

Solving the Curb Space Puzzle Through the Development of Arlington County's Curb Space Allocation Tool

National Capital Region
Transportation Planning Board
Freight Subcommittee Meeting

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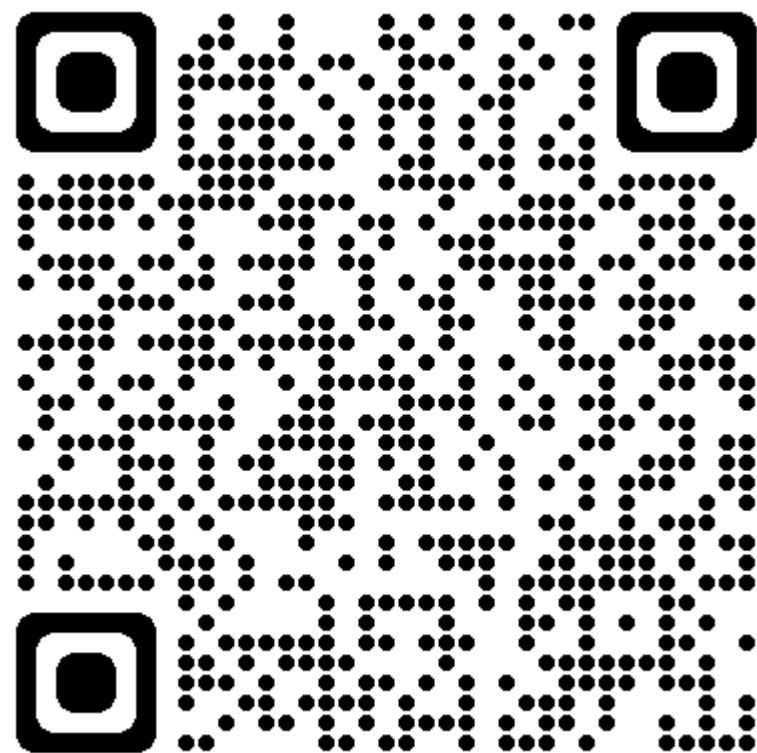
Metropolitan Washington
Council of Governments



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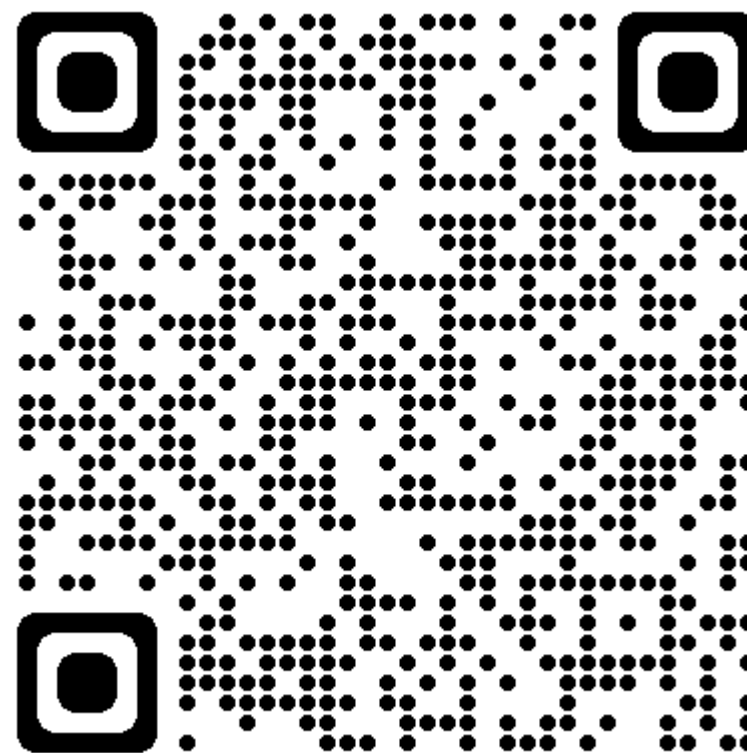
Access the Paper and Tool

Transportation Research Record Article



<https://tinyurl.com/Curb-Space-Paper>

Online Tool



<https://tinyurl.com/Curb-Space>

Outline

- Background
- Developing the Curb Space Allocation Tool
- Using the Curb Space Allocation Tool
- Future Research and Identified Gaps



Background

- **Need**
- **Functionality**
- **Limits**
- **Modes**



Need

- New modes and technologies have fundamentally changed the transportation landscape at the curbside
- On-street parking likely has less value than other uses, but how much?



