Bus Stop Amenity Policy and Practice: A Multiagency, Multijurisdictional Evaluation

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Agenda

- Introduction
- Policy Context and Findings
- Bus Stop Data
- Methodology
- Results and Findings
- Discussion and Conclusions

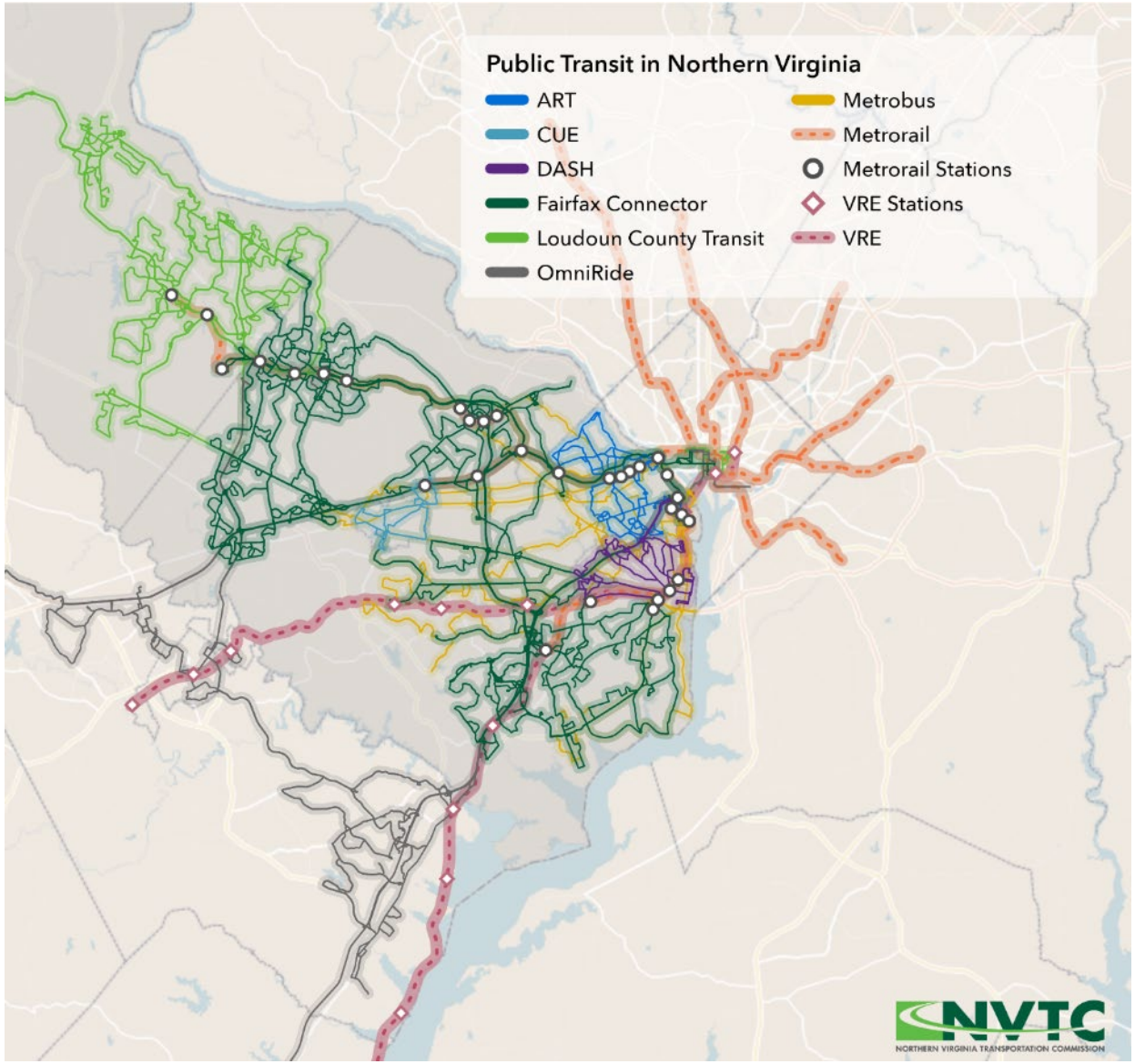
Introduction

- **Bus stops are important; they can:**
  - Increase rider comfort
  - Reduce perception of wait times
  - Contribute to safety and security
  - Reduce demand for more costly transportation alternatives
  - Potentially increase ridership
- **Limited existing work on bus stops (Moran 2022 a notable exception)**
- **This study advances on Moran's in 3 ways:**
  1. Considers different geography and policy context
  2. Evaluates over time, not just space
  3. Evaluates a more complex operating environment

