highway system, its economic vitality and the overall quality of life.

Figure E.1 displays the Region's multimodal goods movement system (with the exception of pipelines).

Figure E.1 H-GAC Regional Multimodal Freight Transportation System

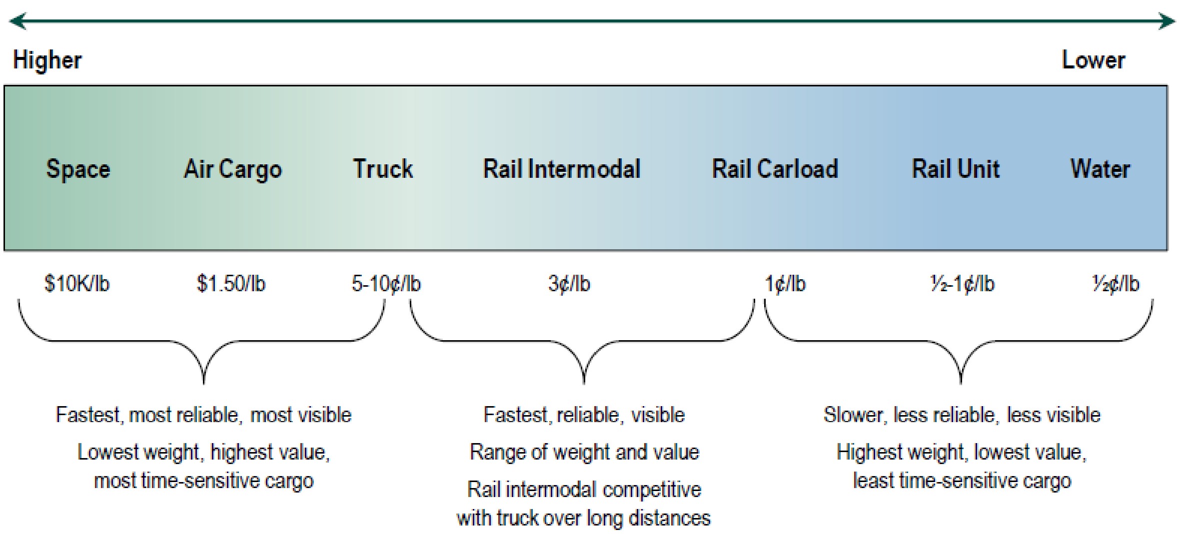


Source: Cambridge Systematics, Inc.

What are the Roles of the Various Modes in the H-GAC Freight System?

Roads, rails, water, pipelines and airport infrastructure each play key, distinct roles in the multimodal freight system, yet they must work together to create an efficient system necessary to serve the needs of the economy. Figure E.2 provides an overview of the goods movement continuum and modal attributes with respect to cost and service. This figure illustrates, from left to right, that while air cargo is costly, it provides the most reliable service for time-sensitive transport. Truck, rail, and water (including barge) are used to move goods at a lower cost for less time-sensitive or bulk commodities. Pipelines also fall on this side of the continuum. While each mode's role is distinct, most often goods are shipped on multiple modes and multimodal connectivity is critical.

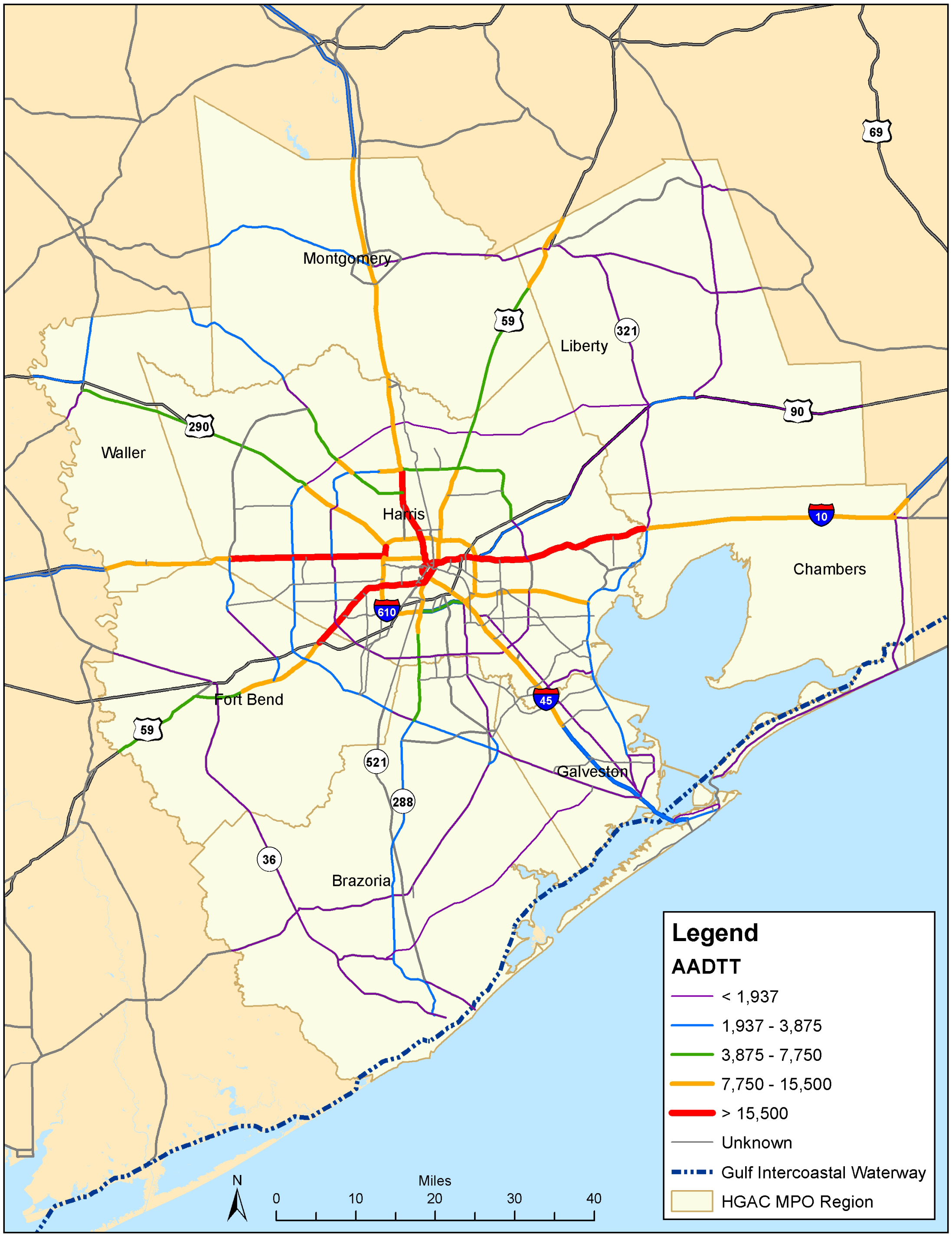
Figure E.2 Goods Movement Modal Service Spectrum



Source: AASHTO Rail Freight Bottom Line Report, 2002.

Highways – Highways and the trucks that use them play a especially important role in the provision of door to door service for the region's businesses and consumers. This means that although millions of tons of commodities are handled in the region by the other modes, they often depend on trucks and highways for pick-up and delivery operations. The Region's three interstates along with U.S. 59 and U.S. 290 carry the largest volume of trucks in the region, averaging more than 20,000 trucks daily in 2008. Figure E.3 displays truck volume data throughout the region.

Figure E.3 H-GAC Region Average Annual Daily Truck Volumes – 2008



Source: Cambridge Systematics, Inc.

Railroads – Houston is an originating and terminating point in the national rail network, and not a hub or transit point. It is a major producing market for the bulk industry and a receiving market for industrial supplies and consumer goods, because it is home to the U.S. petrochemical business and to one of America's largest urban populations. The Houston region is not a network center because it is situated on a coast and because of the design of the Class I rail lines. KCS railroad chiefly runs through the region, BNSF extends to it from the north, and only UP – the largest – surrounds it. There are approximately 2,000 train movements weekly on the Region's network and include private railcars moving loaded and empty between customer and carrier track, unit trains cycling loaded and empty cars, interchanges between railroads and the accommodation of trackage rights, plus the deployments of yard engines to power these activities.

Ports – The ports, ship channels, and waterways of the Houston-Galveston area are of vital regional, national, and international significance, linking key Texas industries, particularly its chemical, oil, and agriculture industries, with markets and suppliers located throughout the world. They also serve industries and markets located in other parts of the country, particularly those in the central U.S. The Ports of Houston, Freeport, and Galveston all handle a variety commodities comprised of bulk, break-bulk and container traffic. The Port of Texas City is far more specialized for the petrochemical industry and primarily handles bulk commodities with the key intermodal connections being pipelines.

Air Cargo – Houston's air freight network is a major link in the nation's air cargo network. Houston airports were ranked sixteenth in the nation for air cargo tonnage in 2009, highlighting the importance of the air freight system to both the Houston region and the nation. IAH handles 98 percent of all of the air cargo in the H-GAC region with the remainder primarily being comprised of cargo in the belly of passenger aircraft operating in and out of Hobby. About 44 percent of the Region's air cargo is international with Asia, Australia, and Africa being major trading partners. Tennessee (due to the FedEx hub in Memphis) and California are major domestic trading partners, although domestic traffic is much more diverse than international. Once at the airports, the air cargo is distributed throughout the region via truck. Hence, intermodal connectors linking the air cargo facilities to regional freeways are important components of the Region's freight system.

Pipelines – Pipelines are more significant in Houston than most any other metropolitan region in the U.S. due to the large petrochemical industry. There are seven types of pipeline systems in the Region, including: gas gathering, gas transmission, carbon dioxide, crude gathering, crude transmission, product lines (not highly volatile), and other product lines (highly volatile). The pipelines are privately owned with more than 300 operators in the region. These operators are often subsidiaries of firms and consolidating them leads to 22 parent companies. Pipelines provide a cost-effective means of transporting large volumes of freight, thus keeping it off from the Region's highways and rail systems. They require connections with ports, railroads, and roadways via tank farms. Although the pipelines and tank farms are privately owned, the roadways (or intermodal connectors) leading to the tank farms and thus pipelines are public facilities.

What Challenges Does the H-GAC Regional Freight System Face?

The H-GAC region has enjoyed significant economic growth over the past decades and even though growth has slowed during the current economic recession, the region has outperformed much of the nation. This growth has resulted in significant increases in freight transportation demand and projections suggest these volumes will continue to increase by nearly 77 percent by 2035.[1] The growth has led to increasing pressure on the Region's freight transportation system. Some modes have responded better than others as a result of increased investment, operational improvements, and regulatory changes. Regardless, each faces some significant challenges going forward, and challenges for one mode ultimately spill over and impact other modes. Each of the modes is facing unique challenges but many of these challenges fall into three broad categories-capacity, community conflicts, and institutional/regulatory. Challenges in each of these categories are summarized below.

Capacity

The inventory of the regional freight system revealed that many of the facilities and modes are already facing capacity constraints and suffer from significant congestion and delay. For example, the level of service (LOS) on significant portions of key freight highway corridors such as I-10, I-45, I-610, and U.S. 59 is D or F, indicating volume to capacity ratio approaching or exceeding 1.0. Truck volumes are projected to increase by 77 percent by 2035. This means for every 100 trucks on the roads today, there will be 177 trucks in 2035. Furthermore, the growth in truck traffic is projected to be widely dispersed, with higher growth rates in the South and Northwestern portion of the region.

Congestion on the Region's rail system results in 300 daily train hours of delay[2] which leads to increased cost and shipping times for regional shippers. In addition to the service capacity concerns, the Region has car storage capacity challenges. The railroads and shippers (such as the petrochemical firms) combined store upwards to 20,000 rail cars at any given time. The storage of these cars consumes valuable real estate and trackage, yet it is necessary to meet the market demands of key industries. Another important challenge facing the region is the introduction of commuter rail.

Three of the Region's four deepwater ports are planning container terminal expansions to accommodate the increase in local demand as well as to capitalize on the widening of the Panama Canal. The success of these expansions will, in large part, depend on the ability of the Region's highways and railroads to accommodate the additional traffic. Another issue impacting the ability of the seaports to expand is the increasing competition for waterfront property for various commercial, industrial, and residential uses. Therefore it

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[1] Analysis of IHS Global Insight Inc. TRANSEARCH data by Cambridge Systematics.

[2] Houston Region Freight Study, TxDOT 2007.

will be important for communities to understand and to balance the tradeoffs of alternative development opportunities for this valuable asset.

Community Impacts

Efficient freight transportation in the H-GAC region is necessary for the Region's core industries and economy as well as to support the quality of life of its residents. However, along with these benefits comes significant community impacts. In addition to congestion, community impacts include safety, air quality, noise, vibrations, water pollution, and wear and tear on the infrastructure. The various modes contribute to these community impacts to varying degrees but addressing any of these impacts requires an understanding of the tradeoffs between the benefits and costs.

Aside from congestion, perhaps the two most frequently cited freight impacts from the community are safety and air quality. Safety concerns arise from several sources, including trucks on the roadways, at-grade rail crossings and the transport of hazardous materials. There were 30,000 truck-involved crashes in the Region in 2007, representing about 30 percent of all crashes. These crashes resulted in more than 100 fatalities, 15,000 injuries and thousands of hours of delay. There are approximately 1,200 at-grade rail crossings in the Region, responsible for 300 crossing incidents and 90 injuries and fatalities in recent years. The movement and storage of hazardous materials occurs throughout the region via pipelines, water, truck, and rail. As the growth in the region spreads, there is growing concern that additional response centers will be required. Addressing the safety concerns on the Region's transportation system requires understanding and mitigating the role of freight transportation.

Air quality is an important concern for the H-GAC region for health and economic development reasons. Poor air quality gives rise to significant health costs for the Region's residents and businesses and increased restriction on Federal funding. Trucks, trains, ships and barges and aircraft all contribute significantly to damaging emissions. Private carriers have made significant investments in cleaner technologies such as newer engines and locomotives, cleaner burning fuels and changes in operational procedures to reduce idling. However, many of these changes are costly, both in terms of capital cost and ongoing operating costs, leading some companies to be slow to adopt. Because freight transportation is a significant contributor to poor air quality, mitigation strategies aimed directly at reducing its impact are necessary.

Community impacts give rise to community resistance. The H-GAC region has enjoyed relatively broad acceptance from the community with regards to its continued development of freight intensive industries. One reason for this is the fact that a majority of the activity and, the most significant impacts have occurred in a relatively condensed area in east Harris County. However, growth projections suggest a spreading of both population and employment to the west and south. As these areas experience rapid growth, the demand for freight transportation to support businesses and residents will also increase. This will give rise to increased conflicts and competition for resources

between freight and non-freight users. Therefore, steps to mitigate these potential impacts should be taken when planning for this additional growth.

Institutional and Regulatory

A modern freight transportation system requires modern infrastructure and modern governance. Many of the laws, regulations, and arrangements governing freight transportation have not kept pace with the rapidly changing trends shaping the industry. The result is a series of institutional bottlenecks. While the specific laws and rules impeding the various modes are too numerous to name, there are four categories of institutional and regulatory issues that are creating widespread challenges for the Region's freight-related industries. These include funding, security, environmental, and permitted loads.

Funding is a major challenge for freight transportation as the need for additional and more modern infrastructure quickly outpaces the funds available. Complicating the funding challenge is the multijurisdictional, multiparty (both public and private) and multimodal aspects of many of the necessary investments. Our public sector funding systems are not structured to recognize and respond to the nature of freight investments and their resulting benefit streams. This is true for Federal, state and local funding. For example, improvements in one part of Harris County are likely to benefit the rest of the County, the H-GAC region, the State of Texas and even other parts of the country. Therefore, it is not unreasonable to consider sharing the costs of those investments among the beneficiaries. Current funding systems often do not account for the allocation of benefits across multiple jurisdictions and are based solely on the geographic location of the improvement. Issues with Federal funding sources such as the Harbor Maintenance Tax continue to slow critical investments. There also is an increased need and desire for public-private partnerships (PPP) to address the mounting freight needs, giving rise to a different set of institutional barriers.

Growing security and environmental concerns are leading to significant new regulations on the transport of freight, from increased screening of cargo to restrictions on storage of certain materials to tighter emission and noise standards. While these new requirements may be necessary, they also are potentially very costly to both the freight transportation industry and the ultimate users – businesses and consumers. Understanding and balancing the tradeoffs of benefits and costs of proposed restrictions, whether they be Federal, state or local is necessary to achieve the desired outcomes without undesirable implications.

A very specific regulatory bottleneck in the region is the movement of permitted loads. Permitted loads refer to the transport of loads that exceed Federal and state size and weight limits and are often called oversize/overweight (OS/OW) loads. These loads require a permit and are restricted to travel only on dedicated routes call heavy-haul routes. These restrictions are in place for safety and infrastructure preservation purposes. However, the designation of heavy-haul routes have not kept pace with the demand for transporting OS/OW loads. The Region's key industries, including petrochemical and fabricated metals, and the Region's deepwater ports depend on the transport of large pieces of machinery and raw materials. Increasing constraints, whether institutional or physical, hamper the ability to move permitted loads efficiently in the region, potentially putting some businesses and resulting economic benefits at risk. Ensuring regulation can effectively balance the public concerns with the business need for these shipments is critical.

1.0 Introduction

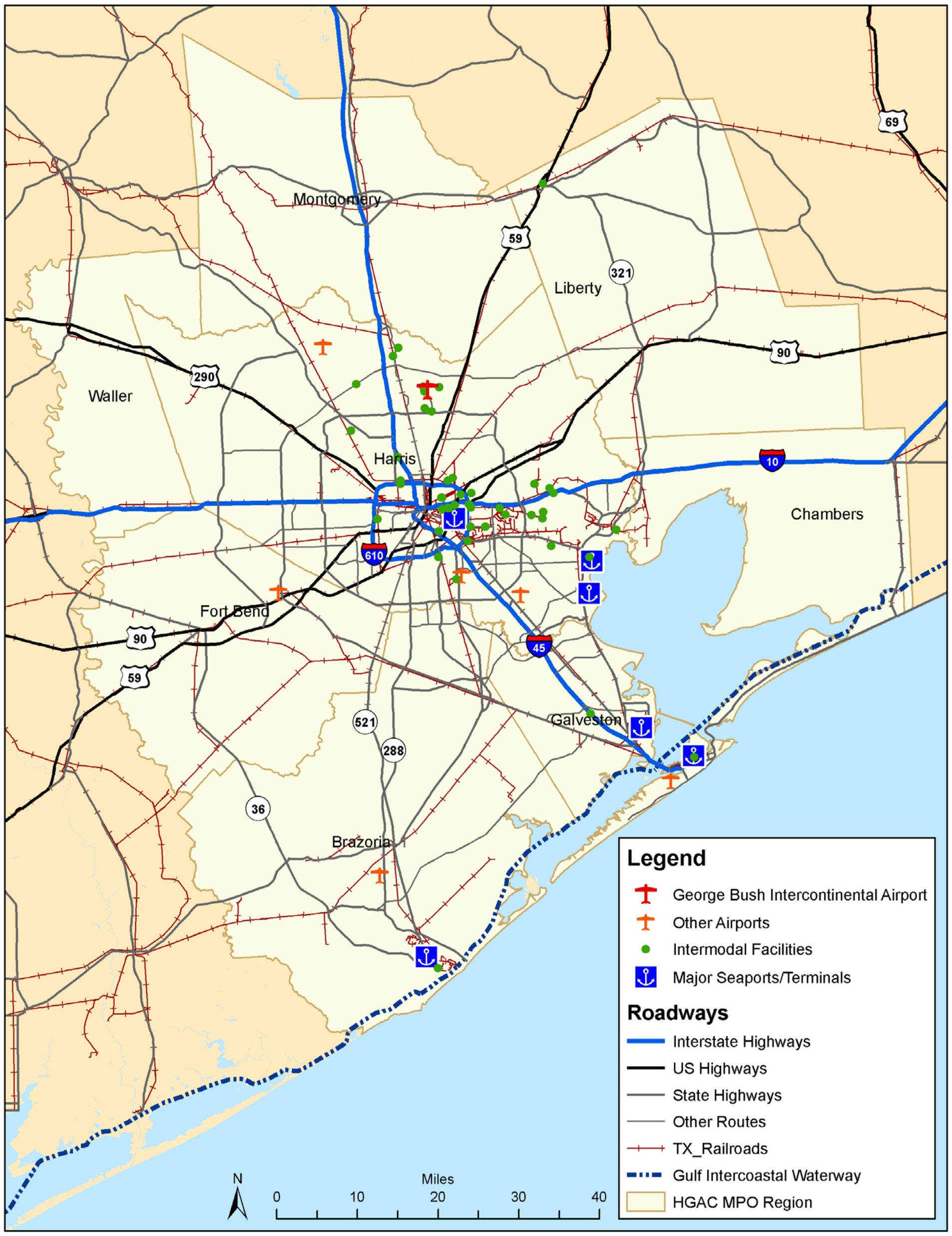
1.1 Overview

The Houston-Galveston Area Council (H-GAC) has commissioned a Regional Goods Movement Study, a comprehensive evaluation of the multimodal goods movement system and development of strategies and recommendations for improving mobility and access for both commuters and freight. The central goal of the study is to develop a plan for a safe and efficient goods movement system that enhances freight mobility and economic competitiveness while mitigating the community impacts of goods movement. This report is one in a series of technical memorandums to be developed as part of the study. The framework for conducting the H-GAC Regional Goods Movement Study provides the building blocks necessary to identify the key elements of the H-GAC region's freight transportation system and how they relate to one another and to the economy. The framework integrates five primary areas of research:

The Regional Goods Movement Profile represents the "freight infrastructure block" through an overview of the H-GAC region's multimodal freight network. It provides information regarding the demand for freight infrastructure and facilities, an inventory of the supply of infrastructure and a discussion of issues, challenges and trends for each of the modes, including highway, rail, waterways, air, and pipelines. A variety of data sources, including previous reports and studies conducted by H-GAC, TxDOT, IHS Global Insight, FHWA, and others, coupled with extensive interviews with public and private sector stakeholders were used to compile the report. The Regional Goods Movement Profile serves as the foundation for a more detailed goods movement needs assessment to be conducted in the next phase of the Regional Goods Movement Study.

Figure 1.1 displays the multimodal freight transportation system (with the exclusion of pipelines)[3] for the eight county H-GAC region.

Figure 1.1 H-GAC Multimodal Freight Transportation Network



Source: Cambridge Systematics, Inc.

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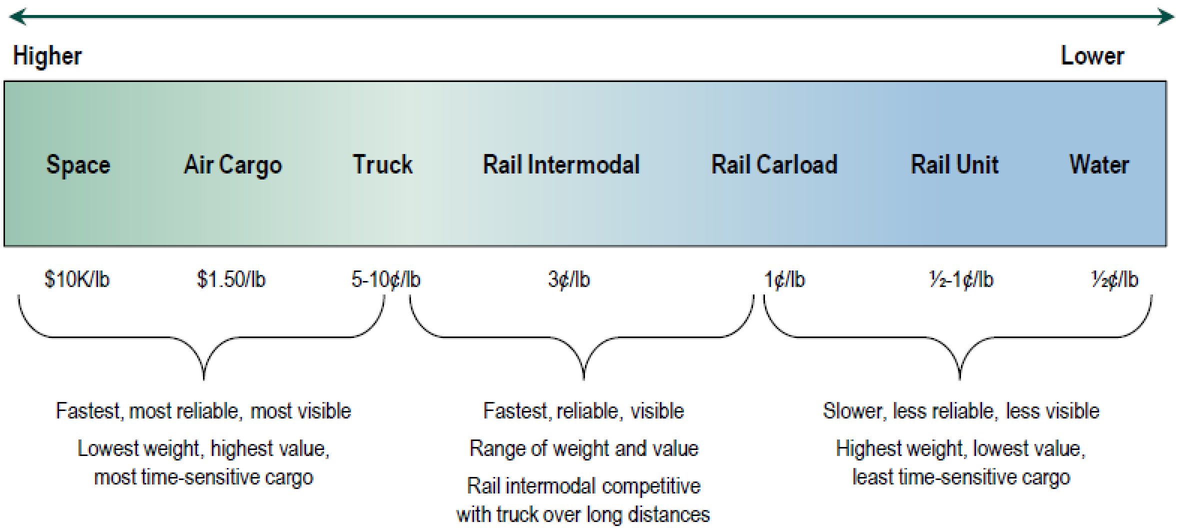
[3] The pipeline network is extensive and displayed in Figure 5.1.

Roads, rails, water, and airport infrastructure each play key, distinct roles in the multimodal freight system, yet they must work together to create an efficient system that drives the economy. Figure 1.2 provides an overview of the goods movement continuum with respect to cost and service. This figure illustrates, from left to right, that while air cargo is costly, it provides the most reliable service for time-sensitive transport. Truck, rail, and water are used to move goods at a lower cost for less time-sensitive or bulk commodities. Cost, weight and time sensitivity of the shipment are primary factors influencing modal choice as there are tradeoffs between costs per ton mile and speed and reliability.

Figure 1.2 Goods Movement Modal Service Spectrum

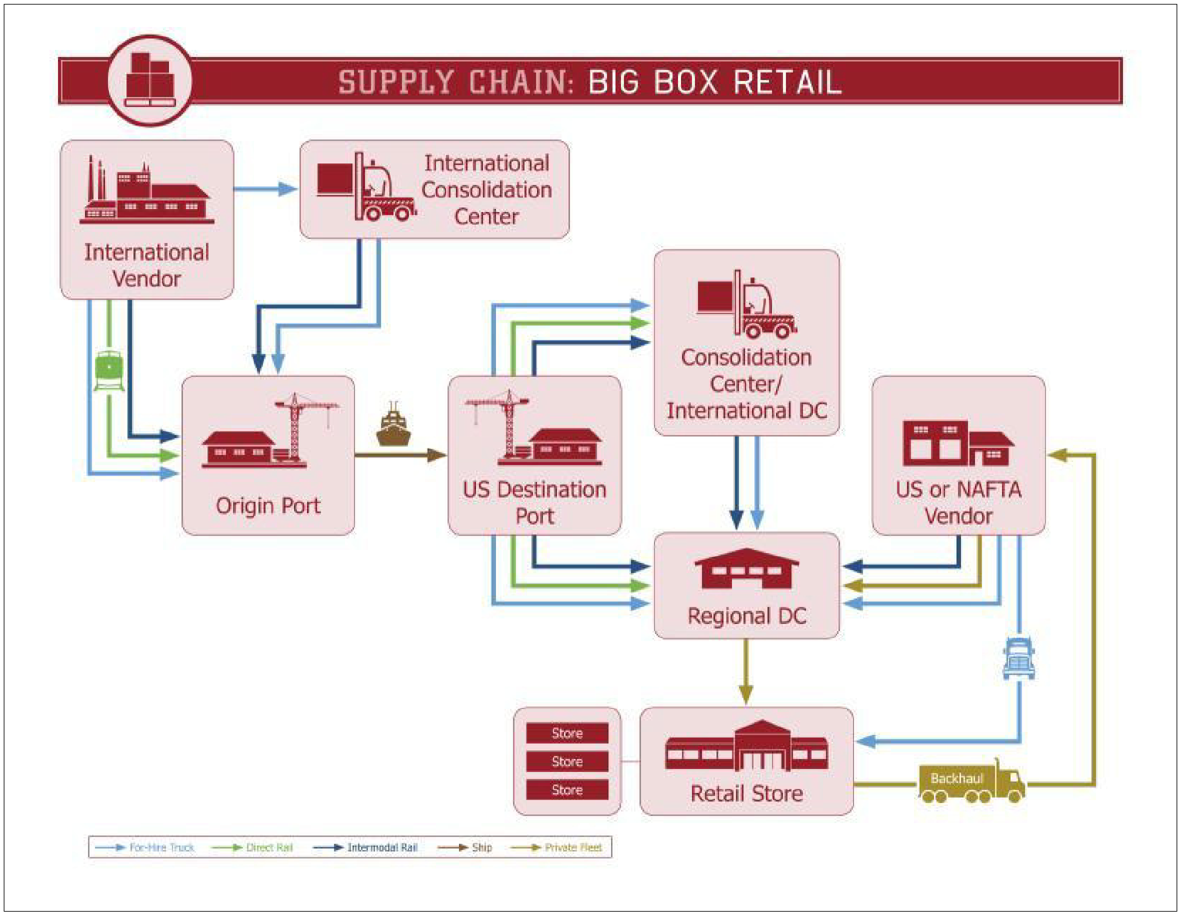


Source: AASHTO Rail Freight Bottom Line Report, 2002.

While each mode's role is distinct, most often goods are shipped on multiple modes and multimodal connectivity is critical. An example of the multimodal aspects of a typical supply chain is the retail industry. Figure 1.3 displays a generic supply chain for a representative "big box" retailer. As can be seen, delivering retail goods from the manufacturers to the local retail outlets depends on connecting shipments into ports such as the container terminals at Port of Houston and Freeport or Los Angeles and Long Beach to rail terminals (often by truck in the absence of on-dock rail transfers) and then for final delivery by truck. The different color lines connecting key freight transfer points in retail supply chain indicate the potential for more than one mode to provide the transport between those points. For example, retail goods for the local market coming into the Bayport terminal will travel by truck to the distribution center, but those coming into Port of Long Beach will travel by rail to either Dallas or Houston and then be trucked to the regional distribution center. In both cases, trucks are necessary to get the goods from the distribution center to the local retail store. Hence, trucks and the roadways they use provide the critical connections between all the other modes and the final consumer. A more in-depth discussion of the region's logistics pattern is provided in the Economic and

Logistics Structure Report, while the current report focuses on the profile of the individual modes that comprise the freight network.

Figure 1.3 Example Retail Supply Chain



Source: Transportation Research Board, NCFRP-15 Technical Report.

Clearly, freight movements utilize a wide array of infrastructure components. And, while much of the non-highway freight system has been developed by and evolved using private sector investment, the public sector has an interest in making sure infrastructure continues to provide for efficient goods movement because of its direct impact on the region's highway system, its effects on economic vitality and the impacts on quality of life. Therefore the Regional Goods Movement Profile will provide an overview of all of the modes, including privately-owned and operated facilities.

1.2 Organization of the Report

Following the introductory chapter, the report provides a profile for each of the five freight modes. Each modal profile consists of a summary of modal demand, an inventory of modal infrastructure and service providers and discussion of key challenges and issues.

- Section 2.0 – Highway Freight;
- Section 3.0 – Rail Freight;
- Section 4.0 – Marine Freight;
- Section 5.0 – Air Freight; and
- Section 6.0 – Pipeline Freight.

Each modal assessment includes an inventory of key facilities, operational aspects of the system, overview of the modal demand and traffic and a discussion of the issues and challenges. Various levels of detail are provided across the modal profiles based on data availability and relative focus of the overall Regional Goods Movement Study.

1.3 Key Findings

Houston is home to a number of regionally and nationally significant freight facilities, gateways, and corridors. This report provides an inventory of key freight infrastructure that is critical to servicing the needs of the region, state, and nation. A summary of the key findings from the Regional Goods Movement Profile follows.

Highway Profile

- Trucks carry more than 465 million tons of goods annually over the region's highway network, accounting for 57 percent of total volume of goods transported in the region.[4]
- I-10, I-45, I-610, U.S. 59, and U.S. 290 carry the largest number of trucks in the region, averaging more than 20,000 trucks daily in 2008.
- There were more than 30,000 truck-involved crashes in the eight-county region in 2007, resulting in more than 100 fatalities and 15,000 injuries.
- Major challenges for freight highways include:

[4] An extensive analysis and discussion of commodity flows is provided in the H-GAC Regional Commodity Flow Analysis, one in a series of technical papers developed as part of the H-GAC Regional Goods Movement Study.

- *Congestion* – The highways that comprise the most significant freight routes also are major commute corridors and suffer from significant congestion and delay. With truck traffic projected to increase by nearly 70 percent by 2035, congestion and delay will worsen for both goods and people. Additional highway capacity will be needed to meet the combined freight and passenger demand.

- *Permitted Loads* – The region is home to major petrochemical firms and other firms that require the transport of large pieces of machinery. The transport of large oversize/overweight (OS/OW) shipments, also referred to as "permitted loads" since they require a special permit, are limited to certain facilities, called "heavy-haul routes," which are those facilities on the highway system that are physically capable of handling these loads. Regulatory or physical infrastructure prevent these loads from using some corridors, which may become an important issue as demand for these types of shipments increases.

- *Operational Issues* – Operational constraints or bottlenecks documented in the region include short-entrance ramps onto interstates; excessive merging and weaving required along major freeways; insufficient turning radii on major arterials especially; numerous at-grade crossings on major freight corridors; and lack of sufficient staging areas in and around freight terminals.

- *Safety* – Primary safety concerns related to truck traffic include crashes and the movement of hazardous material. Safety is equally important to the private freight industry and the traveling public. In recent years, truck-involved crashes have been increasing while non-truck involved crashes have witnessed modest decreases.

- *Air Quality* – Air quality is a significant concern to the region. Poor air quality gives rise to increased health costs for residents, increased costs for businesses and increased restrictions regarding Federal funding. Truck traffic is a significant contributor to poor air quality and emissions mitigation strategies must address truck emissions.

- *Community Impacts* – Goods movement is essential to supporting the region's economy and quality of life. However, truck traffic also gives rise to negative community impacts. In addition to safety and air quality concerns, truck traffic can cause excessive noise and vibration to homes and businesses along significant freight corridors and damage to roads, including pavement wear and tear and curb damage.

Rail Profile

- Houston is an originating and terminating point in the national rail network, and not a hub or transit point. It is a major producing market for bulk industry and a receiving market for industrial supplies and consumer goods.

- The region is served by three "Class I" railroads and the Port Terminal Railroad Authority. Union Pacific is the predominant player with the most extensive regional

network. BNSF accesses the Houston region from the north, and these two railroads jointly share about equally in the operations of the Port Terminal Railroad Authority (PTRA). KCS is a smaller factor in regional train activity and handles only goods originating from or destined for Mexico.

- Railroads handle 22 percent of the freight tonnage generated or received in metropolitan Houston, apart from its pipeline activity. The 152 million tons moved by rail in 2007 represented 28 percent of Houston's inbound receipts, 18 percent of its outbound shipping, and eight percent of its purely local activity.[5]

- A majority of Houston rail freight traffic is carload service direct to customers and port facilities. Houston rail traffic is comprised of manifest and local trains (51 percent), supporting yard work (27 percent), unit trains, including coal and grain (13 percent), and intermodal and auto trains (seven percent).

- Highway access is a crucial concern for any rail intermodal terminal. The majority of intermodal facilities are on the east side of Houston, in the midst of both rail congestion and old industrial neighborhoods whose connectors were not designed for contemporary trucking operations.

- The Region's rail system is modern, yet it faces a series of challenges, including:

- *Service Capacity* – Three-hundred *daily* train hours of delay result from congestion in the Houston rail network. These delays result in public concerns because: a) they affect the competiveness of regional industry; b) growth of rail traffic cannot be supported and it is spilled onto the highway; and c) public planners seek alternatives to roadway investment and the rail cannot respond.

- *Car Management Capacity* – Tens of thousands of railcars are kept or handled daily on the regional rail system, accounting for hundreds of trainloads plus additional car staging operations.

- *Passenger Service* – The challenge for new passenger services is the need for right-of-way, and this is often sought in the freight system. For planning purposes, the key considerations are that an already strained freight rail network has little if any capacity to spare, and any discussion of new passenger services requires adequate investment.

- *Direct Rail Service* – Sites with direct rail service are desirable for the region but it requires track and yard systems. Thus, assuring car management and service capacity fosters the preservation of this service. Where direct rail service is not available, short-

[5] Additional commodity flow information is provided in the H-GAC regional Commodity Flow Analysis.

distance drayage preserves some of its virtues. Property development to support this is a vital feature of service retention as Houston evolves and grows.

- *Grade Crossings* – Houston's extensive direct rail network brings 1,200 at-grade rail crossings, responsible for 300 crossing incidents and 90 injuries in recent years. Crossings also give rise to significant traffic delays, which lead to congestion and air quality impacts.

Port Profile

- Waterborne freight tonnage moving through seaports and terminals in the H-GAC region is expected to grow by approximately 45 percent by 2035, to more than 212 million tons. The greatest total increase in waterborne tonnage is expected in Harris County, home to the Port of Houston, which is expected to experience an increase in total tonnage of nearly 42 million tons.[6]

- The H-GAC region is also expected to experience increases in container traffic as a result of the expansion of the Panama Canal, scheduled to be completed during the mid-2010s. In addition, competition for rail capacity between the West Coast and the interior U.S. is expected to intensify as fuel prices increase and shippers seek to shift products to rail to reduce costs. These trends will further encourage a shift in container traffic growth to Gulf Coast and East Coast ports.

- While the H-GAC port and waterway system currently provides sufficient access to regional, statewide, national, and global markets, physical and operational chokepoints may prevent this system from effectively absorbing future growth in freight traffic, and may lead to other economic, social, and environmental impacts. Challenges include:

- *Access Road Limitations* - At some of the Houston-Galveston area's largest ports, access roads often are not physically capable of efficiently serving large volumes of truck traffic, and many suffer from heavy traffic congestion, inadequate clearances, poor turning radii, and substandard pavement conditions.

- *Limited Channel Depths* - Failure to maintain channel depths can have a number of impacts, including reductions in overall capacity, safety, operational, and efficiency concerns related to passing restrictions. These impacts could lead to the shifting of freight to the region's highway or rail facilities.

- *Institutional Issues* - The ability to quickly, effectively, and equitably enhance the overall capacity and efficiency of the system is hindered by a variety of institutional issues and

[6] H-GAC Regional Commodity Flow Analysis

constraints, including a lack of reliable funding, increased security and environmental mandates and increased conflict with private property rights.

Pipeline System

- There are approximately 21,500 miles of pipelines across the H-GAC Region. More than 1,400 miles, nearly seven percent, of the pipelines are abandoned.

- The pipeline system carried more than 445 million tons of goods in 2007, with 41percent traveling inbound to the region and the remaining 59 percent traveling outbound. Pipeline volumes are projected to grow by more than 20 percent to 540 million tons by 2035.[7]

- Utilization rates of existing pipelines are high, ranging from 100 percent for those transporting carbon dioxide to 55 percent for gas gathering. Projected growth in demand, combined with current utilization rates, suggest the need for additional pipeline capacity.

Air Freight System

- George Bush Houston Intercontinental Airport (IAH) is the major air cargo airport in the H-GAC region. Approximately 98 percent of all air freight in the region is moved through IAH, with the remainder moving primarily on Southwest Airlines passenger aircraft at Houston Hobby (HOU).

- Continental Airlines, Federal Express, and United Parcel Service are the major carriers of air freight to and from the Houston area.

- A significant portion of the freight moving to and from Houston by air is international traffic – approximately 44 percent in 2007. Goods movement between Houston and Asia/Australia/Africa regions continues to grow at a fast pace.

- Air freight, both in terms of tonnage and value, is expected to grow by more than 160 percent by 2035. Despite the rapid growth, air freight's share of total goods movement into and out of the Houston region will remain around one percent.

- IAH has two major air freight facilities (excluding offsite facilities and passenger terminals), the IAH Cargo Center and IAH Central Cargo. The majority of air cargo airlines operate out of the IAH Cargo Center, and this is where expansion is planned.

[7] H-GAC Regional Commodity Flow Analysis.

Federal Express and Continental Cargo still use the IAH Central Cargo aprons and warehouses.

- Several landside issues were mentioned in previous studies and interviews that impact the efficient movement of freight to and from airport facilities. These include the following:

- *Landside Access* - IAH Cargo Center ground access is difficult because of congestion on Lee Road and because of the mix of freight and passenger automobile traffic on John F. Kennedy Blvd and Will Clayton Pkwy

- *Safety Concerns* - There are safety issues for truck drivers turning off of Lee Road into the IAH Cargo Center.

2.0 Regional Highway System

2.1 Introduction

Although freight in the H-GAC region moves by five major modes – truck, rail, water, air, and pipeline – in various combinations,[8] highways and the trucks that use them play an especially important role in that they provide door to door service for the region's businesses and consumers. This means that although thousands of tons of commodities are handled in the region by the other modes, they often depend on trucks and highways for pick-up and delivery operations. Highways are critical as they provide connections to and among every other mode of transport, along with warehouses, distribution centers, manufacturing plants, and other freight hubs. In other words, they are the like the blood vessels that connect all the major organs, allowing the system to work. If the highways, just like the blood vessels, do not work properly, the rest of the system starts to break down as well.

