# STEP-BY-STEP GUIDE TO CONDUCT AN ALLEY INFRASTUCTURE INVENTORY

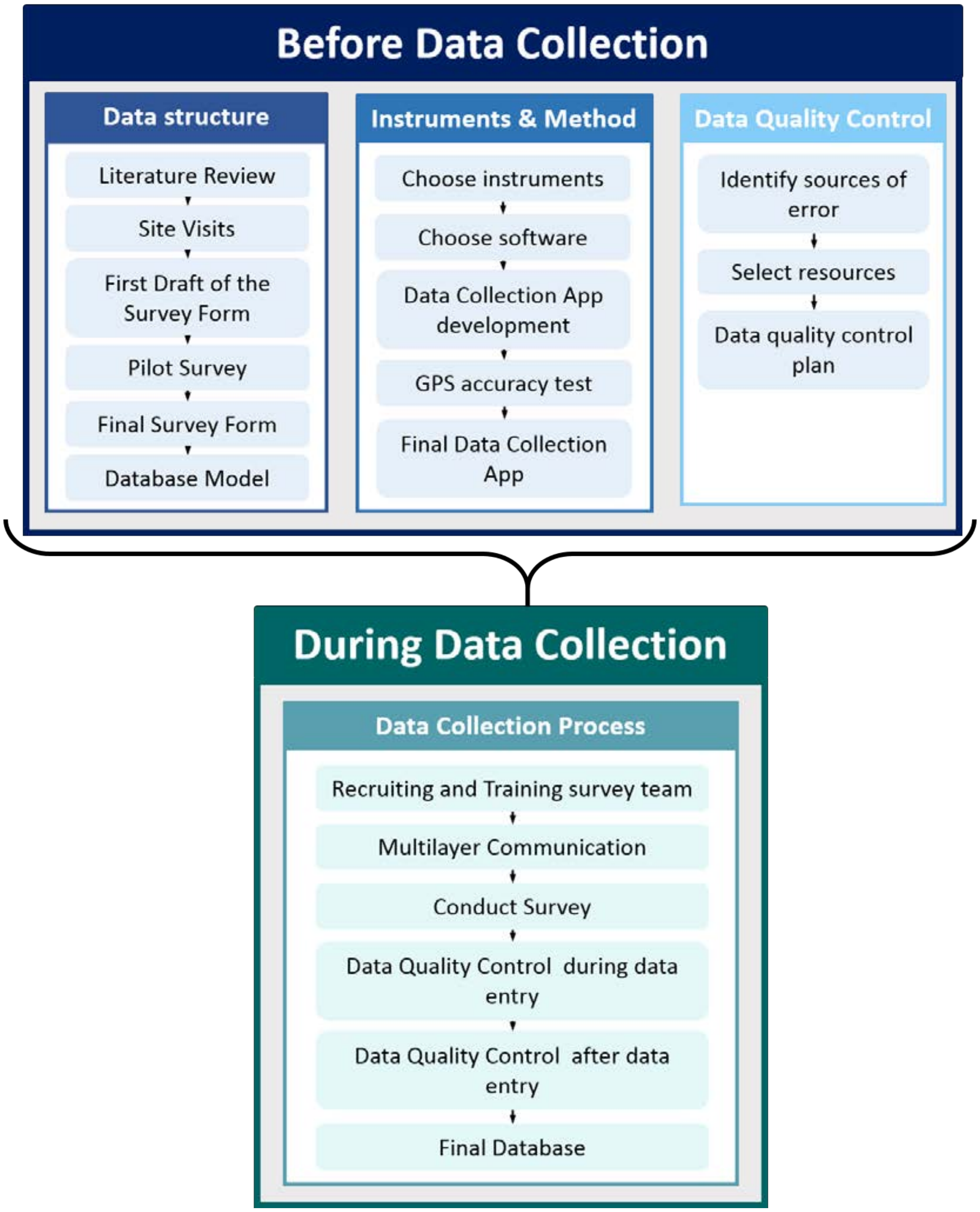
This toolkit describes the step-by-step process that city transportation professionals can follow to carry out an alley inventory survey.

The data-collection and analytic methods represented here are:

- Replicable;
- Available at reasonable cost;
- Ground-truthed;
- Governed by quality-control measures in each step.

The figure A1 below outlines the overall project data process.

**Figure A1.** Data Process.



## STEP 1: DETERMINE STUDY PARAMETERS

The first step should define these key parameters:

Scope/size of desired study area

Number of alleys to inventory: Pre-existing GIS databases such as transportation network may be a valuable resource as these databases might include alleys. If there is a GIS database of the transportation network but it does not include alleys, the number of city blocks could also be used to assess the scope of the effort involved to complete data collection in the defined study area.

