
# Curbside Management Tool

## *User Guide*

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# Curbside Management Tool
## *User Guide*

An Informational Report from the Institute of Transportation Engineers (ITE).

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# Foreword

This Curbside Management Tool User Guide provides instructions for transportation professionals on how to gather, analyze, and assess curb related information in geographic information system (GIS).

## Abstract

The Curbside Management Tool User Guide has been prepared to convey the architecture and framework of the ArcGIS Tool developed for jurisdictional planning of curbside management. The User Guide is intended to provide transportation professionals that have intermediate levels of GIS experience with information on how to use inventory data collected accordingly to the Curbside Inventory Report assess, gather, and analyze information to understand available information on curbside management inventories. This is the first edition of this document and supplements the ITE *Curbside Management Practitioners Guide* and FHWA *Curbside Inventory Report* (forthcoming).

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*Cover Image: Multimodal curbside management application in Chicago, Illinois, USA.*
*Source: Sarah Abel/ITE*

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# Curbside Management Tool

The Curbside Management Tool contains a suite of components that facilitate data collection, analysis, and treatment recommendations for curbside regulation and public right-of-way (ROW) allocation. With the help of this Guide, a transportation professional with GIS experience should be able to identify relevant treatment options to help agencies allocate curbs and public ROW in line with policy priorities. This Tool will allow a transportation professional to understand applications of curbside treatments whether the organization has curb asset data and established curb policies or not.

The Curbside Management Tool allows an analyst to manipulate and summarize data related to curbside management regulations (e.g., “No Parking” or “Loading Zone”). It allows the analyst to identify corridors of interest and express policy-level priorities for each corridor. It associates curb regulations with the corridors along which they are located and summarizes information about curb allocations and ROW availability at the corridor level. Finally, the Tool allows the analyst to identify suites of potential treatments of curb space and ROW, according to the built environment conditions and policy priorities of each corridor of interest.

The structure of this Tool is founded on the premise that curb space management and ROW management are inextricably linked. Certain treatment options depend only on the disposition of the curb, or of the ROW, but many critical treatments require alignment between and modification to both curb regulations and street cross-sections.

### Table 1: Tool Capabilities

| **This Tool does:** | **This Tool does NOT:** |
|---|---|
| • Use curb inventory<br>• Use existing and related data standards<br>• Follow the ITE Curbside Management Practitioners Guide<br>• Leverage qualitative demand inputs<br>• Use geospatial data inputs | • Collect data<br>• Create a curb data specification/standard<br>• Quantify curb supply or demand<br>• Allow users to input quantitative demand<br>• Price the curb |

# Overview of the Curbside Management Tool

The Tool includes five components: four geoprocessing components to prepare data and a fifth component to analyze the data. The five components are as follows:

1. *Component 0. Get SharedStreets Features,* allows the user to select an area of interest and download the street centerline in the SharedStreets linear reference format. If a user doesn't have a centerline file available this component provides the data. If a user has a centerline file that it is not linear referenced, this component provides the data. SharedStreets is built from OpenStreetMap. Users can improve their local area of OpenStreetMap, which can later be reflected in the use of the Tool.

2. *Component 1. Convert CurbLR to Feature Class* (*Convert CurbLR to Feature Class)*, imports curb regulation data from the CurbLR format into an ArcGIS feature class. The project team selected CurbLR as the primary source data format because of its open-source specification and its current use by several cities in the vanguard of the curb data movement.

3. Alternatively, an ArcGIS *Collector schema* offers an alternate path to preparing a curb regulation dataset. The schema is simply a set of fields pre-configured to enable fast, easy curb data collection by hand using smartphones or tablets. Core curb regulation attributes can be directly transcribed into ArcGIS Collector from photographs of curb regulation signs while in the field or at a desktop computer.

4. *Component 2. Prepare Linear Referencing (LR) Correspondence* connects the dots between the curb regulation feature class and a user-supplied feature class designating corridors of interest as collections of street centerlines. This component checks for *proximity*, *parallelism*, and *adjacency* when deciding which curb features to associate with a given street centerline feature.

5. *Component 3. Generate Curbside Statistics* processes the correspondence-enabled curb and centerline feature classes to summarize curb allocation according to each designation's prevalence in terms of foot-hours of curb space/time dedicated to that designation (e.g., "parking" or "loading"). This component also translates centerline features' ROW attributes (e.g., number of car lanes per direction) into indicators of cross-sectional width available for potential repurposing.

6. *Component 4. Curbside Treatment Options* cross-references a customizable table of curb and ROW management treatments with the summary statistics produced by the *Generate Curbside Statistics* function and a set of user-provided policy variables, such as the order in which different travel modes should be prioritized on a given corridor. Each treatment is deemed applicable when a given corridor's attributes satisfy that treatment's criteria.

# Software Requirements

- ArcGIS Pro 2.7+
- ArcGIS Online
- ArcGIS Collector or ArcGIS Field Maps

The software listed was selected based on the most commonly available software stack (ArcGIS) used in local governments around the world and primarily within the United States. It was written in Python, a natively installed scripting language in ArcGIS, because of its flexibility dealing with data ingestion and analysis. Details of the Tool's background are available in **Appendix A**.

# Data Requirements

As the analyst reads through the User Guide, the analyst will understand the required data per function.

- Curb regulation data, either in CurbLR format or manually collected according to the ArcGIS Collector schema provided in the GitHub repository.
- Street centerline data, such as OpenStreetMap (OSM) highway network features. OSM was selected since it is accessible to all users.
- Centerline features corresponding to corridors of analytical interest.
- Policy data, such as sets of modal priorities, for each corridor of interest.
- Shared ROW Specification: https://github.com/d-wasserman/shared-row

# Getting Started

- Download the Tool from GitHub via the following link and save it anywhere on a computer: https://github.com/ITE-Curbside/curbside-management-tool.
- Unzip the downloaded files. The unzipped package contains a .tbx Tool file, a set of Python scripts required to run the Tool, and a copy of this User Guide.
- No installation is necessary. Run the Tool from ArcGIS Pro, or Catalog within ArcGIS Pro. In either of those products, navigate to the folder containing the .tbx file and it should appear as a Tool with components (python scripts). The Tool can also be added to ArcToolbox within ArcGIS Pro to make it easier to find later.

# Workflow

1. Prepare a centerline feature class, potentially from OSM data (via *Get SharedStreets Features*), or manually.
2. Prepare a curb regulation feature class, either by running *Convert CurbLR to Feature Class* or by manually collecting curb regulation data using the *Collector schema*.
3. Run *Prepare Linear Reference Correspondence* to associate curb features with centerline features along one of several corridors of interest.
4. Run *Generate Curbside Statistics* to summarize curb allocations and ROW availability at the corridor level.
5. Run *Curbside Treatment Options* to produce a set of potentially relevant treatment options for each corridor of interest. If the organization has all the required input data, the analyst can run this component without running the previous four components. This is explained in *Component 4 - Curbside Treatment Options* in the User Guide.

## Best Practices

The Curbside Management Tool components are intended for application on feature classes stored within *file geodatabases* (i.e., not shapefiles).

Occasionally, as with any geoprocessing tool, the Curbside Management Tool components may run to completion but produce output that looks incomplete. For example, a “stale” file system connection can result in output feature classes with accurate geometry but seemingly empty attribute tables. If this happens, save the ArcGIS Pro project, then close and reopen ArcGIS Pro. This will almost always resolve the issue—usually the previously produced output is in fact correct but was being rendered incorrectly; or else re-running the Tool will result in correct outputs.

# *Component 0 - Get SharedStreets Features*

## What *Get SharedStreets Features* Does

Given an input polygon defining the geographic area, *Get SharedStreets* retrieves street centerline features from the SharedStreets API (application programming interface) and stores them in an Esri feature class.

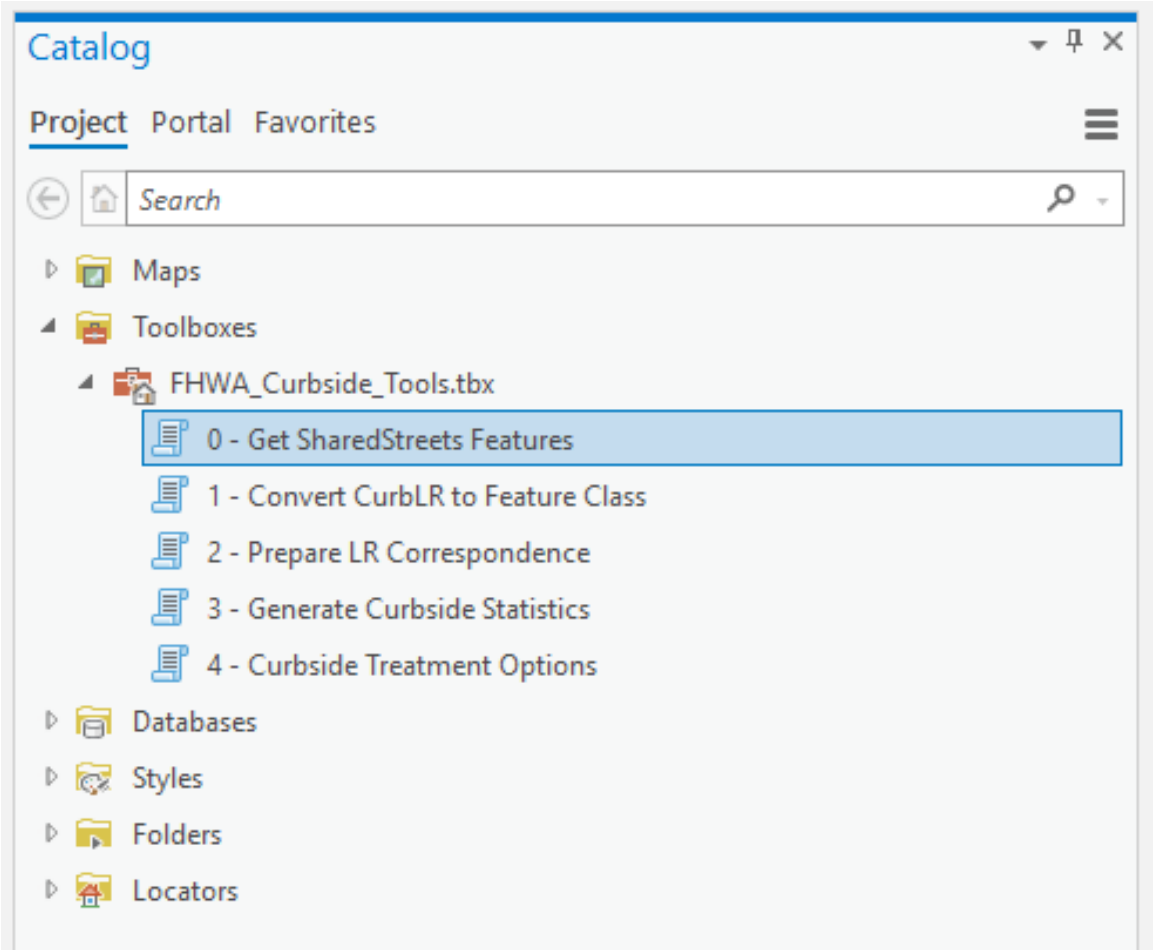



*Figure 1: Get SharedStreets Features.*
*Source: Esri*

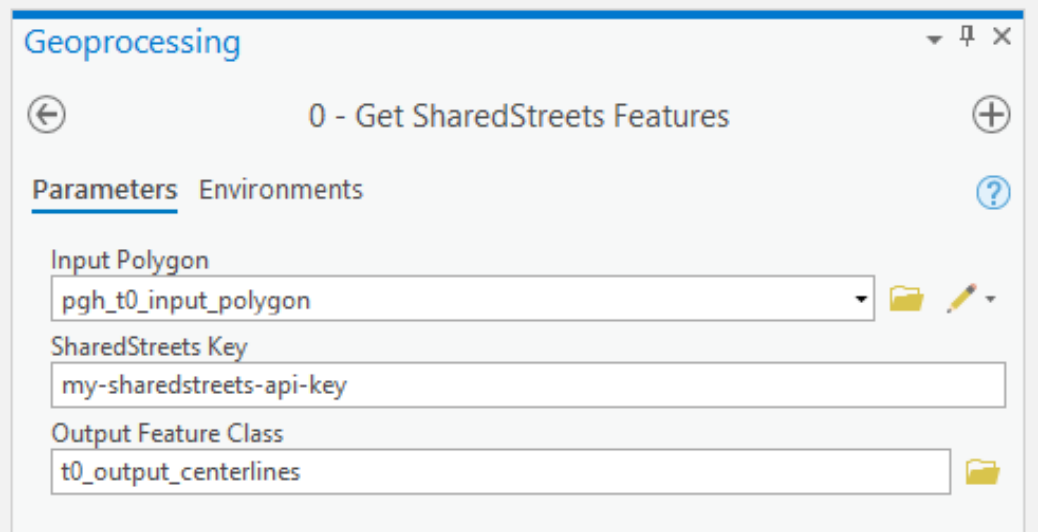



*Figure 2: Function "Get SharedStreets Features"*
*Source: Esri*

# Inputs

- Input Polygon: a feature class containing one polygon feature (such as a rectangle) defining the area within which to retrieve SharedStreets features.

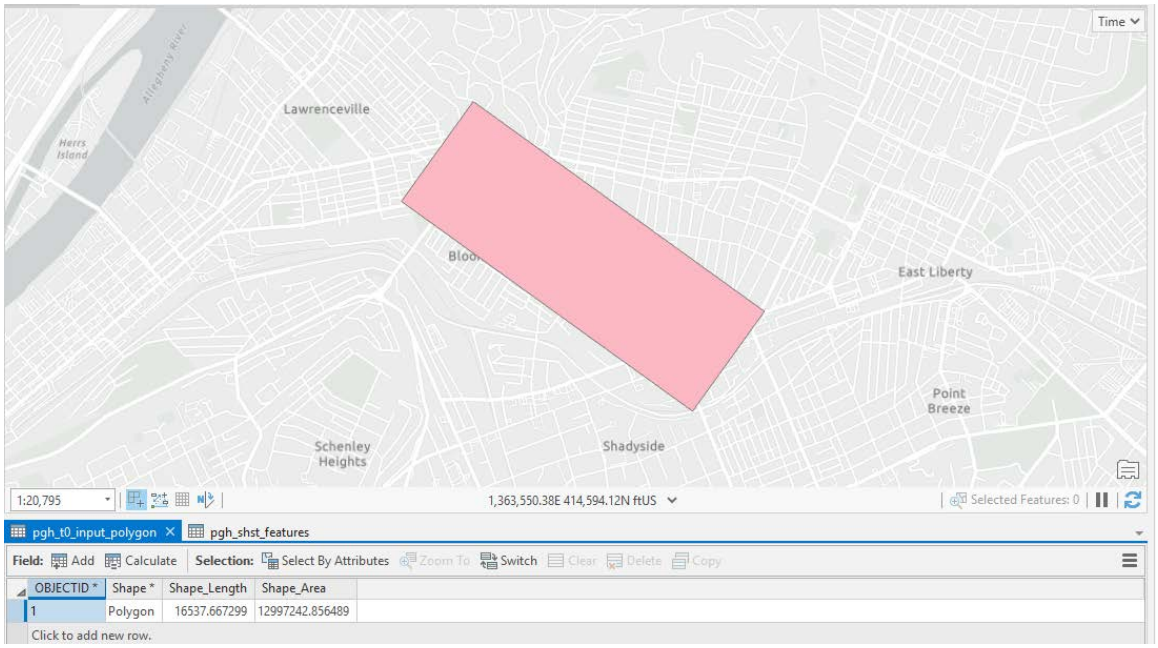



*Figure 3: Example input polygon*
*Source: Esri*

- SharedStreets Key: a SharedStreets API key, which can be obtained for free at https://sharedstreets.io/get-started/ . (Scroll down to the bottom of that page to find the signup form, shown below.)

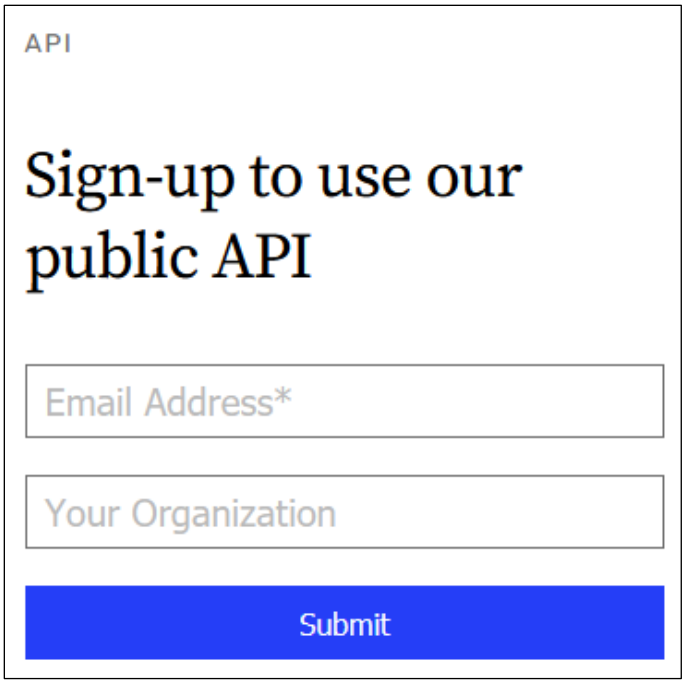



*Figure 4: API signup form on SharedStreets website.*
*Source: SharedStreets*

## Outputs

- Output Feature Class: Feature class of polylines.

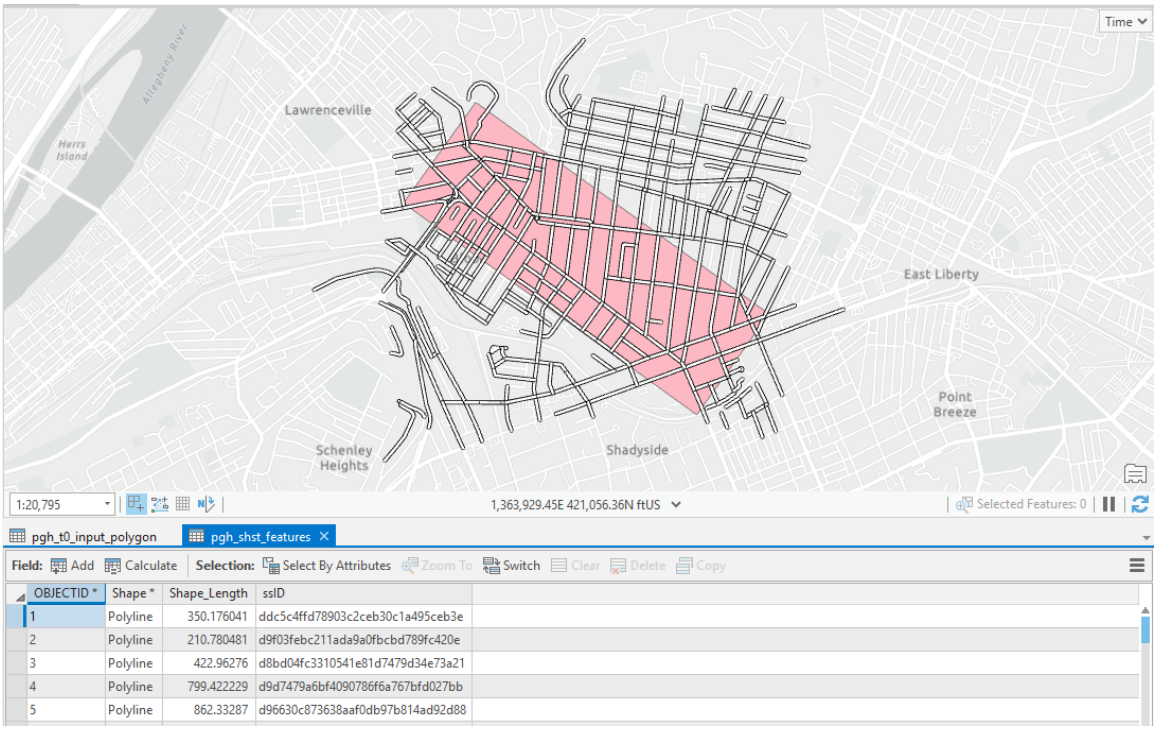



*Figure 5: Example output feature class, shown superimposed on input polygon.*
*Source: Esri*

## Understanding the Outputs

The output feature class will contain several line features, one for each SharedStreets centerline feature returned by the SharedStreets API. The attribute table contains only shape length and a field called "SSID," which contains each feature's unique SharedStreets ID. The SharedStreets ID is valuable if the organization has existing CurbLR data, which often associates curb features with their adjacent street centerlines using the SharedStreet ID.

## Tips and Tricks

SharedStreets features are based on OpenStreetMap geometry, but do not come with OpenStreetMap tag data. We recommend replicating the attributes from the example input centerline feature class for *Prepare Linear Reference Correspondence* (included in this sample geodatabase), including Shared_ROW attributes and policy fields such as modal priorities, in the *Get SharedStreets Features* output. These fields can then be manually populated based on field measurements, policy consensus, and other local knowledge.

Similarly, it may be desirable to dissolve the raw SharedStreets geometry into a smaller number of longer features. For example, individual blocks along a street may be better considered as a single multi-block corridor. Especially where right-of-way allocations and built environment/policy variables do not change substantially from block to block, this approach can reduce the amount of time needed to populate the attribute table in preparation for use with *Generate Curbside Statistics* and *Curbside Treatment Options*.

The polygon used to import centerline features can be as small as a handful of city blocks, or as large as an entire city; however, very large requests to the SharedStreets API may be slow to fulfill or be rejected entirely. If this happens, try dividing the area into several smaller polygons and request each separately. All features will have a consistent SharedStreets ID which can be used to remove duplicate features.)

It is not necessary to carefully draw a polygon outlining the area of interest. Instead, the north/south/east/west extents of the rectangular bounding box containing the polygon will be used to query the SharedStreets API. The API, in turn, will return any features within or intersected by the bounding box.

# *Component 1 - Convert CurbLR to Feature Class*

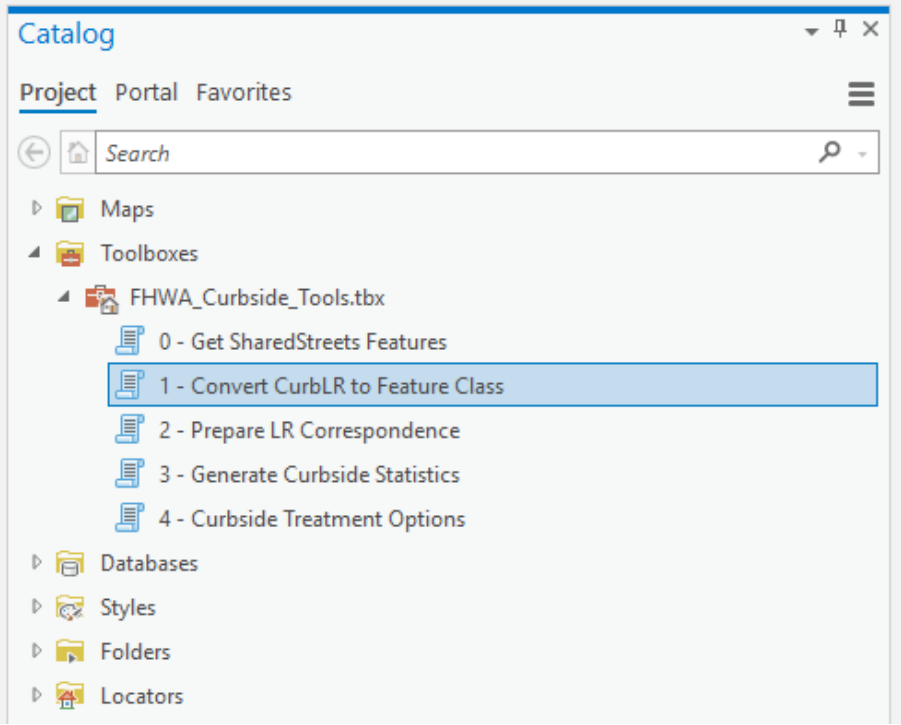



*Figure 6: Convert CurbLR to Feature Class.*
*Source: Esri*

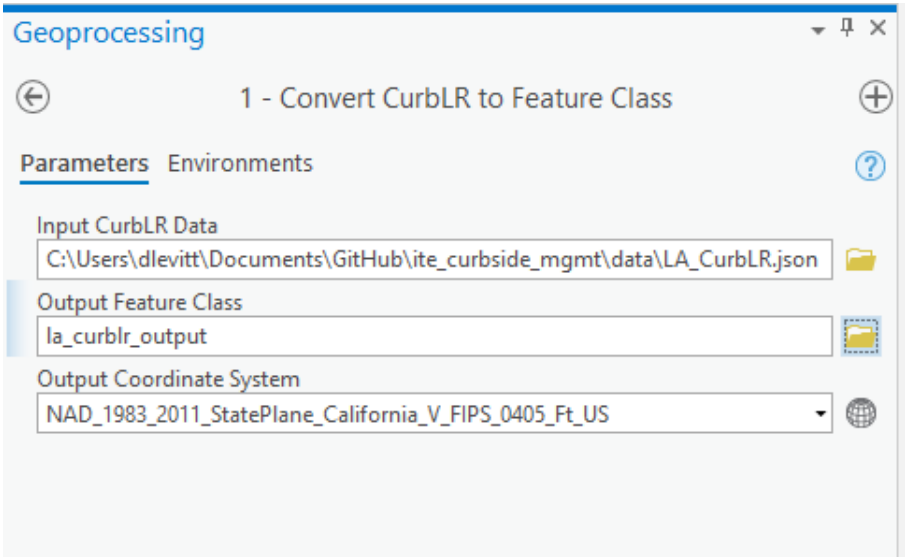



*Figure 7: Function Convert CurbLR to Feature Class.*
*Source: Esri*

## What *Convert CurbLR to Feature Class* Does

Reads in a CurbLR dataset (in JSON format) and exports an Esri feature class of polylines corresponding to each unique combination of geometry, daysOfWeek/timesOfDay, and restriction.

## Inputs

- Input CurbLR Data: .json or .geojson file containing input CurbLR data.
- Output Coordinate System: Spatial reference (projection/coordinate system) to write the curb features to.

## Outputs

- Output Feature Class: Feature class of polylines.

## Understanding the Outputs

The CurbLR format uses a so-called "slice spec," in which a given curb regulation is enforced through different combinations of day and time. When translating CurbLR regulations into ArcGIS features, we duplicate the feature as needed so that each unique day and time when the curb regulation is active receives its own feature. This allows the analyst to take advantage of ArcGIS Pro's time slider functionality, making it easy to visualize only those curb regulations in effect at a given day/time. It is also analytically valuable for the *Generate Curbside Statistics*. A "primary" field distinguishes the original copy of each curb regulation feature from duplicates created, to represent other days/times.

## Tips and Tricks

- The feature class must be written out to a geodatabase (not a shapefile). We recommend storing the output feature class in a feature dataset (essentially a "folder" within a file geodatabase, and a structure that requires all its feature classes to be in the same projection).
    - When writing out to a feature dataset, the Output Coordinate System parameter is disabled. This is because the feature class must match the feature dataset's coordinate system.
- At present, CurbLR is the only curb inventory data format we ingest into this Tool's workflow.

## Using the Collector Schema Curb_Assets

### What ArcGIS Collector Does

For agencies without a curb inventory in CurbLR format, we have provided a schema (Curb_Assets.gdb, essentially, a template) staff can use with the ArcGIS Collector mobile app and/or a desktop web map to manually capture curb regulation data in the field. The Collector app streamlines data collection by using mobile devices' GPS data to identify the geographic extents of a given curb regulation feature. The user also has the choice of inputting the details of the regulation, or simply taking a photo of the regulation for later processing.

Please review **Appendix B**, and see the ESRI ArcGIS Collector instructions if further guidance is required. The Curb_Assets feature class fields are as follows:

Current Layer: Curb_Assets

| Visible | Read Only | Field Name | Alias | Data Type | Allow NULL | Highlight | Number Format |
|---|---|---|---|---|---|---|---|
| ☑ | ☑ | OBJECTID | OBJECTID | Object ID | ☐ | ☐ | Numeric |
| ☑ | ☐ | SHAPE | SHAPE | Geometry | ☑ | ☐ | |
| ☑ | ☑ | GlobalID | GlobalID | Global ID | ☐ | ☐ | |
| ☑ | ☑ | CreationDate | CreationDate | Date | ☑ | ☐ | |
| ☑ | ☑ | Creator | Creator | Text | ☑ | ☐ | |
| ☑ | ☑ | EditDate | EditDate | Date | ☑ | ☐ | |
| ☑ | ☑ | Editor | Editor | Text | ☑ | ☐ | |
| ☑ | ☐ | effectiveDates_from | Effective Dates (From) (e.g. "2020-07-20") | Text | ☑ | ☐ | |
| ☑ | ☐ | effectiveDates_to | Effective Dates (To) (e.g. "2020-07-27") | Text | ☑ | ☐ | |
| ☑ | ☐ | daysOfWeek | Days of Week (e.g. "mo,tu,we") | Text | ☑ | ☐ | |
| ☑ | ☐ | timesOfDay_from | Time of Day (From) (e.g. "9:00") | Text | ☑ | ☐ | |
| ☑ | ☐ | timesOfDay_to | Time of Day (To) (e.g. "16:00") | Text | ☑ | ☐ | |
| ☑ | ☐ | activity | Activity | Text | ☑ | ☐ | |
| ☑ | ☐ | reason | Reason | Text | ☑ | ☐ | |
| ☑ | ☐ | maxStay | Max Stay | Long | ☐ | ☐ | Numeric |
| ☑ | ☐ | noReturn | No Return | Long | ☑ | ☐ | Numeric |
| ☑ | ☐ | payment | Payment | Long | ☑ | ☐ | Numeric |
| ☑ | ☑ | SHAPE_Length | SHAPE_Length | Double | ☑ | ☐ | Numeric |

*Figure 8: Curb Asset Field Names, Alias and Data Type.*
*Source: Esri*

## Inputs

- Use the ArcGIS Collector app to collect curb asset data for use in the Tool.
- Including effective dates, times of day, days of week, activity, priority category (reason), and location.