Functionality

Capabilities

Provides a mechanism to help **determine the optimal allocation of curb space** given a block's existing or proposed land uses and transportation services.

Helps County planners better manage their curb space by understanding the **demand** for various curb uses and the relative **value** of various curb allocations at the block level.

Delivers information for **decision-makers and the public** when presenting curb-allocation alternatives

Offers **an additional input for making decisions** on curbside regulations.

Usage Scenarios

Be utilized as a curb management tool to **understand the value** of curbside uses

Be used for **single-site, corridor** and **small-area planning** efforts that help define the best use of the curb space

Be **functional for the entire County**

Be able to **accommodate various geographies** and functions

Serve as the **foundation for future region-wide efforts**

Provide **results for various times of day**



Limits

- Limited resources and COVID-19 meant no new data was collected
- The focus was developing a methodology and framework that allows new data and mathematical models to be incorporated over time



Modes



**Ride-hailing
service**



**Commercial
loading**



On-street parking



Transit service



Micromobility



**Non-transportation
uses (parklets,
streeteries, etc.)**

The background of the slide is a light gray map of a city street grid. A prominent river or canal winds through the grid, starting from the top center and flowing towards the bottom right. The streets are represented by thin white lines, and the river is a slightly thicker white line. The overall aesthetic is clean and technical.

Developing the Curb Space Allocation Tool

- **Demand calculations**
- **Allocating the curb space**

Ride-Hailing Service Demand

Data Inputs

Arlington County 2019 Census Data

Arlington County 2019 TAZ Socio-Economic Data

Arlington County 2019 Ride-hailing (TNC) Pick-Up & Drop-Off Data (provided by SharedStreets through a license to Arlington County)

Influencing Factors

Median Age

Median Income

Percent of The Population with a Bachelor's Degree or Higher

Population Density

Population to Employment Ratio

Land Use Mix



Commercial Loading Demand (Attempt)

Data Inputs

Arlington County 2019 TAZ
Socio-Economic Data

parkDC: Penn
Quarter/Chinatown
Performance Parking Pilot
Loading Zone Data

Influencing Factors

Freight Trips at Zone Level

Service Trips at Zone Level

Population

Industrial Employees

Commercial Employees



Commercial Loading Demand (Utilized)

- Average commercial loading zone demand based on the parkDC commercial loading data
- Value is applied using a rate of commercial loading spaces per curb space length

Arlington County-specific loading zone data is likely the highest priority research gap in the current tool



Transit Service Demand

Data Inputs

Arlington County 2019 Census Data

Arlington County 2019 TAZ Socio-Economic Data

Arlington County Roadway Speed Limits

WMATA and ART 2019 ridership data at the station level

Influencing Factors

Median Age

Median Income

Household Car Ownership

Population Density

Commercial Land-Use Percentage

Speed Limit



On-Street Parking Demand

- Limited by the lack of available parking inventory data (this is not commonly available)
- Upper limit of 100 on-street spaces per hectare was applied based on the typical density of parking supply in major cities