The region is served by more than 24,000 miles of roadways of which 566 are interstates or other expressways and 781 are principal arterials. The roadway system experiences average traffic volumes (including trucks) in excess of 109 million vehicle miles per day.[9] In 2007, a majority of all freight (61 percent or more than 780 million tons) that moved across the region was hauled by truck,[10] highlighting the importance of highway facilities to the region's economy and the quality of life for its residents.

This chapter inventories and describes the operating conditions of the region's highway network from a freight perspective. Data are presented on the major routes connecting the commercial and industrial centers within the region to external markets, the condition of highway infrastructure and traffic operations, location of intermodal connectors, truck-involved crashes and designation of hazardous material routes. This chapter represents a summary profile and discussion of challenges. A detailed analysis of the region's freight highway system will be provided in the Regional Goods Movement Needs Assessment report.

[8] Pipelines are especially important to the Houston-Galveston region and are considered in a later chapter in this document. Due to data limitations, the figures in this chapter do not include pipeline traffic.

[9] Federal Highway Administration, *Highway Statistics 2008*. Calculated as the sum of the Houston and Texas City Federal aid urbanized areas.

[10] HIS Global Insight's TRANSEARCH data.

Sources of Information

This profile makes use of a variety of sources to detail the current status of the H-GAC highway network, including IHS Global Insight TRANSEARCH database, H-GAC's Traffic Model, data from TxDOT, information gleaned from interviews and surveys and various previous reports. The main sources of information include:

- **Flow Data**: IHS Global Insight's TRANSEARCH database was used to characterize and quantify highway freight demand and traffic. The base year is 2007 with a forecast for 2035.[11] TxDOT's count data and H-GAC's traffic model are used to quantify truck volumes, percentages, and levels of service.

- **Highway Facilities Inventory Data**: Various data sources were used to identify and characterize the region's freight highway system, including H-GAC, TxDOT, Federal Highway Administration, *Highway Statistics 2008,* Research and Innovative Technology Administration's Bureau of Transportation Statistics, Federal Motor Carrier Safety Administration/Research and Innovative Technology Administration, Highway Performance Monitoring System (HPMS), *State of Safety in the Region: 2009*, Houston-Galveston Area Council and American Transportation Research Institute.

- **Field Interviews and Surveys:** During the Summer of 2010, a survey of carriers was conducted by the American Transportation Research Institute. Also, interviews were conducted with carriers and shippers throughout the region, including local drayage operators, regional and national long-haul carriers, freight expeditors, and regional and national manufacturing and retail shippers. The firms interviewed are listed below:

[11] See the H-GAC Regional Commodity Flow Analysis for detailed commodity flow data.

- Gulf Winds
- Palletized Trucking, Inc.
- PepsiCo
- Sysco Corporation
- Academy Sports
- BNSF Railway
- Jones Lang LaSalle
- Linden Bulk Transportation SW, LLC
- Pinch Flatbed
- Trimac, Inc.
- WalMart
- ExxonMobil
- Freeman Decorating
- Methodist Hospital System
- Mission Foods
- Osprey Line
- Port Terminal Railroad Association
- Union Pacific
- Flexicore
- UPS
- Whole Foods
- Waste Management
- FedEx Freight
- Halliburton

2.2 Regional Freight Highway Network

This section describes the various elements of the Houston-Galveston region's highway freight system. It provides an inventory of the current highway infrastructure network, describes its key components, and discusses how the system is performing.

Highway Inventory

In 2009, there were more than 24,000 roadway-lane miles in the H-GAC region, with plans to expand to nearly 28,000 by 2035.[12] The highway network in the Houston-Galveston region roughly resembles a wheel with Houston as its hub, surrounded by the two concentric beltways of I-610 and Beltway 8. The wheel's spokes are the major radial highways, including I-10, I-45, U.S. 59, and others. This network carries the majority of the trucks circulating within the region as well as those hauling goods into and out of the region.

The Houston-Galveston region's roadway system is organized into hierarchical categories. As of 2008, this system consisted of 18,450 total miles[13], distributed as follows:

[12] H-GAC 2035 RTP Update.

[13] Federal Highway Administration, *Highway Statistics 2008*. Calculated as the sum of the Houston and Texas City Federal aid urbanized areas.

- **Interstates –** 166 miles of four- to sixteen-lane access-controlled divided highways that connect the Houston-Galveston region to other major cities in Texas and beyond.

- **Other Freeways and Expressways –** 400 miles of other access-controlled divided highways (including toll facilities) that provide critical connections between important residential, commercial, and industrial areas with the rest of the region and with the Interstate Highway System (IHS).

- **Other Principal Arterials –** 781 miles of streets and highways that carry high volumes of traffic and connect the major regional urban activity centers.

- **Minor Arterials –** 1,742 miles of arterial streets that augment the principal arterial system.

- **Collectors –** 1,907 miles of streets providing traffic circulation within residential neighborhoods, commercial developments, and industrial areas and access to the arterial street system.

- **Local –** 13,454 miles of local streets.

The above categories of roadway facilities are further described below:

- **Interstate Highway System (IHS) –** The system of access controlled freeways in the region nationally designated as part of the IHS and included within the National Highway System (NHS). Key interstate routes include I-10, which bisects the region from west to east; I-45, which enters the region in northern Montgomery County and terminates in the City of Galveston, and I-610 which loops around central Houston in Harris County.

- **Other National Highway System** – The other NHS routes in the region, not including IHS routes, as well as other roads important to the nation's economy, defense, and mobility. NHS routes provide connections to the interstate system and the region's toll facilities.

- **Texas State Roads and Local Roads –** These routes include other primary and minor highways owned and operated by TxDOT or local governments that are not part of the NHS. In many cases, these roads provide the "last mile" connection to shippers and receivers across the region. There are three types of important roads in this category:

  - *Collectors and Distributors* – One-way roads adjacent to interstate highways or expressways designed to manage the traffic flows onto and off of the main lanes of the freeway. They protect the main through lanes from excessive merging and weaving activity.

- *Farm to Market* – Roads originally established to connect rural areas to markets. Many Farm to Market (F.M.) roads in the Houston-Galveston region have been expanded and now serve as major arterials.
- *Other Principal Arterials (Local Counties)* – This important system of streets and highways (outside of the categories already described) serve the region's major activity centers, tend to have very high-traffic volumes, and accommodate both through and intraregional travel. They provide access to freight generating facilities and to major retail centers.

- **Intermodal Connectors –** These short but important routes link heavy freight generators (marine terminals, rail terminals, etc.) to the NHS and are described in some detail in the following pages.

- **Hazardous Materials Routes –** Trucks carrying freight categorized as "hazardous" by the Federal Motor Carrier Safety Administration (FMCSA) must comply with various regulations and practices. Hazardous materials shipments are restricted from some roadways while other roadways are designated as hazardous materials routes. These routes are generally described in the following pages.

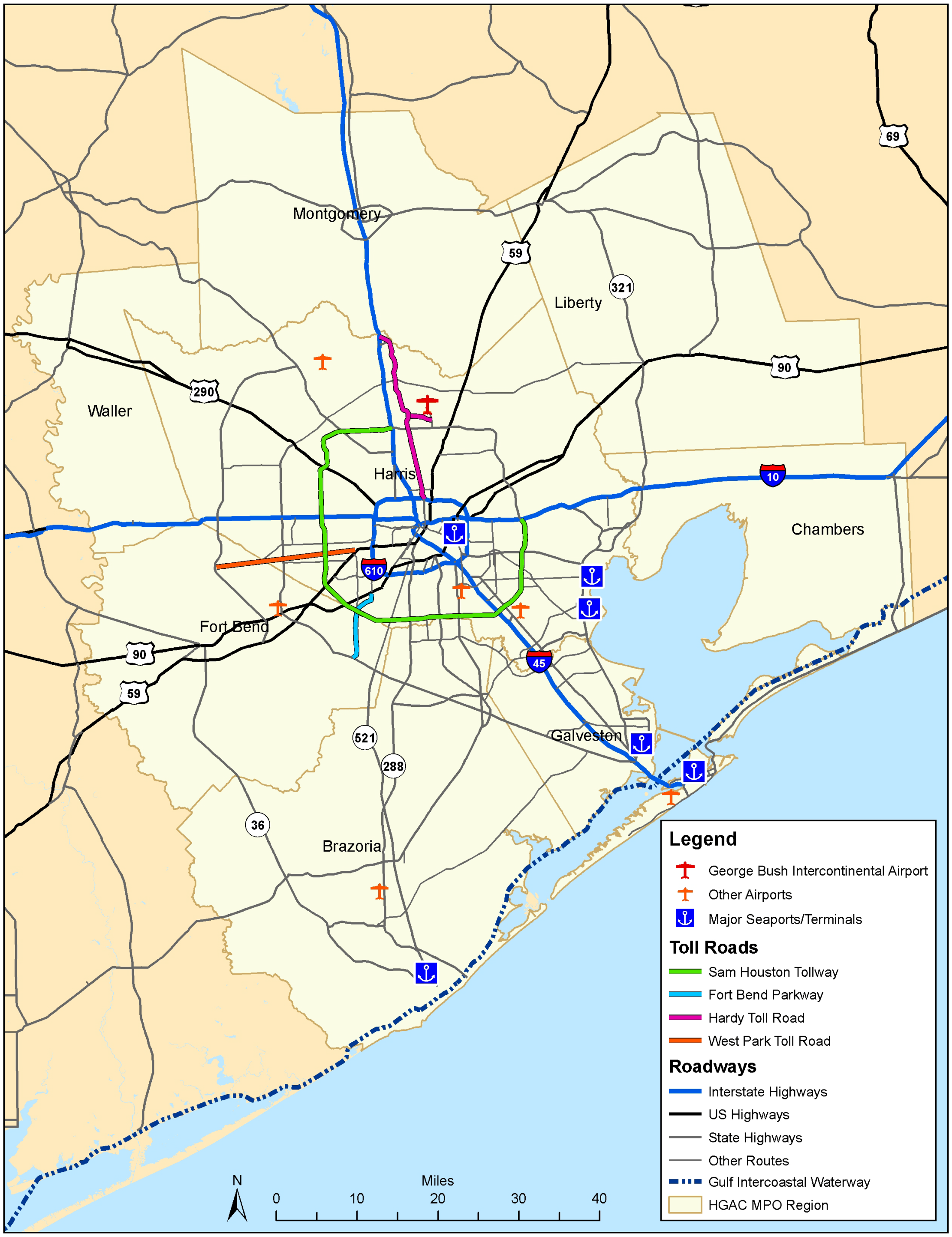
This system is planned, maintained and managed by a number of statewide, regional, and local agencies including TxDOT, H-GAC, and county and municipal governments. In addition, there are two toll agencies operating facilities in the region including:

- **Harris County Toll Road Authority (HCTRA)** – HCTRA, a division of Harris County's Public Infrastructure Department, manages and operates all toll roads in Harris County, including the Hardy Toll Road, the Sam Houston Tollway, and the Westpark Tollway.

- **Fort Bend County Toll Road Authority (FBCTRA)** – FBCTRA manages and operates the Fort Bend Parkway Toll Road and the Fort Bend Westpark Toll Road.

The Houston-Galveston Region's highway network is shown in Figure 2.1.

Figure 2.1 Houston-Galveston Region Highway Network



Source: Cambridge Systematics Inc.

NHS Intermodal Connectors

NHS intermodal connectors are short roadway segments averaging less than two miles in length that link airport, seaport, and rail terminal facilities to the National Highway System. They tend to carry lower traffic volumes at slower speeds than the rest of the NHS and are therefore often designed to lower standards.[14] Because of their key freight role, however, they are used by large and heavy trucks. Those with design deficiencies or in poor condition can slow freight movement or damage goods in transit. The FHWA identifies 21 freight-related intermodal connectors in the Houston-Galveston region.[15]

Hazardous Materials Routes

Hazardous materials (HazMat) fall into three broad categories; chemicals, petroleum products, and "other."[16] Due to the heavy concentration of petrochemical industries in the Houston-Galveston region; more than 130 million tons of petroleum products, chemical products, crude petroleum, and natural gas were moved across the region's highway system in 2007.[17] Much, but not all, of this material is categorized as "hazardous" by the FMCSA. The FMCSA identifies 38 designated Hazardous Materials routes and 6 restricted routes for Hazardous Materials in the Houston-Galveston region.[18] FMCSA Hazardous Materials routes (both restricted and designated) are listed below and shown in Figure 2.3. Table 2.2 describes the 38 FMCSA-designated Hazardous-Materials routes.

[14] http://ops.fhwa.dot.gov/freight/freight_analysis/nhs_intermod_fr_con/chap_2.htm accessed 8/20/10.

[15] Official NHS Intermodal Connector Listing: Texas, http://www.fhwa.dot.gov/planning/nhs/intermodalconnectors/texas.html accessed 8/31/10.

[16] Some materials falling into the "other" category include hazardous waste, medical waste, and radioactive materials.

[17] (Excluding pipelines). IHS Global Insight.

[18] http://www.fmcsa.dot.gov/safety-security/hazmat/national-hazmat-route.aspx accessed 8/31/10.

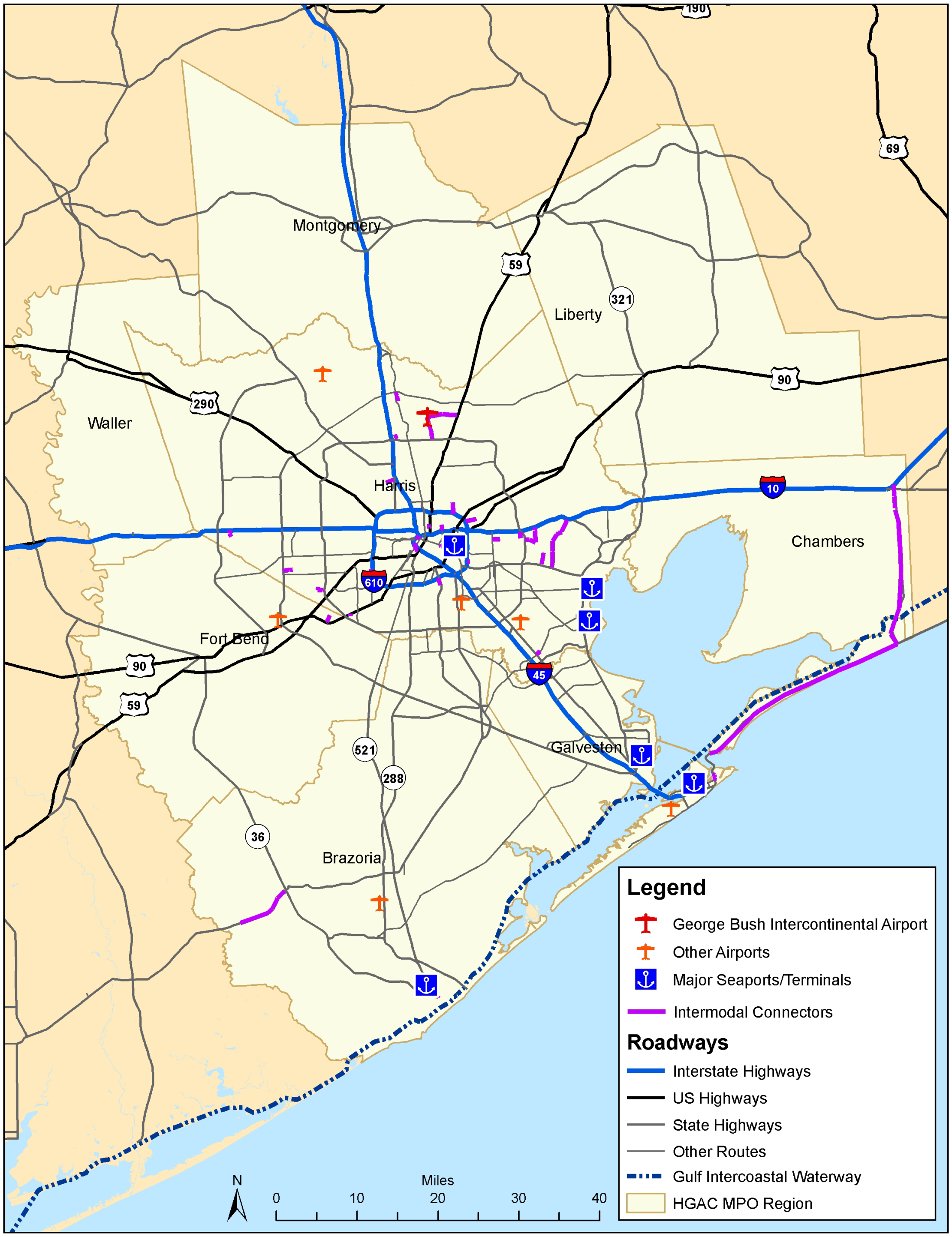
Table 2.1 Listing of National Highway System Intermodal Connectors
Houston-Galveston Region

Freight Facility	Location
AIMCOR Marine Terminal	Galveston, Old Port Industrial Boulevard. (Harborside drive to 28th Street)
Bayport Terminal	Port Road between SH 146 and the terminal
Brazosport Turning Basin, Freeport	FM 1495 between SH 288 and the terminal
Bulk Materials Handling Plant, Houston	Penn City Road (from I-10 to 3100 block)
Care Terminal, Houston	Jacinto Port Blvd (between Beltway 8 and terminal)
Empire Truck Lines Container Yard, Houston	Wallisville Road (from I-610 to Oates)
GATX Terminals Corporation	Jefferson Road (from SH 225 to facility)
Houston Barge Terminal	Navigation Boulevard (between Engle and U.S. 90A)
Jacintoport Terminal	South Sheldon Road (between I-10 and the terminal)
M.P. GMAC Yard	Hardy Road (between Humble Westfield Road and the terminal)
Manchester Terminal Corporation	Manchester Street (between I-610 and the terminal)
Phillips Petroleum Sweeney Complex	SH 35 (between FM 524 and SH 36)
Richardson Steel Yard	Industrial Road (between Federal Road and the terminal)
S.P. Houston Intermodal Hub	Lockwood (between I-10 and the Wallisville); Wallisville (between Lockwood and the terminal)
Shell Deer Park Chemical Plant and Refinery, Houston	Center Road (between SH 225 and the facility)
Star Enterprise/Texaco, Houston	Quitman Street (between U.S. 59 and Stevens Street); Stevens Street (between Quitman Street and the terminal)
Turning Basin Terminal, Houston	75th Street (between Navigation Blvd and the terminal)
Union Pacific Settegast Yard, Houston	Kirkpatrick Blvd (between I-610 and the terminal)
UPS Mykawa Road Facility, Houston	Mykawa Road (from I-610 to Wayside)
UPS Stafford Facility	Stafford Road (from U.S. 90A to Ellis)
UPS Sweetwater Lane Facility	West Canino (from I-45 to Sweetwater Lane); Sweetwater Lane (from West Canino to the facility)

Source: FHWA

These intermodal connectors are shown in Figure 2.2.

Figure 2.2 NHS Intermodal Connectors



Source: Research and Innovative Technology Administration's Bureau of Transportation Statistics (RITA/BTS).

Table 2.2 FMCSA-Designated Hazardous Materials Routes

Connector	Description
10th Street	S. 4th Avenue to S. 6th Avenue, Texas City, Galveston County
14th Street	Loop 197 to 5th Avenue S., Texas City, Galveston County
2nd Avenue	Loop 197 to Bay Street, Texas City, Galveston County
4th Avenue	Loop 197 to 10th Street, Texas City, Galveston County
51st Street/Seawolf Parkway	State 275 (Harborside Drive) to ¼-mile south of Seawolf Park, Galveston, Galveston County
5th Avenue	State 146 to 14th Street, Texas City, Galveston County
Broadway Ave	(Entire Length), Galveston, Galveston County
Farm to Market 1266	Farm to Market 646 to Farm to Market 517, Dickinson, Galveston County
Farm to Market 1764	Entire highway within city limits, Santa Fe, Galveston County
Farm to Market 1764	Interstate 45 to State 146, Santa Fe, Galveston County
Farm to Market 517	Farm to Market 646 to West City Limits, Dickinson, Galveston County
Farm to Market 517	Entire highway, League City, Galveston County
Farm to Market 518	West City Limits to East City Limits, Pearland, Brazoria County
Farm to Market 519	State 146 to Loop 197, Texas City, Galveston County
Farm to Market 565	Loop 207 to East City Limits, Mont Belvieu, Chambers County
Farm to Market 646	Entire Highway Within City Limits, Dickinson, Galveston County
Farm to Market 646	Entire Highway, League City, Galveston County
Farm to Market 646	North City Limits to South City Limits, Santa Fe, Galveston County
Grant Ave	5th Avenue South to FM 519/SH 341, Texas City, Galveston County
Interstate 45	North City Limits to South City Limits, Conroe, Montgomery County
Interstate 45	Northwest City Limits to Southwest City Limits, Dickinson, Galveston County
Interstate 45	West City Limits to Farm to Market 188 (Teichman Road), Galveston, Galveston County
Interstate 45	Entire Highway, League City, Galveston County
Interstate 610	Entire Highway, Houston, Harris County
Loop 197	S. City limits to 2nd Avenue, Texas City, Galveston County
Loop 336	Entire Highway within City Limits, Conroe, Montgomery County

Connector	Description
State 146	North City Limits to South City Limits, Mont Belvieu, Chambers County
State 146	North City Limits to South City Limits, Texas City, Galveston County
State 225	East City Limits to West City Limits, Deer Park, Harris County
State 275 (Port Industrial Boulevard and Harborside Drive)	Interstate 45 to 9th Street, Galveston, Galveston County
State 342 (61st Street)	Broadway Avenue to Seawall Boulevard, Galveston, Galveston County
State 35	North City Limits to South City Limits, Pearland, Brazoria County
State 6/Bus U.S. 290	North City Limits to East City Limits, Hempstead, Waller County
State 6	West City Limits to East City Limits, Santa Fe, Galveston County
U.S. 290	North City Limits to East City Limits, Hempstead, Waller County
U.S. 59	South City Limits to North City Limits, Rosenberg, Fort Bend County
U.S. 59	West City Limits to North City Limits, Stafford, Fort Bend/Harris County
U.S. 90A	West City Limits to East City Limits, Stafford, Fort Bend County

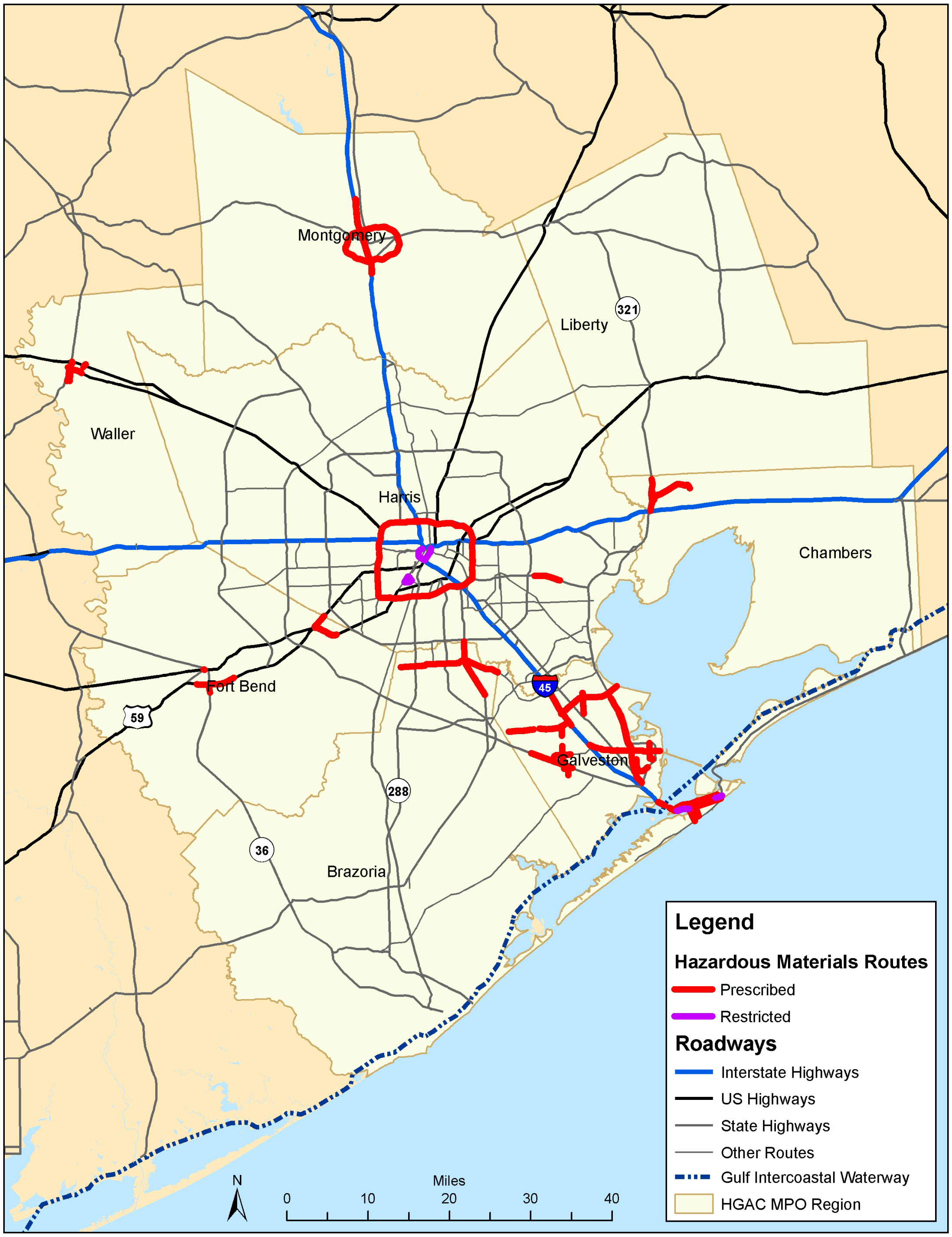
Source: Federal Motor Carrier Safety Administration/Research and Innovative Technology Administration's Bureau of Transportation Statistics (RITA/BTS)/Volpe NTSC.

Table 2.3 describes the six-restricted Hazardous Materials routes.

Table 2.3 FMCSA-Restricted Hazardous Materials Routes

Connector	Description
Holcombe Boulevard	Main Street to South Braeswood Boulevard, Houston, Harris County
Interstate 45	Franklin Street to U.S. 59, Houston, Harris County
N. MacGregor Way	South Braeswood Boulevard to Main Street, Houston, Harris County
North of Church Street	14th Street to 2nd Street, Galveston, Galveston County
South Braeswood Boulevard	Holcombe Boulevard to N. MacGregor Way, Houston, Harris County
U.S. 59	Interstate 45 to Buffalo Bayou, Houston, Harris County

Figure 2.3 Hazardous Materials Routes



Source: Federal Motor Carrier Safety Administration/Research and Innovative Technology Administration's Bureau of Transportation Statistics (RITA/BTS)/Volpe NTSC.

Highway System Characteristics

Highway facilities, even within the same highway classification group (interstates, state roads, etc.), can vary significantly in attributes such as capacity and condition. The level of truck activity impacts both the capacity and condition on highway facilities. To gain a more thorough understanding of the region's highway system in general, and the impacts of truck movements in particular, an inventory of key characteristics of the highway network was conducted. The general characteristics explored in this inventory include:

- Number of lanes;
- Pavement condition; and
- Bridge condition.

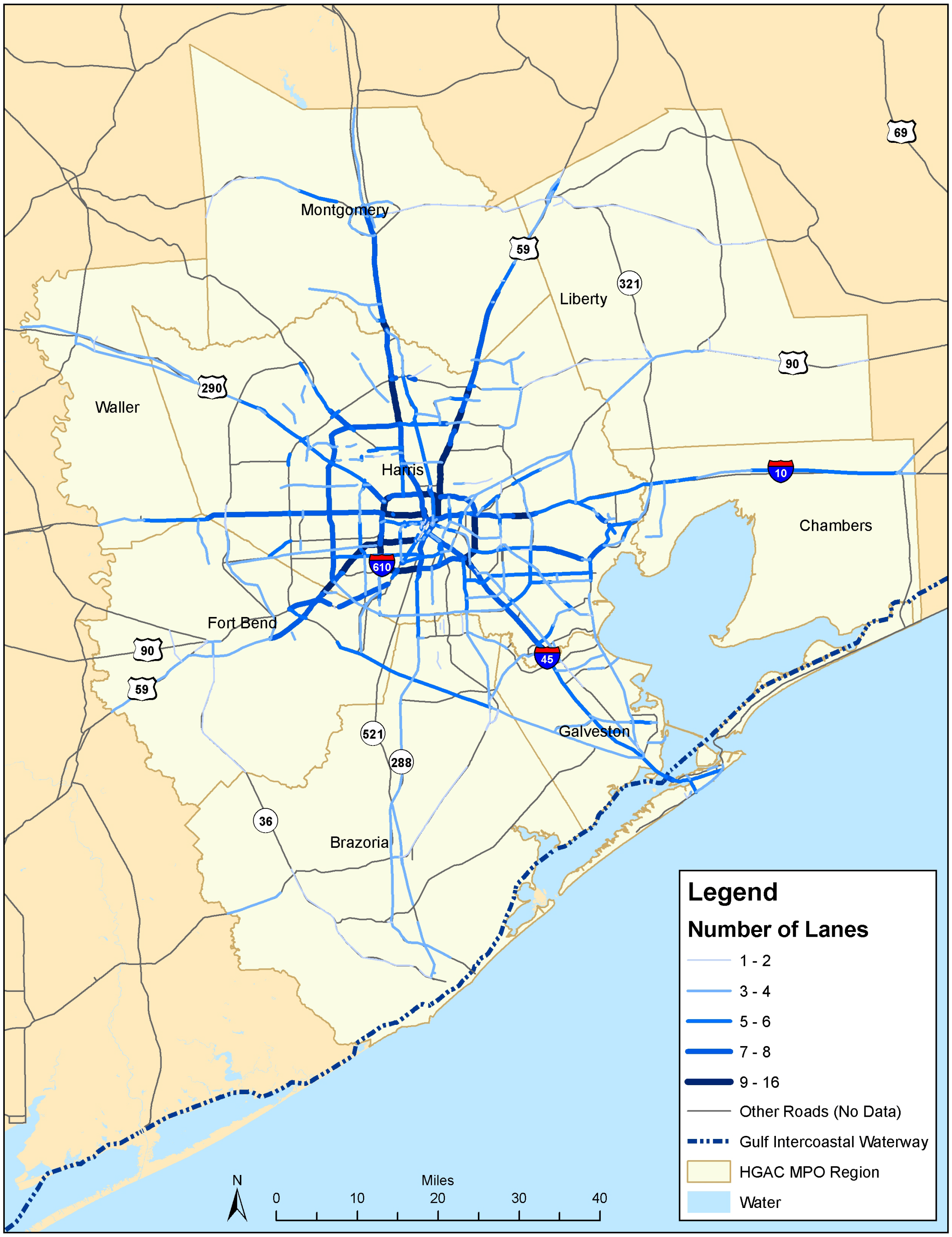
Number of Lanes

The more lanes a roadway has, the greater its capacity to not only handle higher traffic volumes but to also more safely accommodate the shared usage of both automobile and truck traffic. Shared usage can be more of an issue when there are fewer numbers of lanes due to differing vehicle operating requirements such as deceleration, acceleration and merging. Figure 2.4 illustrates the varying capacity levels of the major roadways in the Houston-Galveston region. Interstates and major freeways have the greatest capacity, with capacity on these facilities expanding significantly inside Harris County and the City of Houston.

Pavement Condition

A measure called the International Roughness Index (IRI) is used to classify pavement conditions. IRI measures the cumulative deviation from a smooth surface in inches per mile – in other words, the sum of all the up-and-down road imperfections, from potholes to barely noticeable bumps or road roughness that a vehicle encounters while traveling one mile. The ranges of values correspond to the pavement condition as follows (IRI in inches per mile): very good (0 to 85); good (86 to 110); fair (111 to 140); poor (141 to 175); very poor (more than 175).

Figure 2.4 Number of Lanes – 2009



Source: Houston-Galveston Area Council.

Pavement conditions are constantly changing as repairs are made and as wear and tear accumulate over time. The conditions reported below are based on 2008 sample data, therefore specific conditions may have changed. All vehicles cause a certain amount of damage to roadway pavements. In general, trucks, due to their greater per-axle loads, cause more roadway damage than automobiles. It is important to note that proper distribution of weight across axles helps to minimize the impact of additional weight on pavement and is a greater factor in determining the extent of damage than the absolute weight of a load.

The life of a pavement is related to the magnitude and frequency of axle loads, particularly the heavy-axle loads associated with trucks. Maintaining good pavement conditions on truck-intensive corridors is more costly than on those corridors used primarily by passenger vehicles. Conversely, poor pavement conditions can impact vehicles using the roadway by reducing highway speed (capacity) or even, in extreme cases, by causing damage to vehicles and/or the goods being shipped within them. Therefore, there is both a public- and private-sector cost associated with pavement damage. Tables 2.4 to 2.7 display pavement conditions on the Region's major freeways that pass through multiple counties. Table 2.8 displays pavement conditions for major freeways that are wholly contained in Harris County.

Table 2.4 Pavement Condition – Interstate 10

County	Very Good	Good	Fair	Poor	Very Poor
Waller	100%	–	–	–	–
Fort Bend	–	85%	15%	-	–
Harris	5%	25%	24%	33%	13%
Chambers	100%	–	–	–	–

Source: Highway Performance Monitoring System (2008 Sample Data).

Table 2.5 Pavement Condition – Interstate 45

County	Very Good	Good	Fair	Poor	Very Poor
Montgomery	41%	58%	1%	–	–
Harris	2%	21%	48%	17%	12%
Galveston	32%	34%	23%	9%	2%

Source: Highway Performance Monitoring System (2008 Sample Data).

Table 2.6 Pavement Condition – U.S. 59

County	Very Good	Good	Fair	Poor	Very Poor
Liberty	–	–	14%	37%	49%
Montgomery	–	78%	22%	–	–
Harris	–	19%	33%	25%	23%
Fort Bend	10%	16%	74%	–	–

Source: Highway Performance Monitoring System (2008 Sample Data).

Table 2.7 Pavement Condition – SH 288

County	Very Good	Good	Fair	Poor	Very Poor
Harris	–	4%	–	8%	88%
Brazoria	41%	46%	8%	–	5%

Source: Highway Performance Monitoring System (2008 Sample Data).

Table 2.8 Pavement Condition – Highway Facilities Contained in Harris County

	Pavement Condition				
Facility	Very Good	Good	Fair	Poor	Very Poor
I-610	0%	5%	48%	9%	37%
U.S. 290	5%	16%	33%	45%	1%
SH 225	21%	5%	23%	29%	22%

Source: Highway Performance Monitoring System (2008 Sample Data).

Notable is the fact that the portion of highway facilities with the highest truck volumes have higher percentages of "poor" or "very poor" pavement ratings. For example, 46 percent of I-10 lane miles in Harris County have a pavement rating of poor or very poor, while none of the lane miles in the Waller, Fort Bend, or Chambers County rated "poor" or "very poor." Significantly higher volumes of trucks on I-10 within the Harris County borders relative to the other counties in the study region is a significant contributing factor to poorer pavement conditions within the County. In general, heavy traffic volumes in Harris County, including truck traffic, leads to poorer pavement qualities and higher maintenance costs.

Bridge Condition

The National Bridge Inventory documents the conditions of bridges on all public roads, regardless of their ownership. Bridges are rated as either "not deficient," "functionally obsolete," or "structurally deficient." A bridge rated "functionally obsolete" or "structurally deficient" is not necessarily unsafe. Rather, it typically has an older design that lacks modern safety features such as adequate shoulder space, an appropriate railing system, or other features.[19] Figure 2.5 displays each of the functionally obsolete and structurally deficient bridges in the Houston-Galveston region. While there are a significant absolute number of functionally obsolete and structurally deficient bridges in the region, as a percentage of all bridges, the number is relatively low.

While many of these bridges are not currently impeding freight flows, if left unaddressed, they could give rise to bottlenecks as they become unsafe or impassable for trucks. The most common bridge bottlenecks include weight and height restrictions and operational constraints such as narrowing lanes. In general, structurally deficient structures tend to be more restrictive to truck movements than functionally obsolete bridges.

Notable is the number of structurally deficient and functionally obsolete bridges located in Harris County. This is significant because about 77 percent of all freight tonnage moving in the region moves in Harris County.[20] As truck volumes are projected to increase, including the volume of permitted loads, inadequate bridge conditions could give rise to significant bottlenecks and inefficiencies.

2.3 Regional Highway Freight Traffic and Equipment

Trucking is the most flexible of all the freight modes due to: the ability to serve individual buildings and facilities in almost any location; timing of pick-up and delivery operations; and, the ability to handle nearly any type of commodity due to the diversity in equipment. Highways and trucks are essential to goods movement and are a critical element holding the freight system together. They are responsible for the most tonnage handled and the largest number of trips. They handle the broadest range of commodities, from raw materials to semifinished goods to consumer products. In some cases, they are responsible for the entire freight move via door-to-door service. In other cases, they are part of intermodal trip chains, picking up and delivering to ports, railyards, airports, and warehouse/distribution centers. Every freight shipper or receiver that is not located on a navigable waterway or active rail line or on an air cargo apron is dependent on trucking. Shippers that use railroads, ports, pipelines and airports also rely on trucking to reach customers throughout the Houston-Galveston region and the U.S.

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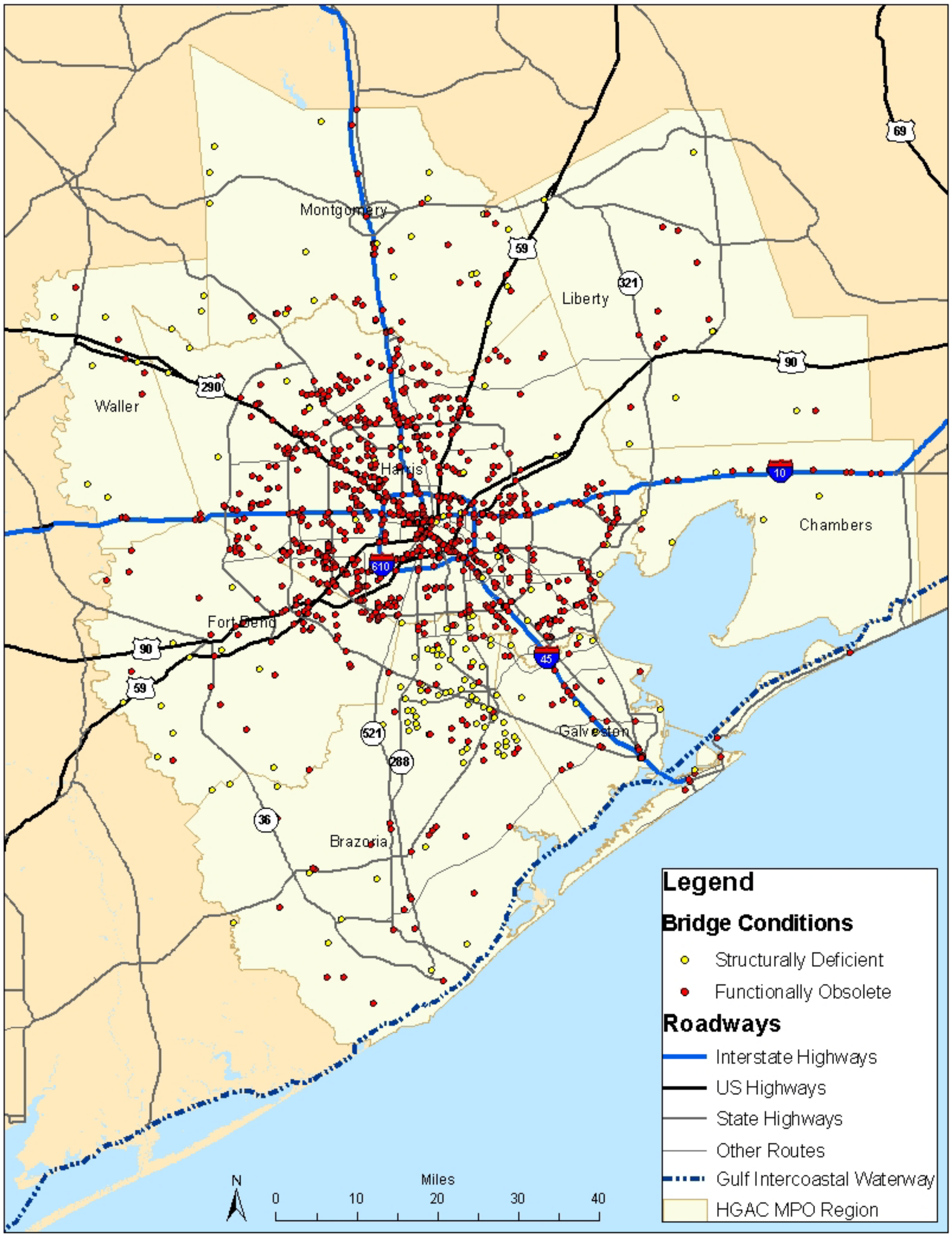
[19] http://www.fhwa.dot.gov/policyinformation/pubs/pl10023/fig7_3.cfm accessed 8/23/10.