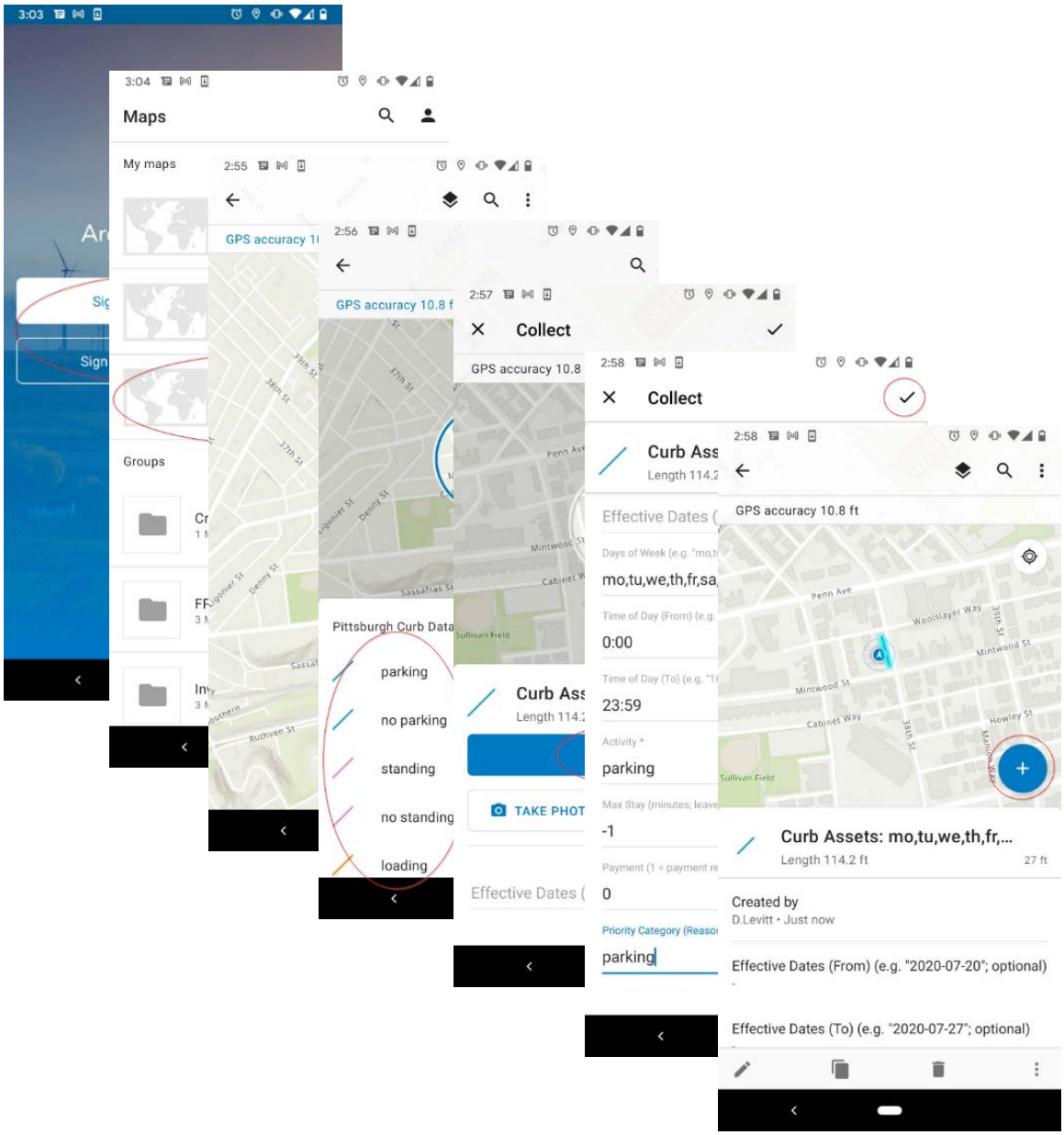



*Figure 9: ArcGIS Collector mobile app used to collect data using the Curb_Assets schema. Source: Esri*

## Outputs

- A definitive data resource to build an agency's Curb Asset Inventory.
- Export from the agency's ArcGIS online account to use in the Tool or other application.
- Input the collected data into *Prepare Linear Referencing Correspondence.*

## Understanding the Outputs

The Collector schema is very similar to the schema of the output feature class from *Prepare Curbside Features*. The only differences are the absence of a "SharedStreetsID" field (because manually entering a

20-digit alphanumeric ID code during field data collection is time- and labor-intensive) and the absence of the "primary" field (because analysts should not create duplicate curb regulation features).

### Tips and Tricks

- Read and understand the CurbLR specification (https://github.com/curblr/curblr-spec) upon which the Collector schema is based before beginning field data collection. This will help the analyst enter appropriate values for "activity," "reason," "noReturn," and other potentially confusing fields.

## Preparing a Centerline Feature Class for *Prepare Linear Referencing Correspondence* and Beyond

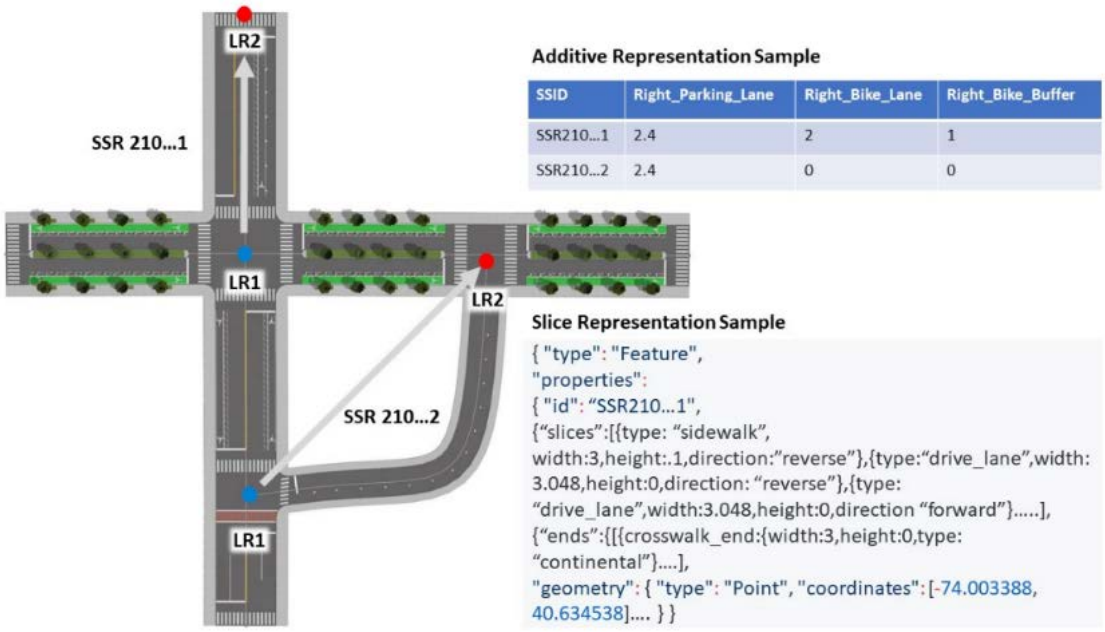



*Figure 10: Shared ROW Additive and Sliced Representation Samples.*
*Source: David Wasserman - https://github.com/d-wasserman/shared-row/blob/master/assets/SpecificationSample.JPG*

### What's the Big Deal?

*Convert CurbLR to Feature Class* produces a curb regulation feature class that fits perfectly into *Prepare Linear Reference Correspondence*. But *Prepare Linear Reference Correspondence* also requires a centerline feature class, which the analyst must supply. The centerline feature class performs several important functions:

- It needs to designate one or more corridors of interest, via a corridor ID field (default "corridor_ID") that assigns each centerline feature to one corridor or another.
- It needs to communicate a variety of information about the ROW cross-section of each centerline feature, in the Shared_ROW specification format.

- It needs to communicate several policy/land use context settings, including the relative priority of each of seven modes of travel along the corridor.

### Getting Started

OpenStreetMap (OSM) data is often a good place to start developing a centerline feature class. The analyst will still need to translate the OSM attributes into the Shared_ROW format, but much of the information needed to complete the Shared_ROW specification is included in common tags such as *lanes* and *bicycle*. Modal priorities must be determined through dialogue with relevant stakeholders.

Consult the attribute table of sample dataset "t2_centerline_input" in the attached file geodatabase for a holistic view of the fields to be populated in the centerline feature class for optimal performance with the Curbside Management Tool.

### Visualizing the Centerline Data

Using the instructions in **Appendix C**, the analyst can create a visualization of the centerline file and its associated curbside features. The dashboard will allow viewing of specific statistics associated with the curbside features.

# *Component 2 - Prepare Linear Reference Correspondence*

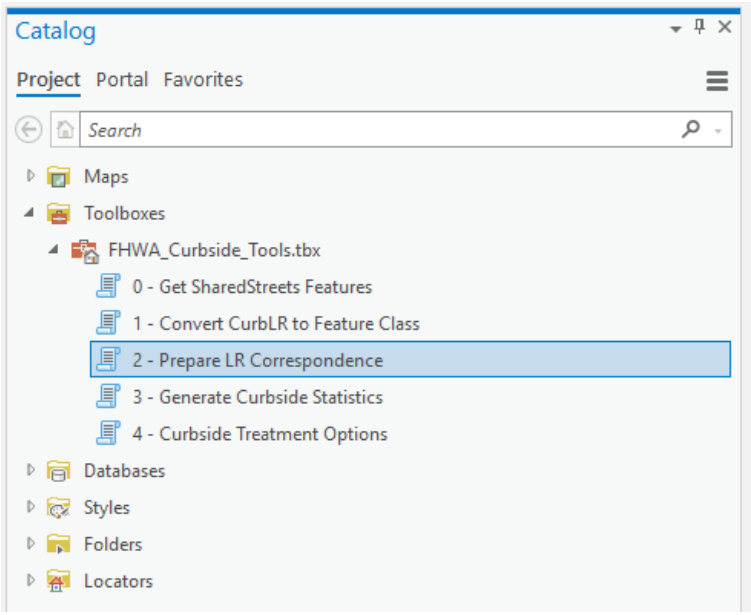



*Figure 11: Prepare Linear Reference Correspondence* Component *in the Tool.*
*Source: Esri*

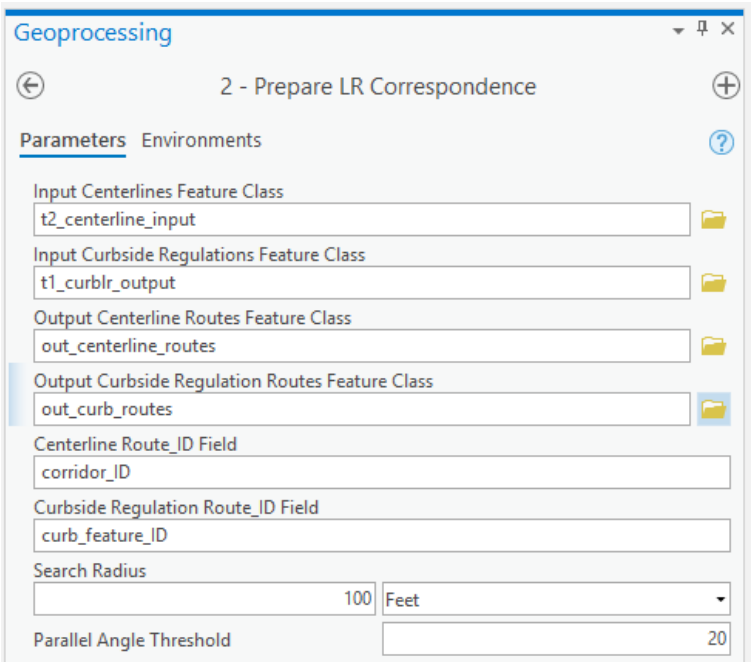



*Figure 12:* Prepare Linear Reference Correspondence *Function.*
*Source: Esri*

## What *Prepare Linear Reference Correspondence* Does

Establishes correspondences between an input curb regulation feature class and an input centerline feature class. Exports two route feature classes (curb features and centerlines).

This component checks for *proximity*, *parallelism*, and *adjacency* when deciding which curb features to associate with a given street centerline feature. See the separate technical documentation of this component in *Component 2 - Prepare Linear Reference Correspondence* for a detailed explanation of the algorithm used to identify appropriate curb feature/centerline feature pairs for association.

## Inputs

- *Input Centerlines Feature Class*: We recommend the analyst base their centerline feature class on OSM data to take advantage of OSM's built-in information on street cross-sections (e.g., number of lanes in each direction).
- *Input Curbside Regulations Feature Class*: Either the output of *Prepare Curbside Features*, or the product of primary data collection using the Collector schema.
- *Centerline Route_ID Field*: Name of field to use as centerline route IDs (component will create and populate this field with OIDs if it does not exist). Defaults to "corridor_ID."
- *Curbside Regulation Route_ID Field*: Name of field to use as curbside regulation route IDs (component will create and populate this field with OIDs if it does not exist). Defaults to "curb_feature_ID".
- *Search Radius*: User-tunable parameter governing the maximum permissible *proximity* between curb features and centerline routes. A default of 100 feet is typically a good choice.
- *Parallel Angle Threshold*: User-tunable parameter governing the maximum permissible *parallelism* between curb features and centerline routes. A default of 20 degrees is typically a good choice.

## Outputs

- *Output Centerline Routes Feature Class*: Linear-referenced centerline feature class.
- *Output Curbside Regulation Routes Feature Class*: Linear-referenced curb regulation feature class.

## Understanding the Outputs

"LR" stands for "linear referencing." This component determines how far along each corridor of interest each curb feature starts and ends. This is necessary to determine the amount of curb space allocated to a given purpose (see *Component 3 - Generate Curbside Statistics*).

## Tips and Tricks

- At some point, the analyst must communicate a set of modal priorities and other policy variables for implementation (see *Component 4 - Curbside Treatment Options*). This component, the first point where a centerline feature class is used, is a good opportunity to introduce these policy

variables. All of the centerline feature class's attributes are inherited through *Prepare Linear Reference Correspondence* and *Generate Curbside Statistics*.

- This component is also the point at which corridors of interest may be defined (using the *centerline_route_field* parameter of this component). Therefore, taking the time to carefully design and populate the input centerline feature class is well worth the effort.

# *Component 3 - Generate Curbside Statistics*

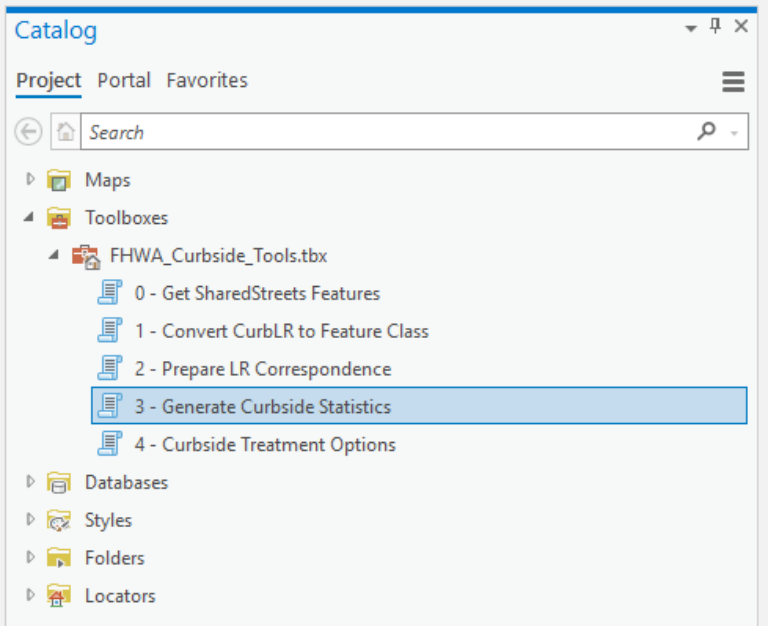



*Figure 13: Generate Curbside Statistics component in the Tool.*
*Source: Esri*

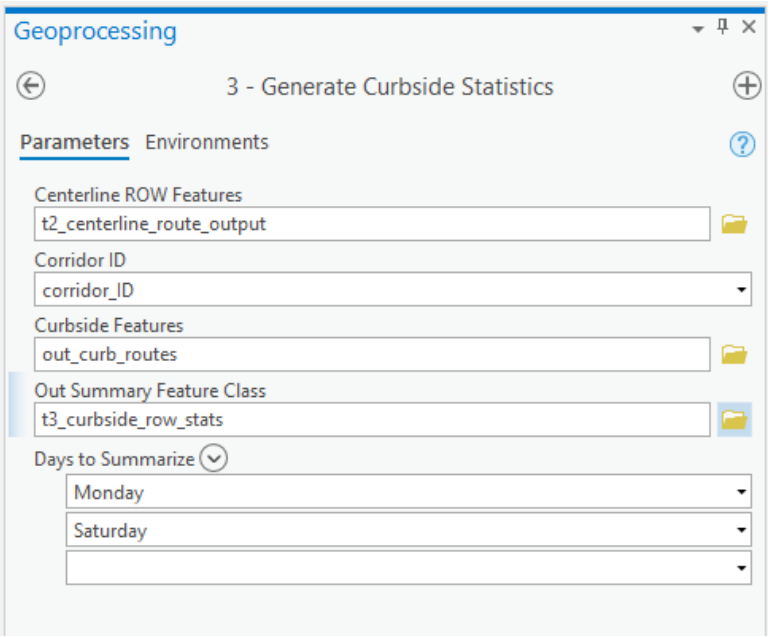



*Figure 14: Generate Curbside Statistics Function.*
*Source: Esri*

## What *Generate Curbside Statistics* Does

Given input centerline and curbside features (typically the route feature classes output by *Prepare Linear Reference Correspondence*), calculates statistics relating to ROW utilization and curb allocation that will be used by *Curbside Treatments Options* to assess the suitability of a range of treatment options for each corridor.

## Inputs

- *Centerline ROW Features*: input centerline feature class. Usually this will be the output centerline routes feature class from *Prepare Linear Reference Correspondence*.
- *Corridor ID*: the field containing the IDs of the corridors to be analyzed and summarized. Defaults to “corridor_ID.”
- *Curbside Features*: input curb regulation feature class. Usually this will be the output curb routes feature class from *Prepare Linear Reference Correspondence*.
- *Days to Summarize*: list of one to seven days of week to consider in the analysis and summary. Only curb regulations active on at least one of the selected days will be included in the analysis.

## Outputs

- Out Summary Feature Class: output centerline feature class, to contain one entry per unique value in the “Corridor ID” field.

## Understanding the Outputs

The output attribute table will include a range of fields pertaining to ROW and curb allocation. The total “available ROW” is calculated according to the following assumptions:

- Parking is removed;
- ROW is 'right-sized' with parking lanes set to 8 feet wide, curbside lanes 11 feet, and other through lanes 10 feet; or
- Application of a road diet or lane removal (does not impact two lane streets).

Curb allocation is expressed in terms of the most ubiquitous curb designation, then the next-most-ubiquitous, etc.

## Tips and Tricks

- If the organization’s curb regulation feature class is sparsely populated, make sure the analyst has selected days of week for the curb regulation data.

# *Component 4 - Curbside Treatment Options*

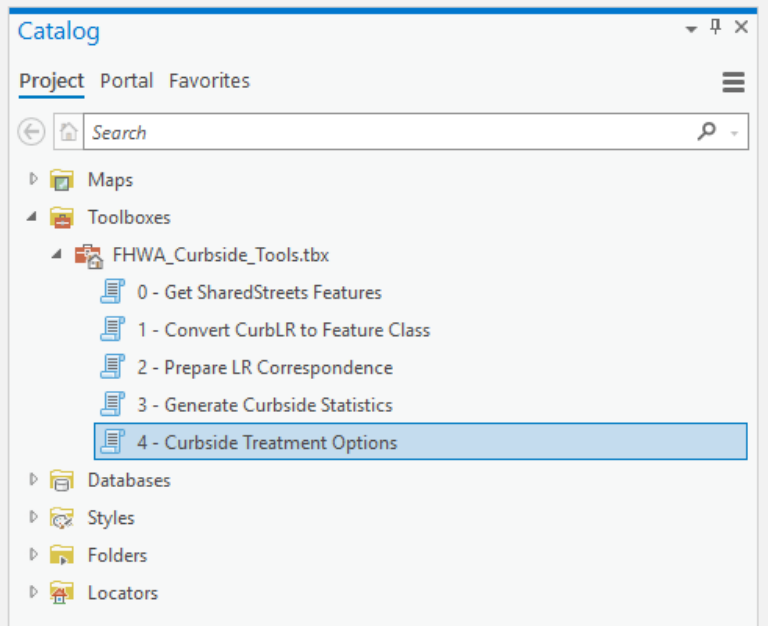



*Figure 15: Curbside Treatment Options component in the Tool.*
*Source: Esri*

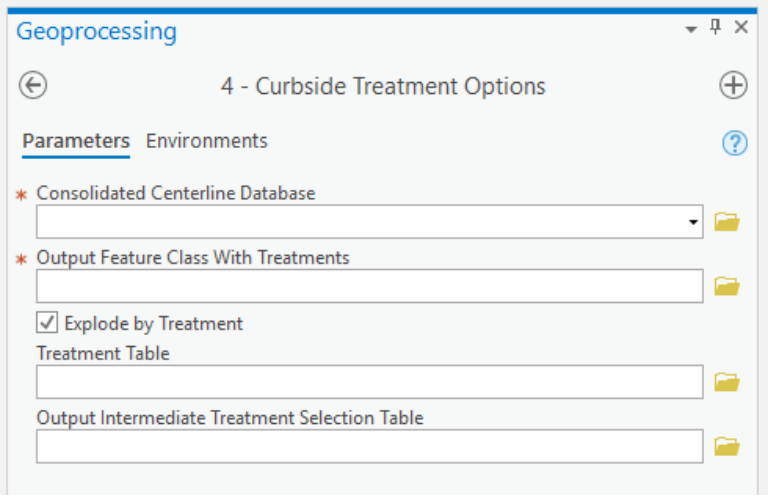



*Figure 16: Curbside Treatment Options Function.*
*Source: Esri*

## What *Curbside Treatment Options* Does

Identifies appropriate treatments for curbside and ROW management for each analysis corridor. These treatments are selected based on the alignment between the criteria required by each treatment option and the curb/ROW characteristics of each corridor as identified by *Generate Curbside Statistics*.

It is important to note that *Curbside Treatment Options* can be used as a stand-alone component, independent of the other components in this Tool. *Curbside Treatment Options* can accept any feature class of corridors to be analyzed (whose attribute table conforms to the expectations of this component) and any table of potential treatments (whose format conforms to the format of the example treatment table included with this Tool; see *Curbside Treatment Options* inputs below).

The following diagram describes in detail the five main criteria applied by *Curbside Treatment Options* to determine whether a given treatment is potentially applicable to a given study corridor. The five criteria are as follows:

- **Modal Priorities**: each corridor has an ordering of modes (or, more generally, potential uses for the corridor to accommodate, including travel modes as well as non-travel uses such as commerce). Each treatment has a mode that must be sufficiently prioritized on the corridor for it to be applicable. The criterion checks the relative priority of the treatment's key mode on each corridor.
- **Land Use**: each corridor has a predominant land use type (commercial, residential, or industrial). Each treatment is applicable within one or more land use types. The criterion checks whether each corridor's land use type matches any of the treatment's applicable land use types.
- **Place Type**: drawing on the "Transect" principle of land use planning and analysis, in which land use intensities and built environments are situated along a continuum from most to least intense and then grouped into so-called "place types," each corridor has a place type expressing the general land use intensity along the corridor. This component uses place types (ranging from "1. Urban Centers" to "4. Suburban Communities") adapted from the Caltrans Smart Mobility Framework. Each treatment is applicable within one or more place types. The criterion checks whether each corridor's place type matches any of the treatment's applicable place types.
- **Available Right-of-Way**: each corridor has some width of right-of-way (measured in meters, per direction of travel) available for repurposing toward treatments that require space for implementation. (Of course, some corridors may have no right-of-way available for repurposing; these corridors would have relatively fewer potentially applicable treatments.) Each treatment requires some width of repurposable right-of-way. The criterion checks whether each corridor has enough repurposable right-of-way for the treatment.
- **Success Metrics**: each corridor may have pre-defined metrics of success pertaining to each mode/activity included in Modal Priorities, and these metrics may or may not already be satisfied. For example, a given corridor may have a pedestrian success metric pertaining to observed pedestrian volumes, and existing pedestrian volumes may already equal or exceed the target established in the metric. If an existing success metric exists *and* is already satisfied, then treatments which seek to improve performance for that mode will not be marked as potentially applicable (because no further improvement is required, according to existing success metrics).

The criterion checks whether each corridor has a satisfied success metric for the mode/activity relevant to the treatment.

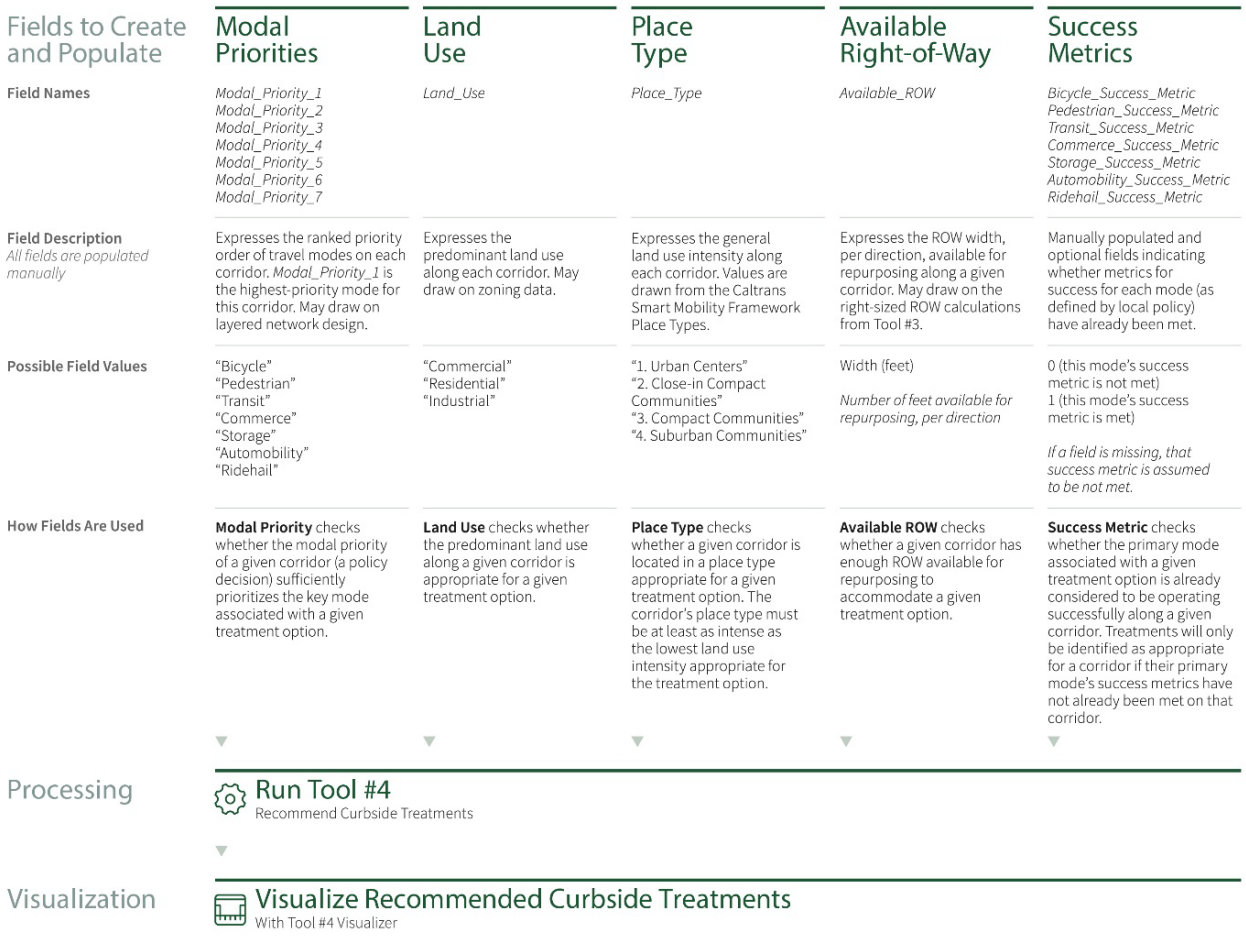



*Figure 17: Details of the internal logic of Curbside Treatment Options.*

# Inputs

- Consolidated Centerline Database: The output centerline feature class from Generate Curbside Statistics.
    - The analyst must add a field called "Available_ROW" (data type Double) and manually populate this field with the width of right-of-way (measured in meters, per direction of travel) available for repurposing. This step is manual because although *Generate Curbside Statistics* calculates the available right-of-way under three different ROW management scenarios, which scenario (or which combination of scenarios) is ultimately applicable for a given corridor is a policy decision the component itself cannot make.
- *Treatment Table*: A user-tunable table designating a range of treatment options, each with associated criteria. The default table, based on treatments described in the ITE Curbside Management Practitioners Guide, is included as *treatment_priority_lookup.xlsx*.

# Outputs

- *Output Feature Class With Treatments*: The feature class to contain the corridors with all relevant treatment options highlighted.
- *Output Intermediate Treatment Selection Table*: An optional output table showing why each treatment was or was not selected for each corridor in more detail.

# Understanding the Outputs

Either the *Output Feature Class With Treatments or* the *Output Intermediate Treatment Selection Table* will offer a view of which treatment measures were identified for which corridors.

# Tips and Tricks

- Explore the treatment table before running the component to make sure the treatments offered are sufficient for the associated criteria and reasonable for the organization's local context.
- Do not forget to create and populate a field called "Available_ROW," reflecting the width of right-of-way (in meters, per direction of travel) available for repurposing.
- Although it is not a required parameter, it is a good idea to specify the path to the treatment table in the geoprocessing component. This will avoid the pitfall of ArcGIS Pro not being able to find the treatment table in an expected location.

### Visualizing the Curbside Treatment Options

Using the instructions in **Appendix C**, the transportation professional will be capable of creating a visualization of the curbside treatment options. This will also include applicable statistics for viewing within the dashboard.

# Appendix A: Curbside Management Tool Documentation

## Glossary of Tool Language

**OpenStreetMap:** OpenStreetMap (OSM) is a collaborative platform for creating editable and free maps. The map data is available across the world. Users of OSM can may collect data using manual survey, GPS devices, aerial photography, and other free sources. The Open Database license makes the crowdsources data available. The map data can be used in different formats such as paper maps and electronic maps. OSM can be used for geocoding of address and place names, and route planning.

**SharedStreets:** SharedStreets supports a global referencing system connecting information about the street across jurisdictions, companies and governments. It develops open source software, digital infrastructure, and governance frameworks to facilitate public-private collaboration with the goal of efficient exchange of transport data.

**CurbLR:** The SharedStreets CurbLR open data specification provides a template for what type of information should be collected for a complete curb supply inventory, and how it can be stored in a consistent, uniform way. This open data specification allows jurisdictions to use an established resource which is compatible with data in its initial states, but does not have an open governance model.
The CurbLR data specification is built upon the Shared Street Linear Referencing system, which is used with OpenStreetMap, a commercial basemap or a city-managed basemap as a linear reference

**ArcGIS:** ArcGIS is a geographic information system (GIS) for working with maps and geographic information maintained by the Environmental Systems Research Institute (Esri). It is used to create and use maps, compile geographic data, analyze mapped information. It is also used for sharing and discovering geographic information, using maps and geographic information in a range of applications, and managing geographic information in a database.

The platform provides an infrastructure for making maps and geographic information available throughout an organization, across a community, and openly on the Web.

**ArcCatalog:** The ArcCatalog application provides a catalog window that is used to organize and manage various types of geographic information for ArcGIS for Desktop. Geodatabases, Raster files, Map documents, globe documents, 3D scene documents, and layer files, Geoprocessing toolboxes, models, and Python scripts, GIS services published using ArcGIS for Server, Standards-based metadata for these GIS information item can be organized and managed through this.

**ArcGIS Online: ArcGIS Online** is a cloud-based mapping and analysis solution. It is used it to make maps, analyze data, and to share and collaborate.

**ArcGIS Collector:** ArcGIS Collector is a mobile data collection app and makes it easy to capture accurate. Fieldworkers use web maps on mobile devices to capture and edit data. ArcGIS Collector works even when disconnected from the Internet and integrates seamlessly into ArcGIS.

**Geodatabase:** An ArcGIS geodatabase is a compilation of geographic datasets of different types organized in a common file system folder, a Microsoft Access database, or a multiuser relational DBMS . it is native to ArcGIS and the primary data format used for editing and data management. It functions as the physical store of geographic information, primarily using a database management system (DBMS) or file system. Geodatabases have a comprehensive information model to represent and manage geographic information by a series of tables holding feature classes, raster datasets, and attributes.

**Shapefile:** A shapefile is a vector data storage format for storing the location, shape, and attributes of geographic features and is native to ArcGIS. It is stored as a set of related files and contains one feature class.

**Feature class:** A **feature class** is a collection of geographic **features** that share the same geometry type (such as point, line, or polygon) and the same attribute fields for a common area. Streets, well points, parcels, soil types, and census tracts are examples of **feature classes**.

**Python:** Python is a programming language that allows the analyst to work more effectively while integrated with ArcGIS Pro. Python is an interpreted, high-level, general-purpose programming language. Python's design philosophy emphasizes code readability with its notable use of significant whitespace. Its language constructs and object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects.

## Background


The foundation of curbside management is an underlying source of quality curb asset data. Curbside management data exists at the intersection of curb asset data and temporally and spatially prioritized use of the curb both plan the future of the organization’s curb uses within ArcGIS Pro. The Curbside Management Tool is intended to help plan the use of curb space. The Tool should be used to build from existing curb inventory to begin planning the prioritization of curb use. The Tool is built to be extensible regardless of jurisdiction size, or area of interest for curbside management planning. The Tool is built upon the foundation of the ITE *Curbside Management Practitioners Guide* and the FHWA *Curbside Inventory Report* (forthcoming).

