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| Charlotte Area Transit System Origin-Destination Study | Transportation |
| Final Working Papers  March 14, 2014  *Submitted by*  RSG ETC Institute |  |

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# Introduction

This document represents the compendium of working papers documenting each phase of the Charlotte Area Transit System (CATS) Origin-Destination Study conducted in the spring and fall of 2013. These documents describe the purpose of the study and the methods used, including the sampling plan, survey design, survey administration procedures, and data cleaning.

# Work Plan

## Introduction

Charlotte Area Transit System (CATS) is charged with the development of a Before-and-After Study report, which is submitted to the Federal Transit Administration (FTA), as required under 49 U.S.C. § 5309 Requirements for New Starts Project Grantees. As part of this project, CATS must collect data to document the system conditions prior to the construction of the LYNX Blue Line Extension (LYNX BLE) Northeast Corridor Light Rail Project. CATS must document system travel patterns, transit use, and related information to preserve the “Before” conditions.

CATS retained Resource Systems Group, Inc. (RSG) and ETC Institute, Inc. (ETC) to conduct an onboard origin-destination (OD) study to understand current travel patterns on the existing transit system. The OD Study will gather travel behavior data from transit users in the CATS service area. The data collected will also be used to improve transit forecasts by updating CATS’ regional travel demand model, mainly the mode choice model component. A recalibrated mode choice model, based on quality data, will enhance CATS’ future competitiveness for federal funds.

In the spring and fall of 2013, RSG and ETC will conduct this system-wide OD study. The study will survey all CATS weekday fixed transit routes, including both bus and rail modes. The study will use a multiple step process, with an On-to-Off study proceeded by a full OD study. All methodologies and techniques are designed to be consistent with FTA guidance and requirements.

## Overall Schedule Considerations

Survey work and the corresponding tasks will be prioritized in order to complete data collection prior to any major service disruptions associated with construction. Advanced utility relocation for the LYNX BLE will begin in July 2013 and may result in service disruptions to the existing LYNX Blue Line light rail and the bus routes located within the Northeast Corridor. Additionally, there are several routes serving University of North Carolina at Charlotte (UNC Charlotte) that will need to be prioritized, as they cannot be surveyed after April 29th due to final exams and the end of the school term. Meanwhile, surveying of other routes may be conducted until June 7th and in September, if necessary.

Therefore, the Northeast Corridor bus routes (including the UNC Charlotte routes) and the LYNX Blue Line light rail will be prioritized ahead of all other routes to ensure that surveying is completed prior to May 2nd (with all UNC Charlotte routes completed by April 29th). These routes include:

|  |  |  |
| --- | --- | --- |
| * 3 | * 29 | * 80x |
| * 4 | * 39 | * 204 |
| * 11 | * 47 | * 211 |
| * 13 | * 49 | * LYNX Blue Line |
| * 22 | * 50 |  |
| * 23 | * 54x |  |

Table : Survey Distribution Blackout Dates

|  |  |  |
| --- | --- | --- |
|  | Date Range | Reason |
| No Surveying | 1/21/13 – 1/22/2013 | Federal Holiday |
| 2/4/2013 | CATS Service Change |
| 2/18/2013 | Federal Holiday |
| 2/25/2013 – 3/2/2013 | CIAA |
| 3/25/2013 – 4/5/2013 | Spring Break |
| 5/17/2013 – 5/24/2013 | NASCAR All-Star/Speed Street/Sprint Cup |
| 5/27/2013 | Federal Holiday |
| 6/3/2013 | CATS Service Change |
| 6/8/2013 – 8/25/2013 | Elementary/Middle/High School Not in Session |
| 9/2/2013 | Federal Holiday |
| 10/7/2013 | CATS Service Change |
| 10/10/2013 – 10/12/2013 | NASCAR Sprint Cup/Nationwide Cup |
| 10/14/2013 | Federal Holiday |
| 11/11/2013 | Federal Holiday |
| 11/27/2013 – 11/29/2013 | Thanksgiving Holiday |
| 12/23/2013 – 1/1/2014 | Winter Break |
| Limited Surveying | 3/8/2013 – 3/14/2013 | No UNC Charlotte Routes |
| 3/11/2013 – 3/15/2013 | No CPCC Routes |
| 4/29/2013 – 5/10/2013 | No UNC Charlotte Routes |
| Spring after 5/9/2013 | Limited Surveying for UNC Charlotte, JCSU and JWU Routes |

The RSG/ETC team will ensure that the Northeast Corridor bus routes and LYNX Blue Line light rail are surveyed within the scheduled timeframe; as such, RSG and ETC divided the tasks into subtasks. For example, the sampling plan for the Full OD will be broken into two parts: Northeast Corridor bus routes/LYNX Blue Line light rail, and all other bus routes. This level of organization will aid in maintaining the project schedule; this schedule includes the time necessary for CATS staff to review and approve each submittal. It will also provide additional time to prepare the complex sampling plans for the remaining routes.

## Task-by-Task Description of Technical Work

### Quality Assurance/Quality Control (QA/QC) Plan

Quality assurance/quality control (QA/QC) will occur throughout the data collection process to ensure high quality and usable data for CATS. Prior to the field effort, a QA/QC Plan will be developed and will describe the QA/QC procedures RSG and ETC will use, including:

* Real-time data review;
* Real-time geocoding;
* Interview tracker;
* QA/QC ride and communication procedure monitoring;
* Verification of data collection;
* Visual inspection of survey records; and
* Methods for reducing non-response bias.

Table : Deliverables: Quality Assurance/Quality Control (QA/QC) Plan

|  |  |
| --- | --- |
| Deliverable | Expected Date of Delivery |
| QA/QC Plan Memo | 1/29/13 |

### Sampling Plan

The study team will develop a sampling plan for weekday travel between 6:30am and 9pm. The surveys will be administered during weekdays, when schools are in session, and will avoid the aforementioned blackout dates.

The RSG team will prepare sampling plans for two separate and sequential surveys. The first survey will be an On-to-Off survey that collects only passenger boarding and alighting pairs for all fixed routes by utilizing plastic cards equipped with barcodes. The data obtained in the On-to-Off survey will be a major determinant to the sampling plan and for data expansion for the on-board survey. The Full OD survey will be a full tablet-based survey that focuses on understanding the travel patterns and key characteristics of current riders.

#### On-to-Off Survey Sampling Plan

The sampling plan for the On-to-Off survey will be designed to obtain completed surveys from a minimum of 20% of the trips on CATS weekday fixed transit routes (bus and rail). For routes with average daily ridership under 500 riders, the RSG team does not recommend conducting the on-to-off survey due to the lower ridership levels. This is consistent with the fielding of other similar FTA studies across the country and ensures riders do not get survey fatigue and that budget/time is spent on more critical routes and tasks. Furthermore, lower volume routes tend to be sampled at higher rates, meaning the actual surveys themselves should closely replicate the actual On-to-Off pairs. The exception to this is the routes that are either close to the cutoff or within the Northeast Corridor. CATS is interested in obtaining additional information for these routes; therefore, these routes have also been included in the On-to-Off survey.

The sampling plan will be designed to ensure that a minimum number of On-to-Off surveys are completed on each fixed route based on the direction of travel and time of day to ensure that the On-to-Off survey database can adequately support data expansion requirements for the full survey. Data needs for preparing this sampling plan are discussed in the Data Needed from CATS Section.

#### Full OD Survey Sampling Plan

Using the data from the On-to-Off survey, the RSG team will prepare sampling plans for each of the CATS weekday fixed routes. The sampling plans will identify the number of surveys that will be completed on each route by direction, time of day, and by boarding/alighting pair. The goal for the sampling plans will be to guide data collection efforts on each route in a manner that will support stop-to-stop expansion (or segment-to-segment) by time of day and direction. On average, 10% of the average daily boardings will be surveyed on each route (7,300 completed surveys), allocated mostly proportionally based on route ridership and On-to-Off patterns.

Below is a table showing the routes to be sampled, the Northeast Corridor bus routes/LYNX Blue Line light rail that will be prioritized, and for which routes the On-to-Off Survey will be conducted.

