An Analytical Framework for Evaluating Potential Truck Parking Locations

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Abstract

As the number of trucks on the road continues to increase, mandatory rest periods combined with a decreasing number of parking spaces and amenities geared towards truck drivers have created a paradoxical yet often overlooked issue of truck parking shortage. Especially within the urbanized landscape of New Jersey, truck stops are rarely considered as the highest and best use form of development and those that exist are often expensive to operate. Most of the existing research on this issue has focused on parking demand modeling or applications of the intelligent transportation system technology to improve the use of existing truck stops. Nonetheless, limited previous research has focused on expanding truck parking capacity. This study develops a methodological framework for evaluating some of the important social, economic, and environmental factors when planning the development of a new truck parking facility. With an example application to the State of New Jersey, this study presents a step-by-step analytical process to help prioritize potential truck parking locations. The results will be useful to develop a practical tool that can be utilized by the private and public sectors involved in addressing regional freight parking capacity shortfall and safety concerns.

Keywords: truck parking; location analysis; cost-benefit analysis

1. Introduction

The United States is experiencing continued growth in commercial vehicle travel on national roadway systems and while facing critical shortages in truck parking facilities. In addition, new federal legislation on hours-of-service (HOS) for truck drivers requires a maximum of 70 hours of driving within a week and a 30-minute break during the first eight hours of a shift. In areas with congested freight operations and inadequate parking facilities, a fatigued driver may continue to drive long distances seeking for parking on highway shoulders, thereby introducing safety and environmental hazards. As such, there is a pressing need to strategically expand or develop existing or new truck parking facilities.

As one of the largest consumer markets and a national gateway for freight movements, the State of New Jersey is experiencing substantial increase in freight traffic and correspondingly, truck parking demand. The North Jersey Transportation Planning Authority has laid the groundwork for identifying the need for additional truck parking in Northern New Jersey area. According to their two-phase studies (Federal Highway Administration, 2012a; Federal Motor Carrier Safety Administration, 2015), more than 80% of the 34 observed truck parking facilities in the region were over capacity, and almost 100% more parking spaces were needed to meet the demand in 2006. In view of growing freight traffic, the gap between parking space demand and supply is expected to widen in the years to come.

To help regional planners evaluate the social, economic, and environmental factors associated with truck parking site selection and facility development, this study investigates a semi-quantitative methodological framework that accounts for these factors. In line with the strategic development of freight infrastructure, the proposed framework can be a practical tool that provides decision makers with engineering guidelines and economic insights for alleviating congestion, facilitating compliance of the HOS requirement, and reducing the safety hazards. By attempting to highlight some of the more important factors to consider when developing truck parking site selections, this framework paves the way for more detailed and relevant cost-benefit analyses. Building upon the premise of a traditional environmental impact analysis, our methodology expands to include economic and safety factors and integrate the most relevant quantitative modeling approaches from existing literature, thus serving as the foundation for more detailed cost-benefit analyses.

This paper is organized as follows. Section 2 reviews previous research related to the development or expansion of truck parking facilities. Section 3 presents a framework to systematically integrate most important factors related to the truck parking location decision. Section 4 illustrates the methodology through a numerical example of a candidate truck stop site in the State of New Jersey. Section 5 summarizes principal research findings and proposes future research directions.

2. Literature Review

Many studies conducted by metropolitan planning organizations (MPOs) and state departments of transportation (DOTs), such as Federal Highway Administration (2012a), Federal Motor Carrier Safety Administration (2015), North Jersey Transportation Planning Authority (2008, 2009), Delaware Valley Regional Planning Commission (2011), Office of Intermodal Project Planning (2001), and Minnesota Department of Transportation (2010), have highlighted a deficit in truck parking that is expected to increase over the next decade. Federal Highway Administration (2012a), Federal Motor Carrier Safety Administration (2015), and North Jersey Transportation Planning Authority (2008) have used a parking demand model developed in Pécheux et al. (2002). Although funding for expanding parking capacity is available, competition and priority issues among other freight and transportation projects along with limited availability make it a challenging and often overlooked problem. For example, a 2014 survey amongst over 4,000 stakeholders identified the parking problem only as the 6th (out of 10) most critical issue facing the trucking industry (Transportation Research Board, 2003). Those funding sources and their associated challenges were detailed by the United States DOT (Federal Highway Administration, 2012b).

