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SB 1524: Preliminary Review Report

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SB 1524 Study: Impact on pavements and bridges by vehicles operating with an Intermodal Containers Permit from or to a port authority that is located contiguous to the Gulf of Mexico or inlet opening into the gulf and does not exceed 30 miles from the port authority.

This Technical Memorandum was prepared in collaboration with the Texas Department of Transportation (TxDOT), the Texas Department of Motor Vehicles (TxDMV), the University of Texas at Austin (UT Austin) and the University of Texas at San Antonio (UTSA) in response to Senate Bill 1524 of the 85th Texas Legislative Session.

1. Senate Bill 1524

This study was conducted to evaluate the impact on infrastructure assets (pavements and bridges) in Texas network of permits issued under the provisions of Senate Bill 1524 (SB 1524) of the 85th Texas Legislative Session, which was implemented under the 2023 Texas Statutes Transportation Code, Title 7: Vehicles and Traffic, Subtitle E: Vehicle Size and Weight, Chapter 623: Permits for Oversize or Overweight Vehicles, Subchapter U: Intermodal Shipping Containers, Sections 623.401 to 623.411. The SB1524 relates to the movement of vehicles transporting an intermodal shipping containers, which in the bill context means an enclosed, standardized, reusable container that: *(i) is used to pack, ship, move, or transport cargo; (ii) is designed to be carried on a semitrailer and loaded onto or unloaded from: a ship or vessel for international transportation or a rail system for international transportation; and (iii) when combined with vehicles transporting the container, has a gross weight or axle weight that exceeds the limits allowed by law to be transported over a state highway or county or municipal road.*

SB 1524 authorized the Texas Department of Motor Vehicles (TxDMV) to issue an annual permit named "Intermodal Shipping Container" (ISC) to a truck-tractor and semitrailer combination with six- or seven-axles, adhering to the specific axle weight and spacing restrictions presented in **Table 1.1** and followed by a schematic representation depicted in **Figure 1.1**.

Table 1.1 Summary of vehicle configuration restrictions under SB 1524

Axle configuration limits	6-axle	7-axle
Max. Gross vehicle weight:	93,000 lbs.	100,000 lbs.
Max dist. between 1st and last axle:	647 in.	612 in.
Truck-tractor		
Max. load for single axle:	13,000 lbs.	15,000 lbs.
Max. load for 2-axle group:	37,000 lbs.	n/a
Max. load per axle:	18,500 lbs.	n/a
Max. distance between axles[1]:	51 - 52 in.	n/a
Max. load for 3-axle group:	n/a	44,500 lbs.
Max. load per axle:	n/a	14,900 lbs.
Max. distance between axles[1]:	n/a	60 in.
Semitrailer		
Max. load for 3-axle group:	49,195 lbs.	46,200 lbs.
Max. load per axle:	16,400 lbs.	15,400 lbs.
Max. distance between axles[1]:	60 in.	60 in.

[1] Distance between axles of the same axle-group.

