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16. ABSTRACT

Google Transit is a public transportation trip planner that enables travelers to obtain information regarding available transit services between a given origin and given destination. While transit agencies can publish their service information onto Google Transit for free, Google requires that service data be submitted using a specific format known as the General Transit Feed Specification (GTFS). For transit agencies, this requirement translates into a need to commit some staff resources to the development and upkeep of the GTFS data, which can be an intimidating task for small agencies with just a few employees.

To evaluate the problems, issues, needs and benefits that small transit agencies must consider when using Google Transit, a pilot program was developed to help a nine small agencies in California publish their service data onto Google Transit. This report was developed based on the experiences from the pilot deployments. It provides transit agencies with (1) a review of the needs associated with GTFS data conversion, data maintenance, data hosting, data security, performance evaluation, and marketing and outreach; (2) a description of free and subscription-based GTFS development tools available to transit agencies; (3) a synopsis of a typical GTFS data development process; (4) a description of various data hosting and maintenance models; (5) an identification of training resources available for free; and (6) a list of technical resources that may be used to assist with the development GTFS data. The results of two surveys that were conducted to evaluate how transit agencies and travelers use online transit trip planners and perceive their benefits are also presented. The project demonstrated that small transit agencies can develop and publish their GTFS data onto Google Transit with relatively minimum financial, time and resource commitments.

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INSTITUTE OF TRANSPORTATION STUDIES
UNIVERSITY OF CALIFORNIA, BERKELEY

Online Transit Trip Planner for Small Agencies Using Google Transit

Final Deployment Package

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California PATH Research Report
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The California Partners for Advanced Transportation Technologies work with researchers, practitioners, and industry to implement transportation research and innovation, including products and services that improve the efficiency, safety, and security of the transportation system.

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Report for Caltrans Task Order 65A0324

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EXECUTIVE SUMMARY

Google Transit is a public transportation trip planner that was launched by Google Inc. in December 2005 and integrated into Google Maps in October 2007. This tool was developed to enable travelers to obtain information regarding transit services between a given origin and a given destination, such as available routes, travel times along each route, and trip costs. The integration of Google Transit within Google Maps notably allows travelers to use a single tool to compare trips to be made by car, bike, walking or using transit services. As a growing number of individuals are becoming familiar with Google Maps, publishing transit service data into Google Transit provides transit agencies with a particularly powerful tool to help disseminate service information to their regular and potential customers, as well as to entice prospective travelers to use public transit services. This potential is further emphasized by the fact that information published within Google Transit is available to anyone using devices with internet browsing capabilities. Such accessibility enables information retrieval not only from desktop computers, but also from mobile phones and portable devices capable to connect to the Internet.

Google does not charge a fee for transit agencies to publish their service information onto Google Transit. However, it requires that service data be submitted using a specific format known as the *General Transit Feed Specification* (GTFS). While this data format was initially developed for Google Transit, it has become a de facto standard for the publication of transit information on web servers and development of transit-based traveler information applications. For transit agencies, the need to convert service data into a specific format translates into a need to commit some staff resources to the development and upkeep of the GTFS data, which can be an intimidating task for agencies with just a few employees, especially those without prior experience in the development of online trip planners.

To evaluate the problems, issues, needs and benefits that small transit agencies must consider when using Google Transit to develop their online transit trip planner, the Partners for Advanced Transportation Technologies (PATH) at the University of California at Berkeley, in conjunction with Caltrans and the Federal Highway Administration (FHWA), developed a pilot program to help a number of small, partner agencies in California publish their service data onto Google Transit. The agencies invited to participate in the pilot deployments included Altamont Commuter Express (ACE Rail), Cerritos on Wheels (COW), Lodi Transit (Grape Line), North County Shuttle (NCS), South County Area Transit (SCAT), Paso Robles Transit (Paso Express), Morro Bay Transit and Trolley, and Yuba-Sutter Transit. As part of the project, these agencies were provided with resources and tools to help them convert their service data into GTFS. Two consulting firms, Marcy Jaffe Company and Trillium Solutions, were also retained to help agencies with the GTFS data conversion and maintenance tasks.

This report was developed as a resource for agencies considering implementing an online transit trip planner using Google Transit. Elements presented in the report include:

- Review of the needs associated with GTFS data conversion, data maintenance, data hosting, data security, performance evaluation, and marketing and outreach.
- Description of free and subscription-based GTFS development tools available to transit agencies.
- Description of a typical GTFS data development process.
- Description of various data hosting and maintenance models available to transit agencies.
- Identification of training resources available for free.
- Technical resources that may be used to assist with the development GTFS data.

The report also presents the results of a survey that was conducted to evaluate how transit agencies use online transit trip planners and perceive their benefits. Results from this survey indicate that transit agencies typically pursue the development of an online trip planner as an effort to improve information dissemination, customer satisfaction. The survey results further indicate that available online trip planners are also frequently used to help respond to customer calls regarding route planning needs.

While it is often acknowledged that online trip planners can be beneficial for transit riders and agency operations, small agencies often hesitate launching their data onto Google Transit. This is greatly due to uncertainty regarding staff capabilities, perceptions regarding the time and financial resources that must be dedicated to the development of GTFS data, and uncertainties regarding the subsequent data maintenance needs. The rationale for these fears is often linked to the limited resources available within small agencies. However, the pilot deployments demonstrated that small agencies could develop their online trip planners with relatively little financial, time and resource commitments.

Most of the participating agencies were able to launch their GTFS data onto Google Transit in less than 5 months. Consultant costs for the development of GTFS data ranged from \$950 for the agencies with the simplest networks to \$9400 for the agency with the most complex network. While some agency staff still needed time to be spent on the data conversion effort, most agencies indicated that this effort involved less than 25% of their total staff time over the few months that the GTFS development took. Data hosting and maintenance also require relatively limited resources. Since the GTFS data for small agencies often only require a few hundred kilobytes of space on a computer server, this data can easily be hosted on an existing computer server. While Google is given the permission to access the computer server to periodically fetch the data, Google is only given access to retrieve data files stored in a specific directory. Instead of hosting data on an agency-own server, data could be hosted on a remote server operated by a consultant for a cost as low as \$75 per year. Data maintenance service contracts may also be signed with consulting firms specializing in such work. Based on data collected between 2009 and 2011, the annual costs of such contracts may vary between \$200 and \$2800, depending on the complexity of the GTFS data to maintain, the support services included in the contract, and the firm offering the services. While agency staff often expressed fear regarding their ability to develop or maintain GTFS data, experiences from this project finally indicate that many of the fears can be alleviated through proper documentation and simple hands-on training.

In addition to agency experiences, a survey of Google Transit users was conducted to gauge how travelers perceive its utility. The survey indicates that Google Transit is generally perceived as a tool facilitating information retrieval and making it easier to plan transit trips. The tool's usefulness is further highlighted by the fact that many respondents indicated using Google Transit or other online trip planners several times a week. Many respondents also indicated having used Google Transit on their mobile phone, thus highlighting a growing trend of accessing information during trips. Among the individuals not using Google Transit, the primary reason for not doing so was attributed to a lack of awareness about the tool, probably due to a lack of adequate marketing.

The report concludes with the presentation of various lessons learned regarding the utility of online transit trip planners, how to evaluate their impact on transit operations, as well as GTFS data development, hosting, and maintenance. Various recommendations that were forwarded to Google regarding potential improvements to Google Transit are also listed.

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1. INTRODUCTION

Google Transit is a travel information application that has been developed by Google Inc. to enable travelers to obtain information about transit services between a given origin and a given destination. Information returned by this tool include available sequences of bus and train routes between the selected origin and destination points, expected travel time for each segment, and required fare. This tool is currently integrated within Google Maps and can be called alongside other applications enabling traveler to route suggestions for travel by car, bike, or walking. This integration has created a “one-stop” information source that helps travelers make more informed travel decisions by enabling them to compare trips made using various transportation models. This ability to compare travel models further enables travelers to make travel choices supporting livability and sustainability. Another integration element is the ability of Google Transit to return trip suggestions involving travel segments using services provided by different transit agencies, thus promoting greater regional integration of transit services. In recent years, the usefulness of publishing transit service information onto Google Transit has further been enhanced by the ability of a growing proportion of individuals to access the tool while traveling from mobile phones and devices with internet browsing capabilities.

While transit agencies have often expressed interests in providing their riders with online transit trip planning tools, the costs associated with the development of a new planner or licensing available commercial tools have frequently prevented agencies with moving forward with such a project. As an example, the Washington Metropolitan Transit Authority (D.C. Metro) reported contracting in the mid to late 2000s an external consultant to develop the latest version of the online transit trip planner at a cost of \$80,000 [1]. Since this cost is for the update of an existing system, a higher cost can be expected for the development of an entirely new application. The Los Angeles County Metropolitan Transportation Authority (LA Metro) further reported spending \$250,000 annually in licensing fees for the third-party software it was using before developing its own transit trip planner. While small transit agencies can expect to pay much lower licensing fees due to their much smaller bus or rail networks, annual licensing fees of several thousand dollars can still be expected for the use of full-featured online transit trip planners similar to those provided by large urban transit agencies. Such expenditures are simply beyond the financial capabilities of many small transit agencies. This has resulted in many agencies opting not to offer an online transit trip planner despite a strong underlying desire to do so.

In the above context, Google Transit presents a unique solution for small transit agencies seeking to provide an online transit trip planner to their customers. Unlike other commercial trip planners, Google allows transit agencies to publish their service data onto Google Transit for free. This removes concerns about high potential purchase and annual licensing costs. However, while no fee is charged for publishing data onto Google Transit, Google requires that bus stops, routes, schedules and any other data characterizing the transit services offered be submitted in a specific format known as the **General Transit Feed Specification (GTFS)**. The GTFS data format was developed by Google to specifically for its Google Transit application. However, the growing popularity of Google Maps has resulted in this data format being increasingly used by information service providers in the United States and across the world to develop applications aiming to provide individuals with transit-related information. Similar to Google Transit, anyone wishing to develop data in the GTFS format can do so at no charge. GTFS is an open-source, reusable data format that is made available to anyone wanting to use it under a Creative Commons Attribution Share Alike license.

While GTFS data can be posted for free onto Google Transit, some time and resources must be dedicated to the development of GTFS data. Unfortunately, small urban and rural transit agencies often have limited resources. In fact, when excluding vehicle operators, many small agencies may only have a handful of full-time employees. For many agencies, such a low staffing level makes it difficult to find time for the development on an online transit trip planner on their own, particularly if there are other pressing needs to address. In addition, existing staff may not have the necessary technical expertise to execute the required GTFS development. Another potential complexity is brought by the fact that many small agencies may contract out some services, making it more difficult to coordinate data development with their various service providers. Finally, while the development and management of the GTFS data may be contracted out to a consulting firm specializing in such work, such contracts have associated costs that must be accommodated within existing agency budgets.

To evaluate the potential merits that small transit agencies may obtain in using Google Transit to provide their customers with an online transit trip planner, the Partners for Advanced Transportation Technologies (PATH) at the University of California Berkeley, in conjunction with Caltrans and Federal Highway Administration (FHWA), developed a pilot program to help a select number of small transit agencies in California move their service data into Google Transit. As part of the project, the selected agencies were provided with resources and tools to help them organize their schedule data, convert them to the required GTFS format and publish them onto Google Transit. Two consulting firms with experience in this matter were also retained to assist transit agencies with their data conversion tasks.

The remainder of this report presents the main findings of the report and is organized as follows:

- **Section 2** provides a brief description of the features offered by Google Transit.
- **Section 3** provides a brief review of the needs associated with the development of online transit trip planners. Elements discussed within the section include needs pertaining to data conversion, data maintenance, data hosting, data security, performance evaluation, marketing and outreach. Results of a survey on resources typically available at small transit agencies are also presented.
- **Section 4** describes tools that are currently available to help transit agencies convert route and schedule information into suitable GTFS formats. This includes descriptions of free tools provided by Google, free tools provided by entities other than Google, and subscription-based transit data management systems offering built-in GTFS data export functions.
- **Section 5** outlines the process that is generally followed to develop and validate online transit trip planners. This section includes descriptions of the GTFS data files to be developed, processes used to validate GTFS data, and examples of online transit trip planner implementations.
- **Section 6** presents various models that can be followed for data hosting and maintenance
- **Section 7** summarizes the process that was followed to identify transit agencies that were invited to participate in the project's pilot online transit trip planner deployments.
- **Section 8** summarizes the activities that were conducted to help the transit agencies selected to participate in the pilot deployments to successfully launch their online transit trip planner.
- **Section 9** provides an evaluation of the use of online transit trip planners by participating travelers and transit agencies. The first part presents the results of a survey of online transit trip planner users that was conducted to gain insight in how travelers perceive and use such a tool.

The second part presents an evaluation of the frequency at which travelers may be accessing online trip planners. The third part presents the results of a survey of transit agencies that was conducted to collect agency experiences with online trip planners.

- **Section 10** presents a summary of the training resources that were developed or identified as part of the project. This includes descriptions of the training sessions that were conducted by PATH and training videos that were recently developed by a consultant for the National Rural Transit Assistance Program (National RTAP).
- **Section 11** identifies various technical resources that are available to transit agencies interested in developing an online transit trip planner. This includes information on tools provided by the National RTAP, information on user groups and blogs that may be used to seek answers to specific problems and issues, a list of consultants that may be contracted to help with the development of online planners, and a list of transit agencies known to have already launched an online transit trip planner.
- **Section 12** provides a summary of lessons learned through the pilot deployments.
- **Section 13** provides general recommendations regarding the implementation of online trip planners by transit agencies, as well as some recommendations that were forwarded to the Google Transit development team on how to improve the tool.

2. GOOGLE TRANSIT FEATURES

Google Transit is a travel information application that was developed by Google Inc. to enable travelers to query information about transit services available between a given origin and a given destination. This tool was launched as a stand-alone application in December 2005 and subsequently integrated into Google Maps in October 2007.

Information returned by Google Transit depends on the transit service data that has been provided to the application but typically include the following:

- Sequences transit routes that a traveler might take to reach a specific destination.
- Information identifying buses or trains running along the specified routes.
- Walking segments at each end of the trip, to reach a bus stop from an origin and destination from a bus stop.
- Expected travel times.
- Fares that may be required.

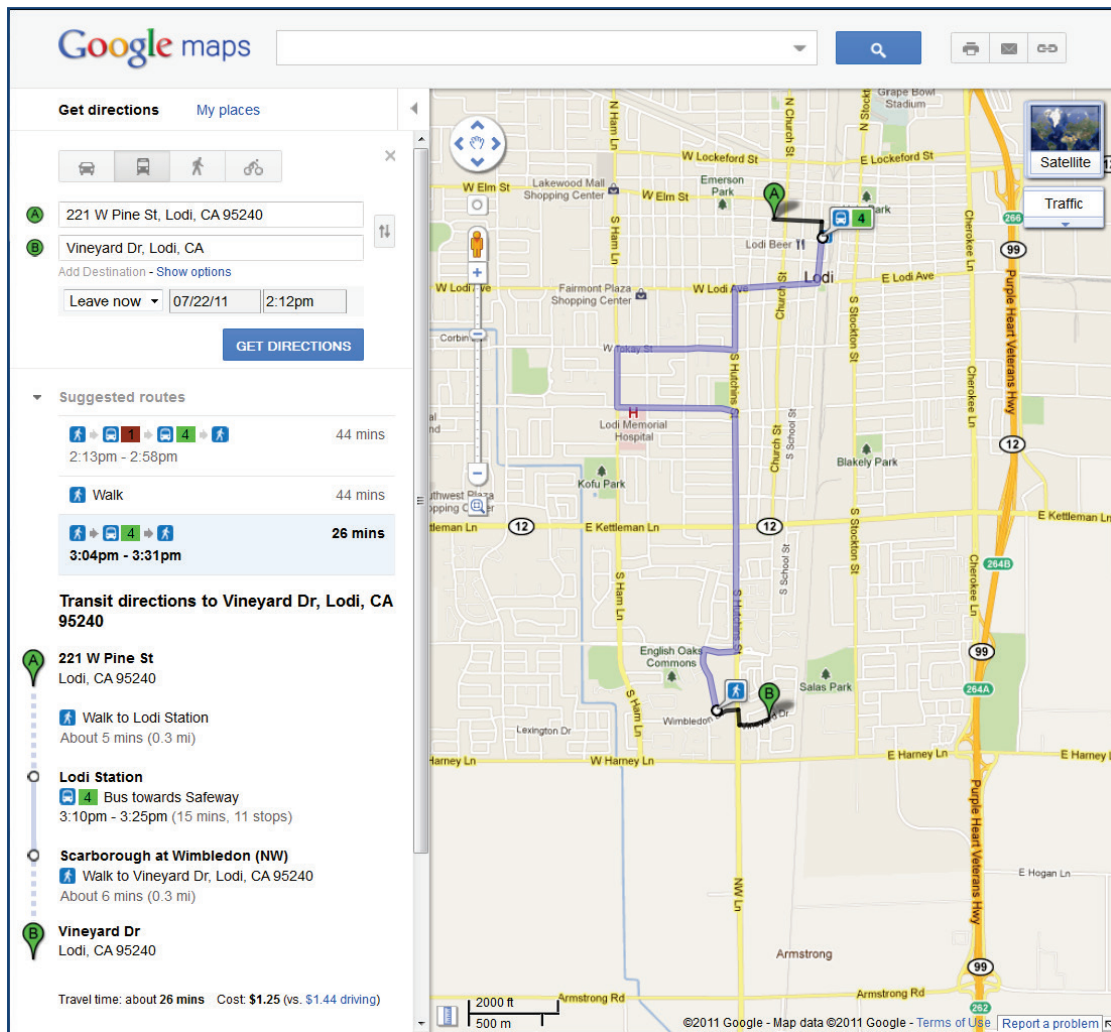


Figure 1: Typical Single-Agency Trip Google Transit Search Result

An application example is shown in Figure 1. This example illustrates the results of a search to find possible itineraries between two points in the City of Lodi, California. Use of Google Transit was triggered by selecting the bus icon near the top of the left pane (indicated by the red arrow above). As shown in the middle of the left pane, three possible trip itineraries were returned: a 26-min trip involving taking Bus 4, a 44-min trip first involving riding Bus 1 and then transferring to Bus 4, and a 39-min trip first involving riding Bus 23 and then transferring to Bus 4. The itinerary shown on the right pane is for the 26-minute trip. The illustrated trip shows portion traveled by bus in light purple, and two walking segments at each end of the trip in black. The first walking segment covers the distance to reach the bus stop nearest to the starting location, while the second segment the covers distance to reach the desired destination from the closest bus stop along Route 4.

The integration of Google Transit within Google Maps allows trip search results to be displayed on maps, making it easier for travelers to understand the directions being given. This integration further allows Google Transit to be called alongside other routing applications that enable travelers to query route suggestions for travel by car, bike, or walking. This creates a “one-stop” information source that helps travelers make more informed travel decisions by enabling them to compare hypothetical trips made using various transportation models. As a growing number of individuals are becoming familiar with Google Maps, publishing transit service data into Google Transit provides transit agencies with a particularly powerful tool to help disseminate service information to their regular and potential customers and to entice prospective travelers in using transit services.

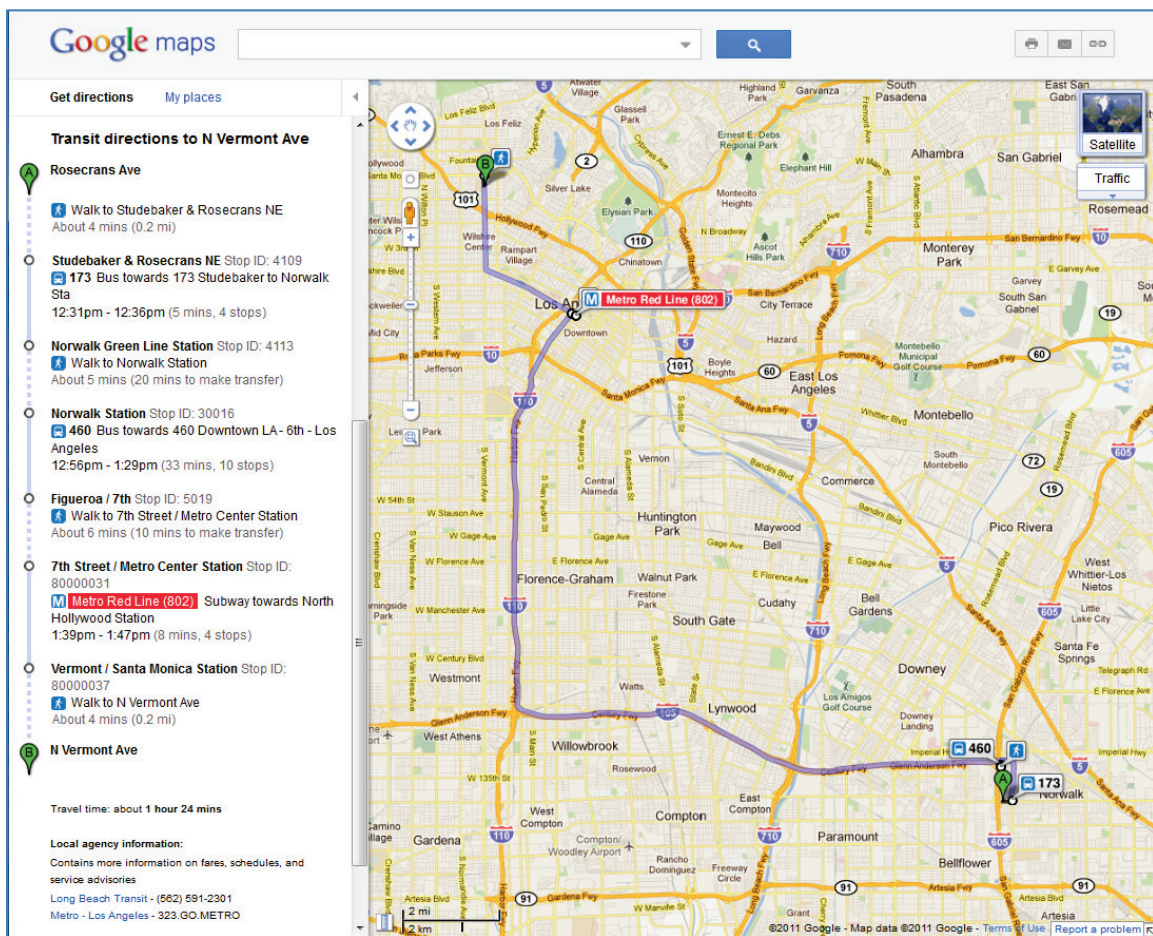


Figure 2: Typical Multi-Agency Trip Google Transit Search Result

Another important element of Google Transit is its ability to return trip suggestions involving travel segments on transit networks operated by different transit agencies. For travelers, this removes the burdensome need to consult multiple schedules to try to figure out on their own how to best plan a transfer from transit network to another. This feature is activated as long as transit agencies sharing transfer point each submit their service data. An example of multi-agency trip is shown in Figure 2. This example shows the result of a search query involving travel segments on Long Beach Transit Route 173, Los Angeles County Metropolitan Transportation Authority (L.A. Metro) Express Route 460, and L.A. Metro’s Red Line, in addition to walking segments at both end of the trip.

In recent years, the usefulness of publishing transit service information onto Google Transit has further been enhanced by the ability of a growing proportion of individuals to access Google Transit while traveling from mobile phones and devices with internet browsing capabilities. This ability not only increases information accessibility, but provide travelers with a tool that they can use to quickly respond to unexpected changes in travel plans or deviations in transit services.

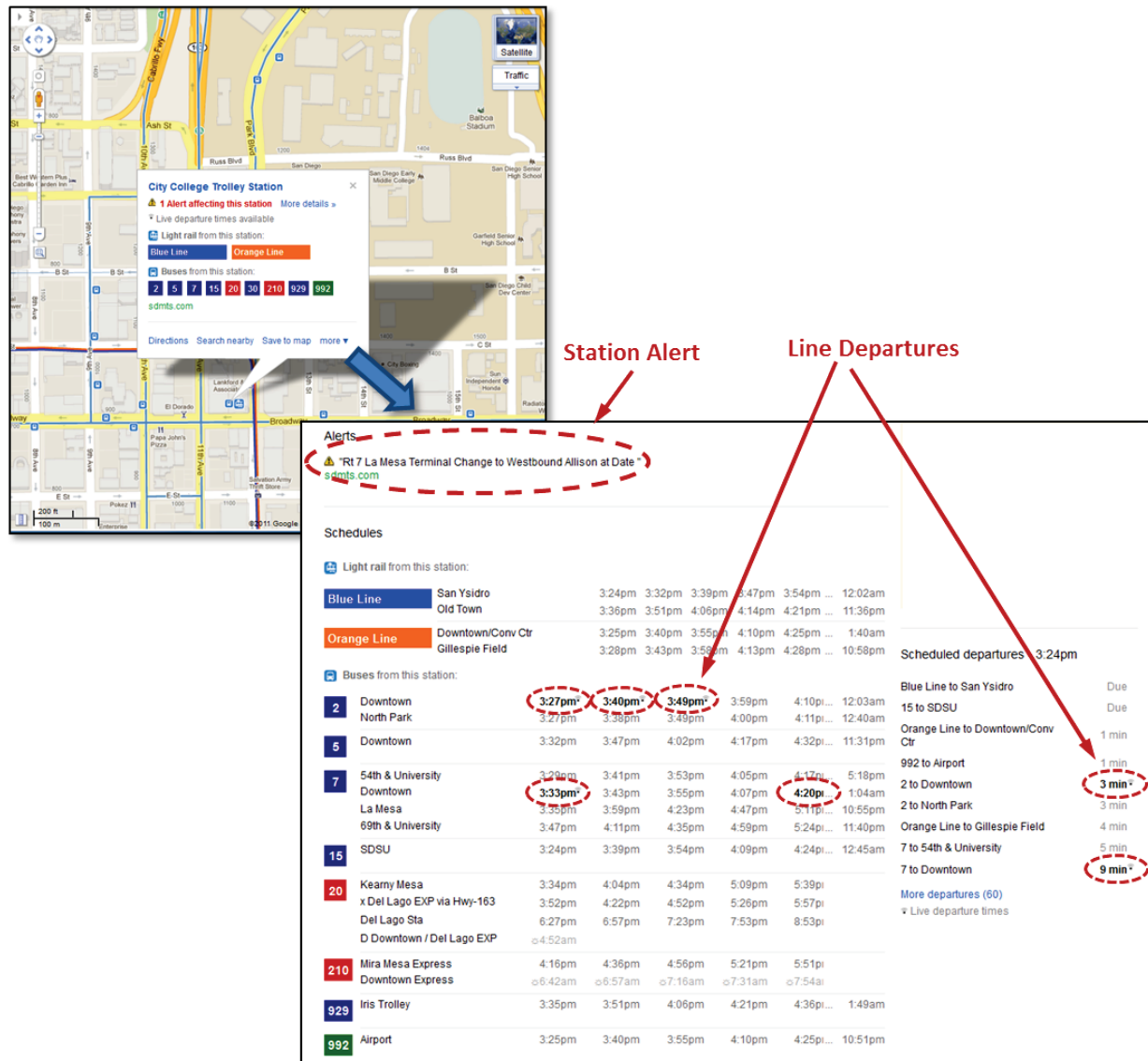


Figure 3: Google Transit Real-Time Transit Information Display

In June 2011, Google added the Live Transit Updates feature to Google Transit. Live Transit Updates is a service providing real-time transit updates to users of Google Maps and Google Maps for Mobile. These updates include live departure and arrival times to transit stations, as well as service alerts. Before real-time data could be posted, agencies are required to have their GTFS feed live onto Google Transit. A GTFS real-time feed must then be developed. A GTFS real-time feed is an extension of the standard GTFS data format defining how transit agency should provide information characterizing trip updates (delays, cancellations, changed routes), service alerts (stops moved, unforeseen events affecting a station, route or entire network), and vehicle positions.

At the time this report was written, Google had already started incorporating real-time transit data for cities such as San Francisco and San Diego in California, Portland in Oregon, and Boston in Massachusetts. An example is shown in Figure 3. This example shows the Google Transit information for the City College Trolley Station in San Diego. In this example, two types of Live Transit Updates data are available for the station: a station alert and live vehicle departures for trolleys servicing the stop. The station alert indicates that the location of the trolley stop has been moved. The live departures data further provide real-time departure information for a few vehicles. Live vehicles departure times are shown in bold in the service schedule and further identified by a special “broadcast” icon displayed next to the departure time, as shown by the red arrows in Figure 3. Since this feature was not available when the project was initiated, it is not part of the GTFS deployment activities reported in this document. However, agencies interested in this new Google Transit feature can obtain more information at the following web address: <http://maps.google.com/help/maps/transit/partners/live-updates.html>.

3. NEEDS ASSESSMENT

Small urban and rural transit agencies typically have limited labor and financial ability to apply for new projects. It is therefore important to know what the implementation of an online transit trip planner requires in terms of resources so that appropriate staff and funding, as well as adequate contractual agreements with consultants, can be developed by small agencies considering this investment. This section summarizes various needs related to the development and operation of online transit trip planners along the following categories:

- Data conversion
- Data maintenance
- Data hosting
- Data access security
- Performance evaluation
- Marketing and outreach

To help frame the needs of rural transit agencies considering the development of an online transit trip planner, the last part of this section presents the results of a survey that was conducted to assess the resources that may typically be available at small transit agencies, and the administrative challenges that may be faced by these agencies.

3.1. GTFS DATA PREPARATION

The process for converting service data into GTFS and uploading the resulting data into the Google Transit trip planning application generally involves the following steps:

- Data gathering
- Conversion of collected data into GTFS.
- Data validation

3.1.1. DATA GATHERING

Before GTFS data conversion can begin, relevant information about transit services must be collected. This includes collecting data regarding:

- Route names and/or representative color
- Route alignments
- Stop locations
- Regular schedules
- Seasonal and holiday schedule changes
- Fare tables
- Transfer preferences
- Agency contact phone numbers

The extent of efforts needed to collect all relevant data will depend on existing data storage practices in place at the agency. For instance, less labor will be required to convert service information into suitable electronic formats if data is already available in electronic format than if the process has to start with

paper-based data, such as information shown only on maps. Similarly, if current practices already result in data being stored on a single computer server at a central location, less effort may be necessary to assemble all the required data.

Typically, initial data gathering will involve one or more of the following activities:

- Gathering of data currently displayed on agency websites.
- Gathering of data stored within Geographical Information Systems (GIS) maintained by the transit agency and/or regional transportation planning agency.
- Field trips to survey and record bus stop locations. Exact bus stop locations can notably be recorded by individuals riding buses or service vehicles with a handheld GPS device.
- Extraction of data from electronic documents.
- Extraction of data from paper schedules and other customer information material.
- Use of Google Street View to verify the location of identified bus stop or equipment installed at particular locations.

3.1.2. INITIAL GTFS DATA CONVERSION

The conversion of transit service data into suitable GTFS feeds requires the development of a series of text files characterizing specific aspects of a transit service. Six files are required for the launch of any transit trip planner, while six other files are optional. The following list defines the content of the various GTFS files that may be developed:

- Required GTFS data files:
 - **agency.txt:** Contains information about the transit agency (or agencies) providing the data contained in the feed.
 - **routes.txt:** Contains information about the transit routes operated by the agency. A route is defined here as a group of trips that are to be displayed to riders as a single service.
 - **trips.txt:** Lists all trips made by vehicles operated by a transit agency. This is often considered as the most important data files. This file contains a separate entry for each trip.
 - **stops.txt:** Contains information about the individual locations where transit vehicles may pick up or drop off passengers.
 - **stop_times.txt:** Lists the times that vehicles arrive at and depart from individual stops for each trip.
 - **calendar.txt:** Defines dates for service IDs using a weekly schedule. Specifies when service starts and ends, as well as days of the week where service is available.
- Optional GTFS data files:
 - **calendar_dates.txt:** Lists exceptions for the service IDs defined in the **calendar.txt** file. If **calendar_dates.txt** includes all dates of service, this file may be specified instead of **calendar.txt**.
 - **fare_attributes.txt:** Defines fare information for the specified routes.

- **fare_rules.txt:** Defines the rules for applying fare information to the specified routes.
- **shapes.txt:** Defines the rules for drawing lines on a map to represent a transit organization's routes.
- **frequencies.txt:** Defines the headway (time between trips) for routes with variable frequency of service.
- **transfers.txt:** Defines the rules for making connections at transfer points between routes.

To a large extent, the size and complexity of the transit network to be codified will determine the resources needed for data conversion. However, existing practices may also have an impact on resources. For instance, Google requires the provision of bus stop locations with latitude and longitude coordinates. Agencies that have been using a Geographical Information System (GIS) to support the system planning or their operations may already have at hand all the required information. This may eliminate altogether the need to send staff to the field to capture the coordinate of each bus stop.

If the development of the GTFS files is to be conducted in-house, needed resources will typically include time and cost for agency staff to collect, prepare and validate all relevant data, as well as costs associated with the use of computers and various supplies. As an example, when Stanford University developed its Google Transit data, it took an entry level planner with basic GIS skills approximately 80 hours to create and validate the data. This was for a relatively small network with many service irregularities. Less time may even be required for small transit systems offering very few fixed routes and/or routes with limited stops.

Using an external consultant to convert data can obviously reduce agency staff time involvement. However, some agency staff time will still be needed to help the consultant gather required service data and to oversee data conversion efforts. In some cases, properly organizing the data or modifying existing operational practices may also be required to satisfy consultant needs. Development costs for consultancy services must further be considered, as these costs may in some cases exceed the cost of converting the data in-house.

Before committing to a specific course of action, a best practice in determining the least cost approach to implementing a Google Transit Trip Planner would be to conduct some detailed analysis of the required task needs and have agency staff conduct some preliminary planning.

3.1.3. DATA VALIDATION

Following the initial conversion of service data into GTFS feeds, resources must be allocated to verifying the accuracy of the developed data and resolving any problems that may have been identified. This may be accomplished either by in-house staff or by external consultants. Similar to the preceding phases, the amount of resources needed for validating the GTFS data will depend on the size of the transit network and complexity of the transit service provided. Small networks with few routes and few stops will obviously require much less validation efforts than networks featuring a large number of routes and stops.

3.2. DATA MAINTENANCE

Following the official launch of an online trip planner, a continuous effort must be made to keep the posted data up-to-date. The amount of effort needed will depend on the frequency with which changes are made to transit services. Networks in which multiple changes are made throughout the year will obviously require more maintenance efforts than networks in which changes made only once a year.

Data maintenance is as important as the initial GTFS data conversion effort, since out-of-date data will affect the usability and credibility of an online planner. Online planner queries returning inaccurate service data may well result in travelers missing a particular bus at a given stop or in much longer than anticipated travel times. Travelers, particularly first-time and occasional transit riders, are particularly sensitive to the provision of inaccurate information. If these experiences repeat frequently, mounted frustration will eventually turn individuals away from using the online trip planners, and thus reduce the value of the investment that was put in developing the tool in the first place.

Since data fetches are performed weekly by Google, service changes can be incorporated relatively quickly into Google Transit. Data maintenance primarily requires tracking changes in schedules, routes, stops and fares and modifying the GTFS data files accordingly. Each agency is responsible for keeping an up-to-date GTFS data in the directory from which Google fetches transit service data. Elements that a transit agency will typically need to consider when developing a data maintenance program include:

- Determining whether the agency, a regional entity or external consultant will have the primary charge of tracking system changes and updating the GTFS feeds.
- Identifying staff at the transit agency responsible for monitoring system changes and, if necessary, notifying the external consultants in charge of the GTFS data updates.
- Developing a schedule for periodic revision of GTFS data.
- Developing processes for incorporating changes into published data, taking into consideration whether these changes are to be implemented by in-house staff or external consultants.
- Coordinating the physical switch over date of planned changes with scheduled Google Transit updates to avoid long periods of bad data from the planner.

Similar to previous tasks, the exact amount of staff and/or consultant time needed to review and update the GTFS data following a service change will depend on the size of the transit network, the complexity of transit schedules, and the complexity of the change(s) being made. A 2009 report evaluating the feasibility of developing GTFS data for rural and small-urban transit agencies in nine counties in Northern California [2] recommends that transit agencies should at least plan to spend one day of agency staff time per quarter (four days a year) and \$400 in GTFS consultant time per year for GTFS data maintenance. This was for a scenario in which data hosting and maintenance would be contracted out to a consultant. Table 1, produced by the PATH project team, presents another estimate of required staff time, looking this time at the amount of time involved if the maintenance is done in-house. In this

Table 1: Estimated Annual Person-hours Required for GTFS Feed Update

Number of Routes	Estimated Effort
5 or less	10-40 person-hours
6 to 10	20-60 person-hours
11 to 15	30-80 person-hours
16 to 20	40-100 person-hours

estimate, staff requirements for each data update vary from 10-40 person-hours for a network featuring less than five routes, to between 40 and 100 person-hours for a network featuring between 16 and 20 bus routes.

When data maintenance is done by external consultants, the agency staff requirement drops to the time needed for a representative to identify service changes, pass the updated data to the consultant, and finally ensure that the data maintenance activities have been completed. In this case, the main cost is the fee charge by the consultant hired to perform the data maintenance. The 2009 Northern California feasibility report mentioned above suggests that consulting fees of at least \$400 should be expected for small transit agencies. On this topic, contractual information provided to the PATH project team further revealed that annual consulting costs for small agency GTFS data maintenance can vary between \$200 and \$2800, depending on network size, schedule complexity, and service contract options.

3.3. DATA HOSTING

Another important need is to determine where the developed GTFS data will be hosted. While the data is eventually to be provided to Google, a specific mechanism is used to collect the GTFS data. Transit agencies do not directly submit data to Google. Each agency is instead required to place a copy of its data in a computer directory that can be accessed by Google on a computer server operated by the agency. Data upkeep within Google Transit is performed by a Partner Content Front End (PCFE) application that periodically attempts to fetch a validated *google_transit.zip* GTFS data file from the agency's designated server. When this report was written, the data fetch was typically scheduled to occur at 1:00 AM on Thursdays for agencies in the Pacific Time zone.

Depending on regional context, various models can be considered for hosting the GTFS data. The following are six potential models that were identified as part of this project:

- Hosting on a server operated by the transit agency itself.
- Hosting on server spaces leased from a data service provider.
- Hosting at Google Sites.
- Hosting on a shared regional server operated by a regional or state agency.
- Hosting at no cost on a server operated by the National RTAP.
- Hosting on a server operated by the consulting firm retained to the data maintenance.

The decision regarding which model to adopt is not primarily influenced by the size of data to store. Since the GTFS data files are simple text files, they do not require large storage space. As an example, the GTFS data for the San Luis Obispo Regional Transit Agency network only occupies 120 Kb of hard drive space. The network covering the six agencies operating in San Luis Obispo County further only occupies 271 Kb of hard drive space. Since a relatively small computer space is required, existing equipment will typically be sufficient for hosting the GTFS data. In many cases, the server used to host the agency's web data could also be used to store the GTFS data.

While GTFS hosting requires little hard drive space, various reasons may incite transit agencies to prefer hosting their data on an external server. Various options exist for this approach. For instance, for instance agencies participating in the National RTAP program can store their GTFS data for free on a computer server operated by the program (see the National RTAP GTFS Builder webpage at http://demopro.nationalrtap.org/admin/gtfs_dashboard.aspx). Agencies can also sign data hosting contracts, without any data maintenance services, on third-party computer servers. When this report

was written, computer space could for instance be leased by small transit agencies for an annual fee as low as \$75. Finally, consultants contracted to help with the data maintenance frequently offer data hosting on their computer server, either as part of the service agreement or for a small additional fee.

3.4. DATA ACCESS SECURITY

As with any system handling and storing operational data, appropriate measures must be taken to ensure that only authorized users can access and manipulate it. This requirement is not fundamentally different than those associated with the handling of databases storing transit service, personnel or other data within a transit agency. While read-only access to the GTFS data may be granted to a relatively large number of persons, the ability to modify and upload the data should typically be restricted to a few select persons in charge of data maintenance.

3.5. PERFORMANCE EVALUATION

Online transit planners are typically developed with the goal of improving the dissemination of transit mobility information, improving customer satisfaction and, ultimately, increasing transit ridership. Evaluating the effectiveness of Google Transit in achieving these goals is an important need, particularly to justify the continuing allocation of funds to GTFS data maintenance.

To judge the ability of online transit planners in achieving the above goals, various performance measures can be selected. Table 2 lists various key measures that can be added to an agency's established criteria for evaluating the quality of the information provided to current and potential riders, as well as the impacts that this information may have on operations. The performance measures are presented according to the following categorization:

1. **Measures of interest to transit riders:** Parameters evaluating the facility with which transit information can be accessed, the benefits that travelers may obtain from online information, and how the provided information may change their perception of offered transit services.
2. **Measures of interest to transit operators:** Parameters characterizing ridership increases, operational cost savings, and changes in public perception of services offered.
3. **Measures of interest to transportation planning agencies:** Parameters used to characterizing traffic demand patterns and distribute available funds (e.g., modal splits along corridors).

An ideal timeframe for evaluation ranges from 9 to 12 months following initial data implementation [2]. This time frame provides enough time for regular transit riders and the community of potential riders to become familiar with Google Transit. After the evaluation period is passed, it is recommended to:

- Gather, analyze, and summarize end-user feedback on the online transit trip planning tool.
- Gather, analyze and summarize transit agency stakeholder feedback on GTFS publishing tools and the usefulness of the online trip planner.
- Evaluate administrative components.
- Compare ridership before and after implementation of the online planner.
- Request trip planner usage data from Google and, if available, analyze the data.
- If available, analyze transit agency website statistics to determine online customer information use, behaviors and referring search queries.

Table 2: Performance Measures for Customer Information with Google Transit

Category	Performance Measure	Data Sources
Customer Perspective		
Access to Information	<ul style="list-style-type: none"> • Clarity of transit information (schedule, maps, transfers and stop locations). • Accessibility of transit information to wider population. • Availability of information in multiple formats (smart phone, land line, internet). 	<ul style="list-style-type: none"> • Customer satisfaction surveys. • Customer feedback (from online comment forms, agency comment box, agency blog, Facebook page, or Twitter feeds).
User Savings	<ul style="list-style-type: none"> • Decrease in time spent in trip planning (especially for trips involving multiple agencies). • Travel cost savings (e.g., transit trip may be cheaper than driving). 	<ul style="list-style-type: none"> • Customer satisfaction surveys • Continual Customer feedback
Experience	<ul style="list-style-type: none"> • Ease of trip planning • Ease in understanding the transit network • More confidence in the transit system and schedules (customer satisfaction, anxiety level) • Increase in transit usage 	<ul style="list-style-type: none"> • Customer satisfaction surveys • Continual Customer feedback
Agency Perspective		
Transit Ridership	<ul style="list-style-type: none"> • Increase in ridership • Increases in intermodal/interagency trips 	<ul style="list-style-type: none"> • Fare box data • Automated Passenger Counts (APC) by route • Manual data collection (bus operators, field supervisors at key/transfer stops)
Public Relations	<ul style="list-style-type: none"> • Positive customer opinion of agency after Google Transit availability • Increase in frequency of website visits to access Google Transit • Successfully meeting customer needs and expectations in technology-driven society 	<ul style="list-style-type: none"> • Customer satisfaction surveys • Continual Customer feedback
Agency Savings	<ul style="list-style-type: none"> • Cost savings resulting from a decrease in the number of calls to agency customer service center • Decrease in cost of printing paper-based information and maintaining online information • Use of Google Transit to assist in agency planning, mapping and maintenance activities • Cost savings in publishing paper based schedules 	<ul style="list-style-type: none"> • Calls to customer service center • Cost of publishing paper-based schedules • Ability to enhance planning activities through better data • Overall information expenditures • Trip statistics from Google*
MPO/DOT Perspective		
Regional/Statewide Planning	<ul style="list-style-type: none"> • Better data to determining traveler behavior and regional route preferences • More knowledgeable disbursement of transit funds 	<ul style="list-style-type: none"> • Trip statistics from Google* • Results of ridership counts and web page visits from agencies

*Subject to possible partnership between Google and a transit or transportation agency

- Compare customer service call volumes before and after implementation of the online planner.
- Find out how many riders, as a percentage of the overall riding population, use Google Transit and online tools to plan their trip.

The evaluation could be completed as part of an existing service evaluation effort, such as a Transit Development Plan or Short-Range Transit Plan update to reduce impact and cost, or it could be a dedicated, single-focused effort.

3.6. MARKETING AND OUTREACH

The successful deployments of an agency's Google Transit planner will often depend on coordinated promotion and marketing strategies to inform current and potential transit users of the availability of the planner. The underlying goal of most online planner marketing and outreach campaigns is to increase awareness of the transit services and increase ridership and customer satisfaction.

Examples of marketing and outreach strategies that transit agencies may consider include:

- Assign a short, easy-to-use URL address to the website hosting the online planner.
- Placement of the online planner in prominent view on the agency main website.
- Print on bus stop signs the URL address of the agency website where the online planner can be accessed.
- Publication of press releases to inform the traveling public of the availability of the tool.
- Placement of advertising material onboard transit vehicles to inform current riders.
- Purchase advertising space on billboards along roadways or key pedestrian pathways to inform potential riders about the availability of the planner.
- Provide a recorded message on the agency's main phone line informing callers of the availability of the online planner.
- Encourage other government agencies, schools, and private information providers to post a link to the online planner on their website.
- Partner with groups organizing events to integrate a link to the online transit trip planner on the event's website.
- Develop special radio or television promotional events highlighting features offered by the online transit planner.
- Mail documents to residents of a service area demonstrating how to use Google Transit.
- Operate information booths at fairs and community events.
- On-site outreach at high schools, colleges and other educational institutions.

Resources that may need to be dedicated to the development of outreach material and marketing events can greatly vary from one agency to another. For instance, the cost of printing flyers will depend on whether this could be done in-house or must be contracted out. Running promotions on the radio, television or large billboards will likely cost more than simply displaying posters on buses. Finally, use of bus space to display posters may come at the expense of lost advertising revenues, which should be considered in assessing outreach and marketing costs. The best strategy to use must be fully assessed and will depend on the specific situation at the agency.

3.7. AGENCY RESOURCES SURVEY

To assess typically available resources and potential obstacles, PATH conducted in February 2010 a survey of small transit agencies in California to assess the availability of resources that might be used for GTFS data conversion and maintenance. The survey also assessed administrative and other obstacles that might affect the implementation of online transit trip planners. Results from this survey greatly helped the project team understanding the needs of small transit agencies.

The following subsections briefly describe the survey questionnaire that was developed, how this questionnaire was distributed, the agencies that provided information, and a summary of the main observations from the responses received.

3.7.1. SURVEY QUESTIONNAIRE

The questionnaire that was developed for the survey is shown in Appendix F. Most transit agencies received the same questionnaire. Some slight modifications were made to the questionnaires that were sent to agencies closely connected to a regional transportation agency. These changes allowed the collection of information characterizing regional perspectives.

3.7.2. QUESTIONNAIRE DISTRIBUTION AND RESPONSE

The survey questionnaire was distributed via email to key agency staff. Participants were requested to respond within a one month period. Two weeks after the initial email, an email was sent to remind participants who had not yet responded to do so. Since staff at PATH had personal contact with many of the potential respondents, a fall-back option was to conduct telephone interview with agency staff members failing to return the survey.

The survey was sent to a total of 20 agencies that were known to have successfully implemented their GTFS data conversion effort, either as part of the present pilot project or through an independent effort. At each target agency, the questionnaire was sent to both the agency's transportation manager and individuals in charge of operations, scheduling and customer service, resulting in an average of 3 survey packages being sent to each agency. Out of the 20 identified agencies, the following 7 agencies agreed to participate in the survey:

- Altamont Commuter Express (ACE Rail)
- Cerritos on Wheels (COW)
- Paso Robles Transit (Paso Express)
- North County Shuttle (NCS)
- Yuba Sutter Transit
- Escalon Transit Services (eTran)
- Folsom Transit Division

3.7.3. SURVEY RESULTS

The following paragraphs summarize the pre-GTFS conversion status of the seven agencies that responded to the survey. More detailed data about the responses that were provided to each specific question can be found in Appendix F.

Transit System Characteristics

The transit agencies surveyed varied greatly in terms of system characteristics. Many agencies had significant route deviations and dial-a-ride services. For instance, Cerritos on Wheels had significant route and schedule changes for the summer months only. In terms of number of routes, many of the responding agencies offered five routes or less, except for Yuba-Sutter Transit, which offered 11 routes. Even though the number of routes was relatively similar across many reporting agencies, the number of stops along the routes varied greatly, with a low of 9 stops for ACE rail and a high of 188 stops for Folsom Transit. Transit ridership varied greatly as well. The smallest ridership was for Escalon Transit, which recorded only 1,830 trips in 2009. On the other end, Yuba-Sutter had the highest ridership, with 988,800 trips in 2009. With the exception of Ace Rail and Paso Robles Transit, all the responding agencies finally featured steady increases in ridership from 2007 to 2009.

Frequency of Service Changes

Most of the agencies reported that changes to their transit service occur relatively infrequently. For most agencies, changes typically occur only once a year.

Availability of Transit Service Information in Electronic Formats

All of the agencies reported having some information published on their website. However, only four agencies indicated keeping data in a electronic spreadsheet (typically Microsoft Excel). Of these four agencies, only two further reported having some data available in GIS format.

Available Resources

There were significant variations in the number of full time employees, staff time, software, and internet access availability across all surveyed agencies. However, many similarities were found:

- All the agencies maintained a website where information about routes, schedules and fares could be obtained. Most of these websites were hosted on servers maintained either by the transit agency or city staff.
- None of the agencies had an automated phone system to receive inquiries or calls.
- None of the agencies tracked call inquiries
- Very few agencies tracked the number of visits to their website.
- Only two agencies reported using software for real-time dispatch, with both reporting using the Trapeze software to manage their operations.
- None of the agencies used automated vehicle location (AVL) technology. This was unlikely to change due to tight budgets at all reporting transit agencies.
- Most of the agencies had access to a web server, either operated by their staff or the city's Information Technology Department.
- Most of the agencies indicated that they were not sure whether they would be able to host or maintain the GTFS feed.
- Maintenance through Excel spreadsheets was the most preferred choice.

Agreement/Approval Process

In the last portion of the survey questionnaire, many of the transit agencies indicated that they required department approval, legal review and Policy Board involvement to proceed with the development of an

online transit trip planner. In most cases, it was estimated that these approvals would take only as few weeks to complete. However, it was also indicated that difficulties associated with the agreement and approval processes were one of the main obstacles working against the implementation of a regional Google Transit application.

4. GTFS RESOURCES

Google Transit presents an opportunity for transit agencies to distribute their schedule and route information to a large pool of potential travelers. However, the development of online planners requires that transit service data – namely bus routes, stop locations, bus schedules, fares and other relevant information – be specified in a specific format developed by Google and known as the General Transit Feed System (GTFS).

For small transit agencies, limited staffing and budgetary resources can create significant challenges for the development and implementation of online planners. However, use of free GTFS development tool can make the development of online transit trip planners economically and practically viable for such transit agencies. This includes software available for free, but for which the user has no access to the underlying code (proprietary tool available with a no-cost license); and software for which agencies have access to the underlying code and are free to make modifications to the tool (open-source tool). Use of open source tools is for instance commonplace in the development of web applications and applications designed to run on mobile phones and portable devices.

This section identifies GTFS resources that are available to transit agencies to support the conversion of service data into the required GTFS format. The section does not aim to present all the tools that may be available. While an effort has been made to develop of a list of resources as exhaustive as possible, the focus of this section is to present the tools most commonly used for GTFS development, as well as other tools that may have value to some agencies. For completeness, the resources described in this section include both tools that are available for free and tools offered as part of existing fee-paid transit management software packages, as some agencies may have accessed to tools in the latter category. The tools described herein include:

- Free Google applications:
 - Google Feed Validator
 - Google Schedule Viewer
 - Google Random Queries
 - Google Transit Feed Report
 - Google Earth
 - Merge.exe
- Other freeware tools supporting GTFS data development:
 - Heitzman's Excel Tool
 - National RTAP in the Cloud GTFS Builder
 - Bmander's Makeshapes
 - TimeTable Publisher
 - Transit Data Feeder
 - Python Scripts
 - KML Writers
- Subscription-based tools:
 - Trapeze GTFS export too
 - HASTUS GTFS export tool
 - Trillium WebScheduling

- Avego's FutureFleet™ Software
- Mentor Street Schedule
- Iteris Bus Feeder
- Next Insight Conductor
- Lasso Feed Generator
- NYDOT's Web Data Maintenance System
- The Master Scheduler (TMS)
- TransitEditor
- Mecatran's Urbineris

4.1. FREE GOOGLE TOOLS

This section describes free tools that are currently offered by Google that transit agencies may use for the development and validation of GTFS data feeds.

4.1.1. FEED VALIDATOR

Google Feed Validator is an open-source tool that assesses whether structural problems exist with the developed GTFS feeds. This tool is designed to detect format errors. It does not check whether the data is right or wrong, such as whether wrong stops or timing are provided.

Use of Google Feed Validator for validating GTFS feeds is mandated by Google. To ensure that all data that are provided to the Google Transit development team are free of errors, Google requires that feeds be first run through the Feed Validator tool. The process is simple: a user only needs to drag the compressed *google_transit.zip* GTFS file or a link to the directory containing the file onto the tool's executable file, as shown in Figure 4. An option involving the use of command lines also exists for more advanced users. A popup window will then open with the validation test results. An example output is shown in Figure 5. This example shows a minor issue with the submitted GTFS data format, as well as the presence of unused bus stops within the coded data.

The Feed Validator tool can be found online at the following address:
<http://code.google.com/p/googletransitdatafeed/wiki/FeedValidator>.

A list of errors and warnings returned by the tool can further be found at:
<http://code.google.com/p/googletransitdatafeed/wiki/FeedValidatorErrorsAndWarnings>.

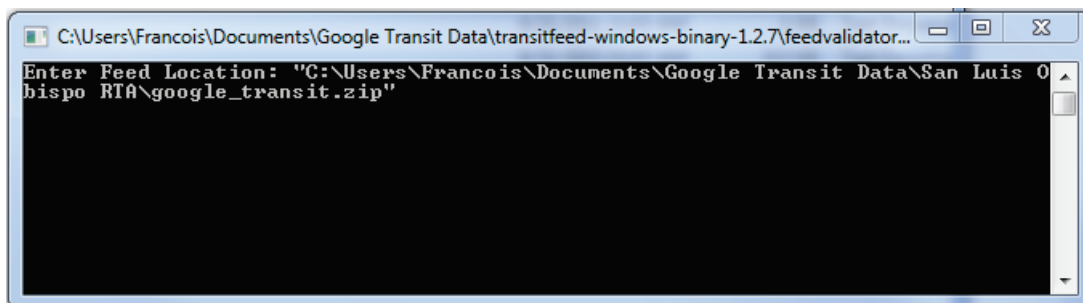


Figure 4: Google Feed Validator Input Screen

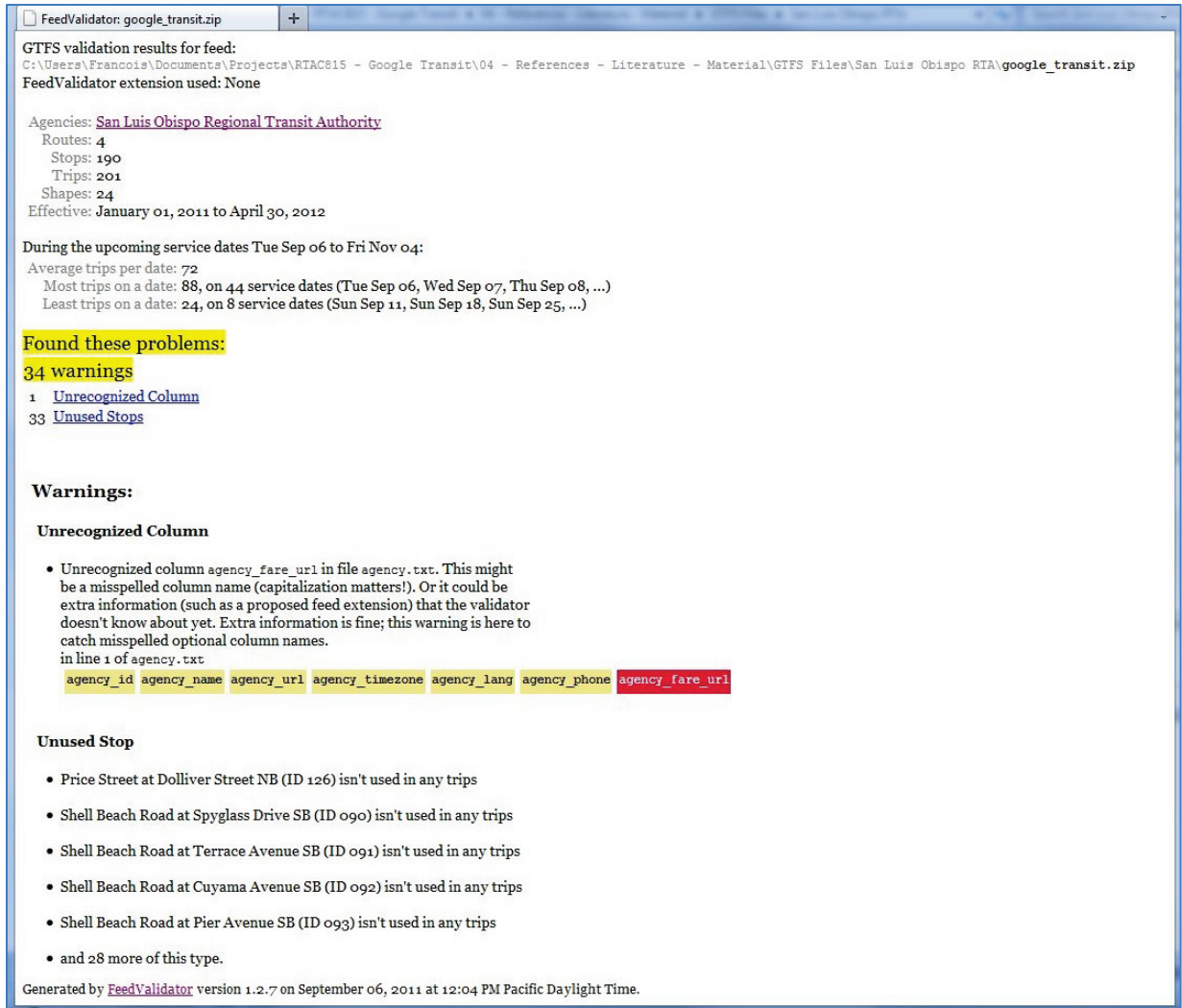


Figure 5: Google Feed Validator Output Example

4.1.1.2. SCHEDULE VIEWER

Schedule Viewer is another essential tool published by Google. It is a Python-scripted diagnostic program for viewing the contents of a GTFS feed on a map. Python is a general-purpose, high-level programming language that is often used as a scripting language for web applications (see for instance descriptions of other non-Google Python-scripted applications in Section 4.2.6). The tool provides a graphical view of bus stops, routes and schedules contained in developed GTFS data feeds. An example is shown in Figure 6. This tool is intended to be used by individuals creating a feed and, consequently, does not include trip planning or other features useful to transit riders. It also provides a Marey graphs to visualize how fast a bus travels along a given route, as well as the times at which a bus is expected to reach each timed stop. This helps check whether bus stops and routes are properly located, whether stops are inadvertently missed or skipped by buses that are supposed to be using it, and whether a route unintentionally loops.

Schedule Viewer, and instructions on how to use this tool, can be found at:

<http://code.google.com/p/googletransitdatafeed/wiki/ScheduleViewer>.

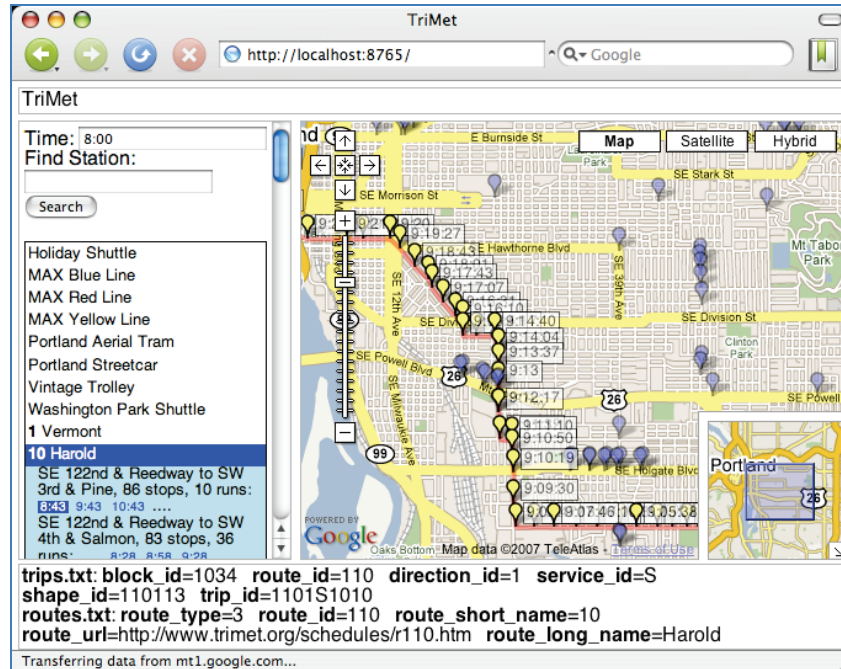


Figure 6: Google Schedule Viewer Example

4.1.3. RANDOM QUERIES

Google Random Queries is another open source tool published by Google. When executed, this tool uses the specified GTFS data files to create a set of up to 50 random test trips that can then be quickly clicked through and tested to ensure the quality of the underlying GTFS data. An output example is shown in Figure 7. This example shows a webpage with a number of URL links at the bottom. Each of these links represents a randomly generated trip by Random Queries that includes start and end points at random locations, as well as starting dates and times within the service area over the next five days.. To evaluate a specific trip, the user only needs to click on the link. This opens a Google Maps site replicating the operation of a Google Transit online planner. The displayed data then checks whether stops are in the right locations, whether returned bus stop arrival times are realistic and correspond to published schedules, and whether returned bus routes correspond to offered transit service.

An important note regarding the data generated by Random Queries is that the information is time sensitive. The links describing the randomly generated trips only remain active for a certain number of days. It is therefore a good practice to examine the trips generated by Random Queries as soon as possible.

The Random Queries application, and instructions on how to use the tool, can be downloaded from the following website: <http://code.google.com/p/googletransitdatafeed/wiki/GoogleRandomQueries>.

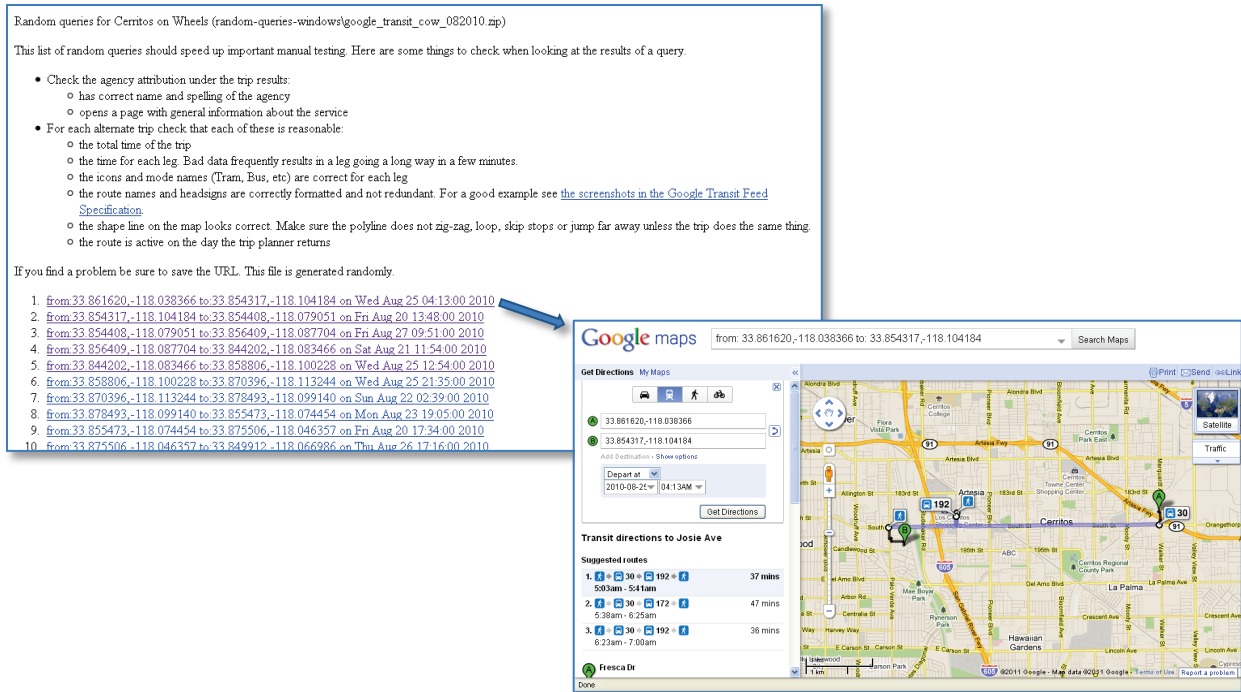


Figure 7: Google Random Queries Output Example

4.1.4. GOOGLE TRANSIT FEED REPORT (SCHEDULATOR)

In an effort to simplify the process for transit agencies to produce their data, Google has introduced in 2011 a new tool called Transit Feed Report, also known as Scheduler, to enable transit agencies to produce feed quality assurance (QA) reports from their latest fetched feed to Google Transit. Given its recent development, its application was not used in the pilot GTFS deployments.

The application runs automatically when transit feeds are uploaded to Google or when they are retrieved as part of a regularly scheduled fetch. Figure 8 provides an example of the overview page of a report produced by the application. The page shows the name and date stamp of the first time the feed version has been seen by the application, the date range of the feed, some counters, information about the agency submitting the data, and a list of routes defined within the feed. Error and warning messages generated by the Feed Validator tool are also included in the report.

Figure 9 illustrates a typical report produced for each travel direction along each defined bus route. At the top of the page, the report shows a table describing the route, agency and head sign information for the route, or multiple routes, shown. The next section present the fare information defined within the feed that apply to the trips and stops. The column "Local Rules" display the fare rules that apply to the route or to a zone belonging to one of the route's stops, while the column "All Rules" shows all the rules for this fare, including those for other routes, stops or zones. The rest of the page includes a map displaying the route, a service calendar for the route, and a schedule table.

Further information about the information generated by this application can be obtained at: <http://www.google.com/support/transitpartners/bin/static.py?hl=en&page=guide.cs&guide=1248912&from=1248912&rd=1>

GTFS Visualisation Report for: demo-feed, first* retrieved Wed 06 April 2011 12:32 (UTC)

This is the Scheduler visualisation report for the [GTFS](#) feed **demo-feed**. This is to allow you to check the contents of the feed quickly and easily, to make it easier to get correct content into GTFS feeds.

*If a feed doesn't change, a report is only generated the first time that feed is retrieved.

Feed Valid From	Feed Valid To	Agencies	Routes	Trips	Stops	Shapes	Transfers	Service Periods	Fare Rules	Fare Attributes
2007-01-01	2050-12-31	1	5	11	9	0	0	2	4	2

Agency Name/ID/URL	Agency Phone Number	Agency Timezone	Agency Language Code
Demo Transit Authority (No agency ID)		America/Los_Angeles	

Agency	Vehicle Type	Route Short Name	Route Long Name	Route IDs	Trips By Direction (date range)
Demo Transit Authority	Bus	10	Airport - Bullfrog	AB	Direction 0, 2007-01-01 to 2050-12-31 Direction 1, 2007-01-01 to 2050-12-31
Demo Transit Authority	Bus	20	Bullfrog - Furnace Creek Resort	BFC	Direction 0, 2007-01-01 to 2050-12-31 Direction 1, 2007-01-01 to 2050-12-31
Demo Transit Authority	Bus	30	Stagecoach - Airport Shuttle	STBA	Direction not specified, 2007-01-01 to 2050-12-31
Demo Transit Authority	Bus	40	City	CITY	Direction 0, 2007-01-01 to 2050-12-31 Direction 1, 2007-01-01 to 2050-12-31
Demo Transit Authority	Bus	50	Airport - Amargosa Valley	AAMV	Direction 0, 2007-01-01 to 2050-12-31 Direction 1, 2007-01-01 to 2050-12-31

There are no errors or warnings. Check the stop locations, trip information, times, fares and transfers are correct by reviewing the route information page.

Total duration: 00:01:28.014208.

Wed 06 April 2011 12:32:51 to Wed 06 April 2011 12:34:19 ([UTC](#))

Copying files 00:00:00.025711
 Splitting GTFS feed 00:00:00.000000
 Loading GTFS feed 00:00:00.000054
 Validating GTFS feed 00:00:00.570210
 Processing routes and trips 00:01:27.417735

transitfeed library version 1.2.6.

Figure 8: Scheduler Overview Page

Route Short Name 50	Route Long Name Airport - Amargosa Valley	Direction Direction 0
Demo Transit Authority		
Vehicle Type Bus	Timezone America/Los_Angeles	Language Code None
Route ID AAMV		

Fare Information

Fare ID	Price	Payment Method	Transfers	Rules For This Route/Zones	Other Rules
a	USD5.25	Pay on board	No transfers allowed	Applies to route "AAMV"	

Service Summary

Display Trips? Service Calendar

Service ID: WE

Jan 2007	Feb 2007	Mar 2007	Apr 2007	May 2007	Jun 2007	Jul 2007	Aug 2007	Sep 2007	Oct 2007	Nov 2007	Dec 2007	Jan 2008
Feb 2008	Mar 2008	Apr 2008	May 2008	Jun 2008	Jul 2008	Aug 2008	Sep 2008	Oct 2008				

Show Trips Available On A Specific Date
Date: (format yyyyymmdd)

Nye County Airport (Demo)	: 08:00:00	: 13:00:00
Amargosa Valley (Demo)	: 09:00:00	: 14:00:00

Figure 9: Scheduler Route Direction Report Page

4.1.5. GOOGLE EARTH

Google Earth provides another way for transit agencies to visualize data. This tool can be particularly helpful for creating optional GTFS shapes.txt files. Shapes files provide Google Maps with information on how to draw bus routes onto a road network. Without a shapes file, the path followed by a bus along a given route appears as a series of straight lines going from one scheduled stop to the next. In this context, Google Earth can be used to map a bus route and modify existing shapes files.

While Google Transit uses data stored using the GTFS data format, Google Earth stores data using the KML format. While this format is different than the one used by Google Transit, many GTFS development tools have been designed with the ability to import and export KML files. This is for instance the case of Heitzman's tool (see Section 4.2.1). The tool allows GTFS data to be exported in a KML format that can be read by Google Earth. This feature allows trip patterns produced by the tool to be loaded and edited in Google Earth. After editing, the updated KML files produced by Google Earth can be pasted back into Heitzman's tool to create new GTFS shapes files, thus providing a quick method of making minor adjustments to existing GTFS data.

4.1.6. MERGE.EXE

Google has introduced in 2009 an open-source tool to help transit agencies merge two *google_transit.zip* files covering different date periods. For instance, this tool may be used to generate a new *google_transit.zip* by combining a *google_transit.zip* describing the service that took effect on January 1, 2011 with another file describing the service scheduled to take effect on January 1, 2012.

When this report was written, the merge tool could be downloaded from the following web address: <http://googletransitdatafeed.googlecode.com/files/transitfeed-windows-binary-1.1.5.zip>. However, GTFS data developers interested in using the tool should be aware that a number of problems have been reported with the use of the tool. For instance, fare data often do not merge. GTFS development consultants working with the tool have also reported having difficulties using the tool with Windows 7.

4.2. NON-GOOGLE FREEWARE TOOLS

This section describes free tools currently offered by various third-parties that transit agencies may use for the development and validation of GTFS data feeds.

4.2.1. HEITZMAN'S EXCEL TOOL

Robert Heitzman, from San Luis Obispo Transit, developed an open source Microsoft Excel tool to develop GTFS feeds that is highly recommended by both Google and consultants involved in the implementation of online transit trip planners. This tool consists of two Excel workbooks containing various macros. A first workbook allows schedule data to be converted into stop times and transit trips. A second workbook is used to finalize data coding and to generate the various GTFS files supporting a Google Transit online trip planner. Figure 10 illustrates the main pages of the tool. The buttons shown that can be seen within the spreadsheet are linked to macros designed to accomplish specific data formatting, validation and maintenance tasks. With this tool, adding optional data files is as simple as adding another spreadsheet to the workbook.

Extensive instructions are provided with the tool to help transit agencies create GTFS feeds with relative ease on their own. Transit agency staff can also obtain more information by visiting the Google Transit Partners Support Group at <https://groups.google.com/forum/?pli=1#!forum/google-transit-partner-support>. Further information may also be obtained from the training videos produced by the National Regional Transit Assistance Program.

	A	B	C	D	E	F	G	H
1	20110603							
2	Run	Macro Names						
3	Import:							
4	<input type="checkbox"/>	ImportAppendGoogleFeedFile - imports text and appends to existing data - you are asked if you want to keep existing data						
5	<input type="checkbox"/>	ImportMergeXLS - Import GT feed data from Excel files; options to delete existing data or append						
6								
7	Maintenance:							
8	<input type="checkbox"/>	Calculate shape_dist_traveled for shapes (required for for Calc shape_dist_traveled for stops_times)						
9	<input type="checkbox"/>	Calculate shape_dist_traveled for stop_times - limit to a specific shape_id or all shape_ids or all trips (will take a while: see status bar for progress)						
10	<input type="checkbox"/>	Stops where used - add where used column to stops tab that reports which shapes use each stop						
11	<input type="checkbox"/>	BuildShapesForTrip - for a given trip turns the stop records into shape records (first pass at shape records) (replaced by dbl click on trips tab)						
12								
13	Map Support:							
14	<input type="checkbox"/>	ExportAllShapesKML - sends shape and stop records to KML file or clipboard						
15	<input type="checkbox"/>	ExportTripShapesKML - QAs distances for single trip; builds KML files for trip for Google Maps/Earth						
16								
17	Export:							
18	<input type="checkbox"/>	ExportGoogleFeedFiles - exports GT data from XLS to .txt files - some QA on export						
19								
20	shapes - double click displays menu of options							
21	trips - double click will offer to export trip to KML - same as ExportTripShapesKML above							
22	stop_times - double click in trip_id column goes to that trip on the trips sheet, on *shape_id column to that shape on the shapes sheet							
23	(use minus value in *seq# to force a specific shape_seq# to be used - helps with routes that loop over themselves)							
24								
25	Please report any bugs/questions/requests to rheitzman@gmail.com							
26								
27	Feed Specification:							
28	http://code.google.com/transit/spec/transit_feed_specification.htm							
29								

Figure 10: Heitzman's Excel Tool

4.2.2. NATIONAL RTAP IN THE CLOUD GTFS BUILDER

The National RTAP GTFS Builder provides simple Excel-based data management tools to help with the creation and management of GTFS data. These tools, which were developed through a project sponsored by the Federal Transit Administration (FTA), further the Heitzman’s Excel tools described in Section 4.2.1 and offer macros automating some of the data development tasks. Two specific Excel workbooks are offered:

- GTFS Schedule Workbook (see Figure 11): Tool used to convert schedule data into GTFS stop times and trips data.
- GTFS Import/Export Workbook (see Figure 12): Tool used to complete the GTFS data development process, store data, and generate the GTFS data files that will be provided to Google Transit.

The Schedules workbook is typically used first, primarily to extract stop times and trips data from bus schedules. These data are then imported into the Import/Export workbook and stored along with other service data. All the data needed to create each of the 12 GTFS files are stored within the workbook in specific tabs corresponding to their destination file. These tabs are shown in the bottom of Figure 11 and Figure 12. Macros built within the workbook are used to automatically create the required GTFS files and export all relevant data from each workbook tab to the corresponding file.

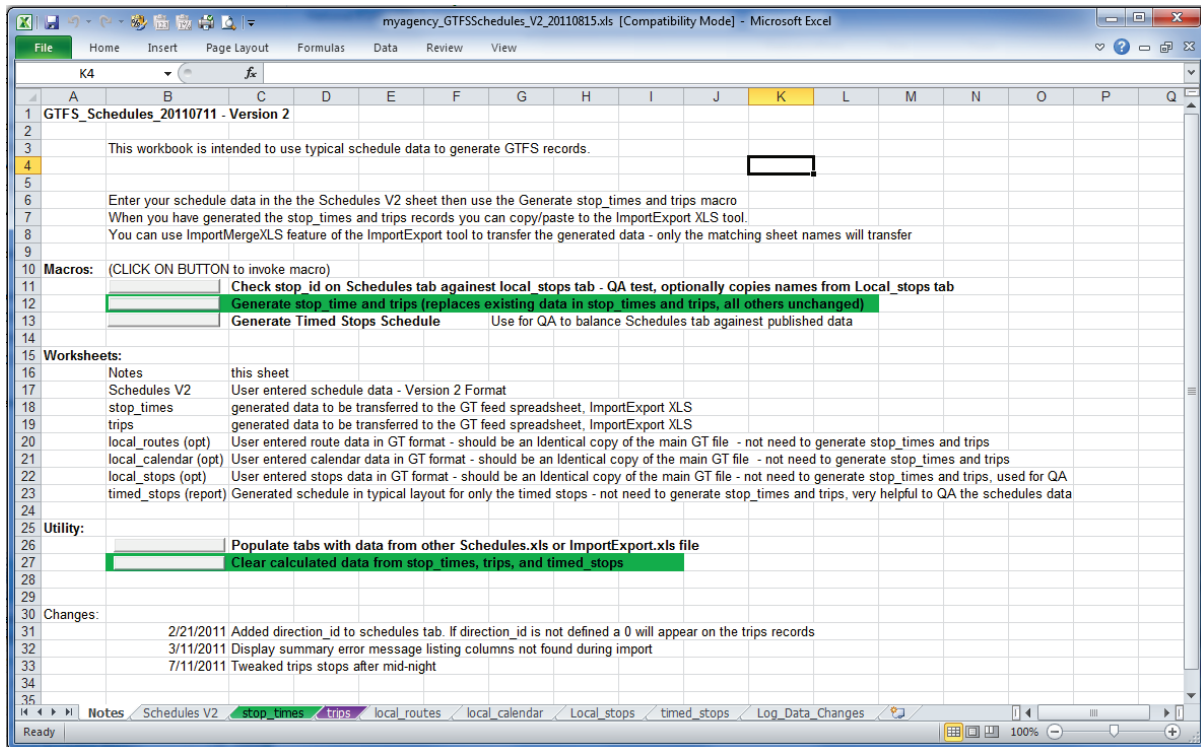


Figure 11: National RTAP Schedules Workbook

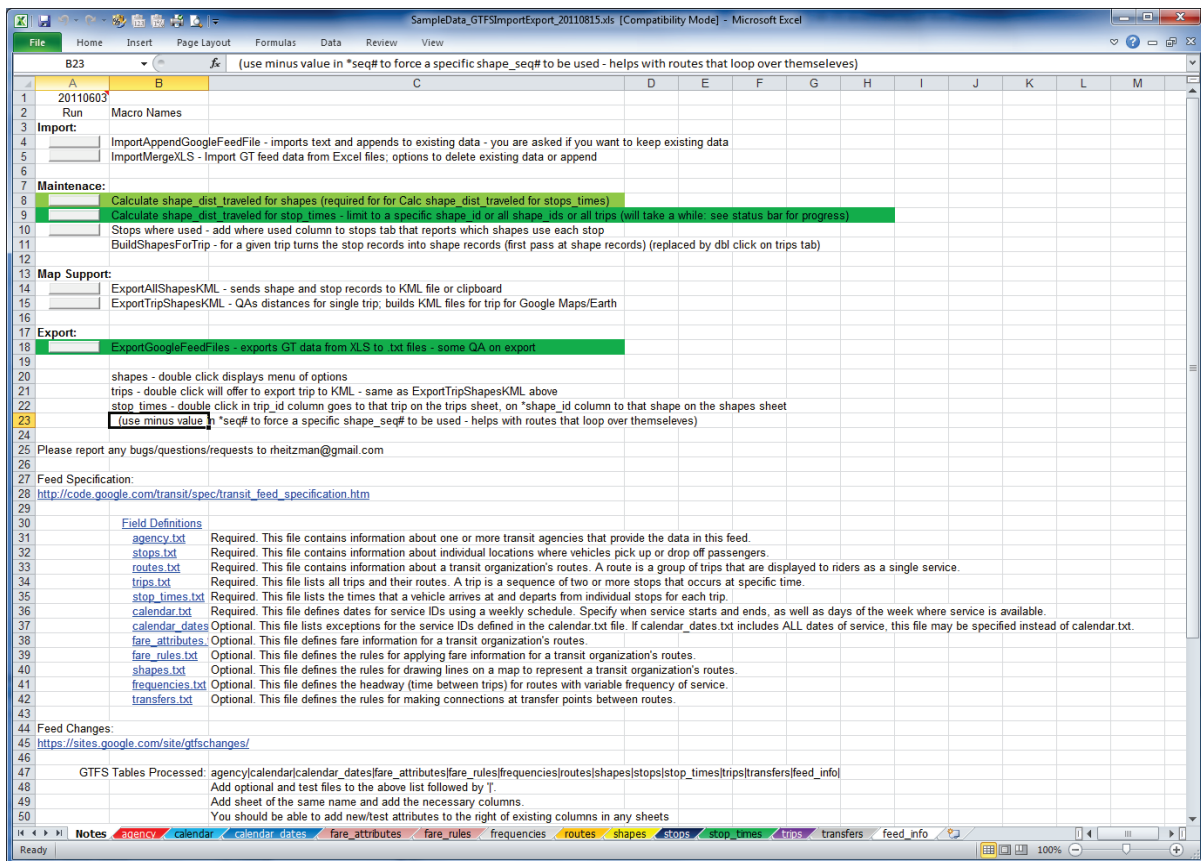


Figure 12: National RTAP Import/Export Workbook

The National RTAP GTFS Builder tools can be obtained at the following web address <http://www.nationalrtap.org/WebApps.aspx>. A free registration to the National RTAP in the Cloud application will be required to access the tool.