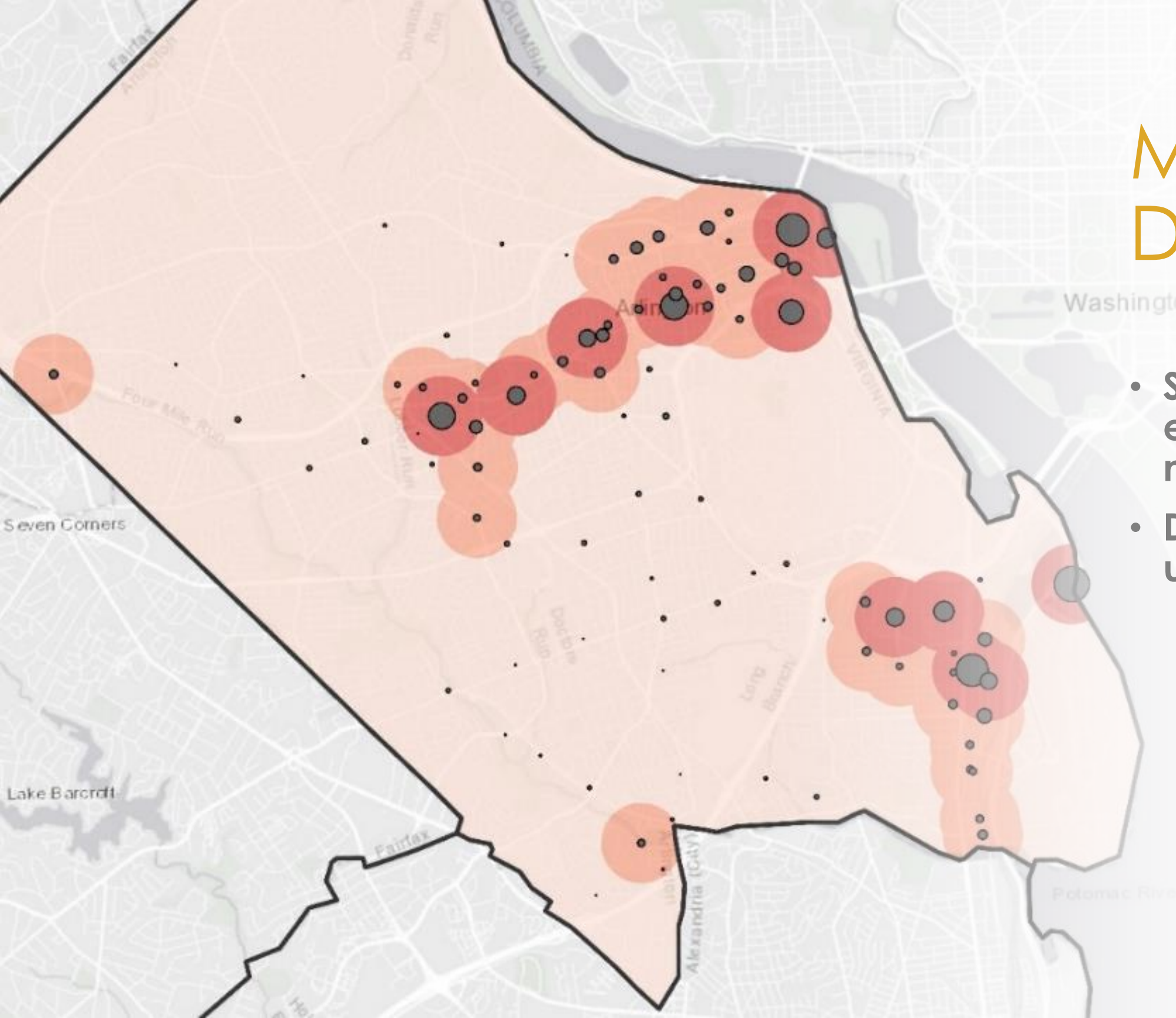


Micromobility Demand

- Statistical models for estimating demand were not easily replicable
- Demand typologies were used instead

TYPOLOGY

- HIGH RIDERSHIP DEMAND
- MODERATE RIDERSHIP DEMAND
- LOW RIDERSHIP DEMAND
- EXISTING CAPITAL BIKESHARE STATIONS





Non-Transportation Uses (Parklets, Streateries, etc.) Demand

- Data is largely unavailable for parklets/streateries
- Demand for parklet/streatery is typically dependent on the fronting business type
- Currently, user input determines the parklet/streatery demand constraints