A Northern Virginia bus stop with temporary seating

Policy Context

- Federal rules set standards for amenity design but not placement
- Virginia state processes can mean it might take years to add new bus stop amenities
- Northern Virginia is a complex bus operating environment
  - 2.5m residents in 9 local jurisdictions
  - 7,500+ stops across 250+ routes from 7 different bus agencies
  - 25+ million bus trips in 2022
  - Overlapping service means 3 different bus agencies can serve same stop, 6 bus agencies can serve 1 location



Policy Findings

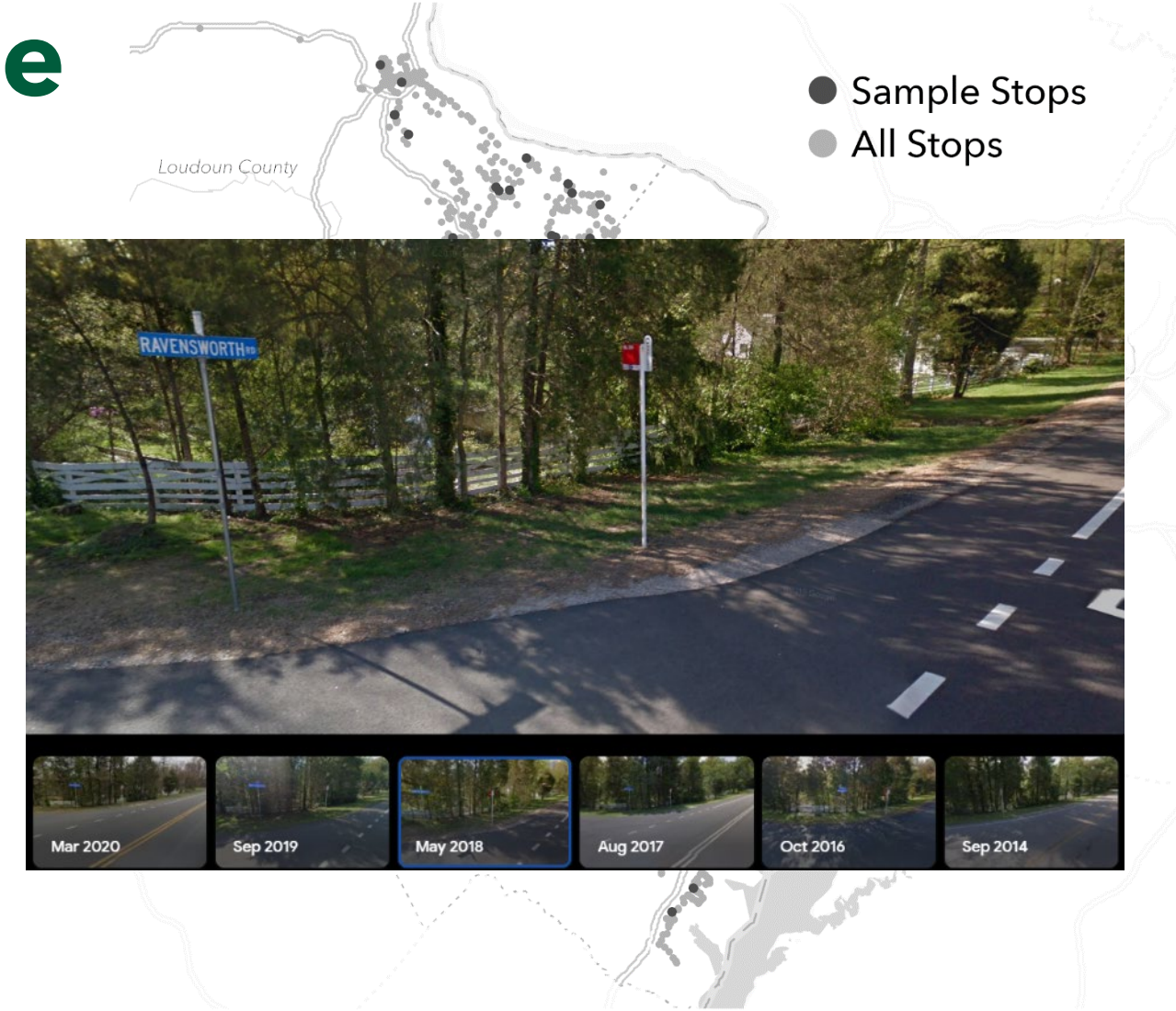
- Bus amenity policies of each agency were evaluated to find consistencies
- WMATA had most detailed policy
- Bus shelters were mentioned in every policy, seating mentioned second most
- Most agencies classified stops into different tiers, primarily based on mode change (car to bus or bus to rail)
- Factors for improving stops varied a lot; daily boardings was only consistent measure