*Figure 18: Curbside Management Practitioners Guide.*

# Tool Framework and Architecture

The core functionality of the Tool follows the Guide by focusing on the six essential functions of the public right-of-way (initially identified by the Seattle Department of Transportation): mobility, access for people, access for commerce, activation, greening, and storage.

**Table 2: Essential Right-of-Way Functions**

| Function | Definition | Uses |
|---|---|---|
| Mobility | Moves people and goods | • Sidewalks<br>• Bus or streetcar lanes<br>• Bike lanes<br>• General purpose travel lanes - includes freight<br>• Right-or left-turn only lanes |
| Access for People | People arrive at their destination, or transfer between different ways of getting around | • Bus or rail stops<br>• Bike parking<br>• Curb bulbs<br>• Passenger load zones<br>• Short-term parking<br>• Taxi zones |
| Access for Commerce | Goods and services reach their customers and markets | • Commercial vehicle load zone<br>• Truck load zone |
| Activation | Offers vibrant social spaces | • Food trucks<br>• Parklets and streateries<br>• Public art<br>• Seating<br>• Street festivals |
| Greening | Enhances aesthetics and environmental health | • Plantings<br>  - Boulevards<br>  - Street trees<br>  - Planter boxes<br>• Rain gardens and bio-swales |
| Storage | Provides storage for vehicles or equipment | • Bus layover<br>• Long-term parking<br>• Reserved spaces (e.g., for Police or other government use)<br>• Construction |

Source: ITE *Curbside Management Practitioners Guide*, page 8.

Related to six typical essential right-of-way functions are a series of Tool considerations used when architecting it. These considerations are tied into the user inputs required by the Tool to narrow the defined measures of effectiveness of the curb management treatment options.

- Existing curb allocations
- Curb allocation priorities (modal prioritization)

- Adjacent land uses and neighborhood characteristics/values
- Accessibility needs/demands
- Demand for shared use space such as car share, van pools, charging stations, etc.
- Goods movement/delivery
- Shared AVs
- Transit routes and stops
- Passenger and freight/delivery loading needs/demands
- Demand for bikeshare stalls or other emerging small vehicle classes such as scooters
- Parking supply/utilization
- Desired activation through parklets and other public realm amenities
- Stormwater and green infrastructure

The Curbside Management Tool is essentially classified into two groups of components. The first group is the geoprocessing group which will prepare data resources for analysis. These components are known as the Curbside Management Tool (Tool), and are referred to in this documentation as components 0, 1, 2, and 3, or, respectively, Get SharedStreets Features, CurbLR to Feature Class, Prepare Linear Reference Correspondence, and Generate Curbside Statistics. The second group is the analysis group, which uses the prepared data and user inputs to process and provide treatment options to the user. This is referred to as Tool 4 or Curbside Treatment Options. Collectively these five components constitute the ArcGIS Pro Curbside Management Tool.

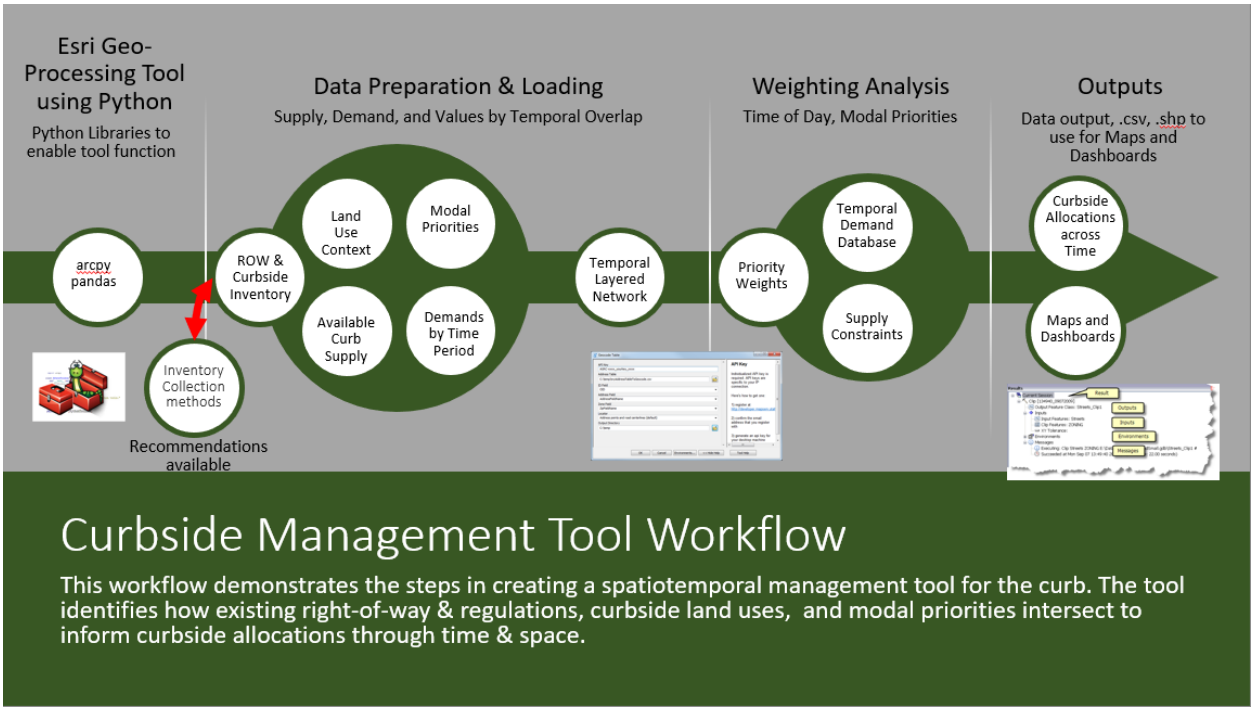



*Figure 19: Curbside Management Tool Workflow.*

The Tool workflow follows the standard data preparation and loading to enable the selection of priorities. Once a jurisdiction organization prioritizes modes and uses, the analysis can output a series of treatment

options. These treatment options leverage the six categories of measures of effectiveness (MOEs). There is a total of 67 treatment options from the six categories as seen in Figure 3. The detailed list of the 67 outputs can be referenced in the chapter on function Curbside Treatment Options.

**Table 3: MOE Categories and Number of Associated Treatments**

| MOE Category | Number of Treatments |
|---|---|
| Mobility | 35 |
| Livability | 4 |
| Access | 7 |
| Safety | 7 |
| Economics | 9 |
| Equity | 5 |
| **Total** | **67** |

## Data Standards Used

The Tool can function with the organization's existing curb inventory and centerline, or a suite of open data standards. These standards are OpenStreetMap (OSM) as a centerline processed through SharedStreets to enable a referencing system for street related data. SharedStreets not only relates data to the centerline, it also incorporates CurbLR to allow curb asset information to be linear referenced onto the street using the SharedStreets Referencing System. The goal of the Tool is to allow organizations to plan for the evolution of curb uses temporally and spatially.

If the organization needs to collect a curb asset inventory, we have provided a data schema that can be used in ArcGIS Online or ArcGIS Server Enterprise to enable ArcGIS Collector or ArcGIS Field Maps for use in an inventory.

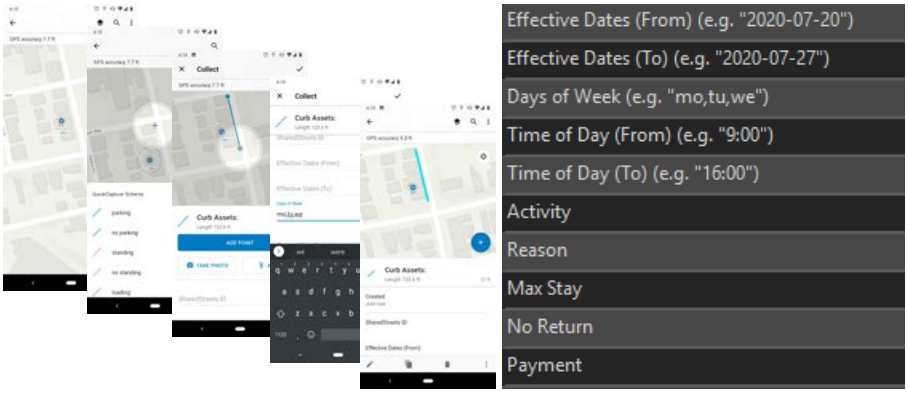



*Figure 20: ArcGIS Collector and Associated Data Schema.*
*Source: Esri*

# Tool Documentation

Each component of the Tool is documented in technical detail. The five components of the Tool are *Get SharedStreets Features*, *Convert CurbLR to Feature Class*, *Prepare Linear Reference Correspondence*, *Generate Curbside Statistics*, and *Curbside Treatment Options*.

# Component 0 - Get SharedStreets Features

SharedStreets, an open data specification built on OpenStreetMap, is a valuable source of street centerline geometry data for analysts who do not already have street geometry data.

According to SharedStreets' website:

> SharedStreets Referencing System is a global, non-proprietary system for describing streets. The Referencing System is the foundation of the SharedStreets toolkit and it is used to connect a wide range of street-linked data. The Referencing System connects street data from private companies and cities. Referenced data can then be transferred between different maps seamlessly.[1]

Thus, SharedStreets is a future-proof standard to use in the case that a jurisdiction does not already have street geometry data. If an agency/analyst does already have street centerlines, it may be preferable to simply use that dataset.

SharedStreets makes their data available through a free API (application programming interface); the *Get SharedStreets Features* conveniently wraps this API in an ArcGIS script that lets an analyst define a geographic area of interest and receive SharedStreets centerline features within that area as a feature class of line geometries, with SharedStreets IDs associated with each feature.

*Get SharedStreets Features* accepts as input a polygon and a SharedStreets API key. Analysts can obtain an API key at https://sharedstreets.io/get-started/ . The polygon's x- and y-extents (not its more detailed geometry) are used to define the region within which SharedStreets features are queried.

The component specifically queries the following SharedStreets API endpoint: https://api.sharedstreets.io/v0.1.0/geom/within?[urlParameters] SharedStreets API endpoints expect bounding box coordinates to be in decimal degrees. Therefore, *Get SharedStreets Features* reprojects the input polygon to the WGS 1984 geographic coordinate system (if it is not already in WGS 1984 projection).

# Component 1 - Convert CurbLR to Feature Class

The Tool needs a way to comprehend curb regulations. Convert CurbLR to Feature Classis the main way that the Tool accomplishes this goal.[2]

---

[1] https://sharedstreets.io/

[2] *The other way that the Curbside Management Tool comprehends curb regulations is via the Collector schema, which makes it easy for an analyst to manually collect data about curb regulations, thereby constructing a dataset analogous to the output of component #1.*

The component reads in a dataset of curb regulations in the CurbLR data format and translates these regulations into an Esri feature class of polyline features. Where CurbLR specifies that a given curb regulation applies at multiple times of day or on multiple days of the week, this component creates duplicate features so that the feature class can be visualized with a time slider, showing only the regulations active at a given time and day.

### SharedStreets and CurbLR

According to the CurbLR website:

> CurbLR is a data standard for describing curb regulations. It uses a simple structure to store complex restrictions and conditions regarding where different users can park, load, or stop their vehicles at different days and times. The CurbLR specification exists to help government agencies effectively manage and regulate the curbside, and to support public and private users of city streets.[3]

CurbLR is an open data standard, developed by SharedStreets (https://www.sharedstreets.io/). While other curb data standards exist, CurbLR is directly linked to OpenStreetMap (OSM). OSM is an openly available international street basemap and is easily integrated into a jurisdiction's workflow, as demonstrated by agencies in Portland, Oregon. Fehr & Peers selected CurbLR as the preferred curb data format to be ingested into the Tool because of its open specification and because of its common use among several major American cities with a substantial curb inventory, such as Los Angeles and Portland, Oregon.

CurbLR data are stored in a JSON (JavaScript Object Notation) file, which includes an array of curb regulation features as well as a manifest containing metadata. Each feature has a variety of properties, including geometry (location data) and regulations (one feature might have several regulations, each active at a different time). The below graphic shows how a real-world curb regulation is translated into CurbLR.

[3] https://curblr.org/

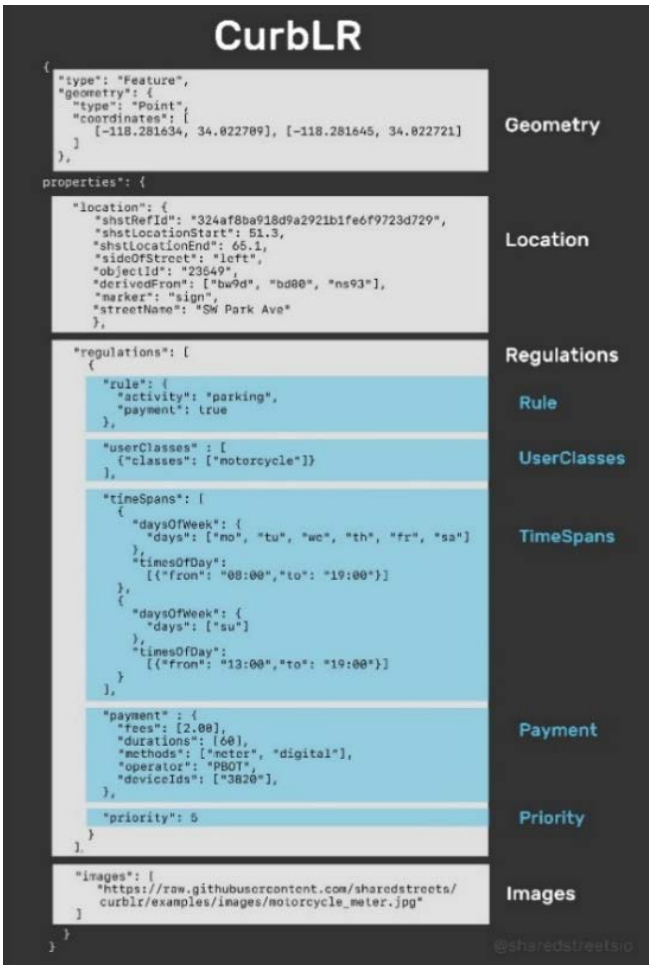



*Figure 21: Example of CurbLR JSON data as associated to signage.*
*Source: SharedStreets*

The CurbLR team has developed some conversion tools to convert cities' curb inventory data into CurbLR format. See https://github.com/sharedstreets/curblr/tree/master/conversions/js for several JavaScript files that convert Los Angeles curb open data to the CurbLR specification. A range of open-source tools to create and convert CurbLR data are also available at https://curblr.org/.

### *CurbLR to Esri Feature Class*

The component uses the `pandas` package, a popular Python library that enables fast, flexible data management and manipulation, to "normalize" the CurbLR JSON object into a table of curb regulations. CurbLR is a very flexible specification, so we do not attempt to translate all the information about a given regulation into our table. Instead, we focus on the following attributes, which together compose the attribute table of the output feature class:

- SharedStreetID – a unique alphanumeric identifier of the SharedStreets street centerline feature along which the curb regulation feature is located.
- effectiveDates_from – a text field containing the first date (inclusive; in MM/DD/YYYY format) on which the curb regulation is in effect. *This attribute was absent from the Los Angeles CurbLR*

*dataset that was used to develop this component, and as such this field is not fully implemented in Prepare Curbside Features.*

- effectiveDates_to – a text field containing the last date (inclusive; in MM/DD/YYYY format) on which the curb regulation is in effect. *This attribute was absent from the Los Angeles CurbLR dataset that was used to develop this component, and as such this field is not fully implemented in Prepare Curbside Features.*
- daysOfWeek – a text field containing a comma-separated list of two-letter day abbreviations (e.g., "mo,tu,we") indicating on which days the curb regulation is in effect. Component #1 includes some data cleaning code that addresses incorrectly formatted day codes in the Los Angeles CurbLR dataset that was used to develop this component.
- timesOfDay_from – a text field containing the first time (inclusive; in 24-hour HH:MM format) at which the curb regulation is in effect.
- timesOfDay_to – a text field containing the last time (*exclusive*; in 24-hour HH:MM format) at which the curb regulation is in effect. For example, "16:00" would mean that the regulation is in effect up to, but not including, 4:00 PM.
- timesOfDay_from_dt – a date field containing the starting day of week and time of day at which the curb regulation is in effect. This is designed for use with ArcGIS Pro's time-slider selection functionality. The date is chosen as one of January 1-7, 1900, where January 1 is a Monday. See "**Duplicate Features, One Per Day**" below for details about how curb regulations that are active on multiple days are duplicated for smooth graphical presentation.
- timesOfDay_to_dt – a date field containing the ending day of week and time of day at which the curb regulation is in effect.
- activity – what activity is forbidden or permitted. Specifically, one of "parking," "no parking," "standing," "no standing," "loading," or "no loading."
- reason – a brief text description of why the activity in question is forbidden or permitted. For example, "snow evacuation route" or "school pick-up/drop-off."
- maxStay – the length of time (in minutes) for which the curb may be used under the regulation.
- noReturn – the length of time (in minutes) that a user must vacate the curbspace before allowed to return for another stay. *This attribute was absent from the Los Angeles CurbLR dataset that was used to develop this component, and as such this field is not fully implemented in Prepare Curbside Features.*
- payment –if payment is required to use the curb; 0 otherwise. CurbLR includes additional payment details, but they are not used in the Tool.
- warnings – metadata indicating any potential data issues with the curb regulation feature (such as missing input data).
- primary – metadata indicating whether this feature is the primary (1) or a duplicate to reflect multiple days on which the regulation is in effect (0).

*See https://github.com/sharedstreets/curblr/blob/master/Rule.md and https://github.com/sharedstreets/curblr/blob/master/TimeSpans.md for more information about the source data in CurbLR.*

### *Duplicate Features, One Per Day*

In CurbLR, a single curb regulation feature can be in effect on multiple days of week and at multiple times of day. *Convert CurbLR to Feature Class*creates duplicate features in the output feature class, one for each unique combination of activity, time of day, and day of week, flagging the original copy of each curb regulation feature as "primary" and the duplicates as non-primary. For example, a given Esri feature class translation of a CurbLR dataset might have a total of 200 features, of which 40 are primary.

This feature is implemented so that the analyst can accurately visualize the curb regulations in effect at a given moment in time. If the component did not create the duplicate features, then ArcGIS Pro's time-slider selectors would show each regulation only on the first day of the week on which it is active. For example, a regulation active on Monday, Wednesday, and Friday would appear only on Monday. Duplicating the features allows *Convert CurbLR to Feature Class*to create timesOfDay_from_dt and timesOfDay_to_dt fields specific to each combination of day of week and time of day for which the curb regulation is active; these duplicate features will then show up correctly during each timespan for which the regulation is active.

## Component 2 - Prepare Linear Reference Correspondence

For Curb Management Prepare Linear Reference Correspondence, we needed to associate curbside regulation features ("curb features") with centerline features where three criteria are satisfied:

1. Proximity – the curb feature is (mostly) within a certain distance of the centerline feature
2. Parallelism – the curb feature is approximately parallel to the local portion of the centerline feature
3. Adjacency – the curb feature at least partially overlaps the centerline feature

In this memo we will examine each criterion in turn and discuss how our selected association approach robustly handles potential input geometries.

### Proximity

The curb feature must be within a certain (user-tunable) distance of the centerline feature. We could use the Esri Near (Analysis) tool to calculate the distance between the two features. This tells us only the minimum distance, not whether all or almost all of the two features are within a certain distance of each other. For example, the gray curb feature below is partially close enough to the blue centerline feature, but not entirely. This curb feature should *not* be associated with the centerline feature.

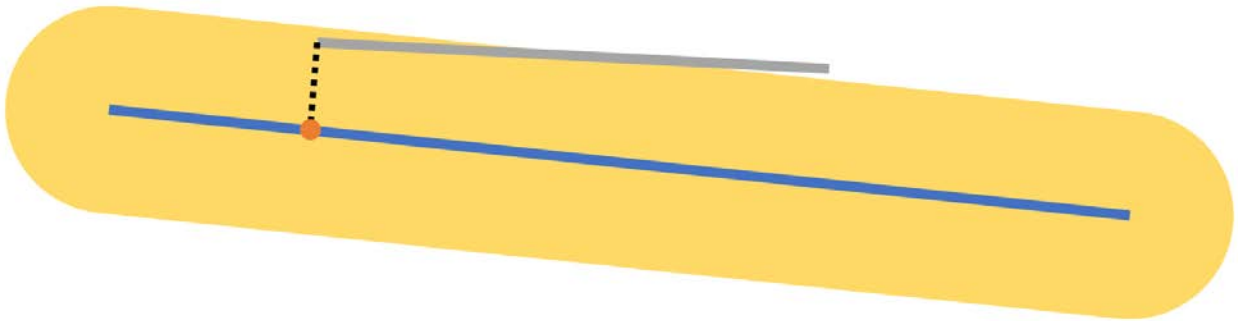


*Figure 22: Prepare Linear Reference Correspondence Proximity.*

Probably the most robust proximity detection approach would be to draw a buffer around a centerline feature and keep only those curb features lying entirely within the buffer. However, this is computationally intensive (one would need to iterate through centerline features) and usually more discerning than necessary. The curb features are usually relatively short and straight, so checking whether the start and end vertices of a curb feature are both within a certain distance of a centerline feature identifies whether the entirety of that curb feature is within that distance of the centerline feature.

A happy middle ground is achievable using the Esri Locate Features Along Routes (Linear Referencing) tool. First converting the start and end vertices of each curb feature to points using Feature Vertices To Points (Data Management), we then locate each vertex point feature along the centerline routes.[4] We specify a search radius, defining how far around each point a search will be done to find a target route. Then we can conclude that a curb feature is proximate to all centerline routes along which both the curb feature's start and end vertices were successfully located.

For example, the gray curb feature below is now correctly identified as *not* being proximate to the blue centerline feature. Meanwhile, the green curb feature *is* proximate to the blue centerline feature, because its start and end vertices were both successfully located along the blue centerline route.

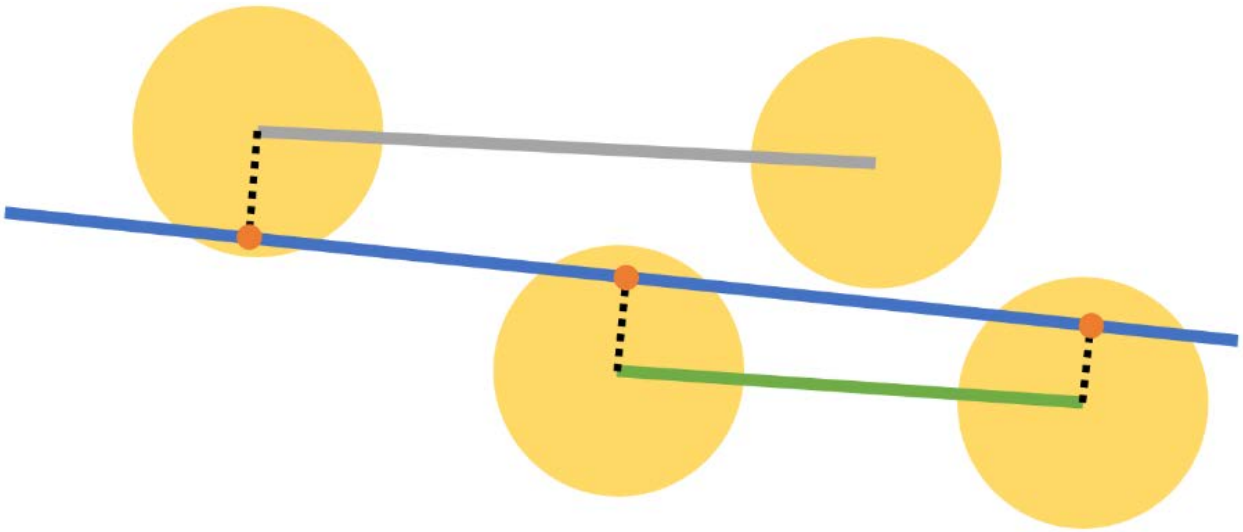


*Figure 23: Prepare Linear Reference Correspondence Proximity.*

What if a curb feature is proximate to more than one centerline route? In this case, we take advantage of the fact that located event tables can include the distance between each feature and route. This is the "Include distance field on output table" option. We associate the curb feature with the *nearest* centerline route (lowest average distance between vertices and route) – so long as that pairing of curb feature and centerline route also passes the parallelism and adjacency checks.

[4] *Use "centerline feature" and "centerline route" interchangeably, because component #2 is designed to output centerline routes and curb feature routes anyway.*

### Parallelism

The curb feature must be within a certain (user-tunable) angle tolerance of parallel to the centerline feature. A typical approach to detecting parallelism might be to calculate the bearing from the start vertex to the end vertex of both the curb feature and the centerline feature, then to compare those bearings. This works well when both the curb feature and centerline feature are approximately straight, but can fail when the centerline feature is curved. For example, the orange curb feature below should in fact be associated with the blue centerline feature, but the global bearing of the orange curb feature is too different from the global bearing of the blue centerline feature.

*Figure 24: Prepare Linear Reference Correspondence Parallelism.*

Again, a buffer-based parallelism solution is available: we could draw a buffer around a curb feature, then intersect that buffer with nearby centerline features, then calculate the bearings of the local portions of the centerline features and compare those bearings with the bearing of the curb feature. However, again, this process would be computationally intensive. Alternatively, we could split long and/or sinuous centerline features into shorter features that would be locally straight, but it is difficult to guarantee that such splits would align well with a given curb feature.

But what if we didn't actually need to calculate and compare bearings at all? It turns out that by using the distance field in the located events table generated by Locate Features Along Routes, we can assess parallelism using some basic trigonometry. We can take the difference in the distance from each curb feature vertex to the route[5] (call this "Distance_delta") and treat that as effectively the "opposite leg" of a right triangle whose hypotenuse is the length of the curb feature. Then we can calculate "d_over_l," Distance_delta divided by the curb feature's length, and low-pass filter our list of candidate curb feature–centerline feature associations such that we keep only associations where d_over_l is less than the sine of the user-specified angle tolerance. The below diagram illustrates this approach:

[5] *Note that the Distance field in the located events table is a signed floating-point number, where input features to the left of the M direction of the route will be assigned a positive distance, and features to the right of the M direction will be assigned a negative distance. This means that this trigonometric calculation will work properly even if the curb feature crosses the centerline feature.*

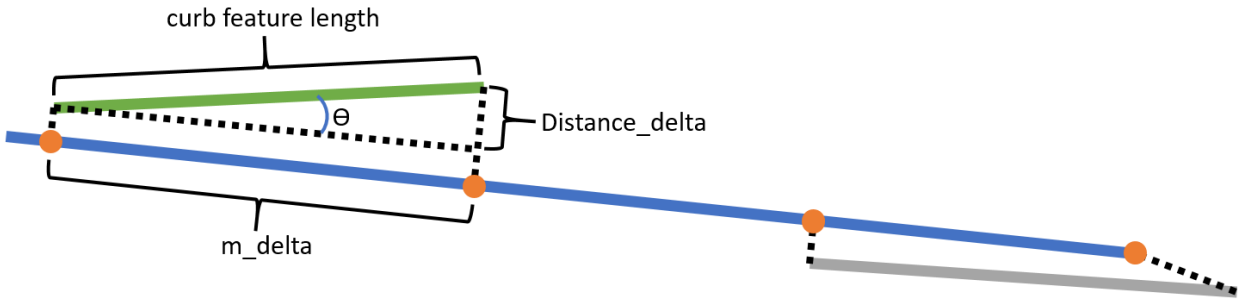



*Figure 25: Prepare Linear Reference Correspondence Parallelism.*

The dashed lines and labels surrounding the green curb feature show how the difference between the distance from each curb feature vertex effectively represents the length of the opposite leg of a right triangle whose hypotenuse is the length of the curb feature and whose adjacent angle is Θ. (The diagram also shows m_delta, the difference in the located m-values of the two vertices, which effectively forms the adjacent leg of this right triangle.) The green curb feature will only be associated with the blue centerline feature if sin(Θ), i.e., Distance_delta/curb feature length, is less than sin (angle tolerance).

It is worth discussing two details of this method.

- First, if both the curb feature and centerline feature are straight, these trigonometric calculations are precise; that is, Θ will be the exact angle between the curb feature and centerline feature. However, if either of the features is curved, the trigonometric calculations will be slightly imprecise, and Θ may not be exactly equal to the true angle between the two features. In practice, though, these discrepancies are sufficiently minute as to be unimportant – we need merely characterize the user-tunable parameter as an "effective angle tolerance" or "approximate angle tolerance" to acknowledge the small degree of discrepancy that can occur when the features are not straight.
- Second, if the curb feature overhangs the centerline feature (as the gray curb feature does in the above diagram), Distance_delta will not accurately represent the opposite leg of a right triangle. The effect of this configuration of features is to artificially increase Distance_delta and therefore to potentially cause the curb feature to incorrectly fail the parallelism check and erroneously *not* be associated with the centerline feature. However, this is not a serious problem in practice, because we can reasonably expect well-formed curb features to typically be (much) shorter than and not to overhang well-formed centerline features.

During development of this approach, we encountered many locations where OpenStreetMap centerline features were split one or more times mid-block (presumably because one or more attributes, such as the number of vehicle travel lanes, changed partway through a block). These locations hampered the correct association of curb features to centerline features. We would recommend that analysts use centerline features that represent, at a minimum, an entire block.

While the vast majority of locations where curb features overhung centerline features were where centerline features broke mid-block, there are also some naturally-occurring situations where a curb feature might reasonably overhang a centerline feature. For example, in the below diagram, the green curb feature spans the top of a T intersection, while the blue centerline feature represents one of the arms of the

T. Analysts are therefore advised to construct their centerline features thoughtfully, and to examine the curb features at the ends of their centerline features if the analysis's outputs are unexpected. (In a pinch, analysts can break long, overhanging curb features where necessary. Again, in practice, we anticipate this will almost never be necessary.)

*Figure 26: Prepare Linear Reference Correspondence Parallelism.*

### Adjacency

The curb feature must at least partially overlap the centerline feature. We implement this criterion by comparing the m-values of the located start and end vertices of the curb feature: if those m-values are the same, then the curb feature is either perfectly perpendicular to the centerline feature, or both of the curb feature's endpoints are offset from the extent of the centerline feature. In either case, the curb feature should not be associated with the centerline feature.

The below diagram shows the adjacency check in action. A buffer is shown around the blue centerline feature to demonstrate whether each curb feature is partially or entirely proximate to the centerline feature. Dashed black lines indicate the point along the centerline route where each curb feature's vertex is located. The two green curb features are both identified as adjacent to the blue centerline feature. (Note that the leftmost green curb feature only partially overlaps the blue centerline feature, but is nevertheless considered adjacent to the centerline feature.) The gray curb feature is *not* adjacent to the blue centerline feature, because both of its vertices were located at the same point along the centerline route. The orange curb feature would be adjacent to the blue centerline feature, except it does not pass the proximity test because one of its vertices is too distant from the centerline feature.

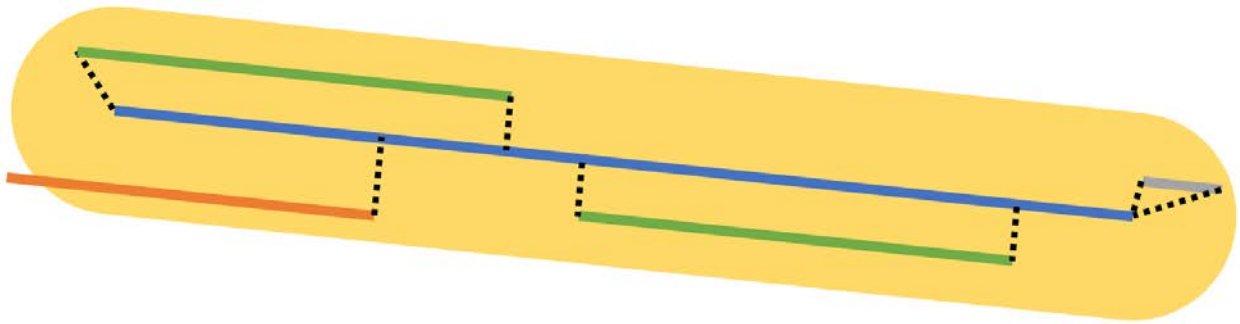


*Figure 27: Prepare Linear Reference Correspondence Adjacency.*

As we have seen above, curb features that only partially overlap a centerline feature may be erroneously *not* associated with the centerline feature if they fail the proximity test (because the overhanging vertex is not within a distance threshold of the end of the centerline feature) or the parallelism test (because the overhang artificially inflates Distance_delta). As stated before, in practice, well-formed curb features should very seldom overhang well-formed centerline features; nevertheless, analysts are advised to exercise caution where curb features are long and centerline features are short.

