DKS MEMORANDUM

DATE: December 18, 2019

TO: Rafael Martinez, Director of Transportation

FROM: John P. Long, P.E., T.E.
Cameron Shew, P.E., T.E.

SUBJECT: TIM Fee Major Update
Technical Memorandum 3B: Winery Trip Rates

Executive Summary

The County's Traffic Impact Mitigation (TIM) Fee Program allocates the cost of roadway improvements based on the number of new vehicle trips generated in the PM peak hour for various land use types. For non-residential development, current land use categories include general commercial, hotel/motel/B&B, church, office/medical, and industrial/warehouse.

Most non-residential development generally falls into one of these above listed categories, although a "per trip" fee may be charged when the County determines that use of the categories is not appropriate. This may be due to an uncommon land use or any other factors that, at the County's sole discretion, render the category unrepresentative of the expected trip generation of the proposed land use.

Wineries and agritourism are growing industries in El Dorado County. Like other industrial and commercial uses, these uses generate employment, commercial/tourism, and delivery-related trips that use the County's roadways, and should pay a fair share toward improving those roadways. Agritourism includes, but is not limited to, pumpkin patches, Christmas tree farms, fruit stands, U-pick orchards, and microbreweries. Sufficient data exists to implement a TIM fee for wineries, which would be based on gross floor area (GFA) of the tasting room. There is not sufficient data to support a broad agritourism category, due to the different independent variables involved and limited data sources. A per-trip fee, assessed based on a development's traffic impact study, is appropriate for agritourism uses other than wineries.

County staff and their consultant (DKS Associates) request direction on whether wineries should be included as a new category in the TIM Fee Program Major Update, and if local data should be collected to develop trip rates for other agritourism-related uses.

Background

Like most development fee programs, the County's Traffic Impact Mitigation (TIM) Fee Program allocates the cost of roadway improvements by land use type based on the concept of "equivalent dwelling units" (EDU). An EDU equals the demand placed on the transportation network relative to one single family dwelling unit which is assigned an EDU of 1. Land uses which have greater overall traffic impacts than a typical single-family residential unit are assigned values greater than 1, while land uses with lower overall traffic impacts are assigned values less than 1.

The County's TIM Fee Program bases its EDUs on the number of vehicle trips generated by a given land use during the PM peak hour. This is because roadway needs are primarily based on traffic flows and conditions during the PM peak hour on a typical weekday. Vehicle trips are derived from studies compiled and vetted by the Institute of Transportation Engineers (ITE), which measure the vehicle trips entering and leaving a specific development.

The current fee program has the following categories for non-residential development:

- General Commercial;
- Hotel/Motel/B&B;
- Church;
- Office/Medical; and
- Industrial/Warehouse

Literature Review

DKS conducted a review of available literature and data sources to determine the current state of the practice, regarding trip generation characteristics of wineries and other agritourism uses. This section summarizes the sources reviewed and our findings.

ITE Trip Generation, 10th Edition

ITE has published trip generation data for wineries (Land Use Code 970), which show that an average trip generation rate of 7.31 PM peak hour trips per thousand square feet of gross floor area (GFA) is appropriate. It should be noted that this average is based on four studies, and collection of local trip generation data may be appropriate.

No land use codes appear to be applicable to other agritourism-related uses.

ITE e-Community Forum

Data was not provided on the ITE e-community forums for specific winery-related trip rates. The discussion was mostly related to traffic impact studies, where there was a general consensus that traffic engineers should consider large events frequently held at wineries. Engineers should also consider the number of anticipated attendees and vehicle occupancy ratios to establish parking demand. Other parameters that may be useful include the requirement for special permits and if additional, temporary infrastructure (e.g. seating or tents) is necessary. However, from a typical weekday PM peak hour perspective, large events are not likely to substantially contribute to trip generation.

No discussions were found, related to other agritourism uses, such as pumpkin patches, Christmas tree farms, fruit stands, and U-pick orchards. One discussion was found related to trip generation of brew-pubs, where it was suggested to break out the different on-site uses. For example, the brewery portion may be considered to be manufacturing, and the public-serving portion may be considered to be a drinking place (Land Use Code 925) or quality restaurant (Land Use Code 931).

Winery Trip Generation and Parking Generation Study, Cal Poly San Luis Obispo

In 2015, the Western District of ITE commissioned a study titled *Winery Trip Generation and Parking Generation*, which was carried out by California Polytechnic State University, San Luis Obispo. The study collected data at three wineries in the Edna Valley region of San Luis Obispo County, located on California's Central Coast. Five independent variables for wineries were reviewed: employees, GFA, total acreage, annual production, and varietals. GFA was found to be the variable most correlated with trip generation. The study only collected data on a Saturday, finding a midday peak trip generation of 26 peak hour trips per thousand square feet of GFA. This is noted to be substantially lower than ITE data, which averages 36.5 trips per thousand square feet GFA on the Saturday peak hour of generator. While Saturday data is not directly applicable to the TIM Fee Major Update, it should be

noted that wineries' weekday PM peak hour trip generation is substantially lower than their Saturday peak.

Napa County Winery Trip Generation Form

Napa County has published a winery traffic information sheet, which estimates trip generation at different times and for events of varying scale. In addition to typical weekday traffic, the worksheet can be used to estimate typical Saturday traffic, trips during a "crush" Saturday, and additional traffic generated by the winery's largest marketing event. Daily trip generation is calculated as the sum of:

- Number of full time employees x 3.05 one-way trips per employee;
- Number of part time employees x 1.90 one-way trips per employee;
- Average number of weekday visitors / 2.6 visitors per vehicle x 2 one-way trips; and
- Wine production x 0.009 trucks/1000 gallons x 2 one-way trips

PM peak hour trips are assumed to be 38% of total daily trips, calculated by summing the above. This method gives a more precise accounting by trip purpose, and may be suitable for application in a traffic impact study. However, many of these variables are not known at the time of a project application. Thus, this methodology is not useful for calculating PM peak hour trips for TIM fee assessment.

El Dorado County Sustainable Agritourism Mobility Study

The El Dorado County Transportation Commission (EDCTC) commissioned a mobility study, which was completed by Fehr & Peers in 2016. The intent of this study was to identify low-cost, high-impact solutions to address agritourism congestion on county roadways in the Camino (Apple Hill) area. The study noted that congestion is primarily concentrated on four to six weekends from late September to early November (peaking during three weekends in mid-to-late October). However, weekday agritourism is growing, as returning and local visitors attempt to avoid weekend crowds. Data was collected on weekends at key locations, including gateways to the Camino Area, High Hill Ranch and Abel's Acres. The study analyzed travel patterns and made recommendations, including:

- Parking and circulation improvements: improve driveway access, queue management/ traffic control, wayfinding improvements, parking management
- Traveler information: electronic and paper resources, traveler information, alternate routes, dissemination of real-time information
- Marketing strategies: encourage weekday and off-peak travel, co-marketing, and social media strategies
- Multimodal strategies: dedicated shuttle right-of-way, multi-purpose trail, product delivery alternatives,
- Vehicle circulation improvements: temporary turn restrictions, adaptive signal timing, realigning intersections, temporary one-way circulation, bus-only roadways, shoulder widening, and drainage improvements.

Most of these improvements are temporary and are the responsibility of parties other than the County (i.e. private landowners and Apple Hill Growers Association) to implement. Of the strategies that could be implemented by the County (i.e. intersection realignment, shoulder widening, and drainage improvements), the feasibility is uncertain. Constraints

include funding, right-of-way, environmental clearance, topography, public support, and benefit-cost considerations. While significant capital improvements in the Camino area may not be feasible, agritourism-related traffic does substantially contribute to West Slope congestion on US 50, particularly on Sunday afternoons. 64 percent of visitors come from the Sacramento Metropolitan Area and the Bay Area, and another 20 percent from western El Dorado County. Weekend traffic demand peaks at 1,800 vehicles per hour around 11:00 am. While US 50 corridor needs (i.e. auxiliary lanes, carpool lanes, and interchange improvements) in the current TIM Fee program are determined based on weekday PM peak hour traffic, agritourism-related traffic would also benefit from these improvements.

VRTC Agritourism Report

The Virginia Transportation Research Council (VTRC) published a report titled *Trip Generation at Virginia Agritourism Land Uses*. The document noted that the following ITE Land Use Codes may be applicable to the following agritourism cases:

- Land Use Code 480 (Amusement Park): May apply to farms or plantations offering rides (e.g. hayrides, pedal tractors, barrel train), entertainment (e.g. pig races, fun barn, corn maze), refreshment stands (e.g. restaurant/grill and bakery), and picnic tables

- Lane Use Code 817 (Nursery with Garden Center): May apply to farm stands and markets that sell produce

- Land Use Code 925 (Drinking Place) and 931 (Quality Restaurant): May apply to breweries and brewpubs

The report also conducted an extensive literature review of trip generation studies of wineries in California, including San Diego County, Sonoma County, Riverside County, and Napa County. Local (Virginia) data was collected at five winery sites. The author concludes that the square footage of the tasting room and number of employees during peak season are variables which exhibit high correlation with vehicle trip generation.

Analysis

Consistent with the findings from the Cal Poly San Luis Obispo and VRTC studies, it is recommended to base PM peak hour trip generation calculations for wineries on the gross floor area (GFA) of the tasting room. It is recommended to use a trip rate of 7.31 PM peak hour trips per thousand square feet GFA, based on ITE data. While visitors sometimes visit multiple wineries during a trip, insufficient data is available to support a pass-by trip reduction assumption.

El Dorado County is ideally situated for a variety of agritourism-related uses, including breweries, fruit stands, U-pick orchards, pumpkin patches, and Christmas tree farms. The wide variety of businesses makes it difficult to correlate trip generation with a single, measurable independent variable. Additionally, data is currently insufficient to support a defensible trip rate for most agritourism-related uses, with the exception of wineries. The recommended approach is to calculate a per-trip fee, based on the traffic impact study for any proposed development.

If the County wishes to develop local trip generation rates, it is recommended to collect data during the weekday PM peak hour in the peak season (i.e. autumn in Apple Hill or early December for tree farms). The general consensus on the ITE e-Community forums is that very high pass-by rates (80%-90%) should be expected for certain uses, such as roadside stands. While agritourism trip generation is not anticipated to be as high during the weekday

PM peak as on the weekend, a substantial portion of the traffic would likely use US 50 facilities that are funded by the TIM Fee program.

Recommended Action: DKS Associates and County Staff recommend the Board consider adding a new TIM Fee Category for wineries, consistent with ITE Trip Generation data. DKS Associates cannot make a recommendation regarding other agritourism uses, as there is not sufficient trip rate information available. DKS Associates and County Staff request Board direction if local data should be collected in 2020, and if so, for what types of agritourism uses.

Appendix A: ITE Forum Discussion

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Winery Trip Generation

Follow

1. Winery Trip Generation

0 Recommend

MENTOR

Ms. Dalene Whitlock P.E., PTOE

Actions

Posted 01-09-2016 02:51 PM | view attached

Reply

Our firm routinely does traffic studies for winery projects in Napa and Sonoma Counties. Both Counties have their own forms for doing the trip generation for wineries to address trips on both weekdays and Saturdays, as well as for special events. Sonoma County uses 2.5 persons per vehicle to determine the number of trips/parking demand for a special event, while Napa County uses 2.8 persons/vehicle. In evaluating potential impacts we use the typical daily trips for the analysis, and only use the trips for an event to look at access issues if there are a sufficient number of events for their impacts to occur during more than 30 hours annually (based on Caltrans' 30th highest hour criterion) as well as for the parking demand. Our firm did counts for one week every month for a year, and determined that 10 percent of

weekday daily trips and 13 percent of Saturday trips occur during the p.m. peak hour. We use this ratio for Sonoma County, but Napa County has its own ratio, as indicated on their winery trip generation form (attached).

Dalene Whitlock P.E., PTOE
Principal
W-Trans
Santa Rosa CA
dwhitlock@w-trans.com

Attachment(s)

Napa Winery Trip Generation Form 2015-06.pdf 129K 1 version

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Winery Traffic Information / Trip Generation Sheet

Traffic during a Typical Weekday

Number of FT employees: _____ x 3.05 one-way trips per employee = _____ daily trips.

Number of PT employees: _____ x 1.90 one-way trips per employee = _____ daily trips.

Average number of weekday visitors: _____ / 2.6 visitors per vehicle x 2 one-way trips = _____ daily trips.

Gallons of production: _____ / 1,000 x .009 truck trips daily[3] x 2 one-way trips = _____ daily trips.

Total = _____ **daily trips.**

Number of total weekday trips x .38 = _____ **PM peak trips.**

Traffic during a Typical Saturday

Number of FT employees (on Saturdays): _____ x 3.05 one-way trips per employee = _____ daily trips.

Number of PT employees (on Saturdays): _____ x 1.90 one-way trips per employee = _____ daily trips.

Average number of weekend visitors: _____ / 2.8 visitors per vehicle x 2 one-way trips = _____ daily trips.

Total = _____ **daily trips.**

Number of total Saturday trips x .57 = _____ **PM peak trips.**

Traffic during a Crush Saturday

Number of FT employees (during crush): _____ x 3.05 one-way trips per employee = _____ daily trips.

Number of PT employees (during crush): _____ x 1.90 one-way trips per employee = _____ daily trips.

Average number of weekend visitors: _____ / 2.8 visitors per vehicle x 2 one-way trips = _____ daily trips.

Gallons of production: _____ / 1,000 x .009 truck trips daily x 2 one-way trips = _____ daily trips.

Avg. annual tons of grape on-haul: _____ x .11 truck trips daily [4] x 2 one-way trips = _____ daily trips.

Total = _____ **daily trips.**

Number of total Saturday trips x .57 = _____ **PM peak trips.**

Largest Marketing Event- Additional Traffic

Number of event staff (largest event): _____ x 2 one-way trips per staff person = _____ trips.

Number of visitors (largest event): _____ / 2.8 visitors per vehicle x 2 one-way trips = _____ trips.

Number of special event truck trips (largest event): _____ x 2 one-way trips = _____ trips.

[3] Assumes 1.47 materials & supplies trips + 0.8 case goods trips per 1,000 gallons of production / 250 days per year (see *Traffic Information Sheet Addendum* for reference).

[4] Assumes 4 tons per trip / 36 crush days per year (see *Traffic Information Sheet Addendum* for reference).

Traffic Information Sheet Addendum

Information for Caltrans Review

Application should include:

Project Location

- Site Plan showing all driveway location(s)
- Show detail of Caltrans right-of-way
- Aerial photo at a readable scale

Trip Generation Estimate

- Please provide separate **Winery Traffic Information / Trip Generation Sheets** for existing and proposed operations.

Napa County Winery Traffic Generation Characteristics

Employees

Half-hour lunch: All - 2 trips/day (1 during weekday PM peak)

Hour lunch: Permanent Full-Time – 3.2 trips/day (1 during weekday PM peak)
Permanent Part-Time – 2 trips/day (1 during weekday PM peak)

Seasonal: 2 trips/day (0 during weekday PM peak)—crush
see full time above—bottling

Auto Occupancy: 1.05 employees/auto

Visitors

Auto occupancy:

Weekday = 2.6 visitors/auto
Weekend = 2.8 visitors/auto

Peaking Factors:

Peak Month:	1.65 x average month
Average Weekend:	0.22 x average month
Average Saturday:	0.53 x average weekend
Peak Saturday:	1.65 x average Saturday
Average Sunday:	0.8 x average Saturday
Peak Sunday:	2.0 x average Sunday

Peak Weekend Hour: Winery (3-4 PM) - 0.57 x total for weekend day involved

Average 5-Day Week (Monday-Friday) - 1.3 x average weekend

Average Weekday: 0.2 x average 5-day week

Peak Weekday Hour: Winery (3-4 PM) - 0.57 x total for weekday involved
Roadway PM Peak(4-5 PM?) - 0.38 x total for weekday involved

Service Vehicles

Grapes (36 days (6weeks)/season): 1.52 trips/1000 gals/season (4 ton loads assumed)
Materials/Supplies (250 days/yr): 1.47 trips/1000 gals/yr
Case Goods (250 days/yr): 0.8 trips/1000 gal/yr

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Trip Generation for Vinyard/Winery

Follow

Mr. Martin Percy MS, PE, PTOE 12-23-2015 07:57 AM

I am evaluating a vineyard/winery that typically sees most of its patrons visit on weekends. While...

1. Trip Generation for Vinyard/Winery

0 Recommend

PTOE

Mr. Martin Percy MS, PE, PTOE

Actions

Posted 12-23-2015 07:57 AM

Reply

I am evaluating a vineyard/winery that typically sees most of its patrons visit on weekends. While information has been provided for total weekend trips, our agency requires Peak Hour Trips (PHTs) as a basis on which to decide if a Traffic Impact Study (TIS) will be required. On the other hand, the

facility in question routinely hosts larger events, weddings for example, that also typically will take place on weekends.

My question is how to evaluate these larger events relative to the regular weekend PHTs generated by the vineyard/winery. In reality, the larger events will result in trips to and from the facility that surpass the typical PHTs generated for the site, but the larger events may not occur every weekend.

Others must have evaluated similar facilities, and I am looking for feedback on the best way to evaluate the trip generation to this vineyard/winery. The regular weekend PHTs seem to be straightforward and predictable, but what is the best way to consider the special events traffic relative to regular weekend trips generated at this site?

Thank you.

Martin C. Percy PE, PTOE

Martin Percy MS, PE, PTOE
Westminster MD
martincpercy@gmail.com
---

2. RE: Trip Generation for Vinyard/Winery

0 Recommend

PTOE
Mr. Jeffrey Dirk P.E., PTOE

Actions

Posted 12-24-2015 07:13 AM

Reply

Martin:

I would suggest that the traffic and parking demands associated with events be defined based on the number of attendees that are anticipated, with data to be provided for both a typical and peak event. From this information, a reasonable vehicle occupancy ratio can be established and applied to the number of attendees to arrive at approximate traffic volume projections and parking demands. The Applicant could then propose appropriate traffic and parking management strategies that would accommodate the projected demands for such events outside of any measures that may be required to accommodate regular operation of the facility.

Jeffrey Dirk P.E., PTOE
Principal
Vanasse & Associates, Inc.
Andover MA
jdirk@rdva.com

Original Message

3. RE: Trip Generation for Vinyard/Winery

0 Recommend

Mr. James Garofalo

Actions

Posted 12-24-2015 12:12 PM

Reply

The number of attendees maybe limited by occupancy restrictions, seating restrictions, parking availability, etc. Are outdoor tents to be erected, parking in grass areas? Does the municipality have a requirement for special permits for gatherings over a certain size? Just a few things to be considered.

James Garofalo
Director-Transportation Div.
Tim Miller Associates, Inc.
Cold Spring NY
jamesgarofalo@earthlink.net

Original Message

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Brew-pub Trip Generation Studies

Follow

Mr. James Aton PE 06-20-2018 09:22 AM

I'm looking for any trip generation studies and numbers for a Brew-pub establishment. This is wher...

1. Brew-pub Trip Generation Studies

0 Recommend

Mr. James Aton PE

Actions

Posted 06-20-2018 09:22 AM

Reply

I'm looking for any trip generation studies and numbers for a Brew-pub establishment. This is where a smaller brewery manufactures their beer and has a bar within the same building that is more than just a tasting room. We've had several of these pop up so far in our town and there seems to be more on the way. We have been breaking the business into an assumed square footage of Manufacturing (140) and the remainder Drinking Place (925) but we don't want to open ourselves up to having to do

this for other business types. Any numbers available will be helpful.

James Aton, PE
Operations Division Chief
Town of Mount Pleasant
Mount Pleasant, SC
jaton@tompsc.com

2. RE: Brew-pub Trip Generation Studies

0 Recommend

Mr. Ali Al-Saudi

Actions

Posted 06-21-2018 02:32 AM

Reply

This consultant provide some Trip Generation numbers, I think you can find what you are looking for at http://www.tripgeneration.org/

Ali F. Al-Saudi, EIT, A.M.ASCE
Transportation Engineer
Mobile: 55315413

› Original Message

3. RE: Brew-pub Trip Generation Studies

0 Recommend

Ms. Lisa Fontana Tierney P.E

Actions

Posted 06-25-2018 11:16 AM

Reply

ITE's land use code 925 Drinking Place is defined as follows: A drinking place contains a bar, where alcoholic beverages and food are sold, and possibly some type of entertainment, such as music, television screens, video games, or pool tables. Establishments that specialize in serving food but also have bars are not included in this land use.

This studies included in this land use do not make specific mention as to the presence of on-site micro-brewing facilities. Therefore, we are uncertain as to the impacts of an on-site micro-brewery on the trip generation rates for drinking places. We encourage users to submit available data on this topic to ITE for possible inclusion in future updates to the *Trip Generation Manual*. The source of trip generation data referenced in this discussion (by Spack Consulting) was submitted to ITE and was considered and incorporated into the current edition of the ITE *Trip Generation Manual (10th Edition*).

Lisa Fontana Tierney P.E.
Traffic Engineering Senior Director
Institute of Transportation Engineers
Washington DC
lfontana@ite.org

Original Message

4. RE: Brew-pub Trip Generation Studies

2 Recommend

Mr. Peter Koonce

Actions

Posted 06-27-2018 12:52 PM

Reply

I am a little surprised no one jumped in on this one.

I would like to volunteer to peer review these studies with targeted site visits.

Please let me know if you need me to come to your local brewpub to collect "data". I can insure you that the first hour of data will be reasonably good, but can give no assurances of quality after that point.

Happy Wednesday!
Peter

Peter Koonce, PE
Portland, OR

Original Message

5. RE: Brew-pub Trip Generation Studies

0 Recommend

Mr. Donald Bennett P.E

Actions

Posted 06-28-2018 07:44 AM

Reply

We have one under construction, as soon as completed and the initial "new" period is over, since it has one driveway, it should be reasonably easy to count. Estimated opening: August/September 2018.

Don Bennett, PE
City Traffic Engineer,
Wilmington, NC
910-341-4696
don.bennett@wilmingtonnc.gov

Original Message

6. RE: Brew-pub Trip Generation Studies

0 Recommend

Mr. B Derr

Actions

Posted 07-02-2018 10:18 AM

Reply

A colleague, Ann Hartell, mentioned that one of her grad school colleagues had done a study of wineries that may be helpful. I didn't check to see if they used Peter's study approach.
https://trid.trb.org/view/1392325

Ray Derr
Project Manager, NCHRP
Transportation Research Board
rderr@nas.edu

Original Message

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Trip generation banquet facilities and farmstands

Follow

Mr. Alexander Garbe P.E., PTOE 06-28-2016 05:32 PM

Does anyone have any trip generation data they'd be willing to share for banquet facilities or for ...

1. Trip generation banquet facilities and farmstands

0 Recommend

PTOE

Mr. Alexander Garbe P.E., PTOE

Actions

Posted 06-28-2016 05:32 PM

Reply

Does anyone have any trip generation data they'd be willing to share for banquet facilities or for a farmstand? For the farmstand, I'm particularly interested in the type that sells pumpkins, apples, etc. in fall. Saturday data would also be nice, but I'll be happy with whatever anyone is willing to share.

Thanks,

Alex

Alexander Garbe P.E., PTOE
Traffic Engineer
Hampton, Lenzini, & Renwick, Inc.
Elgin IL
agarbe@hlreng.com

2. RE: Trip generation banquet facilities and farmstands

0 Recommend

Mr. Steven Scalici P.E

Actions

Posted 06-29-2016 07:15 AM

Reply

Alex, I can't offer any data, but one thing seems very rational: there has to be a rather large pass-by credit as people eyeball a roadside fruit stand (not a special place like Hickory Farms or Delicious Orchards) and just stop on the fly. 80-90% would seem fair to me.

Steven Scalici P.E.
Senior Associate
STV, Inc.
New York NY
steven.scalici@stvinc.com

Original Message

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Appendix B: Related Papers and Research

Land Use: 970
Winery

Description

A winery is a property used primarily for the production of wine. Wineries typically include tasting room facilities and may offer special events such as weddings or parties. Wineries often offer complimentary tours and wine tasting. Visitors also may purchase wine or wine-related products.

Additional Data

For the purposes of this land use, the independent variable “1,000 sq. foot gross floor area” refers to the square footage of the building that houses the tasting room.

Time-of-day distribution data for this land use for a weekday, Friday, Saturday, and Sunday are presented in Appendix A. For the sites with weekday, Saturday, and Sunday data, the overall highest vehicle volumes during the PM were counted between 1:45 and 2:45 p.m. For the sites with Friday data, the PM peak hour was between 4:00 and 5:00 p.m. For all four days, the AM peak hour was between 11:45 a.m. and 12:45 p.m.

The sites were surveyed in the 2010s in California, Illinois, and Virginia.

Source Numbers

807, 851, 894

Winery
(970)

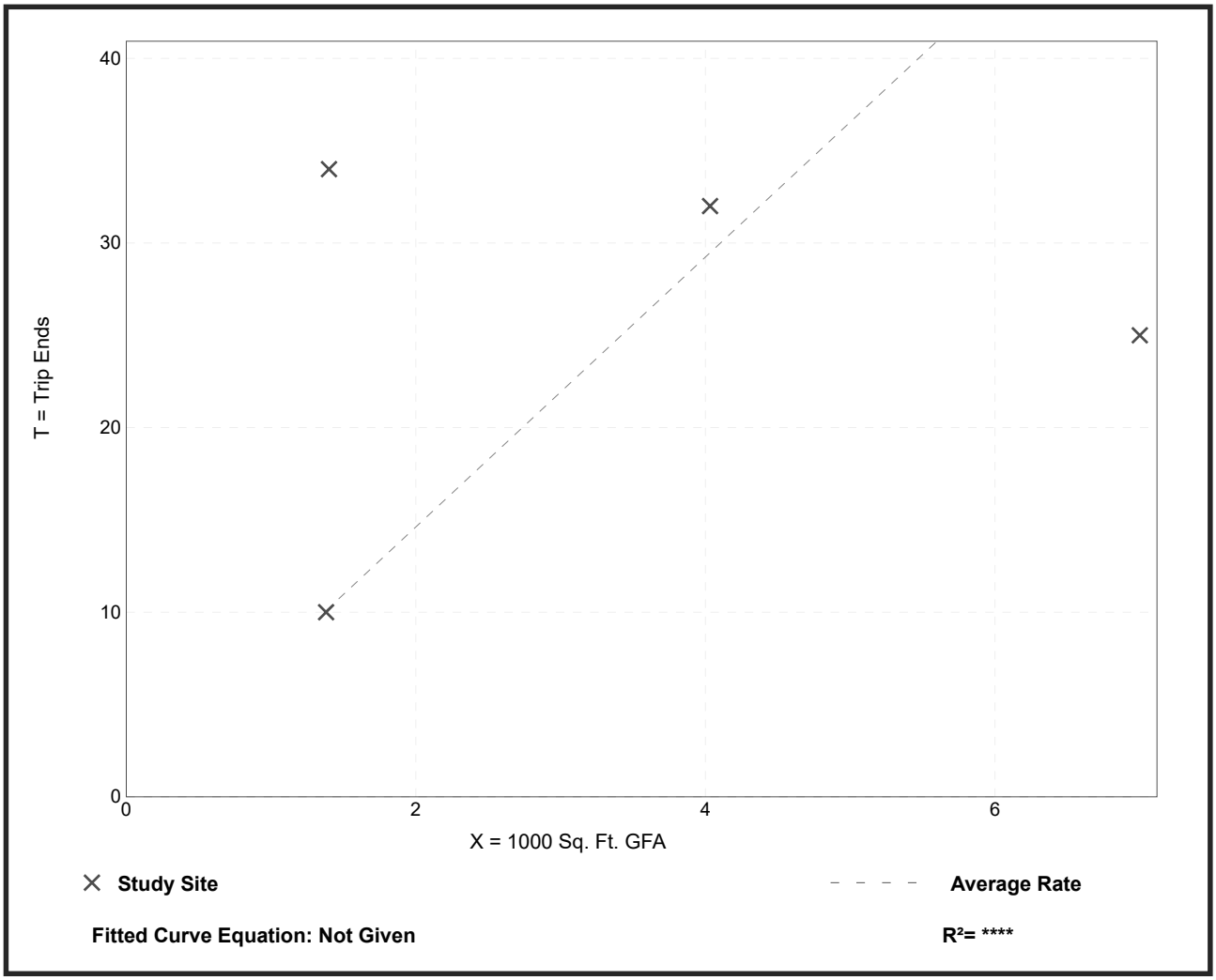
Vehicle Trip Ends vs: **1000 Sq. Ft. GFA**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.
Setting/Location: **Rural**
Number of Studies: 4
Avg. 1000 Sq. Ft. GFA: 3
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
7.31	3.57 - 24.29	6.97

Data Plot and Equation

Caution – Small Sample Size



Trip Generation Manual, 10th Edition ● Institute of Transportation Engineers

Winery Trip Generation and Parking Generation

Institute of Transportation Engineers

California Polytechnic State University, San Luis Obispo

Student Chapter

Spring 2015

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Background

The ITE Student Chapter at Cal Poly San Luis Obispo proposed a trip generation and parking demand study at wineries in order to collect data for this underrepresented land use. The Student Chapter entered into an agreement with the San Luis Obispo Wine Country Association (SLOWCA) to perform data collection on multiple wineries. Figure 1 shows a map of all the wineries in SLOWCA. Because there is no land use classification for wineries in the ITE Trip Generation Manual, the independent variables that are most influential are unknown. An initial study was conducted with the help of students enrolled in CE 322, the Fundamentals of Transportation Engineering laboratory class. These students visited the three chosen winery sites, where they collected preliminary data about possible independent variables.

FIGURE 1: MAP OF SLOWCA

All three wineries are located in the Edna Valley in San Luis Obispo County, California. Table 1 describes the relevant independent variables at each of the three winery sites.

TABLE 1: INDEPENDENT VARIABLES FOR EACH WINERY

Winery	Winery A	Winery B	Winery C
Total Employees	25	12	16
Tasting Room GFA	1000 ft^2	444 ft^2	3375 ft^2
Total Acreage	200	6	1200
Annual Production	35,000 Bottles	90,000 Bottles	225,000 Bottles
Varietals	18	17	27

Note: Acreage based upon only the parcel of land on which the tasting room is located.

Data Collection

On Saturday, April 4, 2015, 20 student members of the Cal Poly ITE student chapter volunteered to collect data. To reflect the overall winery category, three wineries were studied on a single day. The single day of study was used to ensure that weather would be the same for all locations, as the industry is heavily impacted by inclement weather. Data was collected continuously from 7:00 AM to 7:00 PM on the following items: vehicle trips, bicycle trips, pedestrian trips, parking occupancy, and adjacent street traffic for vehicles, pedestrians, and cyclists. Transit does not serve the area and therefore not considered an option for trips to take place. In addition truck traffic to the sites is extremely low. Students were instructed to monitor and note any truck trips, however none occurred at any site. Trips to the site and adjacent street traffic were collected for 12 hours and parking occupancy was collected for 12 hours.

The official data collection took place in early April 2015, and the data included in this report is to be considered representative of the wineries' "shoulder season" as opposed to the "peak season" for this industry, which takes place from about May-September. Peak season data could not be collected due to the schedule of the ITE Western District Data Collection process, which requires a final report before the peak season and selects proposals after the peak season ends. Conversations with the individual wineries involved indicates that the peak occurs on Saturdays around midday. The peak hour is variable depending on the frequent tour groups. Figure 2 shows two student members collecting data.

FIGURE 2: STUDENTS COLLECTING DATA

Trip and Parking Generation Results

Trip generation results were broken down to show generation by vehicles and alternative modes of transportation. Figure 3 shows the vehicular trip generation for the day at all wineries. Figure 4 displays the trip generation from walking and cycling.

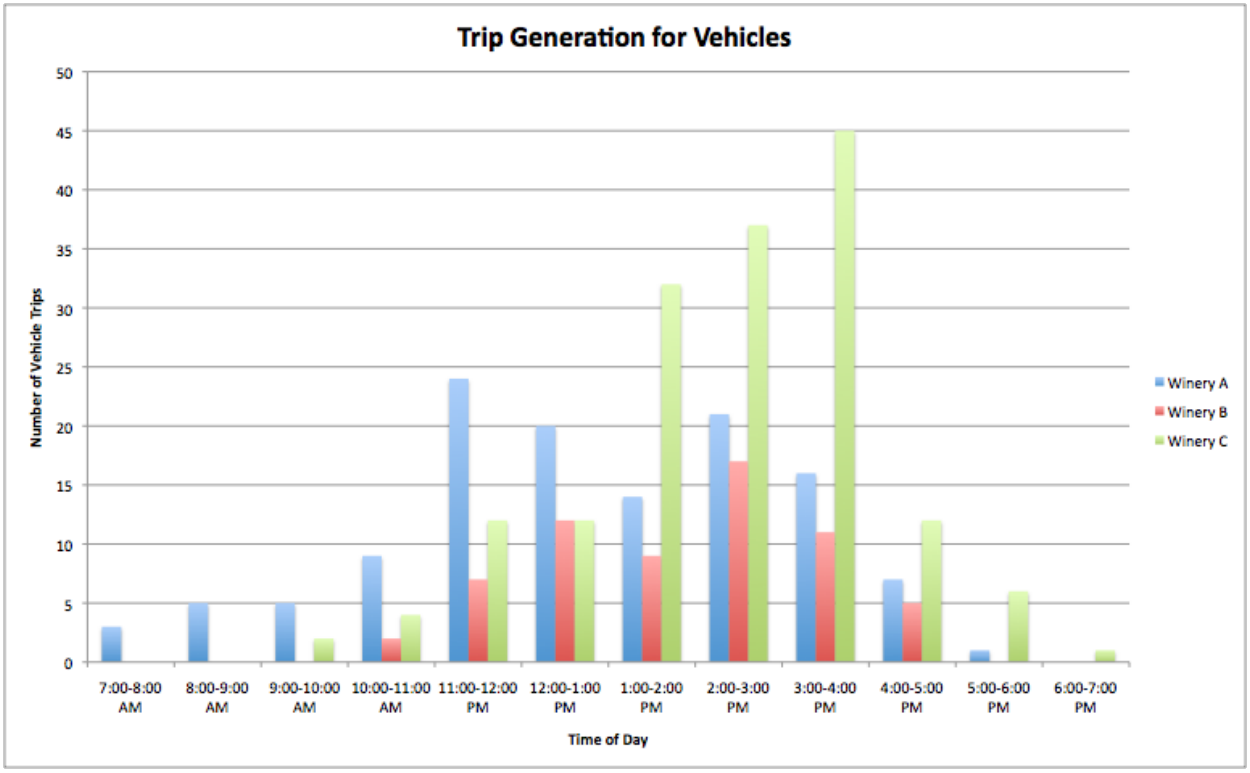

FIGURE 3: TRIP GENERATION FOR VEHICLES

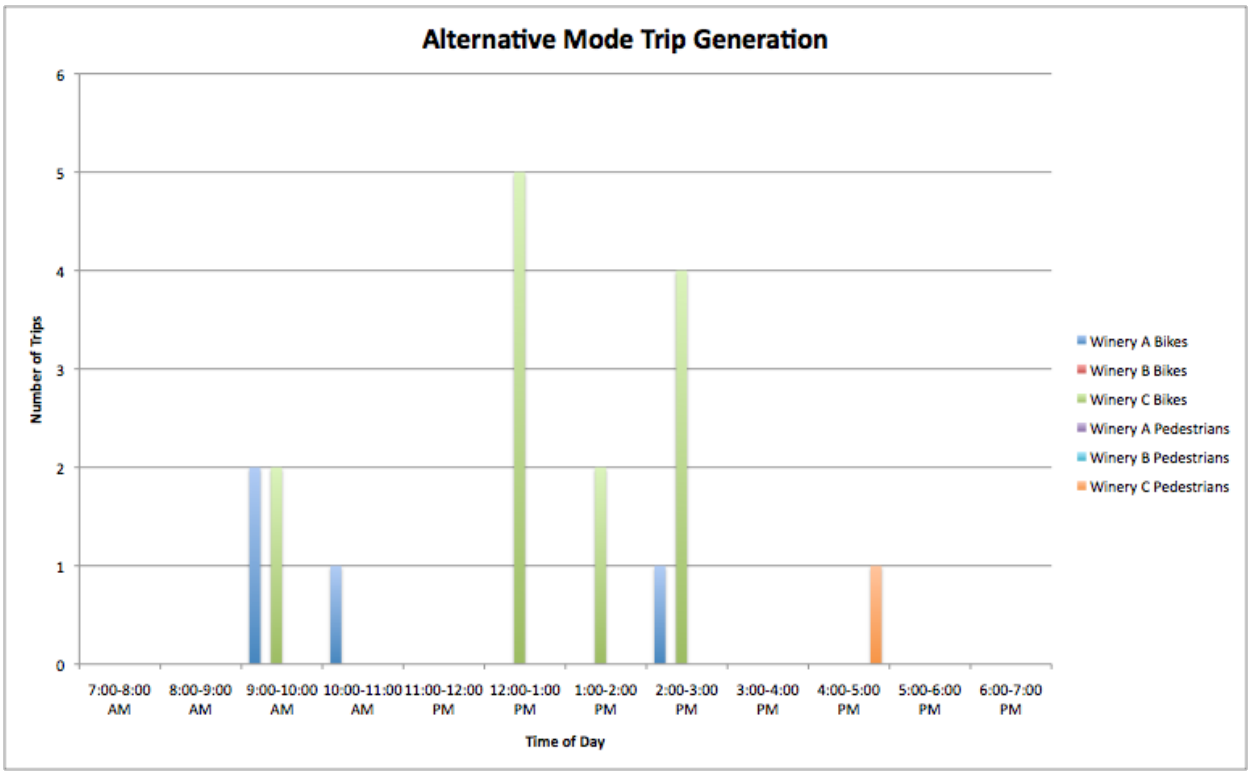

FIGURE 4: TRIP GENERATION FOR ALTERNATIVE MODES

Table 2 shows the peak hour information for each winery. Each winery had a different peak hour and the large majority of trips were generated by vehicles with alternative modes being a small percentages of trips.

TABLE 2: NUMBER OF TRIPS PER MODE DURING THE PEAK HOUR

Winery	Winery A	Winery B	Winery C
Peak Hour	11:00 AM-12:00 PM	2:00 PM-3:00 PM	2:45 PM-3:45 PM
Vehicle Trips	24	17	51
Bicycle Trips	0	0	2
Pedestrian Trips	0	0	0
Total Trips	24	17	53

Parking information was also collected every 15 minutes and compiled. Figure 5 shows the number of parked cars at all 3 wineries for the day. The data follows the expected vehicle trips trend. Table 3 summarizes the peak hour parking information.

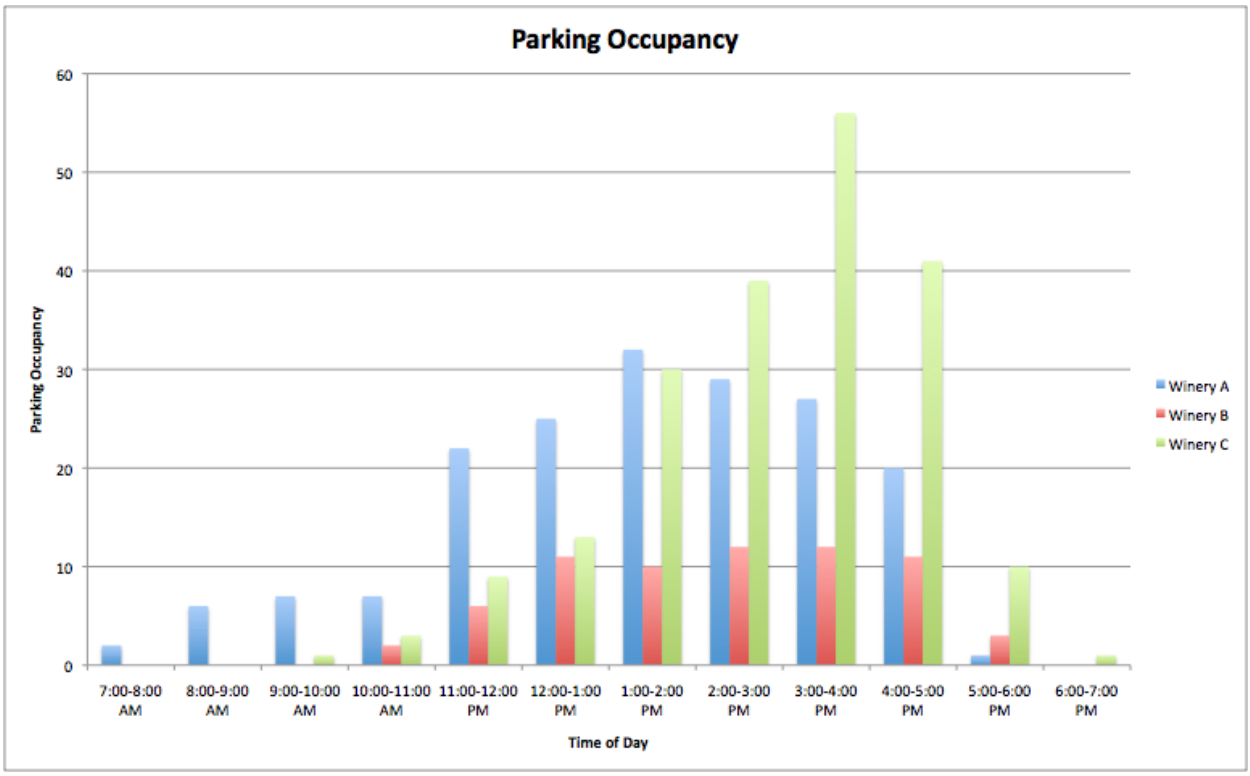

FIGURE 5: PARKING OCCUPANCY

TABLE 3: PEAK HOUR PARKING OCCUPANCY AT EACH WINERY

Winery	Winery A	Winery B	Winery C
Peak Hour	12:45 PM-13:45 PM	2:30 PM-3:30 PM	3:00 PM-4:00 PM
Parked Vehicles	33	14	56

Trip Rate Analysis

Table 4 shows the trip generation rate for each variable from Table 1. The rates are determined by dividing the peak hour vehicle trips by the independent variable. Analysis using adjacent street traffic was not utilized due to the drastic differences between adjacent streets at each site.

TABLE 4: TRIP RATES

Winery	Winery A	Winery B	Winery C	Average
Total Employees	0.96	1.42	3.19	1.86
Tasting Room GFA	24	38	15	26
Total Acreage	0.12	2.83	0.04	1.0
Annual Production	$6.86x10^{-4}$	$1.89x10^{-4}$	$2.27x10^{-4}$	$3.67x10^{-4}$
Varietals	1.33	1.0	1.89	1.41

Note: Trip rates are expressed in trips/employee, trips/1000 square foot, trips/acre, trips/bottle, and trips/varietal.

Conclusions and Recommendations

All of the tested independent variables have high variability and no one factor appears to be the best. Of the variables tested the tasting room gross floor area may be the best option despite also being highly variable. The outside seating areas common at wineries must be taken into consideration for this variable to be accurate. Some variables such as distance to nearby population centers and prestige play an important role in trip generation but are hard to standardize.

Wineries are a unique category of land use that is not yet recognized within the ITE Trip Generation Manual. Along with craft breweries they are a growing recreational facility that should be added. Further study of wineries should be conducted first across multiple wine regions to find the best overall independent variables and account for regional differences.

Appendix

Raw data can be found on the following data collection sheets.

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Trip Generation Data Form (Part 1)

Land Use/Building Type:[1] Winery	ITE Land Use Code: N/A
Source: Cal Poly ITE Student Chapter	Source No. (*ITE use only*):
Name of Development: Winery A	Day of the Week: Saturday
City: San Luis Obispo State/Province: California Zip/Postal Code: 93401	Day: 4 Month: April Year: 2015
Country: USA	Metropolitan Area:

1. For fast-food land use, please specify if hamburger- or nonhamburger-based.

Location Within Area:

☐ (1) CBD ☐ (3) Suburban (Non-CBD) ☒ (5) Rural
☐ (2) Urban (Non-CBD) ☐ (4) Suburban CBD ☐ (6) Freeway Interchange Area (Rural)
☐ (7) Not Given

Detailed Description of Development:[3]

Independent Variable: (include data for as many as possible)[2]	Actual	Estimated
25 (1) Employees (#)	☐	☒
_____ (2) Persons (#)	☐	☐
_____ (3) Total Units (#) (indicate unit: _____)	☐	☐
_____ (4) Occupied Units (#) (indicate unit: _____)	☐	☐
1000 (5) Gross Floor Area (gross sq. ft.)*	☐	☒
(% of development occupied _____)		
_____ (6) Net Rentable Area (sq. ft.)	☐	☐
_____ (7) Gross Leasable Area (sq. ft.)	☐	☐
(% of development occupied _____)		
200 (8) Total Acres (% developed: _____)	☐	☒
_____ (9) Parking Spaces (% occupied: _____)	☐	☐
_____ (10) Beds (% occupied: _____)	☐	☐
_____ (11) Seats (#)	☐	☐
_____ (12) Servicing Positions/Vehicle Fueling Positions	☐	☐
_____ (13) Shopping Center % Out-parcels/pads	☐	☐
_____ (14) A.M. Peak Hour Volume of Adjacent Street Traffic	☐	☐
_____ (15) P.M. Peak Hour Volume of Adjacent Street Traffic	☐	☐
35,000 (16) Other Annual Production (Bottles)	☐	☒
18 (17) Other Varietals	☒	☐

2. Definitions for several independent variables can be found in the *Trip Generation*, Second Edition, *User's Guide* Glossary.

3. Please provide all pertinent information to describe the subject project, including the presence of bicycle/pedestrian facilities. To report bicycle/pedestrian volumes, please refer to Part 4 of this data form.

Other Data:

Vehicle Occupancy (#):
_____ A.M. _____ P.M. _____ 24-hour %

Percent by Transit:
_____ A.M. % _____ P.M. % _____ 24-hour %

Percent by Carpool/Vanpool:
_____ A.M. % _____ P.M. % _____ 24-hour %

Employees by Shift:

	Start Time	End Time	Employees (#)
First Shift:	_____	_____	_____
Second Shift:	_____	_____	_____
Third Shift:	_____	_____	_____

Parking Cost on Site: Hourly _____ Daily _____

Transportation Demand Management (TDM) Information:

At the time of this study, was there a TDM program (that may have impacted the trip generation characteristics of this site) underway?

