ITEM #4

COMMUTER CONNECTIONS TRANSPORTATION DEMAND MANAGEMENT EVALUATION PROJECT

TRANSPORTATION EMISSION REDUCTION MEASURES (TERMS)
REVISED EVALUATION FRAMEWORK
FY2012 – FY2014
PRELIMINARY DRAFT

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EXECUTIVE SUMMARY

The Commuter Connections Program of the Metropolitan Washington Council of Governments (COG), in concert with program partners, is responsible for implementing four Transportation Emission Reduction Measures (TERMs) in support of the metropolitan Washington region's efforts to meet the conformity requirements of federal transportation and clean air mandates. The TERMs include:

- Telework Assistance – Provides information and assistance to commuters and employers to further in-home and telecenter-based telework programs.
- Guaranteed Ride Home – Eliminates a barrier to use of alternative modes by providing free rides home in the event of an unexpected personal emergency or unscheduled overtime for commuters who use alternative modes.
- Employer Outreach – Provides regional outreach services to encourage large, private-sector and non-profit employers voluntarily to implement commuter assistance strategies that will contribute to reducing vehicle trips to worksites, including the efforts of jurisdiction sales representatives to foster new and expanded trip reduction programs. The Employer Outreach for Bicycling TERM also is part of this analysis.
- Mass Marketing – Involves a large-scale, comprehensive media campaign to inform the region's commuters of services available from Commuter Connections as one way to address commuters' frustration about the commute. Various special promotional events also are part of this TERM.

Commuter Connections also operates the Commuter Operations Center (COC), providing direct commute assistance services, such as carpool and vanpool matching, transit information, and other travel information services through telephone and internet assistance to commuters. The COC is not an "official" TERM, however, it supports all the TERMs described above.

This report provides a framework and methodology for evaluating the transportation and air quality impacts of these TERMs. This methodology and numerous surveys and other data collection tools described later in this report have been developed to estimate the TERMs' impacts for the period from July 2011 through June 20014 (FY12 – FY14). These impacts then will be compared against the goals established for each TERM by COG's National Capital Region Transportation Planning Board (TPB), the region's designated Metropolitan Planning Organization (MPO). The TERM evaluation framework and analysis reports are reviewed by the Commuter Connections Subcommittee and the TDM Evaluation Group.

At the early stages of the TERMs' implementation, Commuter Connections elected to undertake significant evaluation for each TERM. The TERM evaluation and analysis process has been ongoing since 1997. The objective of the evaluation process is to provide timely and meaningful information on the performance of the TERMs to decision-makers and other groups, including the TPB and other regional policy makers; COG program funders; Commuter Connections staff; TERM program partners, such as local jurisdictions and Transportation Management Associations (TMA); and employers and commuters who comprise Commuter Connections' clients.

Five previous evaluation frameworks have been prepared, the first for the January 1997 through June 1999 period (FY97-FY99) period, the second for the July 1999 through June 2002 period (FY00-FY02), the third for July 2002 through June 2005 (FY03-FY05), the fourth for July 2005 through June 2008 (FY06-

FY08), and the fifth and most recent for July 2008 through June 2011 (FY09-FY11). The evaluation framework presented in this document builds on the framework used in the FY09-FY11 analysis. Several changes have been made to the TERM evaluation framework for FY12-FY14 to update the methodology to reflect methods applied in the 2011 TERM analysis. These are described later in this document.

The evaluation process outlined in this framework allows for both on-going estimation of program effectiveness and for annual and triennial evaluations. Several types of performance measures are included in the evaluation process to assess effectiveness.

Measures reflecting commuters' and users' awareness, participation, and satisfaction with the program, and their attitudes related to transportation options are used to track recognition, output, and service quality. Measures related to new utilization of alternative modes as a result of TERM service use are used to assess the effectiveness of the services in motivating travel behavior change. Performance on these measures is collected through surveys of users of each program and documented in the survey reports.

Program impact measures are used to quantify five key outcome results, including:

1) Vehicle trips reduced
2) Vehicle miles of travel (VMT) reduced
3) Emissions reduced: Volatile Organic Compounds (VOC), Oxides of Nitrogen (NOx), Particulate Matter ($PM_{2.5}$), and Carbon Dioxide (CO_2) and other associated greenhouse gases
4) Energy reduction (fuel saving)
5) Consumer saving (commuting cost saving)

The evaluation process uses several calculation factors derived from surveys of Commuter Connections' program applicants and/or the public-at-large. These factors include: 1) placement rate (percent of commuters who shift to alternative modes), 2) vehicle trip reduction (VTR) factor (average daily trips reduced for each commuter placed), 3) average commute trip distance, and 4) drive alone access percentage (proportion of rideshare and transit users who drive alone to the locations where they meet their carpool, vanpool, bus, or train).

These performance measures and factors are applied within the basic methodology steps listed below to calculate program impacts for each TERM.

1) Estimate commuter population "base" for the TERM (e.g., all commuters, GRH applicants, rideshare matching applicants, Employer Outreach employees, etc.)
2) Calculate "placement rate" – Percentage of commuters in the population base who made a travel change as a result of the TERM
3) Estimate the number of new alternative mode placements – Multiply placement rate by the population base for the evaluation period
4) Calculate the vehicle trip reduction (VTR) factor for new placements – Average daily vehicle trips reduced per placement
5) Estimate vehicle trips reduced – Multiply number of placements by the VTR factor

6) Estimate vehicle miles traveled (VMT) reduced – Multiply number of vehicle trips reduced by average commute distance

7) Adjust vehicle trips and VMT for access mode – Discount vehicle trips reduced and VMT reduced to account for commuters who drive alone to meet rideshare modes and transit

8) Estimate NOx, VOC, $PM_{2.5}$, and CO_2 emissions reduced – Multiply adjusted vehicle trips and VMT reduced by emissions factors consistent with the regional planning process

9) Estimate the energy and commuter cost savings – Multiply VMT reduced by fuel efficiency and vehicle operating cost factors

The calculations outlined above have been embedded into a spreadsheet used by Commuter Connections and its partners to track estimated results on a quarterly basis. A summary of these results is included in Commuter Connections' Annual Report. The factors used in the spreadsheet are updated as new surveys relevant to each TERM are completed. At the end of the three-year evaluation period, a TERM Analysis Report is prepared to summarize placements; reductions in vehicle trips, VMT, and emissions; and progress toward goals in each of these performance measures for the three-year period.

Throughout the evaluation period, additional reports are prepared to present results of major data collection efforts, such as the rideshare applicant placement survey, the "State-of-the-Commute" survey of regional commuting trends and attitudes, GRH Applicant survey, and others. These reports are distributed to program partners, policy makers, and other with an interest in regional transportation.

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SECTION 1 OVERVIEW

This report provides a framework and methodology for evaluating the transportation and air quality impacts of four Transportation Emission Reduction Measures (TERMs) implemented by the Commuter Connections Program of the Metropolitan Washington Council of Governments (COG), in support of the Washington metropolitan region's efforts to meet the conformity requirements of federal transportation and clean air mandates. The TERMs include:

- Telework Assistance – Provides information and assistance to commuters and employers to further in-home and telecenter-based telework programs.
- Guaranteed Ride Home – Eliminates a barrier to use of alternative modes by providing free rides home in the event of an unexpected personal emergency or unscheduled overtime for commuters who use alternative modes.
- Employer Outreach – Provides regional outreach services to encourage large, private-sector and non-profit employers voluntarily to implement commuter assistance strategies that will contribute to reducing vehicle trips to worksites, including the efforts of jurisdiction sales representatives to foster new and expanded trip reduction programs. The Employer Outreach for Bicycling TERM also is part of this analysis.
- Mass Marketing – Involves a large-scale, comprehensive media campaign to inform the region's commuters of services available from Commuter Connections as one way to address commuters' frustration about the commute. Various special promotional events also are part of this TERM.

Commuter Connections also operates the Commuter Operations Center (COC), providing direct commute assistance services, such as carpool and vanpool matching, transit information, and other travel information services through telephone and internet assistance to commuters. The COC is not an "official" TERM, however, it supports all the TERMs described above.

The evaluation framework serves two purposes. First, it assesses Commuter Connections' progress in meeting the transportation and air quality goals established by COG's National Capital Region Transportation Planning Board (TPB) for the TERMs for the period July 2011 through June 2014 (FY12-FY14). Second, it guides COG's future evaluation efforts to assess the effectiveness of the TERMs. The TERM evaluation framework and analysis reports are reviewed by the Commuter Connections Subcommittee and the TDM Evaluation Group. The framework describes an overall evaluation process for the program and specific evaluation techniques for each TERM.

This report represents an update to the most recent of five previous evaluation framework documents developed to evaluate results and progress toward goals during five three-year periods: January 1997 through June 1999,[1] July 1999 through June 2002[2], July 2002 through June 2005[3], July 2005 through

[1] Commuter Connections Transportation Demand Management Evaluation Project: Transportation Control Measures Evaluation Framework, June 30, 1997.
[2] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework 1999-2002, MWCOG, March 20, 2001.
[3] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework 2002-2005, MWCOG, March 16, 2004.

June 2008[4], and July 2008 through June 2011,[5] respectively. The evaluation seeks to quantify the impacts of the four TERMs, results which will be used in calculations of the region's air quality conformity from the TERM Tracking Sheet. Commuter Connections had previously provided traditional ridematching services. This service is included in the "baseline" of travel and air quality indicators for the purposes of assessing regional air quality conformity.

This evaluation framework report is organized into seven sections following this Section 1 overview:

- Section 2 defines evaluation objectives and issues guiding the process.
- Section 3 enumerates performance measures to be used in assessing program effectiveness and cost effectiveness. This section also presents a proposed approach to determine if new performance indicators are needed to support regional or local transportation initiatives and what indicators will be appropriate.
- Section 4 discusses evaluation components specific to each TERMs: Telework, Guaranteed Ride Home, Employer Outreach / Employer Outreach for Bicycling, and Mass Marketing. This section also presents evaluation activities relevant for the Commuter Operations Center (COC) and the Software Upgrade component of the Integrated Rideshare TERM, which was combined with the COC in the FY06-FY08 evaluation period.
- Section 5 describes the data sources and data collection tools used to collect TERM analysis data.
- Section 6 outlines the method to calculate travel, air quality, energy, and consumer cost impacts of the TERMs.
- Section 7 describes tools currently used to report Commuter Connections' evaluation results to various stakeholder audiences and an approach to expand communication of Commuter Connections' evaluation results.
- Section 8 outlines the evaluation schedule and responsibilities.

[4] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework 2005-2008, MWCOG, May 15, 2007.
[5] Commuter Connections, Transportation Demand Management Evaluation Project: Transportation Emission Reduction Measures (TERMs) Revised Evaluation Framework 2008-2011, MWCOG, May 18, 2010.

SECTION 2 EVALUATION OBJECTIVES AND ISSUES

PURPOSE OF THE EVALUATION

The objective of the evaluation process is to provide timely and meaningful information on the performance of the TERMs to decision-makers and other groups, including the TPB and other regional policy makers; COG program funders; Commuter Connections staff; TERM program partners, such as local jurisdictions and transportation management associations (TMAs); and employers and commuters who comprise Commuter Connections' clients. This information includes travel and air quality impacts, such as vehicle trips and miles of travel reduced and emissions reduced from the four TERMs implemented by the Commuter Connections program.

EVALUATION OBJECTIVES

The ultimate goal of this evaluation is to provide sound, definitive, and useful information about the results of TERMs to document program benefits for conformity reporting, identify program enhancements, and guide future decision-making about funding priorities. To this end, the framework defines a specific evaluation objective of providing useful information to the following groups:

- Regional policy-makers – Information on the effectiveness and cost effectiveness of TERMs in contributing to regional goals for reducing congestion, improving air quality, reducing energy consumption, and improving mobility and accessibility. This includes the development of policy reports that document TERM impacts in simple, clear language.

- Regional policy-makers and TERM program staff – Information to help establish regional commute trends and attitudes and provide an indication of the collective effect of all Commuter Connections programs on regional traffic and air quality, including impacts that are not specifically assigned in the evaluation to one of the four TERMs. A new evaluation-related activity that will be undertaken during this evaluation period is the examination of future performance measures and development of additional communication tools to assist program managers to report the benefits of the TERMs in ways that are most meaningful to policy-makers and funders.

- Program funders – Information on the effectiveness of the TERMs being implemented via the Commuter Connections program.

- Commuter Connections staff and program partners – Information on potential program enhancements to increase service effectiveness and efficiency of service delivery.

- Employers and commuters – Information on the collective, regional impacts of individual participation, the impacts and benefits for employers, and the personal benefits received by commuters who use alternative modes. Evaluation information can also be useful in showing employers the types of trip reduction strategies that might be effective for their specific worksite conditions

Additionally, the evaluation process follows accepted and recognized evaluation techniques; and is rigorous, ongoing, resource efficient, unobtrusive for COG partners, and compatible with regional, state, and national practices.

EVALUATION ISSUES

Prior to discussing the specific evaluation approach for each TERM, it is useful to discuss several key evaluation issues that are addressed in this framework that should be kept in mind as COG utilizes and modifies the process over time.

Purpose of the Evaluation

- The evaluation uses common, quantitative performance measures for all TERMs to allow for comparisons among TERMs and between TERMs and other strategies that could be implemented to address congestion and air quality concerns. A crucial function of this evaluation process is to estimate the combined impacts of TERMs to assess the overall effectiveness of the Commuter Connections Program. Consistent and comparable methodologies also enhance confidence in the results. These common measures are enumerated in Section 3.

- The evaluation framework allows for quarterly activity reporting and benefits projection as a program management information tool. While assessment of travel and air quality benefits is the key purpose of the evaluation, the process must equally provide information to support administration of the Commuter Connections program.

Separating Impacts of Program Elements

- The evaluation separates the impacts of individual Commuter Connections programs to avoid double counting benefits. For example, carpools might be formed as a joint result of online ridematching and GRH program benefits. These impacts must either be credited to one of the two TERMs or divided between the TERMs. Program benefits are not necessarily additive.

- Similarly, the evaluation separates the baseline impacts of Commuter Operations Center "basic" services from the impacts of the new TERM programs. The method for attributing impacts to a specific TERM or service is discussed in Section 6. This is especially important for the Mass Marketing TERM, because its impacts can be "direct," meaning the marketing effort alone motivated use of alternative modes, or "referred," meaning the marketing effort influenced commuters to utilize another Commuter Connections program, such as ridematching. In such cases, the travel and air quality impacts will be assigned to the TERM or to the Commuter Operations Center, based on their respective influences.

- When possible, the evaluation recognizes and attempts to address the possible impacts of exogenous factors. Travel decisions also are influenced by the extent of congestion, work and home locations, economic factors, fuel prices, and other factors. User surveys must carefully query commuters who shift to alternative modes to define the relative importance of TERMs in influencing their mode choices. Data collected through the State-of-the-Commute survey also supports this objective by suggesting exogenous factors that might have influenced travel changes.

Accounting for Prior Mode and Access Mode

- Prior mode is an important variable in this evaluation, because a shift to an alternative mode does not always mean a vehicle trip was eliminated. Vehicle trips are reduced only in three cases: 1) the commuter shifts from driving alone to an alternative mode, 2) the commuter increases the frequency of use of an alternative mode, or 3) the commuter shifts to a higher-occupancy mode (e.g., from carpool to vanpool). Section 6 describes the development of vehicle trip reduction (VTR) factors that are used to convert the number of alternative modes placements into the number of vehicle trips reduced, taking into account these three change factors.

- For air quality evaluation purposes, it is necessary to know the access mode of carpoolers, vanpoolers, and transit riders. Access mode refers to how carpoolers, vanpoolers, and transit riders travel from home to bus stops, train stations, Park & Ride lots, or other places where they meet rideshare partners or board a bus or train. Access mode is a minor issue in the evaluation of travel impacts, because access trips generally account for a very small portion of the total miles traveled and the alternative mode generally is used for the most congested and longest portion of the trip. However, commuters who drive alone to the meeting point still make a vehicle trip and accumulate some drive-alone VMT, which must be subtracted from the vehicle trips reduced and VMT reduced in the air quality analysis.

Updating Calculation Factors and Assumptions Used in the Evaluation

- The TERM evaluation methodology applies calculation factors developed from surveys and other research conducted during the evaluation period. Specific revisions will be incorporated in the FY12-FY14 evaluation as noted later in this report for each TERM. Additionally, regional emissions factors will be updated to reflect factors that will apply in 2014.

Apply Life-cycle Assessment to Mode Shifts to Capture the Full Duration of Benefits for TERM Impacts

- In previous TERM evaluations, mode shifts motivated by TERMs were not assumed to extend beyond the end of the three-year evaluation period, so were not carried over to the next evaluation cycle. If mode shifts do extend beyond three years, however, additional impacts could be retained from one three-year evaluation cycle to the next. The impacts calculated for a particular TERM are based on participation in the program and examination of the calculation method for each TERM indicated that additional impact credit might be possible for GRH and the Commuter Operations Center. In both cases, some additional data and calculation would be needed to document the additional credit. The specific data needed are defined in the individual TERM calculation methodologies for these TERMS in Section 4.

Specific Evaluation Issues for Individual TERMs

In general, the TERM analysis approaches documented in the 2011 TERM Analysis Report are used as the basis for the TERM evaluation methods described in this framework. A sample of the TERM calculations are included in Appendices F through K, as excerpted from the 2011 TERM Analysis Report.

- Telework Assistance – The Telework TERM is a resource service to help employers, commuters, and program partners initiate telework programs. In evaluating teleworking, several travel changes need to be assessed, including: trip reduction due to telework, the mode on non-telework days, and mode and travel distance to telework locations other than home. Telework impacts are

primarily estimated from the State of the Commute survey and from surveys conducted of employers that received telework information or assistance from Commuter Connections.

- Guaranteed Ride Home (GRH) – The primary goal of GRH is to encourage commuters who drive alone to shift to alternative modes and to encourage commuters who were ridesharing before they registered for GRH to continue or expand their use of these modes. Thus, the evaluation for GRH will estimate the influence of GRH availability on both mode shifts and frequency of ridesharing. Enhancements made in past evaluation periods include discounting of VMT reductions made outside the COG non-attainment area and the derivation of one placement rate for both GRH applicants and one-time exemptions.

- Employer Outreach – Employer outreach applies a two-faceted approach employing empirical data on employer programs and modeled impacts. The empirical data come from the ACT! database of employer contacts, including information on trip reduction strategies implemented at each worksite. The EPA COMMUTER model (v 2.0) applies these empirical data to project the likely change in employee commuting behavior for given change in the employer's program. The Model uses time and cost coefficients that are based on coefficients used by MWCOG in regional transportation modeling. In 2010-2011, COG revised the regional travel model, using data from a new Household Travel Survey. This might be expected to result in new regional cost and time coefficients for transit and other non-SOV modes. If the new coefficients differ from those used in the 2011 evaluation, the consultants will update the coefficients used in the COMMUTER Model v. 2.0 to be consistent with the regional model.

  The FY12-FY14 methodology also will distinguish three types of Employer Outreach impacts: new, maintained, and expanded. When the Employer Outreach TERM was adopted, the TPB established a goal to be achieved by June 2005 and evaluations conducted for periods through June 2005 measured impacts against this goal. Beginning with the 2008 analysis, new Employer Outreach goals were established for the overall program and for new program activity during the evaluation period. Thus, the Employer Outreach evaluation calculates impacts for "maintained" employer programs and "new/expanded" programs.

  - Maintained impacts include employers that joined EO before the start of the evaluation period (e.g., before July 1, 2011), continued in the program, but made no changes since that date.
  - New impacts included employers that joined the EO program on or after the start of the evaluation period.
  - Expanded impacts include employers that were involved in EO before the start of the evaluation period, but expanded their commute assistance services after that date.

