

Southeast Michigan Council of Governments

Regional On-Board Transit Survey *2019 DRAFT Report*

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**Prepared for the Southeast
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Executive Summary

Background

In the fall of 2018 and spring of 2019, the Southeast Michigan Council of Governments (SEMCOG), with consultant support from ETC Institute, conducted a regional on-board origin-destination (OD) survey of all fixed-route transit systems in Southeast Michigan. The transit systems surveyed were those operated by the Detroit Department of Transportation (DDOT), Suburban Mobility Authority for Regional Transportation (SMART), Ann Arbor Transportation Authority (AAATA), University of Michigan (UM), Detroit People Mover (DPM), Blue Water Area Transit (BWT), Lake Erie Transit (LET), MTA Flint (FLT), and the Q Line (QLN).

The main purpose of this on-board transit survey is to update SEMCOG's Travel Demand Forecasting Model. The data collected was able to provide valuable, current information on travel patterns and demographics for transit riders as well as service characteristics.

Survey tasks involved developing a sampling plan, designing the survey instrument, conducting a pilot test, processing the data in terms of weight, expansion, and analyzing, and reporting the results. Data collection was performed from December 2018 through June 2019. A total of 17,927 completed questionnaires were collected.

Survey Design and Administration

The survey design process consisted of SEMCOG and ETC Institute collaborating to update the questionnaire that was used for this project based on SEMCOG's 2010-11 on-board survey and develop a sampling plan that would ensure adequate data collection to perform analysis. The goal was to obtain at least 15,388 completed surveys which were allocated among the region's transit systems.

Upon approval of the questionnaire, a pilot survey was conducted to test the efficiency of the survey. The pilot was intended to be a test-run of the full-scale data collection and the results were then used to develop and finalize the data quality assurance and control (QA/QC) plan.

Comparisons are made later in this report to the 2010-11 survey conducted by a different research firm. Any perceived insights when comparing the results of the two surveys should consider the significant differences between the collections. For example, 2010-11 survey was paper-based, and the current survey was largely collected using tablet PCs. One example of a comparison that should consider these differences in collections centers around transfer rates. The transfer rates in 2010-11 were different than the rates in the 2019 survey which may initially spark concern, however, by looking at the decomposition analysis (described in Section 3.4 of this report) it shows that the current dataset does an excellent job of representing the transfers that occurred in each system surveyed. Successful linked decomposition analysis at the overall systems level and higher volume routes levels suggests that the data collected properly represents transfers. Without decomposition analysis for the 2010-11 dataset, the same cannot be said for that project.

Quality Control and Data Processing

Quality control and data processing tasks included the entire QA/QC process, as well as tasks related to sample weighting and expansion.

The QA/QC process was an intensive effort performed jointly by ETC Institute and SEMCOG through all phases of the survey. Records were thoroughly examined for validity, with checks executed to search for and correct many potential logical, duplication, and other errors. Minimizing data errors and increasing accuracy helped maximize the number of usable survey surveys that were collected. In addition, SEMCOG performed an in-depth review of the data based on knowledge of the region and understanding of local travel.

Due to transit system characteristics in Southeast Michigan, for the Iterative Proportional Fitting (IPF) process to work properly for this survey, stop-level IPF input data needed to be aggregated. There were more stop locations where boarding and alighting activity occurred in the population than the boarding and alighting locations captured in the survey samples, spreading the available data very thin. To compensate, SEMCOG and ETC Institute developed and implemented a logical and practical stop aggregation approach that accommodated the IPF process and preserved observed travel patterns.

Along with the IPF weighting factor, the final expansion weight was also a function of factors that accounted for rider non-response on sampled trips and for trips that were not sampled. In addition, the final expansion weight considered expected ridership calculated at both the route level, direction, and time-of-day level.

Survey Results

ETC Institute created sets of statistics at both the regional level and the individual transit system level. These statistics focused on passengers' attitude towards the transit services, transit traveler's demographics, transit travel patterns, trip purposes, and service coverage and quality.

Since the region is considering higher level rapid transit service to complement current bus service in major road corridors, additional survey statistics were developed for the Woodward, Gratiot and Michigan Avenue corridors.

Most riders reported not having to use any additional transfer to make their trip (65.5%) while a nominal percentage of riders used two or more transfers to complete their trip (2.4%).

More than fifteen percent (16.4%) of transit riders are transit dependent and could not make the one-way trip without transit services. Just under half (45.9%) of all transit riders did not have access to a vehicle on the survey day, and this number increased to three-quarters in the Blue Water service area. Another one-third (36.8%) of riders in the SEMCOG region do not have a valid driver's license, and furthermore, twenty-eight percent (28.3%) of riders surveyed in the region were unemployed.

The SEMCOG region's transit systems primarily serve people with lower incomes. While each system varies, the survey found that on average sixty-five percent (65.2%) of riders were from households with an annual income of \$50,000 or less, and that fifteen percent (15.4%) of riders were from households making less than \$10,000 annually. Percentage of low-income riders vary, and it ranges from 2% to 31%, depending upon the system.

For travel characteristics, most transit trips made by riders either begin or end at home (83.8%), and forty-two percent (41.5%) of riders used transit for work-related purposes. To access transit, ninety percent (90.4%) of respondents walked to transit from their origin, and for egress ninety-five percent (95.0%) walked from transit to their destination. Finally, eighty-six percent (86.3%) of riders used transit three or more days per week.

1. Introduction

The Federal Transit Administration (FTA) requires accurate and valid transit usage forecasts for investment purposes, and so to support the demand models' data requirements, up-to-date on-board transit surveys that are fully compliant are needed. Therefore, the Southeast Michigan Council of Governments (SEMCOG), working with transit research consultant ETC Institute, conducted a regional on-board survey for the riders on line-haul fixed bus routes operated by the Detroit Department of Transportation (DDOT), Suburban Mobility Authority for Regional Transportation (SMART), Ann Arbor Transportation Authority (AAATA), University of Michigan Transit Service (UM), Blue Water Area Transportation Commission (BWT), Lake Erie Transit Commission (LET), the Detroit People Mover (DPM), MTA Flint (FLT), and the Q Line (QLN).

The purpose of conducting the 2019 on-board transit survey is to update SEMCOG's Travel Demand Forecast Model (TDFM) and enhance the transit and mode choice component based on previously noted changes. The data collected should provide valid and current transit rider travel patterns, demographic information, and transit service characteristics.

SEMCOG defined a set of criteria for a successful survey that includes the following:

- Proper coverage and representation of transit users and all regional transit service providers;
- Sampling plan and data collection methodology focusing on trip purposes and transit access/egress mode;
- Completeness of detail in the trip OD records collected, including accurate geocoding;
- Comprehensive and transparent documentation of all methods, procedures, and outcomes in the survey.

SEMCOG and transit providers will use this data to characterize and predict travel patterns of customers traveling on transit systems in Southeast Michigan. The collected data will also be essential for the enhancement of the mode choice component of SEMCOG's TDFM and for producing model output that follows the recommendations of federal funding programs. Anticipated applications of these survey data include:

- Enhancement of the transit and mode-choice components of the SEMCOG Regional TDFM,
- Compliance with the travel model recommendations and guidelines for applications,
- Identification of current levels of service,
- Establishing baseline information for boardings/alightings and transfer rates, and
- Identification of ridership patterns on local and express services.

The OD survey was conducted among riders of fixed route bus services for all SEMCOG systems using intercept surveys conducted via transit interviewers on the bus/rail lines. Data collection was conducted on weekdays (Monday through Thursday) from December 2018 through June 2019. A total of 17,927 usable surveys, as included in the final data files, were collected for the OD survey.

This report summarizes the survey methods and findings. Chapter 2 provides a description of the sampling approach, survey instrument and procedures, project challenges and solutions, and weighting and expansion methodology. Chapter 3 provides detailed information for the variables collected during the OD survey and summarizes the data at the regional and corridor levels. Chapter 4 summarizes the major findings and recommendations based on the analysis. Included in the appendices are the Questionnaire (Appendix A), and the SEMCOG Assignment Report (Appendix B).

2. Survey Methods

2.1 Sampling Plan

In order to account for all the various systems and their ridership in the SEMCOG region, the sample plan was developed prior to the data collection with collaboration between SEMCOG and ETC Institute for the most appropriate sample distribution.

The proposed sample plan was based on three main factors:

- First, the plan ensured that the sample adequately met data needs at the regional level;
- Second, the plan ensured the collection of adequate samples at various times of day. Times of day (TOD) are defined as AM Peak, Midday, PM Peak, and Evening/Early Morning time periods and;
- Third, the plan ensured that SEMCOG staff would have the ability to segment the sample on key variables, such as route, time of day, and direction.

The population ridership figures were gathered by each agency from periods meant to best approximate the expected ridership to be encountered during the field data collection. Based on previous discussions with FTA regarding best current practices, ETC Institute suggested a 10 percent sample proportional to population ridership as a starting point in the sample design. However, after further discussions certain concessions were made for specific systems. One exception to the initial 10 percent plan was for UM transit due to its large volume of passengers and homogenous trip types. UM routes were sampled at 2.5 percent for intra-campus routes and 5 percent for inter-campus routes. LET routes were surveyed at 14 percent in order to reach a minimal 150 sample size.

The population ridership figures, and base 10 percent sample figures are contained in Table 1.

Table 1: Year 2019 Average Ridership by System and 10% Sample Allocation

System	Average Weekday Ridership	Sampling Goals at 10% (UM at 2.5% and 5%, LET 14%)
DDOT	74,655	7,461
SMART	28,082	2,806
AAATA	25,269	2,527
QLine	3,368	337
DPM	4,214	421
LET	1,061	150
BWAT	3,212	321
UM	38,659	1,365
FLT	Unavailable	30
<i>Total</i>	178,520	15,418

2.1.1 DDOT and SMART Overview

Meetings were held with DDOT and SMART to better describe each route and route type as well as better understand trip characteristics. SMART serves a larger square mileage area which includes multiple cities and jurisdictions while DDOT only serves the city of Detroit. For this reason, DDOT tends to have less variety in their type of trips compared to SMART. In the previously conducted 2010-11 SEMCOG OB survey, the sample was drawn at a higher percent for SMART than for DDOT, however, in the 2019 OB survey both DDOT and SMART were kept at a 10% sampling goal at the route level.

2.1.1.1 DDOT

A 10 percent sample produced a sample goal of 7,461, which is significantly higher than the 5,624 samples collected during the 2010-11 survey. *Note: The ridership below references the ridership which the collection goals were based. They are not the ridership daily averages that were expanded to at the conclusion of the project. Updated ridership figures were provided during the expansion process.*

ETC Institute implemented a 10 percent sample goal for DDOT routes, as shown in Table 2.

Table 2: DDOT 10 Percent Route Sample Goals

Route	Name	Average Daily Weekday Ridership	10% Ridership Sample
1	VERNOR	945	94
2	MICHIGAN	1,644	164
3	GRAND RIVER	6,142	614
4	WOODWARD	8,817	882
5	VAN DYKE/LAFAYETTE	2,279	228
6	GRATIOT	4,222	422
7	SEVEN MILE	5,420	542
8	WARREN	3,703	370
9	JEFFERSON	2,276	228
10	GREENFIELD	4,286	429
11	CLAIRMOUNT	320	32
12	CONANT	532	53
13	CONNER	508	51
15	CHICAGO/DAVISON	1,262	126
16	DEXTER	5,691	569
17	EIGHT MILE	5,397	540
18	FENKELL	1,658	166
19	FORT	994	99
23	HAMILTON	810	81
27	JOY	1,499	150
29	LINWOOD	767	77
30	LIVERNOIS	704	70
31	MACK	2,213	221
32	MCNICHOLS	2,419	242
38	PLYMOUTH	1,695	170
39	PURITAN	401	40
40	RUSSELL	396	40
41	SCHAEFER	800	80
42	MID-CITY LOOP	179	18
43	SCHOOLCRAFT	789	79

Route	Name	Average Daily Weekday Ridership	10% Ridership Sample
46	SOUTHFIELD	347	35
47	TIREMAN	303	30
52	CHENE	683	68
54	WYOMING	688	69
60	EVERGREEN	1,797	180
67	CADILLAC/HARPER	1,090	109
68	CHALMERS	468	47
80	VILLAGES DIRECT	141	14
89	SOUTHWEST DIRECT	66	7
92	ROSEDALE EXPRESS	152	15
95	RYAN EXPRESS	50	5
96	JOY EXPRESS	102	10
Total for DDOT		74,655	7,461

2.1.1.2 SMART

A 10 percent sample rate produced a sample goal of 2,806 as shown in Table 3.

Table 3: SMART 10 Percent Route Sample Goals

Route	Name	Average Daily Weekday Ridership	10% Ridership Sample
125	FORT ST-EUREKA RD	1,346	135
140	SOUTHSHORE	219	22
160	DOWNRIVER	141	14
200	MICHIGAN AVENUE LOCAL	1,255	125
250	FORD RD	344	34
255	FORD RD EXPRESS	209	21
261	FAST MICHIGAN	651	65
275	TELEGRAPH	1,301	130
280	MIDDLEBELT SOUTH	282	28
330	GRAND RIVER-BEECH DALY	463	46
400	SOUTHFIELD - ORCHARD RIDGE	134	13
405	NORTHWESTERN HIGHWAY	335	34
415/420	GREENFIELD – SOUTHFIELD	922	92
430	MAIN STREET - BIG BEAVER	87	9
445	WOODWARD TELEGRAPH LIMITED	69	7
450/460	WOODWARD LOCAL	1,688	169
461/462	FAST WOODWARD	1,881	188
465	AUBURN HILLS LIMITED	41	4
494	DEQUINDRE	563	56
495	JOHN R	1,262	126
510/515	VAN DYKE	2,122	212
530	SCHOENHERR	104	10
550	GARFIELD	205	21
560	GRATIOT	3,190	319

Route	Name	Average Daily Weekday Ridership	10% Ridership Sample
561/563	FAST GRATIOT	1,947	195
562	FAST GRATIOT	52	5
567	NEW BALTIMORE/LENOX	-	-
580	HARPER	103	10
610	KERCHEVAL-HARPER	701	70
615	JEFFERSON	170	17
620	CHARLEVOIX	74	7
635	JEFFERSON EXPRESS	144	14
710	NINE MILE CROSSTOWN	1,602	160
730	TEN MILE CROSSTOWN	643	64
740	TWELVE MILE CROSSTOWN	1,128	113
752	PONTIAC - NORTH HILL FARMS	171	17
753	PONTIAC - BALDWIN RD	236	24
756	PONTIAC - PERRY – OPDYKE	157	16
760	13 MILE/14 MILE CROSSTOWN	664	66
780	15 MILE CROSSTOWN	638	64
805	GRAND RIVER PARK & RIDE	350	35
830	DOWNRIVER PARK & RIDE	205	21
849	NORTHLAND LOOP PARK & RIDE	19	2
851	WEST BLOOMFIELD - FARMINGTON HILLS PARK & RIDE	237	24
Macomb		27	2
Total for SMART		28,082	2,806

2.1.2 University of Michigan (UM)

The system displaying the greatest level of similarity for travel characteristics is UM, making it the most appropriate system (and routes within a system) on which to reduce the sample size. Through discussions with UM, each route was characterized based on the trip types made. Routes were classified into two groups as follows:

- 1) Housing area to campus with trips made primarily by students (intra-campus trips), and
- 2) Campus to different campus, park and ride, and campus/hospital with trips made primarily by students (also faculty, staff, and patients).

For classifications 1 a lower percentage of trips were recommended based on trips overwhelmingly beginning and ending on campus with common trip types. A higher percentage was recommended for classification 2, as compared to 1, because of the drive access/egress at the park and ride lots, which allowed trips to either begin or end off of campus, thus showing a larger variation in trip type (note that these are still relatively homogeneous trips when compared to “standard” transit systems).

Using these classifications, ETC Institute suggested a 2.5 percent sample for classifications 1 (intra-campus trips) and a 5.0 percent sample for classification 2 (trips where either the origin or destination is off campus), as shown in table 4, below.

Table 4: UM 5.0 Percent and 2.5 Percent Route Sample Goals

Route	Classification	Average Daily Weekday Ridership	2.5% Route Sample Goal (Intra-campus trips), 5% (Off Campus)
Bursley Baitz	1	13,294	332
Diag-to-Diag Express	1	1,467	37
Northwood	1	5,687	142
Northwood Express	1	1,858	46
Oxford Shuttle	1	405	10
Crisler Express	2	121	6
Commuter North	2	10,548	527
Med Express	2	2,606	130
North-East Shuttle	2	1,449	72
Wall Street Express	2	59	3
Wall Street-NIB	2	1,165	58
Total for UM		38,659	1,365

2.1.3 Other Transit Providers

ETC Institute implemented a 10 percent sample goal for AAATA routes, as shown in Table 5.

Table 5: AAATA 10 Percent Route Sample Goals

Route	Name	Average Daily Weekday Ridership	10% Ridership Sample
3	HURON RIVER	1,181	118
4	WASHTENAW	4,366	437
5	PACKARD	2,330	233
6	ELLSWORTH	2,261	226
21	AMTRAK-DEPOT	156	16
22	PONTIAC-DHU WARREN	919	92
23	PLYMOUTH	2,438	244
24	S MAIN-EAST	1,053	105
25	ANN ARBOR-SALINE RD	300	30
26	SCIO CHURCH	164	16
27	W STADIUM-OAK VALLEY	389	39
28	PAULINE	699	70
29	LIBERTY	336	34
30	JACKSON	637	64
31	DEXTER	361	36
32	MILLER-MAPLE	1,049	105
33	NEWPORT	166	17
41	EMU COLLEGE OF BUSINESS SHUTTLE	480	48
42	FOREST-MACARTHUR	494	49
43	E MICHIGAN AVE	300	30
44	ECORSE-TYLER	483	48
45	GROVE	402	40
46	HURON-TEXTILE	332	33
47	HARRIET-W MICHIGAN	237	24
60	U-M-DEXTER	259	26
61	AIRPORT-AVIS FARMS	10	1
62	U-M STATE	1,586	159
63	U-M-PONTIAC	118	12
64	GEDDES-E. STADIUM	205	20
65	U-M-DOWNTOWN-GREEN	601	60
66	CARPENTER-HURON PKWY	763	76
67	PLATT-MICHIGAN	30	3
68	HARRIS-FORD	40	4
81	YPSILANTI TWP EXPRESS	9	1
91	EXPRESSRIDE-CHELSEA	56	6
92	EXPRESSRIDE-CANTON	59	6
98	AIRRIDE	-	-
Total for AAATA		25,269	2,527

The route level sample sizes for BWT are presented in Table 6, while the route level sample sizes for LET are presented in Table 7. LET sample rates were set to collect a minimum of 150 completed interviews thus allocating the sampling rate to be 14%.

Table 6: BWT 10 Percent Route Sample Goals

Route	Average Daily Weekday Ridership	10% Ridership Sample
Route 1	471	47
Route 2	464	46
Route 3	359	36
Route 4	191	19
Route 5	574	57
Route 6	375	37
Route 9	441	44
ShopperShuttle	285	29
I-94 Express	6	1
I-94 Express	-	-
M-29 North	24	2
M-29 South	22	2
Total for BWT	3,212	321

Table 7: LET 14 Percent Route Sample Goals

Route	Name	Average Daily Weekday Ridership	14% Ridership Sample
2	Elm	109	15
3	Southeast	122	17
4	Seventh Street	129	18
5	Telegraph	164	23
6	Macomb	76	11
7	South Monroe	141	20
8	North Monroe	204	29
9	South Custer	117	16
Total for LET		1,061	150

There are two rail transit systems in Detroit metro, DPM & the Q Line. To investigate system operation characteristics, a station-based approach was utilized. Surveyors conducted intercept interviews with passengers on the DPM & Q Line which were then allocated to the individual stations where the passengers boarded the vehicles. The station level goals are provided in Table 8 for the Detroit People Mover.

Table 8: DPM 10 Percent Station Sample Goals

Station	Average Daily Weekday Ridership	10% Ridership Sample
TIMES SQUARE	262	26
MICHIGAN AVE	292	29
FORT/CASS	136	14
COBO	238	24
JOE LOUIS ARENA	318	32
FINANCIAL DISTRICT	383	38
MILLENDER	215	22
RENAISSANCE CENTER	639	64
BRICKTOWN	143	14
GREEKTOWN	648	65
CADILLAC	319	32
BROADWAY	177	18
GRAND CIRCUS	444	44
<i>Total for DPM</i>	4,214	421

The route level sample sizes for the Q Line are represented in Table 9 below and were developed at the station level similar to DPM.

Table 9: Q Line 10 Percent Station Sample Goals

Station	Average Daily Weekday Ridership	10% Ridership Sample
CONGRESS STREET	767	77
CAMPUS MARTIUS	461	46
GRAND CIRCUS	219	22
MONTCALM STREET	131	13
ADELAIDE/SPROAT STREET	241	24
MLK/MACK AVENUE	243	24
CANFIELD STREET	348	35
WARREN AVENUE	271	27
AMSTERDAM STREET	67	6
FERRY STREET	148	15
BALTIMORE STREET	71	7
GRAND BOULEVARD	401	40
<i>Total for QLN</i>	3,368	337

2.1.4 Sample Summary for SEMCOG On-Board Survey

Aggregating each system's route ridership produces the following sample sizes as shown in Table 10. (Within each system, individual route sample sizes were to be allocated in the same proportion format as was constructed for the system sizes.)

Table 10: Sample Allocation at the System Level

System	Sample Sizes	10% Sample Percentage
DDOT	74,655	7,465
SMART	28,082	2,808
AAATA	25,269	2,527
QLine	3,368	337
DPM	4,214	421
LET	1,061	106
BWT	3,212	321
UM	38,659	3,866
Total	178,520	17,852

All surveyed trips were selected at the block level, which is to say a select group of runs or trips were selected which ensured a minimum of 20-25% of the route's total trips.

2.2 Survey Instrument

During the survey design process, SEMCOG and ETC Institute collaborated to design the survey instrument (Appendix A). The survey was designed to obtain information in three major categories: OD travel patterns, usage information, and rider demographics. Interviewers who were bilingual were available to administer the survey in languages other than English depending on the language the passenger spoke. For those passengers who didn't speak English and didn't encounter a bilingual interviewer, the interviewer would record the refusal as "Didn't Speak English" and provide information to the passenger to collect a telephone number so someone from the ETC Institute call center could call back later.

2.3 Survey Administration

2.3.1 Boarding and Alighting (BA) Counts

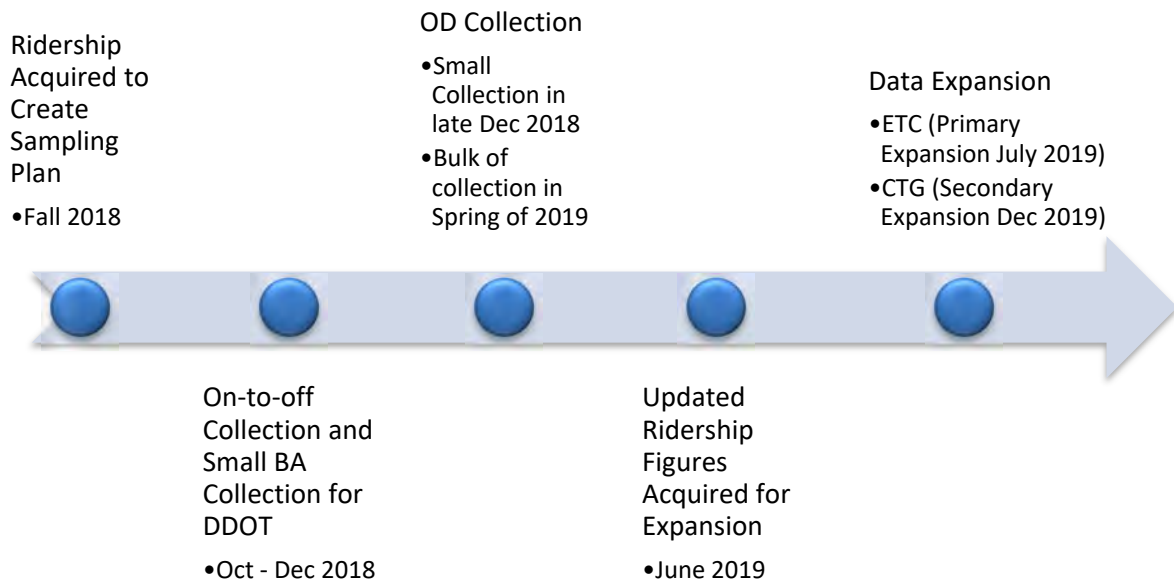
While the original RFP suggested that BA counts could be collected to serve as a proxy for APC data for the expansion process, it was determined that this wasn't needed due to adequate APC data for all systems where this level of detail would benefit the expansion process.

For SMART and AAATA, the APC data was sufficient for stop-group level expansion. For QLine, station level boarding and alighting APC counts were usable for expansion. For DPM, station level farebox boardings were available and used in conjunction with an O2O type data collection previously collected by AECOM to provide a proxy for APC data and O2O collection. For UM, stop level data was not available. However, based on the type of system and routes (large volume of passengers on homogenous sorter length trips) it was determined that the cost to collect a meaningful BA sample was not justified based on the utility it would provide to the expansion. For LET and BWT, stop level boarding and alighting were not available. Because the volume of passengers was so low for these systems, stop level data would not have provided any additional utility for the expansion.

For DDOT, the APC data was available, but ETC did collect data for DDOT in order to help them to validate their APC data and trip times. On a sample of trips ETC collected not only the BA counts, but also collected on-time performance measures by capturing GPS locations at five seconds interval. Once this data was collected it was submitted to DDOT for their analysis.

The figure below shows the general timeline of the major project tasks.

Figure 1 – Timeline of Major Project Tasks



2.3.2 Labor Recruitment and Training

Assembling a team of high-quality surveying staff was one of the most important steps in the OD administration process. ETC Institute collaborated with Stat Team to provide two groups of interviewers: On-to-Off surveyors and OD survey interviewers.

The training session focused on the survey purpose and objectives, the survey instrument, scripts on how to respond to passengers' questions, how to use data collection tools correctly, the random sampling protocol, instructions on how to conduct themselves when working with the public, and safety training. Survey staff were instructed to understand that while they were not SEMCOG employees, they were representing the agency while on transit vehicles or property, and that they always needed to act in a manner that reflected positively on SEMCOG. SEMCOG representatives also participated in the training session to provide an overview of the project as well as express their gratitude of the interviewers. There were additional training sessions conducted throughout the data collection process on an as-needed basis but with smaller groups.

Maximizing participation and legitimizing the survey among passengers depended on the public response to the survey staff. To support a good public image, ETC Institute imposed strict dress code standards that required survey staff to wear clean, appropriate clothing to present a casual, yet neat, appearance that ensured professionalism and comfort. Survey staff were provided with interviewer badges and vests to identify interviewers to SEMCOG staff and passengers to further legitimize their appearance. The badge and dress code standards promoted a professional appearance and reinforced survey legitimacy, which increased passengers' trust in the interviews and the process.

Training On-to-Off Surveyors

The ETC Institute field supervisor created the necessary training materials and conducted the On-to-Off training. The primary tool that was used for the training session was a PowerPoint presentation. The training went over the following details:

- Equipment use and set-up;
- Methodologies for collecting boarding and alighting pairs;
- The importance of achieving 100% coverage of the route;
- How to approach passengers;

- How to handle refusals;
- How to react in various situations that may be encountered;
- Safety training.

Once surveyors had demonstrated that they could perform the On-to-Off counts, the surveyors were invited to field training. The field training provided hands on training that involved the actual conducting of the On-to-Off counts with all passengers. During the field training, surveyors were tested on their proficiency and were provided with additional coaching if needed. Any surveyor deemed unable to perform the On-to-Off count was replaced.

On-to-Off Count Surveyor Roles

The On-to-Off count surveyors were responsible for the distribution and collection of the On-to-Off count cards. Typically, there were two surveyors assigned to each bus with one surveyor covering the front of the bus and a second surveyor positioned at the back of the bus. The surveyor at the front of the bus scanned and distributed bar-coded cards to boarding passengers while the surveyor at the back of the bus collected and scanned the cards as passengers alighted. The surveyors were equipped with handheld scanning devices to capture the boarding and alighting GPS locations and time stamps. The front door surveyor was designated “team leader”. She/he communicated with the bus driver as needed. The rear door surveyor was the dedicated “note taker” who recorded any unusual activity, interruptions or delays on the route throughout the shift. This ensured there were no unexplained gaps in On-to-Off coverage. The note taker submitted daily shift notes to her/his supervisor at the end of each workday. The supervisor would then add those notes to an ongoing shift notes log maintained by the Field Supervisor throughout the project.

Training OD Interviewers

The ETC Institute field supervisors created the training materials and conducted the OD training. The classroom training session included a PowerPoint presentation to explain the purpose and objectives of the survey, questionnaire content, interviewer procedures and requirements, random sampling protocol, survey logistics, how to maximize response rates (including difficult-to-survey passengers), and the data collection process in a step-by-step format. Other goals of the training included building interviewer staff confidence, helping interview staff feel that they are an important part of the survey’s success and helping them understand the importance of the survey and the long-term benefits to their community.

ETC Institute ensured that the training addressed the following details:

- Tips on intercepting/interacting with non-English speakers and passengers with limited English proficiency;
- Cultural sensitivity;
- Importance of understanding the intent of the questions;
- Instructions on conveying the purpose of the survey to passengers;
- Importance of adhering to our random sampling protocol at the outset of every survey;
- Procedure for properly recording all refusals and completing a short observational assessment of the refusing passenger for internal purposes;
- Importance of data confidentiality and instruction on how to address passenger concerns regarding same;
- Overview of the SEMCOG system covering all topics covered in the tablet questionnaire with route-specific instruction as needed;
- How to handle passenger comments and complaints;
- Safety training.

Toward the end of training, interviewers conducted mock interviews using the survey tablets. This allowed ETC Institute staff to gauge each interviewer’s comprehension of the survey instrument and provide feedback as needed. After the training, interviewers were tested on items discussed in training.

Following classroom training, applicants got a chance to conduct interviews under the supervision of an experienced ETC Institute supervisor. Supervisors oversaw interviews and provided feedback on performance throughout the day. Once an interviewer had demonstrated proficiency under direct supervision, he/she was given a field test during which the prospective interviewer conducted surveys on his/her own. During this period the interviewer's productivity and data quality were remotely assessed by ETC Institute's staff.

2.3.2 Survey Administration Methodology

The tablet PCs were the preferred survey method as the tablet PCs have on-screen mapping features that allow for real-time geocoding of addresses and places based off either address, intersection, or place searches using feedback from respondents. The respondents could then confirm the geocoded location based on the on-screen map that displayed the searched address/location via a Google Map indicator icon. In addition to using the mapping feature to collect the global positioning system coordinates of major survey locations (home address, origin address, destination address, boarding location and alighting location), the tablet PC also allowed the interviewer to walk through each question with the respondent. This allowed the interviewer to answer any questions as well as to ensure the accuracy of the data collected. The respondent could also select the answers to the questions directly on the tablet PC during the demographic section to allow for more privacy.

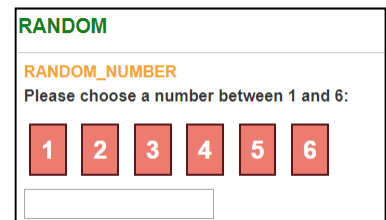
2.3.3 Survey Procedures Selection of Participants

For the OD surveys conducted by tablets, a random number generator (shown in Figure 1) was used to determine which passengers were asked to participate in the survey after boarding the surveying bus.

If six people boarded a bus, the tablet randomly generated a number from 1 to 6. If the answer was 2, the second person who boarded the bus was asked to participate in the survey. If the answer was 1, the first person was asked to participate in the survey, and so forth. The selection was limited to the first six people who boarded a bus/rail at any given stop to ensure the interviewer could keep track of the passengers as they boarded.

