



U.S. Department  
of Transportation

**Federal Railroad  
Administration**

# **Dallas to Houston High-Speed Rail Project**

## **Corridor Alternatives Analysis**

### **Technical Report**

August 10, 2015

# 1. INTRODUCTION

The Federal Railroad Administration (FRA) initiated a National Environmental Policy Act (NEPA) evaluation of Texas Central High-Speed Railway, LLC's and its affiliates (TCR or the Proponent) proposal to implement a high-speed passenger railroad between Dallas and Houston, Texas (Project). As required by NEPA, FRA is preparing an Environmental Impact Statement (EIS) to accomplish this evaluation.

FRA has the authority to regulate the safety of railroads, including the Project. As such, FRA must make specific safety determinations regarding the Project before it can be implemented. For this Project, FRA may issue a Rule of Particular Applicability (regulations that apply to a specific railroad or a specific type of operation), a series of waivers, or another action to ensure the Project is operated safely. This future regulatory action(s) constitutes a federal action and triggers the environmental review under NEPA.

This report reflects FRA's independent analysis and judgment in its capacity as the federal lead agency for the EIS. FRA undertook the Corridor Alternatives Analysis documented in this report in accordance with FRA procedures and generally accepted practices guiding the identification and evaluation of potential corridor-level alternatives. Because the Project is a private proposal by TCR, FRA's alternatives evaluation documented in this report is premised primarily on complying with TCR's technical requirements for the high-speed rail system and meeting the economic viability determinations made by TCR. FRA's additional screening criteria are directly related to FRA's role under NEPA: minimizing impacts to the natural and human environment.

TCR proposes construction and operation of a private, for-profit, high-speed passenger rail system connecting Dallas and Houston using the Japanese N700-I Tokaido Shinkansen high-speed rail technology. The Project encompasses an approximately 240-mile-long corridor between the two cities. TCR's proposed high-speed rail system requires a fully sealed corridor with grade-separated crossings and dedicated right-of-way that is approximately 76 to 200 feet wide in order to accommodate a two-track railroad and an access road. It requires a "closed" system, meaning that the train must run on dedicated high-speed rail tracks for passenger rail service only and cannot travel on existing or planned freight rail lines or share tracks with other passenger services, such as Amtrak.

A key milestone in the EIS process is identification of a range of reasonable alternatives to be evaluated. The No Build Alternative or No Action Alternative, as required by NEPA, will serve as the basis for comparison of the environmental impacts of build or action alternatives in the EIS. FRA undertook this Corridor Alternatives Analysis to identify and evaluate the potential corridors, stations area locations, and service types that could become "alternatives" in the EIS. This evaluation constitutes the first step in narrowing the universe of potential alternatives by identifying the corridor alternatives from which location alignments within corridors can be developed.

FRA undertook a corridor-level evaluation in this report. Therefore, FRA will conduct a second screening analysis that will identify and evaluate potential location alignments within the corridor alternatives identified in this Corridor Alternatives Analysis as feasible and reasonable. Combined with station area

locations, FRA will use the alignments screening analysis to identify “Build Alternatives” that will be the subject of the evaluation in the EIS.

In its *Step 1 Screening of Alternatives Report* (TCR 2015), issued by TCR on March 22, 2015, and available online at: <http://www.texascentral.com/>, TCR used the term “alignment alternatives” to describe the corridor-level alternatives it identified and evaluated. To distinguish between the evaluation undertaken by FRA and corridor-level alternatives proposed by TCR to FRA, different terminology is used throughout this report to refer to FRA’s corridor-level alternatives and TCR’s alignment alternatives. FRA’s Corridor Alternatives Analysis is broken in to two levels: coarse screening analysis and fine screening analysis. FRA uses the term “potential corridor alternatives” to describe the corridors under consideration in this report. FRA uses the term “corridor alternatives” at the conclusion of this report to refer to range of feasible and reasonable corridor alternatives, as required by NEPA. FRA uses TCR’s terminology “alignment alternatives” when referring to the corridor-level alternatives TCR identified as part of its proposal to FRA.

Additionally, TCR used a stop-light chart approach in its screening analysis. Each of TCR’s alignment alternatives were evaluated based on three main criteria – financial and project delivery considerations, engineering considerations, and environmental considerations. TCR developed sub-criteria and assigned numerical values (quantitative analysis) to each sub-criterion in the stop-light chart. TCR normalized the totals in the stop-light chart such that the lowest scoring alignment alternative was given a value of one. TCR then weighted each of the other alignment alternatives in comparison to the normalized total. Conversely, FRA undertook a qualitative pass/fail analysis to determine feasibility and reasonableness.