Bus stop amenity improvement decision-making considerations

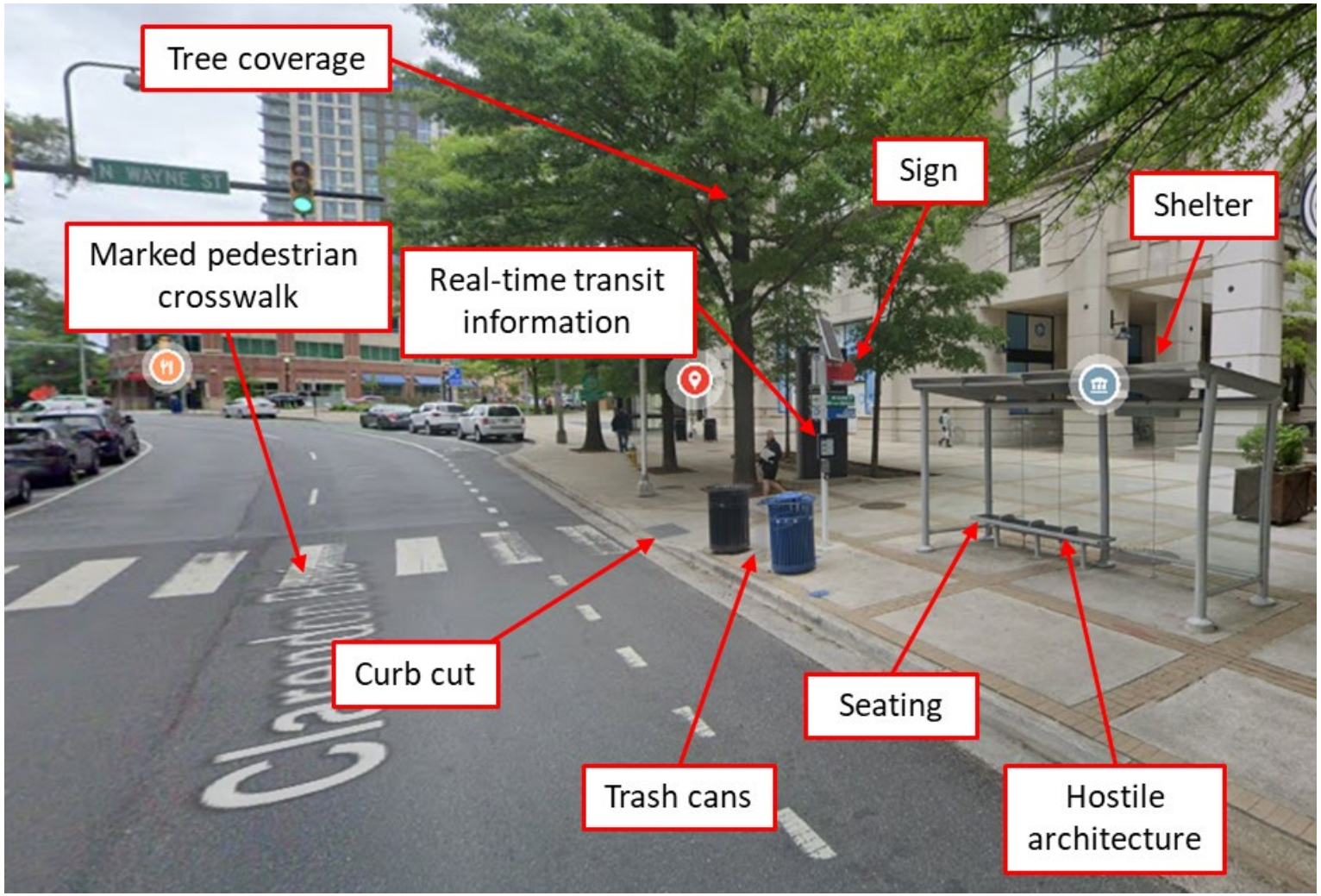
Category	Criteria	Arlington Transit	CUE	DASH	Fairfax Connector	Loudoun County Transit	OmniRide	WMATA
Ridership	Daily boardings	✓	✓	✓	✓	✓	✓	✓
	Trip generators with greater accessibility needs (e.g., percentage of children, elderly, or disabled)	✓						✓
	Trip generators that support transit use		✓	✓	✓			✓
Service Type	Evening service							✓
	Number of bus routes serving stop	✓		✓				✓
	Bus headways							✓
	Commuter bus service					✓	✓	
Connections	Transit centers	✓			✓			✓
	Transfer points			✓		✓		✓
	Park-and-ride lot				✓	✓		
Physical Characteristics	Available right of way	✓	✓	✓	✓			
	Sight distance	✓						
	Obstructions (poles, structures, trees)	✓	✓	✓				✓
	Proximity to other bus stops with amenities				✓			
	Proximity to fast food restaurants or convenience stores							✓
	Adjacent road type				✓			