☐ No
☐ Yes (If yes, please check appropriate box/boxes, describe the nature of the TDM program(s) and provide a source for any studies that may help quantify this impact. Attach additional sheets if necessary)

☐ (1) Transit Service
☐ (2) Carpool Programs
☐ (3) Vanpool Programs
☐ (4) Bicycle/Pedestrian Facilities and Site Improvements
☐ (5) Employer Support Measures
☐ (6) Preferential HOV Treatments
☐ (7) Transit and Ridesharing Incentives
☐ (8) Parking Supply and Pricing Management
☐ (9) Tolls and Congestion Pricing
☐ (10) Variable Work Hours/Compressed Work Weeks
☐ (11) Telecommuting
☐ (12) Other _____

* GFA of Tasting Room Only

Please Complete Form on Other Side

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Trip Generation Data Form (Part 2)

Summary of Driveway Volumes **(All = All Vehicles Counted, Including Trucks; Trucks = Heavy Duty Trucks and Buses)**

	Average Weekday (M-F)						Saturday						Sunday					
	Enter		Exit		Total		Enter		Exit		Total		Enter		Exit		Total	
	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks
24-Hour Volume																		
A.M. Peak Hour of Adjacent[1] Street Traffic (7 – 9) Time (ex.: 7:15 - 8:15):																		
P.M. Peak Hour of Adjacent[1] Street Traffic (4 – 6) Time:																		
A.M. Peak Hour Generator[2] Time:																		
P.M. Peak Hour Generator[2] Time:																		
Peak Hour Generator[3] Time (Weekend): 11:00-12:00							24	0	7	0	31	0						

1. **Highest hourly volume between 7 a.m. and 9 a.m. (4 p.m. and 6 p.m.). Please specify the peak hour.**
2. **Highest hourly volume during the a.m. or p.m. period. Please specify the peak hour.**
3. **Highest hourly volume during the entire day. Please specify the peak hour.**

Please refer to the *Trip Generation User's Guide* for full definition of terms.

Hourly Driveway Volumes- Average Weekday (M-F)

A.M. Period	Enter		Exit		Total		Mid-Day Period	Enter		Exit		Total		P.M. Period	Enter		Exit		Total	
	All	Trucks	All	Trucks	All	Trucks		All	Trucks	All	Trucks	All	Trucks		All	Trucks	All	Trucks	All	Trucks
6:00-7:00							11:00-12:00							3:00-4:00						
6:15-7:15							11:15-12:15							3:15-4:15						
6:30-7:30							11:30-12:30							3:30-4:30						
6:45-7:45							11:45-12:45							3:45-4:45						
7:00-8:00							12:00-1:00							4:00-5:00						
7:15-8:15							12:15-1:15							4:15-5:15						
7:30-8:30							12:30-1:30							4:30-5:30						
7:45-8:45							12:45-1:45							4:45-5:45						
8:00-9:00							1:00-2:00							5:00-6:00						

☒ **Check if Part 3, 4 and/or additional information is attached.**

Survey conducted by: Name: Alex Chambers
Organization: Cal Poly ITE Student Chapter
Address:
City/State/Zip: San Luis Obispo, CA
Telephone #: (206) 788-5742 Fax #: E-mail: calpolyite@gmail.com

Please return to: Institute of Transportation Engineers
Technical Projects Division
1627 Eye Street, NW, Suite 600
Washington, DC 20006 USA
Telephone: +1 202-785-0060
Fax: +1 202-785-0609
ITE on the Web: www.ite.org

Institute of Transportation Engineers

Trip Generation Data Form (Part 3)

Name/Organization: Cal Poly ITE Student Chapter **City/State:** San Luis Obispo, CA

Telephone Number: (206) 788-5742

Detailed Driveway Volumes: Attach this sheet to Parts 1 and 2 if you are providing additional information.

Day of the week: Saturday *(All = All Vehicles Counted, Including Trucks; Trucks = Heavy Duty Trucks and Buses)*

A.M. Period	Enter		Exit		Total		P.M. Period	Enter		Exit		Total	
	All	Trucks	All	Trucks	All	Trucks		All	Trucks	All	Trucks	All	Trucks
12:00-12:15							12:00-12:15	4	0	12	0	16	0
12:15-12:30							12:15-12:30	5	0	3	0	8	0
12:30-12:45							12:30-12:45	5	0	1	0	6	0
12:45-1:00							12:45-1:00	6	0	2	0	8	0
1:00-1:15							1:00-1:15	4	0	3	0	7	0
1:15-1:30							1:15-1:30	3	0	0	0	3	0
1:30-1:45							1:30-1:45	6	0	5	0	11	0
1:45-2:00							1:45-2:00	1	0	8	0	9	0
2:00-2:15							2:00-2:15	6	0	8	0	14	0
2:15-2:30							2:15-2:30	6	0	2	0	8	0
2:30-2:45							2:30-2:45	5	0	6	0	11	0
2:45-3:00							2:45-3:00	4	0	4	0	8	0
3:00-3:15							3:00-3:15	0	0	4	0	4	0
3:15-3:30							3:15-3:30	11	0	7	0	18	0
3:30-3:45							3:30-3:45	0	0	4	0	4	0
3:45-4:00							3:45-4:00	5	0	3	0	8	0
4:00-4:15							4:00-4:15	0	0	3	0	3	0
4:15-4:30							4:15-4:30	5	0	6	0	11	0
4:30-4:45							4:30-4:45	2	0	5	0	7	0
4:45-5:00							4:45-5:00	0	0	9	0	9	0
5:00-5:15							5:00-5:15	0	0	6	0	6	0
5:15-5:30							5:15-5:30	1	0	6	0	7	0
5:30-5:45							5:30-5:45	0	0	0	0	0	0
5:45-6:00							5:45-6:00	0	0	0	0	0	0
6:00-6:15							6:00-6:15	0	0	0	0	0	0
6:15-6:30							6:15-6:30	0	0	0	0	0	0
6:30-6:45							6:30-6:45	0	0	0	0	0	0
6:45-7:00							6:45-7:00	0	0	0	0	0	0
7:00-7:15	0	0	0	0	0	0	7:00-7:15						
7:15-7:30	0	0	0	0	0	0	7:15-7:30						
7:30-7:45	2	0	0	0	2	0	7:30-7:45						
7:45-8:00	1	0	0	0	1	0	7:45-8:00						
8:00-8:15	1	0	0	0	1	0	8:00-8:15						
8:15-8:30	0	0	0	0	0	0	8:15-8:30						
8:30-8:45	1	0	0	0	1	0	8:30-8:45						
8:45-9:00	3	0	1	0	4	0	8:45-9:00						
9:00-9:15	0	0	2	0	2	0	9:00-9:15						
9:15-9:30	1	0	0	0	1	0	9:15-9:30						
9:30-9:45	1	0	0	0	1	0	9:30-9:45						
9:45-10:00	3	0	4	0	7	0	9:45-10:00						
10:00-10:15	0	0	1	0	1	0	10:00-10:15						
10:15-10:30	1	0	2	0	3	0	10:15-10:30						
10:30-10:45	2	0	2	0	4	0	10:30-10:45						
10:45-11:00	6	0	0	0	6	0	10:45-11:00						
11:00-11:15	9	0	1	0	10	0	11:00-11:15						
11:15-11:30	2	0	1	0	3	0	11:15-11:30						
11:30-11:45	4	0	2	0	6	0	11:30-11:45						
11:45-12:00	9	0	3	0	12	0	11:45-12:00						

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Trip Generation Data Form (Part 4)

Summary of Bicycle Volumes

	Average Weekday (M-F)			Saturday			Sunday		
	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
24-Hour Volume									
A.M. Peak Hour of Adjacent[1] Street Traffic (7 – 9) Time (ex.: 7:15 - 8:15):									
P.M. Peak Hour of Adjacent[1] Street Traffic (4 – 6) Time:									
A.M. Peak Hour Generator[2] Time:									
P.M. Peak Hour Generator[2] Time:									
Peak Hour Generator[3] Time (Weekend): 9:30-10:30				3	3	6			

1. **Highest hourly volume between 7 a.m. and 9 a.m. (4 p.m. and 6 p.m.) as defined in Trip Generation Data Form (Part 2). Please specify the peak hour.**
2. **Highest hourly volume during the a.m. or p.m. period. Please specify the peak hour.**
3. **Highest hourly volume during the entire day. Please specify the peak hour. Please attach supplemental hourly volumes.**

Please refer to the *Trip Generation User's Guide* for full definition of terms.

Summary of Pedestrian Volumes

	Average Weekday (M-F)			Saturday			Sunday		
	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
24-Hour Volume									
A.M. Peak Hour of Adjacent[1] Street Traffic (7 – 9) Time (ex.: 7:15 - 8:15):									
P.M. Peak Hour of Adjacent[1] Street Traffic (4 – 6) Time:									
A.M. Peak Hour Generator[2] Time:									
P.M. Peak Hour Generator[2] Time:									
Peak Hour Generator[3] Time (Weekend): N/A				0	0	0			

Survey conducted by: Name: Alex Chambers
Organization: Cal Poly ITE Student Chapter
Address:
City/State/Zip: San Luis Obispo, CA
Telephone #: (206) 788-5742 Fax #: E-mail: calpolyite@gmail.com

Please return to: Institute of Transportation Engineers
Technical Projects Division
1627 Eye Street, NW, Suite 600
Washington, DC 20006 USA
Telephone: +1 202-785-0060
Fax: +1 202-785-0609
ITE on the Web: www.ite.org

Parking Demand Survey Form

Institute of Transportation Engineers

*(fill in all highlighted cells - * are required data)*

Land Use Code*	N/A				
Name of Site	Winery A				
Brief Description of Site	Winery				
Transit*		**City**	San Luis Obispo		
Area*		**State**	CA	**Country**	USA
TMP*					
Parking Price*	$ 0	Daily Rate	$ 0	Hourly Rate	

Site Size*	25	**Units***	Total Employees	**Occupancy***		**Land Use**	
Site Size	1000 ft²	**Units**	Tasting Room GFA	**Occupancy**			
Site Size	200	**Units**	Total Acreage	**Occupancy**			
Site Size	35,000	**Units**	Production (Bottles)	**Occupancy**			
	18		Varietals				
Number of Parking Spaces Provided at Site			90				

Highest Observed Parking Demand for the following hours of the day *(hour beginning)**

Date	April 4th, 2015						
Day	Saturday						
12 Mid							
1:00 AM							
2:00 AM							
3:00 AM							
4:00 AM							
5:00 AM							
6:00 AM							
7:00 AM	4						
8:00 AM	8						
9:00 AM	8						
10:00 AM	11						
11:00 AM	28						
12 Noon	30						
1:00 PM	35						
2:00 PM	30						
3:00 PM	29						
4:00 PM	24						
5:00 PM	5						
6:00 PM	0						
7:00 PM							
8:00 PM							
9:00 PM							
10:00 PM							
11:00 PM							

Person	Alex Chambers	**Organization**	Cal Poly ITE Student Chapter
Phone	(206) 788-5742		
Fax			
Email	calpolyite@gmail.com		
Notes			

Enter data on the web at www.ite.org

Comments to: ite_staff@ite.org

IF not entered on web site, please mail to:

Institute of Transportation Engineers, 1627 Eye Street, NW Suite 600; Washington, DC 20006

Form version 1.4

Institute of Transportation Engineers

Trip Generation Data Form (Part 1)

Land Use/Building Type:[1] Winery	ITE Land Use Code: N/A
Source: Cal Poly ITE Student Chapter	Source No. (*ITE use only*):
Name of Development: Winery B	Day of the Week: Saturday
City: San Luis Obispo State/Province: CA Zip/Postal Code: 93401	Day: 4 Month: April Year: 2015
Country: USA	Metropolitan Area:

1. For fast-food land use, please specify if hamburger- or nonhamburger-based.

Location Within Area:

☐ (1) CBD ☐ (2) Urban (Non-CBD) ☐ (3) Suburban (Non-CBD) ☐ (4) Suburban CBD ☐ (5) Rural ☐ (6) Freeway Interchange Area (Rural) ☐ (7) Not Given

Detailed Description of Development:[3]

Independent Variable: (include data for as many as possible)[2]	Actual	Estimated
12 (1) Employees (#)	☐	☐
_____ (2) Persons (#)	☐	☐
_____ (3) Total Units (#) (indicate unit: _____)	☐	☐
_____ (4) Occupied Units (#) (indicate unit: _____)	☐	☐
444 (5) Gross Floor Area (gross sq. ft.)*	☐	☐
(% of development occupied _____)		
_____ (6) Net Rentable Area (sq. ft.)	☐	☐
_____ (7) Gross Leasable Area (sq. ft.)	☐	☐
(% of development occupied _____)		
6 (8) Total Acres (% developed: _____)	☐	☐
_____ (9) Parking Spaces (% occupied: _____)	☐	☐
_____ (10) Beds (% occupied: _____)	☐	☐
_____ (11) Seats (#)	☐	☐
_____ (12) Servicing Positions/Vehicle Fueling Positions	☐	☐
_____ (13) Shopping Center % Out-parcels/pads	☐	☐
_____ (14) A.M. Peak Hour Volume of Adjacent Street Traffic	☐	☐
_____ (15) P.M. Peak Hour Volume of Adjacent Street Traffic	☐	☐
90,000 (16) Other Annual Production (bottles)	☐	X
17 (17) Other Varietals	X	☐

2. Definitions for several independent variables can be found in the *Trip Generation*, Second Edition, *User's Guide* Glossary.

3. Please provide all pertinent information to describe the subject project, including the presence of bicycle/pedestrian facilities. To report bicycle/pedestrian volumes, please refer to Part 4 of this data form.

Other Data:

Vehicle Occupancy (#):
_____ A.M. _____ P.M. _____ 24-hour %

Percent by Transit:
_____ A.M. % _____ P.M. % _____ 24-hour %

Percent by Carpool/Vanpool:
_____ A.M. % _____ P.M. % _____ 24-hour %

Employees by Shift:

	Start Time	End Time	Employees (#)
First Shift:	_____	_____	_____
Second Shift:	_____	_____	_____
Third Shift:	_____	_____	_____

Parking Cost on Site: Hourly _____ Daily _____

Transportation Demand Management (TDM) Information:

At the time of this study, was there a TDM program (that may have impacted the trip generation characteristics of this site) underway?

☐ No

☐ Yes (If yes, please check appropriate box/boxes, describe the nature of the TDM program(s) and provide a source for any studies that may help quantify this impact. Attach additional sheets if necessary)

☐ (1) Transit Service
☐ (2) Carpool Programs
☐ (3) Vanpool Programs
☐ (4) Bicycle/Pedestrian Facilities and Site Improvements
☐ (5) Employer Support Measures
☐ (6) Preferential HOV Treatments
☐ (7) Transit and Ridesharing Incentives
☐ (8) Parking Supply and Pricing Management
☐ (9) Tolls and Congestion Pricing
☐ (10) Variable Work Hours/Compressed Work Weeks
☐ (11) Telecommuting
☐ (12) Other _____

* GFA of Tasting Room only

Please Complete Form on Other Side

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Trip Generation Data Form (Part 2)

Summary of Driveway Volumes (All = All Vehicles Counted, Including Trucks; Trucks = Heavy Duty Trucks and Buses)

	Average Weekday (M-F)						Saturday						Sunday					
	Enter		Exit		Total		Enter		Exit		Total		Enter		Exit		Total	
	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks
24-Hour Volume																		
A.M. Peak Hour of Adjacent[1] Street Traffic (7 – 9) Time (ex.: 7:15 - 8:15):																		
P.M. Peak Hour of Adjacent[1] Street Traffic (4 – 6) Time:																		
A.M. Peak Hour Generator[2] Time:																		
P.M. Peak Hour Generator[2] Time:																		
Peak Hour Generator[3] Time (Weekend): 14:00 - 15:00							17	0	9	0	26	0						

[1] Highest hourly volume between 7 a.m. and 9 a.m. (4 p.m. and 6 p.m.). Please specify the peak hour.
[2] Highest hourly volume during the a.m. or p.m. period. Please specify the peak hour.
[3] Highest hourly volume during the entire day. Please specify the peak hour.
Please refer to the *Trip Generation User's Guide* for full definition of terms.

Hourly Driveway Volumes- Average Weekday (M-F)

A.M. Period	Enter		Exit		Total		Mid-Day Period	Enter		Exit		Total		P.M. Period	Enter		Exit		Total	
	All	Trucks	All	Trucks	All	Trucks		All	Trucks	All	Trucks	All	Trucks		All	Trucks	All	Trucks	All	Trucks
6:00-7:00							11:00-12:00							3:00-4:00						
6:15-7:15							11:15-12:15							3:15-4:15						
6:30-7:30							11:30-12:30							3:30-4:30						
6:45-7:45							11:45-12:45							3:45-4:45						
7:00-8:00							12:00-1:00							4:00-5:00						
7:15-8:15							12:15-1:15							4:15-5:15						
7:30-8:30							12:30-1:30							4:30-5:30						
7:45-8:45							12:45-1:45							4:45-5:45						
8:00-9:00							1:00-2:00							5:00-6:00						

☒ Check if Part 3, 4 and/or additional information is attached.

Survey conducted by: Name: Alex Chambers
Organization: Cal Poly ITE Student Chapter
Address:
City/State/Zip:
Telephone #: (206) 788-5742 Fax #: E-mail: calpoly.ite@gmail.com

Please return to: Institute of Transportation Engineers
Technical Projects Division
1627 Eye Street, NW, Suite 600
Washington, DC 20006 USA
Telephone: +1 202-785-0060
Fax: +1 202-785-0609
ITE on the Web: www.ite.org

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Trip Generation Data Form (Part 3)

Name/Organization: Cal Poly ITE Student Chapter **City/State:** San Luis Obispo, CA

Telephone Number: (206) 788-5742

Detailed Driveway Volumes: Attach this sheet to Parts 1 and 2 if you are providing additional information.

Day of the week: Saturday *(All = All Vehicles Counted, Including Trucks; Trucks = Heavy Duty Trucks and Buses)*

A.M. Period	Enter		Exit		Total		P.M. Period	Enter		Exit		Total	
	All	Trucks	All	Trucks	All	Trucks		All	Trucks	All	Trucks	All	Trucks
12:00-12:15							12:00-12:15	5	0	0	0	5	0
12:15-12:30							12:15-12:30	1	0	1	0	2	0
12:30-12:45							12:30-12:45	2	0	3	0	5	0
12:45-1:00							12:45-1:00	4	0	3	0	7	0
1:00-1:15							1:00-1:15	3	0	1	0	4	0
1:15-1:30							1:15-1:30	2	0	2	0	4	0
1:30-1:45							1:30-1:45	40	0	5	0	5	0
1:45-2:00							1:45-2:00	4	0	5	0	9	0
2:00-2:15							2:00-2:15	24	0	1	0	5	0
2:15-2:30							2:15-2:30	62	0	2	0	4	0
2:30-2:45							2:30-2:45	6	0	2	0	8	0
2:45-3:00							2:45-3:00	5	0	4	0	9	0
3:00-3:15							3:00-3:15	2	0	5	0	7	0
3:15-3:30							3:15-3:30	2	0	1	0	3	0
3:30-3:45							3:30-3:45	2	0	5	0	7	0
3:45-4:00							3:45-4:00	5	0	2	0	7	0
4:00-4:15							4:00-4:15	3	0	2	0	5	0
4:15-4:30							4:15-4:30	2	0	3	0	5	0
4:30-4:45							4:30-4:45	0	0	4	0	4	0
4:45-5:00							4:45-5:00	0	0	2	0	2	0
5:00-5:15							5:00-5:15	0	0	1	0	1	0
5:15-5:30							5:15-5:30	0	0	3	0	3	0
5:30-5:45							5:30-5:45	0	0	3	0	3	0
5:45-6:00							5:45-6:00	0	0	0	0	0	0
6:00-6:15							6:00-6:15	0	0	0	0	0	0
6:15-6:30							6:15-6:30	0	0	0	0	0	0
6:30-6:45							6:30-6:45	0	0	0	0	0	0
6:45-7:00							6:45-7:00	0	0	0	0	0	0
7:00-7:15	0	0	0	0	0	0	7:00-7:15						
7:15-7:30	0	0	0	0	0	0	7:15-7:30						
7:30-7:45	0	0	0	0	0	0	7:30-7:45						
7:45-8:00	0	0	0	0	0	0	7:45-8:00						
8:00-8:15	0	0	0	0	0	0	8:00-8:15						
8:15-8:30	0	0	0	0	0	0	8:15-8:30						
8:30-8:45	0	0	0	0	0	0	8:30-8:45						
8:45-9:00	0	0	0	0	0	0	8:45-9:00						
9:00-9:15	0	0	0	0	0	0	9:00-9:15						
9:15-9:30	0	0	0	0	0	0	9:15-9:30						
9:30-9:45	0	0	0	0	0	0	9:30-9:45						
9:45-10:00	0	0	0	0	0	0	9:45-10:00						
10:00-10:15	1	0	0	0	1	0	10:00-10:15						
10:15-10:30	0	0	0	0	0	0	10:15-10:30						
10:30-10:45	1	0	0	0	1	0	10:30-10:45						
10:45-11:00	0	0	0	0	0	0	10:45-11:00						
11:00-11:15	1	0	0	0	1	0	11:00-11:15						
11:15-11:30	5	0	0	0	5	0	11:15-11:30						
11:30-11:45	0	0	2	0	2	0	11:30-11:45						
11:45-12:00	81	0	1	0	2	0	11:45-12:00						

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Trip Generation Data Form (Part 4)

Summary of Bicycle Volumes

	Average Weekday (M-F)			Saturday			Sunday		
	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
24-Hour Volume									
A.M. Peak Hour of Adjacent[1] Street Traffic (7 – 9) Time *(ex.: 7:15 - 8:15)*:									
P.M. Peak Hour of Adjacent[1] Street Traffic (4 – 6) Time:									
A.M. Peak Hour Generator[2] Time:									
P.M. Peak Hour Generator[2] Time:									
Peak Hour Generator[3] Time (Weekend): N/A				0	0	0			

[1] **Highest hourly volume between 7 a.m. and 9 a.m. (4 p.m. and 6 p.m.) as defined in Trip Generation Data Form (Part 2). Please specify the peak hour.**
[2] **Highest hourly volume during the a.m. or p.m. period. Please specify the peak hour.**
[3] **Highest hourly volume during the entire day. Please specify the peak hour. Please attach supplemental hourly volumes.**
Please refer to the *Trip Generation User's Guide* for full definition of terms.

Summary of Pedestrian Volumes

	Average Weekday (M-F)			Saturday			Sunday		
	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
24-Hour Volume									
A.M. Peak Hour of Adjacent[1] Street Traffic (7 – 9) Time *(ex.: 7:15 - 8:15)*:									
P.M. Peak Hour of Adjacent[1] Street Traffic (4 – 6) Time:									
A.M. Peak Hour Generator[2] Time:									
P.M. Peak Hour Generator[2] Time:									
Peak Hour Generator[3] Time (Weekend): N/A				0	0	0			

Survey conducted by: Name: Alex Chambers
Organization: Cal Poly ITE Student Chapter
Address:
City/State/Zip: San Luis Obispo, CA 93401
Telephone #: (206) 788 - 5742 Fax #: E-mail: calpolyite@gmail.com

Please return to: Institute of Transportation Engineers
Technical Projects Division
1627 Eye Street, NW, Suite 600
Washington, DC 20006 USA
Telephone: +1 202-785-0060
Fax: +1 202-785-0609
ITE on the Web: www.ite.org

Parking Demand Survey Form

Institute of Transportation Engineers

*(fill in all highlighted cells - * are required data)*

Land Use Code*	N/A				
Name of Site	Winery B				
Brief Description of Site	Winery				
Transit*		**City**	San Luis Obispo		
Area*		**State**	CA	**Country**	USA
TMP*					
Parking Price*	$ 0	Daily Rate	$ 0	Hourly Rate	

Site Size*	12	**Units***	Total Employees	**Occupancy***	[redacted]	**Land Use**
Site Size	444 ft²	**Units**	Tasting Room GFA	**Occupancy**		
Site Size	6	**Units**	Total Acreage	**Occupancy**		
Site Size	90,000	**Units**	Production (bottles)	**Occupancy**		
	17		Varietals			

Number of Parking Spaces Provided at Site 42

Highest Observed Parking Demand for the following hours of the day *(hour beginning)**

Date	April 4, 2015						
Day	Saturday						
12 Mid							
1:00 AM							
2:00 AM							
3:00 AM							
4:00 AM							
5:00 AM							
6:00 AM							
7:00 AM	0						
8:00 AM	0						
9:00 AM	0						
10:00 AM	2						
11:00 AM	8						
12 Noon	11						
1:00 PM	13						
2:00 PM	15						
3:00 PM	13						
4:00 PM	14						
5:00 PM	6						
6:00 PM	0						
7:00 PM							
8:00 PM							
9:00 PM							
10:00 PM							
11:00 PM							

Person	Alex Chambers	**Organization**	Cal Poly ITE Student Chapter
Phone	(206) 788-5742		
Fax			
Email	calpolyite@gmail.com		
Notes			

Enter data on the web at www.ite.org

Comments to: ite_staff@ite.org

IF not entered on web site, please mail to:

Institute of Transportation Engineers, 1627 Eye Street, NW Suite 600; Washington, DC 20006

Form version 1.4

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Trip Generation Data Form (Part 1)

Land Use/Building Type:[1] Winery	ITE Land Use Code: N/A
Source: Cal Poly ITE Student Chapter	Source No. (*ITE use only*):
Name of Development: Winery C	Day of the Week: Saturday
City: San Luis Obispo State/Province: California Zip/Postal Code: 93401	Day: 4 Month: April Year: 2015
Country: USA	Metropolitan Area:

1. For fast-food land use, please specify if hamburger- or nonhamburger-based.

Location Within Area:

☐ (1) CBD ☐ (3) Suburban (Non-CBD) ☒ (5) Rural
☐ (2) Urban (Non-CBD) ☐ (4) Suburban CBD ☐ (6) Freeway Interchange Area (Rural)
☐ (7) Not Given

Detailed Description of Development:[3]

Independent Variable: (include data for as many as possible)[2]	Actual	Estimated
16 (1) Employees (#)	☐	☒
_____ (2) Persons (#)	☐	☐
_____ (3) Total Units (#) (indicate unit: _____)	☐	☐
_____ (4) Occupied Units (#) (indicate unit: _____)	☐	☐
3375 (5) Gross Floor Area (gross sq. ft.) *	☐	☒
(% of development occupied _____)		
_____ (6) Net Rentable Area (sq. ft.)	☐	☐
_____ (7) Gross Leasable Area (sq. ft.)	☐	☐
(% of development occupied _____)		
200 (8) Total Acres (% developed: _____)	☐	☒
_____ (9) Parking Spaces (% occupied: _____)	☐	☐
_____ (10) Beds (% occupied: _____)	☐	☐
_____ (11) Seats (#)	☐	☐
_____ (12) Servicing Positions/Vehicle Fueling Positions	☐	☐
_____ (13) Shopping Center % Out-parcels/pads	☐	☐
_____ (14) A.M. Peak Hour Volume of Adjacent Street Traffic	☐	☐
_____ (15) P.M. Peak Hour Volume of Adjacent Street Traffic	☐	☐
225,000 (16) Other Annual Production (Bottles)	☐	☒
27 (17) Other Varietals	☒	☐

2. Definitions for several independent variables can be found in the *Trip Generation*, Second Edition, *User's Guide* Glossary.

3. Please provide all pertinent information to describe the subject project, including the presence of bicycle/pedestrian facilities. To report bicycle/pedestrian volumes, please refer to Part 4 of this data form.

Other Data:

Vehicle Occupancy (#):
_____ A.M. _____ P.M. _____ 24-hour %

Percent by Transit:
_____ A.M. % _____ P.M. % _____ 24-hour %

Percent by Carpool/Vanpool:
_____ A.M. % _____ P.M. % _____ 24-hour %

Employees by Shift:

	Start Time	End Time	Employees (#)
First Shift:	_____	_____	_____
Second Shift:	_____	_____	_____
Third Shift:	_____	_____	_____

Parking Cost on Site: Hourly _____ Daily _____

Transportation Demand Management (TDM) Information:

At the time of this study, was there a TDM program (that may have impacted the trip generation characteristics of this site) underway?

☐ No
☐ Yes (If yes, please check appropriate box/boxes, describe the nature of the TDM program(s) and provide a source for any studies that may help quantify this impact. Attach additional sheets if necessary)

☐ (1) Transit Service
☐ (2) Carpool Programs
☐ (3) Vanpool Programs
☐ (4) Bicycle/Pedestrian Facilities and Site Improvements
☐ (5) Employer Support Measures
☐ (6) Preferential HOV Treatments
☐ (7) Transit and Ridesharing Incentives
☐ (8) Parking Supply and Pricing Management
☐ (9) Tolls and Congestion Pricing
☐ (10) Variable Work Hours/Compressed Work Weeks
☐ (11) Telecommuting
☐ (12) Other _____

* GFA of Tasting Room Only

Please Complete Form on Other Side

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Trip Generation Data Form (Part 2)

Summary of Driveway Volumes ***(All = All Vehicles Counted, Including Trucks; Trucks = Heavy Duty Trucks and Buses)***

	Average Weekday (M-F)						Saturday						Sunday					
	Enter		Exit		Total		Enter		Exit		Total		Enter		Exit		Total	
	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks
24-Hour Volume																		
A.M. Peak Hour of Adjacent[1] Street Traffic (7 – 9) Time *(ex.: 7:15 - 8:15)*:																		
P.M. Peak Hour of Adjacent[1] Street Traffic (4 – 6) Time:																		
A.M. Peak Hour Generator[2] Time:																		
P.M. Peak Hour Generator[2] Time:																		
Peak Hour Generator[3] Time (Weekend): 14:45-15:45							51	0	27	0	78	0						

1. **Highest hourly volume between 7 a.m. and 9 a.m. (4 p.m. and 6 p.m.). Please specify the peak hour.**
2. **Highest hourly volume during the a.m. or p.m. period. Please specify the peak hour.**
3. **Highest hourly volume during the entire day. Please specify the peak hour.**

Please refer to the *Trip Generation User's Guide* for full definition of terms.

Hourly Driveway Volumes- Average Weekday (M-F)

A.M. Period	Enter		Exit		Total		Mid-Day Period	Enter		Exit		Total		P.M. Period	Enter		Exit		Total	
	All	Trucks	All	Trucks	All	Trucks		All	Trucks	All	Trucks	All	Trucks		All	Trucks	All	Trucks	All	Trucks
6:00-7:00							11:00-12:00							3:00-4:00						
6:15-7:15							11:15-12:15							3:15-4:15						
6:30-7:30							11:30-12:30							3:30-4:30						
6:45-7:45							11:45-12:45							3:45-4:45						
7:00-8:00							12:00-1:00							4:00-5:00						
7:15-8:15							12:15-1:15							4:15-5:15						
7:30-8:30							12:30-1:30							4:30-5:30						
7:45-8:45							12:45-1:45							4:45-5:45						
8:00-9:00							1:00-2:00							5:00-6:00						

☒ **Check if Part 3, 4 and/or additional information is attached.**

Survey conducted by: Name: Alex Chambers
Organization: Cal Poly ITE Student Chapter
Address:
City/State/Zip: San Luis Obispo, CA, 93401
Telephone #: (206) 788-5742 Fax #: E-mail: calpolyite@gmail.com

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ITE on the Web: www.ite.org

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Trip Generation Data Form (Part 3)

Name/Organization: Cal Poly ITE Student Chapter **City/State:** San Luis Obispo, CA

Telephone Number: (206) 788-5742

Detailed Driveway Volumes: Attach this sheet to Parts 1 and 2 if you are providing additional information.

Day of the week: Saturday *(All = All Vehicles Counted, Including Trucks; Trucks = Heavy Duty Trucks and Buses)*

A.M. Period	Enter		Exit		Total		P.M. Period	Enter		Exit		Total	
	All	Trucks	All	Trucks	All	Trucks		All	Trucks	All	Trucks	All	Trucks
12:00-12:15							12:00-12:15	4	0	1	0	5	0
12:15-12:30							12:15-12:30	1	0	4	0	5	0
12:30-12:45							12:30-12:45	1	0	0	0	1	0
12:45-1:00							12:45-1:00	6	0	5	0	11	0
1:00-1:15							1:00-1:15	11	0	1	0	12	0
1:15-1:30							1:15-1:30	4	0	2	0	6	0
1:30-1:45							1:30-1:45	11	0	1	0	12	0
1:45-2:00							1:45-2:00	6	0	6	0	12	0
2:00-2:15							2:00-2:15	11	0	8	0	19	0
2:15-2:30							2:15-2:30	10	0	10	0	20	0
2:30-2:45							2:30-2:45	5	0	6	0	11	0
2:45-3:00							2:45-3:00	11	0	7	0	18	0
3:00-3:15							3:00-3:15	15	0	7	0	22	0
3:15-3:30							3:15-3:30	12	0	6	0	18	0
3:30-3:45							3:30-3:45	13	0	7	0	20	0
3:45-4:00							3:45-4:00	5	0	9	0	14	0
4:00-4:15							4:00-4:15	3	0	15	0	18	0
4:15-4:30							4:15-4:30	6	0	7	0	13	0
4:30-4:45							4:30-4:45	3	0	3	0	6	0
4:45-5:00							4:45-5:00	0	0	12	0	12	0
5:00-5:15							5:00-5:15	3	0	13	0	16	0
5:15-5:30							5:15-5:30	2	0	13	0	15	0
5:30-5:45							5:30-5:45	1	0	8	0	9	0
5:45-6:00							5:45-6:00	0	0	2	0	2	0
6:00-6:15							6:00-6:15	0	0	0	0	0	0
6:15-6:30							6:15-6:30	1	0	3	0	4	0
6:30-6:45							6:30-6:45	0	0	0	0	0	0
6:45-7:00							6:45-7:00	0	0	0	0	0	0
7:00-7:15	0	0	0	0	0	0	7:00-7:15						
7:15-7:30	0	0	0	0	0	0	7:15-7:30						
7:30-7:45	0	0	0	0	0	0	7:30-7:45						
7:45-8:00	0	0	0	0	0	0	7:45-8:00						
8:00-8:15	0	0	0	0	0	0	8:00-8:15						
8:15-8:30	0	0	0	0	0	0	8:15-8:30						
8:30-8:45	0	0	0	0	0	0	8:30-8:45						
8:45-9:00	0	0	0	0	0	0	8:45-9:00						
9:00-9:15	0	0	0	0	0	0	9:00-9:15						
9:15-9:30	0	0	0	0	0	0	9:15-9:30						
9:30-9:45	2	0	0	0	2	0	9:30-9:45						
9:45-10:00	0	0	0	0	0	0	9:45-10:00						
10:00-10:15	0	0	0	0	0	0	10:00-10:15						
10:15-10:30	0	0	0	0	0	0	10:15-10:30						
10:30-10:45	1	0	0	0	1	0	10:30-10:45						
10:45-11:00	3	0	1	0	4	0	10:45-11:00						
11:00-11:15	3	0	1	0	4	0	11:00-11:15						
11:15-11:30	3	0	2	0	5	0	11:15-11:30						
11:30-11:45	3	0	2	0	5	0	11:30-11:45						
11:45-12:00	3	0	1	0	4	0	11:45-12:00						

Institute of Transportation Engineers

Trip Generation Data Form (Part 4)

Summary of Bicycle Volumes

	Average Weekday (M-F)			Saturday			Sunday		
	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
24-Hour Volume									
A.M. Peak Hour of Adjacent[1] Street Traffic (7 – 9) Time (ex.: 7:15 - 8:15):									
P.M. Peak Hour of Adjacent[1] Street Traffic (4 – 6) Time:									
A.M. Peak Hour Generator[2] Time:									
P.M. Peak Hour Generator[2] Time:									
Peak Hour Generator[3] Time (Weekend): 13:00 14:00				2	6	8			

1. Highest hourly volume between 7 a.m. and 9 a.m. (4 p.m. and 6 p.m.) as defined in Trip Generation Data Form (Part 2). Please specify the peak hour.
2. Highest hourly volume during the a.m. or p.m. period. Please specify the peak hour.
3. Highest hourly volume during the entire day. Please specify the peak hour. Please attach supplemental hourly volumes.

Please refer to the *Trip Generation User's Guide* for full definition of terms.

Summary of Pedestrian Volumes

	Average Weekday (M-F)			Saturday			Sunday		
	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
24-Hour Volume									
A.M. Peak Hour of Adjacent[1] Street Traffic (7 – 9) Time (ex.: 7:15 - 8:15):									
P.M. Peak Hour of Adjacent[1] Street Traffic (4 – 6) Time:									
A.M. Peak Hour Generator[2] Time:									
P.M. Peak Hour Generator[2] Time:									
Peak Hour Generator[3] Time (Weekend): 17:00-18:00				1	0	1			

Survey conducted by: Name: Alex Chambers
Organization: Cal Poly ITE Student Chapter
Address:
City/State/Zip: San Luis Obispo, CA 93401
Telephone #(206)788-5742 Fax #: E-mail: calpolyite@gmail.com

Please return to: Institute of Transportation Engineers
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1627 Eye Street, NW, Suite 600
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ITE on the Web: www.ite.org

Parking Demand Survey Form

Institute of Transportation Engineers

*(fill in all highlighted cells - * are required data)*

Land Use Code*	N/A				
Name of Site	Winery C				
Brief Description of Site	Winery				
Transit*		**City**	San Luis Obispo		
Area*		**State**	CA	**Country**	USA
TMP*					
Parking Price*	$ 0	Daily Rate	$ 0	Hourly Rate	

Site Size*	16	**Units***	Total Employees	**Occupancy***		**Land Use**	
Site Size	3375 ft²	**Units**	Tasting Room GFA	**Occupancy**			
Site Size	1200	**Units**	Total Acreage	**Occupancy**			
Site Size	225,000	**Units**	Production (Bottles)	**Occupancy**			
	27		Varietals				
Number of Parking Spaces Provided at Site				61			

Highest Observed Parking Demand for the following hours of the day *(hour beginning)**

Date	April 4th, 2015						
Day	Saturday						
12 Mid							
1:00 AM							
2:00 AM							
3:00 AM							
4:00 AM							
5:00 AM							
6:00 AM							
7:00 AM	0						
8:00 AM	0						
9:00 AM	2						
10:00 AM	5						
11:00 AM	11						
12 Noon	14						
1:00 PM	35						
2:00 PM	41						
3:00 PM	61						
4:00 PM	45						
5:00 PM	22						
6:00 PM	2						
7:00 PM							
8:00 PM							
9:00 PM							
10:00 PM							
11:00 PM							

Person	Alex Chambers	**Organization**	Cal Poly ITE Student Chapter
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Notes			

Enter data on the web at www.ite.org

Comments to: ite_staff@ite.org

IF not entered on web site, please mail to:

Institute of Transportation Engineers, 1627 Eye Street, NW Suite 600; Washington, DC 20006

Form version 1.4

Bicycles and Pedestrians at Winery A				
Time	Bicycles		Pedestrians	
	Enter	Exit	Enter	Exit
7:00	0	0	0	0
8:00	0	0	0	0
9:00	2	2	0	0
10:00	1	1	0	0
11:00	0	0	0	0
12:00	0	0	0	0
13:00	0	0	0	0
14:00	1	1	0	0
15:00	0	0	0	0
16:00	0	0	0	0
17:00	0	0	0	0
18:00	0	0	0	0

Bicycles and Pedestrians at Winery B				
Time	Bicycles		Pedestrians	
	Enter	Exit	Enter	Exit
7:00	0	0	0	0
8:00	0	0	0	0
9:00	0	0	0	0
10:00	0	0	0	0
11:00	0	0	0	0
12:00	0	0	0	0
13:00	0	0	0	0
14:00	0	0	0	0
15:00	0	0	0	0
16:00	0	0	0	0
17:00	0	0	0	0
18:00	0	0	0	0

Bicycles and Pedestrians at Winery C				
Time	Bicycles		Pedestrians	
	Enter	Exit	Enter	Exit
7:00	0	0	0	0
8:00	0	0	0	0
9:00	2	2	0	0
10:00	0	0	0	0
11:00	0	0	0	0
12:00	5	0	0	0
13:00	2	6	0	0
14:00	4	0	0	0
15:00	0	2	0	0
16:00	0	2	0	0
17:00	0	1	1	0
18:00	0	0	0	0

Adjacent Street Traffic - Winery A			
Time	Vehicles	Bikes	Pedestrians
7:00	17	0	0
7:15	11	0	0
7:30	14	2	0
7:45	9	1	0
8:00	23	3	0
8:15	18	1	0
8:30	26	2	0
8:45	27	2	1
9:00	34	1	0
9:15	26	2	0
9:30	23	3	1
9:45	30	3	0
10:00	43	1	0
10:15	27	4	0
10:30	44	1	0
10:45	30	4	0
11:00	45	7	0
11:15	45	3	0
11:30	65	12	0
11:45	43	2	0
12:00	46	1	0
12:15	49	0	0
12:30	37	3	0
12:45	45	2	0
13:00	45	0	0
13:15	41	2	0
13:30	55	2	0
13:45	30	1	0
14:00	45	0	0
14:15	48	1	0
14:30	45	0	0
14:45	48	0	0
15:00	48	2	0
15:15	39	0	0
15:30	23	0	0
15:45	58	0	0
16:00	50	1	0
16:15	45	0	0
16:30	30	0	0
16:45	33	0	0
17:00	34	0	0
17:15	27	0	0
17:30	39	1	0
17:45	36	0	0
18:00	49	0	0
18:15	30	0	0
18:30	29	0	0
18:45	28	0	0

Adjacent Street Traffic - Winery B			
Time	Vehicles	Bikes	Pedestrians
7:00	24	0	0
7:15	28	0	0
7:30	23	0	0
7:45	27	0	0
8:00	27	0	1
8:15	39	0	0
8:30	46	1	0
8:45	61	0	2
9:00	71	0	1
9:15	53	5	0
9:30	57	4	0
9:45	84	3	1
10:00	76	6	0
10:15	67	7	0
10:30	89	2	1
10:45	73	3	0
11:00	86	0	0
11:15	77	3	0
11:30	91	0	0
11:45	91	0	0
12:00	80	0	0
12:15	99	1	0
12:30	87	0	0
12:45	79	3	0
13:00	82	0	0
13:15	81	1	0
13:30	85	0	0
13:45	96	0	0
14:00	91	0	0
14:15	78	3	0
14:30	84	1	0
14:45	114	2	0
15:00	87	2	0
15:15	78	0	0
15:30	67	0	0
15:45	64	2	0
16:00	76	3	0
16:15	64	0	0
16:30	54	1	0
16:45	67	0	0
17:00	65	0	0
17:15	61	0	0
17:30	40	0	0
17:45	58	0	0
18:00	37	0	0
18:15	48	0	0
18:30	52	0	0

Adjacent Street Traffic - Winery C			
Time	Vehicles	Bikes	Pedestrians
7:00	13	0	2
7:15	16	1	1
7:30	21	1	4
7:45	9	2	2
8:00	14	0	0
8:15	12	0	3
8:30	20	13	1
8:45	17	1	3
9:00	33	0	0
9:15	24	0	4
9:30	17	7	2
9:45	19	1	1
10:00	29	9	1
10:15	21	4	0
10:30	28	5	0
10:45	32	9	1
11:00	36	2	0
11:15	35	3	0
11:30	26	3	0
11:45	33	1	0
12:00	38	2	0
12:15	30	0	0
12:30	30	1	0
12:45	30	0	0
13:00	42	6	0
13:15	41	0	0
13:30	29	1	0
13:45	43	3	0
14:00	43	2	0
14:15	39	2	0
14:30	27	2	0
14:45	43	0	0
15:00	36	0	0
15:15	23	0	0
15:30	44	0	0
15:45	45	0	0
16:00	50	0	0
16:15	40	0	0
16:30	43	1	0
16:45	45	0	0
17:00	42	0	0
17:15	33	0	0
17:30	44	0	0
17:45	29	0	0
18:00	25	0	0
18:15	20	0	0
18:30	24	0	0
18:45	17	0	0

Volunteers

Thanks to all of the Cal Poly ITE Student Chapter members who volunteered and participated in the data collection:

Kevin Carstens
Alex Chambers
Keri Chau
Amy Chin
Luis Descanzo
Fabian Gallardo
Mark Howard
Jason Hsia
Ashley Kim
Lance Knox
Kelsey Littell
Erica Madrigal
Patricia Oliveira Braga de Morais
Krista Purser
Simon Qin
Brian Rodriguez
Kaylinn Roseman
Bobby Sidhu
Edward Tang
Ricky Williams

EL DORADO COUNTY
SUSTAINABLE AGRITOURISM MOBILITY STUDY

December 2016

Prepared for:

el dorado county edctc TRANSPORTATION COMMISSION

El Dorado County Transportation Commission

Made possible by a
Federal Highway Administration Partnership
Planning for Sustainable Transportation Grant

FEHR PEERS

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BAKE
SHOP
OPEN
BAKE
SHOP

Introduction

1

BACKGROUND

El Dorado County has a thriving agricultural tourism (or agritourism) industry that brings significant economic benefits to the local community while helping to preserve the county's rural character. Agritourism is a commercial enterprise at a working farm, ranch, or agricultural facility conducted for the enjoyment or education of visitors. Agritourism often generates supplemental income for the owner to support their agricultural operation.[2] This supplemental income makes agricultural operations more economically viable and reduces the pressure for suburban-type development. In addition to economic benefits and preserving the rural character of an area, agritourism also encourages the support of local growers and highlights the growing "farm-to-fork" movement. Supporters of locally-sourced food note that purchasing locally grown food can reduce greenhouse gas (GHG) emissions related to food production and distribution, maintain the natural health benefits and nutritional quality of food and fresh produce, and improve the economic vitality of small and local farms.