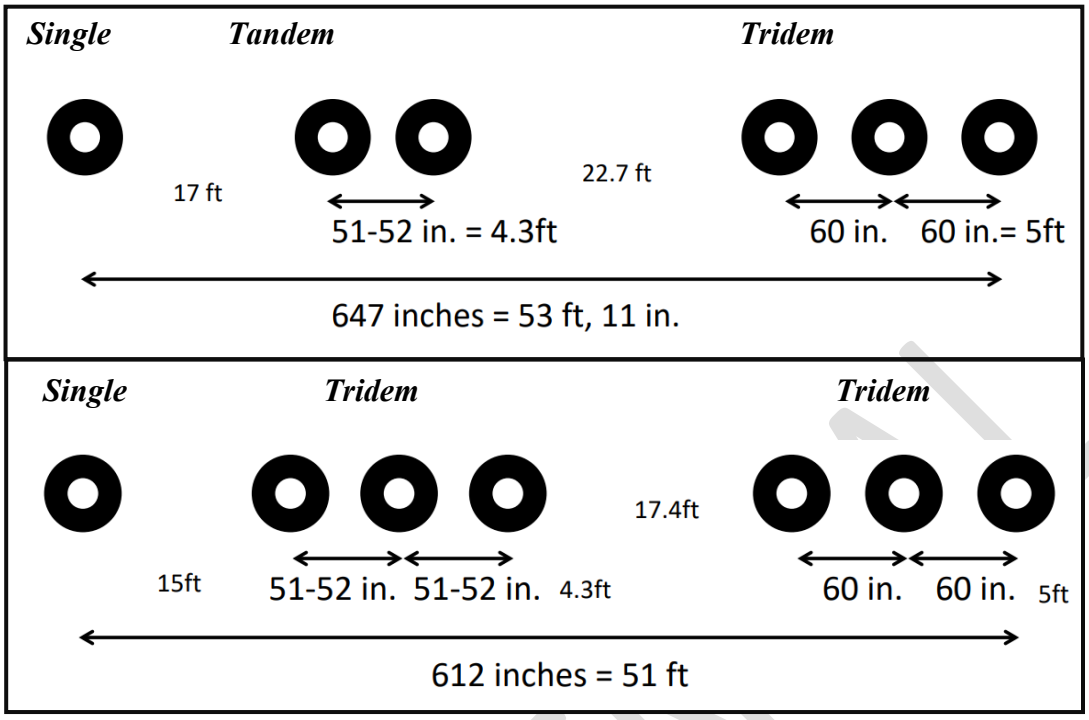

Figure 1.1 Representative vehicles scheme

The TxDMV initially set the permit fee under this bill at $6,000. However, every two years, the Texas Department of Transportation (TxDOT) should reassess and adjust this fee based on a reasonable estimate of the costs associated with the infrastructure assets maintenance and repair. It should be noted that there is a 4 percent administrative fee retained by TxDMV so only $5,760 are directed to pavement and bridge maintenance and repairs.

2. Vehicle Configuration

The TxDMV provided data from the Texas Permit Routing Optimization System (TxPROS) on ISC permits to support the study team in establishing representative vehicle configurations for pavement and bridge analysis. The TxPROS database was analyzed from 2018 to 2023, revealing a total of 1,614 ISC permits. However, information regarding vehicle configuration, particularly axle-weight and spacing, was unavailable for these permits. In contrast, axle information was available for other types of truck permits, such as the "General" permits. Therefore, in order to assess the axle weigh distributions, the study team evaluated data from motor carriers that applied for "General" permits.

To ensure the analyzed vehicles matched the representative vehicles under the provision of SB 1524, only the vehicles complying with the restrictions from **Table 1.1** were assessed. Based on the observed axle weight distribution, nine different

loading scenarios were evaluated by means of a sensitivity analysis. These configurations are shown in **Table 2.1.**

Table 2.1 Loading scenarios for the 6- and 7-axle vehicle configurations

	Axle weight (lbs.)			
Axle Group Configuration	**Single**	**Tandem**	**Tridem**	**GVW (lbs.)**
1-2-3	11,000	32,805	49,195	93,000
	11,000	35,000	47,000	93,000
	11,000	37,000	45,000	93,000
	12,000	31,805	49,195	93,000
	12,000	35,000	46,000	93,000
	12,000	37,000	44,000	93,000
	13,000	30,805	49,195	93,000
	13,000	35,000	45,000	93,000
	13,000	37,000	43,000	93,000
Axle Group Configuration	**Single**	**Tridem**	**Tridem**	**GVW (lbs.)**
1-3-3	11,000	42,800	46,200	100,000
	11,000	44,500	44,500	100,000
	11,000	46,200	42,800	100,000
	13,000	40,800	46,200	100,000
	13,000	43,500	43,500	100,000
	13,000	46,200	40,800	100,000
	15,000	38,800	46,200	100,000
	15,000	42,500	42,500	100,000
	15,000	46,200	38,800	100,000

3. Vehicle Miles Traveled

Vehicles operating under the provisions of SB 1524 must begin, or end, at a port authority (or port of entry) that is located contiguous to the Gulf of Mexico or a bay (or inlet) opening into the gulf and may not exceed 30 miles from the port authority or port of entry (**Figure 3.1**).