Research into possible mitigating solutions has primarily focused on intelligent transportation system technology in the form of interconnected, dynamic parking systems where capacity data can be transmitted directly to the truck drivers through electronic message signs, text message alerts, GPS devices, or radio (I-95 Corridor Coalition, 2009). The I-95 Corridor Collation (2015) has developed a plan for the implementation of such technologies coupled with certain increases in parking capacity, marketing tactics, development of future sustainability plans and the coordination of multiple MPOs and state DOTs across the Northeast and Mid-Atlantic Corridor. Additional mitigation strategies have focused on the commercialization debate and the need for public-private partnerships. The United States DOT recommended the use of public-private partnerships (Federal Highway Administration, 2012b).

While many previous studies called for expanded capacity, only one study included a methodology for site selection that could be used across regional boundaries. Caltrans and the Alameda Contra Costa County Medical Association looked at 33 sites and qualitatively rated them according to various characteristics, ranging from accessibility to economic impact (The Tioga Group, Inc., 2008). Whereas the previous work relies on a qualitative rating scale, this study aims to develop a semi-quantitative methodology by quantifying and where possible, effectively monetizing the social, economic, and environmental consequences associated with developing or expanding any truck stop.

Transportation based cost-benefit methodologies have been the topic of multiple sources (Lewis and Currie, 2016; Litman and Doherty, 2009; Xu and Lambert, 2015). With regards to the development of truck stops, such insights have been very limited. The complete quantification of the social, economic, and environmental costs and benefits associated with developing truck stops is a challenging task due to the lack of data and proper methodologies, each of which requires a separate research effort. Thus, instead of focusing on such cost-benefit methodologies, the purpose of this review is analyzing the previous research highlighting relevant factors to be considered in the truck stop development. As an initial exploration, this research will lead to a larger cost-benefit analysis research regime for freight infrastructure expansion.

3. Methodology

This section is composed of five parts, beginning with an examination of the different data sets and techniques employed throughout the paper. Next, demand estimation, safety analysis, economic and environmental methodologies are explained, along with individual analyses of how future studies and research into these topics should be conducted. Such factors are visualized in Figure 1. Each of these methodologies is additionally employed in the numerical case study in Section 4.