## **1.1 Background**

Both the Texas Department of Transportation (TxDOT) through the Texas Rail Plan (TxDOT 2010) and FRA through the High Speed Rail Strategic Plan (FRA 2009) have identified potential future high-speed rail corridors in Texas. These planning efforts identify potential high-speed rail corridors, but no detailed evaluation of corridors or alignments between Dallas and Houston has been prepared by either agency pursuant to NEPA. Therefore, as part of its proposal to FRA, TCR conducted a corridor-level evaluation to identify alignment alternatives between the two metropolitan areas as a starting point for discussions with FRA, and to enable initiation of FRA’s public scoping process pursuant to NEPA.

TCR reviewed existing planning documents and infrastructure corridors as part of their process to identify potential corridors that could be suitable for the development of its proposed high-speed rail system. TCR then independently undertook a screening analysis to narrow the range of alignment alternatives as part of its proposal to FRA. TCR’s system requirements and planning process for both alignment alternatives and station area locations are documented in their *Step 1 Screening of Alternatives Report* (TCR 2015). TCR’s screening evaluation examined nine potential alignment alternatives to an equal level of detail using the following criteria: financial and project delivery considerations, engineering considerations, and environmental considerations. In the preparation of this report, FRA used technical information, including system requirements and cost projections, from the *Step 1 Screening of Alternatives Report* (TCR 2015).

## **1.2 Purpose and Need for the Project**

As defined by TCR, the purpose of the privately proposed Project is to provide reliable, safe and economically viable passenger rail transportation using proven high-speed rail technology between Dallas and Houston. It would provide a convenient and competitive alternative to automobile travel on Interstate 45 (I-45) or air travel between the two major metropolitan areas and introduce rail capacity in the vicinity of the corridor. To achieve TCR's economic viability and safety requirements, the Project must meet the following technical requirements:

- Technological: bullet train vehicle and operating procedures based on the N700 Tokaido Shinkansen
- Operational: approximate 90 minute travel time between Dallas and Houston, with achievable speeds exceeding 200 miles per hour (mph) in a fully sealed corridor
- Environmental: minimal impacts to the natural and built environments by maximizing adjacency to existing infrastructure right-of-way

FRA, in accordance with federal requirements, must ensure that the system can be operated safely. As the federal lead agency under NEPA, FRA is obligated to avoid and minimize impacts to the human and natural environment. FRA must also ensure that the Project complies with all applicable federal laws and executive orders.

Current transportation options between Dallas and Houston rely on automobile and air travel. Due to increasing congestion on I-45, automobile travel times between the two regions are projected to increase as travel speeds decrease. Flights between the two regions are approximately 65 minutes, in addition to the recommended airport arrival time at the gate approximately 60 minutes before the scheduled departure time. Flights are sensitive to inclement weather and other delay-causing events from inside and outside of Texas. As a result of these constraints, combined with the distance between the two metropolitan areas and potential ridership demand, TCR identified an opportunity to develop a profitable privately-financed and operated high-speed passenger rail system. The mobility and congestion-related issues on the I-45 corridor that TCR's proposed project potentially addresses represents identification of the typical "need" for a FRA Project, which FRA usually addresses through service-level corridor planning.

## **1.3 Study Area and Logical Termini**

The study area for the Dallas to Houston High-Speed Rail Project is approximately 240 miles in length and connects the Dallas and Houston metropolitan areas.

Logical termini for an EIS are rational end points for transportation improvements. When considered with the rest of the corridor, they provide for consideration of all environmental impacts that would result from the proposed improvements. Federal guidelines for logical termini suggest project limits that encompass transportation utility. A project having independent utility should be able to operate and offer transportation and related benefits irrespective of the activity beyond the project's end points. Additionally, the study area defined by the endpoints must be of sufficient size to consider all of the

environmental impacts that would result from the proposed improvement. The study area should have a broad enough footprint that common environmental, economic, and social concerns can be addressed in a meaningful way.

The cities of Dallas and Houston have multiple economic and commercial centers, in addition to downtown business districts, spread across their respective metropolitan areas. Both urban and suburban areas within the two metropolitan areas are well-served by highways and roadways that would make them easily accessible to travelers between the two regions. Therefore, FRA considers both suburban and urban terminus stations as logical termini, including downtown Dallas and southeast Dallas in proximity to I-45, and downtown Houston and north and northwest sections of Houston. For the purposes of this Corridor Alternatives Analysis, FRA is identifying logical termini for the Project as downtown Dallas in the vicinity of Dallas Union Station and downtown Houston in the vicinity of the Houston Amtrak Station. Such identification maximizes opportunities to connect to other existing or proposed intercity, regional and local rail facilities and other transit services, furthering FRA's connectivity goals for rail network development.