Data-collection hours: For security reasons, it is recommended to work only during daylight hours. As this is not an occupancy study, periods of low activity, such as weekend days, are also candidate times to collect alley data.

## STEP 2: DEFINE ALLEY ATTRIBUTES OF INTEREST

Transportation officials should define the specific alley attributes the inventory effort seeks to capture. Cities should decide what agencies, beyond transportation, to include in the definition of attributes as the inventory can have broad applications beyond urban freight. As outlined in the Inventory Method Design, Seattle involved police, public utilities, and fire agencies, as well as firms involved in urban freight. Cities can use (and adapt as desired) the detailed alley typology in the Inventory Method Design to categorize significant alley features. Broadly, Seattle's effort sought to map and inventory various attributes related to 1) Alley connectivity to street network; 2) Alley design; 3) Alley accessibility; 4) Alley pavement condition. Details are available in the Inventory Method Design.

## STEP 3: SELECT DATA-COLLECTION TOOLS

The UFL research team decided that a **mobile-app-based data-collection instrument** built from an off-the-shelf basemap was a better option than a paper-based instrument, as detailed in the Inventory Method Design. That said, a paper-based questionnaire may be a viable alternative if a mobile data-collection app is not available or practical.

It is recommended that the chosen tools of the data-collection method be:

- Able to measure metrics with sufficient accuracy
- Easy to transport
- Reasonably priced
- Available as off-the-shelf technology

Below is the list of tools used in the UFL project and their unit price.

| INSTRUMENT NAME | UNIT PRICE ($) |
|---|---|
| **Laser measuring device** | 80 |
| **Measuring wheel** | 50 |
| **iPad mini 2 with 32 GB and Wi-Fi and cellular option*** | 300 |
| **Portable power bank** | 11 |
| **iPad Case** | 90 |
| **Security Vest** | 17.9 |
| **Clipboard** | 2 |

*This instrument may not be required if the survey instrument is paper-based

## STEP 4: CHOOSE SOFTWARE AND PROGRAM DATA-COLLECTION APP

This step requires choosing a database management software that allows for the following functionalities:

- Controlled submission or input of data
- Data storage in different formats, including databases with relationships, geodatabases and cloud storage
- Multiuser data editing
- Set data rules and relationships
- Secure data
- Data-collection app

These functionalities allow effective data management, data quality control and the scaling up of data collection with multiple staff members. It is also recommended to include a data-collection app for the collection of data in field to reduce transcript time and errors. The Urban Freight Lab effort included development of an alley inventory app, thought to be the first of its kind.

The research team implemented the survey form and data-collection process on tablets using ESRI GIS software Survey123, ArcView and ArcGIS Online. These ESRI products offer a seamless data-collection tool that not only allows for visualization of the collected data but its editing.

Additionally, Survey123 allows selection of the most appropriate basemap to assist the geolocation input.

The mobile data-collection app allows manual input of the infrastructure location supported by offline basemaps. This allowed the UFL research team to avoid the cost of having a wireless Internet plan for the tablets to support data collection. During development of the data-collection app, researchers tested the questionnaire in field and in office to prevent logic and other errors in using the survey form.

Based on the UFL research team experience, the collection of geolocation with off-the-shelf GPS devices in urban areas requires:

- Selection of a basemap to support the data collection
- Manual GPS coordinate reading by dropping a pin with a map-based app
- Definition of the data quality control regarding geolocation measures.

UFL researchers selected as a basemap the World Street from ArcGis.com viewer that was last updated on July of 2017 (3). An appropriate basemap can be created incorporating various elements as needed/available in a given city. In Seattle's case, UFL researchers first selected the World Street Map basemap preloaded within ArcGIS software and available from arcgis.com. This worldwide street map presents highway-level data for the world. To supplement this resource and make the basemap more specific within Seattle, researchers added existing GIS data of the location and key names of alleys and loading bays in Seattle's Center City area. The former was from King County's Metro Transportation Network (TNET) database, and the latter was from the SDOT-UW Final 50 Feet Loading Bays and Docks database.

## STEP 5: PREPARE ALLEY INVENTORY SURVEY FORM

The survey should encompass all key attributes identified in Step 2. The specific scope of work for each project may require adaptation of the survey form used in this report. If changes are needed, the recommended process is to pilot-test the draft survey form as discussed in the Inventory Method Design section. This pilot test enables cities to:

- Estimate the time needed to survey each alley, including walking time between alleys
- Identify potential problems with the survey logic
- Test data-collection methods and instruments

This step should result in a survey form and metadata document that describe survey data structure.