# Component 3 - ROW and Curbside Summary Statistics

Curb Management ROW and Curbside Summary Statistics manipulates feature classes containing curb regulation data and street centerline right-of-way (ROW) data to generate summaries of ROW and curbside utilization by purpose, aggregated to the level of user-defined corridors of interest.

Typically, ROW and Curbside Summary Statistics will operate on the feature classes output by Prepare Linear Reference Correspondence . As the component's name suggests, ROW and Curbside Summary Statistics prepares summary statistics for both ROW allocation and curb allocation, assuming that the necessary fields can be found in the centerline and curb regulation feature classes.

Implicit in the design of ROW and Curbside Summary Statistics (and Curbside Treatment Options) is the notion that curb management is inextricably linked to ROW management.

### Input Dataset Best Practices

As noted, ROW and Curbside Summary Statistics typically operates on the feature classes output by Prepare Linear Reference Correspondence. However, Prepare Linear Reference Correspondence merely performs a geospatial association operation and passes through any fields encountered in its input feature classes' attribute tables. By the time the centerline feature class reaches ROW and Curbside Summary Statistics , it is necessary for the centerline feature class to include ROW data in accordance with the shared-row specification (https://github.com/d-wasserman/shared-row) if the analyst wants to include ROW information in the corridor-level summaries. Therefore, the analyst should consider incorporating shared-row fields into the centerline feature class they input into Prepare Linear Reference Correspondence.

ROW and Curbside Summary Statistics prepares summaries at the level of corridors of interest, defined as aggregations of all centerlines/curb features associated with a given corridor_ID. Despite the name, corridor_ID could be used to analyze an entire two-dimensional area of interest: all features sharing the same corridor_ID will be aggregated together. Note, however, that ROW and Curbside Summary Statistics expects the shared-row values to be the same for all centerline features sharing a given corridor_ID. This may not be an issue if the analysis corridors are each just one block long, but if a study corridor encompasses numerous blocks, it is unlikely that the ROW characteristics of all the blocks will be identical. In this case, the analyst may instead wish to manually populate the shared-row fields with values that roughly correspond to the most prevalent ROW conditions.

### Right-of-Way Summary

ROW and Curbside Summary Statistics attempts to summarize ROW availability and curb allocation; each of these two summaries requires a distinct set of fields in the attribute tables of the input datasets, but

each can occur independently of the other. For example, if the ROW fields are missing, ROW and Curbside Summary Statistics can still summarize curb allocation.

The below graphic from the shared-row repository illustrates the difference between an "additive representation" and a "slice representation" of the same information. ArcGIS attribute tables require the use of an additive representation.

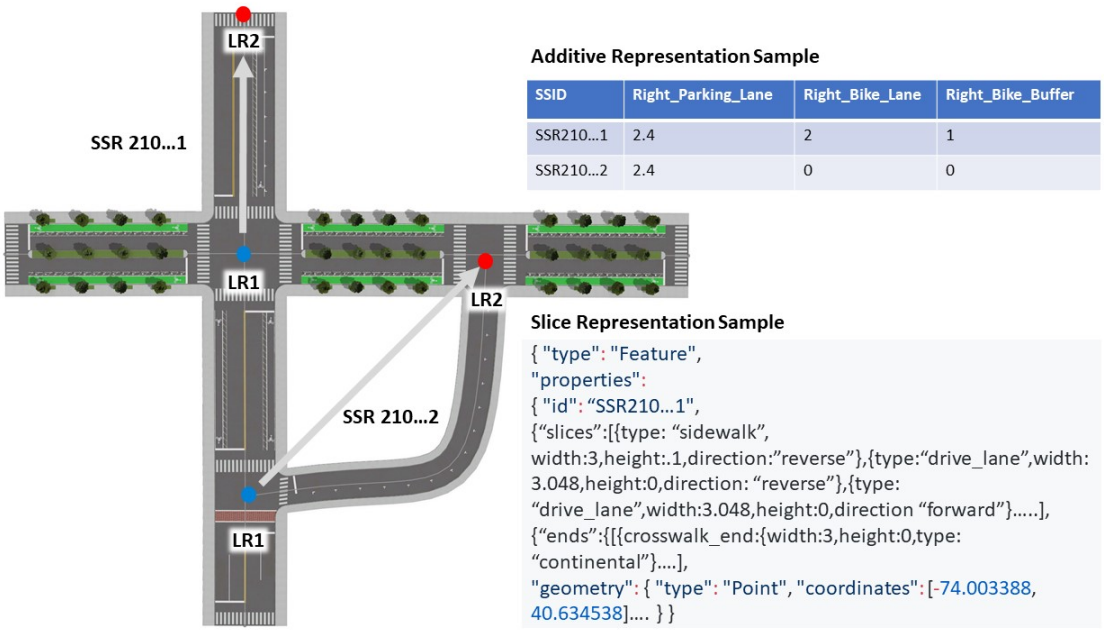



*Figure 28: Shared ROW Specification Sample.*
*Source: David Wasserman - https://github.com/d-wasserman/shared-row/blob/main/assets/SpecificationSample.JPG*

It is often feasible to manipulate the tags of OpenStreetMap (OSM) features to populate many of the essential fields in the shared-row specification. It is anticipated that OSM-to-shared-row ingestion tools will become available in the future; however, as of this writing, no such tools exist. Again, because of ROW and Curbside Summary Statistics expectation that all centerline features sharing a given corridor_ID must share shared-row values, the analyst may be better off manually constructing corridors of interest and populating their shared-row fields with typical ROW values for the corridor considered as a whole.

Because the Tool's set of potential corridor treatments considers not only the amount of curb space available for a treatment, but also the amount of ROW width available for a treatment, ROW and Curbside Summary Statistics evaluates each corridor's ROW availability for reallocation under three sets of assumptions:

1. Parking is removed;
2. ROW is "right-sized" with parking lanes set to 8 feet wide, curbside lanes 11 feet wide, and other through lanes 10 feet wide; and

3. A road diet or lane removal is applied (unless the street in question is already a two-lane street).

If the ROW summary does not function correctly, check to make sure that the input centerline feature class attribute table includes field names and types that are compliant with the shared-row specification, and that these attributes are appropriately populated with values.

### Curb Allocation Summary

Whether or not a ROW summary is feasible, ROW and Curbside Summary Statistics will summarize curb allocation along each corridor. This is accomplished by collecting all curb regulation features associated with the corridor (recall that this association was accomplished by Prepare Linear Reference Correspondence), calculating the number of feet-hours of curb allocated to each combination of activity (e.g., “no parking”) and reason (e.g., “peak period travel lane”) on the days of week to be analyzed, and storing the resulting set of curb allocations in descending order of prevalence.

If the curb allocation summary does not function correctly, check the following items:

- corridor_ID field names must match between the centerline feature class and the curb regulation feature class.
- Curb regulation features must have all the necessary fields as produced by Convert CurbLR to Feature Classor the Collector schema.
- The curb regulation feature class may not include any curb features associated with a given corridor on the days of week to be analyzed.

### Other Parameters

In addition to the input centerline feature class and curb regulation feature class, ROW and Curbside Summary Statistics accepts several other parameters that must be properly understood and configured:

- corridor_ID – the field name in the centerline and curb regulation feature classes’ attribute tables containing the designations of which analysis corridor each feature participates in.
- output_summary_feature_class – the output feature class, to contain the centerline features with summaries of ROW availability and curb allocations by corridor_ID.
- days_of_week_analyzed – which days of week are focused on by the analysis component. This affects only the selection of curb regulation features for the curb allocation summary.

## Component 4 - Curbside Treatment Options

The goal of the Tool Curbside Treatment Options is to provide options for potential curbside treatments based on the context of a street understudy.

This component uses inputs of right-of-way (ROW) centerlines, demand and policy tables, and curbside feature classes to develop summary statistics that relate to the availability of ROW for improvements, curbside allocations by time period, and other summary statistics. Output summary statistics can be used to present curb treatment options or produce infographics to inform curbside management.

This memo will examine how curbside recommendations can be made across different land use and transportation typologies.

### Factors to Consider

Curbside management has many considerations that can influence potential treatment options. Therefore, no one tool can provide comprehensive insights required to address what strategies are more appropriate. A series of treatment options are made available to the user to review and potentially select the ideal option as a preferred treatment. The Data inputs into the component are loaded from the centerline data which is created by prior components, and the treatment table which is detailed later.

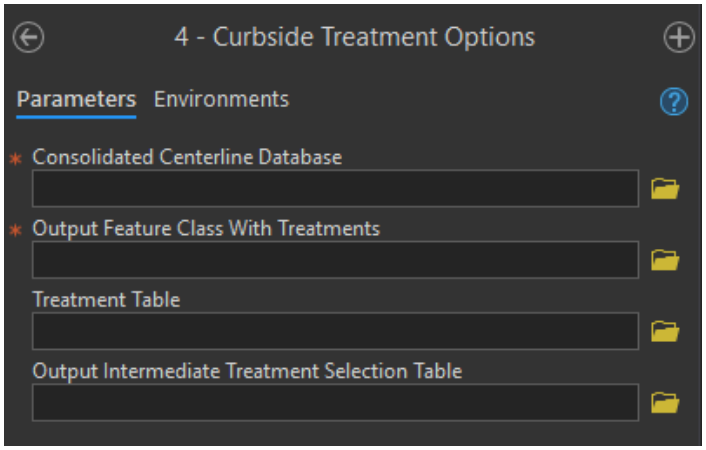



*Figure 29: Curbside Treatment Options Function Source.*
*Source: Esri*

### Analytical Data Requirements

- ROW Centerlines: Consolidated centerlines which has built environment attributes, ROW information and modal priorities. The necessary attributes for this data resources include:

    1. Land Use information
    2. Modal priorities on a range from 1 to 7,
    3. The place type information
    4. ROW that is available
    5. Modal priority success metric information

- Treatment Priority Lookup Table (see **Appendix D**): The Treatment Priority Lookup Table is an essential component which provide user guidance to the component to analyze with the ROW Centerlines. The Treatment Priority Lookup Table is referenced in **Appendix D** and should include the following information:

    1. Mode priority which is applicable for each treatment to be implemented.
    2. The mode priority rank range (Indicates the appropriate modal priority ranking range in the data for the mode priority applicable for the treatment to be applied).
    3. The appropriate place type for each of the treatment to be applied. (Different place types are appropriate for different treatments; this will help checking the consolidated center line database if the necessary place type is available for a treatment to be implemented).

4. Appropriate Land use for each of the treatments. This criterion will also help checking the Land Use information available in the data for any specific treatment to be implemented.
5. Total ROW necessary per direction for a treatment to be implemented. This will again help to compare the ROW information in the data and check if the ROW requirement is present in the data to implement any treatment.
6. The MOEs associated with each of the treatments should be there in the treatment.

- Curbside Feature Classes: The curbside features are initially the curb asset inventory, but ultimately, they are the Curbside statistics.

1. The original curbside features data is derived from the CurbLR data resource processed from a curb inventory and associated with the Shares Streets segments.
2. Otherwise the curbside feature class can be developed from the data schema provided to use in ArcGIS Collector.
3. The collected data can be exported from ArcGIS Online to be input into Prepare Linear Reference Correspondence to produce the Linear Referenced Correspondence and 3 ROW and Curbside Summary Statistics.
4. Lastly the input is the consolidated centerline data which includes the curbside features.

### Analytical Workflow

The component has multiple "sieve" functions which basically use verified data from specific inputs represented by the specific data resource described below. Each "sieve" is scripted to validate treatment types matches according to specific criteria.

Functions are:

1. "modal_priority_sieve": This function validates and assigns a value to the modal priority. A successful match it will return 1 otherwise 0.
2. "land_use_sieve": This function takes validates if a land use orientation is identified as a predominant land use in the ROW.
3. "place_type_sieve": This function validates if a placetype meets the minimum multimodal orientation and density required for a treatment. This is conducted by validating the density of the place type.
4. "row_available_sieve": This validates if the ROW meets the minimum identified for the treatment.
5. "success_metric_sieve": This validates if a success metric for a corresponding modal priority is already met. If a success metric is a 1, then all treatments that relate to that modal priority are not considered.

These functions are also explained in the following diagram, which describes in detail the five main criteria applied by *Curbside Treatment Options* to determine whether a given treatment is potentially applicable to a given study corridor.

Upon running through the validations, the component creates an intermediate table to store treatment and object ID's for each segment. This is accomplished using the database and the treatment table which allows the preferred individual treatments and their associated modal priorities and MOEs. Finally, this function will return an intermediate output where for each segment will have treatments assigned. Each of

the 26 treatments are stored and validated if the treatment is applicable. The output represents the criteria and treatment options for each segment.

Lastly, the final output leverages the treatments table and the intermediate output file to create final output where for each street segment includes all the possible treatment IDs and associated MOEs.

The Curbside Treatment Options component consumes data identifying modal priorities, built environment contexts, ROW information, and other factors to identify treatments options based on demand information, policy data, and the right-of-way uses.

### Parameters for Analysis

Inputs: Consolidated Centerline Database (Feature Class), Treatment Table (CSV),

Output: Output Centerline Database with Treatments (treatments and MOEs associated with feature class).

**Table 4: Curbside Treatment Options Function Parameters.**

| Required Parameter | Parameter Type | Parameter Description |
|---|---|---|
| Consolidated Centerline Database | Feature Class | Input consolidated centerline file that uses attributes from previous components, built environment attributes, ROW information, and modal priorities that treatment fields will be added to in the output feature class |
| Output Centerline Database with Treatments | Feature Class | This output feature class is a copy of the centerline file provided but with treatments and corresponding MOEs for them associated with the feature class. |
| Treatment Table | CSV Table | This CSV file includes all the possible treatments by modal priority, priority rank range, place type, land use, and ROW. By default, one is already created and configured. |
| Output Intermediate Treatment Selection Table | CSV Table | This optional output CSV will provide an intermediate and inspectable output table that identifies exactly why different treatments were identified and selected given its treatment selection criteria in the treatment table. |

Program Steps:

1. Input centerlines are field validated to ensure the required land use, modal priority, and other fields are present in the centerline file.
2. A treatment CSV table containing treatments and their related selection criteria (represented in columns) are read into the component.
3. A new table is created for every segment – the total number of rows is equal to the total number of segments multiplied by the total number of available treatments in the treatment CSV table (this new table is the segment-treatment table).
4. A new column is added to the segment-treatment table for each treatment's criteria column. Each of these new columns are assigned a value of either 1 or 0 based on one or more criteria columns

and its corresponding review functions for each column in the python component. A value of 1 means the segment meets the qualifying criteria for that treatment, while a value of 0 indicates that it does not.

5. Treatments are identified for all segments with successful criteria of 1 across all the identified criteria (the sum of the columns should equal the number of conditions of success identified in the criteria columns).
6. The group-by are used to compress all the treatments that pass all the conditions of success and associated with the output feature class (a copy of the input).
7. If the optional intermediate CSV is given an output path, then this component will export a CSV that can be inspected by the user in order to understand why different selections were made.

### Measures of Effectiveness (MOEs)

The Measures of Effectiveness are taken from the Curbside Inventory Report. The six general categories: Mobility, Livibility, Access, Safety, Economic, and Equity have each metric assigned an ID for use in the data structure of the component. This table is a reference to the Treatment Priority Lookup which is used in the Curbside Treatment Options function.

**Table 5: Measures of Effectiveness by Category, Name and Associated ID used in the Function Curbside Treatment Options.**

| MOE Category | MOE | MOE ID |
|---|---|---|
| Mobility | Increase the number of people and/or access to goods the curb provides | MOB-01 |
| | Fewer blocked transit lanes (i.e., automobiles or loading activity located in transit lanes, impeding transit vehicles) | MOB-02 |
| | Improved transit reliability | MOB-03 |
| | Improved transit ridership | MOB-04 |
| | Improved average transit speed | MOB-05 |
| | Fewer blocked bicycle facilities (i.e., automobiles, loading activity located in bicycle facilities, impeding bicyclists, etc.) | MOB-06 |
| | Increased number of bicyclists | MOB-07 |
| | Additional bicycle parking provided | MOB-08 |
| | Fewer blocked crosswalks | MOB-09 |
| | Fewer blocked sidewalks | MOB-10 |
| | Fewer blocked transit lanes | MOB-11 |
| | Fewer blocked bicycle facilities (i.e., automobiles, loading activity located in bicycle facilities, impeding bicyclists, etc.) | MOB-12 |
| | Fewer blocked crosswalks | MOB-13 |
| | Fewer blocked sidewalks | MOB-14 |
| | Loading zone availability and utilization | MOB-15 |
| | Improved transit ridership | MOB-16 |
| | Increased use of car-share | MOB-17 |

| MOE Category | MOE | MOE ID |
|---|---|---|
| | Higher occupancy in ride-hailing vehicles (i.e., increased use of shared ride-hailing vehicle rides) | MOB-18 |
| | Increased number of bicyclists | MOB-19 |
| | Increased amount of bicycle parking | MOB-20 |
| | Increased use of scooter-share or bike-share | MOB-21 |
| | Increased amount of parking available for scooter-share or bike-share | MOB-22 |
| | Reduced congestion and pollution levels | MOB-23 |
| | Reduced single user vehicle usage | MOB-24 |
| | Reduced parking demand for private vehicles | MOB-25 |
| | Expanded opportunity for electrification of transportation modes | MOB-26 |
| | Target turnover levels achieved | MOB-27 |
| | Improved wayfinding and user experience | MOB-28 |
| | Reduced parking demand for private vehicles | MOB-29 |
| | Reduced cruising behavior | MOB-30 |
| | Reduced congestion and pollution levels | MOB-31 |
| | Improved emergency vehicle response time | MOB-32 |
| | Improved vehicle travel time on designated streets | MOB-33 |
| | Increased average vehicle occupancy | MOB-34 |
| | Multiple curb uses supported in the same curb space simultaneously or sequentially (e.g., flex zones) | MOB-35 |
| Livability | Additional park/green space provided | LIV-01 |
| | Utilization of park/green space | LIV-02 |
| | Additional seating/community gathering space provided | LIV-03 |
| | Enhanced public space activation | LIV-04 |
| Access | More accessible loading and parking zones provided on street | ACC-01 |
| | More accessible loading and parking zones provided off street | ACC-02 |
| | Accessible loading and parking policy and prioritized implementation plan in place and routinely followed | ACC-03 |
| | Fewer ADA lawsuits against the jurisdiction | ACC-04 |
| | Reduced illegal use of accessible loading and parking zones | ACC-05 |
| | Feedback from community members with disabilities that access is safer and more convenient | ACC-06 |
| | Fewer ADA lawsuits against the jurisdiction | ACC-07 |
| Safety | Fewer negative consequences of curbside access events | SAF-01 |
| | Less risky consequences of curbside access events (i.e., collisions are less likely to affect vulnerable users or less likely to be high-speed) | SAF-02 |

| MOE Category | MOE | MOE ID |
|---|---|---|
| | Fewer near miss incidents | SAF-03 |
| | Reduced pedestrian or bicycle conflicts with heavy trucks | SAF-04 |
| | Reduced moving vehicle violations | SAF-05 |
| | Fewer collisions | SAF-06 |
| | Fewer roadway injuries or fatalities | SAF-07 |
| Economic | Staff time coordinating deliveries reduced | ECO-01 |
| | Enhanced availability and convenience of loading zones | ECO-02 |
| | Loading zone utilization | ECO-03 |
| | Additional café/ restaurant seating provided | ECO-04 |
| | Improved sales receipts | ECO-05 |
| | Additional funding available for streetscape and façade enhancements | ECO-06 |
| | Suitable funding streams for maintenance of curb projects is maintained | ECO-07 |
| | Streamlined data collection and analysis procedures in place across city departments | ECO-08 |
| | Innovative technology in place for real-time efficacy monitoring | ECO-09 |
| Equity | Changes do not have negative impacts on vulnerable populations | EQU-01 |
| | Changes include benefits for vulnerable populations | EQU-02 |
| | Changes to the curb prioritize curb uses valued by vulnerable populations | EQU-03 |
| | Increase or improve access to affordable mobility options | EQU-04 |
| | High-functioning, public-private stakeholder body assembled and meeting regularly | EQU-05 |

# Appendix B: ArcGIS Online Step by Step

## Purpose

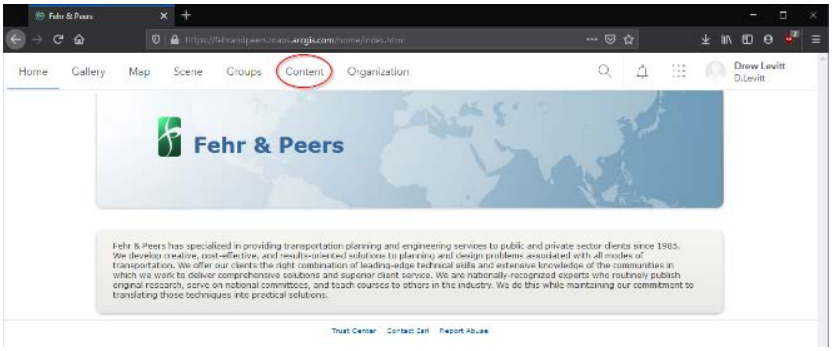
When no curb asset inventory exists, it is possible to use the Esri ArcGIS Collector (or Field Maps) to geographically catalog curb assets. A data schema has been provided for use in ArcGIS online and within the preferred mobile app. This Guide assists in demonstrating how to load the data schema and load it into the app for use in the field. Curb asset data will be used to merge with organization's street centerline in the Tool.

*All images within Appendix B are sourced from Esri.*

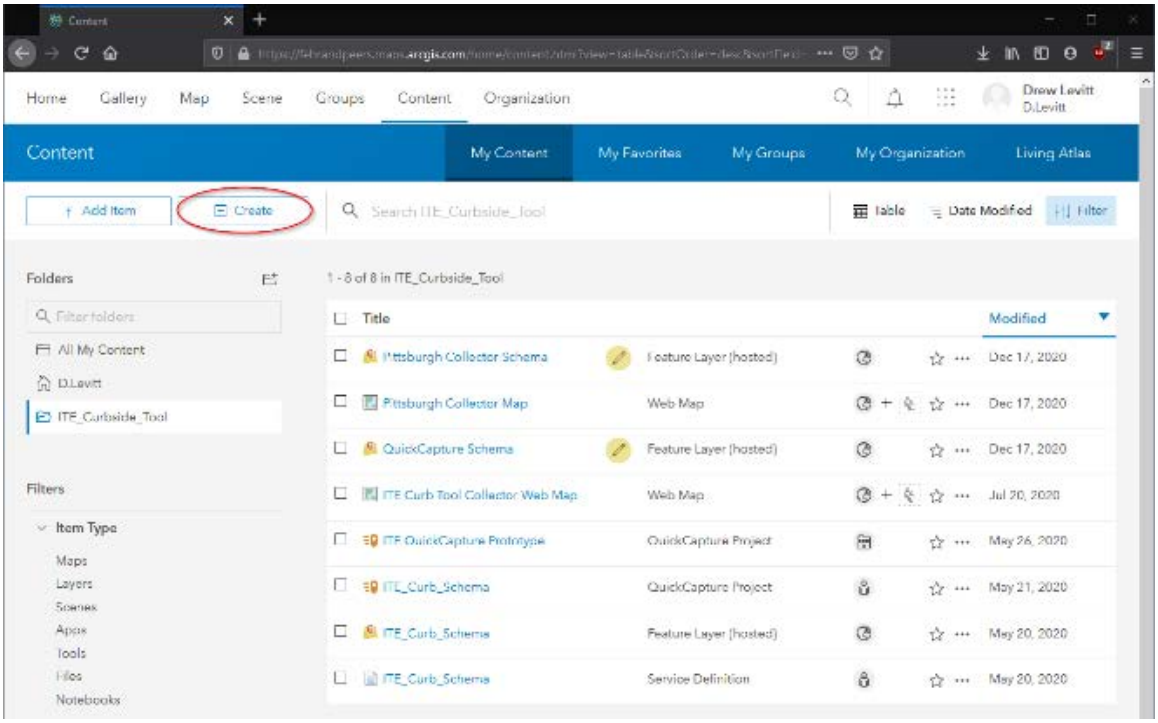
## Create an ArcGIS Online hosted feature layer to store curb data

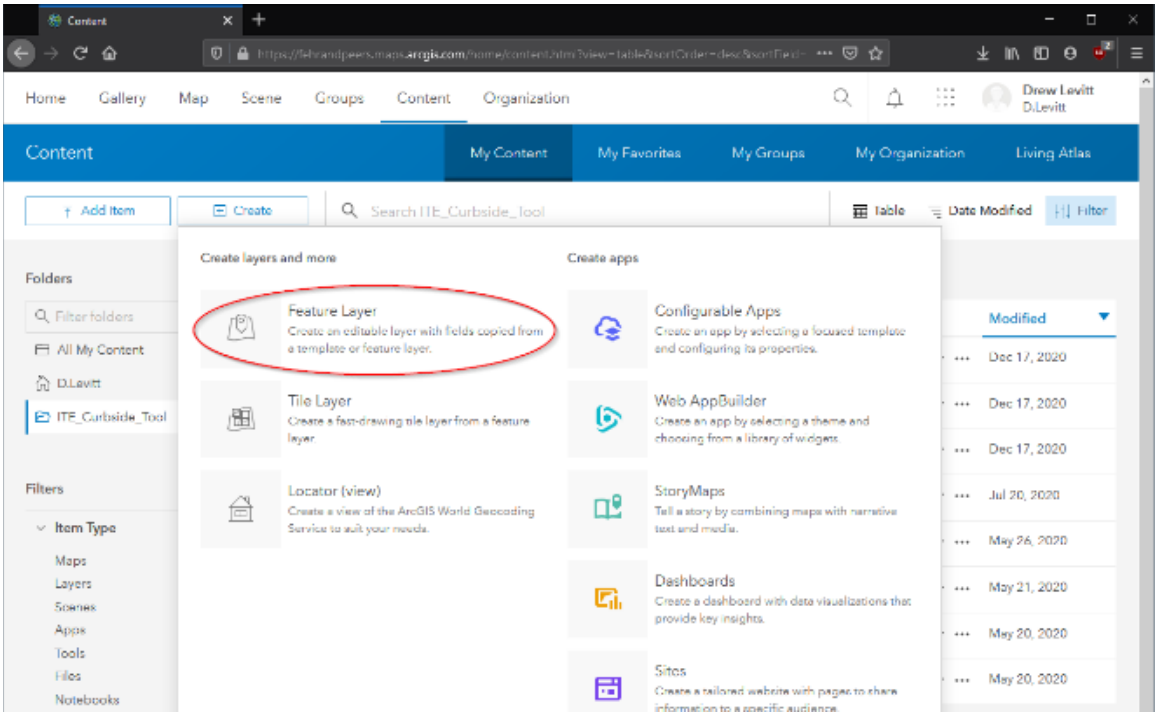
Sign into ArcGIS Online.


Go to "Content."

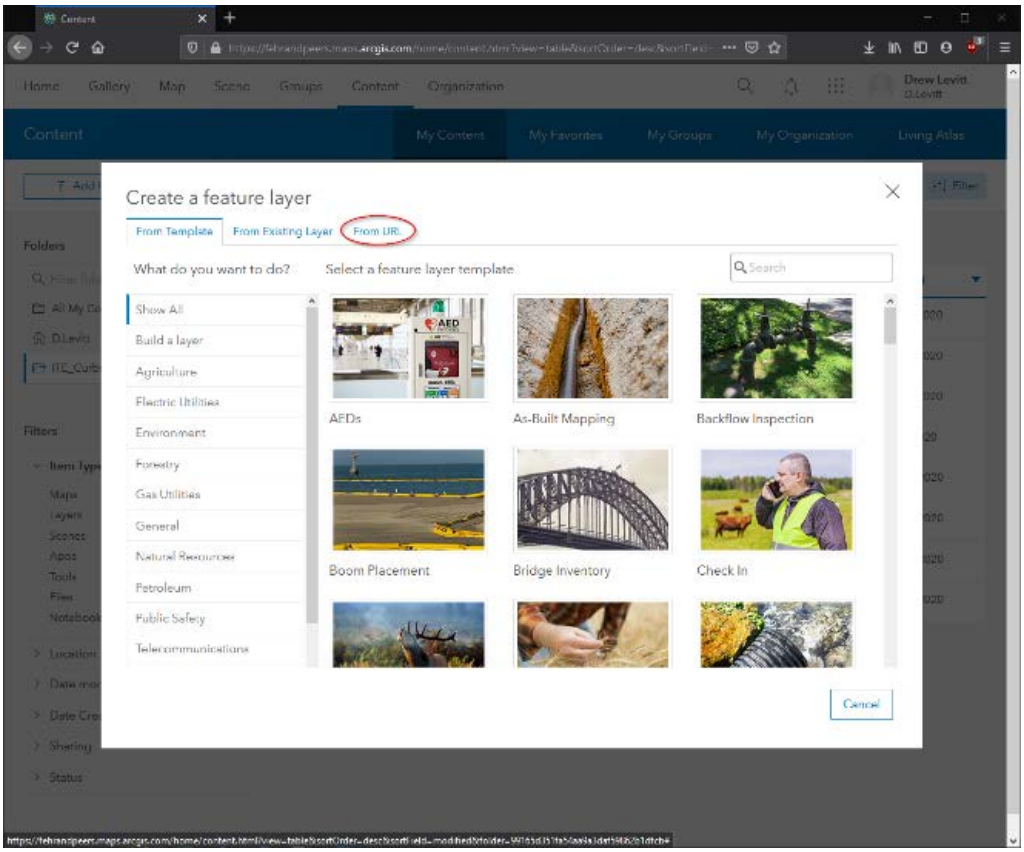


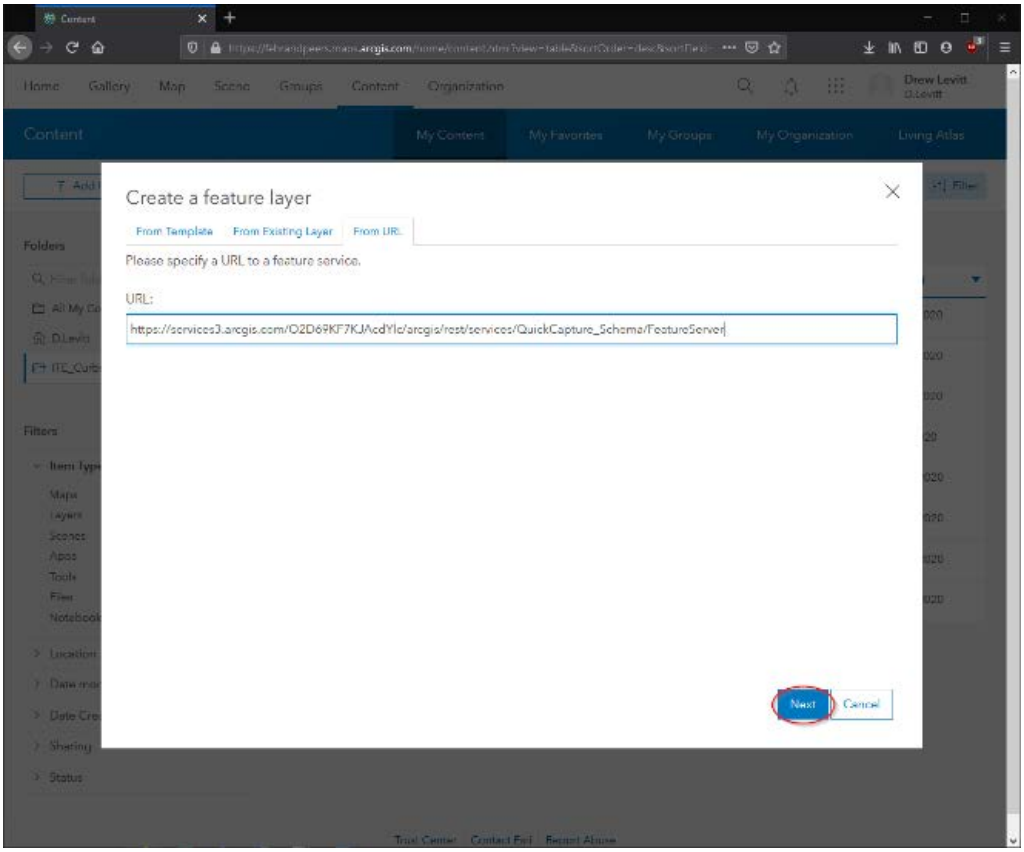
Click “Create” – “Feature Layer”.