[2] University of California Cooperative Extension, UC Small Farm Program. http://sfp.ucdavis.edu/agritourism/

Examples of agritourism activity in El Dorado County include apple orchards, wineries, Christmas tree farms, pumpkin patches, breweries, and other fruit and vegetable farms.

The Apple Hill[SM] growers in and around Camino are the primary agritourism attractions in El Dorado County, with local wineries in the Coloma and Fairplay regions of El Dorado County also notable agritourism destinations. While some of the Apple Hill[SM] ranches, wineries, and breweries operate year-round, the peak visitor season for growers in the area typically occurs between September and November corresponding with the local apple harvest as well as pumpkin patches and other fall produce. In addition, Christmas tree farms in the area attract visitors from Thanksgiving to Christmas. Each fall, Apple Hill[SM] farms contribute over $30 million annually to the local economy. This revenue provides for the sustained use of the land for agriculture and preserves the area's rural quality of life.

While the agritourism draw of Apple Hill℠ growers has resulted in these benefits, the increase in visitors has also come at cost to local and interregional mobility, particularly on fall weekends. Left unaddressed, these mobility challenges are likely to become worse as the popularity of Apple Hill℠ ranches continue to grow. Since adequate transportation infrastructure and services are vital to support agritourism and the local community, mobility issues could threaten the long-term success of agritourism by degrading the visitor experience and impacting the quality of life for local residents. Furthermore, the increasing success of other agritourism destinations in the county, such as wineries in the Pleasant Valley, Somerset, and Fair Play area, may create similar mobility challenges for those communities in the future.

STUDY PURPOSE

The purpose of this study is to evaluate the specific causes of traffic congestion and mobility challenges associated with agritourism travel in El Dorado County, and then identify mobility solutions to sustain the success of agritourism in El Dorado County while preserving the county's rural character. Specifically, this study identifies low-cost, high-impact solutions that make the best use of existing infrastructure to mitigate the current and potential future traffic impacts of agritourism travel on local and regional roadways.

STUDY FOCUS

The mobility challenges faced by local Camino residents and visitors to Apple Hill℠ ranches are the primary agritourism travel issue in El Dorado County. However, the study also recognizes that the growing agritourism traffic to wineries in southern El Dorado County may be a future concern. Therefore, this study focuses on analyzing the existing agritourism mobility challenges in the Camino area while discussing how the lessons learned can be applied to south county wineries.

Specifically, the following goals were identified as part of the study:

- Identify the source of operational issues on US 50 and on local roads in the Camino area.
- Work closely with the Apple Hill℠ growers and the South County winery community to develop creative, context-sensitive mobility solutions.
- Identify potential solutions to improve travel conditions and the sustainability of current and future agritourism activity in El Dorado County.

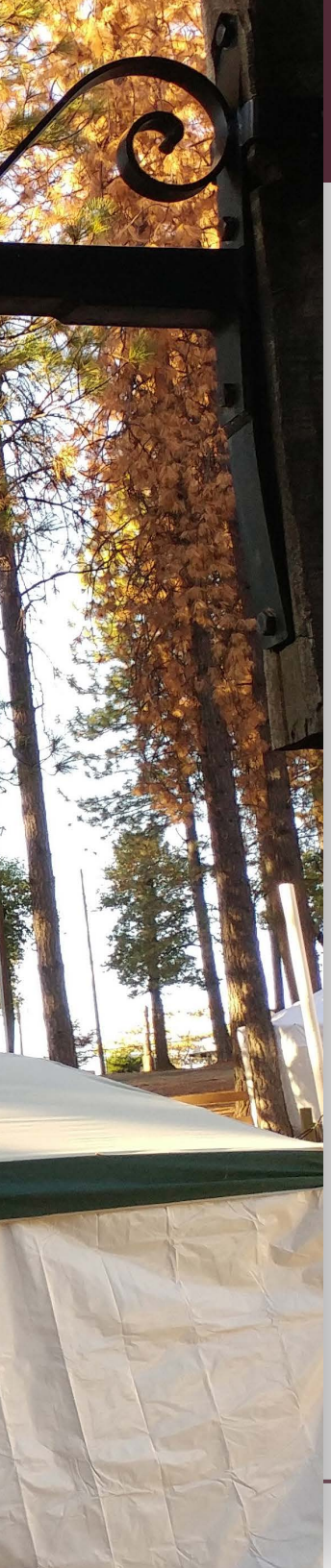
REPORT OUTLINE

This report includes seven chapters that cover the following topics:

1. Introduction to agritourism in El Dorado County and background information for the study
2. Review of relevant studies and projects including:
   - Previously completed planning studies for the area
   - Current and planned transportation projects in the area
3. Summary of community engagement activities during the course of the study
4. Collection of traffic data and field observations
5. Identification of key mobility issues and causes
6. Presentation of possible solutions to address the mobility issues
7. Identification of possible funding sources to support the implementation of the proposed solutions

This outline generally follows the process that the project team undertook to complete the study. Appendix A provides a more detailed summary of the study methodology, including timeframes for community engagement and data collection.


APPLE
HILL SM
Growers



Relevant Plans, Studies & Projects

02

This section summarizes previously completed planning studies and identifies planned transportation projects in the study area that are relevant to this study. This includes studies completed by El Dorado County, the El Dorado County Transportation Commission (EDCTC), the Sacramento Area Council of Governments (SACOG), and Caltrans. The studies reviewed for this effort include:

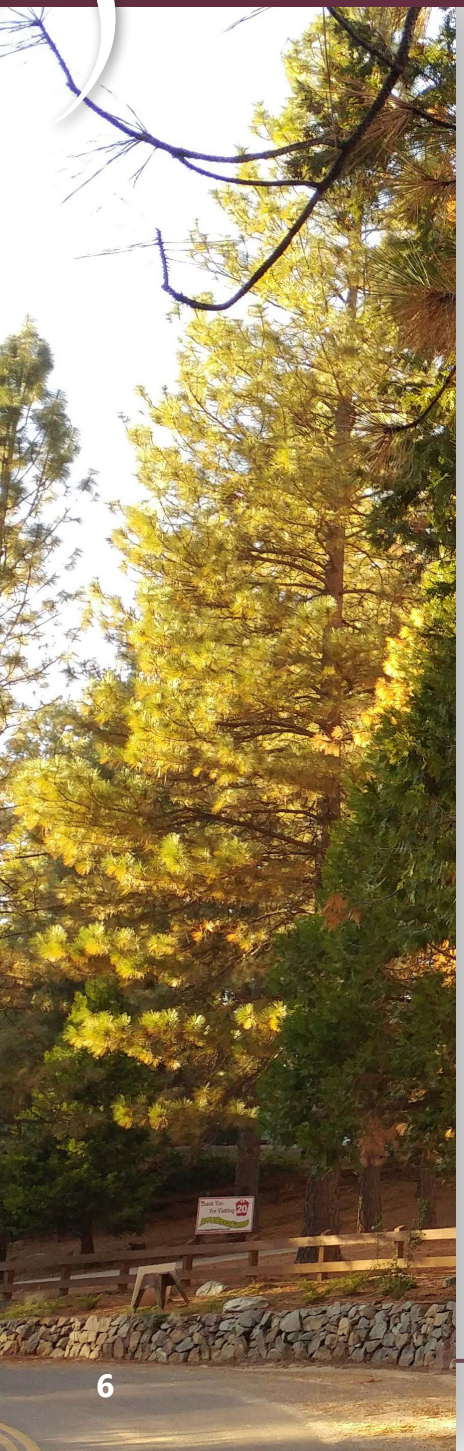
- EDCTC *Bay to Tahoe Basin Recreation and Tourism Travel Impact Study*
- El Dorado County's *Circulation and Safety Review for the Apple Hill℠ Areas including Placerville, Camino, Cedar Grove, and Pollock Pines*
- *Parking Restriction Survey for Gatlin Road*
- *El Dorado County Regional Transportation Plan 2015-2035*
- *SACOG Rural-Urban Connections Strategy (RUCS)*
- Caltrans' *Camino Safety Improvement Project*

PLANS & STUDIES

Bay to Tahoe Basin Recreation and Tourism Travel Impact Study

The *Bay to Tahoe Basin Recreation and Tourism Travel Impact Study* (EDCTC, 2014) examines the characteristics and impacts of regional and interregional tourism travel between Northern California's major urban areas and the "rural areas" of El Dorado, Placer, Amador, and Nevada counties as well as the Lake Tahoe Basin. The study includes an evaluation of tourism-related travel patterns, discusses existing tourist destinations, and identifies possible recommendations to support future tourism activity.

In its discussion of existing tourist destinations, the study specifically identifies Apple Hill℠ and winery destinations on the "west slope" among the several tourist attractions in El Dorado County. Apple Hill℠ is described as a "well-established regional agritourism attraction" with an increasing profile and popularity. The study also compliments the El Dorado American Viticultural Area (AVA) for its unique "high elevation and complex topography, creating a diversity of microclimates and growing condition not found in other regions."



The study states that the active marketing efforts conducted by the Apple Hill℠ Growers Association and the El Dorado Winery Association are expected to have a continued positive impact on tourism market share, with spending predicted to increase at a healthy rate of three to five percent per year. The study's economic evaluation of El Dorado County also suggests that enhancing these marketing efforts and the targeting of specific demographics within the Sacramento and Bay Area regions would likely increase the projected rate of growth. Specific market study recommendations include:

Evolution and Enhancement of Existing Tourism Product

Includes providing appealing accommodations, a diverse range of activities, effective transportation, and a variety of shopping and dining options to appeal to tourist expectations.

Packaging Tourist Offerings

Packaging lodging with selected activities, such as white water rafting and camping with agritourism, reinforces the diversity of a destination, and allows visitors to plan in advance a more memorable, multi-day vacation

Enhance Tourist Transportation and Connectivity

Effective, easy-to-use transportation that provides access to tourism offerings is a key element to the success of a tourism market. Strategies include:

- Providing transit service that is easy to access and use
- Developing pedestrian friendly areas that are conducive to walking and biking and connected to transit service
- Providing signage and wayfinding features so visitors can easily find and access destinations, parking, and transit service

Traveler/Tourist Information

Well-coordinated strategies and channels for the dissemination of visitor information is key. Today's visitors expect to be able to easily find travel information prior to travel and during travel, with the majority of travelers obtaining information from the Internet via personal computers (prior to travel), smartphones, or tablets. The coordinated marketing effort of the Apple Hill℠ Growers Association is identified as a great example of this strategy.

The study also includes several recommendations to improve the traveler experience. This includes:

- Expanding Intelligent Transportation System (ITS) technologies, including the installation and operation of additional changeable message signs (CMS) and other information sharing technologies to manage traffic and improve the traveler experience

- Installing directional and wayfinding signage to guide tourists to recreational and tourism opportunities, and increase awareness of other recreational opportunities and attractions
- Improving roadway conditions, including traffic flow and physical pavement conditions
- Improving ingress and egress to Study Area communities
- Establishing a regionalized Traveler Information website/application

The Sustainable Agritourism Mobility Study considers these recommendations from the Bay to Tahoe Basin study in the development of specific mobility strategies.

Circulation and Safety Review for the Apple Hill™ Areas

In 2013, El Dorado County completed a study titled *Circulation and Safety Review for the Apple Hill℠ Areas including Placerville, Camino, Cedar Grove, and Pollock Pines*, which provides a description of travel patterns during the October-November peak agritourism season for apple growers. The study includes a survey of counts taken at select roadway segments in the Camino area during and outside of the peak fall agritourism season in 2007 and 2013. These counts indicate that the total daily traffic on weekends is greatest along Carson Road, with increases of 200-300% during the fall agritourism season compared to the non-peak season. Based on the resulting queues and congestion levels, the study identifies the following three primary congestion locations:

- Carson Road at Union Ridge Road
- Carson Road at Gatlin Road/High Hill Ranch Road
- Carson Road east of North Canyon Road

The study notes that these three locations are where the majority of motorists are queued, delaying traffic movements substantially. It also acknowledges that ingress and egress for the businesses near these locations appear to be the primary cause for these delays.

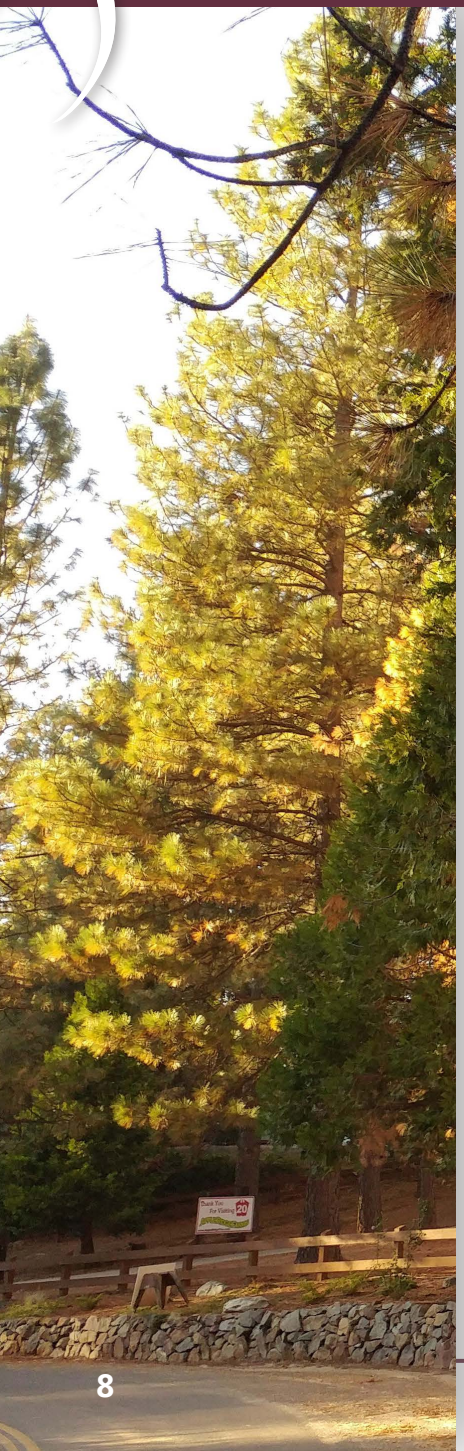
The study also evaluates the feasibility of potential options to address the delays including:

- "No parking" zones along certain county maintained roadways
- Possible one way traffic circulation
- Improved circulation and access at ranch sites
- Public transit shuttle service
- Improved pedestrian safety by providing sidewalks and crosswalks
- Temporary signalization of intersections

The study determines that several of these options are either not feasible or warranted, particularly in light of the temporary/seasonal nature of the traffic issue.

The study concludes with the following recommendations:

- Give consideration to one way exits from businesses that will direct traffic away from congested areas and prevent cross traffic movements while maintaining access to all orchards and businesses in the area
- Have the Apple Hill℠ Growers Association work with a consultant to:
  - Review traffic circulation for existing and proposed improvements
  - Identify the number of parking spaces required for each business
  - Allow businesses to submit improvement plans to the county with possible waivers or reduced fees to allow construction of improvements in a timely manner to address on-site issues



- Provide traveler information through update maps, websites, and message boards to show congested routes and suggested alternate routes to access businesses
- Consider installing permanent signage that may move traffic throughout the area more efficiently

Gatlin Road Parking Restriction Survey

Fehr & Peers also reviewed the parking restriction survey for Gatlin Road prepared by El Dorado County in May 2014. Parked cars along the narrow Gatlin Road, which is adjacent to High Hill Ranch, were causing a travel safety issue by unduly interfering with the increased vehicular and pedestrian traffic and blocking sight distance for pedestrians and motorists using the roadway. The study was initiated in response to a resident living on Gatlin Road who sought a "No Parking" restriction on Gatlin Road. The survey identified the following conclusions:

- Gatlin Road is a local road with marginal shoulders that is not wide enough to accommodate parking vehicles with high volumes of two-way traffic on the roadway section.
- The volume of traffic is not an issue to residents during off-peak months of December through August.
- The high volume of traffic on Gatlin Road during the peak season inhibits accessibility to local residences and may delay emergency response.

The study concluded that a "No Parking" restriction on Gatlin Road during October 1 through December 1 from 10 a.m. to 5 p.m. would address the concerns associated with the high traffic volumes during the peak season.

The request was approved by the El Dorado County Traffic Advisory Committee on May 8, 2014.

El Dorado County Regional Transportation Plan 2015-2035

The El Dorado County Regional Transportation Plan (RTP) 2015-2035 is designed to be a guide for the systematic development of a balanced, comprehensive, multi-modal transportation system for El Dorado County. Adopted on September 3, 2015, the RTP is action-oriented and pragmatic, considering both the short-term (up to 10 years) and long-term (10 to 20 year) periods. The RTP includes the following three components:

- A Policy Element that identifies mobility goals, objectives, and policies of the region
- An Action Element that identifies programs and actions to implement the RTP in accordance with the goals, objectives, and

policies set forth in the policy element. This includes financially constrained short-term and long-term action plans consisting of proposed roadway, transit, aviation, non-motorized, and intelligent transportation systems (ITS) projects, as well as a 2015-2035 action plan for freight movement and transportation systems management (TSM)/transportation demand management (TDM).

- A Financial Element that summarizes the cost of implementing projects in the RTP within a financially constrained environment

The RTP identifies the following projects for the project study area in the short-term and long-term action plans:

Placerville-Camino Area

- US 50 Camino Corridor Safety Improvements
- Mosquito Road/Clay Street Park & Bus Phase II: Construct an additional 50-car parking lot with lighting and landscaping
- Schnell School Road Traffic Signal
- US 50 Eastbound off ramp to Ray Lawyer Drive, Park-and-Ride, and associated bike/pedestrian and roadway improvements
- Carson Road: Add Class II Bike Lanes on climbing shoulder from Jacquier Road to Larsen Drive
- Carson Road: Add Class III Bike Route from Snows Road to Pony Express Trail Road
- Jacquier Road: Add Class II Bike Lanes from Placerville City Limit to Carson Road
- Pony Express Trail Road: Add Class II Bike Lanes from Carson Road to Sly Park Road
- Schnell School Road: Add Class II Bike Lanes from Broadway to Carson Road

South El Dorado County Winery Area

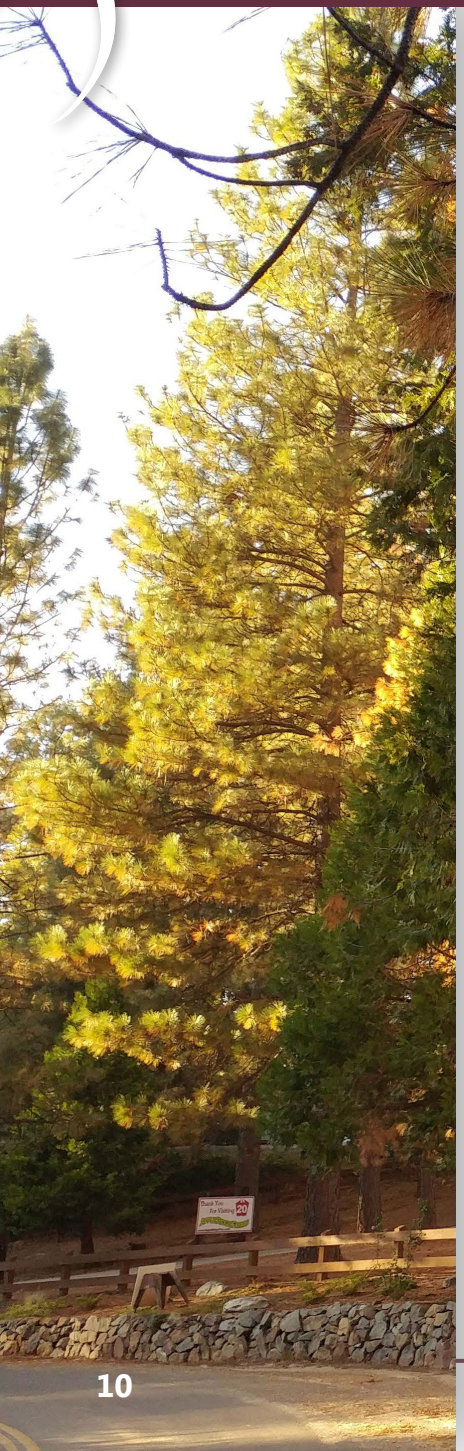
- Bucks Bar Road Bridge Replacement at North Fork Cosumnes River
- Mt. Aukum Road Bridge Maintenance at North Fork Cosumnes River
- Pleasant Valley Road at Oak Hill Road Improvements
- Pleasant Valley Road Widening from Big Cut Road to Cedar Ravine Road
- Sly Park Road Bridge Replacement at Clear Creek Crossing
- Mt. Aukum Road: Add Class III Bike Route from Blackhawk Lane to Fairplay Road
- Fairplay Road: Add Class III Bike Route from Mt. Aukum Road to Unser Way/Pioneer Park
- Pleasant Valley Road: Add Class II Bike Lanes from Big Cut Road to Sly Park Road

Rural-Urban Connections Strategy

The *Rural-Urban Connections Strategy* (RUCS) is an effort by the Sacramento Area Council of Governments (SACOG) to better understand the challenges and opportunities facing both urban and rural areas, and how policies and strategies impact both urban and rural areas in the Sacramento region. Specifically, RUCS looks at the region's prosperity and sustainability from both an urban and a rural perspective with a notable increase in attention to agriculture, open space, and rural issues.

RUCS seeks to support the main land use and economic activity in rural areas (agriculture), while also conserving open lands and the ecosystem services they provide. RUCS is built upon the premise that resource conservation is greatly bolstered by strategies that leverage and enhance the value of these assets. Increased revenues can change the perception of open lands from being "undeveloped" or "future urban," to assets that produce income and should therefore remain open.[2]

[2] Sacramento Area Council of Governments, Rural-Urban Connections Strategy. http://www.sacog.org/rural-urban-connections-strategy



As part of SACOG's *2016 Metropolitan Transportation Plan/Sustainable Communities Strategy (MTP/SCS)*, SACOG prepared the *Rural-Urban Connections Strategy (RUCS) – Interim Report 2015*. This report summarizes the work that SACOG had conducted for the RUCS since late 2007. This includes compiling a technical toolkit to improve the region's understanding of possible economic and environmental outcomes associated with the agricultural economy.

The report also provides a brief description of challenges and opportunities facing rural areas in the Sacramento region. Roads are noted as one of the challenges, as rural roads are often serving rural residential, recreational/tourist, and agricultural users. The report specifically identifies agritourism as an activity that creates trips on roads that were originally designed for low traffic volumes. This additional traffic may create conflicts with the movement of farm equipment and access to markets. While road improvements can help farmers, ranchers, and other users, the net effects can be negative if better roads also lead to speeding and more development in rural areas. Reaching an agreement for funding needed improvements to rural roadways can also be challenging.

On the other hand, the report also notes that agritourism is among the opportunities for rural areas in the Sacramento region. The report notes that there is an increasing public interest in "locally grown" products, as shown in the popularity of farmers' markets, Community Supported Agriculture, and value-added local products, such as jams and sauces. This "locally grown" trend is also creating increased interest in farm and ranch tours, winery visits, and produce stands. The report specifically notes El Dorado County as a popular wine tasting destination and highlights the very popular Apple Hill℠ district. The report goes on to state that agritourism and other revenue generating opportunities within agricultural areas are one way to improve economic vitality of agriculture in the region since landowners are likely to remain in the business of farming if it's more profitable. The report also acknowledges that the potential effect of agritourism success is additional traffic and noise impacts on adjacent areas.

TRANSPORTATION PROJECTS

Camino Safety Project

Caltrans is leading the US 50 Camino Safety Project to improve traffic safety on the US 50 corridor through Camino. The project proposes to install a concrete median barrier that will restrict left-turn movements at at-grade intersections on US 50 from Still Meadows Road to 0.1 mile east of Upper Carson Road. The project will also widen the outside shoulders to standard width and install several acceleration/deceleration lanes to decrease potential vehicle conflicts within the project limits. In addition, a new undercrossing will be constructed to maintain local and regional access to and from the north and south sides of US 50 while providing safe east-west access on and off the highway.

This project is currently in the process of refining project alternatives and completing the corresponding environmental document. The project is scheduled to begin construction in 2019 and finish construction in 2021.

The current alternatives include a concrete median barrier that would eliminate left-turn access from US 50 eastbound at 5 Mile Road and Lower Carson Road, with possible closure of left-turn access at Upper Carson Road – three of the key access points to Apple Hill℠ ranches north of US 50. To maintain access to the north side of US 50, the project proposes constructing a new eastbound off-ramp and on-ramp near Camino Heights Drive, and an undercrossing near Pondorado Road and Carson Court. Instead of turning left off of US 50 towards Carson Road, eastbound traffic to Apple Hill℠ ranches would utilize the new off-ramp and the Pondorado Road undercrossing to access areas north of US 50.

Capital Improvement Program

The El Dorado County Community Development Agency (CDA) prepares the County's Capital Improvement Program (CIP) to address infrastructure development and maintenance. The CIP is a planning document that identifies capital projects and provides a schedule and funding options as a means for the El Dorado County Board of Supervisors to determine capital priorities. These capital improvements are projects that provide tangible long-term improvements or additions of a fixed or permanent nature.

The CIP includes a few minor projects in the study area. In the Camino area, these include constructing the El Dorado Trail from Los Trampas Drive to Halcon Road south of US 50 near Camino Heights as well as a couple of bridge replacement projects at the eastern edge of the Camino study area. The bridge replacement projects are located at Alder Drive at the El Dorado Irrigation District (EID) Canal in Cedar Grove and Blair Road at the EID Canal in Pollock Pines. In southern El Dorado County, the CIP includes a bridge rehabilitation project on Bucks Bar Road at the North Fork of the Cosumnes River.

Community Engagement

03

In addition to reviewing relevant plans, studies, and transportation projects, a robust public outreach effort was performed to gather input and feedback from local residents, businesses, and key stakeholders regarding agritourism in El Dorado County. This outreach effort included a focus group meeting with the Apple Hill℠ Growers Association, visiting South County wineries, engaging local stakeholders through a Stakeholder Advisory Committee, and hosting open house workshops for the community.

STAKEHOLDER GROUPS

A stakeholder database was developed and maintained through the course of this study to ensure key stakeholders were informed during the entire project. Given their key role in the project, the project team hosted a focus group meeting with the Apple Hill℠ Growers Association and traveled to meet with wineries in South County. The focused outreach to these specific stakeholder groups is summarized below. To facilitate discussion with a broad range of stakeholder groups, the project team also formed and met with a Stakeholder Advisory Committee (SAC), as described below.

Apple Hill℠ Growers Association

The Apple Hill℠ Growers Association consists of 57 apple growers, viticulturists, and tree farm owners. The association was formed in an effort to promote common interests and collaborate on marketing ventures. The Apple Hill℠ Growers Association was a key stakeholder throughout the study and provided valuable feedback at many meetings.

A focus group meeting with the Apple Hill℠ Growers Association was held on August 17, 2015 to provide an opportunity for local ranches and wineries to learn more about the study and provide input on the existing conditions experienced in both the Placerville/Camino area and the South County wine region during the peak of the tourism season. Goals of the meeting included:

- Provide a project overview of the study purpose, process, and final deliverable
- Obtain input from Apple Hill℠ growers on existing conditions in the area during the peak season
- Establish a working partnership throughout the study

Following an informational presentation on the project process, project team members facilitated small group discussions. A project team member met with each table of three to four stakeholders to discuss existing conditions and potential improvements around Apple Hill[SM] ranches.

Some of the key feedback provided by the attendees included:

- Agritourism traffic congestion in the Camino area is primarily concentrated on four to six weekends from late September to early November, peaking during three weekends in mid-to-late October.
- Weekday agritourism traffic is significantly lower than weekends during the fall harvest season, but is growing as returning visitors attempt to avoid weekend crowds.
- Key traffic congestion locations are concentrated along the Carson Road corridor particularly near Abel's Acres (at Union Ridge Road), Boa Vista Orchard (east of North Canyon Road), and High Hill Ranch (at Gatlin Road).
- Congestion at these locations can cause queues of vehicles stretching from Schnell School Road in the west to past Barkley Road and into the town of Camino in the east.
- Some traffic congestion also occurs along Larsen Drive.
- US 50 through Placerville experiences long delays, particularly on Sunday afternoons as visitors return to the Sacramento area and San Francisco Bay Area.

This feedback was used in combination with previously collected data from earlier studies to determine the most appropriate key locations for subsequent data collection during October 2015. Appendix B provides a summary of the discussion at the Apple Hill[SM] Growers Association focus group meeting.

Attendees at the Apple Hill[SM] Growers Association Focus Group Meeting

South County Wineries

While the wineries in the South County lack the formal structure of an association similar to the Apple Hill℠ Growers Association, the project team contacted several South County wineries directly to discuss agritourism activity and mobility in the south county region. During this effort, the project team contacted the following wineries and organizations:

- El Dorado County Winery Association
- Mastroserio Winery
- Shadow Ranch Vineyard
- Skinner Vineyards
- Toogood Estate Winery
- Wineries of Fairplay

All of the vineyards universally shared that mobility and traffic congestion is currently not an issue in the south county winery area. Since this winery area is not adjacent to US 50, it does not receive the volume of visitors that travel to Apple Hill℠ growers.

The most commonly used routes to access the wineries in this area are:

- Via Shenandoah Road/Mount Aukum Road (E-16) through Plymouth and the Amador wineries
- US 50 to Missouri Flat Road to Pleasant Valley Road to Bucks Bar Road to Mount Aukum Road (E-16)
- From South Lake Tahoe and Nevada, visitors will take US 50 to Sly Park Road in Pollock Pines to Mount Aukum Road (E-16) in Pleasant Valley

Stakeholder Advisory Committee

In addition to the specific outreach to the Apple Hill℠ Growers Association and South County wineries, the project team formed a Stakeholder Advisory Committee (SAC) consisting of 29 members with unique interests in the outcome of the study. A list of the 29 SAC members is provided at right.

The project team sent out invitations to each SAC organization that provided project background information and asked each organization to identify a representative and alternate to attend SAC meetings. The project team hosted three meetings with the SAC representatives over the course of the study at key milestones. These meetings are summarized below.

SAC Meeting 1: October 15, 2015

The first SAC meeting was held on October 15, 2015 at Boeger Winery. This meeting occurred after the project team reviewed relevant planning studies and previously collected data, and before collecting additional traffic data and conducting field observations. The meeting objectives included:

- Provide the study's purpose and objectives
- Outline the project process and timeline
- Present previous studies related to the project
- Discussion on community goals for this project

Stakeholder Advisory Committee Members

- Apple Hill℠ Growers Association
- Apple Mountain Farm and Business Association
- Audubon Hills Association
- California Highway Patrol
- Camino Community Action Committee
- Camino Heights Advisory Committee
- Camino Hills Homeowners Association
- Camino Hills Property Owners Association
- Camino Union School District
- El Dorado Community Foundation
- El Dorado County Certified Farmers Market Association
- El Dorado County Chamber of Commerce / Visitors Association
- El Dorado County Farm Bureau
- El Dorado County Office of Emergency Services
- El Dorado County Sheriff
- El Dorado County Winery Association
- El Dorado County Youth Commission
- El Dorado Transit Authority
- El Dorado Union High School District
- El Dorado Wine Grape Growers Association
- Fairplay Winery Association
- Farm Trails
- Friends of El Dorado Trails
- Gold Country Lodging
- Placerville Downtown Association
- Rainbow Orchards
- Sierra Banquet Center
- Sierra Pacific Industries
- Social Service Transportation Advisory Council

- Review the stakeholder engagement process and stakeholder roles and responsibilities
- Discuss traffic conditions and identify current issues during the peak season for Apple Hill℠ growers, and discuss potential solutions
- Discuss upcoming traffic data collection and field visit

SAC members were presented with an overview of the project process and a review of the feedback received from and data collection. Preliminary traffic data collected from 2014 was presented to demonstrate expected travel behavior within the area. SAC members were able to contribute to a discussion on the mobility challenges in the area and ask questions about the study methodology. Appendix C provides a summary of this meeting along with comments received from SAC members.

SAC Meeting 2: May 17, 2016

The second SAC meeting was held on May 17, 2016 at the Camino Elementary School gymnasium. At this stage in the study, the project team had completed its data collection efforts and began development of possible solutions to discuss with the stakeholders and community. The meeting objectives included:

- Review the study's purpose and goals
- Review the study's previous community outreach efforts
- Present the traffic data collected and identified travel patterns within the Camino area
- Discuss the developed proposed mobility improvement concepts
- Distinguish the study from Caltrans' Camino Safety Improvements Project
- Review the study's next steps

SAC members were presented with a review of the project process, community feedback, and data collection. Overarching trends in the data (documented in subsequent sections of this report) and proposed solutions were presented. SAC members were able to ask questions and provide comments on the proposed solutions. Appendix C provides a summary of this meeting along with comments received from SAC members.

Stakeholders at the Second SAC Meeting

SAC Meeting 3: October 18, 2016

The third SAC meeting was held on October 18, 2016 at the Camino Elementary School gymnasium. At this stage in the study, the project team had incorporated the feedback received on the possible solutions, identified possible funding sources, and were in the process of developing a draft plan for the stakeholders to review. The meeting objectives included:

- Review the study's purpose and goals
- Review the study's previous community outreach efforts
- Summarize the findings of the study and review the mobility improvement concepts
- Present background information on available funding sources for implementing the mobility concepts

Appendix C provides a summary of this meeting along with comments received from SAC members.

COMMUNITY WORKSHOPS

EDCTC hosted two community workshops during the course of the project study. Stakeholders and the public were notified a couple weeks prior both community workshops via emails and press releases to media outlets.

Public Workshop 1

The first public workshop for the project was held on Tuesday, November 17, 2015 from 6:00 – 8:00 p.m. in the Camino Elementary School upper gym. Community members were invited to learn about the study and share their experiences navigating traffic during peak fall agritourism season and year-round. A total of 26 residents and community members attended the workshop.

The public workshop provided community members with an opportunity to hear from the project team about the study's process and learn how the data collected will be used to help develop traffic improvement strategies for the area. The workshop provided a forum for residents to engage in discussions with one another and project team members to provide their experiences and share their ideas for improved mobility.

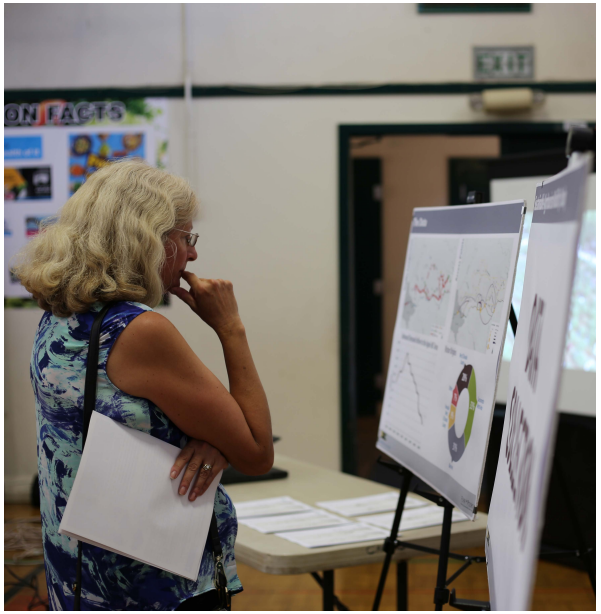
Attendees at the First Public Workshop

Attendees were provided with surveys tailored to residents and visitors, as well as feedback forms. Based on their role in the community, attendees were instructed to fill out one of the surveys and provide their additional comments on the feedback forms. An online version of the survey was also provided and distributed to all of the workshop attendees. Appendix D provides a summary of the workshop along with the responses provided by the public.

Public Workshop 2

The second public workshop was held on Wednesday, June 1, 2016 from 6:00 – 8:00 p.m. in the Camino Elementary School upper gym. Community members were invited to learn about and provide feedback on the study's proposed solutions to improve traffic congestion and parking circulation in Camino during peak season for Apple Hill[SM] growers. More than 20 residents and community members attended the workshop.

The second public workshop provided community members an opportunity to learn about the data collected for the study and the project team's proposed solutions to improve traffic and parking circulation. Community members were able to ask questions and discuss ideas with the project team, and provide their comments on the proposed solutions through feedback forms. Appendix D provides a summary of the public feedback received at the second public workshop.



Community Member Reviewing Data Presented at Second Public Workshop

TECHNICAL ADVISORY COMMITTEE

During the course of the study, the project team also met with a Technical Advisory Committee (TAC) composed of key technical advisory stakeholders. The TAC provided technical guidance on the analysis and methodology of the study. The TAC consisted of representatives from EDCTC, Caltrans, El Dorado Transit, El Dorado County, City of Placerville, and the project team.

The project team met with the full TAC three times during the course of the project, and met with individual TAC members throughout the study. At the project kick-off, the TAC reviewed the project objectives, scope of the study, provided their initial thoughts on the study, and discussed the timeline for future meetings. TAC members also identified relevant studies and traffic data that they could provide to the project team to start the project.

Prior to and during the October 2015 data collection period, the project team met with El Dorado Transit and El Dorado County staff to further refine the data collection process. Following the October 2015 data collection period, the project team met with the TAC to review the data collected effort and presented the findings of the initial analysis. Preliminary operational improvement concepts were presented and then discussed with members of the TAC. The meeting concluded with TAC member feedback on the concepts and thoughts on next steps.

The project team met with El Dorado County staff and EDCTC to refine the improvement concepts per the feedback from the TAC, as well as discuss newly available GPS and cell phone data capturing travel patterns during the previous fall. The third TAC meeting was held on April 20, 2016 where the project team provided an update on the project status. This included a review of the additional GPS and cell phone data, on-site parking circulation improvement concepts for a couple of the key ranches, and presenting analysis results that identified reductions in queueing and delay associated with the improvements. The meeting concluded with members of TAC commenting on the concepts and recommending additional solution concepts to explore.

Data Collection

4

The study used a combination of various traffic data to understand travel patterns during the fall agritourism season in the Camino area. This included historical data provided by Caltrans and El Dorado County from 2014 and earlier, as well as a robust data collection effort of new traffic data in October 2015. The data collection effort was designed to provide a comprehensive understanding of the mobility challenges within the Camino area by collecting data through multiple means over selected "target" months during which peak travel to the Camino area occurs.

2014 BACKGROUND DATA COLLECTION

Prior to the field data collection effort performed during October 2015, the project team obtained and reviewed historical traffic data from Caltrans and El Dorado County to assist with developing a basic understanding of the mobility challenges within the Camino area and help identify areas of highest concern.

Traffic Counts

Caltrans and El Dorado County provided relevant traffic count data to the project team as a starting point during the project kickoff. Caltrans provided hourly traffic counts on US 50 at Bedford Avenue for the entire year of 2014 and at select US 50 access points in the Camino area for Thursday, October 9, 2014 and Saturday, October 11, 2014.

El Dorado County staff shared data from their traffic count database of local roadways throughout the County. In the Camino area, the most recent counts in the database were collected between April and June 2014, which is outside of the fall agritourism season.

The count data was analyzed to identify how trends in travel patterns during the fall agritourism season compared to the off-peak seasons. Some of the key observations include:

- Traffic levels on US 50 are noticeably higher during the fall agritourism season compared to the off-peak season, particularly on weekends
- During the fall agritourism season, up to 40% of traffic traveling through Placerville is due to the morning peak inflow of visitors from the west to the Camino area and the peak westbound outflow from the Camino area in the late afternoon
- The closure of the eastbound left-turns into Camino on eastbound US 50 from Five Mile Road to Carson Road significantly shifts inbound traffic to the Cedar Grove interchange. During these closure periods, the westbound US 50 right-turn traffic volumes increase at these access points indicating that some inbound traffic from the west backtracks on US 50 westbound from Cedar Grove

Appendix E provides a more detailed summary of the traffic data comparison.

2015 FIELD DATA COLLECTION

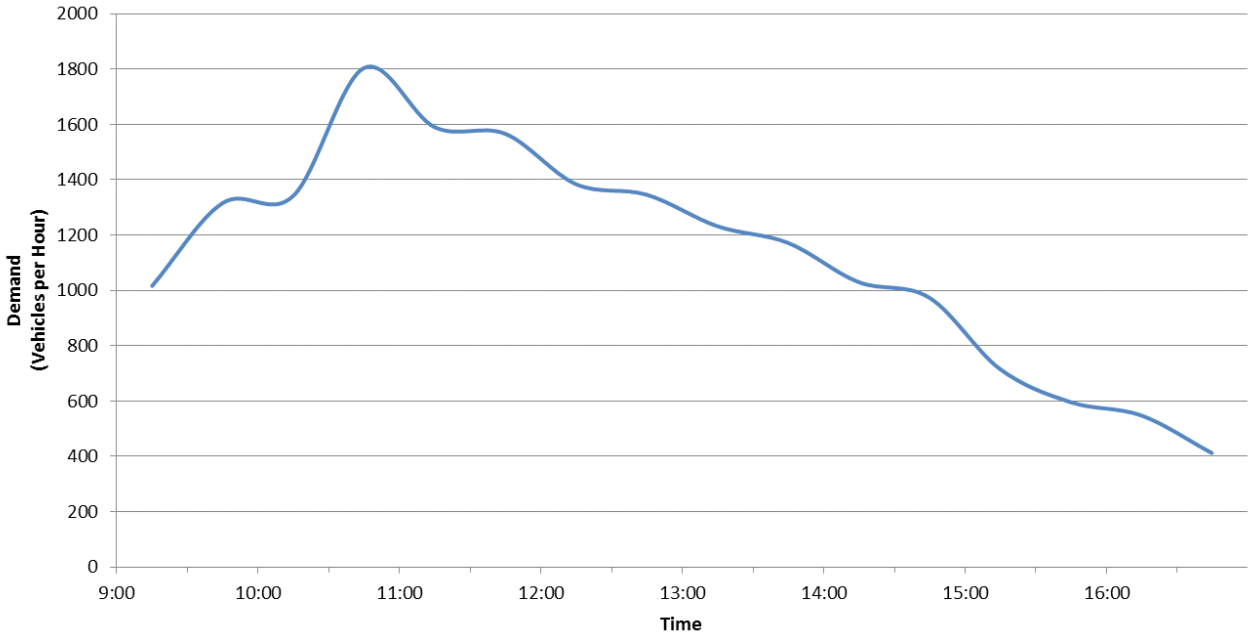
A robust field data collection and observation effort was performed in the Camino area on Saturday, October 17, 2015 through coordination between Fehr & Peers, the El Dorado County Transportation Commission (EDCTC), and El Dorado County.

Traffic counts were collected throughout Camino, including at key access points into and out of the Camino area, intersections adjacent to the most heavily visited ranches, and local roadways between Placerville and Pollock Pines. Traffic counts were collected on the weekend of October 17-18, 2015 to capture travel characteristics during the peak agritourism season. Appendix F provides additional details regarding the traffic counts, including the traffic data sheets.

These traffic counts were used to estimate peak demand entering the Camino area, which is displayed in Figure 1. Demand increases during the morning hours, peaks at around 1,800 vehicles per hour just before 11:00 am, and gradually decreases during the late morning and afternoon.

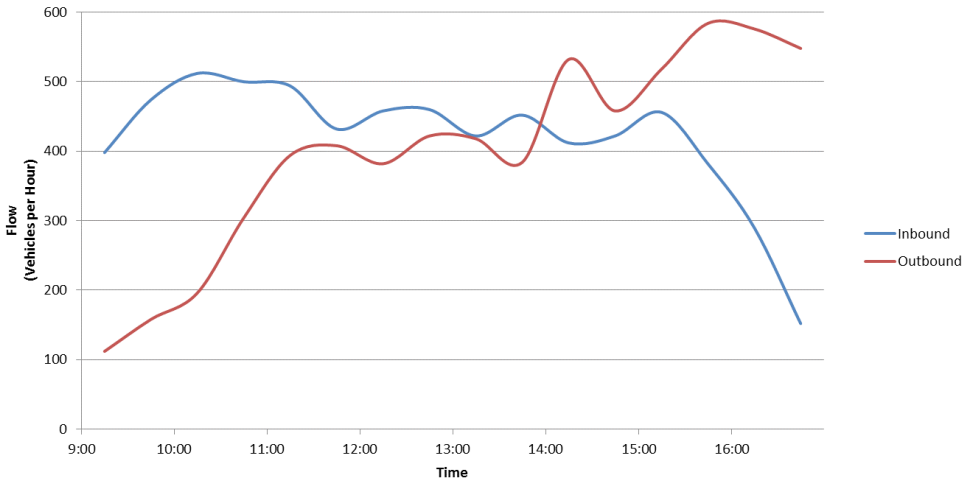
The Camino-area traffic counts were also used to estimate peak flow rates into and out of the orchards near high levels of congestion. Due to the traffic demand exceeding the entering flow rate at these orchards, these volumes represent the saturation flow rate entering the orchards and not actual demand. Traffic demand exceeding the entering flow rate creates queueing on Carson Road, as witnessed in the field. Therefore, traffic counts collected upstream of the queuing were used to estimate the actual traffic demand.

Figure 1: Traffic Demand Entering the Camino Area



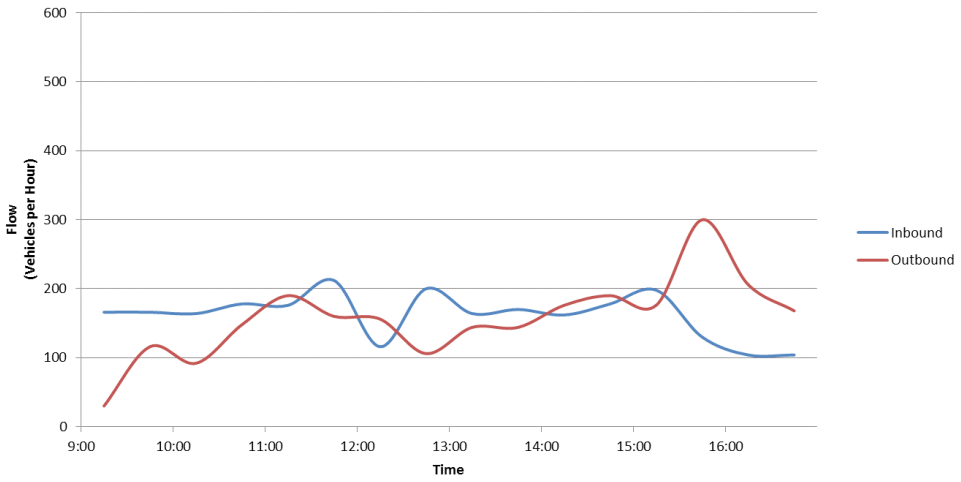
Traffic Queueing on Carson Road near High Hill Ranch

Figure 2: High Hill Ranch – Saturation Flow Rates



As displayed in Figure 2, the inbound saturation flow rate for High Hill Ranch is approximately 500 vehicles per hour. The inbound flow rate greatly exceeds the outbound flow rate during the morning hours and remains above 400 vehicles per hour until around 3:00 pm, at which point the outbound flow rate significantly exceeds the inbound flow rate.