  The evaluation also estimates impacts for employers that participated in the program during the most recent evaluation period (FY09-FY11), but which dropped out of EO before the start of the new period. Commuter Connections determined that the impacts that would have been credited for these employers would have to be replaced or "back-filled" by new/expanded impacts.

  Finally, employer bicycle programs, which were evaluated separately from other Employer Outreach services in 2002 and 2005 under the Employer Outreach for Bicycling TERM, are now ad-

dressed within the broad Employer Outreach TERM. But the contribution of these bicycle programs will continue to be calculated and reported separately.

- Mass Marketing – The critical issue for this TERM is attributing changes in attitudes and behavior to the mass marketing campaign versus another TERM. Three types of impacts are possible for Mass Marketing: 1) "direct" impacts generated by commuters who cite regional commute advertising messages as the reason for their commuting change, 2) "referred" impacts that are generated when advertising encourages commuters to submit rideshare and GRH applications, and 3) event impacts generated from special event programs, such as the Bike to Work Day event. This is explained further in Section 4. The evaluation will be accomplished using a variety of data sources, including the State-of-the-Commuter survey and COC tracking data.

- Integrated Rideshare–Software Upgrades Project – Impacts for this TERM project will continue to be evaluated as part of the Commuter Operations Center (COC) under the Integrated Rideshare TERM. However, their impacts will be calculated and reported as a distinct sub-set of the Commuter Operations Center.

The evaluation activities described in Section 4 elaborate on these issues for individual TERMs.

SECTION 3 PERFORMANCE MEASURES

The previous evaluation frameworks established performance measures for each TERM. This framework updates and expands on those measures. Performance measures are measures of a program's success; how well the program is meeting the program objectives, in particular the travel and emission targets set by the TPB for each TERM. Generally, we recommend that performance measures be established in the following broad categories:

- Awareness and attitudes
- Program participation and satisfaction
- Mode utilization
- Program impacts

Awareness provides an indication of how well known the Commuter Connections program and its service are to commuters. Awareness has been assuming a larger role in this evaluation period since it is a primary objective of the Mass Marketing TERM, one of the newer TERMs.

A related type of measure is commuters' *attitudes* toward their commute and toward various commute modes. These measures examine commuters' personal feelings about travel modes and their willingness to consider and try new modes of travel.

Participation refers to indicators related to travelers' or business/employers' use of TERM services, for example, the number of matchlist requests, the number of GRH applicants, the number of bicyclists who register for Bike-to-Work Day, or the number of employers that participate in Employer Outreach. Participation data measure program output, but also are needed to calculate the ultimate performance measures, program impacts, such as the number of travelers who change mode, changes in mode split, vehicle trips reduced, and emissions reduced.

Satisfaction measures focus on customers' satisfaction with various features of TERM services and the efficiency of service delivery, for example, the speed with which assistance is delivery, and users' impression of the usefulness of the services. These measures are important for tracking funding, estimating staffing, and identifying program improvements.

Utilization measures focus on the new and expanded use of alternative modes motivated by use of TERM services, for example, the percentage of GRH registrants who shift from driving alone to an alternative mode to be eligible for the service.

Program impacts measures estimate the travel, air quality, energy, and commuter cost saving benefits of the TERMs. Both the impact measures and targets that are currently in place were officially set by the MWCOG Transportation Planning Board (TPB) when the TERM was established. In all cases, the impacts are related to the TERM's contribution to the regional conformity assessment.

This section describes several common performance measures recommended for each TERM and for the program as a whole. Performance measures specific to each TERM are listed in Section 4. Impact measure goals also are defined for each TERM in Section 4.

Awareness and Attitudes

- Awareness – Program awareness will be measured in the proportion of residents and commuters who recognize the Commuter Connections "branding" and the range of services it provides or facilitates and are aware of transportation infrastructure or alternative modes available to them. Awareness will be assessed by both unaided and prompted questions in surveys of the public at large.
- Attitudes – A second area of exploration is attitudes toward commuting and solutions to congestion. One goal of the Mass Marketing TERM is to address growing frustration levels among commuters that congestion is worsening and that there are few alternatives to sitting alone in rush-hour traffic. The evaluation will document travel attitudes over time, including commute ease and trial use of alternatives to driving alone. This information is currently captured in the State of the Commute survey and will continue to be tracked as more general population surveys are conducted.

Program Participation and Satisfaction

These performance measures gauge services provided and the use of those services.

- Program Participation – Program participation refers to the number of clients or customers who request TERM services and the number who are assisted. Participation could include the numbers of new employer clients, GRH applicants, online information system users, telework employer sites, etc. A primary participation measure is generally the *number of applicants or users*, but other measures, specific to individual TERMs, also are described in Section 4.
- Program Satisfaction – A primarily qualitative, but important set of performance measures is suggested to assess client satisfaction, an important feedback mechanism to determine whether services are meeting customers' needs and their expectations. This is important to gauge satisfaction of various customers (e.g., employers, commuters, teleworkers, etc.) with the services they receive.

Mode Utilization

- Alternative mode Placements – The measure of "placements" is defined as the number of commuters who shift to alternative mode arrangements as a result of the Commuter Connections services. These commuters could be new carpoolers, vanpoolers, transit riders, teleworkers, etc.

Program Impacts

Program impact measures estimate various benefits of the TERMs. The impact measures calculated in the TERM analysis include: vehicle trips reduced, vehicle miles traveled (VMT) reduced, emissions reduced, energy saving, and consumer cost saving.

- Vehicle Trips Reduced – The number of vehicle trips reduced is one of two transportation impact measure. It estimates the number of daily vehicle trips that new alternative mode placements remove from the road. This is a primary measure of congestion relief, as fewer vehicles on the road during peak hours reduces delay, increases travel speed, reduces commute time, and improves roadway service levels; in essence, trip reduction equates to a roadway capacity increase. It also is a primary input (trip end emissions) to the air quality analysis.

  Vehicle trip reduction is estimated using a *vehicle trip reduction (VTR) factor*, the average number of vehicle trips reduced per day for each alternative mode placement. This rate accounts for shifts from drive alone to alternative modes, shifts among alternative modes (e.g., from carpool to vanpool and from transit to carpool), increases in the frequency (days per week) that a commuter

uses an alternative mode, and increases in the occupancy of carpools and vanpools. Shifts from alternative modes to drive alone are not included, because these changes are not motivated by commuters' contact with Commuter Connections. Appendix A describes how the VTR factor is calculated. Appendix B shows a sample VTR factor calculation.

- Vehicle Miles of Travel (VMT) Reduced – VMT reduced, the third transportation impact measure, estimates the total miles of vehicle travel removed from the road daily. VMT reduction is particularly important to the air quality and energy evaluation, but also is relevant to an assessment of the benefits of the program to roadway system performance.
- Emissions Reduced – Emissions reduced measures the decrease in mobile source (tailpipe) emissions that result from reductions in vehicle trips or VMT. From the start of the TERM evaluations, the primary pollutants of concern were Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOC), which are both ozone precursors. The 2008 TERM Analysis added calculation of impacts for two components of particulate matter (PM): direct PM2.5 emission, and NOx precursors, and for Carbon Dioxide (CO2), the primary greenhouse gas. These measures also will be estimated in the 2012-2014 evaluation.
- Energy Saving – The energy saving, defined as the reduction in the number of gallons of gasoline used, resulting when commuters reduce VMT.
- Consumer Cost Saving – A fifth measure of program impacts is the aggregate cost savings realized by commuters who reduce daily vehicle trips and VMT.

PROCESS TO REVIEW AND UPDATE PERFORMANCE INDICATORS

The impact indicators described above were developed primarily to report TERMs' performance compared to regional goals set for them for conformity determination. Conformity remains central to Commuter Connections' evaluation, but sustainability, climate change, mobility, health/safety, and livability are joining congestion and air quality as forces shaping the region's transportation policies.

The official impact measures for the TERMs cannot be changed without a decision of the TPB. Additionally, this evaluation framework does not recommend any official changes, since the TERMs' primary function is to meet a required regional objective. But the TERMs likely do offer other results that benefit the residents and commuters of the Washington region, in the social objectives noted above. Documenting and communicating the type and magnitude of these benefits will demonstrate the broad value of Commuter Connections programs to the community, validate the investments made in the programs, and could enhance the visibility, participation, and effectiveness of Commuter Connections' programs among the traveling public and employers.

This framework document suggests the following action steps to support broadening the assessment of TERMs' performance in the future. In particular, this approach involves a forward-looking assessment of key policy objectives for the future and how TDM might contribute to addressing urban transportation and livability issues in the region. Following is a brief outline of a process Commuter Connections will undertake to identify and document performance in new benefit areas.

Proposed Process

A four-step process will be undertaken by Commuter Connections and its consultants to assess potential connections between emerging regional priorities and the TERM analysis process and to advance the assessment of enhanced Commuter Connections TERM benefits.

1 – Benefits and Performance Indicators – Define additional benefits and performance measures that could be used by Commuter Connections to document and communicate the value of commuter assistance services. The specific benefits and measures will be selected using input solicited by Commuter Connections from internal MWCOG staff, funders, members of the TDM Evaluation Group and the Commuter Connections Subcommittee, other program partners, and other regional stakeholders as appropriate. Shown below are several example benefits and performance measures that might be identified. For example, a typical performance measure for transportation system efficiency might be reduced hours of travel delay, due to trips / VMT reduced from the road network.

Benefit	Sample Performance Indicator
• Transportation system efficiency	- Reduced travel delay (overall in the region and by major roadway segments)
• Vehicle accident reduction	- Reduced accident costs from reduced VMT
• Public health	- Reduced health costs from reduced vehicle emissions and increased bicycling / walking
• Quality of life (QOL)	- Increased satisfaction with transportation and higher rating of QOL due to greater availability of travel options
• Business and economic vitality	- Employer operating cost savings from offering employee commute services - Employers citing regional services as beneficial to their operation and profitability

Key questions that might assist in identifying benefits and indicators that would resonate in the future could include:

- What new near/mid-term transportation policies and initiatives are being discussed by local or regional agencies?
- What role will / could TDM / TERMs play in supporting the objectives of these policies / initiatives?
- Are the existing TERM performance measures appropriate to assess TDM's contribution to fulfillment of these objectives or will new performance measures be needed?
- Can data collected from the TERM analysis inform this process?
- What new data (e.g., health costs) would need to be collected and what might be the source?

2 - Identify Data Sources and Assessment Methods and Tools – The second step will be to identify data collection needed to assess new measures and define those needs in the descriptions of key surveys to be conducted in the TERM evaluation process. Section 5 of this report defines the primary data collection opportunities in the 2012-2014 evaluation period and new questions that might be included in the surveys to assess additional TERM benefits.

This task also will explore availability of analysis methods and tools that could be used to estimate new benefits. For example, the Trip Reduction Impacts of Mobility Management Strategies (TRIMMS) model offers methods to estimate economic impacts from VMT.[6] Other tools might be utilized to estimate road network delay reduction to assess the TERMs' role in enhancing system performance. Similar models and tools also might be obtained or developed to estimate other benefits. Some data might need to be gathered from sources outside of MWCOG, particularly to measuere non-transportation benefits, such as safety/health and economic vitality. This task will identify potential sources, barriers to collecting and using the information, and recommendations on how to gather the appropriate data.

Two benefit areas that are anticipated to be of particular importance in the near-term include transportation system efficiency and business vitality. Transportation system efficiency is expected to be included as a future regional transportation performance measure to comply with new performance measurement requirements established through MAP-21 transportation funding reauthorization. Business and economic vitality is likely to be relevant to Commuter Connections in the coming years to encourage continued and additional involvement by employers in the Employer Outreach TERM. Appendix C describes a conceptual method to calculate a transportation system performance benefit, defined by the reduction in travel delay. Appendix D outlines an approach to documenting and communicating business-related benefits of TERM involvement to employers.

3 - Collect and Analyze Performance Data – As TERM evaluation surveys are conducted, reassess the objective of the survey and add, if possible, questions to collect data to facilitate assessment of new TERM benefits. In some cases, the data might only be assessed qualitatively at first, if quantitative tools are not readily available. Compile additional data, from sources outside MWCOG, as needed.

4 – Report on Additional Benefits – Finally, to the extent possible, report quantitative and/or qualitative results regarding expanded TERM benefits in survey reports and highlight benefit results in targeted communication outreach. Additionally, the TERM Analysis Report that will be prepared in 2014 could include a section documenting additional benefits of the Commuter Connections program overall. Although the benefits would not be associated with individual TERMs or reported as official TERM impacts, the results could be communicated to funders and other interested parties as enhanced evidence of the value of the TERMs to the region. Recommendations will then be made as to the continuance and enhancements to this benefit reporting.

[6] Sources: EPA: Potential Changes in Emissions Due to Improvements in Travel Efficiency. Environmental Protection Agency. March 2011. http://www.epa.gov/oms/stateresources/policy/420r11003.pdf FHWA: http://www.fhwa.dot.gov/resourcecenter/teams/planning/lut.cfm)

SECTION 4 EVALUATION COMPONENTS FOR INDIVIDUAL TERMS

Sections 2 and 3 stated the objectives and issues guiding the evaluation process and defined several common performance measures that will be used for all TERMs. This section details the specific evaluation approach for each of the four TERMs and for the Commuter Operations Center.

The TERMs included are:

- Telework Assistance
- Guaranteed Ride Home
- Employer Outreach/Employer Outreach for Bicycling
- Mass Marketing
- Commuter Operations Center/Integrated Rideshare

For each TERM, the following information is provided:

- TERM description
- Goals defined for the TERM for 2014
- Nature of the evaluation
- Performance measures recommended for the TERM
- Data needed to measure TERM impacts and recommended data sources

Section 5 of this report provides a more detailed description of the surveys and other data sources enumerated in this section. Section 8 presents a schedule for the collection of data and recommends a party to be responsible for collecting the data. Included in the appendices are examples of how travel and emission impacts are calculated for each TERM. These are taken from the 2011 TERM Analysis Report to provide real examples of how the calculations were performed in the last evaluation period. These calculation methods form the basis for the refinements included in this evaluation framework.

The specific data required for each TERM to calculate alternative mode placements, vehicle trips reduced, and VMT reduced are described in the individual TERM evaluation component sections that follow. Additionally, some common data are needed to calculate emissions, commuter cost, and energy impacts of each TERM, including:

- Access mode and distance to meeting locations for alternative mode users (for air quality analysis)
- Regional emissions factors (to determine emission reductions)
- Regional fuel economy data in average miles per gallon consumed (to calculate energy saving)
- Vehicle operating costs (to estimate commuter cost savings)

4-A TELEWORK ASSISTANCE

Program Description

In the Telework TERM, Commuter Connections, working with numerous partners in Maryland, assists employers to establish worksite telework programs and arrangements and provides telework information to individual commuters. The Telework TERM estimates the impact of the portion of regional telework that is attributable to Commuter Connections' telework assistance.

TERM Evaluation Changes Since FY09-FY11

- No changes

Stated Goals

The purpose of the Telework TERM is to increase the number of full-time or part-time home-based and telework center-based teleworkers in the region. COG/TPB defined five regional goals for this TERM for 2014:

- Maintain 31,854 teleworkers
- Reduce 11,830 daily vehicle trips
- Reduce 241,208 daily miles of travel
- Reduce 0.1222 daily tons of NOx
- Reduce 0.0723 daily tons of VOC

Nature of Evaluation

The populations of interest for this TERM include two groups:

- All regional teleworkers who are influenced by Telework services / assistance they receive from Commuter Connections / MWCOG to begin teleworking
- Telework employees at worksites assisted by Commuter Connections

For the first population, the evaluation determines the number of teleworkers who live or work in the region who were influenced or assisted by Telework TERM services to begin teleworking and the travel impacts of their teleworking.[7] Data for this component come from the State of the Commute survey:

- Number of regional teleworkers and their frequency of teleworking
- Telework locations – the mix between home-based and non-home-based telework
- Teleworkers' commute modes and commute distance on non-telework days
- Teleworkers' travel patterns to telework locations outside the home
- Sources of information teleworkers had used to learn about telework

Placement rates and average trips reduced per placement are derived for home-based teleworkers and for those working at telecenters or other non-home locations.

[7]The Telework TERM provides services to commuters who either work or live in Maryland. Residents of the District of Columbia and Virginia who also work in one of these states would not be eligible for Telework services. But residents of the District and Virginia who work in Maryland would be included. Similarly, residents of Maryland who work in the District or Virginia also would be included.

For the second population, the evaluation estimates the portion of teleworking influenced by the Telework TERM through direct telework assistance to employers. This is accomplished through analysis of data from a survey of telework-assisted employers to determine:

- Percentage of employers with telework programs before and after receiving Telework assistance
- Percentage of teleworkers at assisted sites before and after receiving assistance

Thus, the evaluation will define the telework universe and examine employers' and commuters' sources of information for telework and the value of that information or assistance in their starting or expanding telework programs to estimate the share of telework attributable to the TERM.

Performance Measures

Performance measures recommended to evaluate the Telework TERM include:

Participation, Satisfaction, and Utilization Measures:

- Number of employers that receive telework information or assistance from Commuter Connections
- Number of employers that implement/expand telework programs after receiving assistance
- Number of commuters who receive telework information / assistance from Commuter Connections
- Number of commuters who begin teleworking after receiving assistance
- Number of new teleworkers – home-based and non-home based
- Telework placement rate

Program Impact Measures:

- Daily vehicle trips reduced
- Daily VMT reduced (in miles)
- Daily emissions reduced (in tons of pollutants)

Data Needs and Sources

The following data are needed to assess Telework impacts. Each data source is described in Section 5.

Data Need	*Data Source*
• Regional home-based teleworkers	State of the Commute (SOC) survey
• Non-home-based teleworkers	SOC survey
• Telework frequency (days/week)	SOC survey
• Percent drive-alone on non-telework days	SOC survey
• Travel distance on non-telework days	SOC survey
• Travel distance to telework centers	SOC survey
• Commuters' source of telework information	SOC survey
• TW at assisted employers worksites	TW assistance survey

Proposed timing of data collection

- SOC survey – January-April 2013
- Commuter Connections Telework assistance survey – Early 2014

To avoid double counting benefits, the portion of impacts attributable to the employer assistance component of the Telework TERM will be subtracted from the Employer Outreach TERM.

4-B GUARANTEED RIDE HOME TERM

Program Description

The Guaranteed Ride Home (GRH) program eliminates a real or perceived barrier to use of alternative modes – the fear of being stranded without a personal vehicle. GRH provides free return transportation by taxi or rental car in the event of an unexpected personal emergency or unscheduled overtime to commuters who carpool, vanpool, use transit, or bike or walk to work at least two times per week on average. Commuters pre-register for GRH and may use the service up to four times per year. The program also allows "one-time exception" rides provided to non-registered commuters who used an alternative mode on the day a GRH trip was needed. Commuters who wish to use GRH again in the future must then register.

TERM Evaluation Changes Since FY09-FY11

- No changes

Stated Goals

COG/TPB defined the following regional goals for GRH for 2014:

- Maintain 36,992 GRH applicants
- Reduce 12,593 daily vehicle trips
- Reduce 355,136 daily vehicle miles of travel
- Reduce 0.1766 daily tons of NOx
- Reduce 0.0970 daily tons of VOC

Nature of Evaluation

GRH is intended to encourage drive-alone commuters to shift to alternative modes. Additionally, GRH is expected to help maintain existing alternative mode arrangements and increase frequency of alternative mode use. The evaluation measures the number of new alternative mode users whose shifts were influenced by GRH and the number of commuters who used alternative modes before registering who were influenced to increase use of the modes.