Curb Space Requirements

Use	Arlington County Curb Space Standard	Curb Length Used in Allocation Tool	Notes
Ride-hailing Service	25 feet (Farside) 30 feet (Nearside) 40 feet (Mid-block)	40 feet	Assumptions based on guidance in the ITE Curbside Management Practitioners Guide
Commercial Loading	40 feet	40 feet	Forty feet is long enough for either one single-unit 30-foot truck (SU-30) or two standard vehicles.
Transit Service	40 feet (Stop in travel lane) 70 feet (Farside) 100 feet (Nearside) 130 feet (Mid-block)	100 feet	Space is required for a bus to pull in and out of the bus stop.
Micromobility	10 feet	10 feet	No current standards or guidelines exist. These are generally installed in leftover space that wouldn't fit a parking stall.
On-Street Parking	20 feet	20 feet	ADA stalls require 26 feet
Non-Transportation Uses (Parklets, Streateries, etc.)	40 feet	40 feet	40 feet includes a minimum of a 30-foot long parklet and a 5-foot buffer on both sides of the parklet per County requirements
Walking (Not included in the model)	Not applicable	Not applicable	Not applicable

Effective Capacity of Curb Space Uses

Use	Effective Capacity
Ride-hailing Service	18.91 pick-up/drop-offs per hour <i>(3 minutes, 10 seconds per pick-up/drop-off)</i>
Commercial Loading	0.83 deliveries/ hour <i>(50 minutes per delivery)</i>
Transit Service	25 stops/hour <i>(2 minutes, 24 seconds per stop)</i>
Micromobility	200 trips/day
On-Street Parking	0.73 parked cars/ hour <i>(43 minutes, 48 seconds per stay)</i>
Non-Transportation Uses (Parklets, Streateries, Etc.)	Not applicable
Walking (Not included in the model)	Not applicable

Use	Economic Value (spending per person-trip)		
	Rosslyn-Ballston Corridor	Richmond Highway Corridor	Columbia Pike Corridor
Ride-hailing Service	\$12.88	\$53.07	\$7.75
Commercial Loading	\$500/delivery		
Transit Service	\$11.38	\$48.10	\$6.83
Micromobility	\$18.31	\$40.58	\$7.76
On-Street Parking	\$12.88	\$53.07	\$7.75
Non-Transportation Uses (Parklets, Streateries, etc.)	\$1265.75 daily sales per parklet/streatery		
Walking (Not included in the model)	\$28.72	\$42.23	\$8.45

Economic Value

- Ride-hail, Transit Service, Micromobility, and On-Street Parking values derived from a Seattle neighborhood intercept survey
- The intercept survey data was adjusted for use in Arlington County for each of the County's "transit-oriented planning corridors"

Societal Value

Use	Societal Value
Ride-hailing Service	1.24 persons per trip
Commercial Loading	1 person per trip
Transit Service	4 persons per trip
Micromobility	1 person per trip
On-Street Parking	1.5 persons per trip
Non-Transportation Uses (Parklets, Streateries, etc.)	160 persons per trip
Walking (Not included in the model)	1 person per trip

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Using the Curb Space Allocation Tool

- **Role of the curb space allocation tool**
- **Functionality and requirements**

Role of the Curb Space Allocation Tool

1. Inventory existing conditions

2. Identify land use and activity considerations to develop modal prioritization

3. Identify appropriate treatment alternatives

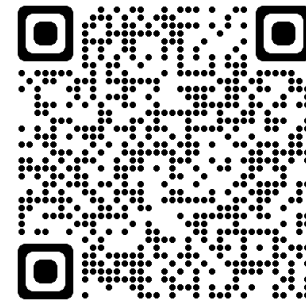
4. Assess and present alternatives for public feedback

5. Refine and implement treatments

"Curb space is flexible—while physically moving the curb usually requires expensive capital construction, curb use can be changed quickly, temporally, and iteratively."