4.2.3. BMANDER'S MAKESHAPES

Makeshapes is a freeware that was developed by Brandon Martin-Anderson to help small transit agency create shapes files for GTFS data feeds. Despite its austere and simple interface (see Figure 13), this tool is commonly used by transit agencies to get a head start on creating the optional shapes.txt files. Use of this tool is relatively simple. After creating a customized Google Map, the URL link is pasted into the tool, which then automatically converts the map pointed to by the URL into a corresponding shapes.txt file. Makeshapes can be found at <http://bmander.com/makeshapes/>.

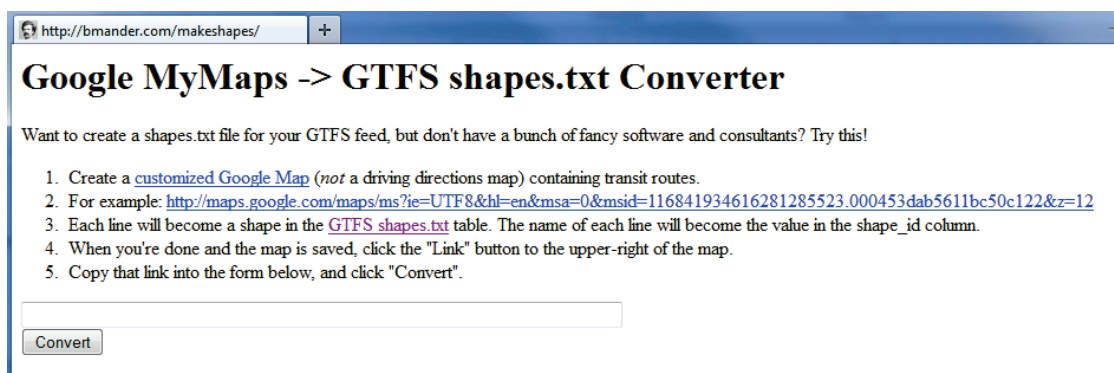


Figure 13: BMANDER'S MAKESHAPES Application

4.2.4. TIMETABLE PUBLISHER

TimeTable Publisher is an open source Java application that was initially developed by Frank Purcell of TriMet, the public transportation agency servicing Portland, Oregon. This application allows an agency to examine, modify, and transform GTFS formatted scheduling data into easy-to-read timetables for customer information purposes. It was developed to simplify and accelerate the production of printed on-street schedules and web schedules, as well as to facilitate the dissemination of accurate, up-to-date, and consistent schedule information to transit customers. A screenshot of the main page of the application is shown in Figure 14

The application was developed to work directly with data in the GTFS format and offers functions allowing data to be read from various sources, including databases, comma separated text files, and XML files. To help with data entry, a relatively easy to use interface is also provided. The ability to store data directly in GTFS format enables in this case transit agencies to quickly update data supporting online trip planners following changes in schedules, bus routes or other service. A function enabling to compare changes between two specific service dates is also offered as part of the application.

During the testing and training of agencies, the installation of Tomcat, the language that runs TimeTable Publisher, was identified as a slow and cumbersome process by the staff of the participating agencies. Marcy Jaffe Company offers a hosted solution for agencies that wish to use the TimeTable Publisher without having to become Tomcat experts.

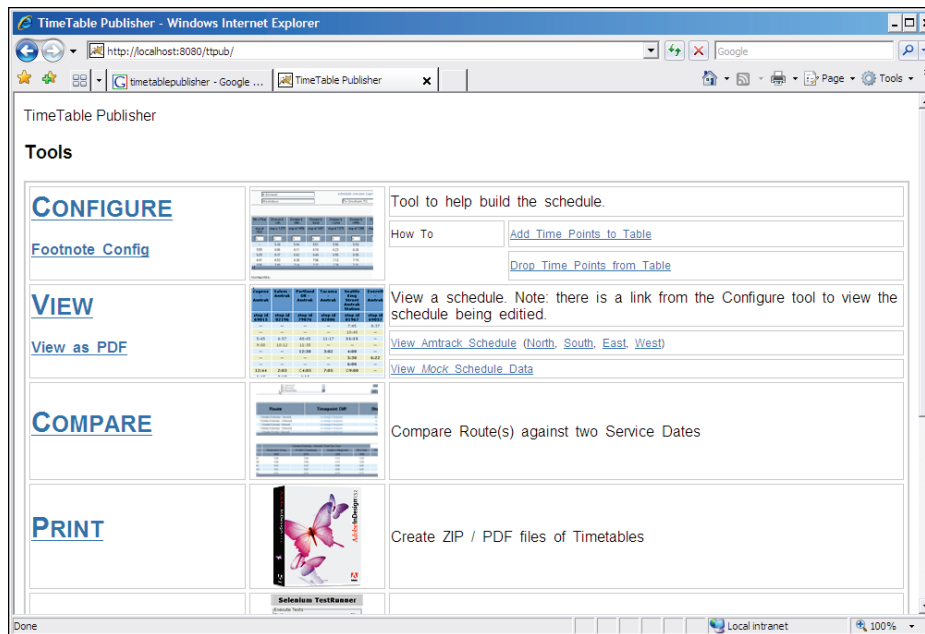


Figure 14: TimeTable Publisher Application

TimeTable Publisher can be downloaded from <http://developer.trimet.org/timetablepublisher.shtml>. There is no cost associated with its use. Since TimeTable Publisher is an open sources application, transit agencies can notably modify it at will to develop new functionalities, thus directly contributing to its enhancement.

4.2.5. TRANSIT DATA FEEDER

Transit Data Feeder is an open source web-based application for creating and maintaining GTFS data that was developed by Trillium Solutions, SingleMind Consulting and PEMCCO. This tool is the end product of a research project sponsored by the Transportation Research Board Innovation Deserving Exploratory Analysis (IDEA) program that was initiated in 2009 and which sought to develop and maintain an application providing a web-based interface for creating and maintaining transit geospatial, schedule, calendar, and fare information in GTFS format. A screenshot is shown in Figure 15. Since this application is available through an open-source license, transit agencies are free to obtain the computer code implementing the application and modify it to meet their specific needs.

The Transit Data Feeder application can be downloaded from the following wed address: <http://code.google.com/p/transitdatafeeder/>. Users wishing to download and view the code will also need the install the Subversion client software. More information about this software can be found at http://code.google.com/p/support/wiki/SubversionFAQ#Subversion_FAQ. Installation of JBoss and Tomcat may further be required for running the software.

Agencies interested in using TransitData Feeder should be aware that there are reports that this tool is still a work in progress. As of August 2011, there are still reports of unresolved bugs. Since Transit Data Feeder is an open-source application, resolution of these bugs will depend on the degree of involvement of the transit community. An agency interested in using this tool may thus require the help of a programmer to make final adjustments to the application.

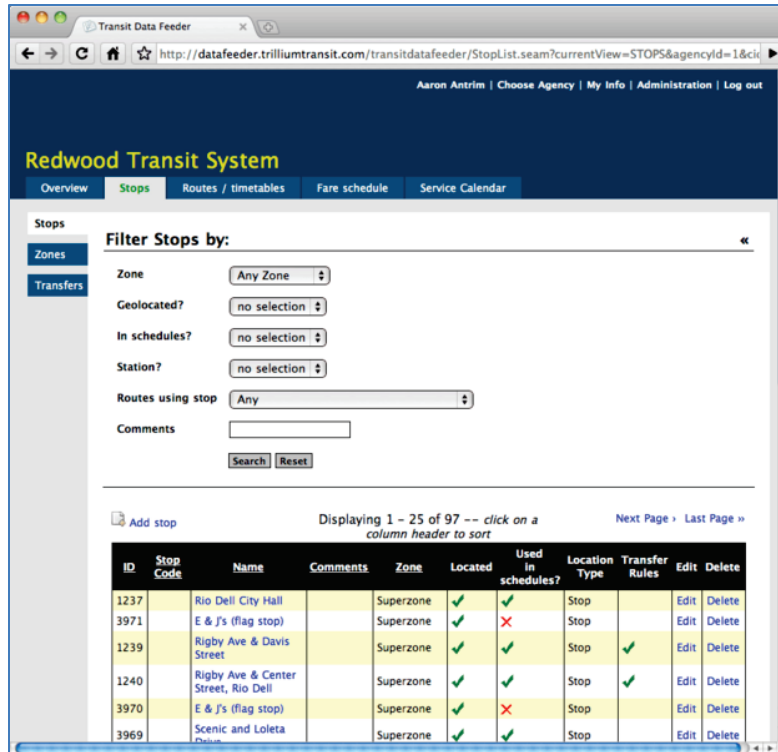


Figure 15: Transit Data Feeder Screenshot

4.2.6. PYTHON SCRIPTS

Several python scripts are available on the internet to convert transit data into GTFS. Python is a general-purpose high-level programming language that is often used as a scripting language for web applications. Google Schedule Viewer, which was described earlier, is an example of python script application. Other python applications that can currently be found on the web include:

- TransitFeed: tool designed for reading, viewing and validating GTFS feeds. This application is available at <http://code.google.com/p/googletransitdatafeed/>.
- ScheduleEditor: tool that can be used to generate shape files, create stops along trips, and create trip patterns. This program is available at <http://code.google.com/p/scheduleeditor/>.
- py-gtfs-mysql: tool to import a GTFS dataset into a basic MySQL database. This application is available at <https://github.com/sbma44/py-gtfs-mysql>.

Use of python script tools generally requires an extensive knowledge of the python language and use of python script readers and editors. For this reason, use of relatively unknown python scripts to develop GTFS data is generally only recommended for agencies that already have on staff individuals familiar with this type of application.

4.2.7. KML WRITER

KML is a file format that is used to display geographic data on two-dimensional maps and three-dimensional earth browsers, such as Google Earth and Google Maps. This format, which was explicitly developed for use with Google Earth, is based on the XML data standard. KML files specify sets of

features to display on a map or earth browser, such as place marks, images, polygons, 3D models and textual descriptions, using a relatively rigid syntax and structure.

KML Writer is a command line tool that was developed to convert stops, trips and shapes data contained in a GTFS files into KML files. Use of this tool to prepare data files that can be read by Google Earth or Google Maps can help confirm that bus stops and transit routes are located in the right place. This tool also provides a 3D visualization of trips that can help find certain types of errors in the times at which transit vehicles are projected to reach each successive stop along their route. Further information about KML Writer and instructions on how to download and run the application can be found at: <http://www.google.com/support/transitpartners/bin/static.py?page=guide.cs&guide=1095593&topic=1095599>

4.3. SUBSCRIPTION-BASED SYSTEMS

This section describes various subscription-based systems that can be used by transit agencies to convert service data into GTFS. This is a partial list of available systems as the section only provides information about systems that were known to the PATH research team at the time the report was written. Other systems are likely to exist and are not intentionally omitted.

The GTFS tool described in this section either require transit agencies to purchase a license for their utilization or are only offered to agencies subscribing to more comprehensive operations management system. Costs for the utilization of these tools will vary based upon the size the transit network to manage, the complexity of the service offered, the frequency of service updates, whether supporting hardware and software must be purchased, and whether full, partial or no GTFS data conversion and maintenance services are contracted with the firm offering the tool. Costs for the purchase of the tools described in this section range from approximately \$200 to \$15,000. Recurring annual licensing fees vary between \$540 and \$6000, with fees in the higher end typically including data maintenance services. Since prices may change, agencies interested in using a particular tool should contact the firm offering the tool to obtain the latest pricing information.

4.3.1. TRAPEZE

Trapeze is a subscription-based transit operations monitoring and analysis tool developed by the Trapeze Group (<http://www.trapezegroup.com/>). When this report was written, this tool was being used by over 30 transit agencies across North America. Trapeze offers a GTFS export tool to agencies subscribing to their Trapeze FX schedule management software. Depending on the modules being subscribed to, this tool may be available at no additional license fee.

For agencies using Trapeze, Google simply suggests that they utilize the GTFS export tools provided with the software for creating suitable Google Transit data files. More information on this tool can be found at http://europe.trapezesoftware.com/solutions/pt_google.php.

4.3.2. HASTUS

Hastus is a modular software solution for transit scheduling, operations and customer information offered by GIRO (<http://www.giro.ca/en/products/hastus/index.htm>) that is used by various transit agencies across North America. The basic HASTUS system provides the required tools to produce

vehicle and operator/crew schedules, using industry-leading optimizers. Fully integrated modules then work from these schedules to manage daily operations and perform accurate operator timekeeping. Other available modules offer solutions for transit network planning, customer information, and performance analysis. The underlying database, easily accessible to other systems through comprehensive integration tools, offers a single, reliable, and complete source of transit operations data. A tool is also provided to generate GTFS files from the data stored within the system.

For agencies already using Hastus, Google simply suggests that they utilize the GTFS export tools provided with the software for creating suitable Google Transit data files. More information on this tool can be found at <http://www.giro.ca/en/products/hastus/index.htm>.

4.3.3. TRILLIUM WEBSCHEDULE

Trillium Solutions offers transit agencies subscribing to its commercial services use of its WebSchedule application. This is a web-based transit schedule manager that was developed by Transit Information Systems to help small and medium sized transit agencies manage transit schedule, stop and fare information. A screenshot of the application is shown in Figure 16. As of August 2011, about 70 transit agencies were using the application according to Trillium Solutions.

More information about WebSchedule, including access to the application’s user’s guide, can be found at: <http://www.trilliumtransit.com/documentation/Schedule%20manager%20guide.pdf>.

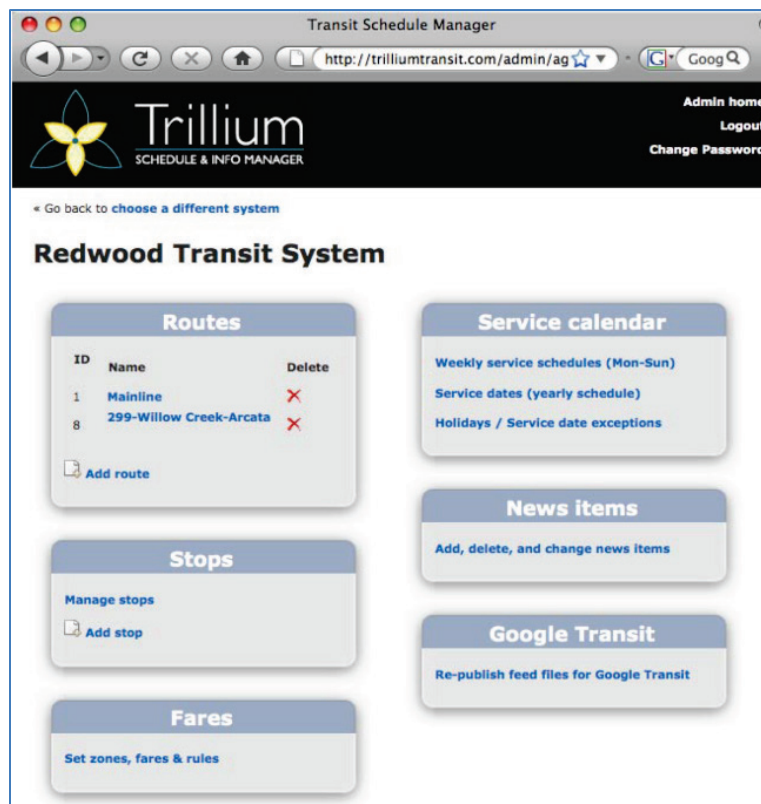


Figure 16: Trillium WebSchedule Application

4.3.4. AVEGO FUTUREFLEET

Avego (<http://www.avego.com/>) is a company specializing in passenger transport technology offering a suite of tools providing on-vehicle mobile data terminals, real-time passenger alerts, fleet management capabilities, electronic fare payment capabilities, and GTFS data maintenance and export. The software suite it offers, known as Futurefleet™, aims to facilitate transit operators with setting up in-vehicle hardware and web applications.

Avego offers free GTFS data maintenance and export to its Futurefleet™ customers. The software suite offers export procedures that format transit information into suitable GTFS format for Google Transit. However, to take full advantage of this feature, a transit agency must purchase Avego's in-vehicle technology as well. Because of purchasing requirements, use of this software may be beyond the ability of small transit agencies to procure it if they are simply looking for GTFS data conversion. However, an agency considering the purchase of real-time fleet monitoring capabilities may find some value in this tool.

More information about the Futurefleet™ program can be found at the following address: <http://www.avego.com/ff/index.php>.

4.3.5. MENTOR STREET SCHEDULE

Streets Schedule is a software suite offered by Mentor Engineering to help transit agencies streamline schedule creation. This software can be used as a stand-alone system or as a building block of a more comprehensive Intelligent Transportation System solution. Recognizing the growing need of transit agencies to make their data available to online transit planners, the Streets Schedule software offers functions allowing agencies to export data store within the software in the GTFS format. The data is automatically validated before export to ensure that Google can incorporate them without further modification. More information about this software can be found at the following web address: <http://www.mentoreng.com/products/streets-transit/index.html>.

4.3.6. ITERIS BUS FEEDER

Bus Feeder is a subscription web-based application that Iteris initially developed for the State of Idaho to simplify the collection, optimization and formatting of fixed-route public transportation information. This application allows transit operators to enter information about routes, stops and schedules, and to automatically format this data into GTFS outputs that can be submitted to Google Transit. A screenshot of the tool is shown in Figure 17. Some BusFeeder features include:

- Fully-integrated shape-building tools using Google Maps
- Graphical route and stop displays using Google Maps
- Error routines to ensure shapes, routes, stops and schedules are consistent and meet GTFS specifications
- Automated tools to for ordering stops in a schedule
- GTFS specifications incorporated into the tool
- One-click access to FeedValidator within BusFeeder
- E-mail alerts when GTFS are updated
- Ability to build GTFS and perform tests before publishing
- One-click publishing

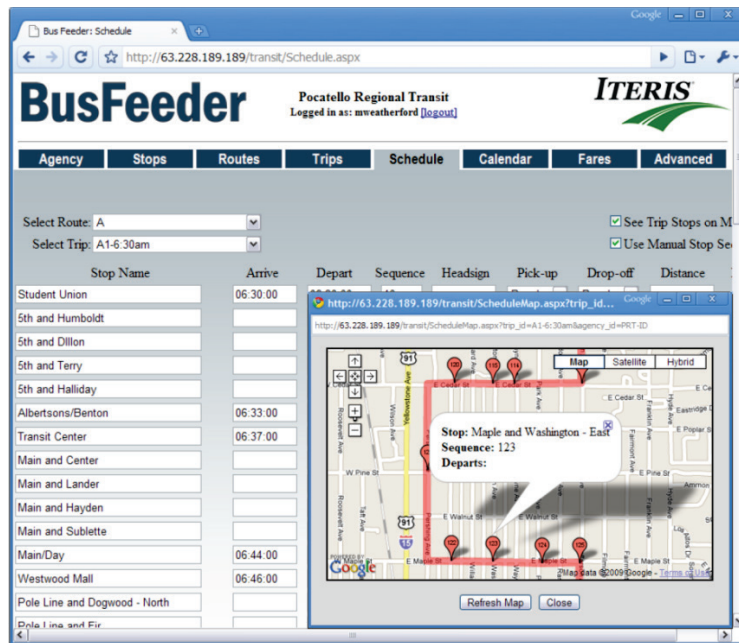


Figure 17: Iteris BusFeeder

The annual fee required for using BusFeeder covers a share of a Google Maps license (required for using the software’s map interface), as well as telephone and e-mail technical support. More information about BusFeeder can be found at <http://www.busfeeder.com/login.aspx?ReturnUrl=%2fdefault.aspx> by reading the software’s User’s Manual is notably available at the bottom left corner of that webpage.

4.3.7. NEXT INSIGHT CONDUCTOR

Next Insight offers transit agencies with a commercial-based subscription to its Conductor schedule management application tools to convert transit routes and scheduling data into GTFS and other formats. More information about this service can be found at <http://nextinsight.com/conductor.php>.

4.3.8. LASSO FEED GENERATOR

The Lasso Feed Generator is a commercial off the shelf (COTS) software tool that has been developed by Vaquero Systems LLC (<http://www.vaquerosystems.com>) to generate Google Transit Feeds. This tool generates a complete GTFS feed ready for upload to Google Transit and, as illustrated in Figure 18, includes a map-based interface to support simple importing, drawing, and editing of routes and stops on a map. It also includes a schedule builder tool for entry of all aspects of a system schedule, including calendar, service days, exceptions and exclusions, routes and trips, and fares and transfer information. Schedules may also be imported via a schedule converter that may custom written for a transit agency, allowing automatic schedule import from electronic files generated within the agency.

The Lasso Feed Generator has been designed to be easy to use and comes with comprehensive training. Purchase price for the tool is dependent on the characteristics of network operated by each agency. However, pricing comes with free lifetime software support and requires no subscription fees for ongoing use. Full integration of a transit property's schedule and geo-data, including ensuring feed approval by Google and going live on Google Transit is further included with purchase of the system.

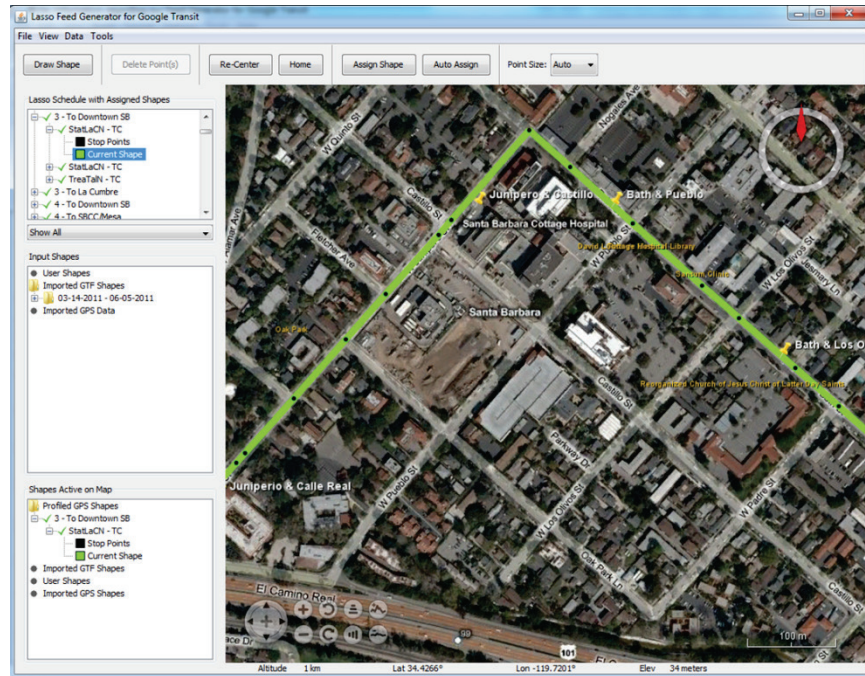


Figure 18: Lasso Feed Generator Screenshot

4.3.9. NYDOT WEB DATA MAINTENANCE SYSTEM

The New York State Department of Transportation’s Web Data Maintenance System (WDMS) is a substitute for Google Transit. This tool, which was developed by Telvent Farradyne, is the result of a collaborative effort aiming to create a regional network of online information for the New York metropolitan area. A screenshot is shown in Figure 19. The system, which uses Google Maps as a base,

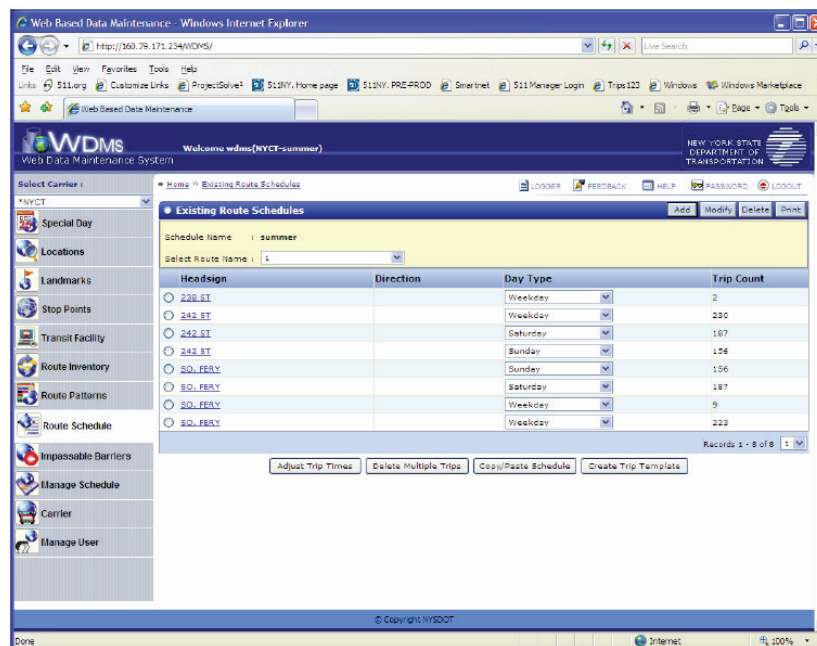


Figure 19: NYDOT Web Data Maintenance System

is designed for the maintenance and transfer of transit schedule information to trip planners and other downstream applications. A web-based mechanism is used to load data into the system, which allows staff at transit agencies to upload the data remotely. Multiple datasets can be stored within the application, which allows for future updates to be entered and saved in advance of the actual date of publication of timetables. This feature also allows transit agencies to manage when data is released to Google Transit. Data formatting into GTFS format is done automatically by the system upon request or when a specific trigger date is reached.

As part of this project, Telvent Farradyne offered to develop online transit trip planners using the WDMS application they developed for a service fee. For small transit agencies, use of the WDMS may only be cost-effective if the agency data could be added to an existing system, as use of the WDMS may require the purchase and installation of various hardware and commercial off-the-shelf software. Agencies interested in using this tool can contact Telvent Farradyne for more information about the services they may offer.

4.3.10. THE MASTER SCHEDULER (TMS)

The Master Scheduler system (<http://themasterscheduler.com/index.php>), which was first released in 1993 by Schedule Masters, was one of the first Windows-based Public Transit Scheduling system. This system uses a table-driven relational database model to store service data components, such as routes, patterns, trips and blocks directly into the system. This system is reportedly currently being used by approximately 20 transit agencies in the United States. An add-on module to the system, known as

Welcome to the INTERcity TRANSIT Trip Planner

English Français Español

From: Address/Intersection To: Address/Intersection
 Burban Ave. NW Sawyer St. SE
 Olympia, WA Olympia, WA

Leaving 11:50 a.m. Aug 26, 2011

Plan Trip

Travel Options:

Option 1 36min 12:07pm [41] [60] 12:43pm
 Option 2 48min 12:37pm [41] [64] 1:25pm

Legend: Bus Transfer Walk

Instructions:

12:07pm	Burbank Ave NW
12:07pm	Leave "Burbank Ave NW".
12:07pm	Walk 241 yards West to stop "Division and Burbank [sb]".
12:09pm	Take bus "41 - TESC - Inbound" at stop "Division and Burbank [sb]".
	The next stop will be "Division and Elliott [sb]".
	Buses also leave at 12:39pm, 1:09pm and 1:39pm.
12:25pm	Exit at stop "Olympia Transit Center - Arrival".
	The stop before will be "Capitol and State [nb]".
	Transfer
12:30pm	Take bus "60 - Lacey via Group Health - Outbound" at stop "Olympia Transit Center - Departure".
	The next stop will be "Franklin and Legion [sb]".
	Buses also leave at 1:30pm, 2:30pm and 3:00pm.
12:38pm	Exit at stop "Boulevard and 7th [nb]".
	The stop before will be "Lions Park".
12:38pm	Walk 552 yards South from stop "Boulevard and 7th [nb]".
12:43pm	Arrive "Sawyer St SE".

Times are approximate and can vary with weather and traffic conditions.
 Please allow yourself enough time.

This page is under development.
 Please send your suggestions [here](#).

Powered by Schedule Masters Inc.

Return Trip Printable Instructions...

Origin:
 Stop: Division and Burbank [sb]
 Route: 41 - TESC
 Direction: Inbound
 Time: 12:09pm

Destination:
 Stop: Boulevard and 7th [nb]
 Route: 60 - Lacey via Group Health
 Direction: Outbound
 Time: 12:38pm

Figure 20: Schedule Master Online Transit Trip Planner

TMSweb, enables transit agencies to use the data stored into the system to develop their own online transit trip planner. An example online trip planner implemented by the system is shown in Figure 20.

4.3.11. URBINERIS

Urbineris (<http://www.mecatran.com/urbineris>) is an online planner developed by Mecatran, from France, to help transit agencies integrate their public transportation network onto Google Transit. This Java-based tool uses cloud computing technologies to provide transit agencies purchasing the application with virtual servers that can be accessed from any location. Two packages were offered at the time this report was written: Urbibase, in which transit agencies are left in charge of the GTFS data conversion and management efforts through the use of user-friendly online web interfaces, and Urbi+, in which all data conversion and management is executed by Mecatran.

4.3.12. TRANSITEDITOR

TransitEditor (<http://www.transiteditor.com/?q=en/home>) is a GTFS development tool developed by the Spanish-based company i2MApp Innovacion en Movilidad S.L. This tool, which relies on cloud computing technology, provides user-friendly forms for creating and managing GTFS data (see Figure 21), maps to help with the creation and management of stops, services and trips, and functions to generate editable shapes. The tool further allows its user to export data in GTFS format for Google Transit. As of August 2011, a basic version of this tool was available for free on a 20-day trial basis, and a full-featured version available for longer use for a \$45 (30 euros) initial registration fee and a 3-month minimum registration of \$45/month. These prices are for utilization of the tool only.

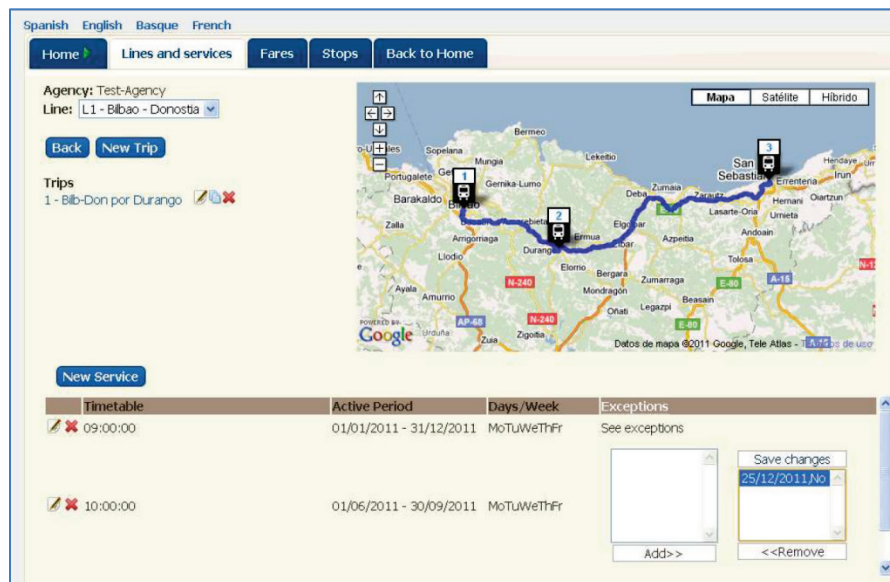


Figure 21: TransitEditor Screenshot

4.4. TOOL SELECTION CRITERIA

Given the relatively large number of available tools, transit agencies should carefully consider which tool, or tools, they would prefer using for developing, and subsequently maintaining, their GTFS feeds. A recent report [2] suggests considering the following parameters:

- **Ease-of-use:** How much training and staff time is needed to familiarize agency staff with the tool.
- **How many agencies have successfully deployed at Google Maps using this approach?** How much time did it take for that agency to be validated by Google and go live for their launch?
- **Data visualization:** Does the tool allow agency staff to see their data on a map? The ability to display data graphically on a map can greatly simplify data entry, validation and maintenance.
- **Data validation features:** Does the tool conduct automatic checks to identify potential problems with exported GTFS data?
- **GTFS publishing features:** Does the tool support optional GTFS elements, such as preferred transfers, fares, fare rules, and shapes/route alignments?
- **Data ownership:** Does use of the tool allow transit agencies to retain full ownership and rights to the published GTFS data. Retaining such rights is important to facilitate use of the data for other purposes.
- **Initial, ongoing, and over cost:** How much will it cost to acquire the tool, use it, and maintain it operational over the years? Potential costs items to consider include: software purchase cost, annual license fee, cost for additional hardware and software required to operate the tool, agency staff time for setting up the tool, agency staff time or consultant fee for collecting and maintaining data using the tool.
- **Upgrade path:** Will the chosen tool grow with GTFS updates and transit agency needs. Will it allow transit agencies to take advantage of new features and upgrade seamlessly without having to reconstruct the data? Google has already indicated that Google Transit will always be backward compatible. Updates have also been relatively rare and optional.
- **Availability of service and support:** Is support regarding use of the tool available should help be needed? Is this support available to answer questions about Google Transit and data validation issues in addition to issues regarding use of the data publishing tool?

To a large extent, the facility, or difficulty, of developing suitable GTFS data for Google Transit using existing staff and budget resources will strongly influence whether the development of online trip planners will be pushed forward as an in-house effort or will rely on the use of outside consultants.

5. GTFS IMPLEMENTATION PROCESS

While various approaches may be used for converting transit service data into GTFS, these approaches generally follow the implementation plan illustrated in Figure 22 and which consists of the following key steps:

1. Gather relevant transit service information
2. Convert Data into GTFS format
3. Validate GTFS data using offline tools
4. Create a Google Transit account
5. Preview testing of Google Transit online trip planner
6. Develop public access to Google Transit (if desired)
7. Official launch of online trip planner
8. Data maintenance

More information about each of the above steps is provided in the subsections that follow.

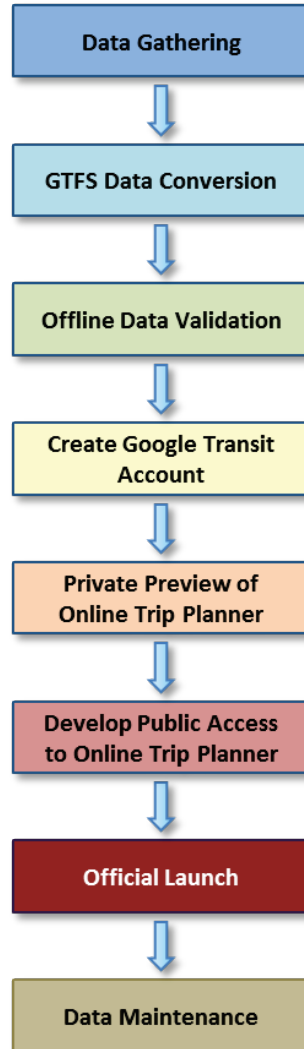


Figure 22: General GTFS Implementation Steps

5.1. INFORMATION GATHERING

Before GTFS data conversion can begin, relevant information about transit services must be collected. This includes gathering information regarding:

- Stop locations
- Regular schedules
- Seasonal and holiday schedule changes
- Route alignments (optional)
- Fares (optional)
- Transfer preferences (optional)
- Agency contact phone numbers

The above information can be collected through various methods. Data collection activities may include:

- Retrieval of information posted on agency websites, such as maps of routes, timetables, event calendars, and contact phone numbers.
- Codification of information contained in published maps and transit service information documents.
- Collection of information about the location of stops and route alignments using handheld GPS receivers carried onboard transit vehicles or by personnel tasked to visit each bus stop.
- Retrieval of information about transit stop locations, route alignments, and neighborhood characteristics contained in Geographical Information System (GIS) libraries maintained by transit agencies, transportation planning departments, and city traffic departments.

5.2. GTFS DATA CONVERSION

Once all relevant data have been collected, it must be converted into the prescribed GTFS format to be accepted by Google Transit. This conversion is typically done using software specifically designed to create and maintain transit data feeds, such as those described in Section 4.

As indicated in Section 3.1.2, data conversion typically involves developing a series of files structuring the information characterizing transit routes and schedules in a very specific format. While some files are required, others are optional. Below is a listing of the various files that must or can be developed, with a description of the key elements defined within each one of them:

- Required GTFS data files:
 - **agency.txt:** Information about the transit agency (or agencies) providing the data contained in the feed.
 - **routes.txt:** Information about the transit routes operated by the agency. A route is defined here as a group of trips that are to be displayed to riders as a single service.
 - **trips.txt:** Lists all trips made by vehicles operated by a transit agency. This is often considered as the most important data files. This file contains a separate entry for each trip.

- **stops.txt:** Information about the individual locations where transit vehicles may pick up or drop off passengers.
- **stop_times.txt:** Lists the times that vehicles arrive at and depart from individual stops for each trip.
- **calendar.txt:** Defines dates for service IDs using a weekly schedule; specifies when service starts and ends, as well as days of the week where service is available.
- Optional GTFS data files:
 - **calendar_dates.txt:** Lists exceptions for the service IDs defined in the **calendar.txt** file. If **calendar_dates.txt** includes all dates of service, this file may be specified instead of **calendar.txt**.
 - **fare_attributes.txt:** Defines fare information for the specified routes.
 - **fare_rules.txt:** Defines the rules for applying fare information to the specified routes.
 - **shapes.txt:** Defines the rules for drawing lines on a map to represent a transit organization's routes.
 - **frequencies.txt:** Defines the headway (time between trips) for routes with variable frequency of service.
 - **transfers.txt:** Defines the rules for making connections at transfer points between routes.

Examples of converted GTFS data files are shown in Appendix B. To further help assess the role played by each data file, Figure 23 identifies the source of the information that is displayed on Google Maps with the information returned by a Google Transit trip search. Each of the labels shown on each side of the figure first indicates the file name from which the data was retrieved, followed by the name of the specific parameter displayed. For instance, the *route: route_long_name* label indicates that the information displayed was retrieved from the *route_long_name* parameter defined in the *routes.txt* GTFS data file. The colors shown in the map further relates to the Excel tabs used by the National RTAP GTFS Builder.

The end product of the GTFS data conversion is a zipped file named “*google_transit.zip*” containing all required and optional individual GTFS data files described above and any additional optional file. A single zipped file is required by the process used by Google to fetch transit service data from agencies participating in Google Transit. While GTFS data is sent to Google, transit agencies are required to keep a copy of their data on a computer server outside Google. This is done to facilitate data maintenance by transit agencies. In this operating framework, all Google needs to do to ensure that data displayed on Google Transit and Google Maps is up to date is to weekly fetch new data from the agencies’ computers. This updating process is typically done approximately every two weeks.

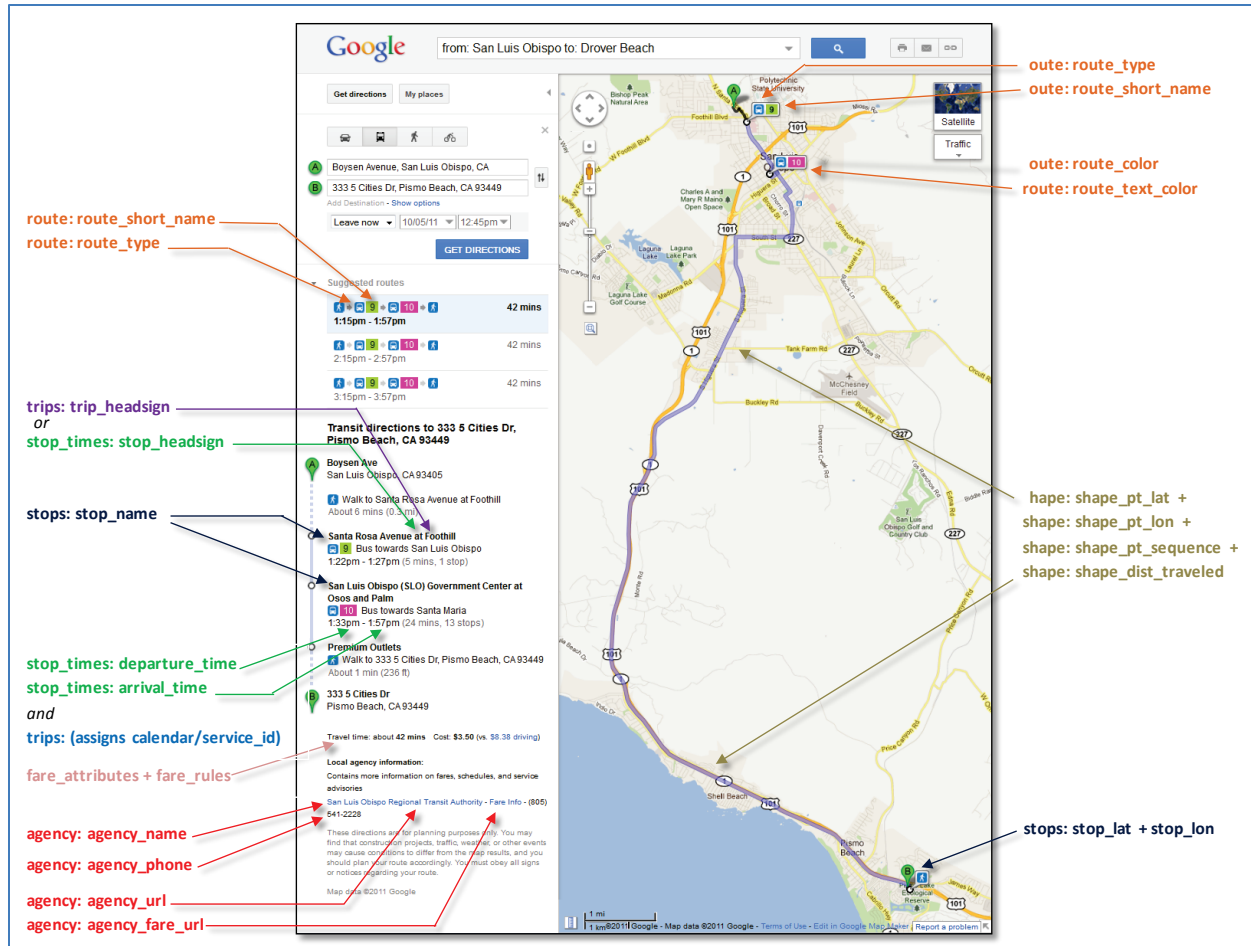


Figure 23: Identification of GTFS Data Elements Displayed on Google Transit Search Results

To facilitate future data maintenance, Google provides the following recommendation regarding the zipped GTFS data file that is to be produced:

- The compressed *google_transit.zip* GTFS feed should be placed in a directory that will always keep the same name, for example, http://myserver.agency.com/current/google_transit.zip.
- The feed should be the only file in the directory.
- Directory listing should be enabled on the directory hosting the GTFS feed file.
- An agency's IT/networking teams should know that Google Maps periodically fetches transit feed data from the specified location and that they should not change file permissions for the feed or otherwise block or break the data fetching process.

5.3. GTFS DATA VALIDATION

To fully realize its expected benefits, GTFS data must report accurate transit service information. For instance, the frequent provision of inaccurate information may result in travelers distrusting online trip planners and stopping using them. In addition, GTFS feeds will only be accepted by Google and uploaded onto Google Transit after they have gone through a thorough validation process.

The validation of GTFS data is a process that may involve several iterations, particularly if there are numerous issues to be resolved. Methods typically used to check and validate GTFS data include:

1. Verification of data formatting. This is usually the first validation pass. Google-supplied tools, such as Feed Validator and KML Maps Parser may be used to determine if the developed Google Transit feeds are correctly formatted and are free of errors that would prevent them to be correctly read by Google Transit.
2. Map-based view of complete routes and schedule data. This second review is usually conducted using Google's Transit Feed Report or Schedule Viewer tool, or any custom-built tool allowing the coded data to be displayed on a map. At this stage, the focus of the verifications is to proof the coded schedule, route alignment and stop location that will eventually be provided to Google.
3. Offline testing of trip planner. This third validation step focuses on testing the operation of the trip planner. Using open-source tools such as Random Queries, the GTFS development team can generate random queries between locations within an agency's service area and test the accuracy and validity of the constructed trips returned by the preview trip planner.

The following subsections detail some of the validation techniques that were used as part of the pilot deployments. This includes the validation technique used by each of the two consultant that were retained to help the transit agencies develop their GTFS data, and the process that was used by PATH researchers to conduct separate data validations. Examples of data validation for the various agencies participating in the pilot GTFs deployment are shown in Appendix C.

5.3.1. MARCY JAFFE COMPANY'S VALIDATION APPROACH

Marcy Jaffe Company typically used Microsoft Excel spreadsheets with embedded test macros to create and validate GTFS feeds. This tool furthers the Heitzman's Excel tool described in Section 4.2.1. Within the tool, agency-supplied timetable data are linked to corresponding GTFS output feeds. Macros are then used to automatically test for out-of-range data, mismatched data, and illogical route timing. If a problem is identified, an error message is displayed describing the identified problem (for instance, time out of order) with a request to update the source data files.

The process used by Marcy Jaffe Company for validating the GTFS data developed as part of the pilot Google Transit deployments conducted during this project consisted more specifically in the following steps:

1. Open data links to routes, stop URLs, fares, etc., to ensure that they display accurately.
2. Confirm accuracy of agency URL, telephone number, head sign, route number, etc.
3. Generate and validate GTFS feed
4. Create sample trips by using the drag and drop Google map function to modify the start and end of the trip by moving the A or the B on the map.
5. Review shared bus stops when agencies connect with neighbor agencies.
6. Confirm that all bus stop locations are in the dataset.
7. Test all stops along the route, and sample images from Google's *Street View*, when available, to confirm that stop locations are visible with a pole, bench or shelter.

8. Examine order of bus stops.
9. Review output from Excel tools to verify that the distance from shape line nodes to bus stops is less than 30 meters (100 feet).
10. Examine transfers and assess whether each transfer is guaranteed or less than the default of five minutes; resolve with transfers.txt, as appropriate.
11. Test trip options by day of week and time of day.
12. View walking directions and if the conditions are not safe use “report a problem” to remove walking on a high-speed highway, etc.
13. Update data to resolve any issues or report them to Google Transit Partner Group or via email if the problem is due to Google trip planner algorithm output.
14. Fully validate and resolve issues before requesting a pre-launch.

5.3.2. TRILLIUM SOLUTION’S VALIDATION APPROACH

Trillium Transit used the following procedure to validate GTFS data feeds:

1. Validate GTFS data formatting. This is a first validation pass, executed primarily to determine if the Google Transit feeds are correctly formatted. Validation is done using Google Feed Validator (see Section 4.1.1) and a map parser.
2. Create a map-based view of complete routes and schedule data. For this task, Google Schedule Viewer (see Section 4.1.2) is used to proof schedule, route alignment, and stop location data that are to be provided to Google Transit.
3. Test the trip planner with random and constructed queries. In this step, the Google Random Queries tool (see Section 4.1.3) is used to generate random test queries between locations within an agency’s service area. Specific test queries may also be generated by the development team and agency staff. The queries are then entered into the preview trip planner to assess the accuracy and correctness of returned trips.
4. Log of identified trip planner issues. For each issue identified in the testing of the preview trip planner, a web form is used to create a report detailing the nature of the uncovered problems.
5. Resolve issues. After an issue is reported, the problem is investigated and appropriate data corrections are made. If it is determined that an issue is not related with the GTFS data but with the Google Transit application itself, the Google Transit Partner Support group (<http://groups.google.com/group/google-transit-partner-support/>) was then notified of the problem to allow other developers to look at the issue and obtain help in identifying the potential source of the problem.

5.3.3. PATH’S VALIDATION APPROACH

In addition to the validation approaches used by Trillium Solutions and Marcy Jaffe Company, PATH developed its own validation tests based on best practices documented in the literature and tips from Google Transit Partners and agencies that had already launched their Google Transit trip planner. This resulted in the use of the following test procedure using Google Feed Validator, Google Schedule Viewer and Google Random Queries (see description of these tools in Sections 4.1):

1. Using Google Feed Validator, check that the developed GTFS data files are free of structural and data format problems.
2. Using Google Schedule Viewer, check that route names are displayed appropriately. For example: "LINE 4 - bus 4 Direction: 4 - Smithtown" should be changed to "4 - Direction: Smithtown" with route_short_name="4", route_long_name blank, trip_headsign="Smithtown".
3. Confirm agency name, telephone number, all URLs.
4. Verify route shape.
5. Determine if the total travel time of the trip plan is accurate.
6. Use the "show options" link to adjust the date and make sure weekend and weekday trips are tested. Ensure that the transfers occur at the appropriate places.
7. Check the location of a stop by zooming in until the street names can be seen. Click on the stop marker to open the window and make sure the marker is in the correct location. Rail stations may be seen more accurately in satellite view. Repeat this for stops in different parts of the service area.
8. Click through all the routes. In each route, explore one trip of each pattern. Watch out for unreasonably fast or slow legs. If the Marey Graph produced by Google Schedule Viewer has any jumps, there may be a stop with the incorrect geographical location or information in the stop time table.
9. Determine if other concerns may exist, such as very long walking trips.
10. Run the Google Random Queries tool to generate a set test trips. Then click on each of the returned links to determine if the returned trips are realistic and error-free.

In the pilot deployments, the above validation process to routes requiring special considerations, such as routes featuring complex alignments or stops, or having significant importance for regional connectivity.

5.3.4. ISSUE RESOLUTION PROCESS

Unexpected results in the Google Transit trip planner can be caused by inaccuracies in the GTFS data provided to Google or by Google's implementation of the transit trip planning software. Once an issue is identified, a multi-step process is typically used to diagnose the issue and set a resolution process in motion:

1. Creation of a log detailing the issue discovered by a consultant or agency stakeholder
2. Examination of erroneous trip planner results. This can involve the following tasks:
 - a. Categorization of query results according to nature of the issue
 - b. Comparison of query result to results with similar error
 - c. Comparison of query results to correct results for similar query
3. Examination of GTFS data for consistency
4. Correction of errors are detected in the GTFS data
5. Resubmission of updated GTFS data to Google.

If the GTFS data is found to be correct but Google Transit is still found to provide unexpected results, the error may then be with the implementation of the online trip planner tool rather than with the data itself. In such a case, the general approach is then for the GTFS development team to report the identified issues directly to Google. To expedite the resolution of uncovered issues, support requests should be submitted to Google as soon as problems are identified.

To expedite the resolution of problems, various official channels may be used to seek information on how to solve difficult problems or to notify Google of potential application issues with the GTFS data and the Google Transit application. These channels include:

- General Transit Feed Spec Changes Group. This group is the official venue for discussing proposed changes to the GTFS data format. Discussion is open to all users of the feed specification. Suggestions can be made to this group on how to extend or modify the GTFS to enable specific service information to be coded in Google Transit or to correct identified problems. While suggestions can be made, these must still follow GTFS stated goals. As of August 2011, the web address of this group was <http://sites.google.com/site/gtfschanges/>.
- Google Transit Partner Support Group: Messages can be posted to this online group for issues related to the implementation of the Google Transit trip planner application. Access to information posted in this group is only authorized to Google Transit feed publishers and partners. As of August 2011, the web address for this group was: <https://groups.google.com/forum/#!forum/google-transit-partner-support>.
- Direct contact with the Google Transit team. Some feed publishing issues can be submitted directly via email to the Google Transit support team, outside the semi-public forums.

5.4. CREATE GOOGLE ACCOUNT

In order to display data into Google Transit, a transit agency must have a Google account. Once this is done, an agency may sign up to the Google Transit Partner program. Registration can be done by clicking the appropriate bullet on the list of options shown at the following web address <http://maps.google.com/help/maps/transit/partners/contactus.html>.

When registering to participate in the Google Transit Partner program, transit agencies are asked to sign a license agreement with Google regarding the publication of GTFS data. A copy of a typical Google Transit license agreement is provided in Appendix A. This agreement is typically signed on-line. While a printed version can be produced for review, the official agreement is executed with an online signature. Under this agreement, while an agency licenses Google to use the data that is being provided to the company, it continues to own the data feeds pertaining to its services and the intellectual property rights to the data provided to Google. In this agreement, Google Transit is simply viewed a tool enabling widespread data dissemination.

5.5. PREVIEW TESTING OF ONLINE TRIP PLANNER

After a Google Transit account has been created and GTFS data has been validated using offline tools, a request is made to Google to preview the agency's GTFS data on an online version of Google Transit that is only accessible by the agency staff. This is commonly known as the "private preview mode". This private preview enables agency staff to test queries that would be returned by Google Transit based on

the GTFS data that had provided to Google and to correct any errors before the trip planner is officially launched.

Trip queries made within the private preview mode will generate up to three trip options. In the search results, the label "Google Confidential" is attached to trips that were provided using only the GTFS data that has been provided by the agency. These are trips that can only be viewed by staff from the agency. Trips options without the "Google Confidential" label are trips that were developed using data that has been provided by other agencies and this is already available to the public. An agency can further request that its private data be integrated with existing public data within Google Transit to allow testing of interactions between datasets, such as transfers. Such integration must be requested to the Google Transit Partners team.

When previewing GTFS data, transit agency staff should be aware that any required update to the GTFS data will need to go through the regular GTFS data fetch process. Once GTFS data corrections are completed, a new *google_transit.zip* file must be produced and placed in the directory from which Google is instructed to fetch the GTFS data. Changes to the data will then take up to a week to appear in Google Transit. Because up to a week can elapse before changes in GTFS data appear in Google Transit, it is important that as much testing as possible be done using offline tools before initiating the private preview review.

5.6. DEVELOP PUBLIC ACCESS TO ONLINE TRIP PLANNER

An important consideration regarding the launch a new Google Transit online trip planner is to determine how individuals may access and use the GTFS data. While the end result is generally the same – i.e., the displaying of route information on a Google Map – the method to enable prospective travelers to provide the origin, destination and departure time of a proposed trip and initiate a search may differ. The three primary approaches adopted by transit agencies include:

- Integration of trip planner on agency website. In this approach, a window or separate webpage is developed on the agency website to allow individuals to provide their intended trip origin, destination and travel time. This information is then captured and used in a behind-the-scenes application of Google Transit. Examples are provided in Figure 24, Figure 25 and Figure 26. In the first example, the planner is implemented directly on the agency's main webpage. In the second example, a link placed on main agency website leads to a separate webpage implementing the online trip planner is provided. In the third example, queries are linked to specific bus routes. Within the pilot deployments, this approach was adopted by a majority of transit agencies.
- Provision of a link to Google Transit. In this approach, only an active link to the Google Transit website is provided. When individuals click the link, they are brought to the Google Transit main page, where they are asked to provide the required trip information. An example is provided in Figure 27. Within the pilot project, Morro Bay was the only agency adopting this approach.
- Provision of transit information to Google only. In this approach, transit agencies provide no online planner on their website or link to Google Transit. Individuals seeking transit information must access it by going to the Google Transit or Google Maps site. Agencies that followed this approach within the pilot deployments were entities that typically offered limited transit services. These included Ace Rail, Paso Express and North County Shuttle (NCS).

The screenshot shows the City of Lodi Transit website. At the top, there is a navigation bar with links for 'lodi.gov', 'Residents', 'Businesses', 'Government', and 'Visitors'. A search bar and a 'Select Language' dropdown are also present. The main content area is divided into a left sidebar with navigation links (Transit Home, Contact Information, Fares, etc.) and a main content area. The main content area features a 'Welcome' message, a list of transit exceptions (New Year's Day, etc.), and a 'Transit Trip Planner' widget. The widget includes input fields for 'Start' and 'End' addresses, 'Date' and 'Time' selectors, and a 'Plan by' dropdown menu. A 'Get Directions' button is located at the bottom of the widget. Below the planner, there is an 'ANNOUNCEMENTS' section and a 'Title VI' notice.

Figure 24: Online Planner Directly Implemented on Agency Website

The screenshot shows the City of Cerritos website. The left sidebar contains a navigation menu with categories like 'RESIDENTS', 'BUSINESSES', 'GOVERNMENT', and 'VISITORS'. The main content area features a 'RESIDENTS' section with a search bar and a 'Cerritos on Wheels (COW)' section. The 'COW' section includes links to 'COW Maps/Schedules', 'COW Map (PDF)', 'Transit Connection Map (PDF)', 'Route 1 Schedule (PDF)', and 'Route 2 Schedule (PDF)'. A 'FEATURED LINKS' section is highlighted with a red dashed circle, containing a link to the 'Google Transit Trip Planner'. An arrow points from this link to a larger screenshot of the 'Transit Trip Planner' interface. This interface includes a title 'Transit Trip Planner', a 'Google Transit Trip Planner' logo, and input fields for 'Start', 'End', 'Date', 'Time', and 'Plan by'. A 'GET DIRECTIONS' button is located at the bottom right of the planner interface.

Figure 25: Link to Online Planner on Agency Website

RTA Fixed Route Schedules

Route #	Description	View Download Schedules	and Google Maps
9	San Luis Obispo towards... Cal Poly, Santa Margarita, Atascadero, Templeton, Paso Robles & San Miguel (limited service to San Miguel)	Map & Google Search - for Route #9	
10	Pismo Beach, Arroyo Grande (Palcoy Park & Ride), Nipomo, & Santa Maria	Map & Google Search - for Route #10	

Google maps from: 980 Osos Street, San Luis Obispo, CA

Get directions My places

Suggested routes:

- 1 hour 9 mins: 12:31pm - 1:40pm
- 1 hour 9 mins: 1:31pm - 2:40pm
- 1 hour 9 mins: 2:31pm - 3:40pm

Transit directions to Amtrak-PRB

- 980 Osos St San Luis Obispo, CA 93401
- Walk to San Luis Obispo (SLO) Government Center at Osos and Palm About 1 min (246 ft)
- San Luis Obispo (SLO) Government Center at Osos and Palm
- Bus towards Paso Robles/San Miguel 12:33pm - 1:40pm (1 hour 7 mins, 25 stops)
- Pine at 8th (Train Station)
- Walk to 800 Pine Street, Paso Robles, CA 93446-2856 About 1 min (223 ft)
- Amtrak-PRB 800 Pine Street Paso Robles, CA 93446-2856

Figure 26: Online Planner Queries Linked to Bus Routes

MORRO BAY, CA

Transit Division

Morro Bay Transit: The City operates a fixed route, Call-A-Ride and trolley service for Morro Bay residents and visitors.

- Morro Bay Fixed Route** - Year round general public fixed route transit service within City limits
- Morro Bay Call-A-Ride** - Year round advanced scheduled curb to curb service within 3/4 of a mile of the fixed route
- Morro Bay Trolley** - Seasonal fixed route service linking the North Main Street and Downtown Business Districts, Embarcadero, and State Parks

QUICK LINKS

- Morro Bay Transit Brochure
- Traffic Brochure
- San Luis Obispo Regional Transit Authority
- Rumboat
- San Luis Obispo Regional Rideshare
- Ride-On Transportation

Google maps

Transit

Plan a trip using public transportation

Use Google Maps to:

- Get step-by-step transit directions on your mobile phone
- Find transit stops in your area
- View station information and schedules

Join the [transit partner program](#)

Get transit directions

Start address:

Destination address:

Leave: 3/23/11 7:21pm

Get directions

Featured searches

- San Diego Amtrak Station to SeaWorld
- Stanley Park, BC to Simon Fraser University
- Space Needle to Safeco Field

Figure 27: Direct Link to Google Transit

5.7. ONLINE PLANNER LAUNCH

The official launch of a transit planner occurs after the engineering team has reviewed the pre-launch requests generated in Google Transit's private preview mode and certified that the GTFS data are accurate and meet their data validation tests. Once Google receive information that the GTFS data development and validation process is complete, it releases the data to the public. The agency then becomes responsible, as per the license agreement, for keeping the data accurate.

5.8. DATA MAINTENANCE

Following the initial launch of an online transit planner, effort must be made to keep the posted GTFS data up-to-date. The amount of effort needed will depend on the frequency with which changes are made to the transit services offered. Information update is not only mandated by the Google Transit license agreement, but important to ensure that actual and potential riders always get accurate information. Data inaccuracies could result in unanticipated delays and, if the experience repeats, mounted frustration that could eventually turn individuals from using the developed tool or even using the transit service.

Data maintenance is provided through a process enabling Google to fetch new data from the computer directory in which the zipped GTFS data files are located. Once a week, Google will process the new data files it has obtained to update data displayed into Google Transit. For an agency, the data update process simply consists in replacing the zipped *google_transit.zip* GTFS file in the directory where Google is instructed to periodically fetch the agency's GTFS data. The process used by Google to fetch the GTFS data stored on an agency-own server can be set up by logging into the Partner Content Front End (PCFE) base page at www.google.com/base/partnercontent and clicking on the "configuration" link.

Google recommends that transit agencies provide feeds that are valid for at least 4 weeks after an initial launch. It is further recommended that data updates be provided as soon as a change in schedule is known, but no later than two weeks prior to the date at which the change is scheduled to take effect to minimize potential discrepancies between the data provided by Google Transit and actual transit service. The two weeks cushion is due to the process used by Google to update GTFS data feeds. While Google accepts new feeds every day, the feeds that are provided by the Friday of a given week are scheduled to be refreshed on Google Maps by the following Friday. However, in recent weeks, the rebuilt data has been displayed as early as on Tuesday or Wednesday.

Since Google completely replace previous GTFS data with new data at each fetch event, the new data must have the same service start date as the posting date. For instance, if the posting date for a change scheduled to take effect on February 20 is February 6, the new feed should include service data from February 6 to February 19 in addition to data describing the new service that is to take effect on February 20. If the feed only includes service data from February 20, no service will then be shown on Google Maps for the period extending from February 13 to February 19.

To help with the creation of updated GTFS files, Google's merge.exe tool (see Section 4.1.6) may be used to combine into a single file two *google_transit.zip* files describing transit services to be offered at different dates. For instance, an agency may have developed in a given set of file the service it is currently offering for 2011 and opted to develop into a separate set of files the service that is scheduled to be implemented on January 1, 2012. In such a case, the merge tool may be used to produce a single

google_transit.zip file describing the transit services offered in both 2011 and 2012. GTFS data developers should however be aware that this tool still does not allow all data to be merged. For instance, fare data is not merged.

While good practice should result in data accurately describing available transit services for each day or period, it is possible that unforeseen service changes result in transit service changes before these modifications could be implemented in the published GTFS data. For this reason, some agencies include on their website a short disclaimer indicating that it may be possible that the data returned by Google Transit may on occasion be inaccurate. An example is shown in Figure 28. The purpose of such a disclaimer is reassure users of the online transit trip planner that the agency is doing all it can to keep the data accurate.



Figure 28: Disclaimer Regarding Potential Data Inaccuracies

6. DATA HOSTING/MAINTENANCE MODELS

An important consideration in the decision to develop an online transit trip planner is where the GTFS data will be hosted and who will be in charge of its maintenance. As explained in a previous section, data upkeep within Google Transit is managed through a Partner Content Front End (PCFE) application that periodically attempts to fetch GTFS data from an agency’s computer server. This application indicates to Google where the GTFS data is located and whether the last attempted data fetch was successful. The fetch is done weekly. At the time this report was written, the data fetch was typically scheduled to occur at 1:00 AM on Thursdays for agencies in the Pacific Time zone. Data maintenance thus primarily involves activities to ensure that the GTFS data stored on the agency’s computer server always adequately reflect current and projected service.

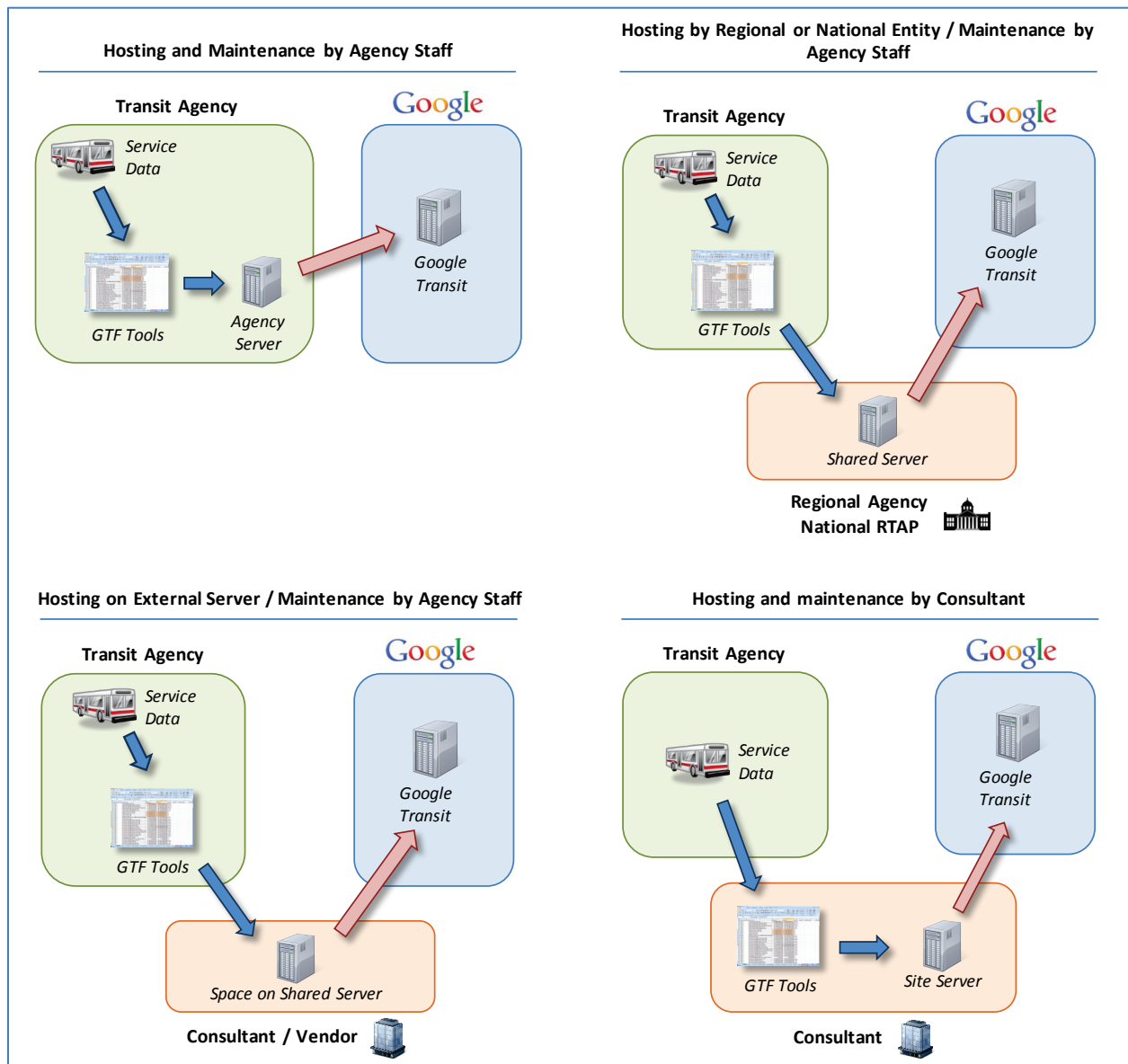


Figure 29: GTFS Data Hosting Models

Figure 29 illustrates four basic models that can be considered for GTFS data hosting and maintenance:

- Data maintenance by agency personnel using in-house servers.
- Data hosting at a server operated by consultant, with data maintenance conducted by agency personnel using web portals.
- Data hosting at a server maintained by a regional or state entity, with data maintenance by agency personnel using web portals.
- Data hosting and maintenance contract with external consultants.

Each of these models is described in more details in the sections that follow.

6.1. IN-HOUSE HOSTING AND MAINTENANCE

In-house data hosting and maintenance requires agency staff to periodically review and update the GTFS data stored on a computer server operated by the agency. Depending on the frequency at which transit service may be changed and the types of changes made, between 20 and 140 hours a year may be required in staff time commitments under this model to keep GTFS data posted onto Google Transit up-to-date. Typically, the same tools that would have been used for developing the data would be used to develop updated GTFS data following a change in service.

The in-house data hosting model puts the transit agency in charge of providing and maintaining the computer space where the final *google_transit.zip* file will be stored and from where Google will fetch the data. Since the GTFS data files are simple text files, they do not require large storage space. As an example, the GTFS data for the transit network covered by the San Luis Obispo Regional Transit Agency only occupies 120 Kb of hard drive space. The network covering the six agencies in San Luis Obispo County further only occupies 271 Kb of hard drive space. Since only a relatively small space is required to support typical GTFS data hosting needs, this allows for the possibility of using existing equipment to host the data, without having to procure new hardware. The data could for instance be hosted on the same computer server holding the data displayed on the agency's website. An option also exists to use Google Transit Sites to host the GTFS data.

An alternative to hosting the data on a physical server within the agency's offices is to host the data on a Google Sites. This solution does not require the agency to pay a fee for setting up the site and can be implemented relatively easily. To set up the site, agency staff must first create a Google account. The account that was used for preview testing of the GTFS data may also be used. Once the account has been created, a Google Sites can be created by visiting <http://sites.google.com>. When creating the site, the agency staff must determine if the site is to be public or protected and establish access permissions accordingly. After the site has been created, a page can be created to manage the validated *google_transit.zip* GTFS file. Finally, the location of the page where Google Transit can fetch the GTFS data is provided to Google by registering the URL of the Google Sites page hosting the *google_transit.zip* file at the Partner Content Front End (PCFE) dashboard, such as `http<s>://sites.google.com/site /<SITE NAME>/google-transit-docs/<optional sub-page>/latest/google_transit.zip`.

Data security should not be a major issue if the same protocols are used to control access to the GTFS data as for the agency webpage information. Google is only provided with the permission to retrieve data files stored in a specific directory. While read-only access may be granted to the GTFS data, the ability to modify and upload the data can be restricted to a few select persons in charge of data maintenance within the agency.

6.2. HOSTING BY REGIONAL OR NATIONAL ENTITY, MAINTENANCE BY AGENCY STAFF

In this model, the GTFS data is hosted on an off-site computer server operated by a regional or national entity and shared by multiple transit agencies. The availability of this data hosting model will largely depend on regional context. For instance, agencies operating in rural areas currently have the option to store their GTFS data at no cost on a server operated by the National RTAP. While the National RTAP currently offers a GTFS builder (See Section 4.2.2), it does not provide GTFS development support other than allowing transit agencies to use a dedicated server to host their GTFS data. For agencies operating within or at the periphery of large metropolitan areas, a possibility may instead exist to store data on a server operated by the local metropolitan planning organization or regional transit authority. The transit division of some state departments of transportation may also offer server space. In California, however, this last option was not available at the time this report was written.

While this model has individual agencies storing data on a shared service, each agency typically remains responsible for the management of its own GTFS data. Data management tasks may be supported by the use of web-based applications enabling transit agency staff to remotely manipulate the data stored on the shared server from their own office via an internet connection or ftp data upload protocols. Data security is still preserved through the implementation of log-ins and other access control mechanism similar to any other computer systems.

6.3. HOSTING BY THIRD-PARTY VENDOR, MAINTENANCE BY AGENCY

A variant of the regional data hosting model involves a transit agency negotiating a contract with a third-party vendor to host their GTFS data, but with the agency retaining the task of updating its GTFS data. Based on information collected by the project team, simple data hosting agreements could be signed with GTFS consultants for as little as \$75 per year. Typically, the costs for such services can be expected to vary based on the size of the transit network to cover and the complexity of transit services offered. Similar to the regional data hosting model, agency staff would perform operations on the data stored on the remote server using web-based software or ftp data upload protocols.

6.4. HOSTING AND MAINTENANCE BY THIRD-PARTY VENDOR

Many consulting firms offer subscription-based GTFS data hosting and maintenance. Under this model, a transit agency contracts an external firm to develop, host and maintain its GTFS data on a computer server operated by the consulting firm. Since the software used to store and manage the data is utilized by multiple clients, this approach allows significant cost reductions. It first eliminates the need for individual agencies to purchase the same software, and possibly hardware, on which to run the software. It also significantly reduces costs associated with ongoing software maintenance, patches and version updates. However, not all costs are eliminated, as an annual service fee still needs to be paid to the contracted firm and agency staff may still need to spend time providing data to and coordinating updates with the consulting firm.

The annual cost of using third-party vendors is likely to vary according to the size and complexity of the transit network for which GTFS data maintenance is expected and the frequency at which changes are made to routes and schedules. Information collected by the PATH project team between 2009 and 2011 indicates that annual contract costs for the hosting and maintenance of GTFS data for small rural transit

agencies can vary between \$200 and \$2800 depending on network size, complexity of data, and frequency of data updates.

Service quotes are often specified based on the estimated number of unlinked passenger trips made per year within the transit network being considered, with a minimum fee charged. Some service contracts may also include an initial, one-time cost for the purchase of software that will be used to transfer data between an agency and the server operated by the consulting firm. A share of the annual license cost for the software used by the consulting firm to develop and manage the GTFS data may further be included in the service contract.

7. SELECTION OF PILOT IMPLEMENTATION PARTICIPATING AGENCIES

This section details the process that was followed by the PATH project team in September 2009 to identify corridors of interest and select agencies interested to participate in the pilot GTFS deployments. Elements covered in this section include:

- Selection criteria
- Description of candidate corridors
- Identification of participating agencies

7.1. IDENTIFICATION OF POTENTIAL CORRIDORS

The initial approach for selecting transit agencies to participate in the Google Transit pilot deployments was to target agencies operating along travel corridors exhibiting the following desired characteristics:

1. Small urban or rural area
2. Presence of multiple modes along the corridor
3. Presence of transit agencies already on Google Transit
4. Corridor connecting two or more major urban areas
5. Commuter corridor
6. Existing commuter rail and ferry services
7. Potential for regionally integrated trip planning

However, after contacting several transit agencies it became apparent that strictly attempting to select agencies operating along specific travel corridors might not be as beneficial as selecting agencies operating within a region. This change of selection strategy was suggested by the fact that many agencies expressed concerns regarding the development of online transit trip planners that were more regionally based than corridor based. The main concerns expressed by the personnel of the various agencies that were contacted were:

- On-going maintenance costs. Many agencies expressed concern on who would eventually maintain the GTFS feeds and how would be funded.
- Connectivity: Many agencies rely on other local and regional agencies to form an area-wide network. If the surrounding agencies are not on Google Transit, there is a potential lack of benefits for their customers. Some agency contacts explained that their riders, especially students and seniors, connect with neighboring transit providers to travel to other cities in the area. For example, students at California State University Long Beach travel from the surrounding cities of Carson and Bellflower, both of which have their own transit systems that feed into Long Beach Transit.
- Coordination. Many small agencies need area-wide coordination to help integrate separate systems and provide better customer information.

Following the adoption of a region-based selection approach, Caltrans requested that PATH specifically outreach to agencies that were not currently part of the regional GTFS implementation efforts led by the Metropolitan Transportation Commission (MTC) and Sacramento Area Council of Governments (SACOG). PATH also agreed to focus on agencies viewed as playing an important role for regional

connectivity needs (for instance, in areas surrounding the Los Angeles metropolitan area). This led to the identification of the following corridors and areas of interest:

- Interstate 80 corridor between San Francisco and Sacramento
- SR-99 corridor south of Sacramento
- Areas surrounding the Los Angeles metropolitan area (Long Beach, Cerritos, Carson)
- Humboldt/Caltrans District 1 region
- San Luis Obispo area

Within each corridor and region, a list of candidate transit agencies was then developed based on the following information:

- List of transit agencies in California that had been compiled in 2008 by PATH (then California Center for Innovative Transportation) as part of a separate project [3]. This list characterized 128 agencies as urban, small urban or rural agencies based on fleet size, number of routes and location of service. This list contained 41 agencies with 10 vehicles or less, 31 agencies with 11 to 20 vehicles, 32 agencies with 21 to 50 vehicles, and 24 agencies with more than 50 vehicles.
- Data compiled by Google identifying agencies that were in discussion with them regarding the use of Google Transit or that had not yet been launched their online planner.

After developing the list of agencies for each corridor and region, personnel at each agency was contacted to gauge interest in participating in the Google Transit pilot deployments. The following sections characterize the agencies that were contacted in each corridor or region. The list of transit agencies that were finally retained to participate in the project is presented in the last section.

7.2. INTERSTATE 80 CORRIDOR

The corridor along Interstate 80 between the San Francisco Bay Area and Sacramento in California was initially considered to demonstrate the conversion of schedule and route data into Google Transit format. However, this corridor was already part of an effort to develop a regional Google Transit database. This effort, described in SACOG's 2009-2010 Overall Work Plan as the 511 Automated Transit Trip Planning, aimed to administer a regional Google Transit database for 11 transit operators in the Sacramento Region, with the Sacramento Regional Transit District (SRTD) managing the project and SACOG providing oversight and funding. This project also gave SRTD the mandate to maintain relationships with each transit operator participating in the project for maintaining a stops manager database that will allow for updates to Google Transit as service changes are made by each operator. Combined with regional GTFS work by the Metropolitan Transit Commission (MTC) in the Bay Area, the above project was expected to largely bridge the transit information gap between the San Francisco Bay Area and Sacramento.

Despite this planned deployment, the PATH research team still opted to explore the possibility of including in the current pilot demonstration project agencies that were not covered by the two above efforts, with the objective to provide more comprehensive network between Sacramento and the San Francisco Bay area. Figure 30 locates on a map the two small transit agencies that were considered as potential participants in the current project. As shown in Table 3, both agencies were relatively small, with Folsom Stage Transit offering only two bus routes and Yuba-Sutter Transit offering 13 routes.

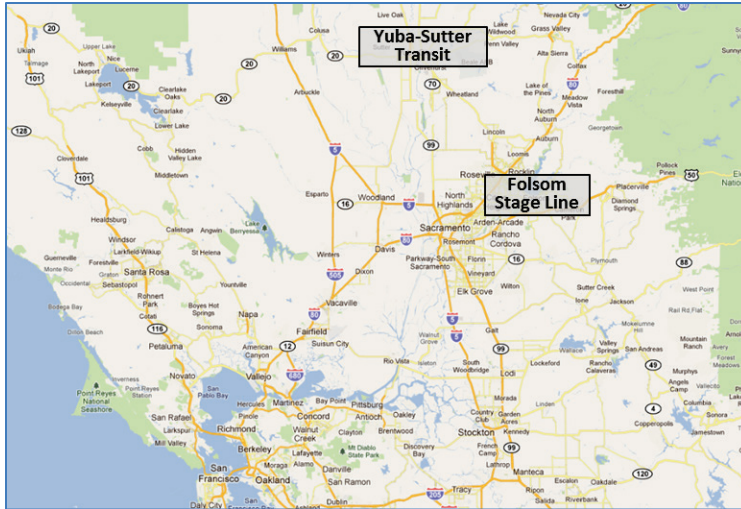


Figure 30: Interstate 80 Corridor Agencies

Table 3: Characterization of Interstate 80 Corridor Agencies

Transit Agency	Google Transit Status	Number of Routes
Yuba-Sutter Transit	Not launched	13
Folsom Stage Line	Not launched	2

7.3. SR-99 CORRIDOR

South of the Sacramento region, the SR-99 corridor showed potential for regional implementation. Many residents along the SR-99 corridor commute between Sacramento, Stockton and the San Francisco Bay Area. Figure 31 locates on a map the various agencies that were considered, while Table 4 lists the Google Transit status and size of each agency at the time of the inquiry.