The GRH TERM evaluation for FY12-FY14 will estimate impacts for commuters who fall into either of two participation categories:

- Commuters who were registered for / participating in GRH at any time during the three-year evaluation period, even if they were no longer registered at the end of the period
- Commuters who did not register for GRH but took an "exception" trip during the three-year evaluation period

Performance Measures

The following performance measures are used for GRH:

Participation, Satisfaction, and Utilization Measures:

- Number of GRH applicants
- Number of one-time exception users
- GRH placement rate
- Percent of GRH participants who take a GRH trip
- Satisfaction of GRH users with the service

Program Impact Measures:

- Daily vehicle trips reduced
- Daily VMT reduced (in miles)
- Daily emissions reduced (in tons of pollutants)

Data Needs and Sources

The following data are needed to estimate GRH impacts. Each data source is described in Section 5.

Data Need	*Data Source*
• GRH applicants	GRH database/archived GRH database
• One-time GRH exception users	GRH database/archived GRH database
• GRH placement rate	GRH Applicant survey
• GRH VTR factor	GRH Applicant survey
• Average travel distance (trip length)	GRH Applicant survey

Proposed timing of data collection

- Commuter Connections GRH database – ongoing
- GRH Applicant survey – April-May 2013

Two subgroups are identified for GRH. The first sub-group includes participants who both live and work within the Washington Metropolitan Statistical Area (MSA). The second group includes participants who work within the MSA but live outside it. Placement rates, VTR factors (average trips reduced per placement), and travel distances are estimated for each of the two sub-groups. This distinction is made because credit for the "out of MSA" participants is discounted to eliminate the VMT reduction that occurs outside the MSA.

The analysis of GRH also includes steps to avoid credit double counting from overlap with two other TERMs. Overlap occurs between GRH and the Commuter Operations Center because some GRH applicants also obtain ridematch lists, transit information, or other commute assistance information. The COC impacts are discounted to account for this overlap. GRH results also will be adjusted to assign a portion of the GRH TERM's impacts to the Mass Marketing TERM to recognize that some GRH applicants will be influenced to apply for GRH by hearing a Mass Marketing advertisement.

4-C EMPLOYER OUTREACH TERM

Program Description

The Employer Outreach TERM is designed to encourage employers to implement new commute assistance programs and to expand the services they offer in existing programs. In this TERM, jurisdiction-based sales representatives contact employers, educate them about the benefits commuter assistance programs offer to employers, employees, and the region, and assist them to develop, implement, and monitor worksite commuter assistance programs. Commuter Connections assists the sales force with the following services, designed to enhance regional coordination and consistency:

- Computerized regional employer contact database
- Marketing and information materials
- Employer outreach sales and service force training
- Annual evaluation program
- Support to Employer Outreach Committee

TERM Evaluation Changes Since FY09-FY11

- No changes

Stated Goals

COG/TPB has defined the following regional goals for Employer Outreach for 2014:

- Maintain 581 total participating employers (100+ employees); 520 without bicycle support and 61 with bicycle support
- Reduce 64,644 daily vehicle trips
- Reduce 1,065,851 daily vehicle miles of travel
- Reduce 0.5485 daily tons of NOx
- Reduce 0.343 daily tons of VOC

Nature of Evaluation

Employer Outreach is aimed at increasing the number of private employers implementing worksite commuter assistance programs, but Employer Outreach is ultimately designed to encourage employees of client employers to shift from driving alone to alternative modes.

Two primary evaluation questions are thus important. First, how many employers start or expand commuter assistance programs? And second, how many employees use alternative modes in response to new employer-sponsored services at the worksite? The populations of interest for this TERM are:

- Employers that participate in Employer Outreach
- Employees at Employer Outreach worksites
- Employers that offer bicycle services (Employer Outreach for Bicycling)
- Employees at worksites that offer bicycle services

Differentiation Between New and Maintained Impacts – When the Employer Outreach TERM was adopted, the TPB established a goal that was to be achieved by June 2005 and evaluations conducted for periods through June 2005 measured impacts against this goal. Beginning with the 2008 Analysis, the Employer Outreach goals were re-set to include a goal for the overall program and a goal for new program

activity since 2005. For this reason, the 2008 and 2011 TERM Analyses defined two categories of Employer Outreach impacts: "new/expanded" impacts and "maintained" impacts. In the 2011 analysis, new/expanded impacts included impacts from employers that joined the EO program during the FY09-FY11 evaluation period and employers that were involved in EO before that time but expanded their commute services after that date. Maintained impacts included those from employers that joined EO before the FY09-FY11 period and made no changes since that date. These impacts were considered part of the baseline for EO.

A similar approach will be applied for the FY12-FY14 evaluation. New/expanded impacts will be defined for new or expanded employer programs since July 1, 2011. Maintained impacts will include those from employers that joined EO before July 1, 2011 and made no changes since that date. Additionally, impacts from program reductions will be "back-filled" from new or expanded programs.

Apply Batch Methodology for COMMUTER Model (v2.0) Runs – Evaluations conducted prior to 2008 classified employers into categories defined by their location and commute program services. Then trip reduction and VMT reduction factors derived from the COMMUTER Model (v2.0) as characteristic of those location and program types were applied to all employers with similar programs. The 2008 and 2011 TERM Analyses applied an improved method, in which the COMMUTER Model (v2.0) was run in a batch format that allowed each employer's program components to be modeled separately. The analysis thus calculated trip reduction for each employer individually. This will not change the results of the analysis, but will enable Commuter Connections to define individual employers' contributions to the impacts, should Commuter Connections or local jurisdictions choose to do so.

Employer Outreach for Bicycling – In the 2002 and 2005 TERM evaluations, bicycle programs offered by employers were evaluated separately from other Employer Outreach services under the Employer Outreach for Bicycling (EOB) TERM. In the 2008 and 2011 evaluations, EOB was incorporated into the overall EO TERM and will be addressed similarly in the 2014 evaluation. However, the contribution of these bicycle programs to the overall EO impact will continue to be calculated and reported separately. The Employer Outreach for Bicycling component also will include employers' support for bikesharing programs, particularly for employers that offer Bikeshare Corporate accounts to employees.

Performance Measures:

The following performance measures are recommended for Employer Outreach:

Participation, Satisfaction, and Utilization Measures:

- Number of employer clients (employers with commuter assistance programs and employers with bicycle programs) – total and new/expanded
- Number of employees at client worksites (worksites with commuter assistance programs and bicycle programs) – total and new/expanded
- Level/extent of employers' commuter assistance programs
- Alternative mode use at worksites with commuter assistance programs (placements)
- Employer satisfaction with outreach assistance and services

Program Impact Measures:

- Daily vehicle trips reduced
- Daily VMT reduced (in miles)
- Daily emissions reduced (in tons of pollutants)

Data Needs and Sources

The following data items will be used to calculate program impacts. Each data source is described in Section 5.

Data Need	*Data Source*
• Employers participating in Employer Outreach	ACT! database
• Participating employers that offer bicycling services to employees	ACT! database
• Employer characteristics	ACT! database
• Commuter assistance services at worksite	ACT! database
• Starting Average Vehicle Ridership (AVR)	Employee baseline surveys
• Ending AVR (estimated)	EPA COMMUTER Model 2.0
• Average travel distance	SOC survey

Proposed timing of data collection

- ACT! database – ongoing
- Employee baseline surveys – ongoing; data to be compiled in Fall 2013
- SOC survey – January-April 2013

The Employer Outreach TERM is the only TERM for which placement rates and VTR factors are not directly used to determine the number of new participants, vehicle trips reduced, or VMT reduced. This is because sufficient employee survey data is not available to assess employees' post-program travel behavior. These missing evaluation elements are modeled using the EPA COMMUTER Model (v2.0).

To estimate impacts, employers' starting mode shares and commuter assistance program strategies are input into the COMMUTER Model (v2.0) and the model estimates "after" mode split and average vehicle ridership, that is, with the program in place. The TERM analysis used this model in the 2002, 2005, 2008, and 2011 evaluations.

Model Coefficients – The EPA COMMUTER model (v2.0) that will be used for the 2014 analysis predicts likely change in employee commuting behavior for given changes in an employer's commute assistance program. The Model uses time and cost coefficients that are based on coefficients used by MWCOG in regional transportation modeling. During the 2008 evaluation, COG and the evaluation team adjusted the cost coefficients used in the model, to correct for the COMMUTER Model's tendency to overestimate the likely impacts of financial incentives on shifts to non-SOV modes. Descriptions of the adjustment and the original and adjusted coefficients are presented in Appendix E. In 2010-2011, COG revised the regional travel model, using data from a new Household Travel Survey. This might be expected to result in new regional cost and time coefficients. If the new COG regional model coefficients differ from those in effect during the 2008-2011 TERM evaluation period, the coefficients for the COMMUTER Model (v2.0) will be updated to be consistent with the regional model.

4-D MASS MARKETING TERM

Program Description

In 2003, Commuter Connections embarked on an ambitious effort to educate the region's commuters about alternatives to stress-filled solo commuting and to raise awareness of commute assistance services available through Commuter Connections and its partners. Radio, direct mail, and other media are used to create a new level of public awareness and to provide a call to action to entice commuters to switch to alternative modes. Other marketing-related programs and events have been added to the TERM since the start of the TERM. Support for Bike to Work Day was added to the Mass Marketing TERM in the 2005-2008 evaluation and the 'Pool Rewards carpool incentive program was added in the 2008-2011 evaluation.

The objectives of the Mass Marketing TERM are to:

- Raise regional awareness about the Commuter Connections brand
- Address commuters' frustration with congestion
- Induce commuters to try and adopt alternative commute modes

TERM Evaluation Changes Since FY09-FY11

- Added Car Free Day event to Mass Marketing calculation

Stated Goals

COG has defined the following regional goals for Mass Marketing for 2014:

- Encourage 11,023 commuters to switch modes
- Reduce 7,758 daily vehicle trips
- Reduce 141,231 daily vehicle miles of travel
- Reduce 0.0721 daily tons of NOx
- Reduce 0.044 daily tons of VOC

Nature of Evaluation

The Mass Marketing TERM has four populations of interest:

1) All commuters in the Commuter Connections service area
2) Commuter Connections rideshare and GRH applicants who were influenced by the marketing campaign to request Commuter Connections services
3) Commuters who participate in special events (e.g., Bike-to-Work Day, Car Free Day)
4) Commuters who participate in the 'Pool Rewards carpool incentive program

The Mass Marketing TERM presents two challenges not encountered in most of the other TERMs. First, it is more difficult to assess the influence of a strategy, such as a marketing campaign, that is applied to the general commuting public, than it is to identify and track known participants in a registration-based program such as GRH. Second, when commuters who changed travel behavior can be identified, it is still necessary to identify what motivated their change. So, the critical issue for this TERM is attributing changes in attitudes and behavior – to the mass marketing campaign, another TERM, or to some other outside influence.

Type of Changes Addressed – The Mass Marketing evaluation method examines impacts from three types of change, which are measured separately. The first is ***"directly" influenced*** change. These are mode shifts that are made when the ads motivate commuters to change mode with no intermediate contact with Commuter Connections. An example of this type of change would be a carpool formed when a commuter hears the ad and asks a co-worker to carpool. Direct influences can only be assessed through a regional survey of commuters that asks about mode change and the reasons for the changes.

This influence of Mass Marketing on the general commuting population will be assessed through questions in the State of Commute survey that estimate the incidence of mode shifting in the region and the motivation for the shift. If a mode shift is attributed to a message that is part of the Mass Marketing campaign, the associated trip, VMT, and emissions reductions can be credited to the campaign. Note that this calculation needs to correct for double counting with commuters who also cite influence of other TERMs on change.

The second type of change is "***referred*** change." These are mode shifts that occur when a commuter is influenced by an ad to contact Commuter Connections, such as when a commuter hears an ad for GRH and registered for the program. Under the evaluation method, any mode change the commuter makes in response to GRH would be measured through the GRH assessment, but a portion of the influence for that change should be credited to Mass Marketing, which provided the information about GRH.

Referred influences are best measured by tracking changes in the volume of requests of information and services through two Commuter Connections' traditional programs: the Commuter Operations Center and GRH. A comparison of the volumes of requests received during periods of media activity to periods without media activity can provide an estimate of the change in requests as a result of the ads. A prorated share of the impacts of these other TERM impacts then can be assigned to Mass Marketing.

The third type of Mass Marketing impacts covers "***special event***" changes, such as would occur following a Bike to Work Day event or participation in a program such as the 'Pool Rewards incentive program. Special events are typically short-term. For example, the Bike to Work Day event is one-day each year and the 'Pool Rewards program benefit period is just three months for an enrolled participant. But the influence of these events and program can be longer-lasting; their purpose is to introduce commuters to a new travel option, with the goal that some will continue using the new mode after the event or benefit period ends. Impacts for these activities will be calculated using data from a survey of participants conducted following the event/enrollment period, which defines changes in commuters' travel during the event/program, but also ongoing use of the mode in the months after the event/program ends.

Performance Measures

The following performance measures are proposed for the Mass Marketing TERM:

Direct / Referred Impacts – Participation, Satisfaction, and Utilization Measures:

- Percentage of regional commuters who are aware of ad campaign and messages
- Percentage of commuters with positive attitudes toward alt modes (e.g., willingness to try)
- Percentage of regional commuters aware of Commuter Connections programs/services
- Number of contacts to Commuter Connections (e.g., call volumes, web hits, registrants)
- Direct change placement rates (temporary and continued change)

Special Events / Special Programs – Participation, Satisfaction, and Utilization Measures:

- Number of riders participating in Bike to Work
- Participants' frequency of bike commuting before and after the Bike to Work Day event
- Number of commuters participating in Car Free Day
- Participants' frequency of alternative mode use before and after Car Free Day
- Number of commuters participating in 'Pool Rewards
- Participants' frequency of alternative mode use before, during, and after 'Pool Rewards

Program Impact Measures:

- Daily vehicle trips reduced
- Daily VMT reduced (in miles)
- Daily emissions reduced (in tons of pollutants)

Data Needs and Sources

Data Needs	*Data Source*
Advertising Campaign	
• Regional commuters aware of ads / messages	SOC survey
• Percentage of commuters who make alternative mode changes after ads	SOC survey
• Influence of ads on mode change	SOC survey
• Contacts to CC info sources	SOC survey and COC tracking
• MM placement rates (temporary and continued)	SOC survey and COC tracking
• MM VTR factors	SOC survey, GRH survey, CC Applicant Placement survey
Bike to Work Day (BTWD)	
• Number of BTWD participants	BTWD survey
• Bike use before, during, and after event	BTWD survey
• Average travel distance	BTWD survey
'Pool Rewards ('PR)	
• Number of 'PR participants	'PR database
• Carpool use before, during, and after enrollment	'PR database
• Average travel distance	'PR database
Car Free Day (CFD)	
• Number of CFD participants	CFD database
• Alternative mode use before and during event	CFD database
• Average travel distance	CFD database or SOC survey

Proposed timing of data collection

- SOC survey – January-April 2013
- CC Applicant Placement survey – December 2011 (completed)
- GRH Applicant survey – April-May 2013
- Commuter Operations Center (COC) tracking – Ongoing
- Bike-to-Work Day (BTWD) event survey – Fall 2013
- 'Pool Rewards program mode use – Ongoing
- Car Free Day event survey – TBD 2014 or 2015

Not all increases in program inquiries resulting from indirect impacts will be assigned to the Mass Marketing TERM. The share of GRH and COC indirect impacts to be assigned to MM will be determined by estimating the increase in applications that occur during period when MM ads are run. These credits will be subtracted from GRH or COC to avoid double counting.

4-E COMMUTER OPERATIONS CENTER

Program Description

Since the 1970's, COG has offered basic commute information and assistance, such as regional ridematching database, to commuters living and/or working in the Washington metropolitan region. Prior to 1997, when Commuter Connections was established, these services were provided by COG's RideFinders program. Because these services were available when the emissions baseline was developed for regional conformity, the Center was not established as a TERM, but was included in the region's TIP as an ongoing program and also is part of the region's congestion management process. But only benefits above the 1997 baseline are included as a TERM.

The function of the Commuter Operations Center is to increase commuters' awareness of alternative modes, through regional and local marketing and outreach programs and to encourage and assist commuters to form ridesharing arrangements. Encouraging commuters who drive alone to shift to alternative modes is a priority for the COC, but the COC also assists commuters who now use alternative modes to continue to do so, by offering ridematching and transit assistance when carpools break up or commuters' travel patterns change and disrupt existing alternative mode arrangements.

Commuter Connections program services include: carpool and vanpool matchlists, transit route and schedule information, information on Park & Ride lot locations and HOV lanes, telework information, commute program assistance for employers, GRH, and bicycling and walking information. Commuters obtain services and information primarily through the Commuter Connections website, but also can call a toll-free telephone number or contact a local partner assistance program for personal assistance from a commuter services representative.

Included within the Commuter Operations Center program is the Integrated Rideshare TERM-Software Upgrades Project. When it began, the Integrated Rideshare TERM provided improvements to the quality and delivery of alternative mode information. In particular, the TERM added transit, park and ride, telecenter, and bicycling information to carpool/vanpool ridematch lists to inform commuters of the range of travel options that were available. Since 2008, when Commuter Connections introduced its updated web-based TDM system, these additional services have been available on a self-service basis through the online information system. But these services represent upgrades to the original ridematching services, so their impacts are captured under the Commuter Operations Center, but are reported separately in the regional TERM tracking sheet.[8]

TERM Evaluation Changes Since FY09-FY11

- *Transit Information Impacts* – The online information system introduced in 2008 substantially changed the way in which commuters access transit information from Commuter Connections. Although Commuter Connections could and did provide information on transit service under the previous system, commuters primarily contacted Commuter Connections for carpool and vanpool match information. It was thus relatively easy to ask commuters in the placement survey if they recalled receiving transit information and identify commuters who received, but had not request-

[8] The Integrated Rideshare TERM originally had two components; Ridematching Software Upgrades, and Inf-Express Kiosks. The InfoExpress Kiosk project was discontinued during the 2005-2008 evaluation period.

ed transit information by comparing their response to the requested services noted in the applicant database.

With the new system, however, commuters who visit the website see that transit information is available and can access it directly. The 2011 online system placement survey reported a much higher use of transit information among online system users than had occurred in past surveys. But it is not clear from the survey data if the commuter visited the website specifically to obtain transit information or came for another purpose (e.g., ridematch) and accessed the transit information as an unplanned but serendipitous action, analogous to the "software upgrade" objective of the TERM. This suggests that additional questions might be needed in future applicant placement surveys to determine the share of online system users who are prompted to access information they weren't initially seeking.

- *Bicycle Information Impacts* – The online information system introduced in 2008 also includes substantially-enhanced bicycling information, such as an interactive bicycle route map and links to other bicycle commute resources. In past evaluations, the Integrated Rideshare-software Upgrades impact included travel change made in response to receiving transit and Park & Ride information, but impacts related to receiving bicycle information were not calculated. The 2014 TERM analysis will add this component to the calculation, using data collected in the 2011 Applicant Placement Survey.

Stated Goals

COG has defined the following goals for the Commuter Operations Center for 2014:

Commuter Operations Center (basic services)

- Register 152,356 commuters
- Reduce 10,399 daily vehicle trips
- Reduce 296,635 daily vehicle miles of travel
- Reduce 0.1474 daily tons of NOx
- Reduce 0.0808 daily tons of VOC

Integrated Rideshare-Software Upgrade Project (additional to Basic COC)

- Reduce 2,370 daily vehicle trips
- Reduce 62,339 daily vehicle miles of travel
- Reduce 0.031 daily tons of NOx
- Reduce 0.017 daily tons of VOC

Nature of Evaluation

Since the basic Commuter Connections ridematching and information services are covered in the conformity baseline, this evaluation component seeks to credit the program with any increases in effectiveness due to program enhancements not covered by other TERMs. Thus, the basic approach is to determine the total transportation and air quality impacts for all Commuter Connections services and subtract out impacts assigned to GRH, Mass Marketing, and any other TERM that overlaps with the COC. The balance of impacts equals the impacts of the COC.