[20] H-GAC Regional Commodity Flow Analysis.

Figure 2.5 Functionally Obsolete and Structurally Deficient Bridges in the H-GAC Region – 2009



Source: FHWA National Bridge Inventory.

In 2007, more than 465 million tons of freight, valued at more than $1.3 trillion, was hauled by truck over the region's roadway infrastructure. Thirty-five percent of the freight volume was inbound to the region, 32 percent was outbound from the region, 18 percent was intraregional, and 15 percent was moving through the region (i.e., had both an origin and a destination outside of the H-GAC region). Trucking accounts for 57 percent of the total volume of goods and freight moving in the H-GAC region, compared to 22 percent for rail, 21 percent for water, and less than one percent of air.[21] Table 2.9 provides a comparison of modal share for the top ten commodity types moving in the region. Except for coal, crude petroleum, and natural gas, each of the leading tonnage commodities depends heavily on trucking. Notable is the fact that secondary traffic, or consumer goods, and clay, concrete, glass and stone, which are used in the construction, are totally dependent on truck transport. The implications of this is that as population growth spreads throughout the region, so will the demand for these goods and the trucks that transport them. Hence, truck traffic will grow at a faster place in the areas experiencing the most growth.

Table 2.10 further breaks down the volume of trucked freight by commodity. Based on volume, the leading regional truck commodities are petroleum and coal products and secondary traffic, which refers to warehousing and distribution activity typically associated with finished goods. This is followed by chemical products, nonmetallic minerals, clay/concrete/glass/stone products, and food products. All of these products represent key economic sectors within the region, illustrating the importance of truck transport to the regional economy.

Table 2.9 Regional Share of Tonnage by Mode – 2007

Commodity	STCC2	Truck	Rail	Water	Air
Petroleum and Coal Products	29	54%	7%	39%	
Chemical Products	28	42%	36%	22%	
Secondary Traffic	50	100%			
Nonmetallic Minerals	14	70%	26%	4%	
Crude Petroleum and Natural Gas	13			100%	
Coal	11		99%	1%	
Clay, Concrete, Glass, and Stone	32	92%	8%		
Farm Products	01	47%	48%	5%	
Food Products	20	83%	15%	2%	
Primary Metal Products	33	69%	26%	5%	
All Others		76%	19%	5%	<1%
Total		57%	22%	21%	<1%

[21] H-GAC Regional Commodity Flow Analysis.

Source: IHS Global Insight.

Table 2.10 Regional Commodities Handled by Truck – 2007

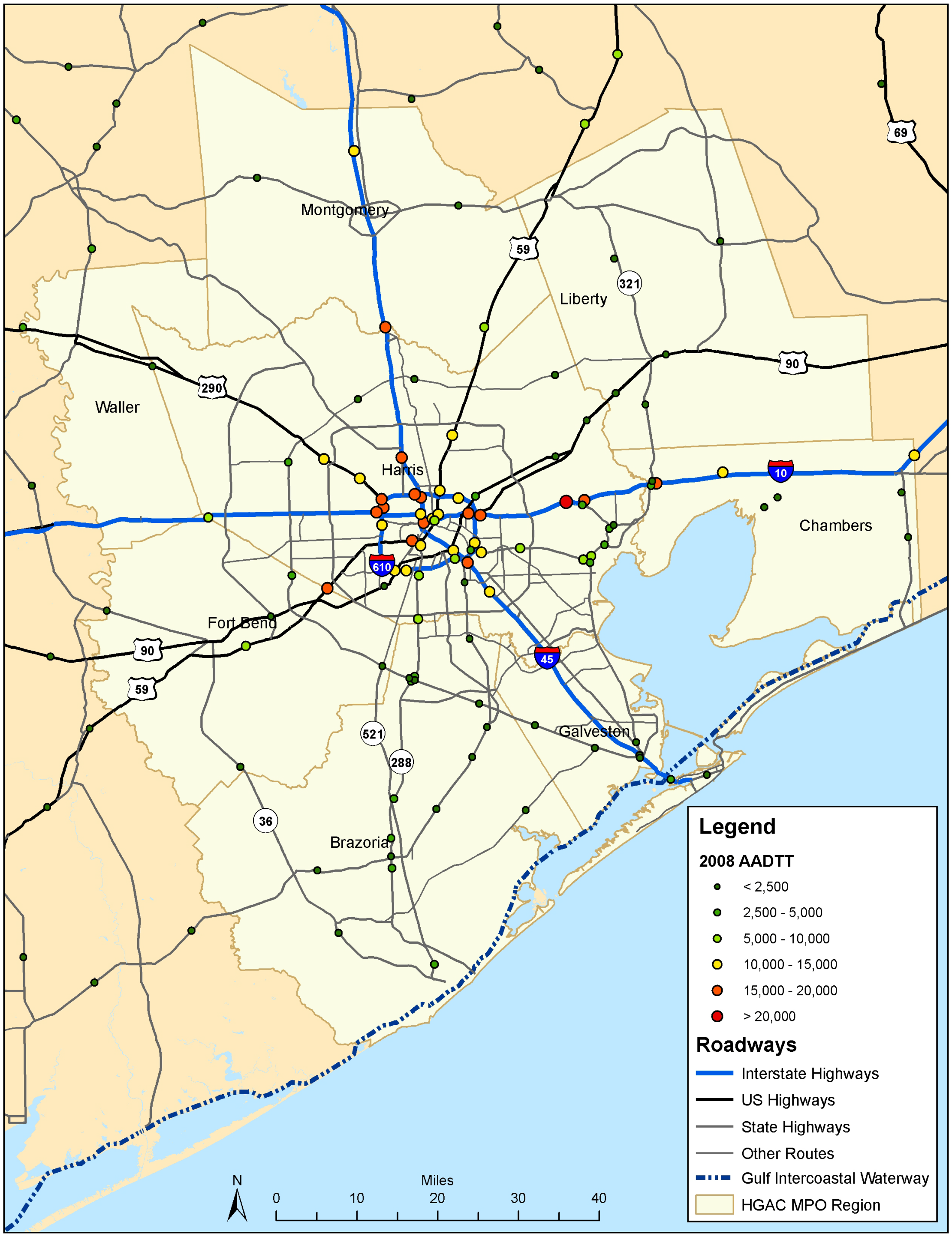
Leading Tonnage Commodities	Thousands of Tons
Petroleum and Coal Products	83,883
Secondary Traffic	74,499
Chemical Products	48,054
Nonmetallic Minerals	47,760
Clay, Concrete, Glass, and Stone	32,368
Food Products	18,272
Lumber and Wood Products	16,090
Farm Products	14,291
Primary Metal Products	12,676
Fabricated Metal Products	9,783

Source: IHS Global Insight's TRANSEARCH data.

Average Annual Daily Truck Traffic (AADTT)

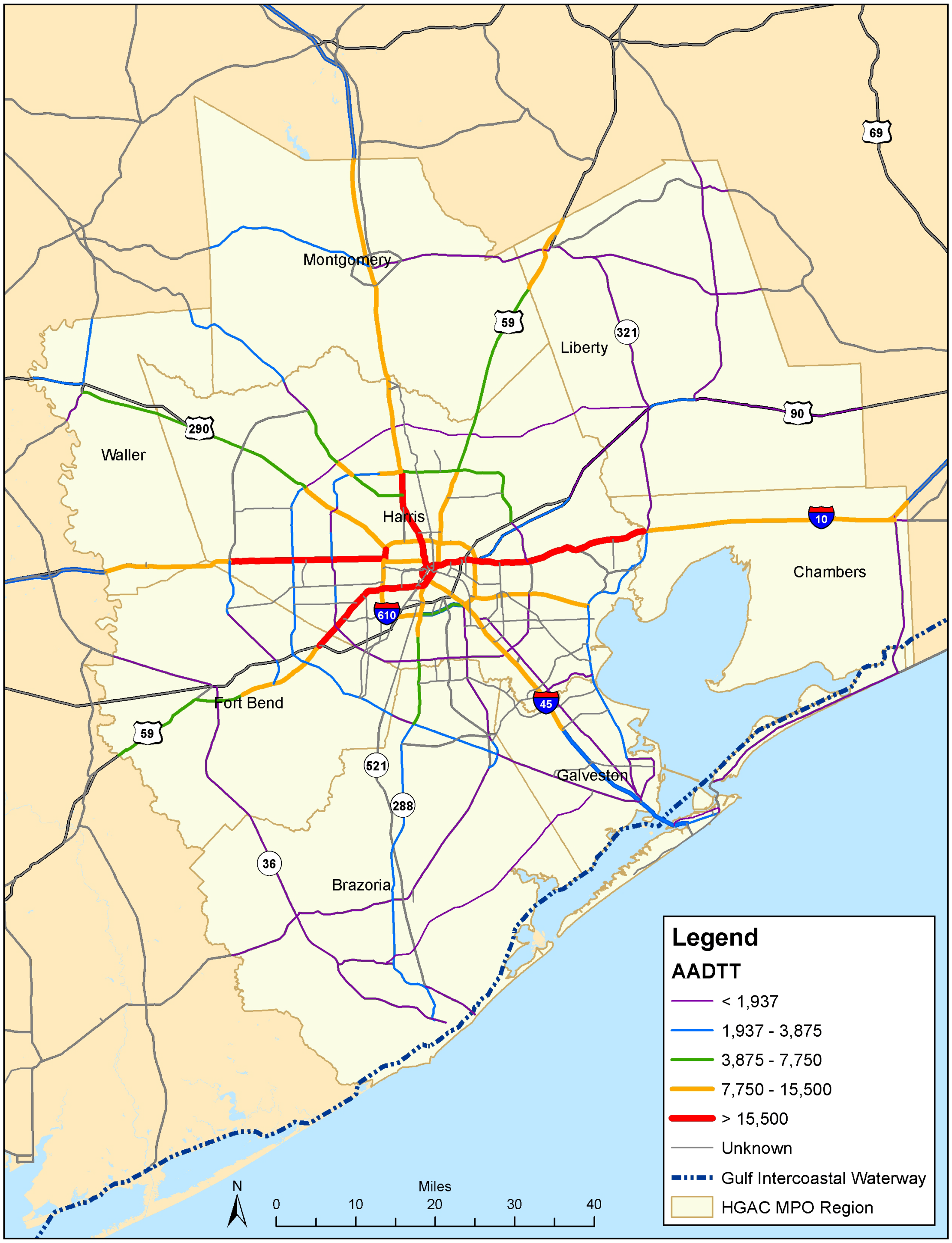
The most common measure of truck volume is average annual daily truck traffic (AADTT). AADTT refers to the average number of trucks using a given roadway segment per day and it indicates the level of freight demand being placed on the various regional highway facilities. Figures 2.6 and 2.7 show AADTT information as point counts at specific count locations and volume ranges. The data indicate that the highest volumes of truck traffic occur on roadways that already experience a high level of overall traffic, with the highest truck volumes on I-10, I-45, and U.S. 59.

Figure 2.6 Truck Counts at Permanent Count Locations – 2008



Source: Cambridge Systematics, Inc mapping of TxDOT data.

Figure 2.7 Average Annual Daily Truck Traffic (AADTT) – 2008



Source: Cambridge Systematics, Inc mapping of TxDOT data.

Average Percentage of Trucks

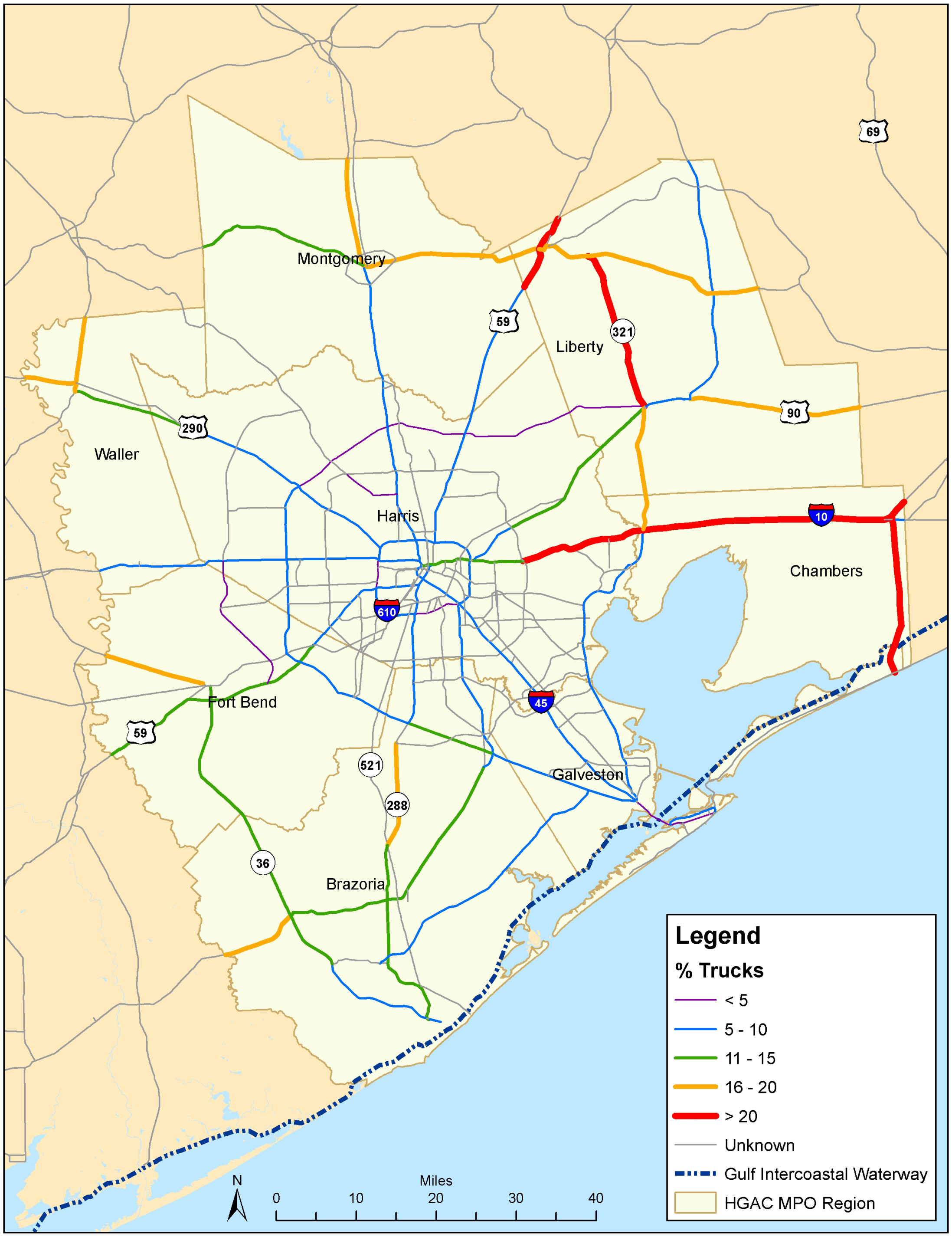
The average percentage of trucks refers to the proportion of trucks relative to overall traffic levels. Figure 2.8 displays the estimated truck percentages for the H-GAC region, indicating that trucks make up a greater proportion of overall traffic outside of the regional core. Even though the overall volume of trucks on the road is greater in and around the center of Houston (see Figure 2.7), the corresponding level of automobile traffic is larger still, lowering the average truck percentages. Conversely, as "background traffic" levels drop outside of the urban core, the proportion of trucks relative to automobiles increases. Interstate 10 in Chambers County and eastern Harris County experiences truck percentages greater than 20 percent as does U.S. 59 in Liberty County and SH 124 in far eastern Chambers County.

Highway Level of Service (LOS)

LOS is a qualitative service rating estimated by comparing the level of traffic volumes to the overall capacity of the highway. The capacity of a highway is determined by examining a number of factors such as the percentage of trucks in the vehicle mix, the grade of the highway, the percentage of no-pass zones for two-lane highways, widths of lanes and shoulders, curves, frequency of traffic signals, and several other factors. In general:

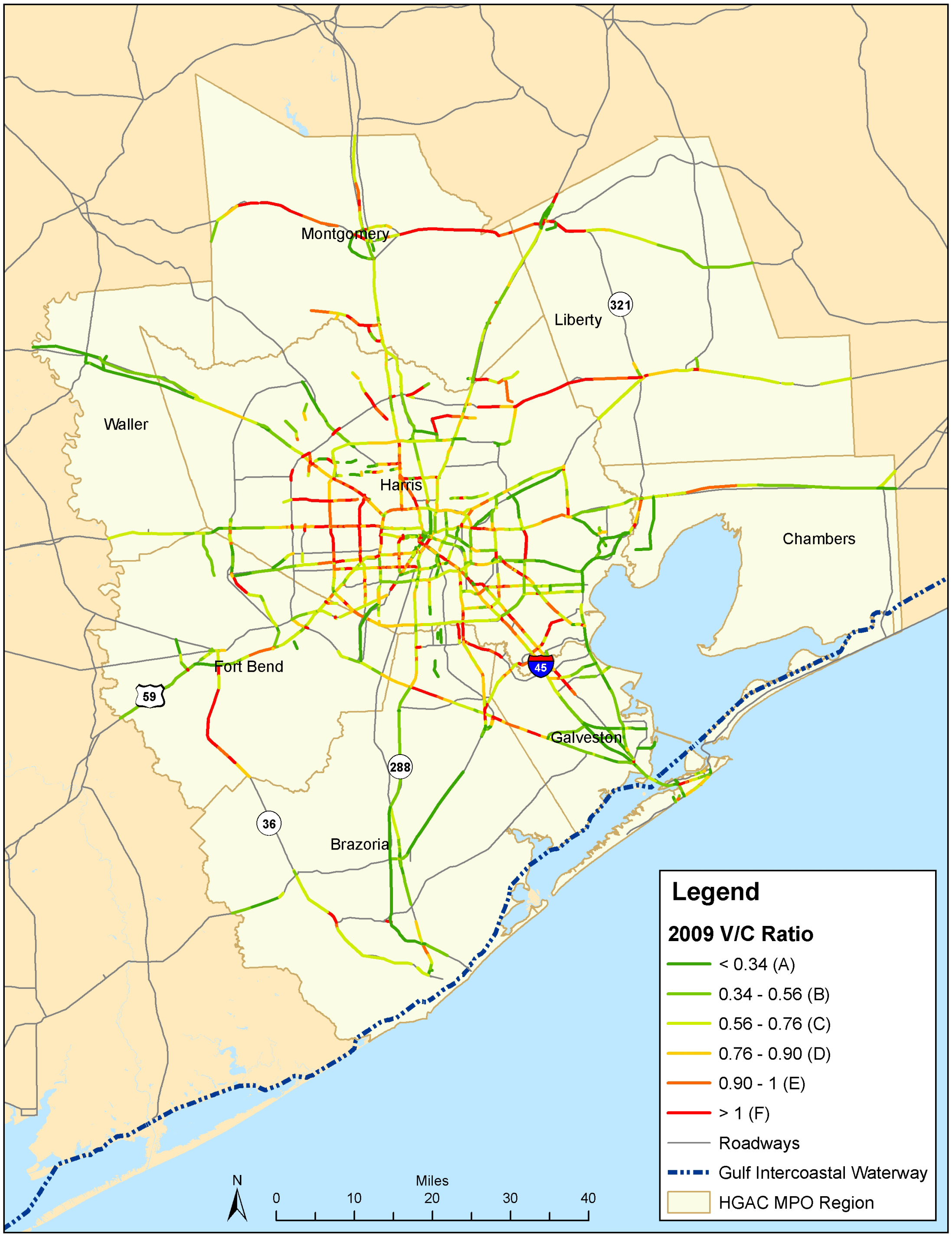
- LOS A indicates free flow conditions with virtually no delays;
- LOS B indicates near free flow conditions and a slight decline in maneuverability;
- LOS C indicates average delays and some difficulty in passing or changing lanes;
- LOS D indicates longer delays and moderate difficulty in passing or changing lanes;

Figure 2.8 Average Truck Percentage – 2008



Source: Cambridge Systematics Inc mapping of TXDOT data.

Figure 2.9 Average Daily Level of Service – 2009



Source: Cambridge Systematics, Inc. Map of data from H-GAC Traffic Model.

- LOS E indicates conditions at or near capacity with moderate to long delays and high levels of difficulty in passing or changing lanes; and

- LOS F indicates a breakdown in vehicular flow. Highway flow is unstable and long delays typically result from quickly developing queues.

As shown in Figure 2.9, much of the Houston-Galveston region's highway system currently operates at a LOS D, E, or F. This indicates a generally high level of congestion throughout the region. Many links within the highway system to the west and northwest of central Houston are operating at LOS E or F. While areas adjacent to the marine terminals along the Houston Shipping Channel, in Galveston, and in Freeport, have relatively good LOS, trucks routed anywhere to the west or north of Houston must pass though portions of the highway network that experience frequent and heavy congestion.

Trucking Equipment

A variety of truck equipment is used to move goods throughout the region (see insert). The mix of commodities influence both the type and the number of trucks required to move the goods, both of which impact the performance on the region's highways. Different vehicle types are used to haul different types of commodities and may have differing operating requirements and give rise to varying types and levels of impacts. For example, flat bed trucks are used to haul heavier, bulkier pieces of equipment and raw materials. Tanker trucks are used to carry liquid bulk, including hazardous liquids. The types of loads may dictate the routes that a truck can and cannot use. Understanding the types of goods being transported in the region provides insight into the type of equipment demanded by the region's shippers.

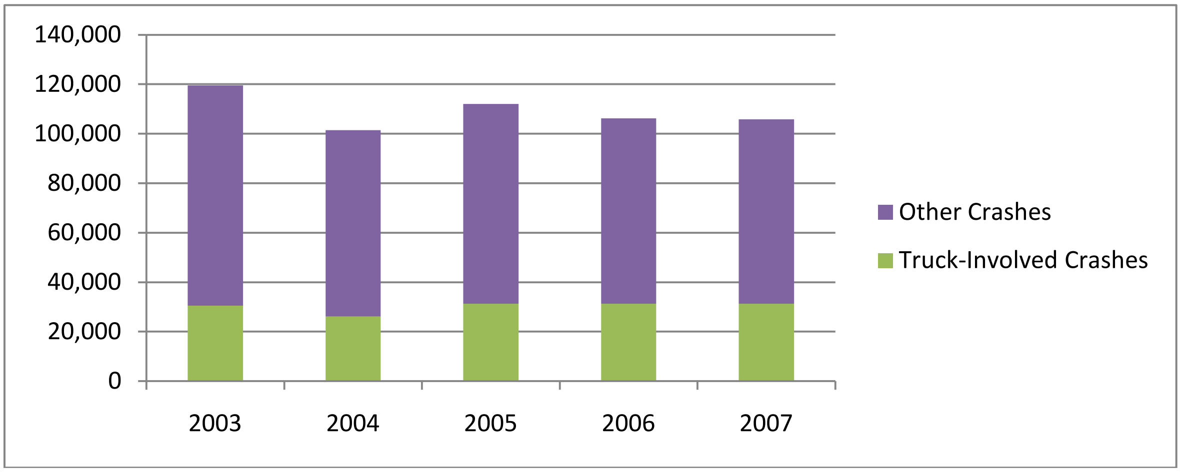
While the region's highway network is publicly owned with the majority of truck freight activity occurring over the interstate and state highway systems, the equipment operating over that network – trucks and trailers – is privately owned. The condition of the private freight vehicles has implications for the public. For example, the working condition of vital parts and systems such as brakes and lighting impact the safety of the vehicle. The age and working condition of the engine and exhaust systems have significant implications on emissions and air quality.

Commercial Vehicle Safety

Total vehicle miles traveled (VMT) over the region's roads has increased approximately 13 percent from 2003 to 2007 (from 45 billion miles to 51). The number of truck-involved crashes in 2007 (31,365) was less than three percent higher than it was in 2003 (30,544). However, the number of total crashes in 2007 (105,862) was actually 11 percent less than in 2003 (119,540). This means that the proportion of truck-involved crashes to total crashes has increased from 25.5 percent in 2003 to 29.6 percent in 2007. These trends are evident in Figures 2.10, 2.11 and 2.12 which show the number of crashes, fatalities, and injuries on the Houston-Galveston region's roadways from 2003 through 2007. For example, the number of total crashes (Figure 2.10) is generally decreasing while the number of truck-involved crashes remains fairly constant. This pattern is repeated for fatalities (Figure 2.11) and for injuries (Figure 2.12).

The H-GAC region has a slightly higher incidence of commercial vehicle crash fatalities than does the state of Texas as a whole. While the Region accounted for about 21 percent of overall VMT in the state of Texas[22] , it accounted for 27 percent of total commercial vehicle crash-related fatalities[23]. Reducing the number of crashes, injuries and fatalities is very important to the Region. The National Safety Council estimates that motor vehicle crashes cost residents and businesses in the H-GAC region approximately $5.4 billion in lost wages, productivity, medical expenses, emergency response and auto repairs.[24] This cost in lives and property is a burden to the Region and the H-GAC should support efforts, such as those in place at TXDOT (through the Texas Strategic Highway Safety Plan) to reduce commercial vehicle crashes and fatalities.

Figure 2.10 Houston-Galveston Region Crashes
2003 to 2007



Source: Data from H-GAC Report, State of Safety in the Region: 2009.

[22] TxDOT.

[23] National Highway Traffic Safety Administration (NHTSA).

[24] "Estimating the Costs of Unintentional Injuries, 2007," National Safety Council.

Types of Trucking Equipment: Trucks can be small delivery vans, medium-size single-unit vehicles, or large combination tractor-trailer vehicles. Cargo can be carried in a liquid bulk tank, on a flatbed trailer, in a dry van or a dry bulk hopper, on a specialized auto rack, or in an intermodal shipping container designed for direct transfer between truck, ship, and train using specialized overhead lift equipment. Following are images of various types of truck equipment required to move goods in the H-GAC region.

Liquid Bulk Truck

Dry Bulk Truck

Auto Rack Truck

Combination Truck with Dry Van Bodies

Single-Unit Truck with Dry Van Bodies

Flat Bed Truck

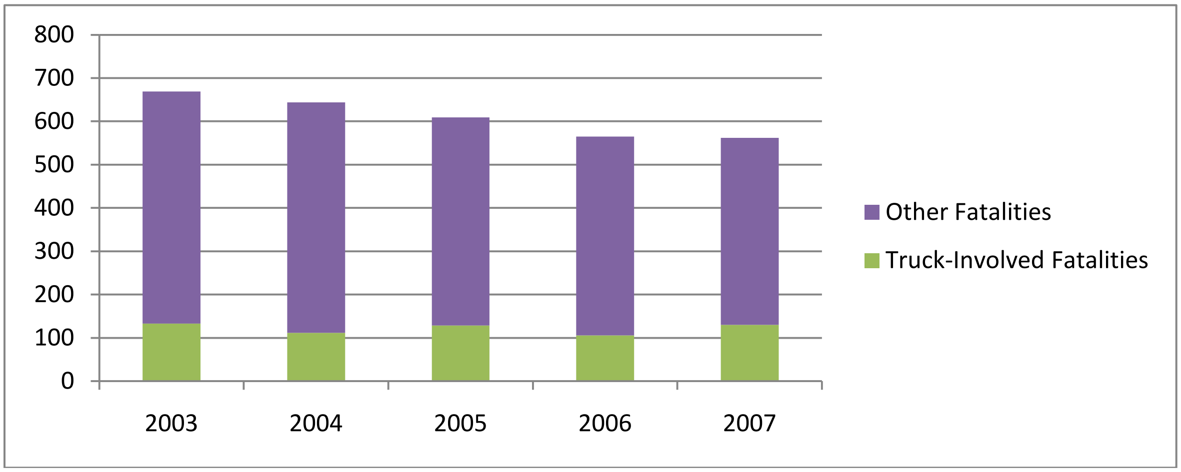
Combination Trucks Carrying Intermodal Shipping Containers
Boxes with Specially Designed Corners (Can Be Lifted from Above)

Dump Truck

Delivery Vans
Specializing in "Last Mile" Commercial and Residential Service

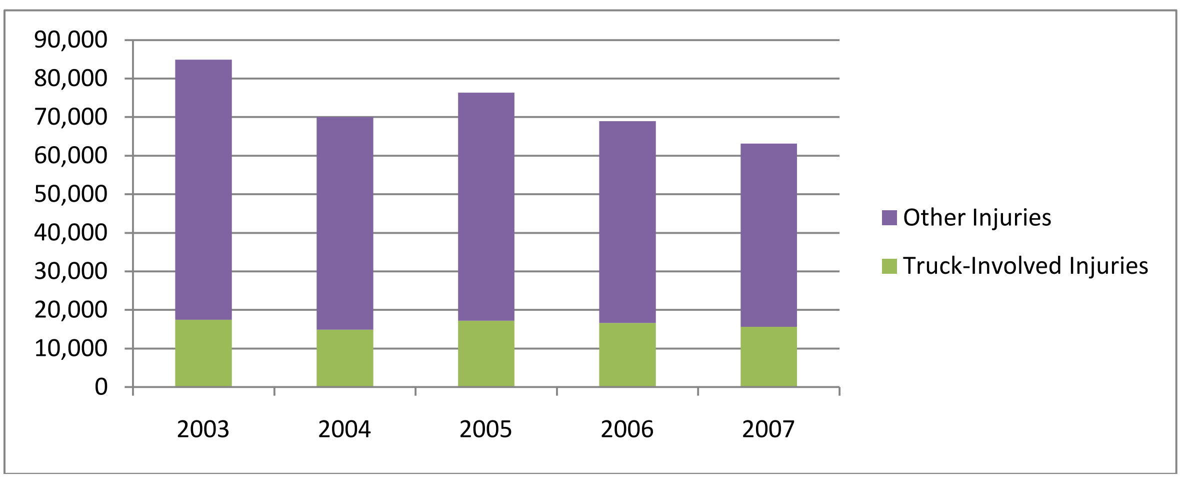
Cement Truck

Figure 2.11 Houston-Galveston Region Crash-Related Fatalities
2003 to 2007



Source: Data from H-GAC Report, State of Safety in the Region: 2009.

Figure 2.12 Houston-Galveston Region Crash-Related Injuries
2003 to 2007



Source: Data from H-GAC Report, State of Safety in the Region: 2009.

Note 1: Injuries in this chart refers to the sum of incapacitating injuries, non-incapacitating injuries, and possible injuries.

Locations on the regional highway network that have relatively high truck-crash rates are shown in Figure 2.13. This map displays the cumulative number of truck-involved crashes from the years 2003 through 2008 per every 0.1 mile roadway segment. Roadway

segments with more than 19 truck-involved crashes are highlighted in red. The greatest concentration of crashes involving trucks has occurred in the following areas:

- Interstate 10 and the Sam Houston Tollway west of central Houston;
- Interstate 10 between U.S. 59 and I-610 east of central Houston;
- Interstate 10 and SH 146 near Baytown;
- Interstate 45 south of Conroe;
- Interstate 45 north of the Sam Houston Tollway north of central Houston;
- Interstate 45 north of I-610 north of central Houston;
- Interstate 610 near U.S. 90 northeast of central Houston;
- U.S. 59 at SH 6 in Sugar Land;
- The Sam Houston Tollway at U.S. 290 and at Clay Road;
- SH 36 and U.S. 90 in Rosenburg;
- SH 249 at FM 2920 in Tomball;
- U.S. 59 near Cleveland; and
- U.S. 90 in Dayton.

Commercial Vehicle Parking

Trucks require short-term parking for staging when they arrive early to their delivery destination and longer-term parking to comply with Federal hours-of-service regulations. Safety regulations imposed by the Federal Motor Carrier Safety Administration (FMCSA) limit the number of hours a driver can operate a truck in a 24-hour period and specify minimum off-duty requirements when operating a truck. To comply with these regulations, drivers need parking facilities along their routes to stop and rest. While full-service facilities (usually private and requiring a highway exit) can provide local economic benefits relative to public or "concessioned" roadside limited-service truck stops, the latter play an important role in improving safety and mitigating negative local impacts at highway exits by enabling combination trucks to stay on limited access highways. For example, roadside truck stops can reduce congestion on local roads and reduce air pollutant "hot spot" emissions by localizing pollutants away from residential and commercial areas. Figure 2.14 identifies the locations of existing truck parking facilities and rest areas in the Houston-Galveston region.

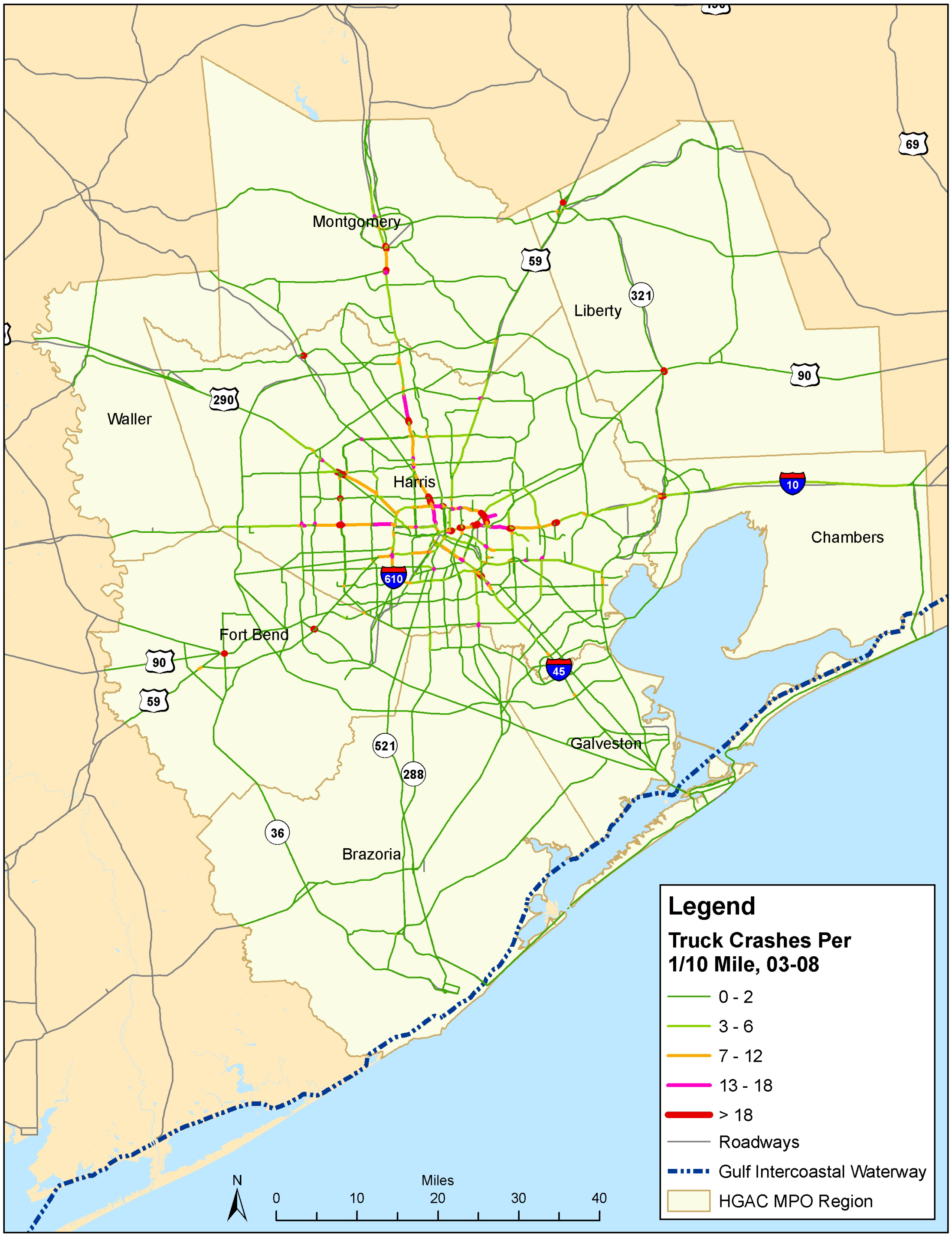
Shortage of parking facilities can lead to undesirable truck parking along roadways, interstate ramps and non-designated facilities or sites. In addition, parking areas often serve as critical staging points as trucks attempt to avoid highly congested peak periods on the interstates and adhere to the federally regulated hours of service requirements.[25] As truck traffic increases and spreads geographically, so will the need for additional parking facilities. Specifically, truck traffic will increase significantly in the northern and western portions of the region as these areas experience population growth, and there are currently few truck parking facilities available. Insufficient truck parking can create safety hazards for the motoring public as well as the truck driver as the trucks are forced to park in non-designated areas. In addition, it increases concerns about the security of the driver and the cargo and makes it more difficult for trucks to find staging areas when trying to avoid congested conditions or fulfill the hours of service requirements.

2.5 Challenges

The region's highway system faces numerous challenges in meeting the ever growing demand of both passenger and freight highway users. Meeting these demands and managing the shared use of the system is critical to the future economic competitiveness and quality of life in the region. While regional freight stakeholders generally view the highway network as good and report that they are able to overcome and work around any difficulties present in the system, several challenges to truck freight operations were noted. A summary of challenges is presented below. A more in-depth analysis of the region's freight highway needs will be presented in the Regional Goods Movement Needs Assessment report.

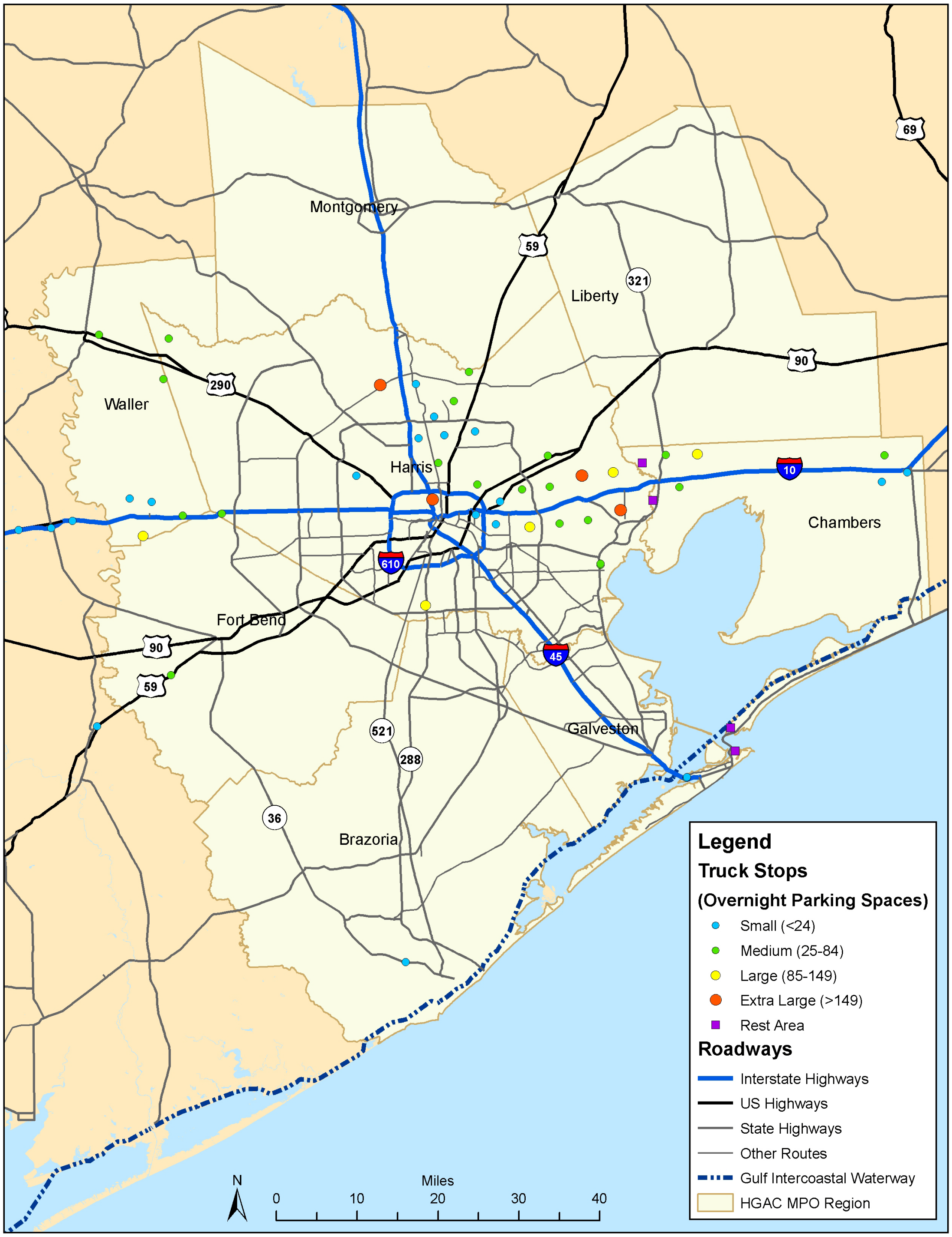
[25] The Federal Motor Carrier Safety Administration (FMCSA) administers hours of service regulations for tractor trailer drivers participating in interstate commerce. In general, drivers of property carrying trucks (non-passenger) are limited to no more than 11 hours of consecutive service following a ten hour rest period.