FRA will complete a more detailed evaluation of station areas in a separate alignments screening analysis in its consideration of potential location alignment linking potential station areas, which FRA will complete using the corridor alternative(s) determination from this report.

## **2. POTENTIAL CORRIDORS**

This section of the report describes FRA's approach to identify potential corridors between Dallas and Houston that would be able to accommodate TCR's proposed high-speed rail system. The potential corridors identified by FRA and described in this report represent only generalized locations that have the potential to accommodate TCR's proposed system. The potential corridors discussed herein do not represent exact right-of-way or track locations. FRA developed the range of potential corridors using high-speed rail corridors identified in previous studies and those using existing linear infrastructure corridors. FRA did not complete any engineering or design work as part of this analysis.

TCR undertook preliminary schematic design and engineering to develop the general infrastructure requirements and system characteristics of its proposed high-speed railway to support its efforts to identify proposed alignment alternatives. TCR's preliminary schematic design and engineering was used to determine if its proposed system could operate within the identified alignment alternatives.

### **2.1 Previous Studies**

In accordance with the Passenger Rail Investment and Improvement Act, TxDOT prepared an annual state rail plan and updated it between 2010 and 2014. It recognizes strategic planning efforts for high-speed rail development, as well as existing freight and passenger rail services and potential areas for investment and improvement. The *Texas Rail Plan* (2010) identified three general corridors that could be considered for future development of high-speed passenger rail service between Dallas and Houston:

Burlington Northern Santa Fe (BNSF) Corridor, Union Pacific Railroad (UPRR) Corridor, and Greenfield Corridor (roughly following I-45). These potential high-speed rail corridors are described below.

### **2.1.1 BNSF Corridor**

The BNSF Corridor would extend from the vicinity of Dallas Union Station in downtown Dallas south through Ennis, Teague, and Pinehurst to north Houston east of the intersection of I-45 and Interstate 610 (I-610). It would generally follow and use the BNSF Teague freight rail line.

### **2.1.2 UPRR Corridor**

The UPRR Corridor would extend from the vicinity of Dallas Union Station in downtown Dallas south through Hockley, Navasota, and College Station to the Houston Amtrak Station in downtown Houston. It would generally follow and use the UPRR Hempstead freight rail line.

### **2.1.3 I-45 Greenfield Corridor**

Because I-45 does not currently have a railroad parallel to the highway, it is considered a new rail alignment or “greenfield” corridor. The I-45 Greenfield Corridor would use a combination of I-45 highway right-of-way or adjacent lands and a portion of UPRR’s Hempstead freight line to reach downtown Houston. It would extend from the vicinity of Dallas Union Station in downtown Dallas south along I-45. It would extend south along I-45 roughly into downtown Houston.

## **2.2 Identification of Other Potential Corridors and Alternatives**

### **2.2.1 Utility Corridor**

In addition to the potential high-speed passenger rail corridors identified in the *Texas Rail Plan (2010)*, TCR proposed to FRA the “Utility Corridor.” TCR identified this corridor to take advantage of relatively straight, existing long, linear infrastructure easements between Dallas and Houston. The Utility Corridor would follow the Centerpoint Energy and Oncor Electric Delivery high-voltage electrical transmission lines (345 to 500 kilovolts (kV)). The utility easement does not extend into downtown Dallas or downtown Houston. The easement originates near Palmer and terminates near Hockley to the south. Therefore, between Dallas and the Trinity River, the Utility Corridor would follow and use the UPRR Corridor to the vicinity of Dallas Union Station. Between Hockley and Houston, the Utility Corridor would follow and use the UPRR Eureka Subdivision into downtown Houston.

### **2.2.2 Other Potential Transportation Alternatives**

Alternatives to high-speed passenger rail service between Dallas and Houston include other types of passenger rail service, as well as other modes of transportation. These other potential transportation alternatives are described below.

### **Higher-Speed and Conventional Rail Service**

High-speed rail service requires a fully-sealed and grade-separated right-of-way and power to achieve high speed (150 mph or higher). High-speed rail systems generally require two separate new tracks for passenger rail service. Higher-speed (90 to 150 mph) and conventional (up to 90 mph) rail service can be implemented in existing railroad right-of-way with at-grade railroad crossings because the passenger trains travel at slower speeds. Therefore, as an alternative to high-speed rail, FRA identified higher-speed and conventional passenger rail service alternatives that could be implemented between Dallas and Houston using the BNSF Teague freight line or the UPRR Hempstead freight rail line. Under both of these alternatives, passenger rail service would be provided between Dallas Union Station and the Amtrak station in downtown Houston.