## STEP 6: CREATE DATA QUALITY-CONTROL PLAN

A data quality-control plan must consider the possible sources of error in the data and the resources available to mitigate these errors at different stages of the data-collection process. This helps ensure the quality of the data before it is collected, entered or analyzed. It also helps with monitoring and maintaining the data once collected. The UFL research team identified the types and possible sources of error specific to this type of project to define the quality-control measures needed:

**Positional error** refers to inaccuracies of GPS coordinate readings due to device issues (e.g. low satellite signal in urban canyons) and mistakes by humans manually collecting this data with tablets.

**Attribute error** is associated with the remaining non-spatial alley data collected with the survey. Some examples are incorrect data entry due to wrong measurements or mistyped data. Lack of access to the information due to obstructions or safety issues may also result in inaccurate data.

**Conceptual error** refers to errors around identification and classification of relevant alley attributes or related information. Concepts wrongly used can result in information misclassified and information not captured.

Figure A-2 below shows the UFL project data quality-control design to address the three types of errors above. Figure A-2 illustrates the measures implemented in three stages: before data collection, during data entry, and after data entry.

The Seattle project used three types of resources to carry out quality-control procedures throughout the three project stages:

**Supervisor(s)** are responsible for defining and enforcing data-collection standards and methodology; training the data collectors; and monitoring and maintaining the database. The supervisor handled the data-control measures implemented before data collection and after data entry.

**Collectors** are responsible for data entry in field and carrying out same-day data quality-control checks after data entry.

**Survey app** refers to the digital and online tool that helps create entry constraints, eases the digitization of the data as it is collected and ends the need for manual information digitalization. The survey app plays an important quality-control role because it is programmed to limit inaccuracies in the data-entry stage by considering the data structure rules, attributes and relationships.

**Figure A-2.** UFL Data Quality-Control Process

| | STAGE 1. BEFORE COLLECTION | | STAGE 2. DURING DATA ENTRY | | STAGE 3. AFTER DATA ENTRY | |
|---|---|---|---|---|---|---|
| | **In office** | **In field** | **In field** | | **In office** | |
| | Supervisor(s) | | Collector(s) | Survey App | Collector(s) | Supervisor(s) |
| **Positional** | Establish physical reference of geopoints | Deliver training session to collectors about GPS location collection with survey app | Instructed to be always aware of their location<br>Keep track of surveyed alley locations with hard copies of maps | Includes manual collection of GPS reading by dropping location pin<br>Includes updated base map with city blocks, building outlines, King County TNET alleys and loading bays in alleys. | Conduct same-day check of surveyed alley locations by reviewing alley end points in ArcGIS Online<br>Check street names of alley end points<br>Check alley TNET id the alley exist in King County's TNET database | Check alleys in TNET database to identify alleys not visited (i.e. missed) |
| **Attributes**<br>(Infrastructure features) | Build questionaries' data entry constrains in survey app<br>Deliver theoretical training session to data collector | Deliver training session on data collection with survey app and measurement devices regarding infrastructure features | Take clear photos to aid data entries | Includes visual and written aid for data fields | Conduct same-day check of data collected in field using ArcGIS Online platform | Check numeric fields for outliers<br>Conduct revisits to missing alley locations |
| **Conceptual**<br>(Infrastructure concepts) | Establish metadata and vocabulary related to the surveyed infrastructure<br>Deliver theoretical training session to data collector | Train collectors in field on how to identify infrastructure relevant to the survey | Write open-ended comments, take additional pictures and use "Other" categories for "undefined" cases | NA = Not applicable | NA = Not applicable | Resolve collectors' observations<br>Check classification of alley end point types with pictures collected and basemap in ArcGIS Online |

## STEP 7: RECRUITING AND TRAINING OF DATA COLLECTORS

### Recruiting

The workforce requirements (number of data collectors and supervisors needed) are determined by the project budget, timeline and survey length. Security concerns and survey complexity may also result in different workforce needs. For instance, data collectors may work better in teams of two to improve security conditions and enable efficient operation of the multiple data-collection instruments (e.g. laser measurement device, measuring wheel, iPad, etc.).

Beyond the time required for data collection in-field, project organizers should also account for the time needed for data-collection staff to commute to/from the study area and conduct data quality-control tasks in office. These tasks will take a varying amount of time depending on the nature, size and location of the study area, and are important to consider when estimating workforce needs in relation to the desired project duration.