Figure 2.13 Commercial Vehicle Crash Locations – *2003 to 2008*



Source: H-GAC and Cambridge Systematics.

Figure 2.14 Truck Parking Facilities and Rest Area Locations



Source: American Transportation Research Institute and TxDOT.

Capacity Constraints

The increasing growth and development of the region will require continued infrastructure improvements. This includes the traditionally freight intensive areas in and around the Port of Houston extending northeast to Baytown, northwest to the Wallisville Road area near I-10 and I-45 and south through Texas City. This area includes many older industrial developments as well as pockets of residential and commercial establishments where buildings are located immediately adjacent to roads with high volumes of truck traffic. In addition, economic forecasts indicate the fastest growth in truck traffic is likely to be in the northern and western portions of the region as population and commercial businesses locate there. The volume of goods moving by truck in the region is projected to grow by more than 75 percent by 2035, indicating the need for additional capacity through expansion of existing facilities and/or new facilities.

Permitted Loads

The region is home to major petrochemical and fabricated metal industries which require the transport of large pieces of machinery and raw materials. These large oversize/ overweight shipments require special permits and are limited to certain facilities, called heavy-haul routes. Increasing constraints, either regulatory or physical infrastructure such as bridge clearance, are hampering the ability to move the cargo efficiently. The inability to efficiently move OS/OW or permitted loads could lead to the loss of industry, jobs and tax base in the region. From the public sector's perspective, permitted loads lead to increased damage to public infrastructure and increased safety concerns.

Operational Bottlenecks

Overall the trucking community reports good operating conditions on the region's major highway facilities and for the most part, they are able to service their customers from these major routes. However, some operational constraints or bottlenecks were reported. These include short-entrance ramps onto interstates which create merging hazards; excessive merging and weaving required along major freeways; insufficient turning radii on major arterials especially in the freight intensive east Houston region; numerous at-grade crossings on major freight corridors; and lack of sufficient staging areas in and around freight terminals.

Safety

Safety is equally important to the private freight industry and the traveling public. Primary safety concerns related to truck traffic include crashes and the movement of hazardous material. The fact is that truck-involved crashes are often more severe, and the probability for injury, fatalities and personal property damage is greater. In addition, the clearance time of truck-involved crashes is likely to be longer, leading to increased delay for all system users.

Air Quality

Air quality is a significant concern to the region. Poor air quality gives rise to increased health costs for residents, increased costs for businesses for mitigation and loss of worker productivity, and increased restrictions regarding Federal funding. Truck traffic is a significant contributor to damaging emissions and emissions mitigation strategies must address truck emissions. Newer equipment and advanced fuels are tools to reduce the emissions arising from truck traffic. However, these technologies can be costly and may lead to decrease fuel efficiency and other engine maintenance concerns, leading the private sector to be slow in adoption.

Community Impacts

Goods movement is essential to supporting the region's economy and quality of life. However, truck traffic also gives rise to negative community impacts. In addition to safety and air quality concerns, truck traffic can cause excessive noise and vibration along significant freight corridors and damage to roads, including pavement wear and tear and curb damage. Much of the community impact of truck traffic has been confined to the more freight intensive regions surrounding ports and industry leading to environmental justice concerns. As population continues to grow outside the urban core, especially in the northern and western portions of the region, so will commercial centers, leading to more widespread dispersion of truck traffic and the associated impacts.

3.0 The Regional Freight Rail System

3.1 Introduction

In 2007, more than one-fifth of the freight volume moving to, from, and around the Houston metropolitan region was transported by rail, accounting for 153 million tons and 22 percent of all its freight activity, excluding pipelines. Nationally in 2007, rail represented 18 percent of such tonnage and its share typically runs lower in cities, indicating that Houston with its huge petrochemical industry is a relatively heavy user of the rail mode. Some 2,200 trains of all types move weekly in the region, more than 1,000 miles of track with exposure to approximately 1,200 roadway-railroad crossings. Two Class I railroads (UP and BNSF), and the Port Terminal Railroad Association (PTRA), account for 96 percent of these trains.

This rail modal profile summarizes the role of rail in the overall system, its interconnection with other modes, its importance to area industry, and some of the challenges it poses. Its findings will have strategic implications for recommendations which come later in the Study.

Sources of Information

A number of prior studies have identified or addressed rail needs and issues in the H-GAC region. This profile draws principally on two studies because of their scope and currency. It also makes use of commodity flow data and forecasts, information gleaned or submitted in field interviews with industry players, and supplemental sources such as railroad web sites. Its main information sources include:

- **Studies**: The *Houston Region Freight Study*, prepared for TxDOT by HNTB Corporation in 2007 (hereafter the HRFS), and *A Rail Network of National Significance*, prepared by the Gulf Coast Freight Rail District in 2008.
- **Commodity Flow Data**: The TRANSEARCH commodity flow database produced by IHS Global Insight is used to characterize and quantify traffic activity. Its base year is 2007, and it offers a year 2035 forecast whose economic assumptions reflect the recent global recession.[26]
- **Field Interviews**: During the summer of 2010, experienced members of the project team conducted face-to-face interviews with representatives of the Union Pacific

[26] A detailed discussion of commodity flows is provided in the H-GAC Regional Commodity Flow Analysis.

Railroad (UP), the Burlington Northern Santa Fe Railway (BNSF), and the Port Terminal Railroad Association (PTRA). Combined, these three entities operate all but four percent of the trains in the district. A fourth railroad, the Kansas City Southern (KCS) accounts for almost all of the rest.

The preferable source for railroad commodity flow data in public planning is the detailed version of the Surface Transportation Board's Carload Waybill Sample (the CWS). Its accuracy and granularity derive from direct sampling of railroad shipment records, but for that reason it is also a confidential source with careful restrictions on use. In the absence of the CWS data, the TRANSEARCH data offer the best alternative because of their derivation from a public version of the CWS itself, although processing techniques have to be applied by the vendor, making the results less precise.

Even so, without access to the detailed CWS some elements of traffic cannot be presented at all, notably the volume of rail business passing through the Houston area. The HRFS did have use of detailed CWS files and that study presents a number of analyses that will be referenced in this profile. There are two drawbacks to this HRFS information, however. The first is that its most recent year is 2004[27] – three years prior to the TRANSEARCH base year and now six years in the past (although the growth between HRFS and TRANSEARCH base years is a moderate 14 percent from 2004 to 2007). Second and more substantially, the HRFS traffic forecast was developed prior to the 2007-2009 recession, and its projections are nearly double the newer ones for a forecast year (2025) that is ten years earlier than the forecast year of this study (2035). Because the base years are generally comparable but the forecasts are not, this profile will rely on the HRFS to enrich the profile of current traffic, and will not use its projections.

Organization of This Chapter

This chapter begins with a discussion of the Houston regional rail freight network, first placing it in the national context, and then describing its local structure and operations. Traffic and intermodal connection are discussed next, including the composition and forecast of rail volume. The chapter concludes with a review of challenges for the rail system in Houston, both in respect to its capacity and to its interaction with the community.

3.2 Houston in the National Network

At least one-third of Houston regional freight tonnage is on through or "overhead" trains, according to the HRFS,[28] carrying shipments that begin and end outside the area. However, that study attributes all of this tonnage to traffic between Mexico and the northern and eastern U.S. Somewhat ambiguously, it documents that there are additional

[27] The HRFS also utilized 2006 train volume information provided directly by railroads in the region.

[28] HRFS Tables 3-7 and 3-8.

through trains[29] running between southern California ports and points east, and regional movements between Texas and Louisiana. Nevertheless, the implication is that Houston is an originating and terminating point in the national rail network, and not a hub or transit point for continuing service with the exception of traffic bound for Mexico.

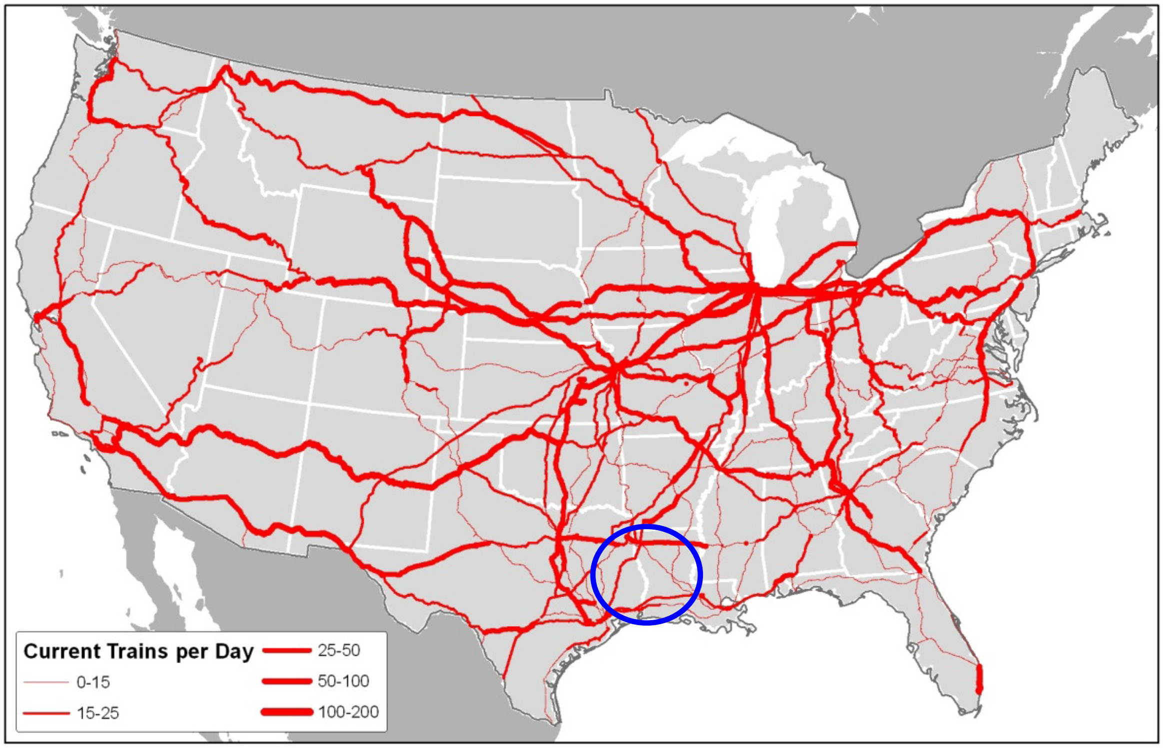
A look at the country's rail network volume supports this assessment. Figure 3.1 shows daily trains on the U.S. rail system (it includes passenger trains, although their quantity is minor in the places relevant to this discussion). The predominant pattern for Houston is of activity from the north and west, with little headed south and the eastward volume dropping off by New Orleans. The density of traffic surrounding Houston is moderate on individual lines but is spread over several of them, implying a substantial total contribution to the network. The region consequently is an important point for the national rail system, yet effectively it sits at a corner in that system. It is a major producing market for bulk industry and a receiving market for industrial supplies and consumer goods because it is home to the U.S. petrochemical business and to one of America's biggest urban populations. It is not a network center because it is situated on a coast and because of the design of the Class I rail lines.

The HRFS provides a breakdown of area train traffic by railroad. Portions[30] of it are reproduced below in Table 3.1, and it points to several things: that the Union Pacific is the predominant player, that the PTRA is relatively important, and that the KCS is a smaller factor in regional train activity.

[29] HRFS page Section 5 page 6 reports just 77 overhead trains out of 2,200 in the region, including all of the KCS trains for Mexico.

[30] The complete HRFS includes two small sources of additional trains: seven-weekly passenger trains on Amtrak, and six-weekly freights from the Timber Line Railroad, a north/south short line along the Louisiana border that is outside the eight counties of Houston, but contributes train volume by interchange.

Figure 3.1 Train Volumes by Primary Rail Freight Corridor
2005 Freight and 2007 Passenger Trains



Source: National Rail Freight Infrastructure Capacity and Investment Study, Association of American Railroads (Cambridge Systematics), 2007.

Table 3.1 Houston Weekly Freight Trains

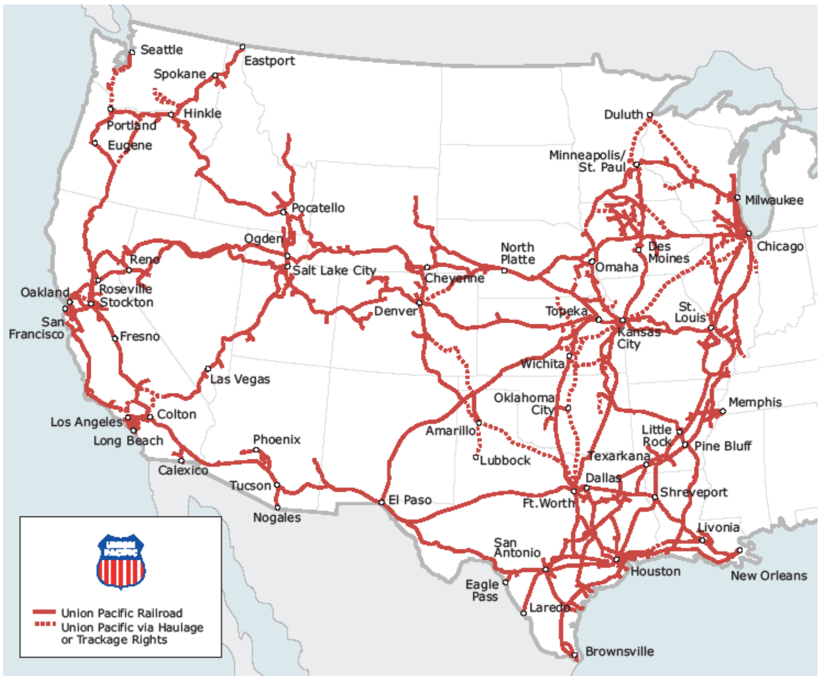
Railroad	Trains Weekly	Percent of Region
BNSF	522	23.9%
KCS	76	3.5%
PTRA	341	15.6%
UP	1,248	57.1%
Total	2,187	100.0%

Source: TxDOT Houston Region Freight Study, from 2006 data.

Consideration of the complete systems for the three Class I railroads operating in Houston begins to account for these patterns. The next several figures (taken from carrier web sites) are maps of those systems, respectively the Union Pacific, BNSF, and the Kansas City Southern. The UP stands out for its coverage of Texas, placing Houston amidst a network that runs broadly in all directions. As an agglomeration of railways that historically were leading servers of this market – the Southern Pacific, Missouri Pacific, and Katy lines – it has extensive track and penetration into industrial sites. The orientation of BNSF in Texas is more north-south, as though it were reaching down into the territory instead of encompassing it, and its lines stop short of the Rio Grande Valley. Even for its service to Houston, BNSF relies partly on trackage rights over Union Pacific (a legacy and condition of the latter's acquisition of Southern Pacific in the 1990s). The pattern on Kansas City Southern is even more pronounced, it being almost strictly a north-south operation whose greatest strength is deep penetration into Mexico (most of which is has been truncated from the map, and results from a franchise acquisition also in the 1990s). KCS is Mexico's largest railway, yet its only route to the country is on trackage rights over UP lines through Houston, and it is prohibited under those rights from picking up or delivering shipments in most of the Houston district except for service to Mexico.

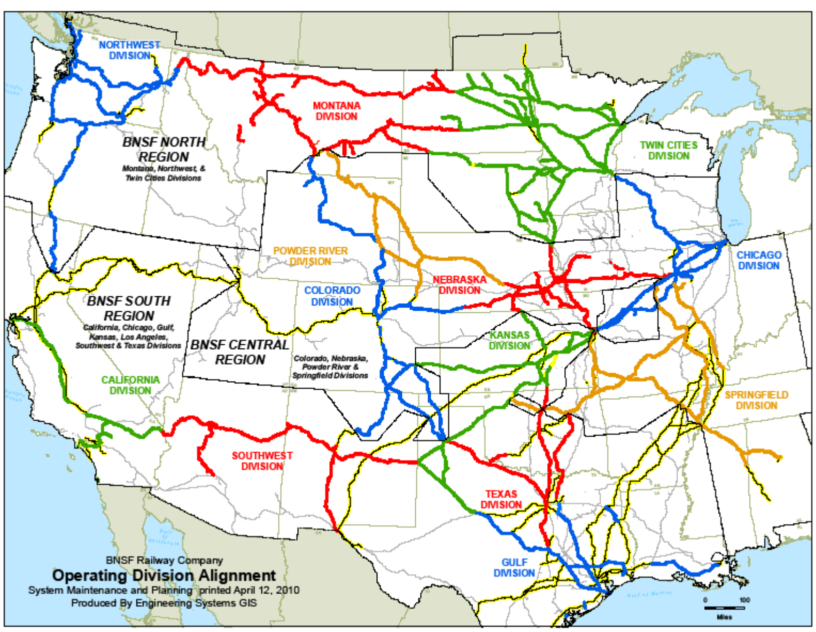
Examination of the system maps reveal that one railroad chiefly runs through the region, a second extends to it from the north, and only the third – the largest – surrounds it. Overhead trains in Houston are principally KCS operations for Mexico, which have no other route. While Union Pacific handles large volumes of Mexican traffic as well, its lines to the principal gateway at Laredo lie to the west, so that its Houston service is mostly for the Houston region. UP's proliferation of routes also gives it options for other corridors. For example, Asian import containers through Los Angeles can reach the eastern U.S. in multiple ways with the line via Dallas to Memphis offering just one of the alternatives. This causes through traffic to choose the Houston-New Orleans (I-10) route only for the most advantageous markets. Network designs thus translate Houston market volumes into large inbound and outbound flows requiring local classification, delivery, and pickup, without imposing significant capacity demands for management of through train operations. These requirements also explain the importance of the PTRA, whose role is discussed in the next section on the regional network.

Figure 3.2 Union Pacific System



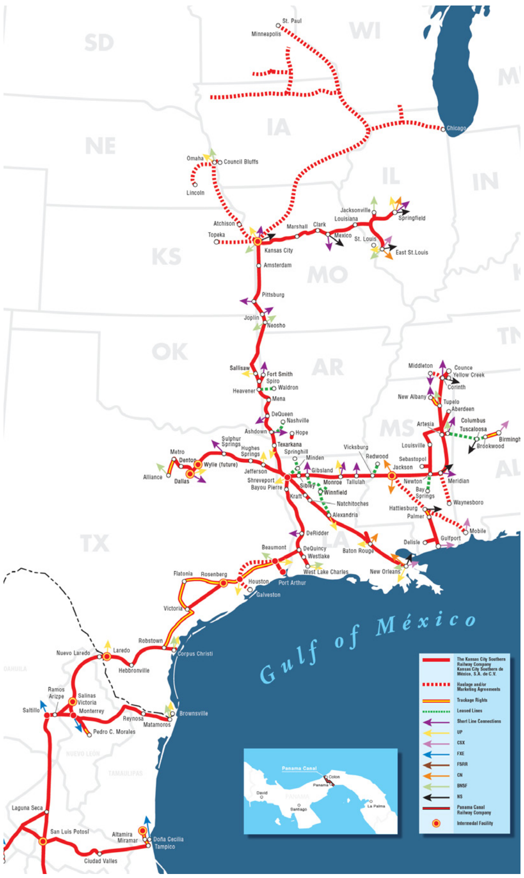
Source: http://www.up.com.

Figure 3.3 BNSF System



Source: http://www.bnsf.com.

Figure 3.4 Kansas City Southern System



Source: Kansas City Southern.

3.3 The Houston Regional Network

The great majority of Houston rail freight traffic is carload service direct to customers and port facilities. Intermodal trailers and containers as well as new automobiles are trucked to and from rail terminals, but unit trains proceed on rail to customer sites, and manifest trains combined with locals provide most of their service right to industry doors. The distribution of trains by type from the HRFS is reproduced below. Manifest, or trains with a mixture of cars and loads, and local trains form the majority at 51 percent, supporting yard work is another 27 percent, unit trains (including coal and grain) are 13 percent, and intermodal and autos are just seven percent of the activity.

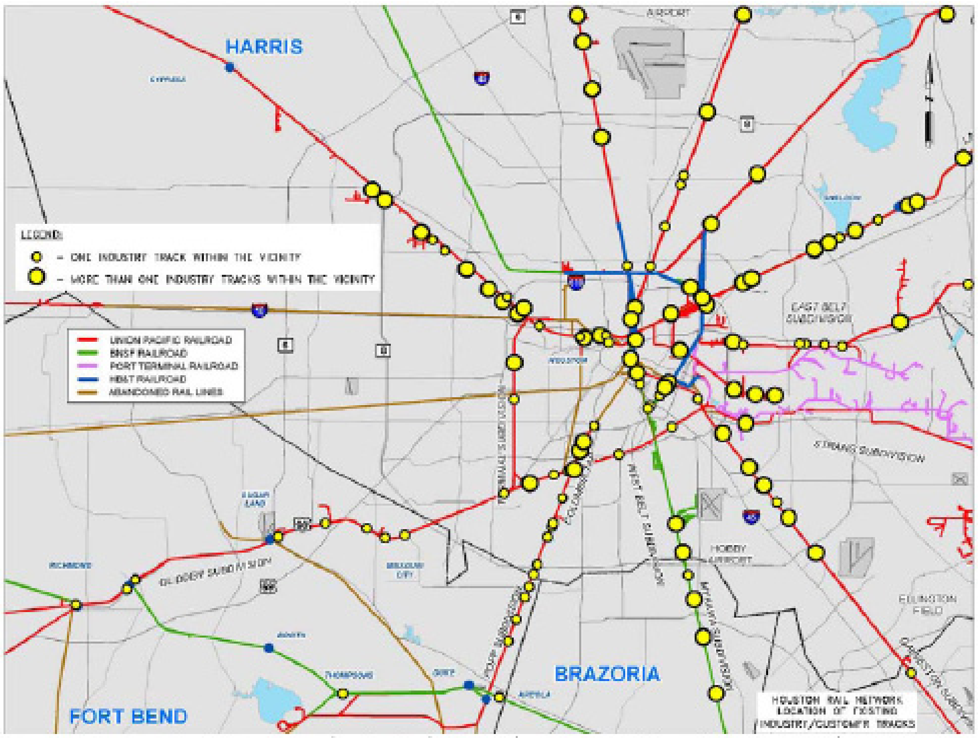
Table 3.2 Houston Freight Trains by Type

Train Type	Trains Weekly	Percent of Total
Intermodal	87	4.6%
Autos and Parts	47	2.5%
Coal	40	2.1%
Grain	64	3.4%
Other Unit (steel and bulks)	140	7.4%
Manifest	571	30.1%
Locals	396	20.9%
Yard Engines	506	26.7%
Locomotives	44	2.3%
Total	1,895	100.0%

Source: TxDOT Houston Region Freight Study, from 2006 data.

The volume of direct service that Houston enjoys is high for an urban area, after an era when rail sidings around the U.S. were pulled out of industrial sites and new facilities were built without them. While many cities have grown dependent on truck drayage to connect to train service, Houston has retained much of its rail infrastructure on carrier and private property. It connects to more than 900 active customers, according to the HRFS, whose location on rail lines across the region is depicted in Figure 3.5. As this map makes plain, they are concentrated in the old industrial neighborhoods to the east side of town, around and radiating from the ship channel. It is not coincidental that the petroleum refineries and their associated businesses are clustered in this district. As scores of American cities lost their manufacturing base, petrochemical production remained in Houston and continued to use rail service because it suited its purposes, and made money for the carriers who continued to provide it. Preserving rail served industrial sites is an important economic development strategy for the region and the State of Texas.

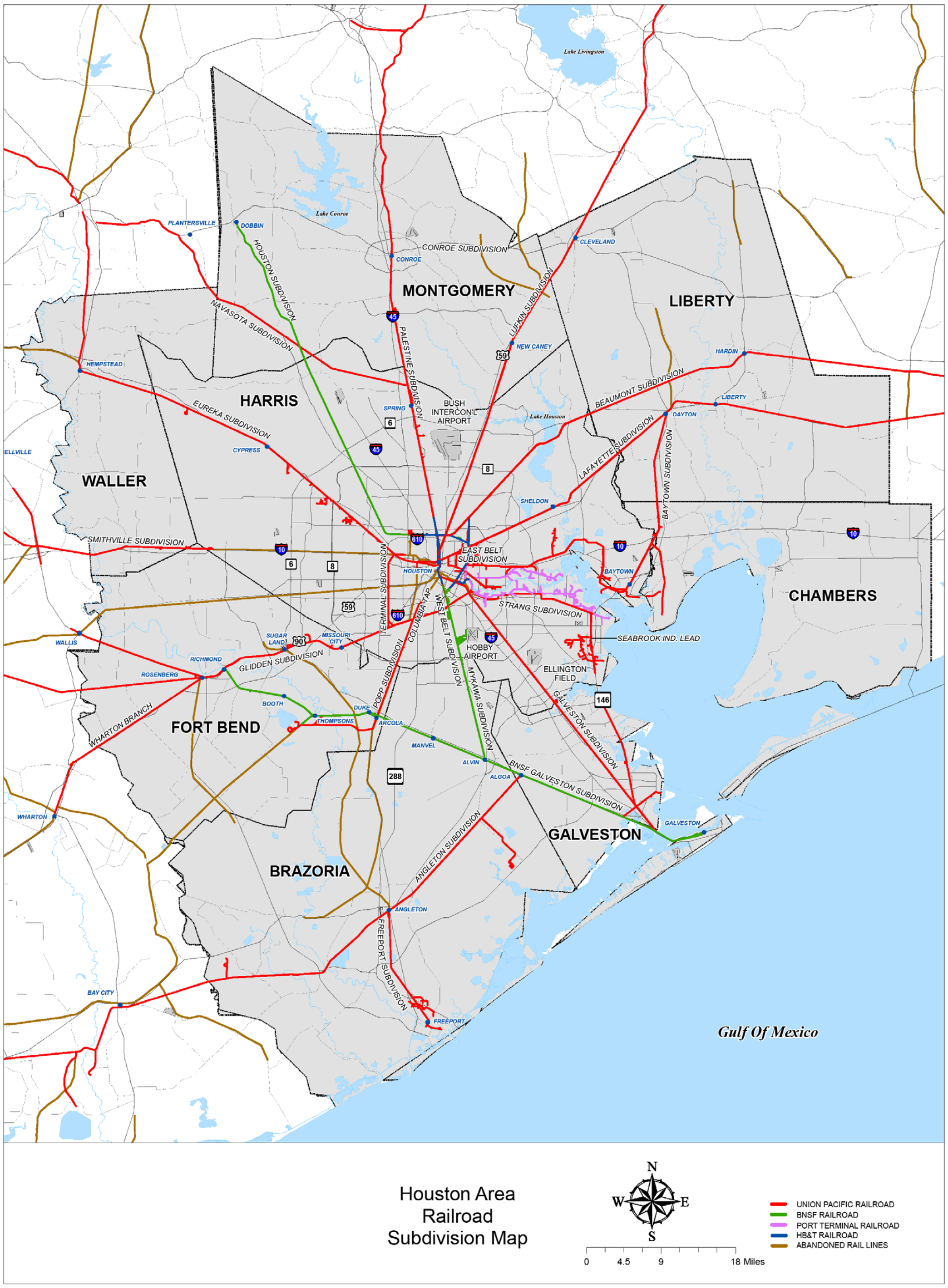
Figure 3.5 Houston Rail Network
Industry and Spur Locations



Source: TxDOT Houston Region Freight Study.

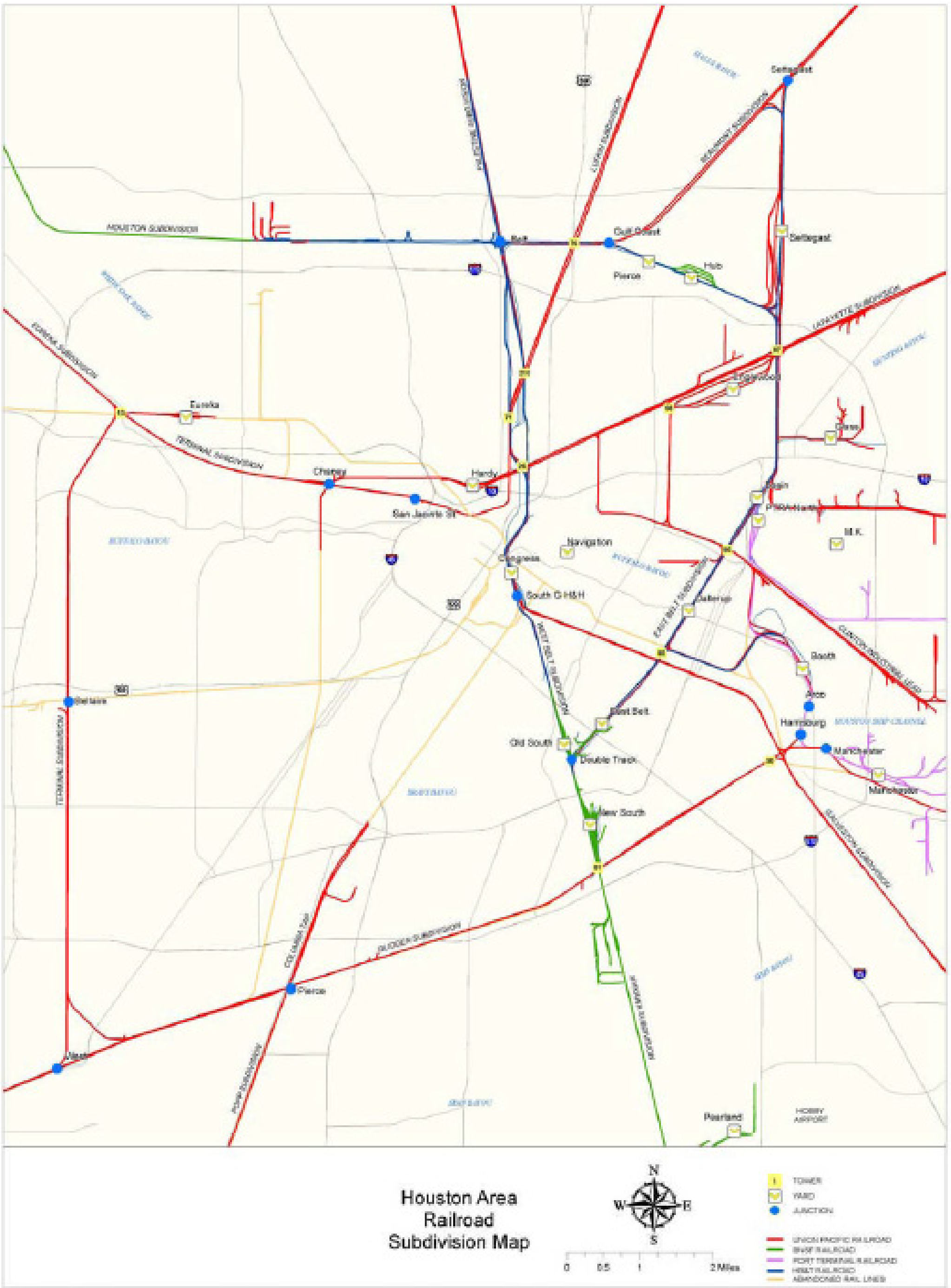
Direct rail service requires a substantial amount of supporting infrastructure and regional operation to sort railcars between road and local trains at classification yards, to allow local and road trains to pass one another as the former make pickups and deliveries and the latter travel to intercity routes, and to manage equipment supplies at carrier and customer sites. The next three figures display the location of this infrastructure in progressive levels of detail.

Figure 3.6 Houston Rail Network



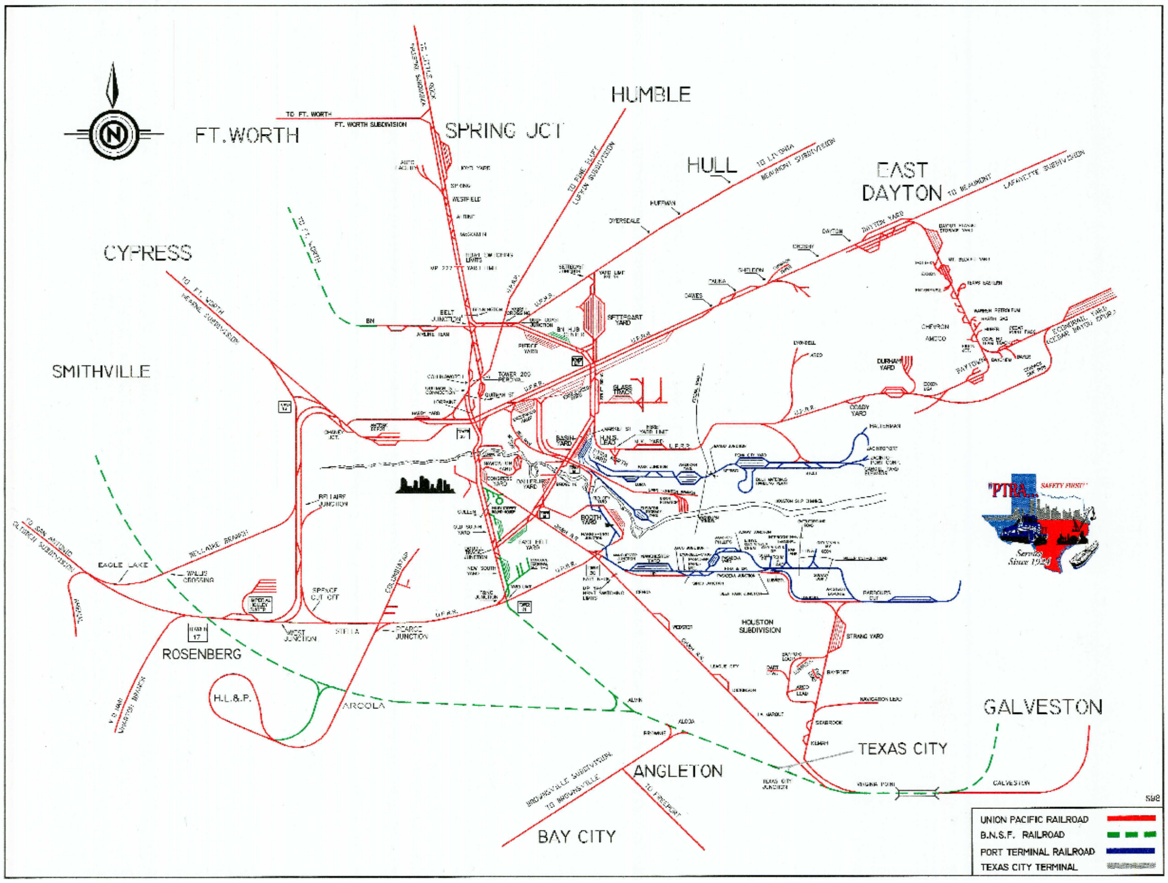
Source: TxDOT Houston Region Freight Study.

Figure 3.7 Houston Rail Network
Inside 610 Beltway



Source: TxDOT Houston Region Freight Study.

Figure 3.8 Houston Rail Network Schematic



Source: Port Terminal Railroad Association.

The first of these figures supplies a regional overview. It identifies the UP, BNSF, and PTRA lines[31] (and the HB&T Harbor Belt that UP and BNSF share), and shows the subdivision names – which are helpful for reference, similar to a street name. It includes abandoned rail lines, which is useful to recognize for planning purposes.[32] The second figure magnifies the first for the area roughly within the 610 Beltway. The third is a schematic map produced by the PTRA that is not to scale, but that offers a rather clear view of the location of rail yards and junctions, both for its own operation and for others. (This map also identifies the Texas City Terminal Railway, another joint facility of the UP and BNSF).

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31 KCS does not appear because it uses trackage rights on UP.

32 For example, the Port of Freeport has expressed interest in returning abandoned line to service that might help it make new connections to rail terminals in the Rosenberg area.

The HRFS reports 999 miles of track in the region, with 829 miles of main, 123 miles of siding, and 47 miles of yard. The PTRA itself operates on 33 miles of track with twin branches on either side of the ship channel, and distances equal on each end. It claims 350 miles of track within its confines, including yard facilities (a number that does not square with the HRFS inventory, presumably due to different accounting). Its principal point of interchange is on its northern branch at North Yard by the turning basin, but it receives trains on the southern branch at both Manchester and Pasadena Yards. It serves 175 customers – 95 percent of them in the petrochemical industry with plastic resins and pellets the top commodity types – providing pickup and delivery service with open access to the Class I railroads. Organizationally, the PTRA is an unincorporated association of Houston's three Class I railroads, and it is effectively their agent. It has an exclusive but not irrevocable right to operate on right-of-way belonging entirely to the Port of Houston over track originally supplied by the Port but subsequently receiving capital improvements from the PTRA.

The continued vitality of direct rail service in the region has helped prevent large scale spinoffs of track, and thus has not given rise to short-line railways. The only entity in the eight-county area that isn't an extension of the Class I's is the Galveston Railroad, a 38-mile switching and terminal road providing service to the Port of Galveston and its tenants. It is operated by the Rail Link Region, an arm of Genesee & Wyoming, Inc.

Network Operations

The operations on this network include private railcars moving loaded and empty between customer and carrier track, unit trains cycling loaded and empty, interchanges between railroads and the accommodation of trackage rights, plus the deployments of yard engines to power these activities. The two thousand train movements weekly in the district are comprised of these activities, and the classification yards, industry service yards, and junctions must be capable of managing them. The HRFS[33] identifies 14 significant switching yards in the terminal area, and includes the following:

- On the Union Pacific: Settegast, Englewood, Strang, Basin, Dayton, and Lloyd/ Westfield. Of these, the UP describes the first two as the key facilities for the movement of manifest trains, and the third (Strang) as important for managing service to heavy industry on the Bayport Loop;
- On BNSF: New South and Dayton; and
- On the PTRA: North, Manchester, and Pasadena.

[33] These points and several following are taken from Section 5 of the HRFS.

All but one of these facilities lie to the east of town. Their concentration, and the related concentration of traffic in a district whose infrastructure was designed many decades earlier, are conditions that create congestion and delay. The HRFS describes the essential difficulty as twofold: a) repetitive switching by yard engines competing for track space with local and road trains; and b) the capacity consumed by the length of contemporary trains – more than a mile in many cases – and the time it takes to stage them. Analysis of train delays in that study places their causes squarely in the condensed area delimited by the PTRA and the East Belt, West Belt, and Terminal subdivisions.

3.3 Traffic and Intermodal Connection[34]

Traffic Composition

Railroads handle 22 percent of the freight tonnage generated or received in metropolitan Houston, apart from its pipeline activity. As a specialist in bulk commodities, railroads carry just nine percent of the value of commodities shipped, yet their services are essential to the petrochemical industry that is a main engine of the regional economy.

The 152 million tons moved by rail in 2007 represented 28 percent of Houston's inbound receipts (including supplies to the region and exports), 18 percent of its outbound shipping (including regional production and imports), and eight percent of its purely local activity. A detailed distribution of this rail tonnage appears in Tables 3.3 and 3.4.

Table 3.3 Houston Annual Rail Freight Tonnage
(Hundred Thousands)

Direction	Carload Tons	Intermodal Tons	NAFTA Tons	Harris County Tons	Total Rail Tons
Inbound	94,852	4,585	2,271	81,978	101,707
Outbound	34,261	4,668	3,503	33,548	42,432
Local	8,414	0	0	7,894	8,415
Total	**137,527**	**9,253**	**5,774**	**123,420**	**152,554**

Source: TRANSEARCH 2007, IHS Global Insight. Total is the sum of carload, intermodal, and NAFTA. Harris County figures contain volumes reported in other columns.