- *ITE Curbside Management Practitioners Guide*

Welcome Page



<https://tinyurl.com/Curb-Space>

The screenshot shows the Arlington County Curb Space Allocation Tool interface. At the top, a blue header contains a hamburger menu icon and the text "Arlington County Curb Space Allocation Tool". Below this is an orange sidebar with icons for home, data, information, and user profile. The main content area features the Arlington Virginia logo on the left and a central heading "Welcome to the Arlington County Curb Space Allocation Tool!". Below the heading is a paragraph explaining the tool's purpose: "This tool can be used to help inform decision-making processes for allocating curb space usage. The tool can provide estimations for demand for six curbside usage types based on location specific metrics, and will optimize the allocation of curb space based on economic and/or societal impacts." Two large buttons are present: "Begin New Analysis" with a subtext "Create a new analysis." and a "BEGIN" button, and "Open Existing Analysis" with a subtext "Open an existing analysis." and an "OPEN" button. A callout box titled "Open Project File" is overlaid on the "OPEN" button, showing a file selection interface with a "Choose File" button, a file name "clarendon.json", and "CLEAR" and "OPEN ANALYSIS" options. Below the callout, project details are listed: Project Name: Clarendon Boulevard, Analyst: ALP, Agency: Agency, and Description: Default values. At the bottom, there are "CONTACT" and "ABOUT" links.

<https://tinyurl.com/Curb-Space-Paper>
<https://tinyurl.com/Curb-Space>



Project Information (Step 1)

☰ Arlington County Curb Space Allocation Tool

🏠
📊
📄
👤

- 1 Project Information**
Enter identifying and documentation information for the project.
- 2 Set Location
- 3 Review Parameters
- 4 Curbside Optimization
- 5 Results
- 6 Report

Welcome to the Curbside Optimization Tool!

Please enter identifying information for the curbside analysis project. Subsequent steps will guide the user through the demand generation modules and the optimization analysis.

Projects can be exported for documentation and/or returned to later at any time using the **Export Analysis** button in the bottom left of the tool.

Project Name:

Project Analyst:

Project Agency:

Additional Project Notes:

BACK **NEXT**

Set Location (Step 2)

Arlington County Curb Space Allocation Tool

Project Information

Set Location
If applicable, select a location for the curbside optimization analysis.

Review Parameters

Curbside Optimization

Results

Selecting a location on the map allows the parameters for the demand regression models to be automatically estimated.
MORE INFORMATION

Bypass Map Location

Location Selection Type Snap to Road Custom Area

Selection Summary

Parameter	Value
Median Age	33.5
Median Household Income	\$144,782.86
Household w/o Vehicles	19.9%
Population >= Bachelors Degree (%)	76.6%
Population Density	20431.8
Industrial Employment	111.9
Retail Employment	438.4
Population to Employment Ratio	0.4
Land Use Mix Entropy	0.7
Freight Trips	133.0
Service Trips	118.7
Commercial Land Use %	18.6%
Measured Route Length	0.70 mi
Measured/Buffered Area	0.03 mi ²

BACK NEXT



Review Parameters (Step 3)

- ✓ Project Information
- ✓ Set Location
- 3 Review Parameters
 - Review module parameters for the demand estimation regressions.
- 4 Curbside Optimization
- 5 Results
- 6 Report

Review Demand Module Parameters

1. Required Curbside Length Availability Inputs:

A. Enter the length in feet of continuous curb space for which the analysis will estimate the optimal allocation of curb usage treatments.

feet
800

- Location Measured Length: 3626 ft
- Location Measured Area: 0.03 mi²

B. Enter the total number of potential parklet/streeteries available (each 30' to 40' in length, or about two parking spaces). More Information: [Parklets - Transportation \(arlingtonva.us\)](#)

spaces
4

C. Select the micromobility demand level

Demand Level
High

2. Optional Demand Model Parameter Overrides:

If a map selection was made at the previous step, the following sections will present the values generated from the geospatial analysis of the census and travel demand data. These values are presented for review, and any value can be optionally override by the user.

If map selection was not made at the previous step, the user is required to provide values for all inputs below.