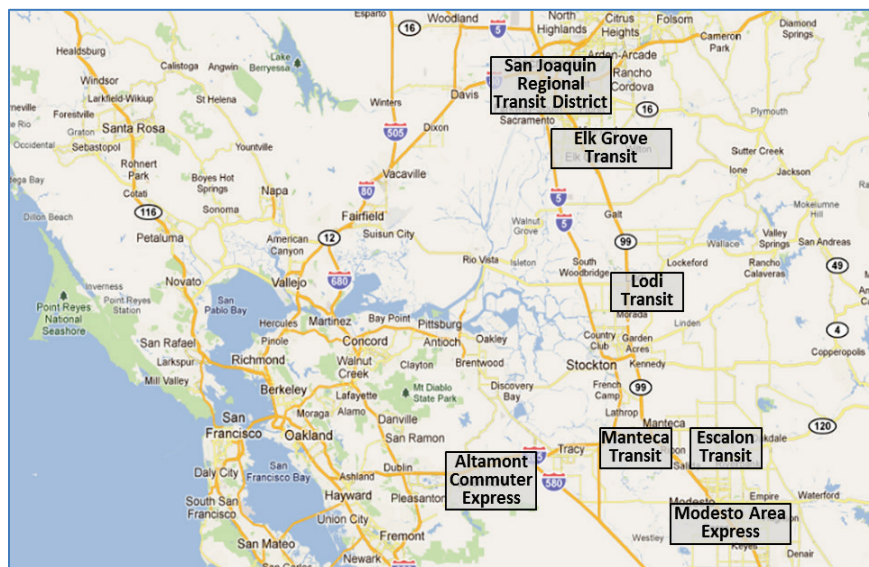


Figure 31: SR-99 Corridor Agencies

Table 4: Characterization of SR-99 Corridor Agencies

Transit Agency	Google Transit Status	Number of Routes
San Joaquin Regional Transit District (RTD)	In development	68
Modesto Area Express	Not launched	31
Elk Grove Transit Services (e-Tran)	Not launched	21
Lodi Transit (GrapeLine)	Not launched	13
Escalon Transit Service (eTran)	Not launched	5
Manteca Transit	Not launched	3
Altamont Commuter Express (ACE Rail)	Not launched	1

7.4. LOS ANGELES REGION

In light of the SACOG and MTC efforts, Jessica Wei, Strategic Partner Development Manager at Google, suggested contacting transit agencies in surrounding communities throughout the Los Angeles region due to the high number of small transit agencies that had not yet been launched on Google Transit. It was assessed that GTFS data could easily be developed for these small agencies since they typically operate between only 1 to 20 routes on relatively limited headways. Many of the larger agencies in the area had also already launched on Google Transit. This included the Orange County Transportation Authority (OCTA), Foothill Transit in the eastern San Gabriel Valley, OMNITRANS in the San Bernardino Valley, Long Beach Transit in the City of Long Beach, and Los Angeles County Metropolitan Transportation Authority (Metro). PATH researchers further determined that these agencies would benefit from the inclusion of information from surrounding smaller agencies, particularly through the ability to provide a complete regional information network.

PATH contacted several of the small transit operators within the region and, based on their interest and geographic location, three key areas emerged for the selection of potential demonstration partners:

- Ventura County,
- South Bay Cities
- Gateway Cities.

7.4.1. VENTURA COUNTY

The transit agencies in Ventura County are dependent on each other to form a coherent transit network. This dependency is best revealed by the fact that Ventura Intercity Service Transit Authority (VISTA), which is operated by the Ventura County Transportation Commission (VCTC), cannot adequately launch its schedules and route information on Google Transit even though the information has been converted to GTFS. As an intercity service, it depends on the other transit agencies in the county to complete connections. Without other agencies on Google Transit, the agency's Google Transit planner cannot effectively be used to map a trip. VCTC suggested launching the five other agencies on Google Transit, with the exception of Thousand Oaks Transit which had already launched its planner. With VCTC as governing body for the county, the selection of this group of agencies was seen as potentially facilitating the demonstration project in terms of coordination, housing the GTFS data and providing on-going maintenance after the demonstration period is concluded. Figure 32 locates on a map the various agencies that were considered, while Table 5 lists the Google Transit status and size of each agency at the time of the inquiry.



Figure 32: Ventura County Transit Agencies

Table 5: Characterization of Ventura County Transit Agencies

Transit Agency	Google Transit Status	Number of Routes
Camarillo Area Transit (CAT)	Not launched	1
Gold Coast Transit	Not launched	16
Moorpark City Transit	Not launched	2
Ojai Trolley Service	Not launched	2
Simi Valley Transit	Not launched	4
Thousand Oaks Transit	Launched	4
VISTA/VCTC	Converted to GTFS but not launched	7

7.4.2. LOS ANGELES SOUTH BAY REGION

The South Bay area of Los Angeles encompasses the cities of Carson, Gardena, Palos Verdes, Redondo Beach and Torrance. The transit services provided by the agencies in the various cities connect with each other, as well as with rail services provided by the Los Angeles County Metropolitan Transportation Authority (LA Metro), to form a comprehensive network for the area. Figure 33 locates on a map the various agencies that were considered in this region, Table 6 further lists the Google Transit status and number of routes provided by each agency at the time of the inquiry. When the project was initiated, a few of the agencies in the area were restructuring their routes due to budget cuts and were not actively considering the launch of an online transit trip planner. Others had been waiting on LA Metro to launch its Google Transit data before initiating the development of their own transit trip planner. This launched occurred just before the start of this project, which allowed considering these agencies as potential partners in the project.



Figure 33: Los Angeles South Bay Transit Agencies

Table 6: Characterization of Los Angeles South Bay Transit Agencies

Transit Agency	Google Transit Status	Number of Routes
Carson Circuit Transit System	Not launched	8
Gardena Municipal Bus Lines	Not launched	4
Long Beach Transit	Launched	38
Palos Verdes Peninsula Transit Authority	Not launched	9
Beach Cities Transit	Not launched	3
Torrance Transit/ Municipal Area Express (MAX)	Not launched	11

7.4.3. GATEWAY CITIES

Transit agencies considered in the Gateway area include Bellflower Bus, Cerritos on Wheels, Compton Renaissance Transit, Cudahy Area Rapid Transit, Norwalk Transit System, Long Beach Transit and South Whittier Sunshine Shuttle. Figure 34 locates on a map these agencies, while Table 7 lists their Google Transit status and the number of routes offered at the time of the inquiry. Similar to the Los Angeles South Bay areas, transit services provided by these agencies connect with each other, as well as regional services provided by LA Metro Rail and the Orange County Transportation Authority (OCTA), to form a comprehensive transit network covering the area.

Most of the above agencies were very interested in the pilot demonstration project. Similar to the South Bay area agencies, some agencies were restructuring and needed better interface with other agencies. With the exception of Long Beach Transit, which was already in discussion with Google Transit, all the agencies operated relatively small networks and were final candidates for inclusion in the project.



Figure 34: Gateway Cities Transit Agencies

Table 7: Characterization of Gateway Cities Transit Agencies

Transit Agency	Google Transit Status	Number of Routes
Bellflower Bus	Not launched	4
Compton Renaissance Transit	Not launched	4
Cerritos on Wheels	Not launched	2
Cudahy Area Rapid Transit	Not launched	1
Norwalk Transit System	Not launched	7
Long Beach Transit	Launched	38
South Whittier Sunshine Shuttle	Not launched	1

7.5. CALTRANS DISTRICT 1 / HUMBOLDT REGION

PATH contacted agencies in Caltrans District 1 to understand their progress with GTFIS implementation and their interest in volunteering for the demonstration. Figure 35 locates on a map the six agencies that were considered in this region. As shown in Table 8, four agencies had already launched onto Google Transit at the time of the inquiry, while the two others had already initiated their GTFIS development process. The two remaining agencies that had not yet launched were Lake Transit, and Redwood Coast Transit (RCT) in Del Norte County.



Figure 36: San Luis Obispo Region Transit Agencies

Table 9: Characterization of San Luis Obispo Region Transit Agencies

Transit Agency	Google Transit Status	Number of Routes
San Luis Obispo Regional Transit Authority	Launched	7
San Luis Obispo Transit (City)	Launched	8
Paso Express	Not Launched	3
South County Area Transit	Not Launched	3
Morro Bay Transit and Trolley	Not Launched	6
North County Shuttle	Not Launched	2

7.7. SELECTED AGENCIES

The final selection of the agencies that were to participate in the pilot Google Transit deployments was based on the following considerations:

- Interstate 80 Corridor:** Through inquiry and discussion with SACOG and local transit agencies, a few transit agencies in the Sacramento area were identified as still needing to be covered and interested in the pilot project. These were Folsom and Yuba-Sutter transit agencies. Yuba-Sutter contracted with PATH, while Folsom Transit opted not to participate due to budget reviews and time constraints.
- SR-99 Corridor:** Altamont Commuter Express Rail and Lodi Transit expressed high interest in making their information available on Google Transit and received management approval. Other agencies were not able to participate due to unstable budgets or ongoing schedule update processes.
- Los Angeles Region:** Cerritos on Wheels was the only transit agency in the Gateway area to participate in the pilot project. Ventura County was unable to secure the funds to host the feeds of its smaller agencies, while PATH did not receive significant interest from the transit agencies that were contacted in the South Bay area.

- **Humboldt/Caltrans District 1:** Lake Transit and Redwood Coast Transit (RCT) expressed interest in the pilot project. However, since both agencies had already started converting their information into GTFS format, they ended up electing not to participate in the pilot project.
- **San Luis Obispo Region:** San Luis Obispo Regional Transit Authority (RTA) had already launched Google Transit. However, the agency still needed some help for the development of shape files supporting the GTFS data. The other three smaller transit agencies, Paso Robles Transit (Paso Express), South County Area Transit (SCAT) and North County Shuttle (NCS) agreed to participate in the pilot project with PATH for promote better regional implementation of transit services.

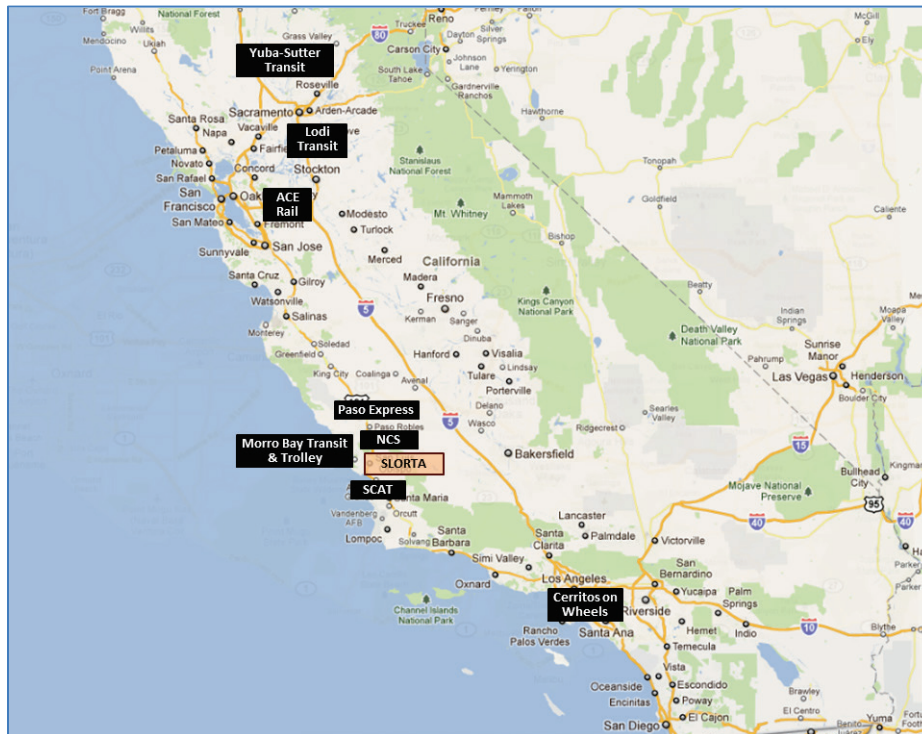


Figure 37: Agencies Participating in Pilot Online Planner Deployments

Figure 37 locates on a map the final nine agencies that were selected and agreed to participate in the pilot online transit trip planner deployments. These include:

1. Yuba-Sutter Transit
2. Altamont Commuter Express (ACE Rail)
3. Lodi Transit (Grape Line)
4. Cerritos on Wheels (COW)
5. North County Shuttle (NCS)
6. South County Area Transit (SCAT)
7. Paso Robles Transit (Paso Express)
8. Morro Bay Transit and Trolley
9. San Luis Obispo Regional Transit Agency (SLORTA)

While San Luis Obispo Regional Transit Agency had already launched its online transit trip planner, it is also considered to be a participating agency since it received assistance from PATH to address issues with the development of its GTFS shapes files.

8. SUMMARY OF PILOT IMPLEMENTATIONS

This section provides a summary of the online transit planner implementation activities for each of the transit agencies that were selected to participate in the pilot deployments. The Information presented herein includes:

- Selection of consultants to help transit agencies with GTFS data conversion
- Key implementation process dates
- Data hosting and maintenance agreements

8.1. SELECTION OF GTFS CONVERSION CONSULTANTS

For this project, PATH hired two consultant teams to help the participating transit agencies convert their schedule, route and fare information into compatible GTFS format. The two retained consulting firms were:

- Marcy Jaffe Company, from Port Townsend, Washington (<http://www.mjaction.com>)
- Trillium Solutions, from Portland Oregon (<http://www.trilliumtransit.com/>)

Both consultants had experience converting GTFS feeds and helping transit agencies using emerging information technologies to provide enhance services for their customers. The two firms were selected based on the fact that they use different methodologies for generating the GTFS data. While Trillium relies on a web-interface tool, Marcy Jaffe Company uses a Microsoft Excel tool that incorporates validation macros. Trillium’s implementation model further requires an annual contract for maintaining and validating any changes to the GTFS feeds, while Marcy Jaffe Company seeks to minimize consultant dependence by teaching each client agency how to update and validate the feeds in-house.

Table 10 lists the consultant that was retained by each participating agency to help them with their GTFS data conversion. As can be observed, most of the agencies contracted with Marcy Jaffe Company. Only one agency, Yuba-Sutter Transit, contracted with Trillium Solutions.

Table 10: Consultants Servicing Participating Transit Agencies

Consultant	Transit Agency
Marcy Jaffe Company	<ul style="list-style-type: none"> • Altamont Commuter Express (ACE Rail): • Cerritos on Wheels (COW) • Lodi Transit (Grape Line) • Paso Robles Transit (Paso Express) • North County Shuttle (NCS) • South County Area Transit (SCAT) • Morro Bay Transit and Trolley
Trillium Solutions	<ul style="list-style-type: none"> • Yuba-Sutter Transit

8.2. KEY IMPLEMENTATION DATES

Table 11 lists key dates associated with the development and implementation of the Google Transit planner of each participating agency, while Table 12 presents the same information in terms of intervals. As can be observed, less than a month typically elapsed between the start of the data collection process and the start of the testing of the preview online planner. In great part, the short implementation intervals are a result of the relatively small scale of the bus or train network associated with each of the participating agency.

Table 11: Key Implementation Dates for Participating Agencies

Agency	Start of Data Conversion	Start of Preview Testing	Launch Date
Lodi Transit	February 16, 2010	March 18, 2010	April 18, 2010
ACE Rail	March 2, 2010	March 18, 2010	April 18, 2010
North County Shuttle	March 21, 2010	April 12, 2010	May 9, 2010
South County Area Transit	March 23, 2010	April 12, 2010	May 20, 2010
Paso Express	March 23, 2010	April 12, 2010	July 12, 2010
Cerritos On Wheels	July 30, 2010	August 4, 2010	December 5, 2010
Morro Bay Transit and Trolley	November 30, 2010	December 4, 2010	February 23, 2011
Yuba Sutter Transit	April 29, 2010	June 14, 2010	March 28, 2011

Table 12: Duration of Major Implementation Steps

Agency	Days Needed to Approve Agreement	Days to Start of Testing	Days from Start of Testing to Launch	Total Conversion Time
Lodi Transit	1	29	31	61
ACE Rail	1	15	31	47
North County Shuttle	1	21	27	49
South County Area Transit	1	19	38	58
Paso Express	65	20	26	111
Cerritos On Wheels	75	5	48	128
Morro Bay Transit and Trolley	1	4	80	85
Yuba Sutter Transit	1	45	287	333

While the initial data collection was typically executed within a month or less, the duration of the subsequent testing phase showed more variability. Depending on the agency, testing varied between one and four months. The particularly long testing phase for Cerritos on Wheels and Paso Express were due to the time that was needed (roughly two months) for the city council to review the Google Transit trip planner project and understand licensing issues with Google. For Yuba-Sutter Transit, the long interval is due to a delay from the agency in initiating data testing and a change to the initial scope of work that resulted in the addition of commuter routes and a need to coordinate data preparation with Sacramento's Regional Transit District (SacRT).

8.3. DEPLOYMENT COSTS

Table 13 lists the deployment costs incurred for each of the transit agencies participating in the pilot project. These costs primarily reflect the fees charged by the consultants that were retained by each

agency to help them with the data conversion. Deployment costs ranged from \$950 for the agencies with the smallest networks to \$9,400 for Yuba-Sutter, the agency with the most complex network.

Table 13: Consultant Deployment Costs for Participating Agencies

Agency	Deployment Cost
Lodi Transit	\$5,400
ACE Rail	\$950
North County Shuttle	\$950
South County Area Transit	\$1,350
Paso Express	\$1,900
Cerritos On Wheels	\$2,400
Morro Bay Transit and Trolley	\$950
Yuba Sutter Transit	\$9,400

While some agency staff time was also spent on the data conversion effort, this time is not counted in the costs listed in Table 13 as most agencies typically considered this effort as being part of normal agency staff duties. Most agencies reported having spent between 5 and 25% of staff time to support the data collection effort. Over a two to five month period, such a level of effort translates into between 17 and 216 hours of staff time. Using an assumed effective salary rate of \$40 per hour, the effort described above results in an additional indirect agency cost varying between \$680 and \$8,640.

8.4. HOSTING AND MAINTENANCE AGREEMENTS

Table 14 summarizes the hosting and maintenance models that have been adopted by the participating agencies. As can be observed, different data hosting and maintenance models were adopted by the various agencies:

- Three of the four agencies within the San Luis Obispo region have opted to have their GTFS data hosted at a server maintained by the San Luis Obispo Rideshare program. This is a program operated by the San Luis Obispo Council of Governments. While data is being hosted remotely, two of these agencies remained in charge of maintaining their own data.
- Five agencies opted to contract out data hosting and maintenance to an external vendor. Four agencies contracted with Marcy Jaffe Company, while one contracted with Trillium Solutions. In all cases, the external vendor is the one that helped them deploy their online planner as part of this project.
 - For ACE Rail, which has only one line, the annual data hosting and maintenance cost is \$200. For Lodi Transit, the annual cost to cover data maintenance for the agency’s 13 routes is \$1000.
 - For South County Area Transit, which only has three routes, the cost is \$1250. However, this cost also includes the publishing of schedules from GTFS data.
 - For Yuba-Sutter, the annual maintenance cost for the agency’s 13 routes is \$2800. This includes email and phone based support, data hosting, application hosting and access, export and validation support for GTFS, bug fixes for the application
 - One agency, Cerritos on Wheels, opted to host the data and maintain them using its own resources.

Table 14: Participating Agency Data Hosting and Maintenance Models

Region	Agency	Hosting	Maintenance
SR-99 Corridor	Lodi Transit	Marcy Jaffe Company	Marcy Jaffe Company
	ACE Rail	Marcy Jaffe Company	Marcy Jaffe Company
San Luis Obispo	North County Shuttle	Rideshare	Marcy Jaffe Company
	South County Area Transit	Marcy Jaffe Company	Marcy Jaffe Company
	Paso Express	Rideshare	In-house
	Morro Bay Transit and Trolley	Rideshare	In-house
Gateway Cities	Cerritos On Wheels	In-house	In-house
Interstate 80 Corridor	Yuba Sutter Transit	Trillium Solutions	Trillium Solutions

8.5. UPDATE ON OTHER CONTACTED AGENCIES

To assess the rate of adoption of online transit trip planners within small agencies, the project team revisited in August 2011 the availability of trip planners at the various agencies that were initially considered as potential partners in the pilot GTFS deployments. Table 15 lists the availability of trip planners for the agencies listed in Table 3 to Table 9 in Section 7 that reported not having such a tool in September 2009. As can be observed, a majority of agencies have since then published their service data onto an online transit trip planner. This indicates significant progress in the acceptance and use of trip planners.

Table 15: Online Planner Deployment of Non-Participating Agencies as of August 2011

Region	Agencies	Trip Planner	Data Format	Open Source Data
Ventura County	Camarillo Area Transit (CAT)	LA Metro / Go511.com	RESTful/XML	
	Gold Coast Transit	LA Metro / Go511.com	RESTful/XML	
	Moorpark City Transit	LA Metro / Go511.com	RESTful/XML	
	Ojai Trolley Service	LA Metro / Go511.com	RESTful/XML	
	Simi Valley Transit	LA Metro / Go511.com	RESTful/XML	
	VISTA/VCTC	LA Metro / Go511.com	RESTful/XML	
Los Angeles South Bay	Carson Circuit Transit System	No		
	Gardena Municipal Bus Lines	LA Metro / Go511.com	RESTful/XML	
	Palos Verdes Peninsula Transit	LA Metro / Go511.com	RESTful/XML	
	Beach Cities Transit	LA Metro / Go511.com	RESTful/XML	
	Torrance Transit	LA Metro / Go511.com / Google Transit	RESTful/XML, GTFS	
Gateway Cities	Bellflower Bus	LA Metro / Go511.com	RESTful/XML	
	Compton Renaissance Transit	LA Metro / Go511.com	RESTful/XML	
	Cudahy Area Rapid Transit (CART)	No		
	Norwalk Transit System	LA Metro / Go511.com	RESTful/XML	
Caltrans District 1 / Humboldt	Lake Transit	No		
	Redwood Transit System	Google Transit	GTFS	Yes
SR-99 Corridor	Elk Grove (e-Tran)	No		
	Escalon Transit Service (eTrans)	Google Transit	GTFS	Yes
	Manteca Transit	No		
	Modesto Area Express	Google Transit	GTFS	Yes
	San Joaquin Regional Transit District	Google Transit	GTFS	Yes

Of the 18 agencies that have published their service data, only 5 agencies developed data in the GTFS format for publication onto Google Transit. 13 agencies published their data using the RESTful/XML format, which is not compatible with Google Transit, while one agency published its data using both formats. The RESTful/XML format is a data format that has been used by a number of transit agencies across the United States and around the world to develop custom online trip planners. Agencies in California that have published data in this format include LA Metro, AC Transit, the San Francisco Metropolitan Transportation Authority (SFMTA), and the San Francisco Bay Area Rapid Transit (BART). However, to enable their service information to be displayed in Google Transit, these four agencies have also published their data using the GTFS format.

Many of the transit agencies listed Table 15 developed used the RESTful/XML format to allow their service data to be included onto LA Metro’s online transit trip planner (See Figure X) and the transit trip planner offered on the **Go511.com** website (See Figure Y). Similar to Google Transit, these trip planners return available transit trip options between a pair of origin and destination points. For each trip option, the LA Metro planner returns the total walking distance, total trip time and fare to be paid. However, the tool only displays on a map the start and end points of a trip, and not the path between the two points. The **Go511** planner provides similar information, but in a different package. This tool, however, only returns one trip option for each query. Furthermore, while the tool also attempts to display the trip on a map, not all segments are necessarily shown.

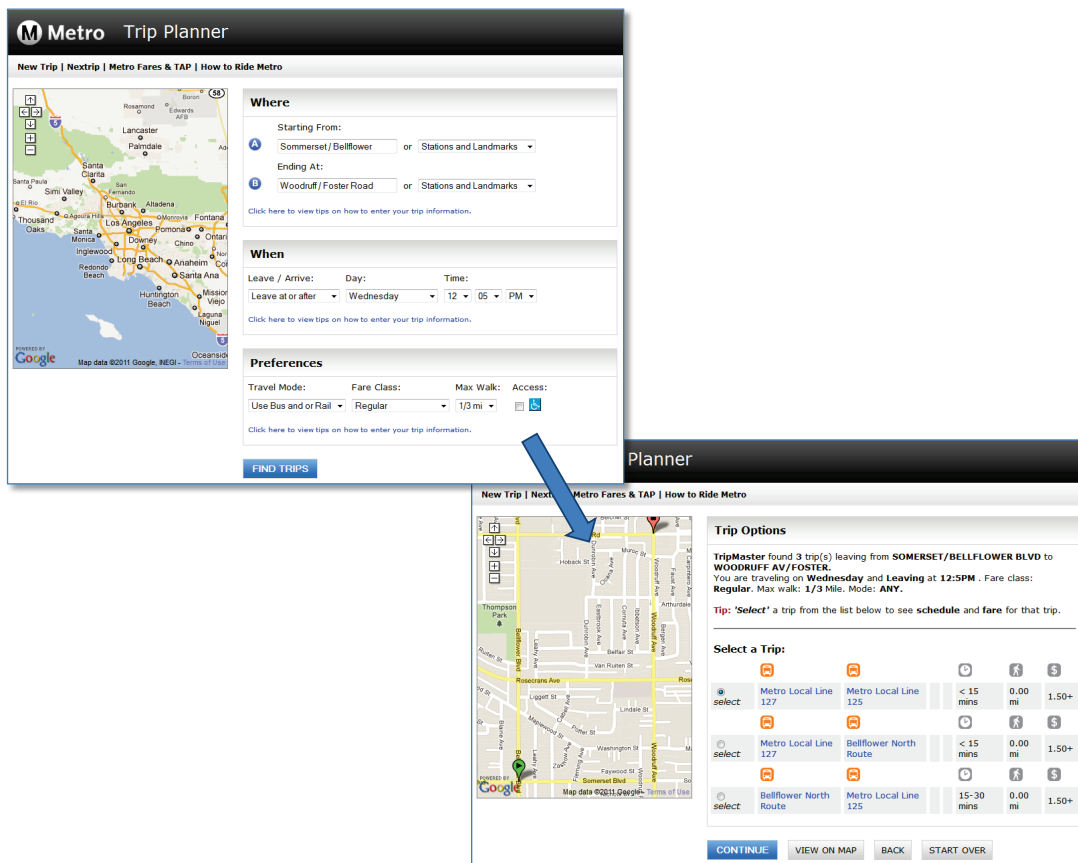


Figure 38: LA Metro Online Transit Trip Planner

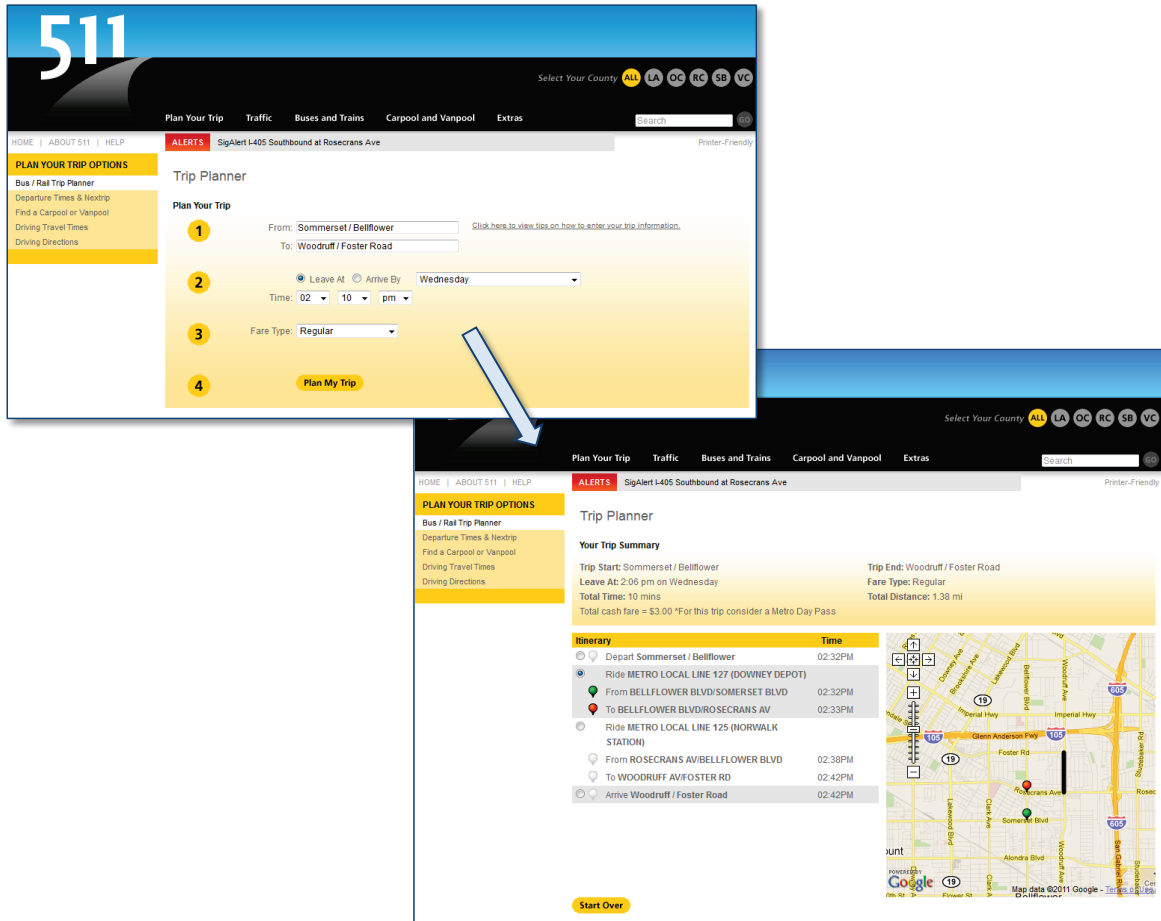


Figure 39: Go511.com Online Transit Trip Planner

To accommodate customers who prefer using Google Transit, LA Metro has recently developed a GTFS version of its service data and added a link to Google Transit on the website hosting its online transit trip planner. As of August 2011, service data for all bus and rail lines operated by LA Metro could be obtained on Google Transit. However, service data for many other regional transit agencies were not yet available. This includes most of the region’s agencies listed in Table 15.

9. ASSESSMENT OF ONLINE TRIP PLANNER UTILIZATION

This section of the report summarizes the activities that were conducted in late 2010 and early 2011 to evaluate the use and benefits of online transit trip planners. Activities reported in this section include:

- Survey of transit agency experiences with Google Transit.
- Survey of Google Transit users.
- Statistics on how often online transit trip planners are accessed online.

9.1. EXPERIENCES OF TRANSIT AGENCIES WITH GOOGLE TRANSIT

While travelers are generally perceived as the ones directly benefiting from the trip planning capabilities offered by Google Transit, transit agencies also benefit from it. Through improved transit information dissemination, Google Transit helps induce increases in ridership, reduces the volume of calls to customer assistants, and provides staff with valuable data when answering queries from travelers. This section summarizes the methodology and results of a survey of transit agencies that was conducted in November and December 2010. This survey was done to assess agency experience with online transit trip planners and the benefits perceived in implementing such a tool. Interested readers may obtain more information about the questionnaire that was distributed, the agencies that responded to the survey, and the responses that were obtained to specific questions in Appendix G.

9.1.1. SURVEY METHODOLOGY

Agency staff were contacted to fill out an online survey. This approach was selected based on its cost-efficiency, its ability to monitor the rate at which agencies are responding to the survey, and its ability to tailor the set of questions asked to the specific situation of each respondent.

The online questionnaire was developed using low-cost software offered by SurveyMonkey (<http://www.surveymonkey.com/>), a private company based in Palo Alto, California. The software enables users to create and administer their own web-based surveys. Agencies were invited to participate in the survey by emailing targeted agency personnel and providing them with a link to the website containing the survey along with some instructions. Participants were drawn from the list of individual who participated in the GTFS training sessions organized by PATH in November 2010 (see Appendix E). Additional emails were also sent to specific agency contacts provided by Marcy Jaffe Company and Trillium Solutions, the two consulting agencies assisting participating transit agencies participating in the project's pilot deployments with their GTFS data conversion.

9.1.2. SURVEY QUESTIONS

Two sets of questions were developed for the survey. The first set targeted agencies with an active online transit trip planner, while the second set targeted agencies that had not launched a tool. Table 16 lists the questions that were asked to agencies belonging to each group. The questions primarily sought information on the motivation for developing or not-developing GTFS data, including information on perceived institutional challenges, agency staff concerns, and potential impacts on transit operations.

Table 16: Agency Survey Questions

Question	Agency with Active Online Planner	Agency without Active Online Planner
How long has it been since the agency went live on Google Transit?	X	
How long was the entire implementation process?	X	
How did or will the agency finance the implementation?	X	X
What was the primary motivation for the agency to implement GTFS?	X	
What is the agency's primary concern regarding GTFS implementation?		X
What was the agency's primary concern for GTFS implementation initially?	X	
What are the agency's concerns after implementation?	X	
What kind of challenges did the agency experience during implementation?	X	
Was the implementation done in-house or contracted?	X	
Percentage of staff time spent in implementing GTFS?	X	
How does/will the agency plan to finance maintenance of the GTFS?	X	X
How is the agency planning to maintain the feed?	X	
Statistics on ridership, calls from customers, hours spent handling calls, visits to website, usage level of online trip planner before implementation.	X	X
Statistics on ridership, calls from customers, hours spent handling calls, visits to website, usage level of online trip planner after implementation.	X	
How has ridership, length of trip, use of transfer stations, number of calls from customers, ease of answering calls, number of website visits, and use of trip planner changed since going live?	X	
How often are Google Maps, Google Transit and the agency website used for answering user questions?	X	X
How often are Google Maps, Google Transit and the agency website used for general operations?	X	
If users can choose between an internal trip planner and Google, which are they choosing?	X	
What do you think is Google Transit's most beneficial feature to the agency?	X	X
Are there any other features of Google Transit you would like to see?	X	X
What is your level of satisfaction with Google Transit?	X	
How important is it that a Google trip planner is made available to the agency website?	X	
Describe any other benefits or consequences of GTFS implementation?	X	X
Do you have any concerns for the future?	X	
How has the agency expanded or improved since GTFS implementation?	X	
Over the next fiscal year, what will your agency invest in?	X	X
In retrospect, would you have done anything differently during the GTFS implementation process?	X	
Would you recommend GTFS implementation for other small agencies?	X	
What steps have you taken towards GTFS implementation?		X
What steps are required for you to take in order to implement GTFS?		X
Any further comments?	X	X

9.1.3. SURVEY RESPONDENTS

The primary target population for the survey was agencies participating in the pilot Google Transit deployments. However, in order to collect as much information as possible on agency experiences with Google Transit, the survey was also open to other small transit agencies.

A total of 29 agencies responded to the survey. This includes responses from 22 agencies with an active online trip planner and 8 agencies without a trip planner (one agency – Morro Bay Transit and Trolley, provided responses to the survey before and after implementation of its planner). Most of the agencies participating in the pilot project responded to the survey, either directly or indirectly. From a geographical standpoint, the survey included responses from 9 agencies in California, 5 in Washington State, 10 elsewhere in the United States, and 4 outside the country. A detailed list of the responding agencies can be found in Appendix G.

9.1.4. SURVEY FINDINGS – AGENCIES WITH ACTIVE TRANSIT TRIP PLANNER

This section summarizes the key findings extracted from the responses provided by the 22 agencies that had already launched their online trip planner. A more comprehensive compilation of the responses provided to individual survey questions can be found in Appendix G.

- Duration of implementation process:** Figure 40 indicates that 11 agencies (50%) reported spending 6 months or less developing their GTFS data, 6 agencies (27%) between 7 and 11 months, and 5 agencies (23%) more than a year. This range may reflect variations in the size and complexity of the transit networks to be coded, although that cannot be stated with certainty due to survey gaps. Administrative delays in obtaining project approval, administrative signatures for the Google Transit license or project funds may have also contributed to some of the longer intervals. Yuba-Sutter Transit, one of the agencies participating in the pilot deployment, is one of the agencies reporting a GTFS development process that extended over a year. In this case, the delay was largely due to a need to coordinate data preparation with Sacramento’s Regional Transit District, thus providing support for the administrative delay assumption.

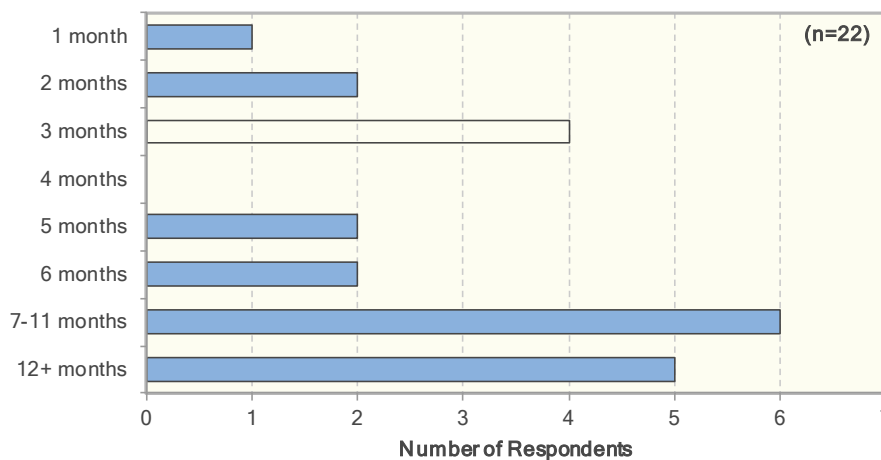


Figure 40: Duration of GTFS Implementation Process

- Financing:** Figure 41 indicates that 14 agencies (64%) used internal funds to finance the implementation of their trip planner. Three agencies also reported using regional funds and four using grants that were available to them. Three agencies further indicated that the implementation of their trip planner was absorbed as part of normal staff duties. 13 agencies further report that data maintenance following the launch of their planner will be considered as part of normal staff duties and will therefore not require special funding.

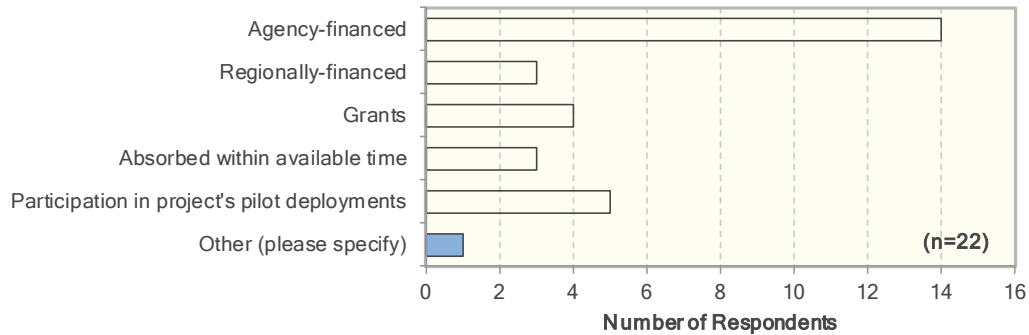


Figure 41: Source of Financing for GTFS Implementation

- Rationale for implementing an online trip planner:** Figure 42 indicates that the primary rationale for implementing an online trip planner was either to improve information distribution (6 agencies), service to customers (6 agencies), or coordination planning with neighboring agencies (4 agencies).

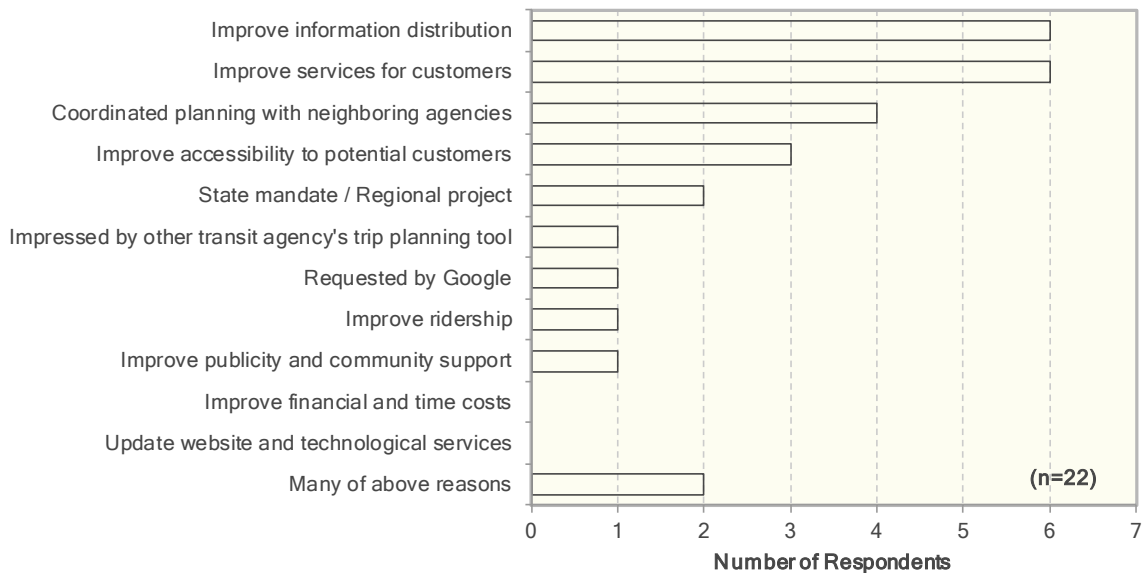


Figure 42: Rational for GTFS Implementation

- Concerns prior to implementation:** Figure 43 compiles the chief concern regarding GTFS development stated by agency staff at the start of the data conversion process. Staff capability to accomplish the upcoming task was by far the primary concern. The second most commonly cited concern was the long-term stability and sustainability of Google Transit. This concern may

simply be due to the still relative novelty the application. If so, this concern can be expected to subside over time. Time, funding, and operational costs were also mentioned as a chief concern by 5 of the 21 responding agencies.

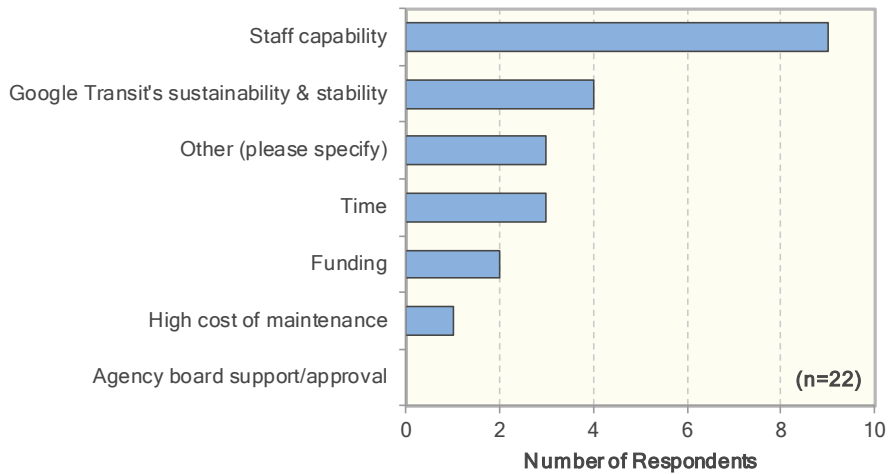


Figure 43: Agency Concerns before Implementation

- Concerns following launch of trip planner:** Figure 44 indicates that the chief concern of agency staff following the launch their online planner is data maintenance. Staff capability, time and data reliability are also mentioned as a chief concern by a few agencies.

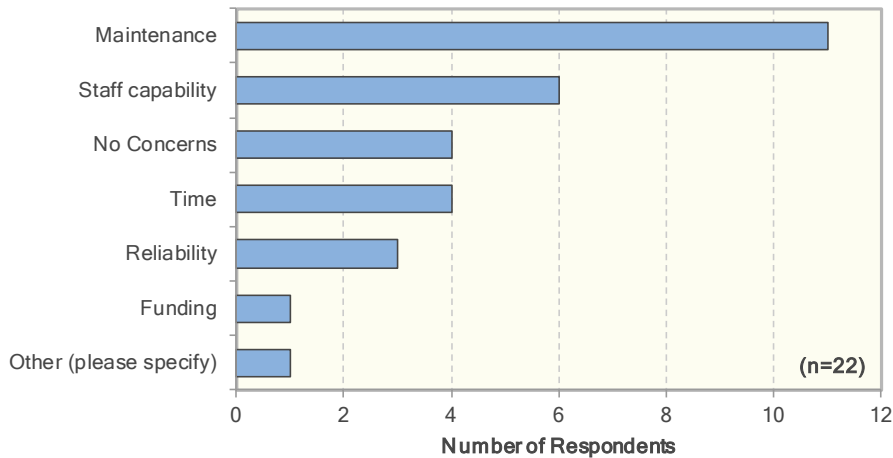


Figure 44: Agency Concerns after Implementation

- Implementation challenges:** Figure 45 indicates that the three most common development challenges are the need to address multiple schedule changes, a lack of detailed information about the GTFS development process, and limited staffing. Other reported challenges pertain to the initial data collection effort, the need to verify data accuracy, uncertainty about the process to upload data onto Google Transit, and the difficulty of obtaining approval from decision makers for GTFS data development. Funding was never mentioned as an issue.

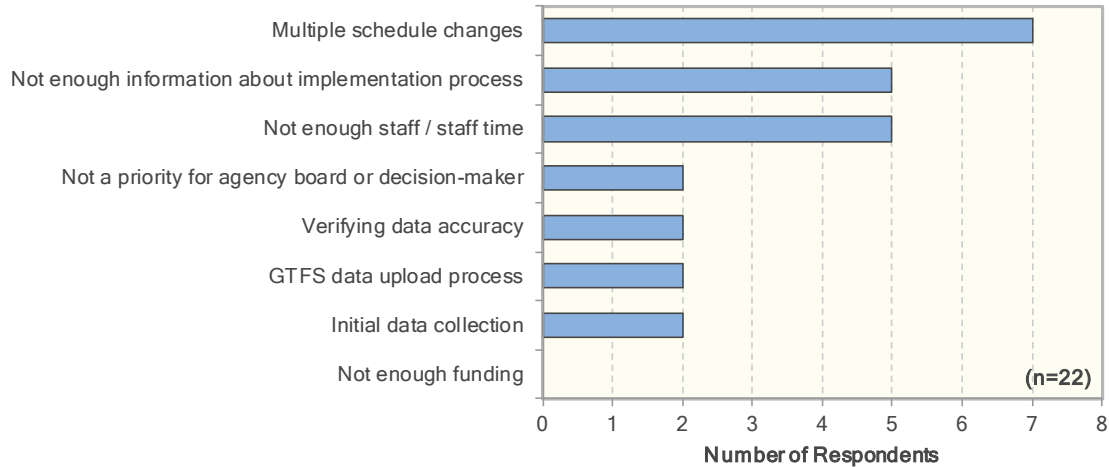


Figure 45: Implementation Challenges

- In-house vs. contracted out work:** Figure 46 shows that 7 agencies conducted their initial GTFS data development in-house, 11 contracted out the work, and 3 developed their online planner in-house with help from an external contractor. For post-implementation data maintenance, 13 agencies indicated planning on conducting data maintenance in-house. Only 3 agencies planned on using, either partially or fully, an external contractor. 3 agencies were still not sure on how they would maintain the data.

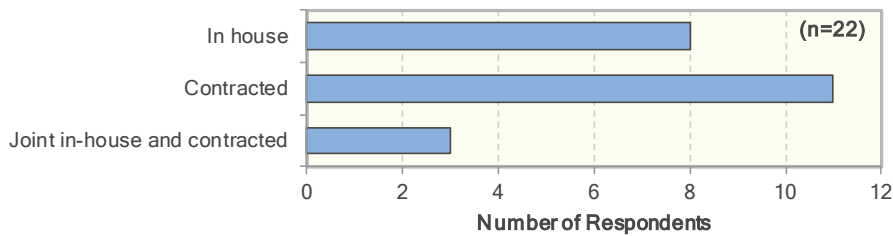


Figure 46: In-House versus Contracted GTFS Development

- Staffing needs:** Figure 47 shows that GTFS development activities are not excessively time-demanding for small transit agencies. 10 agencies (45% of sample) reported dedicating less than 10% of their staff time to the GTFS data development effort, 7 agencies (31% of sample) between 10% and 25%, and 4 agencies (18% of sample) between 25% and 35%. Figure 48 further compiles the reported dedicated times based on whether the work was contracted out, executed in-house, or partly contracted and executed in-house. The preliminary assumption was that agencies contracting out the GTFS data development would generally be reporting smaller proportions of staff time dedicated to the GTFS effort than those conducting the work in-house. This was not the case, as the agencies conducting work in-house generally reported lower dedicated time than agencies contracting the work. This result may be a consequence of a higher number of employees at agencies opting to conduct the work in-house. It may also be the result of fewer issues with data collection and validation at these agencies.

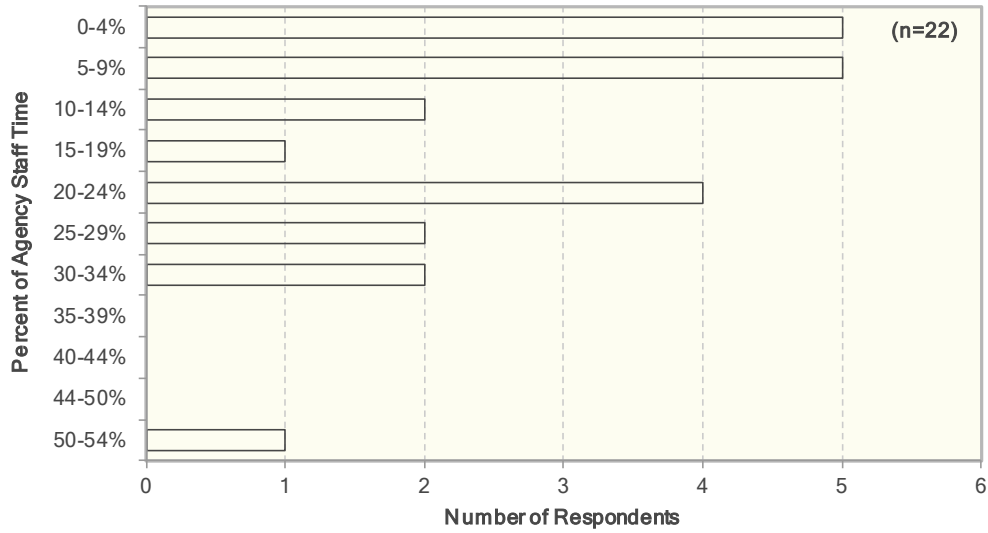


Figure 47: Percent Staff Time Dedicated to GTFS Development



Figure 48: Staff Time Dedicated to GTFS Development based on Location of Work

- Impacts on transit operations:** Not enough data was collected to provide quantifiable proofs of impacts on transit operations. While 6 agencies reported observing ridership increases following the launch of their trip planner, there is not enough information to explicitly link these increases to the launch of the tool. Furthermore, there are only 6 mentions of traffic increases on agency websites, 2 mentions of decreases in customer calls, and 2 mentions of an increased facility to respond to customer calls. The majority of agencies indicated that ridership, length of trip, use of transfer station, calls from customer, ease of answering calls, and use of the agency’s website remained the same or that changes could not be assessed due to a lack of information. While many agencies also reported having improved their website and how information is being disseminated following the launch of their online trip planner, it is unclear whether these changes are a direct consequence of the launch of the planner.

- Perceived benefits of Google Transit:** Figure 49 compiles the most commonly cited benefits of Google Transit by agency staff. The main perceived benefit is that Google does not charge a fee to publish data onto Google Transit. While costs are technically associated with the process of developing GTFS data, the free nature of Google Transit is assessed in comparison to the license fees that may be charged by other companies for using the trip planners they have developed, or the high cost of developing a trip planner from scratch using in-house resources. The ability to use this tool online, its interactivity, the ability to plan trips across multiple transit networks, and the ability to calculate and compare trip times across modes also rank relatively high.

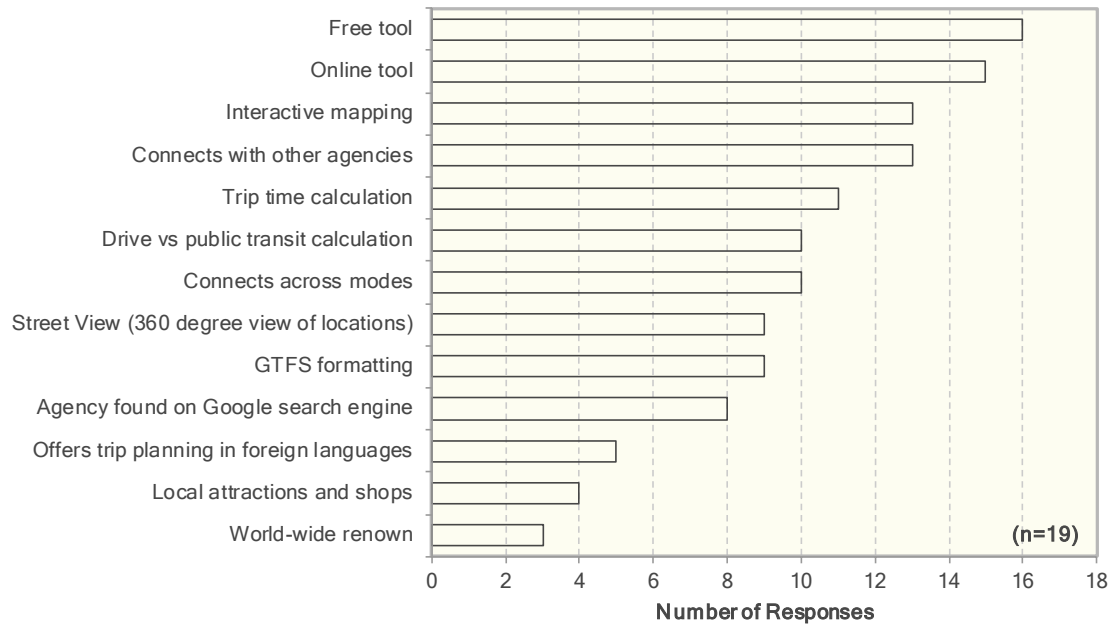


Figure 49: Agency-Perceived Google Transit Benefits

- Use of Google Transit and Google Maps:** Figure 50 indicates that more than half of the agencies surveyed use Google Maps, Google Transit or agency websites to help answer customer calls, typically either once or multiple times per week. Figure 51 further indicates that a majority of agencies also report using these tools to support their day-to-day operations.

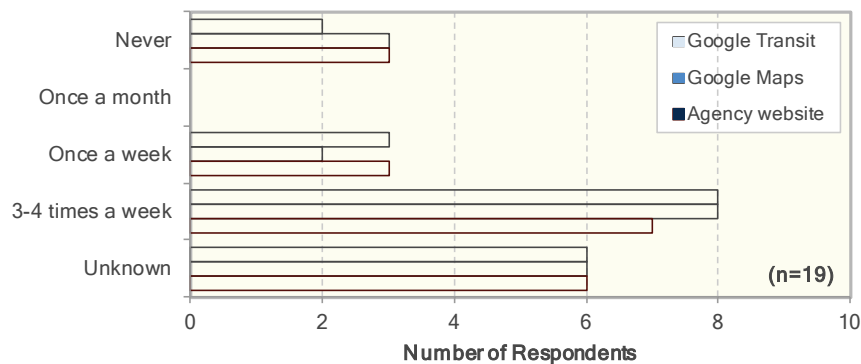


Figure 50: Use of Online Tools to Support Customer Calls

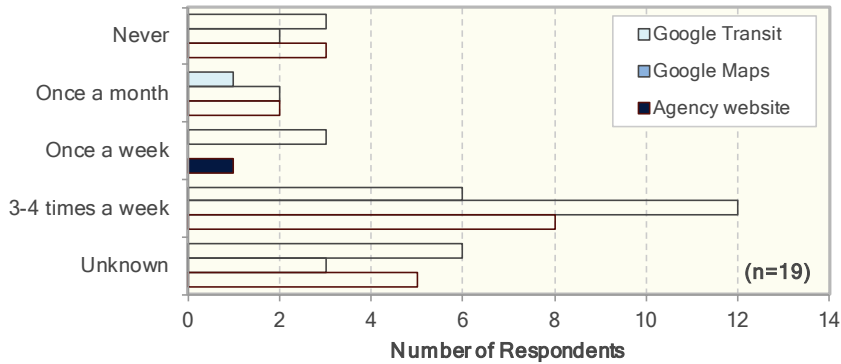


Figure 51: Use of Online Tools to Support Transit Operations

- Desired Google Transit features:** The Top features that agency staff would particularly like to see included in Google Transit include:

 - Real-time transit data.
 - More attention paid to safe walking directions.
 - Better coordination between bus and rail services.
- Satisfaction with Google Transit:** A majority of agency staff indicated being satisfied with the overall effectiveness and benefits provided by Google Transit. Figure 52 compiles satisfaction ratings with various aspects of Google Transit. As indicated, there is a high level of satisfaction with the benefits to both transit riders and agencies themselves. The lowest satisfaction is for the ability of the tool to support transit ridership increases. This can be explained by the difficulty of assessing whether the improved dissemination information provided by Google Transit can significantly affect transit ridership. Figure 53 further indicates that staff at 84% of agencies believes that it is important or very important that an online transit trip planner be made available on their agency website. Staff from 17 agencies (81% of all respondents) would notably recommend to other agencies that they implement a transit trip planner on their website.

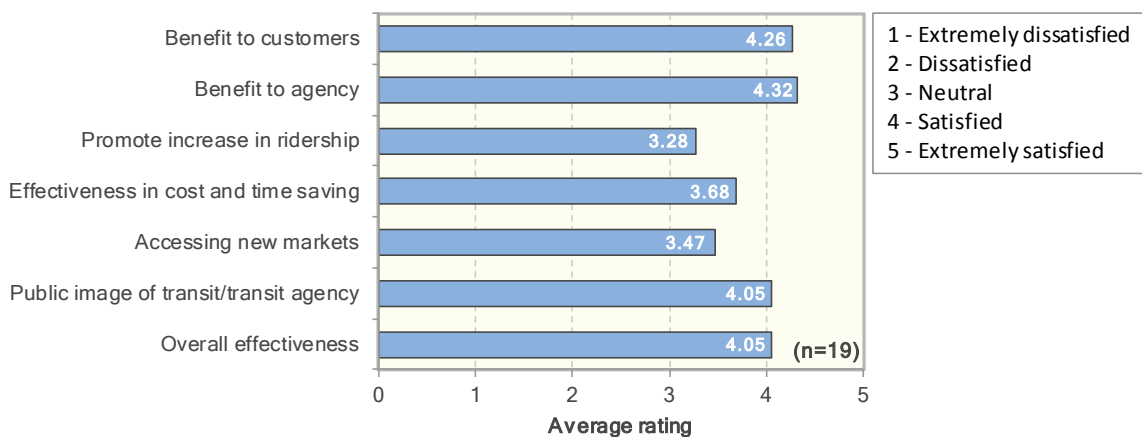


Figure 52: Satisfaction with Google Transit

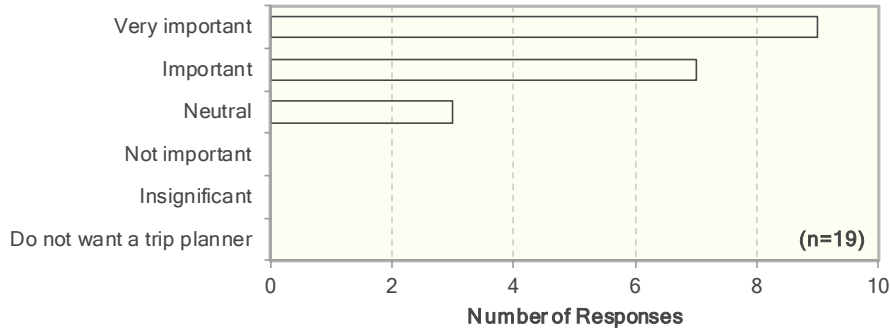


Figure 53: Importance of Offering Online Transit Trip Planner

9.1.5. SURVEY FINDINGS – AGENCIES WITHOUT ACTIVE TRANSIT TRIP PLANNER

This section summarizes key finding extracted from the responses provided by the 7 agencies that had not yet launched an online transit trip planner. A more comprehensive compilation of the responses that were provided to individual survey questions can be found in Appendix G.

- Rationale for lack of online trip planner:** Three agencies indicated that staff capability was a primary concern regarding the development of an online transit trip planner. Staff from other agencies indicated that time requirements, the need to obtain support from the agency board and inaccurate bus stop data were their primary concern. Staff capabilities, lack of information about the GTFS development process, and the need to secure appropriate funding were also mentioned as reasons potentially delaying the development on an online trip planner.
- Projected financing source:** Responses from the various agencies were evenly split between agency financing, financing by a regional entity, use of grants, and absorption of development activities within normal staff duties.
- In-house vs. contracted work:** Four agencies indicated they were considering maintaining in-house the GTFS data of an eventual trip planner. Two agencies further indicated that they were expecting to do data maintenance with the help of a regional entity. No agency within this group of respondents reported considering the use of consultants, perhaps due to a lack of information regarding the services they can provide or due to the perceived cost of doing so.
- Current uses of Google Maps and Google Transit:** Figure 54 indicates that several agencies without online trip planner already use Google Maps, Google Transit and agency websites to help customers plan trips extending beyond their service area. This is further evidence of the significant benefits provided these tools at both the agency and regional level.

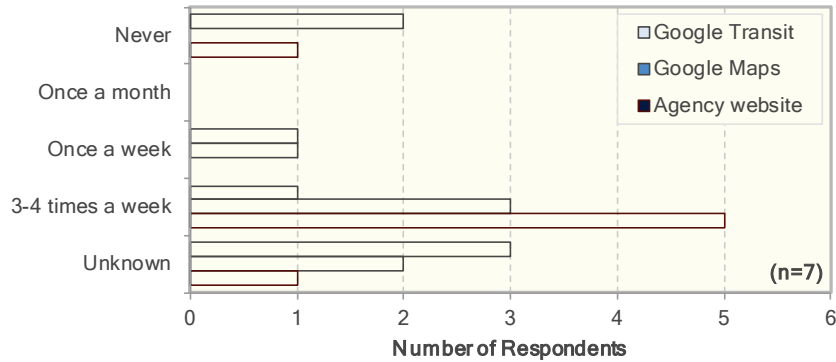


Figure 54: Use of Online Tools to Help Plan Trips on Neighboring Transit Networks

9.2. EXPERIENCES OF TRAVELERS WITH GOOGLE TRANSIT

Travelers are the primary individuals who benefit from the implementation of online trip planners. An evaluation of their experience in using such tools may therefore help understand their effectiveness in affecting transit accessibility and ridership. For this purpose, PATH conducted a survey of users of Google Transit in February, March and April 2011 to help gauge the use and perception of this tool. A summary of the survey methodology and main results of the analysis of responses obtained is provided below. Interested readers may obtain more information about the questionnaire that was distributed, the groups of individuals who responded to the survey, and the responses that were obtained for specific survey questions in Appendix H.

9.2.1. TARGET SURVEY POPULATION

The primary target population for the Google Transit user survey was the community of transit users within the service area covered by the agencies participating in the pilot project. Users of small transit systems were thus primarily sought.

9.2.2. SURVEY DELIVERY APPROACH

Various options were available to distribute the survey. The mechanism that was retained for delivery was through an online questionnaire. This approach was selected based on its cost-efficiency and the fact that it enabled close monitoring of the rate at which individuals were responding to the questionnaire. Another important consideration was the ability to tailor the set of questions asked to the specific situation of each respondent.

Similar to the survey of transit agencies, the online questionnaire was developed using software provided by SurveyMonkey (<http://www.surveymonkey.com/>). The various participating transit agencies put a link on their website informing individuals of the survey and taking them to the survey website.

To assist in the delivery and execution of the survey, Ewald & Wasserman, a professional survey firm, was retained by PATH to review the questionnaires, build the online form in Survey Monkey, assist agencies in implementing a link to the survey on their website, collect survey responses, and perform basic analyses and cross-tabulations of the completed questionnaires.

Various options were considered on how to achieve best visibility for the survey and increase the potential for responses. Table 15 compares the various distribution options that were considered. While an ideal approach was to have a link to the online survey popping up each time an individual would initiate a search on Google Transit’s website (option 1), Google did not allow modifications to be made to its application website. This only left the possibility of distributing the survey through links established on the website on each participating agency. Depending on the preference expressed by staff from each agency, various approaches were used to implement the link to the survey. In most cases, users were made aware of the survey through a pop up window appearing on their computer screen when first accessing the agency’s website or when initiating a search on the agency’s online trip planner. An example of pop-up window is shown in Figure 16.

Table 17: Survey Distribution Option Comparison

	Option	Advantage	Issues
1	Popup from search in Google Transit	<ul style="list-style-type: none"> Maximizes number of persons notified of the survey. Takes customer initiative to not take survey. 	<ul style="list-style-type: none"> Need to obtain permission from Google and to on Google staff for implementing the pop-up (<i>such permission was not granted for the current project</i>).
2	Link to Google Transit from agency website also opens survey popup	<ul style="list-style-type: none"> Customers can keep the survey link on their screens until completion of trip planning. Takes customer initiative to not take survey. 	<ul style="list-style-type: none"> Customers can circumvent the survey by accessing Google Transit without going through the agency website. Requires altering imbedded Google Trip Planner.
3	Redirect to survey before Google Transit	<ul style="list-style-type: none"> Takes customer initiative to not take survey. 	<ul style="list-style-type: none"> Customers must be willing to delay accessing Google Transit to fill out survey. Customers would not have used Google Transit yet before completing the survey.
4	Popup on agency website	<ul style="list-style-type: none"> Takes customer initiative to not take survey. Targets all who access the website regardless of purpose. 	<ul style="list-style-type: none"> Customers can circumvent the survey by accessing Google Transit without going through the agency website.
5	Survey link in addition to agency website link in query balloon and sidebar	<ul style="list-style-type: none"> Maximizes number of persons able to see the survey. Clearly displayed and publicized within Google Transit. 	<ul style="list-style-type: none"> Requires customer initiative to click on link. Coordination with Google needed.
6	Survey link replaces agency website link in query balloon and sidebar	<ul style="list-style-type: none"> Maximizes the number of persons able to see the survey. 	<ul style="list-style-type: none"> Requires customer initiative to see agency website or click on the survey link. Hinders customers from accessing the agency website. Coordination with Google may be needed.
7	Survey link on agency website	<ul style="list-style-type: none"> Easiest maintenance and launching process. Needs agency cooperation only. 	<ul style="list-style-type: none"> Takes customer initiative to notice links and click on them. Customers can circumvent the survey by accessing Google Transit without going through the agency website.

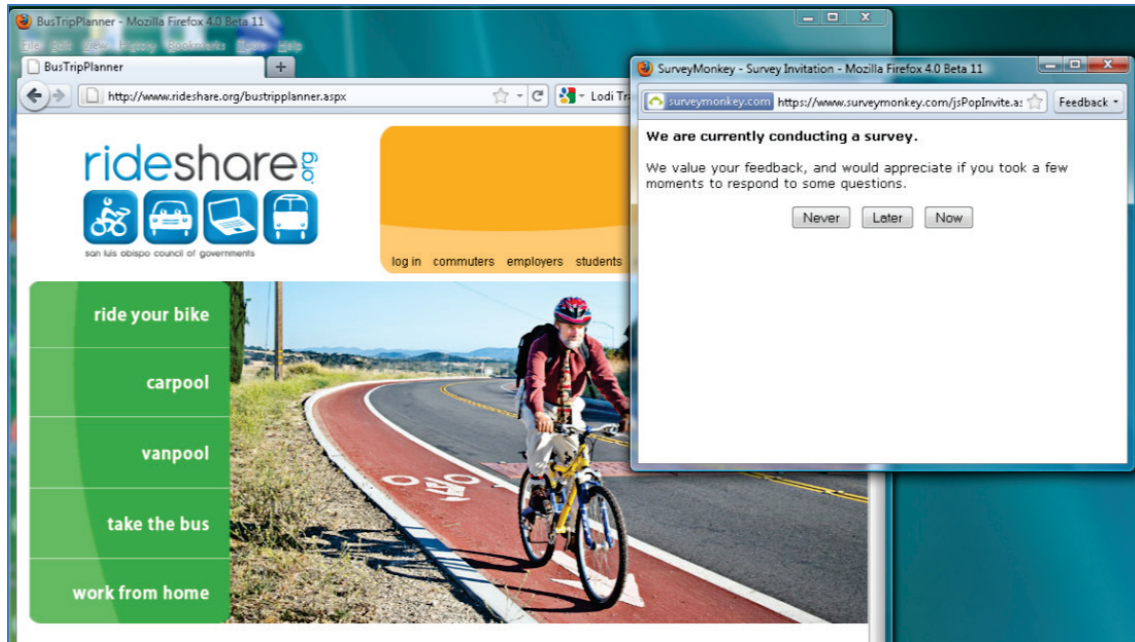


Figure 55: Pop-up Survey Window from San Luis Obispo’s Rideshare Webpage

Information about the survey was also publicized through transit user groups at a transit-related conference held at the University of California Berkeley in late February 2011. Conference attendees were provided with a link taking them to the Survey Monkey website hosting the survey. Since many, if not all, of these respondents may not be users of small transit systems, responses from conference attendees accessing the SurveyMonkey website were compiled separately from responses collected from individuals redirected from transit agency websites. This ensured that the sample population would not be biased by users of large transit systems, such as students using BART or AC Transit around Berkeley, while maintaining the ability to use the collected data for evaluating the use of Google Transit by travelers.

9.2.3. SURVEY QUESTIONS

A total of 28 questions were developed to collect various relevant information about the reasons individual travelers use Google Transit. Some socio-economic data were also asked to help put into context the information provided by respondents.

Depending on the responses provided to some of the early questions, three specific sets of questions were developed to cover the following situations:

- Individuals who used Google Transit to plan their current trip.
- Individuals who did not use Google Transit to plan for their current trip but have prior experience using it.
- Individuals who did not use Google Transit to plan for their current trip and have no prior experience using it.

Table 18 provides a summary of the questions that were asked to each group of individuals. Screenshots of the actual questionnaire that was posted on Survey Monkey can be found in Appendix H,

as well as a comprehensive compilation of responses to most questions. Depending on the situation, individuals were asked to provide answers to between 13 and 25 questions.

Table 18: User Survey Questions

Question	Used Google Transit to Plan Current Trip	Did Not Use Google Transit for Current Trip but Prior Experience	No Google Transit Experience
Did you plan a transit trip today using Google Transit?	X	X	X
Have you ever used Google Transit before?		X	X
Why have you never used Google Transit before?			X
Why did you not use Google Transit to plan your trip today?		X	X
What was the purpose of the trip?	X		
How often do you take this trip?	X		
Is this your first time taking public transportation for this trip?	X		
What mode of transportation do you usually take?	X		
Why did you change your transportation mode?	X		
How often do you use public transportation in general?	X		
How often do you plan to take this trip using public transit?	X		
How many transfers do you have to make for this trip?	X		
What is your starting location?	X		
What is your ending location?	X		
Are you using your car to start or end your trip?	X		
Where are you using Google Transit?	X	X	X
How often do you use online transit information services?	X	X	X
Satisfaction with various Google Transit elements?	X		
How helpful are the Google Transit tools in planning your trip?	X		
Additional features you would like to see on Google Transit?	X		
What is your gender?	X	X	X
What is your zip code?	X	X	X
What is your age range?	X	X	X
What is your total household income?	X	X	X
How many cars does your household own?	X	X	X
How many people live in your household?	X	X	X
What is the highest level of education you have completed?	X	X	X
Do you have any comments for the survey team?	X	X	X

9.2.4. PARTICIPATING AGENCIES

The initial target was to have all agencies participating in the pilot GTFS deployments to place a link to the user survey on their website. However, some agencies did not allow a link to the survey to be added to their website because of administrative issues or declined to participate due to a lack of resources. From the group of agencies participating in the pilot GTFS deployments, a link to the survey could only be placed on the following websites:

- Lodi Transit main webpage (<http://www.lodi.gov/transit/>)
- San Luis Obispo Rideshare webpage (www.ridershare.org)

However, following some outreach effort, the following small transit agencies also expressed interest and agreed to have a link to the user survey posted on their website:

- Monroe County Transit Authority, in Pennsylvania (www.gomcta.com)
- Sage Stage, in Altura, northern California (www.sagestage.com)
- Island Transit (www.islandtransit.org)

9.2.5. SURVEY RESPONDENTS

The user survey was launched early February 2011 and remained active until April 20, 2011. During this period, 215 individuals responded to the survey. This included:

- 60 individuals who responded through a link placed on the website of small transit agencies.
- 155 individuals attending a transit conference that was held at the University of California, Berkeley during the survey period and whom were provided a link to the survey.

Table 19 summarizes the response statistics from both groups. In the group of respondents from small transit agencies, only 21 individuals (35%) indicated having used Google Transit to plan a trip on the day of the survey. For the transit conference respondents, only 30 individuals (19%) indicated having used Google Transit on that day. Overall, 33 respondents (55%) from small transit agencies and 122 respondents (79%) from the transit conference indicated having experience using Google Transit.

Table 19: Survey Response Statistics

Category of User	Small Agency Respondents	University of California Conference Attendees
Total number of respondents	60	155
Used Google Transit on day of survey	21	30
Did not used Google Transit, but have used it previously	12	92
Never used Google Transit	25	29
No answer	2	4

The socio-economic characteristics of respondents within each group are detailed in Appendix H.4 and summarized below:

- Small transit agency users:
 - Primarily women (64%).
 - Age varying between 26 and 45 years, with a majority between 26 and 35 years old.
 - Annual household income between \$0 and \$150,000, with a majority of households earning between \$20,000 and \$80,000.
 - Typical households of 2 or 4 or more individuals.
 - One or two vehicles per household.
 - Individuals holding High School, some college, Bachelor and Master’s degrees.
- Transit conference respondents:
 - Gender evenly split between male and female.
 - Age varying between 18 and over 56, with a majority between 26 and 35 years old.
 - Annual household income between \$0 and \$150,000, with a majority of households earning between \$0 and \$40,000.

- Typical households of 1 or 2 or individuals.
- Typically one or no vehicle per household.
- Individuals primarily holding a Bachelor or Master’s degree.

Because of the notable differences between the two groups of respondents, the analysis of responses is kept separate for each.

9.2.6. SURVEY RESULTS – SMALL TRANSIT AGENCY USERS

This section summarizes key findings from the responses provided by the 60 individuals who were directed to the survey website from a link placed on the website of small transit agencies. A more comprehensive compilation of answers for individuals in this group can be found in Appendix H.

The following are findings from the 21 respondents who indicated having used Google Transit to plan a trip on the day they took the survey:

- **Reason for using Google Transit:** Out of 15 respondents, 4 individuals indicated using Google Transit for a trip they took for first time, while 5 individuals used it for a trip taken once a month or a year. Only 4 persons used it for a trip made every day or weekday. 3 individuals further indicated that their trip involved using transit for the first time. These were individuals who usually make their trip by driving alone or as part of a carpool. Transit was used because Google Transit made it easier to plan the trip, enabled them to save time, was seen as a more environmentally friendly alternative, or simply because a car was not available on that day.

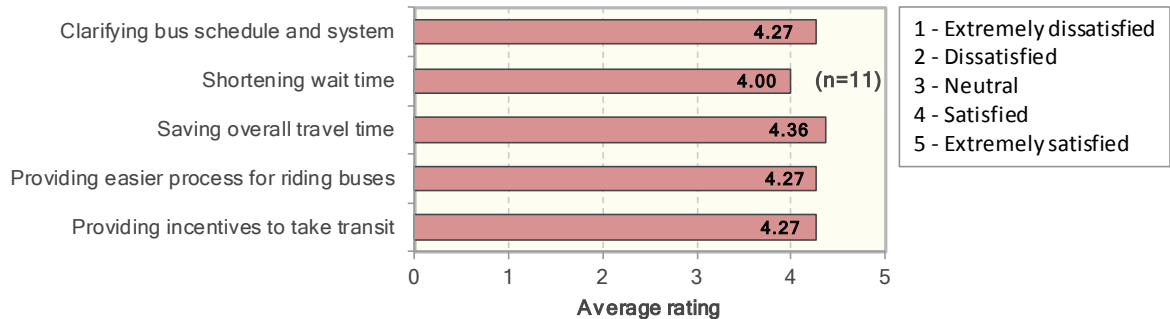


Figure 56: Google Transit Ability to Help with Trip Planning

- **Satisfaction with Google Transit:** Figure 56 summarizes satisfaction with the ability of Google Transit to help them plan trips. Overall, survey respondents showed a high level of satisfaction with the ability of the tool to help them find transit service information, shorten trip wait times and shorten overall travel times. Survey respondents understand that Google Transit displays transit services and view the tool as proving incentives to start or keep using transit services. Figure 57 further indicates that survey respondents are generally satisfied with using of Google Transit alone. However, lower satisfaction levels are expressed when other websites and schedules must be used in addition to Google Transit to find all the information sought, thus indicating a preference for using a one-stop information application.

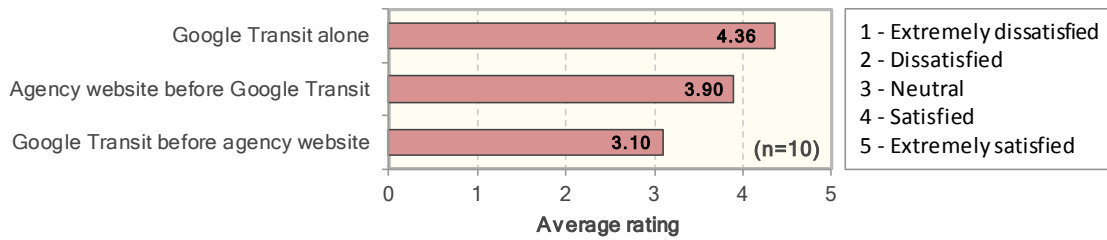


Figure 57: Satisfaction of Using Google Transit

The following are findings from the responses provided by 33 individuals who indicated having some experience using Google Transit, whether on the day they took the survey or prior to it:

- Frequency of use of online tools:** Figure 58 indicates that many of the survey respondents use Google Transit at least once a month, with 41% reporting using it at least once every week and 11% several times a week. Google Maps also appear to be frequently used, with 60% of respondents reporting using it at least once a week, and 97% using it at least once a month. Transit agency websites also appear to be used relatively frequently.

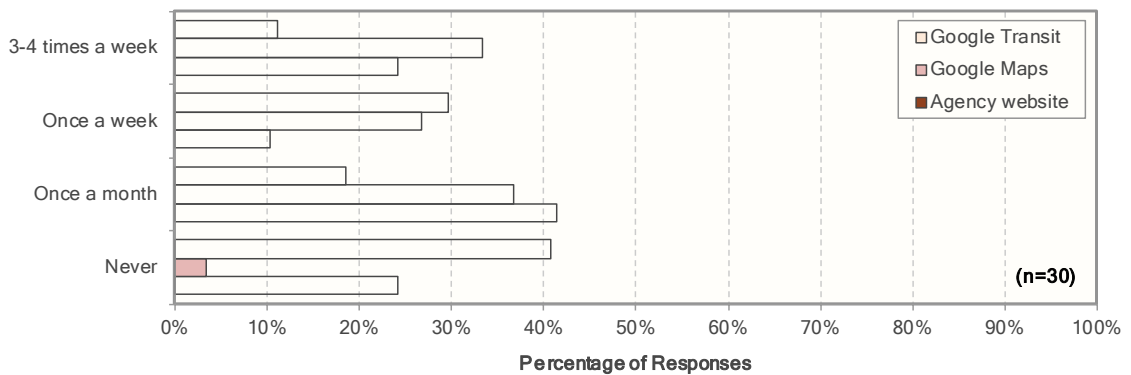


Figure 58: Frequency of use of Online Tools

- Point of access:** Figure 59 indicates where survey respondents typically access Google Transit. As can be expected, most of the respondents access the tool from home, with a sizeable proportion also accessing from their office. A notable observation is that 22% of respondents also indicate accessing Google Transit from their mobile phone, which illustrates a growing need for providing information on platforms compatible with mobile browsers.