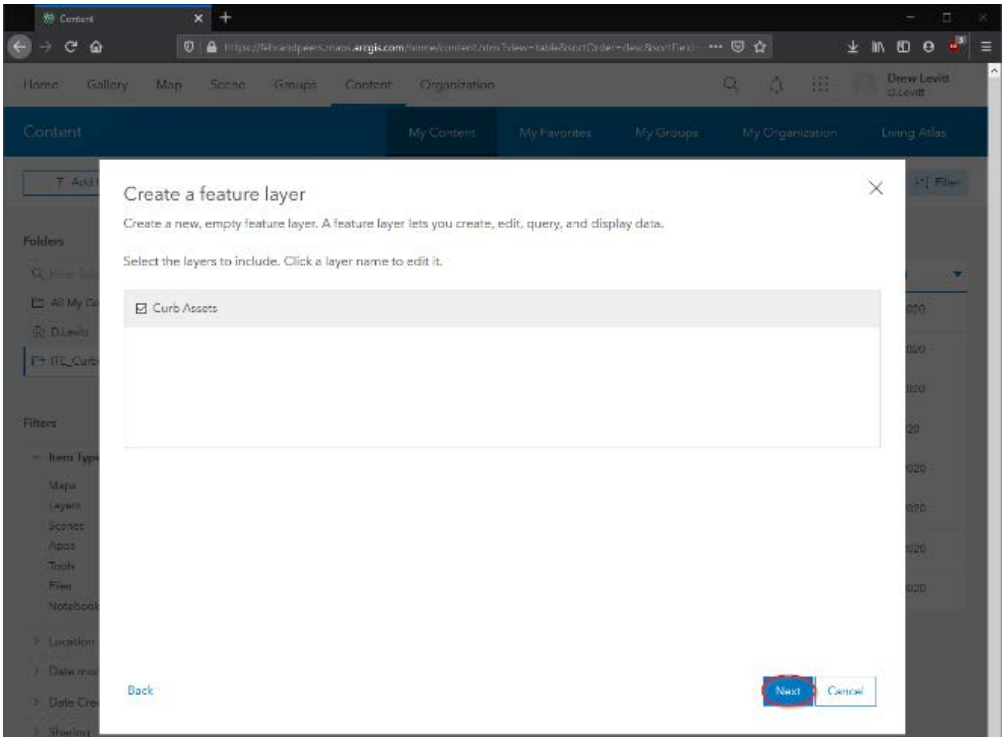




Click “From URL” and paste in the following URL, then click “Next”: This is the Feature Service URL for a template feature class: https://services3.arcgis.com/O2D69KF7KJAcdYlc/arcgis/rest/services/QuickCapture_Schema/FeatureServer.

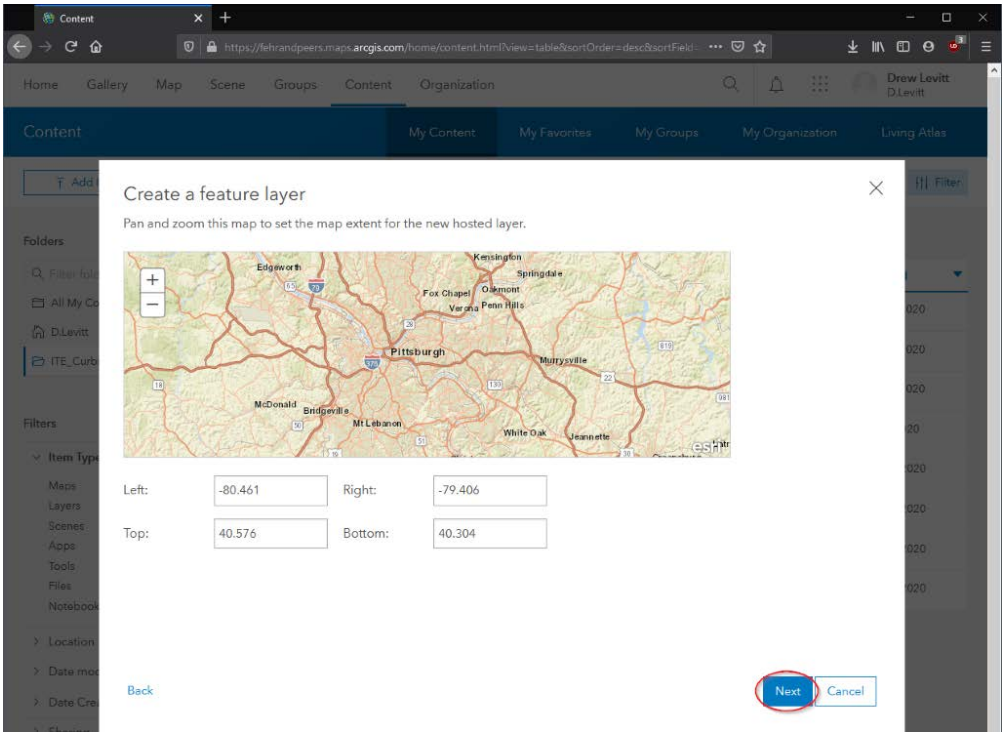

Create a feature layer
From Template
From Existing Layer
From URL
What do you want to do?
Select a feature layer template
Search
Show All
Build a layer
Agriculture
Electric Utilities
Environment
Forestry
Gas Utilities
General
Natural Resources
Petroleum
Public Safety
Telecommunications
AEDs
As-Built Mapping
Backflow Inspection
Boom Placement
Bridge Inventory
Check In
Cancel


Create a feature layer
From Template
From Existing Layer
From URL
Please specify a URL to a feature service.
URL:
https://services3.arcgis.com/O2D69KF7KJAcdYlc/arcgis/rest/services/QuickCapture_Schema/FeatureServer
Next
Cancel

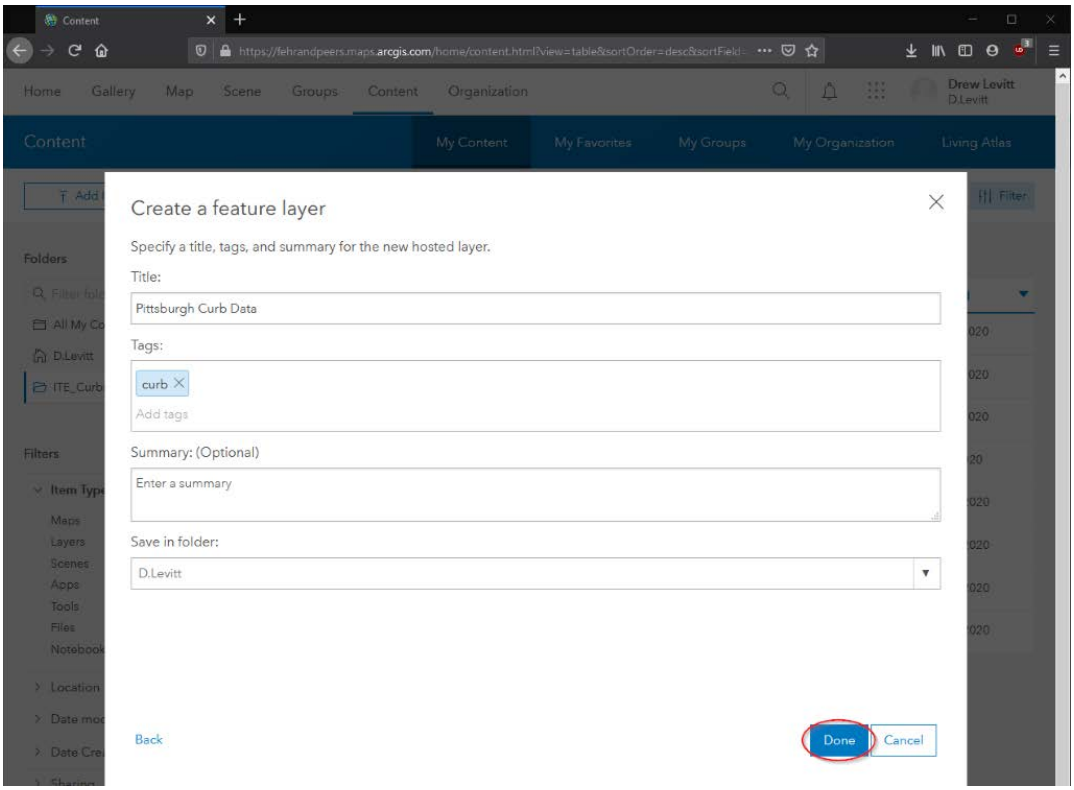
Click “Next” again.




Pan and zoom to the desired map extent (the region in which the analyst will be collecting curb data), then click “Next”.

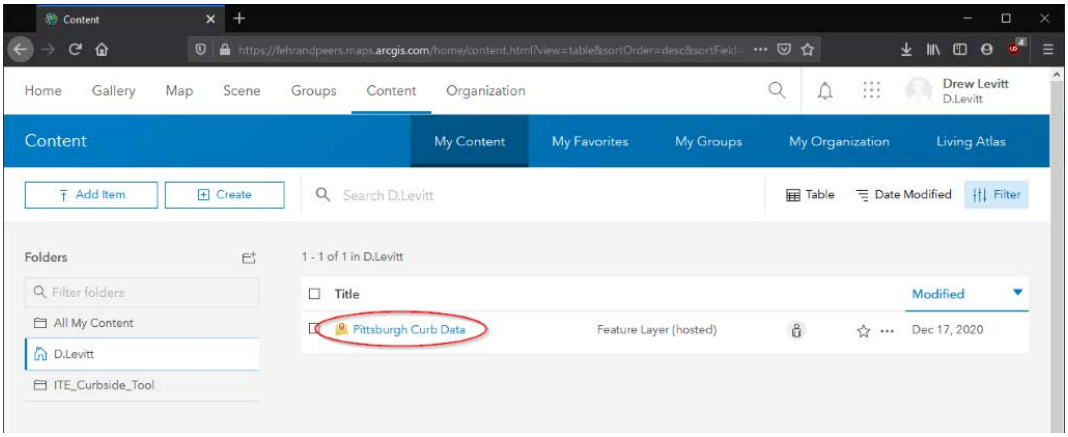


Enter a descriptive title, add at least one tag, optionally provide a summary (description of the feature layer's purpose and contents), and choose a folder in which to save the feature layer, then click "Done".

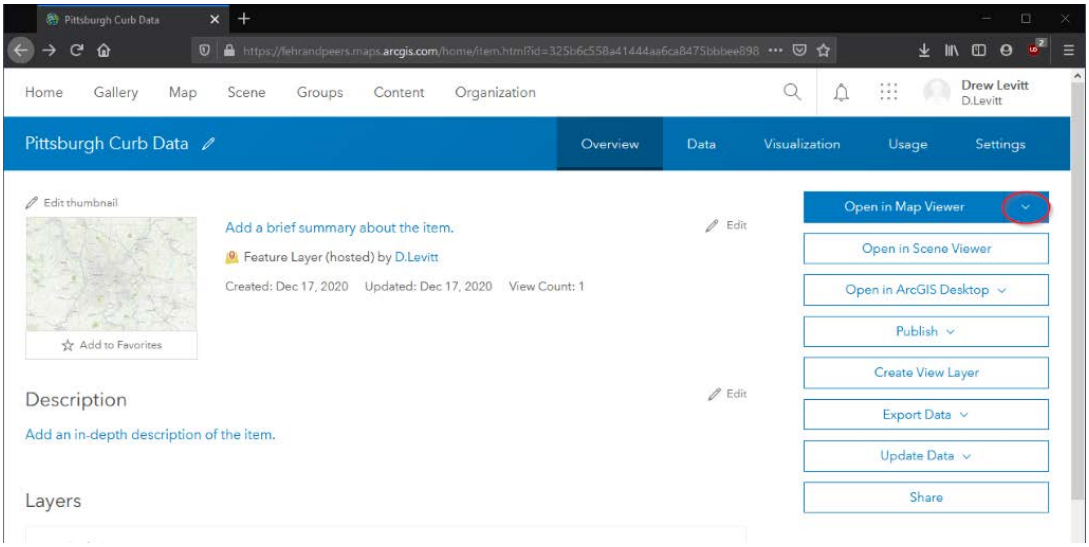


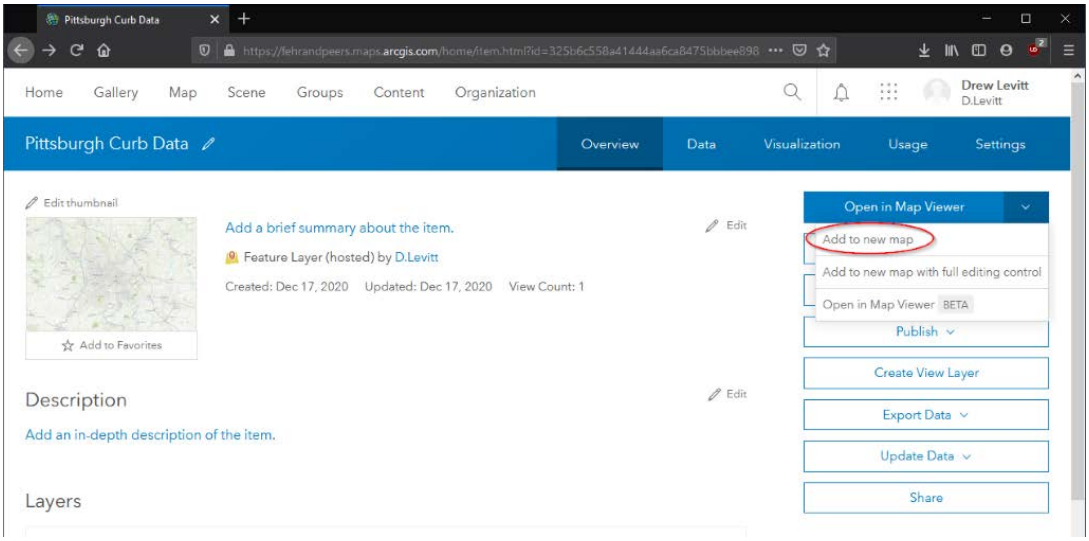

Create a web map for use with the Collector app.

If it's not already open, navigate to and click on the hosted feature layer just created.

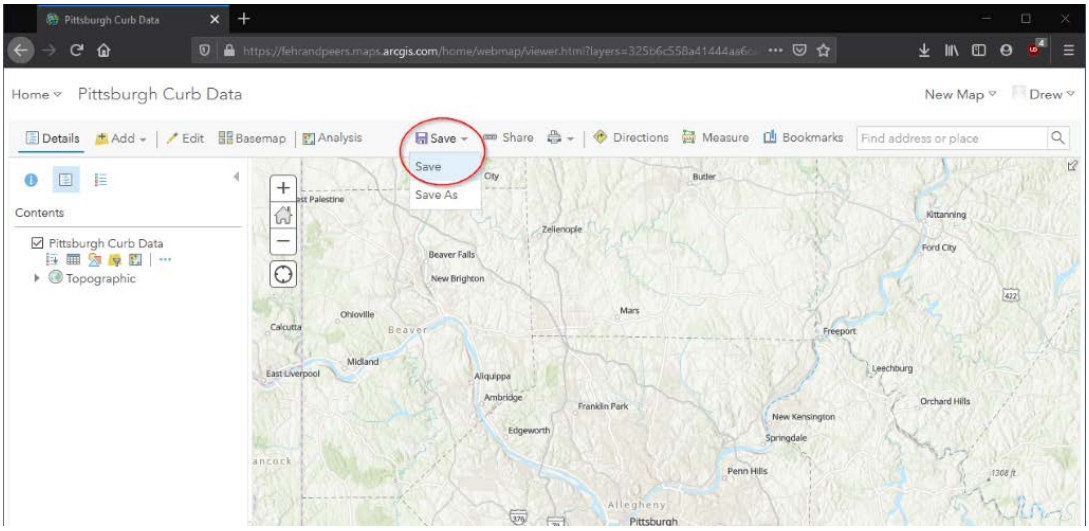


Click “Open in Map Viewer” – “Add to new map”.

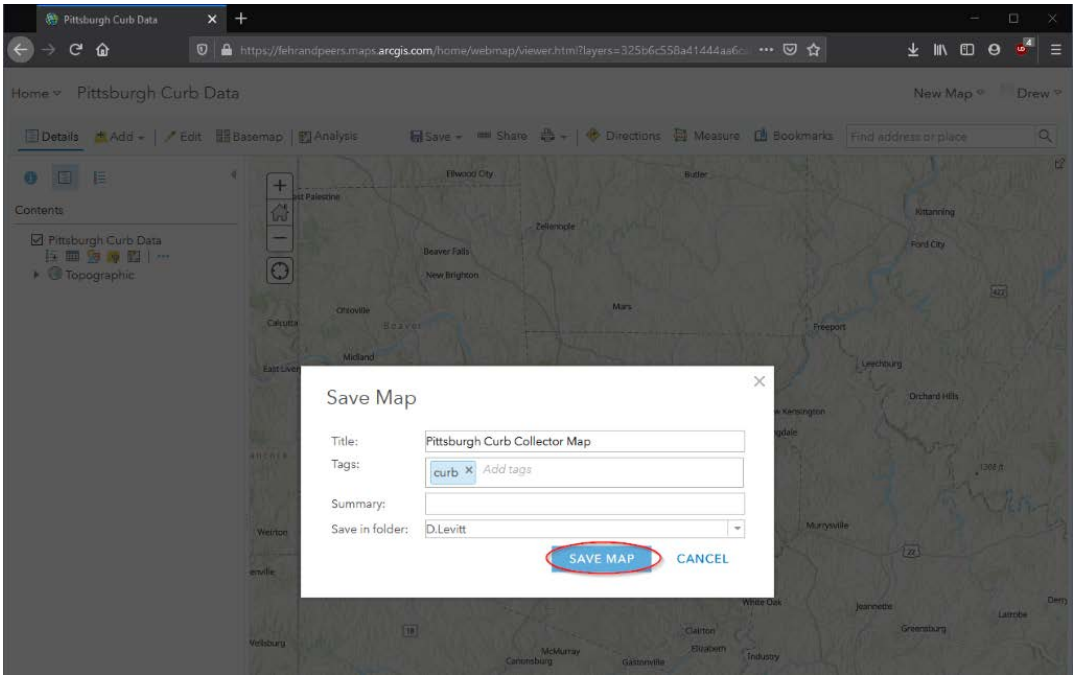


Click “Save” – “Save”.




Enter a descriptive title, add at least one tag, optionally provide a summary (description of the web map’s purpose and contents), and choose a folder in which to save the web map, then click “Save Map”.



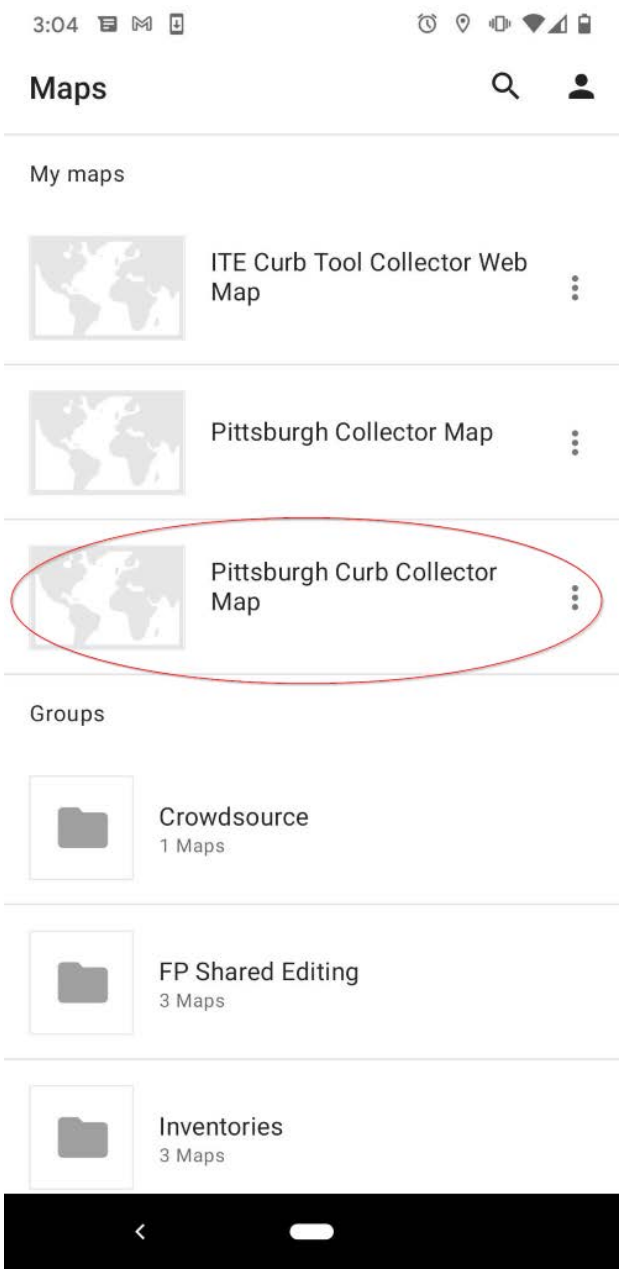

## Data Collection using ArcGIS Collector or Field Maps

Connect the Collector app to the created web map.

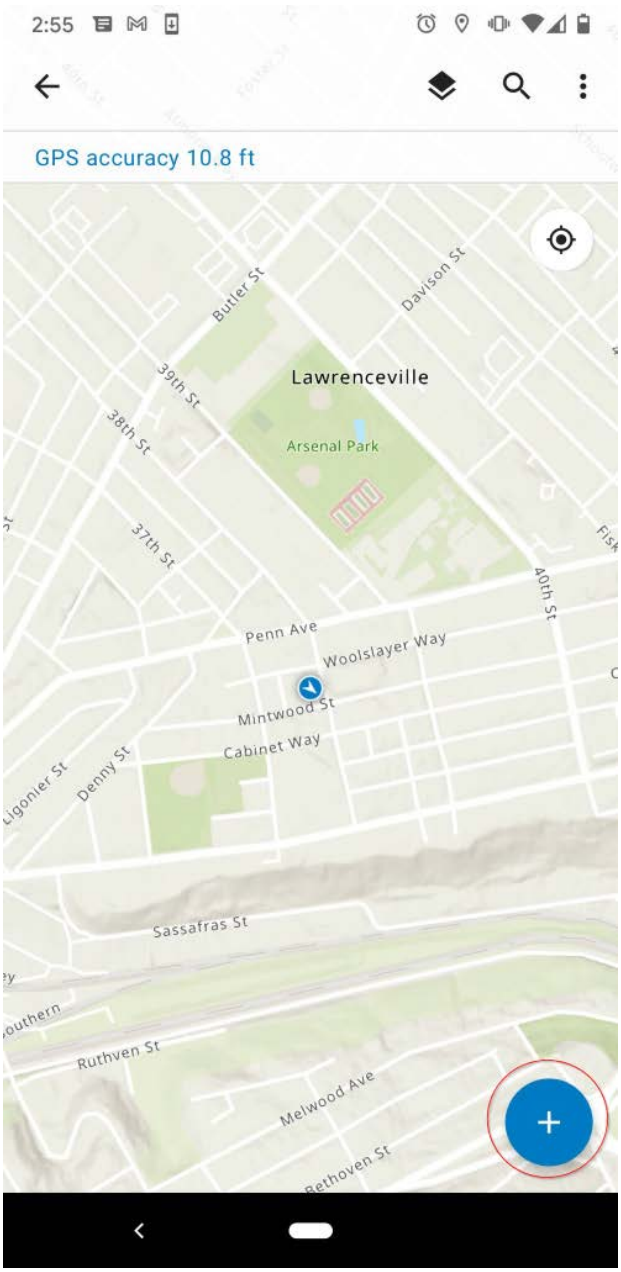
First, install the “ArcGIS Collector” app via the App Store or Play Store.

Open the Collector app and sign into the organization's ArcGIS Online or ArcGIS Enterprise account

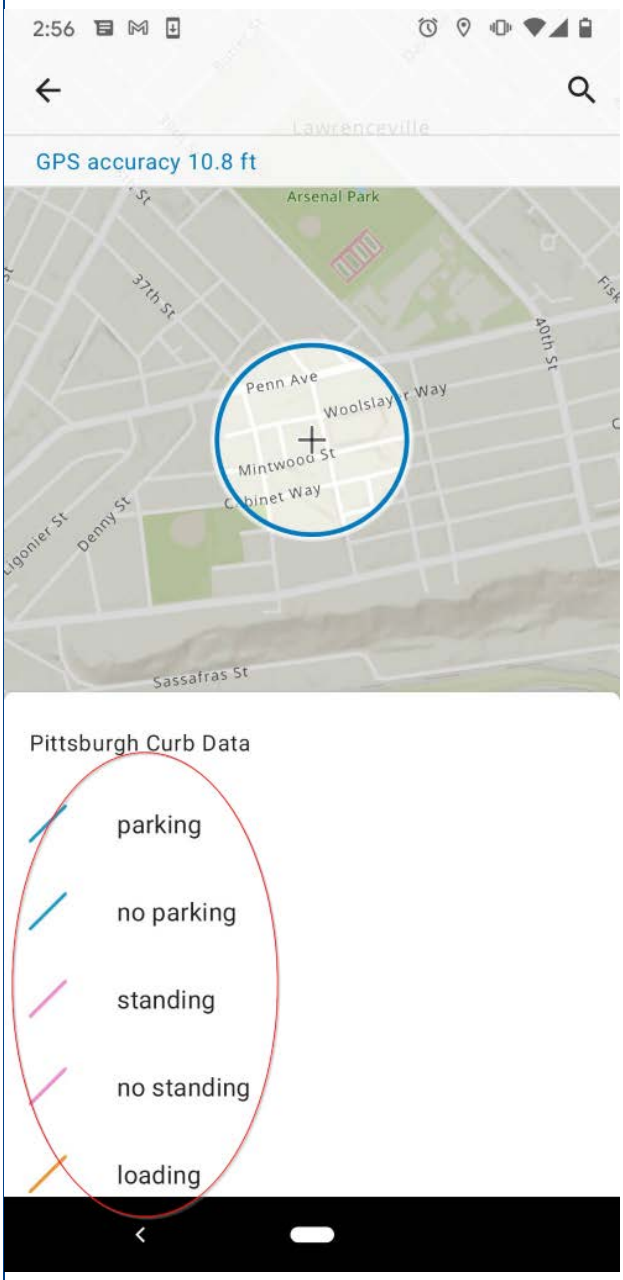

Tap the web map that was created earlier



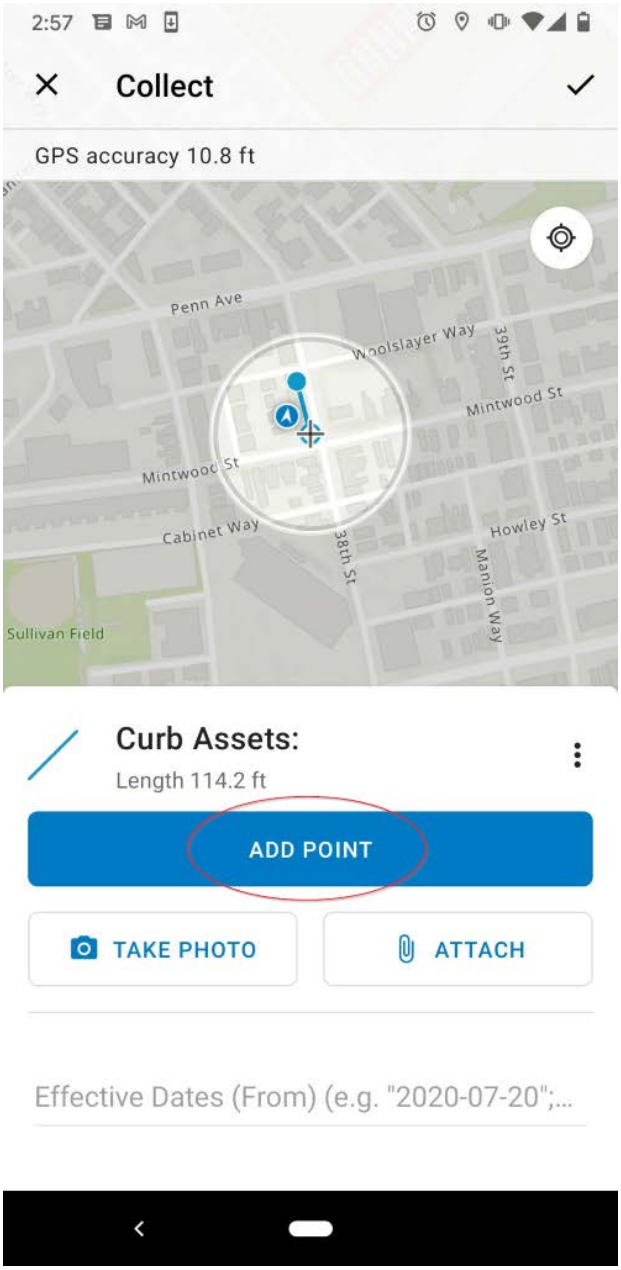
Tap the “+” icon at bottom right.



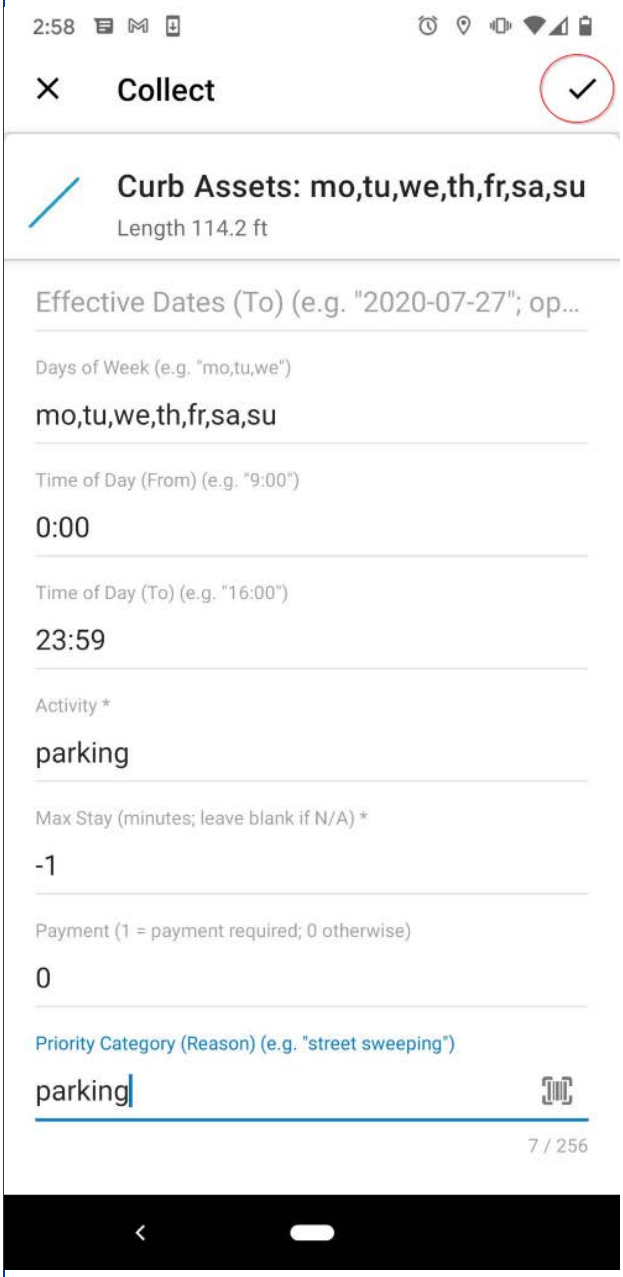

Position the cross-hairs where the analyst wants to start drawing a curb regulation feature, then tap the feature template corresponding to the applicable regulation type.