For example, if 20 people boarded a bus/rail, the tablet program would randomly pick one of the first six people for the survey. If the interview was refused by the randomly selected passenger, then the passenger who boarded before the passenger selected would be attempted (*after, if 1 was elected*).

Figure 2 - Random Number Generator



The image shows a digital interface for a random number generator. At the top, the word "RANDOM" is displayed in green. Below it, "RANDOM_NUMBER" is written in orange. A text prompt in black says "Please choose a number between 1 and 6:". Underneath the prompt, there are six red square buttons, each containing a white number from 1 to 6. At the bottom of the interface is a white rectangular text input field.

Respondents who did not have time to complete the survey during their bus trip or who spoke a language different from the interviewer were given the option of providing their phone numbers to conduct the survey at another time. Those who provided their phone numbers for call back were then contacted by ETC Institute's call center to complete the survey. Those interviewers that did speak the foreign language of the passenger translated the English tablet version and indicated which language the interview was conducted in.

OD Survey Procedure

All routes were classified as fixed routes and were surveyed using the tablet PC method. Fixed routes are routes that provide regular/continuous service throughout the day. A nominal number of routes on the SMART, AAATA, and BWT systems had routes that ran in the peak time periods only, which would be the AM Peak or PM Peak time periods. Typically, these routes are express routes and/or Park-and-Ride routes.

Interviewers selected people for the survey in accordance with the sampling procedures. Once an interviewer had employed random sampling protocol to identify the passenger to be surveyed, the interviewer:

- Approached the passenger who was identified and asked him or her to participate in the survey;
- If the person refused, the interviewer ended the survey, excused themselves and completed three observational questions;
- If the person agreed to participate, the interviewer asked the respondent if he/she had at least 5 minutes to complete the survey;

- If the person did not have at least 5 minutes on the bus/rail, the interviewer asked the person to provide his/her name and phone number for a later call back in the likely event that they alighted prior to completing the survey. A phone interviewer from ETC Institute's call center contacted the respondent and asked him/her to provide the information by phone. This methodology ensured that people who completed short trips on public transit were well represented. Most records were able to be completed on-board with only a nominal amount of records completed by phone;
- If the person had at least 5 minutes on the bus, the interviewer began administering the survey to the respondent as a face-to-face interview using a tablet.

2.3.4 In-Field Quality Assurance / Quality Control

The tablet PCs that were used to collect the Origin Destination (OD) survey data contained an on-screen mapping feature that allowed for real-time geocoding of locations based off of: address, intersection, or place searches gathered from feedback of respondents. The respondents then confirmed the geocoded location based on the on-screen map that showed the searched address/location via a Google Map indicator icon.

In addition to using the mapping feature to collect the GPS coordinates of major survey locations (home address, origin address, destination address, boarding location, and alighting location), the tablet PC program also allowed the interviewer to walk through each question with the respondent to answer any questions as well as to ensure appropriate interpretation of the survey questions.

Field Supervisor Quality Checks

ETC Institute employs full-time Field Supervisors and Assistant Field Supervisors who are solely responsible for: training, scheduling, and managing transit data collection efforts. ETC Institute continually adds steps to improve the Field Supervisors' ability to effectively manage field staff. One way in which Field Supervisors are able to manage their field staff is by the use of an online dashboard that is created for each transit project. The online survey database that stores all the data collected in the field allows for connection to multiple Business Intelligence (BI) dashboards. This allows ETC Institute to create dashboards for Field Supervisors that allows them to instantly see the data collected in the field in a variety of different ways.

They were instantly able to view the number of records completed by route, time period, and direction, which supports effective management of sampling goals. The dashboard also displayed a breakdown of the overall trip information and demographics that were collected. The dashboard then went one step further by providing a breakdown of that same information for each individual interviewer. Individual interviewer data reviews were typically completed while the interviewer is on the bus/train and the findings were discussed with that interviewer when they checked in with the supervisor. This allowed the research team to provide immediate feedback to interviewers to improve their overall performance.

These instant data breakdowns allowed Field Supervisors to ensure that sampling procedures were being followed appropriately and the data collected was representative of the system.

Field Supervisor Online Review Tool

In addition to being able to review various breakdowns of data, Field Supervisors were also able to review each individual record. This was typically done in the field as a way to make sure that trip data was being collected accurately by individual interviewers. Another benefit of Field Supervisors being able to look up individual records by interviewer in database/spreadsheet form, is that it allowed them to call survey respondents in order to check on the accuracy of the data collected, as well as the job performance of the interviewer. Field Supervisors were also able to visually review individual records by using the non-editable version of the online visual review tool. This tool allowed Field Supervisors to see a visual representation of individual surveys. An example screenshot of the Field Supervisor's version of this online tool is shown in the figure below.

Figure 3 – Online Visual Review Tool

The screenshot shows a web-based interface for reviewing transit trip data. On the left is a form with several sections: 'ROUTE CODE' (with a dropdown and 'OK' button), 'Date' (with a date picker), 'Interviewer Initials' (with a text input), 'Distances between various trip points' (with a text input), 'Distance and Ratio Check Flag' (with a text input), and 'Official Route Map and Stops' (with a text input). Below these are five tabs: 'Home Information Tab', 'Origin Information Tab', 'Boarding, Access Mode and Previous Transfers Tab', 'Alighting, Egress Mode and Next Transfers Tab', and 'Destination Information Tab'. The 'Origin Information Tab' is currently selected, showing fields for 'ORIGIN LOCATION' (with a 'Location Search' button), 'PLACE TYPE' (with a dropdown), 'PLACE NAME' (with a text input), and 'ORIGIN ADDRESS' (with a text input). On the right is a map showing a route with points A, B, C, D, and E marked. Arrows point from the form fields to the map points: 'Route Code' points to point A, 'Date' points to point B, 'Interviewer Initials' points to point C, 'Distances between various trip points' points to point D, 'Distance and Ratio Check Flag' points to point E, and 'Official Route Map and Stops' points to the route line. The map also shows a 'Remarks' field and a 'Please choose...' dropdown.

Secret Shopper / Ride Along

Field supervisors or secret shoppers also rode on bus routes to gauge interviewers' demeanor, overall behavior, and adherence to protocols during interviews.

Call Center Field Checks

ETC Institute has an in-house call center that conducts random quality control check calls for each transit project. These calls are similar to the calls made by Field Supervisors just on a larger scale. The call center can conduct hundreds of quality control calls to respondents per project on a weekly basis. The goal of the call is to identify any missing or incorrect elements in the interview as well as gather any feedback regarding the interviewer's job performance during the interview.

Process for Identifying Complete Records

To classify a survey as being completed, the record must have contained all required trip data. ETC Institute has classified required trip data as containing the complete answers to the following:

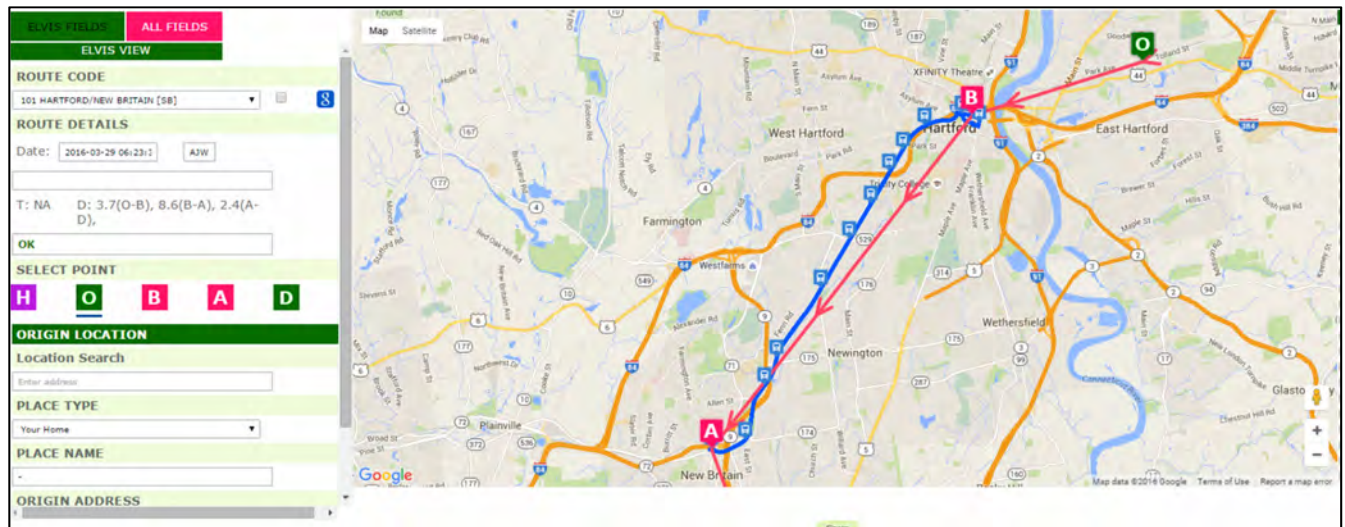
- Route used
- Direction of route
- Time of trip
- Home address
- Origin address
- Destination address
- Origin type place
- Destination type place
- Access mode
- Egress mode
- Boarding location
- Alighting location

In addition to the required trip data questions, a survey must be marked as complete by the online survey program which occurs only if the interviewer has navigated through every required question on the online survey instrument including demographic questions.

Online Visual Review Tool

ETC Institute has created an online visual review tool that allows for the review of all completed records within the database. This tool shows all components of each individual trip as well as a series of preprogrammed distance and ratio checks as described on subsequent pages. After directions were finalized, the next step was to run each record through the Speed/Distance/Time checks. The figure below is an example of the online visual review tool. It is very similar to the online visual review tool used by Field Supervisors described previously, with the additional functionality of being able to review all aspects of the survey as well as being able to make edits when appropriate.

Figure 4 – Online Visual Review Tool – 2nd Example



2.3.5 Pre-Processing Distance Checks

A series of distance and ratio checks are preprogrammed into the online visual review tool in order to allow for ETC Institute's team of Transit Reviewers to take a more systematic approach in reviewing complete records. The Transit Review Team's process for editing surveys is described in a later section. *Note: The distance and ratio checks described were meant to alert the reviewer that closer evaluation was needed. It did not necessarily indicate that the record was inaccurate or unusable.*

The distances used for the checks were created using the great-circle distance formula which is based on a straight line from point A to point B that takes into account the curvature of the earth.

Access/Egress Mode Distance Check

The table below shows the distance checks for access (Origin to Boarding) and egress modes (Alighting to Destination).

Table 11: Distance Checks for Access and Egress Modes

Distance Check Name	Check	Condition 1	Condition 2	Flag?
Origin to Boarding	Origin to Boarding distance is greater than 1.75 miles	Access Mode - <u>ANY USE OF A VEHICLE</u> (ie, dropped off, rode with others, drove, taxi...)		No
		Access Mode - Walk/Wheelchair/Skateboard	There is at least one transfer from origin to boarding	No
		Access Mode - Walk/Wheelchair/Skateboard	There are no transfers from origin to boarding	Yes
	Origin to Boarding distance is less than .2 miles	Access Mode - <u>ANY USE OF A VEHICLE</u> (ie, dropped off, rode with others, drove, taxi...)		Yes
		Access Mode - Every mode	There is at least one transfer from origin to boarding	Yes
		Access Mode - Walk/Wheelchair/Skateboard	There are no transfers from origin to boarding	No
Alighting to Destination	Alighting to Destination distance is greater than 1.75 miles	Egress Mode - <u>ANY USE OF A VEHICLE</u> (ie, will get picked up, ride with others, drive, taxi...)		No
		Egress Mode - Walk/Wheelchair/Skateboard	There is at least one transfer from alighting to destination	No
		Egress Mode - Walk/Wheelchair/Skateboard	There are no transfers from alighting to destination	Yes
	Alighting to Destination distance is less than .2 miles	Egress Mode - <u>ANY USE OF A VEHICLE</u> (ie, will get picked up, ride with others, drive, taxi...)		Yes
		Egress Mode - Every mode	There is at least one transfer from alighting to destination	Yes
		Egress Mode - Walk/Wheelchair/Skateboard	There are no transfers from alighting to destination	No

Origin to Destination Distance Check

The Table below shows the distance checks based on the origin and destination locations.

Table 12: Distance Checks Based on the Origin and Destination Locations

Distance Check Name	Check	Flag Record
Origin to Destination	Origin equals the Destination	Yes
	Origin to Destination is greater than 50 miles	Yes
	Origin to Destination is less than .25 miles	Yes

Boarding and Alighting Distance Check

The table below shows the distance checks based on the boarding and alighting locations.

Table 13: Distance Checks on the Boarding and Alighting Locations

Distance Check Name	Check	Flag Record
Boarding to Alighting	Boarding equals the Alighting	Yes
	Boarding to Alighting is less than .25 miles	Yes

2.3.6 Pre-Processing Ratio Checks

After all transfer checks were completed, the next step in this process involved the application of a series of QA/QC Ratio Checks.

Three ratio checks were conducted for each record. First, the distance between boarding and alighting was divided by the distance between origin and destination. If the rider had a high ratio for this check, the rider was on the bus for an extensive time compared to the origin to destination distance. If the check created an extremely low ratio, the use of transit seemed unnecessary.

Second, the distance between origin and boarding was divided by the distance between origin and destination. If the rider had a high ratio for this check, the origin to boarding distance was excessive compared to the origin to destination.

Lastly, the distance between alighting and destination was divided by the distance between origin and destination. If the rider had a high ratio for this check it meant that the alighting to destination distance was excessive compared to the origin to destination.

The table below describes in more detail the ratio checks used, and the conditions in which a record would be flagged.

Table 14: Ratio Checks

Ratio Checks	Check	Result of Formula	Condition 1	Condition 2	Flag?
Boarding to Alighting distance divided by Origin to Destination distance	Boarding to Alighting Distance/Origin to Destination Distance	the result of this formula is 1.5 or greater			Yes
	Boarding to Alighting Distance/Origin to Destination Distance	the result of this formula is less than .3	Access and Egress modes are both Walk/Wheelchair/Skateboard	There are NO transfers involved in the trip	Yes
	Boarding to Alighting Distance/Origin to Destination Distance	the result of this formula is less than .3	Access or Egress mode - <u>ANY USE OF A VEHICLE</u>		No
	Boarding to Alighting Distance/Origin to Destination Distance	the result of this formula is less than .3	There is at least one transfer involved in the trip		No
Origin to Boarding distance divided by Origin to Destination distance	Origin to Boarding Distance/Origin to Destination Distance	the result of this formula is 1 or greater	there is at least one transfer from origin to boarding		No
	Origin to Boarding Distance/Origin to Destination Distance	the result of this formula is 1 or greater	Access Mode - <u>ANY USE OF A VEHICLE</u> (ie, dropped off, rode with others, drove, taxi...)		No
	Origin to Boarding Distance/Origin to Destination Distance	the result of this formula is 1 or greater	Access Mode - Walk/Wheelchair/Skateboard	There are no transfers from origin to boarding	Yes
Alighting to Destination divided by Origin to Destination	Alighting to Destination Distance/Origin to Destination Distance	the result of this formula is 1 or greater	there is at least one transfer from alighting to destination		No
	Alighting to Destination Distance/Origin to Destination Distance	the result of this formula is 1 or greater	Egress Mode - <u>ANY USE OF A VEHICLE</u> (ie, will get picked up, ride with others, drive, taxi...)		No
	Alighting to Destination Distance/Origin to Destination Distance	the result of this formula is 1 or greater	Egress Mode - Walk/Wheelchair/Skateboard	There are no transfers from alighting to destination	Yes

Transit Review Team

ETC Institute has a dedicated team of employees whose main priority is reviewing and editing completed records through the use of an online visual review tool. One of their other key responsibilities is the process of calling and completing “Callback” surveys. Callback surveys are surveys that were unable to be completed in the field. The “Callback” surveys were conducted within a week of when the initial survey began so that the information of the trip could be more easily be recalled by the respondent.

The Transit Review Team reviewed all complete records collected for the survey, paying special attention to records that were automatically flagged by the online visual review tool. Prior to making edits to any survey, they first attempted to contact the respondent to clarify any questionable answer choices regarding the trip. If no contact was made, or if contact was not possible, the following actions were taken.

Pre-Processing General Issues and Actions

The table below describes the general issues that could occur within a trip where changes may have been appropriate.

Table 15: General Issues

Issue	Description of Issue	Action
Origin/Destination Issue - 1	Origin/Destination appears incorrect because the wrong location of a multiple-location organization was selected	If for example, an Origin/Destination appears illogical based on the college campus that was selected, but an appropriate campus of the same college does appear logical given the other points and answer choices of the trip, then the appropriate campus will be selected.
Origin/Destination Issue - 2	Origin/Destination appears to have been geocoded to the incorrect city/state	If for example, an Origin/Destination appears illogical based on the city/state that was geocoded, but the address/intersection is logical within the trip if the city/state are changed. This occurs occasionally because the surveyor selects the wrong choice from the list of possible address choices that appear in the online survey instrument, then the appropriate address information will be inserted.
Access/Egress Mode	Access/Egress Mode seems illogical based on trip	If the access/egress mode involves the use of a vehicle and the distance from either origin to boarding or alighting to destination is less than .2 miles then the access/egress mode is recoded to walk/walked and that change will be reflected in the database. Unless the terrain of the area makes walking unlikely.
Directionality of Record	Boarding and alighting locations indicate that the trip is going in the opposite direction of what was selected by the surveyor.	Change Direction of Route Selected and if necessary update boarding and alighting locations based on appropriate direction.

2.3.7 Post-Processing Additional Checks

After all records were reviewed by the Transit Review Team, the next step in this process involved the application of a series of QA/QC “non-trip” Checks. Non-trip checks are described as anything not pertaining to the respondent’s actual trip, i.e. demographic information.

Non-trip related checks included:

- Ensuring the respondents who indicated that they were employed also reported that at least one member of their household was employed.
- Ensuring the time of day a survey was completed was reasonable given the published operating schedule for the route.
- Ensuring that the appropriate fare type was used in response to the age of respondent.
- Checking that there is a representative demographic distribution based on age, gender, and income status.
- Removing any personal contact information used for quality control purposes during the data collection portion of the project in order to protect the anonymity of the respondents.

Once all records had gone through the pre-processing and post-processing QA/QC checks, those that were deemed complete and usable were then used to update the completion report used by the Fields Supervisor and Assistant Field Supervisor to ensure that all contractual goals had been met. After the final high-level review was completed, metadata (a codebook) was created in order to suitably explain the data in the database.

On-to-Off Survey Procedure

The On-to-Off counts were collected using ETC Institute’s proprietary software running on GPS-capable tablets equipped with barcode scanners. Tablets on-board the same bus were paired up before a data collection session began. The passengers’ route, direction, boarding and alighting information (time, latitude and longitude) were captured with a high degree of accuracy via the following process:

- Transit passengers were asked to participate as they entered the transit vehicle;
- Each passenger entering the bus was handed a barcoded card moments after the card was scanned by ETC Institutes on-board team member;
- Passengers were asked to keep the bar-coded card for the duration of their trip on that transit vehicle;
- Passengers were asked to hand their cards back as they exited the vehicle. The cards were scanned as the passengers exited the bus.

The On-to-Off software sent the scanned data to the On-to-Off server where a server-side processing system evaluated the data and paired up the boarding and alighting locations of each passenger based on the unique barcode, time stamps, and other variables. Before any collection took place, counter staff were trained on every aspect of the on-board process. Supervisory staff administered a variety of quality control checks during tablet set-up, including review of Route #, Team #, Block #, Run #, Bus #, and Partner Tablet ID #. The On-to-Off software was centered on a live map of the current transit route and associated stops. ETC Institute’s on-board data collection staff could follow the map of the route and accurately select the passengers’ boarding and alighting locations. Route termini were clearly marked on the map and the user was alerted when approaching a route terminus, where the session was closed, and a new session initiated when the bus/train began a new run. An example screenshot of the On-to-Off software is shown in Figure 2.

Figure 5 - On-to-Off Software Program



Pre-Processing Quality Assurance / Quality Control

A thorough analysis of the stop list within the study area is conducted by ETC Institute's GIS analysis before the study. Effective stop geocoding depends on the initial quality of the stop data. Some of the specific checks that are conducted during the pre-processing phase include:

- Sort and delete low confidence records that were created. Confidence levels are created based on the *on-to-off* software's QA/QC algorithm (described below)
- Check completeness of all fields for each record
- Verify the time of day when a survey set was completed was reasonable given the published operating schedule for the route

QA/QC algorithm

The record matching algorithm uses the barcode value and time stamp of the scan to match the ON and OFF records. The level of confidence of the match, expressed as a number - e.g. 100 means perfect match – is determined based on auxiliary attributes of the scans falling within certain tolerances or matching expected values. These auxiliary attributes include:

- Route and Direction of the candidate scans should match; if one or both do not match, the reliability of the match is affected and marked
- Enter and Exit modes – the ON scan is expected to have the Enter mode tag while the OFF scan should have the Exit mode tag; if either scan does not, a capture error is recorded and match reliability is affected
- Paired device ID – the OFF scan is expected to have been captured on a device that was paired up with the ON scan device
- Session Number – an auto-generated globally unique session ID assigned to each scan and is combined with the device ID and the ID of any paired devices
- Time gap between two consecutive candidate scans must be between a minimum and a maximum value, e.g. 1 min to 3 hours; the maximum value is set for the specific transit system under study
- If travel time is greater than X (e.g. 30 min), vehicle speed must be greater than Y (e.g. 5 mph)
- Distance between location of two matching scans must be greater than L (e.g. 0.1 mile)

Post-Processing Quality Assurance / Quality Control

After all addresses were successfully geocoded, the next step in this process involved the application of a series of QA/QC Checks.

Directional Check

Following the boarding and alighting stop locations being geocoded, the direction of travel for each record was confirmed. Stop locations and IDs were then updated based on established direction. **Table 1** shows actions that were taken if the direction was incorrect.

Table 16: Directionality of Record

Issue	Description of Issue	Suggested Action
Directionality of Record	Boarding and alighting locations indicate that the trip is going in the opposite direction of what was selected by the surveyor.	Change Direction of Route Selected and if necessary update boarding and alighting locations based on appropriate direction.

Speed/Distance/Time Check

After directions were finalized, the next step was to run each record through the Speed/Distance/Time checks. If any of the conditions in the table on the following page, were met, the record was flagged for further review.

Table 17: On-to-Off Check Name

On-to-Off Check Name	Check	Condition 1	Flag?
Speed Check	Checks Speed between boarding and alighting pair	< 1mph	Yes
		>70mph	Yes
Distance Check	Checks Distance between boarding and alighting pair	< 0.12 miles	Yes
		Exceeds route terminus to terminus distance	Yes
Time Check	Checks time between boarding and alighting pair	< 1 minute	Yes
		Exceeds route terminus to terminus average time	Yes

2.3.8 In-Field Quality Assurance/Quality Control

Each day, ETC Institute’s field supervisor reviewed each employee’s data regarding the following issues to assess whether the employee was conducting the survey properly:

- Distribution of surveys by demographics;
- Distribution of surveys by trip characteristics;
- Length of each survey in minutes;
- Percentage of refusals.

In addition to daily reviews of demographic responses, length, etc., a comprehensive weekly report was created at the direction of the field supervisors which included a detailed itemized breakdown of each interviewer’s performance for the week, specifically analyzing distribution of survey responses in relation to the norm. The supervisor would take the corrective action, then add a dated note to the weekly report describing in detail the remedial action taken. The same supervisor would be assigned to follow-up on the issue with the interviewer in question during the current week. If the corrective plan did not prove successful, the interviewer was removed from the schedule, either temporarily pending supplemental training or permanently, where such action was deemed appropriate by the field supervisor.

ETC Institute’s field supervisors routinely conducted spot checks on assigned bus routes and made unannounced visits to stops and stations. Supervisors also utilized anonymous “secret shoppers” to pose as passengers on buses to check up on staff attitude, appearance, performance, and compliance with ETC Institute rules and procedures. Also, field supervisors could verify if an interviewer was on their assigned route by viewing the displayed geographic locations of where the interviews were taking place as well as track productivity and data accuracy down to the second it occurred. These checks ensured data integrity and helped identify any interviewer who was falling short of our standards for field survey collection.

3. Survey Weighting and Expansion

SEMOG interviews were expanded by route, direction, time-of-day, and by segments containing the boarding and corresponding alighting location of the passenger. The following sections describe the methodology that was used to develop the unlinked expansion factors.

When survey quantity goals are created, they are typically based upon a percentage of the average weekday ridership for the routes in the system. These are further broken down by time periods and directions. The time periods that are created (e.g., 9 am to 3 pm) are based off the specific needs of SEMOG systems.

The purpose of developing survey quantity goals is to collect an appropriate number of survey records that will be expanded to represent the total average weekday ridership of each route by time period and direction. To further increase the specificity of the expansion process, segments were created for each route. Stops were grouped into segments along that route so that boarding segments could be paired with alighting segments when creating the expansion factor. Segmentation occurs on bus routes because it is unrealistic to expand bus survey data at the stop level.

The ridership provided for the goal creation is not the ridership used for expansion. Earlier in this report, goals were shown based on ridership figures provided in the fall of 2018. Once the OD data collection was finished then the various agencies provided updated ridership data that was representative of the OD collection period. That updated ridership data was used for expansion purposes described in this section.

3.1 Route Segmentation Procedures

3.1.1 Route Segmentation with APC Data

There are two ways ETC Institute creates segments for bus routes: 1) boarding percentages of the route from APC data by direction, and 2) based on the number of stops for the route and direction. When possible, segmenting routes using APC data is the preferred way to segment routes as opposed to segmenting routes based on the number of stops.

Routes with both APC data and On-to-Off counts are separated based on direction, then divided into three segments based on the total boardings. After approximately one-third of the route's total APC ridership has boarded, a new segment begins. After approximately two-thirds of the route's total APC ridership has boarded the third segment begins. The table at the top of the following page is a simplified example of APC Data Segmenting for a route with both APC data and On-to-Off counts. *(Note: Iterative Proportional Fitting (IPF) is discussed later in Type 1 expansion later this document. For IPF to work properly, the boarding totals must match the alighting totals. For this reason, APC alightings are adjusted using a multiplying factor in order to make sure their overall totals match the overall boarding totals. These are typically nominal alterations, however, if there are significant differences in boarding and alighting totals by direction of a route, it may require additional review of the functionality of the route to ensure that the surveys are both collected and expanded appropriately.)*

Table 18: Route Segmenting: APC Provided Routes with On-to-Off counts

Segmentation with APC Example					
Direction: Eastbound	APC DATA		Segmentation		
	Boardings	Alightings	Running Total of Boardings	Running Percentage of Total Boardings	Segment
Stops					
Stop 1	35	0	35	23.0%	1
Stop 2	20	10	55	36.2%	1
Stop 3	20	5	75	49.3%	2
Stop 4	15	10	90	59.2%	2
Stop 5	5	12	95	62.5%	2
Stop 6	4	4	99	65.1%	2
Stop 7	19	4	118	77.6%	3
Stop 8	12	3	130	85.5%	3
Stop 9	15	5	145	95.4%	3
Stop 10	3	10	148	97.4%	3
Stop 11	2	15	150	98.7%	3
Stop 12	2	11	152	100.0%	3
Stop 13	0	10	152	100.0%	3
Stop 14	0	15	152	100.0%	3
Stop 15	0	38	152	100.0%	3
	152	152			

If On-to-Off counts are not collected, but APC data is available, those routes are typically segmented into 2 segments by time period and direction boarding totals. The reason for that is you can only accurately determine the flows between two segments when you only have APC data. Those routes are segmented similarly to the process above with the main difference being that the second segment begins after approximately half of the route's total APC ridership has boarded. When a route is segmented in half, you have the possibility of three boarding to alighting cell combinations: board segment 1 to alight segment 1, board segment 1 to alight segment 2, board segment 2 to alight segment 2. *Note: board segment 2 to alight segment 1 is not possible as that would indicate the individual was traveling in the opposite direction. Also, some route directions may only receive 2 segments if one stop (generally the first boarding stop for the specific route direction) has an inordinately high boarding percentage of greater than 50%.* When you have 3 segments you have twice (6) the number of possible boarding to alighting pair combination possibilities.

3.1.2 Route Segmentation without APC Data

Routes without APC data are divided into three segments based on the total number of stops. After approximately one-third of the route's stops occurred, a new segment begins. After approximately two-thirds of the route's stops have occurred, the final segment begins. Below is an example of segmenting without APC Data.

Table 19: Route Segmenting: Non-APC Provided Route

Segmentation without STOP-LEVEL RIDERSHIP Example														
Direction: Eastbound														
Stops	Stop 1	Stop 2	Stop 3	Stop 4	Stop 5	Stop 6	Stop 7	Stop 8	Stop 9	Stop 10	Stop 11	Stop 12	Stop 13	Stop 14
Segment	1	1	1	1	1	2	2	2	2	2	3	3	3	3

3.3 Expansion Types

The type of bus data expansion conducted depended on the data available for the specific route. The three types of data that created the combinations that guided the type of expansion used were:

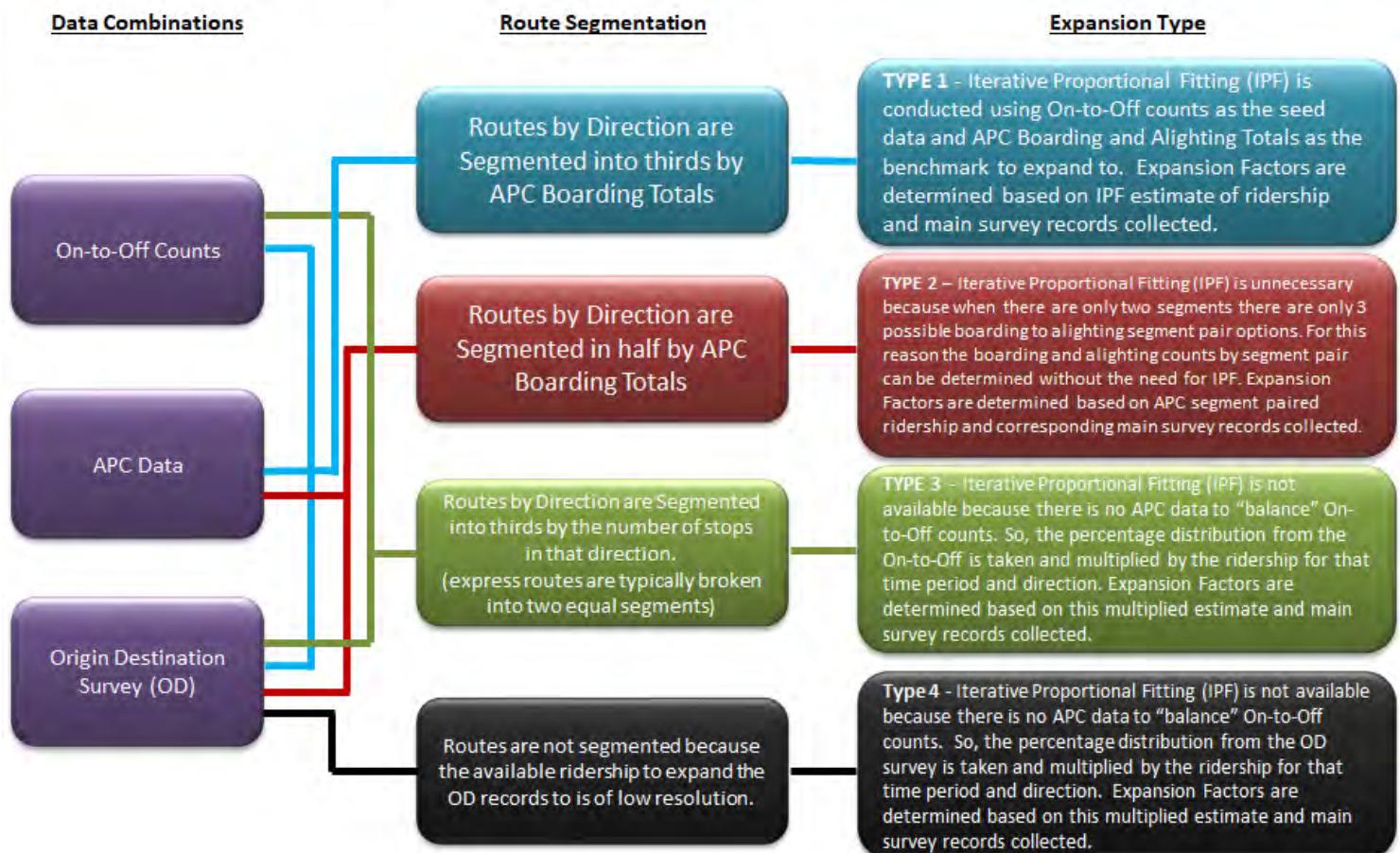
1. Stop-Level Ridership/Automatic Passenger Counter (APC) Data (from SEMCOG agencies),
2. On-to-Off counts data (collected by ETC Institute), and
3. OD Survey Data (collected by ETC Institute).