Figure 3: Abel's Acres Saturation Flow Rates



As displayed in Figure 3, the inbound saturation flow rate for Abel's Apple Acres is approximately 180 vehicles per hour. Similar to High Hill Ranch, the inbound flow rate is higher than the outbound flow rate during the morning hours while the outbound flow rate is higher during the late afternoon.

Aerial Videography

The project provided unique challenges in obtaining a holistic picture of mobility challenges due to the area's hilly terrain, narrow, curving roads that sometimes present unexpected driving challenges, and severe congestion along certain roadways. To ensure that these factors were accurately understood, aerial videography was used to document traffic conditions at a few of the key activity centers identified by the project stakeholders. The aerial videos were used to validate the quantifiable data and assist with identifying sources of mobility impairment.

Aerial videos were captured at the three locations listed below.

- Carson Road near High Hill Ranch Road
- Carson Road east of North Canyon Road (close to Boa Vista Orchards)
- Carson Road near Union Ridge Road (close to Abel's Acres)

Three 60-minute time periods of video were recorded at each location with an additional fifteen minutes to allow for drone takeoff and landing. These time periods were 10:00 am to 11:15 am, 1:00 pm to 2:15 pm, and 3:00 pm to 4:15 pm.

Figure 4: Aerial View of Carson Road/High Hill Ranch Road Area

Figure 5: Aerial View of Carson Road/Union Ridge Road Area

Ground-Level Field Observations

Project team staff were on location throughout the entire duration of count collection from 9:00 am to 5:00 pm on Saturday, October 17 to conduct ground-level field observations. The observations recorded in the field were used to verify that the quantifiable data is representative of typical weekend conditions during the fall agritourism season and identify any abnormalities that may affect the data.

2015 SUPPLEMENTAL DATA COLLECTION

In addition to the field data collected during the weekend of October 17-18, 2015, the project team collected additional data over a longer period of time to understand travel patterns during the fall agritourism season.

TRAFFIC COUNTS – US 50

In addition to the traffic counts collected in the Camino area, traffic counts on US 50 at Bedford Avenue in Placerville were obtained from Caltrans to help understand the effect of agritourism on regional travel facilities. Figure 6 and Figure 7 compare traffic flows on US 50 for the average weekday and average Saturday during the months of October and April, with the month of October representing peak agritourism season and the month of April representing non-peak agritourism season. As shown in Figure 6 and Figure 7, traffic volumes on US 50 are significantly higher during October Saturdays than April Saturdays, especially in the eastbound direction during the morning hours.

The difference in traffic levels between the April Saturday peak and the October Saturday peak is approximately 40%. This supports the study's

Figure 6: US 50 Eastbound Traffic Volumes at Bedford Ave – 2015

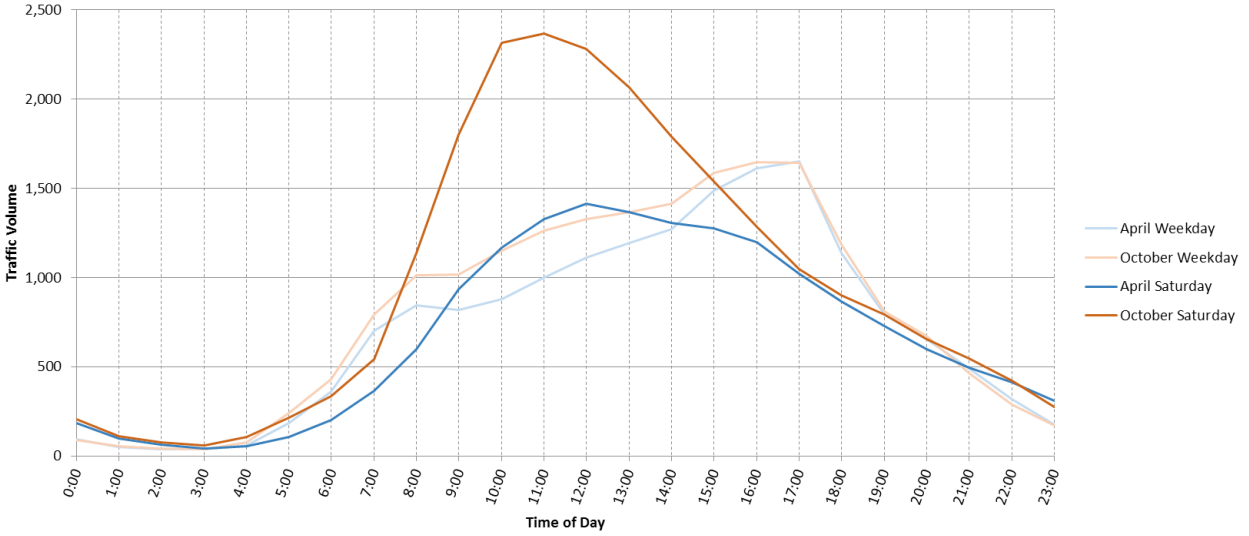
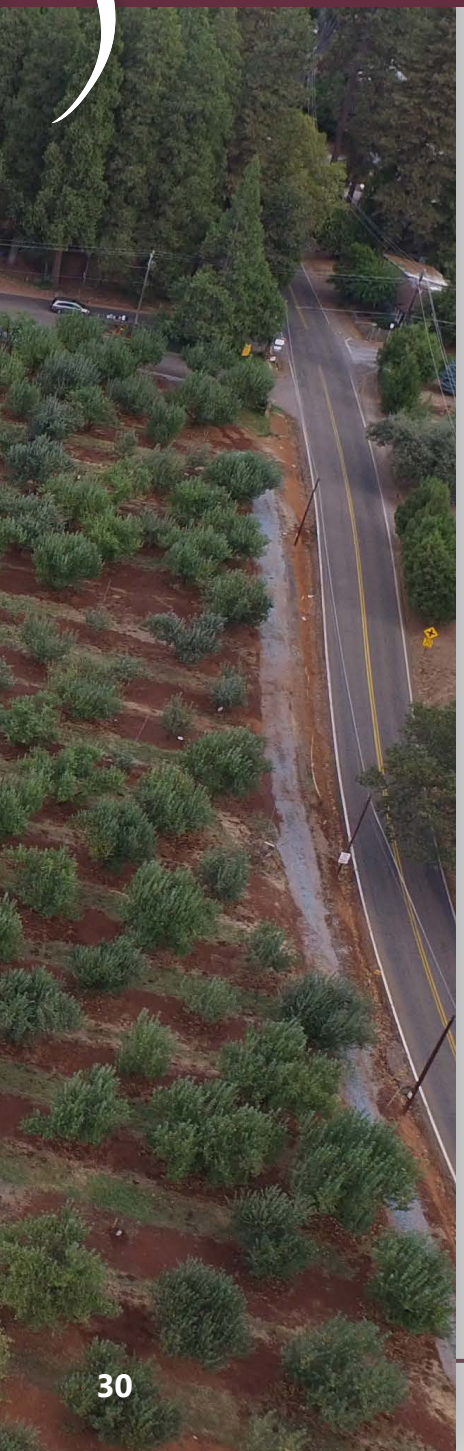


Figure 7: US 50 Westbound Traffic Volumes at Bedford Ave – 2015



earlier statement that 40% of eastbound traffic through Placerville on a peak fall agritourism weekend is bound for the Camino area. It also suggests that the April Saturday volumes are likely the steady background traffic on US 50.

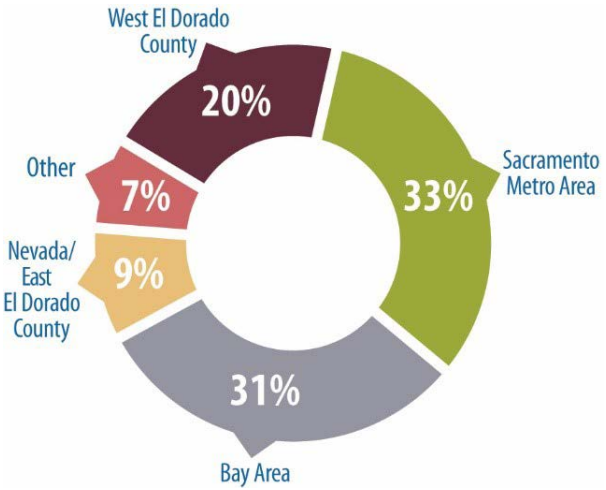
Apple Hill℠ Travel Patterns

To assist with understanding regional travel patterns during the fall agritourism season, GPS and cell phone data was obtained for the months of September, October, and November of 2015. This data was analyzed to help answer three questions about travel behavior within and to the Camino area, as detailed below.

Where are visitors traveling from?

Cell phone data was used to indicate where visitors to the Camino area are traveling from. As shown in Figure 8, the data suggests that approximately 90 percent of trips destined for the Camino area originate from the west while approximately 10 percent originate from the east. Additionally, the Sacramento Metro Area and the San Francisco Bay Area account for approximately two-thirds of all trips destined for the Camino area.

Figure 8: Camino Visitor Origin



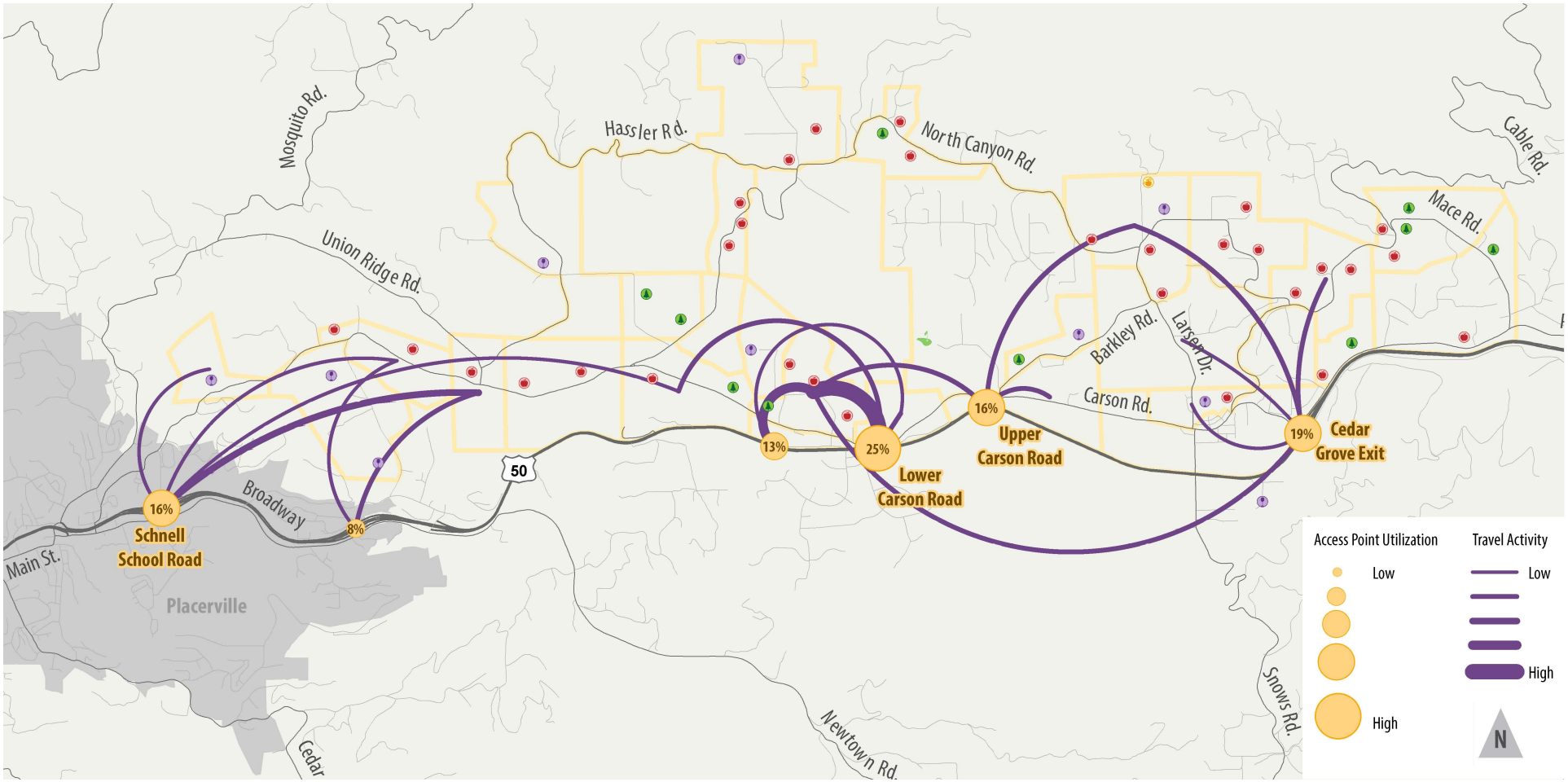
Which routes do visitors use to enter the Camino area?

The GPS and cell phone data was also used to determine which access points are most heavily used by visitors. As shown in Figure 9, the data suggests that the Schnell School Road, Lower Carson Road, Upper Carson Road, and Cedar Grove exits off of US 50 are the most heavily used access points in to the Camino area, while the Point View Drive exit is utilized significantly less.

The large amount of traffic utilizing the Cedar Grove exit is in part due to the traffic control employed by the California Highway Patrol (CHP). The CHP traffic control prohibits left-turns at the

US 50 exits at 5 Mile Drive, Lower Carson Road, and Upper Carson Road from 10 a.m. to 3 p.m. on October weekends. As a result, much of the traffic on eastbound US 50 headed towards Apple Hill℠ farms is directed to the Cedar Grove exit. Some of this traffic gets back on westbound US 50 to the Upper Carson Road, Lower Carson Road, and 5 Mile Drive exits.

Figure 9: Access Points into the Camino Area



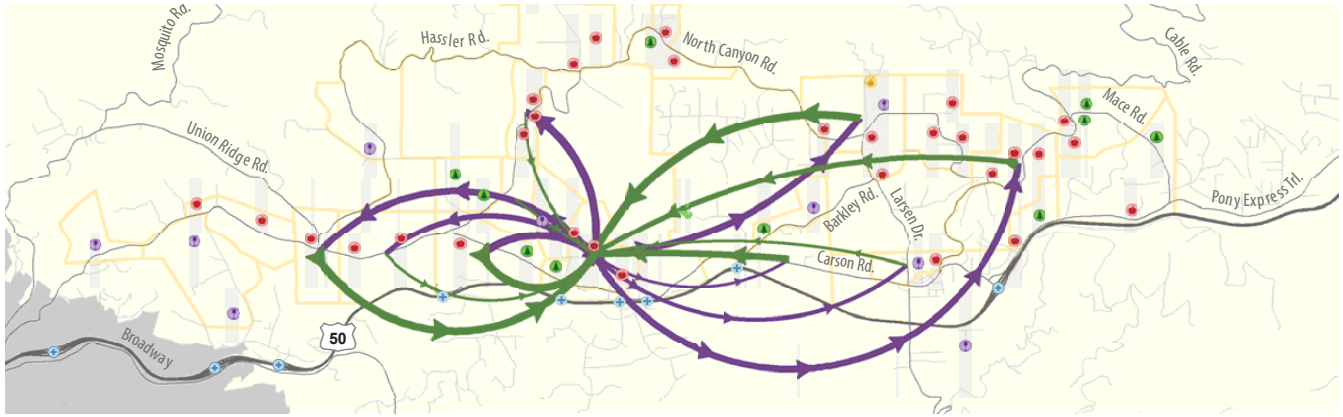
Where within the Camino area are people traveling to?

To understand travel patterns within Camino, the area was divided into 30 zones, roughly grouping orchards that are in close proximity to each other. A GPS travel analysis generated an origin-destination matrix for travel between the 30 zones. Five "hotspots", or zones that had the highest interaction with the other zones, were identified. These zones roughly correspond to the following areas of Camino:

- West Carson Road Area near Union Ridge Road
- Carson Road area near North Canyon Road
- Cable Road/Larsen Drive area
- Carson Road area near Gatlin Road
- Larsen Drive/North Canyon Road area

Individual plots were made for each of the five zones listed above. Overall trends show that the highest amount of interaction occurs between the five zones listed above. Figure 10 shows an example of one of these plots for the Carson Road area near Gatlin Road. Appendix G provides a complete set of these plots for all five zones.

Figure 10: Travel Patterns for Carson Road Area near Gatlin Road



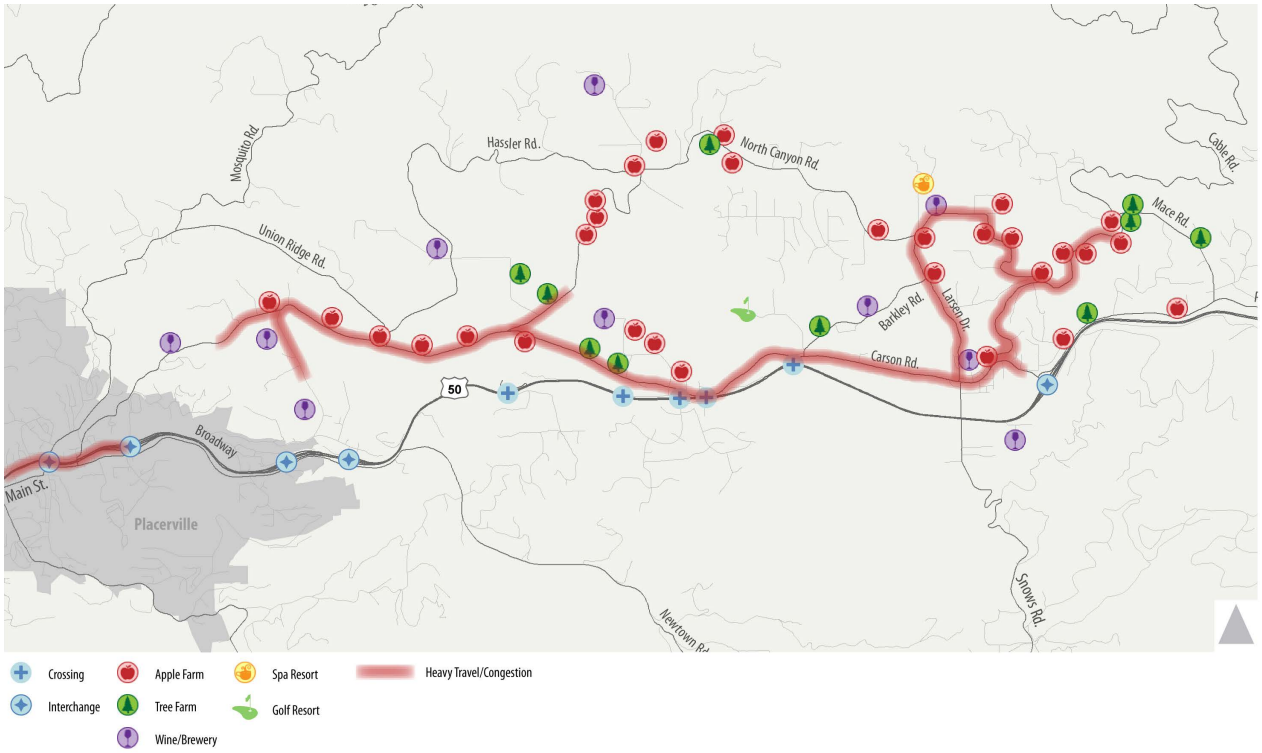
KEY ACTIVITY CENTERS

Through synthesis of the collected data, key activity centers within the Camino area were identified. These activity centers are described below.

- **Carson Road/Union Ridge Road area:** a high amount of congestion occurs along Carson Road in the easterly and westerly directions from the intersection of Union Ridge Road near Abel's Acres. A CHP officer has assisted with traffic control at the Carson Road/Union Ridge Road intersection during October weekend afternoons to allow vehicles to turn onto and off of Union Ridge Road. This has made it easier for vehicles to turn onto and off-of Union Ridge Road but has resulted in higher delays and longer queues on westbound Carson Road.
- **Carson Road west of North Canyon Road:** a moderate amount of congestion occurs along Carson Road in the easterly and westerly directions from the parking areas for Boa Vista Orchards
- **Carson Road/Gatlin Road area:** the heaviest congestion in the area occurs along Carson Road in the easterly and westerly directions from the intersection of Gatlin Road near the High Hill Ranch entrance. The westbound approach at Gatlin Road generates the longest queues and delays, which can extend back to Larsen Drive in Camino and take over an hour to travel through.
- **Eastern Camino area:** a light to moderate amount of congestion occurs along the Larsen Drive/Cable Road loop north of the town of Camino. Key ranches along this loop include Rainbow Orchards, Larsen Apple Barn, Jack Russell Brewery, Denver Dan's, Bolster's Hilltop Ranch, and Apple Ridge Farms.

In addition to the congestion centers listed above, US 50 through Placerville experiences congestion in the eastbound direction during the morning hours and the westbound direction during the afternoon hours. Observed congestion generated by these activity centers is illustrated in Figure 11.

Figure 11: Activity Centers within the Camino Area



Mobility Challenges

05

The collected data, including traffic counts, field observations, GPS data, drone videos, field observations, and stakeholder feedback, was used to inform and identify mobility challenges facing the region. The mobility challenges vary in size and how they affect various stakeholder groups. For the purposes of the study, they are separated into regional and local challenges.

As described below, the primary agritourism related mobility challenges in El Dorado County include:

- Regional traffic on US 50 through Placerville
- A brief but intense peak in agritourism travel during fall weekends
- Insufficient parking access and circulation causing queuing and congestion on Carson Road

REGIONAL TRAVEL CHALLENGES

Regional travel to and from the Camino area poses a complex challenge because of Camino's distance and isolation from population centers and the limited access into and out of the region.

Regional Draw

Over recent decades, the Apple Hill℠ growers have grown to be a major attraction within El Dorado County and now attract regular visitors from all parts of Northern California. Long-distance travel to the area from major population centers in Northern California, such as Sacramento and the San Francisco Bay Area, has created a unique challenge whereby non-local visitors are unfamiliar with the region and therefore mostly only visit those areas that are immediately adjacent to US 50 and Carson Road. This effect is observed in traffic congestion when segments of Carson Road experience severe congestion while roadways farther from US 50 experience minimal congestion. Although marketing efforts have attempted to inform visitors of other Apple Hill℠ growers, the Carson Road corridor remains the primary activity center.

Regional Traffic on US 50

US 50 serves as the regional connection between the metropolitan populations of Sacramento and San Francisco and attractions in eastern and central El Dorado County, such as the Tahoe Basin and Apple Hill℠ growers near Camino. During peak tourism seasons, including alpine sports, summer, and the fall harvest, US 50 carries a significant amount of traffic, particularly during Friday and Sunday afternoons. Multiple events coinciding, such as traffic returning from the Tahoe Basin and Apple Hill℠ growers on Sunday afternoons in the fall, cause a particularly noticeable increase in traffic. These activities result in high volumes of traffic on US 50 that must travel through the City of Placerville.

Traffic Congestion Through Placerville

Within the City of Placerville, US 50 changes from a freeway to an expressway with three signalized at-grade intersections at local roadways and State Route 49 through downtown Placerville. Caltrans has informed the project team that the three traffic signals on US 50 in Placerville are currently operating with maximum cycle lengths and optimized coordination. Pedestrian bridges currently exist at two locations to help reduce automobile delay, and widening of US 50 through Placerville presents considerable challenges due to right-of-way and funding issues. Therefore, minimal opportunity exists to further optimize travel along the corridor without major capacity enhancements.

US 50 was observed to be especially congested in the westbound direction during the afternoon, which may be due to similar departure times for traffic leaving the Tahoe Basin and Apple Hill℠ ranches. Eastbound US 50 during the morning hours experienced somewhat less congestion, which may be due to greater variation in arrival times for traffic bound for Apple Hill℠ growers and the Tahoe Basin.

Peak Travel Times

A key challenge to recognize and consider in assessing mobility solutions is the peak travel times during which congestion occurs. Due to the nature of the harvest season, congestion in the Camino area primarily occurs on four to six weekends per year, which corresponds to less than four percent of days out of the year. Although traffic congestion can be severe on those weekends, the annual frequency of congestion is minimal compared to more conventional transportation projects in urban areas that experience congestion every non-holiday weekday.

Unreliable Cell Service

The region's hilly terrain provides a challenge for receiving reliable cell service. Cell service was observed to be reliable near the Carson Road/US 50 corridor but significantly less reliable as distance from the corridor increases. The unreliability of cell service contributes to wayfinding challenges for areas farther from US 50. Installing a greater number of cell service towers farther from US 50 to improve cell service reliability is costly and likely infeasible for local businesses to fund.

LOCAL TRAVEL CHALLENGES

During the popular apple harvest season between September and November, rural roadways in the Camino area experience significant weekend traffic congestion. Since that type of traffic congestion only occurs during a handful of weekends throughout the year and the community prefers to preserve its rural character, conventional methods of traffic mitigation, such as roadway widening, are not feasible. Therefore, the significant but relatively infrequent weekend traffic congestion presents a unique challenge in identifying solutions that sustain both local and regional agritourism business, improve circulation and mobility, and preserve the rural and natural beauty that makes the region an attractive place to live and visit.

Parking Access & Circulation

The primary factor contributing to local congestion in the Camino area is inefficient parking access and circulation at the most heavily visited orchards, especially ones on Carson Road. At most of these orchards, significant queues of vehicles were observed waiting to enter despite available parking within the parking areas. Those observations indicate that parking access and circulation is limiting the volume of traffic entering the orchards and causing the extensive queuing and congestion on local roadways.

For example, the traffic count data collected in October 2015 showed that the traffic demand at two of the most popular orchards, Abel's Acres and High Hill Ranch, well exceeded the inbound vehicular flow rate. At Abel's Acres, the traffic demand to enter the parking area reached 280 vehicles per hour (vph) at its peak, while the inbound flow rate was a relatively consistent 180 vph. At High Hill Ranch, the traffic demand to enter the parking area peaked at 950 vph, although the inbound flow rate was only 480 vph. Appendix H provides a more detailed analysis of the traffic flow at Abel's Acres and High Hill Ranch.

This shows that the inbound flow rate only represents a portion of the actual demand. The excess traffic demand causes queues to spill back onto Carson Road, creating delays and impeding mobility for visitors, residents, and emergency responders. During peak weekends, vehicles on westbound Carson Road headed in the direction of High Hill Ranch can wait in queues of up to two miles long for over an hour.

Access From US 50

Analysis of multiple data sources was used to determine the primary access points used to enter the Camino area. The Cedar Grove exit, Upper and Lower Carson Road intersections, and the Schnell School exit are heavily used by visitor traffic to access the Camino area. The Upper and Lower Carson Road access points require eastbound vehicles to yield to oncoming westbound traffic. Furthermore, queues of vehicles waiting to enter High Hill Ranch can often spill back to the Upper and Lower Carson Road access points, limiting the number of vehicles able to exit US 50. This can create queues on the US 50 mainline, creating a safety hazard due to the speed differential between exiting traffic and through traffic on US 50.

Local Wayfinding

The rural and topographic environment within Camino creates a navigational challenge for visitors unfamiliar with the area. Many visitors choose to remain close to US 50 (i.e. along Carson Road) where cell reception is reliable and allows them to utilize online navigation tools to make route decisions. Unreliable cell reception in other areas of Camino could be a contributing factor to congestion along Carson Road and a barrier to visitors feeling comfortable enough to explore and experience other Apple Hill℠ ranches beyond Carson Road.

Mobility Challenges

Short Distance Trip Making

The data collection and outreach effort showed that visitors make many short-distance trips between ranches in the Camino area. This is most notable for the following six key areas around Camino:

- Carson Road at Union Ridge Road
- Carson Road near North Canyon Road
- Carson Road at Gatlin Road
- North Canyon Road north of Carson Road
- Larsen Drive from Barkley Road to Cable Road
- Cable Road near Larsen Drive

In some of those areas, tourists visit multiple ranches within one area, such as the ranches along Larsen Drive. In addition, there are a large number of vehicles traveling between individual areas to visit multiple ranches within each area. The interaction between ranches both within and between those areas indicates that a large number of trips are short distance trips within the Camino area. The cumulative effect of short distance trips is a large number of vehicles on local roadways both within each individual area as well as on the roadways between them.

Major Activity Centers

Assessment of the collected data identified areas where congestion occurs (see Figure 11). Despite high levels of congestion along roadways near US 50, including Carson Road, many roadways further from US 50 exhibit minimal to no congestion, such as Union Ridge Road, Hassler Road, and North Canyon Road.

Emergency Responders

Traffic congestion along rural roadways in the Camino area creates a safety hazard by delaying emergency response time or, in extreme cases, preventing emergency access. Areas along Carson Road are particularly vulnerable to this issue due to high levels of congestion and lack of alternate access routes for emergency response vehicles.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Mobility Solutions

06

The unique mobility challenges presented in the previous section necessitate innovative and context-sensitive solutions. Since traffic congestion only occurs during a handful of weekends throughout the year and the community values the area's rural character, conventional methods of traffic mitigation through roadway widening and adding turn lanes are not practical or warranted. In addition, the area's hilly topography would make roadway widening expensive and possibly infeasible. Therefore, the mobility solutions presented below consider these circumstances while promoting business in the region, improving circulation for visitors and local residents, and enhancing the region's scenic beauty.

PARKING & CIRCULATION IMPROVEMENTS

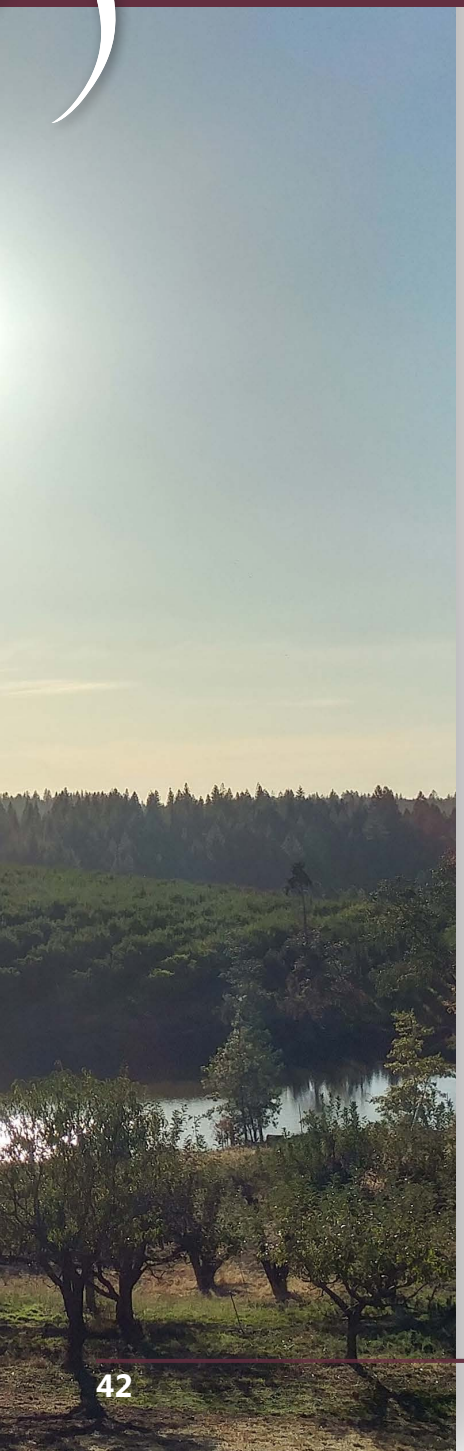
As noted in the previous chapter, insufficient parking access and circulation at the most heavily visited orchards are the primary cause of congestion and queuing on local roadways during peak Apple Hill[SM] weekends. The resulting queues and delays also affect access to the Camino area from US 50 as well as mobility for local residents and emergency responders.

The following parking and circulation improvements represent near-term solutions that can be implemented within the next five years to improve flow into parking areas as well as proactively address possible other parking related issues.

Access & Circulation Improvements

Apple Hill[SM] ranches and El Dorado County should evaluate driveway locations and parking lot circulation at individual ranches to determine whether improvements can be made to minimize conflict points and improve traffic flow into and out of ranch parking areas. Improvements are particularly important when the demand to enter a ranch parking area causes queuing that spills back onto the public roadway. These access and circulation improvements will improve traffic flow on local streets by ensuring efficient flow into and out of ranches as well as increase the amount of visitors that can visit ranches.

Techniques to improve access and parking circulation include extending driveway throats further into a ranch, eliminating parking on entry driveways, employing attendants to direct traffic circulation within a ranch parking area, designing intuitive parking circulation, and separating vehicle



and pedestrian routes to reduce conflicts. For heavily visited ranches, multiple driveways and one-way parking lot circulation should also be considered.

Boa Vista Orchards and Abel's Apple Acres are two examples of ranches that have implemented these types of access strategies and circulation improvements.

Since parking access and circulation is such a critical issue to improving traffic flow, this study conducted a focused evaluation of conceptual improvements at the ranches near the two most congested areas of Carson Road: Abel's Acres and High Hill Ranch. Conceptual improvements at these two locations showed that improved access to parking areas and more effective internal parking lot circulation can result in substantially reduced queuing and delays. While traffic would not reach free-flow speeds, queuing and delays on Carson Road was greatly reduced. At High Hill Ranch, these improvements are particularly important to implement prior to the completion of the US 50 Camino Safety Project to ensure smooth traffic flow from the proposed new eastbound off-ramp. Appendix H provides a more detailed summary of this analysis at Abel's Acres and High Hill Ranch.

El Dorado County is responsible for coordinating with ranches regarding the necessity of these improvements during permitting, while individual ranches are responsible for making these improvements to their property. El Dorado County should provide support to facilitate the implementation of improvements, where appropriate.

Parking Lot Wayfinding

Improved signage within the parking areas of the larger ranches will assist with directing traffic and channelizing pedestrians to appropriate crossings. Signs may be augmented with temporary fences or other means to direct and separate pedestrian and vehicular traffic. Individual ranches are responsible for these improvements.

Prohibit On-Street Parking

"No Parking" signs along public roadways with minimal or no space for parked vehicles will encourage use of designated parking areas, reduce pedestrian and vehicle conflicts, and improve traffic flow. Areas where on-street parking creates safety and operational issues due to sight-distance, vehicle travel speeds, and lack of shoulders are of particular importance. In conjunction with providing an adequate parking supply at ranches, prohibiting on-street parking will improve operations by ensuring that automobile and pedestrian conflicts along roadways are minimized.

On-street parking is currently prohibited along Union Ridge Road north of Carson Road, Gatlin Road south of Carson Road, and along Cable Road at Grandpa's Cellars. El Dorado County is responsible for enforcing these type of improvements via the Ranch Ordinance Code and the Traffic Advisory Committee.

Adequate Parking Supply

Ranches should evaluate their parking supply during peak visitor times and identify "overflow" lots on their property to be used on a temporary basis. Signage of overflow lots should be installed to direct visitors to them when main parking areas are full. Overflow lots should be easily accessible to main ranch buildings and minimize pedestrian conflicts with vehicle circulation. In conjunction with prohibiting on-street parking, an adequate parking supply at ranches will improve operations by ensuring that automobile and pedestrian conflicts along roadways are minimized.

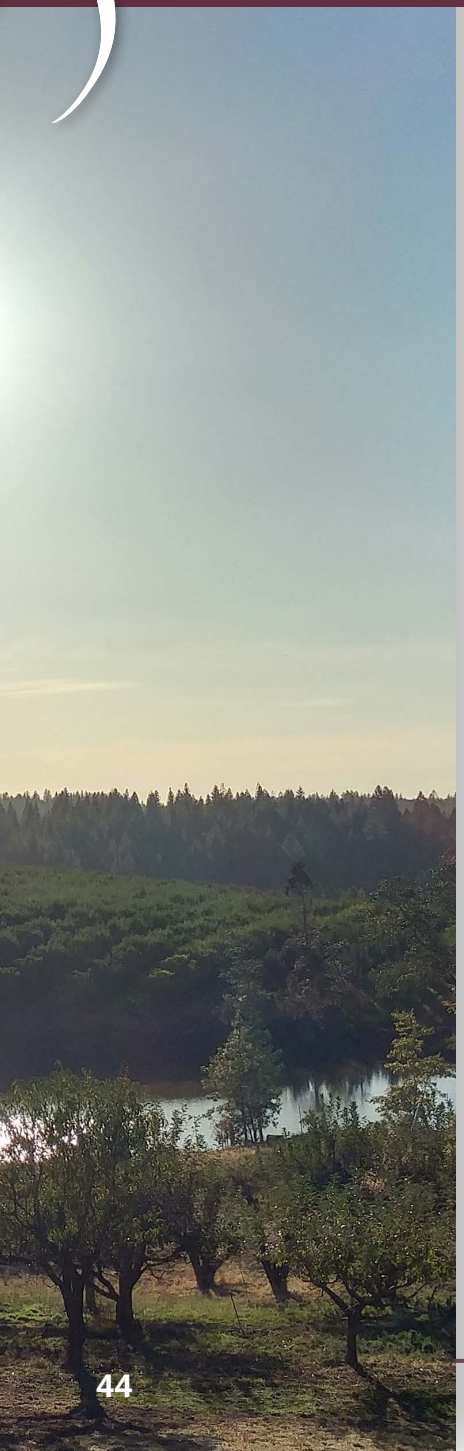
Should parking supply need to be expanded, individual ranches are responsible for those improvements with El Dorado County providing support where appropriate through special use permitting and enforcement of the Ranch Ordinance parking requirements.

TRAVELER INFORMATION

As noted in the *Bay to Tahoe Basin Recreation and Tourism Travel Impact Study*, well coordinated strategies and channels for the dissemination of visitor information is key. Today's visitors expect to be able to find travel information prior to travel and during travel, with the majority of travelers obtaining information from the Internet via personal computers (prior to travel), smartphones, or tablets. To expand upon this strategy in the Bay to Basin study, this study recommends the following improvements to facilitate the dissemination of information to help visitors plan their visit. These improvements are near-term solutions that can be implemented within the next five years.

Augment "Plan Your Trip" Resources

Easily accessible travel information can assist visitors with planning a visit to their agritourism destination. Recommendations of various types of travel information, from real-time to traditional maps, are provided below. The Apple Hill℠ Growers Association already provides some of this information on its website as well as in its Cider Press; however, our review of these existing resources show some room for improvement to ensure visitors are able to more easily find these



resources and tips. The Apple Hill℠ Growers Association and individual ranches are responsible to develop and provide the travel information with El Dorado County, El Dorado County Chamber of Commerce, and the El Dorado Winery Association participating as appropriate.

General Traffic/Travel Information

Ranches should promote the benefits of visiting during off-peak times, set expectations for traffic levels during peak times, inform visitors of all destination/ranch options, and share availability of alternative modes once available. Encouraging visits during off-peak times will reduce the concentration of traffic during peak weekends and improve overall traffic flow through the area.

In the 2016-2017 Apple Hill℠ Cider Press, the Apple Hill℠ Growers Association included a new section called "As Good As Gold" that includes "nuggets" that will help make visits "as Good as Gold" for farms and visitors alike. Within this helpful list of recommendations is the following tip for visitors:

> *To enjoy a leisurely day driving around the hill, the opportunity to interact with the farmers themselves, and the chance for excellent service, plan a trip for September, November, or December or on a weekday, avoiding lines and traffic on busy October weekends.*

While helpful, this tip along with the other recommendations is near the back of the Cider Press and not on the Apple Hill℠ Growers Association website.

Since many visitors now use the Internet to find travel information prior to and during travel and most do not pick up a Cider Press until reaching an Apple Hill℠ grower, these tips would be more effective if published on the Apple Hill℠ Growers Association website.

The Gatlinburg, Tennessee tourism website presented at right is an example of effectively communicating general traffic and travel information to visitors through the Internet.

General Traffic/Travel Information Example: Gatlinburg, Tennessee

Nestled at the entrance to the Great Smoky Mountains National Park, the most visited national park in the country, Gatlinburg, Tennessee is a mountain resort destination that attracts more than 11 million visitors a year. As a result, traffic through Gatlinburg can often be a headache. To assist visitors with navigating the area, the "Visit My Smokies" website includes a page of tips titled "How to Avoid Traffic in Gatlinburg." Included on this webpage are helpful recommendations including:

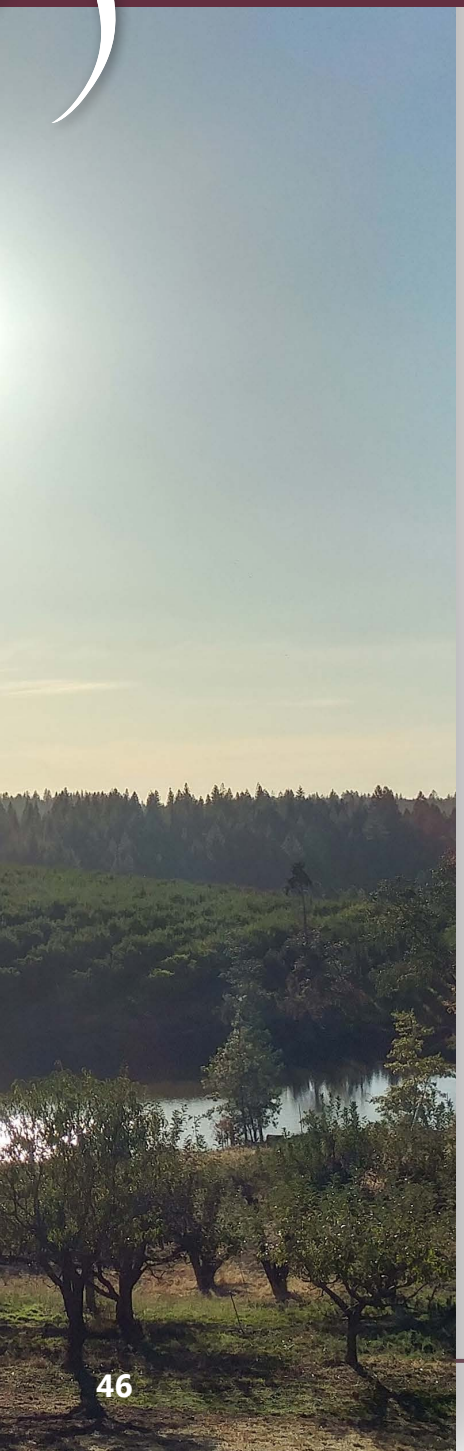
- Avoid the main roads and planning alternate routes
- Travel during off-peak hours
- Promotes the Gatlinburg Trolley as an alternative to driving
- Encourages people to walk as an alternative to driving and an opportunity to enjoy the scenery of the area

This helpful set of tips is presented in an understandable and sensitive manner that prepares visitors to anticipate traffic while constructively providing recommendations and alternatives, similar to the "As Good As Gold" page of the Cider Press but accessible online. You can view this page at: http://www.visitmysmokies.com/blog/smoky-mountains/travel-information/how-to-avoid-traffic-in-gatlinburg/

Informative Guide & Map of Ranches

An online, interactive guide and map of the ranches could inform visitors of the many ranches available beyond the Carson Road corridor and encourage them to visit ranches that are off the main road and away from heavily congested areas. While the Apple Hill℠ Growers Association Cider Press and website include a full list of the Apple Hill℠ ranches, the website's list could be more intuitive to navigate and more clearly articulate the unique attraction or characteristics of individual ranches. For example, the El Dorado County Winery Association website features an interactive online map that effectively communicates the relative locations of wineries along with a description of the particular attributes of each location (see additional details on next page).

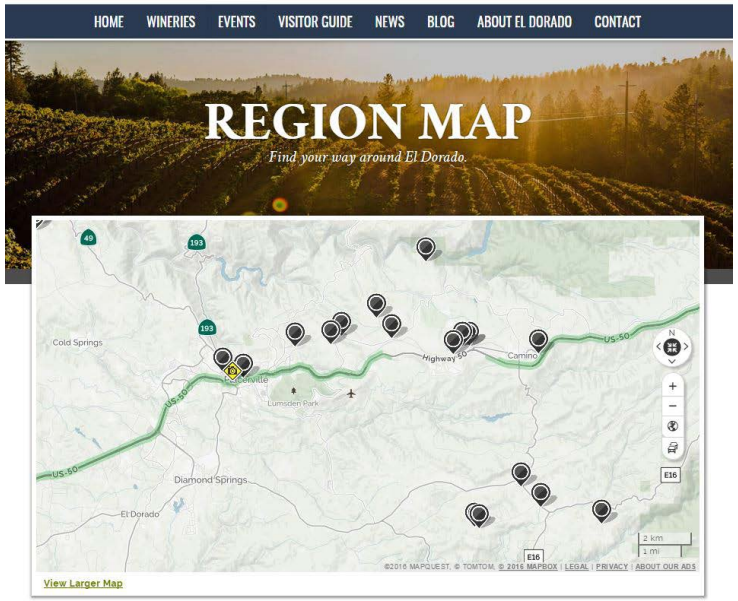
Since mobile data access can be a challenge in the rural areas of El Dorado County, it is also recommended that the Apple Hill℠ Growers Association should consider including a printable map and brochure that specifically includes these tips that address traffic circulation during peak times. These brochures could be made available at individual ranches as well as be available on the "Plan Your Visit" page so visitors can print them out before traveling.