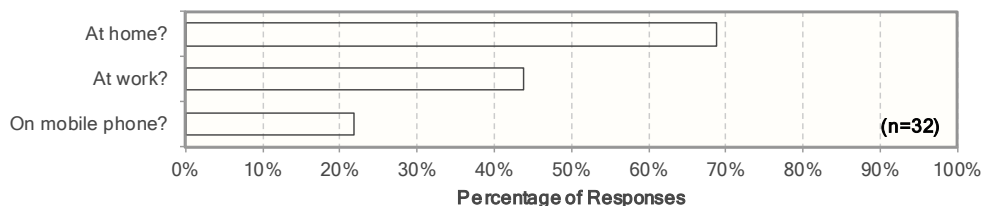


Figure 59: Point of Access of Google Transit

Desired features: Figure 60 compiles the features that Google Transits users would like to see added to the tool. Real-time information is by far the predominant desire. This is a feature that has just recently been added to the tool by Google and which was not available when the survey was conducted. Other requests typically relate to improved information. Respondents sought an improved ability to perform multimodal trip searches, such as trips combining bike and transit segments; improved data accuracy, particularly regarding bus stop locations; improved fare information; the inclusion of vehicle fees that may be paid on trips involving transit, such as fees to park a vehicle in park-and-ride lots or board a ferry. Some other requests pertain to features that already exist, such as the desire for transit agencies to include a link to their website to facilitate searching for additional information on the agency’s website (a link to the agency providing the data is typically shown at the bottom of the left display of each trip plan). Such requests may simply be the results of individuals not being aware of the feature. However, they may also be an indication of missing GTFS data elements. As with any information system, the information returned by Google Transit depends on the data inputted into it. Fares and frequencies are for instance optional GTFS data elements and thus not always provided. The survey comments thus point to a preference for transit agencies to develop comprehensive data feeds rather than basic feeds simply characterizing routes and time tables.

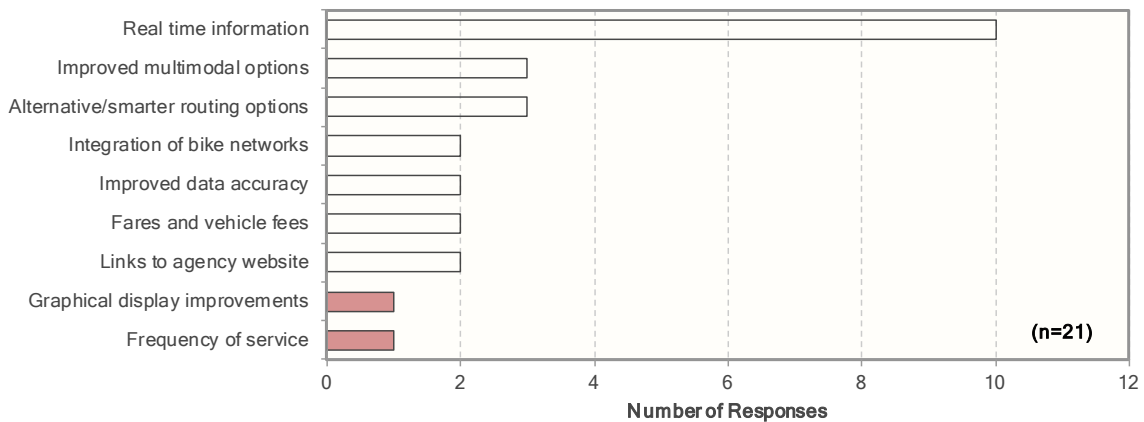


Figure 60: User-Desired Google Transit Features

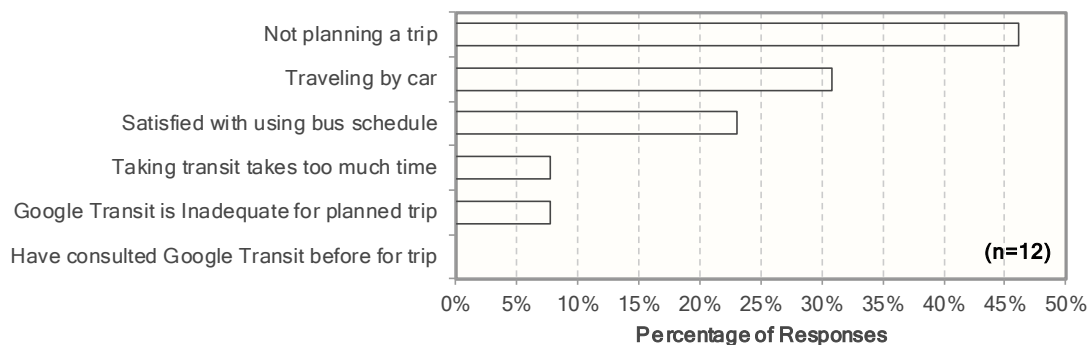


Figure 61: Reasons for not Using Google Transit on Day of Travel

The following are findings from the 12 respondents who indicated having used Google Transit before but not on the day of the day:

- Reason for not using Google Transit on day of survey:** Figure 61 indicates that the most commonly given reason for not using Google Transit on the day of the survey was that a trip was not being planned on that day. Other reasons were that travel was done by car, the person was satisfied with using the schedule information provided on the agency website, or that transit was not considered because it takes too much time. One person notably indicated that Google Transit was not used because it consistently produces inaccurate trip searches in his area. This comment again greatly emphasizes the importance of providing accurate data to Google Transit to avoid alienating potential users.

The following are finally findings from the 25 respondents who indicated having never used Google Transit before:

- Reason for not using Google Transit:** Figure 62 indicates that the primary reason for not using Google Transit is a simple lack of awareness about the tool. This illustrates the importance of conducting appropriate outreach following the launch of an online trip planner. A fair number of individuals also stated already knowing the schedule and route of the buses they normally take, or being satisfied with using printed bus schedules. Five individuals further indicated that they normally use 511 or other information services available in their region.

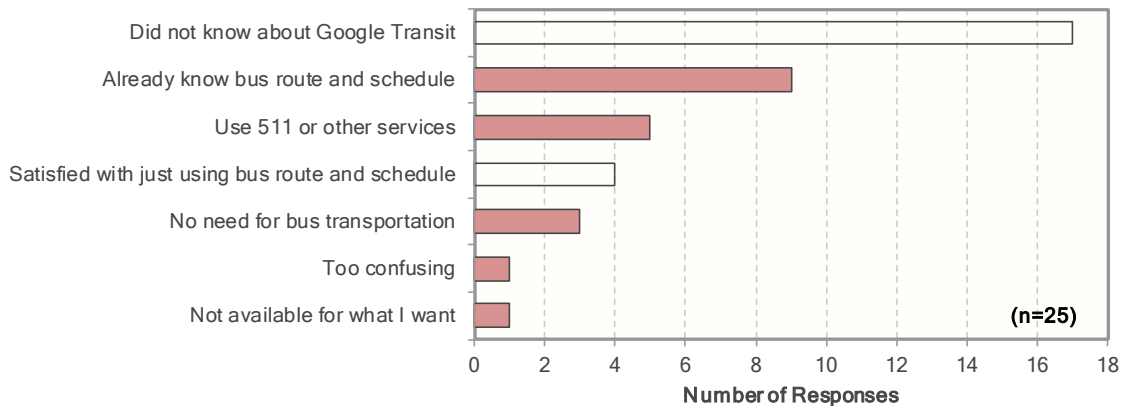


Figure 62: Reasons for Having Never Used Google Transit

9.2.7. SURVEY RESULTS – TRANSIT CONFERENCE RESPONDENTS.

This section provides a summary the findings from the responses obtained from the 155 individuals who attended the transit conference held at the University of California, Berkeley. Similar to other groups of individuals, a more comprehensive compilation of answers provided by individuals in this group to the various questions asked can be found in Appendix H.

The following are findings from the 30 individuals who indicated having used Google Transit to plan a trip on the day of survey:

- Reason for using Google Transit:** Out of 28 respondents, 6 persons (21%) indicated using Google Transit for a trip they took for the first time, while 12 persons (43%) used it for a trip made once a month or once a year. Only 10 (36%) persons indicated using Google Transit for a trip taken

every day, every weekday or once a week. 8 persons (29%) further indicated that their trip involved taking transit for the first time. These were individuals taking the trip every day or a few times a week and who normally drive alone, drive in a carpool, bike, or walk. Transit was used because it was seen as a more economical or environmentally friendly alternative, or simply because a car was not available on that day.

- Satisfaction with Google Transit:** Figure 63 compiles the degree to which travelers are satisfied using Google Transit alone or in conjunction with other online tools. In general, respondents indicated that they were very satisfied using Google Transit alone. Neutral to slightly negative satisfaction levels were indicated when using Google Transit in conjunction with an agency website, likely due to the inconvenience of not being able to access all the required information from a one-stop application. Similar to small transit agency respondents, the need to use an agency website prior to using Google Transit was notably ranked with the lowest satisfaction.

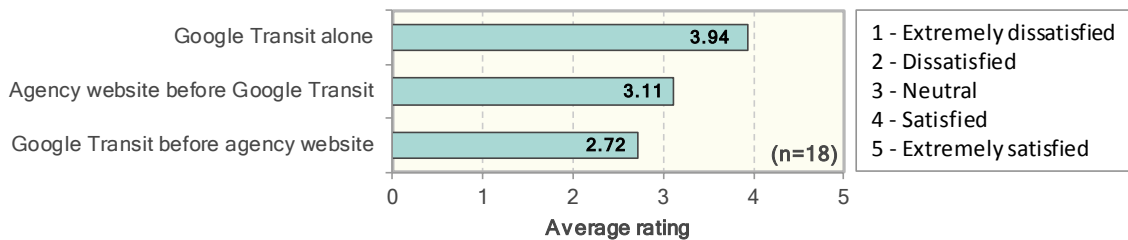


Figure 63: Satisfaction of Using Google Transit (Conference Respondents)

- Satisfaction with trip planning capabilities:** Figure 64 indicates a high level of satisfaction with the ability of Google Transit to help them find transit service information, shorten wait times and travel times, and provide incentives to start of keep using transit services. An interesting observation is that the satisfaction levels expressed by the conference attendees are noticeably lower than those expressed by small transit agency users and shown Figure 56.

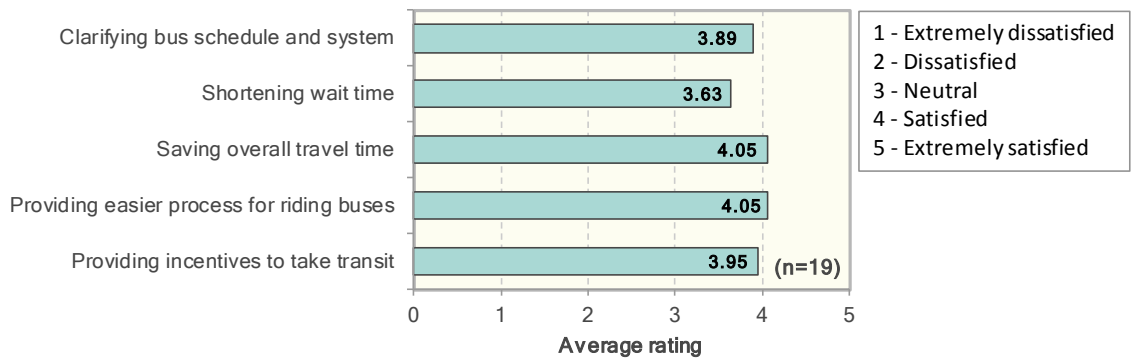


Figure 64: Google Transit Ability to Help with Trip Planning (Conference Respondents)

The following are findings that were obtained by compiling the responses from the 112 who indicated having some experience using Google Transit, whether on the day took the survey or prior to it:

- Frequency of use of online tools:** Figure 65 indicates that 63% of the conference attendees used Google Transit at least once every week and 21% several times a week. Overall, 97% of the survey responded indicated using Google Transit at least once a month. Google Maps also

appear to be frequently used, with 98% of respondents indicating using at least one a week and 82% multiple times a week. Since Google Transit can be accessed from Google Maps, some of these uses might be in conjunction with Google Maps. In this case, websites set up by transit agencies appear to be mainly used by occasional information seekers, with 47% of responding indicating using them at least once a week. While this is still a reasonable proportion, it is significantly less than the use of Google Maps and Google Transit.

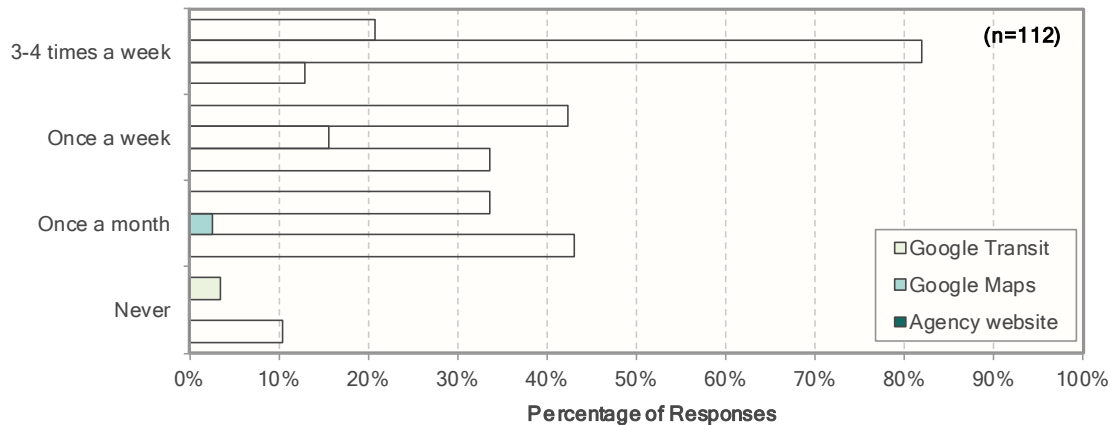


Figure 65: Frequency of Use of Online Tools (Conference Respondents)

- Point of access:** Figure 66 indicates that 96% of the survey respondents indicated using Google Transit at home, with 70% also using it at work. 43% of respondents further indicated accessing Google Transit from their mobile phones, which is significantly higher than the proportion obtained from small transit agency respondents (22%). This may simply be due to a higher proportion of individuals owning smart phones with browsing capabilities within the conference attendees than the group of small agency respondents. Regardless of the difference, this statistics reinforces the high demand for accessing transit information from anywhere, and thus a need to provide information on mobile platforms.

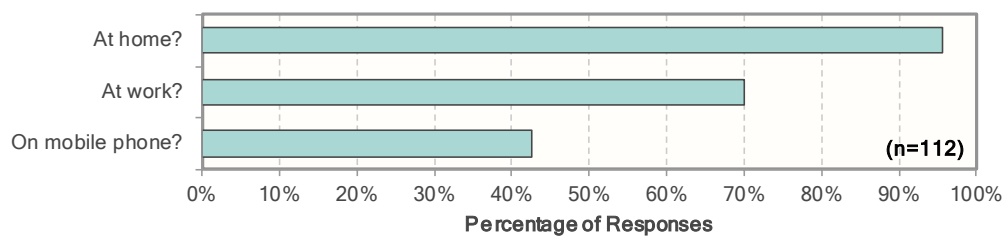


Figure 66: Point of Access of Google Transit (Conference Respondents)

- Reason for not using Google Transit on day of travel:** Figure 67 compiles the reasons given by survey respondents with prior Google Transit experience explaining why they did not use it to plan a trip on the day they took the survey. The most common reason was again that no trip was being planned on that day. Other reasons were that the person was satisfied with using a bus schedule, had consulting Google Transit before and already knew the information needed, or traveled by car, bike or foot on that day. A few respondents indicated that they used other online trip planners, in this case Nextbus (San Francisco bus tracking system) and San Francisco Bay Area 511 services.

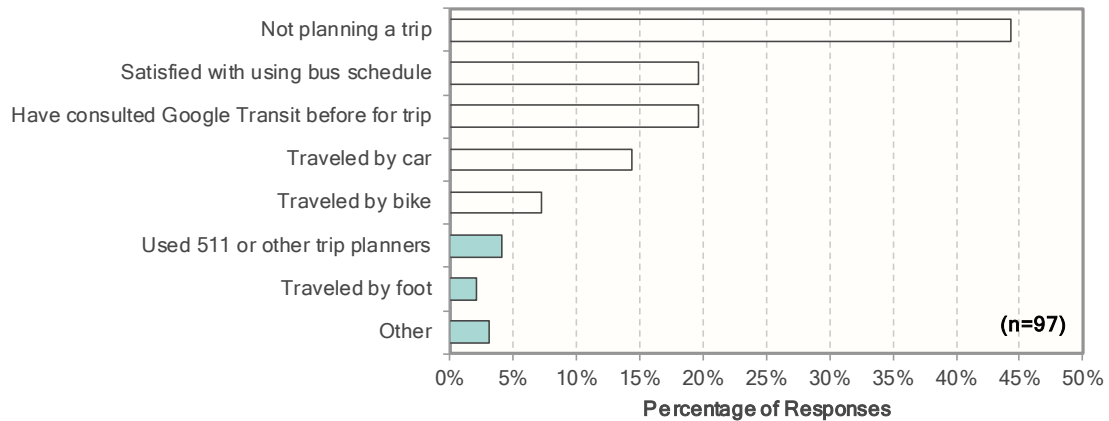


Figure 67: Reasons for not Using Google Transit on Day of Travel (Conference Respondents)

The following are finally findings from the 27 conference respondents who indicated having never used Google Transit before:

- Reason for having never used Google Transit:** Figure 68 indicates that 21 of the 27 respondents (78%) simply did not know about Google Transit, illustrating again the importance of conducting appropriate outreach following the launch of an online trip planner. Many individuals also stated already knowing the schedule and route the buses they normally take or being satisfied with using printed bus schedules. In this case, no one indicated using regional 511 services offered around Berkeley and the Bay Area.

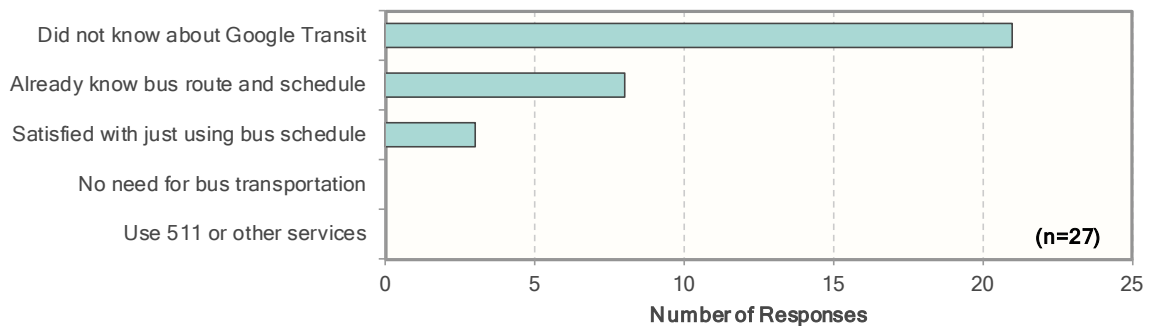


Figure 68: Reasons for Having Never Used Google Transit (Conference Respondents)

9.3. TRANSIT TRIP PLANNER HIT STATISTICS

To complement the survey of Google Transit users, statistics were sought about the number of times the online trip planners offered by small transit agencies are being accessed by individuals. Such statistics can typically be obtained from web counters, i.e., programs indicating the number of visitors, or hits, a particular webpage has received.

For transit agencies, website hit statistics can be obtained in one of two ways. The first approach consists in placing a web counter directly on the agency’s website. Website hit statistics can also be obtained through the use of the Google Analytics application. Google Analytics is a free application offered Google that is commonly used by webmasters to generate statistics about visits to a website. Transit agencies can use the application to track the number of visitors to the webpages where travelers

can access their online trip planner or a link to Google Transit. A screenshot of a Google Analytics report is shown in Figure E16. This example shows the hit statistics for San Luis Obispo Regional Rideshare webpage (<http://www.rideshare.org/NewHome.aspx>) where travelers could access an interface to Google Transit. While Google Analytics can be used to track visits to any website maintained by an agency, this application cannot unfortunately be used to track the number of times individuals access the agency’s GTFS data directly from Google Transit or Google Maps. Since the Google Transit and Google Maps websites are operated by Google, Google considers all statistics regarding their operation as proprietary information.

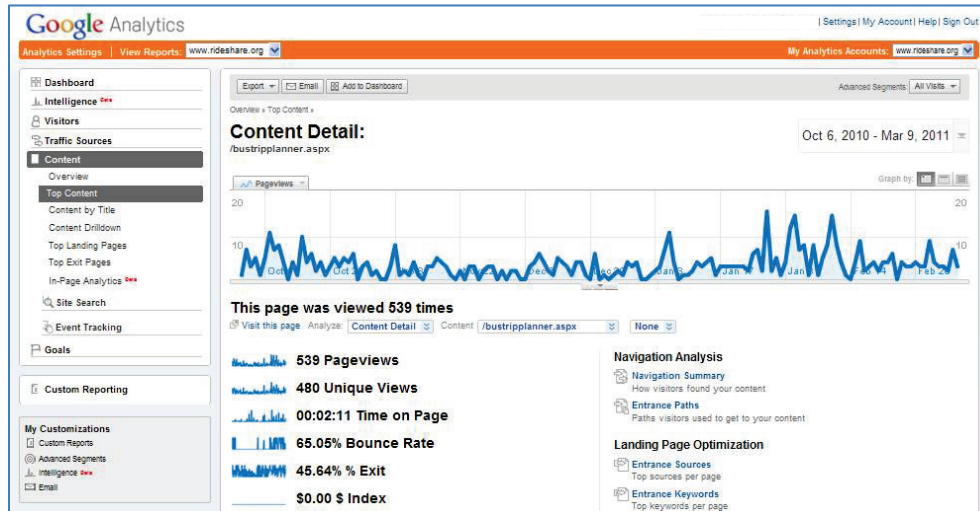


Figure 69: Google Analytics Statistics Example

(Courtesy of San Luis Obispo Rideshare)

Google Analytics compiles statistics by placing cookies on the pages from which visitors are accessing a given website. Cookies are used to store anonymous information such as whether the visitor has been to the site before (new or returning visitor), the time of the current visit, and how the visitor accessed the site (e.g., through a search engine, keywords, banner or email). While this process allows collecting detailed usage statistics, it may not count all users as filtering software may block the installation of cookies. Website access from mobile phones that do not support Java scripts or cookies may also not be counted. Finally, while this application can be used to track visits to any website operated by an agency, it cannot be used to track visits to the Google Transit website directly, as statistics regarding the operation of Google Transit is considered proprietary information by Google.

Despite the availability of tools to track website usage, the agency resource survey that was conducted early in the project (see Section 3.7) revealed that many small transit agencies simply do not track the number of hits on their website. Among the agencies participating in the pilot project, the only ones tracking website hits were Paso Express, Cerritos on Wheels, and the San Luis Obispo Regional Transit Agency. Of these three agencies, Cerritos on Wheels and the San Luis Obispo Regional Transit Agency was the only ones offering an online trip planner on their website and therefore the only ones that could provide statistics of interest to the current evaluation. Additional outreach efforts further resulted in the collection of website hits statistics from a third, out-of-state agency already offering an online trip planner on its website: Island Transit, from Island County in the state of Washington.

9.3.1. CERRITOS ON WHEELS

According to statistics collected using Google Analytics, the transit trip planner on Cerritos on Wheels' main webpage received 335 page views, with 265 unique page views, between January 28 and March 28, 2011. Over the same period, the agency's main webpage had 1210 page views and 1015 unique page views. The unique page view statistic tracks the number of sessions during which a page was viewed one or more times, while the page view statistic simply tracks the total number of times that a page was loaded. A user that hits the reload button while viewing a page will thus generate a new page view, but not a new unique page view. Similarly, a user who navigates away from a page and later returns to it will generate a new page view but not a new unique page view, as this person had previously accessed the webpage.

The above statistics indicate 335 pages views from 265 individuals over a two-month period. This corresponds to an average of 168 page views per month from an average of 133 individuals. When compared to the total number of hits on the agency's main webpage, from which the online planner is accessed, it can be assessed that about 26% of all visits to the website were to consult the trip planner over the reporting period.

Additional information obtained from Cerritos on Wheel staff further indicate that the launch of its online planner did not appear to have increased traffic on its website, as an average of about 20 page views per day has been recorded before and after the launch of the planner.

9.3.2. SAN LUIS OBISPO REGIONAL TRANSIT AGENCY

The San Luis Obispo Regional Transit Agency maintains two webpages from which the online planner could be accessed. The planner is displayed both on the agency's main webpage (<http://www.slorta.org/>) and on a dedicated page (<http://www.slorta.org/google>) that can be reached from a link posted on the agency's main webpage.

For the specific page, the online planner received a total of 4003 visits during 2010, for an average of about 333 visits per month. Most of the visits are assumed to be from individuals who were already on the agency's website. Only 212 visits were from individuals who entered directly onto the page (links from some other site), while 1,286 exits were recorded from it. It can fairly be assumed that most of the exits from the webpage are likely to be searches from the online planner.

Tracking usage of the online planner displayed on the main agency's webpage is more difficult as the tracking tool used by the agency does not distinguish whether the page was accessed for the planner or to obtain other information. This page had about 90,000 page views during 2010 and 26,000 exits. 52% of these visits lasted less than 30 seconds, 17% between 30 seconds and 2 minutes, and 31% more than 2 minutes. Assuming that about half the visits lasting two minutes or more involve use of the online planner would yields an estimate of 3,900 page views for the planner for 2010. Combined with the searches from the specific page, an estimate of nearly 5,200 views could be made for 2010, yielding an average of 430 views per month.

For the online planner displayed on Rideshare webpage (<http://www.rideshare.org/NewHome.aspx>), 993 page views from 855 individuals were recorded in Google Analytics from two starting webpages between October 6, 2010 and March 9, 2011. This corresponds to an average of 320 page views per month from an average of 214 individuals. During the same 5-month period, the transit webpage linked to the Rideshare webpage had 1,598 page views from 1,071 individuals, while the Rideshare main

webpage had a total of 10,664 page views from 8,444 individuals. When comparing the online planner hits to the total number of hits on the Rideshare program webpage, it can be assessed that approximately 15% of the person accessing the site consulted the online planner.

9.3.3. ISLAND TRANSIT

Island Transit reported that its Google Transit planner has been viewed 18,482 times between December 1, 2008 and February 2011. Shortly after the launch of planner in December 2008, an average of 1000 hits per month was recorded. Since then, the hit rate has gradually come down to an average of 500 hits per month. It is suspected that this drop is likely the result of individuals gradually migrating to websites operated by Google (either Google Transit or Google Maps) once they find out that the information they are looking for is also available from these sites.

9.3.4. GENERAL OBSERVATIONS

Based on the statistics reported above, the following general observations can be made regarding the use of online transit planners provided by small transit agencies:

- Usage statistics reported by the three surveyed agencies indicate a consistently moderate use online transit trip planners. Among the surveyed agencies, the lowest monthly average usage rate was 133 visits per month while the highest rate was approximately 500 visits per month.
- Actual usage rates of online trip planners are likely to be higher than the statistics reported by webpage counters installed on agency webpages since such counters do not count individuals directly accessing Google Transit or Google Maps to conduct their searches.
- It is generally thought that information seekers tend to migrate towards Google websites once they find out that transit information be accessed from there directly. However, the magnitude of this migration is difficult to evaluate as Google does not typically share information about the number of times that individual searches are performed on Google Transit.

10. TRAINING RESOURCES

This section presents some training resources that are available to transit agency staff interested in learning how to develop and maintain GTFS data. The resources presented include:

- A Quick Reference Guide that was developed by PATH to provide step-by-step instructions on how to accomplish specific tasks regarding GTFS data preparation and validation
- Training videos that were produced by Marcy Jaffe Company for the National RTAP on how to use an Excel GTFS builder tool offered by the agency.

10.1. QUICK REFERENCE GUIDE

To accompany the material presented during the training sessions, a Quick Reference Guide presenting step-by-step instructions on how to execute specific tasks was produced by PATH and distributed to the session participants. A copy of the reference guide is provided in Appendix D. Topics covered in the guide include:

- Bus stops:
 - Creation or relocation of bus stops
 - Creation of bus stop schedule
- Transit vehicle trips:
 - Addition of a stop to a trip
 - Removal of stop from a trip
 - Building a new trip from an existing trip
 - Adding/deleting a trip with the same pattern of another trip
- Transit schedules:
 - Build/modify a trip calendar
 - Cancel service or assign Sunday schedule for Holiday service
- Fares:
 - Web link to examples on how to code fares
- Transfers:
 - Coding of transfer characteristics between pairs of bus stops
- Bus routes:
 - Coding a bus route in Google Earth
- Posting and validating GTFS data files:
 - Creating a compressed file containing the 6 required and 6 optional (if available) data files associated with Google Transit applications.
 - Installation and use of TripTable Publisher
- Additional information:
 - List of various helpful web links.

10.2. TRAINING VIDEOS FOR NATIONAL RTAP GTFS BUILDER

Professional training videos describing how to develop GTFS data using the National RTAP’s Excel-based GTFS Builder have been produced by Marcy Jaffe Company and released in September 2011 (see Figure 70). These videos, which are 1 to 5 minute in length, provide step-by-step instructions on how to perform specific tasks. Their aim is to allow transit agency staff to visually see and hear, at their own pace, someone going through the process of creating and managing GTFS data using the National RTAP’s tool. While the videos were developed to be used with the National RTAP tool, they can also be used to learn how to use Heitzman’s Excel tool since the National RTAP tool is based on the former. Some of the videos also contain general information on GTFS data development that may be useful to agencies considering using other tools.



Figure 70: National RTAP GTFS Builder Webpage

The National RTAP videos can be accessed from the *National RTAP in the Cloud* website, at <http://www.nationalrtap.org/WebApps.aspx>. After login to the site, the videos can be accessed by clicking on the “Support Center” icon and scrolling down to the “GTFS Builder – How-To Videos” section. As of August 2011, the following videos were available:

- Overview videos:
 - Should my agency proceed to GTFS Builder
 - Summary view of Files Generated & Common Terms
- Data management/download GTFS Excel files/tools:
 - Creating your GTFS builder workspace
 - Download Google Earth
 - Download GTFS Builder files
 - Download validation tools
 - Enable macros
- Gathering/Updating GTFS data - Bus stops:
 - Naming and storing bus stop data into stops tab
 - Geocode bus stop locations with on-line tools
 - Batch geocode your agency bus stops
 - Viewing bus stop locations on the map from Excel
 - Why precise bus stops are important
- Gathering/Updating GTFS data – Schedules:
 - Walk through Schedules Workbook
 - Build GTFS schedules from Excel Schedule files
 - Build GTFS schedules from run cards
 - Using Schedules_V2 to output stop_times and trips
 - Headsigns (Stop_headsigns vs. trip_headsigns)
 - Direction ID
 - Wait times
 - Pick-up/Drop-off types
 - Timed stop
 - Error messages
 - Shape ID (for routes on the road)
 - Block ID
- Schedules - Generate stop times and trips:
 - Output from Schedules Workbook: Stop times and trips
 - Copy/transfer Stop times and trips files to Import/Export Workbook
- Wrap-up one complete route:
 - Walk through Import/Export workbook
 - Agency tab
 - Calendar and Calendar_dates tabs
 - Fares
 - Routes
 - Shapes introduction
 - Transfers
 - Export GTFS and compress (*google_transit.zip*) file
- Validate route / GTFS testing tools:
 - Overview of testing tools

- Drag and drop GTFS zip file onto FeedValidator
 - Drag and drop GTFS zip file onto ScheduleViewer
- Upload validated files / Hosting:
 - Transfer from local computer to NRTAP in the Cloud (*for agency interested in hosting their data onto the NRTAP server*)
- Create Google account / Request preview account:
 - Create Google Account
 - Sign-up for Transit Partner and Preview Testing Account
 - Configure the weekly “Fetch” at Partner Content Front End
 - Sign Google License Agreement
- Build display for routes on the road:
 - What are shapes?
 - Download Google Earth
 - Create straight line output from Import/Export workbook
 - Edit share to centerline of road
 - Test and resolve distance of share from stop
- Test trip planning / Random trips at preview account:
 - Google Activates Preview Testing Account/Trip Plan Testing Begins
 - Drag and Drop GTFS zip file to create random test trips
- Request to go live / Pre-launch:
 - Create and test four sample trips
 - Fill-out on-line form to request final review/pre-launch

In addition to the videos, a *Getting Started Guide* is also offered. Similar to the videos, while this guide is geared towards users of the Excel-based National RTAP GTFS builder, it provides a useful general summary of the process that must be followed to develop and publish GTFS data onto Google Transit.

11. TECHNICAL RESOURCES

This section presents a listing of technical resources that transit agencies may contact to seek help with the development of their online transit trip planner. The resources presented include:

- Google Transit’s best practices webpage
- National RTAP
- User groups
- Blogs
- Consultants
- Agencies with deployed online trip planners

11.1. GOOGLE TRANSIT’S BEST PRACTICE WEBPAGE

Google provides a best practice webpage on the topic of creating and maintaining data for Google Transit at <http://maps.google.com/help/maps/transit/partners/bestpractices.html>. Topics discussed within the webpage include:

- Using optional GTFS feeds to create a high quality feed.
- Best practices for naming routes and stops.
- Recommended pre-launch GTFS data tests.
- Recommended GTFS data update practices.

11.2. NATIONAL RURAL TRANSIT ASSISTANCE PROGRAM (NATIONAL RTAP)

The National RTAP operates under a cooperative agreement between the Federal Transit Administration (FTA) and the Neponset Valley Transportation Management Association. Its overarching mission is to address the needs of rural, small urban and tribal transit operators across the nation. Much of the work of National RTAP is overseen by the National RTAP Review Board, which is made up of personnel from both local transit operators and state departments of transportation. Their expertise in the field of rural transit helps guide and inform the development of National RTAP products and services.

Figure 71 provides a screenshot of the main National RTAP resource page. As can be seen, this program provides small transit agencies a variety of resources to help solve specific problems. Key resources that may be of value for the development of online transit trip planners include:

- **Peer-to-peer network.** The program provides a network of transit professionals that can be contacted for obtain problem-solving support on issues relevant to rural transit agencies.
- **One-on-one assistance.** National RTAP staff is on hand to answer rural transit questions, provide training material and assist with finding solutions to problems facing rural transit agencies.
- **Training materials.** The program provides for free various training materials, such as training books, training videos, interactive CD-ROMs, technical briefs, and webinars.
- **GTFS builder.** National RTAP provides various free web applications. One of these applications, scheduled to be released in fall 2011, is a web-based GTFS Builder designed to help transit agencies create and manage their data in the GTFS format. The builder will also include step-by-

step training videos developed by Marcy Jaffe, which will allow transit agency staff to go through the process of creating and managing a GTFS feed at their own pace.

Contact information:

National RTAP

5 Wheeling Avenue, Unit B
Woburn, MA 01801

Phone: (888) 589-6821

Fax: (781) 895-1122

Email: info@nationalrtap.org

Website: www.nationalrtap.org

National RTAP in the Cloud

Account | Support Center | Forums | National RTAP.org | Logout

- ProcurementPRO**
It is designed to give Indian tribes, non-profit organizations, municipalities and transportation agencies the appropriate federal clauses and certifications regarding federal procurement requirements and processes when utilizing federal funds.
[Access Dashboard](#)
- Website Builder**
A complete content management system that will help you build and manage a website for your organization.
[Access Dashboard](#)
- GTFS Builder**
This collection of technical assistance tools will assist you with getting your bus route and schedule data ready to import into Google Transit.
[Access Dashboard](#)
- Resource Library**
Add the National RTAP Resource Library to your website, and manage and share your own documents online, with an easy-to-use web interface.
(Coming Summer 2011)
- Calendar**
Manage, publish and share your events online, and view events sponsored by other organizations.
(Coming Summer 2011)
- Peer to Peer**
Looking for a Peer rural or Tribal transit operator or state program manager to provide guidance or help you resolve a problem? Would you like to become a Peer and offer your expertise to other transit providers or program managers? Request assistance or volunteer up here.
(Coming Summer 2011)
- 2 The Point Training**
Is training your transit employees hard to schedule without interfering with operations or creating overtime expenses? Access training modules on the go in small, portable segments for a more flexible alternative to the traditional classroom setting.
(Coming Fall 2011)
- Communication**
Manage all your opt-in email lists, including newsletters, announcement lists, discussion groups and email communities.
(Coming Summer 2011)

Figure 71: National RTAP Resources Main Webpage

11.3. USER GROUPS

Google has created two user groups to help transit agencies deal with issues and problems they may have with Google Transit:

- **Google Transit Partners Support Group.** This group, which can be accessed at <https://groups.google.com/forum/?pli=1#!forum/google-transit-partner-support>, is reserved for transit agencies. It provides announcements made by Google Transit, tips and tricks on how to use Google Transit, implement their data into GTFS, as well as troubleshooting. It also allows transit agencies to request features and provide suggestions regarding potential Google Transit improvements. Participation in this group further allows transit agencies to discuss with one another and directly with Google staff.
- **Google Transit Trip Planner Group.** This group, which can be accessed at <http://groups.google.com/group/googletransit>, is open for everyone to join to ask questions, make suggestions, and bring up problems with Google Transit. Since this group is primarily set up to enable travelers and Google Transit users to voice comments and provide feedback to the Google Transit development team, it may be a significantly less important resource for transit agency staff than the Google Transit Partners Support Group.
- **National RTAP in the Cloud Support Center.** This new group, which can be accessed at <http://nrtap.zendesk.com/home>, allows users of the National RTAP GTFS builder to ask questions to community of users of the tool.

11.4. BLOGS

Online blogs can be a resource to understand the latest tools and resources as well as how the public or specific interest groups view a trend or a tool like Google Transit. Below is a list of online blogs that transit agency staff may consult to obtain answers on specific questions:

- **StreetsBlog:** Streetsblog is a daily news source, online community and political mobilizer for the Livable Streets movement. It serves a growing coalition of individuals and organizations in cities around the world working to transform our cities by reducing dependence on private automobiles and improving conditions for cyclists, pedestrians and transit riders.
- **Worldchanging:** Worldchanging.com is a nonprofit media organization dedicated to solutions-based journalism about the planetary future. Since 2003, Worldchanging has brought together a global network of independent journalists, designers and thinkers to cover the world's most innovative solutions to the planet's problems, and inspire readers around the world with stories of new tools, models and ideas for building a bright green future.
- **Trillium Solutions Blog:** This blog is run by Aaron Antrim of Trillium Solutions. This blog addresses various issues related to the use of online transit trip planners and the dissemination of transit service information.

11.5. CONSULTANTS

Below is a list of consultants that can help transit agencies with the tasks of developing online transit trip planners. The list is arranged in simple alphabetical order. Some of these consultants may offer

data conversion and maintenance services without requiring the purchase of a specific software package, while others may require the use of specific software they have developed.

- **Avego Corporation**
5669 Snell Ave #250
San Jose, CA 95123
(408) 540-9942
sales@avego.com
<http://www.avego.com/>
- **BlinkTag, Inc.**
1461 15th St
San Francisco, CA 94103
(415) 373-6442
info@blinktag.com
<http://blinktag.com/>
- **I2MApp Innovacion en Movilidad S.L.** (*developer of TransEditor.com*)
(+34) 94 33 09 07
i2mapp@i2mapp.com
www.i2mapp.com
- **Iteris, Inc.**
(208) 345-4630
busfeeder@iteris.com
<http://www.iteris.com/transportation.aspx?q=10159&c=10026>
- **Marcy Jaffe Company**
1213 Blaine Street
Port Townsend, WA 98368-6505
(360) 379-1382x1
Action4me@gmail.com
<http://mjcaction.com>
- **Mecatran**
17, Rue de Tabari
44190 Clisson
France
(+31) 6 52 34 05 44
info@mecatran.com
<http://www.mecatran.com/urbineris/transit>
- **Mentor Engineering, Inc.**
10, 2175-29th Street NE
Calgary, Alberta
Canada T1Y 7H8
(403) 777-3760
<http://www.mentoreng.com/>

- **Next Insight**
New York State
(914) 613-3500
<http://nextinsight.com/>

- **OpenPlans Transportation**
148 Lafayette St, PH
New York, NY 10013
(212) 796-4220
<http://openplans.org/>

- **Schedule Masters, Inc.**
200-5A Conestoga Drive,
Brampton, Ontario
Canada L6Z4N5
(905) 495-5402
<http://www.themasterscheduler.com/index.php>

- **Telvent Farradyne Inc.**
2101 Webster Street, Suite 1540
Oakland, CA 94612
(510) 869 9986
<http://www.telvent.com/en/>

- **Trillium Solutions, Inc.**
14525 SW Millikan #7680
Beaverton, OR 97005-2343
(707) 633-4464
aaron@trilliumtransit.com
<http://www.trilliumtransit.com/>

- **Vaquero Systems, LLC**
793A Foothill Blvd. #8
San Luis Obispo, CA 93405
(800) 278-4679
sales@vaquerosystems.com
<http://www.vaquerosystems.com/>

11.6. TRANSIT AGENCIES WITH ONLINE TRANSIT TRIP PLANNER

Information about transit agencies that have launched on Google Transit can be obtained from the following websites:

- **Google Transit**, at <http://www.google.com/intl/en/landing/transit/text.html#mdy>.
- **GTF Data Exchange**, at <http://www.gtfs-data-exchange.com/agencies>.

12. LESSONS LEARNED

This section lists various lessons that were learned through the process of developing and implementing GTFS data for the eight agencies participating in the pilot Google Transit deployments, as well as from the various surveys, training sessions, and interviews that were conducted during the project. These lessons are grouped according to the primary types of activities or topic they relate to:

- Utility of online trip planners
- Evaluation of impacts on travel behavior
- Development tools
- GTFS data development and validation
- Implementation process
- Data maintenance and hosting
- Training needs

12.1. UTILITY OF ONLINE TRIP PLANNERS

The following elements were identified regarding the perceived utility of Google Transit and other online trip planners by travelers and transit agency staff:

- Many travelers view online trip planners as tools facilitating the utilization of transit services. They notably credit these tools with facilitating information retrieval and helping shorten wait times due to new and innovative trip plans and reduce . These positive perceptions clearly highlight the need to offer transit trip planning tools and potential for these tools to boost a customer-oriented image.
- Between 20 and 40% of surveyed Google Transit users indicated accessing the tool on their mobile phone. This finding highlights a growing need to provide information in formats that can be accessed from mobile phones and other portable devices with internet browsing capabilities.
- Surveyed Google Transit users generally expressed a greater satisfaction in using Google Transit alone than in combination with other information tools. This finding indicates a preference from transit riders in using one-stop information sources. For transit agencies, this translates into a need to develop online transit trip planners that are as comprehensive as possible.
- The ability to plan trips across transit networks is perceived as a major benefit of Google Transit. This is however only possible if all transit agencies providing services within an area or region have entered their data onto Google Transit or the local online transit trip planner.
- Online transit trip planners not only benefit travelers but agency staff as well. For instance, surveyed agency staff reported frequently using Google Transit to help respond to customer calls. Many individuals also reported using the online planning tools offered by neighboring agencies to help respond to calls regarding trips extending beyond their service area.
- When making bus stop data transparent often other mapping details must be resolved, too. The public agency will be viewing data on the maps and uses the “report a problem” to post corrections to the base map. For example if a point of interest is muddled on the map with many incorrect locations, the report a problem or Map Make could be used to post a correction to the base map. While not a key focus of this project the more accurate data is, the easier it is to plan a trip.

12.2. EVALUATION OF IMPACTS ON TRAVEL BEHAVIOR

The following elements were identified regarding the design and execution of studies aiming to evaluate the impacts of online transit trip planners on travel behavior:

- Online surveys can be cost-effective tools for collecting information from users of online transit trip planners. However, the success of a survey will heavily depend on how the target audience is made aware of its existence. Without proper advertisement or visibility, low response rates may be expected, thus reducing the effectiveness of the survey.
- An in-person survey should be considered to complement any online survey. While an online survey allows capturing responses from individuals who consult web resources, it has a very low probability of capturing responses from individuals who do not use computers. While costing more, interviewing travelers on buses, at bus stops or other public areas would allow capturing responses from all possible types of travelers.
- Statistics on the utilization of online trip planners placed on agency websites are affected by the fact that information seekers tend to migrate from using the agency website to using Google Maps directly once they find out that the information they seek can be obtained from there. This shift can create difficulties in adequately quantifying the benefits provided by an online trip planner, particularly when considering that Google has not provided statistics on the use of Google Transit.
- Without data supplied by Google regarding how often Google Transit is accessed by travelers to seek information regarding transit services offered within a specific area, some agencies may believe that transit trip planners are not frequently used and that there is consequently little reason to put their data on the map. The availability of information describing how often transit trip planners are used would allow transit agencies to better assess the usefulness of such a tool and help assure policy boards of the validity of investing in the development of GTFS data.
- All potential costs associated with the execution of a survey should be considered upfront. This includes costs that may be required to develop and post advertisements on buses, bus stops, or billboards. Transit agencies relying on advertisement revenues may for instance be reluctant in allowing spaces to be used for free for a survey if this results in a loss of needed revenues.

12.3. DEVELOPMENT TOOLS

The following lessons learned were identified regarding the use of available GTFS development tools:

- The project identified many free resources and tools available to transit agencies interested in GTFS implementation. However, these tools are scattered throughout the internet. In addition, while some tools are relatively easy to install and use, others are hard to configure and more difficult to use. New tools also appear to be periodically developed. Transit agencies may thus benefit from some guidance regarding which tool to select, particularly for agencies that do not currently subscribe to transit management systems with built-in GTFS data converters (such as Trapeze or Hastus, which are often only used by agencies with 15 or more routes).
- Heitzman's Excel GTF development tool proved to be a tool that can be learned with relative ease by transit agency staff. This tool also appears to be used by a fair amount of transit

agencies and GTFS consultants, either in its original format or modified version. It is notably the base of the GTFS builder being offered by the National RTAP.

12.4. GTFS DATA DEVELOPMENT AND VALIDATION

The following lessons regarding the development and validation of GTFS data were learned during the course of the project:

- One of the primary concerns of transit agency staff regarding the development of GTFS data is a fear that they may not have adequate technical know-how or available time to develop error-free data for online trip planners. The project demonstrated that small transit agencies could develop such a tool with relatively few resources and in relatively short time. The project also demonstrated that existing development tools offer multiple ways for agency staff to validate GTFS data in just a few weeks, thus increasing the likelihood of developing error-free GTFS data.
- To ensure high acceptance and continuous use of an online planner, transit agencies should consider publishing as much information as possible onto Google Transit. This includes developing optional GTFS data files describing fares, rules for applying fares, frequencies, route shapes, rules for transit, and calendar exceptions in addition to the required files defining bus stops, stop times, routes, trips, and service dates.
- Temporary service modifications, such as detours due to road construction or service deviations to accommodate special events, can be displayed in Google Transit. However most small agencies report that deviations are not known until one or two days ahead, which the weekly updates cannot accommodate. Service deviations can be supplied to Google Transit up to several months ahead of their effective implementation and will only affect trips executed during the day or time of day during which the deviation is in effect. This is an important feature for travelers, particularly those unfamiliar with an area, who then do not have to worry about consulting separate service deviation notices to ensure that the information returned by the online planner is accurate. Transit agency staff using the tool to help answer customer calls also benefit from this feature.
- GTFS data validation is an extremely important task, and the acceptance and use of an online transit trip planner depends heavily on the ability of the tool to return accurate information. During the project, validation activities not only allowed to refine GTFS data but also allowed in some cases the identification and updating of broken URL links on agency websites, out-of-date or missing details, and typos in agency websites and documents. This process ensures that the transit agencies' data is more accurate, transparent and easier to use.
- The coding of bus stops used by multiple agencies may benefit from the establishment of cooperation between the agencies sharing the stop. When agencies are independently coding the location of a shared stop within their respective GTFS data, slight differences in the coded coordinates of the stop often result in the creation of a series of multiple nearby stops onto Google Transit. This creates confusion for travelers, who then think they must look for a second stop at the transfer point where there is in fact a single stop. While Google Transit automatically merges bus stops that are relatively close, this may not occur if the distance between the coded stops is too large. Data sharing among agencies using the stop would prevent such a problem. In this case, coordination would particularly benefit small agencies sharing stops with larger ones, as bus stop data coded by larger agencies often show less precise locations due to their need to manage a very large number of stops.

12.5. IMPLEMENTATION PROCESS

Project activities related to the process of implementing GTFS data highlighted the following elements:

- Agencies considering GTFS implementation were often unsure whether they have the appropriate technical know-how to produce an error-free transit trip planner on their own. In a few cases, this fear led to hesitations in initiating GTFS development. In other cases, it led to the belief that implementation could only be done with the help of external consultants.
- While searching for agencies interested in participating in the pilot deployments, many agencies expressed reticence in initiating GTFS data development based on the rationale that they were already stretched with the task of submitting their mandatory annual National Transit Database (NTD) report. Some agencies also explicitly indicated that they did not want to participate in expanding or improving their service with Google Transit, as they feared that this would lengthen their NTD reporting process.
- Transit agencies should be aware that Google periodically imposes temporary “build freezes” on Google Transit. These freezes, which has often been over the month of December, are typically imposed for maintenance purposes and result in a temporary inability to upload new GTFS data onto Google Transit. Such freezes may thus unexpectedly delay planned system launches or data updates, especially if they happen at inopportune moments. Agencies should therefore plan to update their data describing schedule changes that are to take effect during a build freeze before the freeze. It is also recommended to Google better advertise and consider transit needs when implementing a build freeze.
- A majority of respondents to the Google Transit user survey who had never used the tool indicated not using it simply because they were not aware of its existence. This finding indicates that the launch of online transit trip planner should be accompanied by appropriate outreach and marketing activities, as well as a current list of transit partner agencies so if data does not appear the user can know if that is expected or not.

12.6. DATA MAINTENANCE AND HOSTING

The following lessons learned regarding data maintenance and hosting were identified during the course of the project:

- Since GTFS files for small transit agencies are relatively small (typically less than 100 Kb), there is no strong need for purchasing and maintaining a computer server solely dedicated to the GTFS data. Room can easily be allocated on an existing server.
- Various consulting firms offer GTFS data hosting and maintenance services for a certain fee. Service contracts may only cover data hosting or cover both data hosting and maintenance.
- Agencies participating in the National RTAP can host their GTFS data for free onto a server operated by the program.
- GTFS data maintenance is not inherently expensive. The perception of high maintenance costs was for many agencies a major barrier for them to participate in the pilot program. The project showed that maintenance is not costly and that cost issues should not dissuade agencies from launching into Google Transit and offering open source information. For small agency, a simple data hosting agreement with an external consultant may be as low as \$75 per year. Data

hosting agreements that also include data maintenance service also remain relatively inexpensive, with costs typically varying between \$200 and \$2800 a year depending on the complexity of the data to be maintained.

- A major concern of transit agencies contemplating hosting GTFS data on their own server is how Google can be granted access to the GTFS data without compromising security. This concern was generally alleviated by explaining to agency staff that GTFS data hosting requirements are not fundamentally different than those that would be associated with the handing of databases storing personnel or other information within the agency. While access to the GTFS data may be granted to Google and a relatively large number of persons, the ability to modify the data is restricted to a few select persons in charge of data maintenance.
- The maintenance and hosting of GTFS data can benefit from regional cooperation. Agencies implementing their GTFS data on a shared server may share the costs associated with the purchase, operation and maintenance of the server and associated software. Use of a shared server may further facilitate data coordination across agencies, notably the coding of shared bus stops, transfer fare agreements, and other services.
- Since Google fetches GTFS data files weekly, updates in transit service can be quickly passed on to Google Transit. It is also possible to upload new service data ahead of a scheduled change. However, to address potential delays in Google Transit reflecting services changes that may have not been planned, some agencies found it useful to add a short disclaimer on their website indicating that service information returned by Google Transit may on occasion lag by a few days from the service provided.

12.7. TRAINING NEEDS

The following lessons were learned regarding training needs during the course of the project:

- Agency representatives were often anxious and concerned of the responsibility they were taking on and whether they would be able to develop accurate GTFS data sets through the tools that were presented. This fear led many individuals to feel that they could only accomplish the task ahead with the assistance of consultants to help them with problems that may surface along the way. The on-site training sessions were found to be effective to help transit agency staff alleviate their fear and use clear-minded judgment to determine whether they could develop GTFS data on their own or they truly need the help of a consultant.
- Data validation is a particularly important step to discuss during training sessions, as agency staff often expressed deep concerns regarding their ability to detect errors in coded GTFS data and implement accurate data into Google Transit. A key element to alleviate these fears was to demonstrate the multiple and redundant data validation features offered by the various GTFS development and testing tools available.
- Training sessions featuring hands-on GTFS development exercise are particularly efficient at helping transit agency staff learn what they need to do and helping them build confidence in their capability to handle the GTFS development and publishing tasks. Enabling agency staff to manipulate data from their own agency provides an additional plus.
- There is a need for training sessions focusing on data maintenance. It took an entire day to teach transit agency staff how to use available GTFS development tools. While data updates essentially involve repeating some of the initial GTFS development tasks, agency staff are often

unsure about what to do exactly. Offering a follow-up training session, perhaps every 6 months after the initial session, may thus help transit agency staff becoming more comfortable with data maintenance tasks. Such session may also help answer questions they may have or address any problems they may have encountered after the initial training session.

The development of videos showing agency staff how to use a specific tool can be a relatively complex endeavor and is probably best handled by individuals or firms having experience in developing such tools.

13. RECOMMENDATIONS

This project demonstrated that small transit agencies could publish their service data in Google Transit for relatively small development and maintenance costs. This section highlights recommendations regarding the use and implementation of online transit trip planners that were derived from project activities. Two specific sets of recommendations are provided:

- Recommendations to transit agencies.
- Recommendations to Google on potential improvements to Google Transit.

13.1. RECOMMENDATIONS TO TRANSIT AGENCIES

From a customer service standpoint, it is highly recommended that transit agencies consider implementing their service data into Google Transit or other regionally available online transit trip planning tools. Online trip planning tools are well perceived by transit riders, particularly individuals unfamiliar with the services offered in an area, and contribute to maintaining a customer-oriented image. Users of online transit trip planners frequently credit these tools in helping them saving wait times and travel times. A single tool may also be used to plan trips extending across multiple transit networks if all agencies within a region have implemented their service data onto Google Transit or regional trip planner. The ability to access the planners from internet-enabled mobile phones or any portable device with internet browsing capabilities is further opening the door for travelers to consult service information wherever they are.

While many small transit agencies may express concerns on the ability to develop and maintain trip planning data with limited staff resources, the pilot deployments demonstrated that such tasks can be executed in a relatively short time with minimum staff time commitments when using development tools that are currently available for free. Many consultants can also be contracted for a relatively low cost to help with the development, hosting, and maintenance of data. Agreements with external consultants can notably be made by small transit agencies for annual costs that can be as low as a few hundred dollars.

Where the choice exists, the preference should be to develop service data using the GTFS data format. While this data format was developed by Google specifically for its Google Transit application, it has become a de facto international standard for coding transit service data. The GTFS data format not only allows transit agencies to upload their data onto Google Transit, but also onto a multiple of traveler information applications developed by independent entities and made available to the traveling public either for free or for a nominal fee.

13.2. SUGGESTIONS FOR IMPROVING GOOGLE TRANSIT

The following suggestions for improvement to Google Transit were identified during the course of the project. These suggestions were forwarded to Google in early September 2011. PATH first appreciates the extensive efforts that Google has put into the development of a user-friendly online trip planner that aims to be as convenient as possible. However, while the current tool is quite substantial and has resolved many barriers for agencies who want to offer interagency trip plans, various issues remain. The

following list presents a description of the various issues that were identified and recommendations aiming to address them:

- **Trip Data Collection by Transit Agencies:** One vital reason why transit agencies are often faced with a lack of funding is that there is not enough accurate information on transit ridership and how individual use the offered services. In this context, Google Transit offers a unique opportunity for transit agencies to collect and share detailed information on how individual travelers plan trips and use transit services. Such information would be a very valuable resource for transit agencies. Agencies could for instance use the number of trip plans generated each month to help obtain approval from their Policy Board for the implementation of new routes, alteration of existing services, introduction of new technologies or implementation of proposed subscription-based services. While different agencies may have different needs, generalized data reports may be developed to provide the following information:
 1. Number of trips planned within an agency's service area.
 2. Percent of total "Directions" hits where the rider then clicks on "public transit".
 3. Samples of trips planned within the agency's service area (for instance, top five origin and destination pairs).
 4. Samples of trips requiring more than one transit system (top five).
 5. Summary of trips attempted but for which no valid options were returned. It would be ideal to capture any pattern of day and time resulting in invalid searches, such as searches for trips on Wednesday morning (not necessarily by minute of the day).
- **Posting data tolerances for Transit Partners:** Currently, for a distance of roughly four miles from a bus stop, the traveler will see an option to drive/taxi to begin or end the trip. When bus stops are shared or are nearby Google often conflates the stop. In the cases where there is a distance or tolerance for the data, the transit partners should be notified what is that current distance. For bus stops around the corner can be confusing, if they are merged and could be nudged beyond the distance for conflating the stop, if that were posted. If a trip fails or not based on the origin is also helpful if the mileage from the last or first stop could be posted and updated, as the algorithm is modified.
- **Build Freezes:** While often necessary for system maintenance needs, build freezes can significant impact transit agencies when they occur near a period when transit agencies are planning to implement service changes. For instance, a freeze imposed in December may affect transit agencies planning service changes for January. To reduce the impact of freezes, Google should ensure that sufficient advance warning is provided, such as a notification in September, October or early November for a planned December freeze.
- **Extending the distance for driving to display more frequent available trip plan options:** If a trip search is limited to a narrow radius around a given origin and given destination, Google Transit may fail to return transit trips in rural areas where such trips do exist. An example is shown in Figure 72. The left-hand side of the figure shows a search result for a planned trip from Los Alamos to Paso Robles. For this request, Google Transit indicates that there is no valid transit option. However, if the start point of the trip is moved 20 miles north, a valid trip is returned, as shown in the right-hand side diagram. If it is considered that residents in rural areas often choose to travel one to three hours to reach an airport or to make a connection, this is also true to catch a bus. For the example of Figure 72, a 20-mile search radius would have produced a

valid trip requiring the traveler to drive 20 miles to the nearest bus stop. The zone for capturing a successful trip in rural areas should not therefore be the same as in urban areas. A suggestion is to use a 100-mile range for searches in rural and remote parts of California, as well as other states.

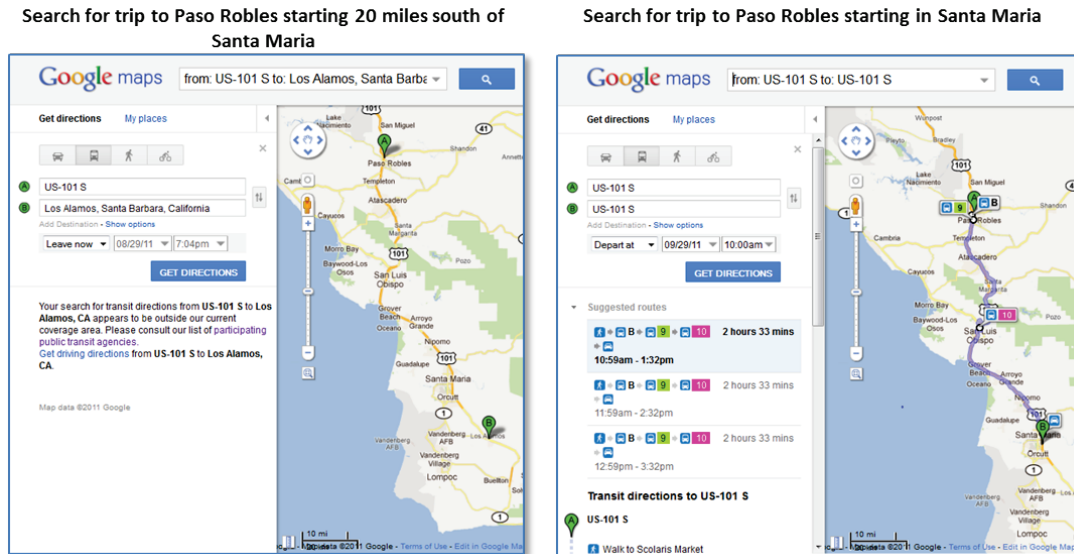


Figure 72: Impact of Short Search Radius around Origin and Destination in Rural Areas

- Trip and Data Integration for Bike to Transit:** Travelers are offered “hotel and car rental packages” at travel websites and expect one-stop services. For the multi-modal offerings of Google Maps with drive, transit, bus and walk there should be an option for the traveler to request “more bike” that displays bike routes to the bus stop vs. walk (slow) or drive (not-green) option.
- Launch Blocking Issues:** Occasionally, issues related to data provided by a neighboring agency may prevent the launch of an online planner by another agency. For example a discrepancy in the precise location of a shared stop. If such a situation arises, Google could inform each agency of the contact person at the other agency who might currently be in charge of the GTFS data, rather than letting each agency try to figure out by themselves who they might need to talk to. Alternatively at the “by invitation only” website the contact person for each agency could be posted for participating transit agencies.
- Easily Posting of Error Reports:** Google currently does not offer a well-known way for reporting or addressing looping issues. Looping occurs when a query returns a trip that initially brings the traveler away from its destination. An example is shown in Figure 73. While looping trips are often simply the results of a lack of transit services, particularly in rural areas, and not an error per se, they may result in trip options that travelers would never consider. A suggestion is to refine the “Report Problem” link to allow developers or users of Google Transit to send looping troubleshooting tickets to Google to allow the issues to be investigated, or make a link to the form that is used more easily found at the trip plan.

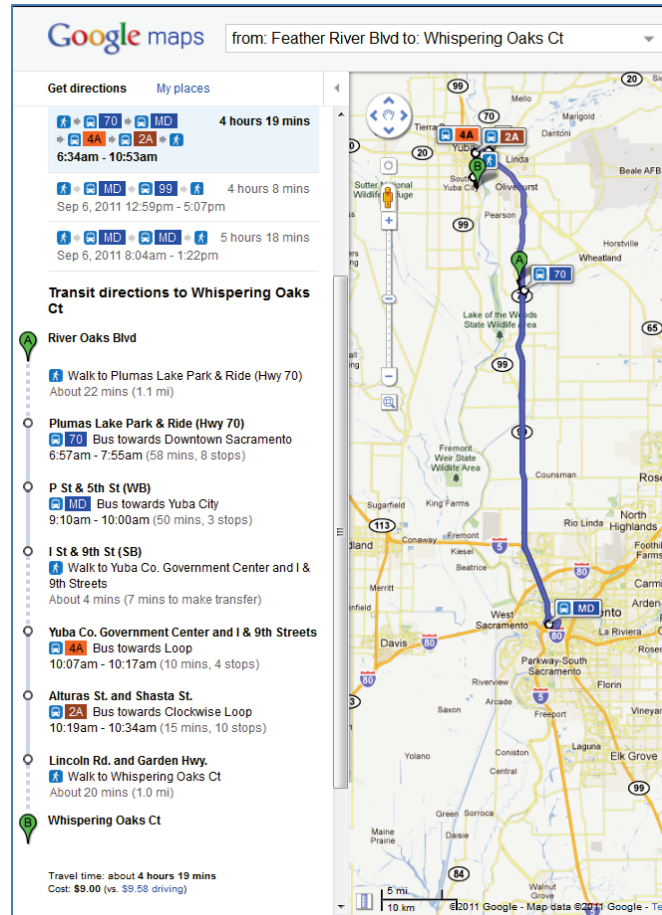


Figure 73: Example of Looping Trip

- Shared Bus Stops:** Google currently relies on each transit agency to submit the latitude and longitude coordinate of bus stops. For bus stops shared by multiple agencies, a problem can result if the two or more agencies using a particular bus stop submit slightly different latitude and longitude coordinates. These differences can lead to the duplication of the bus stop and its representation in Google Maps as a series of distinct stops located in close proximity to each other. For Google Transit users, the result is a perception that different bus stops in close proximity are used while there is in fact one stop. A better system is therefore needed to handle shared bus stops and limit duplicate data. Google could promote better interagency coordination by using shared excel spreadsheets in Google Docs to inform agencies sharing a bus stop of the data that has already been submitted for the stop.
- Combined Bus Stops Reduces Number of Bus Icons on the Map and Confuses Riders/Agencies:** Google Inc. explains that users want less map clutter and to achieve that the icon for bus stops will be merged. The above concern where shared stops between agencies will make sense to merge, in some cases bus stops on opposite sides of the street or around a corner are also often merged. This causes confusion as to which side of the street the user should use when catching the bus. The “central station” concept has not been fully tested where a shared stop for different positions within the intersection will identify all stops within the station. More user feedback will assure public agencies this works well and is not confusing for public users.

- **Walking directions for off-road stops:** Another challenging element regarding walking directions was to create feasible trips involving stops located at some significant distance from the street. As an example, ACE Rail has one station that is accessible through a parking lot. This resulted in difficulties for Google Transit to generate realistic walking directions as the route shape would in this case not directly follow the Google Maps street lines through private property. While Google's Mapmaker functions are improving and expediting a local agencies' ability to upload better local map content, the solution to improved walking directions may require more pro-active participation by local agencies.
- **Promoting the new features:** Google Transit now offers, through "show options" that the user could ask for a trip plan with "less walking," however few travelers have found this feature. Agencies should promote this in their FAQs for trip planning.
- **Fares:** Google has not developed a solution to display accurate fare calculations in situations in which discounted fares are offered for travelers transferring between multiple agencies that share fares. In such situation, the discounted fare is typically not applied. Google Transit may also not supply fares if the details for interagency transfer are incorrect.
- **Customer Feedback:** It is recommended that Google create a simple and easily displayed link, or a comment box, on the Google Transit page allowing users of the tool to send comments to the transit agencies offering the service they are inquiring about. Such a link may help identify inaccurate data or other issues regarding the information being provided. Such a reporting capability would also help remind the transit agency to keep their data current and accurate.
- **Unmet needs:** At this time, no statistics is collected on searches resulting in no valid transit trip being returned by Google Transit. From a transit agency's standpoint, unsuccessful searches could be used to characterize desired trip patterns that are currently unmet with existing service. If made available, statistics about unsuccessful searches could be used to quantify unmet transit needs. For instance, the aggregate number of unsuccessful trip searches between specific pairs of origin and destination zones, zip codes, or intersections could be used to identify service gaps and adjust the transit services offered. The information could further be used for building cases for additional funding from the Federal Transit Administration or other funding agency to meet these gaps.
- **Updated validation tools not synchronized with Google back-end testing:** A recent version of the Feed Validator (version 1.2.7) resulted in warnings stating that deprecated values were posted in a file, implying they should be removed. Removing the data would then allow the feed to pass the tests run by Feed Validator but would then fail when being parsed at Google's Partner Front End dashboard. These types of inconsistencies would be less problematic if they could be resolved within a few weeks of being identified.
- **Trip Plans to Specific Places:** The traveler may specify a location, for example, within a mall or building complex. It is very helpful if that precise destination remains when the Google Transit trip is prepared rather than moving the destination to the nearest bus stop.
- **Travel time Comparison Where Costs Are Compared:** While a savvy user may click between driving time (car icon) and transit time (bus icon) where the comparison is made for cost to drive vs. taking transit another useful comparison could be driving time vs. transit trip (average of the three options shown).

REFERENCES

1. Atkinson, C. (2011). *How to Develop and Launch an Online Trip Planner*. Metro Magazine, Vol. 107, No. 2, February 2011, pp. 38, 40-43
2. Trillium Solutions and Nelson\Nygaard Consulting Associates, Inc. (2009). *Northern California Google Transit Feasibility Study*. Final report, project executed for the Shasta County Regional Transportation Planning Authority.
3. Kumar, M., Pan, X., McDonald, T., Harvey, N., Cohn, J., and Margulici, J.D. (2010). *Efficient Deployment of Advanced Public Transit Systems (EDAPTS)*. Research Report UCB-ITS-CWP-2010-2, California Center for Innovative Transportation, University of California, Berkeley, CA.

APPENDIX A. SAMPLE GOOGLE TRANSIT LICENSE

Version 3 / Last modified on 2010-07-08 11:17 PDT-US/Pacific

Background Information

Google is accepting transit data for use in Google products and services. If your organization is interested in participating in this program, please verify that the Contact Information below is correct and that the person listed is a qualified representative from your organization. That person needs to read and accept our terms and conditions to initiate the transit data collection process.

Effective Date

2010-08-17 10:17 PDT-US/Pacific (YYYY-MM-DD hh:mm)

Agreement

Google Transit Agreement

This Google Transit Agreement is entered into by and between Google Inc., a Delaware corporation, and its affiliates (“Google”), and the entity agreeing to these terms (“Licensor”). This agreement will be effective as of the date you click the “Accept and Sign Up” button below (the “Effective Date”). If you are accepting on behalf of your employer or another entity, you represent and warrant that (i) you have full legal authority to bind your employer or such entity to these terms and conditions, (ii) that you have read and understand this agreement, and (iii) that you agree, on behalf of the party that you represent, to this agreement. If you don't have the legal authority to bind, please do not click the “Accept and SignUp” button below.

1 DEFINITIONS.

1.1 “Licensed Content” means the content provided by Licensor to Google pursuant to the delivery mechanism described in Section 3.1 (Delivery).

1.2 “Licensor Marks” means Licensor’s various service marks, trademarks, company names, trade names, and logos.

1.3 “Distribution Partner” means a third party under an agreement with Google to use Google products or services internally or provide or display Google products or services to end users.

2 LICENSED CONTENT.

2.1 License. Licensor grants to Google a nonexclusive, worldwide, and royalty-free license to: (a) copy, distribute, create derivative works based on, perform, display, and otherwise use the Licensed Content in connection with Google products or services, which license will be perpetual with respect to Licensed Content used in Google products or services displayed in television broadcasts, print media, CDs, DVDs, or other fixed media; and (b) sublicense the license in subsection (a) to end users and Distribution Partners in connection with Google products or services. Google agrees that it will not distribute the Licensed Content to Distribution Partners or end users outside of the Google products or services.

Google may use consultants and other contractors in connection with the performance of obligations and exercise of rights under this agreement, provided that such consultants and contractors will be subject to the same obligations as Google.

2.2 Marks License. Licensor hereby grants to Google a worldwide, non-exclusive, non-transferable, royalty-free right and license to use the Licensor Marks in connection with the Licensed Content in Google products or services. This license may not be sublicensed except to its Distribution Partners in connection with their use of Google products or services.

2.3 Reservation of Rights. Except for the license rights granted in this agreement, each party retains all rights it would have independent of this agreement, including rights under the U.S. Copyright Act or analogous laws in other jurisdictions. Google and its licensors retain all rights in any content used or created in connection with the Licensed Content and Licensor Marks. Nothing in this agreement will restrict Google from using content Google obtains from a source other than Licensor under this agreement.

3 DELIVERY; UPDATES.

3.1 Delivery. Within 14 days after the Effective Date, Licensor will provide the Licensed Content to Google in accordance with the format and specifications set forth in Google's transit feed specifications as updated by Google from time to time, the current version of which is located at http://code.google.com/transit/spec/transit_feed_specification.htm, or in a format as otherwise mutually agreed upon in writing by the parties. If the Licensed Content includes URLs, those URLs will link directly to a Licensor webpage relevant to the Licensed Content without spawning any pop-up advertisements or

new windows that are not relevant to the Licensed Content.

3.2 Updates. During the Term, Licensor will provide updates to the Licensed Content on a regular basis in the manner described in Section 3.1 (Delivery). The updated Licensed Content will be updated as frequently and will be as high in quality and broad in scope as corresponding content that Licensor provides to any other party (including without limitation Licensor's end users). In the event that Licensor is an aggregator of licensed content provided by other entities, Licensor will ensure that the updated Licensed Content will be updated as frequently and will be as high in quality and broad in scope as corresponding content that the originating entities provide to any other party.

4 WARRANTIES AND INDEMNITIES.

Each party represents and warrants that it has full power and authority to enter into this agreement. Licensor represents and warrants that it has all necessary rights to grant the licenses set forth in Section 2. In the event that Licensor is an aggregator of licensed content provided by other entities, Licensor also represents and warrants that it has the full power and authority or has entered into agreements to ensure that the originating entities of the Licensed Content comply with the applicable provisions of this agreement, including, without limitation, the confidentiality obligations set forth in Section 6. Google will indemnify and defend Licensor and its directors, officers, employees, and agents from third party claims arising from or related to a breach of Google's representations and warranties. Licensor will, to the extent permitted by applicable law, indemnify and defend Google and its directors, officers, employees, agents, and Distribution Partners from third party claims arising from or related to (a) a breach of Licensor's representations and warranties or (b) Google's or any Distribution Party's

authorized use of the Licensed Content or any other materials provided by Licensor to Google under this agreement.

5 DISCLAIMERS, LIMITATION OF LIABILITY.

EXCEPT FOR THE EXPRESS WARRANTIES MADE BY THE PARTIES IN SECTION 4, THE PARTIES DISCLAIM ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NONINFRINGEMENT.

EXCEPT (I) INDEMNITIES UNDER SECTION 4, AND (II) BREACHES OF CONFIDENTIALITY UNDER SECTION 6, (A) NEITHER PARTY WILL BE LIABLE FOR LOST REVENUES OR INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL, EXEMPLARY OR PUNITIVE DAMAGES, AND (B) NEITHER PARTY'S AGGREGATE LIABILITY FOR ANY CLAIM ARISING OUT OF OR RELATED TO THIS AGREEMENT WILL EXCEED \$1,000.

6 CONFIDENTIALITY; PR.

6.1 Definition. "Confidential Information" is information disclosed by one party to the other party under this agreement that is marked as confidential or would normally under the circumstances be considered confidential information of the disclosing party. Confidential Information does not include information that the recipient already knew, that becomes public through no fault of the recipient, that was independently developed by the recipient, or that was rightfully given to the recipient by another party.

6.2 Confidentiality Obligations. The recipient will not disclose the Confidential Information, except to affiliates, employees, and agents who need to know it and who have agreed in writing to keep it confidential. The recipient, its affiliates, employees, and agents may use Confidential Information only to exercise rights and fulfill obligations under this agreement, while using reasonable care to protect it. The recipient may also disclose Confidential Information when required by law after giving reasonable notice to discloser.

6.3 Publicity. Neither party may make any public statement regarding the relationship contemplated by this agreement without the other's prior written approval.

6.4 Public Records. Notwithstanding the provisions of Section 6.2, Google understands that, unless exempt under applicable law, this agreement and any documents that it submits under this agreement may be subject to public inspection or copying under the applicable public records act laws to Licensor ("PRA"). For avoidance of doubt, Licensor, solely in compliance with the PRA, may disclose that information to which Licensor has a reasonable good faith belief that no applicable exemption under the PRA applies. If any requests for disclosure are made pursuant to the PRA or comparable applicable laws requiring disclosure of information by public entities, Licensor shall (i) notify Google within 3 days of receiving such request and (ii) provide Google with reasonable information, and assistance to file for or request any applicable exemptions, extensions, responses or petitions and the like to protect Google's trade secrets, Confidential Information or the confidentiality of all or part of this agreement and documents submitted under this agreement.

7 TERM AND TERMINATION.

7.1 Term. This agreement will begin on the Effective Date and continue until terminated in accordance with this agreement (the "Term").

7.2 Termination. Either party may terminate this agreement for convenience with 30 days prior written notice to the other party. Google may terminate this agreement immediately upon written notice to

Licensor if Licensor breaches its representations and warranties in Section 4 of this agreement (Warranties and Indemnities). Google may terminate this agreement upon seven days' prior written notice to Licensor if Google determines that the Licensed Content fails to meet Google's quality standards or technical specifications.

7.3 Effects of Termination. When the agreement terminates:

(a) Licensor will cease providing Google with Licensed Content and, if applicable, provide an empty feed to Google using the delivery mechanism described in Section 3.1 (Delivery) to replace the Licensed Content.

(b) Google will use commercially reasonable efforts to cease display of the Licensed Content and the Licensor Marks to end users within 120 days after termination (and, if applicable, provision of the empty feed), but any sublicenses that Google grants during the Term will continue for the remaining term of the applicable sublicense.

7.4 Survival. Sections 2.1, 2.3 and 4 through 8 will survive any termination or expiration of this agreement.

8 MISCELLANEOUS.

8.1 Notices. All notices must be in writing and addressed to the attention of the other party's Legal Department and primary point of contact. Notice will be deemed given (a) when verified by written receipt if sent by personal courier, overnight courier, or mail; or (b) when verified by automated receipt or electronic logs if sent by facsimile or email.

8.2 Assignment. Neither party may assign or transfer any part of this agreement without the written consent of the other party, except to an affiliate but only if (a) the assignee agrees in writing to be bound by the terms of this agreement and (b) the assigning party remains liable for obligations under the agreement. Any other attempt to transfer or assign is void.

8.3 Change of Control. Upon a change of control (for example, through a stock purchase or sale, merger, or other form of corporate transaction), (a) the party experiencing the change of control will provide written notice to the other party within 30 days after the change of control, and (b) the other party may immediately terminate this agreement any time between the change of control and 30 days after it receives the written notice in subsection (a).

8.4 Force Majeure. Neither party will be liable for inadequate performance to the extent caused by a condition (for example, natural disaster, act of war or terrorism, riot, labor condition, governmental action, and Internet disturbance) that was beyond the party's reasonable control.

8.5 No Waiver. Failure to enforce any provision will not constitute a waiver.

8.6 Severability. If any provision is found unenforceable, it and any related provisions will be interpreted to best accomplish the unenforceable provision's essential purpose.

8.7 No Agency. The parties are independent contractors, and this agreement does not create an agency, partnership or joint venture.

8.8 No Third-Party Beneficiaries. There are no third-party beneficiaries to this agreement.

8.9 Equitable Relief. Nothing in this agreement will limit either party's ability to seek equitable relief.

8.10 Governing Law. This agreement is governed by California law, excluding California's choice of law rules. FOR ANY DISPUTE RELATING TO THIS AGREEMENT, THE PARTIES CONSENT TO PERSONAL JURISDICTION IN, AND THE EXCLUSIVE VENUE OF, THE COURTS IN SANTA CLARA COUNTY, CALIFORNIA.

8.11 Amendments. Any amendment must be in writing and expressly state that it is amending this agreement.

8.12 Counterparts. The parties may execute this agreement in counterparts, including facsimile, PDF, and other electronic copies, which taken together will constitute one instrument.

8.13 Entire Agreement. This agreement is the parties' entire agreement relating to its subject and supersedes any prior or contemporaneous agreements on that subject.

(Last Revised September 10, 2009)

Signatory Information

Contracting Entity: _____ Transit

Url:

Name:

Title:

Email:

Address:

Country:

Phone:

Fax:

Accept Agreement

Note: If you are accepting on behalf of your employer or another entity, you represent and warrant that you have full legal authority to bind your employer or such entity to these terms and conditions. If you don't have the legal authority to bind, please do not click the "Accepted and Agreed" button below.

_____ By checking this box, I am accepting this Agreement on behalf of the entity _____ **Transit**. I represent and warrant that (a) I have full legal authority to bind the entity to this Agreement, (b) I have read and understand this Agreement, and (c) I agree to all terms and conditions of this Agreement on behalf of the entity that I represent.