These three different data types determine the type of expansion (1, 2, 3, or 4 as shown below) that will be used for a route.

Notes: 1) All types of expansion are conducted at the route, time period and direction level. Some more rudimentary expansion occurs when the level of ridership information is of a lower resolution. 2) During Iterative Proportional Fitting, the On-to-Off data serves as the “Seed” data while the APC boarding and alighting counts serve as the totals or “Benchmarks” that the On-to-off data is expanded to. After those two pieces of data finish going through the IPF process the result is a final estimate of ridership flows between segment pairs for that route, direction, and time period. These final estimated segment to segment pair ridership flow counts are then divided by the corresponding number of OD surveys in the same segment to segment pair. 3) Type 3 expansion was not utilized for this project.

The figure below shows the data type (On-to-off counts, APC data, OD data) combinations along with the corresponding types of route segmentation and type of expansion used.

Figure 6 – Data Combination, Route Segmentation, & Expansion Type

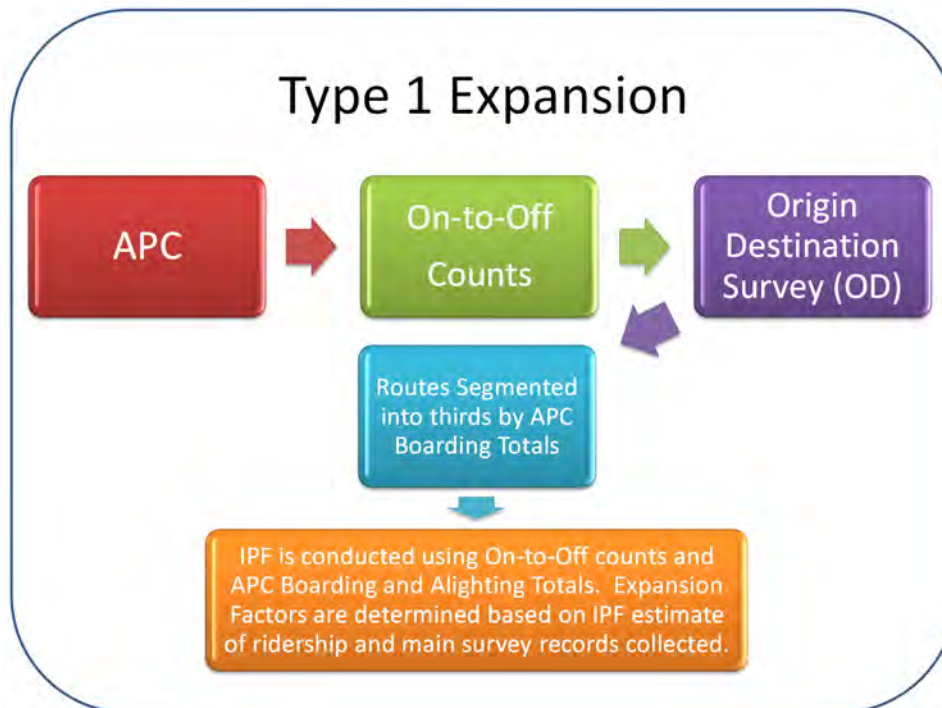


In the subsequent explanation of expansion types, Iterative Proportional Fitting (IPF) is utilized where possible. IPF is an algorithm ETC Institute utilizes to balance the differences between the ridership projected from the On-to-Off counts and the APC ridership for each segment. Further detail on the IPF process is explained under Type 1 expansion.

Type 1 Expansion: Routes with APC Data, On-to-Off Counts, and OD Survey Data

Of the four types of bus expansion discussed, Type 1 Expansion is the preferred method as it incorporates all three types of data available. Typically, On-to-Off data collection is reserved for more heavily traveled routes, so this type of expansion was conducted on the more heavily traveled routes in the system and occurred after route stops were divided into *three segments based on total boarding distribution by direction. The APC daily ridership totals were provided by the appropriate agencies. The segments were then appended to both the On-to-Off counts and the OD data.

Figure 7 – Type 1 Expansion



**Note: One route DDOT route 2 in the westbound direction only received 2 segments because the first stop for this direction had an inordinately high boarding percentage in the APC data).*

An example of the methodology for Type 1 Expansion is as follows:

Type 1: Expansion Methodology for Bus Routes with Stop-Level APC Data, On-to-Off Data, and OD Survey Data

Once the segments were appended to the On-to-Off counts, APC data, and OD Survey databases, the records were ready for expansion. A simplified version of the process for how the data was expanded in Type 1 Expansion is explained below:

Figure 8 shows the segmented results for the On-to-Off counts that were administered for a certain route, direction, and time period. Each row in the table identifies the segment where passengers boarded the bus. The columns in the table identify where passengers alighted the bus. For example, 20 of the On-to-Off counts had passenger board in segment 2 and alighting in segment 3.

Note: The On-to-Off counts serve as the seed data in the IPF process while the APC boarding totals and alighting totals serve as the “Benchmark” totals that the On-to-Off counts are expanded to.

Figure 8: Results of the On-to-Off Survey

Route: Example Eastbound (6am-9am)		ACTUAL RIDERSHIP COUNTS FROM THE ON/OFF SURVEY			
Segment		Total	1	2	3
1	60	5	15	40	
2	45		25	20	
3	10				10
Total	115	5	40	70	

Figure 9 shows the distribution of the data in Figure 8 expressed as a percentage of all boardings for the specific time period and direction. Figure 9 was created by dividing each On-to-Off cell in Figure 8 by the sum of all On-to-Off counts in Figure 8, which is 115. For example, 20/115 (17.4 percent) of all trips boarded in segment 2 and alighted in segment 3 as shown in Figure 9.

Figure 9: Distribution of the On-to-Off Survey

Route: Example Eastbound (6am-9am)		PERCENTAGE DISTRIBUTION OF RIDERSHIP COUNTS FROM THE ON/OFF SURVEY			
Segment		Total	1	2	3
1	52.2%	4.3%	13.0%	34.8%	
2	39.1%	0.0%	21.7%	17.4%	
3	8.7%	0.0%	0.0%	8.7%	
Total	100.0%	4.3%	34.8%	60.9%	

The total ridership for the route, time period, and direction was applied to the On-to-Off distribution percentages shown in Figure 9.

This produces an initial estimate of the ridership flow for the boarding segment to the alighting segment as shown in Figure 10. Applying the actual ridership of 320 creates an initial estimate of 56 trips (17.4% x 320) boarding in segment 2 and alighting in segment 3.

Figure 10: Initial Estimate of Ridership Flows Between Station

(percentages in table 2 were applied to the total boardings for this time period in this direction)					
Route: Example Eastbound (6am-9am)		PROJECTED RIDERSHIP BASED ON THE ON-TO-OFF SURVEY			
Segment		Total	1	2	3
1	167	14	42	111	
2	125	0	70	56	
3	28	0	0	28	
Total	320	14	111	195	

In order to develop a more accurate estimate of the ridership flows between segments on each route, ETC Institute developed an Iterative Proportional Fitting (IPF) Algorithm to balance the differences between the ridership projected from the On-to-Off counts (shown in Figure 10) and the APC ridership for each segment (shown in Figure 11). The IPF process is described below:

Figure 11: Boardings and Alightings by Station

Route: Example Eastbound (6am-9am)				
Average Weekday Ridership	Total	1	2	3
BOARDINGS	320	100	100	120
ALIGHTINGS	320	20	100	200
DIFFERENCE FROM PROJECTED				
BOARDINGS	0	-67	-25	92
ALIGHTINGS	0	6	-11	5

Step 1: Correction for the Boardings

The estimated ridership from the On-to-Off counts for each route (as shown in Figure 10) was multiplied by the ratio of the actual boardings from Stop-Level Ridership/APC Data for each segment by the estimated boardings for each segment. For example, if the actual boardings for Segment 1 were 120 and the estimated boardings were 100, each cell associated with Segment 1 would have been multiplied by 1.2 (120/100) to adjust the estimated boardings to actual boardings.

Step 2: Correction for the Alightings

Once the correction in Step 1 was applied, the estimated boardings would be equal to the actual boardings. However, the adjustment to the boardings total may have changed the alighting estimates. To correct the alighting estimates, the new values calculated in Step 1 were adjusted by multiplying the ratio of the actual alightings from the Stop-Level Ridership/APC Data for each stop by the estimated alightings for each segment from Step 1. For example, if the actual alightings for Segment 2 were 220 and the estimated alightings from Step 1 were 200, each cell associated with Segment 2 would have been multiplied by 1.1 (220/200) to adjust the estimated alightings from Step 1 to actual alightings.

The processes described in Steps 1 and 2 were repeated sequentially until the difference between the actual and estimated boardings and alightings was zero. Figure 12 shows that after seven balancing iterations in this algorithm, there were no differences between the projected distribution and the actual boardings and alightings.

Figure 12: 7th Step of Iterative Balancing to Correct Distribution of Ridership by Alighting Location

Segment	Total	DIFFERENCE FROM ACTUAL BOARDINGS	1	2	3
1	100	0	20	32	49
2	100	0	0	68	32
3	120	0	0	0	120
Total	320	0	20	100	200
DIFFERENCE FROM ACTUAL ALIGHTINGS	0		0	0	0
7th STEP of ITERATIVE BALANCING TO CORRECT DISTRIBUTION OF RIDERSHIP BY BOARDING LOCATION					
Segment	Total	DIFFERENCE FROM ACTUAL BOARDINGS	1	2	3
1	100	0	20	32	48
2	100	0	0	68	32
3	120	0	0	0	120
Total	320	0	20	100	200
DIFFERENCE FROM ACTUAL ALIGHTINGS	0		0	0	0

The final estimate for ridership flows is shown in Figure 13.

Figure 13: Final Estimate of Ridership Flows Between Stations

Route: Example Eastbound (6am-9am)				
Segment	Total	1	2	3
1	100	20	32	48
2	100	0	68	32
3	120	0	0	120
Total	320	20	100	200
DIFFERENCE FROM ACTUAL ALIGHTINGS	0	0	0	0

The actual number of OD records completed for each boarding to alighting segment pair is shown in Figure 14. To calculate the expansion factors, the final estimate of ridership between segments shown in Figure 13 was divided by the actual number of OD records collected, as shown in Figure 14. This calculation produces the expansion factors shown in Figure 15. For example, the 32 estimated passengers projected to board in segment 2 and alight in segment 3 were divided by the 10 OD records to produce an expansion factor of 3.15 to be applied to records who board in segment 2 and alighting in segment 3 as shown in Figure 15.

Figure 14: Number of Completed Surveys

Route: Example Eastbound (6am-9am)				
Segment	Total	1	2	3
1	32	3	9	20
2	17		7	10
3	8			8
Total	57	3	16	38

Figure 15: Weighting Factors

Route: Example Eastbound (6am-9am)				
Segment	Boarding Segment Expansion Factors	1	2	3
1	3.13	6.67	3.50	2.42
2	5.88	0.00	9.78	3.15
3	15.00	0.00	0.00	15.00
Alighting Segment Expansion Factors	5.61	6.67	6.25	5.26

The following routes were expanded using the Type 1 expansion method described on the previous pages:

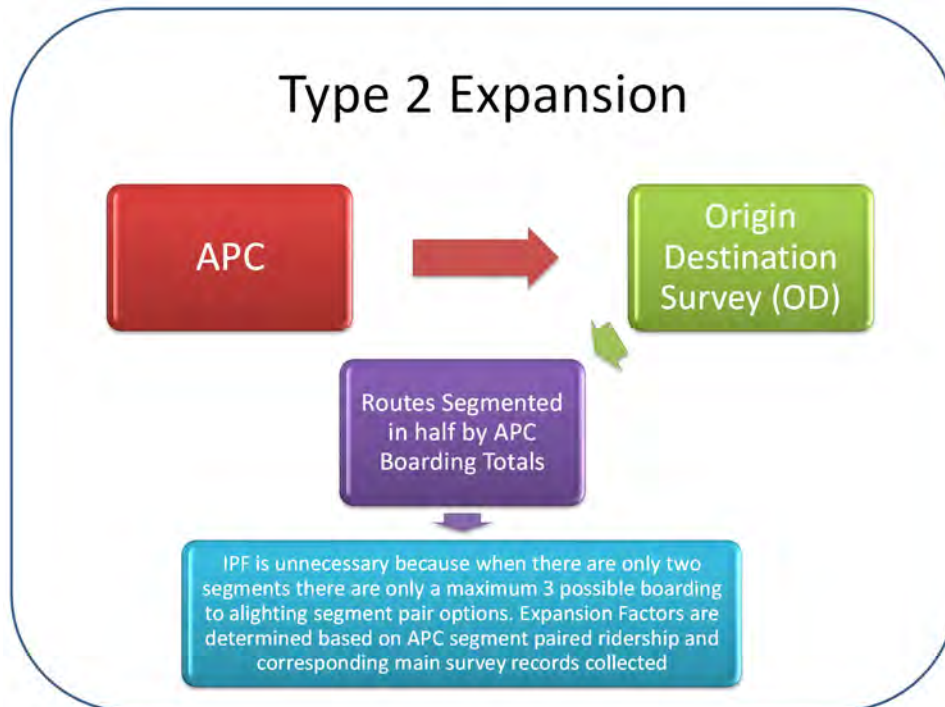
Table 20: Routes Expanded Using Type 1 Expansion

Agency	Route	Expansion Type
DDOT	DDOT 2 - MICHIGAN	Type 1
DDOT	DDOT 3 - GRAND RIVER	Type 1
DDOT	DDOT 4 - WOODWARD	Type 1
DDOT	DDOT 5 - VAN DYKE/LAFAYETTE	Type 1
DDOT	DDOT 6 - GRATIOT	Type 1
DDOT	DDOT 7 - SEVEN MILE	Type 1
DDOT	DDOT 8 - WARREN	Type 1
DDOT	DDOT 9 - JEFFERSON	Type 1
DDOT	DDOT 10 - GREENFIELD	Type 1
DDOT	DDOT 15 - CHICAGO/DAVISON	Type 1
DDOT	DDOT 16 - DEXTER	Type 1
DDOT	DDOT 17 - EIGHT MILE	Type 1
DDOT	DDOT 18 - FENKELL	Type 1
DDOT	DDOT 27 - JOY	Type 1
DDOT	DDOT 31 - MACK	Type 1
DDOT	DDOT 32 - McNICHOLS	Type 1
DDOT	DDOT 38 - PLYMOUTH	Type 1
DDOT	DDOT 60 - EVERGREEN	Type 1
DDOT	DDOT 67 - CADILLAC/HARPER	Type 1
SMART	SMART 125 - FORT ST-EUREKA RD	Type 1
SMART	SMART 200 - MICHIGAN AVENUE	Type 1
SMART	SMART 275 - TELEGRAPH	Type 1
SMART	SMART 495 - JOHN R	Type 1
SMART	SMART 560 - GRATIOT	Type 1
SMART	SMART 710 - NINE MILE	Type 1
SMART	SMART 740 - TWELVE MILE	Type 1
Qline	Qline	Type 1
AAATA	The Ride 23 - Plymouth	Type 1
AAATA	The Ride 24 - South Main - East	Type 1
AAATA	The Ride 3 - Huron River	Type 1
AAATA	The Ride 32 - Miller - Maple	Type 1
AAATA	The Ride 4 - Washtenaw	Type 1
AAATA	The Ride 5 - Packard	Type 1
AAATA	The Ride 6 - Ellsworth	Type 1
AAATA	The Ride 62 - U-M - State	Type 1

Type 2 Expansion: Bus Routes with APC Data, OD Survey Data, but No On-to-Off Counts Data

For Type 2 expansion, On-to-Off counts are not collected; however, these routes still have APC data available. This type of expansion divides the stops into *two* segments based on total boarding distribution by direction. Iterative Proportional Fitting (IPF) is unnecessary because when there are only 2 segments there are only a maximum of 3 possible boarding to alighting segment pair options. The boarding and alighting counts by segment pair can be determined without the need for IPF.

Figure 16 – Type 2 Expansion



After the segmentation process, the segments were then appended to the APC dataset and OD dataset. The next step was to determine how much ridership belonged into each paired boarding to alighting segment for each route, direction, and time period. The figure below shows an example of what the segments look like after being appended to the APC data for the appropriate route, direction, and time period.

Figure 17 – Segments Example for Type 2 Expansion

Route X Eastbound during the AM Peak			
Stops	Boardings	Alightings	Segment
Stop 1	15	0	1
Stop 2	3	3	1
Stop 3	5	4	1
Stop 4	3	7	1
Stop 5	3	3	1
Stop 6	4	3	2
Stop 7	3	4	2
Stop 8	10	5	2
Stop 9	8	10	2
Stop 10	7	5	2
Stop 11	1	8	2
Stop 12	0	10	2
	62	62	

In the previous figure you can see the boardings and alightings for each stop along with the segments. With two segments you have three possible boarding to alighting pair options: a) boarding segment 1 to alighting segment 1, b) boarding segment 1 to alighting segment 2 and c) boarding segment 2 to alighting segment 2. Boarding segment 2 to alighting segment 1 is not an option as that means the rider would be going in the opposite direction. In the case of this example, the rider would be heading westbound if they boarded segment 2 and alighted on segment 1. In order to determine the ridership for the possible boarding to alighting pairs in this example we start with boarding segment 1 to alighting segment 1. This is simple to determine as you simply add up the alightings for those stops associated with segment 1 which equals 17. Since these 17 people alighted in segment 1 that means they must have boarded on stops within segment 1, so boarding to alighting pair (1 to 1) for this route, time period and direction has 17 boardings and 17 alightings. For boarding to alighting pair (2 to 2) instead of looking at the alightings we instead look at the boardings. Adding up the boardings for segment 2 in the example above shows 33 total boardings. If those riders boarded within segment 2, then they must have alighted within segment 2 as well which means boarding to alighting pair (2 to 2) for this route, time period and direction has 33 boardings and 33 alightings. This only leaves boarding to alighting segment pair 1 to 2. This can be determined two different ways. Adding up all the boardings for segment 1 gives us a total of 29 boardings. We have already determined that 17 of those segment 1 boardings alighted within segment 1, which means the remaining segment 1 boardings must have alighted within segment 2, which gives us 12 boardings and 12 alightings for segment pair 1 to 2 (29-17). Likewise, you can sum up the total number of alightings for segment 2 which equals 45 alightings. We have already determined that 33 of those segment 2 alightings boarded within segment 2, which means the remaining segment 2 alightings must have boarded within segment 1, which also gives us 12 boardings and 12 alightings for segment pair 1 to 2 (45-33).

The final step in the process is simply to append the appropriate boarding and alighting segments to each record in the OD dataset based on route, direction, time period, boarding location and alighting location. Then divide the appropriate segment to segment pair ridership, calculated as described previously, by the corresponding number of records that match the same route, direction, time period and boarding segment to alighting segment. For example, in the previously described scenario for Route X heading eastbound in the “AM Peak” time period we had 12 riders boarding on segment 1 and alighting on segment 2. If we had 4 OD surveys that were also Route X heading eastbound during the “AM Peak” time period that boarded within segment 1 and alighted within segment 2, we would just divide 12 riders by 4 surveys to come up with an unlinked weight factor of 3 for each of the 4 OD surveys. These unlinked weight factors are then appended to the OD dataset, summed by route, direction, and time period to ensure that the total summed unlinked weight factors match the provided APC boardings by route, direction and time period.

The following routes were expanded using the Type 2 expansion method described on the previous page:

Table 21: Routes Expanded Using Type 2 Expansion

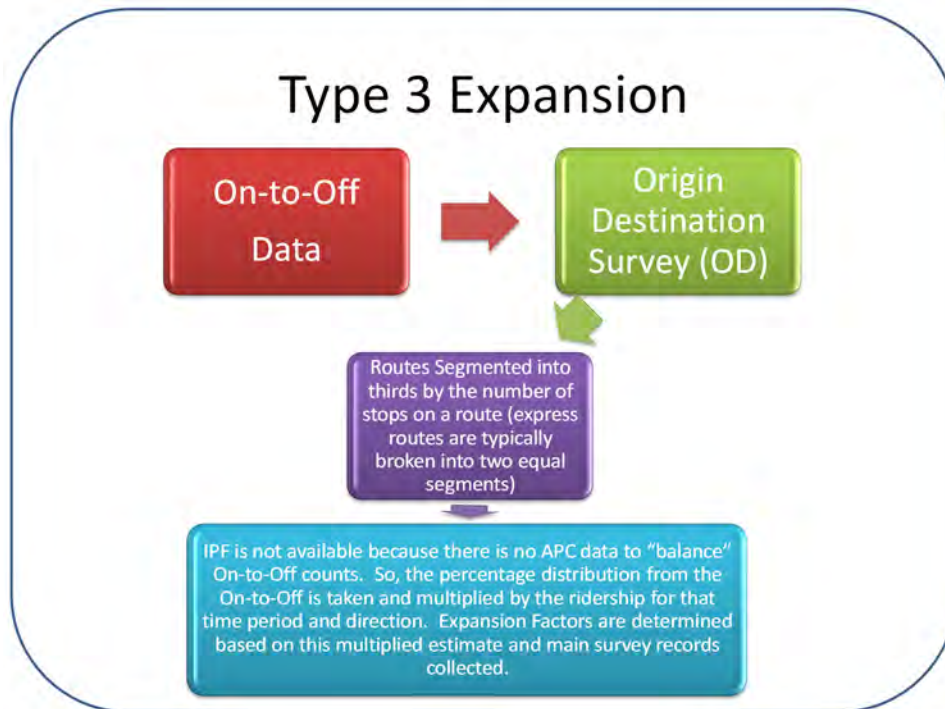
Agency	Route	Expansion Type
DDOT	DDOT 1 - VERNOR	Type 2
DDOT	DDOT 11 - CLAIRMOUNT	Type 2
DDOT	DDOT 12 - CONANT	Type 2
DDOT	DDOT 13 - CONNER	Type 2
DDOT	DDOT 19 - FORT	Type 2
DDOT	DDOT 23 - HAMILTON	Type 2
DDOT	DDOT 29 - LINWOOD	Type 2
DDOT	DDOT 30 - LIVERNOIS	Type 2
DDOT	DDOT 40 - RUSSELL	Type 2
DDOT	DDOT 43 - SCHOOLCRAFT	Type 2
DDOT	DDOT 46 - SOUTHFIELD	Type 2
DDOT	DDOT 47 - TIREMAN	Type 2
DDOT	DDOT 52 - CHENE	Type 2
DDOT	DDOT 68 - CHALMERS	Type 2
DDOT	DDOT 80 - VILLAGES DIRECT	Type 2
DDOT	DDOT 89 - SOUTHWEST DIRECT	Type 2
DDOT	DDOT 92 - ROSEDALE EXPRESS	Type 2
DDOT	DDOT 95 - RYAN EXPRESS	Type 2
DDOT	DDOT 96 - JOY EXPRESS	Type 2
SMART	SMART 140 - SOUTHSORE	Type 2
SMART	SMART 160 - DOWNRIVER	Type 2
SMART	SMART 250 - FORD RD	Type 2
SMART	SMART 255 - FORD RD EXPRESS	Type 2
SMART	SMART 261 - FAST MICHIGAN	Type 2
SMART	SMART 280 - MIDDLEBELT SOUTH	Type 2
SMART	SMART 330 - GRAND RIVER BEECH DALY	Type 2
SMART	SMART 400 - SOUTHFIELD - ORCHARD RIDGE	Type 2
SMART	SMART 405 - NORTHWESTERN HIGHWAY	Type 2
SMART	SMART 430 - MAIN STREET / BIG BEAVER	Type 2
SMART	SMART 445 - MAPLE / TELEGRAPH LIMITED	Type 2
SMART	SMART 465 - NORTHFIELD HILLS / AUBURN HILLS LIMITED	Type 2
SMART	SMART 494 - DEQUINDRE	Type 2
SMART	SMART 530 - SCHOENHERR	Type 2
SMART	SMART 550 - GARFIELD	Type 2
SMART	SMART 562 - FAST GRATIOT	Type 2
SMART	SMART 580 - HARPER	Type 2
SMART	SMART 610 - KERCHEVAL-HARPER	Type 2
SMART	SMART 615 - JEFFERSON	Type 2
SMART	SMART 620 - CHARLEVOIX	Type 2
SMART	SMART 730 - TEN MILE	Type 2
SMART	SMART 752 - NORTH HILL FARMS	Type 2
SMART	SMART 753 - BALDWIN RD	Type 2

SMART	SMART 756 - PERRY-OPDYKE	Type 2
SMART	SMART 760 - THIRTEEN MILE-FOURTEEN MILE	Type 2
SMART	SMART 780 - FIFTEEN MILE	Type 2
SMART	SMART 805 - GRAND RIVER PARK AND RIDE	Type 2
SMART	SMART 830 - DOWNRIVER PARK AND RIDE	Type 2
SMART	SMART 851 - OCC - NORTHLAND PARK & RIDE	Type 2
AAATA	The Ride 22 - Pontiac - Dhu Varren	Type 2
AAATA	The Ride 26 - Scio Church	Type 2
AAATA	The Ride 29 - Liberty	Type 2
AAATA	The Ride 30 - Jackson	Type 2
AAATA	The Ride 43 - E Michigan Ave	Type 2
AAATA	The Ride 45 - Grove	Type 2
AAATA	The Ride 46 - Huron - Textile	Type 2
AAATA	The Ride 60 - U-M - Dexter	Type 2
AAATA	The Ride 64 - Geddes - E Stadium	Type 2
AAATA	The Ride 65 - U-M - Downtown - Green	Type 2
AAATA	The Ride 66 - Carpenter - Huron Pkwy	Type 2
AAATA	The Ride 67 - Platt - Michigan Ave	Type 2
AAATA	The Ride 81 - Ypsilanti Twp Express	Type 2
AAATA	The Ride 91 - ExpressRide: Chelsea	Type 2
AAATA	The Ride 92 - ExpressRide: Canton	Type 2
SMART	SMART 415 - GREENFIELD - SOUTHFIELD	Type 2 [415/420 merge]
SMART	SMART 420 - GREENFIELD - SOUTHFIELD	Type 2 [415/420 merge]
SMART	SMART 450 - PONTIAC - SOMERSET	Type 2 [450/460 merge]
SMART	SMART 460 - PONTIAC - SOMERSET	Type 2 [450/460 merge]
SMART	SMART 461 - FAST WOODWARD	Type 2 [461/462 merge]
SMART	SMART 462 - FAST WOODWARD	Type 2 [461/462 merge]
SMART	SMART 510 - VAN DYKE	Type 2 [510/515 merge]
SMART	SMART 515 - VAN DYKE	Type 2 [510/515 merge]
SMART	SMART 515 - VAN DYKE LIMITED	Type 2 [510/515 merge]
SMART	SMART 561 - FAST GRATIOT	Type 2 [561/563 merge]
SMART	SMART 563 - FAST GRATIOT	Type 2 [561/563 merge]

Type 3 Expansion: Bus Routes with On-to-Off Counts and OD Survey Data, but Without APC Data

Expansion Type 3 is utilized for routes where On-to-Off counts are collected but APC Data is not available. In this expansion method, routes without APC Data are segmented into three segments based on number of stops along a route. For example, if Route X has 30 stops, then the first ten stops would be Segment 1, the second ten stops would be Segment 2, and the remaining ten stops would be Segment 3. These segments were then appended to the On-to-Off and OD survey databases. The data is then expanded using a similar process to the previous expansion methods by route and direction. Instead of using APC Data in this expansion process, however, it is only expanded using the OD Survey Data and the On-to-Off Counts.

Figure 18 – Type 3 Expansion



Note: This type of expansion was not utilized in this project.

Type 4 Expansion: Bus Routes with OD Survey Data, without On-to-Off Counts Data, or APC Data

For routes that *only* have OD survey data, Type 4 expansion is utilized. For this type of expansion there is no stop level data available. For this reason, a more rudimentary form of expansion must take place. The level of granularity for average daily ridership that can be provided from the agency determines the level of granularity for which expansion can occur. For example, when average daily ridership figures were available by route, time period and direction the number of OD surveys captured for that route, time period and direction were directly divided into the corresponding ridership provided. Alternatively, when average daily ridership figures were only available for the entire route and not broken down into time period or direction, the number of OD surveys captured for that route were directly divided into the corresponding ridership provided.

The following routes were expanded using the Type 4 expansion method described above:

Table 22: Routes Expanded Using Type 4 Expansion

Agency	Route	Expansion Type
DDOT	DDOT 39 - PURITAN	Type 4
DDOT	DDOT 41 - SCHAEFER	Type 4
DDOT	DDOT 42 - MID-CITY LOOP	Type 4
DDOT	DDOT 54 - WYOMING	Type 4
SMART	SMART 635 - JEFFERSON EXPRESS	Type 4
UMT	UM TRANSIT Bursley Baits	Type 4
UMT	UM TRANSIT Commuter North	Type 4
UMT	UM TRANSIT Commuter South	Type 4
UMT	UM TRANSIT Crisler Express	Type 4
UMT	UM TRANSIT Diag-to-Diag Express	Type 4
UMT	UM TRANSIT Med Express	Type 4
UMT	UM TRANSIT North-East Shuttle	Type 4
UMT	UM TRANSIT Northwood	Type 4
UMT	UM TRANSIT Northwood Express	Type 4
UMT	UM TRANSIT Oxford Shuttle	Type 4
UMT	UM TRANSIT Wall Street-NIB	Type 4
UMT	UM TRANSIT Wall Street Express	Type 4
DPM	Detroit People Mover	Type 4
AAATA	The Ride 21 - Amtrak - Depot	Type 4
AAATA	The Ride 25 - Ann Arbor - Saline Rd	Type 4
AAATA	The Ride 27 - W Stadium - Oak Valley	Type 4
AAATA	The Ride 28 - Pauline	Type 4
AAATA	The Ride 31 - Dexter Ave	Type 4
AAATA	The Ride 33 - Newport	Type 4
AAATA	The Ride 41 - EMU College of Business	Type 4
AAATA	The Ride 42 - Forest - MacArthur	Type 4
AAATA	The Ride 44 - Ecorse - Tyler	Type 4
AAATA	The Ride 47 - Harriet - W Michigan	Type 4
AAATA	The Ride 61 - Airport - Avis Farms	Type 4
AAATA	The Ride 63 - U-M - Pontiac	Type 4
AAATA	The Ride 68 - Harris - Ford	Type 4

3.3 General Rule for Expansion Factors

While there are no specific guidelines for the expansion factor values, ETC Institute uses a guideline of keeping expansion factors below three times the average expansion factor based on the sampling percentage. This is done to keep any one record from representing a markedly high number of passengers in the system. The formula for determining this guideline is:

$$1 / (\text{Sampling percentage}) \times 3 = \text{Guideline Weight Factor}$$

For example, if the sampling percentage is 10% for a route, then the guideline weight factor would be $[1 / (10\%) \times 3] = 30$, so the guideline weight factor for that route would be 30. If a sampling percentage is 7.5% it would be 40 since $[1 / (7.5\%) \times 3] = 40$.