The Integrated Rideshare-Software Upgrade component is directed to a subset of Commuter Connections clients; applicants who remember receiving transit and/or Park and Ride, Telecenter locations, and

bicycling information with other ridematching information provided through the Commuter Operations Center. This program is aimed at improving the quality and availability of commute information and encouraging commuters to try transit, bicycling, and telework for occasional and full-time use, even if they did not have these options in mind when they contacted Commuter Connections for assistance. Integration of transit and Park & Ride, Telecenter locations, and bicycling information into the computer system will be evaluated through the applicant placement rate survey, described in Section 5. From this survey, a separate placement rate can be derived for those who shifted to an alternative mode after receiving transit or Park & Ride, telework, and bicycling information.

Performance Measures

The following performance measures are proposed for the Commuter Operations Center:

COC (Basic) – Participation, Satisfaction, and Utilization Measures:

- Number of commuters who use the online information system
- Distribution of services accessed (e.g., ridematch, transit, bicycle, telework)
- Online system placement rate
- Applicant satisfaction with online service

Integrated Rideshare-Software Upgrades Project – Participation, Satisfaction, and Utilization Measures:

- Number of applicants who remember receiving or accessing transit, P&R, telework, or bicycle information through the online system
- Number of applicants who use transit, P&R, telework, or bicycle information that was received but not specifically requested
- Software upgrade placement rate (percentage of applicants who use the software upgrade information to shift to an alternative mode)

Program Impact Measures (basic COC and Software Upgrades):

- Daily vehicle trips reduced
- Daily VMT reduced (in miles)
- Daily emissions reduced (in tons of pollutants)

Data Needs and Sources:

The following data items will be used to calculate program impacts for the Commuter Operations Center, including the improved transit information from the software upgrades. Each data source is described in Section 5.

Data Needs	*Data Source*
Commuter Operations Center (Basic)	
• Commuter Connections (CC) online system users	CC online system database
• COC placement rate	CC Online Placement survey
• COC VTR Factor and average travel distance	CC Online Placement survey
• Vehicle trips and VMT assigned to other TERMs	Results of other TERM evaluations

Integrated Rideshare–Software Upgrades (IR-SU)

- Database applicants — CC Online system database
- Applicants who remember receiving transit, P&R, bicycle information — CC Online Placement survey
- IR-SU placement rate — CC Online Placement survey
- IR-SU VTR Factor — CC Online Placement survey
- Average travel distance — CC Online Placement survey

Proposed timing of data collection

- Commuter Connections database – ongoing
- CC Online Placement survey (November 2011) – completed, next survey November 2014
- SOC survey – January-April 2013

Double counting is avoided by subtracting the credit assigned to the Integrated Rideshare-Software Upgrades from the impacts calculated for the Commuter Operations Center (Basic).

SECTION 5 DESCRIPTION OF DATA SOURCES

Much of the data needed to perform the evaluation outlined in this framework is available from two basic sources. Data on program participation will be obtained from ongoing monitoring activities of Commuter Connections and its partners in the form of application records, GRH registration forms, etc. The basic source of travel impact and attitudinal information is periodic surveys of applicants, service users, or the public-at-large. All the surveys proposed for FY12-FY14 have been used in past years; all will be reviewed and modified as needed for the 2014 evaluation. The data sources and surveys can be divided into two groups as follows:

Ongoing Monitoring

- Commuter Connections GRH registrant database and archived GRH database(GRH)
- ACT! Employer Contact database (Employer Outreach and Telework)
- Commuter Operations Center activity tracking (Mass Marketing)
- Bike to Work Day participant records (Mass Marketing)
- 'Pool Rewards registrant database (Mass Marketing)
- Car Free Day participant records (Mass Marketing)
- Commuter Connections online information user database (COC, IR-SU)

Existing/Ongoing Surveys

- Telework assisted employer follow-up survey
- State of the Commute survey
- GRH registrant survey
- Employee commute surveys (voluntarily administered by employers)
- Commuter Connections online assistance placement rate survey (completed in November 2011)
- Bike-to-Work Day participant survey

Each data source, survey, and analysis tool is described below, noting the TERM or TERMs for which it collects evaluation data. Table 1 serves as a quick reference for the proposed uses of each data source. In general, the data are used for either or both of two purposes. The first, TERM tracking, monitors use of and user satisfaction with the TERMs. The second purpose, conformity analysis, refers to the calculation of transportation, air quality, energy, and cost impacts of the TERM. This evaluation framework document deals primarily with the second of the purposes.

Table 1
Data Collection Activities
Applicable TERMs and Uses of the Data

Evaluation Activity/Tool	Applicable TERM	Use of Data
Ongoing Monitoring		
• GRH registrant / archived database	Guaranteed Ride Home	TERM tracking, conformity analysis
• ACT! Employer Outreach & Telework Contact Database	Employer Outreach & Telework	TERM tracking, conformity analysis
• COC website and call volume tracking	Mass Marketing (Secondary – COC, GRH)	TERM tracking, conformity analysis
• Documentation of media / marketing activities	Mass Marketing	Conformity analysis
• Bike to Work Day participant records	Mass Marketing (BTW component)	TERM tracking, conformity analysis
• Car Free day participant records	Mass Marketing (CFD component)	TERM tracking, conformity analysis
• 'Pool Rewards participant records	Mass Marketing ('PR component)	TERM tracking, conformity analysis
• CC online information system user database	COC, Integrated Rideshare-Software Upgrades (Secondary – Mass Marketing)	TERM tracking, conformity analysis
Existing/Ongoing Surveys		
• Telework assisted employer follow-up survey	Telework	TERM tracking, conformity analysis
• State of the Commute survey	Telework, Mass Marketing	Commute trends, conformity analysis
• GRH registrant survey	Guaranteed Ride Home	Conformity analysis
• Employee commute surveys (employer administered)	Employer Outreach	TERM tracking, conformity analysis
• CC online system user placement rate survey	COC, Integrated Rideshare-Software Upgrades (Secondary – Mass Marketing)	TERM tracking, conformity analysis
• Bike-to-Work participant survey	Mass Marketing (BTW component)	TERM tracking, conformity analysis

ONGOING MONITORING

Program activity and utilization tracking is an ongoing function already performed by Commuter Connections staff and regional partners. Included here are records of services provided (e.g., number of employers contacted and GRH rides provided) and information on requests received (e.g., number of ridematch applications). It is important to track these activities by program element, especially for activities within TERM programs.

The information gathered in the ongoing tracking process is summarized in a quarterly Commuter Connections "report card" that shows participation and utilization data and applies factors generated from the most recent placement rate survey to estimate travel, air quality, energy and consumer savings benefits for the quarter. This tool is used primarily by COG/TPB staff and staff of regional Commuter Connections partner programs as a quarterly check of progress in various activity and program areas. Annual Commuter Connections evaluation results also are reported to other policy-makers and to program funding agencies. Additional details on how Commuter Connections evaluation results will be reported are presented in Section 7.

- GRH Registrant / Archived Database – Ongoing tracking of registered and one-time exception GRH users. Database includes contact information, mode at time of registration, and GRH uses. *(Used for GRH TERM.)*

- ACT! Employer Client Database – Tracks the number of employers participating in Employer Outreach Program and the commuter assistance services they offer in worksite programs, including Telework. Sales representatives who assist employers to begin and maintain commuter assistance programs update the database when new employers join the program and when employers already participating in EO change their commuter assistance services. The database includes information on employer characteristics (e.g., number of employees, location, transit accessibility) and on the strategies (e.g., transit subsidies, GRH, preferential parking, teleworking) that the employer offers. *(Used for Employer Outreach and Telework TERMs)*

- Documentation of Commuter Connections Media / Marketing Activities – Ongoing tracking of the dates and types of media activities (media buys, direct mail, Internet outreach, etc) and the number and time distribution of telephone and Internet information requests made to Commuter Connections. Maintained/compiled by Commuter Connections staff, staff of GRH online system vendor, and COG marketing consultant. *(Used for Mass Marketing TERM; secondary use for GRH TERM and Commuter Operations Center, including Integrated Rideshare-Software Upgrades Project)*

- Bike-to-Work Day Records – Provides contact information on commuters who register to participate in Bike-to-Work Day. *(Used for Mass Marketing TERM)*

- Car Free Day Records – Provides information on commuters who register to participate in Car Free Day. Data include contact information, mode used prior to CFD, and mode registrant pledges to use on CFD. *(Used for Mass Marketing TERM)*

- 'Pool Rewards Registrant Records – Provides information on commuters who register to participate in 'Pool Rewards carpool incentive program. Data include contact information, mode used for commuting prior to registration, and carpool days recorded during the enrollment period. *(Used for Mass Marketing TERM)*

- Commuter Connections Online Information System Database – Ongoing tracking of commuters who establish accounts for the online information system and counts of non-registered users. Includes contact information for account holders *(Used for Commuter Operations Center, including Integrated Rideshare-Software Upgrades Project; secondary use for GRH and Mass Marketing TERMs)*

EXISTING/ONGOING SURVEYS

Several surveys are conducted by Commuter Connections to follow-up with program applicants and assess user satisfaction. These surveys also provide data used to estimate program impacts. Some of the surveys, such as the online system user placement survey and GRH Survey, also provide information used by Commuter Connections staff to fine tune program operations and policies.

- Employer Telework Assistance Follow-up Survey – Sent to employers in Maryland that received telework assistance from Commuter Connections to determine if and how they used the information they received. Specifically, the survey asks if the employer has started or expanded a telework program since receiving the information and if the information was helpful. This information is used to estimate the number of teleworkers who were indirectly influenced by Commuter Connections Telework Assistance. *(Used for Telework TERM)*

- State of the Commute Survey – The SOC survey, a random sample survey of employed adults in the Washington metropolitan region, serves several purposes. First, it establishes trends in commuting behavior, such as commute mode and distance, and awareness and attitudes about commuting, and awareness and use of transportation services, such as HOV lanes and public transportation, available to commuters in the region. To this end, it will be compared to data from past State of the Commute surveys (2001, 2004, 2007, and 2010).

  SOC survey data also are used to estimate the impacts of TERMs that have a possible influence on the population-at-large. Specifically, the survey generates information for the Mass Marketing and Telework TERMs, both of which have broad application and for which it is not possible to identify all users from any Commuter Connections database. The survey also is used to assess awareness of the regional GRH program.

  Next, by querying respondents about their attitudes about alternative modes and reasons for choosing or not choosing alternative modes, the survey also suggests how commuter service programs and marketing efforts influence commuting behavior in the region. In this way, it helps to establish the influence of the Mass Marketing advertising messages on mode switching and use of Commuter Connections services, provides opinion research data that could contribute to assessment of broad social and personal benefits of commute programs, and offers an opportunity to test concepts for new services.

  Finally, the 2013 State of the Commute survey will collect data on specific roadways that commuters who travel in personal vehicles use to travel to work and the routes that commuters who travel by public transit would use if they drove to work. These data, in conjunction with data on commuters' modes, will enable analysis of the spatial distribution of alternative mode travel and identification of the routes that are most affected by TERM programs. In the TERM analysis, these data will be used

to estimate the impact of vehicle and VMT reductions from TERM programs on transportation system performance, at the specific corridor level.

The State of the Commute survey is a triennial survey and will be conducted in early 2013. For the first time, the survey will include samples for both landline phones and cell phones. *(Used for Telework and Mass Marketing TERMs)*

- GRH Applicant Survey – Commuters who register with the GRH program or use a one-time exception trip will be surveyed to establish how the availability and use of GRH influenced their decision to use an alternative mode and to maintain that mode. Satisfaction with GRH services also will be polled. Some data collected in the survey, such as current and previous mode, travel distance, and access mode, will be used to develop the GRH placement rate and VTR factor.

  In past TERM evaluations, interviews for the GRH survey have been conducted via telephone. But in 2008, Commuter Connections transitioned to an online ridematching and GRH system. This will facilitate the use of the internet for some data collection. A pilot internet GRH survey was conducted as a companion to the 2007 GRH survey to test the potential of this method. The pilot documented that the results for the telephone and Internet samples were not statistically different in any variable that was important to the TERM analysis and that either an internet alone or an internet/telephone combination would be a valid option.

  For this reason, the methodology for the GRH survey has been modified to use a combination of internet and telephone methods for interviewing. COG's online database vendor has programmed the GRH survey questionnaires for online application. This tool will be used to survey applicants who have provided an email address. To ensure that all GRH registrants are eligible for the survey, telephone interviews will be conducted with a sample of respondents who did not provide an email address. The data from the two methods will be combined for analysis of the GRH survey and used to estimate impacts for the GRH TERM.

- Employee Commute Surveys – Some employers conduct baseline surveys of employees' commute patterns, before they develop commuter assistance programs and follow-up surveys after the programs are in place. The results of these surveys also are available through an employee survey database. *(Used for Employer Outreach TERM)*

- Commuter Connections Online Information System User Placement Rate Survey – Since May 1997, Commuter Connections has conducted commuter applicant placement surveys to assess the effectiveness of the Commuter Operations Center and other program components. Data from the applicant placement surveys are used to calculate placement rates and VTR factors for the Commuter Operations Center and for the Mass Marketing TERM (referred impacts). The surveys also assess users' perceptions of and satisfaction with the services provided.

  One placement survey will be used in the FY12-FY14 evaluation period. This was conducted in November 2011. Results of the survey conducted during this evaluation period were presented in a survey report.[9] Reported results are primarily for internal use by program and technical staff, but results also can be summarized for policy makers, such as the TPB, the TPB's Technical Committee,

[9] Fiscal Year 2012 Applicant Database Annual Placement Survey Report, Applications Received During July-September 2011 (November, 2011 Survey), May 15, 2012.

and other regional policy makers. In the future, selected results may also be summarized for distribution to the media, employers, commuters, and the public-at-large. *(Used for the Commuter Operations Center (Basic), and Software Upgrades; secondary use for Mass Marketing and GRH TERMs)*

- Bike-to-Work Day Participant Survey – A survey among registered participants in the Bike-to-Work Day event is undertaken to assess travel behavior before and after the Bike-to-Work Day, as well as commute distance and travel on non-bike days. *(Used for Mass Marketing TERM)*

ANALYSIS TOOLS

The EPA COMMUTER model (v 2.0), which will be used for the 2014 analysis of the Employer Outreach TERM, predicts likely change in employee commuting behavior for given changes in an employer's commute assistance program. The Model uses time and cost coefficients that are based on coefficients used by MWCOG in regional transportation modeling. During the 2008 evaluation, COG and the evaluation team adjusted the cost coefficients used in the model, to correct for the COMMUTER Model's tendency to overestimate the likely impacts of financial incentives on shifts to non-SOV modes. A description of the adjustment and the original and adjusted coefficients are presented in Appendix E. In 2010-2011, COG revised the regional travel model, using data from a new Household Travel Survey. This might be expected to result in new regional cost and time coefficients. If the new coefficients differ from those used in the 2011 evaluation, the coefficients used in the COMMUTER Model (v2.0) will be updated to be consistent with the regional model.

SECTION 6 BASIC METHOD FOR CALCULATING PROGRAM IMPACTS

This section presents the methodology for calculating and quantifying the travel, air quality, energy and commuter cost impacts of the TERMs. Following are the basic calculation steps common to all TERMs (except Employer Outreach, which uses a modeled method and Mass Marketing, which uses information from the State of the Commute and COC activity tracking to assess mode change due to the campaign). Specific examples of the evaluation calculations and unique methodological elements for each TERM and for the Commuter Operations Center are included in Appendices F through K:

- Appendix F – Telework
- Appendix G – Guaranteed Ride Home
- Appendix H – Employer Outreach
- Appendix I – Mass Marketing
- Appendix J – Commuter Operations Center
- Appendix K – Integrated Rideshare – Software Upgrades Project

DOCUMENTING PROGRAM PARTICIPATION AND UTILIZATION

The evaluation of program impacts requires first an accurate documentation of the participation of employers and commuters in each TERM program. Commuter Connections staff and local jurisdiction program partners will need to consistently and continuously track the number of participants or users of each TERM. Specifically, we propose that the following be counted:

- Employers participating in Commuter Connections' Telework activities should be tracked through telework contact records in the regional ACT! Employer Outreach database. Telework placement rates (proportion of employees at the worksites who become teleworkers) and a corresponding VTR factor will be developed from data collected in the Maryland employer telework follow-up survey.

- GRH registrants and one-time exception users should be tracked as a group, separately from all applicants. A GRH placement rate and VTR factor will be developed from the GRH survey.

- Private and non-profit employers participating in the Employer Outreach TERM – Continue to track details about the employer size, location, transit access, and the commuter assistance services that are offered at the worksite.

- Commuters participating in Bike-to-Work Day, Car Free Day, 'Pool Rewards, and other Mass Marketing special events/programs should be tracked to determine the total number of participants as part of the Mass Marketing TERM.

- Commuters who request or access Commuter Connections assistance also will be tracked, as will the type of information requested (e.g. ridematching, transit information, telework assistance, bicycle information, etc.). Using the results of the online system user placement survey and other surveys conducted under this project, separate placement rates will be developed for the Commuter Operations Center and for the Software Upgrade component previously included in the Integrated Rideshare TERM but now part of the COC section in this report.

The purpose of this tracking process is to determine the "population base" to be used to quantify impacts and then to credit those impacts to the TERM from which they were derived. Other program information, in addition to participation and utilization, also should be tracked and documented for use in program refinement.

Information on participation and utilization will be included in quarterly and annual program summaries. The intent is for Commuter Connections and its partners to input participation results, credited to each TERM, into a form that allows for the calculation of impacts. This is accomplished with a simple spreadsheet that includes the factors discussed below.

CALCULATING PROGRAM IMPACTS

The following subsection provides an example of how program impacts will be calculated for the five TERM programs and for the Operations Center. As each of these services has become fully operational, tailored surveys have been developed to produce unique placement rates and VTR factors for each TERM.

The calculation method is designed to:

- Quantify the benefits of the program
- Compare projected impacts to actual results
- Be simple to understand and apply
- Be inserted into simple spreadsheet program for quarterly and annual reporting

Nine basic steps are used to calculate program impacts. These steps are described on the next page. A hypothetical numerical example of the steps is presented in Figure 1 for one TERM.