### **Direct Bus Service**

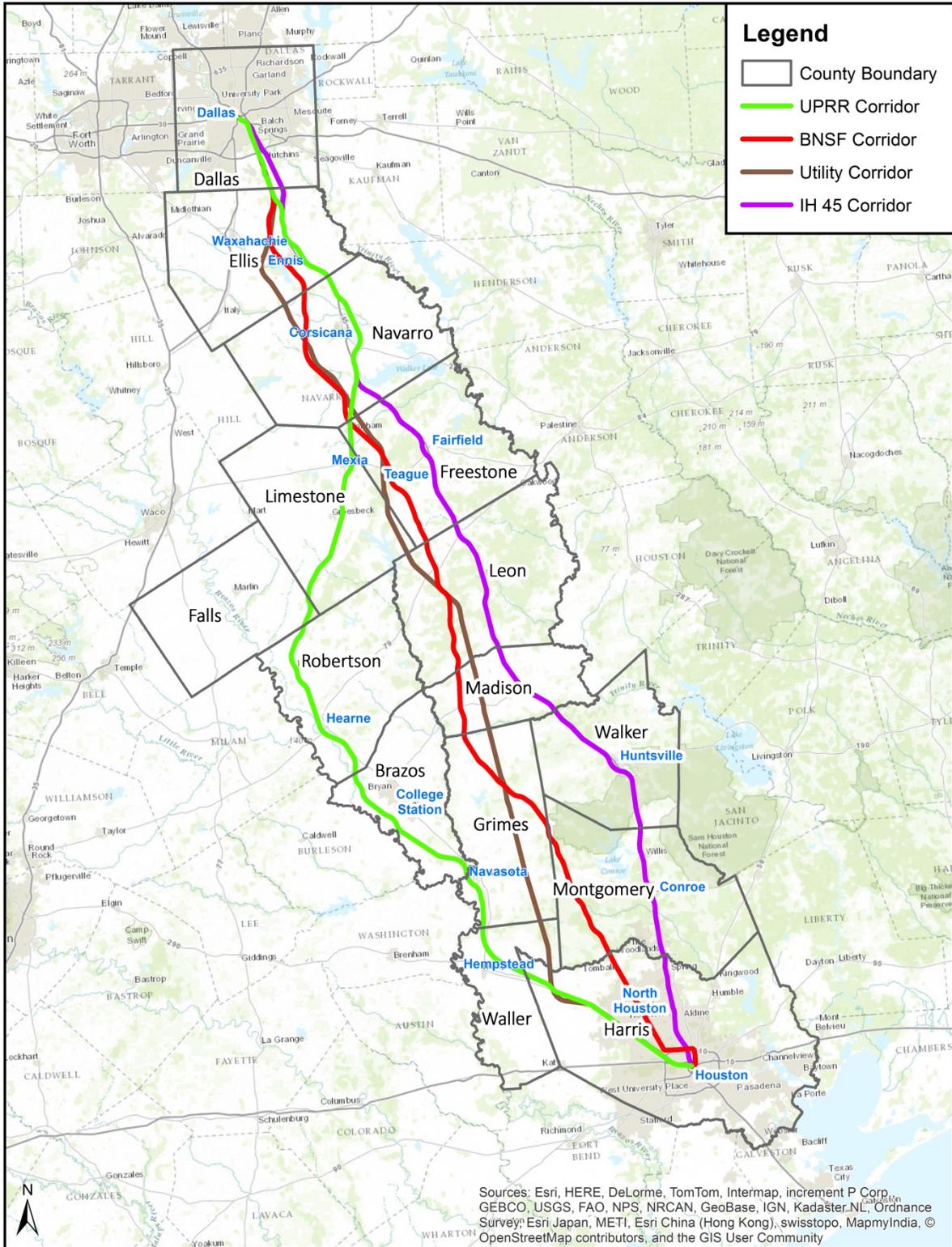
Direct bus service between downtown Dallas and downtown Houston is currently provided by Greyhound, MegaBus and Vonlane. Bus service uses I-45 to travel between the two metropolitan regions and the trip takes approximately 4 hours depending on traffic and road conditions on I-45. There are currently no dedicated bus lanes or carpool lanes for the majority of I-45. A dedicated bus lane has the potential to protect and may decrease the travel time between the two metropolitan regions by eliminating the effects of traffic congestion on bus service. Construction of a new dedicated bus lane would be required in order to maintain the existing automobile travel lane capacity.