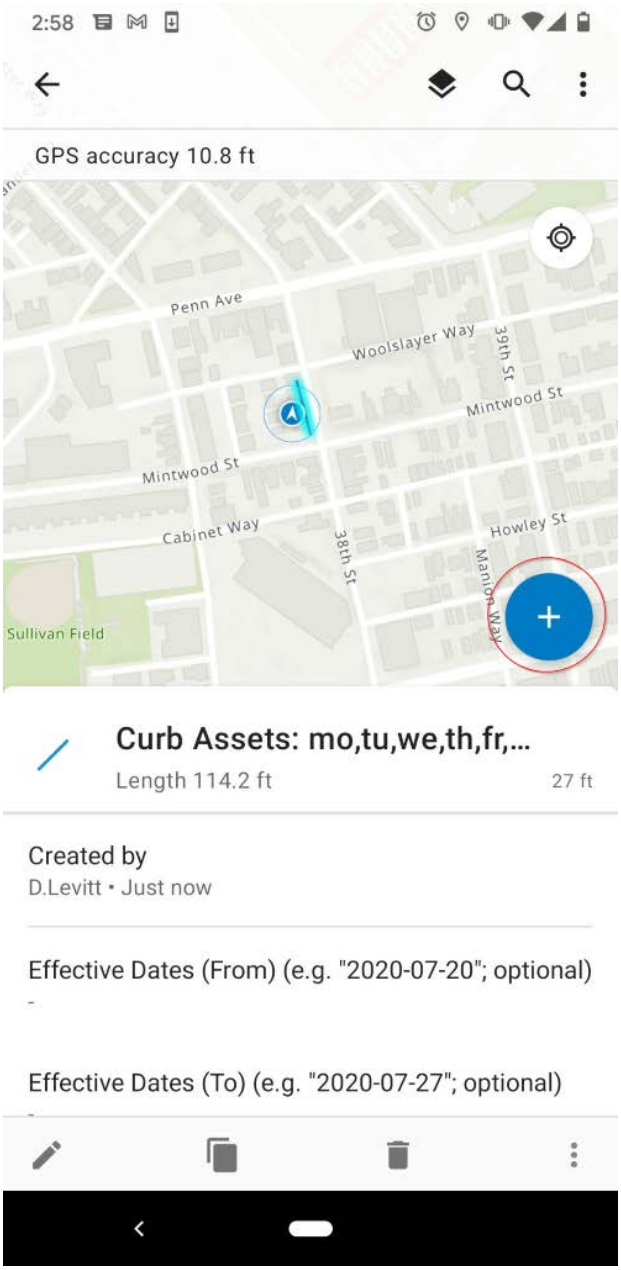
Reposition the cross-hairs and add one or more additional vertices by tapping "Add Point.




Scroll down to populate the feature's attributes, then tap the check mark to finish creating the feature.



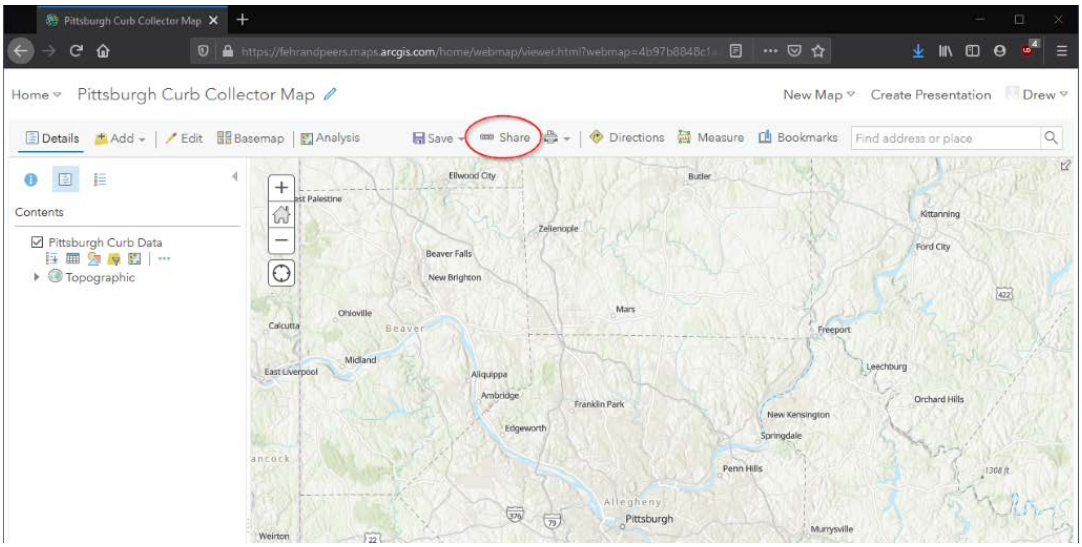
Tap the “+” icon to begin capturing another curb regulation feature.



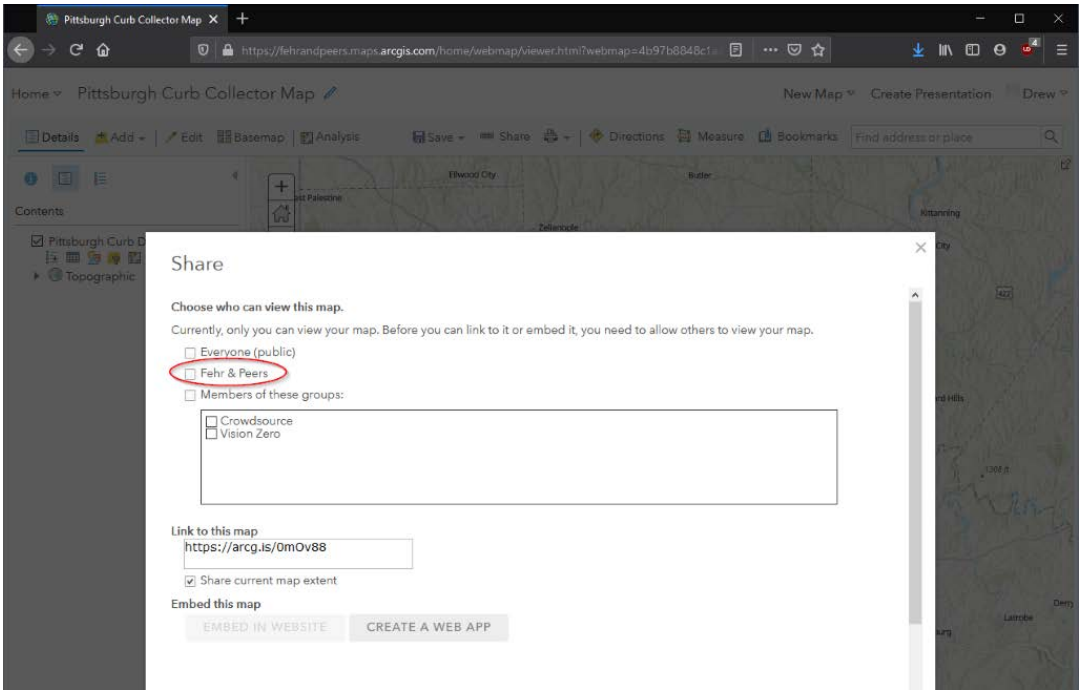

Share the web map and hosted feature layer to enable collaborative data collection.

## Within the ArcGIS online organization

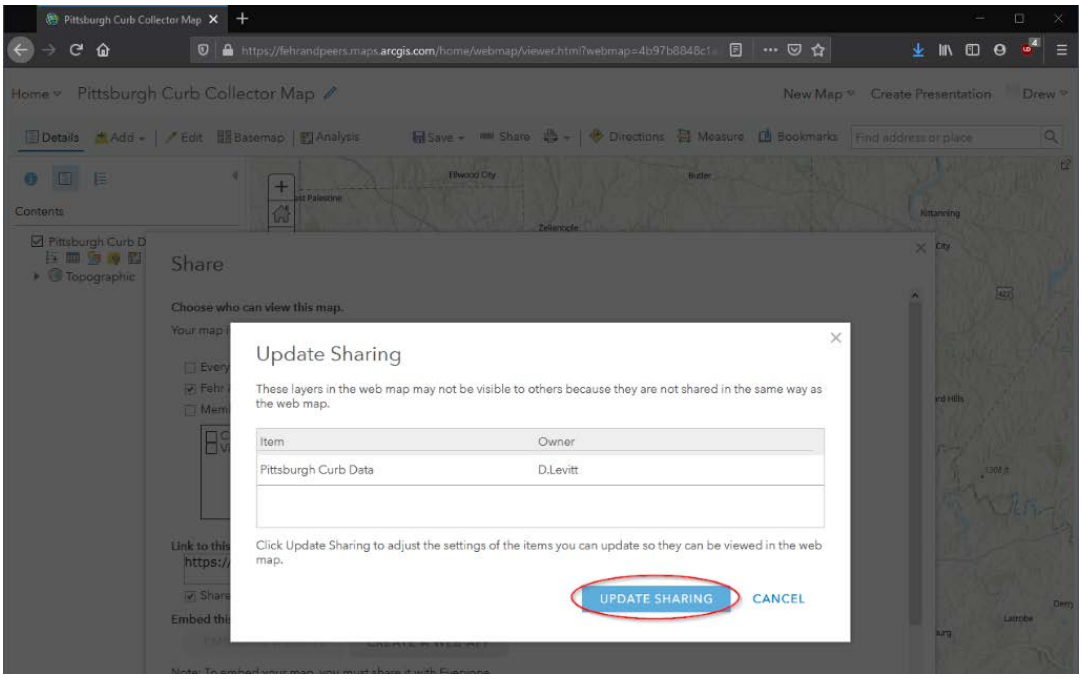
In the web map, click “Share.”



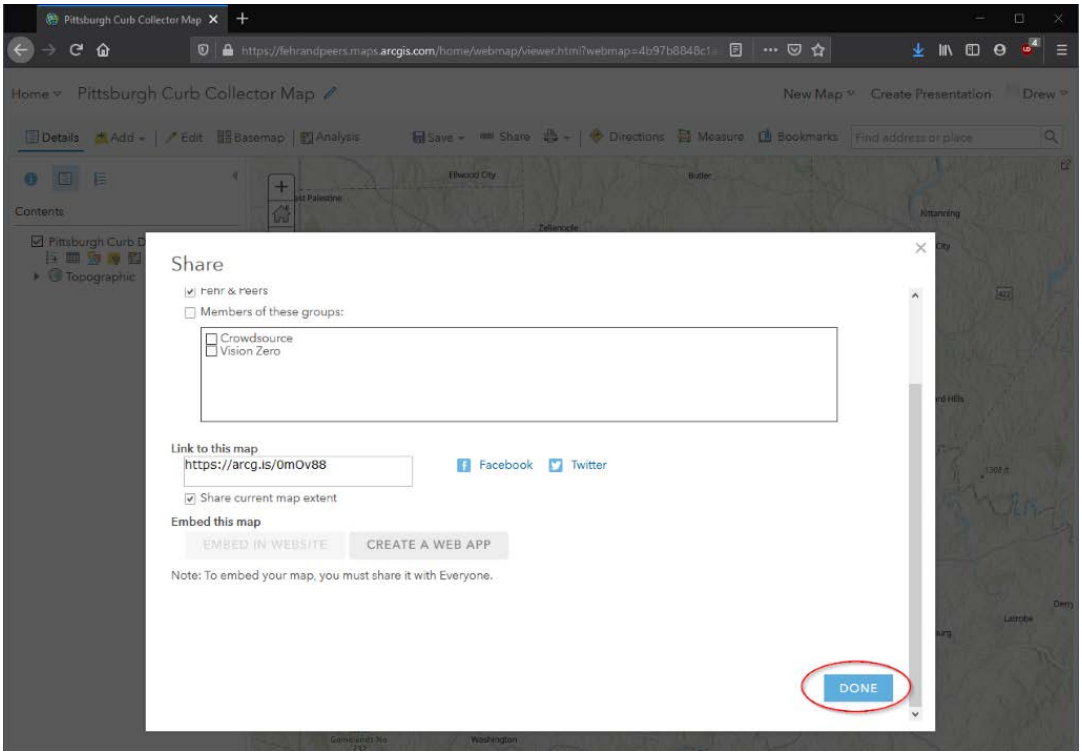

Click the check box next to the ArcGIS online organization name.



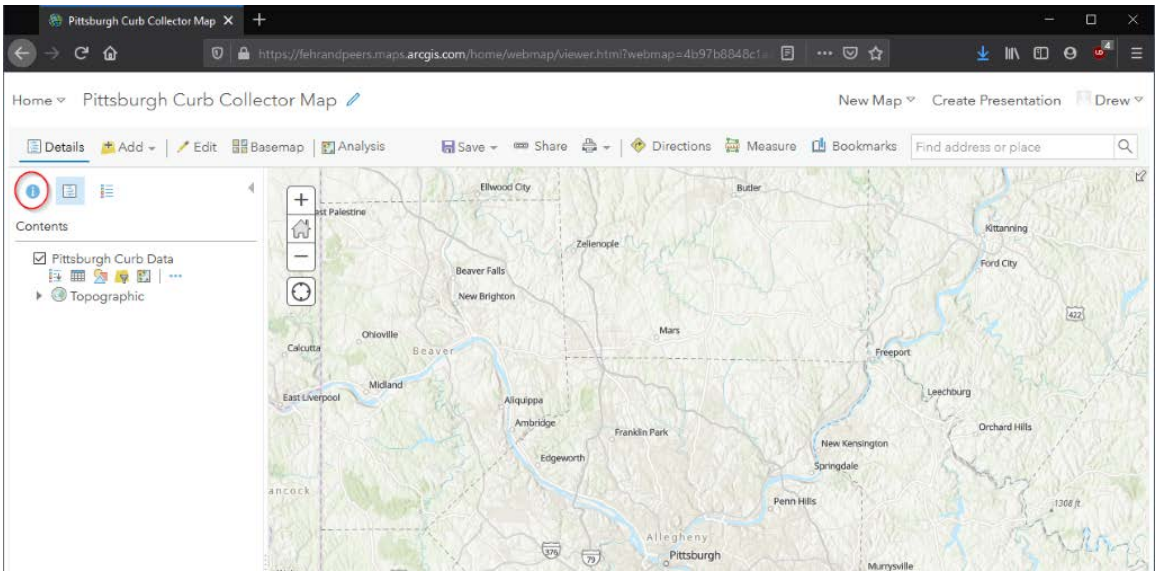

If the analyst has not yet shared the hosted feature layer with members of the organization, the analyst will be prompted to adjust sharing settings on the hosted feature layer. Click “Update Sharing” to automatically share the hosted feature layer.

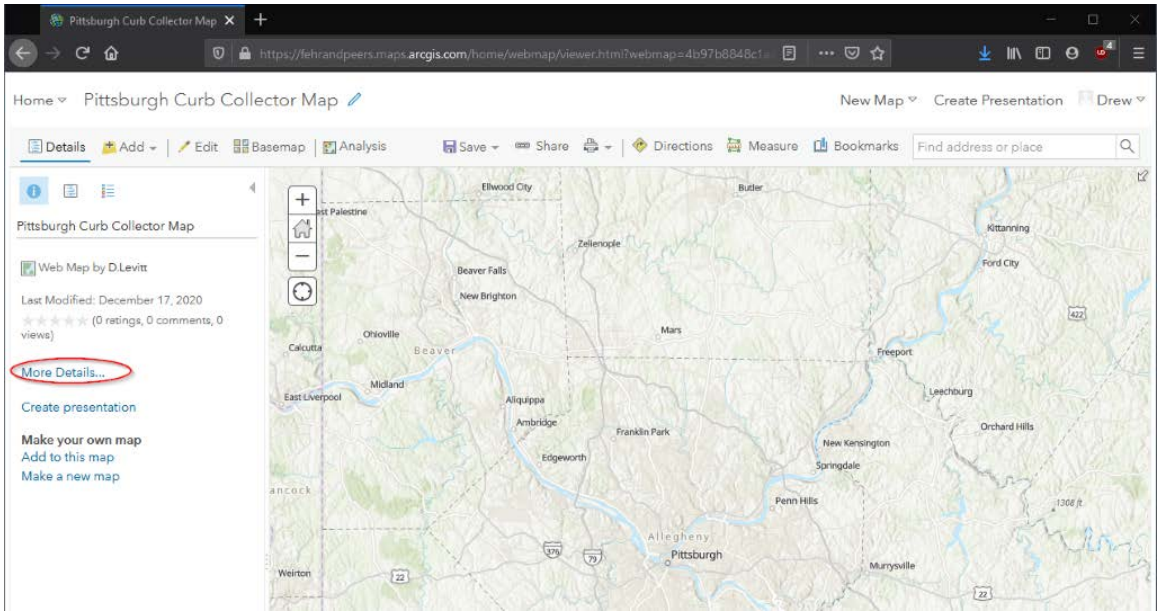



Scroll down and click “Done”.

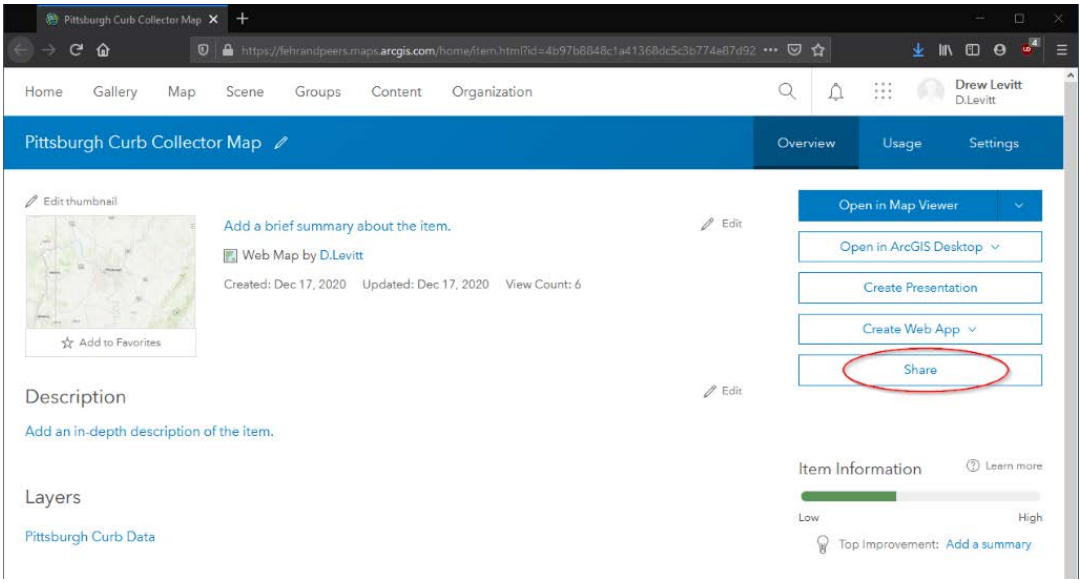


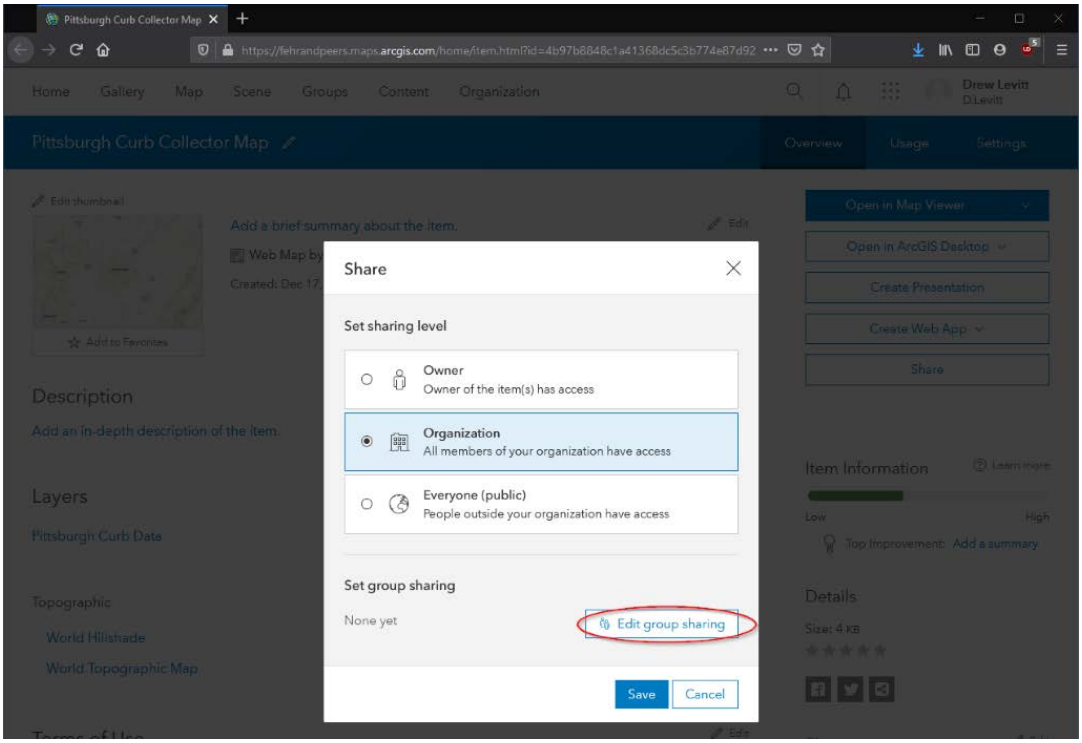

To enable collaborators to quickly find and open the web map in their ArcGIS Collector apps, the analyst will need to share the web map with a group that collaborators are members of. The analyst can do this from the web map item view. To return to item view from the web map viewer, click the “Info” icon, then click “More Details”.


Pittsburgh Curb Collector Map
Home
Pittsburgh Curb Collector Map
New Map
Create Presentation
Drew
Details
Add
Edit
Basemap
Analysis
Save
Share
Directions
Measure
Bookmarks
Find address or place
Contents
Pittsburgh Curb Data
Topographic
Ellwood City
Butler
Zelienople
Kittanning
Ford City
Beaver Falls
New Brighton
Mars
Ohioville
Calcutta
Beaver
Freeport
Midland
East Liverpool
Aliquippa
Ambridge
Franklin Park
Leechburg
Orchard Hills
New Kensington
Springdale
Edgeworth
Penn Hills
Allegheny
Pittsburgh
Murrysville

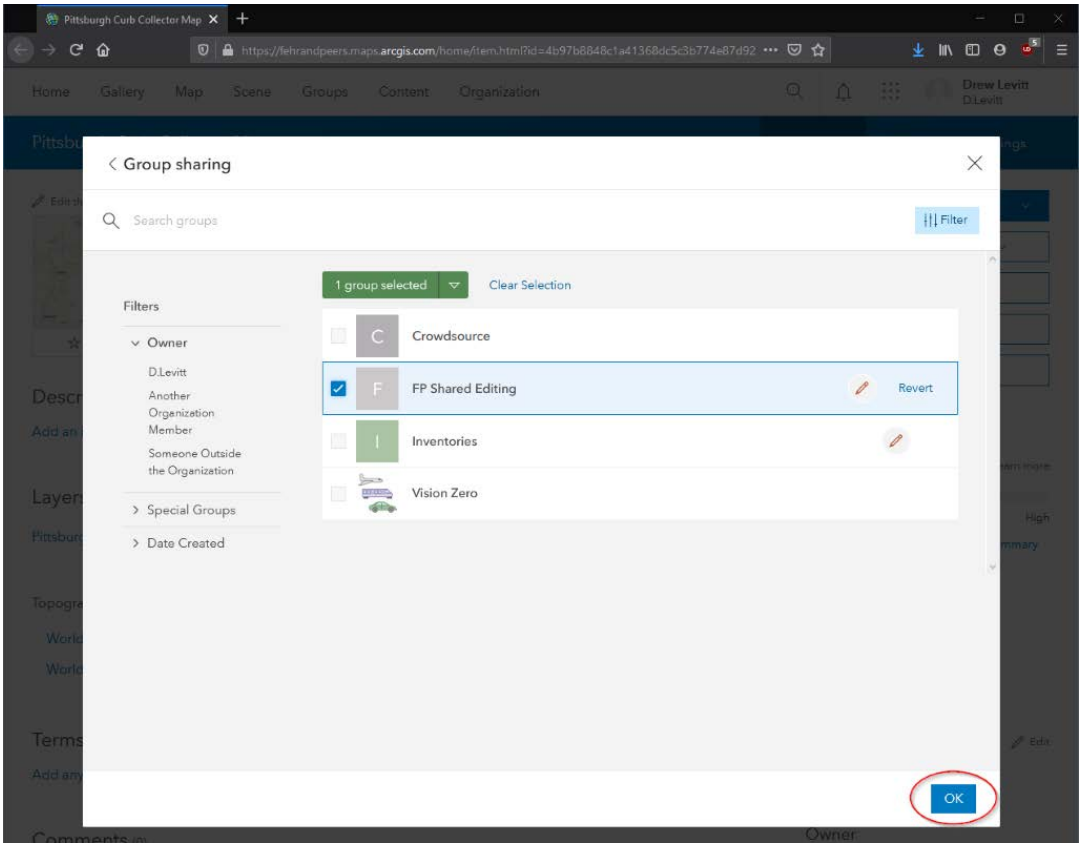

Pittsburgh Curb Collector Map
Home
Pittsburgh Curb Collector Map
New Map
Create Presentation
Drew
Details
Add
Edit
Basemap
Analysis
Save
Share
Directions
Measure
Bookmarks
Find address or place
Pittsburgh Curb Collector Map
Web Map by D.Levitt
Last Modified: December 17, 2020
(0 ratings, 0 comments, 0 views)
More Details...
Create presentation
Make your own map
Add to this map
Make a new map
Ellwood City
Butler
Zelienople
Kittanning
Ford City
Beaver Falls
New Brighton
Mars
Ohioville
Calcutta
Beaver
Freeport
Midland
East Liverpool
Aliquippa
Ambridge
Franklin Park
Leechburg
Orchard Hills
New Kensington
Springdale
Edgeworth
Penn Hills
Allegheny
Pittsburgh
Murrysville
Weirton

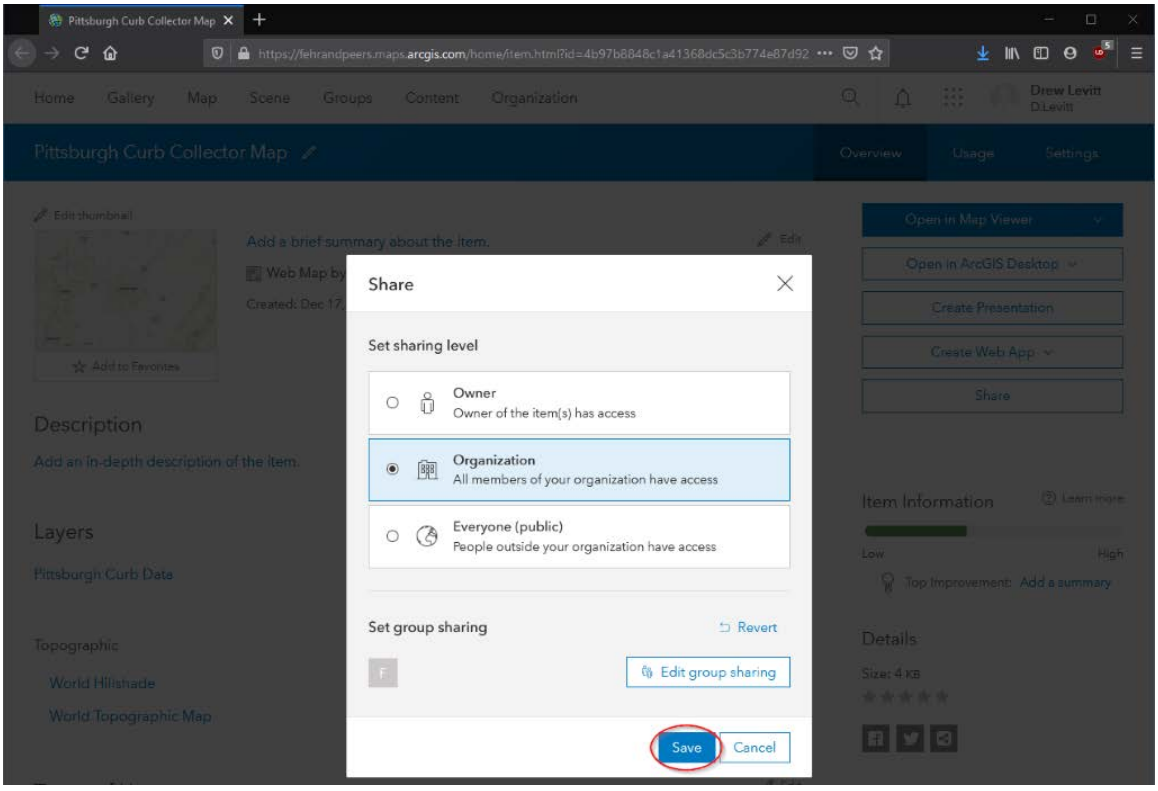
Click “Share,” then “Edit group sharing”.



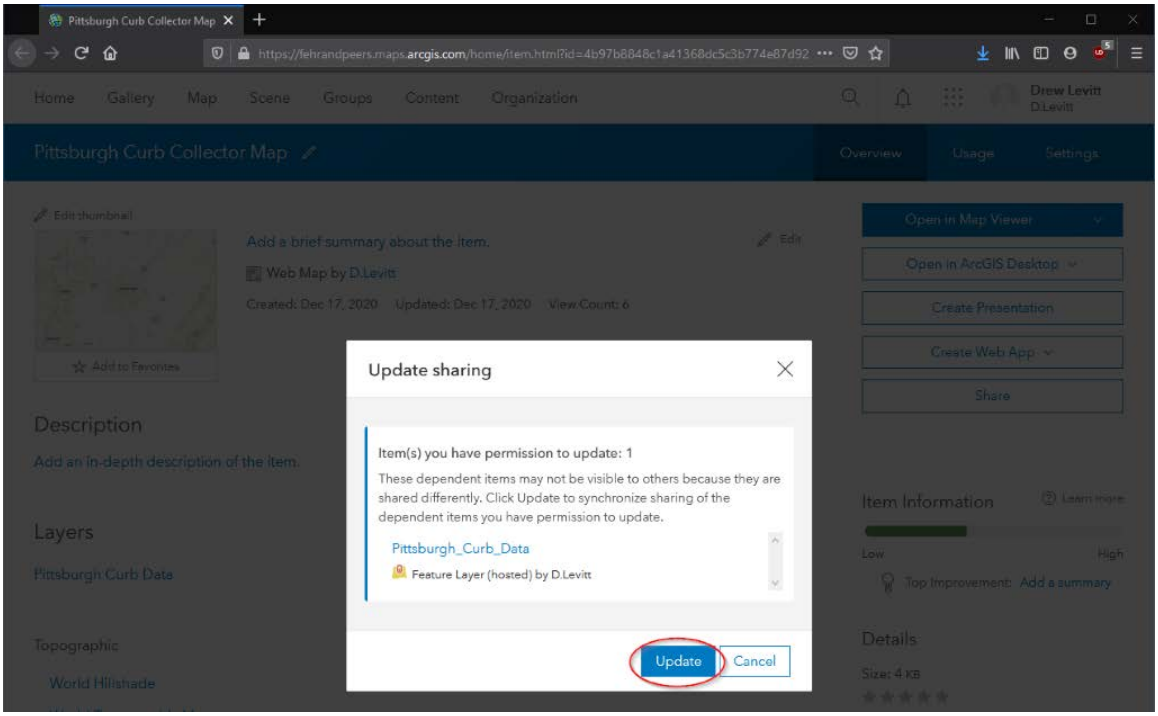



Check the box next to a group that collaborators are members of, then click “OK,” then click “Save”.



If prompted, click “Update” to also update the sharing settings for the hosted feature layer.