TERM Evaluation
Basic Program Impact Calculation Methodology Steps

1. Estimate commuter "population base" for the TERM	= e.g., all commuters, GRH applicants, CC online system users, EO employees
2. Calculate placement rate (from commute survey data)	= Proportion of commuters who made a travel change as a result of the TERM
3. Estimate number of "placements"	= Population base x placement rate
4. Estimate VTR factor (from commute survey data)	= Average daily vehicle trips reduced per placement
5. Estimate vehicle trips (VT) reduced	
- GRH, COC, Telework, MM	= placements x VTR factor
- Employer Outreach	= Modeled method
6. Estimate VMT reduced	= Vehicle trips reduced x avg. trip length
7. Adjust VT and VMT for SOV access	
- Adjusted vehicle trips reduced	= Total vehicle trips – SOV access trips
- Adjusted VMT reduced	= Total VMT – SOV access VMT
8. Estimate emissions reduced	= Vehicle trips x "trip end" emission factors = VMT x "running" emission factor
9. Estimate energy and commuter savings	= VMT reduced x average fuel consumption = VMT reduced x average vehicle operating cost

Figure 1
Example of Basic Program Impact Calculation Methodology Steps for a TERM
(Note: hypothetical example; do not use factors in the example for actual evaluation purposes)

1.	Estimate TERM "population base"	= 8,000 commuters
2.	Calculate placement rate	= 20%
3.	Estimate number of "placements"	= 8,000 x 0.2 =1,600 commuters placed
4.	Estimate VTR factor	= 0.7 daily vehicle trips reduced per placement
5.	Estimate vehicle trips (VT) reduced	= 1,600 x 0.7 trips reduced per placement = 1,120 daily vehicle trips reduced
6.	Estimate VMT reduced	= 1,120 vehicle trips reduced x 25 miles/trip = 28,000 daily VMT reduced
7.	Adjust VT and VMT for SOV access	(assume 60% of placements have SOV access and drive 5 miles to meeting point)
	- Adjusted vehicle trips reduced	= 1,120 trips – 0.6 x 1,120 = 1,120 - 672 = 448 vehicle trips (without SOV access)
	- Adjusted VMT reduced	= 28,000 VMT – (0.6 x 1,120 x 5 miles) = 28,000 – 3,360 = 24,640 VMT
8.	Estimate emissions reduced VOC	= 448 trips x 1.5364 gm/trip = 688 gm = 24,640 VMT x 0.1631 gm/VMT = 4,019 gm = (688 gm + 4,019 gm) / 907,185 gm/ton = 0.0052 daily tons VOC reduced
	Similar calculations used to estimate reductions of NOx, PM2.5 NOx precursors, PM2.5, and CO2	
9.	Estimate energy and commuter savings Energy saving (gallons of fuel)	= 28,000 daily VMT / 23.8 mpg = 1,176 gallons per day x 250 work days/yr = 294,000 gallons saved per year
	Commuter cost saving ($)	= 28,000 VMT x $0.164/mile = $4,592 per day x 250 work days/year = $1,148,000 saved per year / 1,600 placements = $727 saved per placement per year

Step 1 – Determine Commuter Population Base

It is important first to establish the population base, or population of interest, relevant to the specific TERM. This is the population that potentially could have been influenced by the TERM. Depending on the TERM being evaluated, this could be all commuters, GRH applicants, teleworkers, or some other population. In the example shown in Figure 1, the population base is 8,000 commuters.

Step 2 – Calculate Placement Rate

The next step in determining program impacts is to calculate the placement rate for the population base exposed to the TERM. The placement rate is equal to the percentage of commuters in the population base who shift to an alternative mode (carpool, vanpool, public transportation, walk/bike, telework) after receiving assistance under the TERM. Placement rates are calculated from survey data.

Two placement rates are calculated for each TERM, to account for the length of time the commuter uses the alternative mode after shifting: continued rate (did not shift back to original mode), and temporary rate (tried new alternative mode but shifted back to original mode within the evaluation period). For simplicity, Figure 1 shows only one placement rate, 20%. This means that 20% of the commuters in the population base made a change to an alternative mode as a result of the TERM. The placement rates for one TERM will not necessarily be the same as the placement rates for any other TERM.

Step 3 – Estimate Number of New Placements

Step 3 estimates the number of new commuter placements in alternative modes. This is the actual number of commuters who are expected to have made the shift to alternative modes as a result of the TERM. It is calculated by multiplying the placement rate (calculated in Step 2 from a survey of a sample of commuters in the population base) by the total population base. In the example in Figure 1, the calculation of placements is as shown below:

Placements = 8,000 commuters (population base) x 0.2
= 1,600 placements

Step 4 – Estimate VTR Factor

From the same survey data used to calculate placement rate, the Vehicle Trip Reduction (VTR) factor is next calculated. This is equal to the average daily vehicle trips reduced per placement. As described in Section 3, not all commuter placements will reduce the same number of trips. Three types of commute shifts are captured in the VTR factor:

1) Drive alone applicants shifting to alternative modes
2) Alternative mode users shifting to different alternative modes (e.g., carpool to transit)
3) Alternative mode users increasing the number of days they use alternative modes

The number of trips commuters reduce also depends on the frequency with which they use the alternative mode, compared to the number of days they used it before. The VTR factor combines the varied trip reduction results of all commuter placements to develop an average reduction per placement. An explanation of how the VTR Factor is calculated is provided in Appendix A and a numeric example is shown in Appendix B. As for placement rate, VTR factors might be different for different TERMs.

As shown in Figure 1, the VTR factor for the TERM in the hypothetical example is 0.70. This means that each of the placements for this TERM reduces, on average, 0.7 vehicle trips per day.

Step 5 – Estimate Daily Vehicle Trips Reduced

The number of daily vehicle trips reduced for the TERM is then estimated by multiplying the number of commuter placements from Step 3 by the VTR factor, the average number of daily trips reduced per placement, calculated in Step 4. The calculation of vehicle trips reduced for the example shown in Figure 1 would be as follows:

Vehicle trips reduced = 1,600 placements x 0.7 trips reduced per placement
= 1,120 daily vehicle trips reduced

Step 6 – Estimate Daily VMT Reduced

The total daily VMT reduced is calculated by multiplying the number of daily vehicle trips reduced (Step 5) by the average commute distance for the population of interest. The average distance for the population is calculated from the same survey data used to calculate the placement rate and VTR factor. The example in Figure 1 assumes that the average distance is 25 miles per one-way trip. Using this distance, the total VMT reduced for 1,120 vehicle trips is:

VMT reduced = 1,120 vehicle trips reduced x 25 miles per trips
= 28,000 daily VMT reduced

Step 7 – Adjust Vehicle Trips and VMT for SOV Access

Because a basic purpose for implementing the TERMs is to meet regional air quality emission reduction targets, single occupant vehicle (SOV) access to alternative modes must be considered. Emission reduction, as explained in Step 8, is calculated by multiplying vehicle trips reduced and VMT reduced by emission factors. But because commuters who drive-alone to meet a carpool, vanpool, bus, or train do create a "cold start," their trips must be subtracted from the vehicle trip reduction to assess the air quality impact of TERMs. Additionally, the distance they travel to the meeting point must be subtracted from the VMT reduced to obtain an accurate VMT count. It is these "adjusted" vehicle trips reduced and VMT reduced, rather than the initial totals, that are used to calculate emissions reduced.

In the example, it is assumed that 60% of the commuter placements drive alone to the rideshare or transit meeting point and that the average distance to this point is 5 miles. Using these figures, the "adjusted" vehicle trips reduced and VMT reduced are shown below:

Adjusted vehicle trips reduced = 1,120 trips – (1,120 x 0.6 with SOV access)
= 1,120 trips – 672 trips
= 448 vehicle trips reduced (for emissions calculation)

Adjusted VMT reduced = 28,000 VMT – (1,120 trips x 0.6 SOV access x 5 miles)
= 28,000 – 3,360
= 24,640 VMT reduced (for emissions calculation)

Step 8 – Estimate Daily Emissions Reduced

As noted in Step 7, daily emissions reduced are estimated by applying two regional emission factors, a "trip end emissions" factor and a "running emissions" factor, respectively, to the number of vehicle trips or "trip ends" reduced and to the VMT reduced to determine the pollutants (in this case NOx and VOC) reduced as result of the program. The trip end emissions factor accounts for the emissions created from a "cold start," when a vehicle is first started, and a "hot soak," that occur when the vehicle is later turned off. The running emission factor accounts for the emissions generated per mile of travel by a warmed-up engine.

For 2011, the FY09-FY11 TERM Analysis target year, the emission factors[10] were:

Emission Factors	NOx	VOC	PM2.5 NOx	PM2.5	CO2
• Trip end *(gm / one-way vehicle trip)*	0.582	1.5364	0.6652	0.0	0.0
• Running *(gm / mile)*	0.383	0.1631	0.4038	0.115	455.7

To estimate total daily emissions, the trip end emission factor is multiplied by the adjusted daily vehicle trips reduced (Step 7) and the running factor is multiplied by the adjusted daily VMT reduced (Step 7). These two products are then added to determine total daily NOx and VOC reductions in grams. This total is then divided by 907,185 grams per ton to convert the emissions reduced to tons per day. Using these emissions factors, the total VOC reduced for our example in Figure 1 is:

VOC = 448 trips x 1.5364 g/trip = 688 g
= 24,640 VMT x 0.1631 g/VMT = 4,019 g
= (688 gm + 4,019 g) / 907,185 g/ton

= 0.0052 daily tons VOC reduced

The emission reductions for the other four pollutants (NOx, PM2.5 NOX precursors; PM2.5, and CO2) are calculated similarly, using emission factors noted above for each pollutant. However, emissions for PM2.5, PM2.5 NOx precursors, and CO2 are reported as annual reductions, rather than daily reductions. This additional calculation is made by multiplying daily impacts by 250 working days per year.

Step 9 – Estimate Energy and Commuter Cost Savings

While air quality is the primary impact driving the TERM analysis, energy and consumer benefits also are real and tangible benefits from commuter assistance programs. For this analysis, energy and commuter cost savings factors are applied to the VMT reduced. These factors are as follows:

- Energy savings are based on an average fuel consumption factor of 23.8 miles per gallon for the Washington metropolitan area fleet of light duty vehicles (2011 data, provided by MWCOG staff)
- Consumer savings are based on an average marginal operating cost per mile (oil, gasoline, maintenance) for a mix of vehicle types and average distance driven per year. The American Automobile Association estimated a composite national average cost to be 17.0 cents per mile in 2011, the most recent period for which AAA prepared cost estimates. When the 2014 TERM analysis is conducted, the cost per mile will be updated to reflect expenses at that time.

[10] The emission factors presented here are derived from the MOBILE 6.2 emission model. If the model parameters or inputs change, the emission factors also could change.

For this analysis, energy and commuter cost savings are calculated by multiplying the energy and consumer cost factors to the total (not adjusted) VMT reduced. As shown in Figure 1, the daily and annual energy and cost savings for the example TERM are as follows:

Energy saving (gallons of fuel)	= 28,000 daily VMT / 23.8 mpg
Daily saving	= 1,176 gallons per day
Annual saving (250 work days)	= 294,000 gallons saved per year
Commuter cost saving ($)	= 28,000 VMT x $0.170/mile
Daily saving	= $4,760 per day
Annual saving (250 work days)	= $1,190,000 saved per year
Annual saving per commuter (based on 1,600 placements)	= $744 saved per placement per year

SAMPLE CALCULATIONS OF IMPACTS FOR EACH TERM

The impact calculation methodology described above described the basic steps applied to all TERMs and provided one hypothetical numerical example. However, each TERM has unique placement rates and VTR factors and some of the steps differ slightly. Specific examples are presented for each TERM in Appendices C through H.

It should be noted that the numbers shown in the example are from the 2011 TERM Analysis Report, which forms the basis of this evaluation framework. The actual FY12-FY14 values for placement rates, VTR factors, trip distances, SOV access percentages, and other calculation variables will be computed after the appropriate surveys have been completed and are likely to be somewhat different that the values shown in the appendices examples. The appendices are provided for illustrative purposes only.

SECTION 7 REPORTING AND COMMUNICATION OF EVALUATION RESULTS

The objective of the evaluation process is to provide meaningful information on the performance of TERMs to decision-makers and other groups, including the TPB and other regional policy makers; COG program funders; Commuter Connections staff; TERM program partners, such as local jurisdictions and transportation management associations (TMAs); and employers and commuters who comprise Commuter Connections' clients.

These evaluations have provided detailed assessments of the effects of programs such as telework outreach, guaranteed ride home, employer outreach, mass marketing and ridematching. Because the TERMs were adopted to support the region's efforts to meet the conformity requirements of federal transportation and clean air mandates, these evaluations have focused primarily on analyzing travel and air quality impacts, such as vehicle trips and miles of travel reduced and emissions reduced from use of Commuter Connections program and reporting the results in technical reports.

However, the many surveys and analyses performed for the evaluation also collect a wealth of data on current travel patterns and trends, traveler attitudes, and customer satisfaction that could be used to "tell the Commuter Connections story" to other audiences to achieve purposes beyond conformity determination.

Possible other uses for TERM evaluation data include:

1. Inform decision-makers / funders of the cost-effectiveness of providing choices and promoting transportation demand management strategies to garner more TDM program support and resources
2. Demonstrate accountability, transparency and credibility as an objective source/steward of modest public resources
3. Increase marketing and service effectiveness by actively engaging existing and potential customers in outreach and feedback

By expanding the range of data transmitted and by focusing the presentation of data on the needs and interests of other audiences, Commuter Connections could expand the value of its data collection and analysis investment and provide value to various new audiences.

EXISTING REPORTING

Commuter Connections currently uses four primary reporting mechanisms to disseminate program evaluation results:

- Survey reports and presentations
- Quarterly "Report Card"
- Program Annual Report
- TERM Analysis Report

Commuter Connections and/or a contractor produces a technical report for each data collection activity, such as the GRH survey report and the State of the Commute survey report. These reports present technical details of the survey methodology and results. Additionally, the responsible party also prepares presentation materials to summarize highlights of the research for technical audiences, such as the TDM Evaluation Group, Commuter Connections Subcommittee, the Transportation Planning Board, and the TPB Technical Committee.

COG/TPB's Commuter Connections staff prepare quarterly report card summaries for use by internal staff and local jurisdiction program partners to assess on-going progress. And the Program compiles an annual report distributed to COG/TPB staff, local jurisdiction program partners, and regional policy-makers for administrative purposes. Finally, Commuter Connections produces a triennial TERM Analysis Report that documents the impacts of the TERMs for the three-year TERM evaluation period. Formal review of each of these documents is an integral part of the work program development for both COG/TPB staff and Commuter Connections program partners.

But Commuter Connections' TERM evaluation activities collect a wealth of data on current travel patterns and trends, program utilization, and customer satisfaction that could be useful for many audiences and many purposes beyond conformity determination. By expanding the range of data transmitted and by focusing the presentation of data on the needs and interests of other audiences, Commuter Connections could expand the value of its data collection and analysis investment and provide value to various new audiences. Following is a brief outline of a process Commuter Connections could undertake to identify and develop new communication opportunities.

ENHANCED REPORTING

Following is an outline for three steps to enhance the reporting of TERM performance information, to support greater visibility, acceptance, and participation in TERM programs.

1 - Identify target audiences and information needs

2 – Repackage / expand reporting from existing research

3 – Define media / dissemination tools, particularly new outreach media and social media

Target Audiences and Information Needs

The first step would be to define audiences that might be receptive to receiving new or additional information and determine what information would be of value to them and the actions that Commuter Connections would like those audiences to take. Existing and new audiences could include the following:

- State and local decision-makers and funders
- Elected officials
- Commuter Connections program partners
- Local transportation planners, transportation providers
- Commuters / travelers
- Employers

To identify the range of information needs, Commuter Connections staff would solicit input from internal COG staff, funders, members of the TDM Evaluation Group and Commuter Connections Subcommittee on current and anticipated information needs for their key audiences. This information would be used to define specific data needed by each group, messages that would resonate with each group and the media that would be most relevant and appropriate to the audience segments:

- What issues / problems is each audience trying to address?
- What trends or conditions are influencing their organizational or personal success?
- Which issues / problems might have a transportation or TDM-related contribution?
- What information does the audience need to address the issues? What information and messaging would encourage the audience to select TDM actions?
- How could Commuter Connections' research results be packaged to be more useful to each audience?
- What media are used / could be used to reach each audience?

Repackage / Expand Reporting from Existing Research

As a next step, repackage / expand the reporting from existing Commuter Connections research reports to be suitable for different uses. This could include, for example:

- Prepare for key surveys (e.g., SOC, GRH), a 2-3 page survey brief that presents the "top findings" that would be of interest to non-technical audiences
- Post the brief on the Commuter Connections website / Facebook page; distribute to funders and decision-makers
- Excerpt from the brief for outreach to media contacts and elected officials
- Distribute highlights to local program partners for communications to elected officials and decision-makers
- Prepare highlights presentations; post to website / Facebook

Define Media / Dissemination Tools / New Outreach Media

Commuter Connections currently posts research reports on its website, for interested users to download. To expand the visibility of the results, explore options for new information formats, additional online distribution methods, and active distribution methods (e.g., social media, targeted emails, blogs, podcasts, videos, etc.).

Commuter Connections has a Facebook page (about 250 likes) and Bike to Work Day (followers) and Car Free Day (356 followers) programs are on Twitter. But there remains substantial room for growth. Surveys by Nielsen Research and Pew Research Center[11] regarding the use of media and social media found:

- Nearly a quarter of total time spent on the Internet is spent on social networks and blogs
- Nearly four in five active Internet users visit social networks and blogs
- Nearly 40% of social media users access social media content from their mobile phone
- 47% of adults access information on traffic and transportation and 19% of adults use mobile devices to get local traffic or public transportation information
- Social networking apps are the third most-used among U.S. smartphone owners and Internet users over 55 are driving the growth of social networking through the Mobile Internet

Action steps in this category also would need to build on a clear understanding of the audiences to be reached and the messages to be disseminated. But initial ideas could include:

- Post highlights of research on Commuter Connections Facebook page
- Distribute research results as downloadable ebook
- Release individual key research findings as Twitter posts
- Prepare targeted emails and blog posts on key findings of interest to specialized audiences and partner with local organizations to disseminate them
- Create brief video presentations on research highlights; post to website and Facebook

[11] Source: Pew Research Center's Project for Excellence in Journalism and Internet & American Life Project (2011

SECTION 8 EVALUATION SCHEDULES AND RESPONSIBILITIES

The key to any successful evaluation effort is for evaluation information to be generated and reported in a timely manner to decision makers. Commuter Connections prepares quarterly summaries for use by internal staff and local jurisdiction program partners to assess on-going progress. Annual or triennial evaluation results are reported to COG/TPB staff, local jurisdiction program partners, and regional policy-makers in a useful, easily-digestible manner for policy purposes. Formal review of the results is an integral part of the work program development for both COG/TPB staff and Commuter Connections program partners.

Evaluation activities fall into three categories, with various recommended schedules as described in Table 2. The first column shows evaluation activities in three categories: surveys, on-going tracking, and reporting. The second column indicates the recommended frequency for administering surveys and on-going tracking. The specific schedule for all data collection activities has been established by Commuter Connections and is included as Appendix I. The final column of Table 2 indicates the party that would be responsible for collecting or maintaining the data.

Table 2 also shows recommended results reporting activities. It is assumed that reports will be prepared following each survey (placement survey, GRH survey, SOC survey, etc.) to document the results of the survey and calculate updated placement rates and VTR factors (if applicable) for the populations surveyed. As Table 2 indicates, in addition to these reports, internal activity and evaluation reports also are produced to report the progress of the Commuter Connections program as a whole and for individual TERMs. A full TERM Analysis Report will be developed every three years to document the TERM impacts during the previous three-year period. Finally, as described in Section 7, Commuter Connections is considering additional methods to present and disseminate results of its TDM evaluations. The specific schedules for these activities will be documented as the activities are defined.

RECOMMENDED EVALUATION RESPONSIBILITIES

The primary responsibility for performing quarterly and annual evaluations will reside with COG/TPB. COG/TPB will assume responsibility for managing regular and special Commuter Connections survey efforts conducted by outside contractors and will conduct some surveys, such as the GRH satisfaction survey, using in-house staff. COG/TPB staff also will assemble ongoing monitoring data, oversee all activities, and seek input to ensure consistency with accepted TERM analysis methods.

Commuter Connections local jurisdiction program partners will play a role in tracking some ongoing activities, especially in Employer Outreach, and will review and provide input on TERM evaluation activities.

Contractors may be used for some data collection and evaluation activities as directed by Commuter Connections staff. GRH service providers will provide data on usage as required in their contracts. Finally, employers will work with the Commuter Connections network members to provide information on program service utilization.