If the expansion factor for a boarding segment to alighting segment pair is greater than three times the average expansion factor, then it is aggregated into the adjacent boarding-to-alighting segment where it will have the least impact on the previously existing expansion factors. This guideline is standard for all the various expansion types.

3.3.1 Linked Trip Expansion Factors for All Records

The linked-trip expansion factor helps to account for the number of transfers that were made by each passenger, so the linked expansion factors should better represent the overall system. Linked expansion factors are generated after the unlinked expansion factors are created. The equation that is used to calculate the linked trip multiplying factor is shown below:

$$\text{Linked Trip Multiplying Factor} = [1 / (1 + \# \text{ of in-system transfer})]$$

If a passenger did not make a transfer, the linked trip multiplying factor would be 1.0 because the person would have only boarded one vehicle. If a person made two transfers, the linked trip expansion factor would be 0.33 because the person would have boarded three transit vehicles during his/her one-way trip. An example of how the linked trip expansion factors were calculated, and subsequent example results are provided in Figure 19.

Figure 19 – Calculations for Linked Weight Factors

Number of Transfers	Calculation [1/(1+Number of Transfers)]	Linked Trip Multiplying Factor	Unlinked Weight Factor	Linked Weight Factor
0	[1/(1+0)]	1	3	3
1	[1/(1+1)]	0.5	3	1.5
2	[1/(1+2)]	0.33	3	0.99
3	[1/(1+3)]	0.25	3	0.75

Once the linked trip multiplier is created, it is multiplied by the unlinked expansion factor to create the linked expansion factor as shown above.

Table 23 below provides an overall view of how the various weighting factors impacted the raw survey counts:

Table 23: Overall View of Weighting Factors

Number of OD Surveys Collected	17,927
OD Surveys Weighted Using Unlinked Weight Factors (Represents Average Daily Boardings)	168,623
OD Surveys Weighted Using Linked Weight Factors (Represents Estimated Average Daily Trips)	139,375

3.4 Decomposition Analysis

Decomposition analysis measures the overall representativeness of the survey records relative to linked and unlinked trips on an individual route basis. Self-enumeration surveys have historically suffered from substantial errors in route level boarding levels when linked trips were determined by simply dividing the boarding factor by one plus the number of transfers. For example, in systems with both local bus and urban rail routes, the survey typically displayed significant differences in how many local bus riders indicated that they had transferred to/from urban rail compared to the same statistic measured from those who were interviewed on an urban rail route. Difficult decisions had to be made regarding what was the actual value of such transfers.

The advent of the personal interview, coupled with tablet technology, and more effective management of surveyors has greatly reduced this issue. The decomposition analysis examines each record and the recorded sequence of routes and tabulates boardings for each route using this information. After all records have been examined, total boardings by route are summarized and compared with the observed level of boardings. The result of this analysis will help to determine the relationship between observed and estimated boardings by route.

The decomposition analysis below and on the following pages show the summed link factors for the routes for which the survey was conducted along with the summed linked weight factors for those same routes that was captured in transfer information for both previous transfers and transfers that would occur after the rider alighted the route they were being surveyed on. The findings from the decomposition analysis show that the overall results for the onboard survey do an excellent job of representing the system. The routes that deviate the farthest from the summed linked factors compared to the observed counts are typically the routes that are expected to deviate the most as they are low volume ridership routes and therefore have a higher inherit error probability. The higher volume routes that were surveyed (routes over 2,000 daily boardings) which make up over sixty percent (61.4%) of the project's ridership, once summed, are extremely close to the overall ridership for those routes as seen in the figure below:

Figure 20 – Higher Volume Routes (Linked Weight Decomposition)

*Higher Volume Routes (Routes over 2,000 daily boardings)								
Route	Sum of Linked Weights					Observed Boardings	Total Difference	Percentage Difference
	Route Surveyed	Previous Transfers	Next Transfers	Total Summed Linked	Transfer Rate			
*Higher Volume Routes	88,229.4	7,288.6	8,040.9	103,558.9	17.39%	103,573.6	14.7	0.01%

This is an excellent outcome for this type of analysis. The figure on the following page shows the decomposition analysis for each system that was surveyed.

The linked decomposition analysis by system is also extremely good. The only system that had a percentage difference of greater than 5% was the QLine. However, considering that the QLine system only consists of one route and that route is only around 1,500 boardings per day on average; the percentage difference for the route is very reasonable.

Figure 21 – System Totals (Linked Weight Decomposition)

System Totals								
SYSTEM	Sum of Linked Weights					Observed Boardings	Total Difference	Percentage Difference
	Route(s) Surveyed	Previous Transfers	Next Transfers	Total Summed Linked	Transfer Rate			
Blue Water	2,114.0	434.4	501.9	3,050.4	43.69%	3,037.7	(12.7)	-0.42%
DDOT	51,179.2	8,164.0	8,860.5	68,203.7	33.40%	68,272.5	68.8	0.10%
Detroit People Mover	4,227.6	72.9	80.6	4,381.1	8.76%	4,597.9	216.8	4.72%
MTA Flint	295.3	-	-	295.3	1.59%	300.0	4.7	1.57%
LET	755.7	108.4	224.3	1,088.4	44.03%	1,088.4	-	0.00%
Qline	1,513.3	90.9	109.3	1,713.5	5.22%	1,592.3	(121.2)	-7.61%
SMART	18,994.5	2,947.3	2,827.7	24,769.4	29.72%	24,639.5	(129.9)	-0.53%
AAATA	21,113.5	2,373.1	1,998.3	25,484.9	18.34%	24,985.1	(499.8)	-2.00%
UMT	39,181.6	154.9	273.2	39,609.7	2.37%	40,109.5	499.8	1.25%
Total	139,374.7	14,345.8	14,875.9	168,596.4	20.99%	168,622.9	26.4	0.02%

Secondary Expansion

CTG conducted the secondary expansion for the AAATA and DDOT systems. Primary survey expansion occurs shortly after fieldwork. A weight is calculated for each record so that the sum of the weights across all records equals the systemwide ridership. In a similar way, primary expansion weights can be calculated for each route, time period and direction.

Secondary expansion is the process of re-weighting the primary survey weights records by selected categories to correct for natural or unavoidable anomalies in survey sampling, where independent counts by trip or rider types are available, secondary expansions provide results more accurate than the primary expansion. Rider and trip types can include elementary school trips, university student trips, park-ride trips, bicycle access trips and other classifications where count data is available.

Independent count data was provided by AAATA and DDOT for the purpose of conducting a secondary expansion. Both datasets provided enough detail to re-weight the survey records for K-12 (both AAATA and DDOT) and university students (AAATA only). While secondary expansion was attempted for the other major systems in the region, those transit agencies did not have control data that could be used to conduct this effort.

A more detailed description of the secondary expansion process is contained in Appendix B.

3.5 Limitations of the Data

While quality checks on the data such as the linked decomposition analysis suggest that the data collected and the expansion process were of extremely high quality. There are still limitations.

For example, ETC's process for creating segments focuses on the overall daily boardings for routes by direction. Creating segments this way has the potential to misrepresent the alightings for a particular route and direction.

To show an example of what can happen, below is a table that shows some On-to-Off data in a matrix after it has been segmented. As you can see there are no On-to-Off counts in the boarding segment 1 and alighting segment 1 pair. One possible reason for not collecting any On-to-Off counts in that particular boarding to alighting segment pair is because perhaps no one can actually alight that quickly on that route in that direction. In other words, if the first boarding stop was 33% of the overall boardings for that route and direction, through the current segmentation process it would have resulted in the first boarding stop receiving its own segment. With alightings not being possible on the first boarding stop of a route that is directional, you will not be able to capture any On-to-Off records. This results in a need to collapse the boarding segment 1 and alighting segment 1 paired cell into an adjacent cell, which means there are fewer segment to segment pair possibilities which can potentially weaken your expansion for this route and direction.

Table 24: Limitation of Segmentation Example

Route X Eastbound			
Boardings	Alightings		
	1	2	3
	1	0	5
	2		8

A similar limitation of the segmentation is that since the segments are made based on the entire day, it is possible that specific time of day variations may also be misrepresented.

There are other types of segmentation options available such as: 1) focusing on alightings instead of boardings, 2) averaging boarding and alightings before creating segments, 3) focusing more on landuse and so on. All of the different segmentation approaches have benefits and negatives. One possibility in future research could be the use of multiple types of segmentation approaches which could be used to create different sets of weight factors to be utilized for more individualized purposes.

Another limitation of the data is the ridership figures to which the data is ultimately expanded to. APC data is currently the best data available to expand to. The problem with this data is that different APC vendors can capture counts through various methods and output data in different structures. This data also tends to be quite “noisy” as the counters can interpret 1 person getting on and off the bus 5 times as 5 different people. This data can as well sometimes be slow to incorporate the addition of new stops and the removal of discontinued stops.

4. Survey Results

The fully weighted and expanded SEMCOG data were used to create the following analyses, displayed in three separate sections. The first section displays system level frequencies of the survey questions, while the second section focuses on the Woodward, Gratiot, and Michigan corridors. For the third section, the SEMCOG and Greater Detroit area were compared against other major metropolitan areas where similar surveys have recently.

All tables are based on the secondary expansion numbers conducted by CTG and are showing the sum of the linked weight factors except where stated otherwise.

4.1 Regional Data Summary and Analysis

A total of 18,495 questionnaires from seven transit agencies were completed for the survey. The tables in the following section display the weighted frequency of responses to the survey based on the linked weight factors unless noted otherwise. The first question presented to respondents on the survey was the fare payment method they used for their one-way trip. This question was set up to be specific to the service passengers were using. Passengers that were using the DDOT service had the highest for a Regular fare type that was used on their one-way trip. AAATA riders were the next highest to use a regular fare type, while SMART had the highest percentage for using a senior fare payment.

Across the region, just over half of the surveyed trips are made 3-5 days per week, with just under a third being made more often. If the transit system was not available, 30 percent of riders would try to get a ride with someone else, a quarter percent would get a ride with someone else, and only 13 percent would drive their household vehicle. Unlike most transit systems, over half of the SEMCOG transit ridership population have a valid driver's license, although this is not the case for the DDOT service, where riders are more likely to not have one. Almost half of SEMCOG riders are from zero-vehicle households, however, UM service riders were more likely to have one or more vehicles in their household. The majority of SEMCOG riders come from households making less than \$25,000 per year.

4.1.1 Survey Results by System

Riders on UMT service routes were the most likely to get to their destination with zero additional bus/train (95.5%). Out of the various systems, BWT riders are more likely to need more than one transfer to get to their destination (13.0%).

Table 25: Total Transfers by System (based on secondary unlinked weight factors)

System	Total Transfers				
	None	One	Two	Three or More	Total
AAA	67.8%	31.5%	0.7%	0.0%	100.0%
BWT	36.6%	50.4%	11.5%	1.5%	100.0%
DDT	50.7%	45.7%	3.6%	0.1%	100.0%
DPM	84.4%	13.7%	1.8%	0.0%	100.0%
FLT	95.1%	4.9%	0.0%	0.0%	100.0%
LET	35.9%	56.5%	7.7%	0.0%	100.0%
QLN	89.4%	10.0%	0.6%	0.0%	100.0%
SMD	55.0%	42.1%	2.8%	0.1%	100.0%
UMT	95.5%	4.3%	0.3%	0.0%	100.0%
<i>Regional Statistics</i>	65.5%	32.1%	2.3%	0.1%	100.0%

“Your HOME” was the most common origin place type respondents were coming from (49.0%) with “Your usual WORKPLACE” being the second most common place overall (18.5%). FLT was the highest percentage of system services coming from “Your usual WORKPLACE” (45.2%) compared to the regional statistics. The Other category was used to categorize any origin place type that was indicated less than 2.0% of the time including, but not limited to, School (K-12), Your HOTEL, and Airport (passengers only).

Table 26: Origin Purpose by System

System	Origin Trip Purpose									Total
	Your HOME	Your usual WORKPLACE	College or University (student only)	Social or recreational	Personal business	Shopping	Work related	Medical / dental	Other	
AAA	51.9%	18.2%	9.4%	5.2%	4.6%	4.1%	1.0%	1.8%	3.7%	100.0%
BWT	50.0%	11.3%	1.2%	7.6%	5.5%	13.4%	0.2%	5.5%	5.1%	100.0%
DDT	46.1%	22.5%	1.3%	7.4%	7.1%	4.0%	2.7%	3.2%	5.7%	100.0%
DPM	33.8%	18.3%	0.1%	14.1%	5.4%	1.6%	12.2%	0.1%	14.4%	100.0%
FLT	53.9%	45.2%	0.0%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
LET	55.4%	8.4%	1.2%	5.9%	6.4%	18.5%	0.0%	3.3%	0.9%	100.0%
QLN	35.4%	19.1%	5.5%	7.9%	10.5%	3.8%	3.5%	3.0%	11.4%	100.0%
SMD	51.7%	25.7%	0.7%	4.3%	6.2%	4.8%	2.1%	1.9%	2.5%	100.0%
UMT	51.9%	10.2%	31.0%	2.5%	0.7%	0.5%	1.0%	0.6%	1.7%	100.0%
<i>Regional Statistics</i>	49.0%	18.5%	10.8%	5.5%	4.7%	3.3%	2.1%	2.0%	4.1%	100.0%

Most riders walk to access the various transit systems (90.1% overall). Of the other types of access used to get from respondent’s origin to transit, “Drove alone and parked” was the second highest used overall (5.1%) followed by “Was dropped off by someone going someplace else” (2.0%). Out of all the systems, FLT was least likely to walk and more likely to use another form of transportation to reach transit. The Other category was used to categorize any access mode that was indicated less than 2.0% of the time including, but not limited to, Drove or rode with others and parked, Personal Bike, and Wheelchair / scooter.

Table 27: Access Mode by System

System	Access				
	Walk	Drove alone and parked	Was dropped off by someone going someplace else	Other	Total
AAA	92.9%	3.0%	0.8%	3.3%	100.0%
BWT	96.5%	0.0%	2.3%	1.2%	100.0%
DDT	95.2%	0.1%	2.7%	2.0%	100.0%
DPM	77.4%	13.7%	0.1%	8.8%	100.0%
FLT	50.4%	7.6%	21.8%	20.2%	100.0%
LET	98.6%	0.0%	1.0%	0.4%	100.0%
QLN	92.2%	3.6%	0.6%	3.7%	100.0%
SMD	87.6%	2.9%	5.7%	3.8%	100.0%
UMT	84.1%	13.5%	0.1%	2.3%	100.0%
Regional Statistics	90.1%	5.1%	2.0%	2.8%	100.0%

“Your HOME” was the most common destination place type overall (34.8%) followed by “Your usual WORKPLACE” (23.0%). Of the various systems, UMT had the highest percentage of respondent’s travelling to “College or University (student only)” (47.0%) and LET had the highest percentage of respondent’s travelling to “Shopping” (29.1%). The Other category was used to categorize any origin place type that was indicated less than 2.0% of the time including, but not limited to, School (K-12), Your HOTEL, and Airport (passengers only).

Table 28: Destination Purpose by System

System	Destination Trip Purpose										
	Your HOME	Your usual WORKPLACE	College or University (student only)	Social or recreational	Personal business	Shopping	Dining / eating out / coffee	Work related	Medical / dental	Other	Total
AAA	36.1%	26.4%	12.6%	6.7%	4.6%	6.2%	2.5%	1.2%	1.6%	2.2%	100.0%
BWT	32.8%	17.0%	1.5%	11.7%	8.8%	12.8%	3.1%	1.6%	8.0%	2.6%	100.0%
DDT	42.3%	22.0%	1.6%	9.3%	9.4%	3.7%	1.7%	2.3%	3.1%	4.5%	100.0%
DPM	18.9%	24.6%	0.0%	22.2%	4.6%	2.0%	9.5%	10.3%	0.1%	8.0%	100.0%
FLT	43.3%	53.9%	0.0%	0.9%	0.0%	0.0%	0.9%	0.9%	0.0%	0.0%	100.0%
LET	26.3%	13.6%	1.0%	6.7%	8.5%	29.1%	2.0%	2.0%	7.4%	3.5%	100.0%
QLN	23.4%	20.9%	4.5%	21.4%	10.9%	2.0%	10.0%	3.1%	1.3%	2.6%	100.0%
SMD	36.7%	34.8%	0.6%	6.3%	8.0%	5.6%	1.7%	1.5%	2.6%	2.2%	100.0%
UMT	26.0%	16.9%	47.0%	4.1%	1.1%	0.5%	1.8%	1.8%	0.5%	0.3%	100.0%
<i>Regional Statistics</i>	34.8%	23.0%	15.9%	7.6%	6.0%	3.6%	2.2%	2.1%	2.0%	2.7%	100.0%

The majority of riders “Walk” to their destination from transit (94.8%). FLT riders were the least likely to walk from transit to their destination (59.1%) and were the most likely to “Get in a parked vehicle and drive alone” (16.8%). The Other category was used to categorize any access mode that was indicated less than 2.0% of the time including, but not limited to, Get in a parked vehicle and drive / ride with someone, Personal Bike, and Wheelchair / scooter.

Table 29: Egress Mode by System

System	Egress			
	Walk	Get in a parked vehicle and drive alone	Other	Total
AAA	95.1%	1.8%	3.1%	100.0%
BWT	97.9%	0.0%	2.1%	100.0%
DDT	96.9%	0.1%	3.0%	100.0%
DPM	91.9%	5.0%	3.0%	100.0%
FLT	59.1%	16.8%	24.1%	100.0%
LET	98.2%	0.0%	1.8%	100.0%
QLN	96.6%	1.1%	2.3%	100.0%
SMD	92.7%	2.2%	5.1%	100.0%
UMT	93.3%	5.4%	1.3%	100.0%
<i>Regional Statistics</i>	94.8%	2.3%	2.9%	100.0%

Respondents were asked if their employer helped pay for their transportation fare, and the majority of respondents indicated that “No”, their employer did not help pay for any of their fare (63.9%). Of the thirty-six percent (36.1%) that indicated “Yes – their employer paid part or all of their fare”, UMT had the highest amount of riders (84.2%) followed in second by AAA riders (57.9%).

Table 30: Fare Subsidy by System

System	Employer Pay		
	No	Yes	Total
AAA	42.1%	57.9%	100.0%
BWT	92.9%	7.1%	100.0%
DDT	94.8%	5.2%	100.0%
DPM	83.1%	16.9%	100.0%
FLT	72.0%	28.0%	100.0%
LET	99.0%	1.0%	100.0%
QLN	91.8%	8.2%	100.0%
SMD	92.7%	7.3%	100.0%
UMT	15.8%	84.2%	100.0%
<i>Regional Statistics</i>	63.9%	36.1%	100.0%

Across the region, over half of transit riders make this trip 3–5 days per week (57.3%), with just under one-third making the trip more often (29.2%), and thirteen percent (13.4%) less than 3 – 5 days per week. It was more common for a DPM rider to indicate this being their first time to make this trip (9.7%) compared to other systems.

Table 31: Trip Frequency by System

System	Trip Frequency						
	6-7 days /week	3-5 days / week	1-2 days / week	1-3 days / month	Less than 1 day a month	First time to make this trip	Total
AAA	26.6%	63.4%	7.6%	1.4%	0.8%	0.2%	100.0%
BWT	35.3%	46.8%	11.1%	3.0%	0.1%	3.8%	100.0%
DDT	28.2%	55.8%	10.9%	2.9%	1.3%	0.8%	100.0%
DPM	12.6%	39.1%	10.8%	10.2%	17.6%	9.7%	100.0%
FLT	72.3%	26.4%	0.3%	0.9%	0.0%	0.0%	100.0%
LET	26.5%	48.1%	20.0%	1.0%	1.0%	3.3%	100.0%
QLN	19.7%	45.9%	19.8%	6.7%	4.4%	3.6%	100.0%
SMD	27.7%	59.5%	7.7%	3.0%	1.2%	0.8%	100.0%
UMT	34.1%	58.3%	6.0%	1.1%	0.2%	0.2%	100.0%
<i>Regional Statistics</i>	29.2%	57.3%	8.7%	2.4%	1.4%	0.9%	100.0%

Overall, the most common alternative travel mode if transit was not available would be to “Get a ride with someone else” (24.4%). The second highest alternative was to use “Uber, Lyft, etc.” (19.2%). FLT service had the highest percentage of riders that “Could not make trip” if transit were not available (54.9%). BWT had the highest percentage that would take a “Taxi” (12.5%) and the second lowest that would “Drive (own car)” (1.7%).

Table 32: Alternative Travel Mode by System

System	Alternative Travel Mode									Total
	Get a ride with someone	Uber, Lyft, etc	Walk	Could not make trip	Drive (own car)	Bike	Taxi	Other	Not Provided	
AAA	20.3%	18.8%	16.5%	11.9%	21.2%	6.0%	1.8%	3.5%	0.0%	100.0%
BWT	28.9%	1.5%	24.3%	25.6%	1.7%	4.6%	12.5%	0.8%	0.0%	100.0%
DDT	37.9%	17.5%	11.6%	22.3%	3.7%	1.5%	4.4%	0.9%	0.1%	100.0%
DPM	4.3%	18.5%	46.4%	5.7%	17.5%	0.6%	5.6%	1.5%	0.0%	100.0%
FLT	12.7%	0.9%	0.0%	54.9%	31.5%	0.0%	0.0%	0.0%	0.0%	100.0%
LET	29.7%	4.8%	24.7%	36.6%	1.0%	2.6%	0.0%	0.5%	0.0%	100.0%
QLN	9.8%	30.3%	21.4%	7.0%	19.2%	6.8%	0.8%	4.8%	0.0%	100.0%
SMD	33.0%	21.8%	6.1%	20.5%	12.2%	3.2%	1.7%	0.5%	1.0%	100.0%
UMT	7.1%	21.4%	26.1%	10.2%	19.7%	13.0%	0.4%	2.0%	0.0%	100.0%
Regional Statistics	24.4%	19.2%	17.1%	16.6%	12.6%	5.7%	2.6%	1.6%	0.2%	100.0%

Across the region, transit riders are much more likely to have a valid driver’s license than not (63.0%). The areas with the highest concentration of riders with driver’s licenses are served by DPM (90.8%), UMT (88.2%), and QLN (78.2%). BWT (38.6%) and LET (28.4%) had the lowest concentration of riders with driver’s licenses.

Table 33: Valid Driver’s License by System

System	License		
	Yes	No	Total
AAA	71.7%	28.3%	100.0%
BWT	38.6%	61.4%	100.0%
DDT	41.7%	58.3%	100.0%
DPM	90.8%	9.2%	100.0%
FLT	69.0%	31.0%	100.0%
LET	28.4%	71.6%	100.0%
QLN	78.2%	21.8%	100.0%
SMD	55.2%	44.8%	100.0%
UMT	88.2%	11.8%	100.0%
Regional Statistics	63.0%	37.0%	100.0%

UMT (70.6%) followed by AAA (40.2%) systems had the highest percentage of riders under the age of 26. The age category that had the highest percentage of riders overall was 18 – 25 (35.6%). LET had the highest percentage of riders age 55 and older (29.2%).

Table 34: Age by System

System	Age										Total
	Under 6	6-12	13-15	16-17	18-25	26-34	35-54	55-64	65 and older	Unknown	
AAA	0.0%	0.2%	1.3%	3.3%	35.4%	26.1%	20.2%	7.7%	5.7%	0.1%	100.0%
BWT	0.0%	0.0%	0.7%	2.1%	14.7%	18.8%	39.2%	16.1%	8.4%	0.0%	100.0%
DDT	0.0%	0.2%	2.2%	5.7%	20.2%	24.9%	32.1%	10.7%	3.9%	0.1%	100.0%
DPM	0.0%	0.0%	0.0%	0.4%	10.4%	22.2%	46.3%	12.0%	8.7%	0.0%	100.0%
FLT	0.0%	0.0%	0.0%	0.0%	17.2%	28.6%	43.6%	9.6%	1.0%	0.0%	100.0%
LET	0.0%	0.0%	0.8%	1.8%	12.6%	22.7%	32.7%	17.5%	11.7%	0.0%	100.0%
QLN	0.0%	0.0%	0.6%	1.5%	21.9%	32.8%	28.1%	11.4%	3.7%	0.0%	100.0%
SMD	0.0%	0.0%	0.5%	2.1%	16.3%	25.8%	35.6%	13.4%	6.2%	0.1%	100.0%
UMT	0.0%	0.0%	0.1%	0.5%	70.0%	17.1%	9.1%	2.5%	0.6%	0.0%	100.0%
<i>Regional Statistics</i>	0.0%	0.1%	1.1%	3.1%	35.6%	22.9%	24.8%	8.5%	3.8%	0.0%	100.0%

One hundred percent (100.0%) of FLT riders were employed either part- or full-time. UMT had the highest percentage of riders not currently employed (40.6%) and either seeking or not seeking work. LET had the highest percentage of “Retired” riders (19.2%). The Other category was used to categorize any access mode that was indicated less than 2.0% of the time including Not employed (unspecified), Homemaker, and Unknown.

Table 35: Employment Status

System	Employment Status						Total
	Employed full-time	Employed part-time	Not currently employed, and not seeking work	Not currently employed, but seeking work	Retired	Other	
AAA	46.3%	29.4%	12.9%	5.4%	5.2%	0.8%	100.0%
BWT	31.9%	22.2%	20.0%	11.8%	13.7%	0.4%	100.0%
DDT	55.0%	19.3%	8.8%	8.8%	6.4%	1.7%	100.0%
DPM	81.7%	7.6%	1.4%	1.1%	7.7%	0.5%	100.0%
FLT	99.3%	0.7%	0.0%	0.0%	0.0%	0.0%	100.0%
LET	21.5%	22.7%	20.6%	13.0%	19.2%	3.0%	100.0%
QLN	65.4%	14.8%	7.7%	6.8%	5.1%	0.2%	100.0%
SMD	66.6%	15.1%	5.4%	5.7%	6.3%	0.9%	100.0%
UMT	26.3%	32.9%	27.3%	13.3%	0.1%	0.0%	100.0%
<i>Regional Statistics</i>	47.7%	23.7%	14.2%	8.9%	4.6%	0.9%	100.0%

Overall, most respondents indicated they are “Not a student” (61.7%), with UMT having the highest percentage of respondents indicate they are a “College / University” student (79.7%) and DDT riders having the highest percentage of respondents indicate they are a “K-12th grade” student (9.3%).

Table 36: Student Status

System	Student Status					Total
	Not a student	Yes - College / University	Yes - K - 12th grade	Yes - Other type of student	Unknown	
AAA	53.7%	40.8%	4.9%	0.5%	0.1%	100.0%
BWT	90.0%	5.6%	4.4%	0.0%	0.0%	100.0%
DDT	82.3%	7.7%	9.3%	0.7%	0.0%	100.0%
DPM	93.5%	6.2%	0.4%	0.0%	0.0%	100.0%
FLT	89.9%	7.4%	0.7%	2.0%	0.0%	100.0%
LET	91.9%	4.2%	1.8%	2.0%	0.0%	100.0%
QLN	77.9%	18.5%	2.1%	1.5%	0.0%	100.0%
SMD	89.0%	7.5%	3.2%	0.3%	0.1%	100.0%
UMT	19.7%	79.7%	0.4%	0.2%	0.0%	100.0%
<i>Regional Statistics</i>	61.7%	33.0%	4.8%	0.4%	0.0%	100.0%

The majority of riders do not have a working vehicle in their household (45.8%) followed closely by households that have “One (1)” working vehicle (32.2%). FLT had the highest percentage of riders indicate they have “One (1)” working vehicle in their household (61.2%), and DPM had the highest percentage of riders indicate they have “Three or More” working vehicles in their household (20.2%).

Table 37: Household Vehicles by System

System	Household Vehicle				Total
	None (0)	One (1)	Two (2)	Three or More	
AAA	38.3%	38.9%	17.1%	5.7%	100.0%
BWT	76.2%	16.8%	5.5%	1.5%	100.0%
DDT	55.6%	30.0%	12.0%	2.3%	100.0%
DPM	14.8%	31.2%	33.8%	20.2%	100.0%
FLT	18.3%	61.2%	14.0%	6.5%	100.0%
LET	79.8%	13.2%	4.6%	2.4%	100.0%
QLN	35.8%	37.4%	21.0%	5.8%	100.0%
SMD	41.8%	32.0%	19.8%	6.4%	100.0%
UMT	40.5%	32.6%	16.8%	10.0%	100.0%
<i>Regional Statistics</i>	45.8%	32.2%	15.8%	6.1%	100.0%

QLN and LET riders had the highest percentage of respondents indicate they come from “One (1)” person households (39.4% and 35.1% respectively). DDT and DPM riders had the highest percentage of respondents indicate they come from household with “Four or More” members (30.4% and 27.8% respectively). The household size that was most common overall was a “Two (2)” person household (30.2%).

Table 38: Household Size by System

System	Household Size				
	One (1)	Two (2)	Three (3)	Four or More	Total
AAA	25.6%	34.8%	18.5%	21.0%	100.0%
BWT	33.6%	24.6%	19.1%	22.6%	100.0%
DDT	24.9%	24.0%	20.8%	30.4%	100.0%
DPM	22.5%	30.4%	19.2%	27.8%	100.0%
FLT	19.2%	35.0%	19.2%	26.5%	100.0%
LET	35.1%	22.5%	15.3%	27.0%	100.0%
QLN	39.4%	30.0%	15.8%	14.8%	100.0%
SMD	27.0%	25.7%	20.2%	27.0%	100.0%
UMT	21.7%	38.3%	13.9%	26.1%	100.0%
<i>Regional Statistics</i>	24.7%	30.2%	18.3%	26.9%	100.0%

Overall, the majority of respondents indicate they only have “One (1)” employed person in the household (34.7%) followed very closely by “Two (2)” employed persons in the household (34.4%). LET and BWT had the highest percentage of riders indicate they have no employed persons in the household (45.3% and 32.2% respectively), while AAA had the highest percentage of “Three or More” employed people in their household (19.4%).

Table 39: Household Employees by System

System	Household Workers				
	None (0)	One (1)	Two (2)	Three or More	Total
AAA	12.6%	31.3%	36.8%	19.4%	100.0%
BWT	32.2%	34.2%	19.3%	14.2%	100.0%
DDT	10.4%	39.3%	36.5%	13.8%	100.0%
DPM	6.0%	32.1%	45.4%	16.5%	100.0%
FLT	0.0%	43.3%	49.1%	7.6%	100.0%
LET	45.3%	24.0%	14.2%	16.5%	100.0%
QLN	10.1%	45.3%	34.5%	10.1%	100.0%
SMD	9.0%	36.6%	35.4%	19.0%	100.0%
UMT	25.9%	29.8%	29.6%	14.7%	100.0%
<i>Regional Statistics</i>	15.3%	34.7%	34.4%	15.6%	100.0%

Overall, the majority of transit riders make “Below \$25,000” total annual household income (41.2%). LET had the highest percentage of riders make “Below \$25,000” total annual household income (57.0%), followed by BWT (55.5%). DPM riders had the highest percentage of respondents indicate they make “\$100,000 or more” total annual household income (26.8%).