Table : Surveyed Routes/Lines

| Route Number | Route Type | Average Weekday Boardings | Priority Routes | On-to-Off Survey Not Recommended |
| --- | --- | --- | --- | --- |
| 1 | Local | 1,163 |  |  |
| 2 | Local | 667 |  |  |
| 3 | Local | 1,389 | X |  |
| 4 | Local | 507 | X |  |
| 5 | Local (Limited Stop) | 1,222 |  |  |
| 6 | Local | 649 |  |  |
| 7 | Local | 3,545 |  |  |
| 8 | Local | 1,359 |  |  |
| 9 | Local | 4,012 |  |  |
| 10 | Local | 1,345 |  |  |
| 11 | Local | 4,325 | X |  |
| 12 | Local | 550 |  |  |
| 13 | Local | 953 | X |  |
| 14 | Local | 890 |  |  |
| 15 | Local | 1,765 |  |  |
| 16 | Local | 1,713 |  |  |
| 17 | Local | 1,123 |  |  |
| 18 | Local | 301 |  |  |
| 19 | Local | 865 |  |  |
| 20 | Local | 648 |  |  |
| 21 | Local | 353 |  | X |
| 22 | Local | 1,408 | X |  |
| 23 | Local | 1,749 | X |  |
| 24 | Local | 494 |  |  |
| 25 | Local - Crosstown | 258 |  | X |
| 26 | Local | 541 |  |  |
| 27 | Local | 2,073 |  |  |
| 29 | Local - Crosstown | 474 | X |  |
| 30 | Local - Crosstown | 744 |  |  |
| 34 | Local | 1,359 |  |  |
| 39 | Local | 1,088 | X |  |
| 42 | Local – Rail Shuttle | 30 |  | X |
| 43 | Local – Rail Shuttle | 306 |  | X |
| 47 | Local – Campus Shuttle | 491 | X |  |
| 49 | Local – Campus Shuttle | 615 | X |  |
| 50 | Local – Campus Shuttle | 889 | X |  |
| 55 | Local – Rail Shuttle | 423 |  |  |
| 56 | Local – Rail Shuttle | 1,181 |  |  |
| 57 | Local – Rail Shuttle | 346 |  |  |
| 58 | Local – Rail Shuttle | 404 |  |  |
| 60 | Local – Rail Shuttle | 320 |  |  |
| 84 | Local – Uptown Circulator Shuttle | 1,058 |  |  |
| 86 | Local – Uptown Circulator Shuttle | 2,066 |  |  |
| 94 | Local – Town Shuttle | 6 |  | X |
| 97 | Local – Town Shuttle | 196 |  | X |
| 98 | Local – Town Shuttle | 116 |  | X |
| 99 | Local – Town Shuttle | 108 |  | X |
| 201 | Local – Neighborhood Shuttle | 238 |  | X |
| 204 | Local – Neighborhood Shuttle | 620 | X |  |
| 211 | Local – Neighborhood Shuttle | 1,120 | X |  |
| 221 | Local – Neighborhood Shuttle | 774 |  |  |
| 222 | Local – Neighborhood Shuttle | 481 |  | X |
| 232 | Local – Neighborhood Shuttle | 912 |  |  |
| 235 | Local – Neighborhood Shuttle | 367 |  | X |
| 40x | Express | 339 |  |  |
| 41x | Express | 180 |  | X |
| 45x | Express | 111 |  | X |
| 48x | Express | 332 |  | X |
| 51x | Express | 153 |  | X |
| 53x | Express | 133 |  | X |
| 54x | Express | 659 | X |  |
| 61x | Express | 287 |  | X |
| 62x | Express | 158 |  | X |
| 64x | Express | 292 |  | X |
| 65x | Express | 214 |  | X |
| 74x | Regional Express | 159 |  | X |
| 77x | Express | 682 |  |  |
| 80x | Regional Express | 258 | X |  |
| 82x | Regional Express | 139 |  | X |
| 85x | Regional Express | 184 |  | X |
| 88x | Regional Express | 71 |  | X |
| LYNX | Light Rail | 15,800 | X |  |
| **Total** |  | **72,750** |  |  |

#### Auxiliary Data

Additionally, auxiliary data will be collected from CATS Park and Ride lots. The primary purpose of the park and ride counts is to create control totals for mode access (walk or drive) to allow for representative data expansion. Obtaining this data is traditionally a concern for self-administered on-board studies, due to the difference in response rates between passengers who walk and drive (with drive access ridership being more likely to complete questionnaires than walk mode), which may result in sample bias. By utilizing the tablet PC interview method of collection an overall response rate of close to 90% is expected. This method of data collection controls the traditional bias associated with mode access for self-administered questionnaires and therefore makes the need to conduct full counts less necessary than previous methods.

However, a good reason to count park and ride lots is to also understand the rate of parking turnover, which is not something the surveys will tell us, thus the reason we are targeting more active and larger park and ride lots, as discussed below. Thus, the Park and Rides have been separated into two categories:

1. CATS owned Park and Rides and several higher volume leased Park and Rides (see Table 4), where more involved full day of auxiliary data collection will be performed, as described below
2. Leased and lower volume Park and Rides (Table 5), where a simpler and smaller set of data will be collected, as described below

For the first group of Park and Rides (Table 4), data will be collected from 6:30am to 9pm for one weekday; these data will likely be collected via video (or possibly via direct observation or using tube counts) as a cost effective alternative to sending surveyors out to the lots for 15 hours. A lot-by-lot decision about exactly which method to use will need to be made based on the number of entry points, lighting, and other factors. Regardless of the method used, we will collect ingress, egress, and, when possible, vehicle occupancy in 15 minute increments; this will allow CATS to understand vehicle turnover in these larger lots for weighting purposes. Vehicle occupancy will also be collected in the survey and due to high response rates (as described above); this data should accurately reflect travel patterns in case collecting occupancy is not feasible via video, etc.

Table : CATS Park and Rides to Collect Detailed Data from 6:30am and 9pm

| Park and Ride Name | Type of Lot | Address | Number of Spaces | Routes/Lines Served |
| --- | --- | --- | --- | --- |
| Albemarle Road | Owned Park and Ride Lot | 6810 Lawyers Rd Charlotte, NC 28227 |  | 9, 40x |
| Archdale Station | Rail Station | 6230 South Blvd Charlotte, NC 28217 | 432 | LYNX, 57 |
| Arrowood Station | Rail Station | 7717 England St Charlotte, NC 28273 | 289 | LYNX, 24, 56 |
| Huntersville Gateway Park and Ride | Owned Park and Ride Lot | 10300 Compass St Huntersville, NC 28078 | 209 | 48x, 77x, 98, 99 |
| Huntersville Northcross Park and Ride | Owned Park and Ride Lot | 17126 Northcross Drive Huntersville, NC 28078 | 326 | 77x, 97 |
| I-485/South Boulevard Station | Rail Station | 9508 South Blvd Charlotte, NC 28273 | 1,120 | LYNX, 12, 42, 58, 251 |
| Mallard Creek Park and Ride | Owned Park and Ride Lot | 1712 JN Pease Charlotte, NC 28262 | 210 | 54x, 22 |
| Matthews Independence Pointe Park and Ride | Owned Park and Ride Lot | 9614 Independence Point Pkwy Matthews, NC 28105 | 304 | 64x, 65x |
| Northlake Mall | Leased Park and Ride Lot | 6801 Northlake Mall Drive Charlotte, NC 28216 |  | 53x, 99, 7 |
| Scaleybark Station | Rail Station | 3750 South Blvd Charlotte, NC 28209 | 315 | LYNX, 12, 30 |
| Sharon Road West Station | Rail Station | 8815 Crump Rd Charlotte, NC 28134 | 188 | LYNX, 12, 19, 43, 55 |
| Tyvola Station | Rail Station | 5703 Old Pineville Rd Charlotte, NC 28217 | 456 | LYNX, 16, 60 |
| Woodlawn Station | Rail Station | 4756 Old Pineville Rd Charlotte, NC 28217 | 382 | LYNX, 24 |

For the second group of Park and Rides (Table 5), a simpler data collection effort will occur, which will include counting the total number of vehicles parked in the lots once the AM Peak is over on one weekday. This will give CATS the sense of how many vehicles are parked for the day, but since these lots are smaller and riders are likely parked there all day, knowing vehicle turnover is unnecessary. Here again, vehicle occupancy can be accurately collected from the survey data.