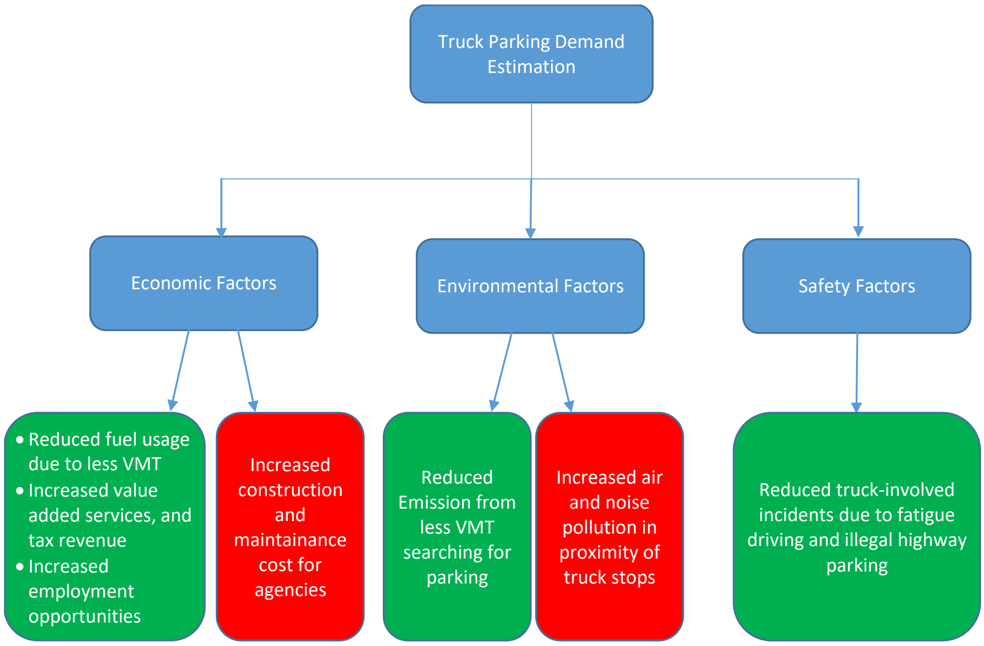

Figure 1. Flow chart of the proposed methodology.

3.1 Data Sources

Demand modeling uses equations and parameters developed by Pécheux et al (2002). Data related to economic and fiscal factors was gathered from Reference USA (2014), a database commonly used for business and consumer research. Truck stops and related businesses are listed under the Standard Industrial Classification (SIC) code 554103. In order to determine economic indicators on a per parking space and per acre basis, multiple datasets from TruckStopGuide.com (2014) were downloaded and compiled. Tax records obtained from New Jersey Transparency Center (2015) were utilized to determine fiscal indicators for each parcel, as part of the economic methodology. The air pollution and noise data and their effects on property values is based on hedonic regressions performed by Chay and Greenstone (2005) and Palmquist (1980). The safety data were obtained from the Plan4Safety New Jersey Crash Database, developed by the Rutgers University Center for Advanced Infrastructure and Transportation. This database records detailed highway crash accident information, but it has not yet been fully geocoded. In this research, the database was utilized to estimate greenhouse gas reductions and analyze safety statistics associated with shoulder-parked and fatigued driver truck-related accidents at the highway corridor level. Lastly, air and noise pollution spatial modeling equations widely used in both academic and professional case studies have been applied in this study. Regulations for noise pollution emission and mitigation standards are in accordance with the Federal Highway Administration (2011) and New Jersey Department of Transportation (2011), respectively.

3.2 Truck Parking Demand Estimation

Before any analysis can be conducted, demand for truck parking is an important consideration in the planning process. In order to estimate truck parking demand at a specific location, this research employed the model developed by Pécheux et al (2002) and added several parameters according to the results from Delaware Valley Regional Planning Commission (2011). Rather than basing the demand for parking on the characteristics of a parking facility, the model predicts truck parking demand for a highway segment based on the total truck hours of travel and the time and duration of stops.

3.3 Safety Factors and Site Selection

As a major driver of developing highway truck stops, safety is an important factor in the context of site selection. Through the analysis of the New Jersey Plan4Safety Crash Database, it was found that approximately 400 accidents involving parked trucks and 10 accidents involving fatigued truck drivers have occurred in New Jersey in 2015. Furthermore, most of them are found to take place on the New Jersey Turnpike/Interstate 95 corridor of the State as shown in Figure 2. Therefore, this corridor, especially within its most heavily congested sections, would represent a candidate location for truck parking in New Jersey. Further research can be conducted to associate crash risk with truck-parking-related factors (Gates et al. 2013).