Table 40: Income by System

System	Income									
	Below \$25,000	\$25,000 - \$29,999	\$30,000 - \$39,999	\$40,000 - \$49,999	\$50,000 - \$59,999	\$60,000 - \$74,999	\$75,000 - \$99,999	\$100,000 or more	Not Provided	Total
AAA	32.0%	6.2%	10.1%	7.5%	6.3%	7.1%	6.5%	6.1%	18.2%	100.0%
BWT	55.5%	6.1%	6.8%	4.3%	3.0%	3.7%	0.6%	1.8%	18.1%	100.0%
DDT	54.3%	9.7%	11.5%	7.2%	3.4%	1.7%	0.7%	0.5%	11.0%	100.0%
DPM	10.0%	4.4%	8.9%	10.6%	8.9%	9.5%	10.0%	26.8%	10.8%	100.0%
FLT	49.8%	10.8%	19.4%	3.4%	5.9%	1.2%	1.5%	2.4%	5.5%	100.0%
LET	57.0%	1.8%	5.7%	1.0%	5.8%	1.6%	0.5%	0.0%	26.6%	100.0%
QLN	27.7%	7.8%	7.9%	11.6%	11.8%	6.2%	6.4%	6.7%	13.9%	100.0%
SMD	31.9%	9.2%	13.4%	8.9%	8.1%	6.8%	4.5%	5.0%	12.1%	100.0%
UMT	36.2%	3.3%	7.4%	4.5%	4.4%	6.4%	6.6%	9.9%	21.2%	100.0%
<i>Regional Statistics</i>	41.2%	7.0%	10.2%	6.8%	5.1%	4.9%	4.1%	5.5%	15.3%	100.0%

4.1.2 Types of Places for Origins and Destinations

The most common trip is from “Your HOME – Origin/Destination” to “Your usual WORKPLACE – Destination/Origin” (21.1% / 15.6%). The second most common trip type was from “Your HOME – Origin to “College or University (student only) – Destination” (11.6%). As noted previously, the Other category was used to categorize any origin place type that was indicated less than 2.0% of the time including, but not limited to, School (K-12), Your HOTEL, and Airport (passengers only).

Table 41: Regional Distribution of Origin Place Type by Destination Place Type

Origin Place Type	Destination Place Type									
	Your HOME	College or University (student only)	Your usual WORKPLACE	Social or recreational	Medical / dental	Personal business	Work related	Shopping	Dining / eating out / coffee	Other
Your HOME	0.0%	11.6%	21.1%	4.1%	1.6%	3.8%	1.2%	2.4%	1.1%	2.0%
Your usual WORKPLACE	15.6%	0.3%	0.2%	0.6%	0.1%	0.6%	0.5%	0.3%	0.2%	0.1%
College or University (student only)	5.9%	3.4%	0.3%	0.5%	0.0%	0.1%	0.0%	0.1%	0.3%	0.0%
Social or recreational	3.1%	0.1%	0.5%	0.9%	0.1%	0.3%	0.0%	0.2%	0.2%	0.1%
Personal business	2.8%	0.1%	0.3%	0.3%	0.1%	0.6%	0.0%	0.2%	0.2%	0.1%
Shopping	2.3%	0.1%	0.1%	0.3%	0.1%	0.2%	0.0%	0.2%	0.0%	0.0%
Work related	1.2%	0.1%	0.1%	0.1%	0.0%	0.1%	0.1%	0.0%	0.1%	0.1%
Medical / dental	1.3%	0.0%	0.1%	0.2%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%
School (K-12) (student only)	1.6%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Dining / eating out / coffee	0.8%	0.2%	0.1%	0.2%	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%
Other	0.2%	0.0%	0.1%	0.2%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%
Total	34.8%	15.9%	23.0%	7.6%	2.0%	6.0%	2.1%	3.6%	2.2%	2.7%

Over eighty-five percent of riders (85.8%) walked to both access and egress the transit system. Five percent (5.1%) of transit riders accessed transit by “Drove alone and parked” and then their egress mode was “Walk”. As noted previously, the Other category was used to categorize any access mode that was indicated less than 2.0% of the time including, but not limited to, Drove or rode with others and parked, Get in a parked vehicle and drive / ride with someone, Personal Bike, and Wheelchair / scooter.

Table 42: Distribution of Access Mode by Egress Mode

Access	Egress			
	Get in a parked vehicle and drive alone	Walk	Other	Total
Walk	2.3%	85.8%	2.0%	90.1%
Drove alone and parked	0.0%	5.1%	0.0%	5.1%
Other	0.0%	2.0%	0.8%	2.8%
Was dropped off by someone going someplace else	0.0%	1.9%	0.1%	2.0%
Total	2.3%	94.8%	2.9%	100.0%

The most common trip type taken by transit riders in the region overall was “Home – Other” (27.9%). LET riders had the highest percentage of respondents indicate they took a “Home – Other” trip (41.8%), and FLT riders had the highest percentage of respondents indicate they took a “Home – Work” trip (53.1%).

Table 43: Distribution of Trip Types

System	Trip Type								Total
	Home - Other	Home - Work	Other - Home	Work - Home	Other - Other	Work - Other	Other - Work	Work - Work	
AAA	27.5%	24.5%	19.6%	16.4%	8.4%	1.7%	1.8%	0.1%	100.0%
BWT	33.9%	16.2%	23.9%	8.9%	13.9%	2.5%	0.8%	0.0%	100.0%
DDT	26.0%	20.2%	22.6%	19.7%	7.0%	2.6%	1.7%	0.2%	100.0%
DPM	11.8%	22.0%	8.7%	10.2%	36.7%	8.0%	2.5%	0.1%	100.0%
FLT	0.9%	53.1%	0.0%	43.3%	0.0%	1.8%	0.9%	0.0%	100.0%
LET	41.8%	13.6%	22.2%	4.1%	14.0%	4.3%	0.0%	0.0%	100.0%
QLN	19.5%	15.8%	15.0%	8.5%	25.9%	10.2%	4.6%	0.4%	100.0%
SMD	19.1%	32.6%	13.6%	23.0%	6.9%	2.5%	2.1%	0.2%	100.0%
UMT	36.6%	15.3%	18.4%	7.5%	18.0%	2.5%	1.4%	0.2%	100.0%
<i>Regional Statistics</i>	27.9%	21.1%	19.2%	15.6%	11.6%	2.7%	1.7%	0.2%	100.0%

4.1.3 Corridor Data Specific Analysis

Three of the most important corridors were also analyzed to show how these areas compare to the overall data. The three corridors selected were Woodward Avenue, Michigan Avenue, and Gratiot Avenue, which all lead into downtown from the Northwest, West, and Northeast, respectively. To analyze the ridership characteristics along these corridors, records were selected that used these corridors on their trip, defined as the following:

- The Woodward Avenue corridor is defined as riders who traveled on Woodward Avenue while being surveyed on the SMART 420, 450, 465, 495, or 610.
- The Michigan Avenue corridor is defined as riders who used the SMART 200 or DDOT 37, covering Michigan Avenue between John Hix Road and downtown, and the Q Line.
- The Gratiot Avenue corridor is defined as riders who traveled on Gratiot Avenue while being surveyed on the SMART 510, 515, 530, 560, 565, or 580, or DDOT 34 or 76 between 23 Mile Road and downtown.

The majority of regional transit riders do not take any additional transfers to get from their origin to their final destination (65.6%). Woodward corridor riders were more likely to take one or more additional transfer (81.5%) to get from their origin to their final destination compared to other corridor riders.

Table 44: Total Transfers by Corridor (based on secondary unlinked weight factors)

Cooridor	Total Transfers				
	None	One	Two	Three or More	Total
GRATIOT	64.9%	33.7%	1.4%	0.0%	100.0%
MICHIGAN	74.9%	24.2%	0.9%	0.0%	100.0%
WOODWARD	18.5%	62.7%	18.8%	0.0%	100.0%
SEMCOG	65.6%	32.0%	2.3%	0.1%	100.0%

Overall, the most common place type regional respondents are coming from are “Your HOME” (49.25%) and “Your usual WORKPLACE” (18.21%) while Michigan corridor respondents were least likely to be coming from “Your HOME” (38.97%). The Woodward corridor had the highest percentage of respondents indicate they are coming from “Your usual WORKPLACE” (30.90%).

Table 45: Origin Purpose by Corridor

Cooridor	Origin Trip Purpose								
	Your HOME	Your usual WORKPLACE	College or University (student only)	Social or recreational	Personal business	Shopping	Work related	Medical / dental	Other
GRATIOT	46.5%	28.5%	0.4%	5.5%	9.8%	4.3%	1.1%	0.5%	3.5%
MICHIGAN	39.0%	19.6%	3.9%	7.8%	9.4%	6.6%	2.7%	2.8%	8.2%
WOODWARD	46.6%	30.9%	0.0%	4.3%	4.0%	5.8%	3.2%	1.0%	4.2%
SEMCOG	49.3%	18.2%	11.2%	5.4%	4.6%	3.2%	2.1%	2.0%	4.0%

The majority of regional transit riders use “Walk” as the most common method to access transit from their origin (90.1%). The next highest in the region overall was “Drove alone and parked” (5.3%) followed by “Was dropped off by someone going someplace else” (1.9%). Gratiot corridor riders were most likely to use an “Other” method of transportation to access transit (5.6%). The “Other” category was used to categorize anything that was selected less than 2.0% of the time including, but not limited to, “Drove or rode with others and parked”, “Uber, Lyft, etc.”, and “E-scooter (e.g. Lime, Bird, etc.)”.

Table 46: Access by Corridor

Cooridor	Access				
	Walk	Drove alone and parked	Was dropped off by someone going someplace else	Other	Total
GRATIOT	85.9%	2.4%	6.2%	5.6%	100.0%
MICHIGAN	92.0%	2.8%	1.7%	3.5%	100.0%
WOODWARD	91.4%	0.0%	4.0%	4.6%	100.0%
SEMCOG	90.1%	5.3%	1.9%	2.7%	100.0%

The majority of transit riders in the region overall ended their trip at “Your HOME” (34.8%) followed by “Your usual WORKPLACE” (22.9%). Michigan corridor respondents were more than double the regional totals for travelling to “Social or recreational” (16.7% vs 7.5%) and concurrently had the highest percentage of respondents travelling to “College or University (student only)” (4.3%) compared to the other corridors.

Table 47: Destination Purpose by Corridor

Cooridor	Destination Trip Purpose										
	Your HOME	Your usual WORKPLACE	College or University (student only)	Social or recreational	Personal business	Shopping	Dining / eating out / coffee	Work related	Medical / dental	Other	Total
GRATIOT	41.0%	27.3%	0.1%	4.2%	14.4%	5.4%	3.0%	1.9%	1.0%	1.7%	100.0%
MICHIGAN	27.9%	22.1%	4.3%	16.7%	11.1%	4.7%	6.9%	2.5%	1.1%	2.7%	100.0%
WOODWARD	41.6%	35.3%	0.0%	5.4%	8.8%	6.2%	0.3%	1.2%	0.0%	1.2%	100.0%
SEMCOG	34.8%	22.9%	16.4%	7.5%	5.7%	3.6%	2.1%	2.1%	2.1%	2.7%	100.0%

The majority of regional transit riders used “Walk” as the most common method of transportation to get from transit to their destination (94.9%). The second most commonly used method of transportation to get from transit to the destination was “Get in a parked vehicle and drive alone” (2.4%). Gratiot corridor riders had the highest percentage of respondents indicate they used an “Other” method of transportation to get from transit to their destination (6.4%). The “Other” category was used to categorize anything that was selected less than 2.0% of the time and includes, but is not limited to, “Get in a parked vehicle and drive / ride with someone”, “Personal bike”, and “Wheelchair / scooter”.

Table 48: Egress by Corridor

Cooridor	Egress			
	Walk	Get in a parked vehicle and drive alone	Other	Total
GRATIOT	92.6%	1.1%	6.4%	100.0%
MICHIGAN	93.7%	1.9%	4.4%	100.0%
WOODWARD	95.8%	0.0%	4.2%	100.0%
SEMCOG	94.9%	2.4%	2.8%	100.0%

Riders using the Michigan corridor were more likely to have their fare paid for by their employer either partially or fully (7.7%), while riders along the Woodward and Gratiot corridors (1.3% & 7.6% respectively) were less likely to have some or all of their fare paid by their employer, compared to the regional average (37.3%).

Table 49: Fare Subsidy by Corridor

Cooridor	Employer Paid		
	No	Yes	Total
GRATIOT	92.4%	7.6%	100.0%
MICHIGAN	92.3%	7.7%	100.0%
WOODWARD	98.7%	1.3%	100.0%
SEMCOG	62.7%	37.3%	100.0%

In the region overall, over half of riders make this trip 3 – 5 days per week (57.5%) followed by 6 – 7 days per week (29.2%) and 1 – 2 days per week (8.6%). Woodward corridor riders were more likely to make the trip 3 – 5 days per week (70.3%) compared to the region overall, and Michigan corridor riders had the highest percentage of respondents indicate that this was their “First time to make this trip” (2.5%).

Table 50: Trip Frequency by Corridor

Cooridor	Trip Frequency						Total
	6-7 days /week	3-5 days / week	1-2 days / week	1-3 days / month	Less than 1 day a month	First time to make this trip	
GRATIOT	35.4%	53.0%	8.1%	1.8%	1.0%	0.8%	100.0%
MICHIGAN	21.0%	52.3%	15.8%	5.3%	3.1%	2.5%	100.0%
WOODWARD	21.1%	70.3%	5.5%	0.8%	0.6%	1.8%	100.0%
SEMCOG	29.2%	57.5%	8.6%	2.4%	1.4%	0.9%	100.0%

If bus service was not available, riders along the Woodward and Gratiot corridors were less likely to report that they “Could not make trip” (6.1% and 5.4% respectively), compared to the riders overall in the region (17.3%). Michigan corridor riders were more likely to use an “Uber, Lyft, etc.” to make the trip (26.2%) than any other method, but also had the highest percentage of respondent indicate that they “Could not make trip” (19.4%) compared to the other corridors.

Table 51: Alternative Travel Mode by Corridor

Cooridor	Alternative Travel Mode									Total
	Get a ride with someone	Uber, Lyft, etc	Could not make trip	Walk	Drive (own car)	Bike	Taxi	Other	Not Provided	
GRATIOT	32.9%	20.4%	5.4%	22.0%	12.1%	3.8%	2.1%	0.0%	1.3%	100.0%
MICHIGAN	17.9%	26.2%	19.4%	9.5%	15.9%	6.4%	0.7%	3.7%	0.4%	100.0%
WOODWARD	26.1%	29.0%	6.1%	26.6%	6.0%	1.6%	2.7%	2.0%	0.0%	100.0%
SEMCOG	24.3%	19.0%	17.3%	16.6%	12.6%	5.8%	2.7%	1.6%	0.2%	100.0%

Riders in the region overall were less likely to have a valid drivers license (63.2%) than to have a valid drivers license (36.8%). Of the three corridors, Woodward corridor riders were more likely to have a valid drivers license (51.0%) compared to Gratiot (48.0%) and Michigan (32.4%).

Table 52: Valid Driver's License by Corridor

Cooridor	Driver's License		
	Yes	No	Total
GRATIOT	48.0%	52.0%	100.0%
MICHIGAN	32.4%	67.6%	100.0%
WOODWARD	51.0%	49.0%	100.0%
SEMCOG	36.8%	63.2%	100.0%

Just over one third of regional transit riders indicated they were between the ages of 18 – 25 (36.4%). All three corridors had a majority of their riders indicate they were between the ages of 35 – 54 (Gratiot – 36.5%, Michigan – 32.2%, and Woodward – 44.2%).

Table 53: Age by Corridor

Cooridor	Age										Total
	Under 6	6-12	13-15	16-17	18-25	26-34	35-54	55-64	65 and older	Unknown	
GRATIOT	0.0%	0.0%	0.1%	2.8%	15.9%	24.6%	36.5%	13.9%	5.7%	0.5%	100.0%
MICHIGAN	0.0%	0.0%	0.4%	1.1%	18.4%	31.5%	32.2%	10.6%	5.7%	0.0%	100.0%
WOODWARD	0.0%	0.0%	0.0%	1.5%	13.3%	26.3%	44.2%	8.5%	6.3%	0.0%	100.0%
SEMCOG	0.0%	0.1%	1.2%	3.1%	36.4%	22.7%	24.4%	8.3%	3.7%	0.0%	100.0%

The Michigan corridor has the highest percentage of retired riders (6.3%) versus the regional average (4.6%), and Woodward corridor has the highest percentage of employed riders (86.3%) versus the region overall (71.0%). Michigan corridor also had the highest percentage of “Not Employed” riders (15.1%) compared to the other two corridors. Employed riders were classified as either part- or full-time, and unemployed riders were classified as either “Not currently employed, and not seeking work”, “Not currently employed, but seeking work”, or “Not employed (unspecified)”.

Table 54: Employment Status by Corridor

Cooridor	Employment Status					Total
	Employed	Not Employed	Retired	Homemaker	Unknown	
GRATIOT	80.4%	12.7%	6.0%	0.4%	0.6%	100.0%
MICHIGAN	78.4%	15.1%	6.3%	0.2%	0.0%	100.0%
WOODWARD	86.3%	8.3%	5.1%	0.0%	0.3%	100.0%
SEMCOG	71.0%	23.8%	4.6%	0.3%	0.3%	100.0%

The majority of regional transit riders indicated they are “Not a student” (60.7%). Michigan corridor riders had the highest percentage of respondents indicate they are a “College / University” student (17.0%), and Gratiot corridor riders had the highest percentage of respondents indicate they are a “K – 12th grade” student (3.5%).

Table 55: Student Status by Corridor

Cooridor	Student Status					Total
	Not a student	Yes - College / University	Yes - K - 12th grade	Yes - Other type of student	Unknown	
GRATIOT	92.3%	3.7%	3.5%	0.0%	0.5%	100.0%
MICHIGAN	79.9%	17.0%	1.7%	1.4%	0.0%	100.0%
WOODWARD	93.3%	5.2%	1.5%	0.0%	0.0%	100.0%
SEMCOG	60.7%	33.9%	4.9%	0.4%	0.0%	100.0%

All three corridors have a higher percentage of riders without a household vehicle, with the largest difference along the Woodward corridor where thirty-nine percent (38.5%) of riders do not have a household vehicle, compared to forty-six percent (45.9%) of overall riders in the SEMCOG region.

Table 56: Household Vehicles by Corridor

Cooridor	Household Vehicle				
	None (0)	One (1)	Two (2)	Three or More	Total
GRATIOT	44.6%	27.6%	21.3%	6.5%	100.0%
MICHIGAN	40.5%	36.5%	17.8%	5.3%	100.0%
WOODWARD	38.5%	37.4%	22.1%	2.0%	100.0%
SEMCOG	45.9%	32.2%	15.7%	6.2%	100.0%

The Michigan corridor has a larger percentage of riders from “One (1)” person households (35.8%) versus the regional average (24.4%). The Gratiot corridor had the highest percentage of respondents indicate they come from a household of “Four or More” people (26.5%) compared to the Woodward and Michigan corridors (17.7% and 17.5% respectively).

Table 57: Household Size by Corridor

Cooridor	Household Size				
	One (1)	Two (2)	Three (3)	Four or More	Total
GRATIOT	27.0%	24.4%	22.1%	26.5%	100.0%
MICHIGAN	35.8%	32.3%	14.4%	17.5%	100.0%
WOODWARD	33.5%	26.6%	22.2%	17.7%	100.0%
SEMCOG	24.4%	30.3%	18.2%	27.1%	100.0%

In the region overall, the highest percentage of respondents indicated they come from a household were “Two (2)” people are employed (34.5%) followed extremely closely by households where “One (1)” person is employed (34.4%). The Woodward corridor had the least percentage of respondents indicate they come from a “None (0)” employed household (9.9%) compared to the Gratiot corridor who had the highest percentage of respondents indicate they come from a household where there are “Three or More” employed people (19.7%).

Table 58: Household Employees by Corridor

Cooridor	Household Workers				
	None (0)	One (1)	Two (2)	Three or More	Total
GRATIOT	10.8%	38.6%	30.8%	19.7%	100.0%
MICHIGAN	10.6%	45.9%	33.4%	10.1%	100.0%
WOODWARD	9.9%	43.6%	32.4%	14.1%	100.0%
SEMCOG	15.4%	34.4%	34.5%	15.7%	100.0%

Just under half of the regional transit riders indicated they make “Below \$25,000” for their annual household income (41.5%). Gratiot and Michigan corridors were right at the regional average for making “\$100,000 or more” for their annual household income (5.5% and 5.2% vs 5.5%), while Woodward corridor had the lowest percentage of respondents indicate they make “\$100,000 or more” (3.5%).

Table 59: Income by Corridor

Cooridor	Income									Total
	Below \$25,000	\$25,000 - \$29,999	\$30,000 - \$39,999	\$40,000 - \$49,999	\$50,000 - \$59,999	\$60,000 - \$74,999	\$75,000 - \$99,999	\$100,000 or more	Not Provided	
GRATIOT	37.1%	10.7%	13.1%	7.7%	7.2%	7.3%	2.2%	5.5%	9.3%	100.0%
MICHIGAN	33.4%	8.4%	9.9%	9.8%	8.9%	6.3%	5.3%	5.2%	12.8%	100.0%
WOODWARD	31.4%	16.3%	16.8%	18.8%	5.8%	3.9%	2.3%	3.5%	1.1%	100.0%
SEMCOG	41.5%	6.9%	10.1%	6.7%	5.0%	4.8%	4.1%	5.5%	15.5%	100.0%

5. Survey Result Comparisons

The survey result comparisons in this chapter are based on the previous 2010 report data and the current 2019 report data. In the previous 2010 report, the methodology used to obtain the onboard data was by a self-completion questionnaire, and defined only as “complete” and “usable” if the following questions were answered: origin address, destination address, mode of access, mode of egress, trip purposes, and trip path. In the most recent 2019 survey, the methodology used to obtain the onboard data was interviewer administered questionnaire utilizing the Tablet PC program as explained in further detail in Section 2.3.2 of this report.

In the 2010 survey the QLN system and the FLT system were not surveyed, so comparisons could not be made for those systems.

All 2019 data in the tables are based on the secondary expansion numbers conducted by CTG and are showing the sum of the linked weight factors except where stated otherwise. The 2019 categories of “Unknown” or “Not Provided” have been removed from the subsequent tables for more accurate comparison purposes.

5.1 Trend Comparisons by System

Overall for the region, respondents were more likely in 2019 to not need any additional transfers to make their trip compared to 2010 (65.5% vs. 52.3%). DDT had the highest difference for respondents that indicated they took “None” additional transfer to make their trip (50.7% in 2019 vs. 39.9% in 2010) or took “Two” additional transfers to make their trip (3.6% in 2019 vs. 13.5% in 2010). SMD was similar in that in 2019 respondents were less likely to need “Two” additional transfers to make their trip (2.8%) compared to 2010 (11.5%).

Table 60: Total Transfers (2019 – based on secondary unlinked weight factors vs. 2010)

System	Year	Total Transfers				
		None	One	Two	Three or More	Total
AAA	2019	67.8%	31.5%	0.7%	0.0%	100.0%
	2010	65.2%	31.2%	3.2%	0.4%	100.0%
BWT	2019	36.6%	50.4%	11.5%	1.5%	100.0%
	2010	35.3%	52.2%	11.4%	1.1%	100.0%
DDT	2019	50.7%	45.7%	3.6%	0.1%	100.0%
	2010	39.9%	44.0%	13.5%	2.6%	100.0%
DPM	2019	84.4%	13.7%	1.8%	0.0%	100.0%
	2010	84.0%	11.0%	4.9%	0.0%	100.0%
FLT	2019	95.1%	4.9%	0.0%	0.0%	100.0%
	2010					
LET	2019	35.9%	56.5%	7.7%	0.0%	100.0%
	2010	39.1%	44.4%	16.5%	0.0%	100.0%
QLN	2019	89.4%	10.0%	0.6%	0.0%	100.0%
	2010					
SMD	2019	55.0%	42.1%	2.8%	0.1%	100.0%
	2010	49.2%	37.9%	11.5%	1.4%	100.0%
UMT	2019	95.5%	4.3%	0.3%	0.0%	100.0%
	2010	90.0%	9.7%	0.3%	0.1%	100.0%
Regional Statistics	2019	65.5%	32.1%	2.3%	0.1%	100.0%
	2010	52.3%	36.0%	10.0%	1.7%	100.0%

Overall, there were no significant differences for the regional statistics for the type of place respondents were coming from for 2010 compared to 2019. “Your HOME” remained consistent as the most common type of place respondents were coming from (49.0% in 2019 compared to 53.3% in 2010). Two of the biggest differences were in 2010 BWT riders were more likely to say they were coming from “Your HOME” (72.9% vs. 50.0%), and in 2010 UMT riders were more likely to say they were coming from “College or University (student only)” (55.3% vs. 31.0%).

Table 61: Origin Trip Purpose by System (2019 vs. 2010)

System	Year	Origin Trip Purpose							
		Your HOME	College or University (student only)	Shopping	Social or recreational	Work or Work related	Medical / dental	Other	Total
AAA	2019	51.9%	9.4%	4.1%	5.2%	19.2%	1.8%	8.3%	100.0%
	2010	55.2%	16.9%	2.1%	4.2%	17.9%	2.1%	1.5%	100.0%
BWT	2019	50.0%	1.2%	13.4%	7.6%	11.5%	5.5%	10.7%	100.0%
	2010	72.9%	2.0%	5.0%	5.4%	9.6%	1.2%	4.0%	100.0%
DDT	2019	46.1%	1.3%	4.0%	7.4%	25.2%	3.2%	12.8%	100.0%
	2010	56.7%	5.8%	3.1%	8.5%	18.3%	3.2%	4.4%	100.0%
DPM	2019	33.8%	0.1%	1.6%	14.1%	30.5%	0.1%	19.8%	100.0%
	2010	42.6%	1.2%	2.5%	26.4%	23.8%	2.2%	1.3%	100.0%
FLT	2019	53.9%	0.0%	0.0%	0.9%	45.2%	0.0%	0.0%	100.0%
	2010								
LET	2019	55.4%	1.2%	18.5%	5.9%	8.4%	3.3%	7.3%	100.0%
	2010	66.5%	3.8%	8.7%	9.2%	8.5%	0.2%	3.2%	100.0%
QLN	2019	35.4%	5.5%	3.8%	7.9%	22.6%	3.0%	21.9%	100.0%
	2010								
SMD	2019	51.7%	0.7%	4.8%	4.3%	27.8%	1.9%	8.8%	100.0%
	2010	59.1%	5.2%	3.2%	6.3%	21.9%	2.1%	2.3%	100.0%
UMT	2019	51.9%	31.0%	0.5%	2.5%	11.2%	0.6%	2.3%	100.0%
	2010	33.1%	55.3%	0.2%	1.4%	9.0%	0.8%	0.1%	100.0%
Regional Statistics	2019	49.0%	10.8%	3.3%	5.5%	20.6%	2.0%	8.8%	100.0%
	2010	53.3%	14.3%	2.6%	6.9%	17.3%	2.5%	3.0%	100.0%

The biggest difference overall between the 2010 and the 2019 surveys for access mode from origin to transit was for “Was dropped off by someone going someplace else”, where respondents were more likely to choose that as their form of transportation from their origin to transit (8.5%) compared to 2019 (2.0%). The majority of respondents for both 2019 and 2010 chose “Walk” as their most commonly used method to get from their origin to transit.

Table 62: Access by System (2019 vs. 2010)

System	Year	Access				
		Walk	Drove alone and parked	Was dropped off by someone going someplace else	Other	Total
AAA	2019	92.9%	3.0%	0.8%	3.3%	100.0%
	2010	86.6%	6.7%	4.4%	2.2%	100.0%
BWT	2019	96.5%	0.0%	2.3%	1.2%	100.0%
	2010	86.9%	1.2%	9.3%	2.6%	100.0%
DDT	2019	95.2%	0.1%	2.7%	2.0%	100.0%
	2010	89.1%	0.5%	9.4%	1.1%	100.0%
DPM	2019	77.4%	13.7%	0.1%	8.8%	100.0%
	2010	70.6%	8.3%	19.5%	1.5%	100.0%
FLT	2019	50.4%	7.6%	21.8%	20.2%	100.0%
	2010					
LET	2019	98.6%	0.0%	1.0%	0.4%	100.0%
	2010	80.6%	1.1%	18.3%	0.0%	100.0%
QLN	2019	92.2%	3.6%	0.6%	3.7%	100.0%
	2010					
SMD	2019	87.6%	2.9%	5.7%	3.8%	100.0%
	2010	80.9%	2.7%	13.0%	3.3%	100.0%
UMT	2019	84.1%	13.5%	0.1%	2.3%	100.0%
	2010	90.9%	7.0%	1.5%	0.6%	100.0%
Regional Statistics	2019	90.1%	5.1%	2.0%	2.8%	100.0%
	2010	87.5%	2.6%	8.5%	1.6%	100.0%

UMT riders were more likely to be going to “College or University (student only)” in 2010 (60.0%) compared to 2019 (47.0%). LET riders were less likely to be going to “Social or recreational” for their destination in 2019 (6.7%) compared to 2010 (20.9%). BWT riders were almost two times as likely to be going to “Work or Work related” in 2010 (31.5%) compared to 2019 (18.6%).

Table 63: Destination Trip Purpose by System (2019 vs. 2010)

System	Year	Destination Trip Purpose							
		Your HOME	College or University (student only)	Shopping	Social or recreational	Work or Work related	Medical / dental	Other	Total
AAA	2019	36.1%	12.6%	6.2%	6.7%	27.6%	1.6%	9.3%	100.0%
	2010	32.6%	25.1%	6.2%	8.6%	23.1%	3.0%	1.5%	100.0%
BWT	2019	32.8%	1.5%	12.8%	11.7%	18.6%	8.0%	14.6%	100.0%
	2010	21.6%	9.0%	14.6%	15.7%	31.5%	4.9%	2.7%	100.0%
DDT	2019	42.3%	1.6%	3.7%	9.3%	24.3%	3.1%	15.7%	100.0%
	2010	33.2%	7.1%	4.6%	17.8%	26.2%	5.4%	5.8%	100.0%
DPM	2019	18.9%	0.0%	2.0%	22.2%	34.9%	0.1%	22.0%	100.0%
	2010	18.2%	2.7%	3.3%	39.1%	33.4%	2.5%	0.8%	100.0%
FLT	2019	43.3%	0.0%	0.0%	0.9%	54.8%	0.0%	0.9%	100.0%
	2010								
LET	2019	26.3%	1.0%	29.1%	6.7%	15.6%	7.4%	14.0%	100.0%
	2010	25.5%	8.4%	19.5%	20.9%	12.9%	11.9%	0.9%	100.0%
QLN	2019	23.4%	4.5%	2.0%	21.4%	23.9%	1.3%	23.4%	100.0%
	2010								
SMD	2019	36.7%	0.6%	5.6%	6.3%	36.3%	2.6%	12.0%	100.0%
	2010	32.4%	6.4%	6.1%	12.3%	35.6%	4.3%	3.0%	100.0%
UMT	2019	26.0%	47.0%	0.5%	4.1%	18.7%	0.5%	3.2%	100.0%
	2010	26.8%	60.0%	0.0%	3.9%	8.2%	1.0%	0.0%	100.0%
<i>Regional Statistics</i>	2019	34.8%	15.9%	3.6%	7.6%	25.1%	2.0%	10.9%	100.0%
	2010	31.6%	16.9%	4.4%	14.3%	24.7%	4.3%	3.9%	100.0%

The majority of regional transit riders both in 2019 and in 2010 “Walked” to their destination after transit (94.8% and 92.5% respectively). There were no statistically significant differences between the egress modes for 2019 compared to 2010. The largest difference was for LET riders who used “Other” to get from transit to their destination (1.8% in 2019 vs. 13.2% in 2010). The “Other” category was used to categorize anything that was chosen less than 2.0% of the time by riders and includes, but is not limited to, “Get in a parked vehicle and drive / ride with someone”, “Be picked up by someone”, and “Personal bike”.