Table : CATS Leased Park and Rides to Collect Post-AM Peak Parking Counts Only

| Park and Ride Name | Address | Routes/Lines Served |
| --- | --- | --- |
| Abbey Plaza Shopping Center | 601 Park Street Belmont, NC 28012 | 85x |
| Arboretum Shopping Center | 8008 Providence Road Charlotte, NC 28277 | 61x, 14 |
| Big Lots | 280 Highway 29 South Concord, NC 28025 | 80x |
| Cheddar’s Café | 620 University Center Blvd Charlotte, NC | 80x |
| Charlotte Motor Speedway | 5555 Concord Pwy Concord, NC 28075 | 80x |
| Calvary Church | 5801 Pineville-Matthews Rd Charlotte, NC 28226 | 62x |
| Carmel Road Park | 2350 Carmel Rd Charlotte, NC 28226 | 45x |
| Carolina Place Mall | 11001 Carolina Place Pkwy Pineville, NC 28134 | 20, 58 |
| Central Church of God | 5301 Sardis Rd Charlotte, NC 28270 | 45x |
| Central Steele Creek Presbyterian Church | 9401 S. Tryon Charlotte, NC 28273 | 41x, 56, 55 |
| Church of Jesus Christ of Latter Day Saints | 5815 Carmel Rd Charlotte, NC 28226 | 45x |
| Cokesbury United Methodist Church | 6701 Idlewild Rd Charlotte, NC 28212 | 51x |
| Cornelius Town Hall | 21445 Catawba Ave Cornelius, NC 28031 | 77x, 97 |
| Cornerstone Baptist Church | 8947 Albemarle Road Charlotte, NC 28227 | 40x |
| Coulwood Shopping Center | 8410 Bellhaven Road Charlotte, NC 28216 | 88x |
| Eastland Mall | 5471 Central Ave Charlotte, NC 28212 | 9 |
| Gastonia Transit Center (Bradley Transfer Center) | 121 North Oakland St Gastonia, NC 28052 | 85x |
| Good Shepherd Presbyterian Church | 3307 Rea Rd Charlotte, NC 28226 | 62x |
| Home Depot | 2815 Home Depot Dr Rock Hill, SC 29732 | 82x |
| K-Mart | 2120 W. Roosevelt Blvd Monroe, NC 28110 | 74x |
| Manchester Theater | 1935 Cinema Dr Rock Hill, SC 29730 | 82x |
| Matthews Presbyterian | 207 W John St Matthews, NC 28105 | 65x, 27 |
| Plaza Fiesta Carolinas | 3700 Avenue of the Carolinas Fort Mill, SC 29715 | 82x |
| Providence Baptist | 4921 Randolph Rd Charlotte, NC 28211 | 45x |
| Providence Methodist | 2810 Providence Rd Charlotte, NC 28211 | 61x, 62x, 14 |
| Providence Presbyterian | 10140 Providence Church Lane Charlotte, NC 28277 | 61x |
| Rock Hill Town Hall | 138 E. White Street Rock Hill, SC 29730 | 82x |
| Sharon Baptist Church | 6411 Sharon Rd,  Charlotte, NC 28210 | 20 |
| St. John Neumann Catholic Church | 8451 Idlewild Rd,  Charlotte, NC 28227 | 51x |
| St. Matthews Catholic Church | 8015 Ballantyne Commons Pkwy, Charlotte NC 28226 | 62x |
| Trinity Presbyterian Church | 3115 Providence Rd Charlotte, NC 28211 | 61x, 62x, 14 |
| Union Town Center Shopping | 5850 E. Hwy 74 Indian Trail, NC 28079 | 74x |
| Whitehall Commons | 8031 S Tryon Charlotte, NC 28273 | 41x, 56 |
| City Save-a-Lot #2 (Strawberry Hill) | 4309 Providence Rd Charlotte, NC 28211 | 14, 45x, 61x, 62x |
| Promenade Shopping Center | 5415 Ballantyne Commons Pkwy  Charlotte, NC | 61x |
| Target/Home Depot | 3333 Cloverly Parkway Concord, NC 28083 | 80x |

Listed below are the deliverables expected from this task.

Table : Deliverables: Sampling Plan

|  |  |
| --- | --- |
| Deliverable | Expected Date of Delivery |
| Sampling Plan for On-to-Off Survey | 2/15/13 |
| Sampling Plan for Full OD Survey | 4/11/13 |
| Sampling Plan for Auxiliary Data Collection at Park and Rides | 3/22/13 |

### Survey Design

The RSG team will design each of the three data collection components during this task:

1. On-to-Off Survey;
2. Full OD Survey; and
3. Auxiliary Data Collection.

Once CATS is satisfied with the sampling plans and survey design, CATS will review the designs with FTA staff; particularly the on-board OD questionnaire and sampling plan prior to the RSG team programming the instrument. Gaining FTA approval early on in the process will put the project on the path towards success and ensure high quality data that will meet model and data preservation needs.

The On-to-Off survey will capture only boarding and alighting information. On buses, plastic cards with barcodes printed on them will be distributed to each rider on sampled trips. These cards will contain both English and Spanish language instructions. The card will be scanned with a GPS-enabled barcode reader as the rider boards and again as the rider alights the bus. For LYNX, a brief tablet-based survey will be conducted onboard to ask riders where they boarded and where they will be alighting. The results will be utilized to revisit the sample allocation plan for the Full OD survey and make adjustments where necessary. The results will also be used by the modeling consultant in developing expansion factors for the survey results.

For the Full OD survey, the RSG team will design a tablet-based (iPad or other tablet device) personal interview. The RSG team will use tablets that integrate with GIS software to allow for accurate geocoding of most survey data as the survey is taken. The full OD survey will be conducted in both English and Spanish.

In addition to the on-to-off and Full OD survey efforts, auxiliary data will also be collected from Park-n-Rides.

### Data to Be Collected

The data to be collected for the On-to-Off survey are as follows:

* Route;
* Boarding location;
* Boarding time;
* Alighting location;
* Alighting time; and
* Direction of travel.

The data to be collected for the full OD survey are as follows:

* Route surveyed on;
* Direction of travel;
* Any other transit routes used;
* Time of trip;
* Origin;
* Boarding location;
* Alighting location;
* Destination;
* Lat/lon and TAZ for each location;
* Access and egress modes;
* Vehicle occupancy (if drove and parked or carpooled);
* Trip purpose; and
* Demographics of respondent.

The auxiliary data to be collected from Park-n-Rides and are as follows:

* Number of cars present before counts begin;
* Ingress number of vehicles;
* Ingress number of people in vehicles;
* Egress number of vehicle
* Egress number of people in vehicle; and
* Number of cars present after counts end.

Table : Deliverables: Survey Design

|  |  |
| --- | --- |
| Deliverable | Expected Date of Delivery |
| Survey Design for On-to-Off Survey | 1/29/13 |
| Survey Design for Full OD Survey | 3/1/13 |
| Auxiliary Data Collection Design | 2/25/13 |

### Survey Management Plan

#### Staffing Plan

ETC will create a staffing plan that indicates an organizational structure as follows:

* Designated Field Project Manager
* QA/QC Coordinator
* Field Supervisors
* Data Collectors (including collectors fluent in Spanish, when necessary)
* Data Editors

#### Survey Training

ETC will conduct training prior to both the On-to-Off survey and the Full OD survey; training will include classroom training and in-field training. ETC will be responsible for preparing all training materials including the Surveyor’s Manual, securing a facility for conducting the training, and providing moderators to conduct the training; RSG will review all training materials.

Each interviewer will be required to demonstrate that they can proficiently conduct the survey before they will be allowed to administer the survey. Interviewers who cannot demonstrate proficiency in all tasks related to the administration of the survey will be replaced. Surveyors will also be reviewed throughout the data collection effort and will be retrained if issues are encountered. If the surveyor continues to perform below standards, the surveyor will be dismissed.

The RSG/ETC team will work with CATS to schedule training dates for the survey efforts, but estimate the training dates in the Deliverables table below.