Accepted and Agreed

APPENDIX B. GTFS FEED EXAMPLE

This section provides example of developed GTFS files. The example shows the GTFS files for the San Luis Obispo Regional Transit Agency that were posted on the GTFS Exchange website on August 31, 2011. Please note that only a fraction of the data from the stop_times.txt and shapes.txt files is displayed for conciseness. More detailed information about the meaning of the various fields within each GTFS file can be obtained from the General Transit Feed Specification webpage maintained by Google can be found at http://code.google.com/transit/spec/transit_feed_specification.html.

agency.txt

```
agency_id,agency_name,agency_url,agency_timezone,agency_lang,agency_phone,
agency_fare_url
slorta,San Luis Obispo Regional Transit
Authority,http://www.slorta.org,America/Los_Angeles,en,(805) 541-2228,
http://slorta.org/fares/rta
```

stops.txt

```
stop_id,stop_code,stop_name,stop_desc,stop_lat,stop_lon,zone_id,stop_url,location_t
ype,parent_station
001,,San Luis Obispo (SLO) Government Center at Osos and Palm,,35.2825532781359,-
120.66192112863,slo,,,
002,,Santa Ysabel Avenue at 15th Street NB,,35.33005911,-120.8267462,mblocay,,,
003,,Santa Ysabel Avenue at 15th Street SB,,35.3298928,-120.8267462,mblocay,,,
004,,Santa Ysabel Avenue at 7th Street,,35.32991906,-120.8353615,mblocay,,,
005,,2nd Street at Santa Maria Avenue - Baywood Park,,35.32826473,-
120.8409297,mblocay,,,
006,,Ramona Avenue at 7th Street,,35.3261552,-120.8353722,mblocay,,,
007,,Pine Street at La Loma Avenue,,35.31797913,-120.8447921,mblocay,,,
008,,Pine Street at Los Osos Valley Road,,35.31285773,-120.8447814,mblocay,,,
009,,Los Osos Valley Road at Palisades,,35.31193846,-120.8364666,mblocay,,,
010,,10th Street at Los Osos Valley Road,,35.3114657,-120.8323681,mblocay,,,
011,,10th Street at Santa Ynez Avenue,,35.31491508,-120.8323574,mblocay,,,
012,,11th Street at Ramona Avenue,,35.3205616,-120.831188,mblocay,,,
013,,11th Street at Santa Maria,,35.32800214,-120.831145,mblocay,,,
014,,Los Osos Valley Road at Buckskin Drive NB,,35.30796364,-120.8190644,mblocay,,,
015,,South Bay Blvd at Quintana Road SB,,35.36200107,-120.8241981,mblocay,,,
016,,South Bay Blvd at Quintana Road NB,,35.36178014,-120.8245951,mblocay,,,
017,,Harbor St at Piney Way entering Morro Bay Park,,35.36650037,-
120.8446527,mblocay,,,
018,,Romauldo Road at Parking Lot #3,,35.3323436,-120.7412589,cuesta,,,
020,,Chorro Valley Road at Building 1400,,35.32719246,-120.7412267,cuesta,,,
021,,Los Osos Valley Road at Buckskin Drive SB,,35.30748209,-120.817852,mblocay,,,
022,,Performing Arts Center NB,,35.30039648,-120.6579843,slo,,,
023,,Performing Arts Center SB,,35.30044901,-120.6579629,slo,,,
024,,Kennedy Library NB,,35.30231624,-120.663161,slo,,,
025,,Kennedy Library SB,,35.30236221,-120.6632361,slo,,,
026,,Bradley Rd at Jones St. (Allan Hancock College),,34.94397798,-
120.4182726,smaria,,,
029,,Achievement House,,35.32482029,-120.744558,cuesta,,,
030,,El Camino Real at Encina Avenue SB,,35.39210902,-120.607076,smatas,,,
031,,El Camino Real at Encina Avenue NB,,35.39196471,-120.6068131,smatas,,,
032,,El Camino Real at Garden Farms SB,,35.41795435,-120.6044769,smatas,,,
033,,El Camino Real at Garden Farms NB,,35.41864289,-120.6039539,smatas,,,
034,,El Camino Real at Avenida Maria,,35.45746057,-120.6412232,smatas,,,
035,,El Camino Real at Patria Circle SB,,35.45869496,-120.6426206,smatas,,,
036,,El Camino Real at Maple Avenue SB,,35.46173171,-120.6451821,smatas,,,

```

037,,El Camino Real at Musselman Drive NB,,35.4615329,-120.6446323,smatas,,,
 038,,El Camino Real at El Bordo Avenue SB (Post Office),,35.46449308,-
 120.6474996,smatas,,,
 039,,El Camino Real at El Bordo Avenue NB (Post Office),,35.46487757,-
 120.6474593,smatas,,,
 040,,El Camino Real at Solano Avenue NB,,35.47182861,-120.6531912,smatas,,,
 041,,El Camino Real at Palomar Avenue NB,,35.4753323,-120.6546879,smatas,,,
 042,,El Camino Real at Plata Lane SB,,35.47292517,-120.653969,smatas,,,
 043,,E. Foothill at Casa,,35.2940283,-120.6661248,slo,,,
 044,,E. Foothill at Casa,,35.294479,-120.665466,slo,,,
 045,,Chamber of Commerce,,35.48470676,-120.6631127,smatas,,,
 046,,El Camino Real at Von's NB,,35.48496229,-120.662992,smatas,,,
 047,,East Main Street at College Drive,,34.95296333,-120.4234761,smaria,,,
 048,,El Camino Real at Adobe Plaza NB,,35.48359507,-120.6609508,smatas,,,
 049,,Chamber of Commerce,,35.48722929,-120.666503,smatas,,,
 051,,Atascadero at Capistrano Avenue,,35.48938048,-120.6648159,smatas,,,
 052,,El Camino Real at West Mall SB,,35.48914025,-120.6701991,smatas,,,
 054,,Dolliver Street at Hinds Ave SB,,35.13976106,-120.6404695,pisgrov,,,
 061,,2nd Street at El Moro in Baywood Park,,35.32669134,-120.8408976,mblocay,,,
 062,,Church St. at Palisade Dr. (Marian Medical Center),,34.95196965,-
 120.4127768,smaria,,,
 064,,Main Street at The Veteran's Hall NB,,35.5651441,-121.0966757,camsshc,,,
 065,,South Ocean Boulevard at Old Creek Road SB,,35.42917139,-
 120.8818656,mblocay,,,
 066,,South Ocean Boulevard at Old Creek Road NB,,35.42891349,-
 120.8813292,mblocay,,,
 069,,Monterey Street at Grand Avenue,,35.28932793,-120.6510428,slo,,,
 070,,West Side - Cuesta College,,35.33048362,-120.74444,cuesta,,,
 071,,Moonstone Beach Drive at Mariners Inn NB,,35.57229808,-121.1122808,camsshc,,,
 072,,Moonstone Beach Drive at Mariners Inn SB,,35.57230899,-121.1125195,camsshc,,,
 073,,Las Tablas Park and Ride,,35.55417297,-120.7138601,temparo,,,
 075,,Pine at 8th (Train Station),,35.62250853,-120.6882772,temparo,,,
 076,,Viejo Camino at El Camino Real NB,,35.44098124,-120.6289977,smatas,,,
 077,,El Camino Real at Carmel Road NB,,35.43327575,-120.6150931,smatas,,,
 078,,El Camino Real at Carmel Road SB,,35.43292389,-120.6145352,smatas,,,
 079,,El Camino Real at Carrow's Restaurant,,35.4834684,-120.6612593,smatas,,,
 080,,El Camino Real at El Camino Real Plaza Shopping Center SB,,35.47590021,-
 120.6553611,smatas,,,
 081,,El Camino Real at Maria Avenue NB,,35.38849675,-120.6132746,smatas,,,
 082,,El Camino Real at Maria Avenue SB,,35.38875914,-120.6132156,smatas,,,
 083,,El Camino Real at Pueblo Avenue NB,,35.48048053,-120.6580219,smatas,,,
 084,,El Camino Real at Santa Margarita Road SB,,35.42910582,-120.6063947,smatas,,,
 086,,El Camino Real at Santa Margarita Road NB,,35.42932437,-120.6063089,smatas,,,
 087,,Mission at 14th St.,,35.75254206,-120.6962568,sanmig,,,
 089,,Shell Beach Road at The Cliffs Resort SB,,35.16574405,-120.6898758,pisgrov,,,
 090,,Shell Beach Road at Spyglass Drive SB,,35.1630207,-120.6862575,pisgrov,,,
 091,,Shell Beach Road at Terrace Avenue SB,,35.15967449,-120.6774813,pisgrov,,,
 092,,Shell Beach Road at Cuyama Avenue SB,,35.15895743,-120.6756735,pisgrov,,,
 093,,Shell Beach Road at Pier Avenue SB,,35.15598386,-120.6680614,pisgrov,,,
 094,,Price Street at Shelter Cove Lodge SB,,35.15228867,-120.6595024,pisgrov,,,
 095,,Main Street at Jamaica Street,,35.3990729,-120.8623284,mblocay,,,
 096,,Price Street at Dolliver Street SB,,35.14694844,-120.6459197,pisgrov,,,
 098,,Monterey Street at The Peach Tree Inn,,35.29002632,-120.6499457,slo,,,
 102,,Nicholson St. at Cypress St. (AMTRAK BUS),,34.95102432,-120.4161161,smaria,,,
 107,,Price Street at Lighthouse Suites SB,,35.14896176,-120.6503052,pisgrov,,,
 113,,El Camino Real at Halcyon Rd. (Park and Ride),,35.12295366,-
 120.5902237,pisgrov,,,
 114,,East Grand Avenue at El Camino Real,,35.12074225,-120.5858517,pisgrov,,,
 123,,Nipomo St. at Higuera Street,,35.27859945,-120.6662107,slo,,,
 125,,Patricia Drive at Craig Way SB,,35.29584971,-120.683417,slo,,,
 126,,Price Street at Dolliver Street NB,,35.14714583,-120.6458527,pisgrov,,,
 127,,Price Street at Lighthouse Suites NB,,35.14950346,-120.6513754,pisgrov,,,
 128,,Price Street at Dinosaur Caves Park,,35.1540365,-120.6628659,pisgrov,,,

129,,Patricia Drive at Highland Avenue NB,,35.29805417,-120.6835431,slo,,,
 130,,Shell Beach Road at Terrace Avenue NB,,35.15977317,-120.6773177,pisgrov,,,
 131,,Shell Beach Road at Spyglass Drive NB,,35.16309306,-120.6861234,pisgrov,,,
 132,,Shell Beach Road at The Cliffs Resort NB,,35.16573528,-120.6896505,pisgrov,,,
 133,,Shell Beach Road at Encanto Avenue NB,,35.17289844,-120.6966001,pisgrov,,,
 134,,Los Osos Valley Rd. at 10th St.,,35.31091413,-120.8315715,mblocay,,,
 135,,Kansas Avenue - County Services,,35.32069728,-120.7169098,slo,,,
 136,,Moonstone Beach Drive at Fireside Inn NB,,35.57871409,-121.1159205,camsshc,,,
 137,,Moonstone Beach Drive at Castle Inn SB,,35.57762988,-121.1151373,camsshc,,,
 138,,Moonstone Beach Drive at San Simeon Pines Resort NB,,35.58464533,-
 121.1210945,camsshc,,,
 139,,Moonstone Beach Drive at San Simeon Pines Resort SB,,35.58345214,-
 121.1205232,camsshc,,,
 143,,Main Street at Arlington Street SB,,35.56725174,-121.1001733,camsshc,,,
 145,,Prime Outlets (Connects with SCAT),,35.13624719,-120.6267178,pisgrov,,,
 165,,Santa Barbara Street at High Street SB,,35.27126386,-120.6563589,slo,,,
 169,,Santa Rosa Street at Buchon Street NB,,35.27884907,-120.6565306,slo,,,
 174,,Castillo Drive at Otter Way NB,,35.61300407,-121.1435795,camsshc,,,
 175,,Hearst Drive,,35.61245239,-121.1440194,camsshc,,,
 176,,Moonstone Drive at Windsor,,35.56879426,-121.1048484,camsshc,,,
 177,,Main Street at Tamson Street SB,,35.56279202,-121.0920408,camsshc,,,
 178,,Main Street at Tamson Street NB,,35.5629513,-121.0919765,camsshc,,,
 179,,Burton at Main St.,,35.56362115,-121.0825995,camsshc,,,
 180,,Burton at Main NB,,35.56373679,-121.0824734,camsshc,,,
 181,,Burton Drive at Cambria Pines Lodge SB,,35.5580222,-121.0807246,camsshc,,,
 182,,Burton Drive at Yorkshire Drive,,35.55712974,-121.0821462,camsshc,,,
 183,,Burton Drive at Ardath Drive NB,,35.55124229,-121.0800567,camsshc,,,
 184,,Burton Drive at Ardath Drive SB,,35.55094769,-121.0800353,camsshc,,,
 185,,Ardath at Hwy 1,,35.55034102,-121.0723346,camsshc,,,
 186,,Ardath at Hwy 1,,35.55035193,-121.0726109,camsshc,,,
 187,,Ocean Blvd. at Cayucos,,35.4498222,-120.9066787,mblocay,,,
 188,,Ocean Blvd. at Cayucos,,35.44967799,-120.9060082,mblocay,,,
 189,,Santa Rosa Street at Higuera Street,,35.28188602,-120.659194,slo,,,
 190,,Santa Rosa Street at Leff Street NB,,35.27754842,-120.6553665,slo,,,
 191,,South Ocean Avenue at 4th Street NB,,35.44591316,-120.8981869,mblocay,,,
 192,,South Ocean Avenue at 3rd Street SB,,35.4459503,-120.8987314,mblocay,,,
 193,,Main St. at San Jacinto,,35.39323727,-120.8604831,mblocay,,,
 194,,Moonstone Dr. at Windsor Blvd. NB,,35.5688968,-121.1047894,camsshc,,,
 195,,Santa Rosa Street at Marsh Street SB,,35.28086131,-120.6585395,slo,,,
 196,,Main St. at San Joaquin St.,,35.39225552,-120.8595738,mblocay,,,
 197,,Main Street at The Veteran's Hall SB,,35.56468809,-121.0964316,camsshc,,,
 198,,Main St. at Bonita St.,,35.38598424,-120.8572108,mblocay,,,
 199,,Main Street at Elena Street,,35.39021981,-120.8587959,mblocay,,,
 200,,Main St. at Errol St. NB,,35.37909795,-120.8545312,mblocay,,,
 201,,Hearst Castle Info. Center,,35.65053564,-121.1865753,camsshc,,,
 202,,Ontario Road at Avila Barn,,35.18171175,-120.704062,slo,,,
 203,,Ontario Road at Bob Jones Trail (Park & Ride) NB,,35.18556782,-
 120.7030267,slo,,,
 206,,South Higuera Street at Bridge Street SB,,35.26721476,-120.6705424,slo,,,
 207,,South St. at Beebee Street,,35.26937401,-120.6687775,slo,,,
 208,,South Higuera St. at Margarita Ave,,35.25641108,-120.6688473,slo,,,
 209,,South Higuera Street at Prado Road SB,,35.254128,-120.669472,slo,,,
 210,,South Higuera Street at Silver City Mobile Home Park SB,,35.24848863,-
 120.6727821,slo,,,
 211,,South Higuera Street at Chumash Avenue NB,,35.25972702,-120.6687212,slo,,,
 212,,South Higuera Street at Elks Lane NB,,35.26482112,-120.6703278,slo,,,
 213,,South Higuera Street at Granada Drive SB,,35.25152891,-120.6709635,slo,,,
 214,,South Higuera Street at Hind Drive NB,,35.24900995,-120.6721517,slo,,,
 215,,South Higuera Street at Prado Road NB,,35.25395141,-120.6691906,slo,,,
 216,,South Higuera at Suburban Road SB,,35.24429163,-120.6753141,slo,,,
 217,,South Higuera at Suburban Road NB,,35.2443683,-120.6749681,slo,,,
 218,,South Street at Broad Street SB,,35.26960833,-120.6576034,slo,,,
 220,,South Street at King Street NB,,35.26939591,-120.6619191,slo,,,

221,,South Street at King Street SB,,35.26959738,-120.6621122,slo,,,
 222,,South Street at Meadow Street NB,,35.26942,-120.6590223,slo,,,
 223,,South St. at Beebee Street SB,,35.2696149,-120.6690404,slo,,,
 226,,Tefft at Carillo SB,,35.0396882,-120.4804865,nipomo,,,
 227,,Viejo Camino at Bocina Lane NB,,35.45451543,-120.6377202,smatas,,,
 228,,Town Center Mall Transit Terminal - Connects with SMAT,,34.95000643,-
 120.4332608,smaria,,,
 229,,Viejo Camino at El Camino Real SB,,35.44110361,-120.6291291,smatas,,,
 230,,Viejo Camino at Santa Barbara Road SB,,35.44968455,-120.6326482,smatas,,,
 231,,Viejo Camino at Santa Barbara Road NB,,35.45034441,-120.6329647,smatas,,,
 232,,Cypress St. at Railroad Ave (GREYHOUND STATION),,34.95108148,-
 120.4444456,smatas,,,
 233,,Highland Drive at North Santa Rosa Street SB,,35.29867806,-120.6729752,slo,,,
 237,,South Higuera St. at Margarita Ave NB,,35.25648554,-120.66852,slo,,,
 241,,Viejo Camino at Bocina Lane SB,,35.45434282,-120.637747,smatas,,,
 242,,Ontario Road at Bob Jones Trail (Park & Ride) SB,,35.18535738,-
 120.7033083,slo,,,
 243,,Main St. at Errol St. SB,,35.37968623,-120.8548263,mblocay,,,
 245,,Main Street at The Bluebird Inn NB,,35.56333095,-121.0860863,camsshc,,,
 246,,Main Street at The Bluebird Inn SB,,35.56324586,-121.0856652,camsshc,,,
 254,,Price Street at Hind Street NB,,35.14089064,-120.6388575,pisgrov,,,
 255,,Ontario Road at Ocean Canyon Resort,,35.18258207,-120.7037187,slo,,,
 256,,Thompson Avenue at East Branch Street NB,,35.04405168,-120.477013,nipomo,,,
 257,,El Camino Real at Pueblo Avenue SB,,35.48005024,-120.6580862,smatas,,,
 261,,Thompson Avenue at West Branch Street SB,,35.04379915,-120.4771149,nipomo,,,
 262,,Thompson Ave at Nipomo High School,,35.05242881,-120.4862157,nipomo,,,
 263,,Thompson Ave at Nipomo High School,,35.05223339,-120.4863417,nipomo,,,
 264,,Thompson Avenue at Highway 101 NB,,35.07202773,-120.5138987,nipomo,,,
 265,,Thompson Avenue at Highway 101 SB,,35.07169406,-120.5133408,nipomo,,,
 266,,El Camino Real at Principal Avenue NB,,35.46754927,-120.6500584,smatas,,,
 267,,Ocean Boulevard at 8th Street NB,,35.4441891,-120.8947402,mblocay,,,
 270,,Tefft St. at Carillo St.,,35.03957401,-120.4803336,nipomo,,,
 273,,Shell Beach Road at Pier Avenue NB,,35.15570755,-120.6669831,pisgrov,,,
 274,,Ocean Boulevard at 9th Street SB,,35.44375207,-120.8942601,mblocay,,,
 275,,Marsh at Broad NB,,35.27794694,-120.6639013,slo,,,
 276,,Creston Rd. at Melody Dr.,,35.62321058,-120.6625897,temparo,,,
 277,,Niblick Rd. at Melody Dr.,,35.61585618,-120.667187,temparo,,,
 301,,Santa Barbara at Church,,35.27528209,-120.6563804,slo,,,
 302,,Santa Barbara at Church,,35.27564339,-120.6564206,slo,,,
 305,,7th and Ramona,,35.32060537,-120.8357853,mblocay,,,
 5082,,Santa Rosa at Buchon (S),Mitchell Park/Senior Center,35.279282,-
 120.657196,slo,,,
 5148,,Highland at Mt. Bishop,,35.302551,-120.66758,slo,,,
 5200,,El Camino Real at Traffic Way NB,,35.4896207087074,-
 120.670590698719,smatas,,,
 5202,,El Camino Real at Rosario Ave,,35.4908218502874,-120.673061013221,smatas,,,
 5206,,El Camino Real at Twin Oaks Apartments,,35.4920011354615,-
 120.67497074604,smatas,,,

routes.txt

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 12A,slorta,12A,San Luis Obispo - Los Osos,,3,,FF9900,FFFFFF
 12B,slorta,12B,San Luis Obispo - Los Osos - Hearst Castle,,3,,006699,FFFFFF

trips.txt

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 10,sun,R10kNB_T02,Santa Maria,1,,R10SB
 10,sun,R10kNB_T03,Santa Maria,1,,R10SB
 10,mtwtf,R10nSB_T01,Santa Maria Express,1,,R10nSB
 12A,mtwtf,R12Aa_700x_T01,San Luis Obispo Express,0,,R12A700x
 12A,mtwtf,R12Ab_T01,San Luis Obispo /Los Osos,0,,R12Ab
 12A,mtwtf,R12Ac_T01,,1,,R12Acircle
 12A,mtwtf,R12Ac_T02,,1,,R12Acircle
 12A,mtwtf,R12Ac_T03,,1,,R12Acircle
 12A,mtwtf,R12Ac_T04,,1,,R12Acircle
 12A,mtwtf,R12Ac_T05,,1,,R12Acircle
 12A,mtwtf,R12Ac_T06,,1,,R12Acircle
 12A,mtwtf,R12Ac_T07,,1,,R12Acircle
 12A,mtwtf,R12Ac_T08,,1,,R12Acircle
 12A,mtwtf,R12Ac_T09,,1,,R12Acircle
 12A,mtwtf,R12Ac_T10,,1,,R12Acircle
 12A,mtwtf,R12Ac_T11,,1,,R12Acircle
 12A,mtwtf,R12Ac_T12,,1,,R12Acircle
 12A,mtwtf,R12Ac_T13,,1,,R12Acircle
 12A,5pm,R12Ac_reduced_T01,,1,,R12Acircle
 12A,5pm,R12Ac_reduced_T02,,1,,R12Acircle
 12A,5pm,R12Ac_reduced_T03,,1,,R12Acircle
 12A,5pm,R12Ac_reduced_T04,,1,,R12Acircle
 12A,5pm,R12Ac_reduced_T05,,1,,R12Acircle
 12A,5pm,R12Ac_reduced_T06,,1,,R12Acircle
 12A,5pm,R12Ac_reduced_T07,,1,,R12Acircle
 12A,5pm,R12Ac_reduced_T08,,1,,R12Acircle
 12A,5pm,R12Ac_reduced_T09,,1,,R12Acircle
 12A,5pm,R12Ac_reduced_T10,,1,,R12Acircle
 12A,5pm,R12Ac_reduced_T11,,1,,R12Acircle
 12A,mtwtf,R12Ad_T01,,1,,R12Ad
 12A,mtwtf,R12Ae_T01,,1,,R12Ae
 12A,mtwtf,R12Af_1720x_T01,Los Osos/Morro Bay,1,,R12A1720x
 12A,mtwtf,R12Ag_T01,San Luis Obispo,0,,R12g
 12A,mtwtf,R12Ah_T01,Cuesta College/Achievement House,1,,R12h
 12B,mtwtf,R12BLim_a_T01,Morro Bay-San Simeon,0,,R12BLimSouth
 12B,mtwtf,R12BLim_a_T02,Morro Bay-San Simeon,0,,R12BLimSouth
 12B,mtwtf,R12BLim_a_T03,Morro Bay-San Simeon,0,,R12BLimSouth
 12B,mtwtf,R12BLim_b_T01,San Simeon,1,,R12BLimNorth
 12B,mtwtf,R12BLim_b_T02,San Simeon,1,,R12BLimNorth
 12B,mtwtf,R12BLim_b_T03,San Simeon,1,,R12BLimNorth
 12B,mtwtf,R12BLim_b_T04,San Simeon,1,,R12BLimNorth
 12B,5pm,R12BLim_b_reduced_T01,San Simeon,1,,R12BLimNorth
 12B,5pm,R12BLim_b_reduced_T02,San Simeon,1,,R12BLimNorth
 12B,5pm,R12BLim_b_reduced_T03,San Simeon,1,,R12BLimNorth
 12B,sat,R12Be_sat_T01,San Luis Obispo,0,736,R12BSouth
 12B,sat,R12Be_sat_T02,San Luis Obispo,0,1029,R12BSouth
 12B,sat,R12Be_sat_T03,San Luis Obispo,0,1329,R12BSouth
 12B,sat,R12Be_sat_T04,San Luis Obispo,0,1629,R12BSouth
 12A,sat,R12Ae_sat_T01,San Luis Obispo,0,736,R12BSouth
 12A,sat,R12Ae_sat_T02,San Luis Obispo,0,1029,R12BSouth
 12A,sat,R12Ae_sat_T03,San Luis Obispo,0,1329,R12BSouth
 12A,sat,R12Ae_sat_T04,San Luis Obispo,0,1629,R12BSouth
 12A,sat,R12Af_sat_T01,San Simeon,1,933,R12A+North
 12A,sat,R12Af_sat_T02,San Simeon,1,1233,R12A+North
 12A,sat,R12Af_sat_T03,San Simeon,1,1533,R12A+North
 12A,sat,R12Af_sat_T04,San Simeon,1,1833,R12A+North
 12B,sat,R12Bf_sat_T01,San Simeon,1,933,R12BNorth
 12B,sat,R12Bf_sat_T02,San Simeon,1,1233,R12BNorth
 12B,sat,R12Bf_sat_T03,San Simeon,1,1533,R12BNorth
 12B,sat,R12Bf_sat_T04,San Simeon,1,1833,R12BNorth
 12B,sun,R12Bg_sun_T01,San Luis Obispo,0,733_sun,R12BSouth
 12B,sun,R12Bg_sun_T02,San Luis Obispo,0,1129_sun,R12BSouth

```

12B_sun,R12Bg_sun_T03,San Luis Obispo,0,1539_sun,R12BSouth
12A_sun,R12Ag_sun_T01,San Luis Obispo,0,733_sun,R12BSouth
12A_sun,R12Ag_sun_T02,San Luis Obispo,0,1129_sun,R12BSouth
12A_sun,R12Ag_sun_T03,San Luis Obispo,0,1539_sun,R12BSouth
12A_sun,R12Ak_sun_T01,San Simeon,1,733_sun,R12A+North
12A_sun,R12Ak_sun_T02,San Simeon,1,1129_sun,R12A+North
12A_sun,R12Ak_sun_T03,San Simeon,1,1539_sun,R12A+North
12B_sun,R12Bk_sun_T01,San Simeon,1,733_sun,R12BNorth
12B_sun,R12Bk_sun_T02,San Simeon,1,1129_sun,R12BNorth
12B_sun,R12Bk_sun_T03,San Simeon,1,1539_sun,R12BNorth

```

stop_times.txt

```

trip_id,arrival_time,departure_time,stop_id,stop_sequence,stop_headsign,pickup_type
,drop_off_type,shape_dist_traveled
R9a_T01,05:35:00,05:35:00,075,1,,,,,15.436
R9a_T01,05:45:00,05:45:00,073,2,,,,,23.946
R9a_T01,05:53:00,05:53:00,051,3,,,,,34.218
R9a_T01,,,069,4,,,,,60.659
R9a_T01,,,023,5,,,,,62.307
R9a_T01,06:18:00,06:18:00,025,6,,,,,62.975
R9a_T01,06:22:00,06:22:00,044,7,,,,,64.217
R9a_T01,06:27:00,06:27:00,001,8,,,,,66.225
R9a_T02,06:21:00,06:21:00,087,1,,,,,0
R9a_T02,06:35:00,06:35:00,075,2,,,,,15.436
R9a_T02,06:45:00,06:45:00,073,3,,,,,23.946
R9a_T02,06:53:00,06:53:00,051,4,,,,,34.218
R9a_T02,,,069,5,,,,,60.659
R9a_T02,,,023,6,,,,,62.307
R9a_T02,07:18:00,07:18:00,025,7,,,,,62.975
R9a_T02,07:22:00,07:22:00,044,8,,,,,64.217
R9a_T02,07:27:00,07:27:00,001,9,,,,,66.225
R9a_T03,06:50:00,06:50:00,075,1,,,,,15.436
R9a_T03,07:00:00,07:00:00,073,2,,,,,23.946
R9a_T03,07:08:00,07:08:00,051,3,,,,,34.218
R9a_T03,,,069,4,,,,,60.659
R9a_T03,,,023,5,,,,,62.307
R9a_T03,07:33:00,07:33:00,025,6,,,,,62.975
R9a_T03,07:38:00,07:38:00,044,7,,,,,64.217
R9a_T03,07:42:00,07:42:00,001,8,,,,,66.225
R9b_T01,06:42:00,06:42:00,001,1,,,,,0
R9b_T01,,,081,2,,,,,16.291
R9b_T01,06:58:00,06:58:00,031,3,,,,,16.992
R9b_T01,,,033,4,,,,,20.048
R9b_T01,,,086,5,,,,,21.294
R9b_T01,,,077,6,,,,,22.206
R9b_T01,07:08:00,07:08:00,076,7,,,,,23.742
R9b_T01,,,231,8,,,,,25.082
R9b_T01,,,227,9,,,,,25.727
R9b_T01,,,034,10,,,,,26.22
R9b_T01,,,037,11,,,,,26.768
R9b_T01,,,039,12,,,,,27.219
R9b_T01,,,266,13,,,,,27.599
R9b_T01,,,040,14,,,,,28.162
R9b_T01,,,041,15,,,,,28.573
R9b_T01,,,083,16,,,,,29.203
R9b_T01,,,048,17,,,,,29.653
R9b_T01,,,046,18,,,,,29.896
R9b_T01,07:22:00,07:22:00,051,19,,,,,30.49
R9b_T01,,,049,20,,,,,31.219
R9b_T01,07:30:00,07:30:00,073,21,,,,,41.182
R9b_T01,07:40:00,07:40:00,075,22,,,,,49.855
R9b_T02,07:42:00,07:42:00,001,1,,,,,0

```



```
R9b_T02,,,081,2,,,,16.291
R9b_T02,07:58:00,07:58:00,031,3,,,,16.992
R9b_T02,,,033,4,,,,20.048
R9b_T02,,,086,5,,,,21.294
R9b_T02,,,077,6,,,,22.206
R9b_T02,08:08:00,08:08:00,076,7,,,,23.742
R9b_T02,,,231,8,,,,25.082
R9b_T02,,,227,9,,,,25.727
R9b_T02,,,034,10,,,,26.22
R9b_T02,,,037,11,,,,26.768
R9b_T02,,,039,12,,,,27.219
R9b_T02,,,266,13,,,,27.599
R9b_T02,,,040,14,,,,28.162
R9b_T02,,,041,15,,,,28.573
R9b_T02,,,083,16,,,,29.203
R9b_T02,,,048,17,,,,29.653
R9b_T02,,,046,18,,,,29.896
R9b_T02,08:22:00,08:22:00,051,19,,,,30.49
```

. . .
(File abridged)

calendar.txt

```
service_id,monday,tuesday,wednesday,thursday,friday,saturday,sunday,start_date,end_
date
mtwtf,1,1,1,1,1,0,0,20110101,20120430
sat,0,0,0,0,0,1,0,20110101,20120430
sun,0,0,0,0,0,0,1,20110101,20120430
```

calendar_dates.txt

This example shows service exceptions for special dates, such as New Year’s Eve, Christmas, and Labor Day, during which regular weekday service (service_id=mtwtf) or Saturday service (service_id=sat) is interrupted (exception_type=2).

```
service_id,date,exception_type
mtwtf,20111124,2
mtwtf,20111125,2
mtwtf,20111226,2
mtwtf,20111231,2
mtwtf,20110530,2
mtwtf,20110704,2
mtwtf,20110905,2
5pm,20111224,1
5pm,20111231,1
sat,20111125,1
```

fare_attributes.txt

```
fare_id,price,currency_type,payment_method,transfers,transfer_duration
125,1.5,USD,0,0,
175,2,USD,0,0,
225,2.5,USD,0,0,
275,3,USD,0,0,
450,5,USD,0,,
```

fare_rules.txt

```
fare_id,route_id,origin_id,destination_id,contains_id
125,,slo,slo,
```

125,,mblocay,mblocay,
 125,,camsshc,camsshc,
 125,,nipomo,nipomo,
 125,,smaria,smaria,
 125,,smatas,smatas,
 125,,temparo,temparo,
 125,,sanmig,sanmig,
 125,,pisgrov,pisgrov,
 125,,cuesta,cuesta,
 175,,slo,smatas,
 175,,smatas,slo,
 175,,slo,pisgrov,
 175,,pisgrov,slo,
 175,,slo,cuesta,
 175,,cuesta,slo,
 175,,smatas,temparo,
 175,,temparo,smatas,
 175,,temparo,sanmig,
 175,,sanmig,temparo,
 175,,pisgrov,nipomo,
 175,,nipomo,pisgrov,
 175,,nipomo,smaria,
 175,,smaria,nipomo,
 175,,cuesta,mblocay,
 175,,mblocay,cuesta,
 175,,mblocay,camsshc,
 175,,camsshc,mblocay,
 225,,slo,temparo,
 225,,temparo,slo,
 225,,slo,nipomo,
 225,,nipomo,slo,
 225,,slo,mblocay,
 225,,mblocay,slo,
 225,,smatas,sanmig,
 225,,sanmig,smatas,
 225,,pisgrov,smaria,
 225,,smaria,pisgrov,
 225,,cuesta,camsshc,
 225,,camsshc,cuesta,
 275,,slo,sanmig,
 275,,sanmig,slo,
 275,,slo,smaria,
 275,,smaria,slo,
 275,,slo,camsshc,
 275,,camsshc,slo,
 450,,sanmig,pisgrov,
 450,,pisgrov,sanmig,
 450,,nipomo,sanmig,
 450,,sanmig,nipomo,
 450,,smatas,mblocay,
 450,,mblocay,smatas,
 450,,smatas,camsshc,
 450,,camsshc,smatas,
 450,,smatas,temparo,
 450,,temparo,smatas,
 450,,temparo,mblocay,
 450,,mblocay,temparo,
 450,,smaria,mblocay,
 450,,mblocay,smaria,
 450,,nipomo,mblocay,
 450,,mblocay,nipomo,
 450,,smaria,camsshc,
 450,,camsshc,smaria,

450,, camsshc,nipomo,
 450,, nipomo,camsshc,
 450,, camsshc,temparo,
 450,, temparo,camsshc,
 450,, smatas,slo,
 450,, slo,smatas,
 450,, nipomo,slo,
 450,, slo,nipomo,
 450,, slo,pisgrov,
 450,, pisgrov,slo,
 450,, temparo,slo,
 450,, slo,temparo,
 450,, smatas,pisgrov,
 450,, pisgrov,smatas,
 450,, smatas,nipomo,
 450,, nipomo,smatas,
 450,, camsshc,pisgrov,
 450,, pisgrov,camsshc,
 450,, pisgrov,mblocay,
 450,, mblocay,pisgrov,
 450,, sanmig,smaria,
 450,, smaria,sanmig,
 450,, sanmig,camsshc,
 450,, camsshc,sanmig,
 450,, smaria,smatas,
 450,, smatas,smaria,
 450,, smaria,temparo,
 450,, temparo,smaria,
 450,, temparo,nipomo,
 450,, nipomo,temparo,
 450,, cuesta,nipomo,
 450,, nipomo,cuesta,
 450,, cuesta,smaria,
 450,, smaria,cuesta,
 450,, cuesta,temparo,
 450,, temparo,cuesta,

shapes.txt

shape_id,shape_pt_lat,shape_pt_lon,shape_pt_sequence,shape_dist_traveled
 R9cSB,35.623199,-120.662597,1,0
 R9cSB,35.622971,-120.661745,2,0.081
 R9cSB,35.622841,-120.661301,3,0.124
 R9cSB,35.622559,-120.660347,4,0.215
 R9cSB,35.622169,-120.659721,5,0.287
 R9cSB,35.621639,-120.65937,6,0.354
 R9cSB,35.621269,-120.659271,7,0.396
 R9cSB,35.621109,-120.659149,8,0.417
 R9cSB,35.619701,-120.659218,9,0.573
 R9cSB,35.617378,-120.65918,10,0.832
 R9cSB,35.617298,-120.659233,11,0.842
 R9cSB,35.6166,-120.659271,12,0.92
 R9cSB,35.615749,-120.659218,13,1.014
 R9cSB,35.615792,-120.667191,14,1.735
 R9cSB,35.61581,-120.669159,15,1.913
 R9cSB,35.615829,-120.676903,16,2.613
 R9cSB,35.615681,-120.677643,17,2.682
 R9cSB,35.61515,-120.679283,18,2.841
 R9cSB,35.61507,-120.679863,19,2.895
 R9cSB,35.615059,-120.680328,20,2.937
 R9cSB,35.615181,-120.684738,21,3.336
 R9cSB,35.61533,-120.688423,22,3.669
 R9cSB,35.615349,-120.690392,23,3.847

R9cSB,35.615978,-120.690399,24,3.917
R9cSB,35.617802,-120.690582,25,4.12
R9cSB,35.618061,-120.690666,26,4.15
R9cSB,35.620419,-120.69088,27,4.413
R9cSB,35.620548,-120.688332,28,4.644
R9cSB,35.622669,-120.68853,29,4.88
R9cSB,35.622669,-120.688339,30,4.898
R9cSB,35.622631,-120.688248,31,4.907
R9cSB,35.62251,-120.688214,32,4.921
R9cSB,35.622471,-120.688042,33,4.937
R9cSB,35.62254,-120.687958,34,4.948
R9cSB,35.622662,-120.687981,35,4.961
R9cSB,35.6227,-120.688049,36,4.969
R9cSB,35.622711,-120.688133,37,4.977
R9cSB,35.622631,-120.688248,38,4.99
R9cSB,35.622669,-120.688339,39,5
R9cSB,35.622669,-120.68853,40,5.017
R9cSB,35.621609,-120.6884,41,5.135
R9cSB,35.620551,-120.688326,42,5.253
R9cSB,35.620423,-120.690867,43,5.483
R9cSB,35.618045,-120.690648,44,5.748
R9cSB,35.617933,-120.690722,45,5.762
R9cSB,35.615947,-120.690543,46,5.984
R9cSB,35.615341,-120.690555,47,6.051
R9cSB,35.615199,-120.690553,48,6.067
R9cSB,35.613318,-120.690986,49,6.28
R9cSB,35.61138,-120.691502,50,6.5
R9cSB,35.610986,-120.691582,51,6.545
R9cSB,35.608398,-120.692192,52,6.838
R9cSB,35.605492,-120.692703,53,7.164
R9cSB,35.602951,-120.692673,54,7.447
R9cSB,35.601761,-120.692833,55,7.58
R9cSB,35.60136,-120.692963,56,7.626
R9cSB,35.600151,-120.693527,57,7.77
R9cSB,35.59721,-120.694992,58,8.123
R9cSB,35.5965,-120.695312,59,8.207
R9cSB,35.595901,-120.69548,60,8.275
R9cSB,35.595161,-120.695534,61,8.357
R9cSB,35.590111,-120.695587,62,8.919
R9cSB,35.5807,-120.696991,63,9.973
R9cSB,35.576118,-120.697601,64,10.486
R9cSB,35.574459,-120.697891,65,10.672
R9cSB,35.573669,-120.698151,66,10.763
R9cSB,35.572788,-120.698532,67,10.867
R9cSB,35.570629,-120.699638,68,11.127
R9cSB,35.566029,-120.702057,69,11.683
R9cSB,35.56514,-120.702599,70,11.793
R9cSB,35.564259,-120.703262,71,11.908
R9cSB,35.55658,-120.710228,72,12.969
R9cSB,35.55518,-120.711708,73,13.175

. . . .
(File abridged)

frequencies.txt

This example shows a blank frequencies text file, as this file was not needed for the transit agency data. For an example of a frequencies text file, the reader is referred to the Google Transit website.

trip_id,start_time,end_time,headway_secs

transfers.txt

```
from_stop_id,to_stop_id,transfer_type,min_transfer_time  
017,017,1,  
024,024,2,120  
025,025,2,120  
024,025,2,120  
025,024,2,120
```

APPENDIX C. DATA VALIDATION FOR PARTICIPATING AGENCIES

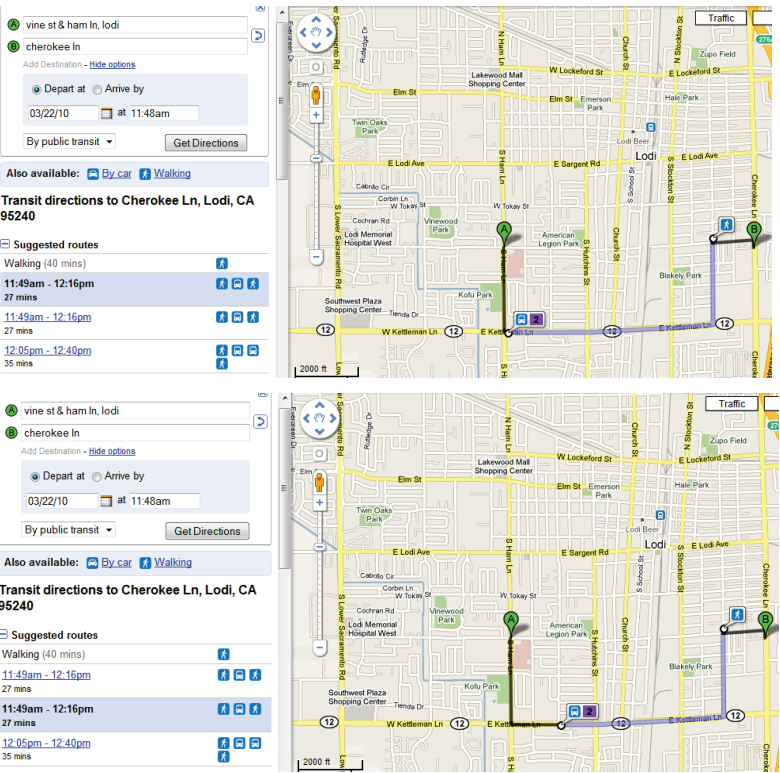
This appendix describes the validation tests that the PATH project team performed for several of the pilot agencies. While most of the validation efforts were conducted by the GTFS consulting firm that was retained by each transit agency to help them with the GTFS data development, PATH staff participated in the validation process to obtain a better sense of the issues that may arise during GTFS implementation and learn how to resolve them with the agency, contractor and Google.


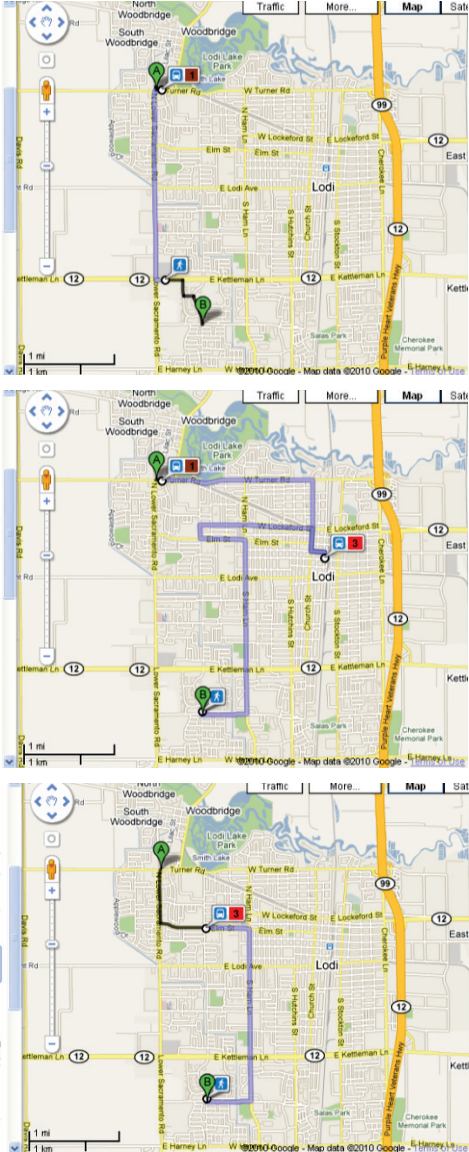
C.1. LODI TRANSIT

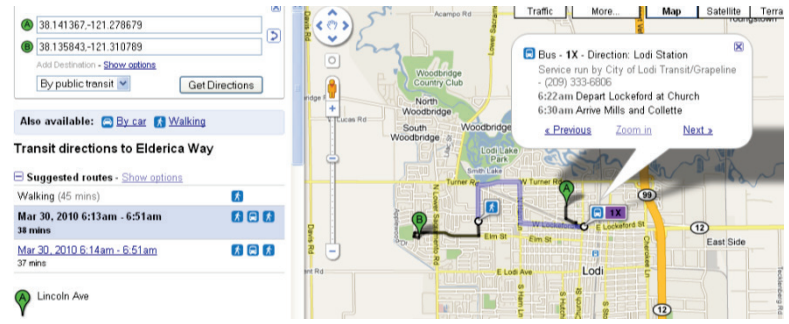
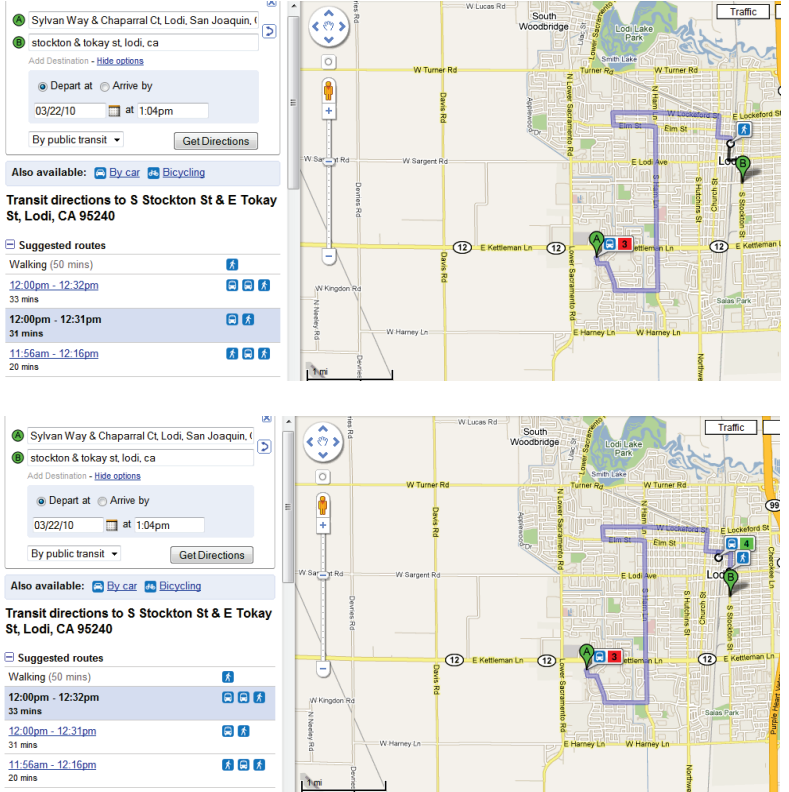
C.1.1. INITIAL GTFS VALIDATION IN GOOGLE TRANSIT PREVIEW MODE

The table below lists the issues that were identified by the PATH project team while validating the GTFS data for Lodi Transit in Google Transit preview mode and the actions that were undertaken by Marcy Jaffe Company to resolve them.

Table C1: Issues Found during Lodi Transit’s GTFS Feed Validation Process

Aspect	Issue and Resolution	Map Display
<p>Weekday Route 2</p>	<p><u>Issue:</u> Two different sets of directions for the same trip</p> <p><u>Resolution:</u> Notified Google Google updated</p>	 <p>The image displays two screenshots of the Google Transit interface for Route 2 in Lodi, CA. Both screenshots show a search for directions from 'vine st & ham ln, lodi' to 'cherokee ln' on 03/22/10 at 11:48am. The top screenshot shows a suggested route of 27 minutes (11:49am - 12:16pm). The bottom screenshot shows a suggested route of 35 minutes (12:05pm - 12:40pm). The map displays the route along E Lodi Ave and E Sargent Rd.</p>

Aspect	Issue and Resolution	Map Display
<p>Transfer Station: Safeway (Kettleman Lane/Lower Sacramento Road)</p>	<p><u>Issue:</u> No time to make transfer – need to show 5 min buffer</p> <p><u>Resolution:</u> Updated spreadsheet transfer tab to correct transfer</p>	 <p>Transit directions to Mills north of Sand Creek</p> <p>Walking (59 mins) About 3 mins</p> <p>Bus - 3 - Direction: Lodi Station Service run by City of Lodi Transit/Grapeline - (209) 333-6806</p> <p>11:50am Depart Mills north of Sand Creek 10 mins</p> <p>12:00pm Arrive Safeway 0 secs to make transfer</p> <p>Bus - 1 - Direction: Lodi Station 12:00pm Depart Safeway 8 mins</p> <p>12:08pm Arrive Turner at Loma (SW) Route Information - lodi.gov</p> <p>Walking to Turner Rd & N Mills Ave, Lodi, CA About 3 mins</p> <p>Turner Rd & N Mills Ave Lodi, CA</p>
<p>Transfer Station: Hollywood Video(Kettleman Lane/Lower Sacramento Road)</p>	<p><u>Issue:</u> Not recognized as a transfer station</p> <p><u>Resolution:</u> Updated spreadsheet transfer tab to correct transfer</p>	 <p>Transit directions to Century Blvd & S Mills Ave, Lodi, CA 95242</p> <p>Suggested routes</p> <p>Walking (59 mins)</p> <p>11:43am - 12:15pm 32 mins</p> <p>12:03pm - 12:50pm 47 mins</p> <p>12:10pm - 12:50pm 40 mins</p> <p>N Lower Sacramento Rd & Turner Rd Lodi, CA 95242</p> <p>Showing Trip 2 \$1.25 (vs. \$1.86 driving) Travel time: about 32 mins</p> <p>Walking to Woodlake Plaza About 2 mins</p> <p>Bus - 1 - Direction: Lodi Station Service run by City of Lodi Transit/Grapeline - (209)</p> <p>Transit directions to Century Blvd & S Mills Ave, Lodi, CA 95242</p> <p>Suggested routes</p> <p>Walking (59 mins)</p> <p>11:43am - 12:15pm 32 mins</p> <p>12:03pm - 12:50pm 47 mins</p> <p>12:10pm - 12:50pm 40 mins</p> <p>N Lower Sacramento Rd & Turner Rd Lodi, CA 95242</p> <p>Showing Trip 3 \$1.25 (vs. \$1.86 driving) Travel time: about 47 mins</p> <p>Walking to Woodlake Plaza About 1 min</p> <p>Bus - 1 - Direction: Lodi Station Service run by City of Lodi Transit/Grapeline - (209)</p> <p>Transit directions to Century Blvd & S Mills Ave, Lodi, CA 95242</p> <p>Suggested routes</p> <p>Walking (59 mins)</p> <p>11:43am - 12:15pm 32 mins</p> <p>12:03pm - 12:50pm 47 mins</p> <p>12:10pm - 12:50pm 40 mins</p> <p>N Lower Sacramento Rd & Turner Rd Lodi, CA 95242</p> <p>Showing Trip 4 \$1.25 (vs. \$1.86 driving) Travel time: about 40 mins</p> <p>Walking to Elm / Mills About 22 mins</p> <p>Bus - 3 - Direction: Lodi Station Service run by City of Lodi Transit/Grapeline - (209)</p>

Aspect	Issue and Resolution	Map Display
<p>General: Information presentation - Express routes</p>	<p>Issue: Website URL missing</p> <p>Resolution: Update spreadsheet to include URL</p>	
<p>General: Time</p>	<p>Issue: Issues with time query (ask for 1PM, get 12PM)</p> <p>Resolution: Notified Google Google updated</p>	

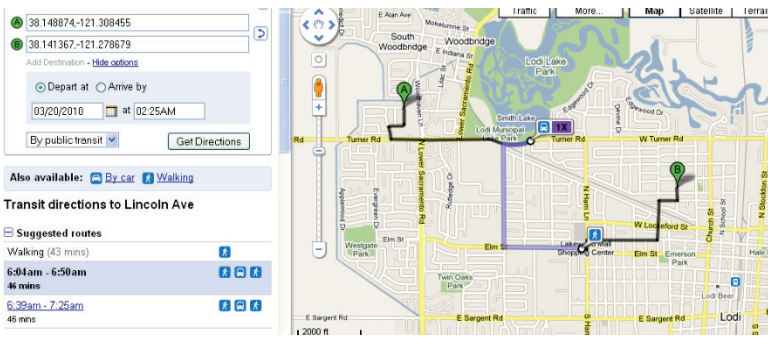
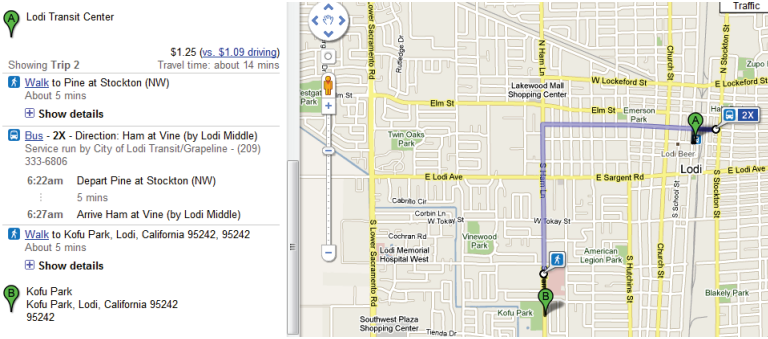
C.1.2. VALICATION OF MAJOR TRANSIT ROUTES

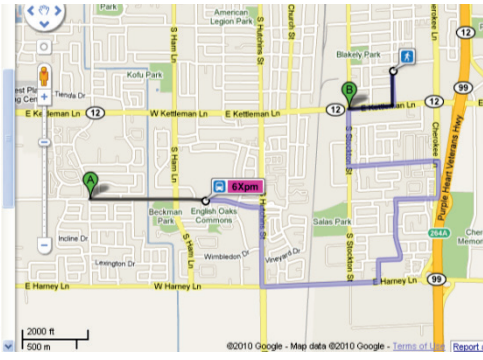
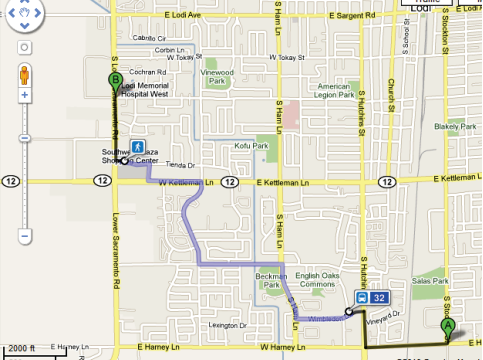
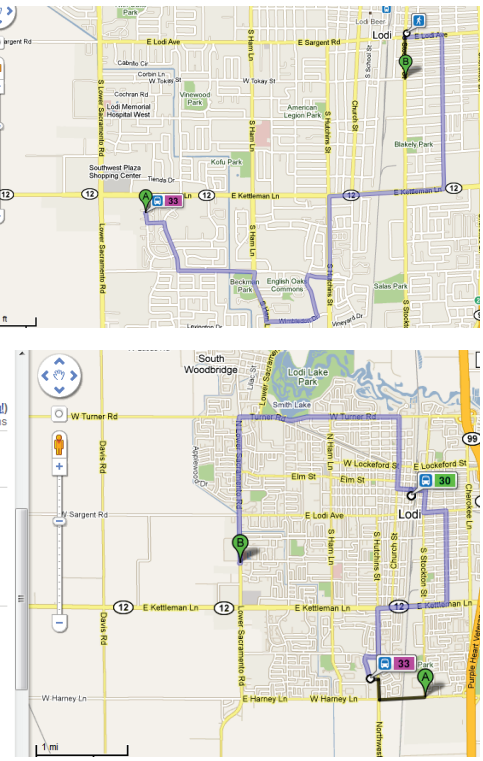
Staff from Lodi Transit identified the following bus routes as requiring more attention, either because of their importance or due to inherent route or stop complexities.

- Weekday Route 3
- Weekend Route 32
- Weekend Route 33
- Express Routes 1, 2 and 6
- Transfer Points:
 - Safeway at Kettleman Lane/Lower Sacramento Road
 - Hollywood Video at Kettleman Lane/Lower Sacramento Road
 - Lodi Station (also known as “Transit Center”)
 - For Route 3, transfer point at SB Ham Lane/Kettleman Lane must be used if behind schedule when school gets out.

The table below describes the issues that were identified with the above routes and transfer points during the GTFS validation process and how these issues were resolved by Marcy Jaffe Company.

Table C2: Status of GTFS Feeds for Lodi Transit’s List of Priority Routes and Transfers

Aspect	Result	Map Display
Express Route 1	The shape, schedule and directions are correct	
Express Route 2	The shape, schedule and directions are correct	

Aspect	Result	Map Display
<p>Express Route 6</p>	<p>The shape, schedule and directions are correct</p>	<p>Transit directions to E Kettleman Ln & S Stockton St, Lodi, CA 95240</p> <p>Suggested routes</p> <p>Walking (39 mins) 21 mins</p> <p>2:18pm - 2:39pm 21 mins</p> <p>2:26pm - 3:08pm 41 mins</p> <p>2:33pm - 3:10pm 37 mins</p> <p>Century Blvd & S Mills Ave Lodi, CA 95242</p> <p>Showing Trip 4 \$1.25 (vs. \$1.17 driving) Travel time: about 37 mins</p> <p>Walk to Tokay High School About 13 mins</p> <p>Show details</p> <p>Bus - 6Xpm - Direction: Central at Hilborn (SE) About 13 mins</p> 
<p>Weekend Route 32</p>	<p>The shape, schedule and directions are correct</p>	<p>Transit directions to S Lower Sacramento Rd & W Vine St, Lodi, CA 95242</p> <p>Suggested routes - Show options</p> <p>9:11am - 9:47am 36 mins</p> <p>9:20am - 10:20am 59 mins</p> <p>9:24am - 10:20am 56 mins</p> <p>E Harney Ln & S Stockton St Lodi, CA 95240</p> <p>Showing Trip 1 \$1.25 (vs. \$2.05 driving) Travel time: about 36 mins</p> <p>Walk to Scarborough at Wimbleton (NW) About 16 mins</p> <p>Show details</p> <p>Bus - 32 - Direction: Lodi Station Service run by City of Lodi Transit/Grapeline - (209) 333-6806</p> <p>9:28am Depart Scarborough at Wimbleton (NW) 12 mins</p> 
<p>Weekend Route 33</p>	<p>The shape, schedule and directions are correct</p>	<p>9:36am - 10:07am 31 mins</p> <p>Syhan Way & Chaparral Ct Lodi, CA 95242</p> <p>Showing Trip 2 \$1.25 (vs. \$1.49 driving) Travel time: about 25 mins</p> <p>Bus - 33 - Direction: Lodi Station Service run by City of Lodi Transit/Grapeline - (209) 333-6806</p> <p>9:33am Depart Syhan at Chapparral (SW) 19 mins</p> <p>9:52am Arrive Stockton / Lodi About 6 mins</p> <p>Walk to S Stockton St & E Tokay St, Lodi, CA 95240 About 6 mins</p> <p>Show details</p> <p>S Stockton St & E Tokay St Lodi, CA 95240</p> <p>Local agency information: Contains more information on fares, schedules, and service</p> <p>Showing Trip 2 \$1.25 (vs. \$2.05 driving) Travel time: about 59 mins</p> <p>Walk to Scarborough at Wimbleton (NE) About 16 mins</p> <p>Show details</p> <p>Bus - 33 - Direction: Lodi Station Service run by City of Lodi Transit/Grapeline - (209) 333-6806</p> <p>9:37am Depart Scarborough at Wimbleton (NE) 17 mins</p> <p>9:54am Arrive Lodi Station Route Information - lodi.gov</p> <p>Bus - 30 - Direction: Lodi Station 6 mins to make transfer</p> <p>10:00am Depart Lodi Station 20 mins</p> <p>10:20am Arrive Lower Sacramento at Vine (SW) Route Information - lodi.gov</p> <p>S Lower Sacramento Rd & W Vine St Lodi, CA 95242</p> 

Aspect	Result	Map Display
<p>Hollywood Video(Kettleman Lane/Lower Sacramento Road)</p>	<p>Not seen as a transfer station and therefore will not include the stop in the directions</p>	<div data-bbox="641 241 950 619"> <p>Transit directions to Century Blvd & S Mills Ave, Lodi, CA 95242</p> <p>Suggested routes</p> <p>Walking (59 mins) </p> <p>11:43am - 12:15pm </p> <p>32 mins</p> <p>12:03pm - 12:50pm </p> <p>47 mins</p> <p>12:10pm - 12:50pm </p> <p>40 mins</p> <p> N Lower Sacramento Rd & Turner Rd Lodi, CA 95242</p> <p>Showing Trip 2 \$1.25 (vs. \$1.86 driving!) Travel time: about 32 mins</p> <p> Walk to Woodlake Plaza About 2 mins</p> <p> Show details</p> <p> Bus - 1 - Direction: Lodi Station Service run by City of Lodi Transit/Grappleline - (209)</p> </div> <div data-bbox="641 630 950 1008"> <p>Transit directions to Century Blvd & S Mills Ave, Lodi, CA 95242</p> <p>Suggested routes</p> <p>Walking (59 mins) </p> <p>11:43am - 12:15pm </p> <p>32 mins</p> <p>12:03pm - 12:50pm </p> <p>47 mins</p> <p>12:10pm - 12:50pm </p> <p>40 mins</p> <p> N Lower Sacramento Rd & Turner Rd Lodi, CA 95242</p> <p>Showing Trip 3 \$1.25 (vs. \$1.86 driving!) Travel time: about 47 mins</p> <p> Walk to Woodlake Plaza About 1 min</p> <p> Show details</p> <p> Bus - 1 - Direction: Lodi Station Service run by City of Lodi Transit/Grappleline - (209)</p> </div> <div data-bbox="641 1018 950 1396"> <p>Transit directions to Century Blvd & S Mills Ave, Lodi, CA 95242</p> <p>Suggested routes</p> <p>Walking (59 mins) </p> <p>11:43am - 12:15pm </p> <p>32 mins</p> <p>12:03pm - 12:50pm </p> <p>47 mins</p> <p>12:10pm - 12:50pm </p> <p>40 mins</p> <p> N Lower Sacramento Rd & Turner Rd Lodi, CA 95242</p> <p>Showing Trip 4 \$1.25 (vs. \$1.86 driving!) Travel time: about 40 mins</p> <p> Walk to Elm / Mills About 22 mins</p> <p> Show details</p> <p> Bus - 3 - Direction: Lodi Station Service run by City of Lodi Transit/Grappleline - (209)</p> </div> <div data-bbox="958 241 1429 619"> </div> <div data-bbox="958 630 1429 1008"> </div> <div data-bbox="958 1018 1429 1396"> </div>
<p>Lodi Station (aka Transit Center)</p>	<p>The shape, schedule and directions are correct for the transfer</p>	<div data-bbox="641 1428 950 1806"> <p> S Ham Ln & W Vine St Lodi, CA</p> <p>Showing Trip 4 \$1.25 (vs. \$1.51 driving!) Travel time: about 35 mins</p> <p> Walk to Ham at Vine (SE-south of driveway) About 1 min</p> <p> Show details</p> <p> Bus - 3 - Direction: Lodi Station Service run by City of Lodi Transit/Grappleline - (209) 333-6806</p> <p>12:06pm Depart Ham at Vine (SE-south of driveway) 13 mins</p> <p>12:19pm Arrive Lodi Station Route Information - lodi.gov</p> <p> Bus - 5 - Direction: Lodi Station 6 mins to make transfer</p> <p>12:25pm Depart Lodi Station 11 mins</p> <p>12:36pm Arrive Cherokee / Hale Route Information - lodi.gov</p> <p> Walk to Cherokee Ln, Lodi, CA 95242 About 4 mins</p> </div> <div data-bbox="958 1428 1429 1806"> </div>

Aspect	Result	Map Display
<p>Ham Lane/ Kettleman Lane southbound</p>	<p>Will not transfer to southbound Route 3, only transfer for northbound available</p>	<div data-bbox="641 241 950 619"> <p>Transit directions to E Kettleman Ln & S Stockton St, Lodi, CA 95240</p> <p>Suggested routes</p> <p>Walking (39 mins) 21 mins</p> <p>2:18pm - 2:39pm 41 mins</p> <p>2:28pm - 3:08pm 41 mins</p> <p>2:33pm - 3:10pm 37 mins</p> <p>Century Blvd & S Mills Ave Lodi, CA 95242</p> <p>Showing Trip 3 Travel time: about 41 mins</p> <p>1 Walk to Mills-south of Sylvan About 2 mins</p> <p>Show details</p> <p>2 Bus - 3 - Direction: Lodi Station</p> </div> <div data-bbox="958 241 1429 619"> </div> <div data-bbox="641 630 950 976"> <p>Transit directions to E Kettleman Ln & S Stockton St, Lodi, CA 95240</p> <p>Suggested routes</p> <p>Walking (39 mins) 21 mins</p> <p>2:18pm - 2:39pm 41 mins</p> <p>2:26pm - 3:06pm 41 mins</p> <p>2:33pm - 3:10pm 37 mins</p> <p>Century Blvd & S Mills Ave Lodi, CA 95242</p> <p>Showing Trip 2 Travel time: about 21 mins</p> <p>1 Walk to Kettleman at Mills (SE) About 12 mins</p> <p>Show details</p> <p>2 Bus - 2 - Direction: Lodi Station</p> </div> <div data-bbox="958 630 1429 976"> </div> <div data-bbox="641 987 950 1396"> <p>E Kettleman Ln & S Stockton St, Lodi, CA 95240</p> <p>Showing Trip 2 Travel time: about 27 mins</p> <p>1 Walk to Kettleman at Stockton (NE) About 1 min</p> <p>Show details</p> <p>2 Bus - 2 - Direction: Lodi Station Service run by City of Lodi Transit/Grapeline - (209) 333-6806</p> <p>11:43am Depart Kettleman at Stockton (NE) : 17 mins</p> <p>12:00pm Arrive Kettleman at Ham (NW) Route Information - lodi.gov</p> <p>3 Bus - 3 - Direction: Lodi Station 6 mins to make transfer</p> <p>12:06pm Depart Ham / Kettleman : 2 mins</p> <p>12:08pm Arrive Ham at Lodi (SE) Route Information - lodi.gov</p> <p>4 Walk to S Ham Ln & E Lodi Ave, Lodi, CA About 1 min</p> </div> <div data-bbox="958 987 1429 1396"> </div>
<p>Safeway Transfer Point (Kettleman Lane/Lower Sacramento Road)</p>	<p>No time to make transfer</p>	<div data-bbox="641 1423 950 1770"> <p>Transit directions to Safeway Transfer Point</p> <p>Suggested routes</p> <p>Walking (39 mins) About 3 mins</p> <p>11:50am Depart Mills north of Sand Creek : 10 mins</p> <p>12:00pm Arrive Safeway Route Information - lodi.gov</p> <p>2 Bus - 1 - Direction: Lodi Station 0 secs to make transfer</p> <p>12:00pm Depart Safeway : 6 mins</p> <p>12:06pm Arrive Turner at Loma (SW) Route Information - lodi.gov</p> <p>3 Walk to Turner Rd & N Mills Ave, Lodi, CA About 3 mins</p> <p>Show details</p> <p>4 Turner Rd & N Mills Ave Lodi, CA</p> </div> <div data-bbox="958 1423 1429 1770"> </div>

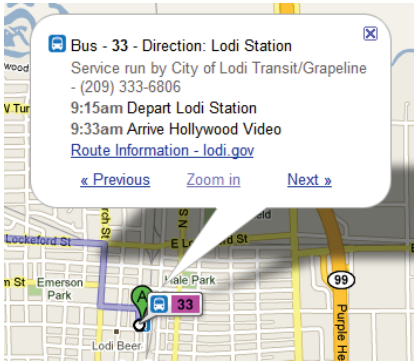
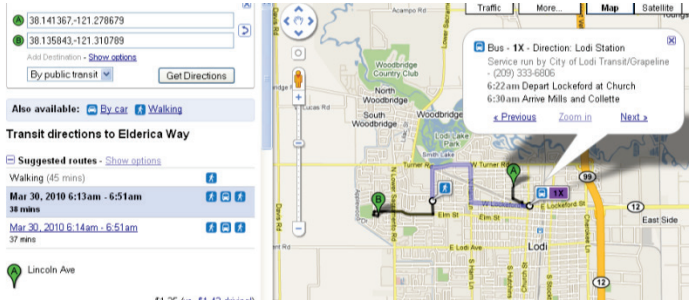
C.1.3. FEED VALIDATION USING GOOGLE’S BEST PRACTICE CHECKLIST

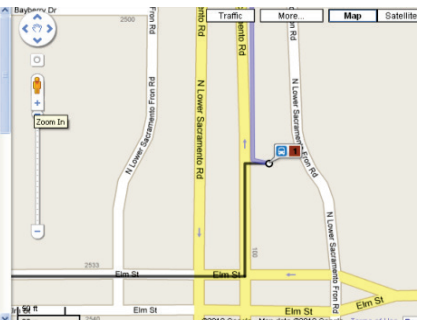
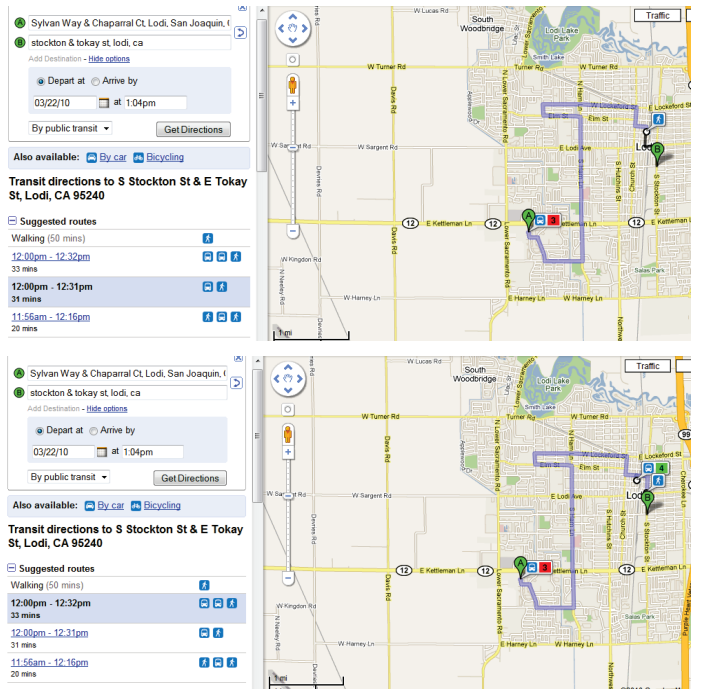
Google provides a checklist that provides guidelines on what information should be checked while the transit agency’s data is in preview mode on Google Transit. This checklist, which can be found at the following address: <http://maps.google.com/help/maps/transit/partners/bestpractices.html>, lists the following items to verify while testing GTFS data in preview mode:

- Route names are displayed appropriately.
- Agency name is correct.
- Phone number is correct.
- All URL's are correct and do not return blank pages.
- Route shape for the trip matches road network on Google Maps.
- The total time of the trips makes sense.
- Test trips for various time periods and days, including weekend.
- Transfers happen at the appropriate places.

This section describes whether issues were found when going through the checklist, and if so, how the issue was resolved. Resolution of these issues was conducted by Marcy Jaffe Company.

Table C3: Validation of Best Practice Checklist for Lodi Transit

Checklist Item	Result	Map Display/Description
Route names are displayed appropriately	Correct	
Agency name is correct	Correct	
Phone number is correct	Correct	
All URL's are correct and don't return blank pages.	Weekend: Correct Weekday: Correct Express Routes: No website	<p>Returns http://www.lodi.gov/transit/weekend_schedule_Jan2010.html for weekend and http://www.lodi.gov/transit/weekday_schedule_Jan2010.html for weekday</p> 

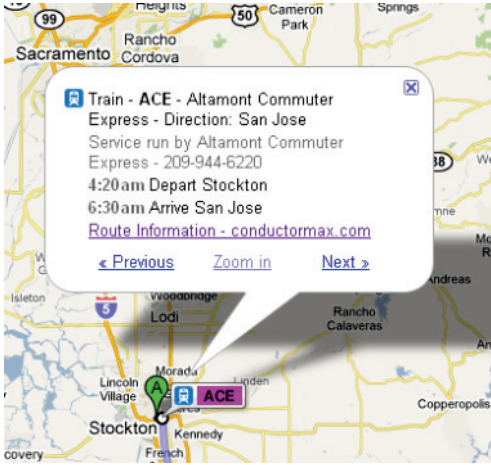
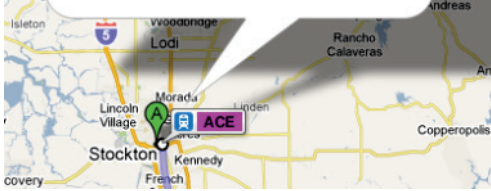
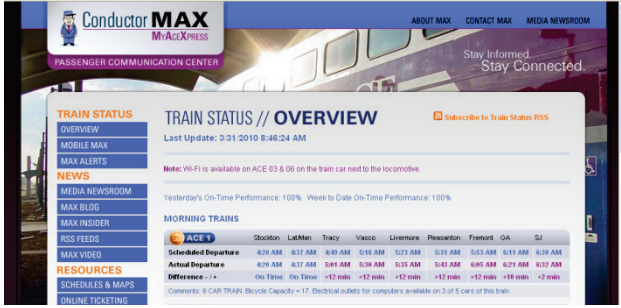
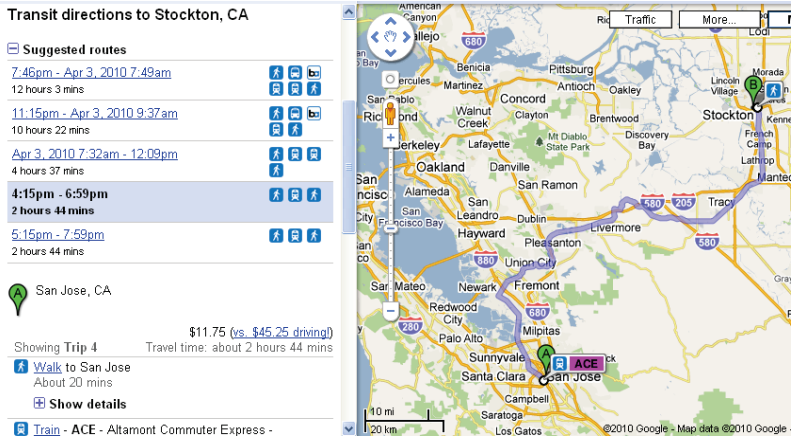
Checklist Item	Result	Map Display/Description
Route shape	Looks as if turning off road	 <p>The screenshot shows a Google Maps interface with a transit route. The origin is 38135843 and the destination is 38133265. The route is highlighted in yellow and shows a sharp turn off the main road. The map includes street names like Bayberry Dr, Elm St, and N Lower Sacramento Rd.</p>
The total time of the trips makes sense	Correct	
Trips returned correctly for different time periods and days	Issues with time query (ask for 1PM, get 12PM)	 <p>The screenshots show Google Maps transit directions for a route between Sylvan Way & Chaparral Ct, Lodi, San Joaquin, CA and Stockton & Tokay St, Lodi, CA 95240. The screenshots show different time periods and a discrepancy in the returned times. The first screenshot shows a departure at 1:04pm and a return time of 12:00pm - 12:32pm. The second screenshot shows a departure at 1:04pm and a return time of 12:00pm - 12:31pm.</p>
Transfers happen at appropriate places	See List of Issues in Table B2	
Check the location of stops	Correct	
Check routes in <i>ScheduleViewer</i> for inaccurate travel times, stop locations and stop times	Correct	
Additional Validation Items		
Verify walking options	Walking as first option even when not viable	
Route verification using <i>Random Queries</i>	50 queries generated with no issue	

C.2. ACE RAIL

C.2.1. INITIAL GTFS VALIDATION IN GOOGLE TRANSIT PREVIEW MODE

The table below lists the issues that were identified by the PATH project team while validating the GTFS data for Ace Rail in Google Transit preview mode and the actions that were undertaken by Marcy Jaffe Company to resolve them.

Table C4: Issues Found during ACE Rail’s GTFS Feed Validation Process

Aspect	Issue and Resolution	Map Display
Route name	<p><u>Issue:</u> Includes Altamont Commuter Express in route name</p> <p><u>Resolution:</u> None. What the agency wanted.</p>	
Phone number	<p><u>Issue:</u> Would the 1-800 number be better?</p> <p><u>Resolution:</u> None. What the agency wanted.</p>	
URL's	<p><u>Issue:</u> Returns http://www.conductormax.com/trainstatus.aspx. Appropriate?</p> <p><u>Resolution:</u> None. What the agency wanted.</p>	
Route Display	<p><u>Issue:</u> Return others that are much longer first and ACE rail after those options</p> <p><u>Resolution:</u> In preview mode, it appends the agency to the end of the list. After it's made public, it will be updated.</p>	

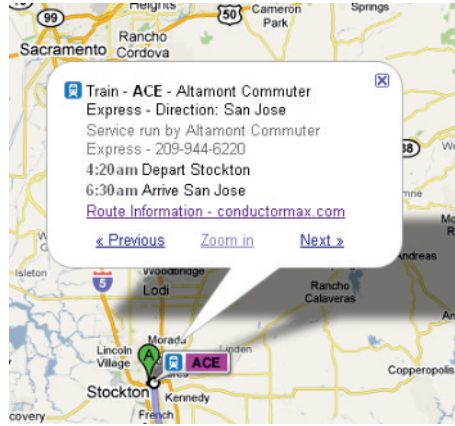
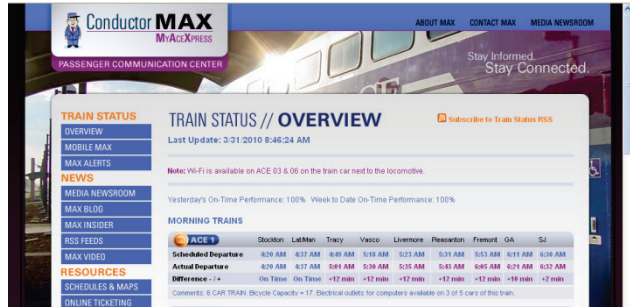
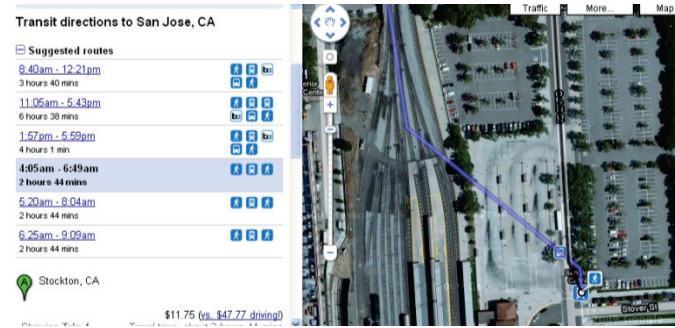
Aspect	Issue and Resolution	Map Display
<p>Shapes</p>	<p><u>Issue:</u> Turns off the tracks?</p> <p><u>Resolution:</u> Road layer and satellite layer incompatibility. On the satellite layer it looks strange but on the roads layer it makes sense.</p>	<p>Transit directions to San Jose, CA</p> <p>Suggested routes</p> <ul style="list-style-type: none"> 8:40am - 12:21pm 3 hours 40 mins 11:05am - 5:43pm 6 hours 38 mins 1:57pm - 5:59pm 4 hours 1 min 4:05am - 6:49am 2 hours 44 mins 5:20am - 8:04am 2 hours 44 mins 6:25am - 9:09am 2 hours 44 mins <p>Stockton, CA</p> <p>\$11.75 (vs. \$47.77 driving)</p> <p>Showing Trip 4</p> <p>Walk to San Jose About 20 mins</p> <p>Show details</p> <p>Also available: By car</p> <p>Transit directions to San Jose, CA</p> <p>Suggested routes</p> <ul style="list-style-type: none"> 8:40am - 12:21pm 3 hours 40 mins 11:05am - 5:43pm 6 hours 38 mins 1:57pm - 5:59pm 4 hours 1 min 4:05am - 6:49am 2 hours 44 mins 5:20am - 8:04am 2 hours 44 mins 6:25am - 9:09am 2 hours 44 mins
<p>Shapes</p>	<p><u>Issue:</u> Stockton ACE rail station</p> <p><u>Resolution:</u> Shape file updated.</p>	<p>Transit directions to Stockton, CA</p> <p>Suggested routes</p> <ul style="list-style-type: none"> 7:46pm - Apr 3, 2010 7:49am 12 hours 3 mins 11:15pm - Apr 3, 2010 9:37am 10 hours 22 mins Apr 3, 2010 7:32am - 12:00pm 4 hours 37 mins 4:15pm - 6:59pm 2 hours 44 mins 5:15pm - 7:59pm 2 hours 44 mins <p>San Jose, CA</p> <p>\$11.75 (vs. \$45.25 driving)</p> <p>Showing Trip 4</p> <p>Travel time: about 2 hours 44 mins</p> <p>Walk to San Jose About 20 mins</p> <p>Show details</p> <p>Also available: By car</p> <p>Transit directions to San Jose, CA</p> <p>Suggested routes</p> <ul style="list-style-type: none"> 8:40am - 12:21pm 3 hours 40 mins 11:05am - 5:43pm 6 hours 38 mins 1:57pm - 5:59pm 4 hours 1 min 4:05am - 6:49am 2 hours 44 mins 5:20am - 8:04am 2 hours 44 mins 6:25am - 9:09am 2 hours 44 mins

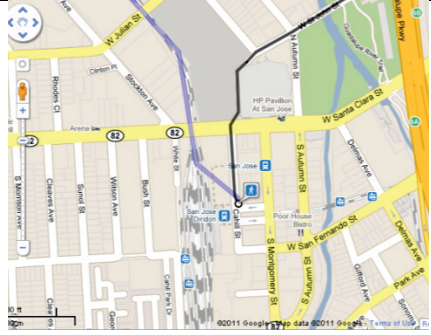

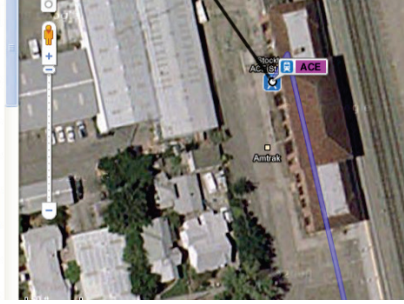

Aspect	Issue and Resolution	Map Display
<p>Train Station Location</p>	<p>Issue: Livermore Station, Lathrop/Manteca</p> <p>Resolution: Stop list updated/Contacted Google about changing location of stop</p>	
<p>Directions</p>	<p>Issue: Shows arrow for walking directions</p> <p>Resolution: The location B is a long driveway leading up to the parking lot of the station, not a street and thus not part of the walking directions.</p>	

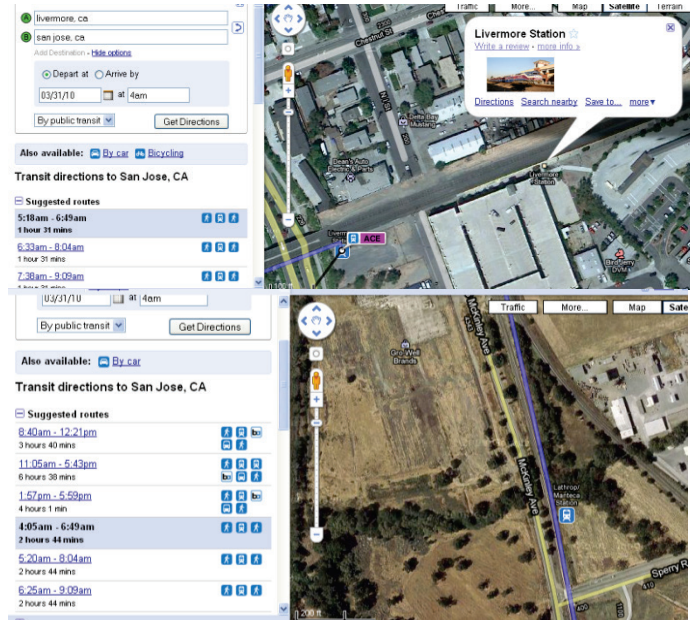
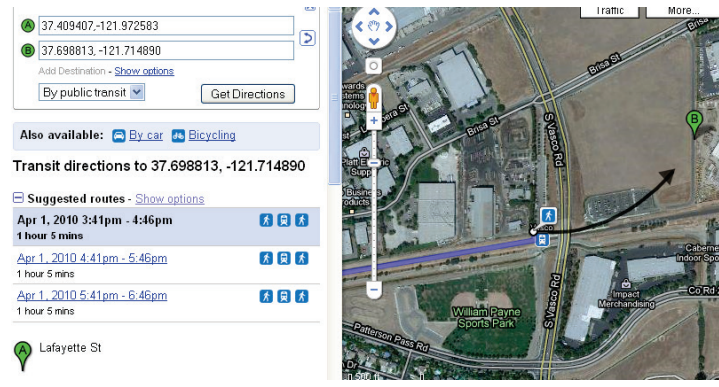
C.2.2. FEED VALIDATION USING GOOGLE’S BEST PRACTICE CHECKLIST

The table below describes the issues that were found by going through the GTFS “best practice” checklist provided at <http://maps.google.com/help/maps/transit/partners/bestpractices.html>, and how the identified issues were resolved.