### **I-45 Expansion**

Congestion on I-45 is increasing and is projected to further increase automobile travel times between Dallas and Houston. To offset congestion, TxDOT is already planning to begin construction this summer to widen I-45 from 4 to 6 travel lanes along approximately 21.1 miles from Corsicana to south of Richland in Navarro County. TxDOT is also planning to widen I-45 from 4 to 6 travel lanes for 6.25 miles from north Huntsville to south Huntsville and another 12.4 miles from south Huntsville to the Montgomery County Line. The remaining 4-lane portions of I-45 could be expanded to 6 travel lanes in each direction for general automotive use.

**Figure 1** shows the locations of the potential corridor alternatives. Note that higher-speed and conventional rail service alternatives would use the BNSF and UPRR Corridors, and direct bus service and I-45 expansion alternatives would use the I-45 Greenfield Corridor.

Figure 1 Potential Corridor Alternatives



## **3. COARSE SCREENING ANALYSIS**

### **3.1 Methodology**

As required by NEPA, the first step in any alternatives analysis is determining if a potential alternative will meet the purpose and need identified for the project. Any potential alternative that does not meet purpose and need is automatically eliminated from further consideration. Only those potential alternatives that meet purpose and need are carried forward to the fine screening analysis.

To determine if the potential corridor alternatives and other potential transportation alternatives warrant more detailed alternatives screening, FRA conducted a pass/fail analysis based on the Project purpose and need. FRA uses the term “fail” if a potential corridor alternative or other potential transportation alternative does not meet purpose and need, and uses the term “pass” if it does. FRA carried all potential corridor alternatives and other potential transportation alternatives that passed the fine screening analysis in Section 4 of this report. Potential corridors and other potential alternatives shown as “passing” at the coarse screening level may be eliminated by FRA as part of the fine screening analysis or in the alignments screening analysis FRA will undertake.

### **3.2 Coarse Screening Criteria**

FRA evaluated each potential corridor alternative and other potential transportation alternative against the Project purpose and need. FRA eliminated a potential corridor alternative or other potential transportation alternative if it failed to meet Project purpose and need. FRA carried forward into the fine screening analysis only those potential corridor alternatives or other potential transportation alternatives that meet Project purpose and need, as defined below.

- Purpose and Need: supports the purpose to provide economically viable high-speed (200 mph) safe and compliant passenger rail service competitive with air travel (90 minute travel time from terminal to terminal) using the N700-I Tokaido Shinkansen in a fully sealed and grade-separated corridor

### **3.3 Coarse Screening Analysis**

Table 1 presents the results of the pass/fail analysis FRA conducted for the potential corridor alternatives and other potential alternatives. An explanation of FRA’s determinations in Table 1 is provided after the table.

**Table 1 Coarse Screening Analysis Pass/Fail Results**

<b>Potential Corridor and other Transportation Alternatives</b>	<b>Purpose &amp; Need</b>
BNSF Corridor	Pass
UPRR Corridor	Pass
1-45 Greenfield Corridor	Pass
Utility Corridor	Pass
Higher-Speed and Conventional Rail Service	Fail
Direct Bus Service	Fail
I-45 Expansion	Fail

Higher-speed and conventional speed passenger rail service, direct bus service, and expansion of travel lanes on I-45 do not meet the Project Purpose and Need to provide high-speed passenger rail service between the Dallas and Houston metropolitan regions. Although higher-speed and conventional rail service may be able to use existing freight railroad right-of-way on either the BNSF or UPRR Corridors, these potential corridor alternatives would not employ the N700-I Tokaido Shinkansen high-speed rail system or reach travel speeds around 200 mph. Additionally, they would both require permission from the host railroad(s) to share the freight rail tracks and/or right-of-way. The existing rail line would need to be improved with additional passing tracks and sidings, track replacement and rail bed rehabilitation, signaling, and communication systems to accommodate passenger train and freight trains on a shared track, or the right-of-way would have to be widened to accommodate passenger rail track. Therefore, FRA eliminated these potential corridor alternatives from further consideration based on failure under the Purpose and Need screening criterion.