Table : Deliverables: Survey Management Plan

|  |  |
| --- | --- |
| Deliverable | Expected Date of Delivery |
| Survey Management and Staffing Plan for On-to-Off Survey | 1/29/13 |
| Survey Management and Staffing Plan for Full OD Survey | 3/15/13 |
| Surveyor Manual for On-to-Off Survey | 2/15/13 |
| Surveyor Manual for Full OD Survey | 3/29/13 |
| Surveyor Training for On-to-Off Survey | 3/4/13 |
| Surveyor Training for Full OD Survey – Spring | 4/22/13 |
| Surveyor Training for Full OD Survey – Fall (*tentative*) | 9/3/13 (*tentative*) |

### Surveys Administration

#### On-to-Off Survey

ETC will conduct an On-to-Off survey in March of 2013, excluding the blackout dates detailed in the CATS/RSG contract. The purpose of the On-to-Off survey will be to collect the boarding and alighting location of riders on each bus route in order to develop a sampling plan for each route for the main survey. The survey will be administered to a random sample of at least 20% of the riders on each route.

Following the administration of the On-to-Off survey, a boarding and alighting matrix will be prepared for each route that shows the number of boardings at each stop along the route on one axis and the number of alighting at each stop along the route on the other axis. These matrices will be used to prepare the sampling plans and data expansion plans for the full survey.

#### Conduct a Pilot Test for Full Survey

ETC will conduct a pilot test of the full survey during the last week of the On-to-Off survey. The pilot test will involve the administration of at least 100 surveys and would replicate all tasks that would be conducted for the administration of the full survey. The pilot test would also serve as the opportunity to conduct training of all field supervisors who will be overseeing the Full OD survey.

The RSG/ETC Team will document the results of the pilot test along with any changes to the survey instrument or survey methodology as a result of the test.

#### Update Methodologies

Following the completion of each pilot test, the RSG/ETC Team will update this work plan. The updated work plan will contain an updated description of all tasks that will be completed. The RSG/ETC Team will also update the tablet programming as needed to ensure that any problems identified during the pre-test are corrected.

#### Full OD Survey

ETC will administer the main survey in the spring and fall of 2013. The main survey will be administered to approximately 10% of the system ridership (7,300 surveys).

#### Survey Administration Team Organization

The survey will be administered by three teams who will be directly supervised by Chris Tatham. Two groups of surveyors will be present during the field efforts.

**Leadership Team.** The leadership team will consist of the deputy project manager, assistant project manager, and 2-3 support personnel. The leadership group will be responsible for reviewing the performance of each team and ensuring that the sampling goals for each route are met. The leadership team will operate from centralized locations, such as transit centers, so that the performance of all teams can be evaluated.

**Field Teams**. The field teams will focus their efforts on the administration of surveys on several bus routes per week. Each of the team leaders will supervise a group of approximately 6-10 surveyors per day. On high volume routes, up to six interviewers may be deployed per route. On low volume routes, just one interviewer may be deployed on a route.

#### Survey Administration Procedures

**Timing of the Survey.** The surveys will be administered during weekdays (Monday-Thursday) when schools are in session and will avoid blackout dates in Table 1. The surveys will be administered from 6:30am-9:00pm or during the hours for which the route is operating.

**During the Administration of the Survey.** Interviewers will select riders at random to participate in the survey based on the sampling goals that will have been established for each route. Once an interviewer has selected a rider for the survey, the interviewer will do the following:

* The interviewer will approach the person selected and ask them to participate in the survey.
* If the person refuses, the interviewer will end the survey, but the refusal will be recorded on the tablet to help assess the overall response rate to the survey.
* If the rider agrees to participate, the interviewer will ask if he/she has at least five minutes to complete the survey.
* If the rider does NOT have at least five minutes, the surveyor will ask the rider to provide his/her boarding location, alighting location, name, and phone number. ETC Institute’s call center will contact the respondent within 24 hours and ask him/her to complete the survey by phone. If a respondent does not have a phone number, then a printed copy of the survey with a postage-paid return will be provided. This will ensure “short-trips” are well represented. This method is the method ETC has used previously and continues to use on OD studies.
* If a rider has at least five minutes, the surveyor will administer the full survey to the respondent as a face-to-face interview using a tablet computer.
* The tablets have been successfully used to field surveys across the U.S. and the RSG/ETC Team has confidence this method will work well in this instance. However, if for some reason the tablets fail, a back-up system is in place that uses MSDOS and runs on older tablets. If both of those fail, printed versions of the survey are available for surveyors to record rider responses.
* The RSG/ETC team will provide weekly progress reports during the data collection effort detailing the survey effort.

**After the Administration of the Survey.** After the surveys are administered, the field team leaders will consolidate the survey data that has been collected by their team and forward the data to the Leadership Team. They will then review each survey record to ensure that all necessary information has been provided. If any information is missing, they will forward the survey record and the name and phone number of the survey respondent to ETC Institute’s call center. Interviewers working in the call center will then call respondents to retrieve missing information by phone.

#### Review of Surveyor Performance

Surveyors and the data they have collected will be reviewed periodically to ensure they are performing up to standard. If they are not, the surveyor will be retrained in the problem areas. If the surveyor continues to underperform, they will be dismissed from the project.

Table : Deliverables: Survey Administration

|  |  |
| --- | --- |
| Deliverable | Expected Date of Delivery |
| On-to-Off Survey Field | 3/5/13 – 3/21/13 |
| Full OD Survey – Spring Field (priority routes first) | 4/23/13 – 6/7/13 |
| Full OD Survey – Fall Field | 9/3/13 – 9/27/13 |
| Weekly Progress Reports | Weekly during field |

### Data Processing and Analysis

The quality assurance/quality control and data cleaning/processing procedures will be fully detailed in the QA/QC Plan and in a memorandum at the completion of this task. During this task, additional QA/QC and cleaning will be conducted. The draft database will have locations geocoded to the lat/lon at the address level and assigned to the appropriate TAZ, trips verified, and a flag for what is considered a “complete/usable” or “incomplete/un-useable” record.

Table : Deliverables: Data Processing and Analysis

|  |  |
| --- | --- |
| Deliverable | Expected Date of Delivery |
| Draft Database of Spring Data | 8/20/13 |
| Draft Database of Fall Data | 11/15/13 |
| Summary of Cleaning and Results Verification Procedures | 11/15/13 |

### Final Data File

The RSG team will prepare final versions of all working papers that reflect feedback from CATS and summarize the entire survey effort. Additionally, RSG will document high-level findings from the survey effort in a final report.

The final data files will be provided to CATS on a CD or DVD, as well as a full data dictionary. If hard copy surveys are used (e.g., for collection of auxiliary data), then copies of the surveys used will be provided. In addition, copies of all raw files will be provided.

Table : Deliverables: Final Data File

|  |  |
| --- | --- |
| Deliverable | Expected Date of Delivery |
| Final Versions of All Working Papers | 12/16/13 |
| Survey Effort Summary | 12/16/13 |
| Final and Raw Data Files | 12/16/13 |

## Project Management Plan

CATS, RSG, and ETC will hold a weekly progress update call for the first two months of this project; once the Full OD survey is in the field, this may be reduced to a biweekly or monthly call that is supplemented with the weekly field progress reports via email.

RSG will be responsible for overall project management, with Greg Spitz as the Project Manager overseeing the process and ensuring the project is conducted to the specifications in this Work Plan. Margaret Campbell will serve as Deputy Project Manager for RSG, managing the day-to-day project work. Polly Ramsey will be providing support on this project.

ETC Institute will take the lead on survey design, management, administration, and implementation and be involved in the planning.

Below is a table showing each task and the lead firm and staff.

Table : Summary of Task Responsibilities

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Task | Lead Firm | Lead Staff | Lead Firm Support Staff | Support Firm |
| Work Plan | RSG | Greg Spitz | Margaret Campbell, Polly Ramsey | ETC |
| QA/QC Plan | RSG | Greg Spitz | Margaret Campbell, Polly Ramsey | ETC |
| Sampling Plan | ETC | Chris Tatham | Fred Gsell, Aaron Hekele, Nick Jones | RSG |
| Survey Design | ETC | Chris Tatham | Fred Gsell, Aaron Hekele, Nick Jones | RSG |
| Survey Management Plan | ETC | Chris Tatham | Fred Gsell, Aaron Hekele, Nick Jones | RSG |
| Survey Administration | ETC | Chris Tatham | Fred Gsell, Aaron Hekele, Nick Jones | ABC, Inc.  CEO Inc. |
| Data Processing and Analysis | ETC | Chris Tatham | Dr. Elaine Tatham, Nick Jones, Aaron Hekele, Fred Gsell | RSG |
| Prepare Final Data  *Dataset*  *Summary Report/Papers* | ETC  RSG | Chris Tatham  Margaret Campbell | Polly Ramsey | RSG  ETC |

### Project Team Contact Information

Listed below is the contact information for all key project team members.