Informative Guide & Map of Ranches Example: El Dorado County Winery Association

The El Dorado County Winery Association website features an interactive online map that shows visitors the locations of wineries and much more. The interactive map allows visitors to click on an individual winery, which immediately brings up a brief description of the winery as well as an intuitive "button" to press to initiate directions. Additional features include a "Traffic" layer that allows viewers to see general traffic speeds, "traffic incidents," and "traffic webcams," as well as layers for points of interest including hotels, food, gas stations, grocery stores, and more.

The El Dorado County Winery Association map can be viewed at:
http://eldoradowines.org/map.php



Identify Alternate Routes

The Apple Hill℠ Growers Association as well as individual ranches should review all access routes into the area and identify alternate route options for visitors to consider. In anticipation of typical traffic congestion, the Apple Hill℠ Growers Association website could identify recommended alternate routes to access the Apple Hill℠ area in addition to the main directions on its website. Similarly, individual ranches that have websites could post a primary set of directions as well as recommended alternate routes to use during peak times to avoid typical traffic congestion. A coordinated effort by all ranches to do this will help disperse traffic and reduce congestion throughout the agritourism area.

Provide Real-Time Traffic Information

Visitors and residents alike would benefit from having access to and being aware of sources for real-time traffic information. Below are examples of real-time traffic information that represent solutions designed to help visitors make informed choices about travel behavior that will result in reduced congestion during peak periods.

Traffic Web-Cams

Utilize existing and/or place additional traffic cameras at key locations on local roads to provide visitors with access to current traffic conditions. Traffic web-cams can be used as a real-time resource to view traffic conditions either further ahead on a route or as a planning resource to estimate traffic conditions for a future visit. The Apple Hill℠ Growers Association and El Dorado County are responsible for implementing traffic web cams on local roads. Caltrans currently has one webcam located in Placerville at the intersection of State Route 49/Spring Street and US 50.

Mobile Traffic Applications

Utilize traffic data in mobile applications, such as Google Traffic and Waze, to inform visitors of traffic conditions, estimated time of arrival, and traffic incidents. The Apple Hill℠ Growers Association and individual ranches are responsible for developing mobile traffic applications.

Ensure Web Access to Mobile Devices

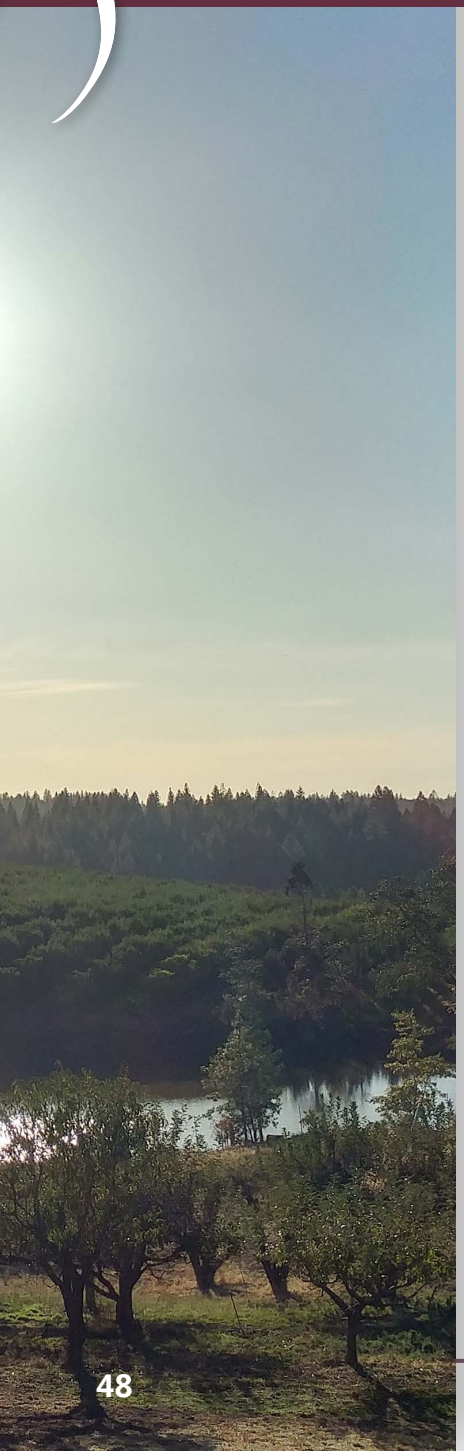
Wi-Fi hotspots can assist with providing web access to mobile users in topographic and rural areas with spotty access to mobile data. Additionally, visitors and residents can be encouraged to download maps to their devices prior to traveling through areas outside mobile data coverage. The Apple Hill℠ Growers Association and individual ranches are responsible for coordinating with service providers to improve web access for mobile devices.

Changeable Message Signs

Changeable message signs (CMS) can alert drivers to congestion and encourage the use of alternative routes. An added benefit of CMS is that they do not require access to a smartphone or GPS and are thus the information they provide is available to all drivers. The Apple Hill℠ Growers Association would need to coordinate with El Dorado County for the installation of CMS on local roads. Caltrans is responsible for installing CMS on US 50.

Improve Local Wayfinding

Improving local wayfinding will help direct visitors to access points to the Camino area when arriving or leaving, as well as better navigate the area to find ranches they want to visit. Improved wayfinding can reduce the number of vehicles dispersed on local roadways while searching for select ranches. All wayfinding signs must comply with the County's Sign Ordinance. Below are suggestions for ways to improve local wayfinding.



Divide Agritourism Area into Districts/Zones

Growers can be grouped into "districts" or "zones" by geographic area to assist with directing travelers to identifiable locations. Each "district" should be large enough to include several growers. Collaborative marketing between growers in each district can take advantage of the unique characteristics of a given district to distinguish it from other areas and improve recognition and increase visitors.

Consider Re-implementing the "Golden Apple Trail"

Current wayfinding signage in the Camino area consists of "Apple Hill Scenic Drive" signs along with a list of nearby ranches. These signs, while present, can be difficult to read while driving around the area. In the 1960s and 1970s, Apple Hill℠ growers used the "Apple Hill Golden Apple Trail" to help visitors find their ranches. In a similar fashion, a continuously branded loop through the Camino area could help visitors travel through the area, including encouraging visitors to explore less-traveled routes further from US 50. As an example, Fresno County's Blossom Trail guides visitors on a scenic drive through orchards in bloom during the spring.

Local Wayfinding Signs

Tourist-oriented destination (TOD) signage strategically located along Carson Road that corresponds to signage for the "districts" approach identified above can assist visitors with local wayfinding.

Regional Access Signs

TOD signage along US 50 can be used to direct visitors to primary access points to Camino. TOD signage is commonly found throughout the Napa County winery region provides a good example of the successful implementation of TOD signage in an agritourism area. El Dorado County and Caltrans are responsible for implementing TOD signage.

MARKETING STRATEGIES

The following marketing strategies promote visitation while remaining strategic about impacts to transportation facilities. These improvements represent near-term solutions that can be implemented within the next five years. The Apple Hill℠ Growers Association and individual ranches are responsible for developing the marketing strategies described below.

Encourage Weekday and Off-Peak Travel

Ranches should encourage off-peak visits through promotions and discounted merchandise.

Co-Market with Other Attractions

Ranches should consider advertising and marketing activities at lodging and tourism destinations in the Tahoe Basin and Reno, as well as local associations such as the El Dorado County Winery Association, El Dorado County Chamber of Commerce, and the City of Placerville. Coordination between the markets can include promotion of off-peak travel days.

Media/Social Media Strategies

Ranches should expand the reach of marketing promotions by making additional efforts to promote through traditional media outlets, such as newspapers and television, as well as social media outlets such as Twitter and Facebook or others as new social media outlets are developed.

MULTIMODAL STRATEGIES

The multimodal strategies identified below can help alleviate traffic congestion along existing roadways without loss in the number of visitors by providing alternate routes and modes of travel. Implementing multimodal travel options within the area represents a long-term solution that will likely require more than five years to implement.

Dedicated Shuttle Facility

Previous transit shuttle service was hindered by traffic conditions on local streets. To improve reliability and make the service a more attractive alternative to driving, a dedicated facility should be provided for shuttles. The facility could also serve as an emergency vehicle access route under periods of roadway congestion. Examples of successful transit shuttles operating in similar conditions include National Park shuttles, such as those operating at Yosemite and Grand Canyon National Parks. Two types of dedicated shuttle facilities are presented below.

Dedicated Shuttle Lane

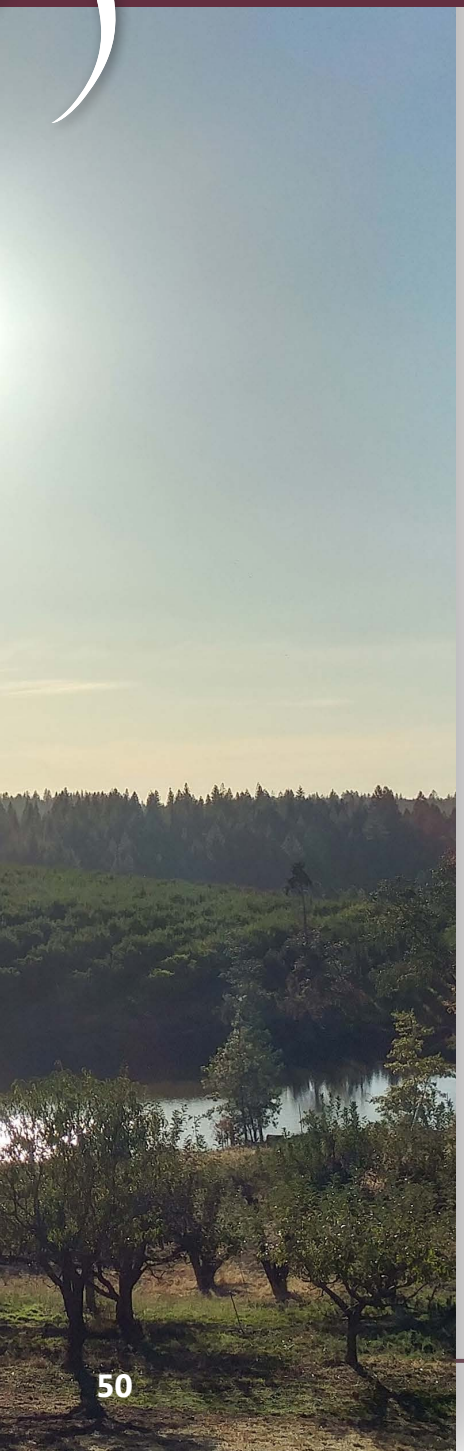
A designated travel lane paralleling congested roadways that would exclusively serve shuttles and emergency vehicles should be explored. Implementation of the dedicated shuttle lane with no expansion of existing transportation infrastructure would require temporary one-way circulation. El Dorado County and a transit provider are responsible for these improvements.

Multi-Purpose Trail

A Class I bike path between ranches and activity centers can provide an alternate route to congested roadways. During off-peak times the facility could be a community asset for walking, running, and cycling. During peak visitor weekends the facility could be used as a dedicated shuttle and emergency vehicle facility. To be able to accommodate shuttle and emergency vehicles, this Class I bike path would need to have a minimum paved width of 12 feet.
El Dorado County and private property owners are responsible for these improvements.

Centralized Park-and-Ride Facilities

Park-and-ride facilities make shuttle service more convenient and effective by offering a centralized location to transfer between private automobile and shuttle service. Park-and-ride facilities should be located in easily accessible, central locations that serve as effective hubs.



Possible park-and-ride locations include:

- Schnell School Road
- US 50/Lower Carson Road
- Sierra Pacific Industries site at Carson Road/Larsen Drive
- US Forest site at Carson Road/Eight Mile Road

Park-and-ride locations will need to be vetted by shuttle service provider, and should have safe and efficient access and internal parking circulation. It may require the cooperation of private landowners.

Utilize Park and Rides as Hubs

To expand upon the services of park-and-ride facilities, informational kiosks, storage lockers, and areas for possible vendors could also be provided. These amenities will transform park-and-ride facilities into local hubs that provide visitors with information for places to visit and answer questions, create opportunities for smaller ranches to sell their products, and provide a place for purchased items to be stored until visitors leave.

Delivery Alternatives

Multimodal travel necessitates alternative ways for visitors to transport purchased goods. Means of transporting purchased goods can include:

- Having products shipped to homes
- Sending products to the park and ride hubs for storage and pick-up at the end of the day
- Renting portable lockers
- Offering refrigerated storage and transportation for perishable goods

Delivery alternatives may also provide ranches with the opportunity to maintain contact with customers.

Shuttle/Tram Service

A transit service could take the form of buses, trams, or hayrides that replace existing automobile trips and thus reduce roadway congestion. The transit service should operate on a dedicated facility or lane (see above) and could be provided by public transit service, a private service, or electric vehicles.

Expand Public Transit Service in the Area

Public transit service by El Dorado Transit could be expanded in the local Camino area, with more frequent service during the peak agritourism season to handle additional demand. Potential Americans with Disabilities Act (ADA) improvements may be necessary to fully accommodate expanded public transit service in the area.

Contract with El Dorado Transit or Private Operator to Provide Service

Ranches or an organization, such as the Apple Hill℠ Growers Association, can contract with El Dorado Transit or a private shuttle operator to provide shuttle service during peak agritourism season. A private operator, such as Amador Stage Lines, would address potential regulatory constraints on public transit providers, such as El Dorado Transit. Larger shuttle vehicles may be appropriate on highly traveled corridors, such as Carson Road, while smaller vehicles may be better suited for less-traveled roadways with challenging topography and curves, such as Hassler Road or North Canyon Road.

Dedicated Shuttle Circulation at Ranches

To facilitate shuttle use, large ranches could have dedicated lanes that ensure shuttles/trams are able to pick-up/drop-off riders efficiently.

Charter Tours

Charter tours offer the ability for large groups to visit ranches without necessitating multiple vehicles which contribute to traffic congestion. Additionally, visitors with charter tours would be able to keep purchases with them. To accommodate charter tours, parking areas should offer spaces for longer vehicles and areas for passenger drop off and pick up.

Walking Trails

Ranches in close proximity could be connected by walking trails either along public the public road right-of-way or through mutual agreement among adjacent property owners. Walking trails could enhance visitors' orchard experience while reducing short vehicle trips between ranches and the roadway congestion associated with automobile trips.

Bicycle Options

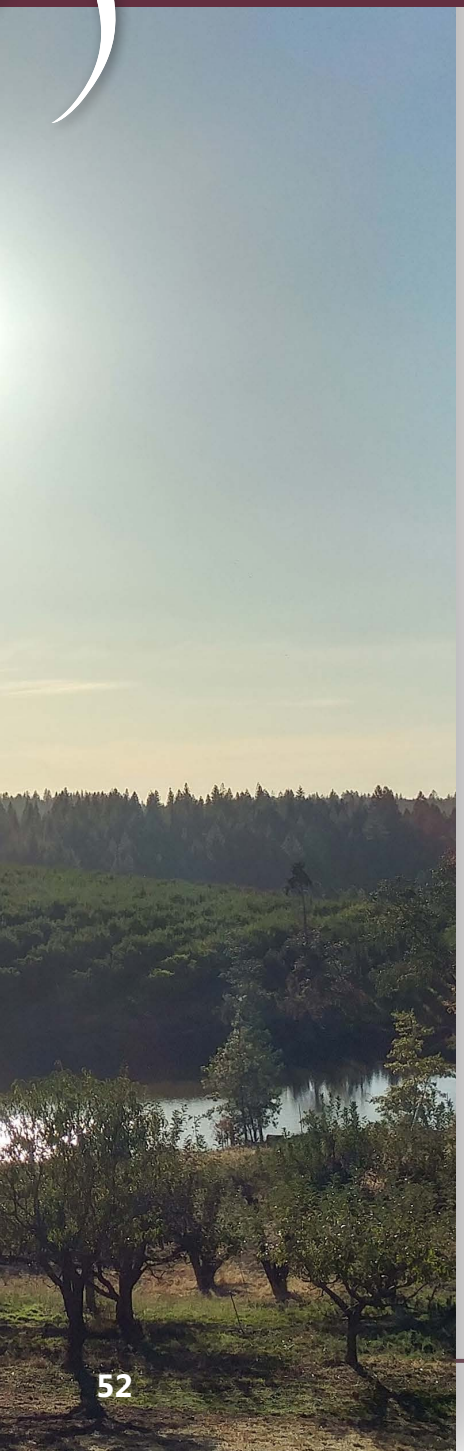
Improved bicycle infrastructure and services will encourage bicycling as a feasible way to travel around the agritourism area, which can reduce trips made by automobile and thus roadway congestion. To encourage bicycling, the following improvements to bicycle facilities and amenities are recommended.

Bike Lanes

On primary roadways through the agritourism area, paved shoulders can be widened to provide on-street bike lanes. Additional pavement width to provide buffered bike lanes or protected bikeways would make these facilities more attractive to novice and amateur cyclists. The 2010 El Dorado County Bicycle Transportation Plan can be referenced as a guide to prioritizing bicycle facility improvements. El Dorado County is responsible for these improvements.

Bike Trails

Bike trails between ranches and activity centers could provide a scenic way to travel through the area. El Dorado County and private property owners are responsible for these improvements.



Bike Rentals

Bike rental locations could offer visitors the spontaneous option to travel to the various growers via bicycle. Bikes should be equipped with baskets or other storage options for small products. Rental locations could be located at park-and-ride hubs with lockers for people with purchased goods.

Vehicle Circulation Improvements

The recommendations below will improve vehicle circulation through Placerville as well as within the agritourism area. Depending on the improvement, Caltrans, El Dorado County, and/or the City of Placerville may be responsible for these improvements.

Traffic Flow Facilitation

At intersections and/or driveways to ranches where traffic congestion is caused by queues spilling back into the intersection or roadway, additional measures can be considered to keep traffic flow moving. These may include:

- Use of hired traffic control, such as CHP officers, to keep traffic moving. This could include directing traffic to continue through on the local roadway when a queue of entering vehicles on a ranch driveway is causing traffic congestion on the local roadway. Ranches in these conditions should consider a secondary entrance point to capture this traffic. See the High Hill Ranch recommendations in Appendix H as an example.
- Temporarily prohibiting left turn movements and identifying alternate routes for those prohibited movements

Adaptive Signal Timings on US 50 in Placerville

Adaptive signal control technologies should be considered for the signalized at-grade intersections on US 50 through Placerville. Adaptive signal control technologies adjust when green lights start and end to accommodate current traffic patterns to promote smooth flow and ease traffic congestion. Due to the capacity and right-of-way constraints through Placerville, peak traffic flow would likely still result in traffic congestion and delay. However, this concept could provide marginal increases in traffic flow and would be an incremental improvement over existing conditions.

Realign Intersections

Some intersections within the Camino area exhibit unconventional geometries that have the potential to confuse drivers. As part of general safety and operational improvements to the County roadway network, El Dorado County can geometrically improve these intersections to create better sight

distance and more intuitive travel movements. Examples of these intersections include North Canyon Road/Carson Road and Cable Road/ Carson Road.

Temporary One-Way Circulation on Local Roadways

Along existing congested corridors, one-way circulation could be considered during peak times. For example, Carson Road could be temporarily converted to one-way for a short segment approaching High Hill Ranch Road to increase its carrying capacity. This could be as short as from the US 50/Lower Carson Road access point to Gatlin Road, or as long as from Larsen Drive or Barkley Road to North Canyon Road or Union Ridge Road. Depending on the length converted to one-way travel, a corresponding route for the opposing direction of travel will need to be identified. For example, if Carson Road is one-way westbound from Larsen Drive, residents along Barkley Road would need to use Barkley Road to Larsen Drive to travel east.

Implementation of this strategy will need to consider the access needs of local residents, businesses, and emergency response vehicles and the potential impact a temporary one-way conversion may cause. Temporary one-way circulation would also require significant signage and utilization of appropriate traffic control officers to ensure compliance.

Limit Access of Private Vehicles on Congested Roadways

In conjunction with a robust shuttle service strategy, (i.e., significant park-and-ride hubs, extensive delivery alternatives, robust shuttle service, etc.), the core of the agritourism area could be closed to vehicular traffic on peak weekends, with exceptions made for local residents, business operators, deliveries, and emergency vehicles. A detailed implementation plan would need to be developed to ensure adequate access to local residences and businesses, and address potential access concerns.

Similar to the temporary one-way circulation strategy, implementation of this strategy would need to consider the access needs of local residents, businesses, and emergency response vehicles and the potential impact a closure may cause. It will also require significant signage and utilization of appropriate traffic control officers to ensure compliance.

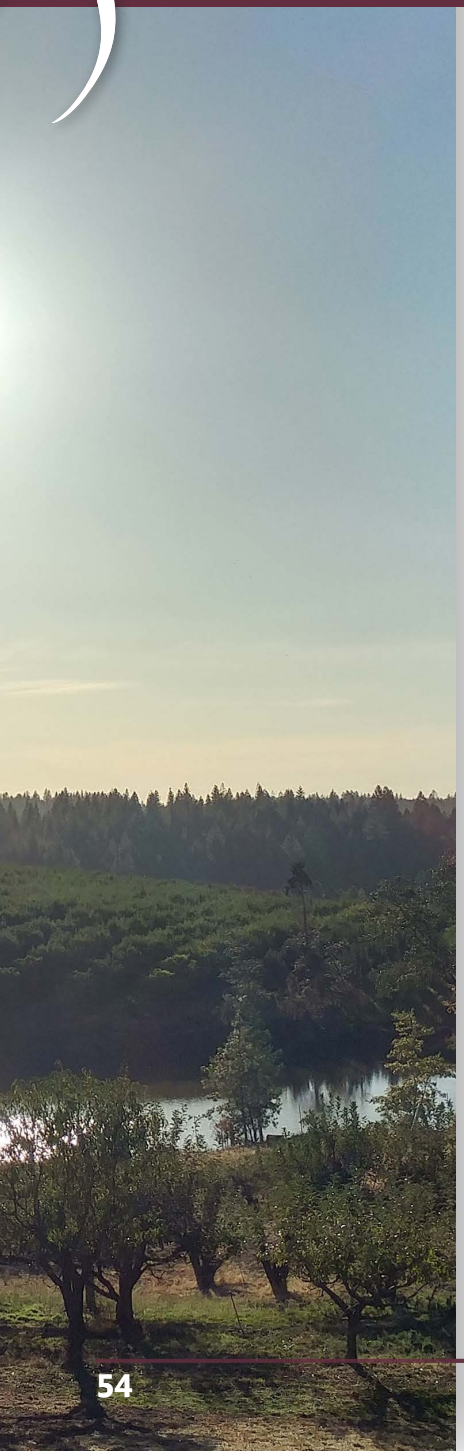
Widen Roadway Shoulders

Widening roadway shoulders along heavily traveled roadways could provide several benefits, including:

- Space for cyclists (via a striped bike lane - see Bicycle Options), or pedestrians (via a walking path along the road; see Walking Trails)
- Space for parked vehicles
- Space for disabled vehicles or emergency vehicle access
- Possible use by a shuttle/mass transit service

Drainage Improvements

To facilitate roadway and access improvements at ranches, drainage facilities should be constructed in accordance with industry standards. El Dorado County, in cooperation with property owners when necessary, is responsible for these improvements.



Roadway Widening

As noted in the introduction to this chapter, conventional methods of traffic mitigation through roadway widening and adding turn lanes are not practical or warranted due to the temporary nature of agritourism traffic and could be detrimental to the area's rural character. Since traffic congestion only occurs during a handful of weekends throughout the year, adding travel lanes, turn lanes, and two-way left-turn lanes may not be cost effective improvements to address a temporary traffic issue. In addition, the area's hilly topography would make roadway widening expensive and possibly infeasible.

Roadway widening also does not specifically address the main cause of traffic congestion, specifically the traffic demand exceeding the inbound vehicle traffic flow rates at the most heavily visited ranches. Adding travel lanes and turn lanes would merely provide additional queuing space without improving traffic flow or addressing the cause of traffic congestion during the few peak agritourism weekends of the year.

Lastly, roadway widening could lead to additional travel and traffic through induced demand and conflict with both community values and the overall focus on environmental sustainability.

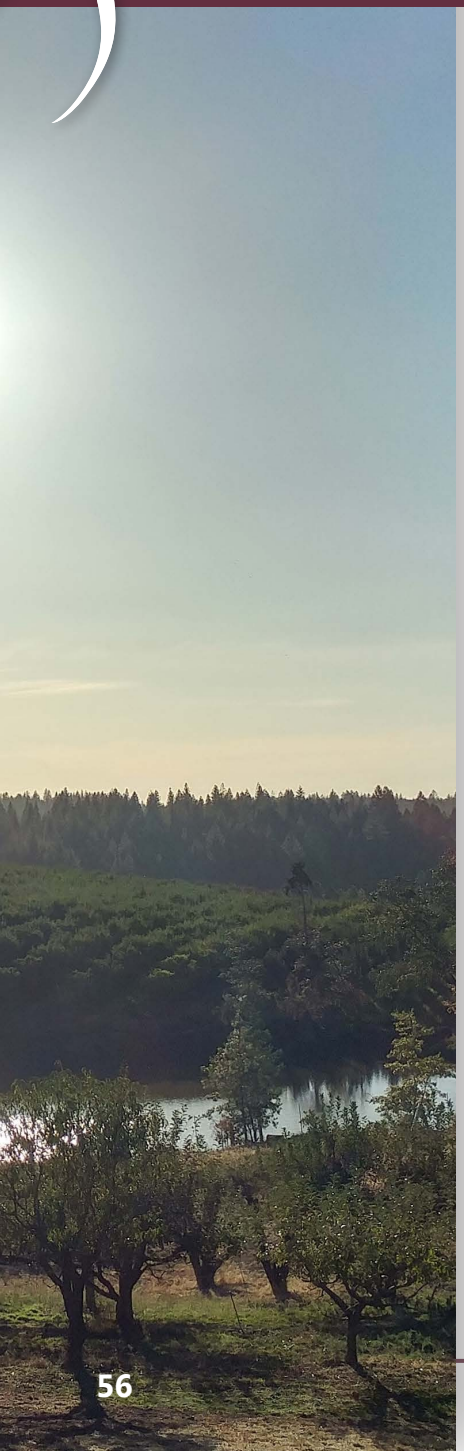
SUSTAINABILITY CO-BENEFITS

One of the key objectives of this study is to address the long-term sustainability of agritourism in El Dorado County. This includes the economic sustainability of agritourism business as well as environmental sustainability to preserve the area's rural character and reduce greenhouse gas (GHG) emissions.

Therefore, the mobility solutions presented above not only are aimed at addressing existing traffic challenges in the near-term, but also consider multimodal and sustainable solutions that can potentially reduce GHG emissions into the future. Table 1 presents the proposed solutions above along with a discussion of their potential environmental sustainability co-benefits.

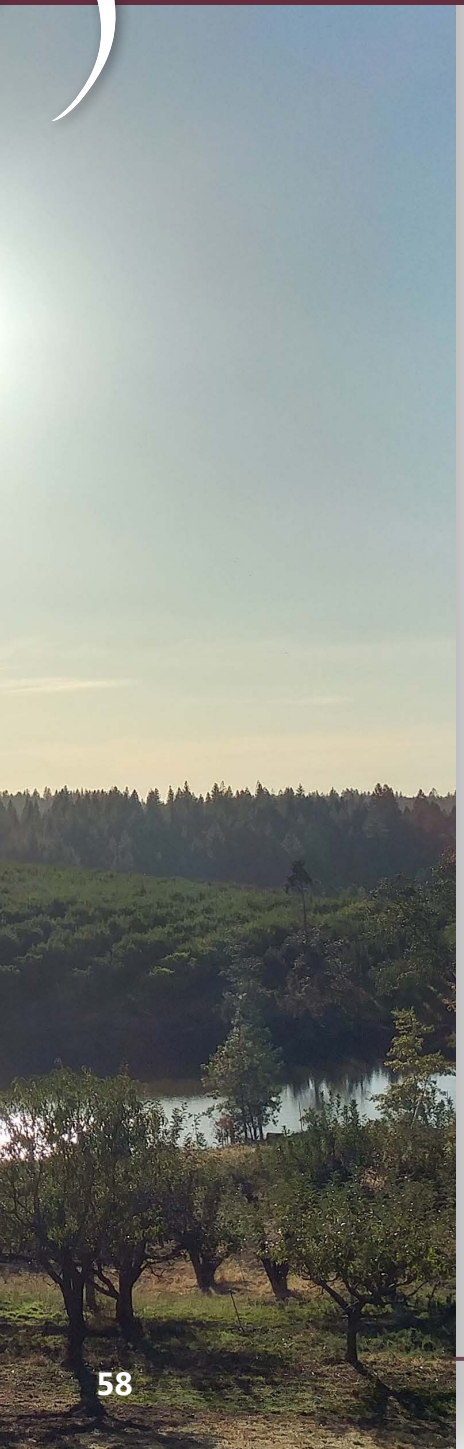
Table 1:
Mobility Solutions Sustainability Co-Benefits

Type	Solution Concept		Sustainability Co-Benefits
Parking & Circulation Improvements	Access & Circulation Improvements		These strategies would improve traffic flow on local roadways and within parking areas, potentially reducing GHG emissions associated with idling vehicles in extensive queues.
	Parking Lot Wayfinding		
	Prohibit On-Street Parking		
	Adequate Parking Supply		
Traveler Information	Augment "Plan Your Trip" Resources	General Traffic/Travel Information	These strategies would encourage people to visit during less congested times, improving traffic flow on peak weekend days which would potentially reducing GHG emissions associated with idling vehicles in extensive queues. Furthermore, improved "plan your trip" information and an informative guide and map of the ranches may improve visitor wayfinding and result in more direct and efficient travel to destinations, reducing out-of-way travel.
		Informative Guide & Map of Ranches	
		Identify Possible Alternate Routes	



Type	Solution Concept		Sustainability Co-Benefits
Traveler Information (Continued)	Provide Real-Time Traffic Information	Traffic Web-Cams	Similar to the "Plan Your Trip" solution concept, these resources would help visitors to avoid congested locations and utilize alternative and potentially more direct routes to their destinations. This would result in reduced queues and idling vehicles on congested routes, which could reduce GHG emissions.
		Mobile Traffic Applications	
		Ensure Web-Access to Mobile Devices	
		Changeable Message Signs	
	Improve Local Wayfinding	Divide Agritourism area into "Districts/Zones"	Improved visitor wayfinding may result in more direct and efficient travel to destinations, reducing out-of-way travel. This would also possibly result in reduced GHG emissions by reducing inefficient travel behavior.
		Consider Re-implementing the "Golden Apple Trail"	
		Local Wayfinding Signs	
		Regional Access Signs	
Marketing Strategies	Encourage Weekday and Off-Peak Travel		These strategies would encourage people to visit during less congested times, improving traffic flow on peak weekend days which would potentially reducing GHG emissions associated with idling vehicles in extensive queues.
	Co-market with Other Attractions		
	Outreach & Engagement via Media & Social Media		

Type	Solution Concept		Sustainability Co-Benefits
Multimodal Strategies	Dedicated Shuttle Facility	Dedicated Shuttle Lane	These strategies will make shuttle service a more viable alternative to driving. Replacing existing and future vehicle trips with shuttle and transit trips will reduce VMT in the area and result in reduced GHG emissions.
		Multi-Purpose Trail	
	Centralized Park-and-Ride Facilities		These strategies will make using shuttle service a more convenient and viable alternative to driving. Replacing existing and future vehicle trips with shuttle and transit trips will reduce VMT in the area and result in reduced GHG emissions.
	Delivery Alternatives		This strategy could reduce GHG emissions by eliminating barriers to using shuttle service. However, it could also result in increased GHG emissions if additional cargo travel is incurred as part of the delivery process.
	Shuttle/Tram Service	Dedicated Shuttle Circulation at Ranches	Replacing existing and future vehicle trips with shuttle and transit trips will reduce VMT in the area and result in reduced GHG emissions.
		Contract with El Dorado Transit or Private Operator to Provide Service	
	Charter Tours		By encouraging larger parties to utilize a charter tour service, multiple private vehicles could be replaced by a single charter vehicle. This would reduce VMT and potentially reduce GHG emissions.



Type	Solution Concept		Sustainability Co-Benefits
Multimodal Strategies (Continued)	Walking Trails		Replacing existing and future vehicle trips with walking trips will reduce VMT in the area and result in reduced GHG emissions.
	Bicycle Options	Bike Lanes	Replacing existing and future vehicle trips with bicycle trips will reduce VMT in the area and result in reduced GHG emissions.
		Bike Trails	
		Bike Rentals	
	Vehicle Circulation Improvements	Adaptive Signal Timings on US 50 in Placerville	This strategy would reduce the amount of time vehicles idle in queues, potentially reducing emissions.
		Realign Intersections	Negligible environmental sustainability benefits.
		Temporary One-Way Circulation on Local Roadways	Depending on how this solution concept is implemented, it could result in reduced or increased GHG emissions. One-way circulation in the Camino area could result in substantial out-of-way travel, which would increase VMT and GHG emissions. On the other hand, reduced congestion and vehicle idling could result in reduced GHG emissions.
		Limit Access of Private Vehicles on Congested Roadways	This concept requires a robust park-and-ride and shuttle service strategy for visitors to travel to Apple Hill℠ ranches. By greatly reducing personal vehicle travel within the core agritourism area and replacing this vehicle travel with shuttles, this strategy would likely result in reduced GHG emissions.
		Widen Roadway Shoulders	Negligible environmental sustainability benefits.
		Drainage Improvements	Negligible environmental sustainability benefits.

APPLYING STRATEGIES TO OTHER AGRITOURISM AREAS

While these strategies were developed to specifically address the mobility challenges currently existing in the Camino area during the peak fall agritourism season of Apple Hill℠ ranches, many of these strategies can also be considered for other agritourism areas of El Dorado County. For example, as wineries in southern El Dorado County become more popular destinations and look to either expand or new wineries look to open, the County should ensure that appropriate parking access and circulation improvements are in place to handle the anticipated demand of visitors. Furthermore, a "wine trail" and local wayfinding can assist travelers with navigating the local roadways to destinations. Lastly, the County, Caltrans, and local growers and communities can possibly collaborate on future park-and-ride locations such that they can serve commuters during the typical weekday while also serving agritourism areas on weekends.

Implementation & Funding Sources

7

This chapter discusses implementation of the proposed mobility solutions presented in the previous chapter. The success of this plan and the proposed mobility solutions depends on the successful implementation of these solutions.

The solutions outlined in this plan have a wide range in scope, scale, cost, and responsible party, and therefore will have differing timeframes for implementation. Some are small-scale actions that can be implemented at individual ranches. The timing for implementing these solutions will be dependent on individual ranches and their ability and willingness to invest in on-site improvements. Others will require collaboration among multiple ranches and/or the community and may benefit from facilitation by public officials. Still others may be larger, long-term investments that will require El Dorado County to pursue funding on behalf of the community and could take years before sufficient funding is available to complete a project. Ultimately, the solutions proposed in this study will be more successful as ranches, stakeholder organizations, local residents, businesses, and El Dorado County officials collaboratively work together towards improving mobility in the community. This is vital for the continued success of agritourism in El Dorado County as well as for maintaining quality of life and safe and efficient travel conditions in the local community.

Table 2 presents a summary of the mobility solutions presented in the previous chapter. Table 2 identifies the responsible party for each solution concept as well as possible funding sources for each concept.

Table 2:
Mobility Solutions Implementation Matrix

Type		Solution Concept	Responsible Party	Funding Options
Parking & Circulation Improvements		Access & Circulation Improvements	Ranches (Primary) & El Dorado County (Secondary)	United States Department of Agriculture (USDA): Farmers Market & Local Food Promotion Program (LFPP), Implementation Grant
		Parking Lot Wayfinding	Ranches	USDA: Farmers Market & Local Food Promotion Program (LFPP), Implementation Grant
		Prohibit On-Street Parking	El Dorado County	Local Funds
		Adequate Parking Supply	Ranches (Primary) & El Dorado County (Secondary)	USDA - LFPP; California Department of Food and Agriculture (CDFA) - Specialty Crop Block Grant
Traveler Information (Continued)	Augment "Plan Your Trip" Resources	General Traffic/Travel Information	Apple Hill℠ Growers Association, Ranches	CDFA - Specialty Crop Block Grant
		Informative Guide & Map of Ranches	Apple Hill℠ Growers Association, Ranches	Private Funds and/or Private Grants
		Identify Possible Alternate Routes	Apple Hill℠ Growers Association, Ranches	USDA - FMPP
	Provide Real-Time Traffic Information	Traffic Web-Cams	Apple Hill℠ Growers Association & El Dorado County	USDA - FMPP
		Mobile Traffic Applications	Apple Hill℠ Growers Association, Ranches	Private Funds and/or Private Grants
		Ensure Web-Access to Mobile Devices	Apple Hill℠ Growers Association, Ranches?	Private Funds and/or Private Grants
		Changeable Message Signs	El Dorado County & Caltrans	Caltrans CMS Program

Implementation & Funding Sources

Type	Solution Concept		Responsible Party	Funding Options
Traveler Information (Continued)	Improve Local Wayfinding	Divide Agritourism area into "Districts/Zones"	Apple Hill℠ Growers Association, Ranches	Private Funds and/or Private Grants
		Consider Re-implementing the "Golden Apple Trail"	Apple Hill℠ Growers Association, Ranches	Private Funds and/or Private Grants
		Local Wayfinding Signs	Apple Hill℠ Growers Association, Ranches, El Dorado County	Caltrans Tourist Oriented Directional signs (Note: may require statutory clarification)
		Regional Access Signs	El Dorado County, Caltrans	Caltrans Tourist Oriented Directional signs (Note: may require statutory clarification). Possible Caltrans LOGO signs
Marketing Strategies	Encourage Weekday and Off-Peak Travel		Apple Hill℠ Growers Association, Ranches	USDA - LFPP; CDFA - Specialty Crop Block Grant
	Co-market with Other Attractions		Apple Hill℠ Growers Association, Ranches	USDA - LFPP; CDFA - Specialty Crop Block Grant
	Outreach & Engagement via Media & Social Media		Apple Hill℠ Growers Association, Ranches	USDA - LFPP; CDFA - Specialty Crop Block Grant
Multimodal Strategies	Dedicated Shuttle Facility	Dedicated Shuttle Lane	El Dorado County & Transit Provider	ED County AQMD - Motor Vehicle Emissions Reduction Grant (AB 2766)
		Multi-Purpose Trail	El Dorado County, Private Property Owners	Possible Active Transportation Programs (ATP) from State. This is an annual "call for projects" process. Based on mix of Federal funds and state funds, amounting to about $130 million, annually. Congestion Mitigation and Air Quality (CMAQ) Private Funds and/or Private Grants

Type	Solution Concept		Responsible Party	Funding Options
Multimodal Strategies (Continued)	Centralized Park-and-Ride Facilities		El Dorado County and El Dorado Transit Authority in coordination with Apple Hill℠ Growers Association, Ranches, & owner/operator of park-and-ride sites	ED County - Highway Users tax CMAQ
	Delivery Alternatives		Apple Hill℠ Growers Association, Ranches	USDA - LFPP
	Shuttle/Tram Service	Dedicated Shuttle Circulation at Ranches	Individual Ranches	
		Contract with El Dorado Transit or Private Operator to Provide Service	Apple Hill℠ Growers Association with support from El Dorado Transit	ED County - TDA LTF Private Funds and/or Private Grants
	Charter Tours		Private operators with support from Apple Hill℠ Growers Association	Private Funds and/or Private Grants
	Walking Trails		Individual Ranches & Private Property Owners OR El Dorado County (if within or adjacent to public right-of-way)	State ATP Grant (Recreational Trails funding) Private Funds and/or Private Grants

Type	Solution Concept		Responsible Party	Funding Options
Multimodal Strategies (Continued)	Bicycle Options	Bike Lanes	El Dorado County	State - ATP Grant ED County - Highway Users Tax CMAQ
		Bike Trails	El Dorado County & Private Property Owners	State - ATP Grant ED County - Highway Users Tax CMAQ
		Bike Rentals	Private operators with support from Apple Hill℠ Growers Association	Private Funds and/or Private Grants
	Vehicle Circulation Improvements	Adaptive Signal Timings on US 50 in Placerville	Caltrans in coordination with City of Placerville and El Dorado County	ED County - Highway Users Tax
		Realign Intersections	El Dorado County	ED County - Highway Users Tax
		Temporary One-Way Circulation on Local Roadways	El Dorado County in coordination with local residents and business owners	ED County - Transient Occupancy Tax
		Limit Access of Private Vehicles on Congested Roadways	El Dorado County in coordination with local residents and business owners	ED County - Transient Occupancy Tax
		Widen Roadway Shoulders	El Dorado County	ED County - Highway Users Tax
		Drainage Improvements	El Dorado County	

FUNDING SOURCES

The following section describes the funding sources identified in Table 2.

Transportation

The majority of public funds for bicycle, pedestrian, and trails projects are derived through a core group of federal and state programs. Additionally, state and federal funding are valued sources for some roadway improvements.

Federal Programs

Federal funding is authorized through the Surface Transportation Block Grant Program (STBGP). STBGP provides flexible funding that may be used by states and localities for projects on any Federal-aid highway.

The FAST Act continues the Highway Safety Improvement Program (HSIP). These federal funds are allocated by Caltrans and described in further detail below.

The Transportation Alternatives Program (TAP), authorized through MAP-21, provides funding for programs and projects defined as transportation alternatives, including on- and off-road pedestrian and bicycle facilities, transit access, mobility, and recreation trails program.

The Congestion Mitigation and Air Quality Improvement Program (CMAQ) also authorizes federal funds, including education programs. FAST maintains the existing CMAQ program from MAP-21.

Federal funds from STBGP, TAP, and CMAQ programs are allocated to El Dorado CTC, and may require coordination with SACOG. Distribution is allocated either competitively or proportionally according to jurisdiction population.

State Programs

There are a number of statewide funding sources and regionally administered funds.

Transportation Development Account (TDA)

This is a long-standing, dedicated local ¼ cent sales tax for urban and rural transit, and rural roadways. The TDA is administered within each county and provides funding in most counties for transit activities. However, in rural areas, some counties may qualify to utilize these funds for roadway improvements, provided there are adequately funded transit systems in a county.

Active Transportation Program (ATP)

The Active Transportation Program was created by SB 99 / Assembly Bill 101 to encourage increased use of active modes of transportation such as biking and walking. The program consolidated five state funded programs: Transportation Alternatives Program, Recreational Trails program, Safe Routes to Schools, Environmental Enhancement and Mitigation Program and the Bicycle Transportation Account. It now provides a comprehensive program that improves program planning and flexibility and is more efficient than multiple programs. Another benefit is that funds can be directed to multi-year projects to make greater long-term improvements to active transportation.

The ATP mixes state and federal funds and provides approximately $130 million annually. This program is funded from a combination of federal and state funds from appropriations in the annual state budget act. Forty percent of the funding is dedicated to metropolitan planning organizations in large urban areas. Ten percent of the funds go to small urban and rural regions. The remaining funds will go to the California Transportation Commission for statewide project allocations.

In order to maximize the effectiveness of program funds and to encourage the aggregation of small projects into a comprehensive bundle of projects, the minimum request for statewide Active Transportation Program funds that will be considered is $250,000. This minimum does not apply to non-infrastructure projects, Safe Routes to Schools projects, and recreational trails projects.

Project types allowed under the ATP include: new bikeways serving major transportation corridors, new bikeways to improve bicycle commuting options, bicycle parking at transit and employment centers, traffic control devices to improve pedestrian and bicycle safety, improving and maintaining safety on existing bikeways, recreational facilities, education programs, and other improvements to bicycle-transit connections and urban environments.

However, the ATP places rural communities such as Camino and Fairplay at a significant competitive disadvantage if they do not qualify as a Disadvantaged Community as defined by the ATP Guidelines. This presents challenges to rural communities that may not be disadvantaged per state guidelines but also do not have the resources necessary to deliver active transportation projects.

Surface Transportation Block Grant Program (STBGP)

The Surface Transportation Block Grant Program (STBGP) provides MAP-21 and FAST funding for transportation projects, including pedestrian and bicycle projects (see above discussion about Federal programs for details). This program is administered by EDCTC, which can prioritize projects for STBGP funding. The total estimated funding available annually for the rural and urban areas of El Dorado County (not including the City of Placerville) is approximately $1 million.

El Dorado County AQMD (AB 2766 Grants)

The County administers this state authorized program which relies on an ongoing vehicle registration fee dedicated to reducing vehicle emissions available to the County's Air Quality Management Board. Recent allocations amounted to $600 thousand over a two-year cycle and the competitive grants are awarded on the cost-effectiveness of the reduction of tons of emissions per dollar. This source has funded shuttle services in and around local agricultural centers in prior years.

Other Programs

The US Department of Agriculture (USDA) offers a series of grant programs some of which are designed to assist the type of agricultural enterprises in El Dorado County.

These include:

Farmer's Market and Local Food Promotion (LFPP)

Grants to improve existing local or regional food business enterprises through such activities as outreach and marketing and non-construction infrastructure.

Specialty Crop Block Grant Program (SCBGP)

These grants are established to fund projects that solely enhance the competitiveness of California specialty crops. This program also involves the state Department of Food and Agriculture, which would be the initial resource for applicants.

Non-Monetary State Programs

Tourist Oriented Directional Signs (TOD)

This is a state authorized, 20+ year-old program intended to guide "out of town" visitors to attractions. Aspects of the program would be desirable for El Dorado County. However, State law may require revisions to put the TOD sign program to beneficial use in El Dorado County.

Changeable Message Signs (CMS)

This is a system of Caltrans electronic boards that have been in use for decades and are intended to be used to alert motorists to travel issues. Caltrans is in the process of upgrading their system of CMS boards, as well as expand their deployment. While best used for non-recurrent incidents along the state's roadways, Caltrans does also employ portable CMS signs and in some cases to highlight for travelers that a "special event" is affecting traffic on their pathway.