[34] Data and analysis presented in this section is based on the H-GAC Regional Commodity Flow Analysis

Table 3.4 Distribution of Rail Freight Tonnage

Direction	Percent Carload Tons	Percent Intermodal Tons	Percent NAFTA Tons	Percent Harris County Tons	Percent Total Rail Tons
Inbound	62%	3%	1%	54%	67%
Outbound	22%	3%	2%	22%	28%
Local	6%			5%	6%
Total	**90%**	**6%**	**4%**	**81%**	**100%**

Source: TRANSEARCH 2007, IHS Global Insight. Total is the sum of carload, intermodal, and NAFTA. Harris County figures contain volumes reported in other columns. Components may not add due to rounding.

Several points can be drawn from these tables:

- Houston is a carload rail market. The intermodal volume is light at six percent of traffic (compared to the national average of nine percent), reflecting in part the low contribution from containers through the Port.
- Absent the KCS overhead volumes, the NAFTA traffic is minor.
- Two-thirds of rail freight is inbound traffic, and four-fifths of the region's rail freight moves into, out of, or around Harris County.
- The commodity composition of these 153 million tons are displayed in Table 3.5 and Table 3.6, which reveal:
- *Products of the petrochemical industry form the leading commodity group*, adding to 34 percent of rail tonnage. They account for most of the outbound volume, essentially all of the local volume, and constitute seven percent of inbound tonnage.
- *Coal is the next most important commodity*. It is all inbound freight, some of it for utility plants and some feeding the petrochemical facilities. It represents 27 percent of rail tonnage and is 40 percent of the inbound freight.
- *Shipments of non-metallic minerals and farm products also contribute heavily to inbound volumes*. They form about one-third of the region's rail freight receipts, and are bound partly for export and partly for local use.

Table 3.5 Houston Rail Freight Commodity Tonnage
(Hundred Thousands)

Commodity	Inbound Tons	Outbound Tons	Local Tons	Total Rail Tons
Chemicals	7,799	25,948	6,798	40,545
Petroleum	3,554	6,501	894	10,949
Coal	41,401	0	0	41,401
N-M Minerals	17,131	237	107	17,475
Farm Products	14,656	51	0	14,707
All Other	17,166	9,695	616	27,477
Total	**101,707**	**42,432**	**8,415**	**152,554**

Source: TRANSEARCH 2007, IHS Global Insight.

Table 3.6 Distribution of Rail Freight Commodity Tonnage

Commodity	Inbound Tons	Outbound Tons	Local Tons	Total Rail Tons
Chemicals	5%	17%	4%	27%
Petroleum	2%	4%	1%	7%
Coal	27%	0%	0%	27%
N-M Minerals	11%	0%	0%	11%
Farm Products	10%	0%	0%	10%
All Other	11%	6%	0%	18%
Total	**67%**	**28%**	**6%**	**100%**

Source: TRANSEARCH 2007, IHS Global Insight. Components may not add due to rounding.

Traffic Forecast

Houston regional freight tonnage is projected to grow 55 percent between 2007 and 2035, excluding through freight and reflecting a conservative post-recession compound annual growth rate of 1.6 percent. The region adds 382 million tons during this period, of which 65 million tons are new rail volume. Rail is thus capturing only 17 percent of the incremental tonnage (its share of growth), reflecting a slower rise in its volumes. They total 218 million tons for a 43 percent increase over the 28 years, and result in a decline in rail market share from 22 percent to 20 percent.

Table 3.6 displays the distribution of forecast tonnage by direction and components of traffic. Table 3.7 depicts the distribution of the 65 million incremental rail tons added over the 28-year period.

Table 3.7 2035 Forecast Rail Freight Tonnage
(Hundred Thousands)

Direction	Carload Tons	Intermodal Tons	NAFTA Tons	Harris County Tons	Total Rail Tons
Inbound	137,860	10,224	2,562	119,940	150,647
Outbound	39,881	11,418	4,435	46,489	55,734
Local	11,572	0	0	10,885	11,572
Total	**189,313**	**21,642**	**6,997**	**177,314**	**217,953**

Source: TRANSEARCH 2007, IHS Global Insight. Total is the sum of carload, intermodal, and NAFTA. Harris County figures contain volumes reported in other columns.

Table 3.8 Contribution to New Rail Tonnage (Share of Rail Growth)

Direction	Carload Percent Tons	Intermodal Percent Tons	NAFTA Percent Tons	Harris County Percent Tons	Total Rail Percent Tons
Inbound	66%	9%	0%	58%	75%
Outbound	9%	10%	1%	20%	20%
Local	5%	0%	0%	5%	5%
Total	**79%**	**19%**	**2%**	**82%**	**100%**

Source: TRANSEARCH 2007, IHS Global Insight. Total is the sum of carload, intermodal, and NAFTA. Harris County figures contain volumes reported in other columns. Components may not add due to rounding.

The data on shares of growth reveal three substantial points: 1) most of the growth is inbound traffic, not outbound; 2) most of the burden of growth for originating and terminating traffic falls on Harris County; and 3) carload freight accounts for the majority of the increase, but intermodal traffic contributes almost 20 percent. The intermodal business climbs by 134 percent compared to 38 percent in carload. It becomes ten percent

of the rail mix, up from six percent today, and is growing a bit faster in the outbound direction (145 percent) than the inbound (123 percent).[35]

Examining the commodity composition provides additional insight into the nature of rail growth in the coming decades, as estimated in this forecast. Tables 3.8 and 3.9 display the 2035 rail tonnage for classes of goods by direction, and the percentage of the new rail tonnage contributed by each category. A number of observations emerge from these tables. First, coal is the expected driver of rail growth, by itself accounting for almost half of the new tonnage and with all of it moving in the inbound direction. Tonnage increases 72 percent over the forecast period. Second, chemicals grow slowly and petroleum products by rail hardly at all, the former by 23 percent and the latter by eight percent over nearly 30 years. Such sluggish increases in important commodities hold down the overall rise in rail, and in its outbound and local tonnage. Third, non-metallic minerals actually decline 14 percent, but farm products inbound for local processing and export go up by a healthy 66 percent. Finally, intermodal growth is contained in the "all other" group (most intermodal shipping lacks specific-commodity definition). It accounts for 70 percent of the new tonnage in this category – more than 60 percent of the inbound and 80 percent of the outbound.

Table 3.9 2035 Forecast Rail Freight Commodity Tonnage
(Hundred Thousands)

Commodity	Inbound Tons	Outbound Tons	Local Tons	Total Rail Tons
Chemicals	9,990	30,450	9,571	50,012
Petroleum	4,403	6,523	845	11,771
Coal	71,391	0	0	71,391
N-M Minerals	14,356	535	108	14,999
Farm Products	24,395	55	0	24,450
All Other	26,112	18,171	1,048	45,330
Total	**150,547**	**55,734**	**11,572**	**217,953**

Source: TRANSEARCH 2007, IHS Global Insight.

[35] Panama Canal expansion may well influence container imports and contribute to the faster outbound growth, but this is not entirely clear in the forecast.

Table 3.10 Contribution to New Commodity Tons (Share of Rail Growth)

Commodity	Inbound Tons	Outbound Tons	Local Tons	Total Rail Tons
Chemicals	3%	7%	4%	14%
Petroleum	1%	0%	0%	1%
Coal	46%	0%	0%	46%
N-M Minerals	-4%	0%	0%	-4%
Farm Products	15%	0%	0%	15%
All Other	14%	13%	1%	27%
Total	**75%**	**20%**	**5%**	**100%**

Source: TRANSEARCH 2007, IHS Global Insight.

Note: Components may not add due to rounding.

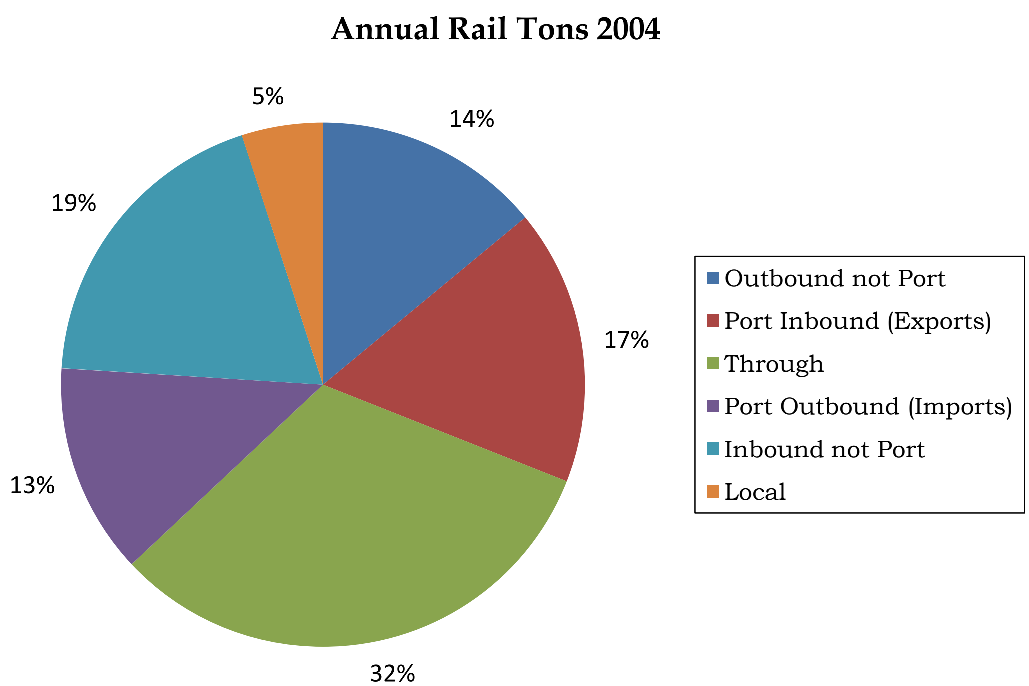
3.4 Intermodal Connection

There are a number of ways that the rail system in Houston interacts with other modes: the relatively small but fast growing container and trailer intermodal business, new automobiles transferred from railcars, and some bulk and breakbulk transload operations. However, the principal intermodal connection made by rail in the region is to the water. Port activities affect several of the functions just cited, but they especially draw direct rail movements to the ship channel and other waterside facilities (see Figure 3.9).

Figure 3.9 Grain Train at Port Elevator

The HRFS distinguishes rail traffic for the Ports of Houston and Freeport only, but allows it to be set in the context of overall rail volume. Its distribution of tonnage appears in Figure 3.10. Apart from the through tonnage for Mexico (which the older data are able to display and the newer not), 45 percent of Houston rail tons are associated with the ports. Imports are 49 percent of the outbound volume (outbound because they begin at the port in Houston), exports are 47 percent of the inbound volume (inbound because they end at the port). While the HRFS does not identify the commodities moving for trade, it is safe to conclude that the leading rail goods figure heavily: coal and farm products for export, for example, and petrochemicals for import.

Figure 3.10 Houston Rail Tonnage Showing Ports



Source: TxDOT Houston Region Freight Study.

The importance of the water connection may be even greater when petrochemical industry location is considered. Refineries locate by the water so that oil tankers and offshore pipelines may reach them readily. Chemical plants link to the refineries to use their byproducts. Substantial portions of Houston rail traffic are related to this industry, handling not only its products but also its supplies in fuel, steel, and other goods. Thus, it is not an exaggeration to say that the majority of the Houston rail business depends on the region's access to the Gulf.

Rail track reaches into port terminals at Freeport via the UP, at Texas City and Galveston via terminal railways with connection to UP and BNSF, and of course via the PTRA, whose purpose is to link the Class I railroads to Port of Houston and private facilities along the ship channel. The most significant ways that rail does not come directly into port is for the container terminals at Barbours Cut and Bayport in Houston, and the planned Velasco Terminal in Freeport. The two Houston terminals are a few miles away from a small and dedicated UP container facility, and are 20-30 miles from larger

intermodal centers on both UP and BNSF. Freeport is about 60 miles from its closest facility, a new KCS intermodal terminal at Rosenberg. Port container terminals with on-dock rail are not common in the U.S. – near-dock is a more usual and simpler arrangement due to space requirements for train operations. The Port of Houston currently handles little of the long-distance inland-import traffic that would most need rail service. However, the Region's ability to capitalize on the opportunities to play a more prominent role as a national gateway will, in part, depend on rail connections at intermodal ports and terminals.

Intermodal Connection: Containers, Trailers, and Autos

Most of the railroad facilities providing intermodal train service to greater Houston's port traffic also are serving other markets for international and domestic container and trailer business. Rail shipments entering or departing Houston are delivered and picked up by local truck drayage companies, or by national truck lines and intermodal companies with Houston operations. At the rail terminals, containers are lifted by crane between truck chassis and railcars (a container on flatcar or COFC service), or wheeled trailers are disconnected from truck tractors and craned on and off the car (a trailer on flatcar or TOFC service). Some of these terminals also handle automobiles between multilevel railcars and trucks with autorack trailers; in other cases, the auto terminals are separate facilities. In all of these operations, the automobiles are simply driven on- and off-rail equipment under their own power.

The Houston regional intermodal facilities for COFC, TOFC, or auto service are these:

- **Union Pacific Bayport,** a small COFC facility in partnership with the Port of Houston and dedicated to their business. Located at 515 East Barbours Cut Boulevard in La Porte, 2 miles from the Barbours Cut Terminal and seven from the Bayport terminal.

- **Union Pacific Englewood,** a COFC facility located at 5500 Wallisville Road in Houston, and 24 miles from Barbours Cut and 30 miles from Bayport. The UP relates that its chief business today is international containers run through the Los Angeles ports.

- **Union Pacific Settegast,** a TOFC and COFC facility located at Kirkpatrick Boulevard in Houston, 28 miles from Barbours Cut and 32 from Bayport.

- **Union Pacific Westfield,** an auto ramp located at 24125 Aldine Westfield Road in spring.

- **BNSF Pearland,** a COFC, TOFC, and auto terminal at 214 Brisbane Road in Houston, 22 miles from Bayport and 24 miles from Barbours Cut.

- **KCS Rosenberg,** a newly opened COFC, TOFC, and auto terminal at 11538 Gin Road in Beasley, 62 miles from Freeport.

- **PTRA** portside auto ramp handling import automobiles delivered by ship or by rail from Mexico.

Road access is a crucial concern for any rail intermodal terminal. It is worth noting that majority of the listed facilities are on the east side of Houston, in the midst of both rail congestion and old industrial neighborhoods whose roads were not designed for contemporary trucking. The drayage approach on Wallisville Road to the Union Pacific's main COFC terminal at Englewood involves a narrow two-lane street with inadequate shoulders, roadside residences, busy truck traffic, and grade crossings – some of which can be seen in Figure 3.11. The UP states that it is contemplating relocation of this terminal to Rosenberg, first to free space for continuing operations in the remainder of the Englewood facility, which is one of its main yards in Houston, second to allow expansion of intermodal functions, and third to improve road access. The first two are the greater factors to the railroad, which reports that its track leads are too short at this yard, obligating it to make use of (and block) its main line during train composition. The drawbacks to relocation in UP's view include the greater dray distances for trucks that would have to serve Houston from the west.

Figure 3.11 Wallisville Road Access

Intermodal Connection: Transload

A small number of private facilities exist in the region that specialize in bulk and breakbulk transfer between railcars and trucks. In bulk transfer, a mechanism like a hose is used to transfer liquid or dry bulks between rail equipment and truck trailers. In breakbulk, a crane inside of a covered warehouse is use to lift typically heavy individual items between rail and truck equipment. As with other intermodal services, the truck supplies drayage to connect the rail line to customer sites that do not have direct rail access.

Transload facilities whose current operations could be identified and confirmed are listed below. Others may exist as well, especially those performing services on an ad-hoc basis, or for whom transload is incidental to broader functions.

- **Bulkmatic Transport Company –** This facility is located at 6505 Homestead Road in Houston and is serviced by BNSF with 20 spots. Bulk products handled include Chemicals (dry), Foods (dry), and Plastics (dry). Dry bulk transfer is by vacuum trailer, blower, or portable vacuum/air conveyor.

- **Fuel Streamers/IFL Terminal –** This facility is located at 17617 Aldine Westfield Road in Houston and is served by UP. Bulk products handled include diesel and biodiesel. On-site services and equipment include blending meters and liquid storage tanks.

- **Gulf Winds –** This facility is located at 411 Brisbane in Houston and is served by the BNSF. A variety of break bulk items are handled. The on-site services and equipment include covered warehouse space with crane equipment.

- **Frontier Logistics – Barbours Cut Terminal –** This facility is located at 101 E. Barbours Cut in Morgans Point and is served by both UP and PTRA with 180 spots. Bulk products handled include plastics (dry). On-site services and equipment include air compressor, scale, and sampling services. Dry bulk transfer is by vacuum trailer, blower, or portable vacuum/air conveyor. Packaging Capacity includes two open mouth sewn bag lines (seven to eight cars daily), one box line (six cars daily), and two bulk container lines (12 cars daily).

- **Hermann Logistics –** This facility is located at the Port of Houston and is served by PTRA. A variety of break bulk and bulk items are handled. On-site services and equipment include hopper car and conveyor.

3.5 Challenges

The rail system in metropolitan Houston faces a series of challenges in preparing a network established in a bygone era for the business and environment of tomorrow. It is a modern system today in that it can handle contemporary equipment, yet the legacy of its original design gives rise to inefficiencies, much as the road network also does in any evolving city. Some concerns are about sustaining capacity and performance, and some about integration with the surrounding community. This section treats each in turn.

Capacity

There are three sets of issues in the general category of capacity challenges: service capacity, car management capacity, and the spreading interest in passenger rail service.

Service Capacity

The HRFS identifies groups of infrastructure improvements intended to reduce delay and improve rail service. Without attempting to evaluate the specific recommendations, it is worthwhile to review the systematic difficulties they are intended to address.

Three-hundred *daily* train hours of delay are estimated in the HRFS due to congestion in the Houston rail network. Each train carries multiple cars – sometimes scores of them – which magnify the effect on the industries they serve. The essential difficulties (cited above in Section 2) are due to conflict between switching and through activity on an old style network. The key responses are to separate switching from through movement as far as possible, and to support bypass and additional train space by creating parallel tracks. When asked about the consequences of rail network congestion, shippers attributed the problems[36] to inadequate switching and classification facilities, and to inadequate sidings and passing tracks – diagnoses that are in line with the modeled findings of the HRFS.

The freight railroad is mostly a private network; improvements in its performance benefit its owners and its customers. However, these things become public concerns in several ways: a) when they affect the competiveness of regional industry and the jobs and related businesses it supports; b) when growth or even retention of rail traffic cannot be supported and it is spilled onto the highway; c) when public planners seek alternatives to roadway investment and the rail cannot respond, or expect it to support port expansion with transportation supply, and it cannot; and d) when various public activities touch on the rail network and help or hinder its operation.

A specific and apparently distant bottleneck alleviation proposal that arose in project discussions with Class I roads is Tower 55 in Dallas. More than 100 trains cross through this junction daily, whose worsening delays cause trains to be held on track many miles to the south. Both UP and BNSF are affected as several of the chief north/south routes carrying Houston trains pass through this point. Delays to them not only affect Houston shipping, they slow the throughput of trains and equipment on the Houston network, contributing a degree to its congestion. The Tower 55 project, which will improve the operation and capacity of the current at-grade crossing for both freight and passenger trains, gained support from the Port of Houston and was awarded a Federal grant in 2010.

Car Management Capacity

The PTRA reports that 80 percent of the railcars it handles are owned or leased by the shipping community. There are 7,300 cars typically held on track inside customer facilities located around its lines, whether storing product, waiting to load or unload, or preparing to move empty. PTRA carries 2,000 cars on its own track, and another 4,300 might be enroute on inbound trains. It estimates customers have storage capacity for 17,000 railcars, but there is little on the PTRA itself, and it relies on the Class I railroads to keep its tracks clear and its operations moving. Meanwhile, the UP estimates its own volume generation at 8,200 to 9,000 cars per day.

These are large numbers even for a slow economy, accounting for hundreds of trainloads daily apart from additional car staging operations. The concentration on the PTRA itself and its position at the heart of the district underscores the importance of a fluid network.

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[36] EBRSI page 20.

When cars don't move, they absorb the storage capacity quickly, the network begins to seize, and the effects radiate outward. This is exactly what happened in the difficult period after the UP-SP merger, and while those conditions were addressed and have not returned in a decade, the risk must be regularly managed. When the question of car management capacity is coupled with chronic delays in the very same service system that supplies fluidity, the interconnected challenges become apparent.

Passenger Service

An outcome from field interviews conducted for this project with logistics personnel from various industries in various logistics roles, is the frequency with which unprompted advocacy of enlarged passenger rail service for the Houston region arises. These individuals have tended to view it as an obvious response to accelerating road congestion, as well as a way to free capacity for freight usage. Meanwhile, the rise in support and funding for high-speed rail initiatives that started at the Federal level is appearing in Texas and elsewhere around the nation.

The challenge for new passenger services is the need for right-of-way, and this is often sought in the freight system. The difficulties this pose to freight service are well understood and documented in sources like the recently released NCHRP Report 657, which analyzes shared use of right-of-way. According to its authors, capacity modeling demonstrates that dedicated track for passenger trains quickly becomes necessary for viable services. For the purposes of goods movement planning in Houston, the key considerations are that an already strained freight rail network has little if any capacity to spare, the elements of its network depend on one another to distribute stress, and any discussion of new passenger services requires consideration of these issues and adequate investment.

Community

There are many concerns surrounding community interaction with the rail freight system. Three significant examples include: the retention of direct rail service, and safety issues attendant to grade crossings and hazardous materials movement.

Retention of Direct Service

Earlier sections have emphasized the high measure of direct rail service to industrial sites enjoyed in metropolitan Houston. It allows large quantities of heavy goods to be picked up and delivered without burdening the roadways, keeping emissions and carbon footprints relatively small. In most of America, rail has been pushed to the metropolitan rim, and the cities have become profoundly truck dependent. However, Houston has been able to retain many of its rail-served industrial sites.

Direct rail service is a benefit to be retained. The particular industrial location and composition of Houston has permitted it to happen, but it requires the track and yard systems that the previous section detailed. In that sense, the assurance of capacity supports continuation of this important class of rail service. Possibilities like the movement of the UP intermodal terminal from urban Englewood to exurban Rosenberg follows the pattern used elsewhere, and may be deserving of additional exploration. On the one hand, freed capacity at Englewood is good for the carload business; on the other hand, Rosenberg adds many miles of truck VMT. Intermodal volumes are going to grow, but where direct rail service cannot be used, short-distance drayage preserves some of its virtues.

The so-called rail renaissance of recent years has seen shippers seeking land parcels with rail access, and finding them few in much of the country. Houston has such parcels, and their development and redevelopment offer value to the public. PTRA claims to possess a number of them on its northern branch, most notably the former Army depot at Jacintoport, where investment reportedly has begun.

Grade Crossings and HazMats

Houston's extensive direct rail network brings with it large numbers of at-grade rail crossings. The HRFS estimates 1,200 of them in the region, with a daily road volume approaching five million cars and trucks. It cites 300 crossing incidents causing 90 injuries from 2000 through the time of the report, pointing up the safety risks to the traveling public as well as to train crews. Crossings impose traffic delays as well, causing trains to slow and road vehicles to wait for trains to pass. In the industrial districts of east Houston where truck terminals and rail switching operations are side by side, crossing queues are an everyday occurrence.

Figure 3.12 Tank Truck at Grade Crossing

The HRFS identifies locations with AADTs as high as 50 to 60 thousand vehicles, and it makes much of the virtue of grade crossing improvements. A city of Houston's great size and growth expectations, desiring to preserve and expand its rail services, should strive for its road and rail systems to interfere less with one another.

A separate yet related matter that also poses safety concerns is the incidence of hazardous materials (or HazMat) movements in the Houston region. The petrochemical industry naturally gives rise to shipping of this form, some of it due to flammable or explosive material, and some due to toxic substances. Much of its shipping does not fall in this category – plastic pellets are a high-volume example – but a portion does. Without access to the detailed records of the STB Carload Waybill Sample, it is not possible to explore HazMat patterns in any depth, and for public security reasons it is desirable not to do so in a public document. What can be said is that railcars are expressly constructed to protect hazardous substances and withstand collisions, and that rail is a preferred mode of shipping for the industry because of the safety it offers. That said, the presence of HazMat shipping by rail and by road, in a region where such movements often may cross (as Figure 3.12 suggests), is another reason for grade crossing improvements to earn public attention.

4.0 Regional Port System

4.1 Introduction

The ports, ship channels, and waterways of the Houston-Galveston area are of vital regional, national, and international significance, linking key Texas industries, particularly its chemical, oil, and agriculture industries, with markets and suppliers located throughout the world. They also serve industries and markets located in other parts of the country, particularly those in the central U.S. While chemicals and petroleum are responsible for making the region's ports among the largest in the nation (as measured by total weight), the system's importance in supporting the flows of containerized goods, grains, cement, and other commodities continues to grow. As a result, these ports and waterways continue to be key contributors to the overall health and competitiveness of the economy, providing a cost-efficient means to move goods into and out of the region, fostering international trade, and creating and supporting high-paying, attractive jobs for residents.

However, this vital transportation network is being stressed by continued growth in freight volumes, driven by the growing populations and economies of Texas and the Gulf Coast region. Even amid the current global economic recession, container volumes at Texas ports are expected to nearly triple by 2035, general cargo volumes are expected to grow by more than 50 percent, and volumes along the Gulf Intracoastal Waterway (GIWW) are expected to grow by 48 percent. These growth patterns will exacerbate existing or create new capacity and congestion problems along the GIWW, at critical ports and intermodal terminals, and along critical highway and rail corridors and access facilities. Travel time and cost will increase, service reliability will decrease, and the ability of the system to recover from emergencies and service disruptions will become severely taxed. Layered on top of these concerns is the increasing challenge of balancing freight mobility needs with environmental, social, and financial concerns; rapidly rising infrastructure maintenance costs; and a recognition that neither the public nor private sectors – acting independently – have the necessary resources to fully address rising port and waterway system demands. Individually or collectively, these issues may erode the efficiency and productivity of the region's freight transportation system, leading to economic implications that will reverberate locally, regionally, nationally, and internationally.

The Houston-Galveston Area's waterborne transportation system, shown in Figure 4.1, consists of a network of Federally maintained coastal and inland waterways ports and private terminals. These facilities are critical to statewide and national economic vitality, handling high volumes of oil, chemicals, stone, cement, machinery, steel, autos, and containers – critical inputs and outputs for Texas industrial, commercial, and consumer markets.

The backbone of this network is the GIWW, a 1,300-mile manmade navigable inland canal that runs along the Gulf of Mexico coastline from the southernmost tip of Texas at

Brownsville to St. Marks, Florida. Texas' portion of the GIWW begins 270 miles west of the Harvey Locks in Louisiana at the Sabine River border with Louisiana and extends approximately 406 miles[37] south-southwest to the Brownsville Channel, just north of the Rio Grande River, Texas' border with Mexico. The waterway provides a channel with a controlling depth of up to 12 feet, and is designated primarily as a protected channel for barges carrying freight, commercial fishing boats, and recreational watercraft. The Texas portion of the GIWW provides access to the State's deep- and shallow-draft seaports, which contain more than 1,000 individual port and terminal facilities.

This H-GAC waterborne freight profile is focused on the eight counties in the Houston-Galveston MPO—Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller—which contain several of the most important ports in the State, including the Port of Houston, which handles the largest volume of foreign trade, by tonnage, in the U.S.

Sources of Information

Numerous prior studies have been conducted on the Region's ports and this profile draws on several of them, with the TxDOT Waterborne Freight Study, Phase 1 Report being a primary source. It also makes use of commodity flow data and forecasts from IHS Global Insight TRANSEARCH: information gleaned from stakeholder interviews and site visits; and individual port web sites. Sources of specific data and information are provided throughout the profile.

Organization of this Chapter

Following the introduction, this profile examines the Region's port system demand. Individual port profiles are provided next, followed by a discussion of challenges for the port system.

[37] United States Army Corps of Engineers Navigation Data Center.

Figure 4.1 Major H-GAC Area Ports

Source: Guide to the Economic Value of Texas Ports, TxDOT Report 0-5538-P1, Center for Transportation Research, University of Texas-Austin, February 2008 (revised December 2008).

4.2 Port and Waterway System Demand

Despite the current (2007-2009) global economic recession, overall demand on the Houston-Galveston area's port and waterway system to support the region's growing population and economy – both domestic and international – is expected to grow significantly by 2035.

Waterborne freight tonnage moving through seaports and terminals in the H-GAC region is expected to grow by approximately 45 percent by 2035, to more than 212 million tons, as shown in Table 4.1. Of the counties that contain major port facilities, Brazoria County, home of Port Freeport, is expected to experience the greatest rate of growth, climbing

74 percent from a 2007 level of 7.7 million tons to nearly 13.4 million tons over this period. The greatest total increase in waterborne tonnage is expected in Harris County, home to the Port of Houston, which is expected to experience an increase in total tonnage of nearly 42 million tons. While Chambers County is expected to experience a very significant increase in waterborne tonnage by 2035, waterborne freight in the County is expected to remain significantly less than one percent of total tonnage in the region.

Table 4.1 H-GAC Waterborne Tonnage Forecasts[38]
2007 to 2035

County	2007 Tons (1000s)	Percent of Total	2035 Tons (1000s)	Percent of Total	Percent Increase 2007 – 2035
Brazoria	7,701	5%	13,381	6%	74%
Chambers	9	0%	49	0%	457%
Galveston	36,777	25%	55,304	26%	50%
Harris	101,405	70%	143,353	68%	41%
Total	145,892	100%	212,087	100%	45%

Source: TRANSEARCH.

Table 4.2 details the value of waterborne freight passing through seaport and terminal facilities in the region. Overall, the total value of waterborne freight in the Houston-Galveston area is expected to climb by 52 percent, from a 2007 level of $76 billion to more than $115 billion by 2035. The majority of this value is handled by facilities in Harris County, which handled more than $56 billion in waterborne freight in 2007 and are expected to handle nearly $80 billion in 2035. Brazoria County is expected to exhibit the greatest rate of growth between 2007 and 2035, climbing nearly 300 percent, from $2.0 billion to $7.9 billion. This does not include any freight moved via pipeline.

[38] Fort Bend, Liberty, Montgomery, and Waller Counties have no significant waterborne freight.

Table 4.2 H-GAC Waterborne Value Forecasts
2007 to 2035

County	2007 Value ($ Millions)	Percent of Total	2035 Value ($ Millions)	Percent of Total	Percent Increase 2007 – 2035
Brazoria	$ 2,007	3%	$ 7,937	7%	295%
Chambers	$ 10	0%	$ 74	0%	623%
Galveston	$ 18,100	24%	$ 27,776	24%	53%
Harris	$ 56,039	74%	$ 79,756	69%	42%
Total	$ 76,157	100%	$ 115,543	100%	52%

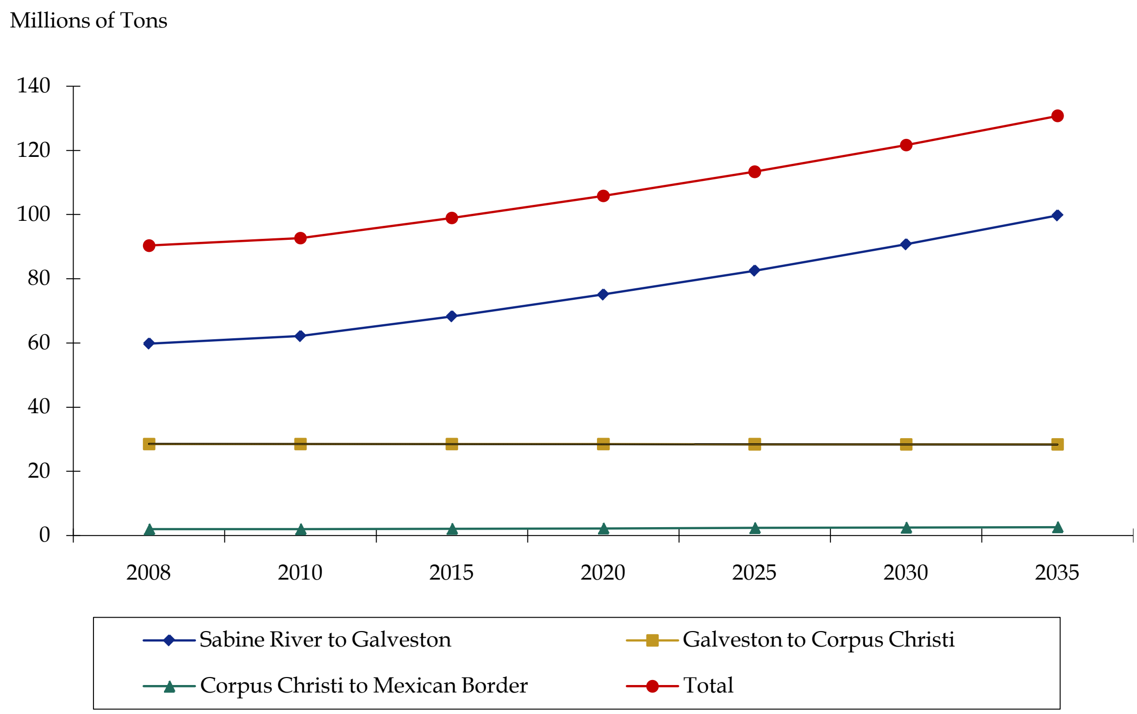
Source: TRANSEARCH.

Total freight volumes along the GIWW are expected to grow by 45 percent, to nearly 131 million tons by 2035. As shown in Figure 4.2, the majority of this growth is expected in the section between Galveston and the Sabine River, indicating continued growth in shallow draft shipping in the H-GAC region.

The H-GAC region is also expected to experience increases in container traffic as a result of the expansion of the Panama Canal, scheduled to be completed during the mid-2010s. In addition, competition for rail capacity between the West Coast and the interior U.S. is expected to intensify as fuel prices increase and shippers seek to shift products to rail to save costs. These trends will further encourage a shift in container traffic growth to Gulf Coast and East Coast ports.

This continued growth in container traffic will result in freight movements becoming a larger component of the traffic mix within the H-GAC region, as these movements favor trucks and railroads as their primary mode of transportation. These increases will have a dramatic impact on the condition, performance, and capacity of both the land and waterside transportation infrastructure.

Figure 4.2 Gulf Intracoastal Waterway Tonnage Forecast
2008 to 2035



Source: Texas Waterborne Freight Study.

4.3 Port Profiles

This section provides a summary profile for each of the four major ports in the H-GAC region: Houston, Freeport, Galveston, and Texas City.

Houston

In 2009, the Port of Houston ranked second in the U.S. in terms of total cargo handled and sixth in container traffic. It is located in the city of Houston and has access to the Gulf of Mexico and the GIWW via the Houston Ship Channel. In 2009 imports accounted for about 57 percent of foreign trade while exports accounted for about 43 percent.[39] This imbalance in favor of imports means that the regions served by the Port experience an outflow of dollars as residents and businesses pay for the goods received. Also, any

[39] Port of Houston Authority web site (http://www.portofhouston.com) and AAPA web site (http://www.aapa-ports.org/Industry/content.cfm?ItemNumber=900), both accessed February 10, 2011.

imbalance of imports to exports results in some landside inefficiencies. In general, this imbalance means that trucks and railcars that arrive at the port with cargo are not always able to leave the port with cargo, resulting in more empty truck or rail car miles. The degree to which this happens depends in large part on the type of commodity hauled. For containerized goods, a given truck can generally pick up any load regardless of the type of containerized load that was delivered. Chemical and other liquid bulk tankers must generally haul the same commodity inbound and outbound thereby increasing the probability of being empty in one direction.

Governance

The Port of Houston Commission governs the Port of Houston Authority. The Commission is made up of seven members. Of the seven commission members, two are appointed by the city of Houston, two are appointed by the Harris County Commissioners Court, the chairman of the Port Commission is jointly appointed by the city of Houston and the Harris County Commissioners Court, and the Harris County Mayors and Councils Association and the city of Pasadena each appoint one member.[40]

Number of Berths, Maximum Length, and Depth at Berth

The Port of Houston owns and operates a total of 45 berths of various types with a maximum length at berth of 1000' and depth of 39.1'.[41]

Highway and Rail Infrastructure Serving the Port

The Port of Houston is served by the UP, BNSF, and KCS railroads[42] as well as numerous major highways, including Interstates 10 and 45.

Recent Projects/Infrastructure Investments

In 2005, the port authority completed a channel deepening and widening project that increased the depth of the Houston Ship Channel from 40' to 45' and widened the channel from 400' to 530'. A combination of local voter-approved bonds and Federal funds was used to finance the improvements. The first phase of the new Bayport container terminal, including the first berth and approximately 65 acres of the facility opened in 2007.[43]

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[40] Port of Houston Authority Website (http://www.portofhouston.com), accessed June 22, 2010.

[41] Ibid.

[42] Ibid.

[43] Ibid.

Top Commodities Moving Through the Port

The top commodities moving through the Port in 2008, by tonnage and value, are shown in Tables 4.3 and 4.4, respectively.

Table 4.3 Top Port of Houston Commodities (Inbound and Outbound)[44], *By Tonnage, 2007*

Commodity Group	Tons
Petroleum and Petroleum Products	95,144,915
Organic Chemicals	13,228,779
Iron/Steel Products	10,463,075
Cereals	5,242,729
Natural Stone	5,162,286

Table 4.4 Top Port of Houston Commodities (Inbound and Outbound)[45] *By Value, 2007*

Commodity Group	Tons
Petroleum and Petroleum Products	$56,022,782,081
Machinery	$18,569,727,647
Organic Chemicals	$13,957,805,373
Iron/Steel Products	$14,594,606,221
Plastic	$7,048,436,519

In addition, the Port of Houston handled nearly 1.8 million Twenty-foot Equivalent Units (TEU) in 2008.[46]

[44] Ibid.
[45] Ibid.
[46] AAPA North American Port Container Traffic 2008 http://aapa.files.cms-plus.com/Statistics/NORTHAMERICANPORTCONTAINERTRAFFIC2008.pdf.

Top Trade Partners

The top trade partners moving, inbound, and outbound, through the Port of Houston include Mexico, Saudi Arabia, China, Venezuela, Brazil, and Iraq. Tables 4.5 and 4.6 display the top trading partners and associated tonnage and value of trade.

Table 4.5 Top Port of Houston Trade Partners (Inbound and Outbound) [47]
By Tonnage, 2007

Country	Total Tons
Mexico	29,212,086
Saudi Arabia	9,982,395
Venezuela	9,973,897
Iraq	5,833,314
China	5,654,132

Table 4.6 Top Port of Houston Trade Partners (Inbound and Outbound) [48]
By Value 2007

Country	Total Value
Mexico	$15,817,117,293
Saudi Arabia	$7,781,944,986
China	$7,621,357,020
Venezuela	$7,570,517,491
Brazil	$7,194,269,949

Current/Ongoing Projects

The $1.4 billion Bayport container and cruise terminal, located in Pasadena, Texas, is planned for full build out, to 1,043 acres, by 2030. When fully developed, the terminal will

[47] Port of Houston Authority Website (http://www.portofhouston.com), accessed June 22, 2010.

[48] Ibid.

have a total of seven container berths with the capacity to handle 2.3 million TEUs on a complex which includes 376 acres of container yard and a 123-acre intermodal facility. Thus far the Port of Houston Authority has invested $400 million in the Bayport project.[49]

In June 2010 the Port Commission of the Port of Houston Authority authorized $2.7 million for the U.S. Army Corps of Engineers to perform dredging of the channels adjacent to the Port of Houston Authority's Turning Basin and Barbours Cut docks.[50]

Security

Security has been a major consideration in recent years and the Port of Houston has made major improvements to meet this challenge. As of 2008, the Port of Houston Authority had received a total of $38.6 million in Federal security grants that have been used as the primary funding sources for Port police services, contract security services, security-related infrastructure, and to make final infrastructure improvements prior to the launch of the Federally mandated Transportation Workers Identification Credential (TWIC) program. The Port's Security Management System (SMS) received international recognition in 2008 by becoming the first in the world designed and implemented by a port authority to be certified as compliant with International Organization for Standardization (ISO) 28000:2007.

Additional progress was also made towards the completion of the Houston Ship Channel Security District (HSCSD), a public-private partnership. The HSCSD will manage the maintenance and operations costs of security along the Houston Ship Channel, using approximately $4 million annually that will be funded by the port authority and private sector businesses on the ship channel. Security district members include East Harris County Manufacturers Association plant facilities, maritime company facilities regulated by Maritime Transportation Act, Port of Houston Authority, and Harris County.

Freeport

Port Freeport is located within the H-GAC MPO region, in Brazoria County, with access to the GIWW and the Gulf of Mexico via the three-mile long ship channel, which has a depth of 45 feet and a width of 400 feet.[51]

Governance

The Port Commission governs Port Freeport. The Commission's members are elected to six-year staggered terms by local residents.[52]

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[49] Ibid.