Table C5: Validation of Best Practice Checklist for ACE Rail

Checklist Item	Result	Map Display/Description
Route names are displayed appropriately	Altamont Commuter Express in Route name	
Agency name is correct	Correct	
Phone number is correct	209 number?	
All URL's are correct and don't return blank pages.	Weekend: http://www.conductormax.com/trainstatus.aspx . Appropriate? Weekday: http://www.conductormax.com/trainstatus.aspx . Appropriate?	
Route shape	Turns off the tracks?	

Checklist Item	Result	Map Display/Description
		
	<p>Stockton ACE rail station</p>	<div data-bbox="727 590 1015 934"> <p>Transit directions to Stockton, CA</p> <p>Suggested routes</p> <ul style="list-style-type: none"> 7:46pm - Apr 3, 2010 7:49am 12 hours 3 mins 11:15pm - Apr 3, 2010 9:37am 10 hours 22 mins Apr 3, 2010 7:32am - 12:09pm 4 hours 37 mins 4:15pm - 6:59pm 2 hours 44 mins 5:15pm - 7:59pm 2 hours 44 mins <p>San Jose, CA</p> <p>Showing Trip 4 \$11.75 (vs. \$45.25 driving)</p> <ul style="list-style-type: none"> Walk to San Jose About 20 mins <p>Show details</p> </div> <div data-bbox="727 947 1015 1249"> <p>Also available: Ry car</p> <p>Transit directions to San Jose, CA</p> <p>Suggested routes</p> <ul style="list-style-type: none"> 8:40am - 12:21pm 3 hours 40 mins 11:05am - 5:43pm 6 hours 38 mins 1:57pm - 5:59pm 4 hours 1 min 4:05am - 6:49am 2 hours 44 mins 5:20am - 8:04am 2 hours 44 mins 6:26am - 9:09am 2 hours 44 mins </div> <div data-bbox="1024 590 1425 934">  </div> <div data-bbox="1024 947 1425 1249">  </div>
<p>The total time of the trips makes sense</p>	<p>Correct, but it appears below others that are longer trips.</p>	<div data-bbox="727 1278 1015 1648"> <p>Transit directions to Stockton, CA</p> <p>Suggested routes</p> <ul style="list-style-type: none"> 7:46pm - Apr 3, 2010 7:49am 12 hours 3 mins 11:15pm - Apr 3, 2010 9:37am 10 hours 22 mins Apr 3, 2010 7:32am - 12:09pm 4 hours 37 mins 4:15pm - 6:59pm 2 hours 44 mins 5:15pm - 7:59pm 2 hours 44 mins <p>San Jose, CA</p> <p>Showing Trip 4 \$11.75 (vs. \$45.25 driving)</p> <ul style="list-style-type: none"> Walk to San Jose About 20 mins <p>Show details</p> </div> <div data-bbox="1024 1278 1425 1648">  </div>
<p>Trips returned correctly for different time periods and days</p>	<p>Correct</p>	
<p>Transfers happen at appropriate places</p>	<p>Not an issue with ACE Rail</p>	

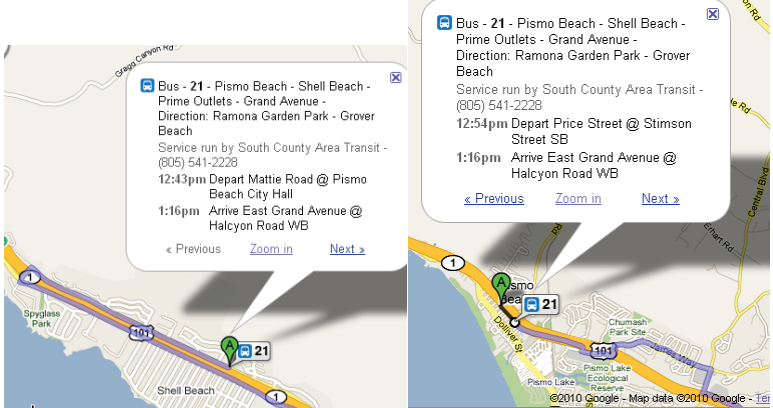
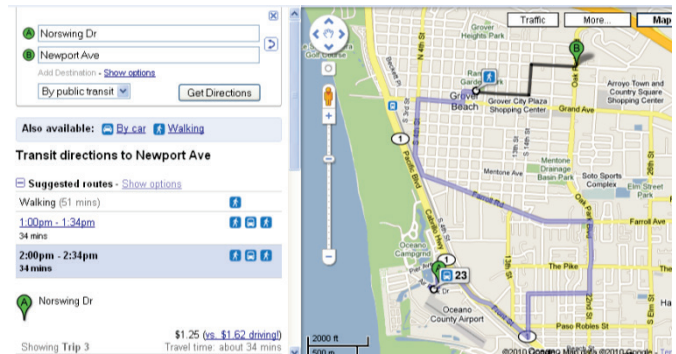
Checklist Item	Result	Map Display/Description
Check the location of stops	Issue with Livermore Station and Lathrop/ Manteca stops	
Check routes in <i>ScheduleViewer</i> for inaccurate travel times, stop locations and stop times	Correct	
Additional Validation Items		
Verify walking options	Arrow	
Route verification using <i>Random Queries</i>	50 queries generated with no issue	

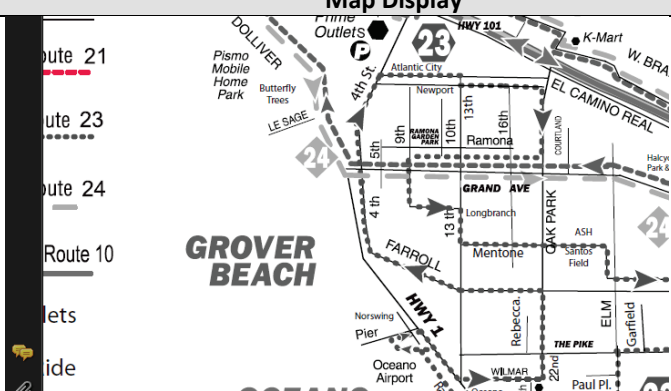
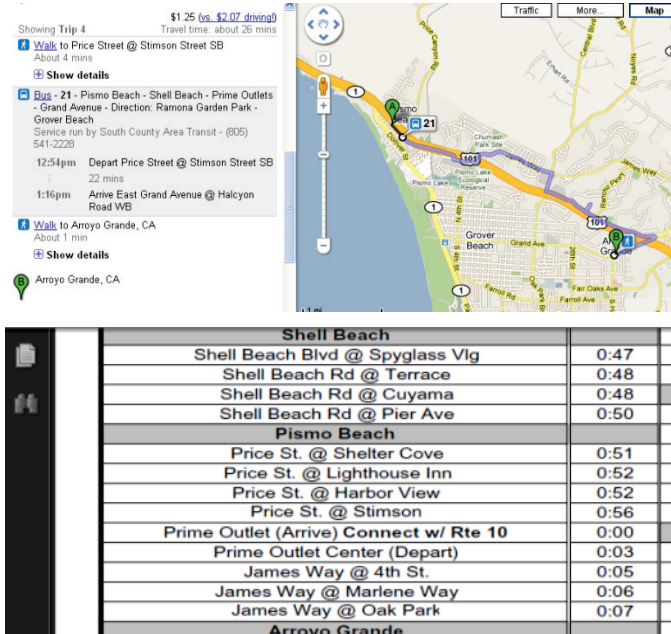
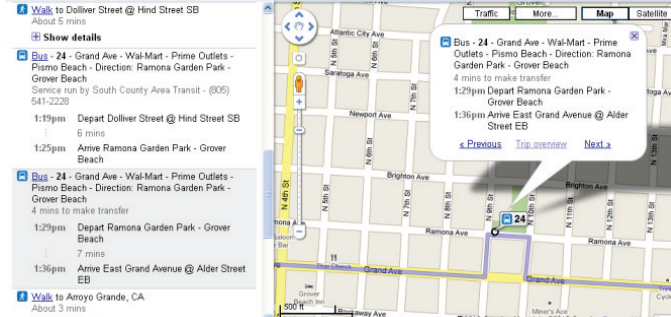
C.3. SOUTH COUNTY AREA TRANSIT

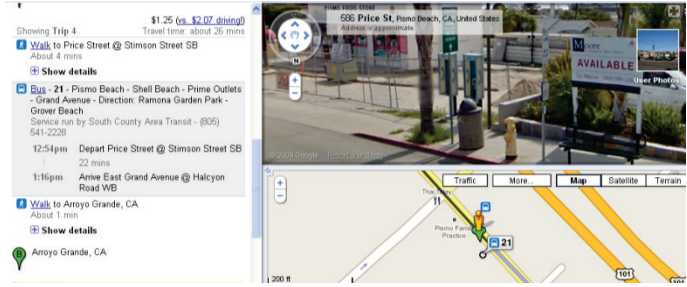
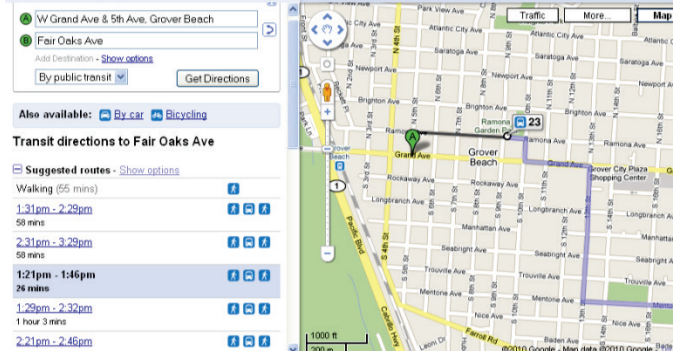
C.3.1. INITIAL GTFS VALIDATION IN GOOGLE TRANSIT PREVIEW MODE

The table below lists the issues that were identified by the PATH project team while validating the GTFS data for South County Area Transit in Google Transit preview mode and the actions that were undertaken by Marcy Jaffe Company to resolve them.

Table C6: Issues Found during SCAT’s GTFS Feed Validation Process

Aspect	Issue and Resolution	Map Display
Route name	<p><u>Issue:</u> Although heading in opposite directions, have same sign</p> <p><u>Resolution:</u> Edited route head sign.</p>	
URL	<p><u>Issue:</u> No URL</p> <p><u>Resolution:</u> Google Quality Assurance does not like multiple routes displaying on one URL so they often ask the feed provider to not supply the URL.</p>	
Route shape	<p><u>Issue:</u> Map & Google Transit doesn’t match in terms of path of bus.</p> <p><u>Resolution:</u> Old map. Google Transit correct.</p>	

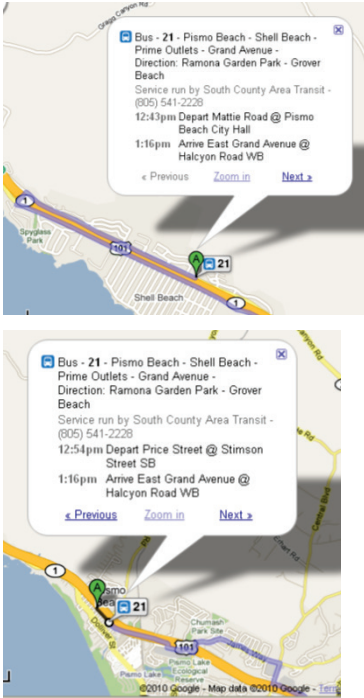
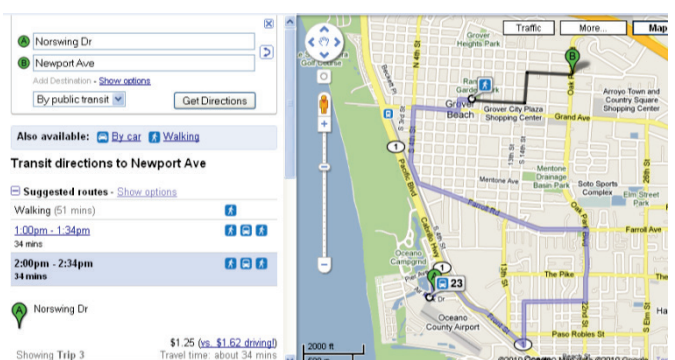
Aspect	Issue and Resolution	Map Display																																
																																		
<p>Trip time</p>	<p>Issue: Wrong departing time – should depart from Price St & Stimson at 12:56</p> <p>Resolution: Schedule updated. Google Transit is accurate.</p>	 <table border="1" data-bbox="649 945 1315 1260"> <thead> <tr> <th colspan="2">Shell Beach</th> </tr> </thead> <tbody> <tr><td>Shell Beach Blvd @ Spyglass Vlg</td><td>0:47</td></tr> <tr><td>Shell Beach Rd @ Terrace</td><td>0:48</td></tr> <tr><td>Shell Beach Rd @ Cuyama</td><td>0:48</td></tr> <tr><td>Shell Beach Rd @ Pier Ave</td><td>0:50</td></tr> <tr><th colspan="2">Pismo Beach</th></tr> <tr><td>Price St. @ Shelter Cove</td><td>0:51</td></tr> <tr><td>Price St. @ Lighthouse Inn</td><td>0:52</td></tr> <tr><td>Price St. @ Harbor View</td><td>0:52</td></tr> <tr><td>Price St. @ Stimson</td><td>0:56</td></tr> <tr><td>Prime Outlet (Arrive) Connect w/ Rte 10</td><td>0:00</td></tr> <tr><td>Prime Outlet Center (Depart)</td><td>0:03</td></tr> <tr><td>James Way @ 4th St.</td><td>0:05</td></tr> <tr><td>James Way @ Marlene Way</td><td>0:06</td></tr> <tr><td>James Way @ Oak Park</td><td>0:07</td></tr> <tr><th colspan="2">Arroyo Grande</th></tr> </tbody> </table>	Shell Beach		Shell Beach Blvd @ Spyglass Vlg	0:47	Shell Beach Rd @ Terrace	0:48	Shell Beach Rd @ Cuyama	0:48	Shell Beach Rd @ Pier Ave	0:50	Pismo Beach		Price St. @ Shelter Cove	0:51	Price St. @ Lighthouse Inn	0:52	Price St. @ Harbor View	0:52	Price St. @ Stimson	0:56	Prime Outlet (Arrive) Connect w/ Rte 10	0:00	Prime Outlet Center (Depart)	0:03	James Way @ 4th St.	0:05	James Way @ Marlene Way	0:06	James Way @ Oak Park	0:07	Arroyo Grande	
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<p>Transfers</p>	<p>Issue: Do people have to get off and then get on?</p> <p>Resolution: It's a transfer point and it is not known whether riders can stay on board. Block_ID can be added at any time.</p>																																	


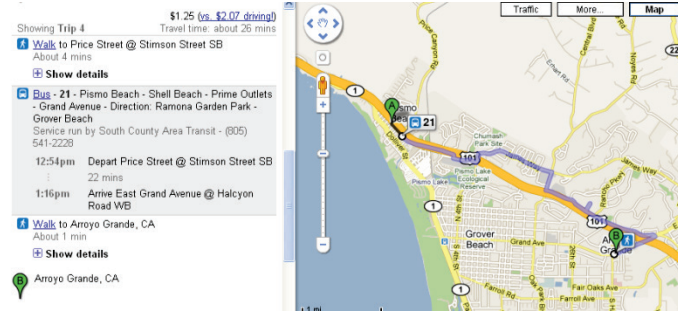
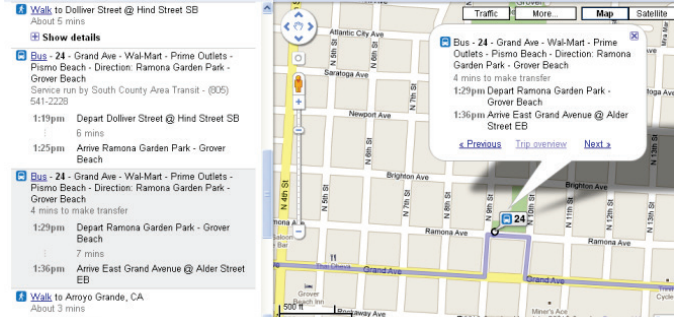
Aspect	Issue and Resolution	Map Display																																													
<p>Stop Locations</p>	<p><u>Issue:</u> Bus stops not exactly in the right location.</p> <p><u>Resolution:</u> This is not an issue in this example.</p>	 <p>Showing Trip 4 \$1.25 (vs. \$2.07 driving) Travel time: about 26 mins</p> <p>Walk to Price Street @ Stimson Street SB About 4 mins</p> <p>Show details</p> <p>Bus - 21 - Pismo Beach - Shell Beach - Prime Outlets - Grand Avenue - Direction: Ramona Garden Park - Grover Beach Service run by South County Area Transit - (805) 541-2228</p> <p>12:54pm Depart Price Street @ Stimson Street SB 22 mins</p> <p>1:16pm Arrive East Grand Avenue @ Halcyon Road WB</p> <p>Walk to Arroyo Grande, CA About 1 min</p> <p>Show details</p> <p>Arroyo Grande, CA</p>																																													
<p>Stops</p>	<p><u>Issue:</u> Stop missing/ not stopping at the nearest stop.</p> <p><u>Resolution:</u> Old schedule. Google Transit is correct.</p>	 <p>W Grand Ave & 5th Ave, Grover Beach Fair Oaks Ave</p> <p>Add Destination - Show options</p> <p>By public transit</p> <p>Get Directions</p> <p>Also available: By car, Bicycling</p> <p>Transit directions to Fair Oaks Ave</p> <p>Suggested routes - Show options</p> <p>Walking (55 mins) 1:31pm - 2:29pm 59 mins</p> <p>2:31pm - 3:29pm 59 mins</p> <p>1:21pm - 1:46pm 26 mins</p> <p>1:29pm - 2:32pm 1 hour 3 mins</p> <p>2:21pm - 2:46pm</p> <table border="1" data-bbox="649 913 1331 1218"> <tbody> <tr><td>0:48</td><td>Oceano</td><td></td></tr> <tr><td>0:50</td><td>Hwy 1 @ 25th St.</td><td>0:56</td></tr> <tr><td></td><td>Hwy 1 @ 21st St.</td><td>0:57</td></tr> <tr><td>0:51</td><td>Oceano Senior Center</td><td>0:59</td></tr> <tr><td>0:52</td><td>Oceano Airport</td><td>0:02</td></tr> <tr><td>0:52</td><td>Hwy 1 @ 13th St.</td><td>0:04</td></tr> <tr><td>0:56</td><td>Wilmar @ 19th</td><td>0:06</td></tr> <tr><td>0:00</td><td>Grover Beach</td><td></td></tr> <tr><td>0:03</td><td>Oak Park @ The Pike</td><td>0:08</td></tr> <tr><td>0:05</td><td>Oak Park @ Farroll</td><td>0:08</td></tr> <tr><td>0:06</td><td>Farroll @ 13th St.</td><td>0:10</td></tr> <tr><td>0:07</td><td>Farroll @ 8th St.</td><td>0:12</td></tr> <tr><td></td><td>4th St. @ Grand</td><td>0:14</td></tr> <tr><td>0:09</td><td>W. Grand @ 5th St.</td><td>0:15</td></tr> <tr><td>0:12</td><td>Ramona Garden Park</td><td></td></tr> </tbody> </table>	0:48	Oceano		0:50	Hwy 1 @ 25th St.	0:56		Hwy 1 @ 21st St.	0:57	0:51	Oceano Senior Center	0:59	0:52	Oceano Airport	0:02	0:52	Hwy 1 @ 13th St.	0:04	0:56	Wilmar @ 19th	0:06	0:00	Grover Beach		0:03	Oak Park @ The Pike	0:08	0:05	Oak Park @ Farroll	0:08	0:06	Farroll @ 13th St.	0:10	0:07	Farroll @ 8th St.	0:12		4th St. @ Grand	0:14	0:09	W. Grand @ 5th St.	0:15	0:12	Ramona Garden Park	
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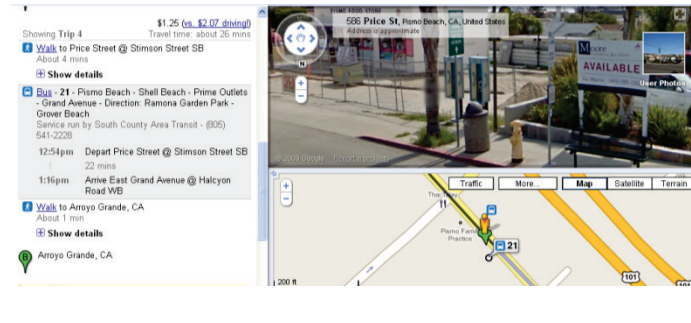
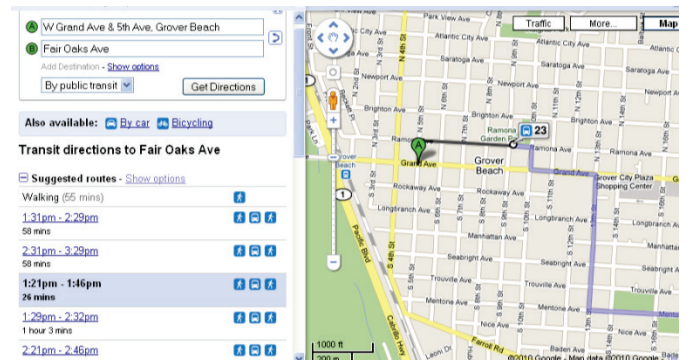
C.3.2. FEED VALIDATION USING GOOGLE’S BEST PRACTICE CHECKLIST

The table below describes the issues that were found by going through the GTFS “best practice” checklist provided at <http://maps.google.com/help/maps/transit/partners/bestpractices.html>, and how the identified issues were resolved.

Table C7: Validation of Best Practice Checklist for South County Area Transit

Checklist Item	Result	Map Display/Description
Route names are displayed appropriately	Same for different directions	
Agency name is correct	Correct	
Phone number is correct	Correct	
All URL's are correct and don't return blank pages.	No URL	
Route shape	Map & Google Transit don't match in terms of shape	

Checklist Item	Result	Map Display/Description																																
																																		
<p>The total time of the trips makes sense</p>	<p>Wrong departing time – should depart from Price St & Stimson at 12:56</p>	 <table border="1" data-bbox="755 966 1429 1281"> <thead> <tr> <th colspan="2">Shell Beach</th> </tr> </thead> <tbody> <tr><td>Shell Beach Blvd @ Spyglass Vlg</td><td>0:47</td></tr> <tr><td>Shell Beach Rd @ Terrace</td><td>0:48</td></tr> <tr><td>Shell Beach Rd @ Cuyama</td><td>0:48</td></tr> <tr><td>Shell Beach Rd @ Pier Ave</td><td>0:50</td></tr> <tr><th colspan="2">Pismo Beach</th></tr> <tr><td>Price St. @ Shelter Cove</td><td>0:51</td></tr> <tr><td>Price St. @ Lighthouse Inn</td><td>0:52</td></tr> <tr><td>Price St. @ Harbor View</td><td>0:52</td></tr> <tr><td>Price St. @ Stimson</td><td>0:56</td></tr> <tr><td>Prime Outlet (Arrive) Connect w/ Rte 10</td><td>0:00</td></tr> <tr><td>Prime Outlet Center (Depart)</td><td>0:03</td></tr> <tr><td>James Way @ 4th St.</td><td>0:05</td></tr> <tr><td>James Way @ Marlene Way</td><td>0:06</td></tr> <tr><td>James Way @ Oak Park</td><td>0:07</td></tr> <tr><th colspan="2">Arroyo Grande</th></tr> </tbody> </table>	Shell Beach		Shell Beach Blvd @ Spyglass Vlg	0:47	Shell Beach Rd @ Terrace	0:48	Shell Beach Rd @ Cuyama	0:48	Shell Beach Rd @ Pier Ave	0:50	Pismo Beach		Price St. @ Shelter Cove	0:51	Price St. @ Lighthouse Inn	0:52	Price St. @ Harbor View	0:52	Price St. @ Stimson	0:56	Prime Outlet (Arrive) Connect w/ Rte 10	0:00	Prime Outlet Center (Depart)	0:03	James Way @ 4th St.	0:05	James Way @ Marlene Way	0:06	James Way @ Oak Park	0:07	Arroyo Grande	
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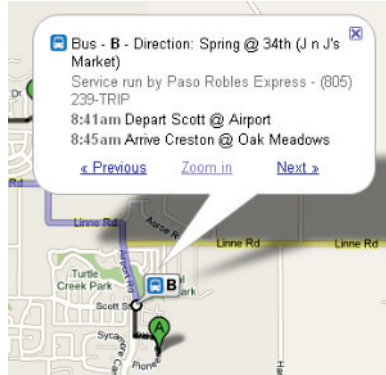
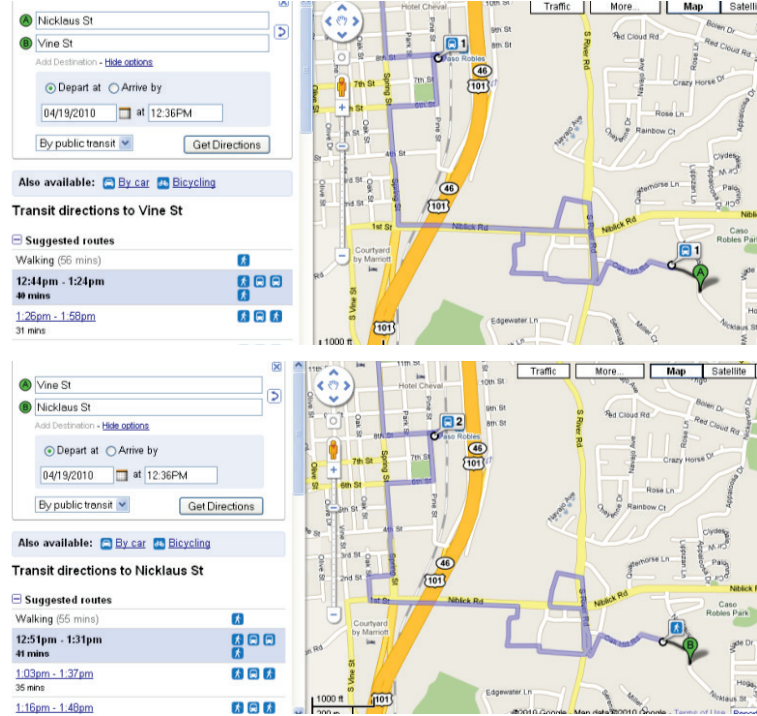
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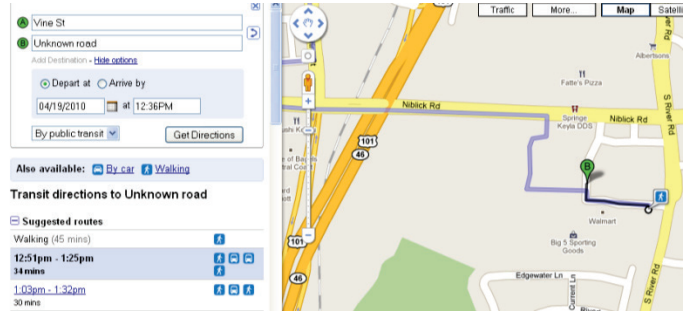
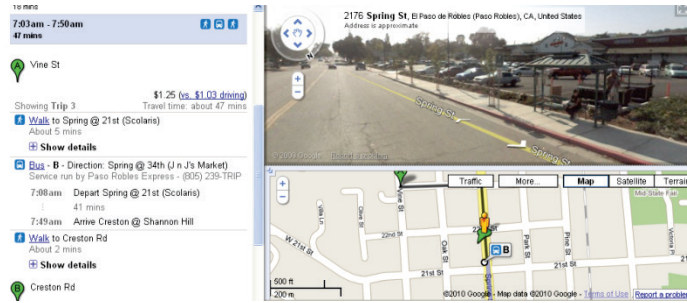
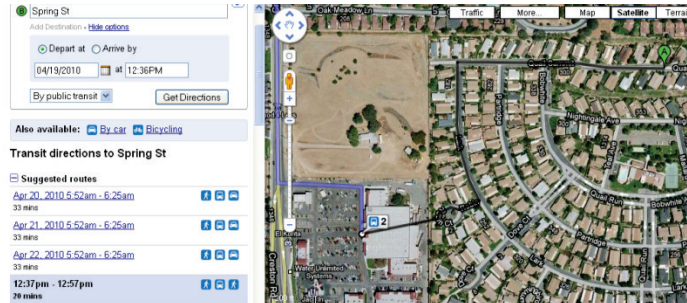
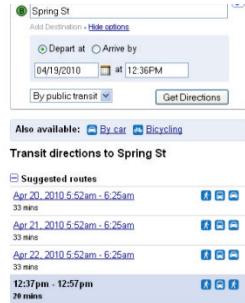

C.4. PASO EXPRESS

C.4.1. INITIAL GTFS VALIDATION IN GOOGLE TRANSIT PREVIEW MODE

The table below lists the issues that were identified by the PATH project team while validating the GTFS data for Paso Express in Google Transit preview mode and the actions that were undertaken by Marcy Jaffe Company to resolve them.

Table C8: Issues Found during Paso Express’s GTFS Feed Validation Process

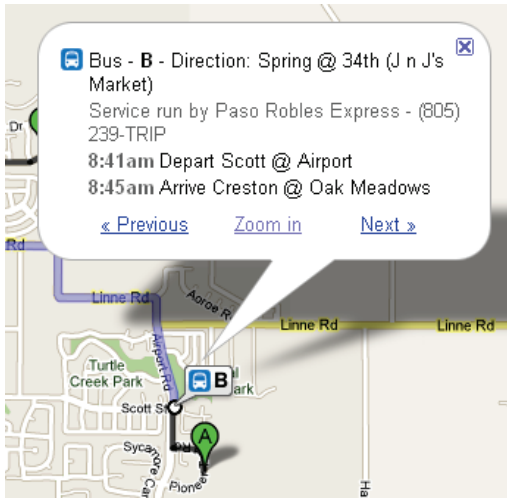
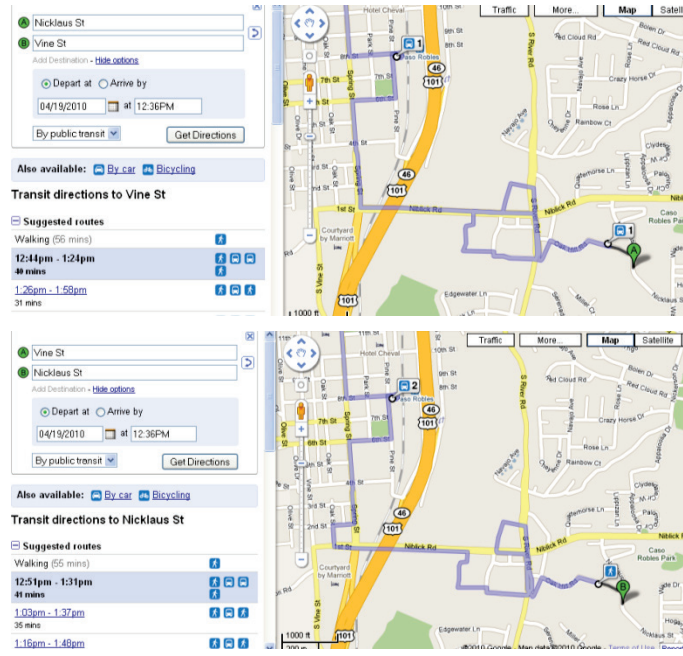
Aspect	Issue and Resolution	Map Display
URL	<p><u>Issue:</u> No URL</p> <p><u>Resolution:</u> Google Quality Assurance does not like multiple routes displaying on one URL so they often ask the feed provider to not supply the URL.</p>	
Route shape	<p><u>Issue:</u> Map & Google Transit doesn't match in terms of path of bus.</p> <p><u>Resolution:</u> Old map. Google Transit correct.</p>	

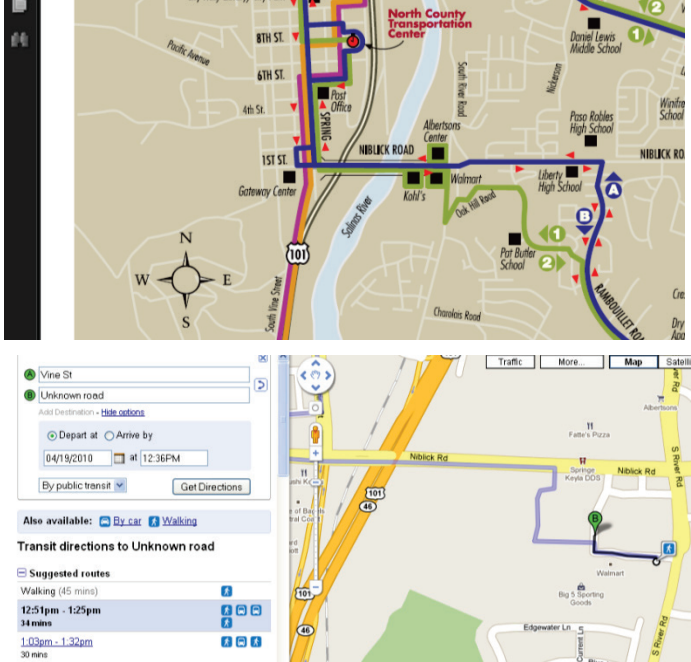
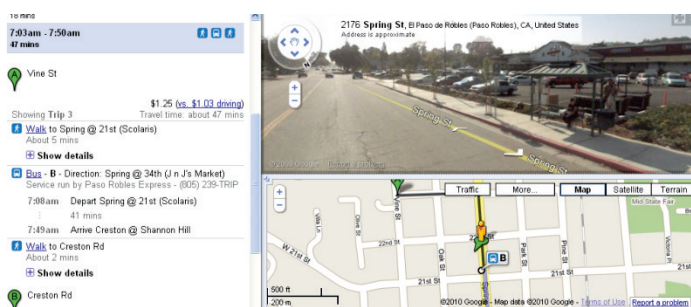
Aspect	Issue and Resolution	Map Display
		 
<p>Stop Locations</p>	<p><u>Issue:</u> Bus stops not exactly in the right location.</p> <p><u>Resolution:</u> Looking at wrong bus stop. Bus stop location is accurate on Google.</p>	 
<p>Walking</p>	<p><u>Issue:</u> 40+ min walking prevalent</p> <p><u>Resolution:</u> Google updated so now not first option but last option.</p>	
<p>Walking</p>	<p><u>Issue:</u> Going through walls</p> <p><u>Resolution:</u> Reported to Google. Google yet to update.</p>	 

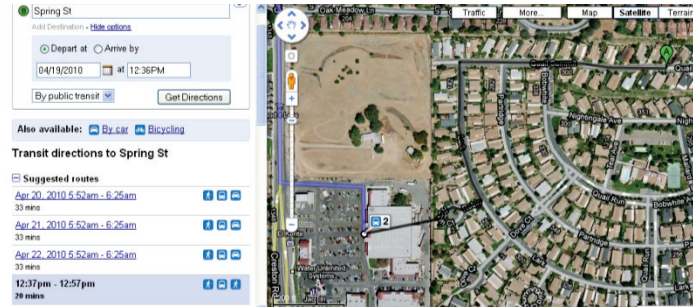
C.4.2. FEED VALIDATION USING GOOGLE’S BEST PRACTICE CHECKLIST

The table below describes the issues that were found by going through the GTFS “best practice” checklist provided at <http://maps.google.com/help/maps/transit/partners/bestpractices.html>, and how the identified issues were resolved.

Table C9: Validation of Best Practice Checklist for Paso Express

Checklist Item	Result	Map Display/Description
Route names are displayed appropriately	Correct	
Agency name is correct	Correct	
Phone number is correct	Correct	
All URL's are correct and don't return blank pages.	No URL	
Route shape	Is this route for 1 & 2 correct?	

Checklist Item	Result	Map Display/Description
		
The total time of the trips makes sense	Correct	
Trips returned correctly for different time periods and days	Correct	
Transfers happen at appropriate places	Correct	
Check the location of stops	Some not at exactly the right location	
Check routes in <i>ScheduleViewer</i> for inaccurate travel times, stop locations and stop times.	Correct	
Additional Validation Items		
Verify walking options	40+ min walking options is prevalent	

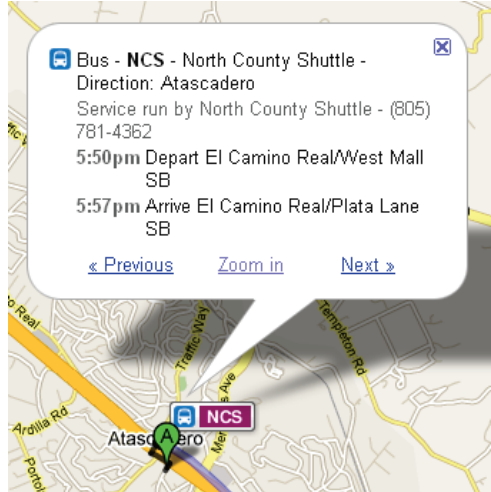
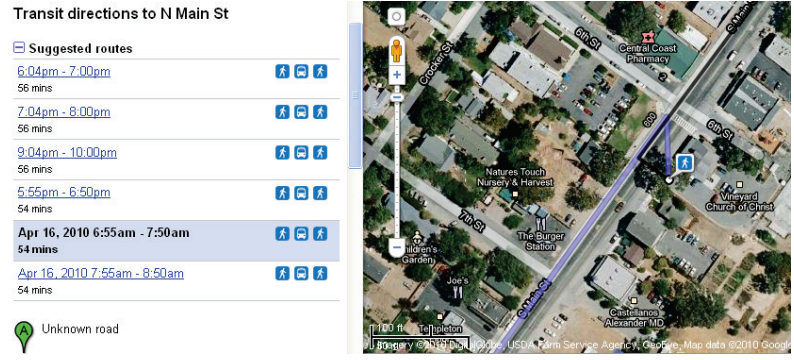
Checklist Item	Result	Map Display/Description
	<p>Goes through the wall. Should be directed to true nearest stop</p>	 <p>The screenshot shows the Google Transit search interface. The destination is 'Spring St'. The departure date is '04/19/2010' and the time is '12:36PM'. The mode is set to 'By public transit'. Below the search bar, there are options for 'Also available: By car, Bicycling'. Under 'Transit directions to Spring St', there are three suggested routes for the dates Apr 20, Apr 21, and Apr 22, 2010, all starting at 5:52am and ending at 6:25am, with a duration of 33 mins. A fourth route is shown for 12:37pm - 12:57pm with a duration of 28 mins. To the right of the search interface is a satellite map view of the area around Spring St, showing a residential neighborhood with a large wall or barrier in the foreground.</p>
<p>Route verification using <i>Random Queries</i></p>	<p>50 queries generated with no issue</p>	

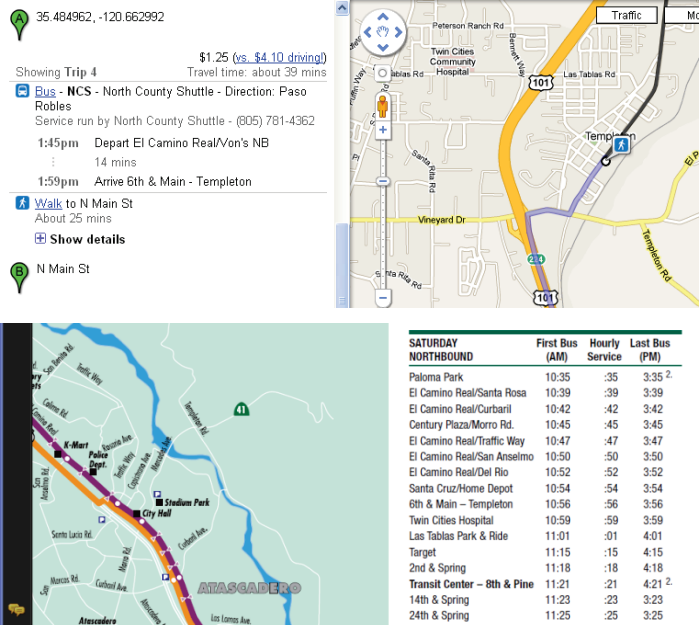
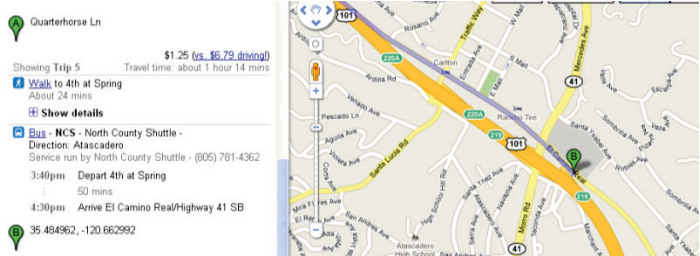
C.5. NORTH COUNTY SHUTTLE

C.5.1. INITIAL GTFS VALIDATION IN GOOGLE TRANSIT PREVIEW MODE

The table below lists the issues that were identified by the PATH project team while validating the GTFS data for North County Shuttle in Google Transit preview mode and the actions that were undertaken by Marcy Jaffe Company to resolve them.

Table C10: Issues Found during North County Shuttle’s GTFS Feed Validation Process

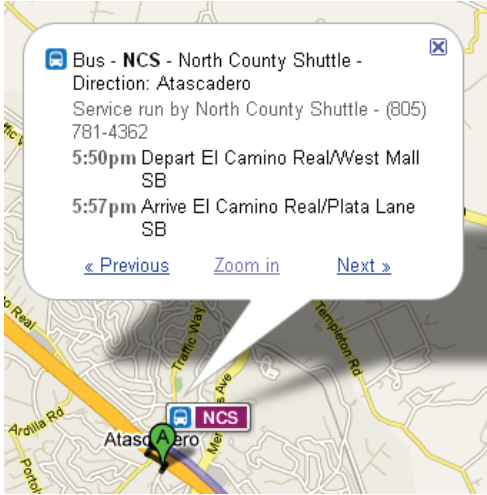
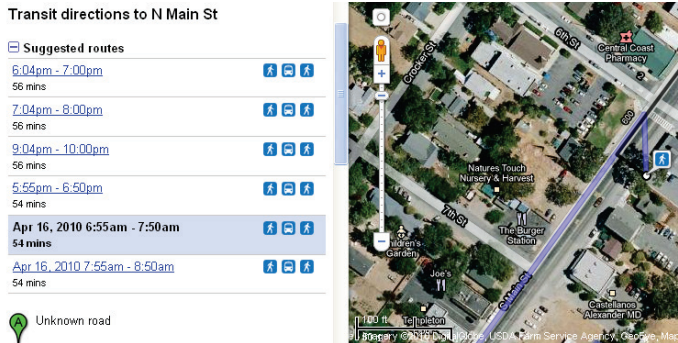
Aspect	Issue and Resolution	Map Display
Route name	<p><u>Issue:</u> North County Shuttle as part of route name isn't necessary</p> <p><u>Resolution:</u> Left in.</p>	
URL	<p><u>Issue:</u> Paso Robles: (805) 239-8747 Atascadero: (805) 466-7433</p> <p><u>Resolution:</u> Number cannot be location based.</p>	
URL	<p><u>Issue:</u> No URL</p> <p><u>Resolution:</u> Google Quality Assurance does not like multiple routes displaying on one URL so they often ask the feed provider to not supply the URL.</p>	
Route shape	<p><u>Issue:</u> Odd angle in shape file</p> <p><u>Resolution:</u> Updated shape file points.</p>	

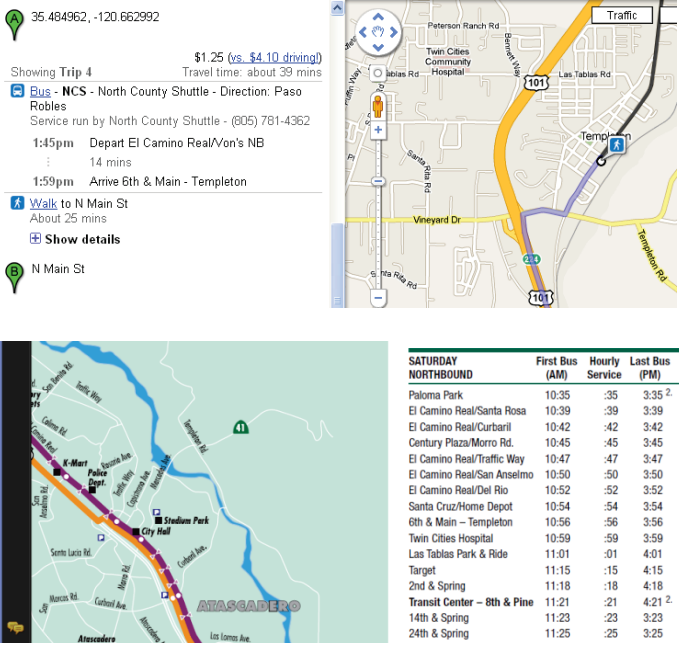
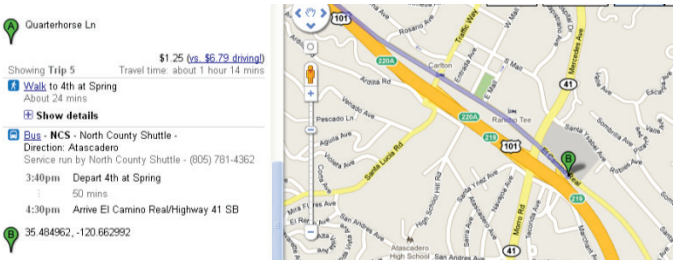
Aspect	Issue and Resolution	Map Display																																																																				
Time	<p>Issue: Wrong arrival time. It should be 1:56.</p> <p>Resolution: Schedule and Google Transit were both updated.</p>	 <p>35.484962, -120.662992</p> <p>Showing Trip 4 \$1.25 (vs. \$4.10 driving) Travel time: about 39 mins</p> <p>Bus - NCS - North County Shuttle - Direction: Paso Robles Service run by North County Shuttle - (805) 781-4362</p> <p>1:45pm Depart El Camino Real/Von's NB : 14 mins 1:59pm Arrive 6th & Main - Templeton</p> <p>Walk to N Main St About 25 mins</p> <p>Show details</p> <p>N Main St</p> <table border="1" data-bbox="1036 573 1308 863"> <thead> <tr> <th>SATURDAY NORTHBOUND</th> <th>First Bus (AM)</th> <th>Hourly Service</th> <th>Last Bus (PM)</th> </tr> </thead> <tbody> <tr><td>Paloma Park</td><td>10:35</td><td>:35</td><td>3:35²</td></tr> <tr><td>El Camino Real/Santa Rosa</td><td>10:39</td><td>:39</td><td>3:39</td></tr> <tr><td>El Camino Real/Carbaril</td><td>10:42</td><td>:42</td><td>3:42</td></tr> <tr><td>Century Plaza/Morro Rd.</td><td>10:45</td><td>:45</td><td>3:45</td></tr> <tr><td>El Camino Real/Traffic Way</td><td>10:47</td><td>:47</td><td>3:47</td></tr> <tr><td>El Camino Real/San Anselmo</td><td>10:50</td><td>:50</td><td>3:50</td></tr> <tr><td>El Camino Real/Del Rio</td><td>10:52</td><td>:52</td><td>3:52</td></tr> <tr><td>Santa Cruz/Home Depot</td><td>10:54</td><td>:54</td><td>3:54</td></tr> <tr><td>6th & Main - Templeton</td><td>10:56</td><td>:56</td><td>3:56</td></tr> <tr><td>Twin Cities Hospital</td><td>10:59</td><td>:59</td><td>3:59</td></tr> <tr><td>Las Tablas Park & Ride</td><td>11:01</td><td>:01</td><td>4:01</td></tr> <tr><td>Target</td><td>11:15</td><td>:15</td><td>4:15</td></tr> <tr><td>2nd & Spring</td><td>11:18</td><td>:18</td><td>4:18</td></tr> <tr><td>Transit Center - 8th & Pine</td><td>11:21</td><td>:21</td><td>4:21²</td></tr> <tr><td>14th & Spring</td><td>11:23</td><td>:23</td><td>3:23</td></tr> <tr><td>24th & Spring</td><td>11:25</td><td>:25</td><td>3:25</td></tr> </tbody> </table>	SATURDAY NORTHBOUND	First Bus (AM)	Hourly Service	Last Bus (PM)	Paloma Park	10:35	:35	3:35 ²	El Camino Real/Santa Rosa	10:39	:39	3:39	El Camino Real/Carbaril	10:42	:42	3:42	Century Plaza/Morro Rd.	10:45	:45	3:45	El Camino Real/Traffic Way	10:47	:47	3:47	El Camino Real/San Anselmo	10:50	:50	3:50	El Camino Real/Del Rio	10:52	:52	3:52	Santa Cruz/Home Depot	10:54	:54	3:54	6th & Main - Templeton	10:56	:56	3:56	Twin Cities Hospital	10:59	:59	3:59	Las Tablas Park & Ride	11:01	:01	4:01	Target	11:15	:15	4:15	2nd & Spring	11:18	:18	4:18	Transit Center - 8th & Pine	11:21	:21	4:21 ²	14th & Spring	11:23	:23	3:23	24th & Spring	11:25	:25	3:25
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The table below describes the issues that were found by going through the GTFS “best practice” checklist provided at <http://maps.google.com/help/maps/transit/partners/bestpractices.html>, and how the identified issues were resolved.

Table C11: Validation of Best Practice Checklist for North County Shuttle

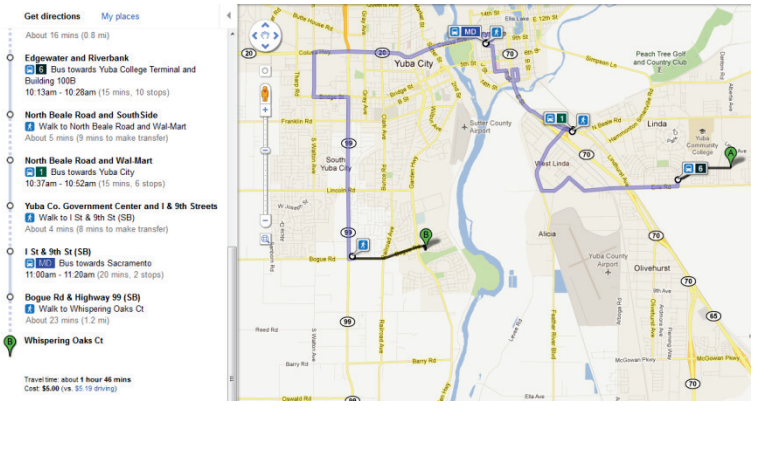
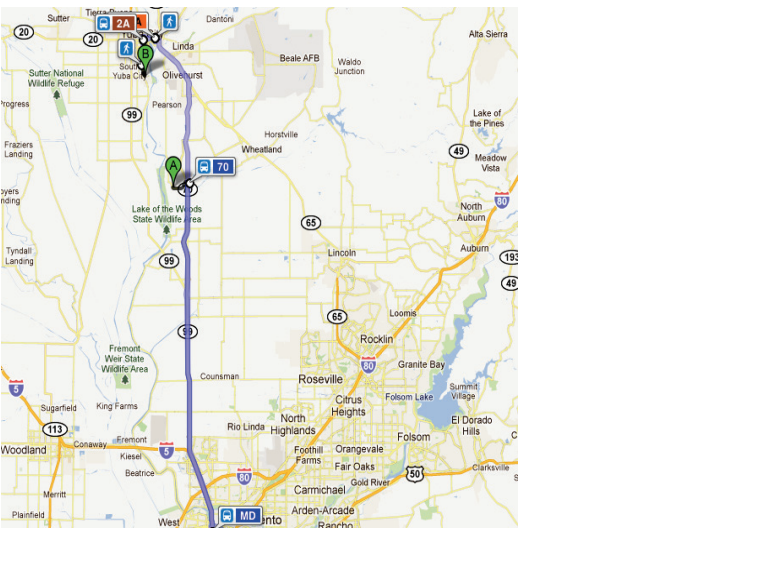
Checklist Item	Result	Map Display/Description
Route names are displayed appropriately	North County Shuttle as part of bus line isn't necessary	
Agency name is correct	Correct	
Phone number is correct	Paso Robles: (805) 239-8747 Atascadero: (805) 466-743	
All URL's are correct and don't return blank pages.	No URL	
Route shape	Shape point placement	

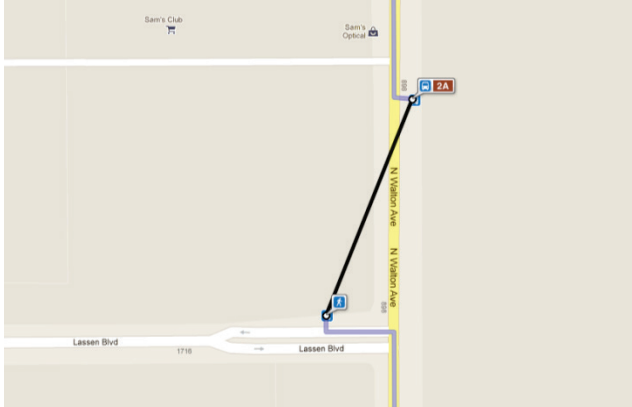
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The total time of the trips makes sense	Wrong arrival time. It should be 1:56.	 <p>35 484962, -120.662992</p> <p>Showing Trip 4 \$1.25 (vs. \$4.10 driving) Travel time: about 39 mins</p> <p>Bus - NCS - North County Shuttle - Direction: Paso Robles Service run by North County Shuttle - (805) 781-4362</p> <p>1:45pm Depart El Camino Real/Von's NB : 14 mins 1:59pm Arrive 6th & Main - Templeton</p> <p>Walk to N Main St About 25 mins</p> <p>Show details</p> <p>N Main St</p> <table border="1" data-bbox="1161 588 1437 882"> <thead> <tr> <th>SATURDAY NORTHBOUND</th> <th>First Bus (AM)</th> <th>Hourly Service</th> <th>Last Bus (PM)</th> </tr> </thead> <tbody> <tr><td>Paloma Park</td><td>10:35</td><td>:35</td><td>3:35²</td></tr> <tr><td>El Camino Real/Santa Rosa</td><td>10:39</td><td>:39</td><td>3:39</td></tr> <tr><td>El Camino Real/Curbaril</td><td>10:42</td><td>:42</td><td>3:42</td></tr> <tr><td>Century Plaza/Morro Rd.</td><td>10:45</td><td>:45</td><td>3:45</td></tr> <tr><td>El Camino Real/Traffic Way</td><td>10:47</td><td>:47</td><td>3:47</td></tr> <tr><td>El Camino Real/San Anselmo</td><td>10:50</td><td>:50</td><td>3:50</td></tr> <tr><td>El Camino Real/Del Rio</td><td>10:52</td><td>:52</td><td>3:52</td></tr> <tr><td>Santa Cruz/Home Depot</td><td>10:54</td><td>:54</td><td>3:54</td></tr> <tr><td>6th & Main - Templeton</td><td>10:56</td><td>:56</td><td>3:56</td></tr> <tr><td>Twin Cities Hospital</td><td>10:59</td><td>:59</td><td>3:59</td></tr> <tr><td>Las Tablas Park & Ride</td><td>11:01</td><td>:01</td><td>4:01</td></tr> <tr><td>Target</td><td>11:15</td><td>:15</td><td>4:15</td></tr> <tr><td>2nd & Spring</td><td>11:18</td><td>:18</td><td>4:18</td></tr> <tr><td>Transit Center - 8th & Pine</td><td>11:21</td><td>:21</td><td>4:21²</td></tr> <tr><td>14th & Spring</td><td>11:23</td><td>:23</td><td>3:23</td></tr> <tr><td>24th & Spring</td><td>11:25</td><td>:25</td><td>3:25</td></tr> </tbody> </table>	SATURDAY NORTHBOUND	First Bus (AM)	Hourly Service	Last Bus (PM)	Paloma Park	10:35	:35	3:35 ²	El Camino Real/Santa Rosa	10:39	:39	3:39	El Camino Real/Curbaril	10:42	:42	3:42	Century Plaza/Morro Rd.	10:45	:45	3:45	El Camino Real/Traffic Way	10:47	:47	3:47	El Camino Real/San Anselmo	10:50	:50	3:50	El Camino Real/Del Rio	10:52	:52	3:52	Santa Cruz/Home Depot	10:54	:54	3:54	6th & Main - Templeton	10:56	:56	3:56	Twin Cities Hospital	10:59	:59	3:59	Las Tablas Park & Ride	11:01	:01	4:01	Target	11:15	:15	4:15	2nd & Spring	11:18	:18	4:18	Transit Center - 8th & Pine	11:21	:21	4:21 ²	14th & Spring	11:23	:23	3:23	24th & Spring	11:25	:25	3:25
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C.6. YUBA-SUTTER

The table below lists the issues that were identified by the PATH project team while validating the GTFS data for Yuba-Sutter in Google Transit preview mode and the actions that were undertaken by Trillium Solutions to resolve them.

Table C12: Issues Found during Yuba-Sutter’s GTFS Feed Validation Process

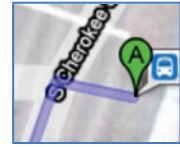
Aspect	Issue and Resolution	Map Display
Fare	<p>Issue: No fare displayed for some transfers.</p> <p>Resolution: Fare data was reconfigured to correctly show that transit to buses operated by other agencies require a new fare to be paid (additional 4\$ if transferring to a Sacramento RT bus)</p>	 <p>The screenshot shows a Google Transit route starting at Edgewater and Riverbank. The route includes several bus lines: 20 (towards Yuba College Terminal), 4 (North Beale Road and South Side), 1 (North Beale Road and Wal-Mart), 1 (towards Yuba City), 4 (Yuba Co. Government Center), 1 (I St & 9th St), 1 (towards Sacramento), and 99 (Bogue Rd & Highway 99). The route ends at Whispering Oaks Ct. The travel time is approximately 1 hour and 46 minutes, with a cost of \$5.99 (vs. \$1.19 driving).</p>
Trip looping	<p>Issue: A trip from Rio Osos requires a trip south that later returns back north to Yuba City</p> <p>Resolution: This is a valid trip, even though it does not make sense. Since there is no local bus service in Plumas Lake, Google Transit is using a combination of service with Sacramento RT that no one would choose but that is still a real pairings.</p>	 <p>The map shows a route starting in Rio Linda, CA, heading south through various locations like Roseville, Granite Bay, and Folsom, eventually reaching Yuba City, CA. The route involves multiple bus lines, including 20, 99, 1, 4, 113, 115, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.</p>

Aspect	Issue and Resolution	Map Display
<p>Bus stop location</p>	<p><u>Issue:</u> There appears to be a transfer between very nearby bus stop locations. One stop appears located in the street and the other on the sidewalk.</p> <p><u>Resolution:</u> Adjustments were made to the bus stop locations.</p>	 <p>The map shows a street layout with 'Lassen Blvd' running horizontally and 'N. Webster Ave' running vertically. Two bus stop locations are marked with icons: a blue 'M' icon on the sidewalk and a red 'ZA' icon on the street. A black line connects the two icons, indicating a transfer point. The map also shows buildings like 'Sam's Club' and 'Sam's Optical' in the background.</p>

APPENDIX D. QUICK REFERENCE GUIDE

Stops (Import/Export): On-line tool to locate new or re-locate a bus stop

- 1) OPEN Import/Export + stops tab (go to existing stop or blank row)
- 2) GO TO: <http://www.getlatlon.com/>
- 3) ENTER city, address or street, or nearby coordinates
- 4) CENTER "+" on map using hybrid view (street names + satellite) on stop
- 5) ZOOM IN
- 6) COPY/PASTE the complete value for latitude, longitude which is displayed below the map into stops tab for stop. More decimals are more precise.
Confirm the "-" on the longitude (e.g. -121.2608456611630)
Remove extraneous data ","
- 7) FILL-IN or UPDATE other stops data, if needed
- 8) RESULT: RE-LOCATED stop will be used throughout the network for that stop_id



Stop_Times & Trips (Create in Schedule_v2, Copy to Import/Export): Build/Modify from Schedules workbook

- 1) FILL-IN schedule_v2 or link timetable from native schedule
- 2) ORGANIZE stops in stop order (timetable)
- 3) ADD-IN intermediate stops (if any)
- 4) ASSOCIATE trip with day of week (service_id)
- 5) ASSIGN headsigns
- 6) FILL-IN pickup/drop off , wait time and timed stop, if needed
- 7) ADD shape_id to top of each row (e.g. green)
- 8) INCLUDE (optional) block_id to top of each row (e.g. green:22)
- 9) GENERATE (use macro on notes tab) stop_time and trips

8:18am	Depart Kennedy Library SB
:	9 mins (2 stops)
8:27am	Arrive San Luis Obispo (SLO) Government Center @ Osos and Palm

To modify selected trip or times update data and proceed to step 4

Trips: Modify the trip by adding a stop

- 1) LOCATE stop_id that you will add in stops tab
- 2) GO TO schedules_v2 tab
- 3) FIND the trip you will modify
- 4) HIGHLIGHT the row (e.g. 7) below the stop that will be added
- 5) ADD a row (above) using Edit>Insert or Home+Insert Sheet Rows
- 6) FILL-IN data for this row route_id, service_id, stop_id, stop name, timed stop or un-timed "*"
- 7) REPEAT this for each occurrence/pattern of the trip (e.g. weekends and sat)

Trips: Modify the trip by removing a stop

- 1) LOCATE stop_id that you will add in stops tab
- 2) GO TO schedules_v2 tab
- 3) FIND the trip you will modify
- 4) HIGHLIGHT the row(s) (e.g. 7) below the stop that will be removed
- 5) DELETE the row(s) using Edit>Delete or Home+Delete Sheet Rows
- 6) REPEAT this for each occurrence/pattern of the trip (e.g. weekends and sat)



Trips: Build Trip from another trip

- 1) GENERATE more than enough blank rows on schedules_v2_tab for new trip
- 2) LOCATE/COPY/PASTE similar trip (copy from Bus Route to bottom of trip)
- 3) MODIFY trip
 - a. add or remove stops (see above)
 - b. update times
 - c. assign unique trip name
 - d. assign service_id
 - e. fill-in all data

Trips: Add/Delete a Trip with same trip pattern

- 1) LOCATE the trip
- 2) ADD time to next blank column (or use fill right functions)
Alternate, to remove a trip time from the schedule clear the data for that trip!

Calendar (Import/Export): Build/Modify (Import/Export)

- 1) LOCATE service_id
- 2) REVIEW 1 (include) or 0 (omit) for day of the week
- 3) ASSIGN service_id to trips (within Schedules_V2)

Calendar_dates (Import/Export): Cancel service or Assign Sunday Schedule for Holiday Service

- 1) LOCATE service_id
- 2) ENTER DATE there is no service (holiday, e.g. New Year's)
- 3) IDENTIFY day of week for holiday (e.g. New Years' is on Saturday)
- 4) CREATE date in required format (YYYYMMDD e.g. 20110101)
- 5) REMOVE service =2 (also found on specifications) for that date
- 6) ALTERNATE: REPLACE Sunday service for a holiday
 - a. REMOVE service (=2) for that date and service_id
 - b. ADD (=1) for the "holiday"/different service_id, e.g. sun for that date



Fares: <http://code.google.com/p/googletransitdatafeed/wiki/FareExamples>



Transfers: Improve connections

- 1) DETERMINE which stop location(s) pairs should display improved or no transfers
- 2) EVALUATE which transfer option
- 3) FILL-IN transfer details
 - a. guaranteed, drivers call ahead =1;
 - b. < 5 min. =2+#min.
 - c. not possible to transfer =3
- 4) REPEAT for each station pair



Route on the road (or become a GIS master in less than 15 min.)

- 1) OPEN Google Earth in Open GL mode (expand “places” & find “temporary places”)
- 2) TURN ON LAYERS (roads): Primary Database, expand, select Borders & Labels + Roads;
- 3) SELECT trip that will be created in Google Earth as straight line shape
- 4) DOUBLE CLICK the trip
- 5) SELECT Yes + “2” to save trip “shape name” to the clipboard
- 6) RESULTS of a test that the shape line is near each stop on the route will display
- 7) GO to Google Earth
- 8) PASTE (right click) onto temporary places
- 9) EXPAND trip within temporary places and double click on it to view it on the map
- 10) DE-SELECT (turn off) shape pts: “shape name”
- 11) EXPAND element named line (with + to the left) to view the shape id layer
- 12) ZOOM to layer where you will see white (local road) or yellow (arterial or highway)
- 13) TO EDIT THE LINE right click on shape id and select properties
- 14) MOVE the edit box out of way and make it small as possible
- 15) EDIT LINE by selecting the red dots (node) and making them blue and moving them adding more and following the white or yellow road layer, as needed
- 16) NOTE important to know direction of travel
- 17) ADD a node close to each bus stop
- 18) COMPLETE editing the shape_id and select OK
- 19) REPEAT from #14 for all portions of the route that need editing
- 20) RIGHT CLICK on (globe) or trip (just below temporary places) and select COPY
- 21) OPEN shapes tab in Import/Export and double click on blank row (this pastes it)
- 22) UPDATE to 7 to paste as KML/GPX line + OK
- 23) NAME the shape (if replacing use same name with YES and AGREE to replace)
- 24) CONFIRM correction is made, go back to step 4 and view results in stop_times

Google Earth will take some practice – but it can be learned and offer you ways to edit your shapes lines is possible. To learn more about Google Earth, visit

<http://earth.google.com/support/bin/static.py?hl=en&page=guide.cs&ctx=go&guide=22550>

Creating the compressed file of the 12 text files, GTFS, for Google Maps & tools

- 1) OPEN Schedules workbook (if you do not have not updates to the schedule go to step 6)
- 2) SELECT+CLICK in notes tab: button near 'Generate trips and stop_times'
- 3) OPEN ImportExport workbook
- 4) OPEN Schedules +COPY all data from trips tab and stop_times tab in the Schedules workbook and paste into the corresponding trips tab and stop_times tab in the ImportExport workbook
- 5) CONFIRM all adjustments to calendar, routes, fares, etc. are complete
- 6) SELECT in notes tab in the ImportExport workbook, 'ExportGoogleFeedFiles'
This next window displays the path for the files to be stored. We suggest creating a folder named 'gtfs'. Add “\gtfs” to the destination path displayed to create a new one to capture all 12 text files that will be generated
- 7) CHOOSE 'OK' to replace existing text files
- 8) OPEN folder 'gtfs' (you will see all 12 'notepads' or text files)
- 9) SELECT ALL { Edit or Organize>Select All} 12 text files and while clicking on one of the 12 files, compress the group of 12 files [Right click > send to compressed (zipped) folder]
- 10) NAME .zip file (e.g. agencyname01.zip, agencyname02.zip, as a temporary name)
- 11) When no further changes are needed, the completed file must be named *google_transit.zip*

Installing TimeTable Publisher:

- 1) LOCATE Java and check whether you have JDK Version 6.0. If not, JDK can be downloaded and installed here: <http://java.sun.com/javase/downloads/index.jsp>
- 2) CREATE a C:\tmp\GTFS folder and place your GTFS txt documents into the folder
- 3) CONFIRM that the trips.txt file has the direction_id field
- 4) UNZIP 'apache-tomcat-7.0.4' downloaded from <http://tomcat.apache.org/>
- 5) UNZIP 'ttpub_war-1.5.1.zip' into '...\apache-tomcat-7.0.4\webapps'
- 6) SETUP Environment variables by going to Control Panel>System>Advanced>Environment Variables
 - a. JAVA-HOME: where JDK is located (i.e. C:\Program Files\Java\jdk1.6.0_25)
 - b. JAVA-OPTS: -Xmx1024m
- 7) OPEN tomcat by clicking on 'startup.bat' located in 'apache-tomcat-7.0.4\bin'
- 8) DIRECT your web-browser to <http://localhost:8080/> to confirm successful Tomcat installation
- 9) OPEN 'TimeTable Properties' using Notepad located in '...\apache-tomcat-7.0.4\webapps\ttpub\WEB-INF\classes'
- 10) ADD a '#' to 'SCHEDULE_DIRECTORY = WEB-INF/classes/org/gtfs/schedule/'
- 11) DELETE the '#' next to 'SCHEDULE_DIRECTORY = /tmp/GTFS/'
- 12) SAVE and close
- 13) DIRECT your web-browser to <http://localhost:8080/ttpub>
- 14) CONFIRM that your GTFS data has been uploaded properly by clicking on CONFIGURE and clicking on the drop-down menu

Additional helpful links:

Google Analytics for web traffic stats: <http://www.google.com/analytics/>

Posting GTFS data for TransitScore, Developers: <http://www.gtfs-data-exchange.com/>

Google Transit Partners Program: <http://maps.google.com/help/maps/transit/partners/>

Once you have log-in permission from Google for an account that manages PCFE:

Transit Partners groups: <http://groups.google.com/group/google-transit-partner-support>

Google Marketing/Media link: <https://sites.google.com/site/transitpartner/Home>

OpenTripPlanner (multi-modal trip planner on your base map or other map with your look/feel)
<http://opentripplanner.org/>

The image shows a Google Transit directions page with various data elements annotated. The route is from San Luis Obispo to Drover Beach. The left sidebar shows suggested routes and transit directions. The main map shows the route with various stops and transit lines. The bottom of the page has a navigation bar with 12 text files.

Annotations on the left side:

- route: route_short_name
- route: route_type
- trips: trip_headsign
- stop_times: stop_headsign
- stops: stop_name
- stop_times: departure_time
- stop_times: arrival_time
- and
- trips: (assigns calendar/service_id)
- fare_attributes + fare_rules
- agency: agency_name
- agency: agency_phone
- agency: agency_url
- agency: agency_fare_ur

Annotations on the right side:

- oute: route_type
- oute: route_short_name
- oute: route_color
- route: route_text_color
- shape: shape_pt_lat + shape: shape_pt_lon + shape: shape_pt_sequence + shape: shape_dist_traveled
- stops: stop_lat + stop_lon

Navigation bar at the bottom:

Notes agency calendar calendar_dates fare_attributes fare_rules frequencies routes shapes stops stop_times trips transfers

Figure D1: General Transit Feed Specification: Viewing data elements from within 12 text files with color code

APPENDIX E. TRAINING PROCEEDINGS

To help transit agency staff develop the necessary expertise to develop, implement and maintain in-house GTFS data, two training sessions were held in November 2010, one in San Luis Obispo and the other in Lodi, California. The goal of these sessions was to inform transit agency staff about available GTFS data conversion and validation tools and to provide basic training on how to use a number of key tools that are available for free. This resulted in the development of sessions that were primarily “hands-on”. Prior to coming to the session, all participants were instructed to download the various tools that were going to be presented. Through examples, participants were then provided with the opportunity to use each tool and to get familiar with their primary functions.

This appendix provides a copy of the training agenda that was distributed to registered participants, followed by a brief summary of the various topics that were discussed during the sessions. These include:

- Data to build GTFS and how this data may be collected
- Geocoding bus stops
- Building schedules
- Development of other GTFS data files
- Generating GTFS data files
- Validating GTFS data feeds
- Mapping tools and use of optional shape files
- Data hosting and posting
- Additional GTFS values: language option and use of TimeTable Publisher
- Other applications that may use GTFS data
- Training session feedback

E.1. TRAINING AGENDA

Data Management for On-Line Trip Planning at Google Maps Using Excel & Testing Tools from Google with TimeTable Publisher

Training Agenda (8:00 a.m. – 4:45 p.m.)

Meet/Welcome	(30 mins)
Discuss your experience with Google Transit to-date	
Identify concerns that we will answer in today’s training	
 Data to build GTFS and how that data is gathered or "found"	 (30 mins)
Open trip in Google Transit	
View the GTFS, 12 files	
Common terms, where defined & displayed at Google	
Exercises that ask you to think about possible data sources and practice geocoding bus stops.	
 Building Schedules	 (90 mins)
What format is schedule data stored at your agency?	

Links from “native” schedule to data format required by GTFS
 Generating “stop_times” (ordered stops) and “trips” (days of week/variations)

BREAK/BEVERAGE (15 mins)

Maintaining GTFS and generating/validating GTFS data files (75 mins)

Connect Schedules & Import/Export workbooks to generate all 12 GTFS files
 Fill-in or review each tab and data element (calendar/holidays, fares, transfers, etc.)
 Using testing tools from Google (Feed Validator/ScheduleViewer)
 Review merge function for current and future schedule

LUNCH (in-house sandwiches & discuss or lunch on-your-own) (60 mins)

Re-cap: Questions/Concerns/Insights (10 mins)

Mapping to display optional "shapes files" for routes on the road (75 mins)

What are “shapes”?
 View data with straight lines and “route on the road”
 Build shape from scratch using output from Excel and Google Earth

BREAK/BEVERAGE (15 mins)

Hosting/Posting/resolving technical issues/best practices (15 mins)

Where will you agency host the data for Google to “fetch” each week?
 Sample of data management on server
 View/practice the Google Partner Content Front End (PCFE)

Re-using GTFS for Web Posted Schedules and Marketing (G. Lin) (65 mins)

TimeTable Publisher (locally you’ve downloaded Tomcat & TTPUB tools)

Other applications that re-use GTFS (10 mins)

Walkscore: <http://www.walkscore.com/transit-map.php>
 Stop and Service finder: http://mtsotp.com/mts/stop_finder/stop_finder.cfm

Wrap-up/Share Experience (30 mins)

E.2. DATA NEEDED FOR GTFS DEVELOPMENT

This first part of the training sessions introduced participants to the basic features of Google Transit. An initial look at the output of the GTFS implementation process was provided by dropping an already developed GTFS file onto Google’s Schedule Viewer. This resulted in the generation of multiple routes that the session participants could then select and compare. While viewing routes, explanations were given to indicate that the information displayed on the screen is extracted from 12 different text files, each having its specific purpose. Each of these files was then briefly presented and described. To help participants associate specific data with specific files, a color code was used to differentiate the various GTFS data files. This color scheme is illustrated in Figure H1. It was used in all presentation material, as well as within the Excel tool that was used to prepare the GTFS data.

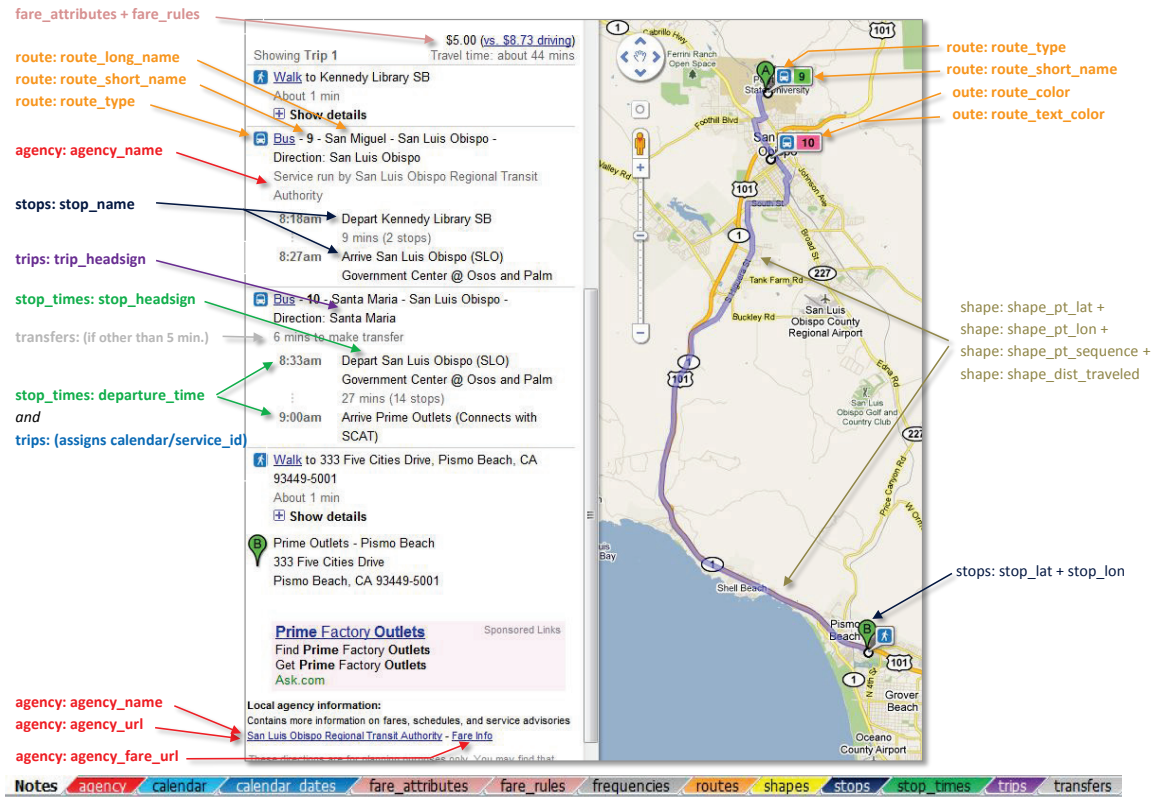


Figure E1: GTFS Data Files Color Scheme

Following explanations on the structure of GTFS data, session participants were introduced to Heitzman’s Excel tool, the primary tool used in the training sessions to provide hands-on experience with GTFS data conversion. Participants were first shown how the tool converts table-based data into text-based GTFS data files. Examples shown include those of Figure H2 and Figure H3. The first example illustrates how data coded within the tool’s “agency” tab is converted into GTFS data stored within the “agency.txt” file. The second example illustrates how trip data stored within the “trips” tab is converted into GTFS data stored within the “trips.txt” file. When presenting these examples, it was emphasized that while the data stored within Heitzman’s Excel tool and the GTFS text files look different, they both represent the same information but organized slightly differently.