A. Population Statistics				
Population Statistics	Calculated	Override	User Value	Required For
Median Age (years)	33.5	<input type="checkbox"/>		
Median Income	\$144,782.86	<input type="checkbox"/>		
Households w/o Vehicles (%)	19.9%	<input type="checkbox"/>		
Population >= Bachelors Degree (%)	76.6%	<input type="checkbox"/>		
Population Density	20431.8	<input type="checkbox"/>		

B. Area Statistics				
Area Statistics	Calculated	Override	User Value	Required For
Freight Trips	133.0	<input type="checkbox"/>		
Service Trips	118.7	<input type="checkbox"/>		
Industrial Employment	111.9	<input type="checkbox"/>		
Retail Employment	438.4	<input type="checkbox"/>		

C. Computed Model Metrics				
Computed Metrics	Calculated	Override	User Value	Required For
Land Use Mix	0.7	<input type="checkbox"/>		
Population to Employment Ratio	0.4	<input type="checkbox"/>		
Commercial Land Use %	18.6	<input type="checkbox"/>		

Micromobility Demand Levels:

- **High:** Central business districts and major transportation hubs. Example areas: National Landing, Rosslyn. (Trip rate per acre = 1.02)
- **Moderate:** Densely developed neighborhood in proximity to key activity centers or adjacent to high-ridership demand areas. Example area: North Highlands. (Trip rate per acre = 0.36)
- **Low:** Areas in suburban and with more auto-oriented land uses. Example areas: Arlington Ridge, North Arlington. (Trip rate per acre = 0.08)

Curbside Optimization (Step 4)

<https://tinyurl.com/Curb-Space-Paper>
<https://tinyurl.com/Curb-Space>



Arlington County Curb Space Allocation Tool

- Project Information
- Set Location
- Review Parameters
- Curbside Optimization**
Review estimated demand for curb usage types and optimization model parameters for spatial requirements, economic values, and societal values.
- Results
- Report

Review Demands and Optimization Parameters

The following values represent the maximum demands of each curb usage type the model should consider when optimizing the allocation of available curb space specified in the previous step. Note that on-street parking is based on a default value and parklet/streatery is based on available space, while the other demands are based on demand models.

Usage Type Demands	Unit	Calculated	Override	User Value
Rideshare®	trips / day	40	<input type="checkbox"/>	
Commercial Loading®	deliveries / day	100	<input type="checkbox"/>	
Transit®	riders / day	224	<input type="checkbox"/>	
Micromobility®	trips / day	50	<input type="checkbox"/>	
On-Street Parking®	spaces / hectare	41	<input type="checkbox"/>	
Parklet/Streatery®	spaces	4	<input type="checkbox"/>	

The following values represent the spatial, economic, and societal values associated with each curb usage type. These values inform the objective that will be maximized in the curbside allocation optimization approach.

Curb Length Requirements

Space Requirements	Unit	Default	Override	User Value
Rideshare®	feet	40	<input type="checkbox"/>	
Commercial Loading®	feet	40	<input type="checkbox"/>	
Transit®	feet	100	<input type="checkbox"/>	
Micromobility®	feet	10	<input type="checkbox"/>	
On-Street Parking®	feet	20	<input type="checkbox"/>	
Parklet/Streatery®	feet	40	<input type="checkbox"/>	

Economic Values

Economic Values	Unit	Default	Override	User Value
Rideshare®	USD / trip	\$12.88	<input type="checkbox"/>	
Commercial Loading®	USD / delivery	\$500.00	<input type="checkbox"/>	
Transit®	USD / rider	\$11.38	<input type="checkbox"/>	
Micromobility®	USD / person / trip	\$18.31	<input type="checkbox"/>	
On-Street Parking®	USD / person / trip	\$12.88	<input type="checkbox"/>	
Parklet/Streatery®	USD / space / day	\$1,265.75	<input type="checkbox"/>	

Societal Values

Societal Values	Unit	Default	Override	User Value
Rideshare®	persons / trip	1.24	<input type="checkbox"/>	
Commercial Loading®	persons / trip	1	<input type="checkbox"/>	
Transit®	persons / trip	4	<input type="checkbox"/>	
Micromobility®	persons / trip	1	<input type="checkbox"/>	
On-Street Parking®	persons / trip	1.5	<input type="checkbox"/>	
Parklet/Streatery®	persons / space / day	160	<input type="checkbox"/>	

BACK NEXT

Results (Step 5)