[50] Ibid.

[51] Port Freeport Website (http://www.portfreeport.com/stats.htm), accessed July 6, 2010.

Number of Berths, Maximum Length, and Depth at Berth

The Port has 14-operating berths (both public and private docks). The maximum berth depth is 70 feet.[53]

Highway and Rail Infrastructure Serving the Port

The Port is served by State Highways 288 and 36 and is served by the Union Pacific Railroad.[54]

Top Commodities Moving through the Port

The top commodities, shown in Table 4.7, include aggregates, chemicals, clothing, and paper goods.

Table 4.7 Top Port Freeport Commodities by Tonnage[55]

Import	Export
Aggregate	Autos
Chemicals	Chemicals
Clothing	Clothing
Crude Petroleum	Foods
Foods	Paper Goods
Paper Goods	Resins
Resins	Rice
Windmills	-

[52] Port Freeport Website (http://www.portfreeport.com/stats.htm), accessed July 6, 2010.

[53] Ibid.

[54] Ibid.

[55] Ibid.

Top Trade Partners

Port Freeport's top overseas import origins and export destinations are shown in Table 4.8. Top trading partners are primarily located in Central and South America and are driven in part by the coffee trade.

Table 4.8 Top Port Freeport Trade Partners[56]

Import Countries	Export Countries
Brazil	Brazil
Columbia	Columbia
Costa Rica	Costa Rica
Guatemala	Cuba
Honduras	Dominican Republic
India	Honduras
Mexico	Nigeria
	Saudi Arabia

Current/Ongoing Projects

The initial phase of the new Velasco Container Terminal is on track to be completed in mid-2010, giving the port its first 800-foot long berth and 20 acres of backland.[57] Once the terminal is completed it will have a total of 2,400-feet of berthing space and more than 90 acres of backland.[58]

Future expansion plans

The Port is in the process of completing a feasibility study on a $300 million project to widen and increase the depth of the Port's channel from 45 to 55 feet.[59]

[56] Ibid.

[57] 2009 Annual Report, Port Freeport (portfreeport.com)

[58] Ibid.

[59] Ibid.

On the landside, the Port is moving toward the engineering and design phase of a maximum-efficiency truck queuing area, grade separating the Texas Highway 36 – Farm Road 1495 intersection, and the development of a new multimodal facility on parcel 14, south of Highway 36.

The elevation of the Texas Highway 36 – Farm Road 1495 intersection will allow the seamless passage of trucks between the queuing area, the Port's future intermodal yard and other key locations, and will allow the unimpeded movement of double-stack container trains.

The initial phase of developing the new multimodal facility consists of leveling the parcels for the future construction of warehouses and rail facilities.

Port of Galveston

The Port's facilities are located alongside the GIWW on the north side of Galveston Island, at the entrance to Galveston Bay, with additional property and facilities located on adjacent Pelican Island. The Port is 9.3 miles (30-minutes sailing time) from the open sea.[60]

The Galveston Channel, which links the port to the Gulf of Mexico, is 1,200 feet wide at its narrowest point and has an authorized maximum depth of 40 feet.[61]

Governance

The Port of Galveston was purchased by the City in 1940 and is managed by the Board of Trustees of the Galveston Wharves with the goal of maximizing the economic benefit of the Port for the City and local area.

Number of Berths, Maximum Length and Depth at Berth

The port has approximately 12 berthing spaces. Maximum berth length is 1,509 feet and maximum depth at berth is 40 feet.

Highway and Rail Infrastructure Serving the Port

The Port has easy access to Interstate 45 as well as to both BNSF and Union Pacific railroads via the Terminal Railway, operated by Galveston Railway L.P.

Top Commodities Moving through the Port

The top export commodities from the port include bulk grains, containers, machinery, vehicles, liner board and paper, carbon black, and light fuels.[62]

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[60] Port of Galveston website (http://www.portofgalveston.com), accessed July 7, 2010.

[61] Ibid.

Top Trade Partners

International trade partners of the port include Mexico, Guatemala, Panama, Columbia, Venezuela, Brazil, Dominican Republic, Spain, Italy, Egypt, Israel, Turkey, Bulgaria, Belgium, England, Germany, Saudi Arabia, United Arab Emirates, Kuwait, Singapore and China.[63]

Current/Ongoing Projects

There currently are projects underway at the Port of Galveston to increase rail capacity, deepen Galveston Channel, and develop a master development plan for the Pelican Island Container Terminal.[64] Other projects to relocate tenants, install lighting, demolish buildings, and make other improvements are also underway.

The rail expansion project will add additional BNSF railroad tracks on the Port property leased to ADM, in order to support increased corn and grain shipments and improve shuttle turnaround time.[65]

The deepening of the Galveston Channel is taking place in two phases. The first phase of the project is maintenance dredging, which is being done in order to return the Federal channel to its currently authorized 40 foot depth.[66] The first part of the second phase will deepen the channel to 45 feet from the Channel entrance to the vicinity of the Pier 38 slip.[67] Currently a study is underway to evaluate whether extending the 45 foot channel to the Pelican Island Bridge is justified.[68]

Funding Sources

The rail expansion project is being funded by ADM, as it is aimed at speeding their grain shipments.[69]

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[62] Texas Ports 2007 – 2008 Capital Program, Texas Department of Transportation as cited in *Guide to the Economic Value of Texas Ports* (2008) Center for Transportation Research, University of Texas-Austin.

[63] *Guide to the Economic Value of Texas Ports* (2008) Center for Transportation Research, University of Texas-Austin.

[64] *Port E-News* (September 9, 2009), Port of Galveston.

[65] Ibid.

[66] Ibid.

[67] Ibid.

[68] Ibid.

[69] Ibid.

USACE identified funding for the Galveston Harbor Channel maintenance dredging in the areas scheduled to be deepened to 45 feet. In April 2009, the Port was awarded $40 million from the American Recovery and Reinvestment Act (ARRA), $14 million of which was designated for the USACE Operations and Maintenance Program to return the entire Channel to its authorized 40 foot depth.[70] The project to deepen the Channel to 45 feet is being completed in two parts: the first, dredging from the entrance to the Channel to near the Yacht Basin, is under contract for $12.95 million, of which the Port is paying a share of $3.35 million.[71] The second phase, which will extend the 45-foot Channel to the vicinity of the Pier 38 slip, will be funded with $25.1 million in CG (Construction General) funds that were part of the Port's $40 million in ARRA funding.[72]

Future Expansion Plans

On Pelican Island, the Port of Galveston is working with the Port of Houston to create a master development plan for a container facility that would serve both ports.[73]

Texas City

The Port is located on Galveston Bay in Galveston County, with easy access to the GIWW, the Gulf of Mexico, and the Houston Ship Channel.

Governance

The Port and the Terminal Railway Company are privately owned and is controlled by their stockholders, Union Pacific Railroad and BNSF Railway.[74]

Highway and Rail Infrastructure Serving the Port

The Terminal Railway Company provides daily connections from the Port to the UPRR and BNSF mainlines. The Terminal Railway Company maintains 32 miles of track and operates three MP1500-horsepower EMD locomotives. [75]

Top Commodities Moving through the Port

Key Commodities passing through the Port include crude petroleum oil and refined petroleum products.[76]

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[70] Ibid.

[71] Ibid.

[72] Ibid.

[73] Ibid.

[74] Port of Texas City website (http://railporttc.com), accessed July 6, 2010.

[75] Port of Texas City website (railporttc.com), accessed July 6, 2010.

4.4 Challenges

While the H-GAC port and waterway system currently provides sufficient access to regional, statewide, national, and global markets, physical and operational chokepoints may prevent this system from effectively absorbing future growth in freight traffic and may lead to other economic, social, and environmental impacts.

Landside Chokepoints

Efficient landside access is a key factor in port competitiveness particularly in the heavily populated H-GAC region. However, the H-GAC port and waterway system is being impacted by three key landside issues: traffic growth along major trade corridors, lack of high-capacity port-access routes, and limited-rail access.

Trade Corridor Volumes

Ports and waterways in the H-GAC region are being impacted by highway bottlenecks at both the regional and local levels. Major highway-trade corridors in the region, including those directly serving major port facilities, already suffer from significant freight bottlenecks.

Truck volumes are expected to grow significantly along the major trade corridors serving the Houston-Galveston Area's port and waterway system, particularly the I-10 and the proposed I-69 corridors, both of which are Federally designated "Corridors of the Future." Volumes along Interstate 10, which runs across the entire State of Texas, could rise to an average 85,000 average daily traffic (ADT) and 20,000 average daily truck traffic (ADTT) by 2035.

Continued traffic growth – particularly truck traffic growth – along these corridors will make it difficult for ports in the H-GAC region to access more distant markets and may also drive up costs for shippers, carriers, and ultimately consumers. The ability to efficiently reach the hinterland markets via truck will be critical to continued service to the greater Texas market, as well as expansion of the region's role as a gateway for the increase in Panama Canal trade.

Limited Port Access

At some of the Houston-Galveston area's largest ports, access roads often are not physically capable of efficiently serving large volumes of truck traffic, and many suffer from heavy traffic congestion, inadequate clearances, poor turning radii, and substandard pavement conditions.

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[76]Guide to the Economic Value of Texas Ports (2008) Center for Transportation Research, University of Texas-Austin.

Many of the access routes used most heavily by the Ports of Houston, Freeport, and Galveston are lower-capacity roadways which may not be sufficient to handle larger volumes of truck traffic and may limit the ability of these ports to attract new business. For instance, Port Freeport is served by State Highway 288 (which provides access to the Houston metropolitan area and I-10) and State Highway 36 (which provides access to U.S. 59 and points south and west). Large segments of these corridors are low capacity (fewer than six lanes) with few access controls, which can reduce overall efficiency for movements into and out of the Port. This type of access may not efficiently support future growth at the Port, as full build-out of the Port's Velasco Terminal is expected to result in total annual capacity of 800,000 to one million TEUs.

Table 4.9 describes existing port access routes and capacity concerns identified by port and waterway stakeholders in the H-GAC region.

Table 4.9 Issues and Concerns of Port Access Routes

Port	Access Route	Key Issues
Freeport	FM 523	Poor pavement condition, limited capacity for trucks
	SH 36	Lack of access controls in many segments
	SH 288	Low capacity, lack of access controls in some segments
Houston	Jacintoport Blvd	Limited capacity, lack of median and shoulders
	Spencer Hwy and Red Bluff Road	Poor pavement condition, low-bridge clearances along some segments, lack of access controls, poor turning radii
	SH 146	Poor pavement condition, congestion issues, grade crossings
	SH 225	Poor connectivity (I-610, Beltway 8), safety issues
Texas City	Loop 197	Limited capacity, access control, poor geometrics for truck traffic

Limited Rail Access

H-GAC ports and waterways will similarly be impacted by a combination of national and local rail bottlenecks. Without additional investment, the national freight rail system is expected to be at or near capacity within 20 years.[77]

These capacity constraints will make it difficult for ports to access the national rail system, contribute to delays on the system, and hinder the ability of the Region's ports to handle

[77] Association of American Railroads National Rail Freight Infrastructure Capacity and Investment Study.

increased volumes. Exacerbating these issues are local rail bottlenecks that are hindering efficient movements into and out of Houston metro port facilities. Critical rail access issues include:[78]

- **Grade Crossings –** Safety at rail grade crossings is a major issue for the greater Houston area and several crossings have been identified as "hot spots" for auto-train collisions. As discussed in Chapter 3, there are more than 1,200 at-grade crossings throughout the region, including several on port access roads for all the Region's port facilities.

- **Sidings –** Longer and heavier trains also are being used by the railroads to maximize existing capacity and improve efficiency. For example, the BNSF prefers that all their international intermodal shipments be handled in 40-foot well cars and all their intermodal trains be 8,000 feet in length. These changes will allow the BNSF to increase the amount of freight that can be handled over its mainlines without increasing the number of trains. However, the longer trains cannot be handled without lengthening sidings to permit trains to meet and pass; and without providing the corresponding yard capacity to assemble and hold the longer trains.

- **Rail Yard Capacity –** Increasing amounts of freight are straining capacity at rail yards. For instance, more than 95 percent of all freight trains moving in the Houston region must stop to pick-up or drop-off cars. This leads to rail-yard capacity constraints as discussed in Chapter 3.

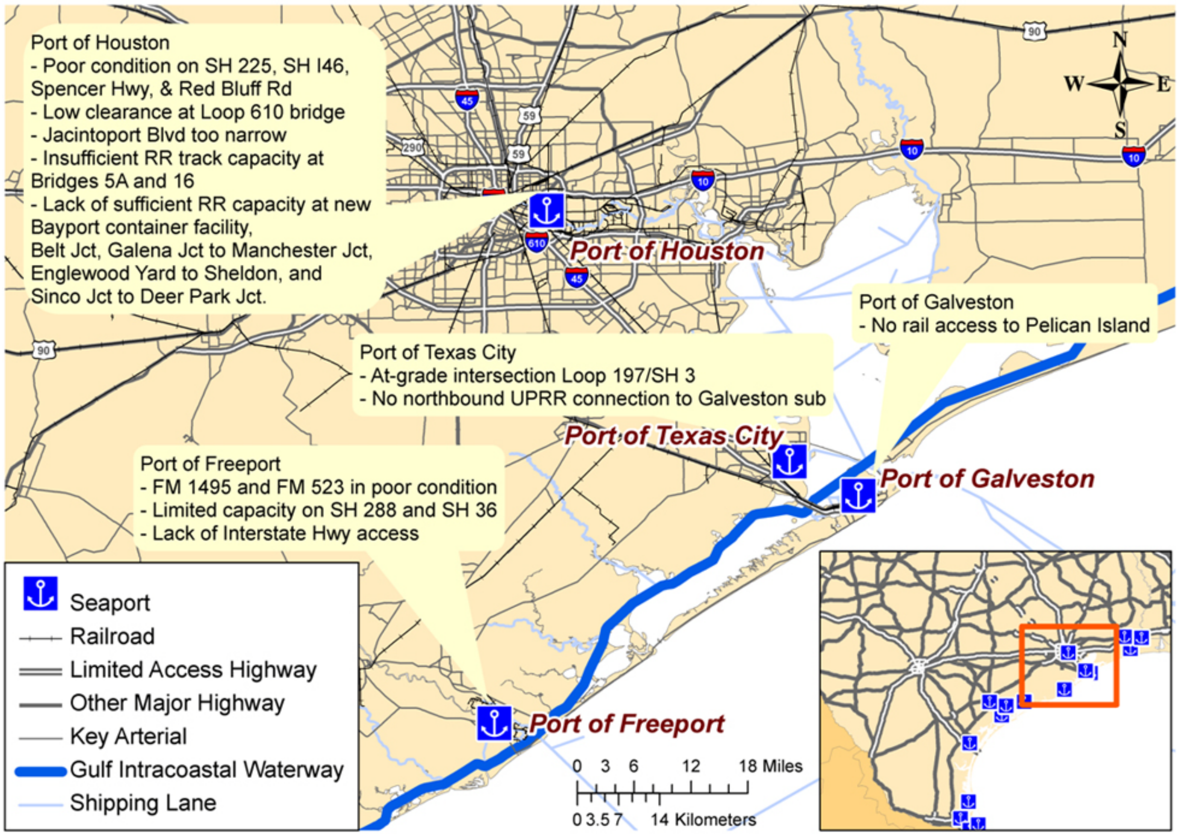
Figure 4.3 summarizes the most critical landside access issues (both rail and highway access) affecting H-GAC waterborne freight system, which were identified by a combination of quantitative analysis of freight demand and expected capacity, as well as interviews with regional port and waterway stakeholders.

Waterside Chokepoints

On the waterside, the H-GAC waterway system is generally considered reliable but faces increasing challenges as the system ages and dredging becomes more expensive. Critical waterside chokepoints include aging locks, channel depths, and span widths and clearance issues.

[78] Detailed rail bottleneck information can be found in the TxDOT Houston Region Freight Rail Study (http://www.txdot.gov/project_information/projects/houston/railway/default.htm), and the Corpus Christi-Yoakum Regional Freight Rail Study.

Figure 4.3 Landside Chokepoints
Houston-Galveston Area



Source: Texas Waterborne Freight Corridor Study, TxDOT (2010) combined with information gleaned from stakeholder interviews.

Aging Locks

The Brazos River Floodgates southwest of Port Freeport are of particular concern, as barge tows must be broken up and tripped through separately and reassembled on the other side because they exceed the 75-foot width of the locks. This process adds a great deal of time and expense to barge shipments using the waterway.

In addition, the Brazos Floodgates present a serious safety hazard with vessels entering the GIWW via the western floodgates pushed underwater by strong currents in the

location, which is believed to be a result of sedimentation at the mouth of the San Bernard River,[79] as shown in Figure 4.4.

Figure 4.4 Hazardous Condition at Brazos River Floodgates

Source: Texas DOT, GIWW Legislative Report, 2007.

Channel Depths and Widths

The GIWW, along with its tributaries, require some degree of maintenance, similar to periodic road repairs. Over time, the depths and dimensions of navigable waterways can change due to the action of wind, waves, currents, and rain that causes the bottom of the waterway system to be filled with sediments storms, and maintenance dredging is needed to restore the appropriate dimensions. Additionally, as the dimensions of vessels used in marine transportation change over time, the standards for the dimensions of navigable waterways must be upgraded.

Failure to maintain channel depths can have a number of impacts, including reductions in overall capacity, safety, operational, and efficiency concerns related to passing restrictions, and even modal shifts that could result in reduced capacity along parallel highway or rail corridors. In the best case, waterway segments are passable but restricted to shallower-draft vessels carrying reduced loads, or to barge tows of limited size; in the worst case, waterway segments become unusable for their intended purpose.

Channel deepening and dredging needs have been cited by several ports, including the Ports of Freeport, Galveston, and Houston. The new generation of containerships, including

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[79] Gulf Intracoastal Waterway – Legislative Report to the 81st Legislature (2008) Texas Department of Transportation.

many of the post-Panamax ships that will be attracted to the expanded Panama Canal, typically require channel depths of at least 50 feet, particularly for fully loaded vessels. Few Texas ports currently have the ability to handle ships of that depth. Although at 45 feet, the Port of Houston has one of the deeper channels among Gulf Coast ports, it still lags behind several of its major East Coast competitors for containerized traffic, including the Port of New York/New Jersey, which has plans to increase its depth to 50 feet, and the Port of Hampton Roads (Virginia), whose channel already is at a depth of 50 feet.

Width limitations are also a concern along the GIWW. While the base width of the navigable channel in the GIWW is 125 feet at a depth of 12 feet, barges are authorized to travel at a width of 108 feet. When barges must pass each other, they must utilize the waters outside of the authorized channel. In some cases, barges operate on the bank of the channel to provide enough space for the pass to be made. The Freeport Wiggles in the Houston area is one such example, where barge tows are hindered by one-way traffic and the many curves that necessitate slow speeds.

Adding in the use of the waterway by fishermen and recreational users, there is constant activity and/or conflicts occurring outside the authorized channel. These factors have led many to believe that the current dimensions of the GIWW and its associated structures do not adequately support modern barge transportation needs.

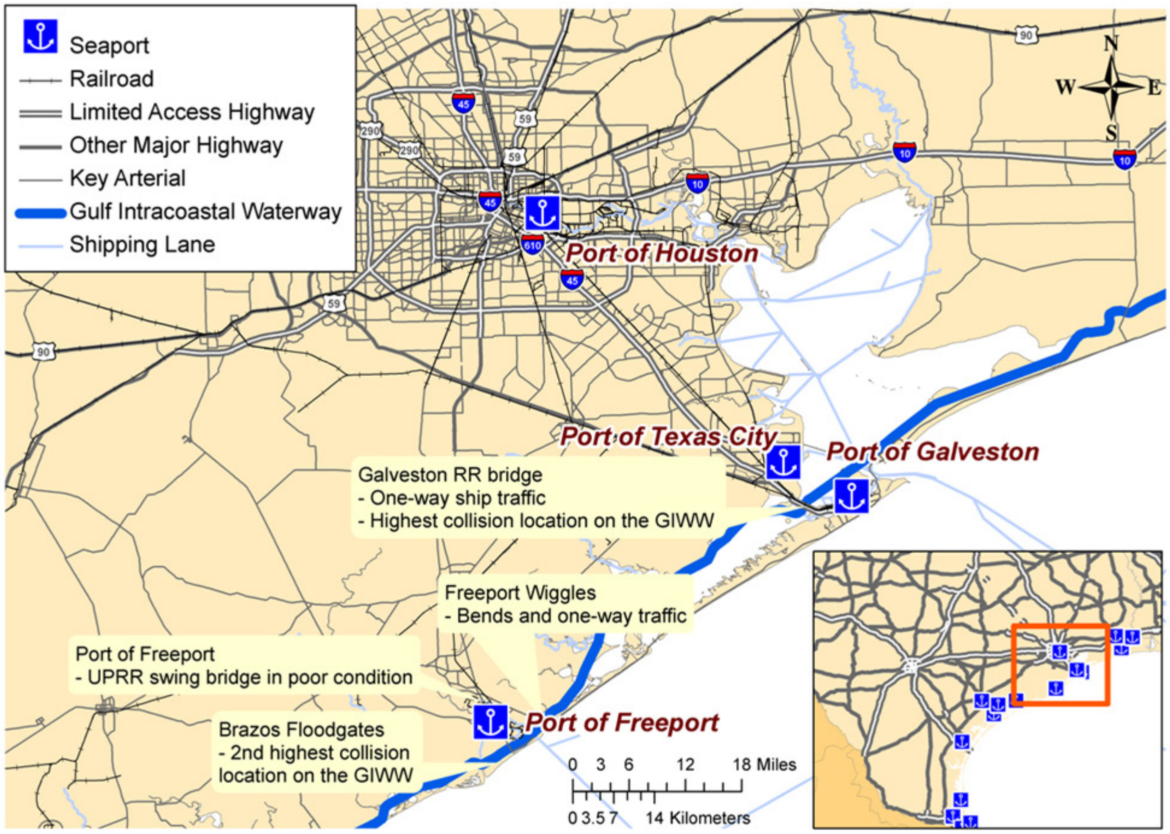
Span Widths, Height, Alignment, and Clearance

The Galveston Railroad Bridge is another serious chokepoint for barge shipments moving on the GIWW in the H-GAC region. The 105-foot opening through which barge traffic must pass under the bridge has been identified by the towing industry as the greatest navigation hazard along the entire length of the GIWW.[80]

Figure 4.5 illustrates the major waterside chokepoints affecting waterborne freight movements in the Houston-Galveston area.

[80] Ibid.

Figure 4.5 Waterside Chokepoints
Houston-Galveston Area



Source: Texas Waterborne Freight Corridor Study, TxDOT, prepared by Cambridge Systematics, 2010.

Institutional Issues and Constraints Impeding Capacity Enhancement

The anticipated growth in freight activity at the Region's ports and along the State's waterway system is encouraging many port and waterway stakeholders to undertake significant capacity enhancement, maintenance, and operational improvement projects. More than $65 million in Federal funding was spent by the U.S. Army Corps of Engineers (USACE) during 2007 and 2008 on Federally contracted and funded projects to maintain the navigability of the Texas portion of the GIWW.[81] More than 5.5 million cubic yards of

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[81] Ibid.

sediment were dredged in four separate projects during 2007 and approximately 4.3 million cubic yards of sediment were dredged in 2008.[82]

In addition, the Ports of Freeport, Galveston, and Houston are undertaking major land development and expansion activities that are likely to affect waterborne trade and the regional economy.

Port and waterway stakeholders understand the importance of investing in the waterborne freight corridor system. However, the ability to quickly, effectively, and equitably enhance the overall capacity and efficiency of the system is hindered by a variety of institutional issues and constraints that combine to limit the ability of port and waterway stakeholders to add or enhance system capacity in a meaningful way.

Lack of Reliable Funding Sources

The waterborne transportation system faces a lack of reliable funding sources at both the Federal and state levels, as described below.

Federal Funding

Federal funding for the maritime transportation system comes from a combination of sources, including:

- *Inland Waterways Trust Fund*, which takes in revenues from a tax levied on diesel fuel used in inland waterborne commerce and distributes the funds to pay for up to half the cost of eligible inland waterway projects.

- *Harbor Maintenance Trust Fund*, an ad valorem tax levied on imports or moved domestically through Federally maintained channels and harbors and deposited into the Harbor Maintenance Trust Fund.[83]

- *Port security grants*, which provide funding to port areas for the protection of critical port infrastructure from terrorism. The Houston-Galveston Area is home to all three of Texas' Group 1 (highest risk) ports (Houston, Galveston, and Texas City), and one Group 2 port (Port Freeport).

However, fund disbursements from both the Inland Waterway and Harbor Maintenance Trust Funds require annual appropriations from Congress, which has not appropriated the full amount of the Harbor Maintenance Trust Fund for many years nor appropriated any funds from the Inland Waterway Trust Fund since the late 1980s.

[82] Ibid.

[83] The levy on exports was declared unconstitutional in 1988.

As a result, Federal expenditures on the waterway system have not been sufficient to fully address needs. In constant dollars, appropriations to the Army Corps for waterway improvements and maintenance have been declining since the mid-1970s. Over the same period, as the system has aged and demand has grown, USACE's estimated operations/maintenance and construction backlogs have grown to $772 million and $44 billion, respectively.[84]

The lack of a reliable Federal funding stream has caused the system to be increasingly dependent on appropriations from the Treasury's general fund, complicating project planning and programming since general fund surpluses fluctuate a great deal from year to year.

State Funding

TxDOT is the designated non-Federal sponsor of the GIWW in Texas. In this capacity, TxDOT coordinates with the USACE (the Federal sponsor) to provide all necessary lands, easements, relocations, and realignments required for new construction and regular maintenance of the GIWW. TxDOT also reviews dredge placement plans, environmental documents, and other technical documents provided by the Corps.

Recognizing this role, as well as the importance of the Texas port and waterway system to the statewide economy, in 2001 the Texas Legislature created the Port Access Account Fund, which is a line item in the general revenue fund that can be appropriated to TxDOT to fund port and waterway projects. However, to date the Legislature has not appropriated any money for the fund; therefore, the projects contained in the Port Capital Program represent unfunded needs. The most recent Port Capital Program for the 2009-2010 biennium identified 71 projects worth $546 million.[85]

Environmental and Security Mandates Increase Costs

There are a variety of state, Federal, and local agencies involved in the planning and approval of port and waterway improvements. Interlocking requirements for coordination among Federal, state, and local agencies, along with permit and environmental approvals, can significantly expand the time required to plan and implement projects, often driving up the cost of a project significantly. Although these reviews and approvals serve an essential function, the costs of the reviews themselves, in dollars, time to complete, and uncertainty, are substantial.

Expansion of freight facilities in existing locations also can create other serious environmental and environmental justice concerns, as these facilities are usually located in

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[84]Department of the Army Corps of Engineers, *Civil Works Strategic Plan FY 2004 to FY 2009*, March 2004.

[85]Texas Department of Transportation, *Texas Ports 2009-2010 Capital Program*.

environmentally sensitive waterfront or urban areas and access improvements may generate additional truck or rail trips in air quality nonattainment regions. Freight-related pollutants, and in particular NO_x, and particulates ($PM_{2.5}$), make it harder to attain health-based national, state, and regional air quality goals, and many goods movement sources are regulated Federally, not at the state level. The Houston-Galveston-Brazoria region is facing a Federal attainment date of 2019 for the eight-hour ozone standard and new diesel engine standards (for trucks, non-road equipment, locomotives, and maritime equipment) will be fully phased in by 2020.[86] The Port of Houston Authority is working with public and private stakeholders through its Clean Air Strategy Plan to reduce emissions from maritime- and goods movement-related industries.

Finally, through the creation of the Department of Homeland Security, the enactment of legislation such as the Marine Transportation Security Act (MTSA) and the publication of rules and regulations governing security of the nation's seaports and waterways, the Federal government has taken the lead in addressing the security of the nation's freight shipments. In many cases, however, the costs of these additional security requirements have trickled down to states, metropolitan areas, and port authorities who have been forced to hire additional police, fire, and rescue personnel, increase overtime hours for existing personnel, and make significant investments in security-related infrastructure and operational improvements, often at the expense of capacity enhancements.

Balancing Private Property Rights and Navigation Interests on the GIWW

Continued population growth in Texas, coupled with the increasing desirability of waterfront property, has led to a development boom of private property along navigable waterways. Marinas, residential developments, docks, piers and other shoreline modifications are occurring throughout the coastal regions of the State. As more projects are developed, safety issues are developing for navigation interests as the navigation channels become restricted and congested.

Although TxDOT has discussed this issue with the work groups of the Texas Coastal Management Program[87] and the USACE, the ability to control shoreline development along navigable waterways has been limited, and TxDOT itself has little or no power to control land uses or development activity in coastal areas, including land adjacent to ports or the GIWW. In addition to safety concerns at points where commercial and recreational traffic comingle, continued development along the GIWW may hinder efforts to increase freight capacity and absorb additional freight demand.

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[86] Houston-Galveston Area Council, Port of Houston Authority.

[87] The Coastal Management Program includes a forum for the coordination of Federal, state, and local programs and activities along the Gulf Coast.

5.0 Regional Pipeline System

5.1 Overview

Pipelines carry more than two thirds of all the crude oil and refined products in the United States. They are generally the most economical way to transport large quantities of oil, refined oil products, or natural gas over land. The Houston-Galveston region, where the heart of the U.S. oil industry is located, has a vast pipeline network. The numerous transportation activities in this region related to oil and natural gas collection and processing, demand an intricate pipeline network. Pipelines are important to the Regional Goods Movement Study because they have access points with other modes, including highways, and they carry large volumes of product that would have to travel via another mode in the absence of pipeline capacity.

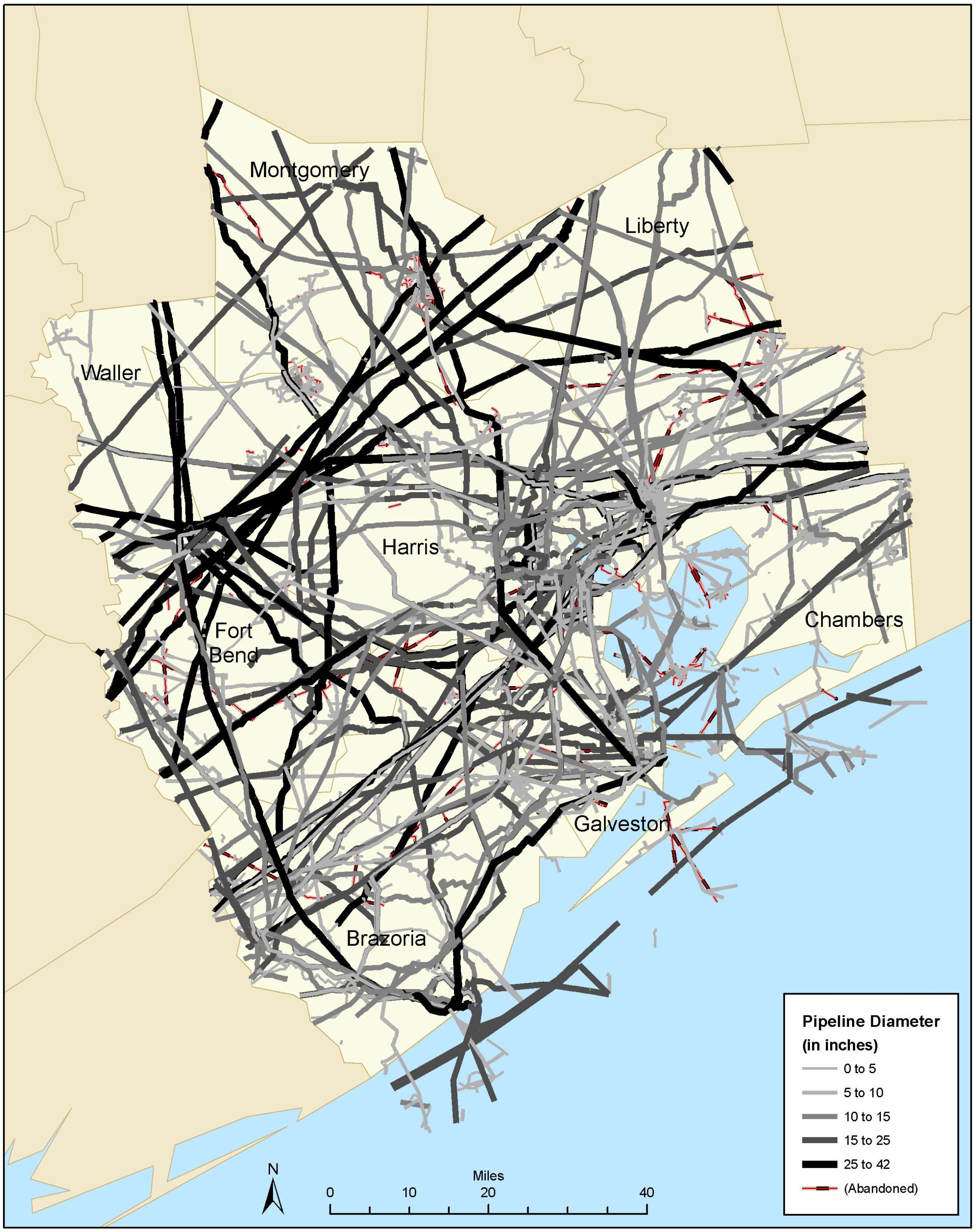
Sources of Information and Organization of Chapter

This section describes the physical and operational characteristics of the pipeline network of the H-GAC eight-county transportation region, as well as challenges. The data analyzed for this pipeline profile were taken from the H-GAC Pipeline GIS Layer, publicly available in the H-GAC web site. Remaining sections provide a summary of the inventory of pipelines, a discussion of pipeline types, traffic and operators, and a summary of challenges.

5.2 Pipeline Inventory

There are approximately 21,500 miles of product pipelines across the H-GAC eight-county transportation region (see Figure 5.1). About 6.6 percent of these pipelines are abandoned (1,418 pipeline miles) and the rest are in service carrying liquids and gases, such as crude oil, refined product, and natural gas. The pipeline sizes range from relatively small lines with less than 10 inches in diameter to very large lines with up to 42 inches in diameter. The diameter of a pipeline is the primary attribute determining capacity. Table 5.1 shows the range of pipeline sizes of the region and the corresponding mileage. About 11,635 pipeline miles (54 percent) are small pipelines with less than ten inches of diameter. Less than two percent of the network (377 pipeline miles) consists of very large pipelines more than 36 inches in diameter. The rest of the pipeline network (9,382 pipeline miles) ranges between ten and 30 inches in diameter.

Figure 5.1 H-GAC Pipeline Network



Source: H-GAC Pipeline GIS Data.

Table 5.1 Pipeline Diameters

Diameter (Inches)	Miles
0-5	3,561.54
5-10	8,074.39
10-14	4,549.90
16-20	2,239.46
22-30	2,593.07
36-42	377.21
Total	21,395.58

Source: H-GAC Pipeline GIS Data 2004. Accessed August 25, 2010.

5.3 Pipeline Type

Depending upon the use of the pipeline there are different line types. The types of pipeline systems include: gas gathering, gas transmission, carbon dioxide, crude gathering, crude transmission, product lines (not highly volatile), and other product lines (highly volatile). Table 5.2 shows the total mileage for each of these systems, including both in service and abandoned line mileage. Table 5.3 presents the system utilization percentages depending upon the pipeline mileage that is in service. About 35 percent (7,404 miles) of the H-GAC pipeline network is dedicated to gas transmission and eight percent (1,653 miles) dedicated to gas gathering; and about 168 miles of the gas transmission lines and 274 miles of the gas gathering lines are abandoned. This represents 98 percent utilization for the gas transmission system, and around 83 percent utilization for gas gathering.

There is roughly the same pipeline mileage (1,600 miles) dedicated to crude gathering as there is to crude transmission, each system representing about 7.5 percent of the total network. However, almost half of the crude gathering lines are not in service. The product lines (not highly volatile), which include pipelines carrying refined products and anhydrous ammonia, represent about 11 percent of the network. The other product lines (highly volatile) carrying highly volatile liquid, natural gas liquids, and liquid petroleum gas, are about 32 percent (6,734 miles) of the network. Both of the product line systems (i.e., not highly volatile and highly volatile) have approximately 98 percent utilization. Finally, the carbon dioxide system in the region is very small with only 2.1 miles of pipeline all in service. The presence of pipelines throughout the region has implications for land development due to restrictions and access.

Table 5.2 System Type
By Pipeline Status

	In Service		Abandoned		Both	
Pipeline System	**Miles**	**Percent**	**Miles**	**Percent**	**Miles**	**Percent**
Gas Gathering	1,379.30	6.45%	273.91	1.28%	1,653.20	7.73%
Gas Transmission	7,235.89	33.82%	167.58	0.78%	7,403.47	34.60%
Carbon Dioxide	2.12	0.01%	0	0%	2.12	0.01%
Crude Gathering	872.11	4.08%	728.68	3.41%	1,600.79	7.48%
Crude Transmission	1,524.03	7.12%	78.78	0.37%	1,602.82	7.49%
Product Lines (Not Highly Volatile)	2,335.18	10.91%	63.95	0.30%	2,399.13	11.21%
Other Product Lines (Highly Volatile)	6,628.87	30.98%	105.18	0.49%	6,734.06	31.47%
Total	**19,977.50**	**93.37%**	**1,418.08**	**6.63%**	**21,395.58**	**100%**

Source: H-GAC Pipeline GIS Data 2004. Accessed August 25, 2010.

Table 5.3 Pipeline System Utilization

Pipeline System	Utilization (Percent)
Gas Gathering	83.4%
Gas Transmission	97.7%
Carbon Dioxide	100%
Crude Gathering	54.5%
Crude Transmission	95.1%
Product Lines (Not Highly Volatile)	97.3%
Other Product Lines (Highly Volatile)	98.4%

Source: H-GAC Pipeline GIS Data 2004. Accessed August 25, 2010.

5.4 Pipeline Traffic

The pipeline system in the H-GAC region carried more than 445 million tons of goods in 2007. Goods traveling into the region represented 41 percent of the pipeline volumes while those traveling outbound from the region comprised the remaining 59 percent of pipeline volumes. The volume of good traveling via pipeline in the region is projected to grow by more than 20 percent to 540 million tons by 2035.[88]

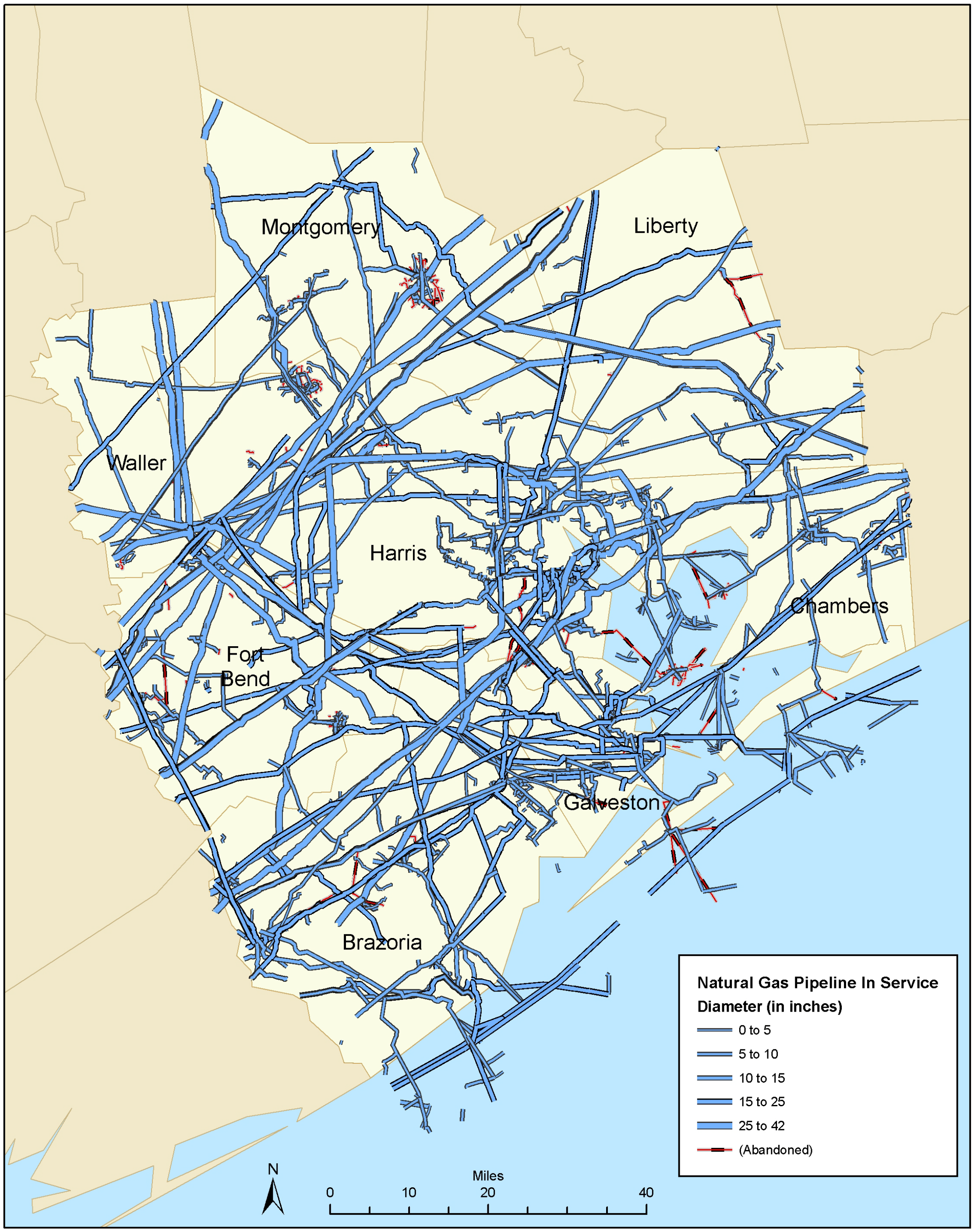
The key commodities transported in the H-GAC study area are:

- Anhydrous ammonia (AA);
- Carbon dioxide (CO_2);
- Crude oil (CRD);
- Hydrogen gas (HG);
- Highly volatile liquid (HVL) (e.g., propylene, ethylene, propane, ethane, and butane);
- Liquid petroleum gas (LPG);
- Natural gas (NG);
- Natural gas liquids (NGL); and
- Product (PRD) (e.g., refined petroleum products, petrochemicals, nitrogen, and carbon monoxide).