Table 2
Data Collection and Reporting Activities
Frequency and Responsibility

Evaluation Activity/Tool	Frequency	Responsibility
Ongoing Monitoring		
• Telework assistance database	Ongoing	CC
• GRH registrant / archived database	Ongoing	CC
• ACT! employer contact database	Monthly	Sales representatives
• COC website and call volume tracking	Ongoing	CC
• Documentation of media / marketing activities	Ongoing	CC, Contractor
• Bike-to-Work Day participant records	Annual	CC
• Car Free day participant records	Ongoing	CC
• 'Pool Rewards participant records	Annual	CC
• Commuter Connections Applicant Database	Ongoing	CC, Contractor
Existing/Ongoing Surveys		
• Telework-assisted employer follow-up Survey	Triennial	CC
• State of the Commute survey	Triennial	Contractor
• GRH registrant survey	Triennial	CC
• Employee commute surveys	Ongoing	Contractor
• CC online system user placement rate survey	Triennial	Contractor
• Bike-to-Work participant survey	Triennial	CC
Evaluation Results Reporting		
• Commuter Connections "Report Card"	Quarterly	CC
• CC Program Annual Report	Annual	CC
• TERM Evaluation Report	Triennial	Contractor
• Commuter Connections survey reports	As produced	Contractor

CC – Commuter Connections

LIST OF APPENDICES

APPENDIX A
BASIC CALCULATION OF VTR FACTOR

The vehicle trip reduction (VTR) factor represents the average number of vehicle trips that a commuter "placed" in an alternative mode would reduce per day. The VTR factor combines the trip reduction results of three possible types of travel changes that new commuter placements might make:

1. Drive alone commuters shifting to an alternative mode
2. Commuters who currently use an alternative mode shifting to another alternative mode (e.g., from carpool to transit)
3. Commuters who currently use an alternative mode increasing their weekly frequency of alternative mode use (e.g., from carpool one time per week to carpool three times per week).

Shown below is a brief example of how the VTR factor would be calculated for seven commuter who made the following travel changes:

- Placement 1 – shifts from driving alone, 5 days per week, to a two-person carpool, 5 days per week
- Placement 2 – shifts from driving alone, 5 days per week, to transit, 5 days per week
- Placement 3 – shifts from driving alone, 5 days per week, to teleworking, 2 days per week and driving alone 3 days per week
- Placement 4 – shifts from driving alone, 5 days per week, to two-person carpool, 2 days per week and driving alone 3 days per week
- Placement 5 – shifts from a two-person carpool, 5 days per week, to transit, 5 days per week
- Placement 6 – shifts from transit, 5 days per week, to a two-person carpool, 5 days per week
- Placement 7 – increases the frequency of carpool from 1 day per week to 3 days per week, driving alone the other 2 days

The VTR factor is calculated by determining the number of vehicle trips all placements would reduce together and dividing that total by the number of placements. We assume that a commuter makes two trips a day, one from home to work and a second from work to home. Thus a commuter who drives alone would make 2 vehicle trips each day. If the commuter carpools, he would make ½ vehicle trip to work and ½ trip back home, for a total of 1 vehicle trip per day. A commuter who uses transit, bikes, or walks is assumed to make 0 vehicle trips. A commuter who teleworks also makes 0 vehicle trips for telework days.

Shown on the next page are the travel modes and the numbers of vehicle trips each of the seven commuters described above would make for each day of the week before the shift to an alternative mode and after the shift. The third column shows the net vehicle trips (number of trips after the shift minus number of trips before the shift). The final column shows the total weekly trips reduced. Note that commuter placement #6 actually increases his weekly commute trips, because he shifts from a higher occupancy alternative mode (transit) to a lower occupancy mode (carpool).

Appendix A, continued

Sample VTR Calculation
Travel Modes Before and After Shifts to Alternative Modes
By Commuter and by Day of the Week

	Vehicle Trips Before Shift					Vehicle Trips After Shift					Vehicle Trips Net Trips					Weekly
	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	Change
Placement 1	D	D	D	D	D	C	C	C	C	C						
DA to 2p CP	2	2	2	2	2	1	1	1	1	1	-1	-1	-1	-1	-1	-5 trips
Placement 2	D	D	D	D	D	T	T	T	T	T						
DA to TR	2	2	2	2	2	0	0	0	0	0	-2	-2	-2	-2	-2	-10 trips
Placement 3	D	D	D	D	D	D	D	C	C	C						
DA to TC/DA (part-time)	2	2	2	2	2	2	2	2	0	0	0	0	0	-2	-2	-4 trips
Placement 4	D	D	D	D	D	D	D	C	C	C						
DA to CP/DA (part-time)	2	2	2	2	2	2	2	2	1	1	0	0	0	-1	-1	-2 trips
Placement 5	C	C	C	C	C	T	T	T	T	T						
2p CP to TR	1	1	1	1	1	0	0	0	0	0	-1	-1	-1	-1	-1	-5 trips
Placement 6	T	T	T	T	T	C	C	C	C	C						
TR to 2p CP	0	0	0	0	0	1	1	1	1	1	+1	+1	+1	+1	+1	+5 trips
Placement 7	D	D	D	D	C	D	D	C	C	C						
DA/CP to CP (part-time)	2	2	2	2	1	2	2	1	1	1	0	0	-1	-1	0	-2 trips
Total weekly trips	11	11	11	11	10	8	8	7	4	4	-3	-3	-4	-7	-6	-23 trips

Total placements	= 7 placements (travel for each shown above)
Total trips reduced per week	= 23 trips per week (all placements together)
Total trips per day (all placements together)	= 23 trips per week / 5 days per week =4.6 trips per day
Average trips reduced per placement	**= 4.6 trips per day / 7 placements** **= 0.66 trips per placement**

The seven commuter placements would reduce a total of 4.6 trips during a single day, thus the average number of trips reduced per day by each of the seven placements would be 0.66. This is the VTR factor.

APPENDIX B
SAMPLE FULL CALCULATION OF VEHICLE TRIP REDUCTION (VTR) FACTOR

Summary of Current and Previous Mode for Survey Respondents
Who Made a Shift to an Alternative Mode

	Current One-Way Weekly Person Trips				Previous One-Way Weekly Person Trips				New One-Way Weekly Person Trips (current – prev)		
	DA	**RS**	**TR**	**RSOcc.**	**DA**	**RS**	**TR**	**RSOcc.**	**DA**	**RS**	**TR**
Drive alone shift to Transit											
	0	0	8	0	8	0	0	0	-8	0	8
	0	0	10	0	2	0	8	0	-2	0	2
	0	0	10	0	10	0	0	0	-10	0	10
Total	**0**	**0**	**28**		**20**	**0**	**8**		**-20**	**0**	**20**
Drive alone shift to Rideshare											
	2	6	0	2	8	0	0	0	-6	6	0
	0	2	8	8	2	0	8	0	-2	2	0
	0	10	0	3	2	8	0	2	-2	2	0
	0	10	0	2	10	0	0	0	-10	10	0
	0	10	0	3	10	0	0	0	-10	10	0
	0	8	0	13	8	0	0	0	-8	8	0
Total	**2**	**46**	**8**		**40**	**8**	**8**		**-38**	**38**	**0**
Rideshare shift to Transit *											
	0	0	10	0	0	2	8	3	0	-2	2
	0	0	10	0	0	10	0	3	0	-10	10
	0	0	10	0	0	10	0	4	0	-10	10
	0	0	10	0	0	8	2	2	0	-8	8
Total	**0**	**0**	**40**		**0**	**30**	**10**		**0**	**-30**	**30**
Rideshare shift to Rideshare (ex. carpool to vanpool)											
	0	5	0	3	0	5	0	2	0	0	0
	0	5	0	3	0	5	0	13	0	0	0
	0	10	0	3	0	10	0	3	0	0	0
Total	**0**	**20**	**0**		**0**	**20**	**0**		**0**	**0**	**0**
Transit shift to Other Transit (ex. bus to train) *											
	0	0	10	0	0	0	10	0	0	0	0
	0	0	10	0	0	0	10	0	0	0	0
Total	**0**	**0**	**20**	**0**	**0**	**0**	**20**		**0**	**0**	**0**
Transit shift to Rideshare*											
	0	10	0	2	0	0	10	0	0	10	-10
	0	10	0	2	0	0	10	0	0	10	-10
	0	10	0	12	0	0	10	0	0	10	-10
	0	10	0	4	0	0	10	0	0	10	-10
	0	10	0	3	0	0	10	0	0	10	-10
Total	**0**	**50**	**0**		**0**	**0**	**50**		**0**	**50**	**-50**
Average RS Occupancy				**4.5**				**4.0**			

Appendix B, continued

Summary of Travel Changes for all Respondents

Current One-way Weekly Trips (all respondents)

	DA	RS	TR/BW
Weekly person trips	2	116	96
Average RS occupancy	1	4.5	N/A
Weekly Vehicle trips (Person trips/RS occupancy)	2	25.8	0

Previous One-way Weekly Trips (all respondents)

	DA	RS	TR/BW
Person trips	60	58	96
Average RS occupancy	1	4.0	N/A
Vehicle trips	60	14.5	0

Net One-way Weekly Trips (all respondents) = current trips – previous trips

	DA	RS	TR/BW
Person trips	-58	58	0
Vehicle trips	-58	11.3	0

Weekly person trips reduced *(DA + RS+ TR/BW)*	0
Weekly vehicle trips reduced *(DA + RS + TR/BW)*	-46.7
Respondents with change	23
Average weekly vehicle trips reduced *(Weekly vehicle trips reduced / # of respondents)*	-2.03
Average daily vehicle trips reduced *(Average wkly vehicle trips reduced / 5 days per week)*	**-0.41**

* For purpose of VTR calculation, Transit category also includes bike/walk

NOTE: Numbers shown in this sample calculation are not based on actual survey data. Data were created as a hypothetical example for illustration only.

APPENDIX C
CONCEPTUAL APPROACH TO DOCUMENT TERM IMPACTS ON TRANSPORTATION SYSTEM PERFORMANCE

Background

One new performance measurement need that the Framework document specifically anticipates is that of documenting TERM impacts on transportation system performance to help Commuter Connections better position itself in regional performance-based planning. Transportation decision-making and investment is increasingly focused on system performance – travel speed, volume, congestion, delay, and travel time reliability – measures that require an understanding of the temporary and spatial distribution of travel. The current TERM analysis evaluates Commuter Connections' impacts only at a regional/aggregate level; it does not estimate where and when reductions in vehicle trips and vehicle miles of travel due to Commuter Connections and its partners are occurring.

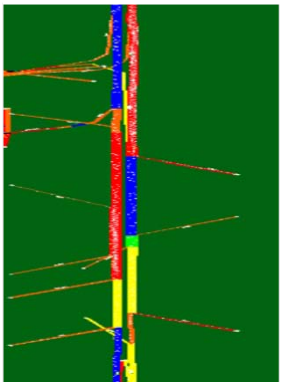
Commuter Connections could better document the congestion-reduction benefits of its programs by estimating where and when travel impacts are occurring and expressing the impact in terms related to congestion levels, such as reduction in delay and increase in travel time reliability. This would require measuring or estimating the spatial and temporal distribute of trip and VMT reduction, to assess impacts on a given facility or corridor.

Conceptual Approach

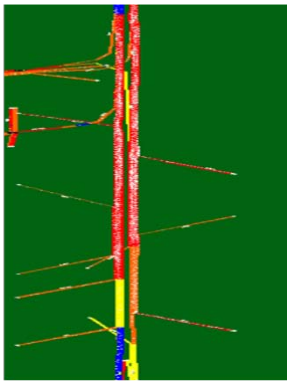
In concept, this enhancement would develop a method to convert VMT reduction from Commuter Connections services into roadway delay reduction. Such a method would enable Commuter Connections to document a program benefit that is expected to be central to performance measurement requirements of recent transportation legislation and keep Commuter Connections' evaluation methodology on the forefront of TDM evaluation research.

Measurement of roadway delay is commonly analyzed for roadway improvements, such as new travel lanes or intersection improvements that would increase travel speed on the roadway by adding road capacity or improving the flow of traffic. Traffic engineering analyses typically estimate reduction in roadway delay through traffic analysis modes that simulate the traffic volume and travel speed when the improvement is in place.

I-95 with TDM



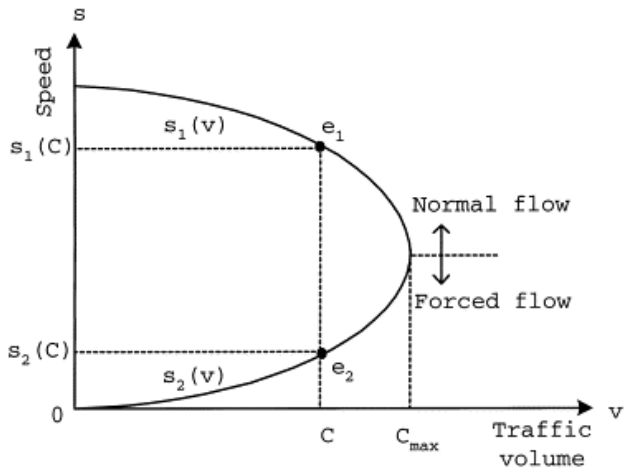
I-95 without TDM



Traffic analysis models generally do not accommodate TDM actions, thus we need an alternative method to estimate how the capacity added when a TERM eliminates trips would affect travel speed. At a minimum, it appears likely that such analysis of Commuter Connections would require data to pinpoint the location of TERM trip and VMT reductions and an estimate of the amount of traffic currently on targeted roads. At a higher level, total VMT reduction could be converted to reductions in delay for the region, but the spatial incidence of these benefits could not be defined unless some gross assumptions are made as to the most impacted corridors from Commuter Connections services.

Appendix C, continued

Delay calculation approaches could include simulation models, but in the short-term, we are more likely to explore approaches that would estimate delay reduction using a multiplier factor. For example, if Commuter Connections programs eliminate 5% of the vehicles traveling on a specific roadway during the peak period, what percentage increase in speed could be expected? This approach might utilize the "speed / flow" relationship shown in the figure to the right, which shows how traffic speeds drop when the traffic volume reaches a certain level of congestion.



A second approach might be to estimate total congestion delay from changes in VMT. This method is used by the TRIMMS™ model to estimate societal costs associated with changes due to TDM and transit incentives/disincentives. Congestion delay is the added delay imposed to all users as an additional vehicle is introduced into the traffic stream. Any Commuter Connections' initiative that removes a vehicle from the road can potentially produce benefits in terms of reduced delay, just as a roadway capacity increase reduces delay by adding new roadway supply. The TRIMMS model assumes a particular number of hours of delay a set number of passenger car trips. This marginal added delay could be used to estimate the congestion delay that would be removed if trips were removed from the roadway.

To develop this approach, the following actions would be needed:

- Define new data elements to identify travel paths of program users who shift travel modes (e.g., O-D, primary travel routes) and the existing volume of traffic on targeted roads. This could entail answering these questions:
  - Will the TERM trip / VMT reduction be sufficient to generate a measurable delay reduction?
  - What geographic subsets are reasonable for analysis (corridor, activity center, state, etc.)? Are regional estimates useful to decision-makers?
  - How should credit/impacts be assigned when trips cross analysis area boundaries?
- Identify data collection methods to collect user location data and sources of data on current volume of traffic (VDOT, MDOT, DDOT, COG).
- Define a simplified calculation method to assign impacts to roadway segments for the 2014 evaluation.
- Explore other calculation and/or modeled approaches that might produce a more comprehensive impact distribution in the future; estimate the costs of other approaches.
- Summarize findings and recommendations on how to assess program impacts on transportation system performance for existing and future TERM analyses.

APPENDIX D
CONCEPTUAL APPROACH TO QUANTIFY BENEFITS OF TERMS TO ENCOURAGE GREATER BUSINESS INVOLVEMENT IN COMMUTER CONNECTIONS PROGRAMS

Background – A large component of the overall TERM impacts is generated by the Employer Outreach program, thus employers' willingness to engage in TDM activities is a fundamental element of the success of the overall program. Employers will be most likely to engage in commuter programs if they perceive a tangible organizational benefit (e.g., reductions in office space and parking, reductions in payroll taxes from commute benefits, receiving LEED certification, recognition from Best Workplaces for Commuters). Some empirical evidence exists for a limited number of TDM services (e.g., telework productivity), but documentation is limited for other modes (e.g., carpool promotion) and TDM services. A systematic method that collects data to document the role of TERM and employer actions in use of alternative modes and commuters' attitudes could help quantify benefits that accrue to employers. This information could help outreach staff to more effectively market Commuter Connection services and, ultimately, yield more TERM results.

1. Personnel operations (absenteeism/tardiness, turnover, recruitment/retention)
2. Employee morale, teamwork, communication
3. Facility impacts (parking reduction, worksite congestion)
4. Cost elements (corporate taxes with pre-tax benefit program, productivity, health insurance saving/company wellness)
5. Social recognition / corporate good will (e.g., image, LEED)

Approach – Seek opportunities through TERM surveys to identify business benefits.

1. Include questions in the SOC survey to estimate reduced tardiness from use of alternative modes, productivity gains when commuters perform work tasks while using transit or riding in a carpool/vanpool, and how availability of commuter options improves job access and affect turnover/recruitment.
2. Prepare a self-administered questionnaire that measures various TDM practices, organizational performance variables and demographic variables to (1) to investigate whether some specific characteristics of employers such as age of organization, size of organization (in capital and in number of employees), employee turnover, and type (retail vs. nonretail) affect organizational performance and (2) to investigate whether TDM programs such as free or reduced price transit passes, telework, compressed work week programs, location (city vs. suburb vs. rural), and parking policies (paid vs. free) are correlated with organizational performance. Given the relatively low incidence of employers providing subsidize commuting benefits, the sample of this survey may need to be substantial (according to the Bureau of Labor Statistics only six percent of employees had access to subsidized commuting in 2011 among private employers).
3. Complement the survey with a comprehensive literature review of self-reported benefits from TDM-related strategies. It is highly probable that a substantial number of case studies will be found related to telework and compressed work week programs. This task would seek to uncover other TDM-related case studies such as the business benefits of vanpooling.
4. Prepare talking points and brief results summaries from research studies that jurisdiction partners could use when meeting with employers.

APPENDIX E
2008 ADJUSTMENT TO COMMUTER MODEL COEFFICIENTS

Impacts for the Employer Outreach TERM are calculated using the EPA COMMUTER model (v 2.0). Prior to the 2008 analysis, the default cost and time coefficients for the Washington DC region were used in model runs. Analysis performed by the LDA Consulting team for COG in 2007 suggested the COMMUTER model overestimated the likely impacts of employers' strategies, in particular those related to financial incentives. Thus the team examined possible adjustment to the COMMUTER model to give more conservative results for the 2005-2008 TERM analysis.

The results of the analysis suggested the most acceptable option was to reduce the cost coefficient to a level that could be expected to produce a vehicle trip reduction (VTR) change that approximated employee survey results of employers for which before commuter programs were implemented and after implementation. Because "with program" employee survey data were not available for the MWCOG region, the team used data from the Seattle, WA metropolitan region and determined the Seattle cost coefficient that would have predicted the result found in the Seattle survey data. The team then applied a proportional reduction to the current MWCOG cost coefficient.

The team performed a coefficient sensitivity analysis to estimate the VTR result at various cost coefficient levels. Two sensitivity cases were run, to test two different employer situations. The first included employers that had maintained or expanded the services in their commute programs, regardless of their program level (Level 1-4). The second case included employers that would have been classified as Level 3 or Level 4 in the TERM analysis, regardless of the changes they had made in their program. This case was run because it was consistent with the TERM analysis methodology.

Table 1 below shows the results for the Level 3-4 employer case, which was deemed more appropriate for this analysis.