Table 64: Egress by System (2019 vs. 2010)

System	Year	Egress			
		Walk	Get in a parked vehicle and drive alone	Other	Total
AAA	2019	95.1%	1.8%	3.1%	100.0%
	2010	91.0%	5.5%	3.5%	100.0%
BWT	2019	97.9%	0.0%	2.1%	100.0%
	2010	93.9%	2.3%	3.8%	100.0%
DDT	2019	96.9%	0.1%	3.0%	100.0%
	2010	93.9%	0.4%	5.9%	100.0%
DPM	2019	91.9%	5.0%	3.0%	100.0%
	2010	91.0%	3.6%	5.3%	100.0%
FLT	2019	59.1%	16.8%	24.1%	100.0%
	2010				
LET	2019	98.2%	0.0%	1.8%	100.0%
	2010	86.9%	0.0%	13.2%	100.0%
QLN	2019	96.6%	1.1%	2.3%	100.0%
	2010				
SMD	2019	92.7%	2.2%	5.1%	100.0%
	2010	88.5%	2.2%	9.3%	100.0%
UMT	2019	93.3%	5.4%	1.3%	100.0%
	2010	92.9%	5.7%	1.4%	100.0%
Regional Statistics	2019	94.8%	2.3%	2.9%	100.0%
	2010	92.5%	2.0%	5.4%	100.0%

There was a larger percentage of respondents in 2010 to indicate their employer did not pay any or all of their fare (89.9%) compared to 2019 (63.9%). BWT was the only system where riders in 2010 indicated a higher percentage of employers that did not help pay for any or all of their fare (66.7%) compared to 2019 where a higher percentage of riders indicated their employer did help pay for some or all of their fare (57.9%). All other systems indicated a higher percentage for both years where their employer did not help pay for any or part of their fare.

Table 65: Employer Pay by System (2019 vs. 2010)

System	Year	Employer Pay		
		Yes	No	Total
AAA	2019	57.9%	42.1%	100.0%
	2010	33.4%	66.7%	100.0%
BWT	2019	7.1%	92.9%	100.0%
	2010	15.5%	84.5%	100.0%
DDT	2019	5.2%	94.8%	100.0%
	2010	8.1%	91.9%	100.0%
DPM	2019	16.9%	83.1%	100.0%
	2010	7.3%	92.7%	100.0%
FLT	2019	28.0%	72.0%	100.0%
	2010			
LET	2019	1.0%	99.0%	100.0%
	2010	13.0%	87.0%	100.0%
QLN	2019	8.2%	91.8%	100.0%
	2010			
SMD	2019	7.3%	92.7%	100.0%
	2010	9.1%	90.9%	100.0%
UMT	2019	84.2%	15.8%	100.0%
	2010			
Regional Statistics	2019	36.1%	63.9%	100.0%
	2010	10.1%	89.9%	100.0%

In 2010 in the region overall riders indicated a higher percentage for making the trip 6-7 days a week (46.4%) compared to 2019 where a higher percentage of riders indicated making the trip 3-5 days a week (57.3%).

Table 66: Trip Frequency by System (2019 vs. 2010)

System	Year	Trip Frequency						
		6-7 days /week	3-5 days / week	1-2 days / week	1-3 days / month	Less than 1 day a month	First time to make this trip	Total
AAA	2019	26.6%	63.4%	7.6%	1.4%	0.8%	0.2%	100.0%
	2010	20.7%	56.7%	11.7%	5.9%	2.1%	2.9%	100.0%
BWT	2019	35.3%	46.8%	11.1%	3.0%	0.1%	3.8%	100.0%
	2010	24.9%	41.9%	20.0%	8.6%	2.0%	2.6%	100.0%
DDT	2019	28.2%	55.8%	10.9%	2.9%	1.3%	0.8%	100.0%
	2010	26.6%	47.5%	11.0%	8.2%	3.0%	3.7%	100.0%
DPM	2019	12.6%	39.1%	10.8%	10.2%	17.6%	9.7%	100.0%
	2010	16.7%	29.0%	30.4%	7.7%	8.5%	7.6%	100.0%
FLT	2019	72.3%	26.4%	0.3%	0.9%	0.0%	0.0%	100.0%
	2010							
LET	2019	26.5%	48.1%	20.0%	1.0%	1.0%	3.3%	100.0%
	2010	5.5%	48.7%	20.7%	20.0%	4.0%	1.1%	100.0%
QLN	2019	19.7%	45.9%	19.8%	6.7%	4.4%	3.6%	100.0%
	2010							
SMD	2019	27.7%	59.5%	7.7%	3.0%	1.2%	0.8%	100.0%
	2010	24.3%	52.4%	10.6%	7.0%	2.8%	2.9%	100.0%
UMT	2019	34.1%	58.3%	6.0%	1.1%	0.2%	0.2%	100.0%
	2010	46.4%	42.2%	7.1%	2.3%	1.2%	0.8%	100.0%
Regional Statistics	2019	29.2%	57.3%	8.7%	2.4%	1.4%	0.9%	100.0%
	2010	46.4%	42.2%	7.1%	2.3%	1.2%	0.8%	100.0%

The 2010 survey showed a higher percentage of respondents that “Could not make trip” (30.5%) compared to 2019 (16.6%) if transit were not available. Additionally, respondents in 2010 showed a higher percentage of respondents that would “Get a ride with someone” (30.7%) compared to 2019 (24.4%). An “Other” and “Not Provided” category were added to the 2019 survey to offer respondents the chance to write in or opt out of the alternative travel mode question.

Table 67: Alternative Travel Mode by System (2019 vs. 2010)

System	Year	Alternative Travel Mode							
		Walk	Drive (own car)	Get a ride with someone	Taxi	Bike	Could not make trip	Other	Not Provided
AAA	2019	16.5%	21.2%	20.3%	1.8%	6.0%	11.9%	22.3%	0.0%
	2010	20.4%	34.9%	21.0%	10.9%	13.8%	18.6%		
BWT	2019	24.3%	1.7%	28.9%	12.5%	4.6%	25.6%	2.4%	0.0%
	2010	37.2%	4.0%	26.8%	20.5%	14.8%	27.8%		
DDT	2019	11.6%	3.7%	37.9%	4.4%	1.5%	22.3%	18.4%	0.1%
	2010	18.1%	10.2%	37.4%	15.7%	4.7%	33.5%		
DPM	2019	46.4%	17.5%	4.3%	5.6%	0.6%	5.7%	19.9%	0.0%
	2010	48.1%	13.7%	25.4%	10.7%	2.2%	8.7%		
FLT	2019	0.0%	31.5%	12.7%	0.0%	0.0%	54.9%	0.9%	0.0%
	2010								
LET	2019	24.7%	1.0%	29.7%	0.0%	2.6%	36.6%	5.3%	0.0%
	2010	37.6%	10.5%	38.0%	4.7%	10.3%	34.8%		
QLN	2019	21.4%	19.2%	9.8%	0.8%	6.8%	7.0%	35.0%	0.0%
	2010								
SMD	2019	6.1%	12.2%	33.0%	1.7%	3.2%	20.5%	22.3%	1.0%
	2010	12.1%	16.3%	31.9%	10.7%	6.5%	39.2%		
UMT	2019	26.1%	19.7%	7.1%	0.4%	13.0%	10.2%	23.4%	0.0%
	2010	25.7%	26.3%	14.0%	7.4%	19.3%	22.4%		
Regional Statistics	2019	17.1%	12.6%	24.4%	2.6%	5.7%	16.6%	20.8%	0.2%
	2010	19.4%	16.3%	30.7%	13.0%	8.4%	30.5%		

In the region overall, respondents were more likely to have a valid driver's license than not for both 2010 and 2019 (53.47% and 63.0% respectively). Riders on the LET system were significantly less likely to have a valid driver's license in 2019 (28.4%) compared to 2010 (40.5%).

Table 68: License by System (2019 vs. 2010)

System	Year	License		
		Yes	No	Total
AAA	2019	71.7%	28.3%	100.0%
	2010	72.5%	27.5%	100.0%
BWT	2019	38.6%	61.4%	100.0%
	2010	36.1%	63.9%	100.0%
DDT	2019	41.7%	58.3%	100.0%
	2010	39.0%	61.0%	100.0%
DPM	2019	90.8%	9.2%	100.0%
	2010	79.4%	20.6%	100.0%
FLT	2019	69.0%	31.0%	100.0%
	2010			
LET	2019	28.4%	71.6%	100.0%
	2010	40.5%	59.5%	100.0%
QLN	2019	78.2%	21.8%	100.0%
	2010			
SMD	2019	55.2%	44.8%	100.0%
	2010	51.0%	49.0%	100.0%
UMT	2019	88.2%	11.8%	100.0%
	2010	91.3%	8.7%	100.0%
<i>Regional Statistics</i>	2019	63.0%	37.0%	100.0%
	2010	53.7%	46.3%	100.0%

In both the 2010 and 2019 surveys, there was a higher percentage of regional transit riders that indicated they were between the ages of 18-25 (34.9% and 35.6% respectively), followed by the age category 35-54 (31.2% and 24.8% respectively). LET riders were significantly less likely to be between the ages of 18-25 in 2019 (12.6%) compared to 2010 (29.1%).

Table 69: Age by System (2019 vs. 2010)

System	Year	Age						Total
		Under 18	18-25	26-34	35-54	55-64	65 and older	
AAA	2019	4.8%	35.4%	26.1%	20.2%	7.7%	5.7%	100.0%
	2010	3.3%	37.2%	23.3%	22.7%	10.1%	3.4%	100.0%
BWT	2019	2.8%	14.7%	18.8%	39.2%	16.1%	8.4%	100.0%
	2010	7.3%	27.7%	19.8%	32.0%	10.0%	3.3%	100.0%
DDT	2019	8.2%	20.2%	24.9%	32.1%	10.7%	3.9%	100.0%
	2010	7.8%	24.7%	16.5%	37.4%	11.8%	1.8%	100.0%
DPM	2019	0.4%	10.4%	22.2%	46.3%	12.0%	8.7%	100.0%
	2010	0.4%	11.9%	18.5%	49.5%	15.6%	4.1%	100.0%
FLT	2019	0.0%	17.2%	28.6%	43.6%	9.6%	1.0%	100.0%
	2010							
LET	2019	2.6%	12.6%	22.7%	32.7%	17.5%	11.7%	100.0%
	2010	0.6%	29.1%	15.6%	41.1%	7.6%	6.0%	100.0%
QLN	2019	2.1%	21.9%	32.8%	28.1%	11.4%	3.7%	100.0%
	2010							
SMD	2019	2.6%	16.3%	25.8%	35.6%	13.4%	6.2%	100.0%
	2010	3.6%	21.7%	19.5%	40.7%	12.0%	2.6%	100.0%
UMT	2019	0.6%	70.0%	17.1%	9.1%	2.5%	0.6%	100.0%
	2010	2.1%	80.9%	7.3%	6.3%	3.4%	0.0%	100.0%
<i>Regional Statistics</i>	2019	4.3%	35.6%	22.9%	24.8%	8.5%	3.8%	100.0%
	2010	5.6%	34.9%	16.2%	31.2%	10.2%	1.8%	100.0%

Regional respondents were more likely to be employed either full- or part-time in 2019 (71.4%) compared to 2010 (53.2%). UMT riders were significantly more likely to be unemployed and either seeking work or not seeking work in 2019 (40.6%) compared to 2010 (3.2%). The percentage of retired employees has gone up slightly for all systems from 2010 to 2019.

Table 70: Employment Status by System (2019 vs. 2010)

System	Year	Employment Status						
		Employed full-time	Employed part-time	Not currently employed, but seeking work	Not currently employed, and not seeking work	Retired	Other / Homemaker	Total
AAA	2019	46.3%	29.4%	5.4%	12.9%	5.2%	0.8%	100.0%
	2010	34.9%	22.2%	6.7%	1.9%	4.9%	2.4%	100.0%
BWT	2019	31.9%	22.2%	11.8%	20.0%	13.7%	0.4%	100.0%
	2010	21.6%	31.9%	21.5%	4.8%	9.7%	6.0%	100.0%
DDT	2019	55.0%	19.3%	8.8%	8.8%	6.4%	1.7%	100.0%
	2010	34.0%	20.9%	18.9%	2.5%	5.6%	6.3%	100.0%
DPM	2019	81.7%	7.6%	1.1%	1.4%	7.7%	0.5%	100.0%
	2010	66.0%	10.5%	8.8%	4.0%	5.7%	2.3%	100.0%
FLT	2019	99.3%	0.7%	0.0%	0.0%	0.0%	0.0%	100.0%
	2010							
LET	2019	21.5%	22.7%	13.0%	20.6%	19.2%	3.0%	100.0%
	2010	21.1%	26.1%	27.8%	11.2%	8.5%	13.1%	100.0%
QLN	2019	65.4%	14.8%	6.8%	7.7%	5.1%	0.2%	100.0%
	2010							
SMD	2019	66.6%	15.1%	5.7%	5.4%	6.3%	0.9%	100.0%
	2010	46.3%	21.0%	14.0%	2.5%	5.5%	4.5%	100.0%
UMT	2019	26.3%	32.9%	13.3%	27.3%	0.1%	0.0%	100.0%
	2010	10.1%	19.8%	1.4%	1.8%	0.2%	0.4%	100.0%
Regional Statistics	2019	47.7%	23.7%	8.9%	14.2%	4.6%	0.9%	100.0%
	2010	32.3%	20.9%	13.9%	2.4%	4.7%	4.6%	100.0%

The percentage of regional respondents had little change from 2010 to 2019 for those respondents who indicated they were a College/University student (32.4% vs 33.0%), and a K-12th grade student (5.8% vs. 4.8%). The biggest difference is for BWT riders where a larger percentage of riders indicated they were a College/University student in 2010 (17.8%) compared to 2019 (5.6%). The 2019 survey included the option to indicate a respondent was “Not a student” and “Unknown”.

Table 71: Student Status by System (2019 vs. 2010)

System	Year	Student Status				
		Not a student	Yes - College / University	Yes - K - 12th grade	Yes - Other type of student	Total
AAA	2019	53.8%	40.8%	4.9%	0.5%	100.0%
	2010		45.4%	2.9%	2.5%	-
BWT	2019	90.0%	5.6%	4.4%	0.0%	100.0%
	2010		17.8%	6.3%	2.7%	-
DDT	2019	82.3%	7.7%	9.3%	0.7%	100.0%
	2010		18.2%	8.9%	4.6%	-
DPM	2019	93.5%	6.2%	0.4%	0.0%	100.0%
	2010		5.6%	0.4%	0.4%	-
FLT	2019	89.9%	7.4%	0.7%	2.0%	100.0%
	2010					
LET	2019	91.9%	4.2%	1.8%	2.0%	100.0%
	2010		15.0%	0.6%	3.4%	-
QLN	2019	77.9%	18.5%	2.1%	1.5%	100.0%
	2010					
SMD	2019	89.1%	7.5%	3.2%	0.3%	100.0%
	2010		18.1%	3.5%	2.6%	-
UMT	2019	19.7%	79.7%	0.4%	0.2%	100.0%
	2010		87.6%	0.1%	0.4%	-
Regional Statistics	2019	61.8%	33.0%	4.8%	0.4%	100.0%
	2010		32.4%	5.8%	3.3%	-

Regional respondents in 2010 were more likely to have zero household vehicles (51.8%) compared to 2019 (45.8%). DPM riders were nearly twice as likely in 2019 to indicate they had three or more working vehicles in their household (20.2%) compared to 2010 (10.3%), while UMT riders were nearly half as likely to indicate they had three or more working vehicles in their household in 2019 (10.0%) compared to 2010 (19.4%).

Table 72: Household Vehicles by System (2019 vs. 2010)

System	Year	Household Vehicle				
		None (0)	One (1)	Two (2)	Three or More	Total
AAA	2019	38.3%	38.9%	17.1%	5.7%	100.0%
	2010	37.8%	35.6%	19.6%	7.1%	100.0%
BWT	2019	76.2%	16.8%	5.5%	1.5%	100.0%
	2010	73.1%	18.8%	7.4%	0.7%	100.0%
DDT	2019	55.6%	30.0%	12.0%	2.3%	100.0%
	2010	60.4%	27.5%	9.2%	2.9%	100.0%
DPM	2019	14.8%	31.2%	33.8%	20.2%	100.0%
	2010	23.7%	38.7%	27.3%	10.3%	100.0%
FLT	2019	18.3%	61.2%	14.0%	6.5%	100.0%
	2010					
LET	2019	79.8%	13.2%	4.6%	2.4%	100.0%
	2010	64.0%	26.7%	3.3%	6.1%	100.0%
QLN	2019	35.8%	37.4%	21.0%	5.8%	100.0%
	2010					
SMD	2019	41.8%	32.0%	19.8%	6.4%	100.0%
	2010	51.7%	32.1%	12.0%	4.2%	100.0%
UMT	2019	40.5%	32.6%	16.8%	10.0%	100.0%
	2010	33.8%	28.9%	18.0%	19.4%	100.0%
Regional Statistics	2019	45.8%	32.2%	15.8%	6.1%	100.0%
	2010	51.8%	29.3%	12.4%	6.4%	100.0%

Regional respondents in 2010 were more likely to have four or more household members (33.4%) compared to 2019 (26.9%). There were no statistically significant differences in household size from the 2010 survey to the 2019 survey.

Table 73: Household Size by System (2019 vs. 2010)

System	Year	Household Size				
		One (1)	Two (2)	Three (3)	Four or More	Total
AAA	2019	25.6%	34.8%	18.5%	21.0%	100.0%
	2010	28.4%	37.6%	14.6%	19.4%	100.0%
BWT	2019	33.6%	24.6%	19.1%	22.6%	100.0%
	2010	25.5%	26.6%	18.8%	29.1%	100.0%
DDT	2019	24.9%	24.0%	20.8%	30.4%	100.0%
	2010	18.1%	24.0%	21.5%	36.4%	100.0%
DPM	2019	22.5%	30.4%	19.2%	27.8%	100.0%
	2010	26.7%	29.3%	22.0%	22.0%	100.0%
FLT	2019	19.2%	35.0%	19.2%	26.5%	100.0%
	2010					
LET	2019	35.1%	22.5%	15.3%	27.0%	100.0%
	2010	32.0%	31.5%	19.1%	17.3%	100.0%
QLN	2019	39.4%	30.0%	15.8%	14.8%	100.0%
	2010					
SMD	2019	27.0%	25.7%	20.2%	27.0%	100.0%
	2010	20.4%	26.9%	23.7%	29.0%	100.0%
UMT	2019	21.7%	38.3%	13.9%	26.1%	100.0%
	2010	16.3%	29.1%	16.4%	38.2%	100.0%
Regional Statistics	2019	24.7%	30.2%	18.3%	26.9%	100.0%
	2010	19.5%	26.9%	20.2%	33.4%	100.0%

Regionally, the percentage of household workers has decreased for zero and one-person household workers in 2010 compared to 2019 and has subsequently increased for two and three or more household workers from 2010 to 2019.

Table 74: Household Workers by System (2019 vs. 2010)

System	Year	Household Workers				
		None (0)	One (1)	Two (2)	Three or More	Total
AAA	2019	12.6%	31.3%	36.8%	19.4%	100.0%
	2010	21.1%	40.0%	29.8%	9.0%	100.0%
BWT	2019	32.2%	34.2%	19.3%	14.2%	100.0%
	2010	37.2%	30.5%	21.1%	11.2%	100.0%
DDT	2019	10.4%	39.3%	36.5%	13.8%	100.0%
	2010	29.0%	40.1%	22.6%	8.3%	100.0%
DPM	2019	6.0%	32.1%	45.4%	16.5%	100.0%
	2010	15.6%	43.8%	33.5%	7.1%	100.0%
FLT	2019	0.0%	43.3%	49.1%	7.6%	100.0%
	2010					
LET	2019	45.3%	24.0%	14.2%	16.5%	100.0%
	2010	43.3%	33.6%	16.0%	7.2%	100.0%
QLN	2019	10.1%	45.3%	34.5%	10.1%	100.0%
	2010					
SMD	2019	9.0%	36.6%	35.4%	19.0%	100.0%
	2010	23.8%	39.2%	27.4%	9.5%	100.0%
UMT	2019	25.9%	29.8%	29.6%	14.7%	100.0%
	2010	30.2%	28.8%	27.5%	13.6%	100.0%
Regional Statistics	2019	15.3%	34.7%	34.4%	15.6%	100.0%
	2010	27.6%	37.9%	25.0%	9.5%	100.0%

The percentage of regional transit riders that indicated they make “Less than \$30,000” for an annual household income decreased from 2010 (66.9%) to 2019 (48.2%). One of the largest differences from 2010 to 2019 were the percentage of DPM riders who indicated they make “\$75,000 or more” significantly increased from 2010 (10.7%) to 2019 (36.8%).

Table 75: Income by System (2019 vs. 2010)

System	Year	Income						Total
		Less than \$30,000	\$30,000 - \$39,999	\$40,000 - \$49,999	\$50,000 - \$59,999	\$60,000 - \$74,999	\$75,000 or more	
AAA	2019	46.8%	12.3%	9.2%	7.7%	8.6%	15.3%	100.0%
	2010	53.0%	12.9%	10.9%	11.8%	6.6%	4.8%	100.0%
BWT	2019	75.3%	8.3%	5.3%	3.7%	4.5%	2.9%	100.0%
	2010	87.7%	5.1%	5.3%	0.5%	1.5%	0.0%	100.0%
DDT	2019	71.9%	12.9%	8.1%	3.8%	1.9%	1.3%	100.0%
	2010	75.2%	11.2%	7.4%	4.8%	0.8%	0.7%	100.0%
DPM	2019	16.1%	10.0%	11.9%	10.0%	10.7%	41.3%	100.0%
	2010	28.8%	14.3%	18.4%	19.4%	8.4%	10.7%	100.0%
FLT	2019	64.2%	20.5%	3.6%	6.2%	1.3%	4.1%	100.0%
	2010							
LET	2019	80.1%	7.7%	1.4%	7.9%	2.2%	0.7%	100.0%
	2010	87.5%	7.3%	2.7%	0.6%	1.9%	0.0%	100.0%
QLN	2019	41.2%	9.2%	13.4%	13.8%	7.2%	15.3%	100.0%
	2010							
SMD	2019	46.8%	15.2%	10.1%	9.3%	7.8%	10.8%	100.0%
	2010	61.6%	13.7%	10.0%	8.6%	3.0%	3.1%	100.0%
UMT	2019	50.2%	9.3%	5.7%	5.6%	8.1%	21.0%	100.0%
	2010	53.0%	7.0%	5.9%	8.1%	7.9%	18.2%	100.0%
Regional Statistics	2019	57.0%	12.0%	8.0%	6.0%	5.7%	11.3%	100.0%
	2010	66.9%	11.1%	8.0%	6.7%	3.0%	4.4%	100.0%

5.2 Trend Comparisons by Place Type & Access/Egress Modes

5.2.1 Place Type Comparisons

The following trend comparisons look at the Origin Place Type by the Destination Place Type for the survey years 2019 and 2010. Some categories for the 2019 survey have been grouped together to better represent comparisons, such as “Your usual WORKPLACE” and “Work Related”.

Regionally, there was not a large difference from the 2010 to the 2019 surveys for the distribution of origin place type to destination place type. Over half of respondents were coming from home in 2010 (53.3%), and just under half of respondents were coming from home in 2019 (49.5%). The percentage of respondent going to “School (K-12) (student only)” decreased slightly from 2010 (3.7%) to 2019 (1.7%).

Table 76: Regional Distribution of Origin Place Type by Destination Place Type (2019)

Origin Place Type (2019)	Destination Place Type (2019)								Total
	Your HOME or Hotel	Work or Work related	College or University (student only)	Social or Eating Out	Shopping	Medical / dental	School (K-12) (student only)	Other	
Your HOME or Hotel	0.0%	22.5%	11.6%	5.4%	2.5%	1.6%	1.6%	4.3%	49.5%
Work or Work related	17.0%	0.9%	0.4%	1.1%	0.4%	0.1%	0.0%	0.8%	20.6%
College or University (student only)	6.0%	0.4%	3.4%	0.8%	0.1%	0.0%	0.0%	0.1%	10.8%
Social or Eating Out	4.0%	0.6%	0.3%	1.4%	0.2%	0.1%	0.0%	0.4%	7.0%
Shopping	2.3%	0.1%	0.1%	0.3%	0.2%	0.1%	0.0%	0.2%	3.3%
Medical / dental	1.4%	0.1%	0.0%	0.2%	0.1%	0.0%	0.0%	0.1%	2.0%
School (K-12) (student only)	1.6%	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	1.9%
Other	3.0%	0.4%	0.1%	0.5%	0.2%	0.1%	0.0%	0.6%	5.0%
Total	35.3%	25.1%	15.9%	9.8%	3.6%	2.0%	1.7%	6.5%	100.0%

Table 77: Regional Distribution of Origin Place Type by Destination Place Type (2010)

Origin Trip Purpose (2010)	Destination Trip Purpose (2010)								Total
	Home	University/ College	Shopping	Social, Eat Out, etc.	Work or Work-Related	High School/ Middle School	Medical Services	Other	
Home	0.0%	10.7%	3.4%	10.4%	21.9%	3.4%	3.5%	0.0%	53.3%
University/College	7.5%	5.4%	0.2%	0.6%	0.5%	0.0%	0.1%	0.0%	14.3%
Shopping	2.0%	0.1%	0.2%	0.2%	0.1%	0.0%	0.1%	0.0%	2.6%
Social, Eat Out, Recreational, Religious, Community, Personal Business	4.2%	0.2%	0.2%	1.5%	0.5%	0.1%	0.2%	0.0%	6.9%
Work or Work-Related	13.7%	0.4%	0.2%	1.2%	1.6%	0.0%	0.2%	0.0%	17.3%
High School/ Middle School	2.4%	0.0%	0.0%	0.2%	0.1%	0.2%	0.0%	0.0%	2.9%
Medical Services	1.8%	0.0%	0.1%	0.2%	0.1%	0.0%	0.2%	0.0%	2.5%
Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Total	31.6%	16.9%	4.4%	14.3%	24.7%	3.7%	4.3%	0.1%	100.0%

5.2.2 Access/Egress Type Comparisons Distribution of Access Mode by Egress Mode

The following trend comparisons look at the Access mode by the Egress mode for the survey years 2019 and 2010. Some categories for the 2019 survey have been grouped together to better represent comparisons, such as “Walk” and “Wheelchair / Scooter”.

Walk remained the predominantly used method of transportation to get both from origin to transit, and from transit to destination, for both 2010 and 2019 surveys. Those respondents that were dropped off from their origin to transit, and were picked up from transit to their destination, decreased from 2010 (2.0%) to 2019 (0.0%).

Table 78: Distribution of Access Mode by Egress Mode (2019)

Access (2019)	Egress (2019)							Total
	Walk / Wheelchair	Get in a parked vehicle and drive alone	Get in a parked vehicle and drive / ride with someone	Be picked up by someone	Personal bike	Taxi	Other	
Walk / Wheelchair	85.9%	2.3%	0.9%	0.7%	0.1%	0.0%	0.2%	90.2%
Drove alone and parked	5.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.1%
Was dropped off by someone going someplace else	1.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.0%
Drove or rode with others and parked	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.5%
Personal Bike	0.1%	0.0%	0.0%	0.0%	0.6%	0.0%	0.0%	0.8%
Taxi	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Other	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%
Total	94.9%	2.3%	0.9%	0.8%	0.8%	0.0%	0.3%	100.0%

Table 79: Distribution of Access Mode by Egress Mode (2010)

Access (2010)	Egress (2010)						Total
	Walked/ Wheelchair	Picked up	Drive alone	Carpool	Bicycled	Taxi	
Walked/Wheelchair	83.8%	1.9%	1.2%	0.2%	0.2%	0.1%	87.5%
Dropped off	6.2%	2.0%	0.1%	0.1%	0.0%	0.0%	8.5%
Drove alone	1.8%	0.1%	0.7%	0.0%	0.0%	0.0%	2.6%
Carpool	0.3%	0.0%	0.0%	0.1%	0.0%	0.0%	0.4%
Bicycle	0.3%	0.0%	0.0%	0.0%	0.5%	0.0%	0.8%
Taxi	0.2%	0.0%	0.0%	0.0%	0.0%	0.1%	0.4%
Total	92.5%	4.1%	2.0%	0.3%	0.7%	0.3%	100.0%

5.3 Trend Comparisons by Corridor

The trend comparisons by corridor are related to the following corridors:

- Gratiot which serves riders who travel on Gratiot Avenue while being surveyed on the SMART 510, 515, 530, 560, 565, or 580 routes, or the DDOT 34 or 76 between 23 Mile Road and downtown.
- Michigan which serves riders who use the SMART 200 or DDOT 37 routes, covering Michigan Avenue between John Hix Road and downtown, and the Q Line. The Q Line, however, was not surveyed during the 2010 survey, so Michigan corridor percentages may be significantly more different than other corridors.
- Woodward which serves riders who traveled on Woodward Avenue while being surveyed on the SMART 420, 450, 465, 495, or 610 routes.

Woodward corridor riders were more likely to have zero additional transfers in 2010 (40.8%) compared to 2019 (18.5%). Woodward corridor riders were also less likely to take one additional transfer in 2010 (43.1%) compared to 2019 (62.7%).

Table 80: Total Transfers by Corridor (2019 – based on secondary unlinked weight factors vs. 2010)

Corridor	Year	Total Transfers				
		None	One	Two	Three or More	Total
GRATIOT	2019	64.9%	33.7%	1.4%	0.0%	100.0%
	2010	47.4%	38.8%	11.0%	2.8%	100.0%
MICHIGAN	2019	74.9%	24.2%	0.9%	0.0%	100.0%
	2010	41.2%	46.9%	10.0%	1.9%	100.0%
WOODWARD	2019	18.5%	62.7%	18.8%	0.0%	100.0%
	2010	40.8%	43.1%	13.3%	2.8%	100.0%
SEMCOG	2019	65.6%	32.0%	2.3%	0.1%	100.0%
	2010	52.3%	36.0%	10.0%	1.7%	100.0%

Gratiot corridor respondents were less likely in 2010 to be coming from “Work or work related” (19.8%) compared to 2019 (29.6%). The 2010 survey respondents were more likely to be coming from Home in all corridors and the region overall compared to the 2019 survey respondents.

Table 81: Origin Trip Purpose by Corridor (2019 vs. 2010)

Corridor	Year	Origin Trip Purpose							Total
		Your HOME	College or University (student only)	Shopping	Social or recreational	Work or Work related	Medical / dental	Other	
GRATIOT	2019	46.5%	0.4%	4.3%	5.5%	29.6%	0.5%	13.3%	100.0%
	2010	58.0%	4.2%	5.9%	7.8%	19.8%	2.0%	2.2%	100.0%
MICHIGAN	2019	39.0%	3.9%	6.6%	7.8%	22.3%	2.8%	17.6%	100.0%
	2010	57.5%	9.3%	1.6%	9.7%	17.8%	0.8%	3.4%	100.0%
WOODWARD	2019	46.6%	0.0%	5.8%	4.3%	34.1%	1.0%	8.2%	100.0%
	2010	56.0%	5.3%	2.7%	6.6%	20.3%	5.6%	3.5%	100.0%
SEMCOG	2019	49.3%	11.2%	3.2%	5.4%	20.3%	2.0%	8.6%	100.0%
	2010	53.3%	14.3%	2.6%	6.9%	17.3%	2.5%	3.0%	100.0%

The 2019 survey respondents had higher percentages across the corridors to use “Walk” as the method they used to get from their origin to transit compared to the 2010 survey respondents. Michigan corridor respondents were significantly more likely to use “Was dropped off by someone going someplace else” (14.9%) compared to the 2019 survey respondents (1.7%). The “Other” category was used to categorize anything that was chosen less than 2.0% of the time as the method respondents used to get from their origin to transit.