Even though pipelines can carry different commodities, there is usually a primary commodity which is transported. Figure 5.4 shows a chart with the distribution of the pipeline mileage by primary commodity carried. Natural gas is transported through roughly 39 percent of the network, highly volatile liquid is carried through 20 percent, crude oil uses 15 percent, and product is carried through 12 percent of the network. The rest of the commodities (i.e. natural gas liquids, liquid petroleum gas, hydrogen gas, anhydrous ammonia, and carbon dioxide) use less than 13 percent of the network; and there are 73.5 miles of pipeline that are mainly empty. The specific locations of the most significant types of pipelines are shown in Figure 5.2 to Figure 5.8. AA, CO2 and empty pipelines are minimal and confined to one specific geographic location in the region and thus not presented graphically.

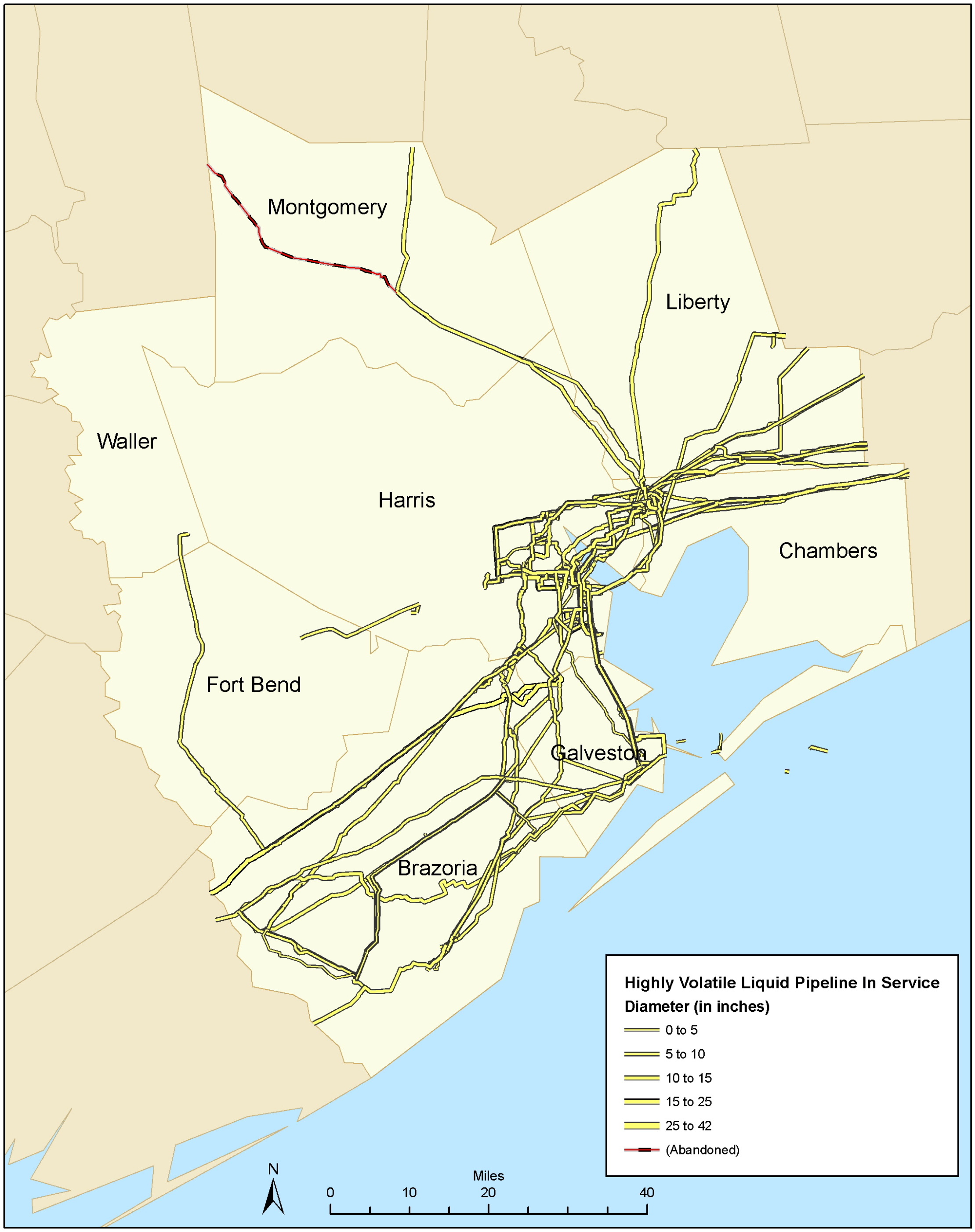
[88] Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework 3.

Figure 5.2 Natural Gas Pipelines – *Status and Size*



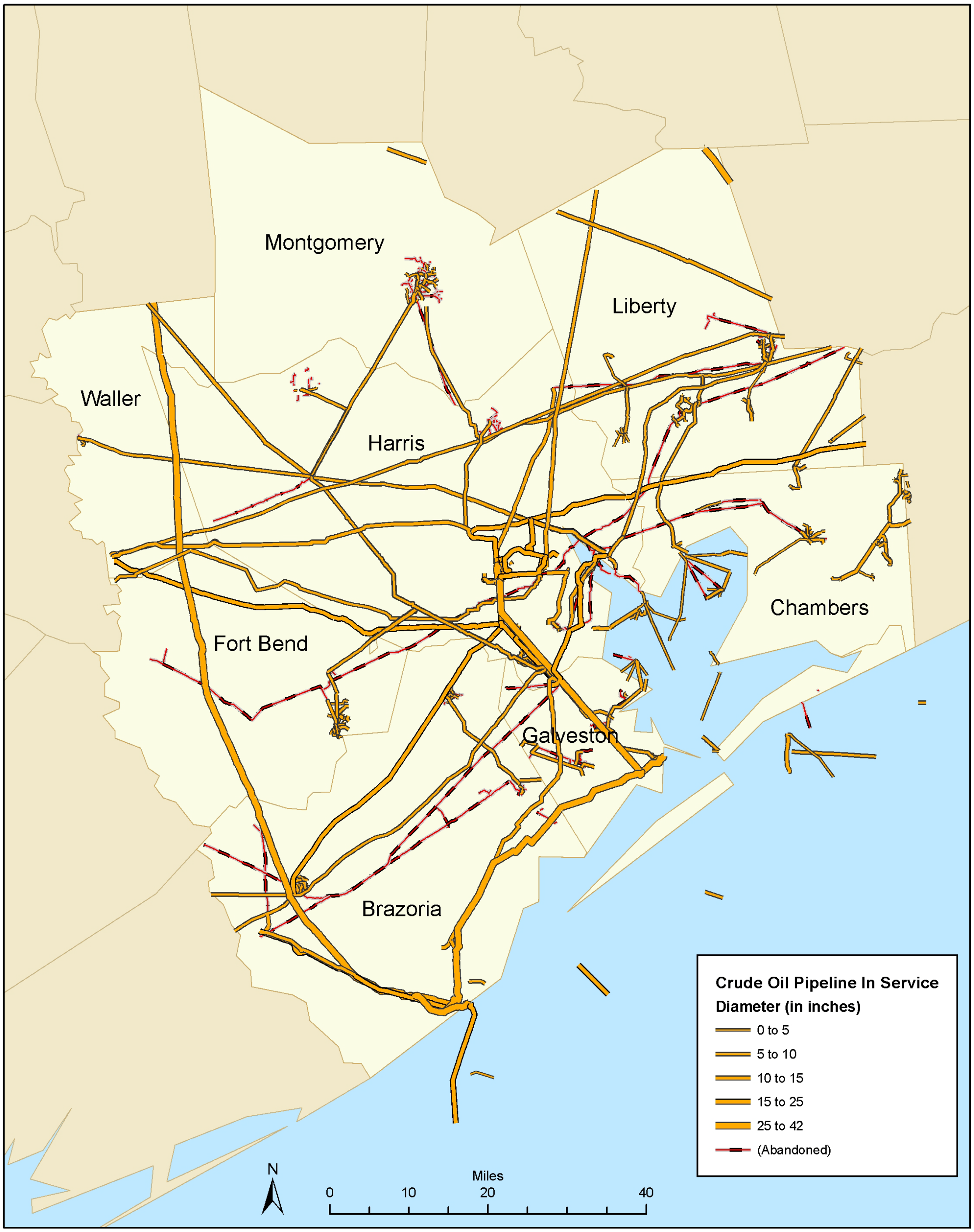
Source: H-GAC Pipeline GIS Data 2004.

Figure 5.3 Highly Volatile Liquid Pipelines – *Status and Size*



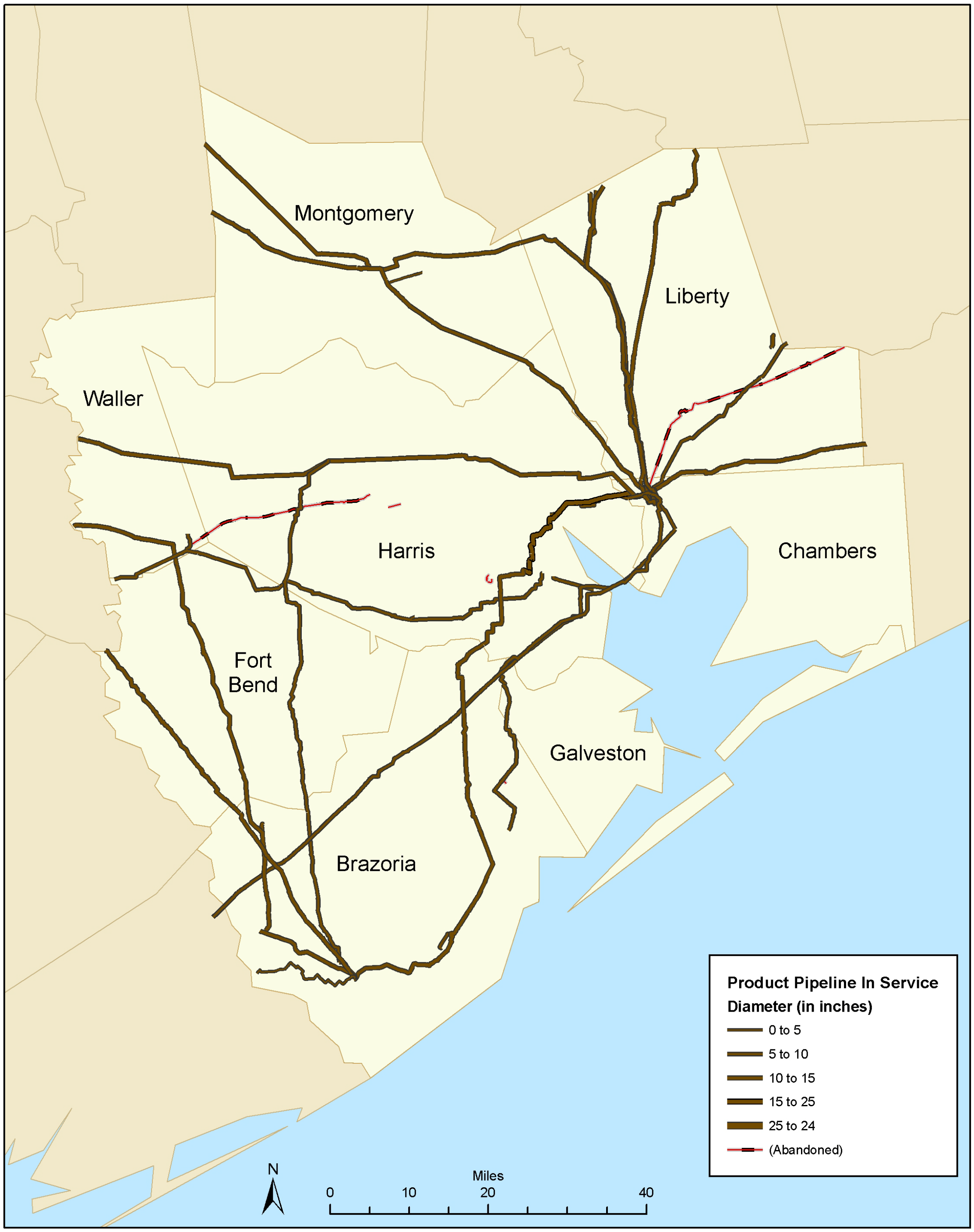
Source: H-GAC Pipeline GIS Data 2004.

Figure 5.4 Crude Oil Pipelines – *Status and Size*



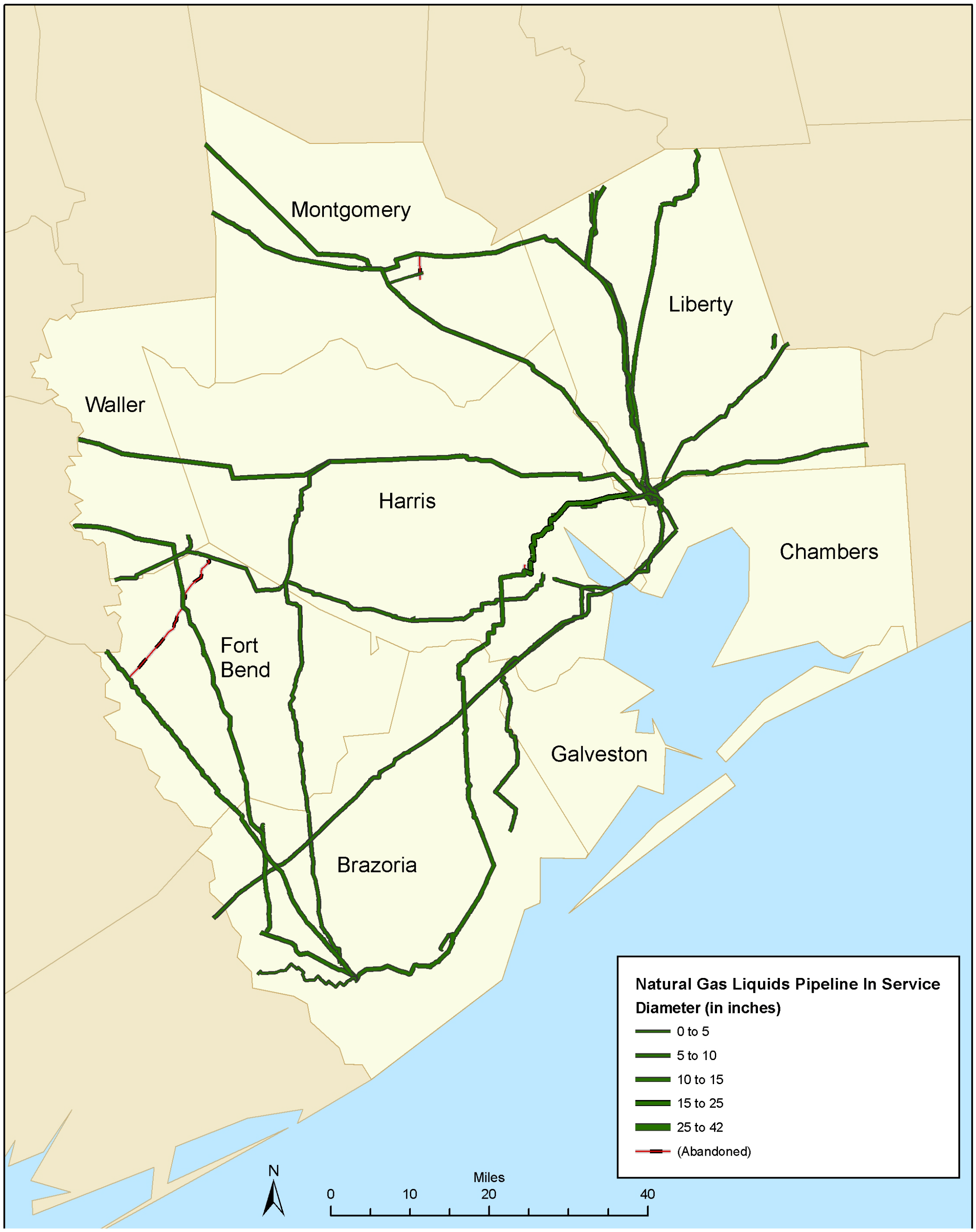
Source: H-GAC Pipeline GIS Data 2004.

Figure 5.5 Product Pipelines – *Status and Size*



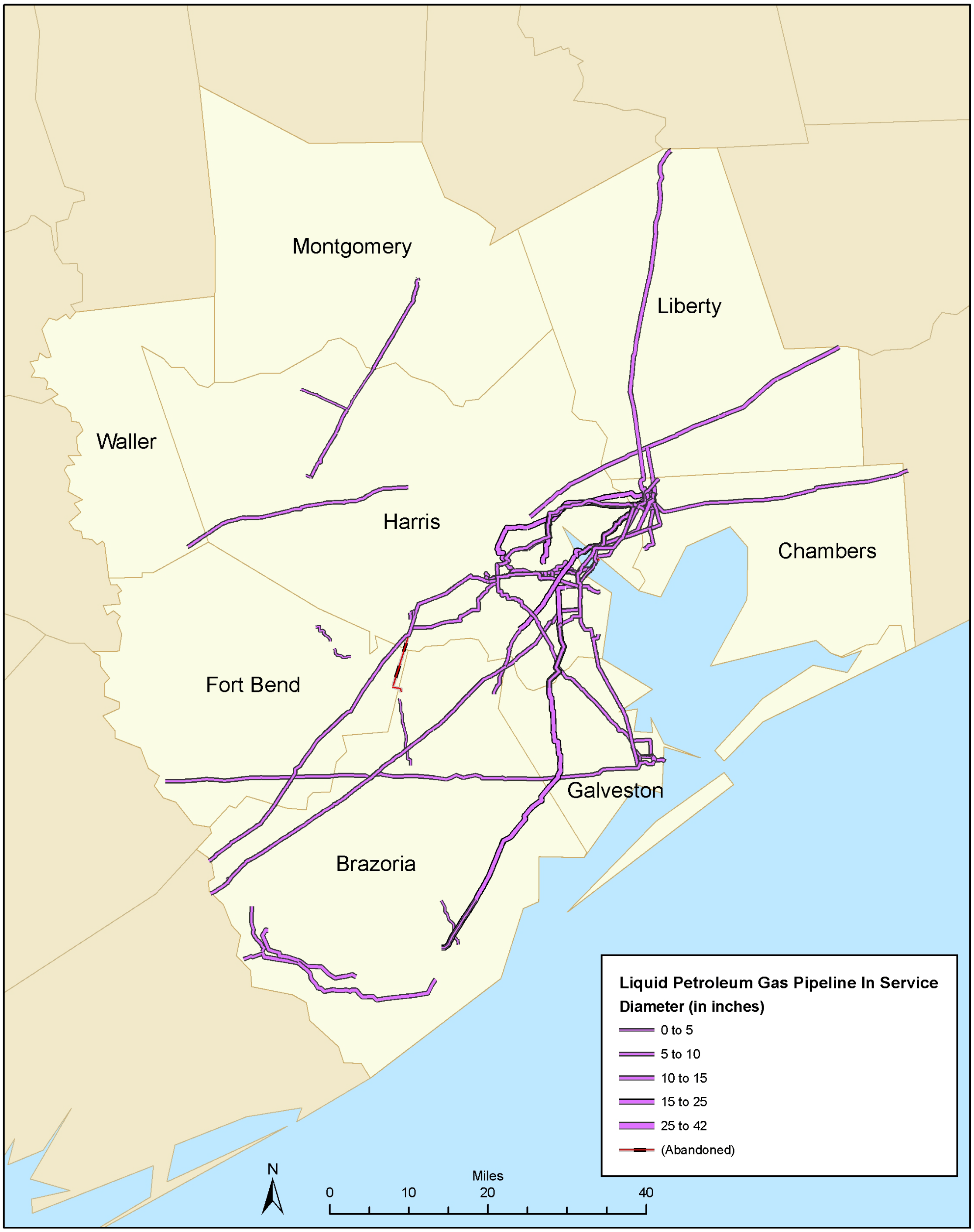
Source: H-GAC Pipeline GIS Data 2004.

Figure 5.6 Natural Gas Liquids Pipelines – *Status and Size*



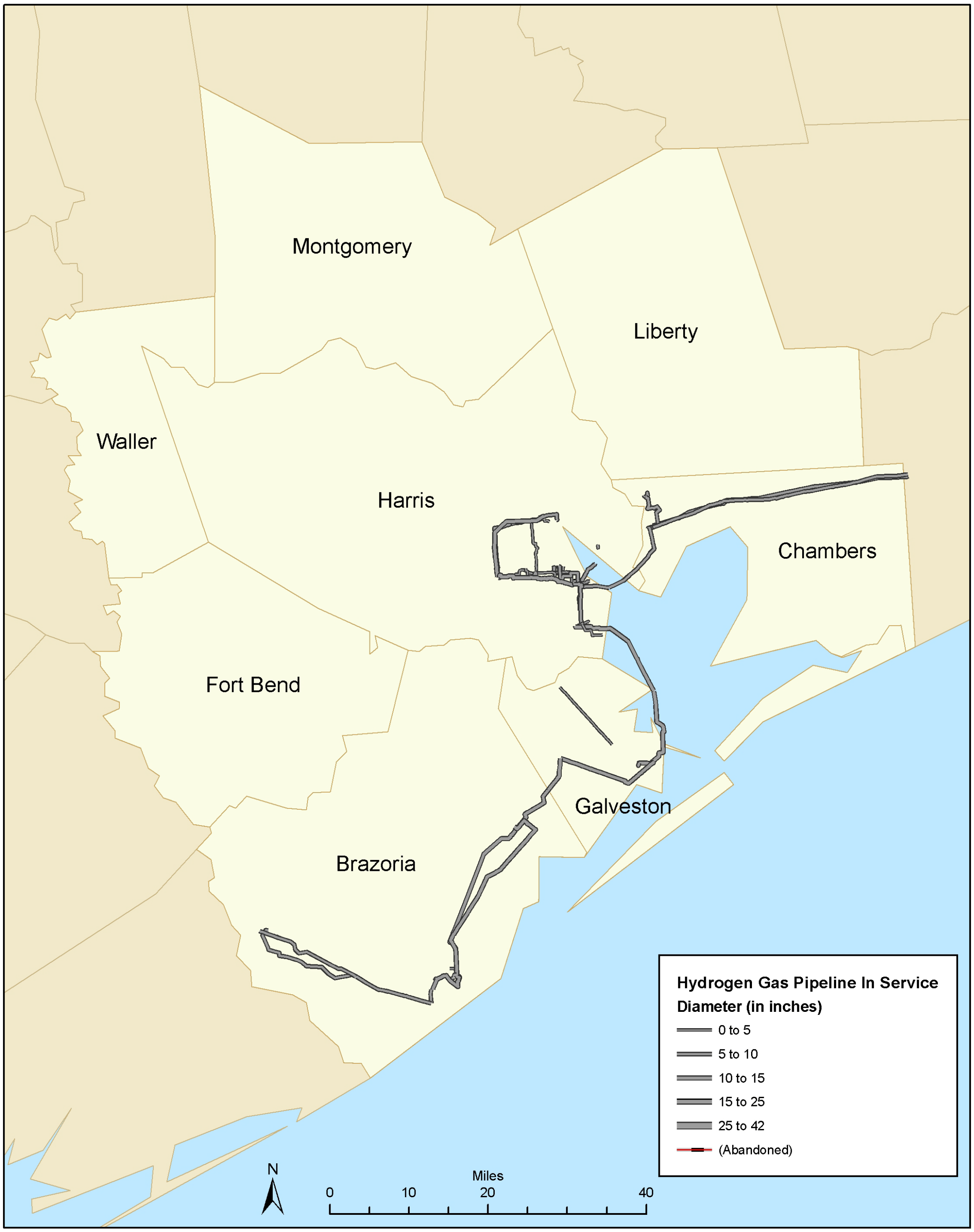
Source: H-GAC Pipeline GIS Data 2004.

Figure 5.7 Liquid Petroleum Gas Pipelines – *Status and Size*



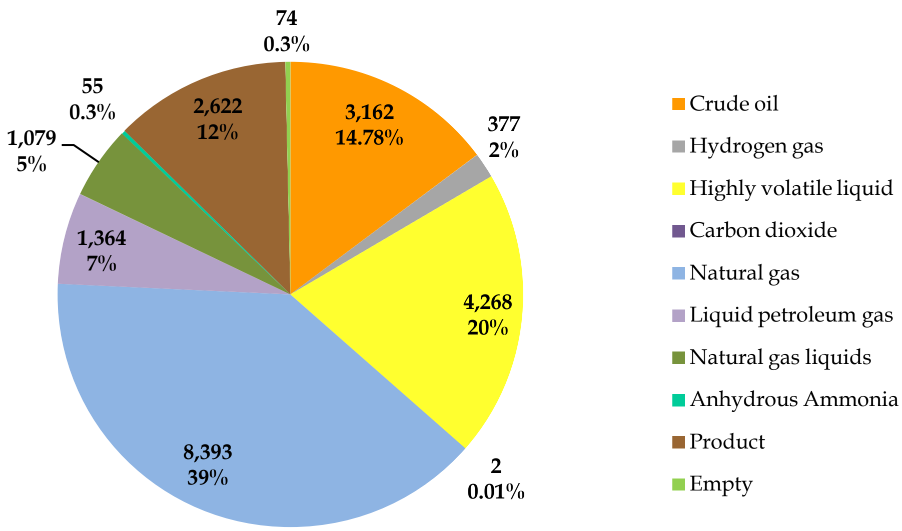
Source: H-GAC Pipeline GIS Data 2004.

Figure 5.8 Hydrogen Gas Pipelines – *Status and Size*



Source: H-GAC Pipeline GIS Data 2004.

Figure 5.9 Primary Commodities Carried
Miles and Percentages



Source: H-GAC Pipeline GIS Data 2004.

5.5 Pipeline Operators

The pipeline data from H-GAC listed about 300 pipeline operators in the region; however, a large number of these operators are subsidiaries or business units of major companies. Others no longer exist because of recent company acquisitions or mergers. An effort was made to consolidate all operators owned by the same company, as well as to update the operator names which over the last years have been acquired by other companies. Table 5.4 shows the major pipeline operators after the companies were consolidated and updated. They are sorted by pipeline mileage in descending order. Also shown are the primary commodities transported by operator. These 22 companies operate about 80 percent of the H-GAC eight-county pipeline network. These are some of the key highlights:

- Exxon Mobil Corporation operates about 2,530 miles (12 percent) of the network moving mainly highly volatile liquid, crude oil, product, natural gas, and liquid petroleum gas. Exxon Mobil operated 75 percent of the carbon dioxide pipeline system which corresponds to 1.6 miles of pipeline.

- Enterprise Products Partners (EPP) includes TEPPCO, which was acquired by Enterprise GP Holdings in 2007. EPP moves about 48 percent of the natural gas liquids pipelines (which corresponds to 513 miles). Additionally, EPP moves crude oil, liquid

petroleum gas, highly volatile liquid, and natural gas in its remaining 1,431 miles of pipeline.

- Kinder Morgan primarily transports natural gas (1,796 miles)
- Natural Gas Pipeline Company of America (NGPL) transports exclusively natural gas (392.7 miles). Kinder Morgan operates and owns a 20 percent interest in NGPL.
- ConocoPhillips operates about 1,377 miles of pipeline moving primarily highly volatile liquid, product, natural gas, and crude oil. Additionally, ConocoPhillips moves about 15 percent of the hydrogen gas along 55.8 miles of pipeline; and owns 65.3 miles of empty pipelines.
- Houston Pipe Line Company operates mainly natural gas pipelines (1,199.6 miles).
- Dow Chemical, through its subsidiaries (e.g., Dow Chemical Pipe Line Company, Seadrift Pipeline, and UCAR Pipeline), operates about 1,105 miles of pipeline, transporting primarily highly volatile liquid, natural gas, and liquid petroleum gas.
- Chevron pipelines primarily carry highly volatile liquid, liquid petroleum gas, crude oil, and product.
- LyondellBasell Industries includes: Lyondell Chemical Company, which in 2007 merged with Basell Polyolefins and created LyondellBasell; and Equistar Chemicals, a unit of Lyondell Chemical. LyondellBasell mainly moves highly volatile liquid (639 miles), and to a less extent product, natural gas liquids, and hydrogen gas.
- El Paso Corporation's Pipeline Group, through its subsidiaries, mostly moves natural gas and some liquid petroleum gas in its 775 miles natural gas.
- Buckeye Partners, transports highly volatile liquid, natural gas liquids, and product. Buckeye also operates half a mile of carbon dioxide pipelines, which represents 25 percent of the carbon dioxide pipeline system (Exxon Mobil operates the rest of the carbon dioxide pipelines).
- For the most part BP and Amoco transport product and highly volatile liquid. Additionally, BP transports anhydrous ammonia through 15.6 miles of pipeline; and it owns 8.3 miles of empty pipeline (ConocoPhillips operate the rest of the empty lines).
- Air Products carries hydrogen gas through 143 pipeline miles (38 percent of the hydrogen gas lines).

Table 5.4 Major Pipeline Operators

Pipeline Operator	Primary Commodity Carried	Miles	Percent
Exxon Mobil Corporation	HVL, CRD, PRD, LPG, NG, NGL, HG, CO_2	2,529.88	11.8%
Enterprise Products Partners	NGL, CRD, PRD, LPG, HVL, NG	1,944.43	9.1%
Kinder Morgan	NG, HVL, PRD, NGL	1,853.10	8.7%
ConocoPhillips	HVL, PRD, NG, CRD, NGL, HG, EMT, LPG	1,377.38	6.4%
Houston Pipe Line Company	NG, HVL	1,201.35	5.6%
Dow Chemical	HVL, NG, LPG, PRD, CRD	1,104.86	5.2%
Chevron	HVL, LPG, CRD, PRD, NG	1,061.74	5.0%
LyondellBasell Industries	HVL, PRD, NGL, HG, NG	841.47	3.9%
El Paso Corporation	NG, LPG, NGL	775.15	3.6%
Buckeye Partners	HVL, NGL, PRD, NG, HG, CO2	457.69	2.1%
Koch Pipeline Company	CRD, NGL, LPG, HVL	415.67	1.9%
Shell	CRD, HVL, PRD, NG	412.09	1.9%
Natural Gas Pipeline Company of America	NG	392.72	1.8%
Genesis Pipeline Texas	CRD	382.41	1.8%
BP	PRD, HVL, NG, AA, EMT	380.68	1.8%
Vintage Petroleum	NG, CRD	373.49	1.7%
San Jacinto Gas Transmission	NG	298.46	1.4%
Sunoco	CRD, NG	296.07	1.4%
Williams Companies	NG, PRD	260.25	1.2%
Valero	HVL, LPG, PRD, NGL, NG, CRD	257.73	1.2%
Texas Eastern Transmission	NG	208.61	1.0%
Air Products	HG, PRD	205.20	1.0%
Other	NG, CRD, HVL, PRD, NGL, HG, LPG, AA	4,365.14	20.4%
Total		**21,395.58**	**100%**

Source: Cambridge Systematics Inc analysis of H-GAC Pipeline GIS Data 2004.

5.6 Challenges

Pipelines are a critical part of the H-GAC region's freight transportation network. The ability to efficiently handle the growth in the petrochemical industry will depend on the ability to accommodate the future pipeline demand. Data on pipeline operations are limited and the fact that the infrastructure is privately owned makes it difficult to obtain detailed information. Therefore, a full assessment of challenges could not be conducted. However, based on data and information available, the primary challenges are ensuring adequate capacity and intermodal access to the pipeline terminals. While conducting a full capacity analysis is beyond the scope of the Regional Goods Movement Study, this report documents relatively high-utilization rates for the Region's existing system. This suggests that additional capacity may be needed to accommodate future growth. In addition, as many of the pipeline terminals are located in the already congested east side of the Houston area, truck access to the terminals suffers from congested facilities and numerous facilities with at-grade crossings and community conflicts.

6.0 Regional Air Cargo System

6.1 Introduction

Air freight is a small yet critical component of the Houston metropolitan region's freight transportation network. Overall, only 0.08 percent of all freight volume and 0.32 percent of total freight value moving to and from the region moves by air.[89] Although small in terms of value and volume, air freight provides expedited service for high-value shipments that many businesses and industries rely on to remain competitive. In turn, the Houston economy relies on air freight to serve time-sensitive industries that create jobs and income for residents in the region.

This chapter provides a profile of the current Houston air cargo system, goods movement by air, as well current issues. The document will focus on George Bush Intercontinental Airport (IAH), as the majority of air freight traffic in the Houston region occurs here.

Sources of Information

Several sources were used to prepare this regional air cargo profile. The primary sources include plans, several data sources, as well as responses from interviews. These include:

- *IAH Cargo Sector Plan*: This document presents detailed information about current and future air cargo details and issues at IAH. It is used to help describe current air cargo infrastructure, projected air cargo traffic, and other relevant data that help describe Houston's air cargo system.

- *TRANSEARCH Commodity Flow Data*: This dataset is used to provide information on inbound and outbound commodities by air cargo, both in terms of tonnage and value. This data is supplemented by data presented in the IAH Cargo Sector Plan and additional data provided by the Bureau of Transportation Statistics (BTS).

- *Department of Aviation Statistical Summary Reports*: These reports are found on the Houston Airport System (HAS) web site and provides detailed data on pounds of air freight shipped by carrier, by flight type, and by airport. These data were used in conjunction with TRANSEARCH data to provide information concerning freight demand in the region.

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[89] These calculations do not include pipeline volumes or value.

- *Interviews*: Interview results and information from airport officials were also incorporated into the report.

Chapter Organization

This air cargo profile begins with an overview of Houston area air freight demand, placing it in the national context as to how air freight serves the region currently and in the future. Analysis of current freight demand helps paint the freight picture at Houston airports. Section 3 provides detail on the current facilities that enable efficient air cargo movement into and out of the Houston region, as well as detail on landside infrastructure that facilitates freight movement out of IAH. Expansion plans are also discussed here. Finally, landside challenges that impact the effectiveness of goods movement into and out of airport facilities are discussed.

6.2 Air Freight Demand

Current Air Freight Demand

Houston's air cargo system is a significant hub in the national freight network, both in terms of exports and imports. More than 830 million pounds of air freight were handled by the Houston Airport System in Fiscal Year 2010. In addition, 82 million pounds of airmail was handled.

Table 6.1 summarizes air cargo activity by airport. In 2007, Houston aviation gateways were ranked sixteenth in terms of the value of freight moved by aviation gateways in the United States. When comparing Houston's aviation gateways to all gateways (including water ports and land border crossings), Houston's aviation gateways are ranked 55th in terms of value imported and exported (as a comparison, Houston's water ports were ranked fourth).[90] These numbers underscore the importance of Houston's air cargo system to industries in the region. It also highlights the importance of the system as an access point to Houston's large consumer base for businesses throughout the United States and abroad.

Table 6.1 Air Freight by Airport, Fiscal Year 2011 *(in Pounds)*

	IAH	Hobby	Ellington	Total
Air Freight	805.8	25.7	0.002	831.5

[90] Bureau of Transportation Statistics: http://www.bts.gov/publications/americas_freight_transportation_gateways/2009/appendix/html/table_appendix.html.

	IAH	Hobby	Ellington	Total
Airmail	81.6	0	0	81.6
Total	807.8	25.7	0.0002	832.5

Source: HAS Annual Statistics, Fiscal Year 2011.

Table 6.2 below provides a list of the air cargo providers serving IAH. The variety of international and domestic cargo operators highlights Houston's role as an integral part of the air cargo network.

Table 6.2 Cargo Airlines Serving the Houston Region

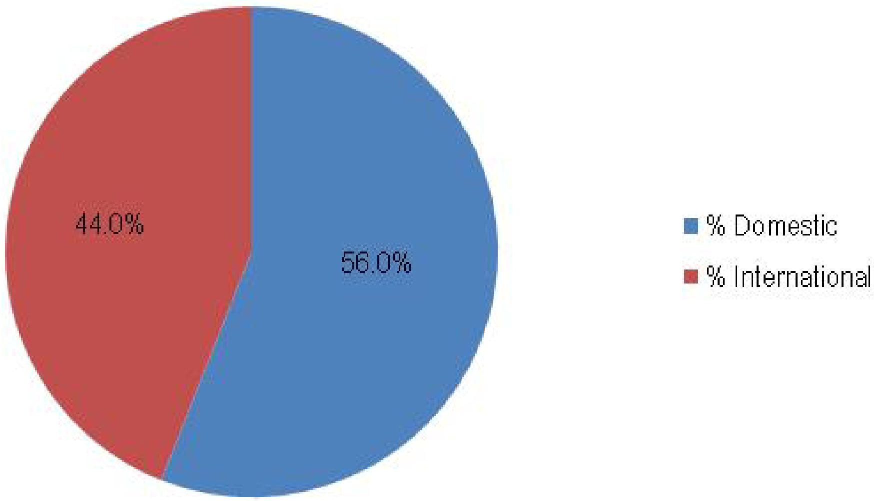
Air Bridge Cargo	Continental Cargo	Polar Air Cargo
AA Cargo	DHL/Airborne Express	Polet Air Company
Aeromexpress	Delta Airlines Cargo	Qatar Airways Cargo
Air Canada Cargo	Emirates SkyCargo	Saudi Arabian Airlines
Air France Cargo	Eva Air Cargo	Singapore Airlines Cargo
Alitalia Cargo	FedEx	Southwest Airlines Cargo
America West Cargo	Frontier Cargo	Scandinavian Airlines
Arrow Air Cargo	Japan Airlines	Taca Cargo
Antonov Airlines	KLM Cargo	U.S. Airways
BAX Global	Lan Chile Cargo	U.S. Postal Service
British Airways Cargo	Lufthansa Cargo	UPS
Cargolux	Martinair Cargo	United Cargo
Cathay Pacific Cargo	Menlo Worldwide	Volga Dnepr
China Airlines Cargo	Northwest Cargo	World Airways Cargo

Source: Houston Airport System Web Site, September 16, 2010.

Freight Demand – International and Domestic Air Freight

As shown in Figure 6.1 below, a significant percentage of all air freight is international traffic – approximately 44 percent of all freight tons at Houston airports were international movements.