Bus service or expanding I-45 may temporarily relieve congestion on I-45, meeting the transportation need of the Project. However, these other potential transportation alternatives rely on vehicular travel as the primary means of transportation between the Dallas and Houston metropolitan regions. These other potential transportation alternatives would not offer a long-term alternative to travel on I-45 and they would not offer a one-way trip in 90 minutes or less, which is needed in order to be competitive with air travel. Additionally, these other potential transportation alternatives would not provide passenger rail service, as per TCR's purpose of the Project. Therefore, FRA eliminated these alternatives from further consideration based on failure under the Purpose and Need criterion.

The BNSF, UPRR, I-45 Greenfield, and Utility Corridors would all meet the TCR's purpose of the Project to provide high-speed passenger rail service between Dallas and Houston as an alternative to automobile travel. FRA carried these potential corridor alternatives into the fine screening analysis.

### **3.4 Alternatives Retained for Further Analysis**

Four of the potential corridor alternatives were determined to meet the purpose and need of the Project: BNSF, UPRR, I-45 Greenfield, and Utility Corridors. FRA evaluated these potential corridor alternatives as part of the fine screening analysis.

## 4. FINE SCREENING ANALYSIS

### 4.1 Methodology

FRA conducted a second pass/fail analysis to determine if fatal flaws exist that would result in elimination of a potential corridor alternative from further consideration. FRA uses the term “fail” when a fatal flaw exists. If an alternative fails in any one criterion, FRA eliminated it from further consideration. FRA recommends the remaining potential corridor alternatives as feasible and carries them forward for more detailed investigation of location alignments within corridors. FRA may deem potential corridor alternatives shown as “passing” at the fine screening level infeasible in the alignments screening analysis.

### 4.2 Fine Screening Criteria

The screening criteria applied at the fine screening analysis are listed below. FRA evaluated each potential corridor alternative individually and each screening criterion was given equal weight by FRA in its determination of pass or fail. If a potential corridor alternative fails in any one criterion, FRA eliminated it from further consideration. A potential corridor alternative must receive a pass in each screening criterion for FRA to carry it forward for more detailed investigation of location alignments within corridors.

- Physical characteristics: endpoints, length of the corridor, number of curves, number of at-grade crossings, physical obstructions or encroachments onto the right-of-way
- Operational feasibility: ownership, travel time, number of bridges, implementability
- Environmental constraints: direct impacts to residential and commercial properties; wetlands, floodplains, waterways and waterbodies; section 4(f) resources; section 6(f) resources; and threatened and endangered species

FRA uses environmental constraints during the screening of potential corridor alternatives. Environmental constraints can include direct impacts to residential and commercial properties; wetlands, floodplains, waterways and waterbodies; section 4(f) resources; section 6(f) resources; and threatened and endangered species. For the purposes of this evaluation, FRA chose to conduct a pass/fail analysis. Environmental constraints represent the potential for a corridor to create significant environmental impacts that require detailed investigation as part of the EIS. However, environmental constraints data gathered by TCR show relatively similar results for all potential corridor alternatives, as shown in Table 2. All of the potential corridor alternatives have the potential to create significant environmental impacts.

**Table 2 Environmental Constraints**

Environmental Constraint	Potential Corridor Alternative			Utility Corridor
	BNSF Corridor	UPRR Corridor	1-45 Greenfield Corridor	
Number of stream crossings	127	148	125	113
Acres of wetlands	399	368	202	380
Acres of floodplains	15	0	0	0
Number of historic properties and archaeological sites	3	3	5	7
Acres of parks and national forests/national parks	35	1	433	1
Acres of managed habitat areas	0	0	80	1

Source: TCR 2015.

Pursuant to NEPA, FRA is required to evaluate potential environmental constraints and develop measures to avoid, minimize, or mitigate impacts through the EIS process. However, FRA will identify environmental constraints as fatal flaws at the corridor-level if a potential corridor alternative is anticipated to create substantially greater impacts in comparison to the other potential corridor alternatives. FRA will undertake a review of environmental constraints in the alignments screening analysis of location alignments within corridors identified in this Corridor Alternatives Analysis and may use the data gathered to narrow the range of location alignments within corridors considered in the EIS. As required by NEPA, FRA will also evaluate a No Build Alternative as part of the EIS.

### 4.3 Fine Screening Analysis

Table 3 presents the results of the pass/fail analysis FRA conducted for the potential corridor alternatives. An explanation of FRA’s determinations in Table 3 is provided after the table.