A permit issued under this bill does not authorize the operation of a truck-tractor and semitrailer combination on the national system of interstate and defense highways (Interstate Highways) or on load-restricted roads or bridges, including roads or bridges with maximum weight and load limits established and posted by the Texas Department of Transportation (TxDOT).

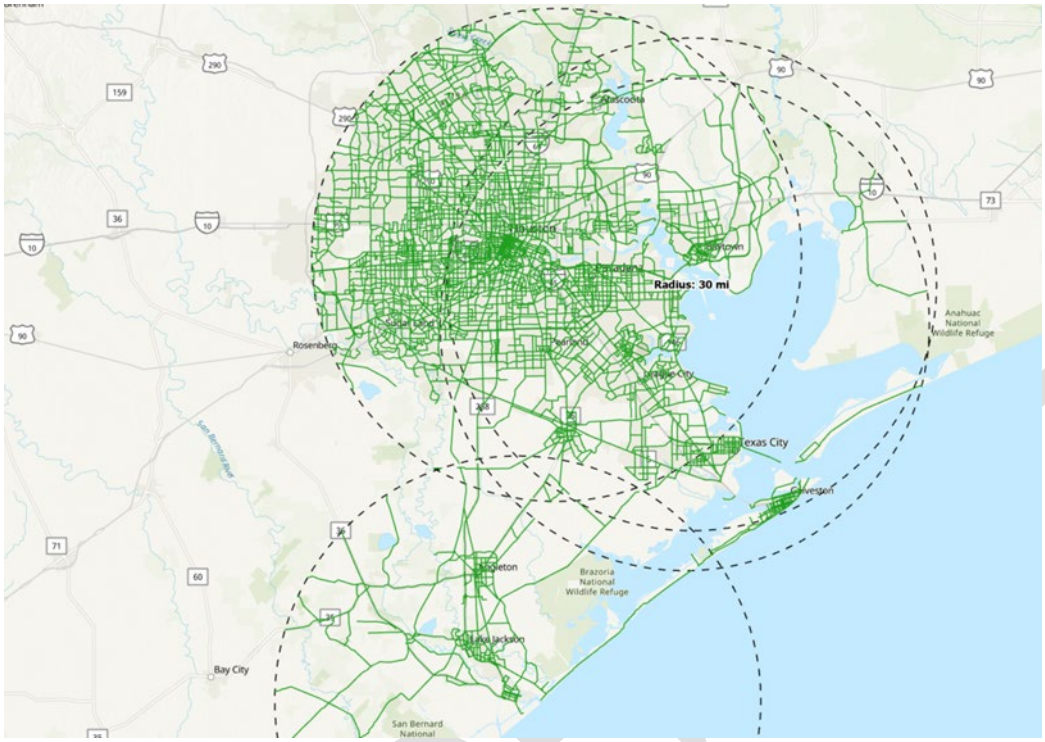

Figure 3.1 Highway network under the provisions of SB 1524

The restricted highway network (**Figure 3.1**) encompasses 5,671 centerline miles (1,797 miles on-system and 3,874 miles off-system), accounting for 3,243 bridges (925 on-system and 2,318 off-system). It should also be noted that 727 of these ISC permits have been issued between 2022 and 2023, which correspond to the analysis period that this study addresses.

4. Pavement Analysis

The pavement analysis was based on the methodology developed during the study conducted for the House Bill 2223 (Prozzi et al., 2022a), which was based on the equivalent consumption factor (ECF) concept. The ECF represents the relationship between the amount of pavement life a given axle configuration consumes relative to the standard axle. Traditionally, the standard axle is a single axle loaded to 18,000 lbs., commonly referred to as and equivalent single axle load (ESAL).