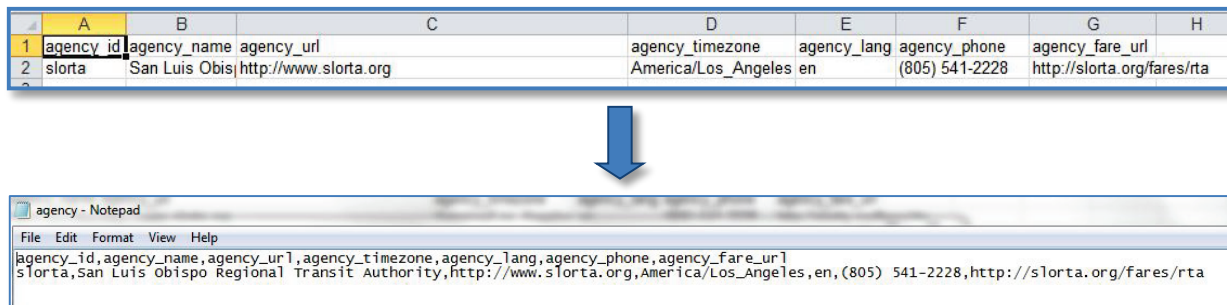


Figure E2: Conversion of Agency Data from Heitzman Excel Tool’s into GTFS Datafile

	A	B	C	D	E	F	G
1	route_id	service_id	trip_id	trip_headsign	direction_id	block_id	shape_id
2	9	mtwtf	R9a_T01	San Luis Obis	0		R9aSB
3	9	mtwtf	R9a_T02	San Luis Obis	0		R9aSB
4	9	mtwtf	R9a_T03	San Luis Obis	0		R9aSB
5	9	mtwtf	R9b_T01	Paso Robles	1		R9bNB
6	9	mtwtf	R9b_T02	Paso Robles	1		R9bNB
7	9	mtwtf	R9c_T01	San Luis Obis	0		R9cSB
8	9	mtwtf	R9d_T01	San Luis Obis	0		R9SB
9	9	mtwtf	R9d_T02	San Luis Obis	0		R9SB
10	9	mtwtf	R9d_T03	San Luis Obis	0		R9SB



```
trips - Notepad
File Edit Format View Help
route_id,service_id,trip_id,trip_headsign,direction_id,block_id,shape_id
9,mtwtf,R9a_T01,San Luis obispo,0,,R9aSB
9,mtwtf,R9a_T02,San Luis obispo,0,,R9aSB
9,mtwtf,R9a_T03,San Luis obispo,0,,R9aSB
9,mtwtf,R9b_T01,Paso Robles,1,,R9bNB
9,mtwtf,R9b_T02,Paso Robles,1,,R9bNB
9,mtwtf,R9c_T01,San Luis obispo,0,,R9cSB
9,mtwtf,R9d_T01,San Luis obispo,0,,R9SB
9,mtwtf,R9d_T02,San Luis obispo,0,,R9SB
9,mtwtf,R9d_T03,San Luis obispo,0,,R9SB
9,mtwtf,R9d_T04,San Luis obispo,0,,R9SB
9,mtwtf,R9d_T05,San Luis obispo,0,,R9SB
```

Figure E3: Conversion of Trips Data from Heitzman Excel Tool's into GTFS Datafile

After the data conversion demonstrations, common terms were defined to ensure that everyone would be on the same page regarding their meaning. Definitions were provided for: *GTFS*, *Lat/Long*, *trip pattern*, *trip*, *route*, *block ID*, and *direction ID*. For each term, an explanation of its relation to the building of GTFS data was also given.

The two Excel workbooks developed by Bob Heitzman to help generate GTFS text files were then formally introduced. These included:

- The Schedules workbook, which is used to convert schedule data into stop times and trips.
- The Import/Export workbook, which is used to store all coded transit service data and to generate the GTFS text files.

It was explained that the Schedules workbook is typically used first, primarily to extract stop times and trips data from bus schedules. These data are then imported into the Import/Export workbook and stored along with other service data. It was explained that all the data needed to create each of the 12 GTFS files are stored within the workbook in specific tabs corresponding to their destination file. Macros built within the workbook are then used to automatically create the required GTFS files and export all relevant data from each workbook tab to the corresponding file.

To provide session participants with the ability to quickly implement GTFS data, each individual was provided with a workbook already containing the following items:

- Geocoded bus stop locations (using the WGS 84 latitude/longitude referencing system)
- Schedule data
- Bus head sign data, to indicate the direction of the trip
- Holiday exceptions
- Route map for variations (patterns) of bus routes

These data items represent the minimum set of information needed to implement a GTFS data feed in Google Transit. While all participants were provided with a reference set of data, each was also invited to bring data characterizing the service offered by its own agency as the opportunity to manipulate familiar data rather than just random data may lead to a better learning experience.

E.3. GEOCODING BUS STOPS

Generally, agency staff did not have much trouble with the data coding examples presented, except for the geocoding of bus stops. To address this issue, the *GetLatLon* application was introduced. Figure E4 shows a sample screenshot of this application, which can be found at www.getlatlon.com. It is an interactive web-based application that gives the latitude and longitude coordinates for any location in the world. Use of this tool, or other similar tool, is recommended to obtain the coordinates of bus stops as they can significantly reduce the time that would otherwise need to be spent in the field trying to figure out the coordinates of each bus stop by driving to each one of them.

To verify whether a set of latitude and longitude coordinates adequately represents a given stop, it was indicated that the coordinates obtained from GetLatLon can be validated by pasting them into Google Maps. This can be done by simply entering the suffix “loc:” followed by the latitude and longitude coordinates of the point of interest in Google Maps’ search box. An example is shown in Figure E5. It was further noted that Heitzman’s Import/Export spreadsheet also allows bus stops coded within the tool to be selected (by double-clicking) and viewed in Google Maps at any moment.

At this point, it was suggested that transit agencies should not spend too much time on geocoding bus stops early in the GTFS conversion process. Since Google allows GTFS data updates every 2 weeks, an opportunity exists for slowly refining bus stop locations while other information is being built. A gradual development approach would notably prevent holding the release of information that may be useful, and thus more important, to transit riders solely for the purpose of refining the coding of bus stop locations.

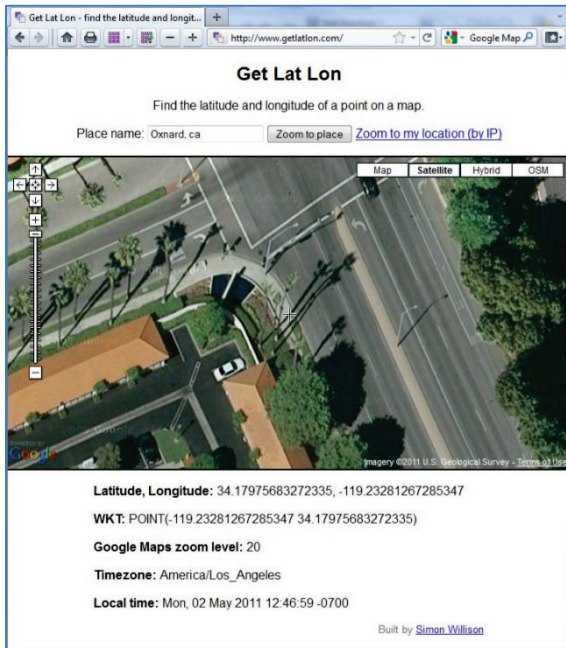


Figure E4: GetLatLon Application

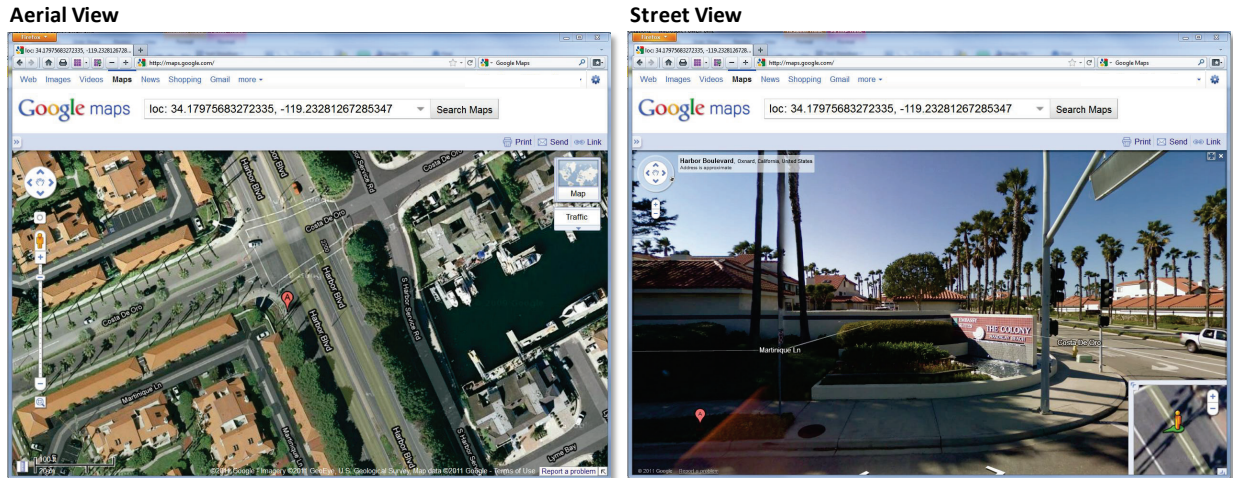


Figure E5: Verification of Latitude and Longitude Coordinates using Google Maps

Following the discussions on how to obtain and validate bus stop coordinates, the session moved into how bus stops are represented within the “stops” tab of Heitzman’s Import/Export spreadsheet. An example is shown in Figure E6. While the information looks straightforward, explanations were needed to clarify the difference between the *stop_id* and *stop_name* parameters. For each stop, an agency needs to assign a unique value to the *stop_id* parameter. This parameter is used by Google Transit, as well as Heitzman’s tool, to reference specific bus stops. The value assigned to *stop_id* can be an internal code specifically created for the development of the GTFS data or a code based on the location of the stop. In Figure E6, a simple sequential numbering system is used. On the other hand, *stop_name* is used to provide a more representative description of the bus stop. The information held by this parameter is notably used by Google to display the name of bus stops on Google Maps. Since bus stop names can be relatively long and complex, this is where use of the *stop_id* parameter to reference bus stops provides a quick way to link specific stops to specific routes when developing GTFS data.

5.326155	-120.835372	mblocay
5.317979	-120.844792	mblocay
5.312858	-120.844781	mblocay
5.311938	-120.836467	mblocay
5.311466	-120.832368	mblocay
5.314915	-120.832357	mblocay
5.320562	-120.831188	mblocay
5.328002	-120.831145	mblocay
5.307964	-120.819064	mblocay
5.362001	-120.824198	mblocay
35.36178	-120.824595	mblocay
35.3665	-120.844653	mblocay
5.332344	-120.741259	cuesta
5.327192	-120.741227	cuesta
5.307482	-120.817852	mblocay
5.300396	-120.657984	slo
5.300449	-120.657963	slo
5.302316	-120.663161	slo
5.302362	-120.663236	slo
4.943978	-120.418273	smaria
35.32482	-120.744558	cuesta
5.392109	-120.607076	smatas
5.391965	-120.606813	smatas
5.417954	-120.604477	smatas
5.418643	-120.603954	smatas
5.457461	-120.641223	smatas

Figure E6: Heitzman’s Import/Export Workbook - Stops Tab Spreadsheet

E.4. BUILDING SCHEDULES

The second part of the training sessions addressed the process of creating schedules using Heitzman’s Schedules workbook. At this point, participants were reminded that the tool can be used to create two of the 12 GTFS files, namely the *stop_times.txt* and *trips.txt* files by using data that is ultimately stored in the “stop_times” and “trips” tabs.

This involved using a sample dataset from San Luis Obispo. A screenshot of this dataset is shown Figure E7. This dataset contained information detailing the schedule of five bus routes, namely routes 9, 10, 12A, 12B and 12 Limited. As shown in the figure, information about each bus route was stored in a separate tab. Links to data contained within each of these tabs were then used to create a master timetable “Schedules V2” tab, with the “stop_times” and “trips” tabs (shown in purple in the figure) being the recipients of the data that is to be saved in the GTFS data files.

Route	Stop	Stop ID	Stop Description	T01	T02	T03	T04	T05	T06	T07	T08	T09
Bus Route: 9C	San Luis Obispo	076	Creston Rd. @ Melody Dr.	06:12:00								
	San Luis Obispo	077	Niblick Rd. @ Melody Dr.	06:14:00								
	San Luis Obispo	075	Pine @ 9th (Train Station) Connects w/PRICats	06:20:00								
	San Luis Obispo	073	Las Tablas PARK & RIDE - Connects w/NCS	06:30:00								
	San Luis Obispo	052										
	San Luis Obispo	051	Atascadero City Hall	06:38:00								
	San Luis Obispo	043										
	San Luis Obispo	045										
	San Luis Obispo	079										
	San Luis Obispo	057										
Bus Route: 9D	San Luis Obispo	080										
	San Luis Obispo	080										
	San Luis Obispo	042										
	San Luis Obispo	038										
	San Luis Obispo	036										
	San Luis Obispo	035										
	San Luis Obispo	041										
	San Luis Obispo	030										
	San Luis Obispo	076	Viejo Camino @ El Camino	06:48:00								
	San Luis Obispo	078										
Bus Route: 9B	San Luis Obispo	084										
	San Luis Obispo	052										
	San Luis Obispo	030	El Camino Real @ Encino Ave.	07:01:00								
	San Luis Obispo	082										
	San Luis Obispo	069										
	San Luis Obispo	023										
	San Luis Obispo	025	Kearney	07:18:00								
	San Luis Obispo	044										
	San Luis Obispo	001	SLO Gymnat Ctr - Connects w/SLO Transit & RTA	07:27:00								
	Bus Route: 12B	San Luis Obispo	087	Mission @ 14 St.								
San Luis Obispo		075	Pine @ 9th (Train Station) Connects w/PRICats	7:30:00	08:20:00	09:20:00	10:20:00	11:20:00	13:20:00	14:20:00	15:20:00	1
San Luis Obispo		073	Las Tablas PARK & RIDE - Connects w/NCS	7:30:00	08:30:00	09:30:00	10:30:00	11:30:00	13:30:00	14:30:00	15:30:00	1
San Luis Obispo		052										
San Luis Obispo		051	Atascadero City Hall	7:38:00	08:38:00	09:38:00	10:38:00	11:38:00	13:38:00	14:38:00	15:38:00	1
San Luis Obispo		049										
San Luis Obispo		045										
San Luis Obispo		079										
San Luis Obispo		057										
San Luis Obispo		080										
Bus Route: 12B Limited	San Luis Obispo	042										
	San Luis Obispo	038										
	San Luis Obispo	036										
	San Luis Obispo	035										
	San Luis Obispo	041										
	San Luis Obispo	030										
	San Luis Obispo	076	Viejo Camino @ El Camino	7:48:00	08:48:00	09:48:00	10:48:00	11:48:00	13:48:00	14:48:00	15:48:00	1
	San Luis Obispo	078										
	San Luis Obispo	084										
	San Luis Obispo	023										

Figure E7: Heitzman’s Schedules Workbook

It was first explained to participants that the Schedules workbook organizes route variations, or *trip patterns*, according to the day of week and time of day. A route variation consists in a specific set of bus stops visited in a given sequence. Each route variation is defined by simply providing an ordered list of bus stops and defining the characteristics of each stop. As an example, Figure E7 illustrates the stops being visited by a bus along two variations of the bus route 9 (variation 9C and 9D). Within each variation, bus stops are identified by simply providing their *stop_id* parameter.

It was then pointed out that schedules can easily be built with Heitzman’s Schedule tool using source data stored in various formats, such as printed schedules, website data, bid/run cards, or bus operator paddles. If the agency data is already stored in Microsoft Excel, schedules can be built by simply linking cells within the “Schedule V2” tab to the original timetable and by using the Excel “fill” and “time” commands. This discussion led to exercises in which session participants were given the opportunity to

experiment with the process of creating a schedule within the Schedule workbook by linking data across tabs and using the Excel “time” command to automatically add set time intervals when only a trip start time and trip duration is known.

Following the description of how schedules are organized, discussion focused on other parameters used in the workbook:

- For each route, the *trip_headsign* indicates the route direction. This information comes up in Google Transit as the direction a user is traveling.
- Intermediate stops are identified by coding and asterisk (*) without a 1 designation in the *timed_stop* column, while timed stops are identified by providing the time at which a bus is expected to reach the stop. Since intermediate stops do not have a specific arrival time assigned to them, Google Transit will estimate bus arrival times based on the time needed for the vehicle to reach it from a given origin.
- Finally, the *service_id* parameter is a designation of which day of the week the trip runs. The values assigned to this parameter can be any code that is specific to an agency. These values are encoded in the “Calendar” tab within the Import/Export workbook. Figure E8 illustrates an example used during the training sessions. In this case, three codes are defined: “mtwtf” for buses running during weekdays, “sat” for buses running Saturdays, and “sun” for buses running Sundays. Simple 0/1 switches are used to identify which day a specific pattern is valid. The start and end dates further designate the time period during which the encoding is valid, in this case from February 02, 2009 to October 31, 2011.

	A	B	C	D	E	F	G	H	I	J	K
1	service_id	monday	tuesday	wednesday	thursday	friday	saturday	sunday	start_date	end_date	
2	mtwtf	1	1	1	1	1	0	0	20090201	20111031	
3	sat	0	0	0	0	0	1	0	20090201	20111031	
4	sun	0	0	0	0	0	0	1	20090201	20111031	
5											
6											

Figure E8: Development of Transit Service Calendars in Heitzman’s Import/Export Workbook

After going through the steps of generating a schedule, the training session explored how to modify a trip, a time, a stop, etc. These operations were shown as simple Excel manipulations, such as adding or deleting a row. At this time, it was emphasized that anyone who is moderately familiar with Excel could easily build the GTFS data, at least from what had been seen so far. It was also pointed out that future data validation and modification efforts should take significantly less time and effort than the initial data conversion and validation, as all that would be required would be to perform small alterations to the data already stored within the Excel spreadsheets.

The last topic of this portion of the training focused on the “Notes” tab. This tab contains macro buttons allowing agency staff to proof the schedules that have been coded, as well as macro buttons for clearing existing schedule data and generating the GTFS stop times and trips tabs data in the corresponding workbook tabs.

E.5. DEVELOPMENT OF OTHER GTFS FILES

Following the exercises on how to build schedules with the Schedule workbook, the discussions moved to the process of developing other GTFS data with Heitzman’s Import/Export workbook. This change first required session participants to copy the content of the “stop_times” and “trips” tabs within the Schedules workbook into the corresponding tab within the Import/Export workbook.

At this point in the training, participants had already completed data coding for two of the required GTFS text files: the *stop_times.txt* and *trips.txt* files, which are among the hardest of the mandatory files to develop. Since the other files generally contain information that is already on hand, they are typically easier to develop.

A particular note was made of the value of developing a *calendar_dates.txt* file. While this GTFS file is optional, its development is highly recommended as it lists exceptions to the transit service defined in the *calendar.txt* file. This file is for instance used to define service exceptions during a holiday or festival, or during periods during which roadway construction projects may affect transit service. Figure E9 shows the example that was discussed during the sessions. This example illustrates various exceptions coded within the “calendar_dates” tab of the Import/Export workbook.

	A	B	C	D	E
1	service_id	date	exception_type		
2	mtwtf	20101231	2		
3	mtwtf	20100906	2		
4	mtwtf	20101125	2		
5	mtwtf	20101224	2		
6	sat	20110101	2		
7	sat	20101225	2		
8	mtwtf	20110530	2		
9	mtwtf	20110704	2		
10	mtwtf	20110905	2		
11					
12					
13					

Figure E9: Service Exceptions in Calendar_Dates Tab of Heitzman’s Import/Export Workbook

E.6. GENERATING GTFS FILES

After completing the coding of GTFS data within Heitzman’s Import/Export workbook, session participants were shown how to actually generate the 12 GTFS data files supported by Google Transit. This typically involves pressing a single macro button within the “Notes” tab and subsequently providing the name of the directory where the files should be created. An example of this process, extracted from the recorded training session videos, is shown in Figure E10.

Upon completion of the data file creation exercise, session participants were further instructed on how to package the data for Google, as Google requires that all data be submitted in a single zipped file. This led to an exercise on how to zip groups of data files using standard Windows functions.

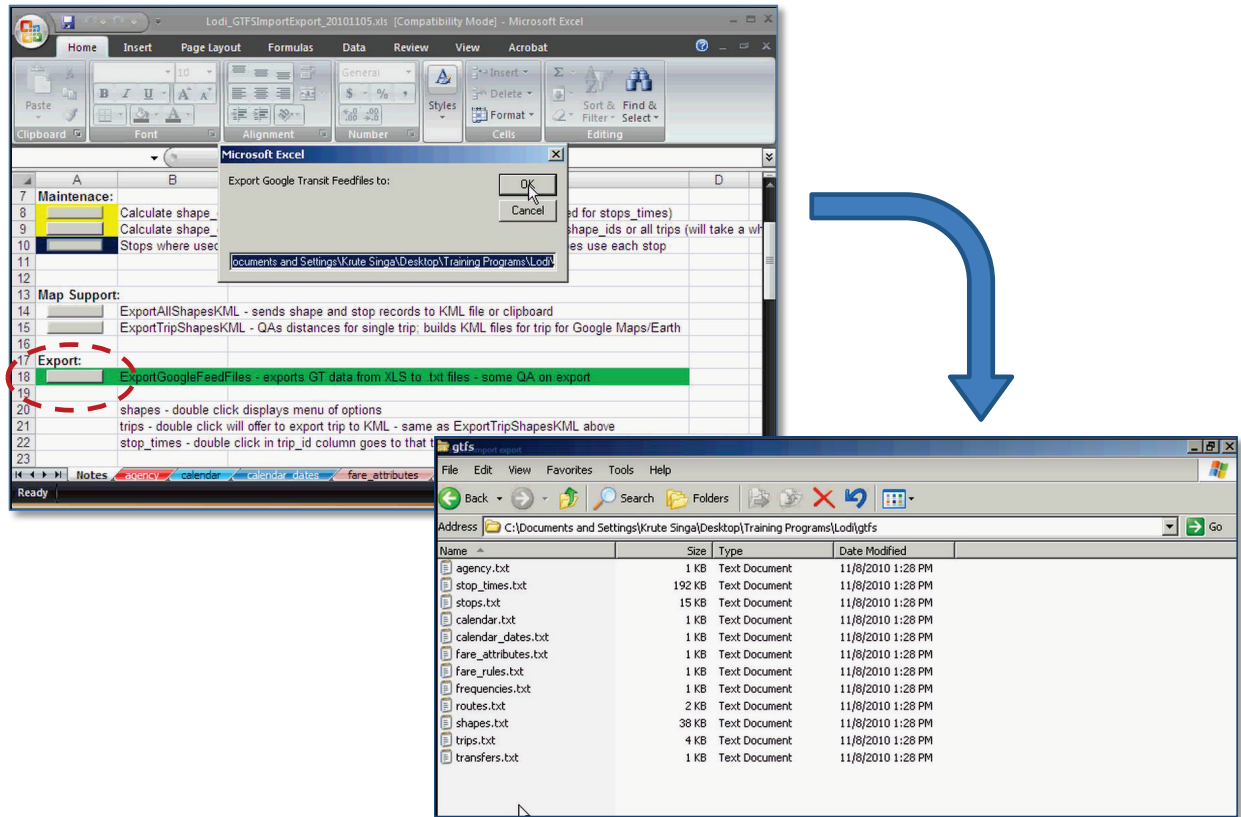


Figure E10: Generating GTFS Files with Heitzman’s Import/Export Workbook

E.7. VALIDATING GTFS DATA FEEDS

Following the discussion and exercises on how to create GTFS data files, session participants were introduced to various validation tools that may be used to ensure that the data do not contain errors and accurately portray the transit service offered.

Participants were first informed that Heitzman’s Import/Export workbook offers built-in validation tools that can be called at any time during the data development process. It was also noted that the GTFS file generation process will typically stop if any major problems are encountered. The discussions then moved to brief descriptions of the various available tools, with a particular emphasis on Google Feed Validator, Google Schedule Viewer, KML Writer, and Google Random Trips Generator.

Using examples with errors, transit agency representatives were shown how the various tools can be used to detect errors in GTFS data. For instance, Google Schedule Viewer was used to show the effects of erroneous data on the displayed paths of buses or estimated travel times from one bus stop to the next. Another example showed how simply forgetting to type a minus sign in the latitude/longitude coordinates of a bus stop could result in the stop being displayed in China instead of California. To show how each tool would catch very simple but significant and often different errors, the same erroneous data was purposefully processed through different tools.

Discussions on validation were an important part of the training sessions, as many of the agency representatives had concerns whether they would be able to produce error-free data in a timely manner when using the tools presented on their own. Understandably, many of the tools and procedures that

had been introduced were new to them and, even with training, fear could linger in taking on a project featuring so many new elements. These fears were alleviated by emphasizing that the validation tools presented do offer several safety buffers built into them to ensure that accurate GTFS data is published in Google Transit.

A final validation tool that was presented, and which did not require using any software, was to ask other individuals look at the output data produced by the GTFS tools before sending it to Google. This was presented as a cost-effective tools, as individuals taking a fresh, first look at coded data may be able to spot problems that have gone unnoticed by individuals who have already spent significant time manipulating them.

E.8. MAPPING TOOLS AND OPTIONAL SHAPES FILES

This portion of the session introduced Google Earth and how this tool can be used to verifying the coordinates of bus stops and developing shape files modeling transit routes. Shape files were presented as simple text files containing information about the location of points visited by a vehicle along a given route. While shape files are an optional GTFS data item, their absence results in transit routes appearing on Google Maps as a series of straight lines from one bus stop to the next, rather than appearing to follow existing roads. Their primary purpose was presented as allowing bus routes to be “shaped” to conform to the road geometry.

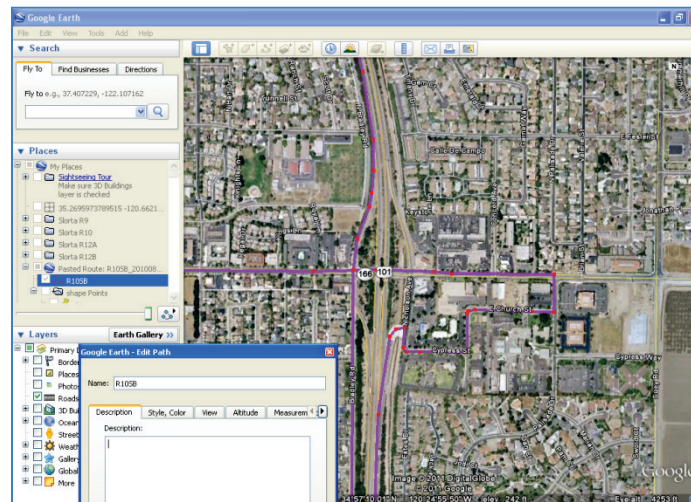


Figure E11: Editing Shape Points in Google Earth

Agency representatives were then provided with the opportunity to create shapes files in Google Earth and export them into a GTFS text file using Heitzman’s Import/Export workbook. This was done using the example of Figure E11, which represents points along San Luis Obispo Regional Transit Authority’s bus route 10. When loaded into Google Earth, the points coded along the route appear in red. The selection of a point along the route (which would then turn blue) allows other points located downstream along the direction of travel to be inserted or adjusted. However, no upstream point can be modified.

Session participants were also shown how to create an alternate route or a detour using Google Earth. They were shown how to do this by pasting an existing shape file into Google Earth and then shifting and adding points to accommodate the alternate route or detour. The resulting pattern was then pasted

back into the “shapes” tab of Heitzman’s Import/Export workbook, with a new name representing the new trip pattern.

An important reminder was that changes made in Google Earth are not incorporated into GTFS text files until the route is selected, copied and pasted back into the “shapes” tab of the Import/Export workbook. It was also indicated that while editing data directly within the “shapes” tab is acceptable, it is highly recommended to make changes in Google Earth instead as use of this tool would allow obtaining an immediate visual confirmation of how the modified route would eventually be displayed in Google Maps.

E.9. DATA HOSTING AND POSTING

This portion of the training session focused on options available to host GTFS data and how to resolve various technical issues. Session participants were informed that when a transit agency is satisfied with the developed GTFS data, the resulting dataset has to be hosted on a server for Google to fetch the data. Google does this through a Partner Content Front End (PCFE) application. This application indicates to Google where the GTFS data is located and whether the last attempted data fetch was successful or unsuccessful. The fetch is done weekly and was, at the time of this report, typically scheduled to occur at 1:00 AM on Thursdays.

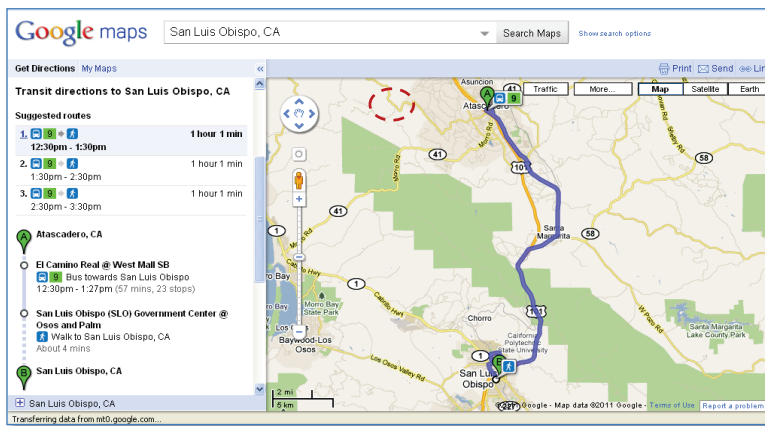
Since the GTFS files are simple text files, they take up very minimal space on any computer server. An example indicated that the GTFS data for the San Luis Obispo Regional Transit Agency only occupied 120 Kb of hard drive space. This provided small transit agencies with various options to host their GTFS data:

- Use of in-house servers.
- Renting of server space from a storage supplier (for approximately \$50/year).
- Upload of data to a server maintained by a regional or national agency providing support for the transit agencies, with data maintenance still executed by agency staff using web portals.
- Use of consultant servers with an on-going maintenance contract.
- Upload of data upload onto a third-party server, such as the GTFS Data Exchange (discussed later on in the session).

E.10. ADDITIONAL GTFS VALUES: LANGUAGE OPTION, SCHEDULE PUBLISHING

This portion of the session emphasized that finally going live on Google Transit is not the whole story. Session participants were informed of various additional values that can be extracted from developed GTFS data. One such value is the ability to post GTFS data in multiple languages. Transit agencies are for instance required by the federal government to provide transit information in several languages. Within Google Transit, the use of language codes greatly simplifies tasks aiming to satisfy this requirement. An example is shown in Figure E12. Through this example, session participants were shown that simply changing the language code in the page link from English (code: **en**) to Spanish (code: **es**) automatically results in Google Transit displaying the GTFS data retrieved from a query in Spanish. While this is a very useful, time-saving feature, a survey of training participants revealed that most of them were not aware of this function.

http://www.google.com/maps?f=d&source=s_d&saddr=Atascadero,+CA&daddr=San+Luis+Obispo,+CA&hl=en&geocode=%3BFUBfGIdYOHO-Cknwmx7vubsgDFGD-_OwpACvA&mra=ls&dirflg=r&ttype=dep&date=4%2F11%2F11&time=1:11pm&noexp=0&noal=0&sort=def&sll=35.46364,-120.66016&sspn=0.50221,0.883026&ie=UTF8&z=11&start=0



http://www.google.com/maps?f=d&source=s_d&saddr=Atascadero,+CA&daddr=San+Luis+Obispo,+CA&hl=es&geocode=%3BFUBfGIdYOHO-Cknwmx7vubsgDFGD-_OwpACvA&mra=ls&dirflg=r&ttype=dep&date=4%2F11%2F11&time=1:11pm&noexp=0&noal=0&sort=def&sll=35.46364,-120.66016&sspn=0.50221,0.883026&ie=UTF8&z=11&start=0

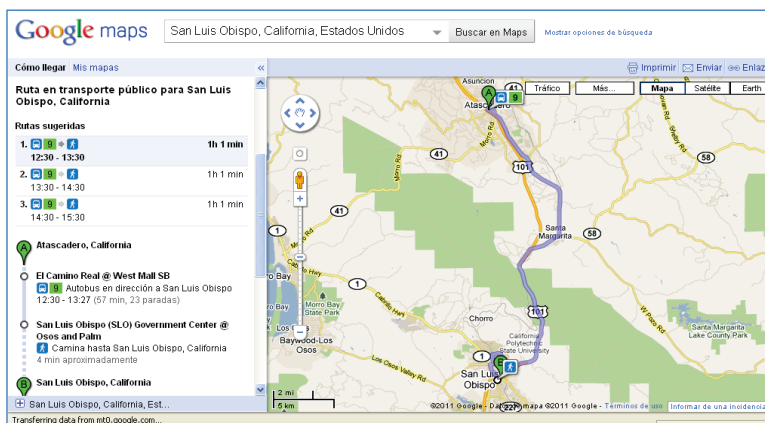


Figure E12: Effect of Language Option on Displayed Information

The most complicated part of the training program was the portion on the use of TimeTable Publisher and its associated tools, such as the Java Development Kit and Tomcat. As an open source tool developed with Tri-Met in mind, the tool has a relatively complicated installation process. Once installed, however, its use is relatively simple. TimeTable Publisher was introduced as a time-saving opportunity for agencies. With this tool, they only have to update their GTFS data when changes in service would occur. The tool would further allow timetables and maps to be updated with a few keystrokes. It was further indicated that the adoption of this tool by multiple agencies could provide a tremendous opportunity for standardizing tables and maps across a region. An effort from the National RTAP to developing a web-based tool based on the use of TimeTable Publisher was also briefly presented.

E.11. OPEN-SOURCE GTFS DATA AS SUPPORT FOR OTHER APPLICATIONS

The last part of the training sessions introduced participants to some applications beyond transit trip planners that may use GTFS data. This included a brief presentation of the Walk Score application (shown Figure E13), which has recently become a standardized evaluation of the attractiveness of a region based on the ability to walk to local amenities and accessibility of transit.

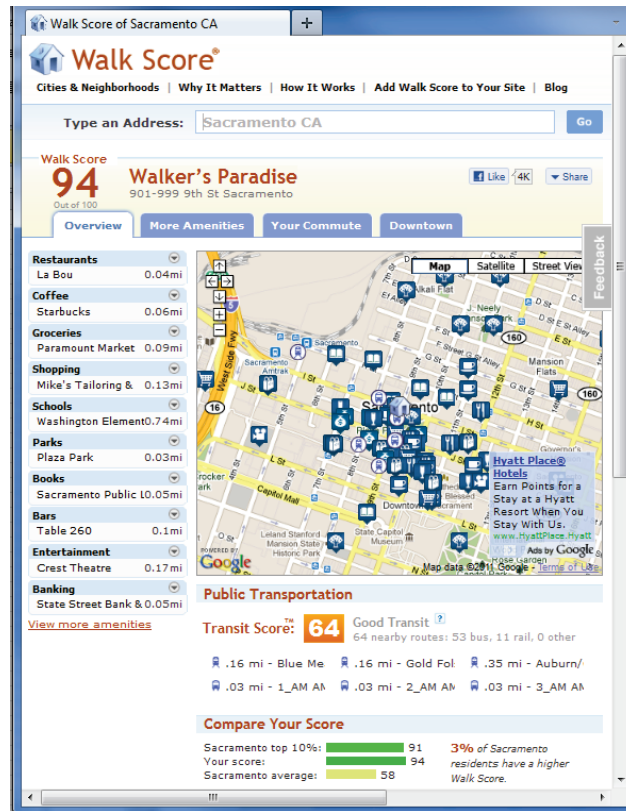


Figure E13: Walk Score Application

Session participants were then informed that many applications are created by developers who rely on open data to access the information they need. For transit-related applications, this is particularly dependent on having access to published GTFS data. Participants were shown the City-Go-Round website (shown in Figure E14), which is a web application developed by Walk Score aiming to help developers and travelers find useful transit applications and transit-related data and which notably publishes a list of transit agencies for which open data is available.

It was further emphasized that open data provide tremendous marketing opportunity for transit agencies at a very low cost, as it enables developers to create applications serving transit riders at no charge to the transit agency. These applications then act as indirect publicity mechanisms by providing travelers with information regarding available transit services in a region. All that is required from the transit agencies is to supply accurate, up-to-date GTFS data to open data repositories. This led to discussions on how to create open data. A commonly used method that consists of directly uploading developed GTFS data onto the GTFS Data Exchange (see Figure E15) was presented. A note was also made to indicate that a link to the location where the data may also be provided the Exchange as an alternative to directly supplying the data.

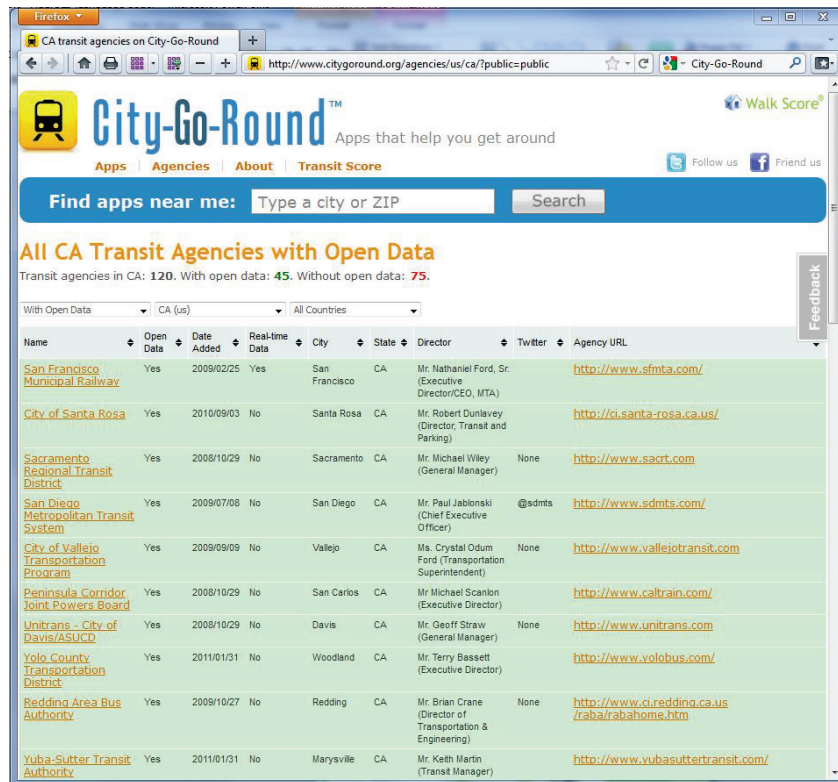


Figure E14: City-Go-Round Application

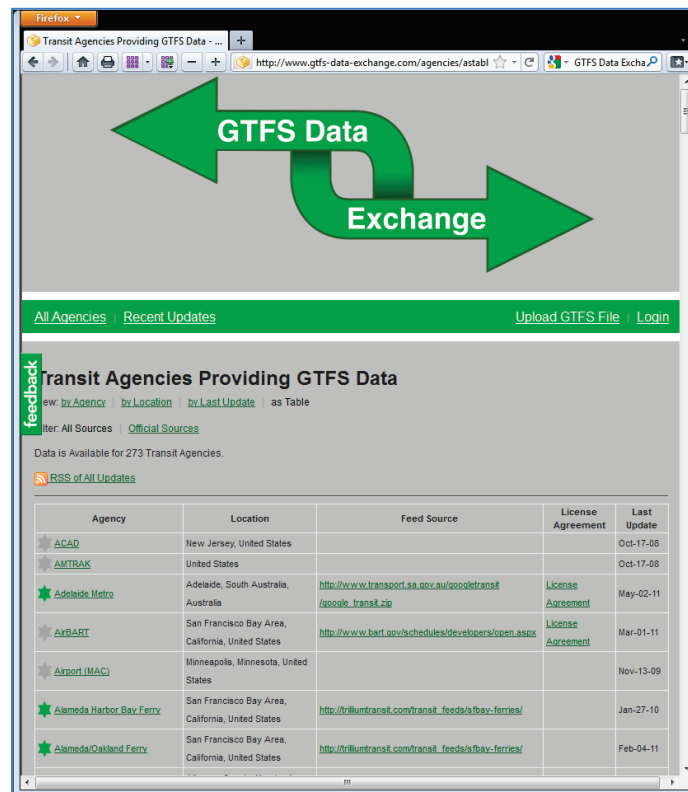


Figure E15: GTFS Data Exchange

A final topic of discussion was the potential to obtain online trip planner utilization statistics by subscribing to Google Analytics. Google Analytics is a free application offered Google commonly used by webmasters to generate statistics about visits to a website. Transit agencies can use the application to track the number of visitors to the agency’s webpages where the online trip planner or a link to Google Transit can be accessed. A screenshot of a Google Analytics report is shown in Figure E16. This example shows hit statistics over a 5-month period for the San Luis Obispo Regional Ridershare webpage (<http://www.rideshare.org/NewHome.aspx>) where travelers could access an interface to Google Transit. Use of this information can give transit agencies a sense of how many people are planning trips using their GTFS data, as well as their website in general. However, while Google Analytics can be used to track visits to any website maintained by an agency, this application cannot be used to track the number of times individuals access the agency’s GTFS data directly from Google Transit or Google Maps. Since the Google Transit and Google Maps websites are operated by Google, Google considers all statistics regarding the operation of these websites as proprietary information.

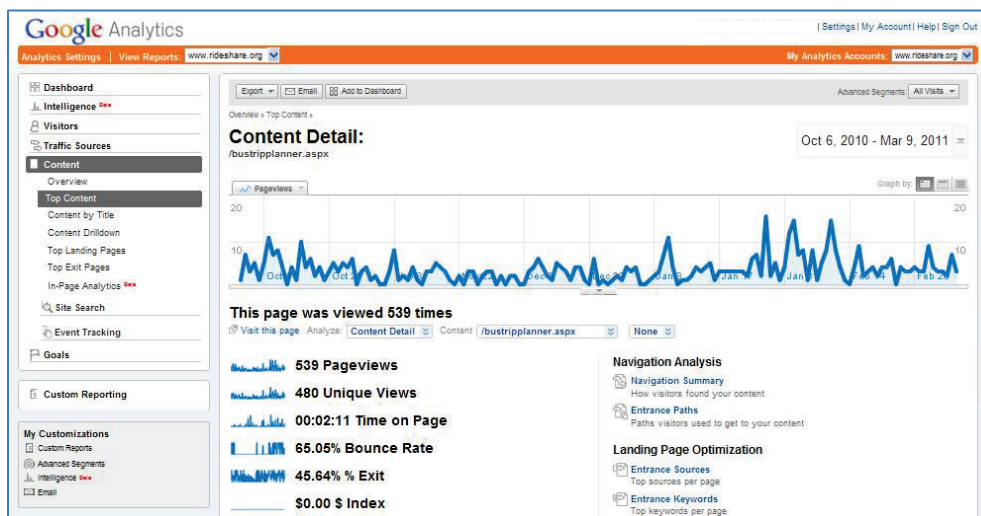


Figure E16: Google Analytics Statistics Example
(Courtesy from San Luis Obispo Ridershare)

E.12. TRAINING SESSIONS FEEDBACK

At the end of the training session, a feedback questionnaire was passed out to the participants. Results from the questionnaire indicated overall satisfaction with the sessions. Responses indicated that the technical level of the presented material was just right, that the sessions were an effective learning tool, and that the material presented was neither easy nor difficult. In addition to providing a resource tool for transit agency staff seeking to develop on their own their GTFS data, the training sessions helped the project team getting feedbacks on agency perspectives, suggestions for future sessions, and support for further developing a vision for the potential and growth of an information network on Google Transit.

APPENDIX F. AGENCY RESOURCE SURVEY DATA

This appendix provides additional details on the survey of transit agencies that was conducted in February 2010 to assess the needs associated with the development of GTFS data for online transit trip planners. Information provided below includes:

- The questionnaire that was sent to transit agencies
- A summary of the raw data that was collected through the survey

F.1. SURVEY QUESTIONNAIRE

INTRODUCTORY TEXT

Caltrans Division of Mass Transportation and Division of Research and Innovation has partnered with California Center for Innovative Transportation (CCIT) to research options for disseminating public transportation and schedule information over the internet for smaller transit agencies, in a convenient and clearly accessible form. Easily accessible information on transit options will improve the overall levels of service and encourage modal shift by facilitating casual users, non-locals and social service agencies to use transit.

CCIT/Caltrans are selecting a few smaller transit agencies in California to provide them with the resources and technical skills to organize their stops/routes/schedule data and convert it to the Google Transit feed Specification (GTFS) format. Creating the GTFS feed will require a time commitment from the transit agency staff to locate the vehicle stops accurately. The agency's time commitment will vary based on the number of stops and routes.

CCIT and Caltrans will provide all the resources needed for developing the GTFS feed and limited initial maintenance assistance to the participating agencies. After full implementation, the agencies will be responsible for the continued maintenance of the GTFS feeds.

The following four maintenance models are being explored:

1. Web-based upkeep and hosting by a third party vendor, which costs about \$900 per year;
2. Spreadsheet tools based upkeep by the transit agency staff for which time commitment may vary upwards of 40 hours a year based on the frequency and the types of modifications to the system;
3. GTFS feed is hosted by an entity in your general area (e.g., Council of Governments or Larger Regional Transit Agency) through an agreement;
4. GTFS feed is hosted at a central location by Caltrans and kept up using a centralized open source software by the transit agency through a web interface.

A web-server that may host the GTFS feed at the transit agency would be helpful. If there is no geo-referenced data on the stops, CCIT will collect some or most of the data, relying on the agency for verification of the accuracy. The transit agency will own the final product, and will be able to provide access to Caltrans and others for planning purposes on request.

QUESTIONS REGARDING SYSTEM CHARACTERISTICS

1. What type of transit services do you offer? (please note *that demand responsive services cannot be published on Google Transit*)

	Yes / No
Fixed Route	
Routes with Allowed Deviations	
General Public Dial-a-Ride / Demand Responsive	

2. Do your agency schedules and routes vary by the time of year? (Yes/ No) _____
3. How many routes do you serve? _____
4. How many stops do you serve? _____
5. How often are changes to your transit schedules or routes made? _____
6. Indicate which of the following information you have in an electronic format? (*if so, please indicate in what format they are available*)

	Spreadsheets	GIS	AutoCAD	Other Electronic Formats	Non-Electronic Format
	Yes / No				
Stop Location information					
Route information					
Schedule information					

7. Please indicate your ridership for the years 2007, 2008 and 2009 (*if available*).

	Estimated Ridership in 2007	Estimated Ridership in 2008	Estimated Ridership in 2009
Fixed Route and Routes with Allowed Deviations			

QUESTIONS REGARDING AVAILABLE RESOURCES

1. How many full-time employee equivalents (FTEs) did your agency maintain for FY 2008/09?

2. Among administrative and office staff, what percentage of total staff time is devoted to the following functions (FY 2008/09)? If consultants were retained to perform any of these functions, please estimate the total consultant cost during the past three fiscal years.

Function	Percent of staff time in 2009 (doesn't need to add up to 100%)	Consultant cost over past three fiscal years
Marketing & advertising		
Information technology		
Scheduling		
Planning		
Trip Planning (Customer Service)		
Other, specify:		
Other, specify:		
Other, specify:		

3. Does your agency provide route and schedule information on a website?
(Yes/ No) _____
 - a. If yes for above, provide number of visits to your website in the year 2009

4. Does your agency track the number of route and schedule information inquiries?
(Yes/ No) _____
 - a. If yes above, provide an estimate of number of queries for the year 2009?

5. Are you using an automated phone system to answer route, schedule, and trip planning information requests? (Yes/ No) _____

6. Does your agency use any software programs/ technologies for dispatching and/or scheduling?
(Yes / No) _____
 - a. If yes above, what software is used? _____

7. What sort of internet access do you have, if any, at your location(s) for administration and scheduling/dispatch? If there are multiple locations, please specify for each location.

8. Do you have access to a web-server? (Yes/ No) _____
 - b. If yes, please indicate who owns and operates the server. _____

9. Do you use Automated Vehicle Location (AVL) technology? (Yes/ No) _____

10. Please rate your agencies capabilities to perform the following?

Tasks	Capable	Not Capable	Not Sure
Hosting GTFS feed in-house			
Maintaining GTFS feed in-house			

11. Please indicate your order of preference for GTFS feed maintenance.

GTFS feed maintenance	Rank Order (1 to 4)
Web-based upkeep and hosting by a 3 rd party vendor	
Spreadsheet tools based upkeep by the transit agency staff	
GTFS feed is hosted by an entity in your general area (e.g., Council of Governments or Larger Regional Transit Agency) through an agreement	
GTFS feed is hosted at a central location by Caltrans and kept up using a centralized open source software by the transit agency through a web interface.	

QUESTIONS REGARDING AGREEMENT/APPROVAL PROCESS

By implementing GTFS, transit agencies license their data in the GTFS format to be used by Google Inc. Transit agencies continue to own the data feed and the intellectual property rights to their data. Agencies agree to keep their GTFS feed updated.

1. What are the steps needed to be undertaken by your agency to sign the standard agreement with Google Transit? (example agreement available on request)

Process Steps	Description of the Step	Estimated Timeline (in weeks)
Step 1 (e.g., department approval)		
Step 2 (e.g., legal counsel review)		
Step 3 (e.g., Planning Committee Review)		
Step 4 Sign the agreement with Google Inc.		

2. What information does your agency need from CCIT to start the agreement process?

F.2. SURVEY RESPONSES

Responses from the survey questionnaire were obtained from the seven following transit agencies:

- Altamont Commuter Express (ACE Rail)
- Cerritos on Wheels (COW)
- Escalon Transit Services (eTran)
- Folsom Transit Division
- Paso Robles Transit (Paso Express)
- North County Shuttle (NCS)
- Yuba Sutter Transit

Tables B1, B2 and B3 provide the raw data that was collected from the returned questionnaires. Each of the table corresponds to one of the main section of the questionnaire. Interpretation of the data is provided in the main section of the report.

Table F1: Survey Results – System Characteristics

	Type of Transit Services			Schedule & Routes vary?	Routes	Stops	Frequency of changes?	Electronic Format			Ridership			
	Fixed Routes	Allow Deviations	Dial-a-ride					Stops	Route	Schedule	2007	2008	2009	
ACE Rail	Y	N	N	N	3	9	1 / year	XLS GIS CAD Other Non	Web	Web	Web	752,286	864,617	682,719
Cerritos on Wheels	Y	Y	N (for seniors & disabled residents)	Y (schedules change in summer, Saturday different)	2 (1 route per direction on same path)	85 (on each route)	not often	XLS GIS CAD Other Non	Y Y N N Y	Y Y N N Y	Y N N N Y	230,158	246,335	285,674
Escalon	Y	Y	Y	N	1	30	1 / year	XLS GIS CAD Other Non	Y Y N Y Y	Y Y N Y Y	Y N N Y Y	1,282	1,308	1,830
Folsom	Y	Y	Y	N	2	188	1.8 / year	XLS GIS CAD Other Non	N N N Y N	N N N Y N	N N N Y N	71,801	79,028	87,449
Paso Express	Y	N	Y	N	5	138	0.5 / year	XLS GIS CAD Other Non	Y N N Y Y	Y N N Y Y	Y N N Y Y	179,795	204,571	194,659
North County Shuttle	Y	N	Y	N	1	41	1 / year	XLS GIS CAD Other Non	Y N N N N	Y N N N N	Y N N N N	43,629	50,386	55,322
Yuba Sutter	Y	Y	Y	N	11	280±	1.5 / year	XLS GIS CAD Other Non	N N N N N	N N N N N	N N N N N	759,100	878,900	988,800
														No DR

Table F3: Survey Results – Agreement/Approval Process

Agency	1. Steps Needed		2. Information Needed	
	Description	Time (Weeks)		
ACE Rail	Step 1	Agreement in Place	Agreement in place	
	Step 2			
	Step 3			
	Step 4			
COW	Step 1		Sample agreement & references from other agencies that have been assisted in the past	
	Step 2			
	Step 3			
	Step 4			
Escalon	Step 1	Request	1	Agreement, program details and cost implications
	Step 2	Submit Documents	3	
	Step 3			
	Step 4	Sign Agreement	1	
Folsom	Step 1	Department Approval	2	Notice of Intent to Department Head, Richard Lorenz
	Step 2	Legal Review	2	
	Step 3	Information Staff Approval	2	
	Step 4			
Paso Express	Step 1	Department Approval	1	Cost & Template
	Step 2	City Attorney Review	2	
	Step 3			
	Step 4	Approval by City Manager	3	
NCS	Step 1	Director Signature	1	Draft Agreement
	Step 2	City Attorney	4	
	Step 3	City Council (possible)	4	
	Step 4	After City Council Action if needed	4	
Yuba Sutter	Step 1	Department Approval	NA	Send Draft Agreement for Signature
	Step 2	Legal Counsel Rev.	Done	
	Step 3	Planning Committee	NA	
	Step 4	Sign Agreement	Waiting	

APPENDIX G. GOOGLE TRANSIT AGENCY EXPERIENCE SURVEY DATA

This appendix provides additional details on the survey of experiences of transit agencies with Google Transit that was conducted between November 1, 2010 and December 7, 2010. Information provided below includes:

- Questionnaire that was administered to agencies that had already launched an online transit trip planner
- Questionnaire that was administered to agencies that had not yet launched an online transit trip planner.
- List of agencies that responded to the survey
- Summary of data collected through the survey for both agencies with and without an online transit trip planner.

G.1. QUESTIONNAIRE 1: AGENCIES WITH ONLINE TRANSIT TRIP PLANNER

INTRODUCTORY TEXT

This survey will help to determine whether Google Transit is effective in enhancing your agency's operations and ability to provide transit information to customers. Your cooperation is highly appreciated and will be used to help other small agencies throughout the state to make informed decisions in their operations and choices regarding transit planners.

Caltrans has partnered with the California Center for Innovative Transportation (CCIT) at UC Berkeley to research options for disseminating small public transit agency schedule information over the internet. Easily accessible information on transit options will improve information availability and can encourage a shift to public transportation by facilitating route planning for casual users, non-locals and social service agencies. This survey is a part of the evaluation of the GTFS implementation process and results.

GTFS IMPLEMENTATION PROCESS

1. What is the name of your transit agency? _____
2. How long has it been since the agency went live on Google Transit? _____ months
3. How long was the entire implementation process? _____ months
4. How did the agency finance implementation?
Self-financed Regionally-financed Grants CCIT pilot project participation
Other: _____

5. What was the primary motivation for the agency to implement GTFS?

Improve information distribution

Improve ridership

Improve coordinated planning with other agencies

Improve services for customers

Improve financial and time costs

Improve publicity and community support

Improve accessibility to potential customers

Update website and technological services

Other: _____

6. What was the agency's primary concern for GTFS implementation initially? *Choose one.*

Funding

High cost of maintenance

Time

Staff capacity

Google Transit's sustainability and stability

Agency board's support/approval

Other: _____

7. What are the agency's concerns after implementation? *Check all that apply.*

Funding

High cost of maintenance

Time

Staff capacity

Google Transit's sustainability and stability

No concern

Other: _____

8. What kind of challenges, if any, did the agency experience during/through implementation?
Check all that apply.

Not enough staff

Not enough information

Not enough funding

Unstable schedule

Other: _____

9. Was the implementation in-house or contracted?

In-house

Contracted

Other: _____

10. Please indicate the percent of staff time spent in implementing GTFS: _____

11. *Any further comments on the implementation process?*

AGENCY MAINTENANCE AND OPERATIONS

12. How does/will the agency plan to finance maintenance of the Google Transit feed?

13. How do you plan to maintain the feed?

With in-house staff With a third-party consultant With a regional entity

Other: _____

14. Please indicate the approximate amounts for **the month before** GTFS implementation, if available.

Ridership	_____
Calls from customers	_____
Hours of handling calls, questions, or concerns	_____
Visits to website	_____
Users using trip planner on website	_____

15. Please indicate the approximate amounts **3 months** after GTFS implementation, if available.

Ridership	_____
Calls from customers	_____
Hours of handling calls, questions, or concerns	_____
Visits to website	_____
Users using trip planner on website	_____

16. How have the following changed **since going live** on Google Transit?

Ridership	Decreased	Increased	Same	Unknown
Length of trips	Decreased	Increased	Same	Unknown
Users of transferring stations	Decreased	Increased	Same	Unknown
Calls from customers	Decreased	Increased	Same	Unknown
Ease of answering calls	Decreased	Increased	Same	Unknown
Visits to website	Decreased	Increased	Same	Unknown
Uses of trip planner on website	Decreased	Increased	Same	Unknown

17. How often do you use the following for **answering users' questions**?

Google Maps	Never	Once a month	Once a week	3-4 times a week	Unknown
Google Transit	Never	Once a month	Once a week	3-4 times a week	Unknown
Agency website	Never	Once a month	Once a week	3-4 times a week	Unknown

18. How often do you use the following for **general operations**?

Google Maps	Never	Once a month	Once a week	3-4 times a week	Unknown
Google Transit	Never	Once a month	Once a week	3-4 times a week	Unknown
Agency website	Never	Once a month	Once a week	3-4 times a week	Unknown

19. Any further comments on maintenance or changes to operation?

AGENCY EXPERIENCE

20. If users can choose between an internal trip planner and the Google trip planner, which are they choosing?

Internal Trip Planner	Google Trip Planner	Unknown	Not Applicable
-----------------------	---------------------	---------	----------------

21. What do you think is Google Transit’s most beneficial feature to the agency?

Trip time calculation	It is free	Local attractions and shops
The interactive map	Street view	It’s an online trip planner
Connects several different modes	World-wide renown	Search engine
Connects with other agencies	GTFS formatting	None
Other: _____		

22. Are there any other features of Google Transit you would like to see?

23. Please scale your satisfaction with Google Transit.

	<i>1-Extremely Dissatisfied</i>	<i>2-Dissatisfied</i>	<i>3-Neutral</i>	<i>4-Satisfied</i>	<i>5-Extremely Satisfied</i>		
Benefit to customers			1	2	3	4	5
Benefit to agency			1	2	3	4	5
Increase in ridership			1	2	3	4	5
Effectiveness in cost and time saving			1	2	3	4	5
Accessing new markets			1	2	3	4	5
Public image of transit/transit agency			1	2	3	4	5
Google Transit’s overall effectiveness			1	2	3	4	5

SUMMARY

24. How important is it that a Google trip planner be made available on the agency website?

- Very important Important Neutral
Not Important Insignificant Do not want a planner

25. Please describe any other benefits or consequences of GTFS implementation.

Benefits: _____

Consequences: _____

26. Do you have any concerns for the future? Please describe if any.

27. How has the agency expanded or improved **since GTFS implementation**? *Check all that apply.*

- | | |
|--|-----------------------------------|
| More informational improvements | Coordination with nearby agencies |
| More website improvements | Budgeting |
| Adjusting the number of or size of buses | Staffing |
| Adjusting the routes, schedule, or locations | Node |

Other: _____

28. Over the next fiscal year, will your agency invest in the following? *Check all that apply.*

- | | |
|--|-----------------------------------|
| More informational improvements | Coordination with nearby agencies |
| More website improvements | Budgeting |
| Adjusting the number of or size of buses | Staffing |
| Adjusting the routes, schedule, or locations | Node |

Other: _____

29. Now that your agency has gone live on Google Transit, would you have done anything differently during the implementation process?

Financing: _____

Board approval: _____

Consulting: _____

Other: _____

30. Would you recommend GTFS implementation for other small agencies? Y N

Why or why not? _____

31. Any further comments?

G.2. QUESTIONNAIRE 2 : AGENCIES WITHOUT ONLINE TRANSIT TRIP PLANNER

INTRODUCTORY TEXT

This survey will help to determine whether Google Transit is effective in enhancing your agency's operations and ability to provide transit information to customers. Your cooperation is highly appreciated and will be used to help other small agencies throughout the state to make informed decisions in their operations and choices regarding transit planners.

Caltrans has partnered with the California Center for Innovative Transportation (CCIT) at UC Berkeley to research options for disseminating small public transit agency schedule information over the internet. Easily accessible information on transit options will improve information availability and can encourage a shift to public transportation by facilitating route planning for casual users, non-locals and social service agencies. This survey is a part of the evaluation of the GTFS implementation process and results.

SURVEY QUESTIONS

1. What is the name of your transit agency? _____
2. How long has it been since the agency went live on Google Transit? _____ months
3. What is the agency's primary concern regarding GTFS implementation?
Funding High cost of maintenance Time
Stability Agency board support/approval Staff capability
Other: _____
4. Is the above concern the primary reason why the agency is not yet live on Google Transit?
Yes No Do not know Prefer not to say
If no, what is the main reason? _____
5. How will the agency plan to finance implementation? *Check all that apply.*
Self-financed Regionally-financed Grants Unknown
Other: _____ \
6. How do you plan to maintain the GTFS feed?
With in-house staff With a third-party consultant With a regional entity
Other: _____
7. How often does the agency use the following for planning a trip in an adjacent community, if Google Transit is available?
Google Maps Google Transit Agency website

8. Please indicate the approximate amount for the month of September, if available.

Calls from customers _____
Hours of handling calls, questions, or concerns _____
Visits to website _____
Users using trip planner on website _____

9. Please indicate ridership for the following years as reported to Caltrans or NTD. (*Note: We are hoping to look at ridership for agencies without Google Transit and then revisit next year to report to the Legislature on any impacts this investment has offered our communities*)

2007 _____
2008 _____
2009 _____

10. Over the next fiscal year, will your agency invest in the following? *Check all that apply.*

More informational improvements	Coordination with nearby agencies
More website improvements	Budgeting
Adjusting the number of or size of buses	Staffing
Adjusting the routes, schedule, or locations	Node
Other: _____	

11. What benefits does Google Transit provide for transit agencies? *Check all that apply.*

Trip time calculation	It is free	Local attractions and shops
The interactive map	Street view	It's an online trip planner
Connects several different modes	World-wide renown	Search engine
Connects with other agencies	GTFS formatting	None
Other: _____		

12. Are there any other features of Google Transit not currently offered that you would like to see?

13. Please describe any other benefits or consequences of GTFS implementation.

Benefits: _____

Consequences: _____

14. What steps have you taken toward GTFS implementation?

15. What steps are required for you to take in order to implement GTFS?

16. Any further comments?

G.3. RESPONDING AGENCIES

The table below lists the agencies that responded to the survey. A total of 29 agencies, both within and outside California, responded to the survey (the names of 3 agencies are missing as some questionnaires were returned without agency identification). Of these agencies, 22 agencies submitted responses after having already launched their online transit trip planner while 8 submitted responses before having launched a trip planner.

Table G1: Agency Participating in Google Transit Experience Survey

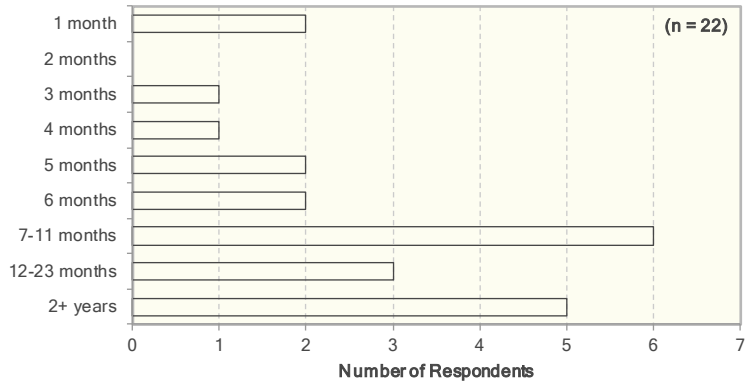
Agency	State	Launched Online Planner at time of survey?
Agencies Participating in Pilot Deployments		
ACE Rail / San Joaquin Regional Rail Commission	California	Yes
San Luis Obispo Regional Transit Agency (SLORTA); South County Transit Shuttle (<i>joint questionnaire returned</i>)	California	Yes
San Luis Obispo Regional Rideshare	California	Yes
City of Lodi	California	Yes
Cerritos on Wheels	California	Yes
Morro Bay Transit and Trolley	California	No / Yes *
Yuba-Sutter Transit	California	Yes
Other Transit Agencies		
Torrance Transit & Municipal Area Express (MAX)	California	Yes
iShuttle (City of Irvine)	California	Yes
Consultant for multiple agencies within Tulare County	California	No
Clallam Transit System	Washington	Yes
Grays Harbor Transportation Authority	Washington	Yes
Island Transit	Washington	Yes
Mason Transit Authority	Washington	Yes
Valley Transit	Washington	Yes
Curry Public Transit Inc.	Oregon	Yes
Blacksburg Transit	Virginia	Yes
Monroe County Transit Authority	Pennsylvania	Yes
Raider Regional Transit	Pennsylvania	No
Rockland County	New York	Yes
AppalCART	North Carolina	Yes
Megabus	United States	No
Tauranga	New Zealand	No
Athens Public Transportation Agency	Greece	No
CholetBus	France	Yes
Eilandhopper Islandhopper (sailing ferry service)	Netherlands	No

* Morro Bay submitted responses both before and after the launch of their trip planner.

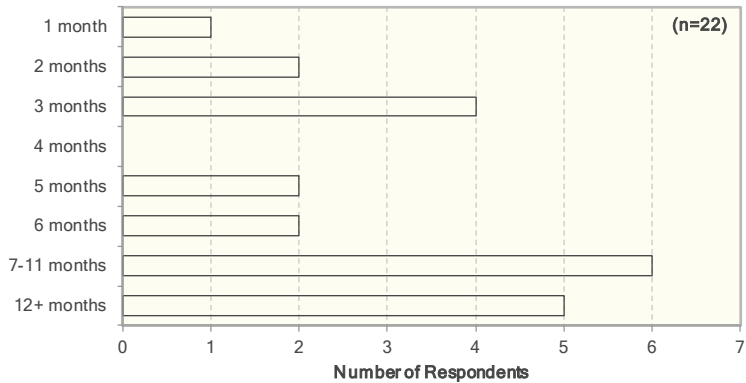
G.4. SURVEY RESPONSES – AGENCIES WITH ACTIVE TRANSIT TRIP PLANNER

Below is a summary of the responses that were provided by the agencies that had already launched their online transit trip planner at the time the survey was conducted.

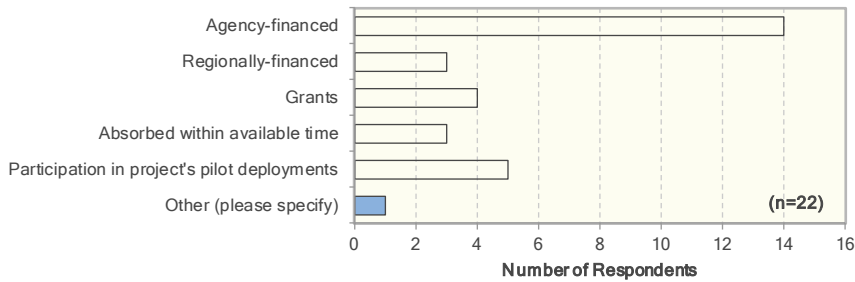
Question 2: How long has it been since the agency went live on Google Transit?



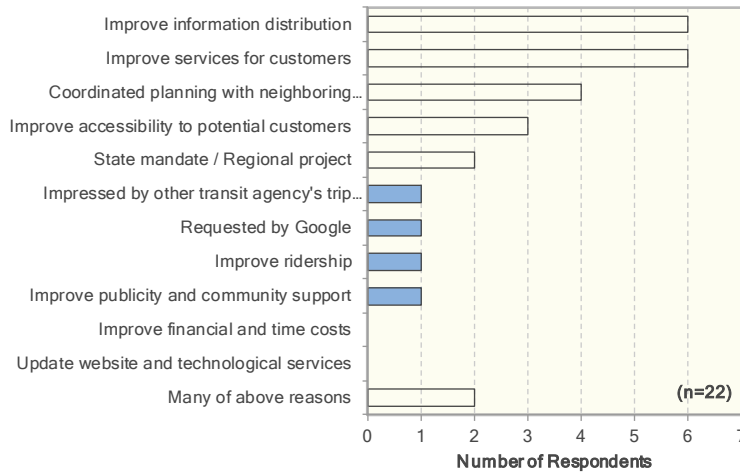
Question 3: How long was the entire implementation process starting from initial contact with Google to going live onto Google Transit?



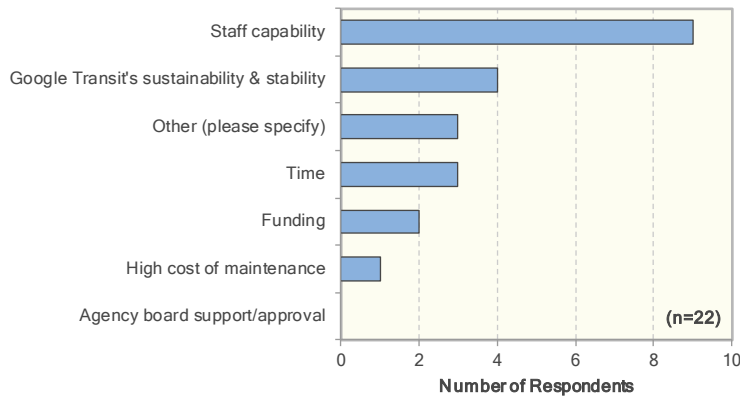
Question 4: How did the agency finance implementation? Check all that apply.



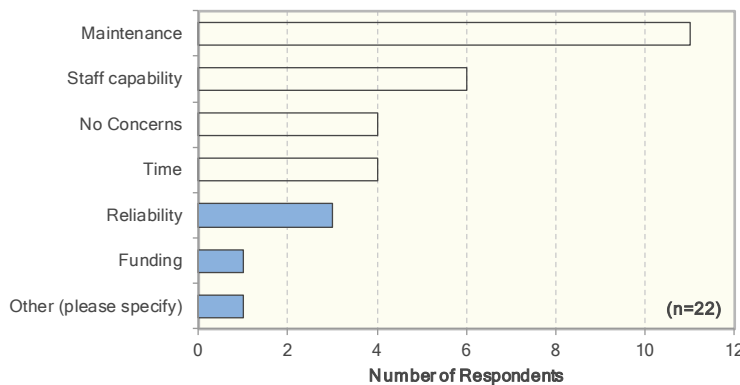
Question 5: What was the primary motivation for the agency to implement GTFS?



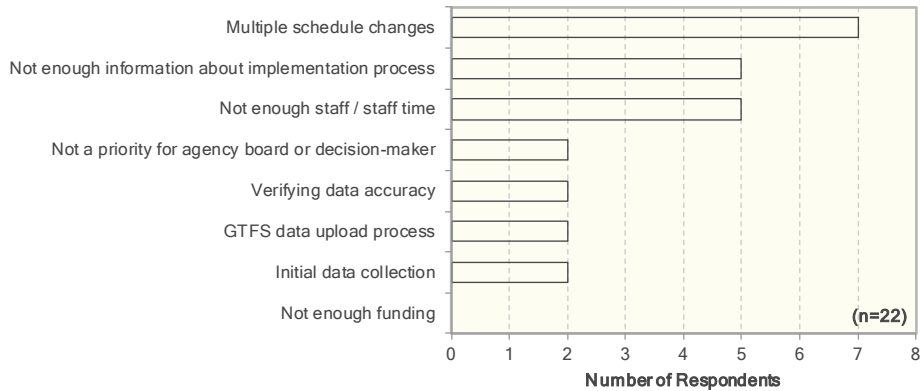
Question 6: What was the agency's primary concern regarding GTFS implementation initially?



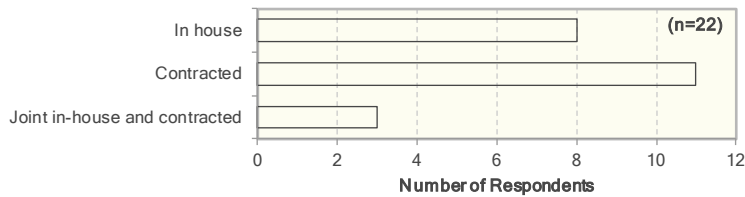
Question 7: What were the agency's concerns after implementation? Check all that apply.



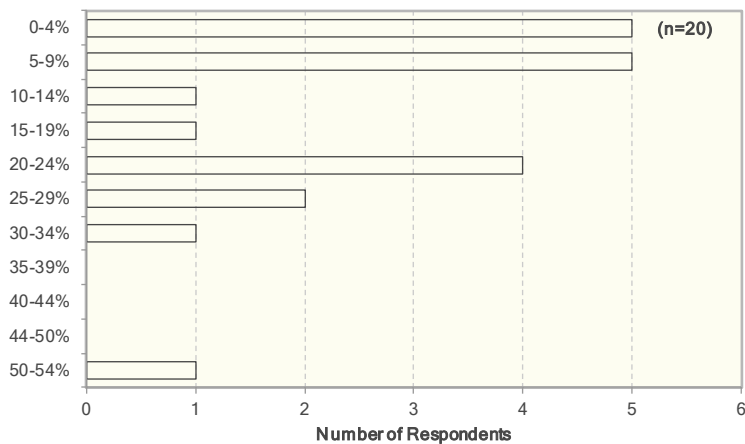
Question 8: What kind of challenges, if any, did the agency experience during/through implementation? Check all that apply



Question 9: Was the implementation in house or contracted?



Question 10: Please indicate the percent of agency staff time spent in implementing GTFS compared to the overall workload?



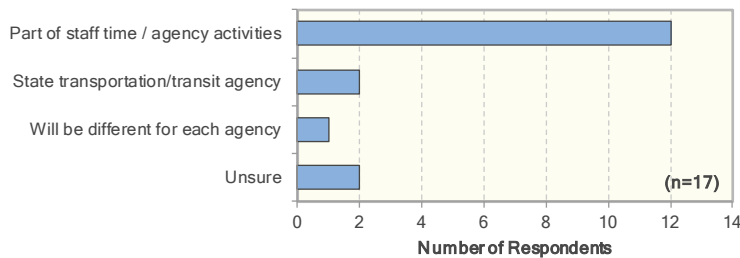
Question 11: Any further comments on the implementation process?

- End-user interface is a thing of beauty, but Google needs to provide much better documentation and communications for the transit agencies who provide the data.
- The method of testing the data for feedback is very efficient. And the ease that the corrections were made is amazing.
- Creating the GTFS isn't that difficult. It could be done as a volunteer project from a local college or university service learning project. However, once the GTFS is created - and a way to manage

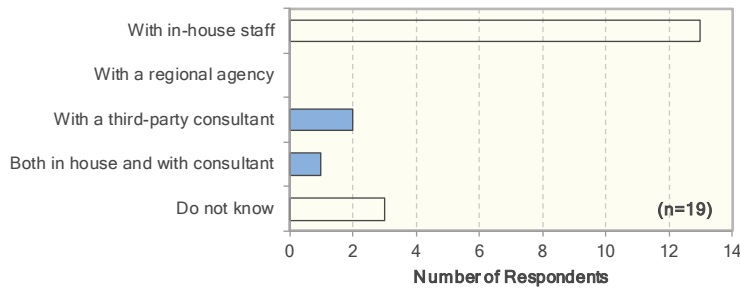
updates developed - it does not take that much to keep the system going. It is worth the effort because there are other technologies that could use the feed.

- It would be nice if there could be more contact with Google during the waiting period, no word, no answers for months, then can you be ready next week, by which time some of my info had become out of date.
- It would help if the changes could be loaded immediately to Google Transit without waiting a week to view the changes. We found an error in a dataset we published and had to wait a week for the corrections to take effect. So, during that week, our customers would have been quoted trips that did not exist.

Question 12: How does/will the agency plan to finance maintenance of the Google Transit feed?



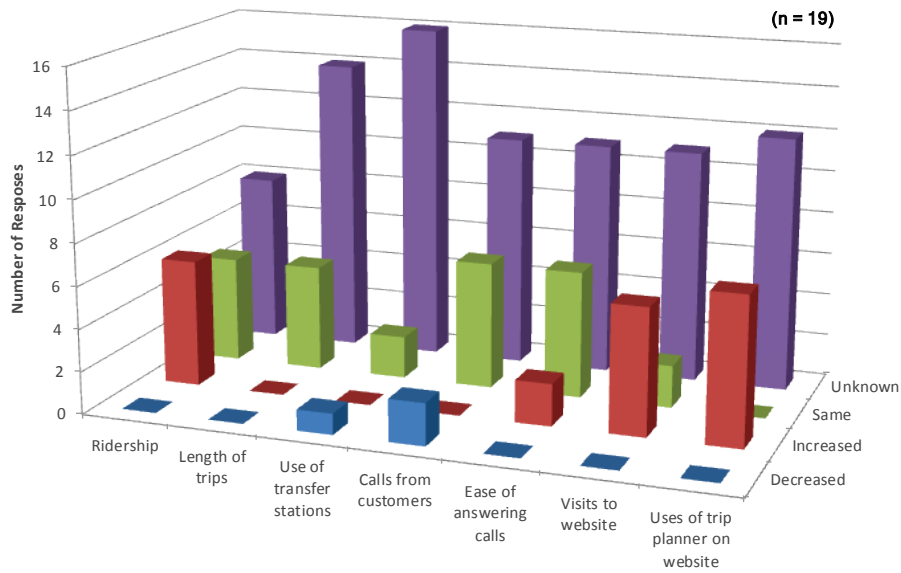
Question 13: How do you plan to maintain the GTFS feed?



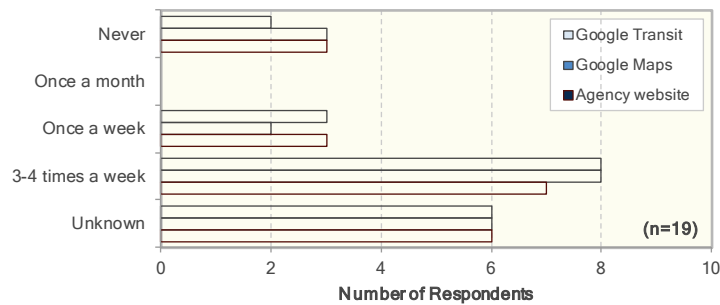
Questions 14-15: Changes in operations statistics 1 month before/3 months after launch of planner

	Ridership	Calls from Customers	Hours of Handling Calls	Visit to Website	Users Using Trip Planner
Morro Bay	893 / 1,149			845 / 1173	
Cerritos on Wheels	17,435 / 21,463			561 / 601	--- / 163
Grays Harbor Transportation	81,342 / 81,640				
Unknown agency	27,989 / ---			2,345 / 2,395	

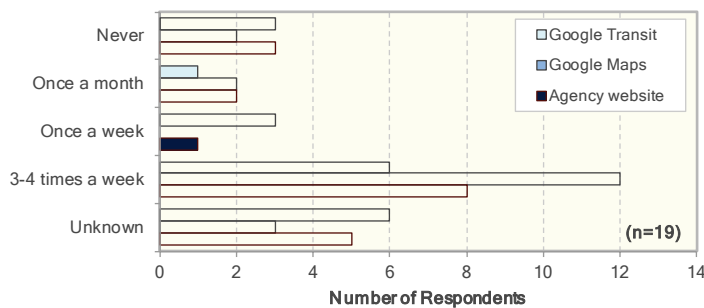
Question 16: How have the following changed since going live on Google Transit?