Table : Contact Information

|  |  |  |  |
| --- | --- | --- | --- |
| Person | Firm | Email | Phone |
| Greg Spitz | RSG | [Greg.Spitz@rsginc.com](mailto:Greg.Spitz@rsginc.com) | 802-295-4999 x1424 |
| Margaret Campbell | RSG | [Margaret.Campbell@rsginc.com](mailto:Margaret.Campbell@rsginc.com) | 619-375-0717 |
| Polly Ramsey | RSG | [Polly.Ramsey@rsginc.com](mailto:Polly.Ramsey@rsginc.com) | 802-295-4999 x3309 |
| Chris Tatham | ETC | [CTathamETC@aol.com](mailto:CTathamETC@aol.com) | 913-254-4512 |
| Fred Gsell | ETC | [fgsell@etcinstitute.com](mailto:fgsell@etcinstitute.com) | 512-653-5551 |
| Aaron Hekele | ETC | [ahekele@etcinstitute.com](mailto:ahekele@etcinstitute.com) | 913-523-5681 |
| Nick Jones | ETC | [njones@etcinstitute.com](mailto:njones@etcinstitute.com) | 913-687-2174 |

### Project Invoices

RSG will submit lump sum invoices with a progress report when project deliverable milestones have been reached (**Error! Reference source not found.**).

## Data Needed from CATS

The RSG/ETC team needs CATS system data to build sampling plans, design the survey and validate the results. The RSG/ETC team expects to need the following data:

Table : Data Needs from CATS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data Needed | Preferred Format | Task Data Needed For | Date Needed By | Received |
| Average weekday boardings by route, time of day, and direction | Excel or a flat file | Sampling Plan for On-to-Off Survey | As soon as possible  (no later than 1/15) | ✓ |
| Route schedule data for post-February 4th schedule change | Excel or a flat file | Survey Management Plan for On-to-Off Survey | As soon as possible  (no later than 1/15) | ✓ |
| Stop lists by route (an up-to-date GTFS file will work) | Excel or a flat file | Survey Design (Full OD Survey) so that stops can be included in the survey itself | 1/25/13 | ✓ |
| Automatic Passenger Data by route, stop, direction, and time of day | Excel or a flat file | Validate On-to-Off data collected, also can be used for weighting and expansion | 3/1/13 | ✓ |

# QA/QC Plan

Quality assurance/quality control (QA/QC) will occur throughout the data collection process to ensure high quality and usable data for CATS. The following section describes the QA/QC procedures RSG and ETC Institute will use. In addition, this section addresses specific plans for ensuring the completeness and quality of the data collected.

## Overall Plan

### Sufficient Sample Collection

The Survey Sampling Plan will detail the number of surveys which should be collected on each route in order to obtain statistically robust data. This Sampling Plan will be created by RSG and ETC using ridership data. Sample quotas will be closely tracked and reported. All surveyors will be aware of these quotas and their importance. If a survey team is not able to reach a given quota, they will return to the same route on a different day. If the problem can be attributed to a specific surveyor continually failing to meet our performance expectations, that surveyor will be replaced.

### Completeness of Data

An incomplete survey will not be counted toward the survey returns. In order to ensure complete data collection, the importance of data completeness will be emphasized to the surveyors and incomplete surveys will not be accepted.

For the On-to-Off survey, a complete survey simply requires the return of the plastic card containing a bar code at the respondent’s alight stop or station. Bar codes which are distributed but not returned will not be considered completed surveys.

For the Full OD study, the tablet survey tool will not allow the interviewer to continue through the survey if a question is left unanswered. The only exception would be certain demographics questions which some respondents are uncomfortable answering (e.g., household income). Therefore, a completed survey will be one which has every question answered, except certain demographics questions. If, while interviewing a respondent, it is found the respondent cannot finish the survey, that survey will be marked incomplete and will not be counted toward the quota goal.

While much of the review for completeness will occur during the field effort (see the Detailed QA/QC Procedure Section below), additional cleaning and review will occur once fieldwork is finished. If it is found that there are an insufficient number of completed surveys for a particular sample cell from the spring survey effort, additional sample will be obtained during the fall survey effort. The exceptions are Northeast Corridor Routes and routes that will significantly change during the June Service change, as it may not be possible to survey these routes in the fall. The team will aim to collect slightly more surveys than needed to ensure a sufficient number of completes for these routes that cannot be resurveyed at a later date.

### Data Collection Schedule

The data collection schedule is tailored to observe blackout dates, holidays and construction that could significantly affect or alter service. In particular, the Northeast Corridor routes are scheduled to be surveyed before construction begins on the LYNX Blue Line Extension light rail project. In addition, this schedule is reasonable and may be implemented by the ETC team in the time frame given.

If the schedule cannot be met, the ETC team will extend the field effort by the number of days required to meet all quotas (which likely means simply surveying more routes in the fall). However, for the Northeast Corridor routes, there is no alternative but to complete the work as scheduled.

### Reducing Non-Response Bias

Non-response bias will be addressed through the use of tablet-based in-person interview. This survey method will address:

* Language bias—Spanish interviewers will be hired to administer the interview to non-English speakers;
* Literacy bias—since the survey will be primarily administered by a surveyor, the number of surveys that could potentially be affected by the literacy of those surveyed will be significantly reduced. For those making a short trip, a phone-based interview will be conducted and as a last resort if no phone number is available, a paper survey will be provided, so literacy bias may still affect a very small number of individuals;
* Sample size distribution bias—based on the on-to-off flow survey, the sampling plan will be adjusted in order to obtain a minimum sample size for each cell in the on-to-off matrix;
* Short trip bias—the on-to-off flow survey and real-time quota tracking will minimize short trip bias. Individuals who make trips that are less than five minutes long will be asked for their contact information and will be contacted by the team’s call center later that day to finish the survey. If the respondent does not have a phone number, then a paper survey will be provided; and
* Heavy load conditions/seat availability bias—this is also minimized with the in-person interview, as we are not relying on riders to be seated and have room to complete the survey. This is true for bus and rail.

### Review of Deliverables

Each deliverable will be reviewed prior to sending to CATS staff. For example, if RSG leads the task, then ETC Institute will provide review and vice versa.

# Sampling Plan

## Sampling Plan

### Important Dates for On-to-Off Survey

The On-to-Off survey captures travel flows between 6:30 am and 9:00 pm. The surveys will be administered during weekdays when schools are in session, and will avoid all blackout dates. The training for data collectors will occur on March 4th, followed by data collection from March 5th –March 21st.

### Sampling Plan Design

The On-to-Off survey will collect passenger boarding and alighting pairs for all fixed bus routes by utilizing plastic cards equipped with barcodes. For LYNX, interviews will occur for all boarding passengers capturing their boarding and alighting stations via in-person interview using an iPad. This method will be more effective for LYNX, as it would otherwise be difficult to effectively distribute and collect the barcode cards on these trains with multiple larger doors that several passengers can pass through at once.

The sampling plan for the On-to-Off survey was designed to obtain completed boarding and alighting pairs from a minimum of 20% of the transit rider trips on CATS weekday fixed bus and rail routes. Routes with average daily ridership under 500 riders will not be surveyed with exceptions of routes that are either close to the cutoff or within the Northeast Corridor, in addition to a few other routes of interest. For the purposes of developing the sample goals, average weekday ridership from March of 2012 was utilized.

For bus routes, the sampling plan was designed to ensure that a minimum number of On-to-Off surveys are completed on each fixed bus route based on the direction of travel and time period. The time periods are defined as follows:

* AM Peak (6:30 – 9:29 am)
* Midday (9:30 am – 3:29 pm)
* PM Peak (3:30 – 6:29 pm)
* Evening (6:30 – 8:59 pm)

For the LYNX Blue Line light rail, each station will act as an individual sampling unit with samples collected based on direction of travel and time period. The same time period definitions were used for LYNX Blue Line sampling.