Table 82: Access by Corridor (2019 vs. 2010)

Corridor	Year	Access				
		Walk	Was dropped off by someone going someplace else	Drove alone and parked	Other	Total
GRATIOT	2019	85.9%	6.2%	2.4%	5.6%	100.0%
	2010	83.4%	12.9%	1.2%	2.5%	100.0%
MICHIGAN	2019	92.0%	1.7%	2.8%	3.5%	100.0%
	2010	83.2%	14.9%	0.6%	1.3%	100.0%
WOODWARD	2019	91.4%	4.0%	0.0%	4.6%	100.0%
	2010	86.7%	10.2%	0.6%	2.6%	100.0%
SEMCOG	2019	90.1%	1.9%	5.3%	2.7%	100.0%
	2010	87.5%	8.5%	2.6%	1.6%	100.0%

Gratiot corridor respondents and Woodward corridor respondents were much more likely to be going to “Social or recreational” in 2010 (16.6% and 17.5% respectively) compared to 2019 (4.2% and 5.4% respectively), while Michigan corridor respondents were just the opposite, where 2010 respondents were less likely to be going to “Social or recreational” (9.9%) compared to 2019 respondents (16.7%).

Table 83: Destination Trip Purpose by Corridor (2019 vs. 2010)

Corridor	Year	Destination Trip Purpose							Total
		Your HOME	College or University (student only)	Shopping	Social or recreational	Work or Work related	Medical / dental	Other	
GRATIOT	2019	41.0%	0.1%	5.4%	4.2%	29.2%	1.0%	19.1%	100.0%
	2010	32.3%	6.0%	7.2%	16.6%	27.9%	3.3%	6.6%	100.0%
MICHIGAN	2019	27.9%	4.3%	4.7%	16.7%	24.6%	1.1%	20.7%	100.0%
	2010	30.8%	8.6%	8.4%	9.9%	34.6%	4.3%	3.4%	100.0%
WOODWARD	2019	41.6%	0.0%	6.2%	5.4%	36.4%	0.0%	10.3%	100.0%
	2010	30.8%	7.7%	5.6%	17.5%	26.5%	8.7%	3.2%	100.0%
SEMCOG	2019	34.8%	16.4%	3.6%	7.5%	25.0%	2.1%	10.6%	100.0%
	2010	31.6%	16.9%	4.4%	14.3%	24.7%	4.3%	3.9%	100.0%

The largest difference between the 2010 survey and the 2019 survey in regard to how respondents travelled from transit to their destination was in the “Other” category. Respondents of the 2010 survey were more likely to use an “Other” method of transportation to get from transit to their destination compared to respondents of the 2019 survey.

Table 84: Egress by Corridor (2019 vs. 2010)

Corridor	Year	Egress			
		Walk	Get in a parked vehicle and drive alone	Other	Total
GRATIOT	2019	92.6%	1.1%	6.4%	100.0%
	2010	91.2%	1.9%	6.8%	100.0%
MICHIGAN	2019	93.7%	1.9%	4.4%	100.0%
	2010	90.0%	0.6%	9.3%	100.0%
WOODWARD	2019	95.8%	0.0%	4.2%	100.0%
	2010	92.1%	0.6%	7.2%	100.0%
SEMCOG	2019	94.9%	2.4%	2.8%	100.0%
	2010	92.5%	2.0%	5.4%	100.0%

Respondents of the 2010 survey were more likely to have their employer pay for all or part of their fare in the corridors (8.4%, 11.1%, 9.4%) compared to respondents of the 2019 survey (7.6%, 7.7%, 1.3%), except in the region overall where there was a higher percentage of 2019 survey respondents to indicate their employer paid for all or part of their fare (37.3%) compared to 2010 (10.1%).

Table 85: Employer Paid by Corridor (2019 vs. 2010)

Corridor	Year	Employer Paid		
		Yes	No	Total
GRATIOT	2019	7.6%	92.4%	100.0%
	2010	8.4%	91.6%	100.0%
MICHIGAN	2019	7.7%	92.3%	100.0%
	2010	11.1%	88.9%	100.0%
WOODWARD	2019	1.3%	98.7%	100.0%
	2010	9.4%	90.6%	100.0%
SEMCOG	2019	37.3%	62.7%	100.0%
	2010	10.1%	89.9%	100.0%

Woodward corridor residents were significantly more likely to make the trip 3-5 days a week in 2019 (70.3%) compared to 2010 (49.1%). There were no other statistically significant differences between 2010 to 2019.

Table 86: Trip Frequency by Corridor (2019 vs. 2010)

Corridor	Year	Trip Frequency						Total
		6-7 days /week	3-5 days / week	1-2 days / week	1-3 days / month	Less than 1 day a month	First time to make this trip	
GRATIOT	2019	35.4%	53.0%	8.1%	1.8%	1.0%	0.8%	100.0%
	2010	28.0%	45.2%	13.5%	6.2%	3.9%	3.2%	100.0%
MICHIGAN	2019	21.0%	52.3%	15.8%	5.3%	3.1%	2.5%	100.0%
	2010	19.7%	55.9%	10.8%	8.0%	3.6%	1.9%	100.0%
WOODWARD	2019	21.1%	70.3%	5.5%	0.8%	0.6%	1.8%	100.0%
	2010	21.9%	49.1%	12.5%	9.3%	3.5%	3.8%	100.0%
SEMCOG	2019	29.2%	57.5%	8.6%	2.4%	1.4%	0.9%	100.0%
	2010	25.2%	49.7%	11.2%	7.7%	2.9%	3.5%	100.0%

Respondents from the 2010 survey were significantly more likely to not make the trip at all if transit were not available in all three corridors and the region overall compared to 2019 survey respondents.

Table 87: Alternative Travel Mode by Corridor (2019 vs. 2010)

Corridor	Year	Alternative Travel Mode						
		Walk	Drive (own car)	Get a ride with someone	Taxi	Bike	Could not make trip	Total
GRATIOT	2019	6.88%	15.47%	41.99%	2.73%	4.89%	28.05%	100.00%
	2010	14.1%	12.2%	35.5%	11.9%	4.8%	38.0%	100.0%
MICHIGAN	2019	27.76%	22.77%	25.64%	0.98%	9.22%	13.63%	100.00%
	2010	13.3%	11.4%	34.5%	14.7%	6.0%	40.2%	100.0%
WOODWARD	2019	8.89%	8.69%	37.79%	3.85%	2.29%	38.49%	100.00%
	2010	18.3%	13.1%	36.6%	13.8%	4.7%	31.8%	100.0%
SEMCOG	2019	21.88%	15.87%	30.65%	3.36%	7.29%	20.95%	100.00%
	2010	19.4%	16.3%	30.7%	13.0%	8.4%	30.5%	100.0%

SEMCOG respondents overall had higher percentages in 2010 (53.7%) compared to 2019 (36.8%) to have a valid driver's license.

Table 88: Driver's License by Corridor (2019 vs. 2010)

Corridor	Year	Driver's License		
		Yes	No	Total
GRATIOT	2019	48.0%	52.0%	100.0%
	2010	40.8%	59.2%	100.0%
MICHIGAN	2019	32.4%	67.6%	100.0%
	2010	36.2%	63.8%	100.0%
WOODWARD	2019	51.0%	49.0%	100.0%
	2010	46.2%	53.8%	100.0%
SEMCOG	2019	36.8%	63.2%	100.0%
	2010	53.7%	46.3%	100.0%

Survey respondents in all three corridors and in the region overall were more likely to be under the age of 18 in the 2010 survey compared to the 2019 survey. Subsequently, survey respondents were more likely to be age 65 and older in 2019 compared to 2010.

Table 89: Age by Corridor (2019 vs. 2010)

Corridor	Year	Age						
		Under 18	18-25	26-34	35-54	55-64	65 and older	Total
GRATIOT	2019	2.9%	16.0%	24.8%	36.6%	14.0%	5.7%	100.0%
	2010	5.1%	24.7%	19.3%	37.6%	11.2%	2.1%	100.0%
MICHIGAN	2019	1.6%	18.4%	31.5%	32.2%	10.6%	5.7%	100.0%
	2010	7.1%	20.8%	17.6%	43.6%	10.2%	0.7%	100.0%
WOODWARD	2019	1.5%	13.3%	26.3%	44.2%	8.5%	6.3%	100.0%
	2010	4.9%	15.0%	14.5%	43.8%	18.1%	3.8%	100.0%
SEMCOG	2019	4.4%	36.4%	22.7%	24.4%	8.3%	3.7%	100.0%
	2010	5.6%	34.9%	16.2%	31.2%	10.2%	1.8%	100.0%

Survey respondents were much more likely to be employed either part- or full-time in 2019 compared to in 2010. The “Not Employed” category could include respondents that were not employed and seeking work, or not employed and not seeking work.

Table 90: Employment Status by Corridor (2019 vs. 2010)

Corridor	Year	Employment Status				
		Employed	Not Employed	Retired	Homemaker	Total
GRATIOT	2019	80.9%	12.7%	6.0%	0.4%	100.0%
	2010	59.3%	17.8%	4.6%	6.4%	100.0%
MICHIGAN	2019	78.4%	15.1%	6.3%	0.2%	100.0%
	2010	57.0%	23.8%	4.5%	8.4%	100.0%
WOODWARD	2019	86.6%	8.3%	5.2%	0.0%	100.0%
	2010	55.0%	22.8%	10.9%	5.5%	100.0%
SEMCOG	2019	71.3%	23.9%	4.6%	0.3%	100.0%
	2010	53.2%	16.3%	4.7%	4.6%	100.0%

The Gratiot, Michigan, and Woodward corridor respondents were more likely to be College/University students in 2010 (17.3%, 21.1%, & 16.8%) compared to 2019 (3.7%, 17.0%, & 5.2%), while in the region overall respondents were less likely to be College/University students in 2010 (32.4%) compared to 2019 (34.0%). The category “Not a student” was added to the 2019 survey to allow for respondents to indicate they were not a student at all if applicable.

Table 91: Student Status by Corridor (2019 vs. 2010)

Corridor	Year	Student Status				Total
		Not a student	Yes - College / University	Yes - K - 12th grade	Yes - Other type of student	
GRATIOT	2019	92.8%	3.7%	3.5%	0.0%	100.0%
	2010	-	17.3%	7.2%	5.7%	-
MICHIGAN	2019	79.9%	17.0%	1.7%	1.4%	100.0%
	2010	-	21.1%	6.1%	3.1%	-
WOODWARD	2019	93.3%	5.2%	1.5%	0.0%	100.0%
	2010	-	16.8%	5.3%	3.0%	-
SEMCOG	2019	60.7%	34.0%	4.9%	0.4%	100.0%
	2010	-	32.4%	5.8%	3.3%	-

The Gratiot corridor and Michigan corridor respondents were slightly more likely in 2019 to have three or more working vehicles in their household (6.5% and 5.3% respectively) compared to in 2010 (4.2% and 2.4% respectively). Woodward corridor respondents were much more likely to have two working vehicles in their household in 2019 (22.1%) compared to 2010 (9.4%).

Table 92: Household Vehicle by Corridor (2019 vs. 2010)

Corridor	Year	Household Vehicle				
		None (0)	One (1)	Two (2)	Three or More	Total
GRATIOT	2019	44.6%	27.6%	21.3%	6.5%	100.0%
	2010	58.2%	27.5%	10.1%	4.2%	100.0%
MICHIGAN	2019	40.5%	36.5%	17.8%	5.3%	100.0%
	2010	54.4%	31.3%	11.8%	2.4%	100.0%
WOODWARD	2019	38.5%	37.4%	22.1%	2.0%	100.0%
	2010	61.7%	26.5%	9.4%	2.4%	100.0%
SEMCOG	2019	45.9%	32.2%	15.7%	6.2%	100.0%
	2010	51.8%	29.3%	12.4%	6.4%	100.0%

On average, corridor respondents were more likely to have either one or two people in their household in 2019 compared to 2010 yet were less likely to have three or four or more people in their household in 2019 compared to 2010.

Table 93: Household Size by Corridor (2019 vs. 2010)

Corridor	Year	Household Size				Total
		One (1)	Two (2)	Three (3)	Four or More	
GRATIOT	2019	27.0%	24.4%	22.1%	26.5%	100.0%
	2010	18.6%	26.5%	20.2%	34.7%	100.0%
MICHIGAN	2019	35.8%	32.3%	14.4%	17.5%	100.0%
	2010	15.9%	22.9%	28.6%	32.6%	100.0%
WOODWARD	2019	33.5%	26.6%	22.2%	17.7%	100.0%
	2010	28.1%	26.7%	19.5%	25.7%	100.0%
SEMCOG	2019	24.4%	30.3%	18.2%	27.1%	100.0%
	2010	19.5%	26.9%	20.2%	33.4%	100.0%

Woodward corridor residents were more likely to have one, two, or three or more people in their household who were employed in 2019 compared to in 2010. All three of the corridor's respondents were more than twice as likely to have zero household workers in 2010 compared to 2019.

Table 94: Household Workers by Corridor (2019 vs. 2010)

Corridor	Year	Household Workers				
		None (0)	One (1)	Two (2)	Three or More	Total
GRATIOT	2019	10.8%	38.6%	30.8%	19.7%	100.0%
	2010	26.1%	41.6%	24.6%	7.7%	100.0%
MICHIGAN	2019	10.6%	45.9%	33.4%	10.1%	100.0%
	2010	26.3%	38.3%	23.0%	12.3%	100.0%
WOODWARD	2019	9.9%	43.6%	32.4%	14.1%	100.0%
	2010	32.9%	42.0%	17.7%	7.4%	100.0%
SEMCOG	2019	15.4%	34.4%	34.5%	15.7%	100.0%
	2010	27.6%	37.9%	25.0%	9.5%	100.0%

All three corridors and the region overall were significantly more likely to have annual household incomes of less than \$30,000 in 2010 compared to 2019 and were all more likely to have annual household incomes of more than \$60,000 in 2019 compared to 2010.

Table 95: Income by Corridor (2019 vs. 2010)

Corridor	Year	Income						Total
		Below \$30,000	\$30,000 - \$39,999	\$40,000 - \$49,999	\$50,000 - \$59,999	\$60,000 - \$74,999	\$75,000 or more	
GRATIOT	2019	52.6%	14.5%	8.5%	8.0%	8.0%	8.4%	100.0%
	2010	71.3%	11.5%	8.6%	6.4%	1.3%	0.9%	100.0%
MICHIGAN	2019	47.9%	11.4%	11.3%	10.2%	7.2%	12.0%	100.0%
	2010	66.2%	10.4%	14.0%	6.2%	2.2%	0.9%	100.0%
WOODWARD	2019	48.3%	17.0%	19.0%	5.8%	3.9%	5.9%	100.0%
	2010	69.2%	14.0%	8.6%	5.2%	1.7%	1.3%	100.0%
SEMCOG	2019	57.2%	12.0%	7.9%	5.9%	5.7%	11.4%	100.0%
	2010	66.9%	11.1%	8.0%	6.7%	3.0%	4.4%	100.0%

5.4 Comparison of SEMCOG Survey Results to Other Agencies

ETC has compiled a database of six recent onboard surveys (completed within the last 5 years) for transit agencies serving large metropolitan areas (populations greater than 250,000) in order to provide comparative benchmarks on a few select items. These benchmarks include onboard OD data results from the following agencies:

- MUNI (San Francisco, CA)
- AC Transit (Oakland, CA)
- H-GAC (Houston-Galveston, TX)
- IndyGo (Indianapolis, IN)
- LYNX (Orlando, FL)
- MTA (Nashville, TN)

Notes: 1) The percentages in the following charts are weighted in a similar manner to the SEMCOG survey results. 2) Some SEMCOG answer choices were grouped for comparative reasons.

The number of transfers indicated by respondents both before and after the route they were surveyed on was very similar to the number of transfers provided by respondents in the other large metropolitan area surveys.

Table 96: Next Transfers (SEMCOG compared to Large Metropolitan Benchmark)

Next Transfers	SEMCOG	Large Metro Benchmark
(0) None	82.1%	81.0%
(1) One	17.9%	17.1%
(2) Two	0.1%	1.8%
(3) Three	0.0%	0.1%

Table 97: Previous Transfers (SEMCOG compared to Large Metropolitan Benchmark)

Previous Transfers	SEMCOG	Large Metro Benchmark
(0) None	82.6%	82.8%
(1) One	15.8%	15.4%
(2) Two	1.5%	1.7%
(3) Three	0.1%	0.1%

SEMCOG survey respondents were most likely to be in the 18 to 34 age range compared to respondents in the other large metropolitan area surveys who were most likely to be in the 35 and older age range.

Table 98: Age (SEMCOG compared to Large Metropolitan Benchmark)

Age	SEMCOG	Large Metro Benchmark
Under 18	4.3%	5.3%
18 to 34	58.5%	42.4%
35 and Older	37.1%	52.3%

SEMOG respondents had a slightly lower number of workplace/work-related origin and destination place types when compared to respondents in the other large metropolitan area surveys.

Table 99: Origin Place Type (SEMOG compared to Large Metropolitan Benchmark)

Origin Place Type	SEMOG	Large Metro Benchmark
Home	49.0%	48.6%
Workplace/Work-related	20.6%	25.6%
Other	30.4%	25.8%

Table 100: Destination Place Type (SEMOG compared to Large Metropolitan Benchmark)

Destination Place Type	SEMOG	Large Metro Benchmark
Home	34.8%	37.4%
Workplace/Work-Related	25.1%	31.4%
Other	40.0%	31.2%

SEMOG respondents are more likely to only speak English at home compared to respondents in the other large metropolitan area surveys.

Table 101: Language Other than English Spoken at Home (SEMOG compared to Large Metropolitan Benchmark)

Speak another language at home	SEMOG	Large Metro Benchmark
Yes	11.9%	29.0%
No	88.1%	71.0%

A slightly higher number of males participated in the SEMOG survey compared to respondents in the other large metropolitan area surveys.

Table 102: Gender (SEMOG compared to Large Metropolitan Benchmark)

Gender	SEMOG	Large Metro Benchmark
Female	44.3%	48.4%
Male	55.6%	51.2%
Other	0.2%	0.4%

SEMOG respondents were more likely to have an annual household income of less than \$25,000 compared to respondents in the other large metropolitan area surveys.

Table 103: Income (SEMOG compared to Large Metropolitan Benchmark)

Income	SEMOG	Large Metro Benchmark
Less than \$25,000	48.7%	29.8%
\$25,000 - \$50,000	28.3%	32.2%
\$50,000 - \$74,999	11.7%	17.0%
\$75,000 - \$99,999	4.8%	8.1%
\$100,000 or more	6.5%	12.9%

Appendices

Appendix A: Questionnaire

SEMCOG 2018-2019 Transit On-Board Survey

Please take a few minutes to answer a few questions to help us plan for your transit needs.

All personal information will be kept strictly confidential and WILL NOT be shared or sold.

Are you a visitor to the Southeast Michigan area? ☐ Yes ☐ No

What is your HOME ADDRESS (please be specific, ex: 123 W. Main St):
(If you are visiting the SE Michigan area, please list the **hotel name** or address where you are staying)

Street Address

City

Zip Code

COMING FROM?

1. What type of place are you

COMING FROM NOW?

(the starting place for your one-way trip)

- ☐ Your usual WORKPLACE
- ☐ Work related
- ☐ Your **HOME** → Go to Question #4
- ☐ Your hotel → Go to Question #4
- ☐ Social or recreational
- ☐ Shopping
- ☐ School (K-12) (student only)
- ☐ College or University (student only)
- ☐ Airport (airline passenger only)
- ☐ Medical / dental
- ☐ Dining / eating out / coffee
- ☐ Escorting others (children, elderly)
- ☐ Personal business
- ☐ Other: _____

2. What is the NAME of the place you are coming from now?

3. What is the EXACT ADDRESS of this place? (OR Intersection if you do not know the exact address:)

City: _____ Zip: _____

4. How did you GET FROM your origin (the place in Question #1) TO THE VERY FIRST bus/train you used for this one-way trip?

- ☐ Walk ☐ Wheelchair / scooter
- ☐ Personal Bike ☐ Bike share
- ☐ E-scooter (e.g. Lime, Bird, etc.)
- ☐ Was dropped off by someone going someplace else (answer 4a)
- ☐ Drove alone and parked (answer 4a)
- ☐ Drove or rode with others and parked (answer 4a)
- ☐ Car share (e.g. Zipcar, etc.) (answer 4a)
- ☐ Uber, Lyft, etc.
- ☐ Work Shuttle (e.g. May Mobility)
- ☐ Taxi ☐ Other _____

4a. Where did you board the first bus/train you used for this one-way trip (Nearest intersection / Park & Ride lot / Transit Center / Station Name):

5. Where did you get ON this bus/train?

Please provide the nearest intersection / Transit Center / Station Name / Park & Ride lot:

GOING TO?

6. What type of place are you

GOING TO NOW?

(the destination for your one-way trip)

- ☐ Your usual WORKPLACE
- ☐ Work related
- ☐ Your **HOME** → Go to Question #9
- ☐ Your hotel → Go to Question #9
- ☐ Social or recreational
- ☐ Shopping
- ☐ School (K-12) (student only)
- ☐ College or University (student only)
- ☐ Airport (airline passenger only)
- ☐ Medical / dental
- ☐ Dining / eating out / coffee
- ☐ Escorting others (children, elderly)
- ☐ Personal business
- ☐ Other: _____

7. What is the NAME of the place you are going to now?

8. What is the EXACT ADDRESS of this place? (OR Intersection if you do not know the exact address:)

City: _____ Zip: _____

9. How will you GET TO your destination (listed in Question #6) after you exit the LAST bus/train you will use for this one-way trip?

- ☐ Walk ☐ Wheelchair / scooter
- ☐ Personal Bike ☐ Bike share
- ☐ E-scooter (e.g. Lime, Bird, etc.)
- ☐ Be picked up by someone (answer 9a)
- ☐ Get in a parked vehicle and drive alone (answer 9a)
- ☐ Get in a parked vehicle and drive/ride with someone (answer 9a)
- ☐ Car share (e.g. Zipcar, etc.) (answer 9a)
- ☐ Uber, Lyft, etc.
- ☐ Work Shuttle (e.g. May Mobility)
- ☐ Taxi ☐ Other _____

9a. Where will you get off the last bus/train you are using for this one-way trip (Nearest intersection / Park & Ride lot / Transit Center / Station Name):

10. Where will you EXIT this bus/train? Please provide the nearest intersection / Transit Center / Station Name / Park & Ride lot:

11a. Did you transfer FROM another bus BEFORE getting on this bus/train?

☐ Yes ☐ No

11b. Will you transfer TO another bus AFTER getting off this bus/train?

☐ Yes ☐ No

11c. Please list the **SYSTEM / ROUTES** in the order you use them for this one-way trip

START → → → → → END

1st Route

2nd Route

3rd Route

4th Route

Continue

OTHER INFORMATION ABOUT THIS TRIP

12. What time did you BOARD this bus/rail? _____ : _____ am / pm (circle one)
13. Will you (or did you) make this same trip in exactly the opposite direction today? ☐ No
☐ Yes - At what time did / will you leave for this trip in the opposite direction? _____:_____ am/pm (circle one)
☐ Yes - I will make a return trip but will not use the bus/rail. How will you return?
☐ Pick up/carpool/drop off ☐ Uber, Lyft, Taxi ☐ Other
14. What fare payment methods did you use for this one-way trip? (select all that apply)
- Free:
15. What type of fare was this? ☐ Regular
Discount Fare:
16. Did your employer or another organization pay for your fare? ☐ No ☐ Yes, entire fare by employer
☐ Yes, partial fare by employer ☐ Yes, entire fare by non-employer ☐ Yes, partial fare by non-employer
17. How would you make this trip if the bus/rail was not available?
☐ Walk ☐ Uber, Lyft, etc. ☐ Taxi ☐ Could not make trip
☐ Drive (own car) ☐ Get a ride with someone ☐ Bike ☐ Other (specify) _____
18. On average, how many days a week do you use public transportation?
☐ 6-7 days / week ☐ 3-5 days / week ☐ 1-2 days / week
☐ 1-3 days / month ☐ Less than 1 day a month ☐ First time to make this trip
19. Do you have a Smartphone? ☐ Yes ☐ No
20. Do you have a Credit or Debit card? ☐ Yes ☐ No
21. Do you use any of the following services in the Southeast Michigan area? (check all that apply)
☐ Uber, Lyft, etc. ☐ Bike Share ☐ Car Share (e.g. Zipcar, etc.) ☐ E-scooter (Lime, Bird, etc.)
☐ Other _____ ☐ None of these

ABOUT YOU AND YOUR HOUSEHOLD

22. How many working vehicles (cars, trucks, or motorcycles) are available to your household? _____ vehicles
22a. [If Q23 is more than NONE] Could you have used one of these vehicles for this trip? ☐ Yes ☐ No
24. Including YOU, how many people live in your household? _____ people
25. Including YOU, how many people (over age 15) in your household are employed full or part-time? __# people
26. What is your employment status? (check the one response that BEST describes you)
☐ Employed full-time ☐ Not currently employed, but seeking work ☐ Retired
☐ Employed part-time ☐ Not currently employed, and not seeking work ☐ Homemaker
27. What is your student status? (check the one response that BEST describes you)
☐ Not a student ☐ Yes – Full time College / University ☐ Yes – Part time College / University
☐ Yes – K - 12th grade ☐ Yes, other type of student
28. Do you have a valid driver’s license? ☐ Yes ☐ No
29. Do you have an ADA certified physical disability or other disability that limits your mobility? ☐ Yes ☐ No
30. What is your AGE?
☐ Under 6 ☐ 6-12 ☐ 13-15 ☐ 16-17 ☐ 18-25 ☐ 26-34 ☐ 35-54 ☐ 55-64 ☐ 65 and older
31. What is your race / ethnicity? (check all that apply)
☐ American Indian/Alaska Native ☐ Asian ☐ Black/African American ☐ Hispanic/Latino
☐ Middle Eastern ☐ White/Caucasian ☐ Native Hawaiian/Pacific Islander ☐ Other: _____
32. What is your gender? ☐ Male ☐ Female ☐ Other _____
33. Do you speak a language other than English at home? ☐ No ☐ Yes - Which language? _____
33a. [If #33 is Yes] How well do you speak English? ☐ Very Well ☐ Well ☐ Less than well ☐ Not at all
34. Which of the following BEST describes your TOTAL ANNUAL HOUSEHOLD INCOME in 2017 before taxes?
☐ Below \$10,000 ☐ \$25,000 - \$29,999 ☐ \$60,000 - \$74,999
☐ \$10,000-\$14,999 ☐ \$30,000 - \$39,999 ☐ \$75,000 - \$99,999
☐ \$15,000-\$19,999 ☐ \$40,000 - \$49,999 ☐ \$100,000 or more
☐ \$20,000-\$24,999 ☐ \$50,000 - \$59,999
35. Do you regularly use public transit on the weekend? ☐ Yes ☐ No
35a. [If #35 is Yes] Do you make the exact same trip on the weekend? ☐ Yes ☐ No
35b. [If #35a is Yes] Do you use the exact same routes to make this trip on the weekend? ☐ Yes ☐ No

REGISTER TO WIN A \$100 GIFT CARD
People who submit an accurately completed survey will be entered in a random drawing for one of five \$100 gift cards. You must provide your home address at the beginning of the survey and answer all questions to be eligible.
Your Name: _____
Phone Number: (_____) _____

Thank you for your help!

Appendix B: Secondary Expansion and Assignment Report

South East Michigan Council of Governments 2019 Regional Transit On-Board Survey SECONDARY EXPANSION TECHNICAL MEMORANDUM

Draft

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For:

ETC Institute and

The Southeastern Michigan Council of Governments

Acronyms and Initialisms

Acronym / Initialism	Description
AAATA	Ann Arbor Area Transportation Authority
AM	Ante Meridiem (before morning)
BWT	Blue Water Area Transit
CTG	Connetics Transportation Group, Inc.
DDOT	Detroit Department of Transportation
DPM	Detroit People Mover
EMU	East Michigan University
ETC	ETC Institute
FLT	Mass Transportation Authority (Flint, MI)
K-12	Grades kindergarten through 12 th
SEMCOG	South East Michigan Council of Governments
O/D	Origin/Destination
P&R	Park & ride or park & ride facility
PM	Post Meridiem (after noon)
QLN	Q-Line
SMD	3-letter abbreviation for SMART (Suburban Mobility Authority for Regional Transportation) Mobility Development [same as SMART]
SMART	Suburban Mobility Authority for Regional Transportation
TAZ	Traffic Analysis Zone
TLF	Trip Length Frequency
TOD	Time of Day
UMT	University of Michigan Transit

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Executive Summary

This report summarizes the process and high-level results from performing a secondary expansion of the AAATA and DDOT survey records from the 2019 SEMCOG transit on-board survey.

Primary survey expansion occurs shortly after fieldwork. A weight is calculated for each record so that the sum of the weights across all records equals the systemwide ridership. In a similar way, primary expansion weights can be calculated for each route, time period and direction.

Secondary expansion is the process of re-weighting the primary survey weights records by selected categories to correct for natural or unavoidable anomalies in survey sampling. where independent counts by trip or rider types are available, secondary expansions provide results more accurate than the primary expansion. Rider and trip types can include elementary school trips, university student trips, park-ride trips, bicycle access trips and other classifications where count data is available.

Independent count data was provided by AAATA and DDOT for the purpose of conducting a secondary expansion. Both datasets provided enough detail to re-weight the survey records for K-12 (both AAATA and DDOT) and university students (AAATA only). The report provides details on the new columns to the survey database that reflect the adjusted weights. Information about county to county and district to district transit trip tables, developed directly from the survey data, is also provided.

1 Introduction

The South East Michigan Council of Governments (SEMCOG) contracted ETC in 2018 to conduct a systemwide survey of transit services within their service region. ETC conducted the survey fieldwork in 2018-2019 and performed a primary expansion of the sample. Connetics Transportation Group, Inc. (CTG) was tasked with performing a secondary expansion and review of the survey datasets.

Sample expansion is the process of weighting the sample to match observed counts, as expressed in the following formula:

$$Factor_{xyz} = \frac{Count_{xyz}}{Sample_{xyz}}$$

Where $Count_{xyz}$ is the observed count for attributes x , y and z (an attribute could be a route, direction, time of day period, etc.), $Sample_{xyz}$ is the number of samples (records) collected given the attributes x , y and z , and the $Factor_{xyz}$ is the computed factor (weight or expansion factor) applied to the samples with attributes x , y and z .

During survey fieldwork, samples are collected in a manner that reduce the likelihood of response bias. Response bias occurs when samples are collected at different participation rates. While great strides have been made by ETC in reducing response bias, it cannot be eliminated completely due to logistical constraints, rider response (e.g., some riders systematically prefer not to answer surveys), random chance (e.g., some riders who would respond to the survey are sick during the survey fieldwork), and other reasons.

ETC performed a primary expansion of the sample across four dimensions: route, time of day, direction, and passenger flow (segment to segment, where a segment is a grouping of contiguous stops). These means that factors were calculated for each route, each of the four time periods (AM peak, midday, PM peak, and evening), each direction, and all possible segment to segment flow combinations.

A secondary expansion builds upon the primary expansion by re-expanding the sample across additional dimensions such as students, mode of access/egress, park-ride trips etc. This allows the survey dataset to closely represent known travel patterns. The secondary expansion corrects for differences in response rates across markets that are not as easily addressed. CTG utilizes three methods, described below, as part of the secondary expansion process. The preferred method can depend on:

- (1) The desired breakdown of rider and/or trip types that the survey records should match
- (2) The extent of response bias in the collected dataset, and/or
- (3) The ancillary data available to the rider/trip types.

A different method can be applied to each transit system or transit route, allowing the secondary expansion to maximize utilization of the available data. The three methods are described below.

Method #1: Standard Expansion Process (SP). This method follows the traditional expansion equation by dividing counts by the number of records collected. A common example is university students, who generally participate in surveys at a higher rate than the general population. Consequently, a traditional expansion of the survey records would typically over-estimate university student ridership. In the Table 1.1, a route with 800 boardings per average weekday is surveyed. Assuming, the route has counts by student/non-student via electronic fare card data, Method #1 can correct the over-sampling of university students and report the right number of trips by rider type.