Bus Stop Data Sample

- June 2023 GTFS data for stop population (~7,500 stops)
- Stratified random sampling strategy
  - Statistically significant sample size rounded up to ~400
  - Sample proportioned based on how population stops are proportioned between agencies
- Study team collected data by manually viewing Google Street View
  - Data collected for 2014, 2018, and 2022
  - 91% of stops had at least 1 observation, 45% of stops had all 3 years



Google Street View Bus Stop Data



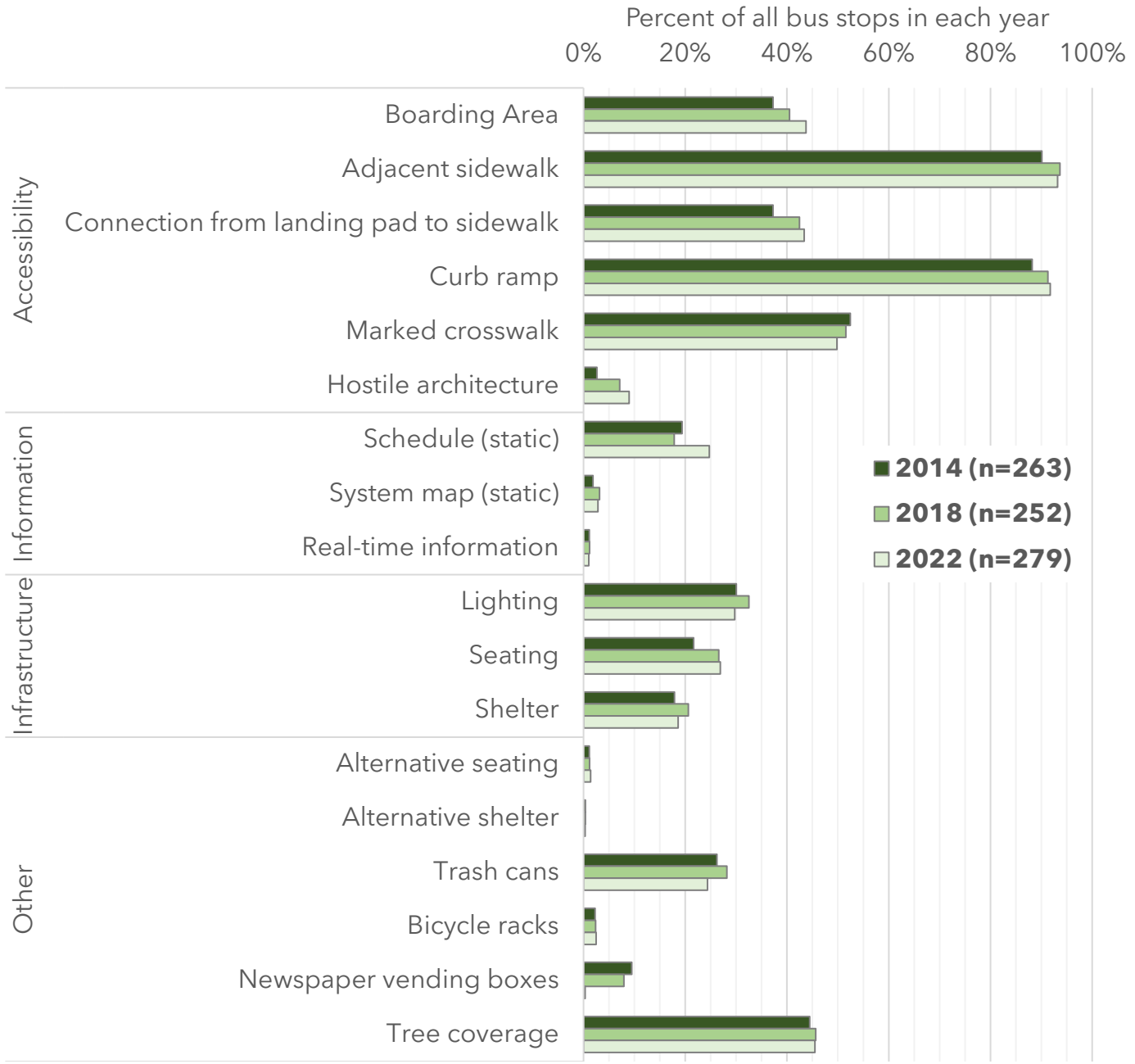
Methodology

Four analysis methods:

1. Graphs and figures used to identify data trends
2. Statistical tests (t-tests, chi-squared) to identify potential relationships
3. Maps to identify spatial trends
4. Binary logistic regression to understand characteristics associated with bus stop amenities