The data obtained in the On-to-Off survey will be a major determinant of the sampling plan and of data expansion for the Full OD survey. The completed survey quotas set for bus and rail will ensure that the On-to-Off survey database can adequately support data sampling and expansion requirements for the Full OD survey.

Routes 60, 40x, 54x, 77x, and 80x did not reach the On-to-Off sampling goal due to low ridership and were therefore oversampled in the Full OD.

The complete sampling plans are shown in Table 15 and Table 16 below.

Table : Bus Sampling Plan

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Route | Total Ridership | On-to-Off Sampling Goal | Full OD Sampling Goal | Route (cont.) | Total Ridership | On-to-Off Sampling Goal | Full OD Sampling Goal |
| 1 | 1,163 | 233 | 116 | **50** | 889 | 178 | 89 |
| 2 | 667 | 133 | 67 | **55** | 423 | 85 | 42 |
| 3 | 1,389 | 278 | 139 | **56** | 1,181 | 236 | 118 |
| 4 | 507 | 101 | 51 | **57** | 346 | 69 | 35 |
| 5 | 1,222 | 244 | 122 | **58** | 404 | 81 | 40 |
| 6 | 649 | 130 | 65 | **60** | 320 | 64 | 32 |
| 7 | 3,545 | 709 | 355 | **84** | 1,058 | 212 | 106 |
| 8 | 1,359 | 272 | 136 | **86** | 2,066 | 413 | 207 |
| 9 | 4,012 | 802 | 401 | **94** | 6 | 0 | 1 |
| 10 | 1,345 | 269 | 135 | **97** | 153 | 0 | 15 |
| 11 | 4,325 | 865 | 433 | **98** | 125 | 0 | 13 |
| 12 | 550 | 110 | 55 | **99** | 112 | 0 | 11 |
| 13 | 953 | 191 | 95 | **201** | 195 | 0 | 20 |
| 14 | 890 | 178 | 89 | **204** | 493 | 99 | 49 |
| 15 | 1,765 | 353 | 177 | **211** | 811 | 162 | 81 |
| 16 | 1,713 | 343 | 171 | **221** | 424 | 85 | 42 |
| 17 | 1,123 | 225 | 112 | **222** | 383 | 0 | 38 |
| 18 | 301 | 60 | 30 | **232** | 708 | 142 | 71 |
| 19 | 865 | 173 | 87 | **235** | 326 | 0 | 33 |
| 20 | 648 | 130 | 65 | **40x** | 246 | 49 | 25 |
| 21 | 353 | 0 | 35 | **41x** | 174 | 0 | 17 |
| 22 | 1,408 | 282 | 141 | **45x** | 73 | 0 | 7 |
| 23 | 1,749 | 350 | 175 | **48x** | 329 | 0 | 33 |
| 24 | 494 | 99 | 49 | **51x** | 118 | 0 | 12 |
| 25 | 258 | 0 | 26 | **53x** | 94 | 0 | 9 |
| 26 | 541 | 108 | 54 | **54x** | 659 | 132 | 66 |
| 27 | 2,073 | 415 | 207 | **61x** | 304 | 0 | 30 |
| 29 | 474 | 95 | 47 | **62x** | 145 | 0 | 15 |
| 30 | 744 | 149 | 74 | **64x** | 248 | 0 | 25 |
| 34 | 1,359 | 272 | 136 | **65x** | 187 | 0 | 19 |
| 39 | 1,088 | 218 | 109 | **74x** | 120 | 0 | 12 |
| 42 | 30 | 0 | 3 | **77x** | 695 | 139 | 70 |
| 43 | 306 | 0 | 31 | **80x** | 191 | 38 | 19 |
| 47 | 491 | 98 | 49 | **82x** | 109 | 0 | 11 |
| 49 | 615 | 123 | 62 | **85x** | 187 | 0 | 19 |
|  |  |  |  | **88x** | 55 | 0 | 6 |
|  |  |  |  | **Total** | **55,331** | **10,188** | **5,533** |

Table : Rail Sampling Plan

|  |  |  |  |
| --- | --- | --- | --- |
| Station | Total Ridership | On-to-Off Sampling Goal | Full OD Sampling Goal |
| I485 / South Blvd | 1,937 | 387 | 194 |
| Sharon Rd. West | 1,114 | 223 | 111 |
| Arrowood | 1,005 | 201 | 101 |
| Archdale | 1,051 | 210 | 105 |
| Tyvola | 788 | 158 | 79 |
| Woodlawn | 699 | 140 | 70 |
| Scaleybark | 772 | 154 | 77 |
| Newbern | 453 | 91 | 45 |
| East / West | 577 | 115 | 58 |
| Bland | 331 | 66 | 33 |
| Carson | 231 | 46 | 23 |
| Stonewall | 244 | 49 | 24 |
| 3rd St / Convention Center | 1,028 | 206 | 103 |
| CTC | 3,127 | 625 | 313 |
| 7th St | 853 | 171 | 85 |
| Total | **14,210** | **2,842** | **1,421** |

# Survey Design

The following is a survey design for the study which includes three data collection components:

1. On-to-off survey;
2. On-board origin-destination survey;
3. Auxiliary data collection

This section will initially provide more detail on the On-to-Off survey, as that is being conducted first. In March, the Full OD Survey and Auxiliary data sections will be added as the details are confirmed.

## Survey Administration

### On-to-Off Survey

Plastic cards with barcodes printed on them will be distributed to each rider on sampled trips. The card will be scanned with a GPS-enabled barcode reader as the rider boards and again as the rider alights the bus, collecting the following data automatically:

* Route;
* Boarding location;
* Boarding time;
* Alighting location;
* Alighting Time; and
* Direction of travel.

The card will contain instructions, written in both Spanish and English, on how the rider can return the barcode card to a survey administrator. These cards will be scanned by the survey administrator when they are distributed, and again when they are returned. This will allow all of the above information to be stored for analysis and the full boarding/alighting pair to be obtained.

### Full OD Survey

The Full OD Survey will be conducted on-board via personal interview. Conducting a personal interview will minimize non-response bias for customers with literacy issues, as the interviewer will ask the questions and fill out the survey. There will also be Spanish-speaking interviewers available to administer the survey in Spanish, if needed.

As noted in the Work Plan, the Full OD Survey will collect the following data:

* Route surveyed on;
* Direction of travel;
* Any other transit routes used;
* Time of trip;
* Origin;
* Boarding location;
* Alighting location;
* Destination;
* TAZ for each location;
* Access and egress modes;
* Vehicle occupancy (if drove and parked or carpooled)
* Trip purpose; and
* Demographics of respondent.

For the full personal interview surveys, the survey team will use tablets that integrate with GIS software to allow for accurate geocoding of most survey data as the survey is taken. In addition to the address information, the TAZ for each location will be captured, which will minimize the need for extensive data entry/cleaning efforts after the survey is administered.

The tablet survey will include a series of logic checks, including:

* Feasibility of transfers;
* Ratio of the access/egress distance to transit from the rider’s origin/destination relative to the distance traveled on transit and total travel distance; and
* Total travel distance relative to the mode of access and egress.

Paper-based surveys will be created in order to provide an alternate administration method for if the tablet-based survey malfunctions. These paper-based surveys will be printed in both English and Spanish. Additionally, the paper-based survey will be provided to passengers who don’t have sufficient time to complete the interview on the vehicle; their contact information will also be obtained during this time so that they can be contacted via phone if they do not complete the survey within 5 days. Finally, this method will likely be used for some express routes because the literacy levels on these routes and the limited number of stops that occur make this a more efficient means of surveying these routes.

### Auxiliary Data

In addition to the on-to-off and on-board survey efforts, auxiliary data will also be collected from Park and Rides. As detailed in the Work Plan, the Park and Rides will be divided into two groups with varying data collection plans.