Table 1.1 Example explaining Standard Expansion Process (Method #1)

	Survey Records in Collected Dataset	Primary Expansion Factor	Estimated Boardings (from primary Expansion)	Fare Card Counts	Expansion Factors (from Method #1)	Estimated Boardings (from Method #1)
University Students	50	10.0 (= 800 / 80)	500	250	5.0 (=250/50)	250
All Other Rider Types	30		300	550	18.3 (=550/30)	550
Total	80		800	800		800

The method is straightforward and easy to apply. However, it assumes that there are no rider/trip type gaps in the collected dataset; that is, is a rider type was not surveyed at all or was missed due to day-to-day variations in travel patterns. Also, these computations can become unwieldy with more than 3-4 rider/trip types beyond those used in the primary expansion.

In some cases, the available auxiliary datasets (like fare card counts) are from different time period than the data used during primary expansion. So, we use the auxiliary datasets to establish the share of different rider categories, while maintaining total ridership unchanged. In such a case, the ridership by category (same as fare card counts in Table 1.1) is obtained by multiplying total ridership with the observed shares by category type from the auxiliary dataset. Figure 1.1 summarizes this process of expansion.

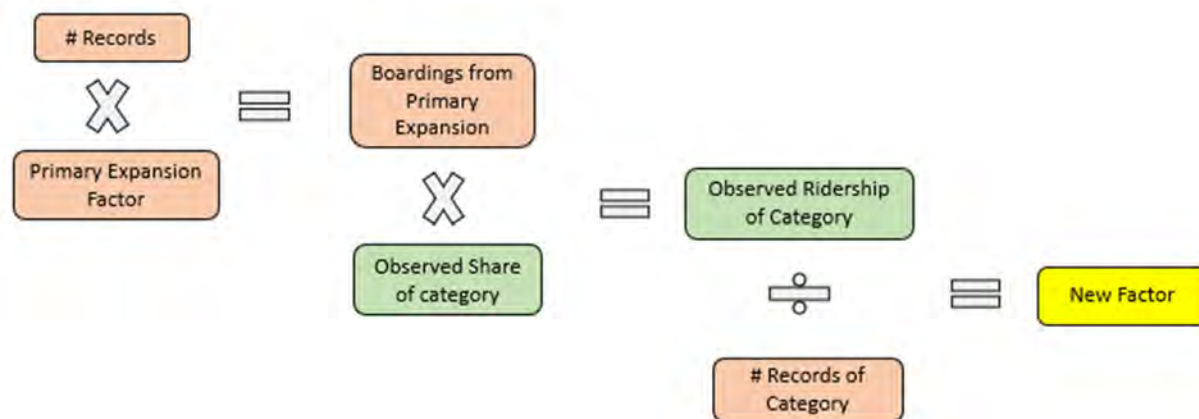


Figure 1.1 Method #1 Workflow

Method #2: Synthetic Survey Record Enhancement (SSRE). This method builds upon Method #1 by identifying gaps in the collected data – where rider/type trips are absent in the collected dataset – and resolving those gaps using similar records from the collected dataset and modifying their data fields that are relevant to the data gap. For instance, assume that four types of rider counts are collected at a major transfer stop (see Table 1.2), but the fourth rider type is missing from the collected dataset (row 4, column 2). The primary expansion overlooks this data gap, while Method #1 is unable to compute a factor.

Table 1.2 Example explaining Synthetic Survey Record Enhancement (Method #2)

	Count	Survey Records in Collected Dataset	Primary Expansion Factor	Method #1 Expansion Factor	Method #2 Expansion Factor	Method #2 Total Survey Records
Rider Type 1	100	10	10.0 (= 200 / 20)	10.0	10.0	10
Rider Type 2	50	5		10.0	10.0	5
Rider Type 3	25	5		5.0	5.0	5
Rider Type 4	25	0		Cannot compute (= 25 / 0)	2.5 (= 25 / 10 synthetic records from other rider types)	10
Total	200	20				30

Method #2 randomly samples the collected records that are as similar as possible to the data gap. In this case, it randomly selects 10 of the 20 records (at the same transfer stop) already collected, and modifies the survey number and rider type data fields – keeping all other information identical – to reflect rider type 4’s characteristics. (The modified records are called ‘synthetic’ records since they are synthesized from similar records.) This method assumes that riders who travel with type 4 riders are likely to have similar trip patterns and characteristics. The result is that Rider Type 4 riders are accounting for in the secondary expansion and the dataset now includes 30 records, 20 from the originally collected dataset and 10 synthetized records for rider type 4.

Method #3: Multivariate Error Minimization (MEM). This method is best applied when synthetic records are not desirable, but the collected dataset still needs – as best it can – reflect a wider array of rider and trip types. Method #3 uses an optimization approach to minimize error by considering multiple rider and trip types simultaneously, yielding a single error-minimized expansion factor for each survey record. Priority can be given to selected rider/trip types over others.

The error optimization algorithm uses the primary expansion factors, the priority settings, and the counts for each rider/trip type. The procedure is flexible and can include multiple priority settings to help determine which setting minimizes the overall error.

A summary of all three methods is shown in the following table. Different methods can be applied to individual routes, depending on the available data, the diversity of rider/type types on the route, and the desired approach to handle data gaps.

	Standard Process (SP)	Synthetic Survey Record Enhancement (SSRE)	Multivariate Error Minimization (MEM)
Available counts/data for rider/trip types (in addition to types used in primary expansion)	1-2 types	3-5 types	5+ Types
Resulting error for all rider/trips types (weighted records)	0%	0%	>0%
Survey Records in Final Dataset	Collected records only	Collected + synthetic records	Collected records only
Addresses rider/trip types missing in primary expansion (data gaps)	X	√	X
Can be applied to specific routes	√	√	√

For the SEMCOG Regional Transit On-board Survey, CTG was provided with various datasets apart from the primary expansion of OD survey, which are summarized in the following table.

Table 1.3 Summary of Various Datasets Provided for Secondary Expansion

Agency	Route Level Ridership	APC Dataset	P&R Data	Student Ridership Data
AAATA	February - April 2019	Yes – but not used	--	11 th - 15 th March, 2019

BWT	February - April 2019	--	--	--
DDOT	February - April 2019	Yes – but not used	--	22 nd - 26 th April, 2019
DPM	March - April 2019	--	--	--
LET	February - April 2019	--	--	--
QLN	February - April 2019	Yes – but not used	--	--
SMART	--	Yes – but not used	Yes – incomplete vehicle counts	--

In the datasets provided to CTG, “Route Level Ridership” and “APC” information are already used in the primary expansion. So, they cannot be used for secondary expansion as it would not add any additional information to the expansion. The P&R and student ridership data can be used for secondary expansion are discussed below.

1. The P&R dataset provides some ridership information at the park and ride facility, but it does not include a count of parked vehicles. This ambiguity of the ridership information and the absence of parked vehicles makes the data to unusable for secondary expansion.
2. The student ridership data reflects a weeks’ worth of ridership information that does not include holidays. This ridership information was processed and used in the secondary expansion.

This reminder of the report describes the secondary expansion of SEMCOG On-Board Survey. Chapter 2 describes secondary expansion methodology adopted for AAATA and Chapter 3 describes the secondary expansion for DDOT.

2 Secondary Expansion of AAATA

This chapter describes the secondary survey expansion methodology used for the AAATA system. The adopted expansion methodology is identical to Method #1 discussed in Chapter 1. The inputs for the secondary expansion include primary expansion of the SEMCOG OD survey, and ridership of AAATA by fare category and route. The fare categories that represent K-12 students, college/university students and non-discounted regular trips were identified with the help of descriptions obtained from AAATA.

The methodology adopted for secondary expansion is presented in the section 2.1, whereas the expansion process and the cross check are provided in section 2.2.

2.1 Methodology

The expansion process (Method #1 discussed in Chapter 1) is carried out for both K-12 and university student categories. The AAATA trips are expanded to K-12 and college student shares by route, direction and TOD. The adjusted factors are estimated by the following formula:

$$Adjusted\ Factor_{RTDC} = \frac{\sum Initial\ Factor_{RTD}}{Number\ of\ OD\ records_{RTDC}} \times \frac{Observed\ Share_{RC}}{OD\ Share_{RC}}$$

Where '**R**' is the route, '**T**' is TOD, '**D**' is direction, '**C**' is category of the individual (K-12, student or other), '**Adjusted Factor**' is the revised expansion factor, '**Initial Factor**' is the original expansion factor, '**Observed Share**' is the share of observed ridership from auxiliary dataset and '**Number of OD records**' is the number of records with '**R**', '**T**', '**D**', '**C**' combination in the OD dataset. The equation adjusts the factors so that the total share of each category of riders equals observed share of that category in the ridership dataset.

Table 2.1 summarizes the step-by-step process of secondary expansion with an example.

Table 2.1 Example of Secondary Expansion Methodology Adopted to AAATA

For each Route, Direction and TOD	K-12	College Student	Others	Total
Observed Share from Auxiliary Ridership data	10%	30%	60%	100%
Share from Primary OD Expansion	9%	33%	58%	100%
Estimated Ridership from Primary OD Expansion	90	330	580	1,000

For each Route, Direction and TOD	K-12	College Student	Others	Total
Number of OD Records	9	40	50	99
Primary Expansion Factors	10.00	8.25	11.60	--
Adjusted Ridership	1000 * 10% =100	1000 * 30% =300	1000 * 60% =600	100+300+600 = 1,000
Adjusted Factor (Adjusted ridership/ number of OD records)	100/9 = 11.11	300/40 = 7.5	600/50 = 12	--

2.2 Process

The secondary expansion is based on the shares of K-12 and college student categories observed from auxiliary ridership data by route from the AAATA system. The trips in the OD survey (from primary expansion) are adjusted to match these shares as explained in

Table 2.1.

Based on the auxiliary ridership information received from AAATA, the observed shares of K-12 and college student riders by route are presented in Table 2.2.

Table 2.2 Observed Shares of Ridership from AAATA Auxiliary Ridership Data

Route	Ridership				Share		
	K-12	College	Other	Total	K-12	College	Other
3	122	402	630	1,154	11%	35%	55%
4	189	2,141	2,122	4,453	4%	48%	48%
5	170	909	1,354	2,433	7%	37%	56%
6	78	696	1,296	2,070	4%	34%	63%
21	8	12	36	55	14%	21%	65%
22	59	570	333	962	6%	59%	35%
23	14	2,053	448	2,515	1%	82%	18%
24	140	226	707	1,073	13%	21%	66%
25	31	115	169	316	10%	37%	54%
26	21	53	77	151	14%	35%	51%
27	19	183	238	439	4%	42%	54%
28	25	239	346	609	4%	39%	57%

Route	Ridership				Share		
	K-12	College	Other	Total	K-12	College	Other
29	15	120	125	261	6%	46%	48%
30	29	135	399	564	5%	24%	71%
31	10	119	228	357	3%	33%	64%
32	117	423	464	1,004	12%	42%	46%
33	18	56	75	148	12%	38%	50%
41	86	0	424	509	17%	0%	83%
42	66	36	432	534	12%	7%	81%
43	25	16	247	288	9%	6%	86%
44	76	24	334	434	18%	5%	77%
45	26	34	261	321	8%	11%	81%
46	53	30	274	357	15%	8%	77%
47	43	9	193	245	18%	4%	79%
60	3	202	25	230	1%	88%	11%
61	-	1	8	10	0%	13%	88%
62	1	1,326	99	1,425	0%	93%	7%
63	1	78	10	89	1%	87%	12%
64	49	172	19	240	21%	72%	8%
65	13	447	142	602	2%	74%	24%
66	138	344	259	742	19%	46%	35%
67	8	4	16	27	28%	13%	59%
68	1	2	29	32	4%	7%	89%
81	-	17	4	21	0%	83%	17%
91	-	-	50	50	0%	0%	100%
92	-	-	51	51	0%	0%	100%
Unknown	2	52	32	86	3%	59%	38%
Total	1,657	11,245	11,956	24,858	7%	45%	48%

Each route, direction, time of day, and rider category were expanded with the methodology discussed in section 2.1. A sample of expanded factors is as presented below.

Table 2.3 Sample of Adjusted Factors for AAATA

Route	TOD	Direction	Adjusted Factors for K-12 Trips	Adjusted Factors for College Student Trips	Adjusted Factors for Other Trips
3	AM Peak	0	10.6243	17.4580	6.0860
3	AM Peak	1	8.1896	13.4572	7.0369
3	Evening	0	7.0269	4.6186	7.2454
3	Midday	0	28.2148	7.1327	12.1217
3	Midday	1	9.4085	9.2761	13.2288
3	PM Peak	0	17.0331	6.2198	14.6357
4	AM Peak	0	9.0531	9.3051	3.2725
4	AM Peak	1	33.7880	20.1060	8.8052
4	Evening	0	17.2574	17.7378	9.6692
4	Evening	1	5.0290	5.1690	3.3149
4	Midday	1	12.3427	10.2109	4.6104
4	PM Peak	0	11.6883	22.0250	10.9148
4	PM Peak	1	3.1470	17.7903	7.3468
5	AM Peak	1	5.0416	17.1423	15.5951

A cross-check confirmed the consistency of the route-level data before and after the secondary expansion. The secondary expansion should not affect the total ridership at the route level. Table 2.4 presents comparison of ridership before and after secondary expansion at route level. From the comparison, it can be observed that the shares of K-12 and college students are adjusted but the total ridership at route level remains unchanged.

It should be noted there are two situations where it was not possible to apply the secondary expansion. One, Route 41 in AAATA transit system is dedicated line serving East Michigan University (EMU). All the student rides on this route are provided fare-free and tabulated in a way that combined university student trips with other fare-free rider types. This made it impossible to specify the number of student trips on this route.

Two, the OD survey data is sparse on some routes for some combinations of direction, TOD and student category. In these situations, the number of OD records is either very small or zero. The expansion process was not used in these situations.

Table 2.4 Comparison of Ridership Before and After Secondary Expansion of AAATA

Route	K-12 Trips		College Student Trips		Other Trips		Total		K-12 Trip Share		College Trip Share	
	Before Expansion	After Expansion	Before Expansion	After Expansion	Before Expansion	After Expansion	Before Expansion	After Expansion	Before Expansion	After Expansion	Before Expansion	After Expansion
3	117	131	480	411	600	654	1,197	1,197	10%	11%	40%	34%
4	107	153	1,627	2,027	2,571	2,125	4,305	4,305	3%	4%	38%	47%
5	205	154	593	843	1,504	1,304	2,302	2,302	9%	7%	26%	37%
6	57	45	553	627	1,538	1,476	2,148	2,148	3%	2%	26%	29%
21	12	6	58	45	42	60	112	112	10%	6%	52%	40%
22	37	27	456	504	463	425	957	957	4%	3%	48%	53%
23	40	6	1,221	1,643	1,308	920	2,569	2,569	2%	0%	48%	64%
24	103	121	362	250	620	714	1,085	1,085	10%	11%	33%	23%
25	39	21	93	124	189	175	320	320	12%	6%	29%	39%
26	57	39	10	23	129	135	197	197	29%	20%	5%	12%
27	8	6	117	139	304	284	428	428	2%	1%	27%	32%
28	19	16	153	210	484	429	655	655	3%	2%	23%	32%
29	30	26	62	68	223	222	316	316	10%	8%	20%	21%
30	30	6	88	96	468	484	586	586	5%	1%	15%	16%
31	-	-	52	52	344	344	395	395	0%	0%	13%	13%
32	147	121	115	446	799	493	1,060	1,060	14%	11%	11%	42%
33	36	36	39	39	75	75	151	151	24%	24%	26%	26%
42	74	69	63	32	405	441	542	542	14%	13%	12%	6%
43	17	17	16	16	257	257	290	290	6%	6%	6%	6%

Route	K-12 Trips		College Student Trips		Other Trips		Total		K-12 Trip Share		College Trip Share	
	Before Expansion	After Expansion	Before Expansion	After Expansion	Before Expansion	After Expansion	Before Expansion	After Expansion	Before Expansion	After Expansion	Before Expansion	After Expansion
44	68	74	38	19	352	364	457	457	15%	16%	8%	4%
45	3	5	73	73	305	301	380	380	1%	1%	19%	19%
46	95	75	95	27	203	291	393	393	24%	19%	24%	7%
47	49	52	14	5	247	254	310	310	16%	17%	5%	2%
60	13	4	46	121	185	119	244	244	5%	2%	19%	50%
61	-	-	-	-	11	11	11	11	0%	0%	0%	0%
62	-	-	785	785	370	370	1,155	1,155	0%	0%	68%	68%
63	-	-	67	67	31	31	98	98	0%	0%	69%	69%
64	42	39	36	49	129	118	207	207	20%	19%	18%	24%
65	20	3	301	355	278	242	600	600	3%	1%	50%	59%
66	91	85	271	325	390	342	752	752	12%	11%	36%	43%
67	-	-	-	-	24	24	24	24	0%	0%	0%	0%
68	-	-	29	29	30	30	60	60	0%	0%	49%	49%
81	-	-	-	-	21	21	21	21	0%	0%	0%	0%
91	-	-	-	-	39	39	39	39	0%	0%	0%	0%
92	-	-	6	-	43	49	49	49	0%	0%	13%	0%
Total	1,546	1,367	8,329	9,734	15,109	13,883	24,984	24,984	6%	6%	33%	39%

3 Secondary Expansion of DDOT

This chapter describes the secondary survey expansion methodology used for the DDOT system. The adopted expansion methodology is identical to Method #1 discussed in Chapter 1. The inputs for the secondary expansion include primary expansion of the SEMCOG OD survey, and DDOT ridership by fare category and route. The fare categories that represent K-12 students and other trips were identified with the help of descriptions obtained from DDOT.

The methodology adopted for secondary expansion is presented in section 3.1, whereas the expansion process and the cross check are provided in section 3.2.

3.1 Methodology

The expansion process (Method #1 discussed in Chapter 1) is carried out for K-12 students. The DDOT trips are expanded to K-12 student shares by route, direction and TOD. The adjusted factors are estimated by the following formula:

$$New\ Factor_{RTDC} = \frac{\sum_{RTDC} Old\ factor_{RTDC}}{Number\ of\ Records_{RTDC}} \times \frac{Observed\ Share_{RC}}{OD\ Share_{RC}}$$

Where '*R*' is the route, '*T*' is time of day, '*D*' is direction, '*C*' is category of the individual (K-12, or other), '*New factor*' is the revised expansion factor, '*Old Factor*' is the original expansion factor, '*Observed Share*' is the observed share in ridership dataset, '*OD Share*' is the estimated share from OD Survey dataset and '*Number of OD records*' is the number of records.

3.2 Process

The secondary expansion is based on the shares of K-12 and college student categories from auxiliary ridership data by route from the AAATA system. The trips in the OD survey (from primary expansion) are adjusted to match these shares as explained in Table 2.1.

The secondary expansion is based on the shares of K-12 students from auxiliary ridership data by route. The trips in the OD survey (from the primary expansion) are adjusted to match these shares. The observed shares by route on DDOT are presented in Table 3.1.

Table 3.1 Shares of K-12 Students in DDOT System from Auxiliary Ridership Data

Route	Ridership						Share	
	Not student	Full time Student	K-12	Part-time Student	Other	Total	K-12	Non-K-12
1	1,032	24	36	6	76	1,175	3%	97%
2	1,811	78	116	17	89	2,112	5%	95%
3	4,633	78	288	89	518	5,606	5%	95%
4	5,120	260	289	17	137	5,822	5%	95%
5	2,148	17	113	-	369	2,646	4%	96%
6	3,010	89	220	33	167	3,519	6%	94%

Route	Ridership						Share	
	Not student	Full time Student	K-12	Part-time Student	Other	Total	K-12	Non-K-12
7	4,670	112	208	31	664	5,685	4%	96%
8	2,704	189	170	25	290	3,378	5%	95%
9	2,142	88	195	15	228	2,668	7%	93%
10	3,268	159	163	23	276	3,889	4%	96%
11	257	-	-	33	11	301	0%	100%
12	440	23	13	-	70	546	2%	98%
13	563	22	23	19	35	662	3%	97%
15	989	9	12	1	73	1,085	1%	99%
16	3,936	268	268	13	375	4,859	6%	94%
17	4,177	126	266	3	321	4,893	5%	95%
18	1,234	23	34	4	172	1,467	2%	98%
19	687	34	2	-	13	736	0%	100%
23	1,003	11	68	58	15	1,154	6%	94%
27	1,512	83	73	33	120	1,821	4%	96%
29	527	59	22	-	60	668	3%	97%
30	584	27	10	-	41	662	2%	98%
31	1,751	50	81	16	136	2,034	4%	96%
32	1,816	91	33	10	110	2,059	2%	98%
38	1,446	18	-	4	150	1,619	0%	100%
39	277	12	2	12	43	345	1%	99%
40	251	6	13	-	20	289	4%	96%
41	563	10	68	-	90	731	9%	91%
42	156	42	31	-	8	237	13%	87%
43	627	-	10	10	53	701	1%	99%
46	170	7	23	-	15	215	11%	89%
47	109	14	1	-	96	220	0%	100%
52	512	3	53	-	57	625	8%	92%
54	497	9	22	8	59	594	4%	96%
60	1,178	74	102	8	106	1,469	7%	93%

Route	Ridership						Share	
	Not student	Full time Student	K-12	Part-time Student	Other	Total	K-12	Non-K-12
67	764	65	48	5	134	1,016	5%	95%
68	282	48	8	-	19	357	2%	98%
80	68	-	-	-	12	81	0%	100%
89	30	-	11	-	7	49	22%	78%
92	124	-	-	-	15	139	0%	100%
95	44	-	-	-	-	44	0%	100%
96	76	-	-	-	19	95	0%	100%
Total	57,188	2,228	3,095	493	5,269	68,273	5%	95%

Each route, direction, time of day, and rider category were expanded with the methodology discussed in section 3.1. A sample of expanded factors is as presented below.

Table 3.2 Sample of Adjusted Factors for DDOT System

Route	Direction	TOD	Adjusted K-12 Factor	Adjusted non-K-12 Factor
1	0	PM Peak	8.0208	9.7389
1	0	Midday	0.0000	8.4043
1	0	Evening	11.9767	12.9913
1	0	AM Peak	6.4566	10.9715
1	1	PM Peak	8.0208	9.7389
1	1	Midday	0.0000	8.4043
1	1	Evening	11.9767	12.9913
1	1	AM Peak	6.4566	10.9715
2	0	PM Peak	10.2896	8.7392
2	0	Midday	9.8535	8.4569
2	0	Evening	13.1264	9.7305
2	0	AM Peak	15.0984	14.9673
2	1	PM Peak	10.2896	8.7392
2	1	Midday	9.8535	8.4569
2	1	Evening	13.1264	9.7305

Route	Direction	TOD	Adjusted K-12 Factor	Adjusted non-K-12 Factor
2	1	AM Peak	15.0984	14.9673

A cross-check confirmed the consistency of the route-level data before and after the secondary expansion. The secondary expansion should not affect the total ridership at the route level. Table 3.3Table 2.4 presents comparison of ridership before and after secondary expansion at the route level. From the comparison, it can be observed that the shares of K-12 students are adjusted but the total ridership at route level remains unchanged.

It was not possible to apply the secondary expansion for some route, TOD, direction and student category combinations due to sparse records. In these situations, the number of OD records is either very small or zero.

Table 3.3 Comparison of Ridership Before and After Expansion for DDOT system

Route	K12 Trips		Non-K-12 Trips		Total Trips		K12 Trip Share	
	Before Expansion	After Expansion	Before Expansion	After Expansion	Before Expansion	After Expansion	Before Expansion	After Expansion
1	153	138	2,197	2,212	2,350	2,350	7%	6%
2	179	204	4,045	4,020	4,223	4,223	4%	6%
3	1,036	1,012	10,176	10,199	11,212	11,212	9%	6%
4	274	529	11,370	11,115	11,644	11,644	2%	6%
5	737	568	4,555	4,725	5,293	5,293	14%	6%
6	334	317	6,703	6,721	7,037	7,037	5%	6%
7	1,327	1,611	10,042	9,758	11,369	11,369	12%	6%
8	579	794	6,177	5,962	6,756	6,756	9%	6%
9	457	362	4,880	4,975	5,336	5,336	9%	6%
10	552	455	7,226	7,323	7,778	7,778	7%	6%
11	22	36	580	566	602	602	4%	6%
12	140	101	952	991	1,092	1,092	13%	6%
13	70	198	1,254	1,126	1,324	1,324	5%	6%
15	147	214	2,023	1,956	2,170	2,170	7%	6%
16	750	1,001	8,968	8,717	9,718	9,718	8%	6%
17	642	686	9,144	9,100	9,786	9,786	7%	6%
18	344	322	2,590	2,612	2,934	2,934	12%	6%
19	25	66	1,447	1,406	1,472	1,472	2%	6%
23	30	34	2,278	2,274	2,308	2,308	1%	6%

Route	K12 Trips		Non-K-12 Trips		Total Trips		K12 Trip Share	
	Before Expansion	After Expansion	Before Expansion	After Expansion	Before Expansion	After Expansion	Before Expansion	After Expansion
27	239	155	3,403	3,488	3,643	3,643	7%	6%
29	121	176	1,215	1,160	1,336	1,336	9%	6%
30	82	116	1,242	1,209	1,324	1,324	6%	6%
31	272	410	3,795	3,658	4,068	4,068	7%	6%
32	220	495	3,899	3,623	4,118	4,118	5%	6%
38	301	290	2,937	2,948	3,238	3,238	9%	6%
39	85	26	605	665	690	690	12%	6%
40	40	21	539	557	579	579	7%	6%
41	181	178	1,281	1,284	1,462	1,462	12%	6%
42	17	45	457	429	474	474	4%	6%
43	107	37	1,294	1,365	1,401	1,401	8%	6%
46	30	27	400	403	430	430	7%	6%
47	191	58	249	381	440	440	43%	6%
52	114	220	1,137	1,031	1,251	1,251	9%	6%
54	118	433	1,071	755	1,188	1,188	10%	6%
60	212	169	2,726	2,769	2,938	2,938	7%	6%
67	268	474	1,764	1,558	2,032	2,032	13%	6%
68	38	82	676	633	715	715	5%	6%
80	24	20	137	141	161	161	15%	6%
89	14	16	84	82	98	98	14%	6%

Route	K12 Trips		Non-K-12 Trips		Total Trips		K12 Trip Share	
	Before Expansion	After Expansion	Before Expansion	After Expansion	Before Expansion	After Expansion	Before Expansion	After Expansion
92	30	13	248	264	277	277	11%	6%
95	-	-	87	87	87	87	0%	6%
96	38	44	152	146	190	190	20%	6%
Total	10,539	12,151	126,007	124,394	136,545	136,545	8%	9%

4 Technical Appendix

This section describes the electronic files that are enclosed with this report.

4.1 Updated OD Survey Data

The expanded DDOT and AAATA factors are updated to the SEMCOG Survey data. This file named “SEMCOG OD_EXPANDED_11222019” is same as the primary OD survey received by CTG (“SEMCOG OD_DRAFT_EXPANDED_07032019.xlsx”) except for the column “Updated_UnLinkedWeightFactor” that represent the updated unlinked weight factors and “Updated_LinkedWeightFactor” that represent the updated linked weight factors.

4.2 County to County Flows

The counties in the SEMCOG region are shown in Figure 4.1. County-to-county trip tables are generated using the expanded survey data by access mode, trip purpose, number of transfers, number of vehicles owned by household, annual household income and trip path. They are presented in the file named “count_9x9.xlsx”. The description of the sheet names and the categories in each item are presented in Table 4.1.



Figure 4.1 County Map of SEMCOG Region

Table 4.1 Description of County to County Flow File

Sheet name	Description	Categories of trip tables
D2D_8x8_Total	Entire survey data	--
D2D_8x8_AccMode	By Access Mode	1. Walk 2. PNR 3. Other
D2D_8x8_Purpose	By Trip Purpose	1. HBW 2. HBNW 3. HBCU 4. NHB
D2D_8x8_Transfers	By Number of Transfers	1. 0 2. 1 3. 2+
D2D_8x8_VehOwned	By Number of Vehicles Owned by Household	1. 0 2. 1 3. 2+
D2D_8x8_Income	By Annual Household income	1. <30,000 \$ 2. 30,000 to 50,000 \$ 3. 50,000 to 75,000 \$ 4. > 75,000 \$ 5. No response
D2D_8x8_Path	By Trip Path	1. Bus and Rail 2. Bus only 3. Rail only

4.3 District to District Flows

Among the Shapefiles shared with CTG, “*SEMCOG_2899_TAZ*” provided the information of super districts in SEMCOG region. The SEMCOG map of super districts is as provided in Figure 4.2. District to District trip tables are generated using the expanded survey data by access mode, trip purpose, number of transfers, number of vehicles owned by household, annual household income and trip path. They are presented in the file named “*D2D_26X26.xlsx*”. The description of the sheet names and the categories in each item are presented in Table 4.2.

Table 4.2 Description of County to County Flow File

Sheet name	Description	Categories of trip tables
D2D_Total	Entire survey data	--
D2D_AccMode	By Access Mode	1. Walk 2. PNR 3. Other

Sheet name	Description	Categories of trip tables
D2D_Purpose	By Trip Purpose	1. HBW 2. HBNW 3. HBCU 4. NHB
D2D_Transfers	By Number of Transfers	1. 0 2. 1 3. 2+
D2D_VehOwned	By Number of Vehicles Owned by Household	1. 0 2. 1 3. 2+
D2D_Income	By Annual Household income	1. <30,000 \$ 2. 30,000 to 50,000 \$ 3. 50,000 to 75,000 \$ 4. > 75,000 \$ 5. No response
D2D_Path	By Trip Path	1. Bus and Rail 2. Bus only 3. Rail only

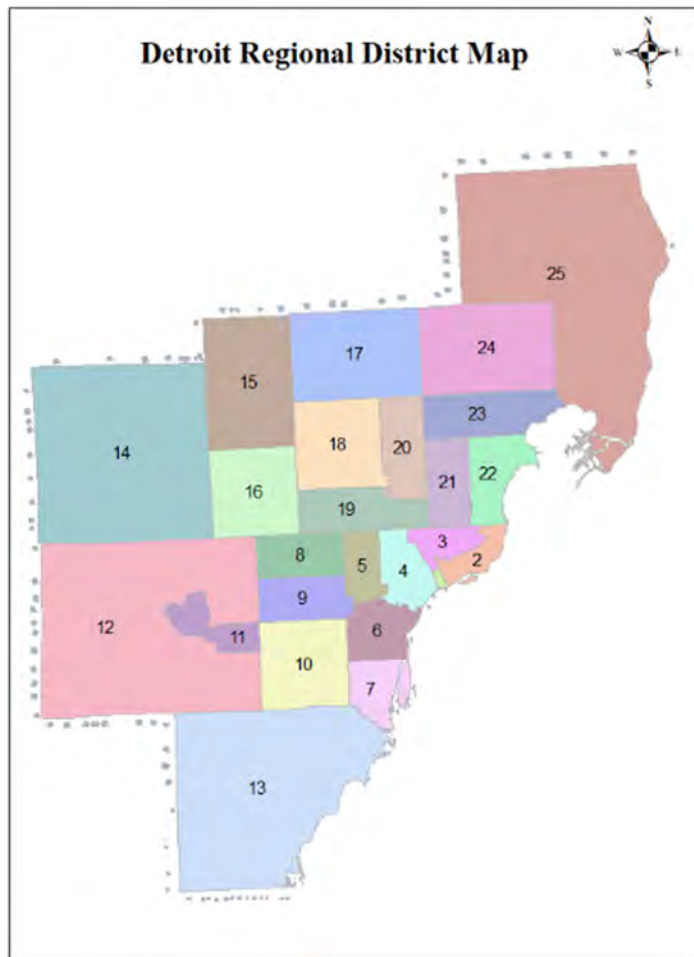


Figure 4.2 Super District Map of SEMCOG Region