### Training

Three different data-collector training sessions are suggested:

**The first session instructs data collectors in alley concepts and attributes.** This training session can be done in a classroom-type setting, with a slide presentation introducing the audience to alleys and the various features and concepts that surround them. The research project should be explained, providing everyone with the goal, process, timeline, and information on shifts. This is also where data collector security and safety protocols can be covered. (See Step 8.)

**The second session focuses on practical aspects of data collection**, such as how to use the questionnaire in the tablet app and the measurement tools. This training session can be done in-field to give the collectors real-world practice with the materials and process.

The materials needed for alley inventory data collection are detailed in Appendix B. These materials should be acquired before the second training session. Enough should be purchased so every collector and collector pair has what they need. Maps should be prepared that divide up the study area into sectors, allowing data collectors to always have a hard copy map to reference in-field.

This training session should lead the collectors through the actual process of collecting data. Attention should be paid to teaching how to take accurate measurements with the laser and wheel devices and how to effectively divide the collection work between the pair. One person may become very familiar with the measurement tools and always take measurements; the other may become adept at navigating and filling in the survey tool and always take responsibility for this task. Data collectors also had a chance to practice security and safety protocol in field, such as pausing to look down the alley length and determining whether they felt safe before entering. (See Step 8.)

**The third session centers on how to implement data quality-control measures.** After every shift in-field, one of the data collectors in each pair must clean the data he or she just collected. The third training session should be dedicated to this data-cleaning process: how to access the survey data results and how to properly clean the data, noting common errors to look for and needed changes to make.

## STEP 8: DATA COLLECTION

The actual data-collection step depends on the size of the study area and, subsequently, the size of the workforce required. It is recommended that collectors work in pairs on each alley. Depending on collectors' schedules, works shifts can be formed around a geographic area, with more city blocks and alleys included if the shift is longer. A check-out and check-in process can be developed for collectors to pick up and drop off the required materials needed for each shift. Supervisors must make sure territory assignments are formed and hard-copy maps are printed for each team and shift. Data collectors were instructed to inspect every city block searching for alleys, whether the county basemap showed an alley or not.

### Security in field

Safety of data collectors visiting and surveying alleys is paramount. It is essential to have a multilayer communications plan in place for all parties with an interest in the study area and the survey. It is also essential to have a comprehensive security protocol to avoid unsafe situations in field.

Data collectors should carry official documents from the sponsoring agency explaining the project and granting data-collection authorization. The documents should include agency official contact information should questions arise in field. Police and other relevant agencies should be informed and recruited to help communicate with all building managers in the survey area.

Relevant agencies can also publish and disseminate information on the survey and its progress to communicate with the public and relevant stakeholders. This communication can indicate where surveyors will be working and when. In Seattle, for example, the Seattle Police Department notified all building managers in the survey area in real time through the Seattle Shield program, a pre-existing information exchange for building operators and the police. SDOT also set up a new webpage at http://www.seattle.gov/transportation/thefinal50feet.htm to communicate with the public and relevant stakeholders.

It is recommended that data collectors follow a security protocol before entering the alley and once they are working inside the alley. In Seattle, data collectors were instructed to not enter in the alley if any staff felt uncomfortable. The presence of obstructions, such as garbage trucks, that made the alley access difficult was sufficient reason to avoid entering the alley. Once inside the alley, data collection teams were directed to exit the alley if any staff felt uncomfortable at any point while collecting features. In some cases, data collectors were able to go around the block to the second alley end point to finish the data collection. The survey logic considered possible interruptions, such as those due to security issues, so that valuable alley information was not lost and data collectors could at a minimum collect data from either end of an alley.

## STEP 9: DATA CLEANING

After data collection, data must be cleaned. Both the data collectors and the supervisors play a role in this effort, which is detailed further in Figure A-2, Stage 3. The data collector must conduct a check of the surveyed alley locations after having completed in-field data collection. This step makes the final cleaning of the complete dataset easier and more efficient. The supervisor(s) can conduct their data-cleaning steps during the collection process, but must perform a comprehensive clean *after* all the data has been collected.

## STEP 10: PUT TOGETHER AND SUMMARIZE THE DATA

Varying city needs may require different final formats. The final format can be a database made of spreadsheets with relationship between them. In the Seattle project, alleys were considered a point feature layer of alley reference end points, which could be displayed and mapped in GIS software. Most information about the alley was stored in a corresponding attribute table. Information about passenger parking, driveways, buildings' main entrances, and narrowest points along the alley were stored in table attachments that had a relationship one-to-many with the alley reference end points layer. Pictures of alley features were also collected and stored as JPEG files with a naming convention that allowed relating them to the corresponding alleys.