Stop Amenities

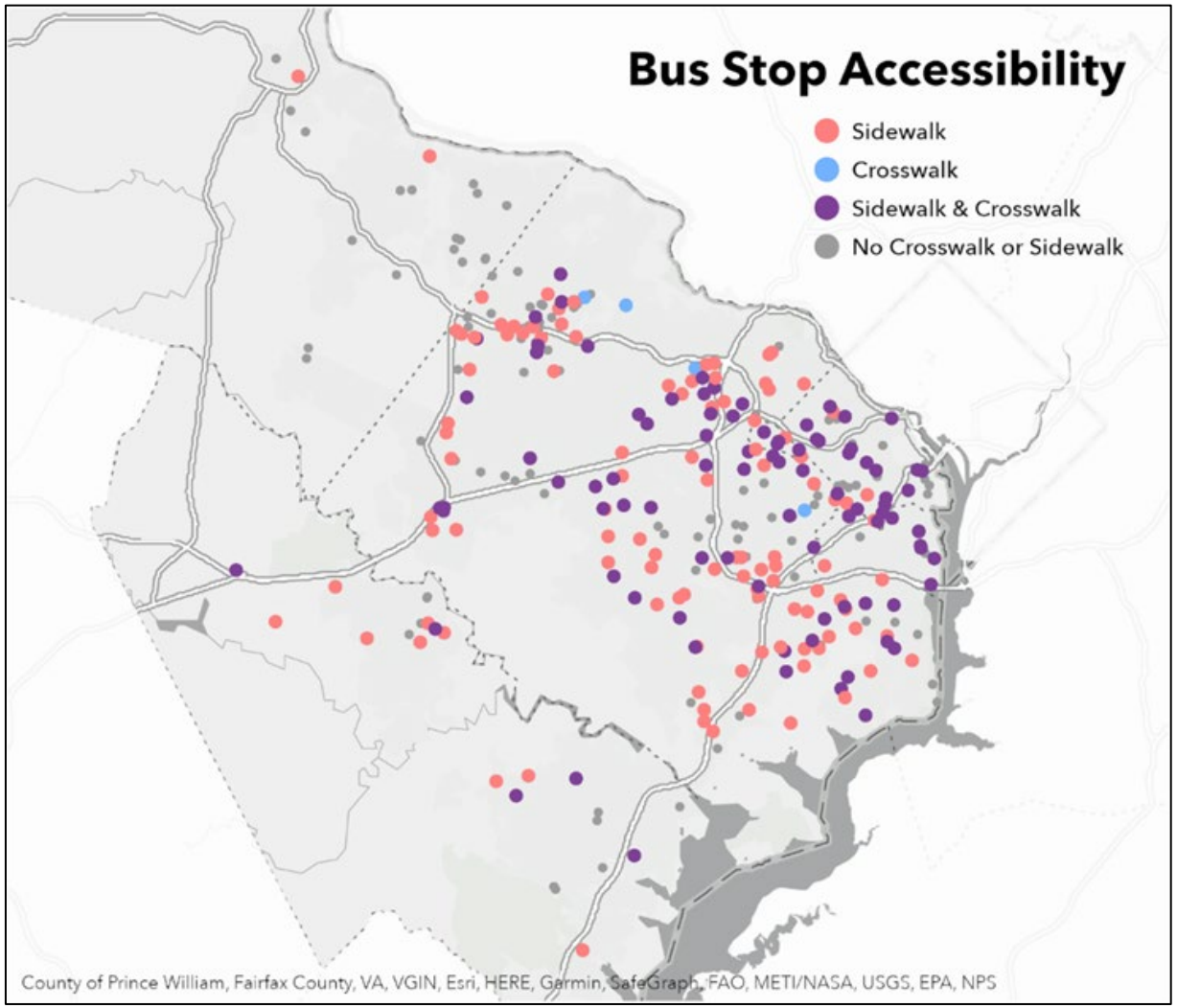
- Northern Virginia had fewer amenities than San Francisco (Moran 2022)
- Accessibility-oriented amenities are most prevalent
- Stops adjacent to retail 2x more likely to have seating or shelter compared to stops adjacent to office
- Areas with higher low-income populations had more amenities
- Less dense areas were less likely to have amenities