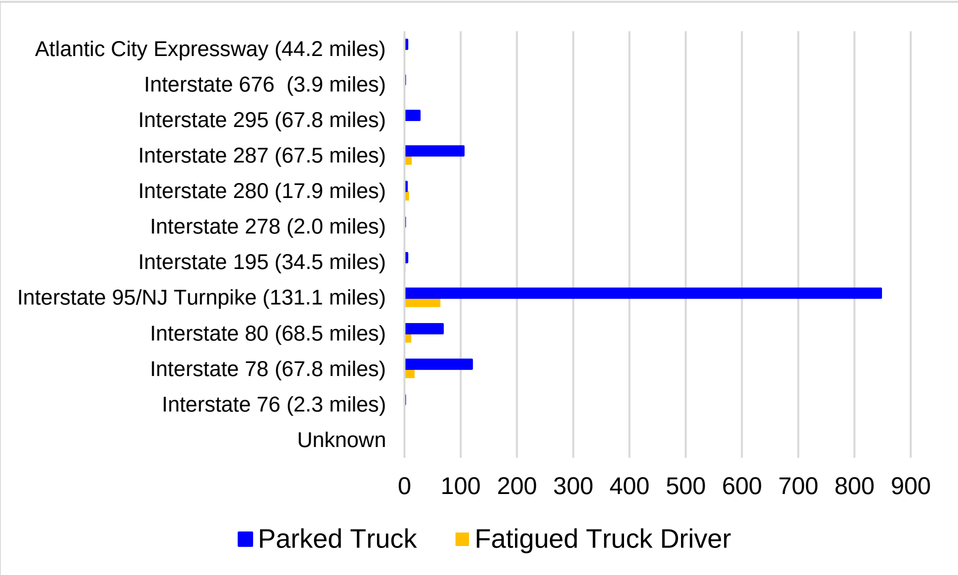

Figure 2. Number of accidents by New Jersey Interstate Highways (2003-2015).

3.4 Economic Analysis

To date, there are no known studies analyzing the economic impacts of truck stops. Recent work suggests that general rest stops bring economic benefits in the form of reduced excess driving, construction business, business and employment opportunities, tax revenue and value added services for commercial truck stops, as well as traveler comfort and tourism promotion; however, quantification of these benefits can be difficult (McArthur et al., 2013). This section quantifies possible benefits based on truck stop data in New Jersey.

In total, 86 locations containing long-term parking for trucks were identified within the State. Among them 29 locations were privately owned gas stations and 26 locations were missing significant data on TruckStopGuide.com (2014) datasets. Therefore, those sites were omitted, leaving a total of 31 applicable truck stops, which were broken down as 5 single-service and 26 full-service rest areas. Single-service rest areas solely provide fuel, restrooms, and overnight parking, while full-service rest areas additionally include available services such as food and repair shops.

Table 1 compiles economic averages for single-service and full-service truck stops in New Jersey. Of those full-service rest areas, 9 locations were identified as being larger than 15 acres in size. These larger rest areas are separately analyzed, as larger truck stops would help to reduce truck parking shortages and be more attractive to private investors. The decrease in job density for larger full-service truck stops can be attributed to most of the associated acreage being devoted to parking, where even as the number of parking space increases, the number of amenities and services provided will remain constant.

Table 1. New Jersey truck stop economic indicators.

	Total Parking Spaces	Total Acreage	Spaces per Acre	Aggregate Number of Employees Needed	Jobs per Acre
Single-Service Truck Stops	89	19.48	4.57	37 to 85	1.90 to 4.36
All Full-Service Truck Stops	2,208	364.75	6.05	564 to 1,298	1.55 to 3.56
Large Full-Service Truck Stops (15+ Acres)	1,682	280.95	5.99	315 to 740	1.12 to 2.63

Using the same datasets analyzed for the economic methodology (TruckStopGuide.com, 2014) along with the New Jersey tax records (New Jersey Transparency Center, 2015), the fiscal methodology attempted to analyze payroll, sales and property tax totals for the different breakdowns of the 31 rest areas. This information for 2014 is presented in Table 2.

Table 2. Fiscal data for existing New Jersey truck stops in 2014.