Implementation & Funding Sources

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Trip Generation at Virginia Agritourism Land Uses

http://www.virginiadot.org/vtrc/main/online_reports/pdf/16-r18.pdf

PETER B. OHLMS, AICP
Research Scientist

Final Report VTRC 16-R18

VIRGINIA TRANSPORTATION RESEARCH COUNCIL
530 Edgemont Road, Charlottesville, VA 22903-2454
www.VTRC.net

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16. Abstract:

When new agritourism land uses are initially proposed, a lack of data on how many vehicle trips these uses tend to create (known as trip generation) means that there is limited guidance available for transportation planners and engineers to make appropriate and sound recommendations regarding entrances and other traffic improvements. Agritourism land uses can include farm wineries, breweries, distilleries, orchards allowing visitors to pick fruits and vegetables, and farm stands and markets. This study reviewed existing information about agritourism trip generation rates and conducted data collection and analysis with regard to these rates at five winery and cidery sites in Virginia. In Virginia, localities have the ability, albeit limited, to regulate special events held at agritourism sites, so this study looked at non-event trip volumes.

Engineers and transportation planners typically use trip generation data from the Institute of Transportation Engineers' Trip Generation Manual to determine entrance categories and to recommend street improvements and strategies for safety or capacity. The manual includes trip rates for several uses that could be considered related but that do not exactly represent the range or character of agritourism uses, with the possible exception of breweries serving a full menu approximating the manual's definition of "quality restaurant." The data reported in the manual for most of these agritourism-related uses had a large degree of variability. Recent studies of trip generation at wineries, all from California, were also reviewed.

Data collected for the five Virginia sites had high variability, but certain independent variables had moderately high correlations with trips: (1) number of employees, (2) population within a 60-minute drive, (3) households within a 60-minute drive, and (4) square footage of tasting room. Although based on a small sample size, the results suggest that established retail wineries/cideries are likely to exceed the Virginia Department of Transportation's 50-trips-per-day maximum threshold for a "low volume commercial entrance," falling instead into the "moderate volume commercial entrance" or the "commercial entrance" category.

Based on the findings of this study, it appears that VDOT's practice of assuming low trip volumes for agritourism land uses may result in entrances that are undersized for the amount of traffic they carry. The "moderate volume commercial entrance" category may be appropriate for agritourism land uses in most cases. In addition, weekday peak hour volumes for the agritourism land use sites studied did not occur during the weekday peak hours of adjacent streets. Promising site-based variables for Virginia wineries include square footage of a tasting room and number of employees at peak season, and when no site-based variables are available other than location, Census-derived variables can provide some information. Additional research could clarify the findings of this study.

Recommendations for VDOT's Office of Land Use include (1) providing guidance to VDOT's transportation and land use directors indicating that retail-focused wineries can be assumed to generate well more than 50 vehicle trips per day at peak season and (2) investigating possible adjustments to the traffic volume thresholds for the "moderate volume commercial entrance" category.

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FINAL REPORT

TRIP GENERATION AT VIRGINIA AGRITOURISM LAND USES

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In Cooperation with the U.S. Department of Transportation
Federal Highway Administration

Virginia Transportation Research Council
(A partnership of the Virginia Department of Transportation
and the University of Virginia since 1948)

Charlottesville, Virginia

June 2016
VTRC 16-R18

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ABSTRACT

When new agritourism land uses are initially proposed, a lack of data on how many vehicle trips these uses tend to create (known as trip generation) means that there is limited guidance available for transportation planners and engineers to make appropriate and sound recommendations regarding entrances and other traffic improvements. Agritourism land uses can include farm wineries, breweries, distilleries, orchards allowing visitors to pick fruits and vegetables, and farm stands and markets. This study reviewed existing information about agritourism trip generation rates and conducted data collection and analysis with regard to these rates at five winery and cidery sites in Virginia. In Virginia, localities have the ability, albeit limited, to regulate special events held at agritourism sites, so this study looked at non-event trip volumes.

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Based on the findings of this study, it appears that VDOT's practice of assuming low trip volumes for agritourism land uses may result in entrances that are undersized for the amount of traffic they carry. The "moderate volume commercial entrance" category may be appropriate for agritourism land uses in most cases. In addition, weekday peak hour volumes for the agritourism land use sites studied did not occur during the weekday peak hours of adjacent streets. Promising site-based variables for Virginia wineries include square footage of a tasting room and number of employees at peak season, and when no site-based variables are available other than location, Census-derived variables can provide some information. Additional research could clarify the findings of this study.

Recommendations for VDOT's Office of Land Use include (1) providing guidance to VDOT's transportation and land use directors indicating that retail-focused wineries can be assumed to generate well more than 50 vehicle trips per day at peak season and (2) investigating possible adjustments to the traffic volume thresholds for the "moderate volume commercial entrance" category.

FINAL REPORT

TRIP GENERATION AT VIRGINIA AGRITOURISM LAND USES

Peter B. Ohlms, AICP
Research Scientist

INTRODUCTION

Agritourism land uses, which can be broadly defined as farm wineries, breweries, distilleries, retail orchards, and farm stands and markets, comprise a growing economic activity in parts of Virginia. Depending on the type of enterprise, visitors can typically pick fruits or vegetables, purchase produce and related products, consume items on premises, and attend events. The Virginia Department of Transportation (VDOT) field offices wanted to understand trip generation for these land uses better, because predicted traffic volumes inform the VDOT processes of approving entrance permits and recommending street improvements. Such information helps planners in their attempts to ensure traffic safety and minimize congestion while ensuring that agritourism land uses are not unfairly burdened. This study was initiated to review existing information about agritourism trip rates and conduct additional information-gathering and analysis for Virginia sites to the extent feasible.

Some wineries host events frequently and rely on them for income, and some agritourism land uses called "event centers" exist solely for events. Because localities, rather than VDOT, can regulate event-related impacts for events that could affect the health, safety, or welfare of the public, this study focused on determining non-event daily trip volumes. VDOT can work with localities in the process of approving special permits for events by using the maximum number of attendees to estimate traffic impacts.

Problem Statement

Unlike with most land uses, when new agritourism land uses are proposed, transportation planners and engineers have limited guidance available to make appropriate and sound recommendations regarding entrances and other traffic improvements. A similar situation exists when existing agritourism operations are to be expanded.

Background

VDOT's involvement in the local land use permitting process includes granting entrance permits for new uses. Two broad categories of entrances, commercial and residential, are typically considered, and each is associated with specific rules and regulations. For example, according to the *Code of Virginia* (hereinafter *Code*), VDOT has the authority to close a commercial entrance if necessary but not a residential one (*Code* §§ 33.2-223, 33.2-241, and

33.2-245). Further, there are several types of commercial entrances, which are classified by traffic volume. Because the proprietor of an agritourism land use often resides on the property, it can be difficult to determine whether an entrance should be designated commercial or residential.

One key factor in the process of granting an entrance permit, as well as in the process of recommending street improvements and strategies for safety or capacity, is trip generation data. These data are available in the Institute of Transportation Engineers' (ITE) *Trip Generation Manual* (hereinafter *ITE Manual*) (ITE, 2012). The data include trip rates for various types of land uses and contexts based on prior studies of traffic entering and leaving specific land uses. The process for collecting trip generation data is described later.

Virginia Law

Virginia law defines an "agritourism activity" as "any activity carried out on a farm or ranch that allows members of the general public, for recreational, entertainment, or educational purposes, to view or enjoy rural activities, including farming, wineries, ranching, historical, cultural, harvest-your-own activities, or natural activities and attractions" (*Code* § 3.2-6400). Breweries are not included in the definition but are defined in *Code* § 4.1-500. Wineries appear in both *Code* sections; farm wineries are specifically defined in *Code* § 4.1-100. For the purposes of this study, rural breweries were considered to be similar to agritourism uses, although the *Code* does not explicitly define them as such. This study is not necessarily concerned with "agricultural operations" as defined in *Code* § 3.2-300 but rather with agritourism activities and land uses, which would in some cases relate to agricultural operations, such as when an agricultural product offered for sale is cultivated on the same property.

Other relevant sections of the *Code* included the following.

- *Code* § 33.2-240 addressed connections to highways from private roads leading to and from private homes. Guidance was limited to a statement that the Commissioner of Highways shall permit connections to provide "safe and convenient means of ingress and egress."

- *Code* § 33.2-241 covered connections to highways for commercial establishments. This section allowed for "access management standards for the location, spacing, and design of entrances" and "minimizing the impact of such ingress and egress on the operation of such highways" in providing the same "safe and convenient means of ingress and egress." It gave requirements for permits and for the person desiring the entrance to pay for its construction meeting VDOT design standards and those of the Land Use Permit Manual, seek joint use with adjacent property owners, and maintain the entrance.

Indirectly relevant was *Code* § 15.2-2288.3 regarding licensed farm wineries, which preempted localities from regulating certain activities of a licensed farm winery. The section did not directly address transportation until 2014, when *Code* § 15.2-2288.3:1, which addressed "limited brewery licenses" for agricultural breweries manufacturing no more than 15,000

barrels of beer annually, was added. The final legislation (SB 430, 2014) stated: "Any locality may exempt any brewery licensed in accordance with subdivision 2 of § 4.1-208 on land zoned agricultural from any local regulation of minimum parking, road access, or road upgrade requirements." (The original legislative proposal had barred localities from imposing minimum parking, road access, or road upgrade requirements without "a substantial impact on the health, safety, or welfare of the public.")

Code § 3.2-300 through 302, among other sections, addressed "right to farm" issues in Virginia, barring localities from requiring special-use permits for protected agritourism activities but not specifically addressing transportation improvements.

Other Considerations

Agritourism land uses have received growing attention in parts of Virginia. Areas that seek to maintain a rural character while encouraging tourism and growing an economic base may find these uses particularly attractive. As these enterprises flourish, challenges can arise.

One example is at farm wineries, many of which host weddings and other events in addition to conducting their daily business of wine tastings and sales. Virginia is home to more than 250 wineries, the fifth highest state count in the United States, and more than 1.6 million tourists visited Virginia wineries in 2013 (Virginia Office of the Governor, 2014). In addition to a major economic impact, the industry has an impact on auto trips. Larger events can lead adjacent residents to express concerns about traffic and noise, and some local governments have sought to limit events as a result. The Virginia legislature expressly limited some local ability to regulate "usual and customary activities and events" of farm wineries, breweries, and agricultural operations (*Code* §§ 15.2-2288.3, 15.2-2288.3.1, and 15.2-2288.6). VDOT's authority regarding entrances was unaffected, and localities remain able to enact reasonable regulations for activities and events where there is a substantial impact on the health, safety, or welfare of the public, although the law did not provide specific guidance or thresholds (Tubbs, 2014b). For example, Albemarle County enacted an ordinance in 2014 requiring an administrative zoning clearance for farm events or sales generating more than 50 vehicle trips per day and a special use permit for farm or farm brewery events with more than 200 attendees; county regulations already required a special use permit for farm winery events exceeding 200 attendees (Tubbs, 2014a, 2014b).

Agritourism land uses have two very different types of trips: non-event and event trips. Non-event trips, i.e., daily trips such as for wine tasting or berry picking, are expected to have low to moderate vehicle volumes and be scattered throughout the day, with seasonal peaks. Event trips, i.e., related to events such as weddings, are more likely to be associated with high vehicle volumes in a small time span, typically in the evenings and on weekends or holidays. As noted, this study focused on determining non-event daily trip volumes.

PURPOSE AND SCOPE

The purpose of the study was to provide VDOT staff with guidance on estimating trip generation for agritourism land uses as accurately as possible. After the determination that clear guidance did not already exist for these specific land uses, additional study and analysis were conducted in order to develop such guidance based on the Virginia experience.

The study addressed two questions:

1. Are trip generation rates for agritourism land uses in Virginia substantially different from rates for related land uses shown in the *ITE Manual* (ITE, 2012)?

2. What amount of variation in trips generated by agritourism land uses in Virginia is explained by observable land use factors (e.g., acres planted or square feet of event space)?

METHODS

To answer the two questions, three tasks were performed:

1. A review of the literature was conducted to establish the state of the practice regarding established methods for trip generation estimation in general and agritourism trip generation in particular.

2. Trip data were collected from selected agritourism land uses in Virginia.

3. The data collected in Task 2 were compiled and analyzed in the manner recommended by ITE (2004) in order to establish local trip generation rates.

Literature Review

The Transport Research International Documentation (TRID) database was used to identify literature published since 1975 on agritourism trip generation rates and the trip generation process in general. The identified literature was reviewed to determine how to collect trip generation data for Task 2 in accordance with established methods for trip generation estimation. Provisions of the *Code* and VDOT's *Road Design Manual* (VDOT, 2005) relating to residential and commercial entrances and agritourism activities were also reviewed.

Data Collection

The data collection procedure was based on recommendations from ITE's *Trip Generation Handbook* (hereinafter *ITE Handbook*) (ITE, 2004). Key considerations included

the selection of an independent variable on which to base the data collection and analysis. The independent variable was to be "related to the land use type and not solely to the characteristics of the site tenants" and was to be information that is typically available when a new use is proposed.

Potential independent variables were identified by a review of the literature and consultation with VDOT staff. In addition, inquiries were sent to local planners in the counties of Albemarle and Nelson to find out what information might typically be known or available when land uses are proposed, which is the stage when VDOT typically reviews land use proposals (i.e., when a rezoning or special use permit is requested). These adjacent counties in central Virginia were selected because they each have a relatively high number of farm wineries but have different local review and approval processes. They also represent different contexts that can be found across Virginia: Nelson County (population 15,074) has a few small towns but is primarily rural and has a small planning staff, whereas Albemarle County (population 103,707) has a larger planning department and is a rural area with small towns that surrounds a ring of urban and suburban development adjacent to the City of Charlottesville. (Population estimates are for July 1, 2014, and are from the Weldon Cooper Center for Public Service, 2015).

Selecting Sites

ITE (2004) noted that common practice was to collect data from at least three, and preferably at least five, representative sites to establish a trip generation rate. A representative site was described as having at least 85% occupancy, being at least 2 years old, and having characteristics making data collection safe and easy.

Based on recommendations from five of VDOT's transportation and land use directors, a list of 37 relatively well-established agritourism sites in Virginia, including pick-your-own farms/orchards, wineries, cideries, produce stands, farm markets, and a brewery, was developed.

A subsample of this list was then created based on the following considerations:

- geographic location (given a goal of studying sites from different parts of the state)
- paved vs. unpaved driveway (some automated traffic counters could be used only on paved surfaces)
- dedicated driveway vs. one shared with other land uses and configuration of other driveways or cross streets on adjacent road (to avoid capturing trips not destined for the agritourism land use)
- volume and speed of traffic on adjacent road (to avoid sites where crews would be at a safety risk when placing and removing counting equipment on a major road)
- review of the website of each agritourism site (some sites were removed from consideration because they included other land uses, such as a restaurant, camp, or

lodge; other sites were removed from consideration because they were for sale, under construction, using buildings termed "temporary," or not offering a key element of their usual operation, such as pick-your-own fruit, because of a particular issue).

Representatives of the 20 remaining candidate sites were contacted by telephone with an invitation for their proprietors to answer a questionnaire about the characteristics of the site. The introductory script and questions used in this contact are provided in Appendix A. Representatives of 10 sites (50%) provided responses. A plan to collect data for 3 pick-your-own farms and 3 wineries was amended to include only wineries and cideries because the representatives of the farms either declined to participate or did not respond to the invitation to participate. The revised data collection plan involved 5 winery/cidery sites. In order to obtain permission to collect data, it was necessary to keep the identity of each site confidential, which is consistent with ITE's procedures (2004).

Conducting Traffic Counts

According to ITE (2004), the best time period for conducting counts is when "the combination of site-generated traffic and adjacent street traffic is at its maximum." For automatic counts, a 7-day count was recommended. Because trip volumes generated by agritourism land uses have seasonal variation, "time periods representing the 30th to 50th highest hours of the year may be used." For this study, it was assumed that this time period would correspond to the fifth busiest day of the year.

Permission to place counting equipment was requested of each proprietor, as recommended by ITE (2004). In most cases, the ideal location to place counting equipment to ensure count accuracy and safety for technicians was private property, making permission a necessity. Site contacts were also asked about any events that might affect traffic counts during the count period. All five sites studied were rural wineries/cideries in northern, central, or southern Virginia within a 30-minute drive of a town or urbanized area.

Technicians from VDOT district offices set up and removed automatic traffic counting equipment (pneumatic tubes) at each site. Counts were to be conducted for 7 full 24-hour days to include the day (or one of the days) identified as the fifth busiest day of the year, but technicians deviated from this research plan in some instances (presumably because of other work demands or for efficiency in deploying and retrieving count equipment), as indicated in Table 1. Count increments were not specified in the research plan. Data for Sites 1 and 5 were reported in 1-hour increments, whereas those for adjacent streets were reported in 15-minute increments.

Pneumatic tubes were used to obtain automated traffic counts at entrances and exits to each site. Because the goal was simply to quantify the number of vehicles entering and exiting each site for daily business, there was no need to consider automobile occupancy rates or to separate counts by vehicle classification. After the researcher received the count data set for a site, the data set was sent by e-mail to the site contact for use as desired.

Table 1. Reported Fifth Busiest Days, Dates of Traffic Counts, and Site Comments for Study Sites

Site No.	Reported 5th Busiest Day	Count Dates	Comments
1	Labor Day weekend. Memorial Day weekend is the busiest; all of October is pretty busy.	8/27/14–9/2/14	Data were reported in 1-hr increments. [a]
2	The Saturday of one of these: Memorial Day weekend, Labor Day weekend, the last weekend in September, or any weekend in October	10/9/14–10/16/14	Data were reported in 15-min increments. Counters were activated midday on Day 1 and deactivated midday on Day 8 (both Thursdays); for analysis purposes, these two 12-hr periods were added together to represent 1 full day. No traffic volume data were available for the street adjacent to this site.
3	A weekend in mid-September	10/22/14–10/28/14	Data were reported in 15-min increments. Permission to count was obtained on October 2, 2014; the researcher chose to collect data immediately rather than wait 11 months for a mid-September weekend. A count was completed in early October, but equipment was placed on only one of the site's two driveways, so the count was redone in late October. Counters were activated midday on Day 1 and deactivated at 8 A.M. on Day 7; because these two time periods were on different weekdays and because together they provided only 20 hr of data, both were excluded from the analysis.
4	A Saturday in November	11/5/14–11/11/14	Data were reported in 15-min increments.
5	A Saturday in October	10/24/14–10/26/14	Data were reported in 1-hr increments. [a] Weekday data were based only on a count for a Friday, the only weekday the site was open to visitors. This site was determined to have a substantially different context than the other 4 sites, which were all relatively popular retail or destination wineries/cideries. This site had elements of agritourism such as a tasting room and outdoor space for picnics and events, but its management advised that although it was open to the public for tastings, it did very little retail sales business, with wholesale selling representing the vast majority of its business.

[a] Count increments were not specified in the research plan because the primary time span of interest was a full day and because it was assumed that a consistent counting method was used across VDOT. In fact, data for Sites 1 and 5 were reported in 1-hr increments, whereas those for adjacent streets were provided in 15-min increments, so the hour of site data closest to the street's actual peak hour was used to calculate volumes during street peak hours for Sites 1 and 5.

Trip generation rates have systematic variation (variability based on factors not under statistical control) and random variation (variability attributable to chance). This study attempted to eliminate known sources of systematic variation in the data by identifying factors that might influence rates, such as season of the year, and then by collecting data in a way that controlled for these factors. Standard practices for collecting trip generation data are specified in the *ITE Handbook* (2004), which includes guidance for steps data collectors need to follow in order for ITE to accept their data. These steps help minimize systematic variation.

Unlike systematic variation, random variation cannot be controlled during the data collection process. For example, even if two counts were conducted on summer Saturdays at the same winery, the number of trips generated would be nominally different. Appropriate statistical testing was conducted to address random variation.

Data Compilation and Analysis

Prior to statistical analysis, two Census-related independent variables were constructed with the use of GIS software. Statistical analyses were conducted with the data collected.

GIS Analysis

Two independent variables were constructed with the use of Census data and GIS software: population within a 60-minute drive and number of households within a 60-minute drive. Because these variables are based only on publicly available data and the site location, it was thought that they could be useful for trip estimation in cases where local governments do not require any site data along with land use proposals. The value of 60 minutes was selected arbitrarily; another value could be chosen if desired.

The following basic procedure was used to construct these variables in ArcGIS version 10.0 with the Network Analyst extension; Appendix B shows the full step-by-step procedure.

1. Add the following data to a GIS map:

    - Esri U.S. streets layer or similar street network dataset

    - 2010 Census Block file containing population and household data

    - a point layer containing the location of the agritourism land use to be studied. Locations of existing wineries were extracted from a publicly available shapefile (Virginia Economic Development Partnership, 2011); new locations could be manually digitized.

2. Configure the Network Analyst environment and create a new service area analysis layer. Set the properties of the service area analysis layer to use Minutes as the Impedance and a default break value of 60. This configures the analysis layer to compute the area within a 60-minute drive of the point. Solve the analysis using the point layer representing the site location as a Facility.

3. Select the blocks with centroids within the service area polygon and sum their populations and/or households.

Step 3 of this procedure (Step 8 of the full procedure in Appendix B) is an approximation using the block centroids. This relatively simple method was employed along with finer grained block level data to obtain a planning-level estimation.

Statistical Analysis

For each site, traffic volume information was summarized as follows:

- 24-hour average weekday volume

- 24-hour Saturday volume
- 24-hour Sunday volume
- 1-hour volume during the morning and afternoon peak hour for the adjacent street
- morning and afternoon weekday average peak hour and volume
- weekend average peak hour and volume.

To obtain the 1-hour volume during the adjacent street peak hours, the most recent volume data available as of November 2014 for each site's adjacent street (i.e., the street serving the site's main entrance; see Figure 1) were acquired from VDOT's Traffic Engineering Division. The data were collected in 2011, 2012, or 2014, depending on the site, and no data were available for the street adjacent to Site 2.

Because data collection results indicated that Saturday and Sunday volumes were higher than weekday volumes, additional analysis was performed for these weekend days. In accordance with ITE guidelines (ITE, 2004) for the type of analysis to conduct based on data sample size, weighted average trip generation rates were calculated for independent variables with two or more data points (i.e., where values for the variable existed for two or more of the sampled sites). Where three or more data points were available, a standard deviation was calculated, more precisely defined as the standard deviation of the weighted average trip generation rate for each site. With four or more data points, a linear regression model was created for each variable (ITE reports the equation only if the R^2 is greater than or equal to 0.5).

To quantify the uncertainty that results from use of a trip generation rate that is based on data from a small number of sites, a prediction interval was calculated for the independent variable whose linear regression equation had the highest R^2, i.e., Saturday trips per peak season employee, excluding Site 5, as explained later.

A closer examination of the fit of a regression equation for the Census-derived variable of population within a 60-minute drive led to calculation of a 95% confidence interval of the mean for a cluster of three data points. The normal distribution was also applied to illustrate the probability of a site generating a certain number of trips, given the mean and standard deviation.

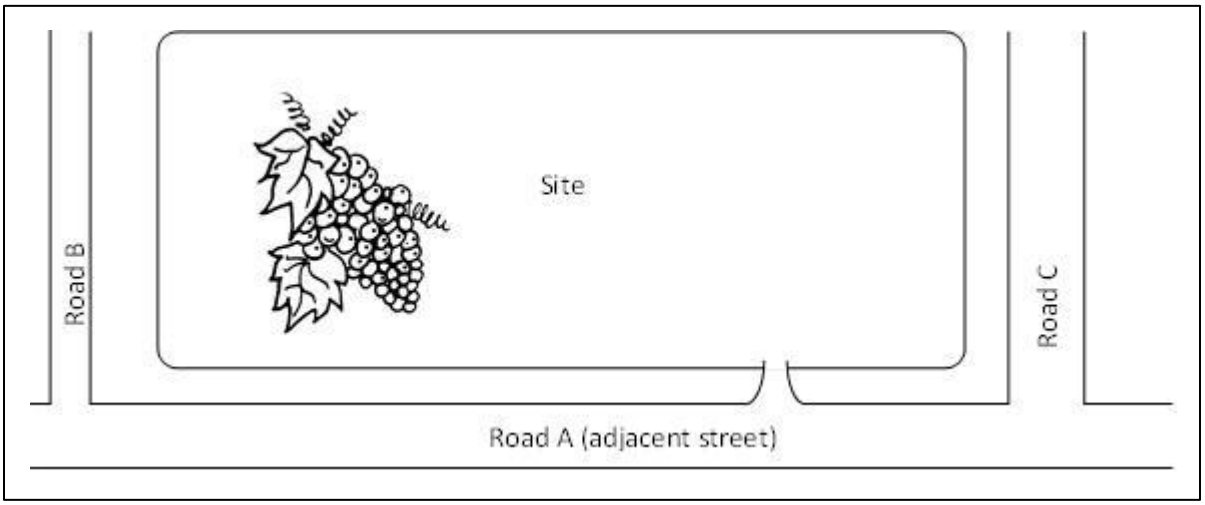

Figure 1. Depiction of Generic Site Showing Adjacent Street (Road A) and Other Streets (Roads B and C)

Use of a hypothesis test (comparison of means or *t*-test) was demonstrated for one ITE land use classification to examine the hypothesis that the average Virginia agritourism trip generation rate differs significantly from the average ITE rate for a related land use.

Multivariate linear regression models were not developed because of the limited number of sites and the uncertainty about which independent variables would be available in a given locality.

RESULTS

Literature Review

Trip Generation Data Collection Process

The *ITE Handbook* (2004) provided details of the trip generation data collection process. The typical process for estimating trip rates is to collect traffic count data at existing sites that are representative of a land use category. For different time periods (e.g., weekend days vs. weekdays), the traffic counts are plotted against site characteristics that serve as independent variables. For ITE's purposes, it is not necessary to prove that an independent variable actually causes changes in trip volumes rather than vice versa; the correlation is the main focus. ITE (2012) assembles the results of multiple studies across the United States for many different land use types, and transportation planners and engineers make generalizations from these data. Several authors have criticized various aspects of the ITE trip generation process, primarily whether it is applicable to sites in mixed-use and/or transit-oriented areas (for example, Lee et al., 2012).

To use existing ITE data when evaluating a new site

> [t]he value of the independent variable for the [new] study site must fall within the range of data included [in ITE's existing data]. . . . The number of trips determined by either the rate or the equation should fall within the cluster of data points (i.e., the range of trip values) found at the study site's independent variable value. Otherwise, additional local data are needed.

Local data collection was also advised when a study site was not compatible with ITE land use code definitions, which appeared to be the case for agritourism land uses in general.

The *ITE Handbook* provided guidelines for executing a local trip generation study, which was recommended when published data did not fit the situation in question. Key considerations included the selection of an independent variable on which to base the data collection and analysis. The independent variable chosen should be "related to the land use type and not solely to the characteristics of the site tenants" and should be information that is typically available when new development is proposed. For some agritourism land uses, then, candidate independent variables might include number of seats, number of tasting stations, size of parking area, acreage planted, or frequency and size of events.

The *ITE Handbook* noted that although there was no simple statistical method to determine the number of sites that should be studied to obtain statistically significant trip generation results, common practice was to collect data from at least three, and preferably at least five, representative sites to establish a trip generation rate. A representative site was defined as being reasonably full, mature, and with characteristics making collecting data easy and safe.

As noted earlier, the best time period for analysis according to the *ITE Handbook* would be when "the combination of site-generated traffic and adjacent street traffic is at its maximum." With automatic counts, a 24-hour period was the minimum, 48 hours were preferred, and 7 days were ideal. Because trip volumes generated by agritourism land uses have seasonal variation, "time periods representing the 30th to 50th highest hours of the year may be used."

Arnold (1984) detailed the process used to develop trip generation rates based on Virginia data for several land uses, including selection of sites, collection of data, and analysis of data.

The Federal Highway Administration's *Traffic Monitoring Guide* (2013) contained typical time-of-day traffic patterns for rural areas and day-of-week traffic patterns for recreational trips. In rural areas, car traffic typically increases throughout the day to a single peak hour in the afternoon and then tapers off, in contrast to the dual peaks (morning and afternoon) typical of urban car travel. Recreational car travel has relatively constant volumes on weekdays with increased traffic on Fridays, Saturdays, and Sundays. These patterns provided useful background for the likely traffic patterns on streets adjacent to rural agritourism land uses.

Examples of Agritourism Trip Generation Rates

ITE Manual

The *ITE Manual* (ITE, 2012) contained no information for agritourism land uses, although some uses it included could be considered related. The general purpose of the *ITE Manual* is to provide the results of traffic counts compared to quantifiable site variables that could serve as proxies for the number of trips generated by a land use, which is typically closely related to business volume. For trip generation methods to be useful, causality need not be demonstrated, only a moderately strong bivariate correlation with traffic volumes.

The *ITE Manual* contained published trip rates for the land use categories of "amusement park," "nursery (garden center)," "specialty retail center," "drinking place," and "quality restaurant," none of which individually can represent exactly the character of all Virginia agritourism uses, although each represents some portion of some agritourism uses.

Table 2 lists ranges of trip rates for the peak hour of the generator (i.e., the land use under study). Table 3 gives the range for weekdays and Sundays instead for the specialty retail center land use, which had no data for the peak hour of the generator. As shown in these two tables, trip rates included in the *ITE Manual* can vary substantially, often by an order of

magnitude or more. An example can help explain the values presented in Tables 2 and 3. For the specialty retail center land use, the *ITE Manual* provided several tables. Two tables plotted trips per 1,000 square feet gross leasable area on a weekday; one was for the A.M. peak hour of the generator (i.e., the hour during the morning when the land use generates the most trips), and one was for the P.M. peak hour of the generator. The lowest trip rate (4.59 trips per 1,000 square feet gross leasable area) was observed at one of three sites with data for the P.M. peak hour of the generator. The highest trip rate (14.08 trips per 1,000 square feet gross leasable area) was observed at one of four sites with data for the A.M. peak hour of the generator. Table 2 shows these two values to indicate the variation in the ITE study data for each land use of interest. ITE also provided trip rates per employee for this land use, but these rates were shown for full days rather than for the A.M. and P.M. peak hour of the generator. Thus, Table 3 indicates the lowest (8 trips per employee per day, which was observed at one site on a Sunday) and highest (25.95 trips per employee, which was observed at one site on a Saturday) trip rates that were given.

Each of these land use categories is examined here. In some cases, values are given for R^2, which is a measure of how well a factor accounts for the variation in a dependent variable (trips, in this case). Expressed on a scale of 0 to 1, R^2 values closer to 1 indicate that the relationship is stronger than for lower R^2 values. ITE publishes best fit regression curves and R^2 values only when the R^2 is at least 0.50, there are at least four data points, and the relationship is in the expected direction (i.e., the number of trips increases as the size of the independent variable increases).

Table 2. Range of Rates (Trips per Independent Variable) for A.M. and P.M. Peak Hour of Generator (All Days)

ITE Land Use Name	Code	Independent Variable									
		Employees		1,000 Sq. Ft. Gross Floor Area		Acres		1,000 Sq. Ft. Gross Leasable Area		Seats	
		Low	High	Low	High	Low	High	Low	High	Low	High
Amusement Park	480	0.09	2.55	—	—	0.68	22.92	—	—	—	—
Nursery (Garden Center)	817	0.26	30.14	2.08	45.5	0.6	150.71	—	—	—	—
Specialty Retail Center	826	—	—	—	—	—	—	4.59	14.08	—	—
Drinking Place	925	—	—	3.73	29.98	—	—	—	—	—	—
Quality Restaurant	931	—	—	0.87	15.89	—	—	—	—	0.05	0.5

ITE = Institute of Transportation Engineers; — = *ITE Manual* (ITE, 2012) did not include rates for a particular combination of independent variable and land use.

Table 3. Range of Rates for Weekday and Weekend Days for Land Uses Without Peak Hour Data

ITE Land Use Name	Code	Employees	
		Low	High
Specialty Retail Center	826	8	25.95

ITE = Institute of Transportation Engineers.

- *Amusement Park.* The *ITE Manual* defined an amusement park as containing "rides, entertainment, refreshment stands and picnic areas." Belvedere Plantation near Fredericksburg offers rides (hayride, pedal tractors, barrel train); entertainment (pig races, fun barn, corn maze); refreshment stands (restaurant/grill, bakery); and picnic tables in the parking area (Belvedere Plantation, 2013). It is thus an example of an agritourism land use that has characteristics similar to those of a small amusement park.

  The *ITE Manual* trip rates used employees and acres as the independent variables and were based on 1970 and 1987 data from three California and Oklahoma sites with 108, 300, and 600 employees and 697, 2,200, and 3,000 parking spaces, respectively. Charts based on two studies presented weekend data based on (1) Saturday or Sunday and (2) the peak hour of the generator. A table provided weekday data based on a single study. With such a small sample, average rates are not particularly meaningful other than to illustrate some minimum and maximum trip rates; full-day Saturday/Sunday rates ranged from 9.17 to 25.2 trips per employee and from 82.5 to 198.97 trips per acre.

- *Nursery (Garden Center).* Farm stands and markets that sell produce share some characteristics with this ITE land use, defined as "a free-standing building with an outside storage area for planting or landscape stock." The definition noted that trip characteristics at nurseries have seasonal variations, which is also expected for most agritourism land uses. ITE data came from studies in the 1980s in California and were presented at varying temporal levels for the independent variables of employees, gross floor area, and acres. Only the employee variable had data with correlations suitable for publishing fitted curve equations. The time period with the best fit was on a weekday (R^2 of 0.81), when rates ranged from 10.71 to 53.86 trips per employee.

- *Specialty Retail Center.* The ITE definition for this land use ("small strip shopping centers that contain a variety of retail shops") does not appear to encompass any agritourism land use, but some wineries and farm markets do include a mix of retail uses. For example, in addition to its produce, a farm market might sell clothing, dry goods, and prepared foods. The ITE data were based on sites in five states surveyed between the late 1970s and the 2000s and were presented for two independent variables: gross leasable area and employees. For the P.M. peak hour of adjacent street traffic, a reasonable fit for trips per gross leasable area was obtained (R^2 of 0.98) based on five studies, with rates of 2.03 to 5.16 trips per 1,000 square feet gross leasable area. Only three studies were based on the number of employees, with weekday and Saturday rates from 21.96 to 25.95 trips per employee.

- *Drinking Place.* The *ITE Manual* described a drinking place as containing "a bar, where alcoholic beverages and food are sold, and possibly some type of entertainment, such as music, television screens, video games, or pool tables." Restaurants with bars were excluded. Available studies used the gross floor area as the independent variable but did not find a consistent relationship with trips. Two

charts based on studies conducted in 1987, 1995, and 1997 in Colorado, Oregon, and South Dakota, respectively, did not meet the conditions to show fitted curve equations. The range of rates was 3.73 to 29.98 trips per 1,000 square feet of gross floor area for a peak hour, which may be too large a range to be considered useful for estimating trips.

- *Quality Restaurant.* With more related published studies than most other land uses summarized here (studies throughout the United States from the 1970s through the 1990s), the *ITE Manual* defined this land use as consisting of "high quality, full-service eating establishments with typical duration of stay of at least one hour," typically open for dinner only or for lunch and dinner, and that may require reservations, in contrast with those in the "High-Turnover (Sit-Down) Restaurant" category. Some agritourism land uses, such as breweries serving a full menu, appear to fit the definition of a quality restaurant. A VDOT analysis of an on-site brewery with associated restaurant in the Town of Floyd applied this land use type (Johnson, 2013).

  Quality restaurant study data for the weekday P.M. peak hour of the generator (11 studies) ranged from 0.18 to 0.44 trips per seat, with an R^2 of 0.74. Data based on gross floor area had lower R^2 values, when given.

  Agritourism uses often have outdoor seating. As such, a note in the *ITE Manual* for "quality restaurant" was instructive: "The outdoor seating area is not included in the overall gross floor area. Therefore, the number of seats may be a more reliable independent variable on which to establish trip generation rates for facilities having significant outdoor seating."

Other Studies

One study from the 1970s covered trip generation for scenic areas (Miles and Smith, 1977), not quite matching the desired land uses of agritourism activities.

There were several relevant studies regarding areas of California including San Diego and the counties of Sonoma, Riverside, and Napa.

- *San Diego.* This study used surveys and traffic counts for three types of wineries (County of San Diego, Department of Planning and Land Use, 2010). Data collected at three representative wineries, each with a different geographic classification, found the highest traffic at the "backcountry-destination" site, with the "suburban" site following and the "backcountry-rural" site having the fewest trips. The highest observed traffic for a single winery was 40 weekday average daily traffic and 160 weekend average daily traffic, and the amount of wine produced annually (cases of wine per year, based on a case size of approximately 2.38 gallons) was used as an independent variable. Calculated weekday trip generation rates ranged from 5.9 to 11.8 trips per 1,000 cases per year. Weekend values ranged from 11.8 to 40 trips per 1,000 cases.

- *Sonoma County.* A draft report from 2011 indicated that Sonoma County used a winery trip generation form to estimate traffic volumes. The assumed daily rate used was 3 trips per employee plus 0.8 trip per tasting room visitor. Winery driveway counts showed that 10% of daily trips were in the afternoon peak hour and 13% were during the weekend midday peak hour (Aguayo, 2011).

  Sonoma County also used trip generation curves to determine traffic impact fees based on case production for two categories: "winery only" and "winery with tasting." The curves were created in 1998 based on a few counts, traffic generation estimates, and many assumptions (Kottage, 1998). For wineries that produced 50,000 cases or less per year only, the county used the following fitted curve, where "Cases" is the number of cases produced per year:

  $$\text{One-way trip ends} = -0.00000001(\text{Cases})^2 + 0.0013(\text{Cases}) + 9.5$$

  The application of this curve for wineries that produced 50,000 cases or less per year yields trip generation figures of fewer than 50 trips per day, which is the upper threshold for VDOT's category of low volume commercial entrance.

- *Riverside County.* This study collected driveway traffic counts at five wineries, among other tasks, to create a travel demand model (Pack and Johnson, 2011). The study provided the number of trips generated; the values of explanatory independent variables (restaurant size, parking spots, and number of hotel rooms); and a table of regression coefficients relating the number of trips at each site to the three independent variables. A limitation of the study is that information about statistical significance was not given, which is to be expected because the linear regression equation consisted of four terms (the three independent variables and a constant) and four sites serving as data points (not enough to allow one to test any of the variables for statistical significance).

  However, when the author of the current study used these same data with just one independent variable (the number of hotel rooms), the variable was either statistically significant or approached significance ($p = 0.04$ for the peak weekend coefficient and $p = 0.06$ for the peak weekday coefficient). Further, the equation explained more than 80% of the variation. Thus, the data collected by Pack and Johnson (2011), although based on a limited number of sites, do suggest that activity (in this case, the number of hotel rooms) explains to some extent the number of trips observed at wineries in California. The results may also suggest that some California destination wineries differ from Virginia wineries, which may be seen as the destination for a day trip but which do not typically include hotel rooms.

- *Napa County.* Consultants collected 7-day traffic counts at 22 wineries in October 2014 (Fehr & Peers, 2014). They also surveyed winery patrons in person and gathered cell phone trip-making data for vehicle trips across Napa County. The data analysis report for the Napa County study became available after the researcher had completed data collection for the present study.

The Napa County study used multivariate linear regression to estimate models for average Monday to Wednesday weekday, Thursday, Friday, Saturday, and Sunday trip generation rates for all 434 wineries in the county. The authors noted that wineries' reluctance to participate in the study affected the sample size for data collection. Three independent variables were included in the final analysis:

1. annual gallons produced
2. whether the winery was located on the Napa Valley floor
3. whether the winery required advance appointments.

The resulting models had R^2 values of 0.79 to 0.86. When applied to all 434 wineries, the models estimated that total daily vehicle trip generation from all Napa County wineries exceeded 50,000. Combined with analysis of cell phone and survey data, the study found that winery trips by employees or visitors constituted 34% of all Saturday trips in the county.

Several variables from a preliminary analysis were removed when the final analysis was developed. Variables representing parking supply and employees were removed because of the perception that those variables were caused by demand rather than being predictors of demand. Square footage and approved visitation (the maximum number of visitors per day or week a site is allowed under its local permit) were removed because of a high correlation with the gallons-produced variable that remained in the analysis.

VDOT *Road Design Manual*

VDOT's *Road Design Manual* (VDOT, 2005) included definitions for the following entrance types:

- **Commercial Entrance:** Any entrance serving land uses that generate more than 50 vehicular trips per day or the trip generation equivalent of more than five individual private residences or lots for individual private residences using the methodology in the Institute of Transportation Engineers Trip Generation.

- **Moderate Volume Commercial Entrance**: A commercial entrance along highways with shoulders with certain site and design criteria reduced. Site requirements are: maximum highway vehicles per day: 5,000, maximum entrance vehicles per day: 200, maximum entrance percent truck trips of vehicles per day: 10%.

- **Low Volume Commercial Entrance:** Any entrance, other than a private entrance, serving five or fewer individual residences or lots for individual residences on a privately owned and maintained road or land uses that generate 50 or fewer vehicular trips per day using the methodology in the Institute of Transportation Engineers Trip Generation.

- **Private Subdivision Road or Street Entrance:** A commercial entrance for a road or street that serves more than five individual properties and is privately owned and maintained.

- **Private Entrance:** An entrance that serves up to two private residences and is used for the exclusive benefit of the occupants or an entrance that allows agricultural operations to obtain access to fields or an entrance to civil and communication infrastructure facilities that

generate 10 or fewer trips per day such as cell towers, pump stations, and stormwater management basins.

With the exception of a sight distance requirement, the *Road Design Manual's* design for a low volume commercial entrance was identical to that for a private entrance, with a surfaced width of 12 to 24 feet and a minimum graded width of 16 feet. Moderate volume commercial entrances had a required width of 18 to 30 feet, and two-way commercial entrances had a required width of 24 to 40 feet with a minimum of 30 feet if not on a local street. Commercial entrances had additional requirements such as longer throat lengths, curb and gutter or curbing along the entrance, and entry/exit tapers.

Summary of Literature Review

There was not a broad body of quantitative data regarding agritourism trip generation. National guidance from ITE included related uses but not the uses of interest specifically; they were examined only in limited studies and in a California context.

Collected Data

Table 4 lists the results of inquiries sent to local planners in the counties of Albemarle and Nelson about what information on potential independent variables would typically be available (i.e., either required by the locality or likely to be provided at the locality's request) when new development was proposed. (The exact question was: "Which of the following are typically available when agritourism land uses are proposed?") The differing responses from these adjacent counties with different contexts illustrate the difficulty of selecting an independent variable or set of variables that will be useful statewide.

Table 4. Local Availability of Data on Potential Independent Variables at Land Use Proposal Stage

Variable	Albemarle County	Nelson County
Number of seats	Good estimate of indoor seats	Typically not known
Number of tasting stations for wineries	Good estimate	Typically not known
Size of tasting room for wineries	Good estimate	Typically not known
Size of interior space	Good estimate	Sometimes provided/defined
Size of parking area or number of spaces	Good estimate	Typically provided/estimated
Acreage planted	Good estimate	N/A[a]
Frequency and size of events	Often unsure of frequency; depends on how initial events go	Typically not provided/defined, but alluded to as a conceptual element of the plan/design
Production for wineries (cases per year)	Somewhat difficult to know	N/A
Expected number of employees at peak season	Unsure	Typically provided/estimated
Expected number of daily visitors at peak season	Very unsure	Typically not provided/estimated

[a] "N/A" means that based on limited experience, the respondent could not address whether the variable would be known.

Although the planner for the more populous Albemarle County expected to have good estimates of the number of indoor seats; the number of tasting stations; and the size of the tasting room, interior space, and parking area, the planner for the more rural Nelson County expected to know only estimates of parking area, the expected number of employees at peak seasons, and possibly the size of interior space. Neither planner expected to know the frequency and size of events, annual production, or expected number of daily visitors at peak season.

The planners also noted several other items of useful background information:

- Depending on the locality, these land uses might not need more than a building permit, which would not invoke substantial local review requirements. For example, at the time, Albemarle County did not require zoning clearances from wineries that were not planning to host events of more than 200 attendees.

- Proprietors of agritourism land uses tend to introduce products and services slowly and scale up operations incrementally. If and when a site becomes popular, growth pressures and traffic increase rapidly.

- The size of interior space may not be an accurate predictor for land uses that rely on having plenty of outdoor space available.

- Outdoor fields can become overflow parking areas, which are typically not formalized as parking areas if used infrequently.

- Limited data are available initially, often depending mostly on who the applicant retained as a traffic consultant. More information is sometimes made available at various points in the review process, such as at a site review committee meeting, as part of developing a staff report, or at the hearing of the planning commission.

- Some localities do not have a well-defined set of information that is requested or required of applicants but might be able to implement such a checklist in the future.

Site Characteristics and Trip Volumes

The questionnaire response from Site 4 indicated that it had a parking area of 100 square feet. Because this was smaller than a single typical parking space (9 feet by 18 feet), the response was deemed invalid. The distance measurement feature of Google Maps was used to estimate the size of a gravel parking area at the site, visible from Google's aerial imagery. This was roughly 75 feet by 75 feet, or 0.13 acre, so that value was used for Site 4's parking area size. (As with other sites, it is possible that additional parking occurs in fields when this area is at capacity.)

Table 5 summarizes the results for site-specific data (independent variables) including the Census-derived variables. Table 6 provides notes about unique characteristics or circumstances for each site. As noted previously, the data are for a small sample of sites and

have substantial variability. Although not by any means a complete picture of agritourism traffic patterns in Virginia, this information can begin to address the previous complete lack of Virginia data on the topic.

Site 5 was determined to have a substantially different context than the other sites, which were all relatively popular retail or destination wineries/cideries. Site 5 has elements of agritourism such as a tasting room and outdoor space for picnics and events, but its management advised that although it is open to the public for tastings, it did very little retail sales, with wholesale representing the vast majority of its business.

Table 7 shows each site's trip volumes (total of entering and exiting vehicles at all driveways) at various scales of analysis. The weekday peak hour volumes for each site were higher than the site's 1-hour volume during the adjacent street's peak hours. That is, the peak hour for the site entrance was at a different time than the A.M. and P.M. peak hours of the adjacent street.