The pavement structures within a 30-mile radius of each of the four Gulf ports addressed in this study include: asphalt concrete pavements (ACP), surface treated pavements (STP), jointed concrete pavements (JCP/JRCP), and continuously

reinforced concrete pavement (CRCP). The failure criteria adopted for each pavement type are summarized in **Table 4.1**.

Table 4.1 Failure criteria adopted for ACP

Failure Criteria	Pavement Type			
	ACP	STP	JCP	CRCP
Rutting	0.5 in	0.5 in		
Fatigue Cracking	25% area	25% area		
Roughness[1]	172 in/mi	172 in/mi	172 in/mi	172 in/mi
Transverse Cracking			14% area	
Faulting			0.12 in	
Punchout				10 units/mi

[1] An initial IRI of 63 inches per mile was used in the analysis.

Due to the inherent differences in the foregoing failure mechanisms, it is impossible to reach all terminal distress levels simultaneously at the end of the design period. Although one would develop separate ECFs based on each failure criterion, from a practical point of view, a given axle configuration should result in a single ECF. Therefore, after calculating the ECF for each failure mechanism separately, a weighted average was employed based on distribution of the different pavement structures. Note that, by definition, axles with an ECF of less than one will take longer than the design period (20 years) to reach the failure criteria; while axles associated with an ECF of greater than one will take less than the design period to reach the same failure condition. The total ECF for the 6-axle and 7-axle vehicles are presented in **Table 4.2** and **Table 4.3**.

Table 4.2 Equivalent consumption factors for the 6-axle vehicle

Loading Scenario	Axle Group (lbs.)			ECF
	Single	Tandem	Tridem	
1	11,000	32,805	49,195	3.55
2	11,000	35,000	47,000	3.61
3	11,000	37,000	45,000	3.74
4	12,000	31,805	49,195	3.48
5	12,000	35,000	46,000	3.56
6	12,000	37,000	44,000	3.70
7	13,000	30,805	49,195	3.43
8	13,000	35,000	45,000	3.52
9	13,000	37,000	43,000	3.68

Table 4.3 Equivalent consumption factors for the 7-axle vehicle

Loading Scenario	Axle Group (lbs.)			ECF
	Single	Tridem	Tridem	
1	11,000	42,800	46,200	3.01
2	11,000	44,500	44,500	2.99
3	11,000	46,200	42,800	3.01
4	13,000	40,800	46,200	2.97
5	13,000	43,500	43,500	2.93
6	13,000	46,200	40,800	2.97
7	15,000	38,800	46,200	3.01
8	15,000	42,500	42,500	2.94
9	15,000	46,200	38,800	3.01

The inherent variability of each ECF was another key concern. For example, an ECF calculated based on surface rutting criterion could result in lower uncertainty as compared to an ECF calculated based on fatigue cracking or roughness criteria, which are predicted with higher uncertainty. Thus, for the ECFs with lower variability, the research team employed a relatively higher weight. In analyzing the allowed route under this permit, the ECF was obtained as the average plus one standard deviation, resulting in ECF values of 3.69 and 3.01 for the 6-axle and 7-axle vehicles, respectively.

Based on the above-reported values, the state average unit consumption cost for Texas pavements was 7.2 cents per ESAL per mile (based on April 2024 dollars). Thus, the calculated average consumption cost for the 6-axle and the 7-axle vehicles are $0.267/mi and $0.218/mile, respectively.

5. Bridge Analysis

The bridge consumption methodology treated each passage of the representative vehicle configuration (**Table 1.1**) as a fractional consumption of the bridge's design life, using the moment ratio concept. This procedure was extensively documented on similar bridge consumption cost determination studies (Weissmann et al., 2024).