**Table 3 Fine Screening Analysis Pass/Fail Results**

Potential Corridor Alternative	Screening Criteria		
	Physical Characteristics	Operational Feasibility	Environmental Constraints
BNSF Corridor	Fail	Fail	Pass
UPRR Corridor	Fail	Fail	Pass
1-45 Greenfield Corridor	Fail	Fail	Fail
Utility Corridor	Pass	Pass	Pass

#### BNSF and UPRR Corridors

To operate within the BNSF or UPRR freight rail right-of-way would require the consent of the host railroad(s). In negotiations with TCR, BNSF and UPRR have declined to consent to share their right-of-way for the majority of distance between Dallas and Houston (TCR 2015), but will continue to negotiate for use of the freight rail right-of-way for short distances needed to enter downtown Dallas and downtown Houston. Therefore, FRA deems it infeasible to use existing freight rail right-of-way in the BNSF and UPRR Corridors.

To be located immediately adjacent to but outside of the freight rail right-of-way would require that TCR construct a barrier wall between the freight rail tracks and the high-speed rail tracks for safety purposes. This is to prevent derailment of one service from colliding with the other service. The cost of an approximately 240-mile barrier wall exceeds TCR's purpose in that the Project would not be economically viable.

Another option is to locate the high-speed rail two-track at a safe distance away from the freight rail tracks. Separation from the freight rail right-of-way would be anticipated to result in greater property impacts compared to using a portion of or being located immediately adjacent to the existing freight rail right-of-way.

Additionally, the existing freight rail rights-of-way are not suitable for safe operation of higher- or high-speed passenger rail service. Freight rail service uses diesel locomotives with steel wheel on steel track technology and travels up to 80 mph. Because freight rail lines travel at slower speeds and the rail lines were established a century ago or earlier, there are frequent curves along the track. Passenger rail service is permitted to travel at higher speeds than freight rail service. FRA defines core express high-speed passenger service as having train speeds 150 mph or higher. Even though high-speed trains can travel at faster speeds than freight trains, all trains are affected by curves in the track and slower speeds are required by FRA through sharper curves to prevent derailment. Because the freight rail tracks were designed to accommodate a different type of service and technology, and were built as an early form of transportation typically following the topography of the land, both the BNSF and the UPRR Corridors have numerous curves. To be located roughly adjacent to but at a safe distance from the existing freight rail right-of-way would require that the high-speed rail service travel at slower speeds and would not meet the 90-minute travel time required by TCR to be competitive with air travel.

If the high-speed rail line were to diverge from the BNSF and UPRR Corridors to create a corridor with fewer curves, these potential corridor alternatives would parallel the existing rail rights-of-way less than 40 percent of the 240-mile distance between the Dallas and Houston metropolitan regions. Therefore, these potential corridor alternatives would no longer be consistent with the BNSF or UPRR Corridors identified in previous high-speed rail studies, would not take advantage of existing infrastructure right-of-way identified in TCR's functional requirements, and would be anticipated to result in greater property impacts.

FRA eliminated the BNSF and UPRR Corridors from further consideration based on failure under the Physical Characteristics and Operational Feasibility screening criteria. Nonetheless, opportunities may exist for TCR to negotiate with BNSF and UPRR to locate the high-speed rail track adjacent to or within the right-of-way of the host railroad for short distances in order to avoid significant impacts. This concept will be considered in more detail in the alignments screening analysis.

#### I-45 Greenfield Corridor

The I-45 Greenfield Corridor presents similar challenges. The I-45 Greenfield Corridor would generally parallel the existing interstate travel lanes on either the east or west side within the right-of-way. However, adequate high-speed rail right-of-way does not exist throughout the entirety of the interstate

right-of-way to accommodate the two-track alignment with necessary separation or barriers/elevation changes for safety and maintain the existing travel lanes and frontage roads. It would be necessary to expand the interstate right-of-way or locate the high-speed rail right-of-way adjacent to the interstate right-of-way.

The I-45 Greenfield Corridor extends from north to south through the Sam Houston National Forest. The interstate right-of-way within the boundaries of the forest is narrow to maximize acreage within the forest. To widen the interstate right-of-way within the forest or locate the high-speed rail right-of-way adjacent to the interstate right-of-way would be anticipated to create significant impacts to recreation resources and managed habitat, as shown in Table 2. In comparison to the other potential corridor alternatives, the I-45 Greenfield Corridor has the potential for tremendous environmental impacts that would not be anticipated to result from any of the other potential corridor alternatives. Therefore, FRA eliminated the I-45 Greenfield Corridor from further consideration based on failure under the Environmental Constraints screening criterion.