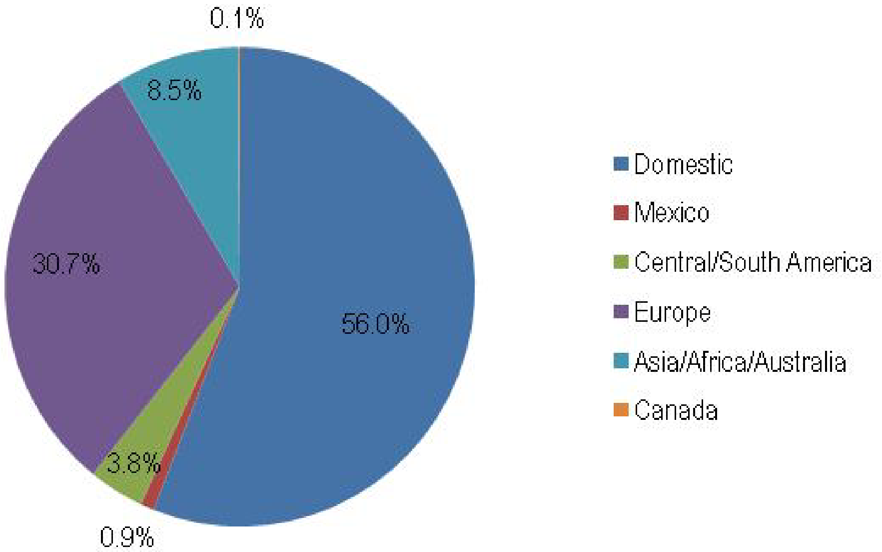
Figure 6.1 Houston International and Domestic Air Freight
2007



Source: Yearend Report – 2007 Statistical Summary prepared by the Department of Aviation.

International shipments, especially from Asia/Africa/Australia (AAA) region, continue to grow. Between 2005 and 2007 alone, the volume of goods moved between Houston and the AAA region has grown approximately 76 percent. Increasing trade with China and other Asian countries is the driver behind this growth in demand for trade. Europe, however, makes up the highest percentage of total international freight trade – nearly 31 percent of freight moved through Houston is arriving from or moving to Europe. Figure 6.2 below highlights the breakdown of trade between Houston and various international regions.

Figure 6.2 International Air Freight Breakdown by Region
2007

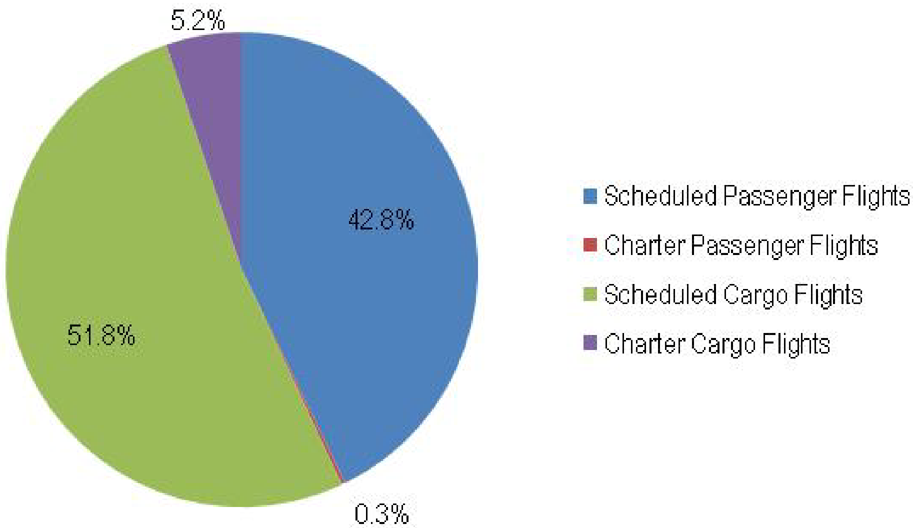


Source: Yearend Report – 2007 Statistical Summary prepared by the Department of Aviation

Major passenger carriers, including Continental, British Airways, Lufthansa, and KLM, move significant amounts of freight to and from Europe on their regularly scheduled passenger flights. These three airlines alone ship approximately two-thirds of the freight moving between Houston and Europe – the remainder is shipped by cargo airlines and other passenger flights. This highlights the importance of intercontinental passenger flights to freight. If, for example, KLM were to cut their flights to IAH, nearly seven percent of total Houston air freight traffic supply would be impacted. This could have an impact on Houston businesses and the competitiveness of the local economy.

Figure 6.3 shows the breakdown of freight volume carried by scheduled cargo airlines, charter cargo airlines, and scheduled passenger service. This highlights the reliance of the freight sector on existing passenger flights as well as scheduled/chartered cargo flights.

Figure 6.3 Air Freight Volume by Type of Flight
2007



Source: Yearend Report – 2007 Statistical Summary prepared by the Department of Aviation.

A variety of air cargo carriers move freight to and from Houston's airports. Table 6.3 displays the top 10 air-cargo carriers in 2007, broken down by all cargo movements and scheduled passenger service. Federal Express is a major player in the air cargo market, as is Continental, as a result of its hub status in the city and connections throughout the world.

Table 6.3 Top Air Carriers Serving the Houston Area (All Airports) by Volume – *2007*

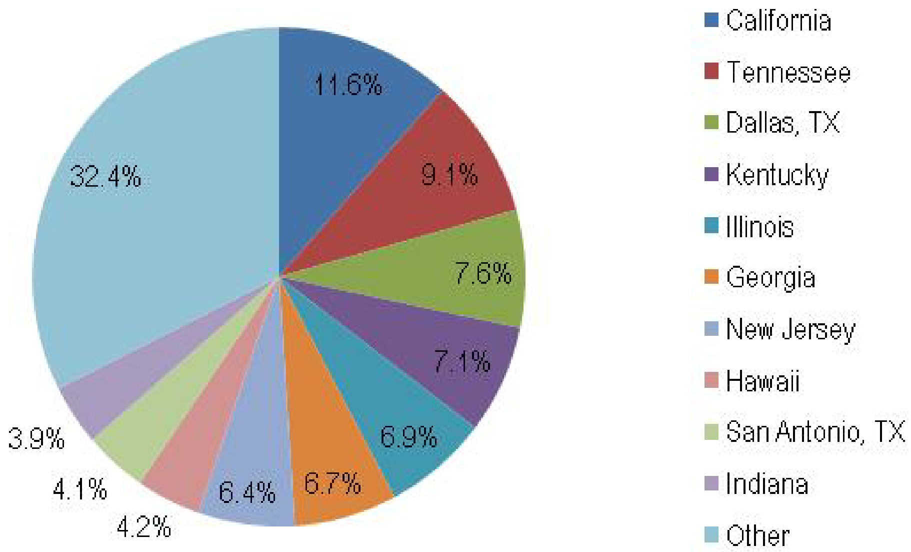
All Cargo		Passenger Service – Belly Freight	
Air Freight Carrier	**Market Share (in terms of volume)**	**Air Freight Carrier**	**Market Share (in terms of volume)**
Federal Express Corporation	23.6%	Continental	24.3%
United Parcel Service Company	11.2%	KLM Royal Dutch Airlines	6.5%
Cargolux International Airlines, S.A.	4.2%	British Airways, Plc.	4.1%
ABX Air, Inc.	4.1%	Southwest Airlines	2.0%

All Cargo		Passenger Service – Belly Freight	
Air Freight Carrier	**Market Share (in terms of volume)**	**Air Freight Carrier**	**Market Share (in terms of volume)**
Southern Air, Inc	2.4%	Lufthansa	1.9%
Total All Cargo Freight	**56.9%**	**Total Passenger Service Belly Freight**	**43.1%**

Source: Yearend Report – 2007 Statistical Summary prepared by the Department of Aviation.

Fifty-six percent of total cargo described above is domestic air cargo, and is a critical component of Houston's air freight service. Air cargo moves from the Houston area to several major domestic markets, including California and Tennessee, where Federal Express has its hub. Figures 6.4 and 6.5 highlight the top domestic locations that Houston goods are moved to and from. These figures include volumes and values for both origins and destinations. Table 6.4 includes more detailed information on the breakdown of domestic movements by direction (inbound versus outbound).

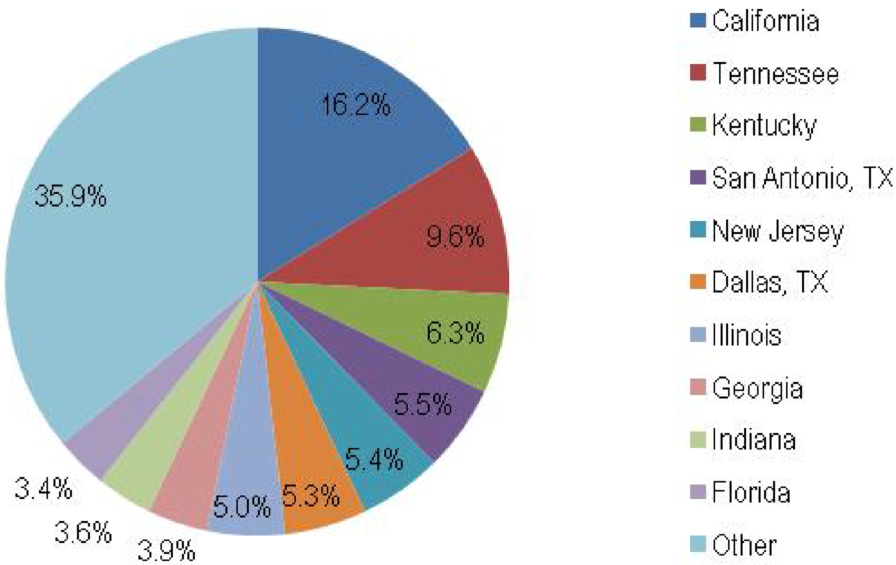
Figure 6.4 Top Air Freight Trading Partners by Volume
2007



Source: TRANSEARCH 2007, IHS Global Insight and Yearend Report – 2007 Statistical Summary prepared by the Department of Aviation.

Many of the same trading partners make up the top 10 both in terms of volume and value of air freight. Of note should also be the importance of Dallas as an air freight trading partner, as well as San Antonio within the State.

Figure 6.5 Top Air Freight Trading Partners by Value
2007



Source: TRANSEARCH 2007, IHS Global Insight and Yearend Report – 2007 Statistical Summary prepared by the Department of Aviation.

When comparing top domestic trading partners, Tennessee is a major destination for goods originating in Houston (mainly because of Federal Express in Memphis) while California is by far the state that imports the most goods by air into the Houston area. Other major trading partners include Hawaii, Illinois, New Jersey, Georgia, as well as Texas cities like Dallas and San Antonio.

Table 6.4 Top 15 Domestic Origin/Destination Pairs for Houston Air Freight[91]
By Volume and Value, 2007

By Volume						By Value					
Outbound			Inbound			Outbound			Inbound		
Destination	Tons	Percent of Total Domestic	Origin	Tons	Percent of Total Domestic	Destination	Value (Million Dollars)	Percent of Total Domestic	Origin	Value (Million Dollars)	Percent of Total Domestic
Tennessee	12,180.3	11.3%	California	19,608.1	16.0%	Tennessee	110.6	14.2%	California	307.0	22.5%
Dallas, Texas	9,267.5	8.6%	Kentucky	12,839.9	10.5%	Kentucky	99.2	12.7%	Tennessee	94.3	6.9%
Illinois	8,922.8	8.3%	Tennessee	9,614.2	7.8%	Dallas, Texas	57.2	7.3%	San Antonio, Texas	79.0	5.8%
New Jersey	6,711.1	6.2%	Georgia	9,148.0	7.5%	Georgia	47.6	6.1%	New Jersey	78.3	5.7%
Georgia	6,472.2	6.0%	Dallas, Texas	8,788.7	7.2%	Illinois	43.0	5.5%	Illinois	63.6	4.7%
Indiana	6,410.8	6.0%	New Jersey	8,172.3	6.7%	Indiana	42.4	5.4%	Dallas, Texas	56.1	4.1%
California	6,365.4	5.9%	Illinois	7,528.5	6.1%	California	40.7	5.2%	Arizona	50.5	3.7%
San Antonio, Texas	6,033.6	5.6%	Hawaii	5,523.3	4.5%	San Antonio, Texas	38.6	4.9%	Florida	48.0	3.5%
Hawaii	4,377.8	4.1%	San Antonio, Texas	3,934.9	3.2%	New Jersey	36.4	4.7%	Oregon	44.2	3.2%
Florida	3,906.6	3.6%	Indiana	3,241.8	2.6%	Missouri	31.2	4.0%	Washington	43.1	3.2%
Missouri	3,596.1	3.3%	Colorado	2,787.8	2.3%	Hawaii	27.5	3.5%	Maryland	38.1	2.8%
Kentucky	2,817.1	2.6%	Pennsylvania	2,601.8	2.1%	Florida	24.3	3.1%	Kentucky	36.4	2.7%

[91] TRANSEARCH 2007 volumes were adjusted using total volume data from the airports 2007 statistical data. TRANSEARCH 2007 value data was used – no adjustments made to value presented by TRANSEARCH 2007. Texas was broken down into individual cities, as opposed to showing the state as a whole.

Table 6.4 Top 15 Domestic Origin/Destination Pairs for Houston Air Freight
By Volume and Value, 2007 (continued)

By Volume						By Value					
Outbound			Inbound			Outbound			Inbound		
Destination	Tons	Percent of Total Domestic	Origin	Tons	Percent of Total Domestic	Destination	Value (Million Dollars)	Percent of Total Domestic	Origin	Value (Million Dollars)	Percent of Total Domestic
Maryland	2,368.4	2.2%	Oregon	2,511.4	2.0%	Colorado	15.9	2.0%	Georgia	35.9	2.6%
Pennsylvania	2,218.7	2.1%	Ohio	2,361.9	1.9%	Ohio	14.3	1.8%	Indiana	34.8	2.6%
Ohio	2,131.4	2.0%	Massachusetts	2,235.5	1.8%	North Carolina	14.3	1.8%	New Mexico	30.0	2.2%
Other U.S.	23,787.4	22.1%	Other U.S.	21,863.5	17.8%	Other U.S.	137.6	17.6%	Other U.S.	323.3	23.7%

Source: TRANSEARCH 2007 and 2007 Statistical Summary prepared by the Department of Aviation.

Finally, a review of the types of commodities that move into and out of Houston is necessary to understand which industries rely on air freight and will continue to do so. Table 6.5 highlights the commodities that rely on air freight to move goods into and out of the Houston region. In terms of tonnage, goods such as electrical equipment and machinery are major commodities.

The list of outbound commodities reveals the types of commodities that are dependent on air freight – electrical equipment, machinery, transportation equipment and others are dependent on air freight to get their goods to market. Industries such as machinery manufacturing and transportation equipment manufacturing rely on air freight to get goods to market. As a result, it is important to make airport access for these industries a priority – this includes reducing highway and road bottlenecks between major clusters of these air-freight dependent industries and the airport.

On the other hand, inbound commodities can be consumer-ready products or parts required for value-added manufacturing in the Houston region. Keeping transportation costs low (by reducing congestion) for shipments moving from the airport to the Houston region also is important for keeping product prices reasonable for consumers and businesses that use these goods in their manufacturing processes.

Table 6.5 Top 10 Commodities Moving Into/Out of Houston Airports[92]
By Volume and Value, 2007

By Volume				By Value			
Inbound Commodities		Outbound Commodities		Inbound Commodities		Outbound Commodities	
Commodity	Tons	Commodity	Tons	Commodity	Dollars (Millions)	Commodity	Dollars (Millions)
Mail or Contract Traffic	73,776	Electrical Equipment	81,989	Electrical Equipment	450.1	Machinery	536.3
Miscellaneous Mixed Shipments	22,271	Machinery	48,855	Transportation Equipment	415.4	Electrical Equipment	345.1
Machinery	20,121	Mail or Contract Traffic	28,065	Machinery	410.0	Transportation Equipment	191.6
Electrical Equipment	18,692	Fabricated Metal Products	12,844	Mail or Contract Traffic	182.3	Fabricated Metal Products	93.8
Pulp, Paper or Allied Products	12,896	Miscellaneous Manufacturing Products	11,510	Instrument, Photo Equipment, Optical Equipment	118.1	Miscellaneous Manufacturing Products	58.6
Chemicals or Allied Products	12,817	Transportation Equipment	6,738	Miscellaneous Mixed Shipments	100.4	Mail or Contract Traffic	31.2

[92] TRANSEARCH 2007 volumes were adjusted using total volume data from the airports 2007 statistical data. TRANSEARCH 2007 value data was used – no adjustments made to value presented by TRANSEARCH 2007. Texas was broken down into individual cities, as opposed to showing the state as a whole.

Table 6.5 Top 10 Commodities Moving Into/Out of Houston Airports
By Volume and Value, 2007(continued)

By Volume				By Value			
Inbound Commodities		Outbound Commodities		Inbound Commodities		Outbound Commodities	
Commodity	Tons	Commodity	Tons	Commodity	Dollars (Millions)	Commodity	Dollars (Millions)
Transportation Equipment	10,198	Farm Products	5,851	Miscellaneous Manufacturing Products	63.0	Apparel or Related Products	23.2
Printed Matter	6,924	Chemicals or Allied Products	4,412	Apparel or Related Products	58.9	Furniture or Fixtures	13.1
Apparel or Related Products	3,533	Clay, Concrete, Glass, or Stone	3,912	Chemicals or Allied Products	51.2	Waste or Scrap Materials	12.7
Instrument, Photo Equipment, Optical Equipment	3,532	Misc Mixed Shipments	3,377	Printed Matter	37.7	Chemicals or Allied Products	11.5

Source: TRANSEARCH and 2007 Statistical Summary prepared by the Department of Aviation.

6.3 Air Freight Demand Forecast

TRANSEARCH data provide projections for air freight traffic in the future which can be used to understand the demand for freight in the region in the future. Overall, according to these data, total freight volume is expected to grow by more than 160 percent by 2035, while freight value is expected to increase by approximately 170 percent.[93] In addition, air freight's percentage of the total share of freight movements into and out of the Houston area is forecasted to increase significantly by 2035, as shown in Table 6.6. Outbound freight shipments are expected to drive a large proportion of this growth.

Table 6.6 Air Freight's Percentage of Total Inbound/Outbound Freight Movements
2007 and 2035

	Freight Volume	Freight Value
Percent of total freight, 2007	0.08%	0.32%
Percent of total freight, 2035	0.13%	0.40%

Source: TRANSEARCH 2007.

Looking forward, there are a number of industries that will grow significantly in terms of their demand for air freight. Table 7.7 highlights the fastest growing commodities in terms of the value of air freight moved into and out of Houston airports. Current major commodities, such as machinery and electric equipment, will continue to grow at a rapid pace in terms of value.

[93] TRANSEARCH 2007 Data.

Table 6.7 Top 10 Inbound/Outbound Commodities in Terms of 2007 to 2035 Goods Value Growth Rate

Inbound Commodities		Outbound Commodities	
Commodity	**Value Growth Rate (Percent)**	**Commodity**	**Value Growth Rate (Percent)**
Primary Metal Products	659	Furniture or Fixtures	572
Miscellaneous Manufacturing Products	341	Leather or Leather Products	484
Misc Freight Shipments	341	Instruments, Photo Equipment, Optical Equipment	307
Electrical Equipment	219	Miscellaneous Mixed Shipments	304
Machinery	212	Ordnance or Accessories	254
Furniture or Fixtures	176	Electrical Equipment	248
Instruments, Photo Equipment, Optical Equipment	170	Primary Metal Products	239
Rubber or Miscellaneous Plastics	156	Machinery	224
Fresh Fish or Marine Products	153	Lumber or Wood Products	183
Transportation Equipment	149	Misc Manufacturing Products	157

Source: TRANSEARCH 2007

Capacity constraints as a result of future traffic are not expected to be a major concern at IAH, Houston's main freight airport. This is discussed in more detail in the following sections.

6.4 Houston's Regional Air Freight Infrastructure and Intermodal Connections

Approximately 98 percent of the air freight in the Houston region moves through George Bush Intercontinental Airport (IAH). While Houston Hobby (HOU) does move freight on passenger flights (almost all on Southwest Airlines), all of the major cargo facilities and cargo airlines are based at IAH. As a result, this section about Houston's air freight infrastructure will focus on facilities at IAH.

The location of Houston airports are shown in Figure 6.6. IAH is located to the north of downtown, while HOU is located southeast of downtown. Both airports have adequate access to highways – IAH to Interstate 45 and U.S. 59, HOU to Interstate 45 – which is important in connecting the region's industries with the air freight system. However, as goods movement to and from the airports is dependent on trucks to bring goods to and from the airport, air transportation costs may increase and service will be impacted by increases in congestion and delay. Houston was ranked sixth in terms of congestion in the United States, and many of the major bottlenecks exist along Interstate 45, which is a key route that connects both freight airports. This type of delay is costly to local businesses, as transportation costs increase to and from freight hubs, such as airports.

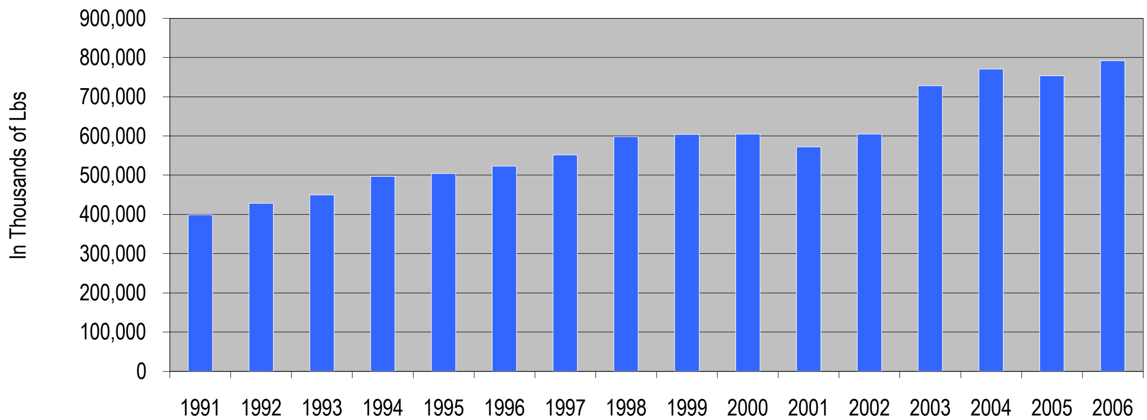
Figure 6.6 Freight Airports and Transportation Infrastructure

Source: Cambridge Systematics, Inc.

Existing IAH Freight Infrastructure

Air freight at IAH doubled between 1991 and 2006, as shown in Figure 6.8 below.

Figure 6.7 Past Cargo Activity at IAH
1991 to 2006



Source: IAH Cargo Sector Plan.

As a result of this growth, IAH recently opened its new IAH Cargo Center, which now handles the majority of freight movements. This facility was meant to handle the expected increase in freight traffic. The older freight facility, the IAH Central Cargo area, still operates, but handles less freight than the new IAH Cargo Center.

Passenger terminals and off-airport cargo facilities also are facilities from which freight is moved at the airport. However, in this document we focus on the two above (IAH Cargo Center and IAH Central Cargo Area), as they are concentrated entry points for heavy freight and warehousing.

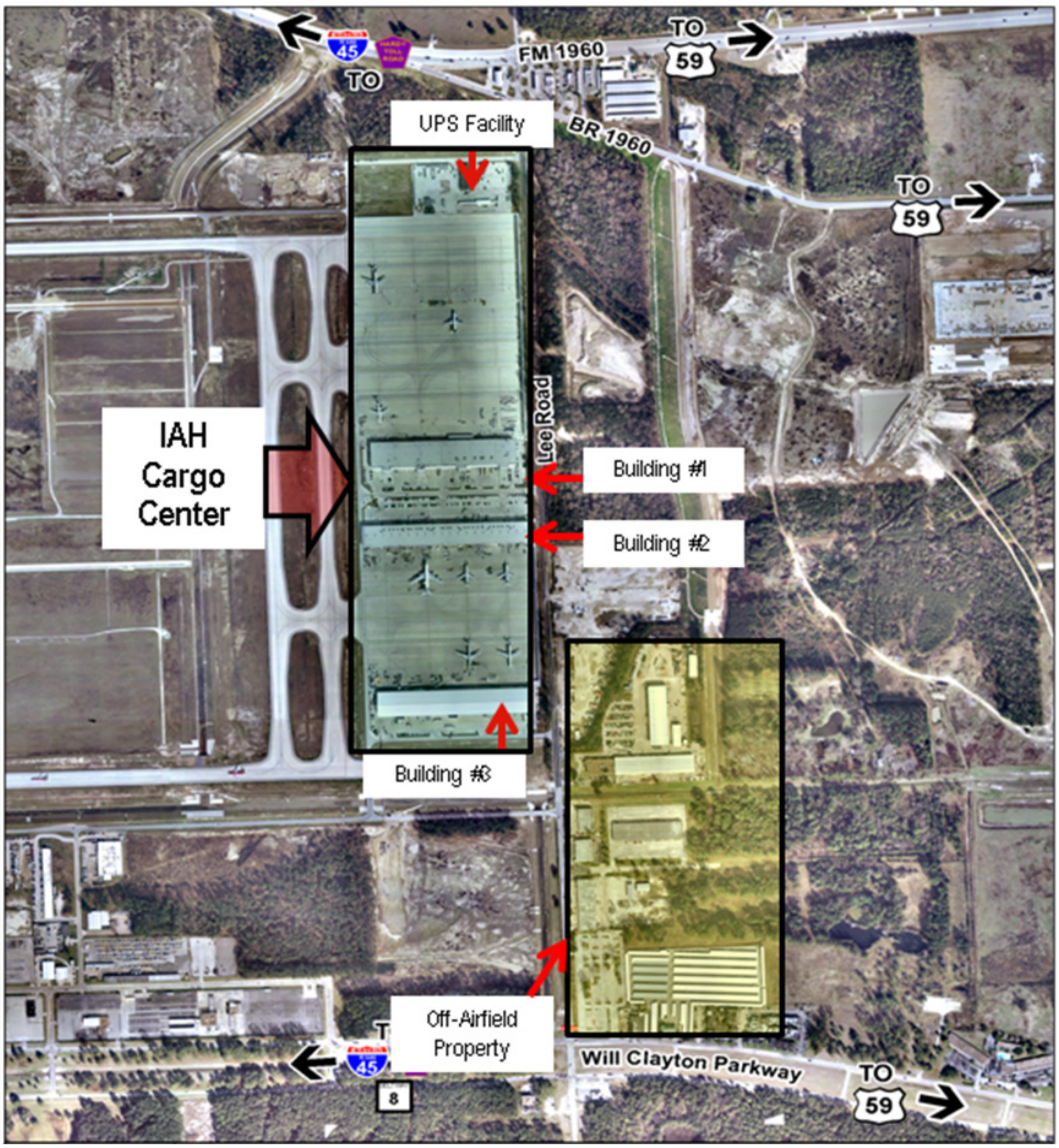
IAH Cargo Center

The IAH Cargo Center is the airport's new, state-of-the-art cargo facility, which handles the majority of the airport's airside cargo volumes. This facility is located in the northeastern section of the airport. Current cargo operations take place on approximately 146 acres, with significant room for expansion. Approximately 20 aircraft parking spaces are available for use and more than 1.3 million square feet of warehouse space (including the buildings and parking/truck dock area) are available. This includes three large warehouses as well as a separate facility for United Parcel Service (UPS) operations. Among other buildings, a perishables facility is located at the IAH Cargo Center.

Figure 6.8 shows the location of the major facilities in relation to major roads and highways at the airport. It shows that several roads provide access to the major facilities of the IAH

Cargo Center – FM 1960, BR 1960, and Will Clayton Parkway provide access to and from the facilities to Interstate 45 and U.S. 59. Lee Road is the main north-south artery that connects the warehouse buildings and the airfield with these three east-west connectors.

Figure 6.8 IAH Cargo Center
Main Facilities and Infrastructure



Source: HAS Planning (from the IAH Cargo Sector Plan) with modifications by Cambridge Systematics, Inc.

IAH Central Cargo Area

The IAH Central Cargo Area handles less volume than the IAH Cargo Center to the east, but is a critical freight facility since Federal Express and Continental Cargo, two of the largest freight shippers in Houston, use this facility. Located at the intersection of John F. Kennedy Boulevard and Will Clayton Boulevard, the facilities are located in an area where there is little room for further development or expansion. The area is made up of 70 acres of intensely developed apron, parking lots, warehouses, and roads. The aprons have room for 11 aircraft (four for Continental Cargo, four for Federal Express, and the remaining three serve Aeroterm warehouse D). Much of the warehousing in this area has limited airside access, as shown in Figure 6.9.

Figure 6.9 IAH Central Cargo
Main Facilities and Infrastructure

Source: HAS Planning.

IAH Cargo Facility Expansion

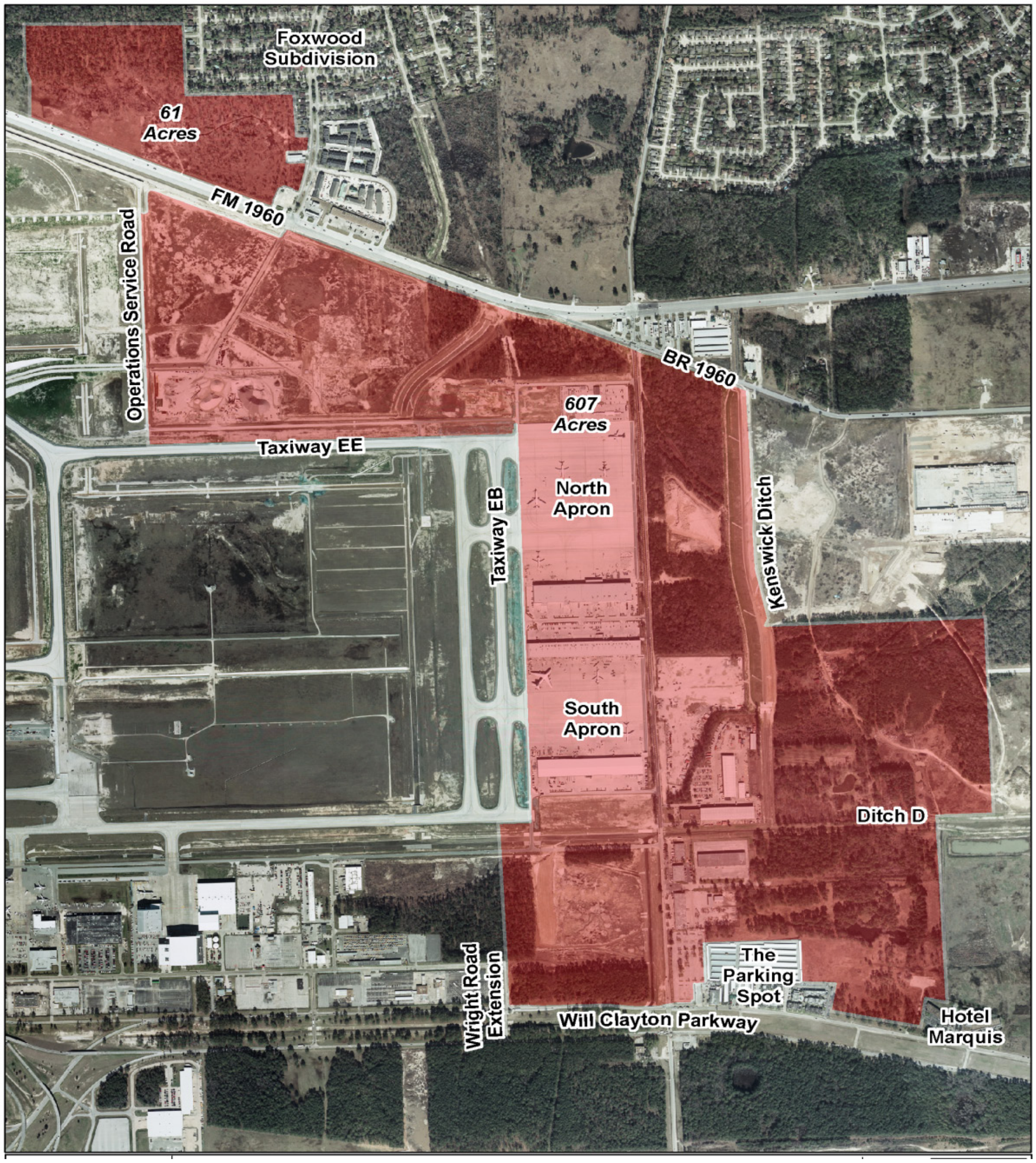
The George Bush Intercontinental Airport 2005 Airport Master Plan recommended several major developments in the cargo sector of the airport. This includes eastward expansion of cargo facilities near the IAH Cargo Center, land acquisition east of the current IAH Cargo Center, as well as a shift in the roads used to access the IAH Cargo Center. As is evident from the airport master plan, the IAH Cargo Center is the focus of air freight facility expansion efforts, while stating that the IAH Central Cargo area is designated more for the receiving of flight kitchens and concessions. The IAH Cargo Center is preferred for expansion for several reasons:

- Space for expansion is available in proximity to the East Cargo whereas little if any space is available at the Central Cargo area;
- The Central Cargo area has limited airside access with limited, if any, space for additional access whereas the East Cargo area has more opportunities for providing additional airside access; and
- Groundside cargo traffic to the Central Cargo area must mix with groundside passenger traffic accessing the passenger terminals. Groundside access to the East Cargo area is partially separate from groundside passenger traffic and can be enhanced to further the traffic separation.

Currently, the IAH Cargo Center is located on approximately 146 acres, highlighted in green in Figure 6.8 above. Expansion outside of current facilities would expand the IAH Cargo Center to approximately 671 acres. See Figure 6.10 below to see the areas that are currently under consideration for air freight uses at IAH.

In addition to the 671 acres highlighted, another estimated 495 acres north of Runway 8L-26R would be available for cargo expansion if needed. However, this area is currently not a part of the plan, because of the abundance of land currently available for development.

Figure 6.10 Future IAH Cargo Center Potential Air Cargo Land



Source: HAS Planning.

Intermodal Connection

Air freight originating or terminating at IAH is moved to and from the airport by trucks. As the main cargo facilities, IAH Central Cargo and IAH Cargo Center are located at different ends of the airport, the intermodal connections of each will be discussed separately.

IAH Central Cargo

The IAH Central Cargo Facility is accessible to both Interstate 45 and U.S. 59, the major highways that connect IAH to the region. Interstate 45 is accessible to the west via John F. Kennedy Boulevard and the Texas 8 Beltway, while U.S. 59 is accessible via Will Clayton Parkway. One of the main concerns with the IAH Central Cargo area as an ongoing major cargo facility is that freight traffic and passenger vehicles are forced to share limited road access on Will Clayton Boulevard and John F. Kennedy Boulevard. The location of the facilities makes this conflict unavoidable. This passenger traffic may have a negative impact freight-travel time, and freight traffic may slow down passenger travel to and from the main terminal.

Access to IAH Central Cargo

IAH Central Cargo's major access point is at the northern section of the cargo area on McKaughan Road. Cargo traffic from John F. Kennedy Boulevard, Will Clayton Boulevard and the terminal area all enter the IAH Central Cargo in this way. In addition, the FedEx facility is accessible further south from the John F. Kennedy Boulevard northbound service road.

Once freight traffic has accessed the IAH Central Cargo area, a small street grid allows trucks to get to and from their intended warehouses and destinations. Exiting traffic can access John F. Kennedy Boulevard and Will Clayton Boulevard using Mecom Road. Additional exiting access to John F. Kennedy Boulevard is provided by Pallet Road.

IAH Cargo Center

As the IAH Cargo Center is located on the eastern half of the airport, it is located closest to U.S. 59. However, Interstate 84 also is accessible from F.M. 1960 to the west. The Master Plan describes the surrounding roadway system as "not providing off-airport freight forwarders an efficient route to either the northeast or central cargo areas."

Access to IAH Cargo Center

Lee Road is the only entrance and exit thoroughfare for cargo activity at this facility. Lee Road connects to Will Clayton Boulevard on the south and F.M. 1960 on the north to provide access to John F. Kennedy Boulevard and freeways U.S. 59 and Beltway 8.

6.4 Air Freight Issues and Challenges

The 2005 IAH Airport Master Plan lists several actions that should be taken to mitigate key air freight issues. The air freight actions include:

- Extension of airfield pavement south of current cargo ramp area;

- Land acquisition east of current cargo area;
- Abandonment of Lee Road as primary access route and replaced by the extension of Volta Road to Kenswick Road; and
- Eastern extension of cargo warehouse buildings.

These developments would address some of the key issues that currently exist for air freight at IAH, including issues related to apron capacity, warehousing capacity, road capacity, and others. This section highlights some of the main issues and challenges that the airport in its current form presents to the effective movement of freight to and from air freight facilities.

One thing to note is that there are no real land capacity constraints for future development – sufficient land for expansion exists to support growth of the air freight component and warehouses at the airport.

Current Major Landside Freight Issues

This section focuses on the primary issues that impact goods movement between the airport cargo warehouses and the rest of the region. These are discussed individually below.

Congestion on the primary IAH Cargo Center Access Road. Lee Road, which is currently the only route that serves the IAH Cargo Center, experiences significant congestion on northbound lanes. This is a result of heavy traffic volumes and left-turn volumes at the intersection of Lee Road and F.M. 1960. Also contributing to the traffic on Lee Road is the close proximity of B.R. 1960 to F.M. 1960. As a result, widening Lee Road would not eliminate traffic delays and congestion because of the current road configuration and induced cut-through demand would create congestion.

Kenswick Drive, an alternate north-south route that can be used to avoid Lee Road, has some design deficiencies which does not make it an attractive option. The main deficiency is the intersection with Will Clayton Parkway, as southbound trucks have to make a couple of turns to get on eastbound Will Clayton Parkway, which leads to U.S. 59.

A final issue on Lee Road is that the bridge in the southern portion of Lee Road is in a floodplain. Replacing this bridge will be expensive. In addition, freight forwarders are concerned that the bridge on Lee Road is structurally incapable of handling very heavy cargo loads moving to the IAH Cargo Center. Therefore, heavy cargo transporters enter Lee Road on the south via Will Clayton Boulevard and turn onto the airfield access road before the bridge. From there, trucks enter the airfield and use the tug roads to access the cargo area as opposed to heading further up Lee Road.

In order to mitigate the problems with congestion around the IAH Cargo Center on Lee Road, one proposal in the Airport Master Plan (see bullets in the first paragraph of this chapter) was to remove Lee Road and extend Volta Road westward to the current IAH Cargo Center aprons. This would move all north-south cut-through traffic to Kenswick Drive, and would allow Volta Road to be used primarily for air freight-related traffic.

Safety issue for truckers on Lee Road. It was mentioned by stakeholders that it is dangerous for truckers turning into IAH Cargo Center facilities from Lee Road.

Existing infrastructure (pipelines) make expansion more difficult. Currently, pipelines run next to Lee Road, which prevents the construction of structures and roads. Without purchase of these pipelines and the land, expansion to the east of Lee Road becomes more difficult.

7.0 Summary and Next Steps

The H-GAC regional freight transportation system is composed of:

- More than 24,000-lane miles of roadways carrying more than 465 million tons of goods annually;
- Three Class I railroads operating nearly 1,000 miles of track and carrying more than 150 million tons of local freight annually;
- Four deepwater ports, including the Ports of Houston, Freeport, Galveston, and Texas City, and the Gulf Intracoastal waterway System which handle more than 145 million tons of freight annually;
- Two major air cargo facilities at George Bush Houston Intercontinental Airport (IAH) that handle more than 800,000 of air freight annually; and
- Approximately 21,500 miles of pipelines that carry more that 445 million tons of freight annually.
- Each of these systems plays distinct roles in the multimodal freight system, yet also work together as a system to serve the needs of the Region's economy.
- The amount of freight carried by this multimodal system is projected to grow nearly 77 percent by 2035, leading to increasing pressure on the system. These challenges will be felt in three ways going forward:
- **Capacity –** the projected growth in freight demand presented in this report represents unconstrained growth, meaning it is assumed that there will be enough capacity to efficiently carry the increase in traffic. If capacity is not addressed adequately, the result will be increased congestion and inefficiencies on the Region's transportation system and an increased probability that the freight and the economic activity associated with it will go elsewhere.
- **Community Impacts –** aside from congestion, impacts such as safety air quality, noise, vibrations, water pollution, and wear and tear on infrastructure will be exacerbated by the increasing volumes of freight moving over more of the transportation system.
- **Institutional and Regulatory Issues –** laws, regulations, and arrangements governing freight transportation will need to be revised and updated to keep pace with the rapidly changing trends shaping the goods movement industry. The four primary categories of institutional and regulatory issues that will be increasingly challenging for the Region include funding, security, environmental, and permitted loads.

The Regional Goods Movement Profile represents a baseline of existing conditions in the H-GAC Region and it will serve as input into the Regional Goods Movement Needs Assessment. The challenges brought forth in this report will be investigated in greater detail in the Needs Assessment document and recommended solutions and plans for implementing them will be developed and documented as part of the overall recommendations of the Study.