	Single-Service Truck Stops	All Full-Service Truck Stops	Large Full-Service Truck Stops (15+ Acres)
Payroll Volume & Tax (1%)			
Total Payroll	$3,300,000 - $11,600,000	$23,250,000 - $61,250,010	$10,750,000 - $37,500,000
Total Payroll Tax	$33,000 - $116,000	$232,500 - $612,500	$107,500 - $375,000
Payroll per Acre	$169,405 - $595,483	$63,742 - $167,923	$38,263 - $133,475
Payroll Tax per Acre	$1,694 - $5,954	$637 - $1,679	$382 - $1,335
Sales Volume & Tax (7%)			
Total Sales	$30,000,000 - $70,000,000	$502,000,000 - $1,695,000,000	$213,000,000 - $745,000,000
Total Sales Tax	$2,070,000 - $4,900,000	$35,140,000 - $118,650,000	$14,880,000 - $5,215,000
Sales Volume per Acre	$1,510,000 - $3,590,000	$1,380,000 - $4,650,000	$760,000 - $2,650,000

Sales Tax per Acre	\$110,000 - \$250,000	\$100,000 - \$330,000	\$50,000 - \$190,000
Property Tax			
Total Net Property Value	\$4,496,100	\$91,494,700	\$57,110,500
Total Prior Year Tax Amount (2014)	\$111,104	\$1,615,245	\$836,793
Net Property Value per Acre	\$230,806	\$250,843	\$203,276
Prior Year Net Tax Amount per Acre	\$5,704	\$4,428	\$2,978

The table shows there are notable differences in the per acreage values of each tax. The high payroll and property tax per acre efficiency for single-service rest areas can be attributed to a larger portion of such properties being devoted to revenue generating usage while larger full-service truck stop acreage will likely be devoted to actual non-revenue generating spaces, i.e., parking. The variations for payroll and sales volume taxes can be attributed to the fluctuations in the number of employees. Property tax on the other hand is solely based on the property specifics and is independent of total employees or sales volume, resulting in a specific figure for this category. Per-acre figures are utilized numerical example calculations in Section 4 to estimate revenues as a result of proposed truck parking development.

3.5 Environmental Factors and Analysis

Utilization of existing methods of spatial air and noise pollution measurement is proposed as a means of estimating the environmental impacts of developing a new truck stop, particularly to the neighborhoods.

3.5.1 Air Pollution Analysis

Although this study assumes that there will be no net increases in air pollution as a result of expanded truck parking, increased particulate concentrations in and around truck stops are expected to negatively affect nearby property values. It is estimated that every 1-$\mu g/m^3$ increase in total suspended particulates results in a 0.05% decrease in property values and vice-versa (Chay and Greenstone 2005). Precise reductions in air quality to the adjacent properties can be estimated using the Gaussian plume modeling equation (Stockie, 2011) shown in equation (1).

$$C(X, Y, 0) = [Q/(\Pi\times u\times\sigma_y\times\sigma_z)]\ EXP[(-H^2)/(2\times\sigma_z^2)]\ EXP[(-Y^2)/(2\times\sigma_y^2)] \qquad (1)$$

Where

C = Concentration at some specific point or receptor (grams per meters cubed)

Q = Source pollutant emission rate (grams per second)

Π = Pi

u = Horizontal wind velocity along plume centerline (meters per second)

σ_y & σ_z = Horizontal & Vertical dispersion coefficients (meters)

H = Effective plume stack height (meters)

Y = Downwind perpendicular distance (meters)
X = Downwind distance at which C is calculated (meters)

Given the flat terrain of New Jersey, the Z-coordinate is assigned a value of 0 since ground level is the most relevant in the case of analyzing emission levels of nearby properties. Note that horizontal and vertical dispersion coefficients vary based on downwind distance and atmospheric conditions. See Plume Dispersion Coefficients (2014) for a table providing these values. In order to fully utilize the Gaussian plume equation (1), a truck stop which consists of numerous individual point sources is considered as a single point source with plumes being emitted from the center of the truck stop.