Table 5. Independent Variables for the Five Sites

Independent Variable	Site 1	Site 2	Site 3	Site 4	Site 5
Number of marked parking spaces	40	0	90	0	0
Number of unmarked parking spaces	Unknown	300	Unknown	16	Unknown
Size of parking area (acres)	5	4	1	0.129	0.115
Square feet of total interior space	30,000	16,500	Unknown	1,440	7,500
Square feet of tasting room	4,032	7,000	1,400	1,380	1,500
Number of tasting stations	4	6	25	2	1
Number of acres planted	53	30	26	14	5
Annual production (cases)	14,000	9,000	35,000	Multiple	1,000
Number of employees, peak season	40	90	25	14	2
Population within 60-minute drive	433,922	1,975,753	326,127	346,400	233,880
Households within 60-minute drive	167,198	713,382	122,272	137,047	92,989

Unknown = a respondent said a site had the factor but did not know or did not provide a quantity; Multiple = site produced various products (e.g., fresh fruit and beverages) and provided information for all of them.

Table 6. Site Notes

Site No.	Notes
1	One tasting station on weekdays. Number of employees does not include event staffing.
2	Tasting stations accommodate 120 guests. Seeks to be a destination winery, encouraging people to stay longer and share the day with friends and family.
3	Has additional off-site planted acreage. Can accommodate 150-person events.
4	Combined with an orchard; number of acres planted reflects all fruit trees. Tasting room was expanded from 575 to 1,380 square feet within 6 months before the count dates. Production was 500-1,000 bushels of fruit, 2,500 gallons of fresh juice, and 7,500 gallons of alcoholic beverage. (Because any one of these numbers would not represent the site's total production, the site was excluded from analysis for the production variable.) At peak season, there are 4 full-time and 10 part-time employees. Size of parking area was estimated based on aerial imagery.
5	Does very little retail business; 99% of product is sold wholesale to other wineries for resale.

Table 7. Trip Volumes for the Five Sites

Measure of Trip Volumes	Site 1	Site 2	Site 3	Site 4	Site 5[a]
24-hour average weekday volume	370	192	261	91	4
24-hour Saturday volume	735	1,205	596	509	20
24-hour Sunday volume	878	1,173	431	351	8
1-hour volume during street A.M. weekday peak hour[b]	9	N/A	10	2	0
1-hour volume during street P.M. weekday peak hour[b]	28	N/A	32	5	1
A.M. peak hour volume	27	9	21	13	1
P.M. peak hour volume	51	26	38	14	1
Weekend peak hour volume	148	188	68	83	5

[a] Site 5 was excluded from some analyses because it was a primarily wholesale rather than retail operation.
[b] Data for Sites 1 and 5 were reported in 1-hour increments, and adjacent street data were provided in 15-minute increments, so for those sites, the hour of site data closest to the street's actual peak hour was used.

Results of Data Analysis

Tables 8 and 9 present average trip rates and statistical information based on Saturday data. For the analysis of all five sites and for each independent variable, Table 8 presents the number of cases (i.e., how many sites provided data on the particular variable; see Table 5); the mean trip rates per independent variable (if at least two cases); a standard deviation of the set of individual site trip rates (if at least three cases); and the R^2 value for a bivariate linear regression equation (if at least four cases). Certain variables as noted are shown in units of 1,000 for ease in displaying trip rates. If ITE's guidelines (ITE, 2004) are used, the regression equation or R^2 value of the following four variables with an R^2 value below 0.50 would not be shown: total interior space, tasting stations, acres planted, and annual production.

For example, the independent variable "size of parking area" was an available variable in five cases, i.e., for all five sites (see Table 8). The sites had 5, 4, 1, 0.13, and 0.11 acres, respectively, available for parking (Table 5). Traffic volumes were collected at each site on one Saturday, with results of 735, 1,205, 596, 509, and 20 trips, respectively (Table 7). The mean trip rate is calculated as the sum of these trips (3,065 trips) divided by the sum of the acreage available for parking (10.24 acres). That is, it is the average change in the number of trips per 1 unit change in the independent variable averaged across the five cases.

Table 8. Mean Trip Rates (Average Change in Number of Trips per 1 Unit Change in Independent Variable) and Statistical Information, Saturday Data, All Five Sites

Independent Variable	No. of Cases	Mean Trip Rate	Standard Deviation	R^2
Number of marked parking spaces[a]	2	10.2	—	—
Number of unmarked parking spaces	2	5.42	—	—
Size of parking area (acres)	5	299	1,636	0.54
1,000 square feet of total interior space	4	44.5	163	0.22
1,000 square feet of tasting room	5	200.2	166	0.72
Number of tasting stations	5	80.7	108	0.03
Number of acres planted	5	24.0	15.0	0.39
Annual production (1,000 cases)	4	43.3	54.4	0.04
Number of employees, peak season	5	17.9	10.3	0.89
1,000 people within 60-minute drive	5	0.924	0.755	0.69
1,000 households within 60-minute drive	5	2.49	1.97	0.69

[a] Only the two sites with marked parking spaces were used.

For each site, a value of trips per acre of parking can be calculated (i.e., 147, 301, 596, 3,942, and 174), and the standard deviation is the standard deviation of these five individual trips-per-acre values. The R^2 value reported for this variable in Table 8 is for a bivariate linear regression with size of parking area as the independent variable and number of trips as the dependent variable.

Because of the different context of Site 5, some analyses were performed a second time excluding data from Site 5. Table 9 presents the same information as Table 8 based on analysis without Site 5. The smaller number of data points means there are more empty cells in Table 9, and under ITE's conditions, two variables (size of parking area and number of acres planted) would not have regression equations or R^2 values shown.

As a comparison, Saturday trips vs. size of tasting room and employees are graphed in Figures 2 and 3, respectively, with and without Site 5. Appendix C includes all charts for Saturday and Sunday data with linear regression equations displayed where appropriate.

Table 9. Mean Trip Rates (Average Change in Number of Trips per 1 Unit Change in Independent Variable) and Statistical Information, Saturday Data, Excluding Site 5

Independent Variable	No. of Data Points	Mean Trip Rate	Standard Deviation	R^2
Number of marked parking spaces	2	10.2	—	—
Number of unmarked parking spaces	2	5.42	—	—
Size of parking area (acres)	4	301	1,806	0.44
1,000 square feet of total interior space	3	51.1	178	—
1,000 square feet of tasting room	4	220	129	0.95
Number of tasting stations	4	82.3	99.3	0.04
Number of acres planted	4	24.8	12.2	0.07
Annual production (1,000 cases)	3	43.7	59.9	—
Number of employees, peak season	4	18.0	9.88	0.9995
1,000 people within 60-minute drive	4	0.988	0.547	0.94
1,000 households within 60-minute drive	4	2.67	1.40	0.93

Predicting a Likely Range of Trips

When the number of sites used to determine a trip generation rate is small (i.e., below 30), one appropriate tool for quantifying the uncertainty that results from using the linear regression equation is a prediction interval, which is similar but not identical to a confidence interval. For a given value of the independent variable (such as number of employees), a prediction interval shows the expected range of the dependent variable (number of trips) with a certain probability.

The following expression is used to calculate a prediction interval (Hillier and Lieberman, 2001):

$$Y_c \pm \left(t_{0.025,n-2}\right)\sqrt{1+\frac{1}{n}+\frac{\left(X-\overline{X}\right)^2}{\sum_{i=1}^{n}\left(X_i-\overline{X}\right)^2}}\left(Y_{SE}\right)$$

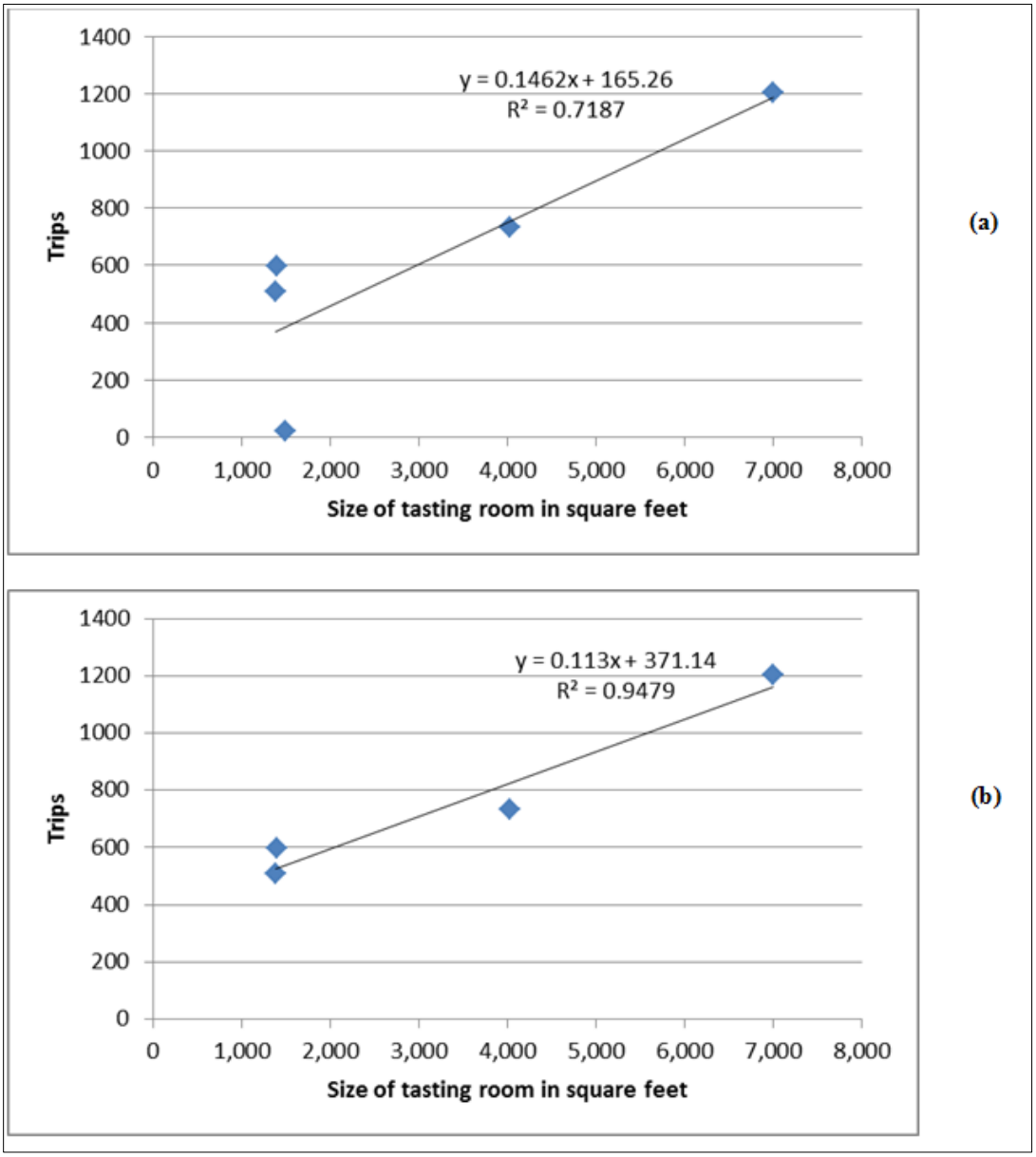

Figure 2. 24-Hour Saturday Scatter Plots for Trips vs. Size of Tasting Room: (a) including Site 5, (b) without Site 5

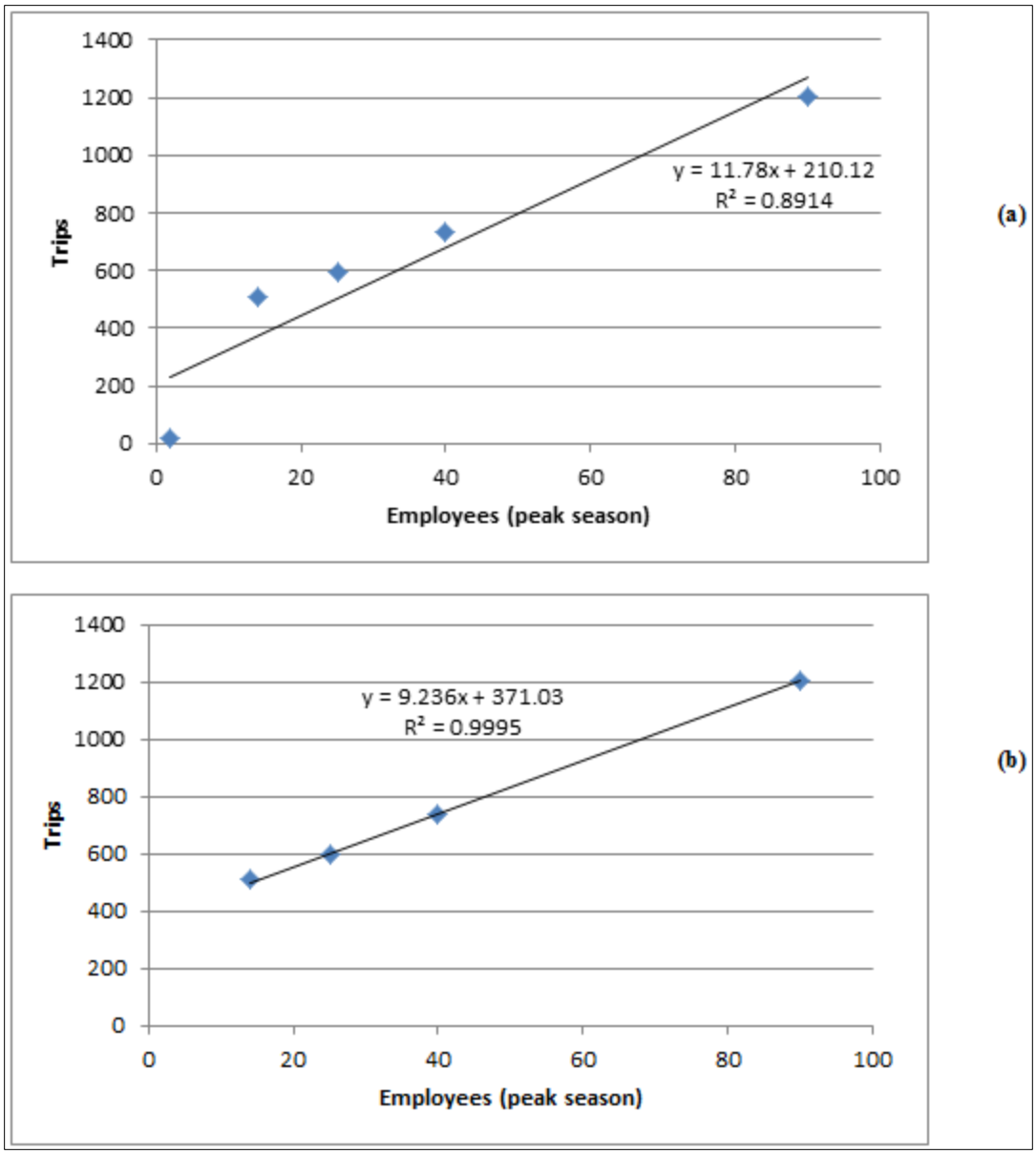

Figure 3. 24-hour Saturday Scatter Plots for Trips vs. Employees: (a) including Site 5, (b) without Site 5

where

Y_c = value of the dependent variable given X, computed with the linear regression equation

$t_{0.025, n-2}$ = a *t*-statistic for a prediction interval called the two-tailed inverse of the Student's *t*-distribution (which captures 95% of the observations)

n = sample size (number of sites used to calibrate the regression model)

X = given value of the independent variable used to compute Y_c

$\bar{X}$ = average value of the independent variable in the regression

X_i = each individual value of the independent variable

Y_{SE} = standard error of the Y estimate, which is calculated from the following equation:

$$Y_{SE} = \sqrt{\frac{\sum_{i=1}^{n}(Y_i - y_i)^2}{n-p-1}}$$

where

n = sample size (number of sites used to calibrate the regression model)

Y_i = value of the dependent variable for a given value of the independent variable, computed using the linear regression equation for each point in the data underlying the regression

y_i = actual value of the dependent variable for a given value of the independent variable from the data underlying the regression

p = number of independent variables.

The formula for a prediction interval was applied to the linear regression equation for Saturday trips by number of employees at peak season, excluding Site 5 (Figure 2d) with an arbitrarily chosen value of 60 employees, which falls between the data points that were collected. This yields the following values for each variable:

Y_c = 925 trips

$t_{0.025,n-2}$ = T.INV.2T(0.05,2) = 4.3

n = 4 sites

X = 60 employees (given)

$\bar{X}$ = 42.25

X_i values are 14, 25, 40, and 90

Y_{SE} = 8.59 based on Y_i values of 500, 602, 740, and 1,202; y_i values of 509, 596, 735, and 1,205; and p = 1.

The resulting range of predicted Saturday trips is 882 to 968. That is, for an agritourism use with 60 peak employees that is similar in other ways to those surveyed, there is a 95%

probability that it would see between 882 and 968 trips on a Saturday near peak season. The prediction interval concept could be applied to any of the other linear regression equations.

Testing the Fit for Census-Derived Variables

Figure 4 displays the data points and linear regression equations for the Census-derived variables, population within a 60-minute drive and households within a 60-minute drive, on a Saturday without Site 5. Despite relatively high values of R^2, these models do not necessarily demonstrate a good fit, because one of the data points is far away from the other three, which are clustered around a 60-minute population of 325,000 to 450,000. Although it may be the case that additional data collection would fill in other "dots along the line," it may also be the case that the data point outside the cluster represents an outlier that has undue influence on the regression equation. This remains true when Site 5 is included, but for the purposes of this example, it was excluded.

This example reflects only the Saturday equation for population within a 60-minute drive (Figure 4a), but similar results would be expected for households or Sunday data. Three of the four data points are clustered because the 60-minute populations for those sites are in the same range, between 325,000 and 450,000, whereas the fourth data point had a 60-minute population of nearly 2 million. This fourth point greatly influences the regression equation, one of the perils of having so few data points, and the equation no longer fits the data if that point is removed. Although one cannot make predictions using these regression equations, one can investigate the mean value of trips generated by agritourism sites that have a similar population within a 60-minute drive.

Interpreting the Mean Value of Trips Generated

Transportation and land development agencies may be interested in the mean value of trips generated by agritourism sites in order to compare them with other types of land development. For example, to what extent do agritourism sites tend to generate more trips than a coffee shop? In this regard, planners would want to know the extent to which the mean value of trips generated (based on this study) likely represents the mean value of trips generated from all sites comparable to these (in addition to those sites studied). This question can be answered by using inferential statistics, which use data from a sample to make inferences about the entire population.

With regard to the three sites, for example, that had a similar population within a 60-minute drive and that generated 509, 596, and 735 trips, respectively, the mean of these sites is 613 trips and the 95% confidence interval of this mean value can be calculated as

$$\text{Confidence interval} = \bar{Y} \pm \frac{TS}{\sqrt{n}}$$

where

$\bar{Y}$ = mean value of trips for the three data points = 613 trips

T = *t*-statistic for a confidence interval, calculated in Excel as T.INV.2T(0.05,n-1)

S = standard deviation for the three data points, calculated in Excel as STDEV.S(509,596,735)

n = sample size = 3 sites.

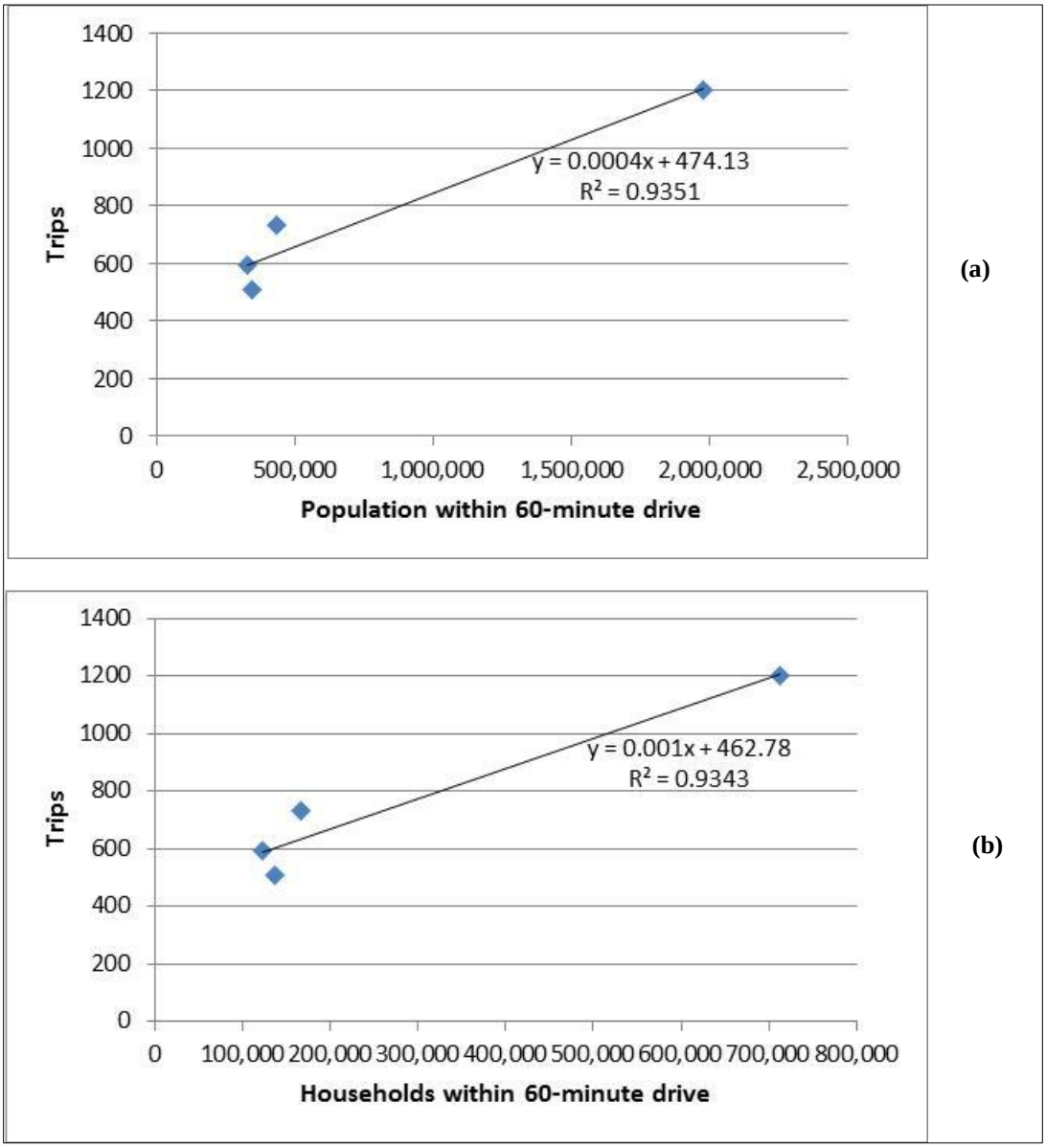

Figure 4. 24-Hour Saturday Scatter Plots for Trips vs. (a) Population and (b) Households Within a 60-Minute Drive Without Site 5. Despite the R^2 values greater than 0.9, the regression equations shown are not good fits because of the clustering of some data points far away from another.

Montgomery (2001) explained that if many such intervals are created, where each one is drawn from a random sample of sites (with characteristics similar to those of the three observed in this study), 95% of the confidence intervals will include the true mean. The equation is applied as shown:

$$613 \pm \frac{4.30(114)}{\sqrt{3}} = 330 \text{ to } 897 \text{ trips}$$

Thus, the 95% confidence interval of the mean is 330 to 897 trips. This large interval reflects the small sample size. Although this is a broad range, it nonetheless remains useful if VDOT staff simply need to predict whether anticipated trips will exceed a threshold that is far outside this range, such as 50 trips per day.

Interpreting the Distribution of Trips Generated

A planner looking at a specific future agritourism site is less interested in the mean number of trips generated by all sites and more interested in what will happen at that particular site. Because only three sites that have similar characteristics were studied to develop the confidence interval noted, it is not possible to state precisely which distribution would be followed if all agritourism sites had been examined. However, because ITE (2012) presumed the normal distribution for a variety of other land uses, and because some have argued that the normal distribution can describe a variety of phenomena (for example, Véron and Rohrbasser, 2003), it is appropriate to consider inferences that could be drawn if the random component of the trips generated by a site does follow the normal distribution.

If it is the case that the number of trips for a Virginia agritourism site follows a normal distribution with a mean of 613 and a standard deviation of 114, one can determine the probability of a site generating a certain number of trips. For example, based on Figure 5, there is a 16% probability that a site will generate 500 trips or less but a 95% probability that a site will have 800 trips or less. Thus, if no other information were available, and if planners wanted to be able to be confident that a given site design would handle the number of trips generated by, say, 75% of all agritourism sites, then based on Figure 5 they would want the design to be able to accommodate up to about 700 trips.

Comparison of Average Rates

Another question of interest was whether the average trip rates calculated from the data were significantly different from ITE's rates for related land uses (ITE, 2012). This is illustrated here by a comparison of this study's average rate for trips per employee on a Saturday using the five-site chart (i.e., Figure 2c) and the same rate given by ITE for the specialty retail center land use. For each study, Table 10 shows the sample sizes and standard deviations that were used in this calculation.

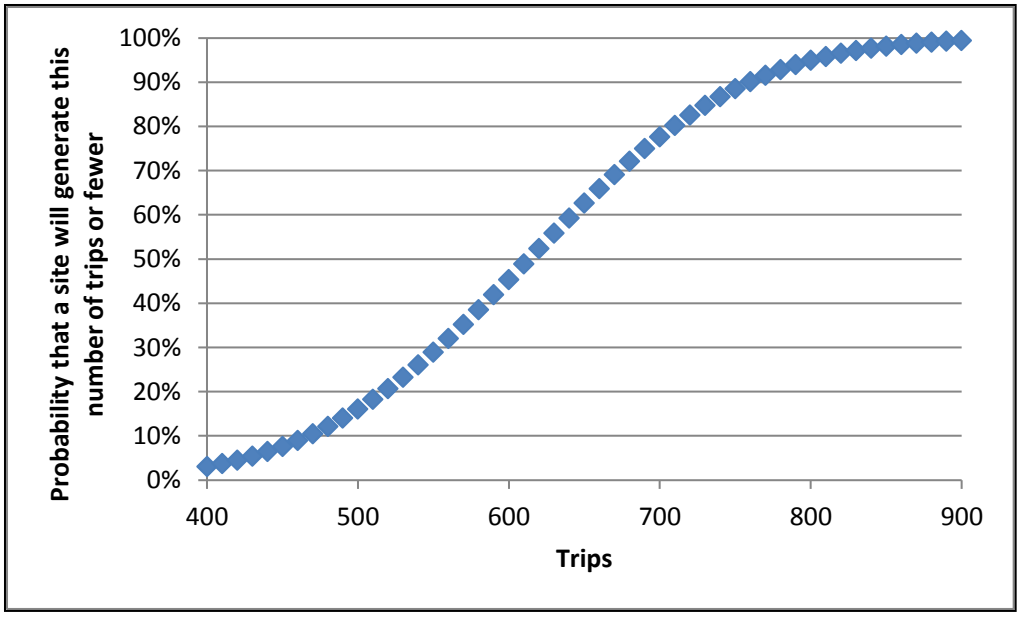

Figure 5. Cumulative Probability Distribution for Trip Generation. A normal distribution with a mean of 613 and a standard deviation of 114 is assumed.

Table 10. Data Used for Comparison of Average Rates From Two Studies

Study 1 (Current study): Virginia wineries (see Figure 2c)	
Sample size (n_1)	5
Standard deviation (S_1)	10.34
Average rate	17.92
Study 2: Specialty Retail Centers (ITE, 2012)	
Sample size (n_2)	3
Standard deviation (S_2)	4.94
Average rate	23.11

The following statistical calculations were used to compare the mean of two study samples. First, the standard deviation of the difference in means was calculated (Garber and Hoel, 2002):

$$Sd = \sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}$$

where

S_1 and S_2 = standard deviations for Study 1 and Study 2, respectively
n_1 and n_2 = sample sizes for Study 1 and Study 2, respectively.

Sd was calculated to be 5.43.

Second, because the sample sizes were relatively small, a *t*-statistic was calculated based on a 95% confidence level and N, the sum of the sizes of the two samples (8 in this case). The *t*-statistic value was 2.45.

The absolute value of the difference between the two means was compared to the product of Sd and the *t*-statistic. If the absolute value of the difference between the two means (calculated to be 5.19) is greater than the product of Sd and the *t*-statistic (calculated to be 13.30), there is a significant difference between the means at the 95% confidence level.

Therefore, it cannot be concluded that there is a significant difference between these two means. That is, the average trip rate per employee on a Saturday in this study is not significantly different from the average trip rate per employee on a Saturday for ITE's specialty retail center land use. A similar result is obtained by comparing this study's average rate for trips per employee on a Sunday and the same rate given by ITE for the specialty retail center land use: at a 95% confidence level, it cannot be said that there is a significant difference between the average trip rates.

It should be noted that this result does not necessarily imply that it is appropriate to use the specialty retail center land use to evaluate agritourism land uses. This study had a small sample size of five, whereas the ITE rates were based on an even smaller sample size of three. The statistical result might differ with a larger sample of cases.

In fact, a different result was obtained when the weekday average rates were compared. For the five study sites, the average rate for weekday trips per peak employee was 5.36, whereas for ITE's three study sites for the specialty retail center land use, this rate was 22.36. Given the standard deviations for the two study samples, the absolute value of the difference between these means was higher than the product of Sd and the *t*-statistic, so at a 95% confidence level, it can be concluded that the average weekday trip rates per employee for agritourism land uses in this study are different from the weekday rates published by ITE for the specialty retail center land use.

DISCUSSION

For the limited sample of Virginia winery sites studied, variables that appear to have relatively high correlations with trips include square footage of tasting room, number of employees, and the Census-derived variables of population and households within a 60-minute drive.

Any discussion of these results must acknowledge the small sample size of four sites (or five, depending on the analysis presented). Given the hundreds of wineries and cideries in Virginia, the sample is likely not entirely representative. Extrapolating to other agritourism land uses such as farm markets or pick-your-own orchards would introduce additional uncertainty. In addition, the unique nature of agritourism land uses and the limited amount of information on independent variables that localities and VDOT may have at the review stage make it difficult to model these uses without complications. A final caveat is that many of the potential independent variables are in fact correlated (the most obvious example being the two Census-derived variables, which represent essentially the same measure), so any attempt to create a multivariate model would first need to address this multicollinearity.

The high standard deviation for the "size of parking area" variable is due to the small estimated parking area size for Site 4, which saw almost as many trips as Site 3 despite a significantly smaller formalized parking area. Although it may be possible to demonstrate correlation of trips with the parking variable given better data, it is equally possible that the nature of agritourism land uses—which often rely on informal grassy fields for peak season parking—may make it impractical, if not impossible, to collect objective data on parking supply.

Entrance Categories

Even a cursory examination of the results suggests that during relatively busy weekends in the fall, all surveyed sites with the exception of Site 5 (the primarily wholesale winery) had daily traffic volumes of well over 50 trips per day. Weekday traffic was lower but still above this amount. Because 50 trips per day is VDOT's maximum threshold for a low volume commercial entrance, it appears that established retail-focused wineries/cideries similar to those studied would fall into either the moderate volume commercial entrance category or the commercial entrance category. The statistical analyses that were performed further support this determination.

A rural context is integral to the nature of agritourism land uses, and entrance design can support or detract from this context. It could be argued that VDOT's standard commercial entrance design requirements detract from a rural context attributable in part to the pavement widths required (24 feet minimum, 30 feet minimum if not on a local street). In recognition of the integral nature of a rural context to the vitality of agritourism land uses and the Commonwealth's ongoing interest in facilitating these businesses, VDOT could consider requiring a moderate volume commercial entrance for such land uses by default. Guidelines could be developed, or engineering judgment could be used, to determine whether a full-scale commercial entrance would be required instead. One factor in this decision could be information about the anticipated size and frequency of events.

Only one of the surveyed sites represented a non-retail focus, and its very low traffic volumes suggested that it would likely meet VDOT's requirements for a low volume commercial entrance. It is not possible to generalize this determination for all wholesale-focused agritourism land uses based on this one data point, however.

Usefulness of Certain Variables

Although the "employees" variable may be driven by visitor volume rather than vice versa, its high degree of correlation with trips makes it an attractive independent variable. An estimate of the number of employees at peak season appears likely to relate to the number of trips a site will have. However, this variable is more prone to year-to-year adjustment than semi-permanent site characteristics such as square footage of a tasting room and factors not influenced by the site such as the Census-derived variables. A winery that opens with 10 peak

season employees its first year may well have 20 the next year and 50 within a few years, but "10" would be the only number submitted for VDOT's review.

For wineries, square footage of a tasting room may be the most useful site-based variable for predicting a rough estimate of trip volume. Applicants are likely to have at least a good estimate for this quantity at the site plan stage, and it is unlikely to change frequently. However, the tasting room could be expanded as visitor volume grows (as occurred at one of the study sites shortly before data collection), and that expansion might or might not trigger notification to VDOT. Additional data collection could confirm whether a robust relationship with trip volumes exists.

Unlike the California studies cited in the literature review, this study did not find annual production to be a good predictor of trip volume. In fact, number of cases produced per year had one of the lowest correlations with trips of any independent variable, and when Site 5 was excluded, the relationship was in the opposite direction from what would be expected. This may be related to the generally smaller production volumes of Virginia wineries compared to those in Napa County; however, one-half of the 22 Napa County wineries used in developing that study's model had annual production volumes in the same range as those of the Virginia sites in this study (based on each case of wine containing 2.38 gallons).

Other Issues

Other variables not considered in this study could predict vehicle trips at agritourism land uses. One would be a measure of the amenities offered, such as outdoor recreational space or event space. This would not be captured by the variables examined in this study, such as interior space or acreage planted, and it is possible that additional recreational space or programming could affect trip generation rates by imparting a "destination" quality to the venue.

In addition, the predictive power of variables could be misleading. For example, the relationship between trips and population or households within a 60-minute drive of a site may not be linear if, say, people desire to visit certain remote destination wineries precisely because they are located away from developed areas.

The scope of this study did not include reviewing crash data near wineries or after events or addressing expansion of agritourism land uses over time, after an initial VDOT review. As noted earlier, when an agritourism land use begins operating, VDOT might be involved in the local approval process, but over the years, incremental expansion might not trigger re-review. This issue is not necessarily limited to agritourism land uses.

Other strategies could address traffic and safety concerns at other types of agritourism land uses, such as working with localities to allow for centralized farm markets with improved entrances rather than a farm stand in every unimproved driveway.

CONCLUSIONS

- *VDOT's practice of assuming low trip volumes for agritourism land uses in the absence of other data and the rural nature of the businesses may result in entrances that are undersized for the volume of traffic they carry, causing potential safety concerns for the traveling public.* During the peak season, only one site, which was not primarily a retail facility, had trip volumes under the threshold of 50 trips per day for a low volume commercial entrance. The four retail wineries/cideries studied had traffic volumes of 2 to 7 times this threshold on a weekday and 10 to 24 times the threshold on a Saturday.

- *The moderate volume commercial entrance category may be appropriate for agritourism land uses in most cases.* Although it appears that most mature agritourism land uses generate too much traffic to qualify for a low volume commercial entrance, there is interest at the state level in promoting and supporting agritourism land uses, to which a rural context and appearance are integral. Although exact trip volumes may be hard to predict, this entrance category might strike an appropriate balance between improving safety and maintaining a rural context.

- *Weekday peak hour volumes for the agritourism land use sites studied did not occur during the weekday peak hours of adjacent streets.* This was most pronounced for the morning peak hour for the adjacent streets, when the wineries studied all had volumes of 10 vehicles or less, representing less than 4% of their 24-hour average weekday volumes. Winery volumes were higher in the afternoon peak hour for the adjacent street but still lower than in the peak hour for site traffic.

- *Promising site-based variables for Virginia wineries include square footage of a tasting room and number of employees at peak season.* Square footage of a tasting room may be the most promising site-based variable, but additional data would be helpful to confirm this. Although subject to year-to-year fluctuations, an estimate of the number of employees at peak season was a strong correlate of the number of trips to a site. The availability of this information early in the site development process may vary by locality. Unlike previous studies from California, this study did not find annual production to be a good predictor of trip volume, suggesting that local differences may make it difficult to generalize the findings of this study to other states.

- *When no site-based variables are available other than location, Census-derived variables can provide some information.* In some cases, localities may not require applicants to provide site-based variables that VDOT could use to estimate trips. Although a larger or different sample might yield different regression equations, these variables can allow VDOT to assume a broad range of possible trip generation figures if a new site has levels of nearby population or households similar to those of the cluster of sites identified in this analysis.

- *Additional research could clarify the findings of this study.* Additional research could address topics outside the scope of this study, such as analyzing crash data near wineries or considering how to address the incremental expansion of agritourism land uses over time. Additional data collection from various types of well-established agritourism locations

across Virginia could refine the results presented in this study, particularly at sites closer to large urbanized areas and with different types of agritourism land uses, such as farm stands.

RECOMMENDATIONS

1. *VDOT's Office of Land Use should provide guidance to VDOT's transportation and land use directors indicating that retail-focused wineries can be assumed to generate well more than 50 vehicle trips per day at peak season.* When determinations about entrance permits are made, this assumption could affect what type of entrance is required and whether safety improvements such as turn lanes are warranted.

2. *VDOT's Office of Land Use should investigate possible adjustments to the traffic volume thresholds for the moderate volume commercial entrance category.* Although peak season trips for retail wineries might exceed this category's maximum threshold of 200 entrance vehicles per day, volumes might be much lower for most of the year. It could also be the case that a higher maximum threshold (such as 500 entrance vehicles per day; alternatively, a threshold could be expressed as a percentage of the adjacent street's daily volume) is appropriate for this entrance type.

BENEFITS AND IMPLEMENTATION

Benefits

The main benefit of this study is in providing guidance that was requested by VDOT's transportation and land use directors. This guidance will allow them to make the soundest decisions possible when reviewing entrance permit requests, which in turn could provide benefits for traveler safety.

The result of a sound decision would be an entrance type that aligns with actual vehicle volumes. The benefit expected from such a decision is the *avoided cost* of making a suboptimal decision (in this case, about an entrance category). Additional benefits to travelers could be realized if safety improvements such as turn lanes are justified and installed.

One example of a decision that is less than ideal would be requiring an entrance that is "too small" or underdesigned; i.e., actual traffic volumes are higher than it can handle. The costs to travelers associated with this error could be expressed in terms of time cost (delays) and crash costs, both resulting from queueing vehicles trying to enter and exit a site driveway that cannot handle the volume. These increasingly frequent conflicts potentially increase the costs attributable to delay and crashes. In addition, costs to proprietors could include (1) property damage attributable to trucks or other large vehicles that cannot navigate the entrance without leaving the pavement and (2) being required to upgrade (reconstruct) the entrance because of safety, use, or maintenance concerns.

On the other hand, requiring an entrance that is "too large" for actual traffic volumes would also be an imperfect decision. This study recommends considering the moderate volume commercial entrance category rather than the commercial entrance category partly because of the much higher construction costs of a commercial entrance to the proprietor. (There could also be aesthetic costs attributed to unnecessary damage to the rural context.) These costs would be based on the design requirements for the three categories of commercial entrances; some of these requirements are highlighted in Table 11, which is based on Figures 4-1, 4-9, and 4-15 in Appendix F of VDOT's *Road Design Manual* (VDOT, 2005).

Table 11. Selected VDOT Design Requirements for Commercial Entrance Categories

Dimensional Requirement	Low Volume Commercial Entrance	Moderate Volume Commercial Entrance	Commercial Entrance
Surfaced width	12-24 ft	18-30 ft	30-40 ft
Graded width	16 ft minimum	Surfaced width	Surfaced width
Entrance radius	20 ft minimum	25 ft minimum	25-50 ft; 12 by 48 ft taper
Distance from edge of pavement that surface requirements apply	Greater of right-of-way line or length disturbed	25ft minimum	35 ft minimum

Implementation

To implement Recommendation 1, VDOT's Office of Land Use plans to provide guidance in the form of a presentation to VDOT's transportation and land use directors at one of the group's quarterly meetings and to post guidance on InsideVDOT. This will be accomplished in Fiscal Year 2017.

To implement Recommendation 2, VDOT's Office of Land Use plans to meet with staff of VDOT's Location and Design Division and initiate a review of the standards and restrictions associated with the "moderate volume commercial entrance" design within a month of the publication of this study.

Additional implementation activities have already been completed. Trip generation results from this study were presented in 2015 at VDOT's Land Development Summit and at the American Planning Association's Virginia Conference. In 2015 and 2016, the researcher submitted the trip generation data from this study to ITE, which considers all new land use data it receives. Coupled with potential future data submittals for wineries in other states, these data could prove useful. Although this study's sample size of four or five sites was small, ITE presents data even for land uses with very few data points. ITE's Traffic Engineering Senior Director responded to the submittals and stated that the data would be considered for inclusion in an upcoming update of the *ITE Manual.*

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APPENDIX A

INVITATION SCRIPT AND SITE QUESTIONNAIRE

Invitation Script

[An earlier version of the script was used for some initial contacts. After some negative feedback was received by the researcher, the script was revised, as seen here, and reviewed by a survey expert.]

If a human answers: Hi, my name is [name]. I'm with the research division of VDOT, the Virginia Department of Transportation. We are studying the variation in traffic patterns at seasonal businesses such as wineries and pick-your-own orchards. We know that everyday traffic volumes for [farm wineries/ pick-your-own orchards] can vary greatly by time of the year. If you have five minutes, I'd like to see if you could answer nine questions for me.

> [If busy:] I'd be glad to call another time, come talk in person, or send the questions by email.
>
> [If yes:] These questions ask about characteristics of [business name]. We chose your business because it is seen as a well-established example of a [farm winery/pick-your-own orchard]. We are interested in this information to find out whether any of these characteristics can predict traffic volumes.

If a machine answers: Hi, my name is [name]. I'm with the research division of the Virginia Department of Transportation. We are studying the variation in traffic patterns at seasonal businesses such as wineries and pick-your-own orchards. We know that everyday traffic volumes for [farm wineries/ pick-your-own orchards] can vary greatly by time of the year. If you have five minutes, I'd like to set up a time to ask you nine questions about this subject. When you get a chance, please give me a call at [callback number]. I'll also send this in an email so you can reply to that instead. Thanks!

Site Questionnaire

[The following questions were asked of each site. Some questions, as noted, were different for pick-your-own orchards than for wineries.]

1. Number of parking spaces (some respondents noted that spaces were not marked but provided the number of cars they could accommodate)
2. Size of parking area (including unmarked spaces; square feet or acres)
3. Size (square feet of total interior space)
4. *Wineries only:* Size (square feet of tasting room)
5. *Wineries only:* Number of tasting stations
6. Number of acres planted with grapes (*wineries*) or fruit trees (*orchards*)

7. Annual production (*wineries:* gallons or cases) (*orchards:* bushels of fruit)
8. Expected number of employees at peak season
9. *Orchards only:* Number of cash registers at peak operation
10. Thinking about daily business and excluding events, what is your guess as to the 5th busiest day of the year for your facility?
11. Would you be willing to give VDOT permission to place temporary counting equipment across your entry drive to count vehicles entering and exiting? (We would be glad to share the data with you.)

APPENDIX B

GIS ANALYSIS PROCEDURE

What follows is step-by-step ArcGIS guidance for VDOT staff to produce a planning-level estimate of the population within a 1-hour drive of a given site. If this population is within the range of 325,000 to 450,000 people, a likely trip generation range can be stated.

This example was written using ArcMap version 10.0 and assumes basic familiarity with GIS. (As of September 2015, version 10.0 was the standard installation for VDOT employees, who had the option to upgrade to version 10.2.1 if needed, but version 10.2.1 was not compatible with some planning-related VDOT software.)

First, a word about data management. In some cases, performing GIS computations over the VDOT network may be impractical because of the amount of data being transferred. It is preferable to perform the analysis with the data saved locally, i.e., on your computer's hard drive. However, it is still important to save your data on the network in case something happens to your hard drive. Therefore, it is suggested that you save your data as follows:

- *"Pristine" data:* save on the network. The data you begin with, such as downloaded Census files, should be stored on the network in its original form and copied locally for analysis.
- *Working data:* save on your hard drive. This includes any intermediate files produced as part of the analysis as well as copies of pristine and final data.
- *Final data:* save on the network. You will create it locally and then copy it to the network for storage.

1) Add data to a GIS map. These data are required in order to complete the service area analysis and include a street network and the location of the site of interest. (Census population data will be added later.)