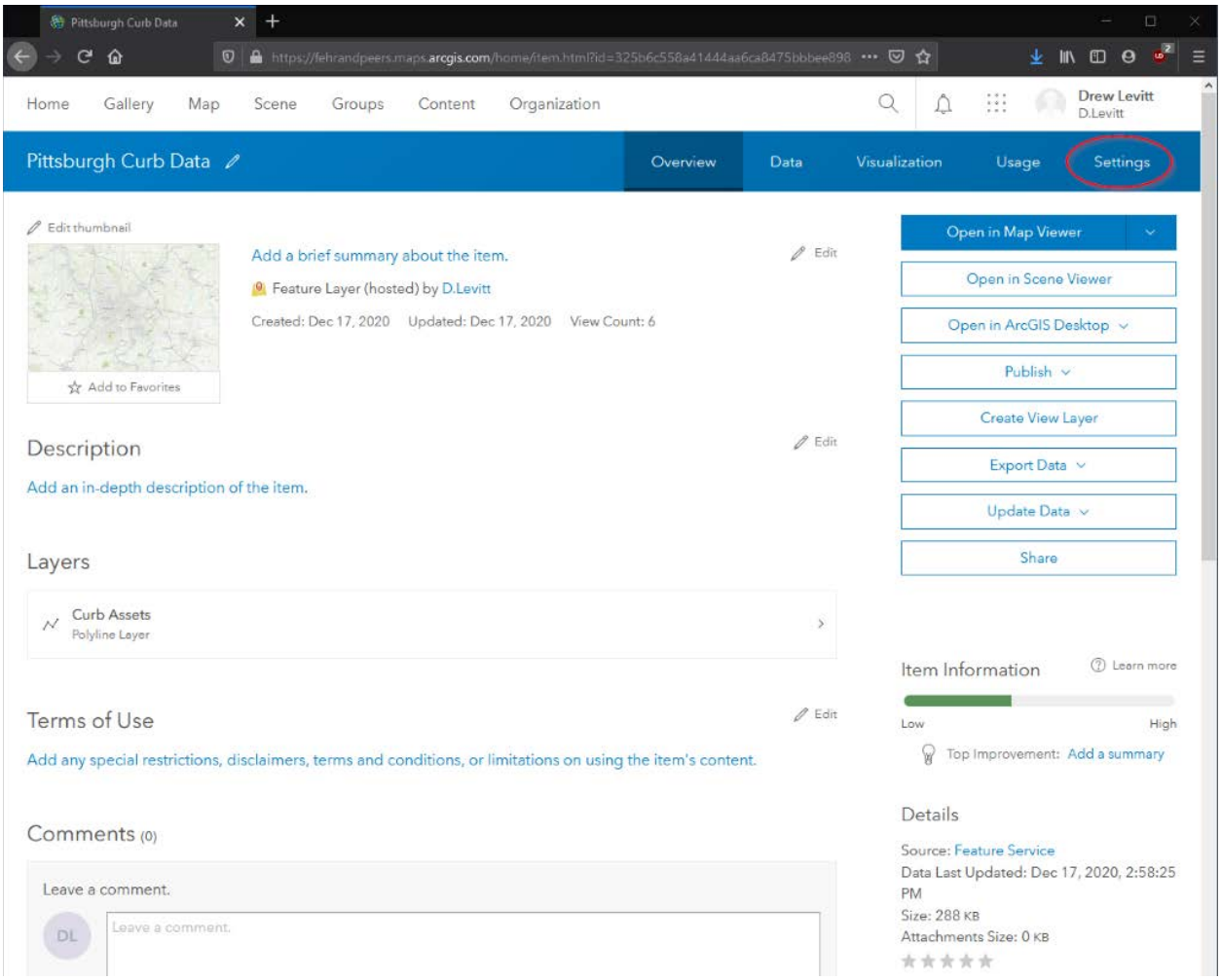



## Outside the ArcGIS online organization

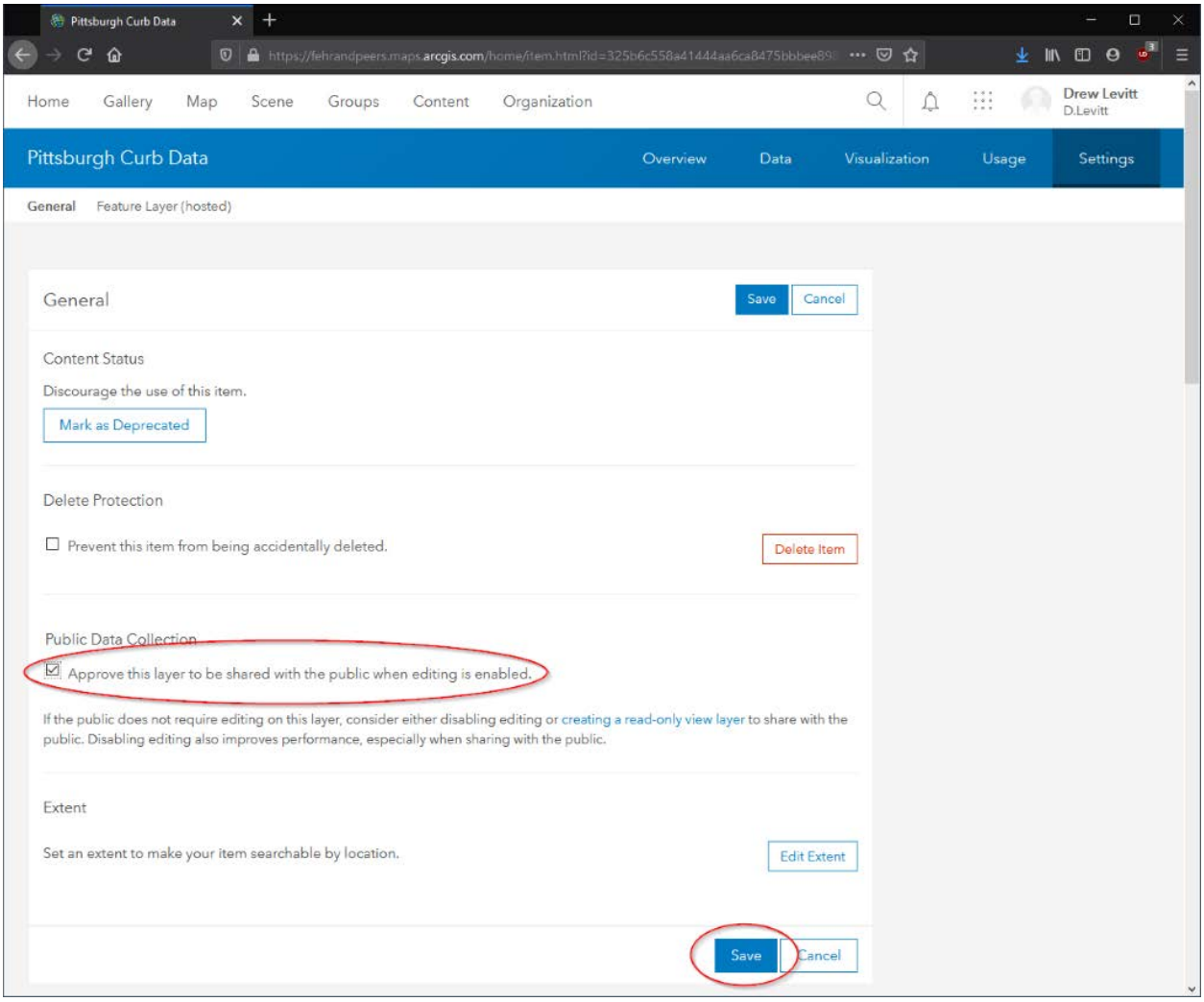
The ArcGIS Collector app shows only web maps that were created, or that the creator shared with collaborative group. This means that individuals outside the organization will not be able to access the web maps in their Collector apps. If the desire is to collaborate on data collection with individuals outside the organization, a few additional steps are required.

*Note: these steps will enable **anyone with the link** to contribute to the dataset, so only share the link with that in mind.*

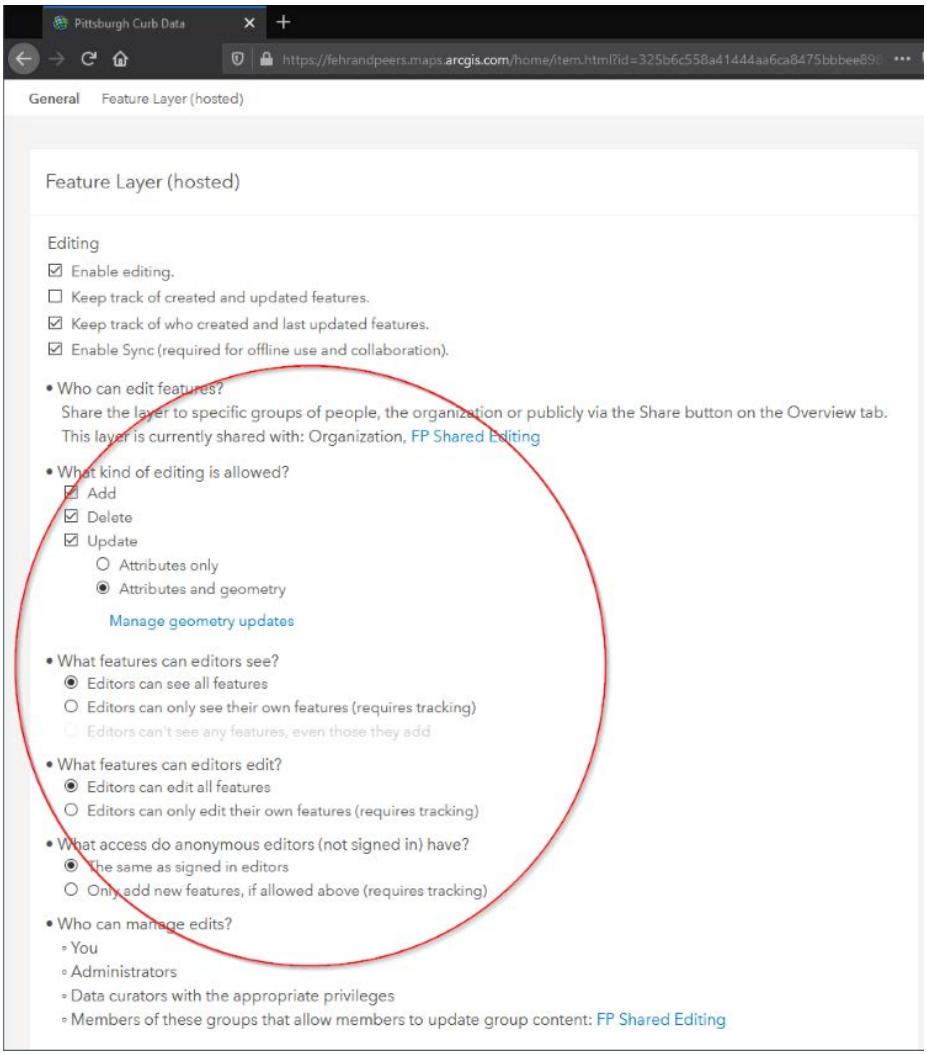
Enable Public Data Collection on the hosted feature layer: from the hosted feature layer item view, click “Settings”.



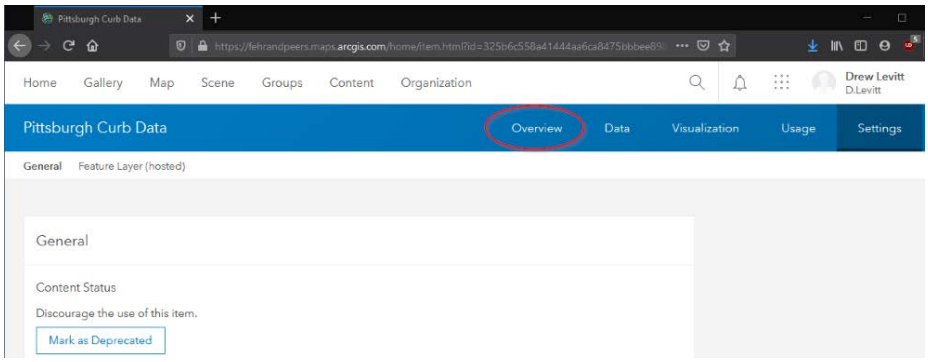
Click “Approve this layer to be shared with the public when editing is enabled” then click “Save”.

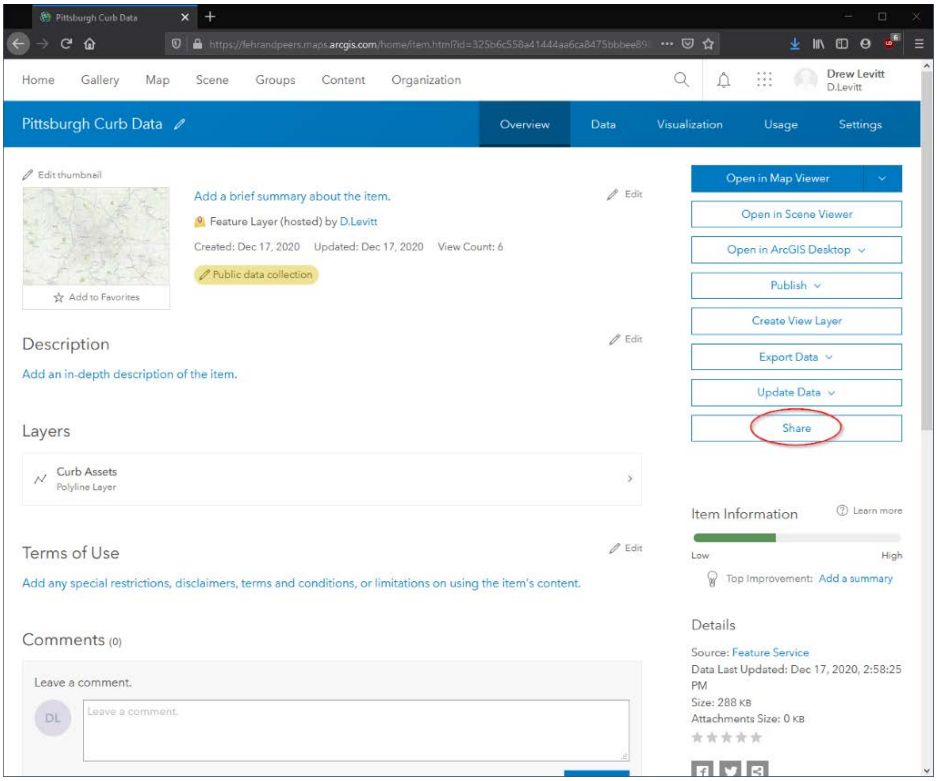


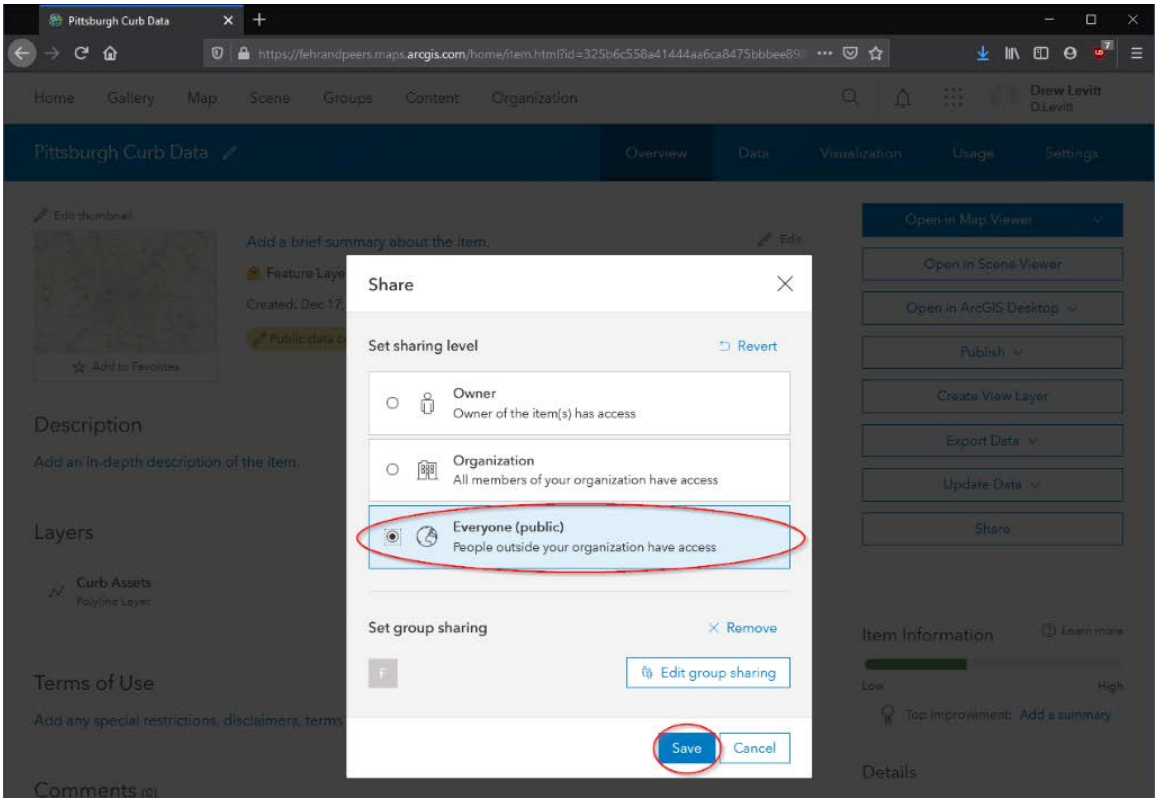
Optionally, use the options farther down on the Settings page to control who can add, edit, and delete features. For example, the analyst may want to limit external contributors to adding features only.

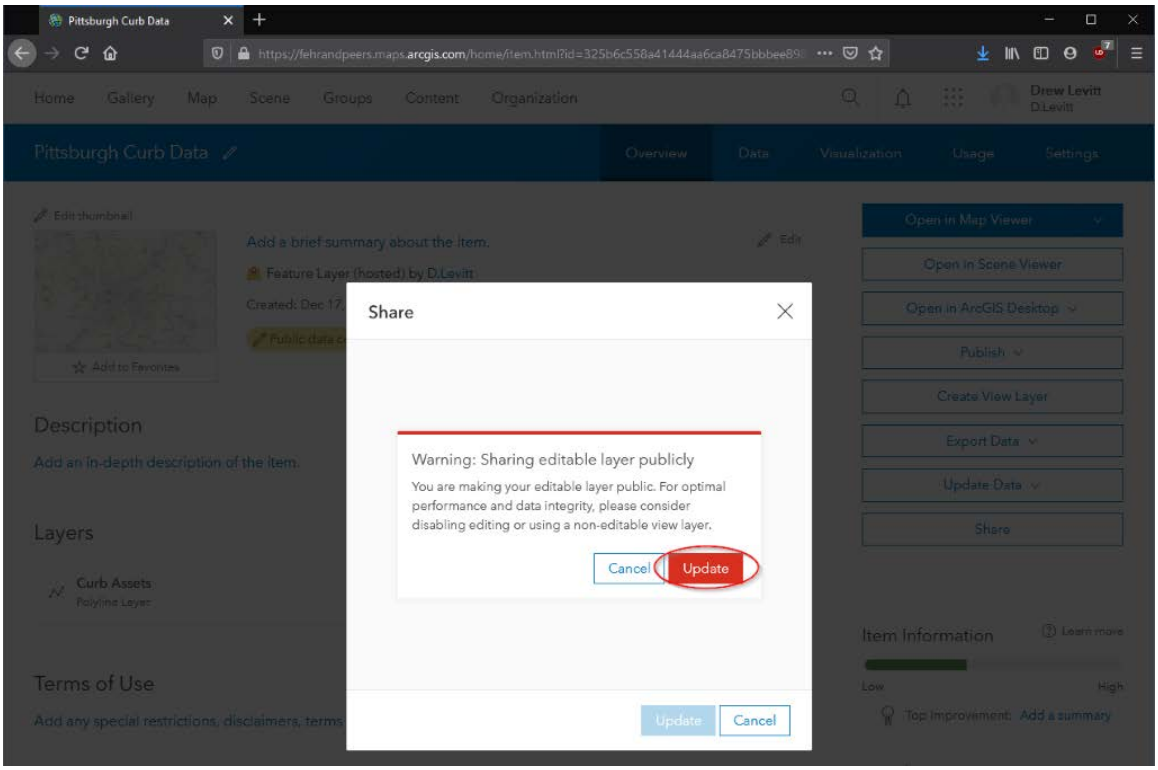



Return to the hosted feature layer's overview, then share the hosted feature layer with everyone by making public.

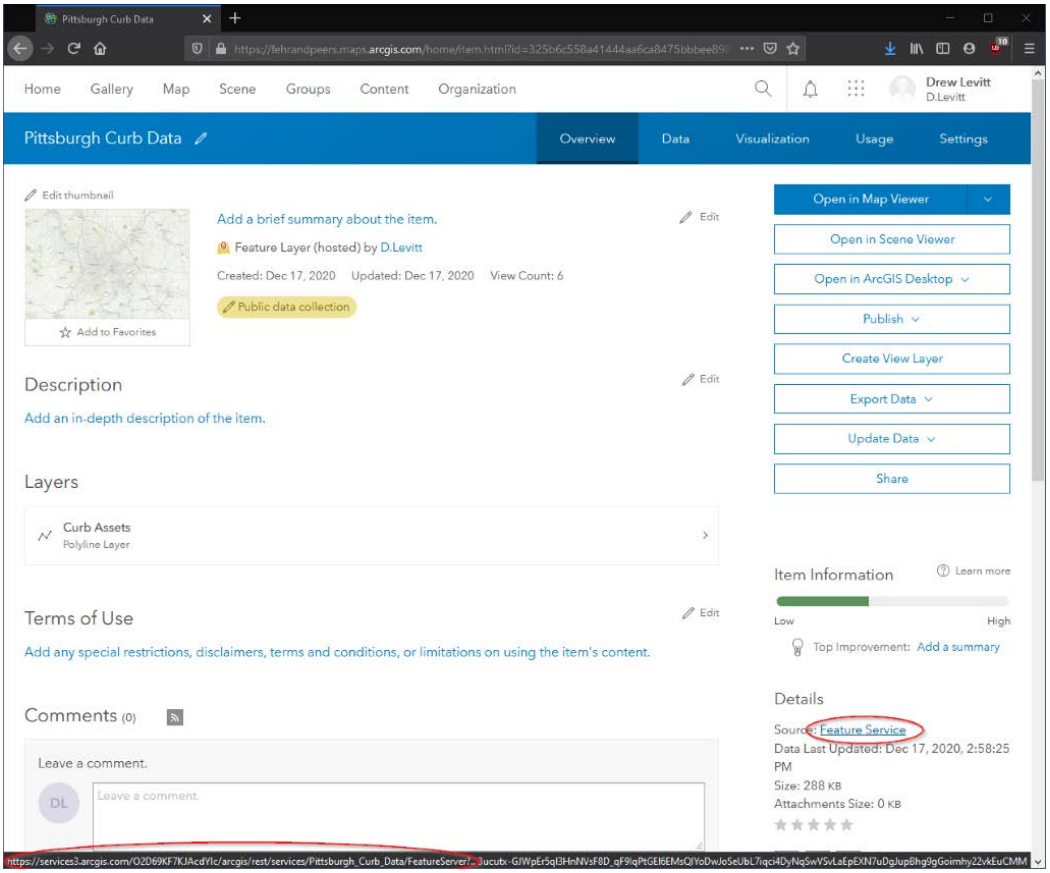



Pittsburgh Curb Data
Home
Gallery
Map
Scene
Groups
Content
Organization
Drew Levitt
D.Levitt
Pittsburgh Curb Data
Overview
Data
Visualization
Usage
Settings
Edit thumbnail
Add a brief summary about the item.
Feature Layer (hosted) by D.Levitt
Created: Dec 17, 2020 Updated: Dec 17, 2020 View Count: 6
Public data collection
Add to Favorites
Description
Add an in-depth description of the item.
Layers
Curb Assets
Polyline Layer
Terms of Use
Add any special restrictions, disclaimers, terms and conditions, or limitations on using the item's content.
Comments (0)
Leave a comment.
Open in Map Viewer
Open in Scene Viewer
Open in ArcGIS Desktop
Publish
Create View Layer
Export Data
Update Data
Share
Item Information
Learn more
Low
High
Top Improvement: Add a summary
Details
Source: Feature Service
Data Last Updated: Dec 17, 2020, 2:58:25 PM
Size: 288 KB
Attachments Size: 0 KB

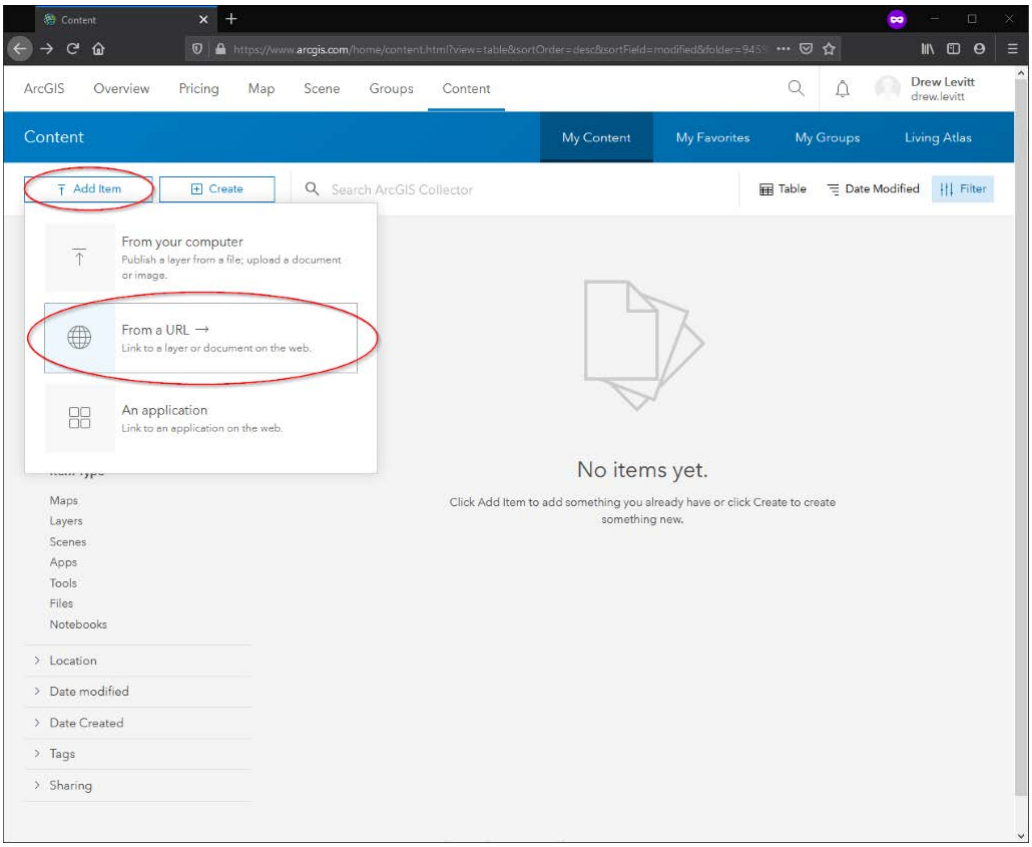

Share
Set sharing level
Revert
Owner
Owner of the item(s) has access
Organization
All members of your organization have access
Everyone (public)
People outside your organization have access
Set group sharing
Remove
Edit group sharing
Save
Cancel


Pittsburgh Curb Data
Home
Gallery
Map
Scene
Groups
Content
Organization
Drew Levitt
D.Levitt
Pittsburgh Curb Data
Overview
Data
Visualization
Usage
Settings
Add a brief summary about the item.
Feature Layer (hosted) by D.Levitt
Created: Dec 17
Add to Favorites
Description
Add an in-depth description of the item.
Layers
Curb Assets
Polyline Layer
Terms of Use
Add any special restrictions, disclaimers, terms
Open in Map Viewer
Open in Scene Viewer
Open in ArcGIS Desktop
Publish
Create View Layer
Export Data
Update Data
Share
Item Information
Low
High
Top improvement: Add a summary
Share
Warning: Sharing editable layer publicly
You are making your editable layer public. For optimal performance and data integrity, please consider disabling editing or using a non-editable view layer.
Cancel
Update
Update
Cancel

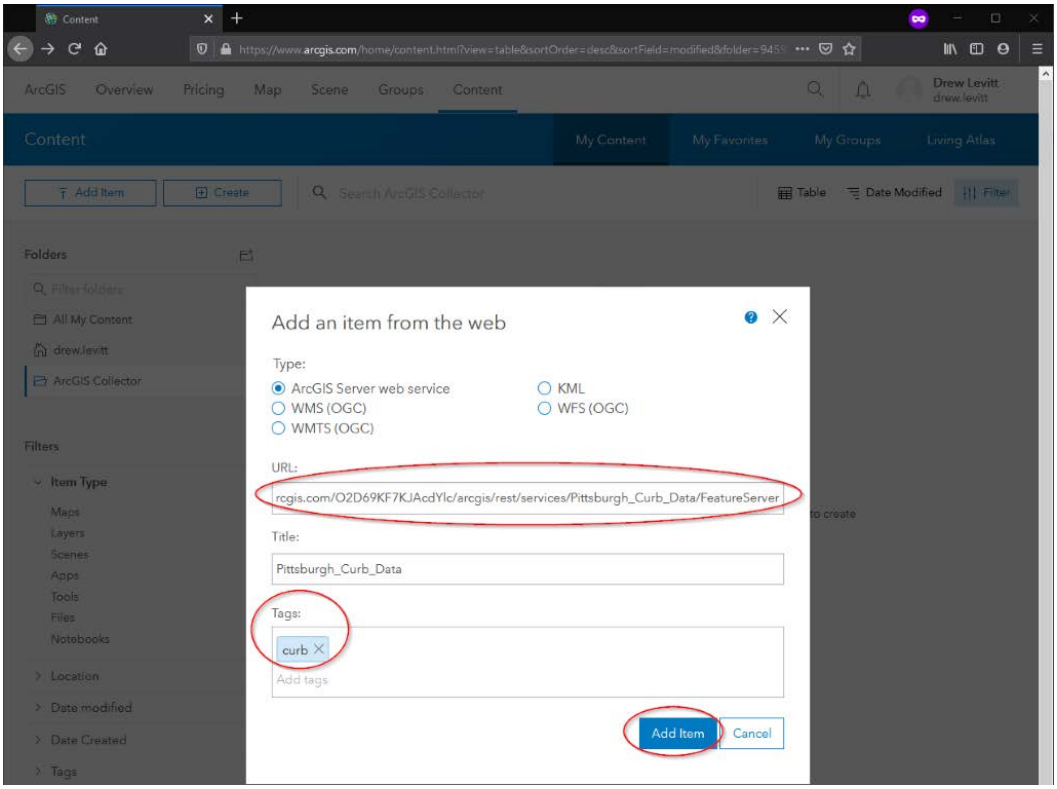
Copy the Feature Service URL for the hosted feature layer. This is the URL labeled as “Feature Service,” up to and including the string `FeatureServer`. Right-click the “Feature Service” link and select “Copy Link Location,” then remove the characters after `FeatureServer`.



Send the Feature Service URL to the collaborator. From their Content page, they will need to click “Add Item,” then “From a URL”.