3.5.2 Noise Pollution Analysis

Increases in noise pollution are inevitable in such a case where dispersed idling trucks are centralized into the new or expanded truck stops. This methodology takes into account the projected increases in noise as well as commonly implemented noise abatement criteria using the following basic equation:

Net Noise Pollution = Increase in Noise Level at Truck Stop – Noise Abatement Implementation

Changes in noise levels at the new or expanded truck stops can be computed through the following equation (2), while changes in sound level over distance is presented in equation (3) (Occupational Safety and Health Administration, 2014):

$$\Delta L = 10 \log_{10} n \quad (2)$$

Where ΔL = the decibel level increase and n = the number of equal sound sources.

$$2d = L - 6 \text{ dBA} \quad (3)$$

Where d = the distance from the sound source and L = the decibel level in dBA.

As the distance from the sound source is doubled, noise levels decrease by 6 dBA (Federal Highway Administration, 2011). Mandated by the Federal Highway Administration, maximum noise levels for large trucks are not to exceed 85 dBA 50 feet away. Combined, this data can be used to approximate sound values over different distances. For every 2.5 dBA increase in noise levels above 55 dBA, residential property values are assumed to decrease by 0.2% to 1.2% with wealthier communities, containing higher willingness to pay for peace and quiet, being more sensitive to such increases in noise pollution (Palmquist, 1980). Any truck stop development project will require a noise impact study that evaluates the feasibility of installing noise barriers to remediate the noise pollution problem. Specific noise remediation guidelines are determined by state, and municipal factors and those guidelines used by the New Jersey DOT based on existing land use are accessible via the website (New Jersey Department of Transportation, 2011).

4. Case Study in New Jersey

4.1 Site Selection

In this section, the proposed methodology has been applied to evaluate a 200-space, 46.76-acre parcel in Newark, New Jersey, identified by the North Jersey Transportation Planning Authority as a site of interest for a new truck stop. The site is along one of the busiest sections of the Interstate 95/New Jersey Turnpike Corridor. As Figure 2 shows, this is also on the corridor where the most truck-related accidents take place. A 30,000 square foot facility is also proposed, which would include a convenience store, multiple meal options, and maintenance facilities, in addition to a fueling station. Since the focus of this study is the methodology integration and development, the case study serves as an application example for illustration purpose.

Located on Hyatt Avenue in the Ironbound District of Newark and consisting of 5 separate parcels, the currently vacant site is just down the road from Port Newark and Port Elizabeth Marine Terminal and other related industrial sites. The site is situated between Interstate 95 and US 1-9, which also acts to separate it from any residential or noise-sensitive areas, which is especially useful in noise pollution evaluations. Additional nearby points of interest include the Interstate 95 and Interstate 78 junction and Newark Liberty International Airport. The site and surrounding areas are visualized in Figure 3.

Figure 3. Case study site location within Newark, New Jersey.

4.2 Parking Demand Analysis

The truck parking demand estimation formulas and associated model parameters in Pécheux et al. (2002) are applied to estimate the parking demand for each analysis segment. Regional Travel Model-Enhanced data is acquired from North Jersey Transportation Planning Authority to help select analysis segments with more than 1,000 trucks volume per day and provide traffic volume for conducting the demand model calculation. Additionally, the parking inventory of public rest areas and private truck stops for this segment were obtained given the distribution of truck parking facilities in New Jersey. The results are as follows:

Site Factor – Truck Traffic along I-95 (New Jersey Turnpike)

Length (L, Bi-directed, from New York City to Philadelphia) = 343 km (213 mi)

Daily total truck volume (V_t) = 17,500 trucks per day

Speed limit (S) = 105 kph (65 mph)

Supply – Truck Parking Facilities along I-95 (New Jersey Turnpike)