- ✓ Project Information
- ✓ Set Location
- ✓ Review Parameters
- ✓ Curbside Optimization
- 5 Results
 - Optimization Results
- 6 Report

Optimization Model and Results - Daily Weekday

The following tables display the optimization model constraints, the economic objective results, and the societal objective results

Demand Constraints by Type	Unit	Daily Need	Est. Treatments to Serve All Demand
Ridesharing	trips	40	1
Commercial Loading	deliveries	100	6
Transit Stop	riders	224	1
Micromobility Station	trips	50	1
On-street Parking	spaces	41	41
Parklet/Streatery	patrons	4	4

Economic Model Results

Feasible:	Yes	Bounded:	Yes
Available Curb (ft)	800	Curb Utilized (ft)	800
Total Economic Value	\$59,197.38	Total Societal Value	1754 persons

Usage Type	Recomm. # Spaces	Spatial Req.	Demand/Need Met	Demand Not Met	Economic Value (\$)				
					Daily	AM	MD	PM	NT
Ridesharing	1	40 ft	40	0	\$866	\$124	\$299	\$254	\$188
Commercial Loading	6	240 ft	100	0	\$50,000	\$7,450	\$20,250	\$11,900	\$10,400
Transit Stop	1	100 ft	224	0	\$5,419	\$1,311	\$1,479	\$1,766	\$856
Micromobility Station	2	20 ft	50	0	\$1,257	\$226	\$370	\$429	\$233
On-street Parking	12	240 ft	12	29	\$209	\$30	\$72	\$62	\$45
Parklet/Streatery	4	160 ft	4	0	\$4,800	\$192	\$1,973	\$1,238	\$1,397

Societal Model Results

Feasible:	Yes	Bounded:	Yes
Available Curb (ft)	800	Curb Utilized (ft)	790
Total Economic Value	\$58,723.14	Total Societal Value	1756 persons

Usage Type	Recomm. # Spaces	Spatial Req.	Demand/Need Met	Demand Not Met	Societal Value (Persons)				
					Daily	AM	MD	PM	NT
Ridesharing	1	40 ft	40	0	50	8	18	15	11
Commercial Loading	5	200 ft	99	1	99	15	41	24	21
Transit Stop	1	100 ft	224	0	896	217	245	293	142
Micromobility Station	1	10 ft	50	0	50	9	15	18	10
On-street Parking	14	280 ft	14	27	21	4	8	7	5
Parklet/Streatery	4	160 ft	4	0	640	26	264	166	187

EXPORT ANALYSIS

BACK GENERATE REPORT

Time Of Day Definitions

AM (Morning)

MD (Midday)

PM (Evening)

NT (Nighttime)

Time Period

6:00 AM to 9:00 AM

9:00 AM to 3:00 PM

3:00 PM to 7:00 PM

7:00 PM to 6:00 AM

Arlington County Curb Space Allocation Tool

- Project Information
- Set Location
- Review Parameters
- Curbside Optimization
- Results
- Report

Optimization Results

← BACK PRINT

Project Report: Clarendon Boulevard

Arlington County Curb Space Allocation Tool

Project Name: Clarendon Boulevard
 Analyst: ALP
 Agency: Agency
 Project Notes:
 Default values

Leaflet | Tiles © Esri — Esri, DeLorme, NAVTEQ

Demand Module Statistics

Population Statistics	Value	Source*	Area Statistics	Value	Source*
Median Age	33.5	Derived	Freight Trips	133.0	Derived
Median HH Income	\$144,783	Derived	Service Trips	118.7	Derived
% HH No Vehicles	19.9%	Derived	Industrial Employment	111.9	Derived
% >= Bachelor's degree	76.6%	Derived	Retail Employment	438.4	Derived
Pop. Density	20431.8	Derived			

Computed Statistics	Value	Source*	Additional Metrics	Value	Source*
Land Use Mix	0.7	Derived	Available Curb Length (ft)	800	User
Pop. to Emp. Ratio	0.4	Derived	Micromobility Demand Level	High	User
Comm. Land Use %	18.6%	Derived	Parklet/Streatery Space Demand	4	User

* Derived = Lists derived from census, TUE, and other data sources. "User" = Specified directly (or overridden) by the user. "Additional Metrics" are user specified for all analyses.