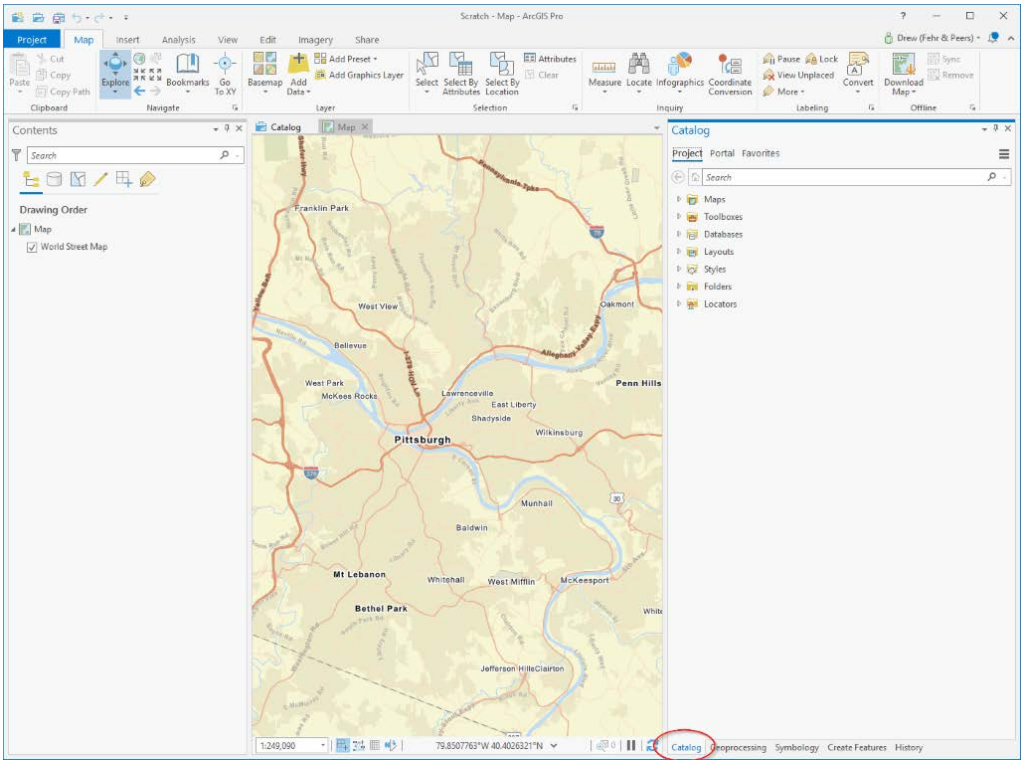
Then need to paste in the Feature Service URL, add one or more tags, and click “Add Item”.

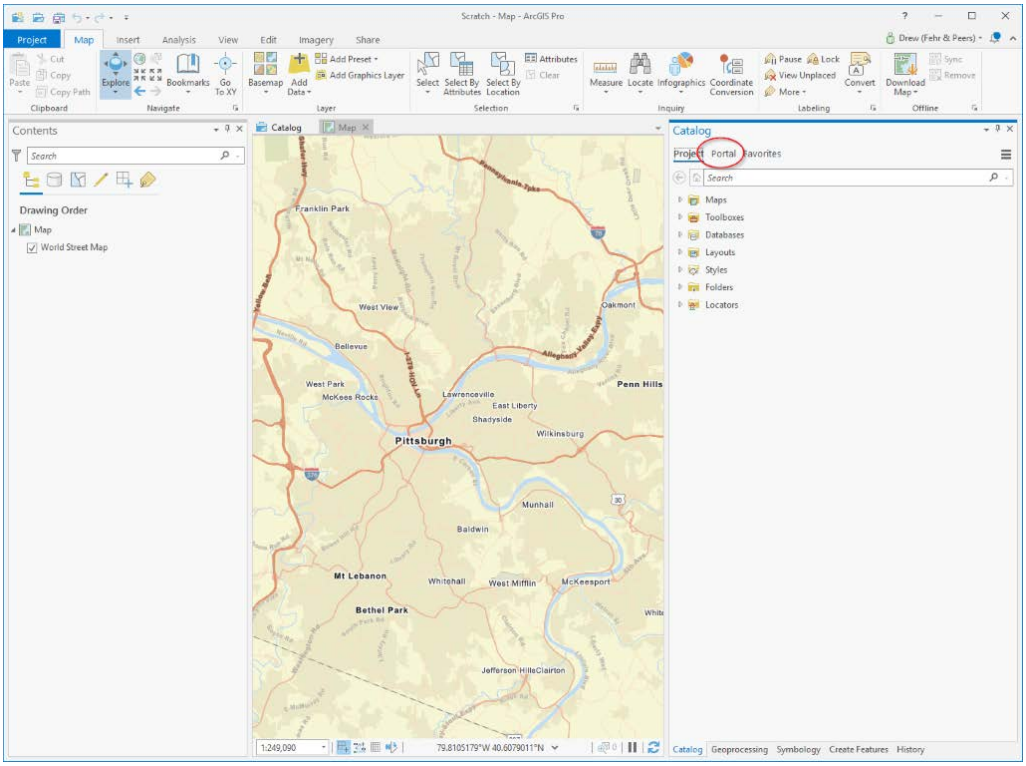



They then follow the instructions for creating a new web map (see page 3). They will then be able to open their own web map in ArcGIS Collector, but any features they create will be stored in the hosted feature layer.

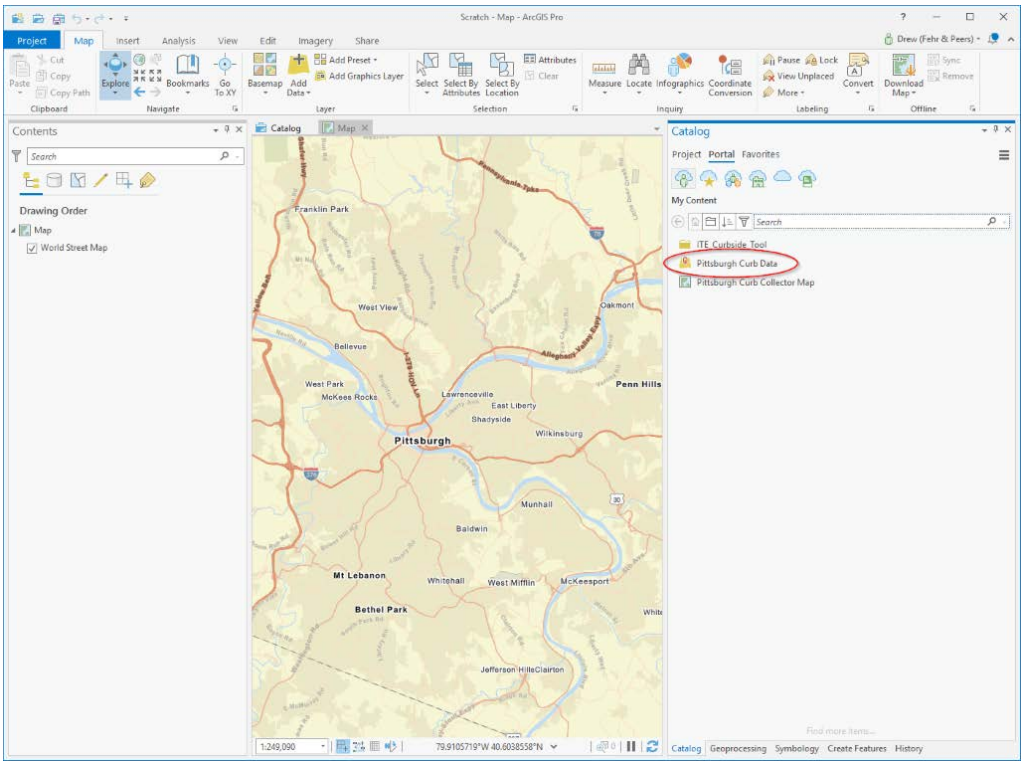
Import the hosted feature layer into ArcGIS Pro.

In ArcGIS Pro, go to “Catalog,” then “Portal”.

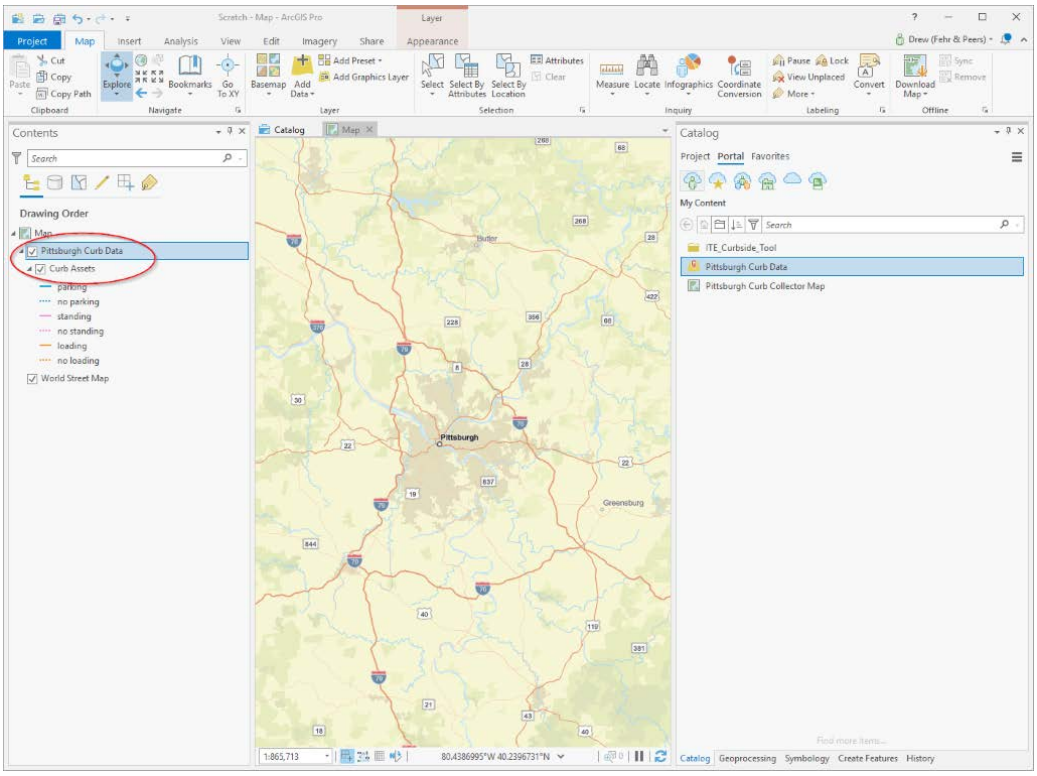


Select the hosted feature layer, then either drag it into the map pane or right-click it and select “Add To Current Map”.



Click the triangle next to the name of the hosted feature layer in the Contents pane to reveal the actual curb data feature layer (“Curb Assets”).



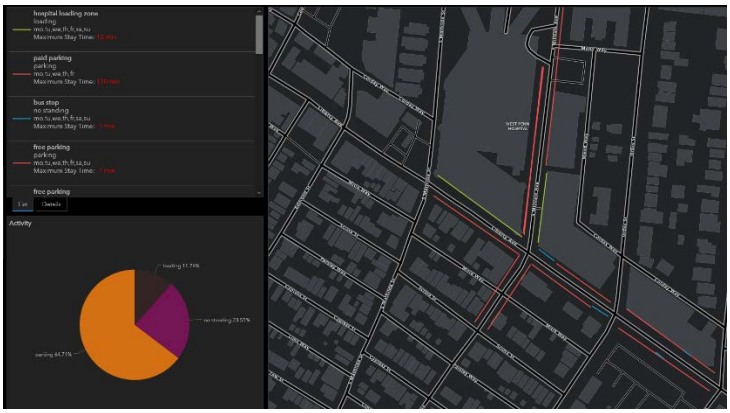

The analyst should make a copy of the data in the hosted feature layer (via the “Feature Class to Feature Class” geoprocessing tool) before running the Tool components on the curb features.

# Appendix C: Dashboard Instructions

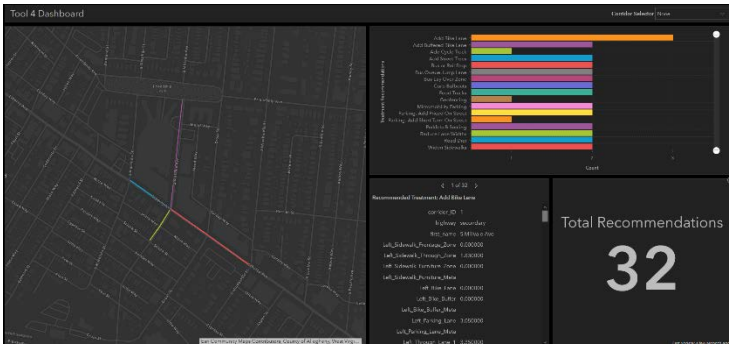
The dashboards associated with the Tool are examples of how the outputs can be visualized in an easily digestible format. More information about the configuration of an ArcGIS Dashboard can be found here: https://doc.arcgis.com/en/dashboards/get-started/what-is-a-dashboard.htm All images in Appendix C are sourced from Esri.

To use the example dashboard as a template, simply follow the steps on how it can be copied into the organization here: https://community.esri.com/t5/arcgis-dashboards-blog/how-did-they-make-that-dashboard/ba-p/888765. Two dashboards have been created to visualize the output from Components 1 and 4.

Component 1 Dashboard Curbside Features - https://esridot.maps.arcgis.com/home/item.html?id=5e99f740bea344ae91359982f1100a69



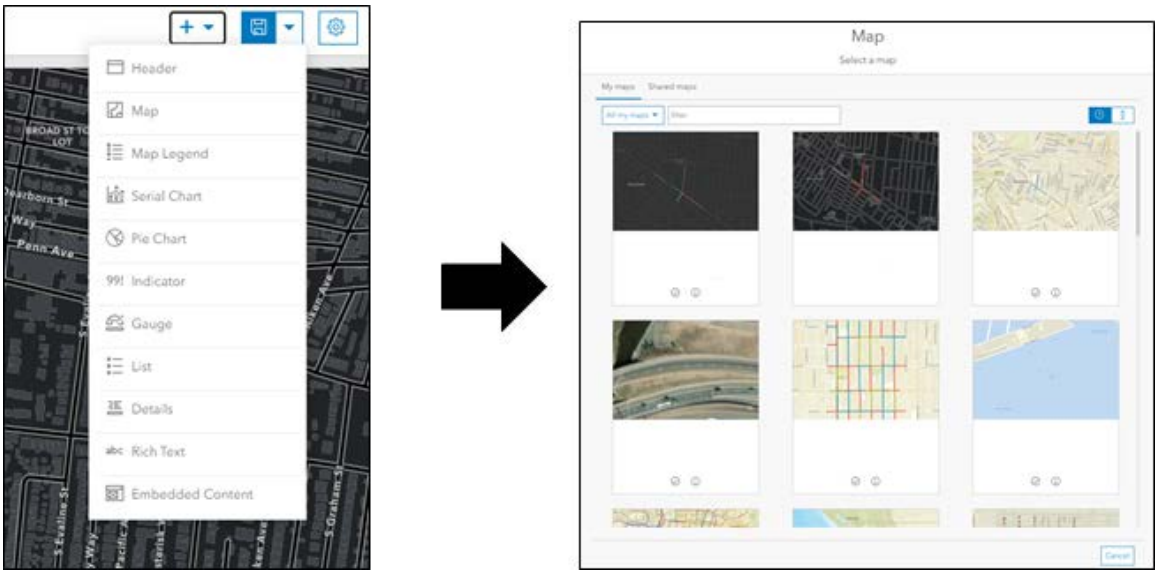

Component 4 Dashboard Curb Treatment Options - https://esridot.maps.arcgis.com/home/item.html?id=7dd1b533a1d742fd88f5c624694b53f3



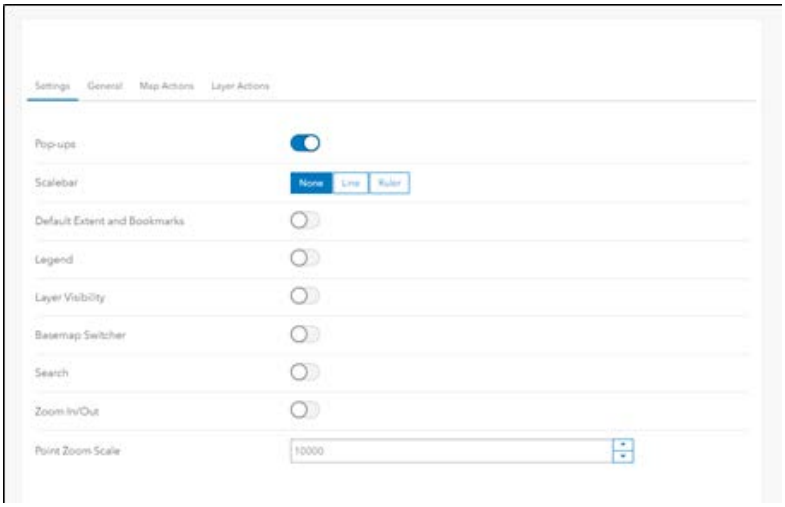

After creating a copy of the ArcGIS Dashboard following the steps outlined in the previous link, the dashboard can be reconfigured using a new dataset.

Click on the *Edit Dashboard* button on the *Item Details* page.

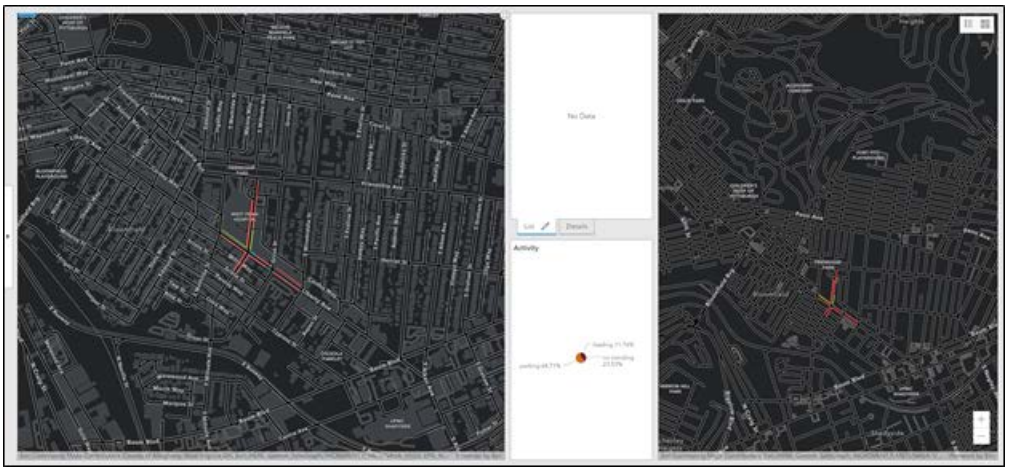

Add the webmap to the dashboard.




Accept the defaults and click *Done*. The analyst can come back later and change the preferred map settings.

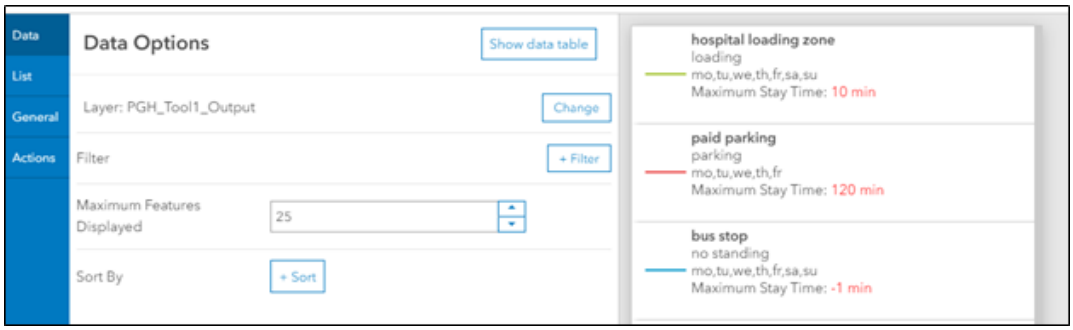


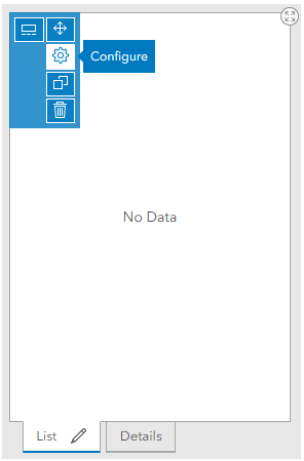
The dashboard should look similar to the image below. The map on the left is the map t that was added. The map on the right is the old map. The old map will be deleted once the widget is reconfigured to use the data from the new map.



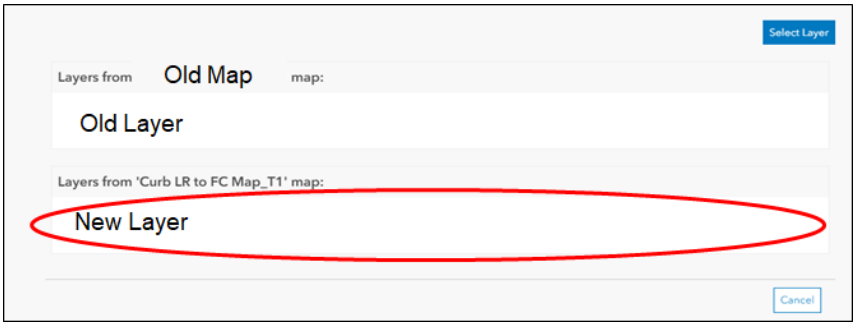
When hovering over the widget a blue box will appear in the top left-hand corner. Hover over that blue box and select the cog labeled *Configure.*

Click the *Change* button to change the layer from which this widget will read.




Click the layer from the new map then click the *Select Layer* button.



# Appendix D: Treatment Priority Lookup

As referenced above, and also available as an Excel table within the GitHub repository, the Treatment Priority Lookup Table is an essential component which provides user guidance to the component to analyze with the ROW Centerlines. The Treatment Priority Lookup Table should have the following information:

1. Mode priority which is applicable for each treatment to be implemented.
2. The mode priority rank range (Indicates the appropriate modal priority ranking range in the data for the mode priority applicable for the treatment to be applied).
3. The appropriate place type for each of the treatment to be applied. (Different place types are appropriate for different treatments; this will help checking the consolidated center line database if the necessary place type is available for a treatment to be implemented).
4. Appropriate Land use for each of the treatments. This criterion will also help checking the Land Use information available in the data for any specific treatment to be implemented.
5. Total ROW necessary per direction for a treatment to be implemented. This will again help to compare the ROW information in the data and check if the ROW requirement is present in the data to implement any treatment.
6. The MOEs associated with each of the treatments should be there in the treatment. The MOEs are listed in detail in **Table 5** in the User Guide.

**Table 6. Treatment Priority Lookup Table**

| Treatment ID | Treatments | Description | Mode Priority Applicable | Modal Priority Complement | Appropriate Priority Rank Range | Place Types | Appropriate Land Use | Total ROW Necessary Per Direction | Strategy Type | Measures of Effectiveness |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Widen Sidewalks | Either widen or add sidewalks | Pedestrian | | 1-2 | 2. Close-in Compact Communities | Commercial, Residential | 5 Feet | Additive | MOB-10,MOB-14,MOB-21,MOB-22,MOB-23,MOB-24,MOB-28,MOB-31,MOB-32,MOB-33,ACC-04,ACC-06,ACC-07,SAF-04,EQU-01,EQU-02,EQU-03,EQU-04 |
| 2 | Curb Bulbouts | Widen sidewalks into parking lanes near intersections. | Pedestrian | | 1-3 | 3. Compact Communities | Commercial, Residential | 8 Feet | Additive | MOB-09,MOB-10,MOB-13,MOB-22,MOB-28,ACC-04,ACC-06,ACC-07,SAF-02,SAF-03,SAF-04,SAF-06,SAF-07,EQU-03,EQU-04 |
| 3 | Parklets & Seating | Add parklets or miniature curbside parks in place of other uses. | Pedestrian | Commerce | 1-2 | 4. Suburban Communities | Commercial | 8 Feet | Additive | MOB-10,MOB-14,MOB-22,LIV-01,LIV-02,LIV-03,LIV-04,ACC-04,ACC-07,ECO-04 |
| 4 | Add Street Trees | The addition of trees to either the street sidewalks or median. | Pedestrian | | 1-2 | 4. Suburban Communities | Commercial, Residential | 2 Feet | Additive | MOB-23,MOB-31,LIV-01,LIV-04,SAF-02,SAF-06,SAF-07,EQU-01 |
| 5 | Food Trucks | The provision of food trucks at certain times of day to activate an area. | Pedestrian | Commerce | 1-3 | 3. Compact Communities | Commercial | 8 Feet | Additive | MOB-01,MOB-06,MOB-12,MOB-15,SAF-01,SAF-02,SAF-04,SAF-06,SAF-07,ECO-05,EQU-01 |
| 6 | Commercial Loading Zone | Addition of commercial loading zones for truck/commercial vehicle loading and unloading. | Commerce | | 1-2 | 2. Close-in Compact Communities | Commercial, Industrial | 8 Feet | Additive | MOB-01,MOB-06,MOB-09,MOB-12,MOB-13,MOB-15,ACC-05,SAF-01,SAF-02,SAF-04,SAF-06,SAF-07,ECO-01,ECO-02,ECO-03 |
| 7 | Passenger Drop-off Zones | Addition of a passenger drop off zone Taxi/Ride-hail passenger loading and unloading. | Ride-hail | | 1-2 | 3. Compact Communities | Commercial, Residential | 8 Feet | Additive | MOB-01,MOB-02,MOB-06,MOB-09,MOB-11,MOB-12,MOB-13,MOB-15,ACC-01,ACC-02,ACC-05,SAF-01,SAF-02,SAF-06,SAF-07,ECO-05 |
| 8 | Geofencing | Identifying locations where pick up drop - off for either TNCs, or Good Delivery, and Scooters. | Ride-hail | Commerce | 1-4 | 4. Suburban Communities | Commercial, Residential, Industrial | 8 Feet | Subtractive | MOB-01,MOB-02,MOB-06,MOB-09,MOB-10,MOB-11,MOB-12,MOB-13,MOB-14,MOB-15,ACC-01,ACC-02,ACC-05,SAF-01,SAF-02,SAF-06,SAF-07,ECO-05 |
| 9 | Micromobility Parking | Addition of bike parking or parking for other small micromobility class vehicles. | Bicycle | | 1-3 | 3. Compact Communities | Commercial, Residential | 8 Feet | Additive | MOB-07,MOB-08,MOB-10,MOB-14,MOB-19,MOB-20,MOB-21,MOB-22,MOB-23,MOB-24,MOB-25,MOB-29,MOB-31,MOB-32,MOB-33,ECO-05,EQU-01,EQU-02,EQU-03,EQU-03,EQU-04 |
| 10 | Add Bike Lane | Addition of a bike lane at least 4 feet wide. | Bicycle | Pedestrian | 1-3 | 5. Rural and Agricultural Lands | Commercial, Residential, Industrial | 5 Feet | Additive | MOB-07,MOB-19,MOB-21,MOB-23,MOB-24,MOB-28,MOB-31,MOB-32,MOB-33,EQU-01,EQU-02,EQU-03,EQU-04 |
| 11 | Add Buffered Bike Lane | Addition of a bike lane at least 4 feet wide with a buffer at least 18 inches. | Bicycle | Pedestrian | 1-2 | 3. Compact Communities | Commercial, Residential | 7 Feet | Additive | MOB-07,MOB-19,MOB-21,MOB-23,MOB-24,MOB-28,MOB-31,MOB-32,MOB-33,SAF-03,SAF-06,SAF-07,EQU-01,EQU-02,EQU-03,EQU-04 |
| 12 | Add Cycle Track | Addition of a bike lane of at least 5 feet wide, with a buffer at least 2 feet wide. | Bicycle | | 1-1 | 3. Compact Communities | Commercial, Residential | 8 Feet | Additive | MOB-07,MOB-19,MOB-21,MOB-23,MOB-24,MOB-28,MOB-31,MOB-32,MOB-33,SAF-03,SAF-04,SAF-05,SAF-06,SAF-07,EQU-01,EQU-02,EQU-03,EQU-04 |

| Treatment ID | Treatments | Description | Mode Priority Applicable | Modal Priority Complement | Appropriate Priority Rank Range | Place Types | Appropriate Land Use | Total ROW Necessary Per Direction | Strategy Type | Measures of Effectiveness |
|---|---|---|---|---|---|---|---|---|---|---|
| 13 | Add A General Purpose Lane | Add a general purpose driving lane to the street. | Automobility | | 1-2 | 5. Rural and Agricultural Lands | Commercial, Residential, Industrial | 11 feet | Additive | MOB-23,MOB-24,MOB-31,MOB-32,MOB-33 |
| 14 | Add Right Turn Lane | Add a right turn lane to one or both sides of the street. | Automobility | | 1-2 | 4. Suburban Communities | Commercial, Residential, Industrial | 11 feet | Additive | MOB-06,MOB-12,MOB-23,MOB-24,MOB-31,MOB-32,MOB-33 |
| 15 | Add Left Turn Lane | Add a left turn lane to one or both sides of the street. | Automobility | | 1-1 | 4. Suburban Communities | Commercial, Residential, Industrial | 11 feet | Additive | MOB-23,MOB-24,MOB-31,MOB-32,MOB-33 |
| 16 | Reduce Lane Widths | Reduce curblane widths to 11 feet, and non-curb lane widths to 10 feet. | Automobility | | 6-7 | 3. Compact Communities | Commercial, Residential | 0 Feet | Subtractive | ACC-06,SAF-02,SAF-06,SAF-07 |
| 17 | Road Diet | Remove one automobile lane, and replace another lane with a two-way left turn lane. | Automobility | | 6-7 | 4. Suburban Communities | Commercial, Residential | 0 Feet | Subtractive | ACC-06,SAF-02,SAF-06,SAF-07 |
| 18 | Parking: Add Long Term On-Street | Add long term unpriced parking to the street. | Storage | Pedestrian | 1-1 | 4. Suburban Communities | Commercial, Residential, Industrial | 8 Feet | Additive | MOB-27,EQU-01 |
| 19 | Parking: Add Short-Term On-Street | Add short-term parking (limited duration) to the street. | Storage | Pedestrian | 1-4 | 3. Compact Communities | Commercial, Residential | 8 Feet | Additive | MOB-01,MOB-04,MOB-06,MOB-09,MOB-12,MOB-13,MOB-15,MOB-16,MOB-27,MOB-30,ACC-05,SAF-01 |
| 20 | Parking: Add Priced On-Street | Add priced parking to the street. | Storage | Pedestrian | 5-7 | 3. Compact Communities | Commercial | 8 Feet | Additive | MOB-04,MOB-07,MOB-16,MOB-17,MOB-18,MOB-19,MOB-21,MOB-23,MOB-24,MOB-25,MOB-27,MOB-30,MOB-31,MOB-32,MOB-33,MOB-34,ECO-06,ECO-07 |
| 21 | Parking: Electric Vehicle Charging | Add parking with eletric vehicles. | Storage | Pedestrian | 1-4 | 3. Compact Communities | Commercial | 8 Feet | Additive | MOB-26,ECO-05 |
| 22 | Bus-Lay Over Zone | Add a curbside bus lay over zone for transit vehicles. | Transit | | 1-4 | 4. Suburban Communities | Commercial, Residential, Industrial | 10 Feet | Additive | MOB-02,MOB-03,MOB-04,MOB-05,MOB-11,MOB-16,MOB-23,MOB-24,MOB-31,MOB-32,MOB-33,SAF-01 |
| 23 | Bus or Rail Stop | Add a curbside stop for for transit vehicles. | Transit | | 1-3 | 4. Suburban Communities | Commercial, Residential, Industrial | 0 Feet | Additive | MOB-01,MOB-02,MOB-03,MOB-04,MOB-05,MOB-11,MOB-16,MOB-23,MOB-24,MOB-31,MOB-32,MOB-33,SAF-01,ECO-05,EQU-01,EQU-04 |
| 24 | Bus Queue Jump Lane | Add a queue jump lane for buses near intersection. | Transit | | 1-2 | 3. Compact Communities | Commercial | 11 Feet | Additive | MOB-02,MOB-03,MOB-04,MOB-05,MOB-11,MOB-16,MOB-23,MOB-24,MOB-31,MOB-32,MOB-33 |
| 25 | Bus Lane | Add a bus lane for transit vehicles only. | Transit | | 1-1 | 4. Suburban Communities | Commercial | 11 Feet | Additive | MOB-02,MOB-03,MOB-04,MOB-05,MOB-11,MOB-16,MOB-23,MOB-24,MOB-31,MOB-32,MOB-33 |
| 26 | Flex Zones | Add a zone that has multiple uses by time period. | Ride-hail | Commerce, Transit | 1-2 | 3. Compact Communities | Commercial, Residential, Industrial | 8 Feet | Additive | MOB-01,MOB-02,MOB-03,MOB-04,MOB-05,MOB-11,MOB-15,MOB-16,MOB-18,MOB-22,MOB-35,SAF-01,SAF-04,ECO-01,ECO-02,ECO-03 |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