$Parking_{RA}$ = 855 spaces

$Parking_{TS}$ = 1,489 spaces

Demand – Truck Parking Demand along I-95 (New Jersey Turnpike)

Segment truck travel time per trip (TT) = L/S = 343/105 = 3.27 hrs

Truck-hours of SH travel (THT_{SH}) = $P_{SH}\times V_t\times TT$ = (.36)(17,500)(3.27) = 20,601 veh-hrs

Truck-hours of LH travel (THT_{LH}) = $P_{LH}\times V_t\times TT$ = (.64)(17,500)(3.27) = 36,624 veh-hrs

Truck-hours of SH parking demand (THP_{SH}) = $THT_{SH}/12$ = 20,601/12 = 1,716 veh-hrs

Truck-hours of LH parking demand (THP_{LH}) = Parking time/Driving time×THT_{LH} + $THT_{LH}/12$

= 0.70×36,624 + 36,624/12 = 28,689 veh-hrs

Peak-hour parking demand for SH (PHP_{SH}) = $PPF_{SH}\times THP_{SH}$ = (.02)(1,716) = 34 veh

Peak-hour parking demand for LH (PHP_{LH}) = $PPF_{LH}\times THP_{LH}$ = (.09)(28,689) = 2,582 veh

SH and LH peak-hour parking hourly demand by facility type:

$PHP_{(SH,RA)} = P_{RA}\times PHP_{SH}$ = (.23)(34) = 8 veh

$PHP_{(SH,TS)} = P_{TS}\times PHP_{SH}$ = (.77)(34) = 26 veh

$PHP_{(LH,RA)} = P_{RA}\times PHP_{LH}$ = (.23)(2,582) = 594 veh

$PHP_{(LH,TS)} = P_{TS}\times PHP_{LH}$ = (.77)(2,582) = 1,988 veh

The total peak-hour parking demand for public rest areas is 8+594 = 602 trucks, and the total peak-hour parking demand for private truck stops is 26+1,988 = 2,014 trucks. Considering the supply of parking spaces on this segment, there is a surplus of public rest area parking of 855-602 = (+) 253 spaces, while there is a shortage of private truck stop parking of 1,489-1,988 = (-) 499 spaces. Hence, based on the predicted truck traffic volume and current truck parking spaces, we can forecast there will be a significant shortage of truck parking spaces in the near future along New Jersey Turnpike, which is the major freight route in New Jersey.

4.3 Economic Analysis

As described earlier, the economic analysis accounts for various factors. Based on this analysis the primary quantifiable factors are the anticipated number of jobs created and the associated increased in tax revenue.

Employment

The average of the 'average number of employees needed' figure for the large full-service truck stops of 1.875 jobs per acre (see Table 1) is used in the calculation herein. Considering the site area size of 46.76 acres, the estimated number of new jobs is 88 (1.875 jobs per acre×46.76 acres).

Revenue

The average value of revenue is used in this calculation (see Table 2). The total payroll is \$4,015,234 (\$85,869×46.76). The sales revenue is \$79,725,800 (\$1,705,000×46.76). The annual payroll tax is \$40,167 (\$859×46.76). The annual sales tax is \$5,611,200 (\$120,000×46.76). The annual property tax is \$139,251 (\$2,978×46.76).

4.4 Environmental Impacts Analysis

Recalling from the previous methodology section, air and noise pollution impacts from the truck stops are monetized based on their impacts on residential property values. In this case study, the truck stop is separated from residential areas by US Highway 1-9, which is a major truck route. On this route, a large portion of the noise pollution can be ameliorated since the traffic on the highway will produce more noise. To demonstrate the methodology, our calculations will assume that the proposed truck stop has a direct effect on property values in the neighboring Ironbound neighborhood of Newark.