Demand Constraints and Optimization Values

Type	Unit	Daily Need	Est. Total Treatments*	Economic Value (\$ / Treatment)	Societal Value (Persons / Treatment)
Ridesharing	trips	40	1	\$12.08	1.2
Commercial Loading	deliveries	100	6	\$500.00	1.0
Transit Stop	riders	224	1	\$11.38	4.0
Micromobility Station	trips	50	1	\$18.31	1.0
On-street Parking	spaces	41	41	\$12.08	1.5
Parklet/Streatery	patrons	4	4	\$1,265.75	160.0

* Estimated total treatments of each type needed to satisfy # of demand.

Report (Step 6)

Analysis Results

Economic Model Results

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Future Research and Identified Gaps

- **Gaps in Research and Data**
- **Future Tool Updates**

Gaps in Research and Data (1)

General Considerations

- Rules of thumb, industry standards, and data from other regions were frequently used so that the project team could focus on developing the tool's methodology, equations, and user interface. **Collecting local data, such as spending data by trip type and mode like the data collection efforts in Seattle, would substantially upgrade the calculations and allow for potential calibration of the model to local subareas.**

Economic and Societal Benefits

- The tool relied on a narrow definition of direct economic benefits in consumer spending; **future research and data gathering could be undertaken to incorporate indirect economic benefits.** The tool's **consideration of societal benefits could also be expanded** beyond individuals served to include the monetized value of other societal benefits.

Pricing and Time Limit Adjustments

- The tool does not adjust the demand or allocation based on pricing or time limits due to limited available data about the **impacts of price or time limit adjustments on the demand, economic, or societal values associated with these changes.** Incorporating pricing and time-limit adjustments would also help provide a more reasonable constraint on the current "limitless" demand for on-street parking spaces within the tool.

Ride-hailing Services

- An improved understanding of ride-hailing services, particularly in Arlington, would be beneficial. However, **the substantial resources required to collect and process a sufficient amount of data to provide a tangible benefit are likely not worth the effort at this time.**

Gaps in Research and Data (2)

Commercial Loading

- **A significant gap exists in available commercial loading data.** An initiative by the County to collect and inventory on- and off-street loading zones and usage data, including time-of-day, length-of-stay, distance and proximity to customers, and supplemental information including the number of parcels delivered, the number of customers served, and collecting potential economic value information associated with loading zones would provide a substantial upgrade to the curb space allocation tool. **This is likely the highest priority research gap.**

Off-Street Parking

- Incorporating off-street parking inventory and **upgrading the parking demand module to consider the off-street parking supply** in conjunction with demand for on-street parking would provide a much more reasonable constraint on the demand for on-street parking spaces.

Micromobility

- **An improved understanding of micromobility demand**, especially if the demand estimation could be upgraded to a regression approach, would provide more useful micromobility demand estimations and allocation outputs.

Non-transportation mode (parklet/streeteries)

- Use new data on parklets and streateries, especially spending and usage information, to substantially upgrade the non-transportation mode module. Further, the tool does not adjust for potential shifts in demand for the use of outdoor space if the demand for indoor dining space returns after the COVID-19 pandemic subsides. **This is likely the second highest priority after commercial loading.**

Future Tool Updates

The ability to break down the available curb space into smaller segments could be useful for allocating "leftover" space. This could be done by combining the tool with a curbside inventory conducted using a linear referencing system.

Further enhancements could include a graphical output (like StreetMix) that provides visually appealing inputs and outputs.

Incorporating pricing and time changes with the parking demand calculations could allow additional functionality as the County explores performance parking initiatives.

Adding a supplemental electric vehicle charging component to the on-street parking module would allow the tool to consider electric vehicles' potential economic or societal benefits.

Considering the "Flex Zone" or the roadway lane immediately in front of the curb along with the sidewalk space adjacent to the curb could allow for the tool to analyze benefits associated with parking-protected bike lanes, transit lanes, an expanded sidewalk area, and landscaping including trees and shade.

Thank you

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