Table 1 - COMMUTER model Vehicle Trip Rate (VTR) change prediction by travel cost coefficient - Level 3 and 4 Employers (Sample size 609)

Travel Cost Coefficient	Survey VTR Change	COMMUTER VTR Change
-0.0009	-2.32	-1.89
-0.0013	-2.32	-2.19
-0.0015	-2.32	**-2.35**
-0.0019	-2.32	-2.66
-0.0024*	**-2.32**	-3.06
-0.0029	-2.32	-3.46
-0.0031	-2.32	-3.62
-0.0034	-2.32	-3.86
-0.0039	-2.32	-4.26
-0.0043**	-2.32	-4.58
-0.0047	-2.32	-4.9
-0.0049	-2.32	-5.06

Coefficient -0.0024 vs -.0015,
Difference of 0.0009
VTR change difference 0.74

VTR difference 0.74
Coefficient difference of 0.009
-0.0043 vs -0.0034

*Coefficient for Seattle **Coefficient for MWCOG region

Appendix E, continued

As shown, the VTR reduction measured from the Seattle survey for these employers was -2.32. The COMMUTER model, using the Seattle cost coefficient of -0.0024 would have predicted a VTR result of -3.06, or a difference of about 0.74. To obtain a result of -2.32, the cost coefficient would have to have been -0.0015, or a reduction of 0.0009.

When the sensitivity results were plotted with coefficient on one axis and the VTR change on the other, it was clear that the change in VTR was directly proportional to the change in coefficient. Thus, it was reasonable to apply the same 0.74 difference from the Seattle VTR results to the MWCOG predicted result to estimate the coefficient that would produce a proportionately accurate result in the MWCOG region.

The cost coefficient used with the COMMUTER model in the 2002-2005 TERM analysis was -0.0043. Referring again to Table, 1, a coefficient of -0.0043 would predict a VTR change of -4.58. Applying the 0.74 difference in the VTR change result from the Seattle case to the MWCOG coefficient would result in a new VTR change of -3.84. This number does not match the -2.32 VTR change result for the Seattle data, not is it reasonable to expect that it would, since the Seattle area survey results reflect Seattle area conditions. It is not unreasonable to assume that the MWCOG area could have a higher VTR change when similar commuter program conditions are in place.

To obtain this -3.84 VTR value, the coefficient for MWCOG would have to be -0.0034. The VTR result of -3.84 would represent about a 16% reduction in impact compared to that produced using the -0.0043 cost coefficient.

With these changes, the old (2005) and new (2008) coefficients used in the COMMUTER Model were as follows. Note that no changes were made to the time coefficients. The 2008 coefficients also were used in the 2011 analysis.

	2008 Coefficients	2005 Coefficients
IVTT- In-vehicle travel time - all modes (minutes)	-0.0300	-0.0300
OVTT - Transit walk time (minutes)	-0.0750	-0.0750
OVTT - Transit wait time (minutes)	-0.0750	-0.0750
Cost - Auto parking (cents)	-0.0034	-0.0034
Cost - Transit fare (cents)	-0.0034	-0.0034

APPENDIX F
SAMPLE CALCULATIONS OF TELEWORK IMPACTS

Populations of Interest

• All regional teleworkers (TW)	603,305	(from SOC survey)
• Employees at worksites assisted by TW	6,384	(from TW assistance survey)

Telework Placement Rates

• Directly assisted TW	5.8%	(% of TW assisted by TW, from SOC survey)
• Assisted worksites	0.9%	(% of new TW at sites, from TW assistance survey)

Placements

Mixed home and Non-home based

• Directly assisted TW	35,176	(regional TW x directly assisted placement rate)
• TW at TW asst. sites	60	(employees at assisted sites x asst site placement rate)
Total assisted TW	**35,237**	

Breakdown of placements by Location (home-based and telecenter-based)

• % Home-based TW	97%	(from SOC survey)
• % Non-home (NH)-based TW	3%	(from SOC survey)
• Home-based TW	34,180	(total assisted TW x % Home-based TW)
• NH-based TW	1,057	(total assisted TW x % NH-based TW)

Daily Vehicle Trips Reduced

VTR Factors

• Home-based factor	0.36	(from SOC survey)
• NH-based factor	0.09	(from SOC survey)
• Home-based VT reduced	12,403	(HB TW x HB VTR factor)
• NH-based VT reduced	96	(NH-based TW x NH VTR factor)

Total Daily Vehicle Trips Reduced	**12,499**

Appendix F, continued

Daily VMT Reduced

Ave one-way trip distance (mi)

• Home-based TW	18.5	(SOC survey)

Telecenter reductions (TC days) – other than MWTC

• VMT reduction – Non-home days	23.6	(SOC survey)
• Ave. days/wk at TC	1.3	(SOC survey)
• VMT reduction – home TW days	39.8	(SOC survey)
• Ave. days/wk at home	0.7	(SOC survey)
• Total weekly VMT reduction	58.5	
• Daily reduction per teleworker	11.7	

VMT reductions on TW days

• Home-based VMT reduced	229,458	(HB VT reduced x ave trip distance)
• NH-based VMT reduced	12,377	(NH-based TW x daily miles reduced)
Total Daily VMT Reduced	**241,834**	

Daily Emissions Reduced – NOx and VOC

NOx	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start	12,499	0.5182			6,477	0.0071
• Running (40 mph)			241,834	0.3444	83,288	0.0918
Total NOx reduced (tons)						**0.099**

VOC	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	12,499	1.4592			18,239	0.0201
• Running (40mph)			241,834	0.1558	37,678	0.0415
Total VOC reduced (tons)						**0.062**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

PM 2.5	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start	12,499	0.000			0	0.0000
• Running (40mph)			241,834	0.0115	2,781	0.0031
					Daily	**0.003**
Total PM 2.5 reduced (tons)					**Annual**	**0.77**

Appendix F, continued

PM 2.5 Precursor NOx	Trips	11 Emiss Factor	VMT	11 Emiss Factor	Tot gm	Tot ton
• Cold start	12,499	0.6160			7,699	0.0085
• Running (40mph)			241,834	0.374	90,446	0.0997
					Daily	**0.108**
Total PM 2.5 Precursor NOx reduced (tons)					**Annual**	**27.0**

CO2	Trips	11 Emiss Factor	VMT	11 Emiss Factor	Tot gm	Tot ton
• Cold start	12,499	0.000			0	0.
• Running (40mph)			241,834	461.7	111,654,939	123.1
					Daily	**123.1**
Total CO2 reduced (tons)					**Annual**	**30,770**

APPENDIX G
SAMPLE CALCULATIONS OF GUARANTEED RIDE HOME IMPACTS

Populations of Interest		
• New GRH registrants	15,369	(GRH database)
• Re-registrants	6,904	
• One-time exceptions	711	(GRH database)
Total GRH base	**22,964**	
Within MSA	62%	14,250
Outside MSA	38%	8,734
GRH Placement Rates (continued rates only)		
• Within MSA placement rate	39.6%	(GRH survey)
• Outside MSA placement rate	40.2%	(GRH survey)
Placements (continued only)		
• Within MSA	**5,643**	(Within MSA base x within MSA placement rate)
• Outside MSA	**3,511**	(Outside MSA base x outside MSA placement rate)
Total Placements	**9,154**	
Daily Vehicle Trips Reduced		
VTR Factors (continued only)		
• Within MSA	0.90	(GRH survey)
• Outside MSA	0.99	(GRH survey)
VT Reduced (continued only)		
• Within MSA	**5,079**	**(**Within MSA placements x within MSA VTR factor)
• Outside MSA	**3,476**	(Outside MSA placements x outside MSA VTR factor**)**
Total Daily Vehicle Trips Reduced	**8,555**	
Daily VMT Reduced		
• Ave one-way trip distance (mi)		
• Within MSA	26.1	from GRH survey)
• Outside MSA	26.1	discounted from actual 50.3 miles from GRH survey)
VMT reduced		
• Within MSA	132,555	(Within MSA VT reduced x trip distance)
• Outside MSA	90,722	(Outside MSA VT reduced x trip distance)
Total Daily VMT Reduced	**223,276**	

Appendix G, continued

Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)

Inside MSA

- SOV access percentage 58% (GRH survey)
- SOV access distance (mi) 5.7 (GRH survey)

Outside MSA – not applicable – all access outside MSA

VT Reduction

- No SOV access 5,609 (VT x non-SOV access %)

Total VT for AQ analysis **5,609**

VMT Reduction

- No SOV access 146,395 (VT x SOV % x trip distance)
- With SOV access 60,092 (VT x SOV % x (trip distance – access distance)

Total VMT for AQ analysis **206,486**

Daily Emissions Reduced – NOx and VOC

NOx reduced	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	5,609	0.5182			2,907	0.004
• Running			206,486	0.3444	71,114	0.078
Total NOx reduced (tons)						**0.082**

VOC reduced	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	5,609	1.4592			8,185	0.009
• Running			206,486	0.1558	32,171	0.035
Total VOC reduced (tons)						**0.044**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

PM 2.5	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start	5,609	0.000			0	0.000
• Running (40mph)			206,486	0.0115	2,375	0.003
					Daily	**0.003**
Total PM 2.5 reduced (tons)					**Annual**	**0.65**

Appendix G, continued

PM 2.5 Precursor NOx	Trips	11 Emiss Factor	VMT	11 Emiss Factor	Tot gm	Tot ton
• Cold start	5,609	0.6160			3,455	0.004
• Running (40mph)			206,486	0.374	77,226	0.085
					Daily	**0.089**
Total PM 2.5 Precursor NOx reduced (tons)					**Annual**	**22.2**

CO2	Trips	11 Emiss Factor	VMT	11 Emiss Factor	Tot gm	Tot ton
• Cold start	5,609	0.000			0	0.0
• Running (40mph)			206,486	461.7	95,334,675	105.1
					Daily	**105.1**
Total CO2 reduced (tons)					**Annual**	**26,272**

Correction for Overlap with MM TERM

Total GRH apps FY 09, 10, 11	22,984	
New GRH apps FY 09, 10, 11	15,369	67%
Estimated MM share of new GRH	10%	
Estimated MM share of GRH impact	6.7%	

	Net GRH	GRH base	MM
Placements	8,542	9,154	612
VMT reduced	7,983	8,555	572
VMT reduced (mi)	203,346	223,276	14,930
Daily Emissions Reduced			
NOx (T)	0.076	0.082	0.005
VOC (T)	0.042	0.044	0.004
Annual Emissions Reduced			
PM 2.5 (T)	0.61	0.65	0.04
PM 2.5 Precursor NOx (T)	20.7	22.2	1.5
CO2 (T)	24,515	26,272	1,757

APPENDIX H
SAMPLE CALCULATION OF EMPLOYER OUTREACH

Populations of Interest

Level 3 or 4 sites (data from ACT! database)

	Employers	Employees
• 2008 unchanged programs	568	184,660
• Expanded programs in 2011	267	173,346
• New programs in 2011	284	108,516

Average Vehicle Occupancy (AVO)

Starting AVO from employee survey data, Final AVO from COMMUTER model

	Starting AVO	Ending AVO
• 2008 unchanged programs	1.29	1.45
• Expanded programs – continued base	1.26	1.45
• Expanded programs – new impacts	1.45	1.49
• New programs	1.22	1.38
• Deleted programs	1.37	1.25

Daily person trips

Total employees x 2 one-way trips per day

Starting (pre-program) and ending (with-program)

	Starting	Ending
• 20008 unchanged programs	369,320	369,320
• Expanded programs – continued base	346,692	346,692
• Expanded programs – new impacts	346,692	346,692
• New programs	217,032	217,032
• Deleted programs	68,808	68,808

Daily vehicle trips

Total employees / starting AVO)

Starting (pre-program) and ending (with-program)

	Starting	Ending	Difference
• 2008 unchanged programs	287,341	254,108	33,234
• Expanded programs – maintained base	274,195	239,776	34,419
• Expanded programs – new impact	239,776	232,554	7,222
• New programs	178,363	157,486	20,877
• Deleted programs	50,163	55,126	(4,963)

Total Daily Vehicle Trips Reduced

• 2008 maintained impacts	67,653
• New/expanded impacts	28,099
Net 2011 vehicle trips reduced	**95,751**

Appendix H, continued

Daily VMT reduced

Results produced by COMMUTER model, assuming travel distanced by mode from SOC survey

- 2008 unchanged programs 547,509
- Expanded programs – maintained base 574,822
- Expanded programs – new impact 117,030
- New/expanded programs 344,220
- Deleted programs (81,576)

Total Daily VMT Reduced

- 2008 continued impacts 1,122,331
- New/expanded impacts 461,250

Net 2011 VMT reduced 1,583,581

Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)

- SOV access percentage 28% (from 2010 SOC survey)
- SOV access distance (mi) 2.6 (from 2010 SOC survey)

VT Reduction without SOV access – used as base for AQ analysis

(VT reduced x non-SOV access %)

- 2008 maintained impacts 48,710
- New/expanded impacts 20,231

VMT Reduction without SOV access

(Total VT reduced – (VT reduced x SOV % x trip distance)

- 2008 maintained impacts 1,063,608
- New/expanded impacts 436,861

Emissions Reduced – Maintained from 2008

Daily Emissions Reduced – NOx and VOC

NOx reduced	Trips	11 Emiss Factor	VMT	11 Emiss Factor	Tot gm	Tot ton
• Cold start + hot soak	48,710	0.5182			25,242	0.028
• Running			1,063,608	0.3444	366.307	0.404
Total NOx reduced (tons)						**0.432**

VOC reduced	Trips	11 Emiss Factor	VMT	11 Emiss Factor	Tot gm	Tot ton
• Cold start + hot soak	48,710	1.4592			71,078	0.078
• Running			1,063,608	0.1558	165,710	0.183
Total VOC reduced (tons)						**0.261**

Appendix H, continued

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

PM 2.5	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start	48,710	0.000			0	0.0
• Running (40mph)			1,063,608	0.0115	12,231	0.013
					Daily	**0.013**
Total PM 2.5 reduced (tons)					**Annual**	**3.4**

PM 2.5 Precursor NOx	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start	48,710	0.6160			30,004	0.033
• Running (40mph)			1,063,608	0.374	397,790	0.439
					Daily	**0.472**
Total PM 2.5 Precursor NOx reduced (tons)					**Annual**	**117.9**

CO2	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start	48,710	0.000			0	0
• Running (40mph)			1,063,608	461.7	491,067,975	541
					Daily	**541**
Total CO2 reduced (tons)					**Annual**	**135,327**

Emissions Reduced - New / Expanded

Daily Emissions Reduced – NOx and VOC

NOx reduced	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	20,231	0.5182			10,484	0.012
• Running			436,861	0.3444	150,455	0.165
Total NOx reduced (tons)						**0.177**

VOC reduced	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	20,231	1.4592			29,521	0.033
• Running			436,861	0.1558	68,063	0.075
Total VOC reduced (tons)						**0.108**

Appendix H, continued

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

PM 2.5	Trips	11 Emiss Factor	VMT	11 Emiss Factor	Tot gm	Tot ton
• Cold start	20,231	0.000			0	0.0
• Running (40mph)			436,861	0.0115	5,024	0.006
					Daily	**0.006**
Total PM 2.5 reduced (tons)					**Annual**	**1.4**

PM 2.5 Precursor NOx	Trips	11 Emiss Factor	VMT	11 Emiss Factor	Tot gm	Tot ton
• Cold start	20,231	0.6160			12,461	0.014
• Running (40mph)			436,861	0.374	163,386	0.180
					Daily	**0.194**
Total PM 2.5 Precursor NOx reduced (tons)					**Annual**	**48.5**

CO2	Trips	11 Emiss Factor	VMT	11 Emiss Factor	Tot gm	Tot ton
• Cold start	20,231	0.000			0	0
• Running (40mph)			436,861	461.7	201,698,650	222
					Daily	**222**
Total CO2 reduced (tons)					**Annual**	**55,584**

Correction for Overlap with TW TERM and Impacts for EO for Bicycling

	EO base	TW	Net EO	EO-bike
Vehicle Trips Reduced	90,788	437	90,350	180
VMT Reduced (miles)	1,665,157	7,348	1,657,809	1,083
Daily Emissions Reduced				
NOx (tons)	0.581	0.003	0.578	0.001
VOC (tons)	0.369	0.002	0.367	0.001
Annual Emissions Reduced				
PM 2.5 (T)	4.8	0.02	4.7	0.0
PM 2.5 Precursor NOx (T)	166.3	0.8	165.5	0.1
CO2 (T)	190,911	935	189,976	138

Appendix H, continued

COMMUTER CONNECTIONS
EMPLOYER SERVICES PARTICIPATION LEVELS
(EFFECTIVE JULY 1, 2008)

SUPPORT STRATEGIES

Likely range of trip reduction 0%

- Expresses Interest and/or distributes/displays information on Ozone Actions Days

LEVEL 1 (BRONZE)

Likely range of trip reduction 0% to 1%

- Expresses interest in telework, transit benefits, Smart Benefits, or other TDM strategy,
- Conducts Commuter Survey
- Distributes alternative commute info to employees
- Posts alternative commute information, on employee bulletin board(s), intranet sites, newsletter or e-mail

LEVEL 2 (SILVER)

Implements two or more of the following strategies

Likely range of trip reduction 0% to 3% without Telework/Compressed Work Schedules
0% to 9% with Telework/Compressed Work Schedules

- Installs a permanent display case or brochure holders and stock with alternative commute information
- Provides preferential parking for carpools and vanpools
- Implements a telework program with 1-20% of employees participating
- Facilitates car/vanpool formation meetings
- Hosts/sponsors an alternative commute day or transportation fair
- Implements flex-time or staggered work schedule
- Implements compressed work week for 1-20% of employees
- Installs bicycle racks or lockers
- Installs shower facilities for bicyclists and walkers
- Establishes an ETC who regularly provides alternative commute information to employees
- Becomes a Commuter Connections member and provides on-site ridematching
- Supplements GRH program with payment for additional trips or own program

Appendix H, continued

LEVEL 3 (GOLD)

Implements at least one of the following (in addition to the two or more Level 2 strategies):

Likely range of trip reduction **2% to 5% without financial incentive/disincentive, Telework/Compressed Work Schedules**
5% to 20% with financial incentive/disincentive, Telework/Compressed Work Schedules

- Implements a telework program with more than 20% of employees participating
- Implements compressed work week for 21%+ of employees
- Implements a transit/vanpool benefit, Smart Benefits, or parking "cash out" program
- Implements a carpool/bicycle/walk benefit
- Provides free or significantly reduced fee parking for carpools and vanpools (valid only for companies where employees pay for parking)
- Implements a parking fee (valid only for companies that previously did not charge for parking)
- Provides employee shuttle service to transit stations
- Provides company vanpools for employees' commute to work
- Implements a comprehensive Bicycle/Walking program (includes installation of showers bicycle racks/lockers, and financial incentives for bicycling and/or walking)

LEVEL 4 (PLATINUM)

Likely range of trip reduction **2% to 8% without financial incentive, Telework/Compressed Work Schedules**
5% to 30% with financial incentive, Telework/Compressed Work Schedules

Implements two or more of the Level 3 TDM programs (in addition to the 2 or more Level 2 strategies) and actively promotes these programs and alternative commuting

APPENDIX I
SAMPLE CALCULATION OF MASS MARKETING IMPACTS

5 impact components
- Part 1 - Commuters influenced by ads to change mode – no contact CC (direct influence)
- Part 2 – Commuters influenced by ads to contact CC (referred influence)
- Part 3 – Pool Rewards carpool incentive participants
- Part 4 – Bike to Work Day
- Part 5 – GRH credit

PART 1 – Direct MM Influence

Populations of Interest – commuters influenced by ads to change mode – no contact CC

Total commuters in region	2,569,890	(SOC)
• % recall commute message	39%	(SOC)
• % chg to alt mode after ads	0.9%	(SOC)
• % chg influenced by ad	84%	(SOC)
Placements – no contact with CC	**7,177**	(COC – monthly applicant analysis)
Placement Rates		
• Continued placement rate	62%	(SOC)
• Temporary placement rate	18%	(SOC)
• One-time/occasional placement rate	20%	(SOC)
Placements		
• Continued placements	4,450	(Placements x continued placement rate)
• Temporary placements	1,292	(Placements x temporary placement rate)
• One-time/occasional placements	1,435	(SOC)
Daily Vehicle Trips Reduced		
• VTR factor	0.97	(SOC)
• Continued VT reduced	4,316	(Continued placements x continued VTR factor)
• Temporary VT reduced	940	(Temporary placements x temporary VTR factor x 75% credit for temporary use)
• One-time/occasional VT reduced	27	(Temporary placements x temporary VTR factor x 2% credit for one-time/occasional use)
Total Daily Vehicle Trips Reduced	**5,283**	
Daily VMT Reduced		
• Ave one-way trip distance (mi)	9.4	(SOC)
Total Daily VMT Reduced	**49,659**	

Appendix I, continued

PART 1 (cont.)

Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)

• SOV access percentage	28%	(from SOC – transit riders)
• SOV access distance (mi)	2.7	(from SOC – transit riders)

VT Reduction

• No SOV access	3,804	(VT x non-SOV access %)
Total VT for AQ analysis	**3,804**	

VMT Reduction

• No SOV access	35,754	(VT x SOV % x trip distance)
• With SOV access	9,911	(VT x SOV % x (trip dist – access dist)
Total VMT for AQ analysis	**45,665**	

PART 2 – Referred MM Influence

Populations of Interest – commuters influenced by ads to contact CC

New CC apps (does not include re-apply or follow-up)

• FY 2009	7,644	(CC database)
• FY 2010	5,987	(CC database)
• FY 2011	7,374	(CC database)
Total new applicants	**21,005**	
Total CC applicants	81,675	(includes new, re-apply, and follow-up)
New apps 09-11 as % of total	26%	(new apps FYs 09-11 / total CC apps)
% influenced by ads to contact CC	2.2%	(COC – monthly applicant analysis)
% all apps influenced by ads	0.6%	

CC Impacts – FY 09-11	**MM Share**	**Total**
• CC placements	174	30,816
Total Daily Vehicle Trips Reduced	**48**	**8,433**
Total Daily VMT Reduced	**1,400**	**247,400**

CC Impacts – FY 09-11 – Discounted for AQ Analysis

	MM Share	**Total**
• CC Vehicle trips reduced	32	5,698
• CC VMT reduced	1,315	232,384

Appendix I, continued

PART 3 – Pool Rewards Participants

Program participants	171	
Placement Rates		
• Continued placement rate	93%	(Pool Rewards follow-up survey)
• Temporary placement rate	7%	(Pool Rewards follow-up survey)
Placements		
• Continued placements	159	(Placements x continued placement rate)
• Temporary placements	12	(Placements x temporary placement rate)
Total placements	**171**	(Total new + increased riders)
Daily Vehicle Trips Reduced		
• VTR factor	0.73	(Pool Rewards logging data)
• Continued VT reduced	115	(Continued placements x continued VTR factor)
• Temporary VT reduced	2	(Temporary placements x temporary VTR factor x 25% credit for temporary use)
Total Daily Vehicle Trips Reduced	**117**	
Daily VMT Reduced		
• Ave one-way trip distance (mi)	31.1	(Pool Rewards logging data)
Total Daily VMT Reduced	**3,653**	

Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)

• SOV access percentage	50%	
• SOV access distance (mi)	5.5	
VT Reduction		
• No SOV access	59	(VT x non-SOV access %)
Total VT for AQ analysis	**59**	
VMT Reduction		
• No SOV access	1,827	(VT x SOV % x trip distance)
• With SOV access	1,504	(VT x SOV % x (trip dist – access dist)
Total VMT for AQ analysis	**3,330**	

Appendix I, continued

Part 4 - Bike to Work Day Credit

Participants' riding percentage and frequency

Number of riders	11,794	(BTWD registration data, 2008, 2009, 2010)
% biking to work before event	83.5%	(BTWD survey)
% new riders	9.9%	(BTWD survey)
Number of new riders	1,168	
% who increase riding days	21.8%	
Number of increased riders	2,571	
Total placements	**3,739**	(Total new + increased riders)

Change in Bike Days

Summer Biking

% new riders in summer	9.5%	(BTWD survey)
Weekly new bike days summer	1.4	(BTWD survey)
Weekly new bike days summer	1,569	
% increased riders in summer	20.6	(BTWD survey)
Weekly inc bike days summer	1.6	(BTWD survey)
Weekly inc bike days summer	3,887	

Winter Biking

% new riders biking winter	7%	(BTWD survey)
Weekly new bike days winter	1.4	(BTWD survey)
Weekly new bike days winter	1,222	
% increased riders biking winter	13%	(BTWD survey)
Weekly inc bike days winter	1.7	(BTWD survey)
Weekly inc bike days winter	2,506	

New Bike Days

• Total new bike days summer	152,768	(wkly summer days x 28 wks – Apr-Oct)
• Total new bike days winter	82,019	(wkly winter days x 22 wks – Nov-Mar)
• Total new bike days-year	234,787	(summer bk days + winter bk days)
• New bike trips - year	469,573	(annual bike days x 2)

New Bike Trips and VT Reduction

• Ave new daily bk trips	1,878	(Annual new bike trips / 250)
• % DA/RS on non-bike days	48%	(BTWD survey)
BTWD Daily Vehicle Trips Reduced	**902**	(daily new bike trips x DA %)

Daily VMT Reduced

• Ave trip distance (mi)	9.6	(BTWD survey)
BTWD Daily VMT Reduced	**8,655**	(vehicle trips reduced x average trip distance)

Appendix I, continued

PART 5 – GRH Credit – From GRH Analysis

Total GRH apps FY 09, 10, 11	22,984	
New GRH apps FY 09, 10, 11	15,369	62% of total applications
Estimated MM share of new GRH	10.0%	
Estimated MM share of GRH impact	6.7%	

	MM Share	GRH base
Placements	612	9,154
VT reduced	**572**	**8,555**
VMT reduced	**14,930**	**223,276**

Daily Emissions Reduced (NOx, VOC) Parts 1, 2, 3, 4, and 5 combined

NOx reduced	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	5,171				2,680	0.003
• Running			72,772	0.3444	25,063	0.028
Total NOx reduced (tons)						**0.031**

VOC reduced	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	5,171	1.4592			7,546	0.008
• Running			72,772	0.1558	11,338	0.013
Total VOC reduced (tons)						**0.021**

Annual Emissions Reduced (PM 2.5, Precursor NOx, and CO2) Parts 1, 2, 3, 4, and 5 combined

PM 2.5	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start	5,171	0.000			0	0.000
• Running (40mph)			72,772	0.0115	837	0.001
					Daily	**0.001**
Total PM 2.5 reduced (tons)					**Annual**	**0.23**

PM 2.5 Precursor NOx	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start	5,171	0.6160			3,185	0.004
• Running (40mph)			72,772	0.374	27,217	0.030
					Daily	**0.034**
Total PM 2.5 Precursor NOx reduced (tons)					**Annual**	**8.4**

Appendix I, continued

Annual Emissions Reduced (continued)

CO2	Trips	11 Emiss Factor	VMT	11 Emiss Factor	Tot gm	Tot ton
• Cold start	5,171	0.000			0	0
• Running (40mph)			72,772	461.7	33,598,943	37.0
					Daily	**37.0**
Total CO2 reduced (tons)					**Annual**	**9,259**

Mass Marketing

Total – PART 1, PART 2, PART 3, PART 4, PART 5

	Total MM	No CC Contact	CC Contact	Pool Rewards	GRH	BTWD
Placements	10,438	5,742	174	171	612	3,739
VT reduced	6,922	5,283	48	117	572	902
VMT reduced	78,297	49,659	1,400	3,653	14,930	8,655
Daily Emissions Reduced						
NOx (T)	0.031					
VOC (T)	0.021					
Annual Emissions Reduced						
PM 2.5 (T)	0.231					
PM 2.5 Precursor (T)	8.4					
CO2 (T)	9,259					

APPENDIX J
SAMPLE CALCULATION OF COMMUTER OPERATIONS CENTER IMPACTS

Populations of Interest – Commuter Connections Rideshare Applicants

New, Reapply, Transit/other, follow-up requests

• FY 2009	22,578	(CC database)
• FY 2010	24,572	(CC database)
• FY 2011	34,525	(CC database)
Total assisted commuters	**81,675**	

Within MSA (62%)	50,639
Outside MSA (38%)	31,037

COC Placement Rates	**In MSA**	**Out MSA**	
• Continued rate	22.4%	30.4%	
• Temporary rate	12.1%	12.6%	
• Total	34.5%	43.0%	
Placements			
• Continued	11,343	9,435	(Apps x cont. rate)
• Temporary	6,127	3,911	(Apps x temporary rate)
• **Total placements** **30,816**			

Daily Vehicle Trips Reduced

VTR Factors			
• Continued	0.37	0.38	
• Temporary	0.66	0.45	
• Temporary discount	10.6%	12.6%	
• Continued trips reduced	4,197	3,585	(Placements x cont. VTR factor)
• Temporary trips reduced	429	222	(Placements x temp VTR factor)
Total Daily Vehicle Trips Reduced	**8,433**		

Daily VMT Reduced

Ave one-way trip distance (mi)			
• Continued	29.4	29.4	(Actual Outside dist. 54.4 miles)
• Temporary	28.6	28.6	(Actual Outside dist. 57.9 miles)
• Continued VT reduced	123,389	105,409	(Vehicle trips x ave distance)
• Temporary VT reduced	12,260	6,342	
Total Daily VMT Reduced	**247,400**		

Appendix J continued

Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)

	In MSA	Out MSA	
• SOV access % -Continued	62%	0%	(CC placement survey)
• SOV access dist (mi) – Continued	5.5	0.0	(CC placement survey)
• Non-SOV access % - Temporary	31%	0%	(CC placement survey)
• SOV access dist (mi) – Temporary	5.3	0.0	(CC placement survey)

VT Reduction

• Cont VT with no SOV access	1,595	3,585	
• Temp VT with no SOV access	518	222	(VT x non-SOV access %)
Total no-SOV VT access **5,598**			

VMT Reduction

• No SOV access (cont)	46,888	105,409	(VT x SOV % dist)
• No SOV access (temp)	8,459	6,342	
• SOV access (cont)	62,190	0	(VT x SOV % x (dist – access dist))
• SOV access (temp)	3,096	0	
Total SOV VMT access **232,384**			

Daily Emissions Reduced – NOx and VOC

NOx	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	5,698	0.5182			2,953	0.003
• Running			232,384	0.3444	80,033	0.088
Total NOx reduced (tons)						**0.091**

VOC	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	5,698	1.4592			8,314	0.009
• Running			232,384	0.1558	36,205	0.040
Total VOC reduced (tons)						**0.049**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

PM 2.5	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start	5,698	0.000			0	0.00
• Running (40mph)			232,384	0.0115	2,672	0.003
					Daily	**0.003**
Total PM 2.5 reduced (tons)					**Annual**	**0.74**

Appendix J, continued

PM 2.5 Precursor NOx	Trips	11 Emiss Factor	VMT	11 Emiss Factor	Tot gm	Tot ton
• Cold start	5,698	0.6160			3,510	0.004
• Running (40mph)			232,384	0.374	86,912	0.096
					Daily	**0.100**
Total PM 2.5 Precursor NOx reduced (tons)					**Annual**	**24.9**

CO2	Trips	11 Emiss Factor	VMT	11 Emiss Factor	Tot gm	Tot ton
• Cold start	5,698	0.000			0	0
• Running (40mph)			232,384	461.7	107,291,595	118.3
					Daily	**118.3**
Total CO2 reduced (tons)					**Annual**	**29,567**

Correction for Overlap with Integrated Rideshare and GRH TERMs

	Net COC	COC base	MM	Soft Upg	GRH
Placements	25,541	30,816	174	3,354	1,747
Vehicle Trips Reduced	6,190	8,433	48	1,717	478
VMT Reduced (miles)	180,409	247,400	1,400	51,569	14,022
Daily Emissions Reduced					
NOx Reduced (tons)	0.066				
VOC Reduced (tons)	0.036				
Annual Emissions Reduced					
PM 2.5 (T)	0.53				
PM 2.5 Precursor (T)	18.0				
CO2 (T)	21,393				

Notes:
MM influenced commuters – from MM analysis
GRH – 13.3% of new apps/reapps ask for GRH and other info = 5.7% of COC total after MM adjustment

APPENDIX K
SAMPLE CALCULATION OF INTEGRATED RIDESHARE - SOFTWARE UPGRADE PROJECT IMPACTS

Populations of Interest – Commuter Connections Rideshare Applicants

New, Reapply, Transit/other, follow-up requests

• FY 2009	22,578	(CC database)
• FY 2010	24,572	(CC database)
• FY 201	34,525	(CC database)
Total assisted commuters	**81,675**	

Within MSA (62%)	50,639
Outside MSA (38%)	31,037

COC Placement Rates	**In MSA**	**Out MSA**	
• Continued rate	0.8%	2.4%	
• Temporary rate	0.5%	1.4%	
• Total	1.3%	3.8%	
Placements			
• Continued	911	1,241	(Apps x cont. rate)
• Temporary	506	714	(Apps x temporary rate)
• **Total placements 3,373**			

Daily Vehicle Trips Reduced

VTR Factors			
• Continued	0.67	0.83	
• Temporary	0.94	0.57	
• Temporary discount	12.1%	6.9%	
• Continued trips reduced	611	1,030	(Placements x cont. VTR factor)
• Temporary trips reduced	58	28	(Placements x temp VTR factor)
Total Daily Vehicle Trips Reduced	**1,727**		

Daily VMT Reduced

Ave one-way trip distance (mi)			
• Continued	30.2	30.2	(Actual Outside dist. 54.2 miles)
• Temporary	26.8	26.8	(Actual Outside dist. 49.1 miles)
• Continued VT reduced	18,443	31,118	(Vehicle trips x ave distance)
• Temporary VT reduced	1,546	755	
Total Daily VMT Reduced	**51,862**		

Appendix K, continued

Trip and VMT Adjustment for SOV Access to HOV Modes (reduce VT and VMT for AQ analysis)

	In MSA	Out MSA	
• SOV access % -Continued	87%	0%	(CC placement survey)
• SOV access % - Temporary	38%	0%	(CC placement survey)
• SOV access dist (mi) – Continued	3.3	0.0	(8.1 mi access outside MSA)
• SOV access dist (mi) – Temporary	2.0	0.0	(7.7 mi access outside MSA)

VT Reduction

• Non-SOV access (cont + temp)	115	1,058	(VT x non-SOV access %)
Total VT for AQ analysis	**1,174**		

VMT Reduction

• SOV access (cont + temp)	18,170	31,873	
Total VMT for AQ analysis	**50,043**		

Daily Emissions Reduced – NOx and VOC

NOx	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start	1,174	0.5182			608	0.001
• Running			50,043	0.3444	17,235	0.019
Total NOx reduced (tons)						**0.020**

VOC	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start + hot soak	1,174	1.4592			1,713	0.002
• Running			50,043	0.1558	7,797	0.008
Total VOC reduced (tons)						**0.010**

Annual Emissions Reduced – PM 2.5, Precursor NOx, and CO2

PM 2.5	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start	1,174	0.000			0	0.000
• Running (40mph)			50,043	0.0115	575	0.001
					Daily	**0.001**
Total PM 2.5 reduced (tons)					**Annual**	**0.16**

PM 2.5 Precursor NOx	**Trips**	**11 Emiss Factor**	**VMT**	**11 Emiss Factor**	**Tot gm**	**Tot ton**
• Cold start	1,174	0.6160			723	0.001
• Running (40mph)			50,043	0.374	18,716	0.020
					Daily	**0.021**
Total PM 2.5 Precursor NOx reduced (tons)					**Annual**	**5.4**

Appendix K, continued

CO2	Trips	11 Emiss Factor	VMT	11 Emiss Factor	Tot gm	Tot ton
• Cold start	1,174	0.000			0	0.0
• Running (40mph)			50,043	461.7	23,104,852	25.5
					Daily	**25.5**
Total CO2 reduced (tons)					**Annual**	**6,367**

Correction for Overlap with MM TERM

Total CC applications FY 09, 10, 11	81,675	
New CC applications FY 09, 10, 11	21,005	26%
Estimated MM share of new CC	2%	
Estimated MM share of IR impact	0.6%	

	Net SU	SU Base	MM Share
Placements	3,354	3,373	19
VT reduced	1,717	1,727	10
VMT reduced	51,569	51,862	293
Daily Emissions Reduced			
NOx reduced (T)	0.020		
VOC reduced (T)	0.010		
Annual Emissions Reduced			
PM 2.5 (T)	0.16		
PM 2.5 Precursor (T)	5.3		
CO2 (T)	6,331		

APPENDIX L
COMMUTER CONNECTIONS TERM EVALUATION SCHEDULE – FY2012 - FY2014

Measure	Data Collection Activity	Deadline(s)	FY Completion
Telework	2013 State of the Commute Survey	June 2013 (Draft Report) June 2014 (Final Report)	FY13 FY14
	Employer Survey	January 2014	FY14
Employer Outreach	Database Information Analysis From ACT!	December 2013 (interim) June 2014 (final)	FY14
GRH	2013 GRH applicant Survey	June 2013 (Draft Report) December 2013 (Final Report)	FY13 FY14
Commuter Operations Center	Placement Rate survey ***(survey completed)***	December 2011	FY12
Mass Marketing	2013 State of the Commute Survey	June 2013 (Draft Report) June 2014 (Final Report)	FY13 FY14
Bike To Work Day	2013 Participant Survey	Nov/Dec 2013 (Draft Report) June 2014 (Final Report)	FY14
ALL	2013 State of the Commute Survey	June 2013 (Draft Report) June 2014 (Final Report)	FY13 FY14
ALL	2012 -2014 TERM Analysis Report	June 2014 (Draft Report) January 2015 (Final Report)	FY14 FY15

APPENDIX M
GLOSSARY OF ACRONYMS

CC	-	Commuter Connections
CCWP	-	Commuter Connections Work Program
CO2	-	Carbon dioxide (primary greenhouse gas)
COC	-	Commuter Operations Center
COG	-	Council of Governments
DDOT	-	District of Columbia Department of Transportation
FHWA	-	Federal Highway Administration
GRH	-	Guaranteed Ride Home
HOV(s)	-	High Occupancy Vehicle(s)
MTA	-	Maryland Transit Administration
MDOT	-	Maryland Department of Transportation
MWAQC	-	Metropolitan Washington Air Quality Committee
MWCOG	-	Metropolitan Washington Council of Governments
NO_X	-	Nitrogen Oxides
P & R	-	Park and Ride
PM	-	Particulate Matter
PM2.5	-	Particulate Matter, 2.5 microns
SOC	-	State of the Commute
SOV	-	Single Occupant Vehicle
TDM	-	Transportation Demand Management
TERM	-	Transportation Emission Reduction Measure
TIP	-	Transportation Improvement Program
TMA	-	Transportation Management Association
TMO	-	Transportation Management Organization
TPB	-	Transportation Planning Board
VDOT	-	Virginia Department of Transportation
VDRPT	-	Virginia Department of Rail & Public Transportation
VMT	-	Vehicle Miles Traveled
VOC	-	Volatile Organic Compounds
VRE	-	Virginia Railway Express
VT	-	Vehicle Trips
VTR	-	Vehicle Trip Reduction
WMATA	-	Washington Metropolitan Area Transit Authority