Question 17: How often does the agency use the following for answering customer questions?



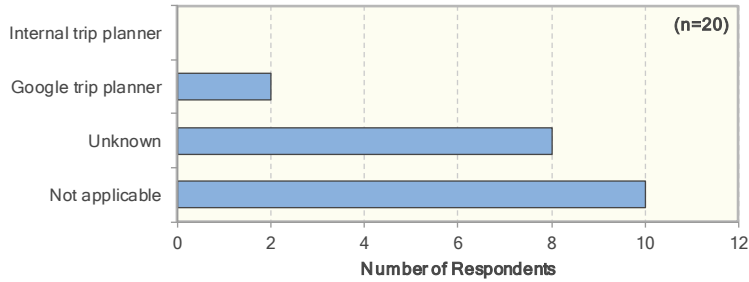
Question 18: How often does the agency use the following for general operations?



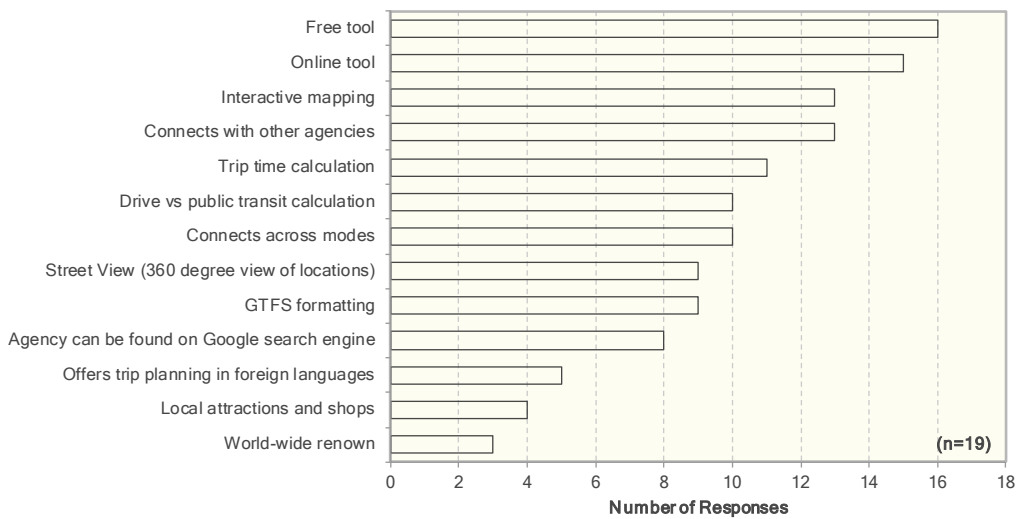
Question 19: Any further comments on maintenance or changes to operation?

- It's difficult to identify which trip planner they are using, as we can't get figures from Google on the number of users accessing the trip planner directly from their site.
- I think Google trip planner is gradually becoming more popular as riders realize the resources are available.
- Working with staff to use Google Transit was a challenge, but they use it more frequently now.

Question 20: If users can choose between an internal trip planner and the Google trip planner, which are they choosing?



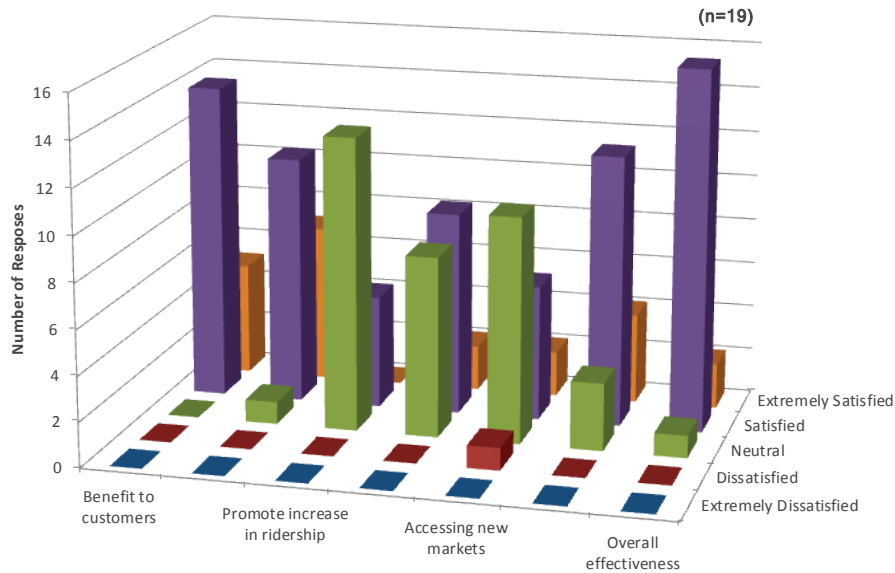
Question 21: What benefits does Google Transit provide for transit agencies?



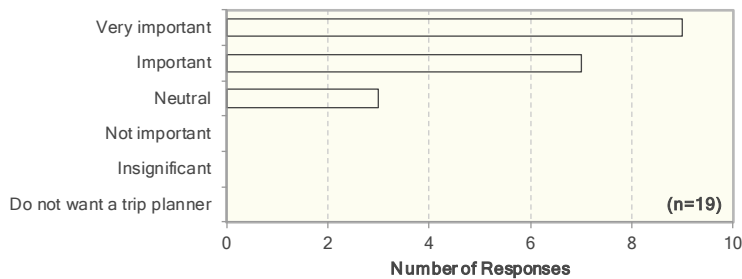
Question 22: Are there any other features of Google Transit not currently offered that you would like to see?

- Online schedules.
- More attention paid to providing safe walking directions; This is a critical issue for suburban transit systems.
- Real-time info
- Integration plan with GPS information.
- Real-time arrival info; Better coordination between bus and rail times.
- More nearby transit agencies should be added to improve trip planning/transfers

Question 23: Please scale your satisfaction with Google Transit from extremely dissatisfied to extremely satisfied.



Question 24: How important is it that a Google trip planner is made available on the agency website?



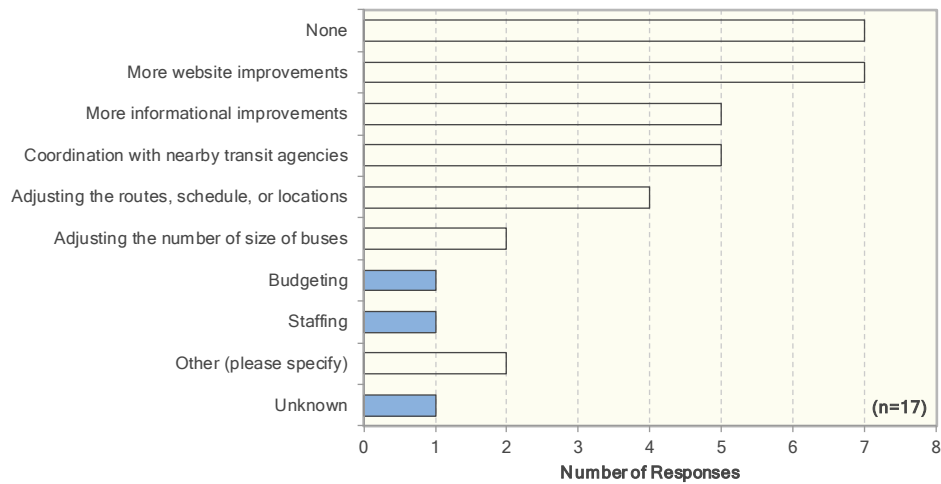
Question 25: Please describe any other benefits or consequences of GTFS implementation.

Benefits	Consequences
<ul style="list-style-type: none"> No barriers to access. Other positive uses for additional public agencies (police dept) "free" trip planner Shows we are a customer focused organization with an eye on technology. Did not need to develop a trip planner Improved awareness of connectivity Enhanced technology level of system dramatically 	<ul style="list-style-type: none"> Another thing for agencies to update when there is a route change. Difficult to instill ownership over data. have to keep feed current It is free and the public understand that we don't pay to have this information broadcast. Slow updates from Google can cause bad data for customers Greater ease of use for staff in answering telephone inquiries

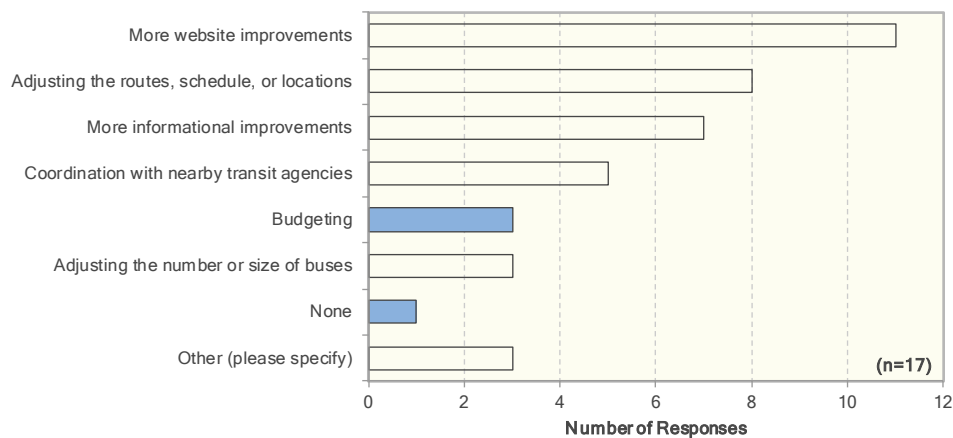
Question 26: Do you have any concerns for the future in supporting the Google Transit feeds?

- Concerned about agencies not updating their own data, and users becoming disatisfied with the service as a result.
- Small agency having to update changes is a bit of a concern.
- I hope there will not be many changes to the feed that causes more than the minimum of manpower to make those changes.
- Worried feed standard might change.
- Sole source of developing the feed. At this time there is no backup to change and publish the feed.
- Ability to make change to the schedule in GTFS accurately with in-house expertise. Afraid of doing it wrong.
- Keeping the trip planner current as system changes.
- Staff time available to update information given workload changes since implementation.

Question 27: How has the agency expanded or improved since GTFS implementation?



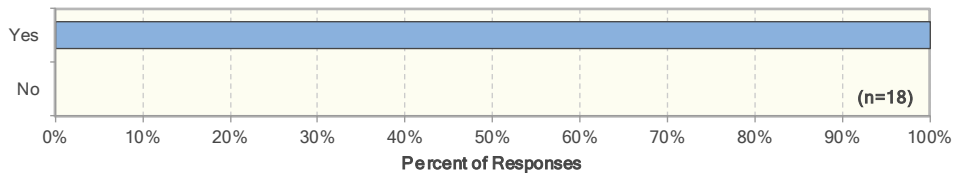
Question 28: Over the next fiscal year, will your agency invest in the following?



Question 29: Now that your agency has gone live on Google Transit, would you have done anything differently during the implementation process?

- There were no suggestions of things that should have been done differently. Most of the comments provided on this questions were simply observations of what was done.

Question 30: Would you recommend GTFS implementation for other transit agencies?

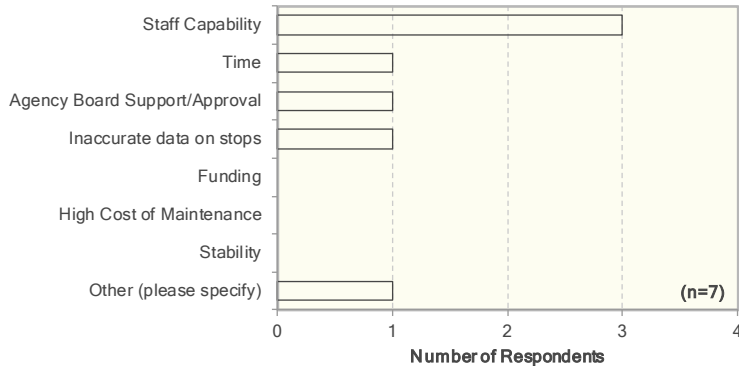


- It is a low cost option to provide information and access to users.
- Being on Google Transit has made it much easier to help callers plan a trip because it saves so much time, and the data is accurate, so the customer can know it's reliable.
- Google improved their processes for implementing Google Transit from about a year ago.
- Helps customers see potential for public transit vs driving, especially when planning longer trips - wish more agencies were on line with this
- Google Transit is an extremely useful tool not only for the public but for the agency also.
- Although we are not able to track the number of passengers who check Google Transit instead of calling our Dispatchers, we feel that it has the potential to reduce the number of calls our Dispatchers deal with on a daily basis.
- Easy to use.
- The feed alone is useful in planning a system. We don't have any sophisticated tools for planning, so the Google feed validation tool is very useful. And heck, if we can do it, we'll just about anyone can.
- Excellent free trip planner that is integrated with other operators.

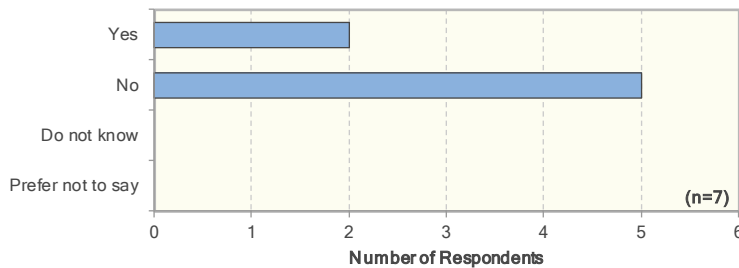
G.5. SURVEY RESPONSES – AGENCIES WITHOUT ACTIVE TRANSIT TRIP PLANNER

Below is a summary of the various responses that were provided by the transit agencies that had *not yet* developed an online transit trip planner.

Question 3: What is the agency's primary concern regarding GTFS implementation?



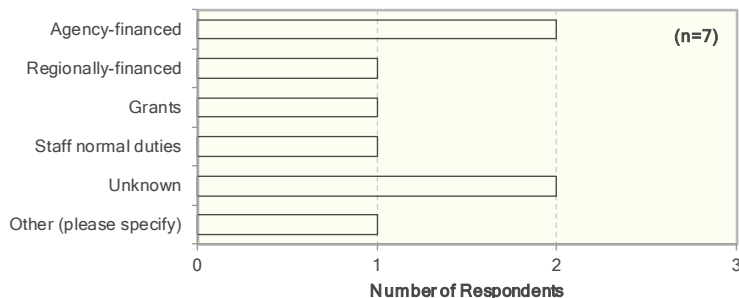
Question 4: Is the above concern the primary reason why the agency is not yet live on Google Transit?



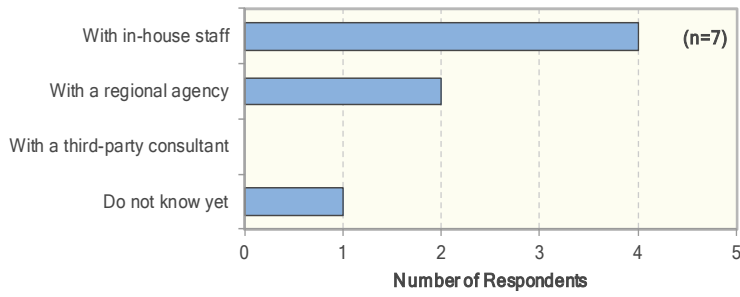
If no, please state reason

- Did not know how to make successful contact with Google.
- Never explored the option, and tasks associated with it.
- Buy in from management and other staff.
- Limited number of skilled and open minded engineers.
- No particular reason.

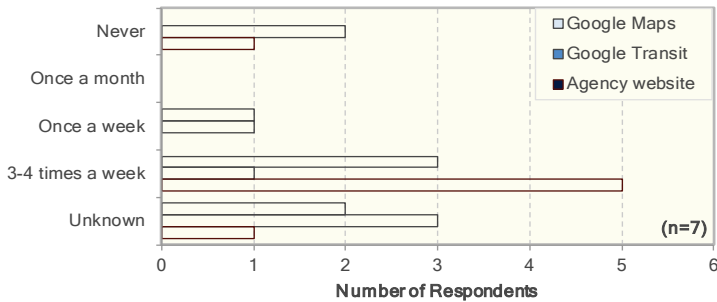
Question 5: How will the agency plan to finance implementation?



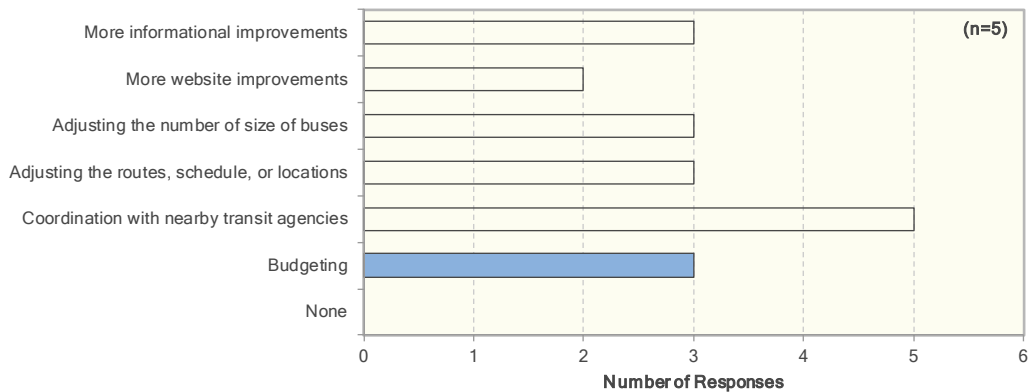
Question 6: How do you plan to maintain the GTFS feed?



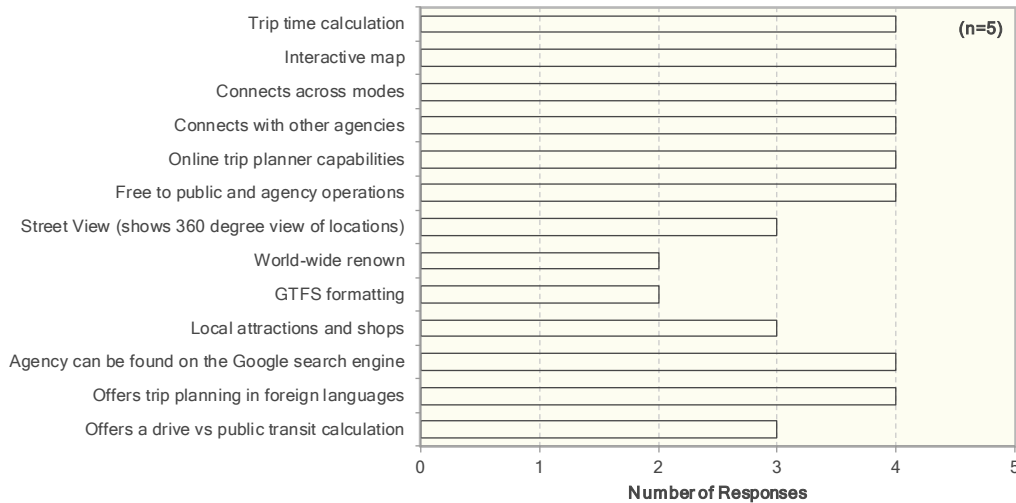
Question 7: How often does the agency use the following for planning a trip in an adjacent community, if Google Transit is available?



Question 10: Over the next fiscal year, will your agency invest in the following?



Question 11: Over the next fiscal year, will your agency invest in the following?



Question 12: Are there any other features of Google Transit not currently offered that you would like to see?

- Availability of bicycle parking
- Ability to include it in own website like google maps API; Ability to change algorithm parameters - max walking distance; Ability to print Marea charts; Ability to view specific bus lines / routes like in schedule viewer; Better KML support in google maps - it is really painful to create the shapes.txt"

Question 13: Please describe any other benefits or consequences of GTFS implementation.

Benefits	Consequences
<ul style="list-style-type: none"> • FREE of charge, standardization in internal procedures, openness and better coordination of change management due to the need to produce a specific set at 	<ul style="list-style-type: none"> • Fall behind on current trends • Labor intensive, need for highly qualified GIS/computer engineer, cooperation between engineering dept., scheduling dept., and IT (turf wars...)

Question 14: What steps have you taken toward GTFS implementation?

- Contacted Google numerous times; sought out Sole Source agreement with consultant; working with local Council of Governments.
- Determined cost of initial implementation.
- "fast prototyping:
 - hand-made set produced based on DB with aggregated frequencies in MSACCESS + kml production, verification with Google's tools Validator Schedule viewer and KMLeditor
 - Lobbying with people from the scheduling department in order to convince them to join the effort (schedule viewer's results really useful)
 - Self-experimentation in massive updates of Hastus/GIRO and export of the included GTFS script
 - Sceduling dept colleague and me (IT) proceduced the first error-less feed. We left the warnings for future correction.

- Initiated the conversation with Google. Director of IT (luckily) took charge of the talks with Google. Lobbying with legal advisor of the company in order to convince higher ranks to agree in signing the contract with Google
- Contract agreed.....

Question 14: What steps are required for you to take in order to implement GTFS?

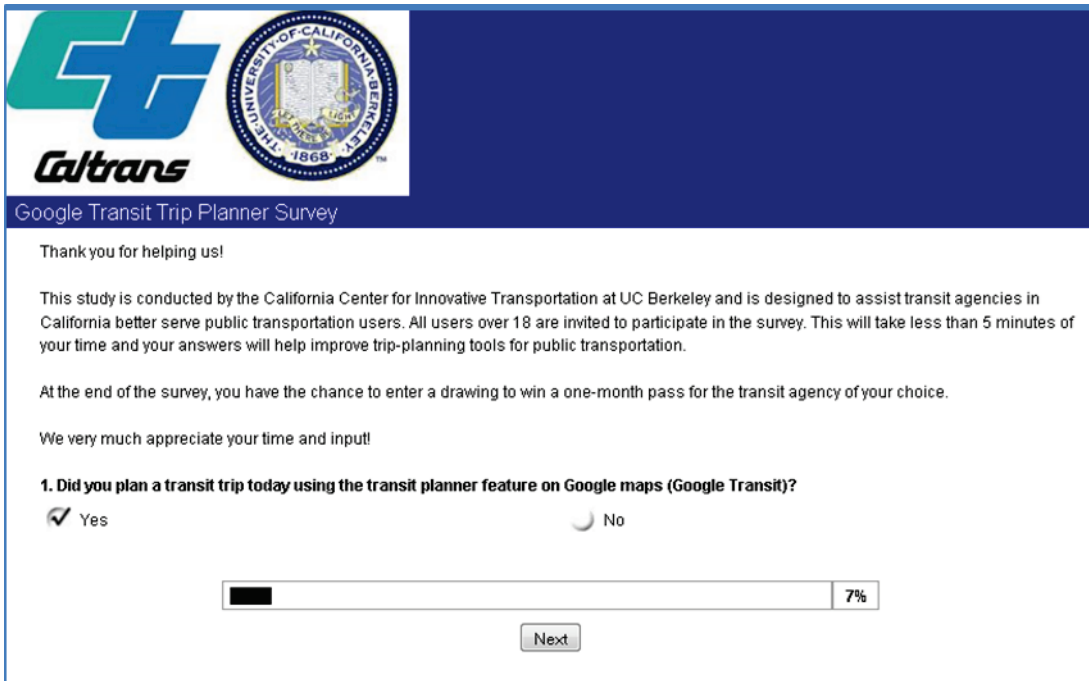
- Learn the process.
- Secure funding for initial implementation.
- Automate the manual corrections performed by scheduling department colleagues; Investigate the warnings that are still pending.

APPENDIX H. GOOGLE TRANSIT USER SURVEY DATA

This appendix provides additional information on the online survey of Google Transit users that was conducted between January and April 2011 to assess their experience with online transit trip planners and their perception of such tools. Elements presented include:

- Survey questionnaire administered to individuals who used Google Transit to plan their current trip (set of 26 questions)
- Survey questionnaire administered to individuals who did not use Google Transit to plan for their current trip but have prior experience with the tool (set of 14 questions)
- Survey questionnaire administered to individuals who did not use Google Transit to plan for their current trip and have no prior experience with the tool (set 15 questions)
- Summary of responses provided.

H.1. QUESTIONNAIRE 1: INDIVIDUALS WHO USED GOOGLE TRANSIT FOR CURRENT TRIP



Thank you for helping us!

This study is conducted by the California Center for Innovative Transportation at UC Berkeley and is designed to assist transit agencies in California better serve public transportation users. All users over 18 are invited to participate in the survey. This will take less than 5 minutes of your time and your answers will help improve trip-planning tools for public transportation.

At the end of the survey, you have the chance to enter a drawing to win a one-month pass for the transit agency of your choice.

We very much appreciate your time and input!

1. Did you plan a transit trip today using the transit planner feature on Google maps (Google Transit)?

Yes No

7%

Next

Figure H1: User Survey Questionnaire – Google Transit User – Page 1

Google Transit Trip Planner Survey

5. What mode of transportation do you usually take?

- Car (drive alone)
- Carpool
- Bicycle
- Walk
- Taxi
- Motorcycle/Scooter
- Other (please specify)

6. Why did you change your transportation mode?

- Google Transit made planning a trip easier
- More economical
- More environmentally friendly
- I save time by taking transit
- My usual trip had to be modified
- My car was not available
- My carpool was not available
- Other (please specify)

7. How often do you use public transit in general?

- Never
- First time
- Every day
- Every weekday
- Every weekend
- Few times a week
- Once a week
- Once a month
- Once a year

20%

Figure H3: User Survey Questionnaire – Google Transit User – Page 3

Google Transit Trip Planner Survey

8. How often do you plan to take this trip using public transit?

- Never
- First time
- Every weekday
- Every weekend
- Few times a week
- Every day
- Once a week
- Once a month
- Once a year

9. How many transfers do you have to make for this trip?

- 0
- 1
- 2
- 3
- 4 or more

10. What is your starting location (street intersection)?

11. What is your ending location (street intersection)?

██████████ 27%

Figure H4: User Survey Questionnaire – Google Transit User – Page 4

Google Transit Trip Planner Survey

12. Are you using your car to start or end your trip?

- Yes
- No

13. Are you using Google Transit...

	Yes	No
at home?	<input type="radio"/>	<input type="radio"/>
at work?	<input type="radio"/>	<input type="radio"/>
on your mobile phone?	<input type="radio"/>	<input type="radio"/>

14. How often do you use the following:

	Never	Once a month	Once a week	3-4 times a week
Google Maps?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Google Transit?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Transit Agency Website?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

██████████ 33%

Figure H5: User Survey Questionnaire – Google Transit User – Page 5

Google Transit Trip Planner Survey

15. Please rate your satisfaction on the following using a scale from 1 to 5, with 1 being extremely dissatisfied and 5 being extremely satisfied.

	1-Extremely Dissatisfied	2-Dissatisfied	3-Neutral	4-Satisfied	5-Extremely Satisfied
Google Transit?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Transit agency website before Google Transit?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Transit agency website after Google Transit?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

16. How helpful are the Google Transit tools in planning your trip?

	1-Extremely Unhelpful	4-Unhelpful	3-Neutral	4-Helpful	5-Extremely Helpful
In clarifying the bus schedule and system?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In shortening the time you wait for public transit?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In saving you time overall?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In providing an easier process for riding the bus?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In encouraging you to take public transit more often?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

17. What additional features would you like to see on Google Transit to improve your trip planning?

40%

Figure H6: User Survey Questionnaire – Google Transit User – Page 6

Google Transit Trip Planner Survey

18. And finally a few demographic questions.

Are you:

Male

Female

19. What is your zip code?

73%

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Create your own [free online survey](#) now!

Figure H7: User Survey Questionnaire – Google Transit User – Page 7

Google Transit Trip Planner Survey

20. What is your age range?

- 12-17
- 18-21
- 22-25
- 26-35
- 36-45
- 46-55
- 56+

21. Please tell us your total household income, including all earners in your household?

- \$0-19,999
- \$20,000-39,999
- \$40,000-59,999
- \$60,000-79,999
- \$80,000-99,999
- \$100,000-149,999
- \$150,000+


 80%

Figure H8: User Survey Questionnaire – Google Transit User – Page 8

Google Transit Trip Planner Survey

22. How many cars does your household own?

- 0
- 1
- 2
- 3+

23. How many people live in your household?

- 1
- 2
- 3
- 4+


 87%


Figure H9: User Survey Questionnaire – Google Transit User – Page 9

Google Transit Trip Planner Survey

24. What is the highest level of education you have completed?

- Less than high school
- High school/GED
- Some college
- Associates
- Bachelors
- Masters
- Doctorate
- Professional

25. Do you have any comments for us? We love to hear them!




93%

Prev Next

Figure H10: User Survey Questionnaire – Google Transit User – Page 10

Google Transit Trip Planner Survey

26. Please enter your email address for a chance to win a one-month pass for the transit agency of your choice. We will not share your email nor any information collected. Providing your email address is only for the purpose of the drawing.



100%

Prev Done

Figure H11: User Survey Questionnaire – Google Transit User – Page 11

Google Transit Trip Planner Survey

Thank you for completing our survey! If you would like more information about this project, please visit the California Center for Innovative Transportation of the University of California, Berkeley at:
<http://calccit.org/>

Done

Figure H12: User Survey Questionnaire – Google Transit User – Page 12

H.2. QUESTIONNAIRE 2: NON-GOOGLE USERS WITH PRIOR EXPERIENCE

Google Transit Trip Planner Survey

Thank you for helping us!

This study is conducted by the California Center for Innovative Transportation at UC Berkeley and is designed to assist transit agencies in California better serve public transportation users. All users over 18 are invited to participate in the survey. This will take less than 5 minutes of your time and your answers will help improve trip-planning tools for public transportation.

At the end of the survey, you have the chance to enter a drawing to win a one-month pass for the transit agency of your choice.

We very much appreciate your time and input!

1. Did you plan a transit trip today using the transit planner feature on Google maps (Google Transit)?

Yes No

Progress bar: 7%

Next

Figure H13: User Survey Questionnaire – Non User with Prior Experience – Page 1

Google Transit Trip Planner Survey

2. Have you ever used Google Transit before?

Yes No

Progress bar: 47%

Prev Next

Figure H14: User Survey Questionnaire – Non User with Prior Experience – Page 2

Google Transit Trip Planner Survey

3. Why did you not use Google Transit to plan your trip today? Choose all that apply.

- Not planning a trip
- Taking trip by car
- Satisfied with just using bus route and schedule
- Have already consulted Google Transit before for trip details
- Other (please specify)




Figure H15: User Survey Questionnaire – Non User with Prior Experience – Page 3

Google Transit Trip Planner Survey

4. Are you using Google Transit...

	Yes	No
at home?	<input type="radio"/>	<input type="radio"/>
at work?	<input type="radio"/>	<input type="radio"/>
on your mobile phone?	<input type="radio"/>	<input type="radio"/>

5. How often do you use the following...

	Never	Once a month	Once a week	3-4 times a week
Google Maps?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Google Transit?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Transit Agency Website?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>




Figure H16: User Survey Questionnaire – Non User with Prior Experience – Page 4


Google Transit Trip Planner Survey

6. And finally a few demographic questions.

Are you:

- Male
- Female

7. What is your zip code?



Powered by **SurveyMonkey**
 Create your own [free online survey](#) now!

Figure H17: User Survey Questionnaire – Non User with Prior Experience – Page 5

Google Transit Trip Planner Survey

8. What is your age range?

- 12-17
- 18-21
- 22-25
- 26-35
- 36-45
- 46-55
- 56+

9. Please tell us your total household income, including all earners in your household?

- \$0-19,999
- \$20,000-39,999
- \$40,000-59,999
- \$60,000-79,999
- \$80,000-99,999
- \$100,000-149,999
- \$150,000+


 80%

Figure H18: User Survey Questionnaire – Non User with Prior Experience – Page 6

Google Transit Trip Planner Survey

10. How many cars does your household own?

- 0
- 1
- 2
- 3+

11. How many people live in your household?

- 1
- 2
- 3
- 4+


 87%


Figure H19: User Survey Questionnaire – Non User with Prior Experience – Page 7

Google Transit Trip Planner Survey

12. What is the highest level of education you have completed?

- Less than high school
- High school/GED
- Some college
- Associates
- Bachelors
- Masters
- Doctorate
- Professional

13. Do you have any comments for us? We love to hear them!




93%

Prev Next

Figure H20: User Survey Questionnaire – Non User with Prior Experience – Page 8

Google Transit Trip Planner Survey

14. Please enter your email address for a chance to win a one-month pass for the transit agency of your choice. We will not share your email nor any information collected. Providing your email address is only for the purpose of the drawing.



100%

Prev Done

Figure H21: User Survey Questionnaire – Non User with Prior Experience – Page 9

Google Transit Trip Planner Survey

Thank you for completing our survey! If you would like more information about this project, please visit the California Center for Innovative Transportation of the University of California, Berkeley at:
<http://cal.cit.org/>

Done

Figure H22: User Survey Questionnaire – Non User with Prior Experience – Page 10

H.3. QUESTIONNAIRE 3: NON-GOOGLE USERS WITHOUT PRIOR EXPERIENCE

Caltrans

THE UNIVERSITY OF CALIFORNIA BERKELEY
1868

Google Transit Trip Planner Survey

Thank you for helping us!

This study is conducted by the California Center for Innovative Transportation at UC Berkeley and is designed to assist transit agencies in California better serve public transportation users. All users over 18 are invited to participate in the survey. This will take less than 5 minutes of your time and your answers will help improve trip-planning tools for public transportation.

At the end of the survey, you have the chance to enter a drawing to win a one-month pass for the transit agency of your choice.

We very much appreciate your time and input!

1. Did you plan a transit trip today using the transit planner feature on Google maps (Google Transit)?

Yes No

7%

Next

Figure H23: User Survey Questionnaire – Non User – Page 1

Google Transit Trip Planner Survey

2. Have you ever used Google Transit before?

Yes No

47%

Prev Next

Figure H24: User Survey Questionnaire – Non User – Page 2

Google Transit Trip Planner Survey

3. Why not? Choose all that apply.

Did not know about it

Already know bus route and schedule

Satisfied with just using bus route and schedule

Other (please specify)

53%

Prev Next

Figure H25: User Survey Questionnaire – Non User – Page 3

Google Transit Trip Planner Survey

4. Why did you not use Google Transit to plan your trip today? Choose all that apply.

- Not planning a trip
- Taking trip by car
- Satisfied with just using bus route and schedule
- Have already consulted Google Transit before for trip details
- Other (please specify)


 60%

Figure H26: User Survey Questionnaire – Non User – Page 4

Google Transit Trip Planner Survey

5. Are you using Google Transit...

	Yes	No
at home?	<input type="radio"/>	<input type="radio"/>
at work?	<input type="radio"/>	<input type="radio"/>
on your mobile phone?	<input type="radio"/>	<input type="radio"/>

6. How often do you use the following...

	Never	Once a month	Once a week	3-4 times a week
Google Maps?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Google Transit?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Transit Agency Website?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>


 67%

Figure H27: User Survey Questionnaire – Non User – Page 5

Google Transit Trip Planner Survey

7. And finally a few demographic questions.

Are you:

- Male
- Female

8. What is your zip code?


 73%

Figure H28: User Survey Questionnaire – Non User – Page 6

Google Transit Trip Planner Survey

9. What is your age range?

- 12-17
- 18-21
- 22-25
- 26-35
- 36-45
- 46-55
- 56+

10. Please tell us your total household income, including all earners in your household?

- \$0-19,999
- \$20,000-39,999
- \$40,000-59,999
- \$60,000-79,999
- \$80,000-99,999
- \$100,000-149,999
- \$150,000+


 80%

Figure H29: User Survey Questionnaire – Non User – Page 7

Google Transit Trip Planner Survey

11. How many cars does your household own?

- 0
- 1
- 2
- 3+

12. How many people live in your household?

- 1
- 2
- 3
- 4+


 87%

Figure H30: User Survey Questionnaire – Non User – Page 8

Google Transit Trip Planner Survey

13. What is the highest level of education you have completed?

- Less than high school
- High school/GED
- Some college
- Associates
- Bachelors
- Masters
- Doctorate
- Professional

14. Do you have any comments for us? We love to hear them!

93%

Figure H31: User Survey Questionnaire – Non User – Page 9

Google Transit Trip Planner Survey

15. Please enter your email address for a chance to win a one-month pass for the transit agency of your choice. We will not share your email nor any information collected. Providing your email address is only for the purpose of the drawing.

100%

Figure H32: User Survey Questionnaire – Non User – Page 10

Google Transit Trip Planner Survey

Thank you for completing our survey! If you would like more information about this project, please visit the California Center for Innovative Transportation of the University of California, Berkeley at:
<http://calccit.org/>

Figure H33: User Survey Questionnaire – Non User – Page 11

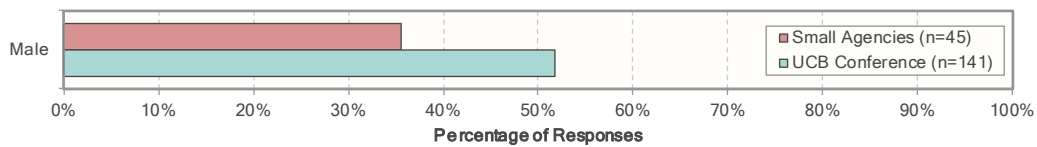
H.4. SURVEY RESPONDENTS

A total of 215 responses were obtained from the online survey. Responses were obtained from two primary groups of individuals:

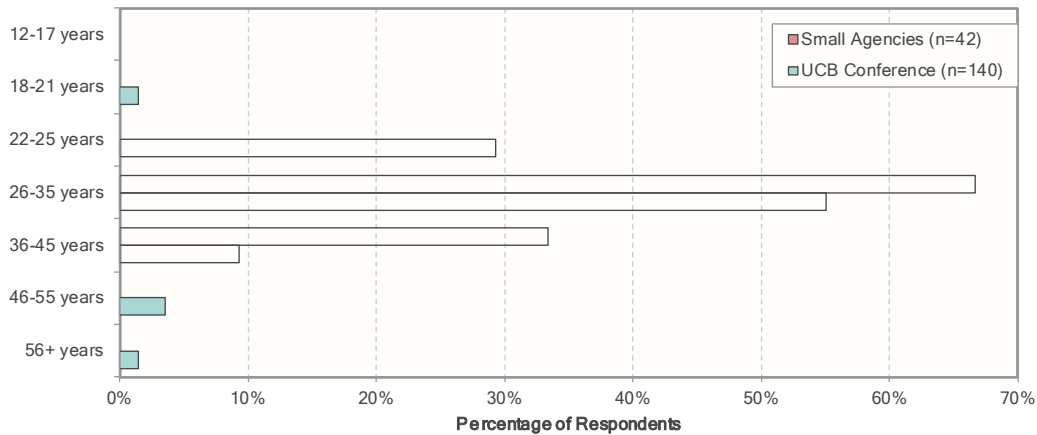
- 60 responses from user of small transit agencies through the survey link placed on agency websites.
- 155 responses from individuals attending a transit conference that was held at the University of California Berkeley during the survey period and whom were provided a link to the survey.

The graphs below provide a more detailed breakdown of demographic characteristics of the survey respondents in each group, as well as their respective experience with Google Transit.

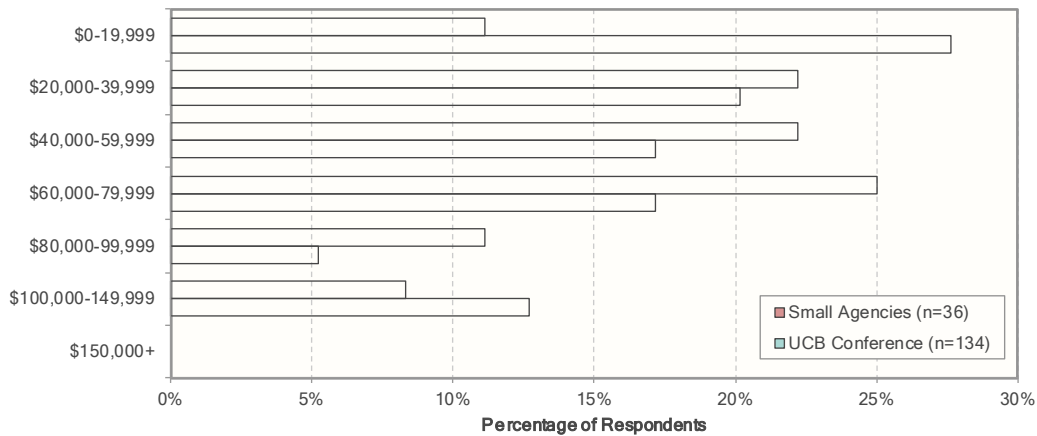
Question 1: What is your gender?



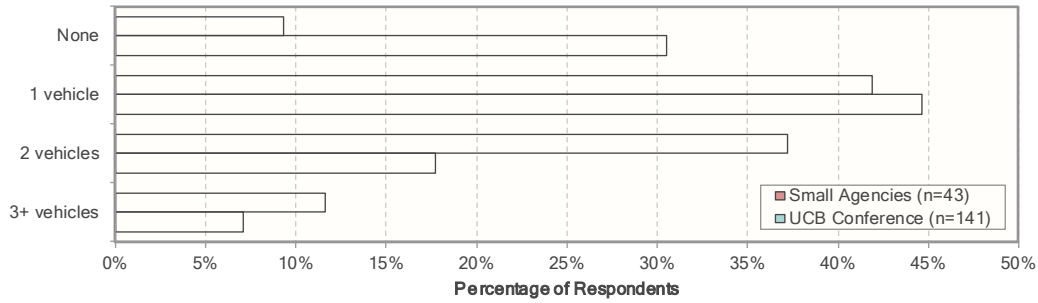
Question 2: What is your age?



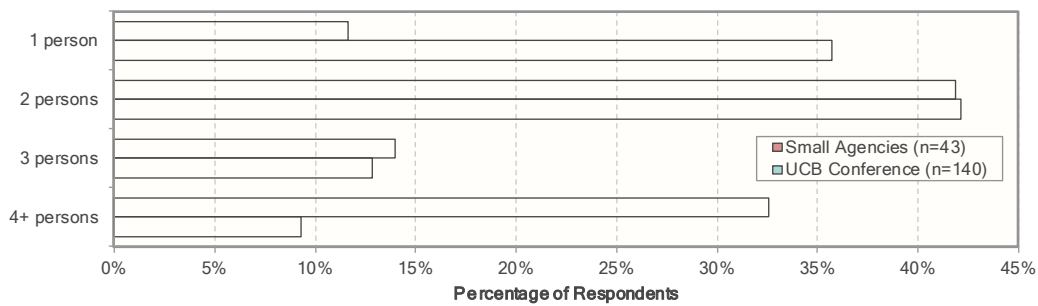
Question 3: What is your annual household income?



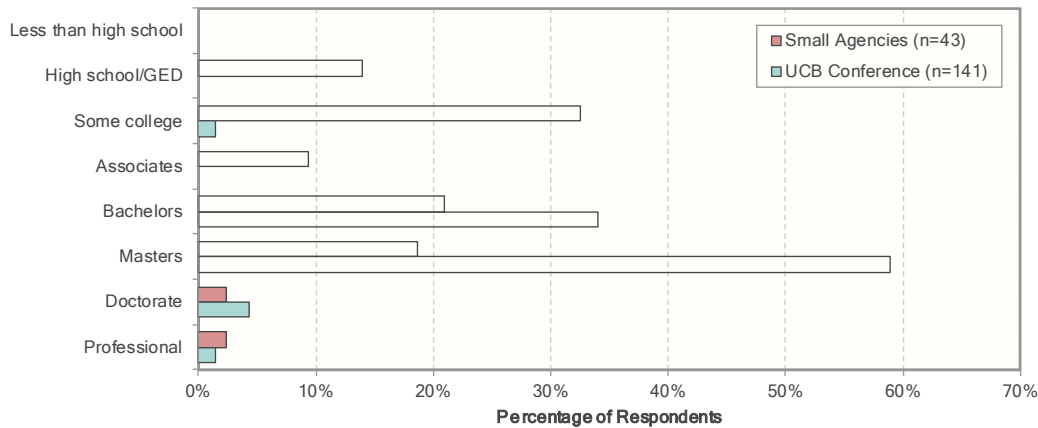
Question 4: How many cars does your household own?



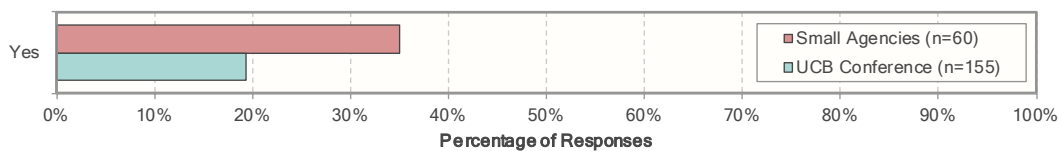
Question 5: How many people live in your household?



Question 6: What is the highest level of education you have completed?



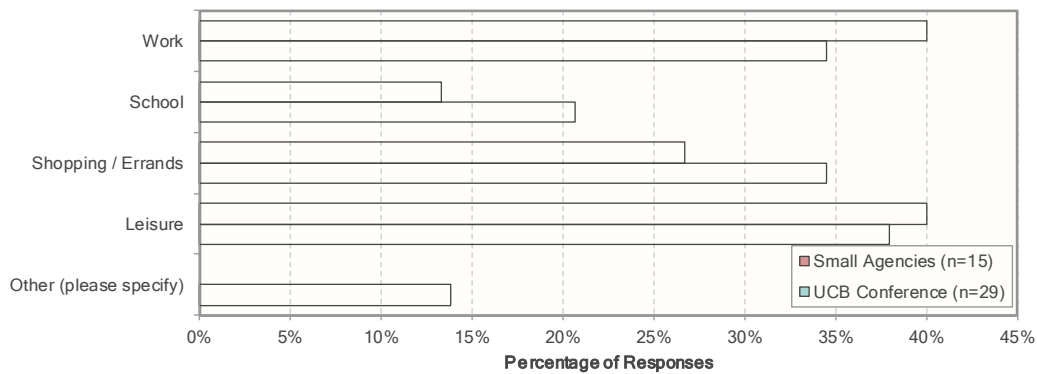
Question 7: Did you plan a transit trip today using the transit planner feature on Google maps (Google Transit)?



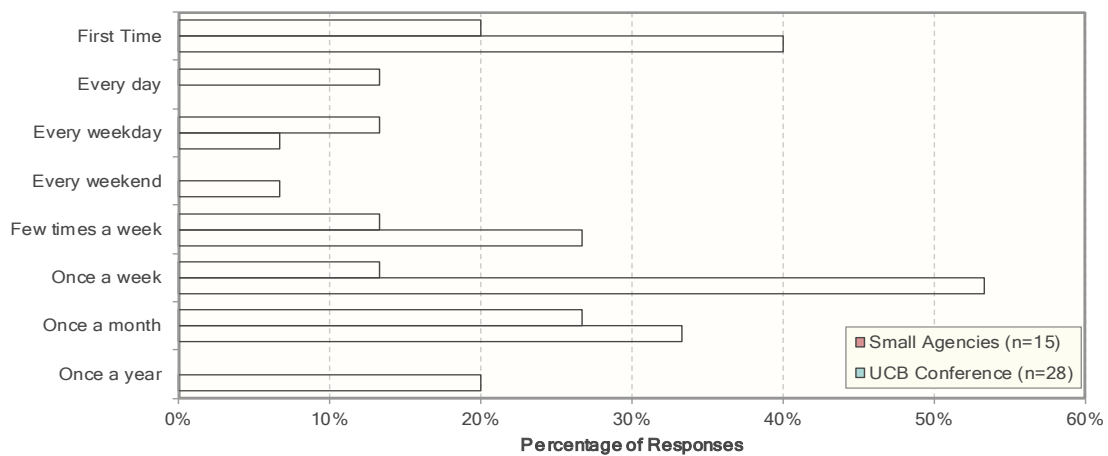
H.5. RESPONSES FROM INDIVIDUALS WHO USED GOOGLE TRANSIT ON DAY OF TRAVEL

This section provides a summary of the responses that were provided by individuals who had a planned a trip using Google Transit on the day they took the survey. As indicated in Table D2, this includes 21 individuals from the group of respondents accessing the survey from a link posted on a transit agency’s website, and 30 individuals who attended a conference at the University of California, Berkeley. In many cases, the total number of responses is less that the number of respondents since some individuals did not provide answers to all questions. The question numbers refer to the numbering of items in the questionnaire presented in Section D1.

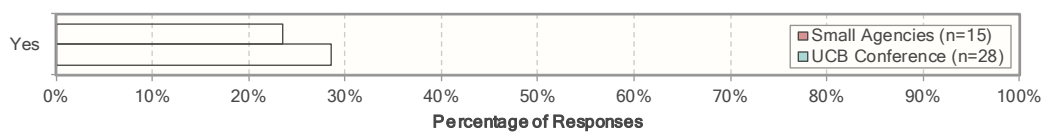
Question 2: What is the purpose of your trip?



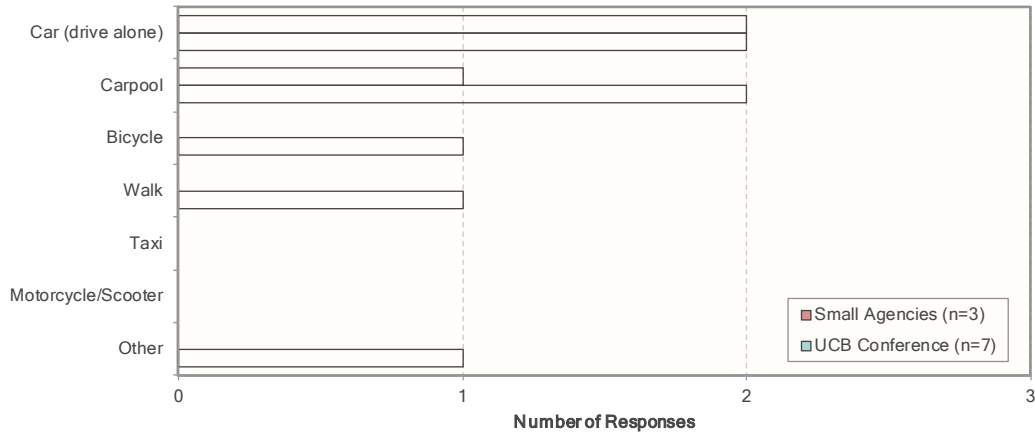
Question 3: How often do you take this trip?



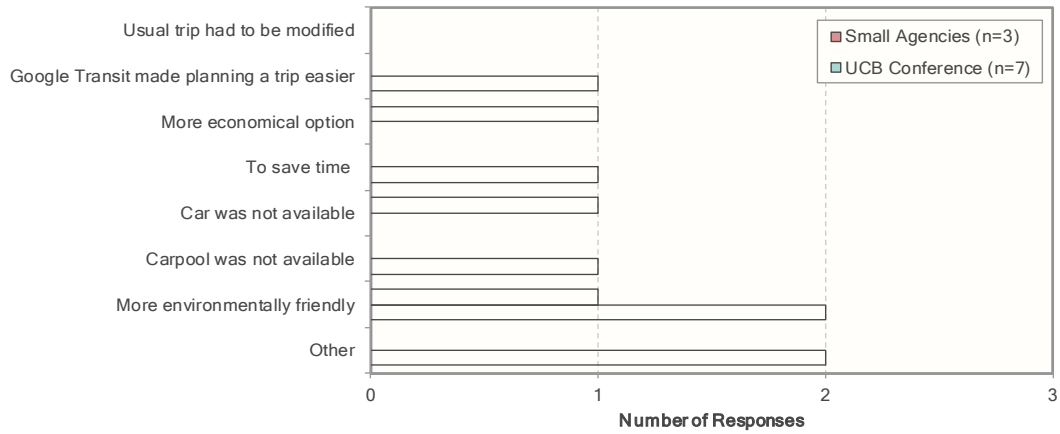
Question 4: Is this your first time taking public transportation for this trip?



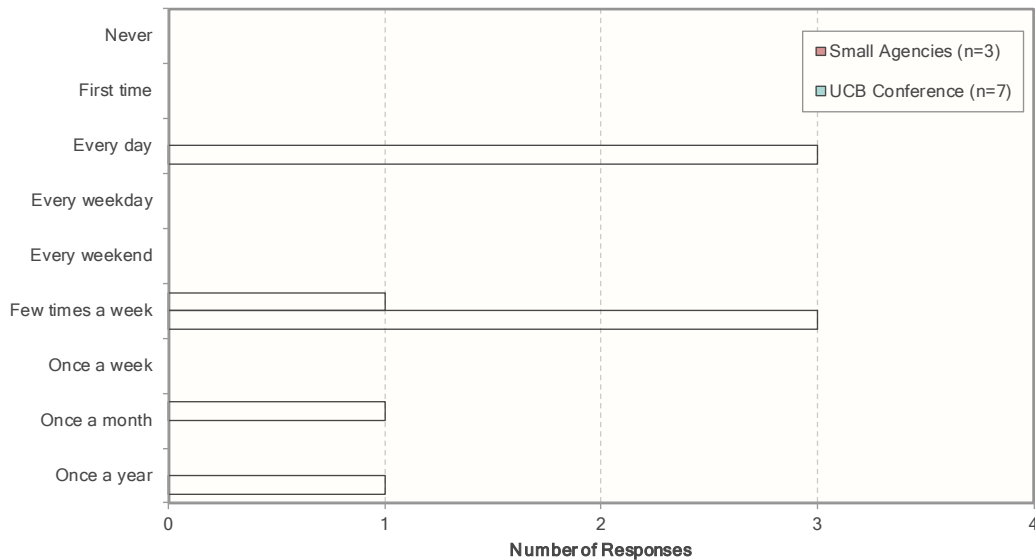
Question 5: What mode of transportation do you usually take?



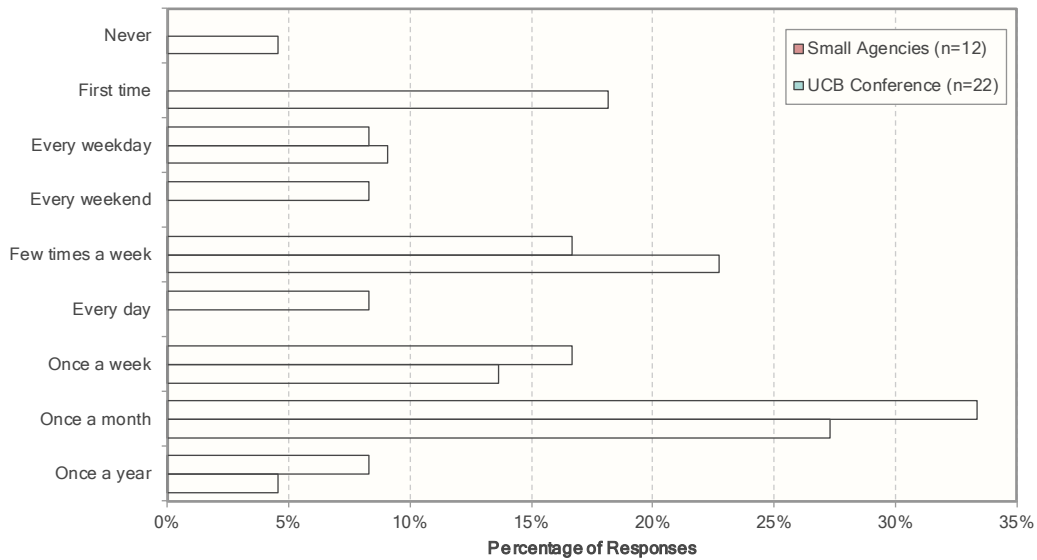
Question 6: Why did you change transportation mode?



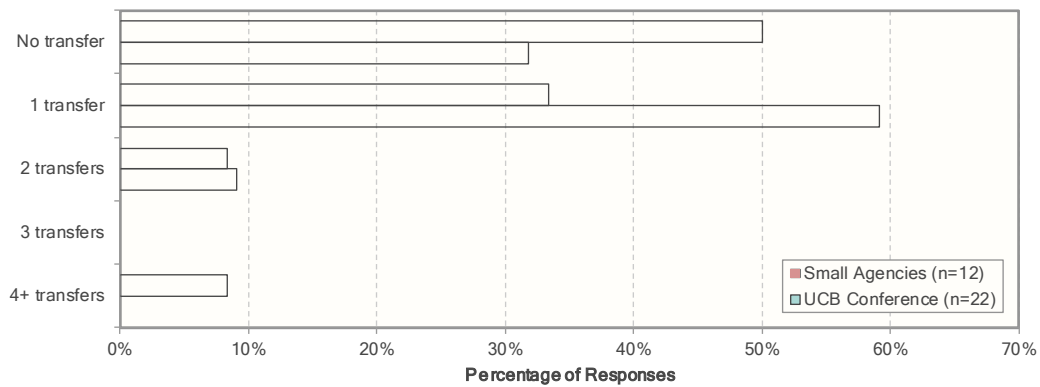
Question 7: How often do you use transit in general?



Question 8: How often do you plan to take this trip using public transit?



Question 9: How many transfers do you have to make for this trip?



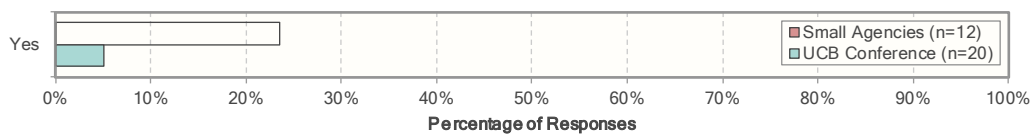
Question 10: What is your starting location (street intersection)?

- Trip-specific answer

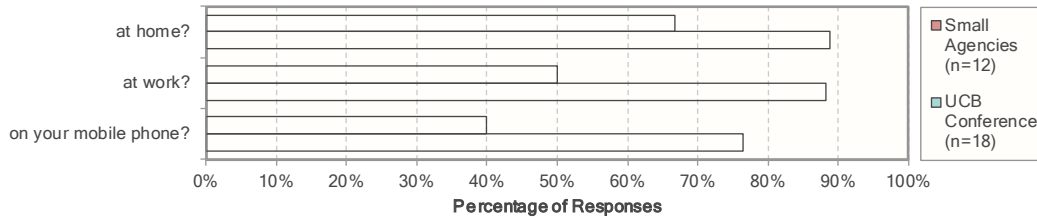
Question 11: What is your ending location (street intersection)?

- Trip-specific answer

Question 12: Are you using your car to start or end your trip?

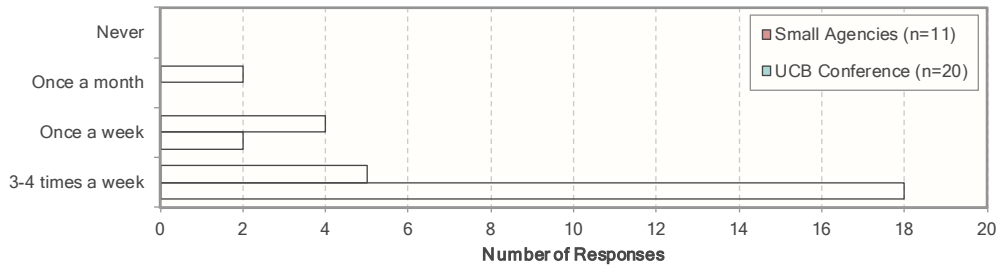


Question 13: Are you using Google Transit...

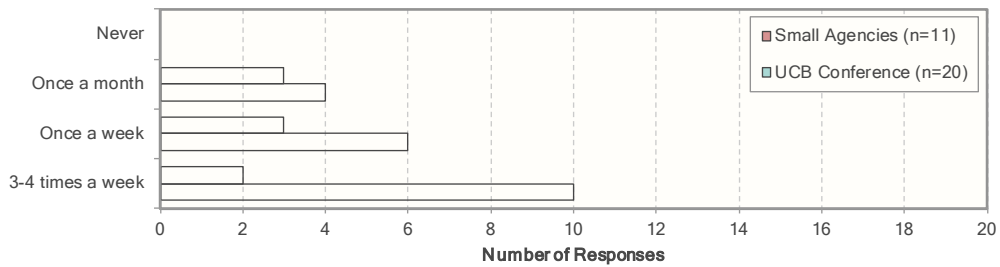


Question 14: How often do you use the following?

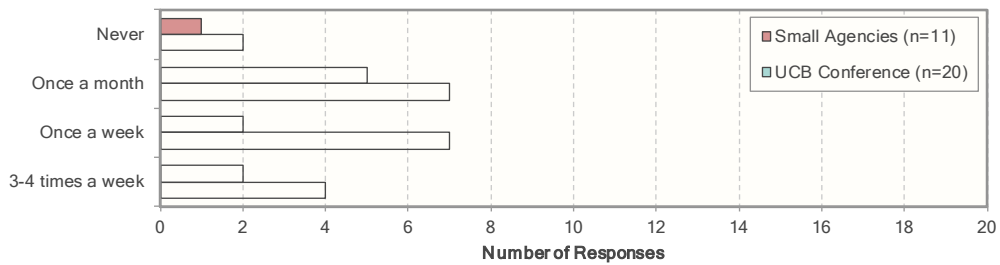
Google Maps:



Google Transit:

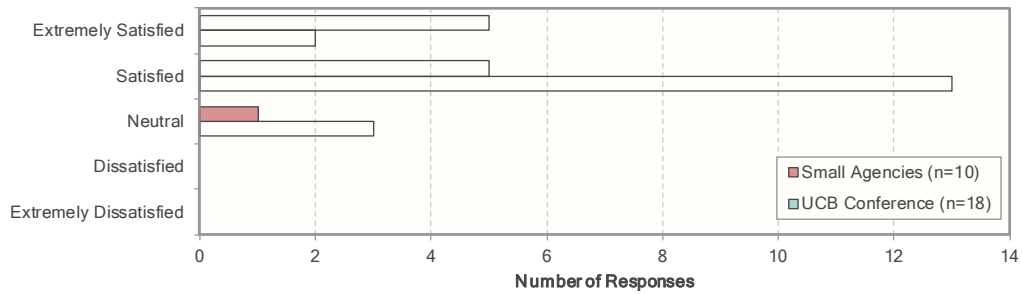


Transit agency website:

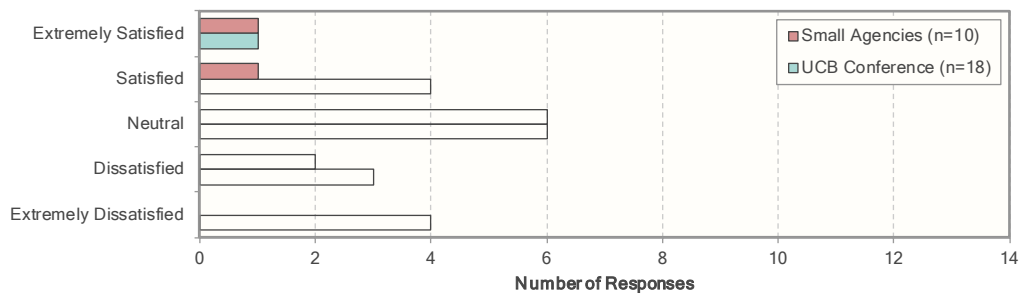


Question 15: Please rate your satisfaction on the following using a scale from 1 to 5:

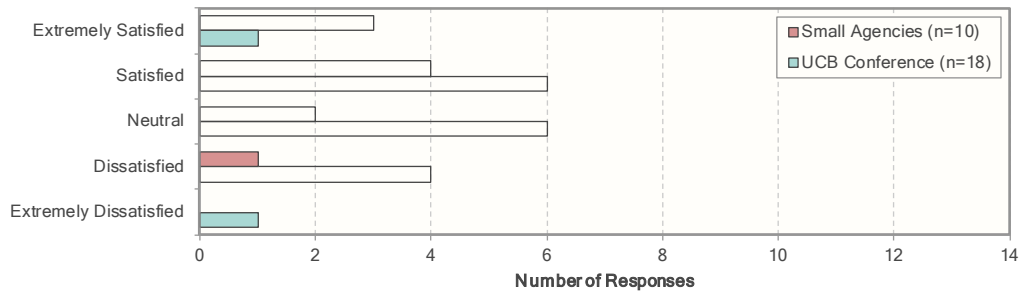
Using of Google Transit Alone:



Using transit agency website before Google Transit:

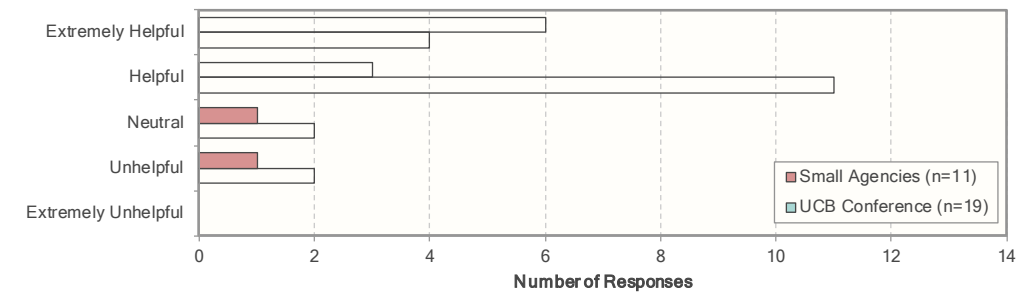


Using transit agency website after Google Transit:

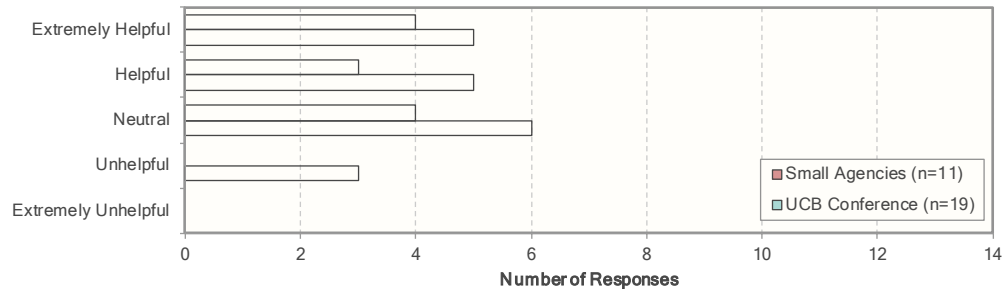


Question 16: Please rate your satisfaction on the following using a scale from 1 to 5:

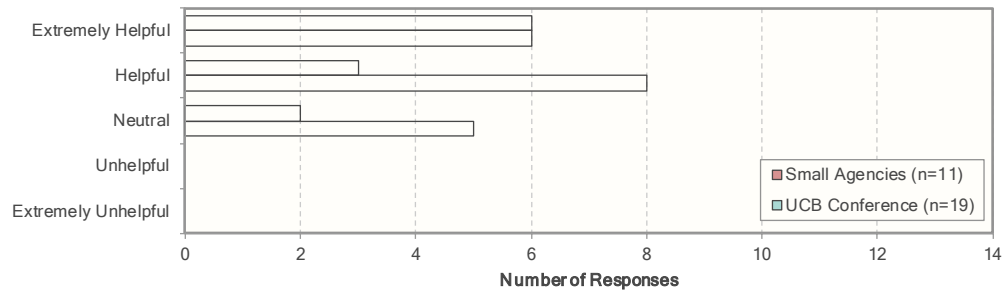
In clarifying bus schedule and system:



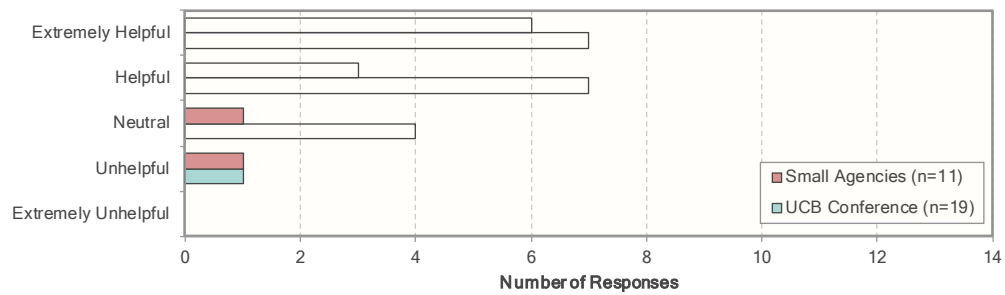
In shortening wait time?



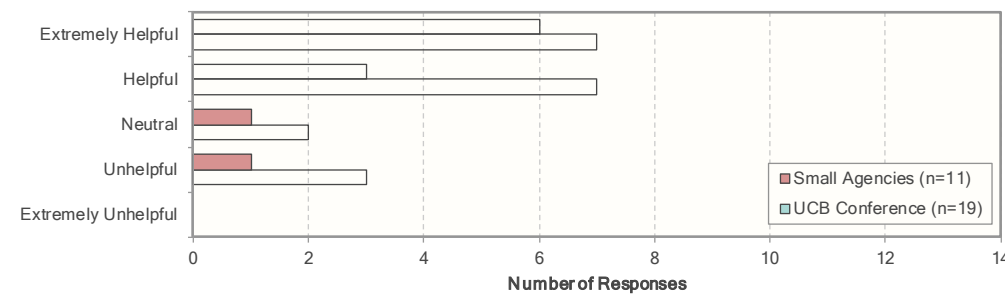
In saving overall travel time?



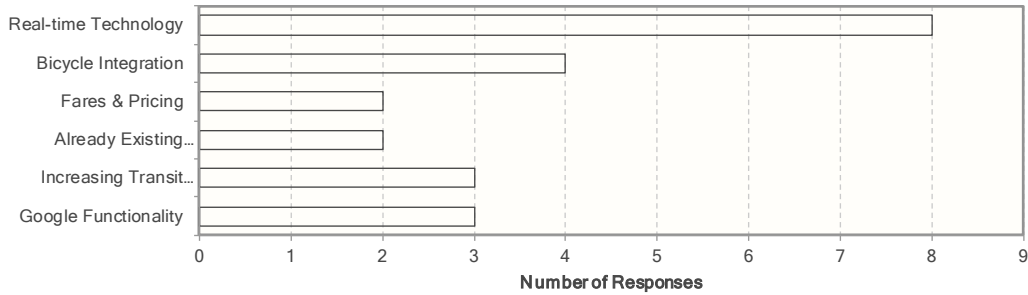
In providing easier process for riding buses?



In providing incentives to take transit?



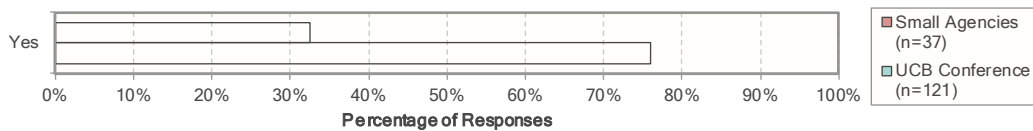
Question 17: What additional features would you like to see on Google Transit to improve your trip planning?



H.6. RESPONSES FROM INDIVIDUALS WHO DID NOT USE GOOGLE TRANSIT ON DAY OF TRAVEL

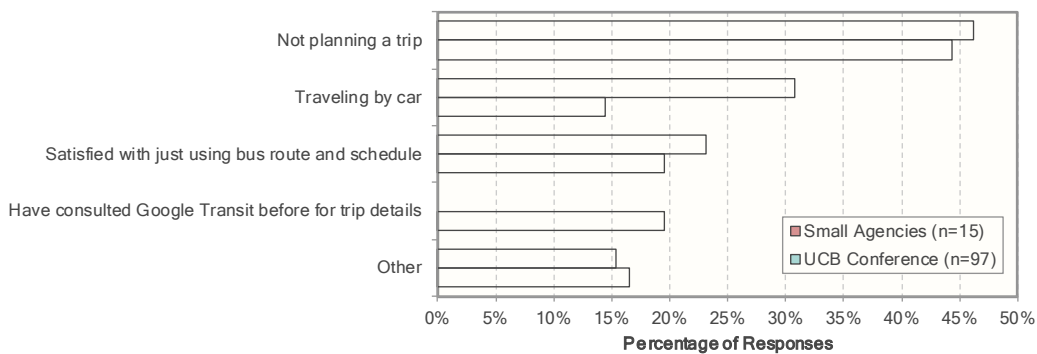
This section provides a summary of the responses that were provided by individuals who indicated that they had not planned a trip using Google Transit on the day they took the survey. This group includes both individuals with and without prior experience using Google Transit. As indicated in Table D2, this includes 39 individuals from the group of respondents accessing the survey from a link posted on a transit agency’s website, and 125 individuals who attended a conference at the University of California, Berkeley. In many cases, the total number of responses is less than the number of respondents since some individuals did not provide answers to all questions. In this section, the question numbers refer to the numbering of items in the questionnaires presented in Section D2 and D3.

Question 2: Have you ever used Google Transit before?

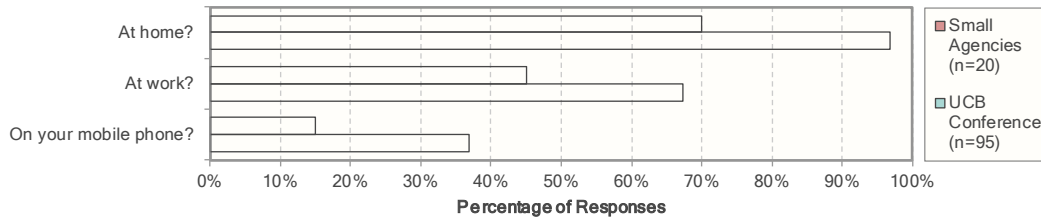


INDIVIDUALS WITH PRIOR GOOGLE TRANSIT EXPERIENCE (QUESTIONNAIRE 2)

Question 3: Why did you not use Google Transit to plan your trip today? Choose all that apply.

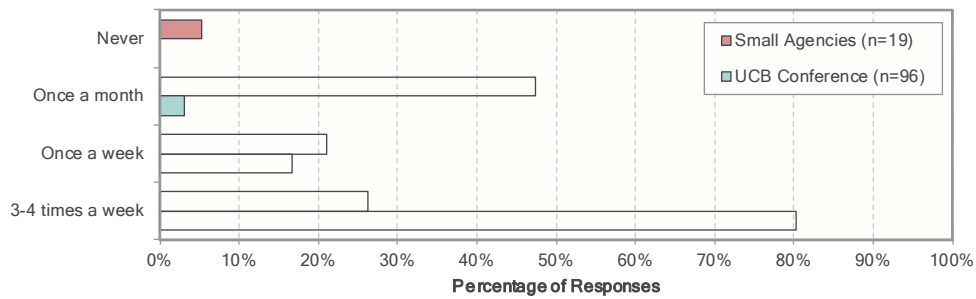


Question 4a: Are you using Google Transit?

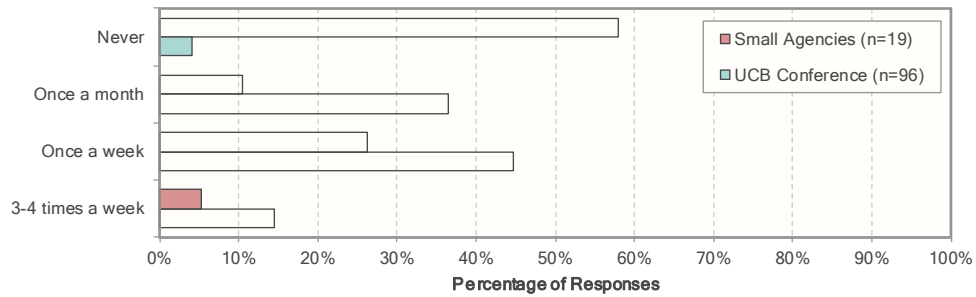


Question 5: How often do you use the following?

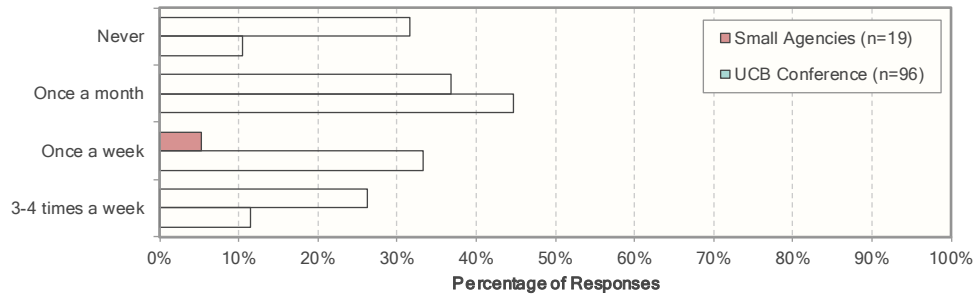
Google Maps?



Google Transit?

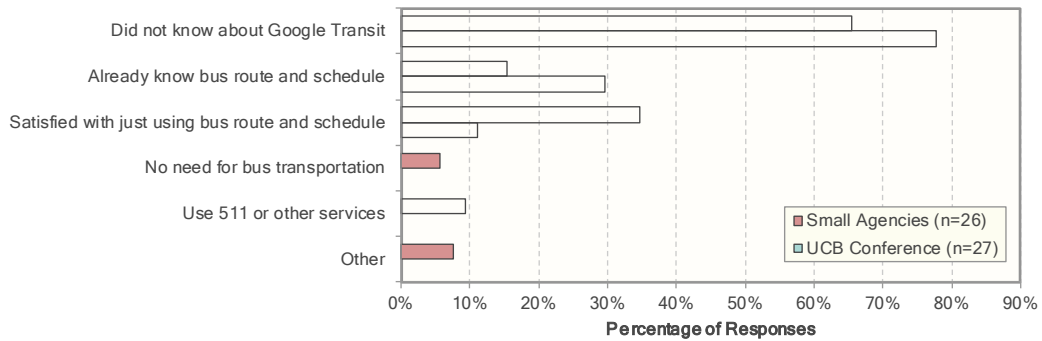


Transit agency Website?

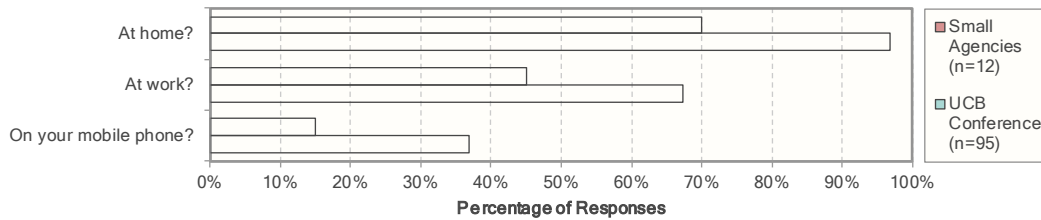


INDIVIDUALS WITHOUT PRIOR GOOGLE TRANSIT EXPERIENCE (QUESTIONNAIRE 3)

Question 3: Why not? Choose all that apply.

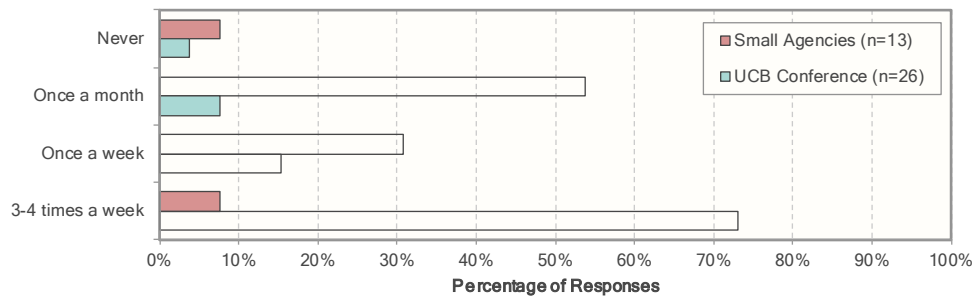


Question 4: Are you using Google Transit?

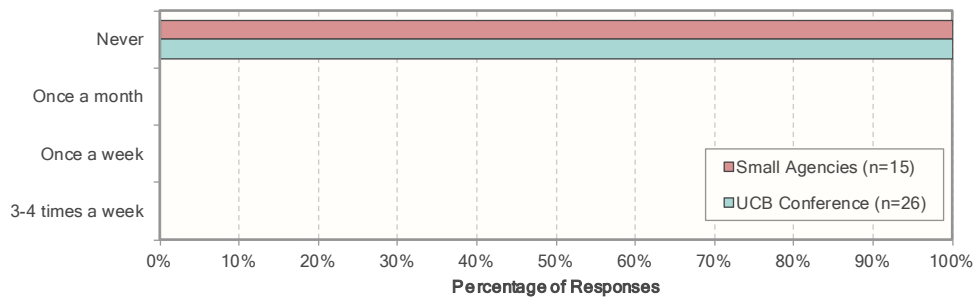


Question 5: How often do you use the following?

Google Maps?



Google Transit?



Transit agency Website?