Gaussian Plume Dispersion Modeling to Determine Impact on Property Values

Step 1: Assumptions

- A single emission source consisting of 200 trucks in 0.7 km (2,300 feet) from residential neighborhood.
- Plume stack height of 4.2 meters, approximately the average height of a large truck tractor trailer.
- Downwind (u) of 4.7 mph (2.1 m/s) at transverse distance (Y) of 100 m (Stockie, 2011).
- σ_y and σ_z values of 48 m and 24 m based on neutral atmospheric conditions (Plume Dispersion Coefficients, 2014).

Step 2: Utilization of Gaussian Equation

The Gaussian Plume model is applied with the following values for each variable:

Q (measured in micrograms) = 0.014×10^6 µg/s

u = 2.1 m/s downwind

σ_y & σ_z = 48 m & 24 m, respectively

H = 4.2 m

The given numerical values for all variables are applied in equation (1) and C = 1.02 µg/m^3 per parking space could be calculated. This figure is multiplied by 200 to get the total emissions experienced in 0.7 km (2,300 feet) and thus 204 µg/m^3 are obtained for 200 parking spaces. Lastly, this figure is multiplied by 0.05%, representing the decrease in property values per µg/m^3 of pollution. The final result, 10.2% decrease in property values, is the approximate reduction in residential property values closest to the truck stop based on NO_X emissions coming from parked trucks at the proposed site.

Estimated Noise Pollution Impact on Nearby Property Values

Step 1: Assumptions

- Noise levels adhering to the maximum allowable federal guidelines.
- A single sound source consisting of 200 trucks in 0.7 km (2,300 feet) from residential neighborhood.
- To show the entire methodology, disregard adjacent highways between truck stop and residential areas, which would produce much higher dBA levels than truck stop.

Step 2: Estimation of Impacts on Property Values

Considering there are a total of 200 trucks (n), the ΔL in equation (2) is computed as 23 which is added to 85 dBA to represent the maximum allowable noise level at 50 feet from any truck, yielding a total of about 108 dBA at a 50 feet distance from the approximate center of the truck stop. Using the distance-based exponential decay equation, the dBA level at 2,300 feet can be estimated at about 75 dBA.

Step 3: Assessment of Noise Abatement Strategies

As identified in the methodology, every 2.5 dBA increase in noise levels above 55 dBA results in anywhere from 0.2% to 1.2% reduction in property values. Given the characteristics of the Ironbound neighborhood of Newark, a value of 0.5% could be appropriate. The percentage reduction in property values due to the noise generated from the truck stop (without application of noise abatement criteria) has been calculated as 4% since there are 8 step reductions given 2.5 dBA threshold.

5. Conclusions

As part of freight system development, strategic expansion of truck stops is expected to not only improve mobility of the freight industry and reduce freight cost, but also boost local and regional employment and revenue opportunities, and thereby increase a region's long-term economic competitiveness. This study presented guidelines for truck parking site selection and outlined some of the major social, economic, and environmental factors associated with developing or expanding truck stops. The framework and its application to empirical case studies can provide useful insights to both public and private agencies into addressing regional parking capacity shortfall and safety concerns. The case study shows that certain factors of a truck stop development or expansion are more impactful to society than others. For example, sales tax proves to be the most lucrative source of revenue to the state government. On the other hand, society appears to be directly affected by air pollution to a much greater extent than noise pollution by means of significantly larger reductions in residential property values.

Future research is suggested as follows. Additional research is needed to investigate the truck parking deficit problems faced by New Jersey and many other states. As New Jersey's commercial industrial economy continues to thrive, distribution centers and other similar facilities will continue to remain the highest and best uses for the dwindling available industrial space, with truck stops receiving little consideration. Therefore, decision makers need to find a strategy to provide long-term truck parking space at the highest and best use sites such as distribution centers or warehouses. For example, sustainable methods of providing truck parking space, such as increasing the profitability of truck stops as ventures for the private and public sectors, could be possible. Such a strategy will require careful policy development along with strong and sustained cooperation between states and multiple private sector companies.

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