The bridge consumption analysis is generally divided between state-managed bridges (on-system) and local-managed bridges (off-system) due to the requirements of the analytical procedures and data availability. The consumption per mile for off-system bridges was higher than that for on-system bridges due to their lower load ratings. Lastly, by combining both on- and off-system bridge results, a total bridge consumption cost per mile was obtained for each representative vehicle and loading scenario; The unit costs for each loading scenario are summarized in **Table 5.1** and **Table 5.2**.

Table 5.1 Bridge consumption for the 6-axle vehicle

Loading Scenario	Consumption Cost ($)	Network Mileage (miles)	Cost per mile ($/mi)
1	1,316	5,671	0.23
2	1,249	5,671	0.22
3	1,223	5,671	0.22
4	1,302	5,671	0.23
5	1,209	5,671	0.21
6	1,207	5,671	0.21
7	1,288	5,671	0.23
8	1,190	5,671	0.21
9	1,196	5,671	0.21

Table 5.2 Bridge consumption analysis for the 7-axle vehicle

Loading Scenario	Consumption Cost ($)	Network Mileage (miles)	Cost per mile ($/mi)
1	1,767	5,671	0.31
2	1,812	5,671	0.32
3	1,874	5,671	0.33
4	1,718	5,671	0.30
5	1,766	5,671	0.31
6	1,865	5,671	0.33
7	1,671	5,671	0.29
8	1,723	5,671	0.30
9	1,858	5,671	0.33

Tables 5.1 and **5.2** indicate that the bridge consumption per mile was higher for the 7-axle vehicle (100,000 lbs.) in comparison to the 6-axle vehicle (93,000 lbs.). This finding supports the fact that bridge consumption is governed by GVW and axle spacing, unlike pavement consumption, which is close related to axle weight. The calculated average cost per mile for the 6-axle and 7-axle vehicles are $0.219 and $0.313, respectively, expressed in April 2024 dollars.

6. Infrastructure Consumption Analysis

The total infrastructure consumption, combining both bridge and pavement consumption costs, are $0.49/mile and $0.53/mile for the 6-axle and 7-axle vehicles, respectively.

From January 2022 to December 2023, 727 ISC permits were issued; however, no information is available regarding the annual vehicle miles traveled (VMT) for these permits. To address this limitation, a sensitivity analysis was performed to estimate the mileage at which the total infrastructure consumption cost equals the permit fee. Total pavement and bridge consumption was calculated for a range of VMTs from 2,300 to 328,000 miles; the results are shown in **Table 6.1** and **Table 6.2** for the 6- and 7-axle truck, respectively.

Table 6.1 Infrastructure consumption for the 6-axle vehicle

VMT	Pavement Consumption	Bridge Consumption	Total Consumption
2,300	$613.28	$503.44	$1,116.73
5,000	$1,333.23	$1,094.44	$2,427.67
10,000	$2,666.45	$2,188.89	$4,855.34
11,863	**$3,163.22**	**$2,596.68**	**$5,759.89**
24,637	$6,569.34	$5,392.77	$11,962.11
50,000	$13,332.27	$10,944.44	$24,276.72
100,000	$26,664.55	$21,888.89	$48,553.44
200,000	$53,329.09	$43,777.78	$97,106.87
328,000	$87,459.71	$71,795.56	$159,255.27

Table 6.2 Infrastructure consumption for the 7-axle vehicle

VMT	Pavement Consumption	Bridge Consumption	Total Consumption
2,300	$500.72	$720.67	$1,221.38
5,000	$1,088.52	$1,566.67	$2,655.18
10,000	$2,177.03	$3,133.33	$5,310.37
10,846	**$2,361.21**	**$3,398.41**	**$5,759.62**
24,637	$5,363.56	$7,719.59	$13,083.15
50,000	$10,885.17	$15,666.67	$26,551.83
100,000	$21,770.34	$31,333.33	$53,103.67
200,000	$43,540.67	$62,666.67	$106,207.34
328,000	$71,406.70	$102,773.33	$174,180.04

Based on the results of the sensitivity analyses presented in **Tables 6.1** and **6.2**, the current permit fee is only adequate for 6-axle vehicles traveling up to 11,863 annual miles and for 7-axle vehicles traveling an annual mileage up to 10,846.