1. CATS owned Park and Rides and several higher volume leased Park and Rides, where more involved full day of auxiliary data collection will be performed. For these Park and Rides, video will likely be used to collect ingress, egress, and vehicle occupancy.
2. Leased and lower volume Park and Rides, where an abbreviated set of data will be collected. At these lots, a count of the park vehicles in the lot will be conducted after the AM Peak; this will likely be collected via simple clipboard recording.

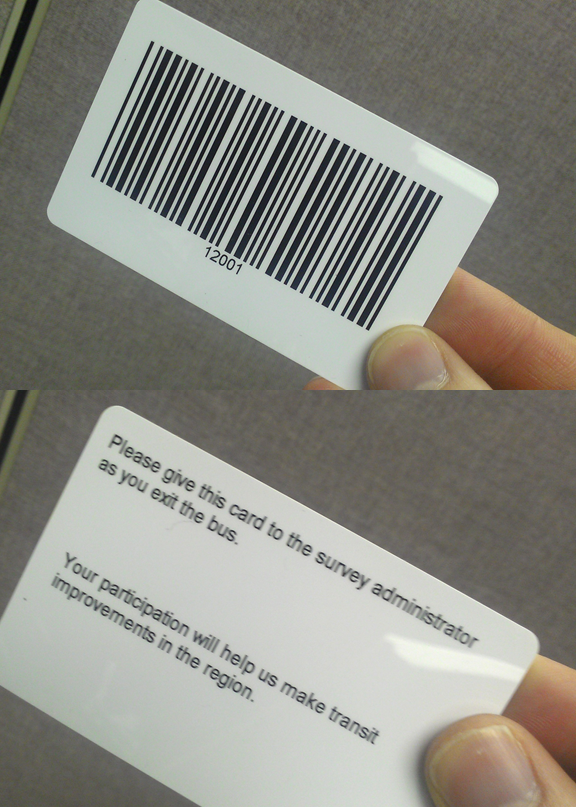
As mentioned, more detail on the auxiliary data collection instrument design will be provided in March.

## Survey Instruments

### On-to-Off Survey

As explained above, the On-to-Off survey design involves only cards with barcodes and both English and Spanish language instructions. An example of one of these cards is shown in the figure below (only includes English text).

Figure : Example On-to-Off Survey Card



### Full OD Survey

Please see the attached document for a draft of the Full OD Survey.

### Auxiliary Data

This data will likely come via a combination of video data collection and paper-based recording. This instrument is currently being developed and will be provided in March.

## Survey Coding Scheme and Data Dictionary

The coding scheme and data dictionary will be provided once the tablet-based Full OD Survey has been programmed. Once prepared, CATS will be given a chance to review the database format and coding scheme with their modeling consultant. All data will be clearly labeled so that CATS and their modeling consultant can easily use the data.

# Survey Management Plan

This section provides detail on the survey management practices, including the staffing plan, staff recruitment, and training. This section will initially provide more detail on the On-to-Off survey, as that is being conducted first. In March, survey management plans for the Full OD Survey will be added to as the details are confirmed.

## Staffing Plan

The organizational structure of the staffing plan is as follows:

* Designated Project Manager—the Project Manager is Greg Spitz, Director at RSG, and he will work closely with Deputy Project Manager, Chris Tatham of ETC institute.
* QA/QC Coordination—Aaron Hekele, Fred G'sell, and Jason Jones have been named the persons responsible for QA/QC Coordination, and will be on site in Charlotte to monitor the entire field process.
* Field Supervisors—The field supervisors for this survey effort can be found in Table 17.

Table : Field Supervisors

|  |  |  |
| --- | --- | --- |
| Name | Company | Email Address |
| Fred G'sell | ETC Institute | fgsell@etcinstitute.com |
| Aaron Hekele | ETC Institute | ahekele@etcinstitute.com |
| Jason Jones | ETC Institute | jjones@etcinstitute.com |

* Data Collectors and Editors—Based on the project management and sampling plans, it has been decided 20 to 30 data collectors and editors are required for this survey effort. These surveyors will be hired through two certified DBE firms, Absolute Business Connections, Inc. and CEO, Inc. Five to ten of these surveyors will be able to speak Spanish fluently, and can therefore administer the survey in Spanish if necessary.

## Recruitment

All field supervisors are permanently employed by ETC Institute. Each of the field supervisors has more than three years of field survey experience. They all have the professional and management skills required to successfully lead a team of surveyors.

Data collectors and editors will be been recruited from two certified DBE firms: Absolute Business Connections, Inc. and CEO, Inc. Both firms have agreed to perform a nationwide background check.

## Training

Each interviewer will receive a Surveyor’s Manual, and be expected to familiarize themselves with all included information. This manual is currently being updated and will be provided to CATS at least one week before training for the On-to-Off survey begins.

### On-to-Off Survey Training

ETC Institute will conduct training on how to conduct the On-to-Off survey; it will include classroom training and in-field training. ETC Institute will be responsible for preparing all training materials and will conduct the training; RSG will review all training materials. The specific topics that will be covered during the training will include:

* How to properly use the interviewing equipment;
* Sampling procedures;
* How to approach riders to ask them to participate in the survey;
* How to react in various situations that may be encountered; and
* CATS Operations and Safety Training.

Each interviewer will be required to demonstrate that they can proficiently conduct the On-to-Off survey by the end of the day. Interviewers who cannot demonstrate proficiency in all tasks related to the administration of the survey will be replaced.

This training is scheduled for March 4th at the South Tryon bus garage training room.

### Pilot Full OD Survey Training

There will be only a brief surveyor training for a few select staff from the On-to-Off Survey for the pilot survey. The focus of the pilot will be more about ensuring the protocols and equipment work than the specifics of the collection; thus, a full training is unnecessary for the pilot.

We do not anticipate needing the incentive cards for this portion of the study.

### Main Full OD Survey Training

Following the completion of the On-to-Off survey and prior to the start of the main survey, ETC Institute will conduct training on how to conduct the main survey; it will include classroom training and in-field training. ETC Institute will be responsible for preparing all training materials, securing a facility for conducting the training, and providing moderators to conduct the training; RSG will review all training materials. Some of the topics that will be covered during the training will include:

* Purpose and objectives for the surveys;
* Questionnaire content;
* Surveyor responsibilities and standards for performance;
* Getting to and from an assignment;
* Data reporting requirements;
* Interlined routes;
* Goals for passenger response rate;
* How to properly use the interviewing equipment;
* Sampling procedures;
* How to react in various situations that may be encountered;
* Procedures for conducting debriefs with passengers who complete printed versions of the survey;
* How to conduct the survey if rider has at least 5 minutes for the survey;
* How to conduct the survey if the rider has less than 5 minutes for the survey;
* What to do if a rider refuses to participate in the survey;
* Frequently asked questions; and
* CATS Operations and Safety Training.

Each interviewer will be required to demonstrate that they can proficiently conduct the full survey before they will be allowed to administer the survey. Interviewers who cannot demonstrate proficiency in all tasks related to the administration of the survey will be replaced. Surveyor performance will also be reviewed throughout the data collection effort and surveyors will be retrained if issues are encountered; if the surveyor continues to perform below standards, the surveyor will be dismissed.

A record of surveyor training will be provided to CATS upon completion of each training session. This record will include the surveyor’s name and contact information, as well as the date of the training.

# Full OD Pilot Survey

ETC Institute conducted a pilot test of the CATS On-Board OD Transit Survey during the week of March 18th, 2013. The purpose of the pilot test was to assess all aspects of the survey including: survey design, sampling methodology, implementation, and data processing tasks.

Two versions of the survey were administered: one for rail and one for buses. The goal was to obtain 100 completed surveys of each version. The actual number of completed survey was 232 (130 - Rail Version and 102 - Bus Version).

This section briefly summarizes the major findings.

## Routes/Lines Involved

The pilot test was administered to transit riders on five bus routes and the LYNX rail line between the hours of 7am and 7pm. The bus routes that were included in the pilot are listed below:

* 11 North Tryon / Sugar Creek
* 27 Monroe Road
* 56 Arrowood / South Tryon
* 58 Pineville
* 9 Central Avenue

## Personnel and Training

All interviewers who participated in the pilot test were also previously involved in the On-to-Off Survey collection. This served two purposes – allowing a sufficient number of routes to be surveyed while continuing the On-to-Off Survey and also providing pre-training and screening for potential interviewers for the full-scale study.