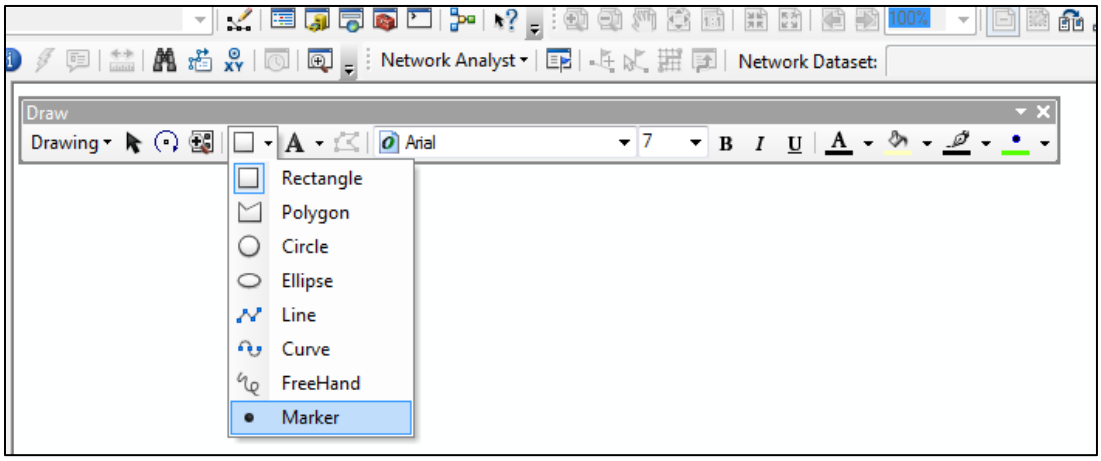
a) Add a *street network dataset.* For areas not within 1 hour of another state, a Virginia-only file will suffice. For this study, a network dataset called *streets.rsx* that was included with ArcGIS base data was used and is available from the author. (Esri's StreetMap Premium service would also work, although its World Street Map service would not. The Virginia Geographic Information Network [VGIN] provides official street data for Virginia that may be suitable for areas in central Virginia. The VGIN street data do not work for areas near other states, since it does not contain street information for adjacent states. Data files of VDOT roads have the same limitation and the additional problem that city- and town-owned streets are not included.)

i) Add data to a new map by clicking the *Add Data* button (), navigating to the folder where the file is saved, selecting it, and clicking *Add*. Be sure to select the network dataset, which would have an icon similar to this: 

. In the dialog box that opens, click *Yes* to add the network dataset and all its source feature classes to the map.

ii) Zoom roughly to the area of interest to minimize drawing time, especially if using a U.S.-wide street file.

b) Create a point layer containing the *location of the agritourism site* to be studied.
   i) If you are able to locate the site by zooming in on the streets, the easiest way to do this is by using the *Draw* toolbar. Turn it on from the *Customize* menu.
   ii) Zoom in on the site location so that you will be able to click and place a dot with sufficient precision.
   iii) In the *Draw* toolbar, click the drop-down arrow next to the rectangle and select *Marker*.



   iv) Click on the map to create a point at the site location. You can move it around with the toolbar's Select arrow if needed.
   v) On the *Draw* toolbar, click *Drawing*, then *Convert Graphics to Features*. In the dialog box, choose where to save the file, name it, check the box next to *Automatically delete graphics after conversion*, and click *OK*. In the subsequent dialog box, click *Yes* to add the data to the map. Close the *Draw* toolbar if desired and save your map.

2) Configure the Network Analyst environment and create a new service area analysis layer. (The instructions in Steps 2 through 5 are based on the *Network Analysis Workflow* page within ArcGIS 10 Help and other pages linked from that page.)

a) General setup and preparation:
   i) Ensure that the Network Analyst extension is enabled: In the *Customize* menu, choose *Extensions* and ensure that the Network Analyst box is checked. Click *Close*.
   ii) Display the Network Analyst toolbar and Network Analyst window: In the *Customize* menu, choose *Toolbars* and ensure that the Network Analyst toolbar is checked.

b) Create a new service area analysis layer: On the Network Analyst toolbar, the name of your network dataset should appear next to Network Dataset (*streets*, in this case). On the Network Analyst toolbar, click *Network Analyst*, then *New Service Area*.

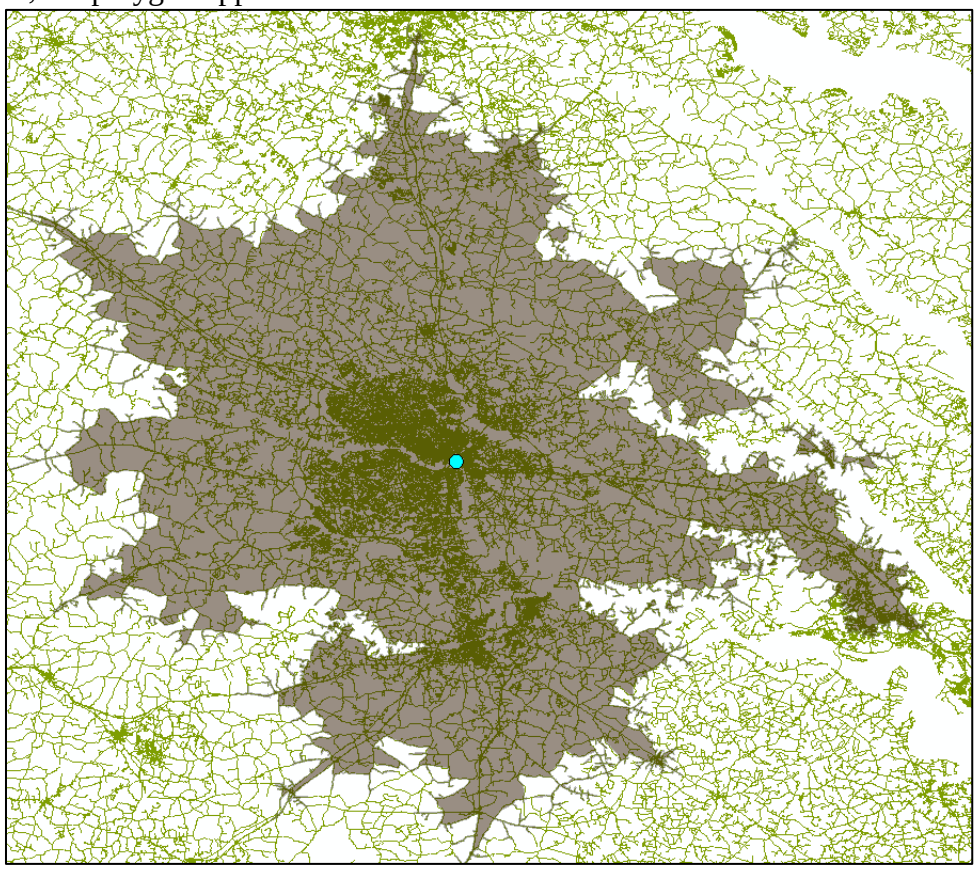
3) Load the point layer that represents the site location as a network analysis object.

a) In the Network Analyst toolbar, click the icon to display the Network Analyst window.
b) In the Network Analyst window, right-click on *Facilities (0)* and select *Load Locations*.
c) In the dialog box that opens, the point layer you created in Step 1(b) should be shown next to *Load From*. Leave other options as they are and click *OK*.

4) Configure the service area analysis layer to compute the area within a 60-minute drive of the study site.

a) In the Network Analyst window, click the icon to display the Layer Properties dialog box. (In ArcMap version 10.2, this dialog box is called Service Area Properties.)
b) Click the *Analysis Settings* tab.
c) Next to Impedance, *Time (Minutes)* should be shown.
d) Next to Default Breaks, type *60*.
e) Under Restrictions, *OneWay* and *Non-routeable Segments* should be checked.
f) Click *OK*.

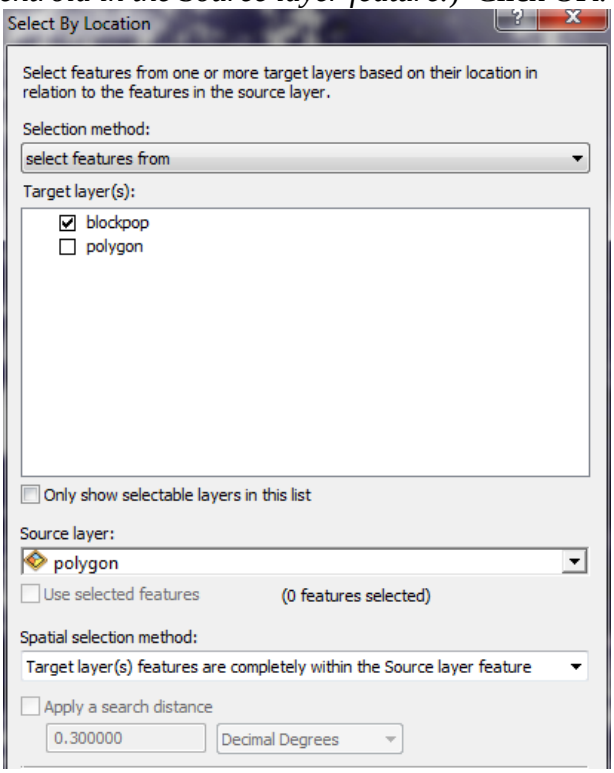
5) Perform the analysis. On the Network Analyst toolbar, click the Solve button ( ). The analysis may take some time. When it completes, if everything worked properly, you will see a new polygon representing the 60-minute drive time from your study site. (To see it, you may need to right-click the *Polygons* icon shown in the Table of Contents and click *Zoom to Layer*.) For a dummy site location at the VDOT headquarters in downtown Richmond, the polygon appeared as follows.



6) **Export the service area polygon so you can open it in the future if needed without redoing the analysis.**
   a) In the Table of Contents window, right-click on the polygon within the service area layer, select *Data*, and select *Export Data.*
   b) Select the option to use the same projection as the data frame. Choose a location to save the new file and click OK. After the file is created, click OK to add it to the map; you can turn off or remove the service area and streets layers to reduce drawing time.

7) **Add a file containing population data by census block, optionally clipped to Virginia and contiguous states to reduce computation time.** Click the *Add Data* button (), navigating to the folder where the file is saved, selecting it, and clicking *Add*. For this study, a dataset called *blockpop.sdc* that was included with ArcGIS base data was used and is available from the author. It displays a point at the centroid of each census block and contains population data. Data could instead be downloaded from the National Historical Geographic Information System (NHGIS) or U.S. Census websites (e.g., TIGER files); in those cases, it might be necessary to download both a table of population data and a block geography file and join the two for analysis.

8) **Select the blocks with centroids that are within the polygon.**
   a) In the *Selection* menu, click *Select by Location.*
   b) Configure the window that opens to select features from your block centroid layer (the target layer) that are completely within the polygon (the source layer), as shown. (Note that if you are using a polygon block file with actual boundaries rather than centroids, you may want to choose a different spatial selection method, such as *Target layer(s) features have their centroid in the Source layer feature.*) Click OK.



(Note that blocks with some area within the service area polygon but a centroid outside it will be excluded and blocks with some area outside the polygon but a centroid inside it will be included. A more precise approximation could be obtained by calculating the area of each census block that is within the service area polygon and multiplying the block's population by that proportion, as was done by Schneider et al. (2012) for block groups.)

9) **Export the selected blocks to a new file so you can open it in the future if needed without redoing the analysis.**
   a) Right-click on the block file, select *Data*, and select *Export Data.*
   b) Ensure that the option to export only *Selected features* is selected. Choose a location to save the new file and click OK. After the file is created, click OK to add it to the map; you can turn off or remove the block file.

10) **Open the attribute table of your new blocks file.** Select the column representing population by clicking its heading. Right-click the heading and select *Statistics*. The total population for the collection of blocks is shown next to *Sum*; make a note of it.

As noted in the "Testing the Fit for Census-Derived Variables" section of this report, the small sample size of this study led to regression equations with questionable fit for Census-derived variables. Estimating trip generation based on population within a 1-hour drive of the site is possible only when the population falls in the range of 325,000 to 450,000, the range of 1-hour populations surrounding three of the sites in this study. If your newly calculated total population is in that range, the 95% confidence interval of 330 to 897 Saturday trips provides a likely range of trips. Assuming the normal distribution for the unpredictable component of trips, Figure 5 would give the probability of a site generating a certain number of trips.

If your newly calculated total population is outside that range, additional data collection from sites with 1-hour populations between 450,000 and 2 million would be necessary in order to validate or adjust a regression equation for this variable.

Reference

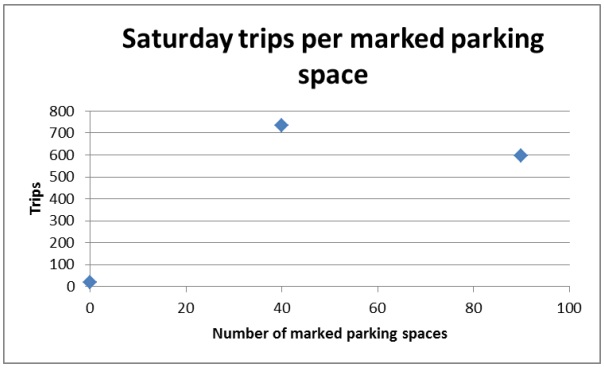
Schneider, R.J., Shafizadeh, K., and Handy, S. *Methodology for Adjusting ITE Trip Generation Estimates for Smart-Growth Projects, California Smart-Growth Trip Generation Rates Study, Final Report, Appendix F*. 2012. http://downloads.ice.ucdavis.edu/ultrans/smartgrowthtripgen/Appendix_F_Adjustment_Method.pdf. Accessed October 15, 2015.

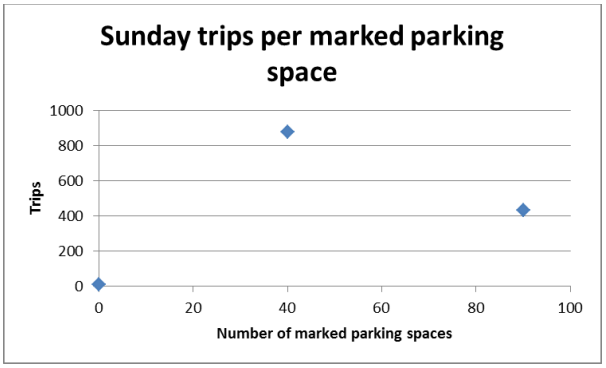
APPENDIX C

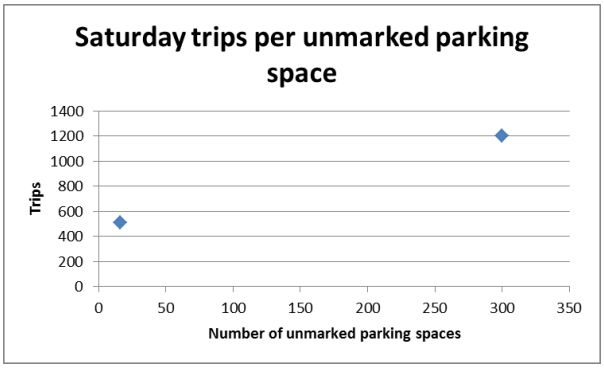
CORRELATION CHARTS

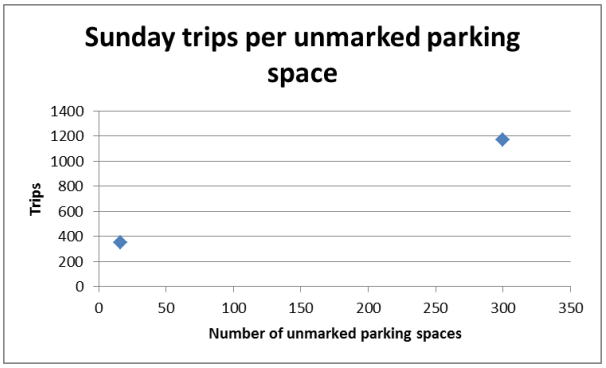
The charts in this appendix display 24-hour Saturday and Sunday scatter plots for each variable analyzed in this study, first for the analysis of all five sites and then again excluding Site 5 because of its different context. For variables with at least four data points, a linear regression equation is shown along with its R^2 value.

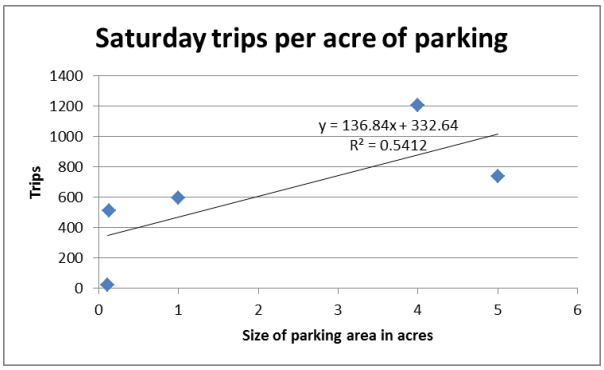
Charts Including Site 5

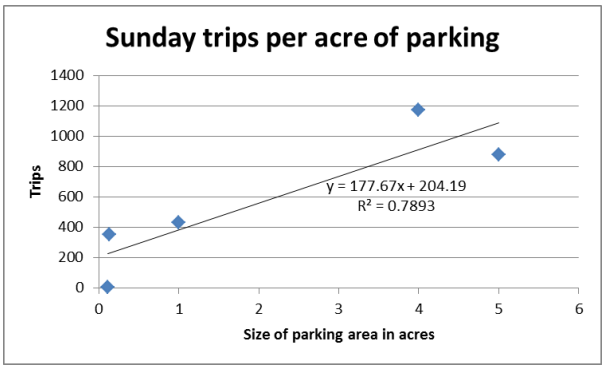


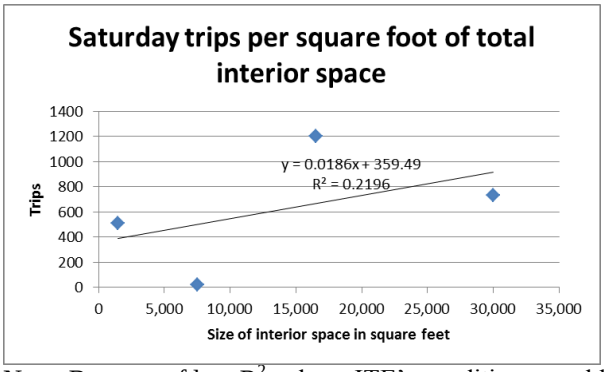


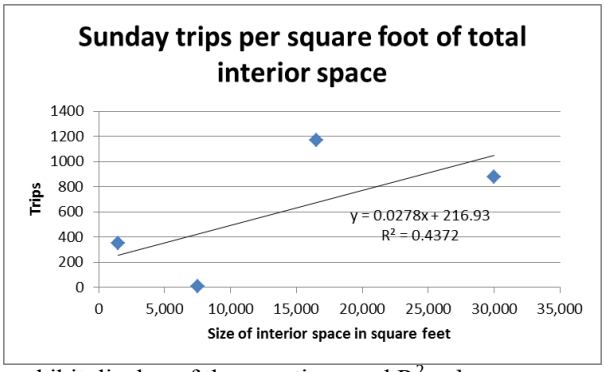




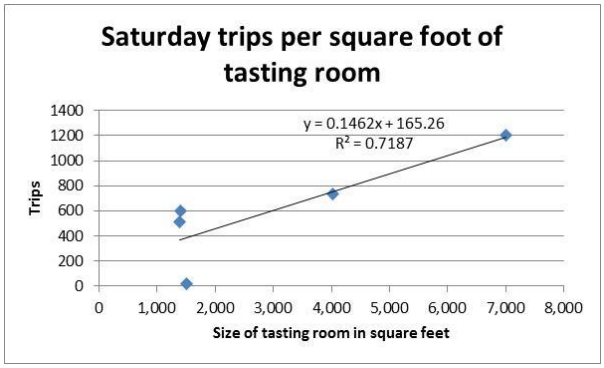


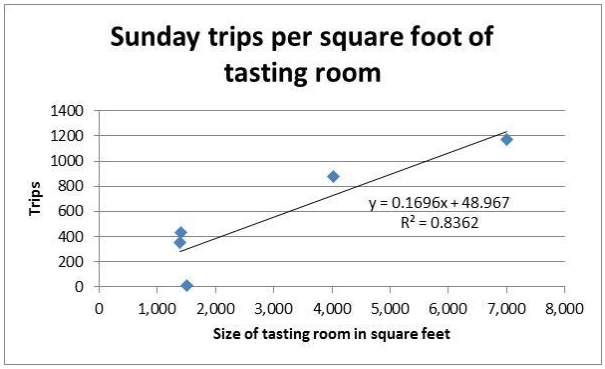


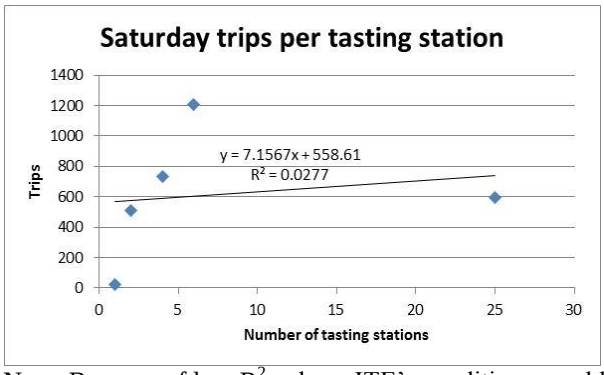


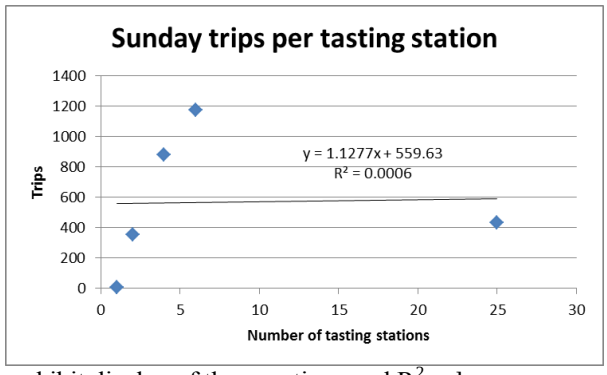


Note: Because of low R^2 values, ITE's conditions would prohibit display of the equations and R^2 values.

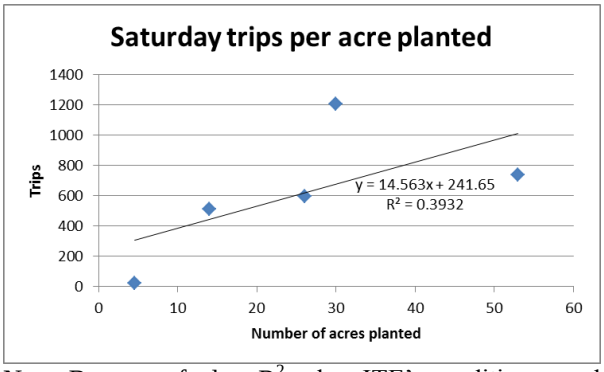


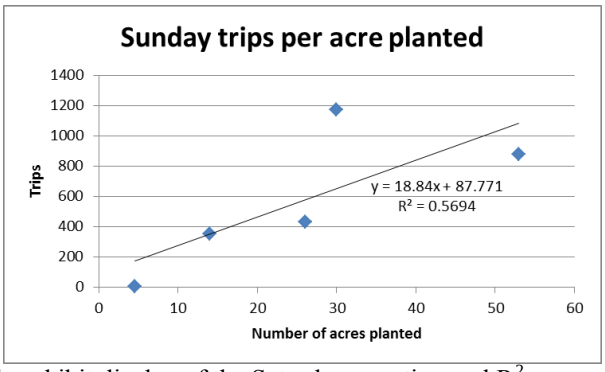




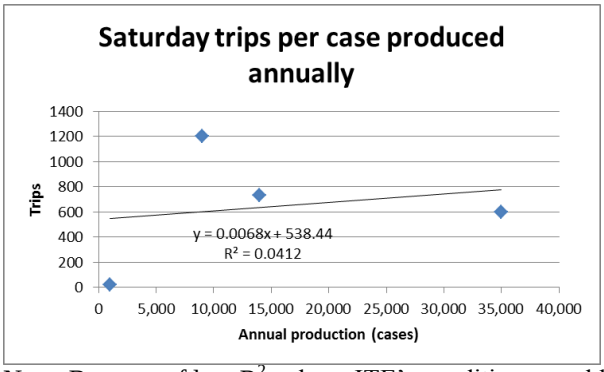


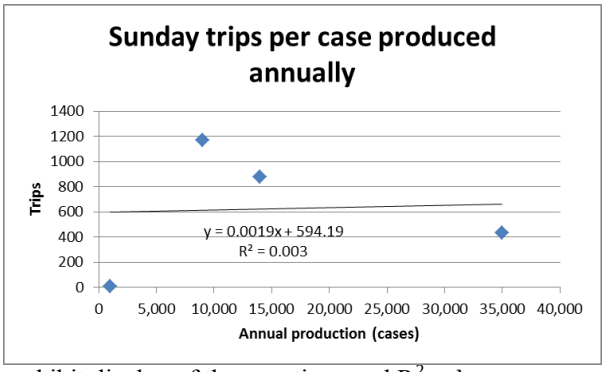
Note: Because of low R^2 values, ITE's conditions would prohibit display of the equations and R^2 values.



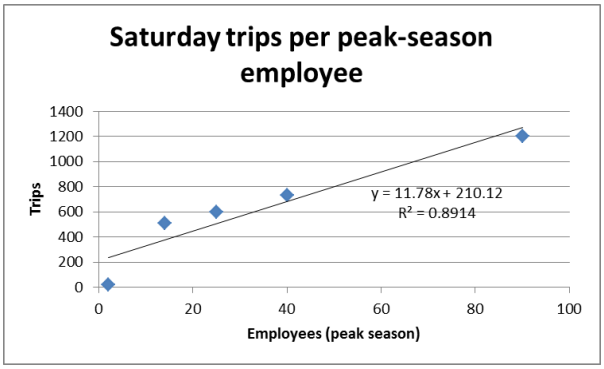


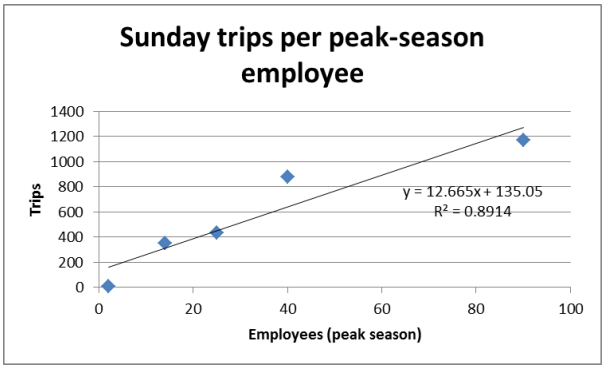
Note: Because of a low R^2 value, ITE's conditions would prohibit display of the Saturday equation and R^2.

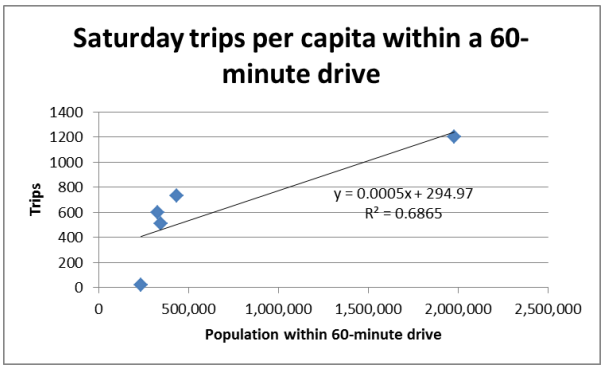


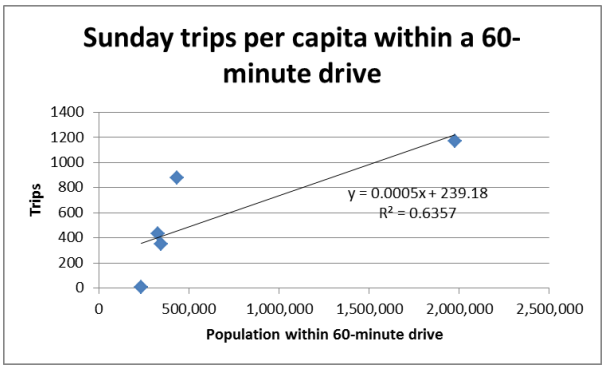


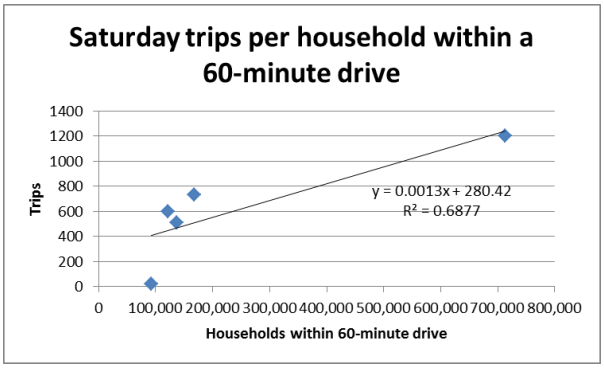
Note: Because of low R^2 values, ITE's conditions would prohibit display of the equations and R^2 values.

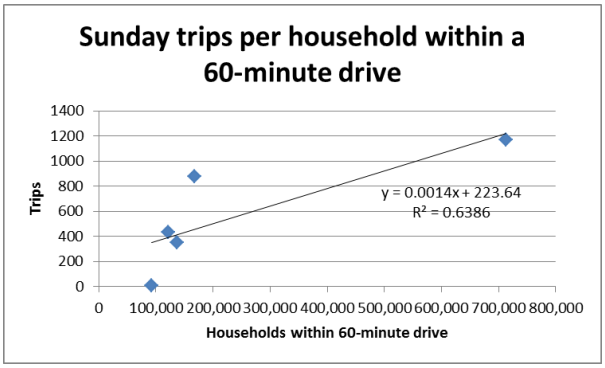




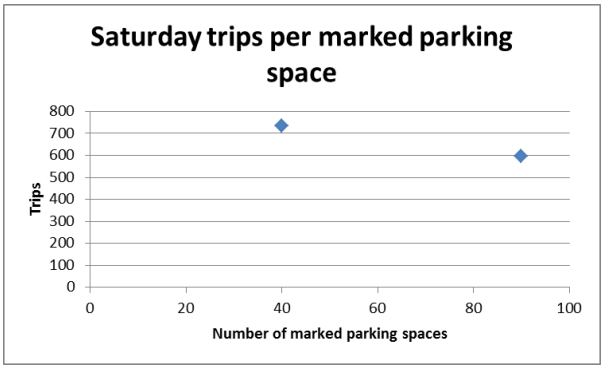


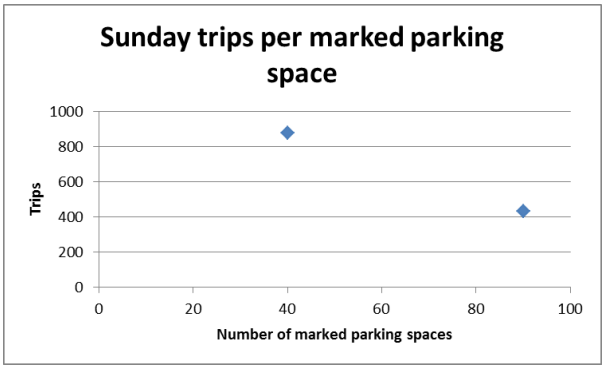


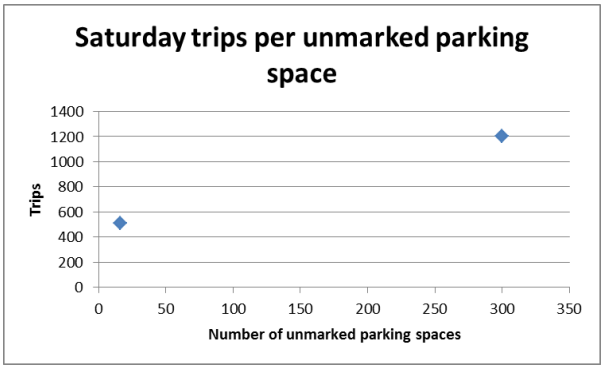


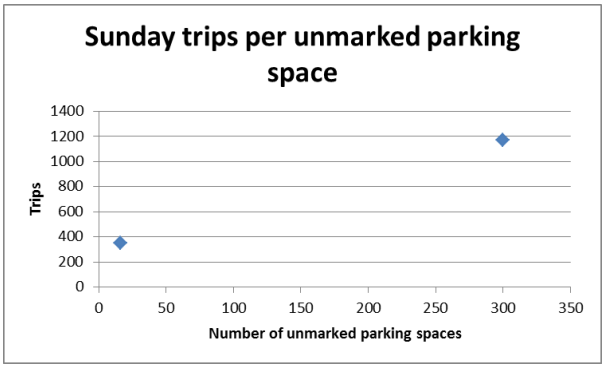


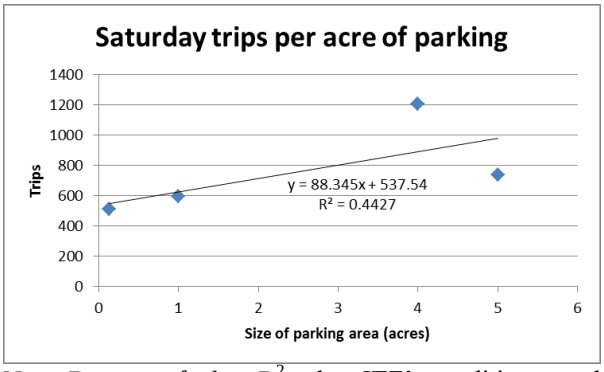
Charts Excluding Site 5

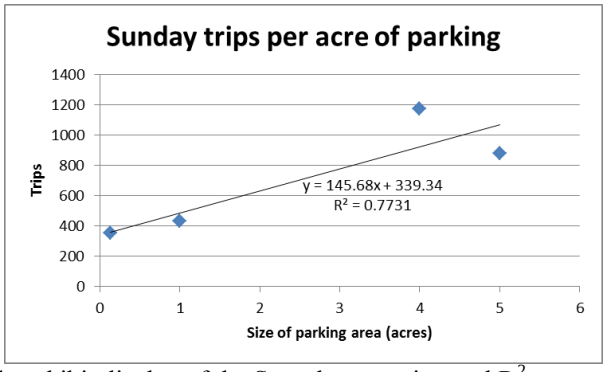




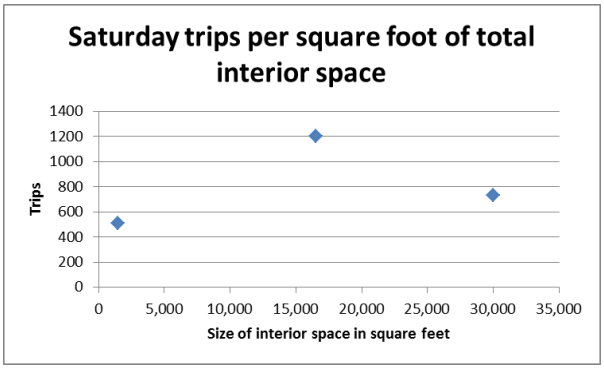


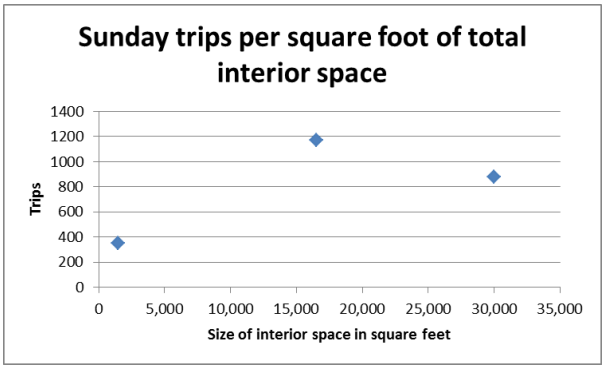


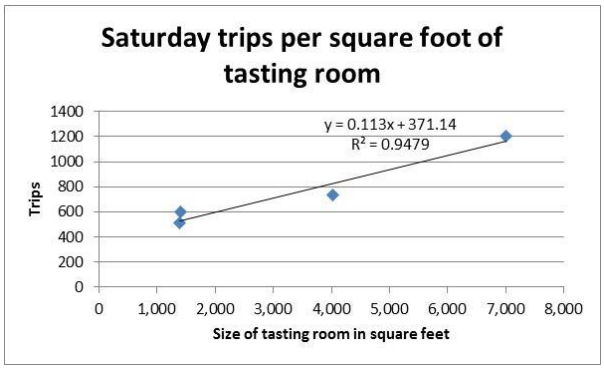


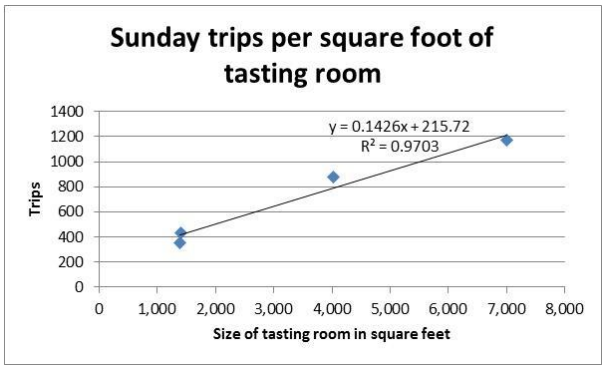


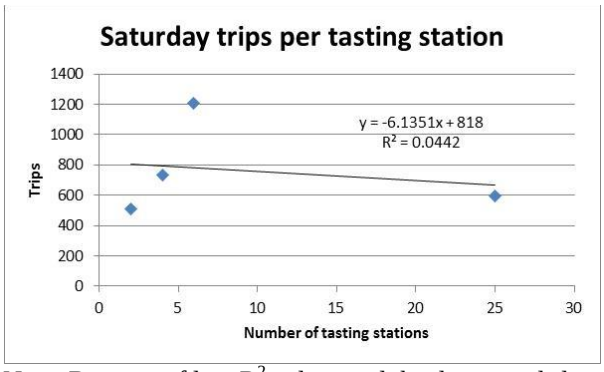
Note: Because of a low R^2 value, ITE's conditions would prohibit display of the Saturday equation and R^2.

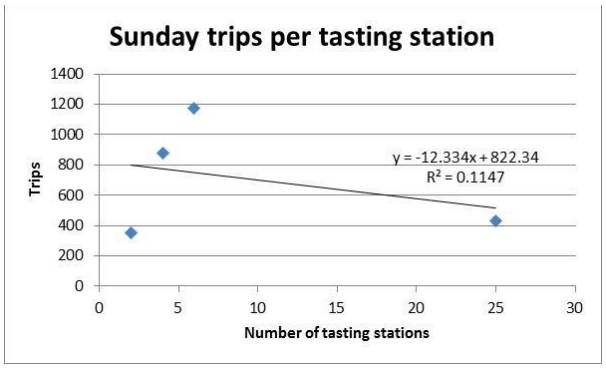




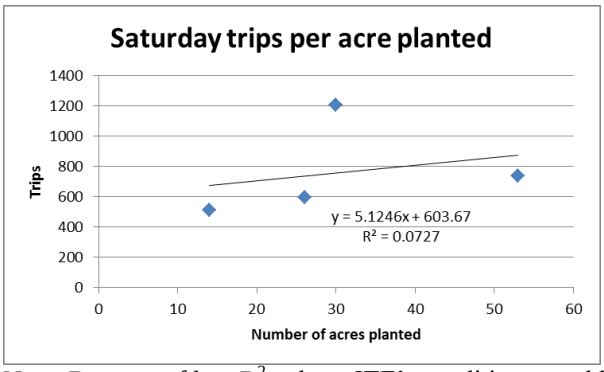


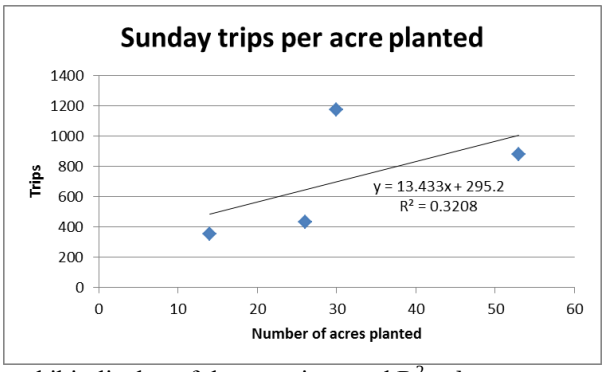




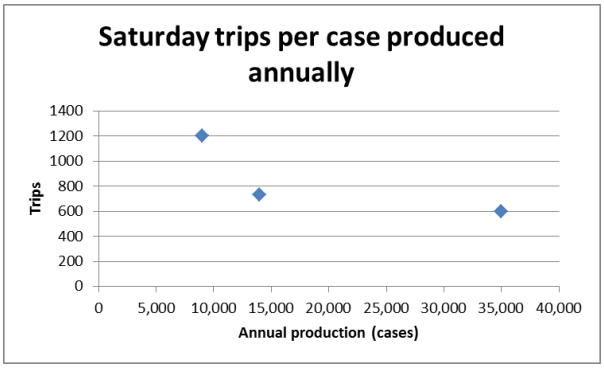


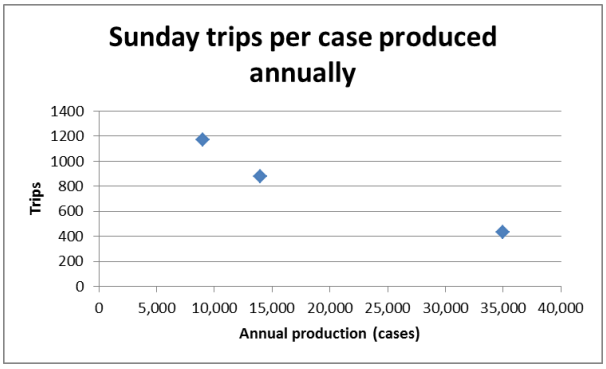
Note: Because of low R^2 values and the downward slopes of the trend lines, ITE's conditions would prohibit display of the equations and R^2 values.

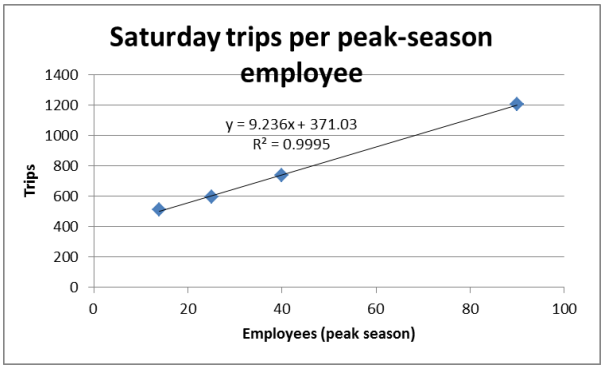


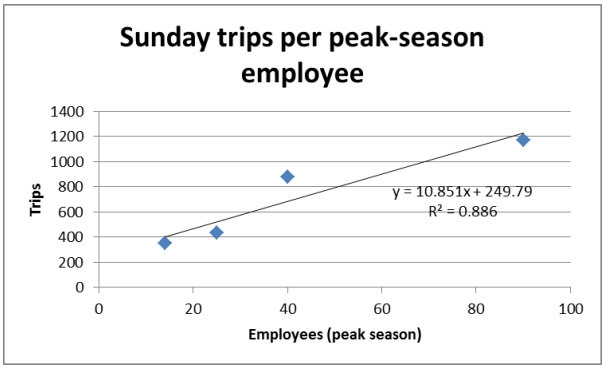


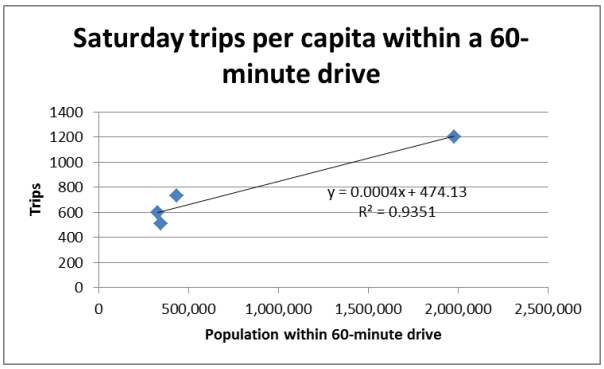
Note: Because of low R^2 values, ITE's conditions would prohibit display of the equations and R^2 values.

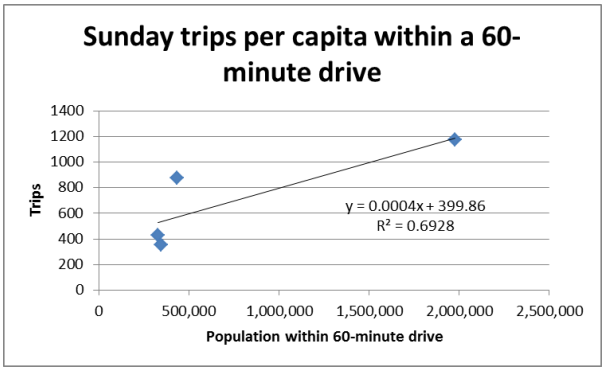


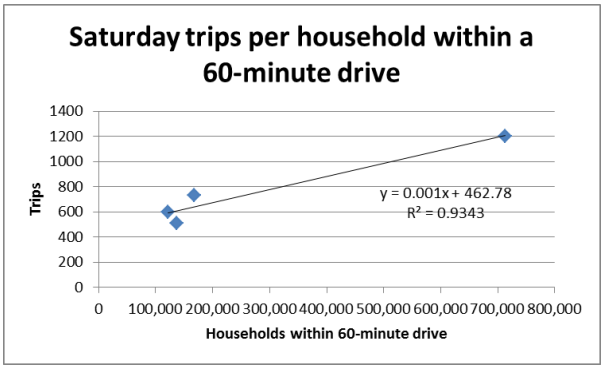


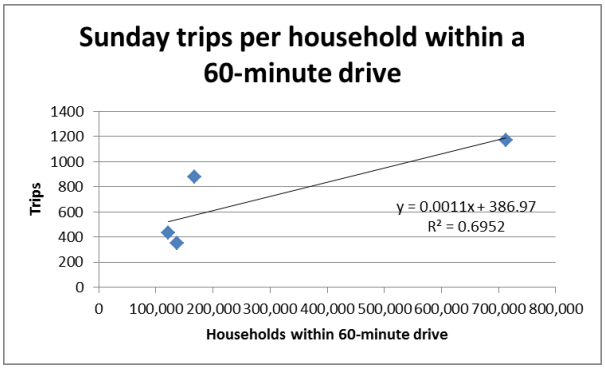

Saturday trips per peak-season employee
y = 9.236x + 371.03
R² = 0.9995
Trips
Employees (peak season)


Sunday trips per peak-season employee
y = 10.851x + 249.79
R² = 0.886
Trips
Employees (peak season)


Saturday trips per capita within a 60-minute drive
y = 0.0004x + 474.13
R² = 0.9351
Trips
Population within 60-minute drive


Sunday trips per capita within a 60-minute drive
y = 0.0004x + 399.86
R² = 0.6928
Trips
Population within 60-minute drive


Saturday trips per household within a 60-minute drive
y = 0.001x + 462.78
R² = 0.9343
Trips
Households within 60-minute drive


Sunday trips per household within a 60-minute drive
y = 0.0011x + 386.97
R² = 0.6952
Trips
Households within 60-minute drive