The study team, in collaboration with personnel from TxDOT's Maintenance Division, administered an online survey to request VMT information directly from the carriers that applied for such permits from January 2022 to December 2023. The response to the survey was limited but insightful and the self-reported VMT

data varied over a very wide range, i.e., from 2,300 to 328,000 annual miles. Due to the high variability of the self-reported values, the study team decided to use the median reported value of 49,274 miles. Assuming that the vehicles are fully loaded in one direction, it is reasonable to assume that the median VMT of 24,637miles. Therefore, and based on the self-reported median VMT values, the permit fee should be raised to $13,000 per permit to fully recover the pavement and bridge consumption costs.

7. Crash Analysis

During 2022 and 2023, 68 crashes were reported involving vehicles that have applied for this permit. These 68 crashes involved 229 different vehicles. For seven of these crashes there is no location information, another six crashes occurred outside the area of interest. Of the 229 vehicles involved, only four were flagged as "Intermodal Container Permit", 89 were not flagged and the remaining 136 are unknown. **Table 7.1** is based on the flagged vehicles only.

Table 7.1: Motor Vehicle Traffic Crashes involving Permitted Vehicles

Crash Year	Fatal Crashes	Suspected Serious Injury Crashes	Suspected Minor Injury Crashes	Possible Injury Crashes	Non-Injury Crashes	Unknown Injury Crashes
2022	0	0	0	0	4	0
2023	0	0	0	0	0	0

The information contained in **Table 7.1** represents reportable data collected from Texas Peace Officer's Crash Reports (CR-3) received and processed by the Texas Department of Transportation (TxDOT). A reportable motor vehicle traffic crash is defined as: *"Any crash involving a motor vehicle in transport that occurs or originates on a traffic way, results in injury to or death of any person, or damage to the property of any one person to the apparent extent of $1,000."*

Federal highway safety laws require the state to create this crash database for use in obtaining federal safety improvement funds. Section 409 of Title 23 of the United States Code, forbids the discovery and admission into evidence of reports, data, or other information compiled or collected for activities required pursuant to Federal highway safety programs, or for the purpose of developing any highway safety construction improvement project, which may be implemented utilizing federal-aid highway funds, in tort litigation arising from occurrences at the locations addressed in such documents or data. Information that is not available to a party in civil

litigation may be confidential under state law, pursuant to Texas Government Code Section 552.111. For definitions, please go to: http://www.txdot.gov/inside-txdot/forms-publications/drivers-vehicles/publications/annual-summary.html and view the Annual Motor Vehicle Crash Data Report Definitions report (TxDOT, 2020).

8. Conclusions

In preparation of this report, the study team gathered and evaluated relevant permit data provided by the Texas Department of Motor Vehicles (TxDMV), as well as crash data from the Crash Records Information System (CRIS) provided by the Texas Department of Transportation (TxDOT). To reach the conclusions of this study, the following data were analyzed:

- Gross vehicle weights, axle weight and spacing of vehicles complying with the same axle configuration restrictions of those operating under an Intermodal Shipping Container permit;
- Restricted highway network at a port authority (or port of entry) located in a county contiguous to the Gulf of Mexico (or a bay or inlet opening into the gulf) within a 30-miles-radius from the port authority (or port of entry);
- Crash records involving vehicles with an Intermodal Shipping Container permit and within the area of interest for this study.

The study team aggregated this information and, based on the methodology developed during the HB 2223 Study, conducted a series of analyses on the area of interest to determine and quantify the pavement and bridge consumption, along with its associated costs. A sensitivity analysis revealed that the current fee structure is adequate if the 6-axle vehicle (93,000 lbs.) and the 7-axle vehicle (100,000 lbs.) drive up to 11,863 and 10,846 miles, respectively, per year. However, if the annual VMT exceeds these values, the current annual fee will not cover the consumption costs of roads and bridges.

References

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