An additional training was held focusing on the specifics of the Full OD pilot test. The training activities that were covered included:

* An introduction to the purpose of this portion of the project including a review of the hard copy instrument
* Training on the different types of tablet PCs
* On-site reconnaissance of the routes and rail lines that were included in the pilot test; team members rode each bus route that was included in the pilot test multiple times
* Training on survey administration and sampling procedures
* Practical exercise to ensure that all interviewers were technically competent enough to perform all tasks that would be required in the field

### Perceptions of Staffing

The overall quality of the staffing for the pilot test was excellent. Of the interviewers who were initially recruited, only two were dismissed for not being technically competent. The remaining staff were able to quickly understand and demonstrate an ability to perform the tasks required. Another staff member had motion sickness issues that also prevented her from continuing on this portion. Based on the results of the pilot test, ETC Institute does not anticipate difficulties with our ability to recruit and training staff to successfully conduct the main survey.

## Assessment of Survey Length

Two versions of the survey were tested. Each version had the same core set of questions. The difference between the two versions involved differences related to the mode of travel (Bus vs. Rail).

The time it took survey participants to fully complete the survey on a tablet PC ranged from minimum of 3.90 minutes to a maximum of 13.24 minutes. The average time was 5.68 minutes, with the bus version taking slightly longer (5.83 minutes) than the rail version (5.56 minutes).

## Assessment of Survey Design

Overall, the questions on both versions of the survey worked very well. Interviewers did not have any difficulty administering the questions, and respondents did not seem to have difficulty understanding them. No changes are recommended to the survey design.

## Assessment of Sampling Procedures

There were no problems with the sampling procedures. The process for randomly selecting riders on buses and trains that is described in the work plan worked very well. No changes to the sampling procedures are recommended.

## Assessment of Survey Participation

**Overall Rate of Participation**. Overall, 89.3% of the riders who were asked to complete a survey agreed to participate.

**Short Trip Participation.** Among those who agreed to complete the survey, 94% indicated they had time to complete the FULL version of the survey and 6% indicated that they did not have time to complete the FULL version of the survey, but were willing to do the SHORT version.

Among the 16 people who agreed to do the short version of the survey, ETC Institute was able to complete the FULL version by phone with 11 of these 16 people (69% completion rate). None of the riders who were given a mail-back version of the survey returned it by mail, so phone follow-up the next day would appear to be the best method of ensuring that short trips are well-represented.

## Assessment of Survey Quality

A total of 311 passengers were asked to participate in the pilot test. Of these, 278 agreed, and ETC Institute was able to obtain a complete survey from 233 people (5 people who did the SHORT version of the survey were not reached).

Of the 233 surveys that were completed using ETC Institute’s Google-maps integrated survey, 211 passed the first two phases of ETC Institute QA/QC review, which are conducted in the field and immediately after the data is retrieved. This means that 90.6% (211 of 233) of the data collected for the pilot test has been deemed “usable” so far.

For the pilot test, ETC Institute did not complete a visual review of each record or perform a series of logic checks to test each record, but we expect that most of the records will pass these tests.

## Conclusions

Based on the results of the pilot test, ETC Institute recommends that we proceed with the administration of the main survey as scheduled with no modifications to the survey design or procedures.

# Data Verification

The following section describes the data verification procedures RSG and ETC Institute used prior to delivering the final datasets for the CATS OD study.

A total of 9,221 surveys were obtained from the primarily tablet-based field effort. After cleaning and data verification was complete, 8,476 were deemed usable and included in the dataset, for a recovery rate of 92%. This is significantly higher than the recovery rate for a full paper survey administration method, which typically sees recovery rates around 70-75%.

## Detailed Full OD Data Verification

### Real-Time Data Review

For the Full OD study, the tablet survey tool did not allow the interviewer to continue through the survey if a question was left unanswered. The only exception was household income, which some respondents were uncomfortable answering. Therefore, a completed survey was one which had every question answered, except income.

While in the field, to ensure that accurate and quality data was collected, completed surveys were reviewed by field supervisors upon receipt. If any issues were found (e.g., an interviewer accepted an unreasonably long walk access trip), field supervisors then provided feedback and additional training to interviewers. Where possible, the data were corrected by the supervisor if the correct information was apparent. If a fix could not be made based on the information supplied, a follow up was done with respondents via phone to obtain missing information or clarify inconsistent information.

### Real-Time Geocoding

Because a web-based tablet survey was used to conduct and administer intercept interviews, addresses and intersections collected during field interviews were instantaneously geocoded with nearly 100% accuracy because the tablets are equipped with 4G/3G service and interface with Google Maps in real-time. In addition, after addresses and intersections were geocoded, the survey software plotted the locations on a map, which served as a visual aid that interviewers used to confirm accurate information was gathered.

### Paper Surveys

For the paper-based survey returns, the data were entered into the tablet survey. This has the advantage of stepping through the survey so the data can be checked in real-time. If information was missing but the correction needed was obvious, the data were populated by data cleaners. For example, if the respondent reported a walk access mode but did not provide their boarding stop, the data cleaner assigned the closest stop to their origin on the first route taken.

If information was unclear or major information was missing, an attempt was made to reach the respondent via phone to correct the information; if the respondent could not be reached, the data were discarded. Because the paper surveys were entered directly into the tablet system, there is not a way to differentiate surveys that were completed on paper v. tablet.

### Verification of Data Collection

As noted, much of the data verification occurred in real-time; however, additional checking was done after data collection was complete. One staff person was responsible for reviewing all records, providing a consistent source of review for the full study. The following data verification steps were taken and applied consistently across all records:

* Checking for valid home, origin, and destination street names, city names, and zip codes;
* Ensuring the number of household occupants was greater than or equal to the number of employed members of the household and the number of adults in the household;
* Ensuring the respondents who indicated that they were employed also reported that at least one member of their household was employed;
* Ensuring that transit route/line names and stops/stations were consistently spelled/coded;
* Ensuring that transfers to/from other transit routes/lines were possible, with some leeway provided for riders who walk several blocks to reach their next route;
* Ensuring the time of day a survey was completed was reasonable given the published operating schedule for the route;
* Ensuring the origin and destination addresses are not the same;
* Ensuring that the boarding and alighting addresses are not the same;
* Ensuring the boarding and alighting addresses make sense for the route;
* Ensuring that the respondent did not list the same route twice;
* Checking to be sure the access/egress mode is appropriate given the distance of travel from the trip origin/destination to place where the respondent boarded/alighted transit; and
* Reviewing the total distance on transit compared to the total trip distance.

### Visual Inspection

This step involved a visual inspection of the trip record. The key tasks completed as part of this visual inspection included the following:

* Visually inspecting and examining key variables of survey trips with very short distances;
* Visually inspecting the sensibility of trips with zero transfers or three or more transfers;
* Visually inspecting the sensibility of drive access/egress trips given the distance traveled by car relative to the distance traveled by transit;
* Visually inspecting the sensibility of drive access/egress trips with more than one transfer;
* Visually inspecting sensibility of the origin-to-destination path with respect to the survey route that was used for the trip; and
* Visually inspecting the routes reported being used for the trip.

If a record passes all of the visual checks and verifications listed above, the record was classified as “useable” and included in the final survey database. A total of 726 surveys (8%) were not included in the final database due to missing or illogical data; these surveys were discarded and are not available.

## On-To-Off Survey Data Processing

The On-to-Off survey data were processed to assign the boarding/alighting stop ID which matched with the stop ID in the Full OD dataset for easier analysis. The route names and stop names were also standardized.

## Park-And-Ride Data Verification

The Park-And-Ride data from lots counted for the full day were checked by reviewing the vehicle count at the start of the day, the number of vehicles that entered and exited, and the number remaining at the end of the day. It was confirmed that the combination of these numbers totaled up to 0 at the end of each day for each of the lots.

## Results

The result of the data verification process was a set of fully cleaned, labeled, and geocoded datasets. The final On-to-Off dataset contains a total of 29,691 records (20,922 bus surveys, 8,769 LYNX surveys), well in excess of sampling goals. The final Full OD dataset contains 8,476 total records (6,439 bus surveys, 2,037 LYNX surveys), again, well in excess of the sampling goals.