The interstate was designed for automobile travel and the curves are sharper than the operations of a high-speed train can safely allow. To roughly parallel I-45 would require slower speeds around curves and would not achieve the TCR's technical requirement of a 90-minute travel time. If the high-speed right-of-way were to diverge from the interstate to avoid the curves, it would parallel the interstate less than 60 percent of the 240-mile distance between Dallas and Houston. Therefore, this potential corridor alternative would no longer be consistent with the I-45 Greenfield Corridors identified in previous high-speed rail studies, would not take advantage of existing infrastructure right-of-way identified in TCR's functional requirements, and would be anticipated to result in greater property impacts.

Additionally, there are numerous roadway interchanges along I-45 and roadway bridges spanning the interstate. Because the proposed high-speed rail system must operate in a fully sealed, grade-separated corridor, roadway interchanges and roadway bridges present a physical constraint from both horizontal and vertical perspectives that must be designed and constructed around. Accommodating existing transportation infrastructure such as interchanges while maintaining a sealed corridor adds a level of complexity to the design of the high-speed rail alignment, increasing both cost and construction time in comparison to other potential corridor alternatives. It also has the potential to affect large groups of people who travel in the vicinity of the construction area from numerous temporary roadway and lane closures during construction. It has the potential to result in permanent impacts to the transportation system because it may require permanent road closures or substantial re-routing of the roadway, and would be likely to require the acquisition of private property to accommodate changes to the roadway network. The reconfiguration of every roadway crossing and interchange along the I-45 Greenfield Corridor was deemed infeasible by TCR based on the substantial increase in cost and additional years of construction time (TCR 2015).

Because it was deemed economically infeasible by the Proponent, FRA eliminated the I-45 Greenfield Corridor from further consideration. FRA also determined that the I-45 Greenfield Corridor fails under the Physical Characteristics, Operational Feasibility, and Environmental Constraints screening criteria. Nonetheless, opportunities may exist for TCR to locate the high-speed rail two-track alignment within or

adjacent to the interstate right-of-way for short distances. This concept will be considered in more detail in the alignments screening analysis.

#### Utility Corridor

The Utility Corridor would parallel high-voltage electrical transmission lines owned by Centerpoint Energy and Oncor Electric Delivery. However, adequate high-speed rail right-of-way does not exist within the existing utility easements to provide the required separation distances between the electrical transmission poles and towers and the high-speed rail two-track alignment. It would be feasible to parallel the existing Centerpoint Energy and Oncor Electrical Delivery electrical transmission lines for more than 70 percent of the existing utility easements. The utility easement is generally straight and would not require many divergences for curves or to avoid crossing the utility lines. Additionally, a reduction in the train speed is not anticipated due to the limited number of curves along Utility Corridor. TCR preliminarily identified the Utility Corridor as appropriate to meet the 90-minute travel time and to meet TCR's other technical requirements. Therefore, FRA determined that the Utility Corridor be carried forward for further consideration because it passes the Physical Characteristics, Operational Feasibility, and Environmental Constraints screening criteria.

#### **4.4 Potential Corridor Alternatives Retained for Further Analysis**

FRA determined that the Utility Corridor should be retained for further investigation. It has the potential to meet TCR's purpose and technical requirements for high-speed passenger rail service between the Dallas and Houston metropolitan regions. There are no physical characteristics, operational feasibility, or environmental constraints at this first planning stage that would result in FRA eliminating the Utility Corridor from further consideration. Therefore, FRA carries the Utility Corridor forward into the alignments screening analysis. FRA's next step will be to identify and screen potential location alternatives within corridors and potential station area alternatives. FRA also determined that the BNSF, UPRR, and I-45 Greenfield Corridors should be retained for further investigation for portions of these corridors in the event that constraints arise along the Utility Corridor that warrant potential location alternatives within portions of these eliminated corridors that avoid the constraints.

Based on the evaluation documented in this report, a second screening analysis will be conducted. The second screening analysis will provide a more detailed evaluation of the range of potential location alignments near and within the Utility Corridor recommended in this Corridor Alternatives Analysis. Combined with station area locations, the alignments screening analysis will evaluate the location alignments within this corridor to identify the Build Alternatives that will be the subject of the evaluation in the EIS.

## 5. REFERENCES

Federal Railroad Administration, High-Speed Rail in America: High-Speed Rail Strategic Plan, April 2009, available online at: <https://www.fra.dot.gov/eLib/Details/L02833>.

Texas Central High-Speed Railway, *Step 1 Screening of Alternatives Report: Dallas-Houston, Texas, High-Speed Rail Project*, March 22, 2015, available online at: <http://www.texascentral.com/>.

Texas Department of Transportation, *Texas Rail Plan*, November 2010.