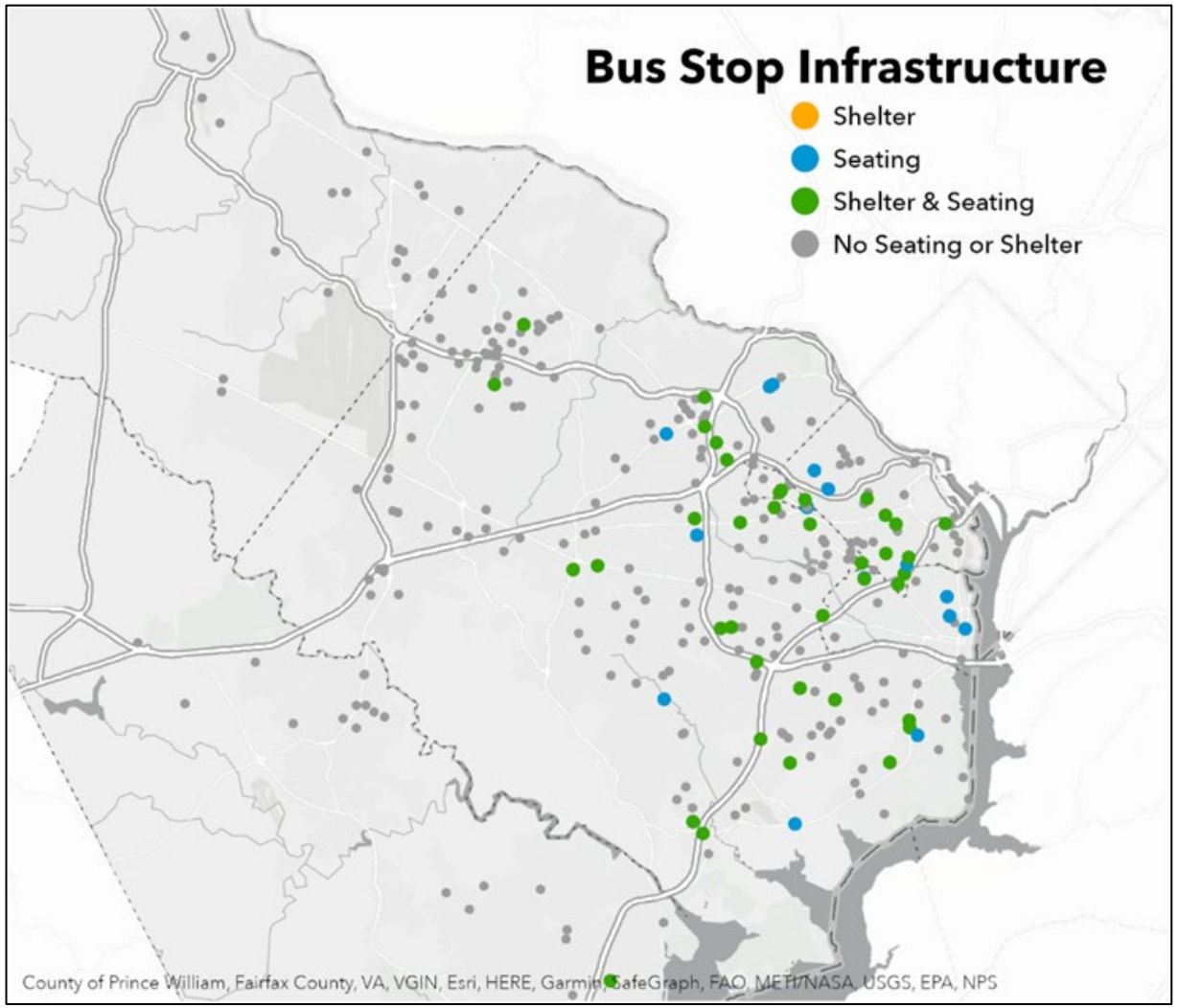


Crosstabs

	Boarding Area	Adjacent sidewalk	Connection from landing pad to sidewalk	Curb ramp	Marked crosswalk	Hostile architecture	Schedule (static)	System map (static)	Real-time information	Lighting	Seating	Shelter	Trash cans	Bicycle racks	Tree coverage
Boarding Area		94%	94%	95%	61%	20%	35%	5%	2%	35%	56%	42%	52%	6%	43%
Adjacent sidewalk	44%		47%	98%	51%	10%	24%	3%	1%	31%	28%	20%	26%	3%	46%
Connection from landing pad to sidewalk	95%	100%		99%	63%	21%	35%	6%	2%	36%	58%	42%	53%	6%	43%
Curb ramp	45%	99%	47%		53%	10%	25%	3%	1%	32%	29%	20%	27%	3%	45%
Marked crosswalk	53%	96%	55%	97%		16%	37%	5%	2%	40%	37%	26%	35%	5%	45%
Hostile architecture	100%	100%	100%	100%	88%		64%	4%	4%	64%	100%	88%	76%	4%	24%
Schedule (static)	62%	91%	61%	93%	74%	23%		10%	4%	43%	41%	30%	38%	6%	48%
System map (static)	75%	100%	88%	100%	88%	13%	88%		0%	63%	63%	50%	50%	13%	50%
Real-time information	67%	100%	100%	100%	100%	33%	100%	0%		67%	33%	33%	67%	0%	0%
Lighting	52%	98%	52%	98%	67%	19%	36%	6%	2%		43%	34%	41%	6%	45%
Seating	91%	99%	93%	97%	69%	33%	37%	7%	1%	48%		69%	76%	7%	41%
Shelter	98%	98%	98%	98%	69%	42%	40%	8%	2%	54%	100%		87%	6%	40%
Trash cans	94%	99%	94%	100%	71%	28%	38%	6%	3%	50%	84%	66%		9%	47%
Bicycle racks	100%	100%	100%	100%	100%	14%	57%	14%	0%	71%	71%	43%	86%		57%
Tree coverage	41%	94%	41%	91%	50%	5%	26%	3%	0%	29%	24%	17%	25%	3%	

Distribution of Bus Stop Amenities





Binomial Logistic Regression

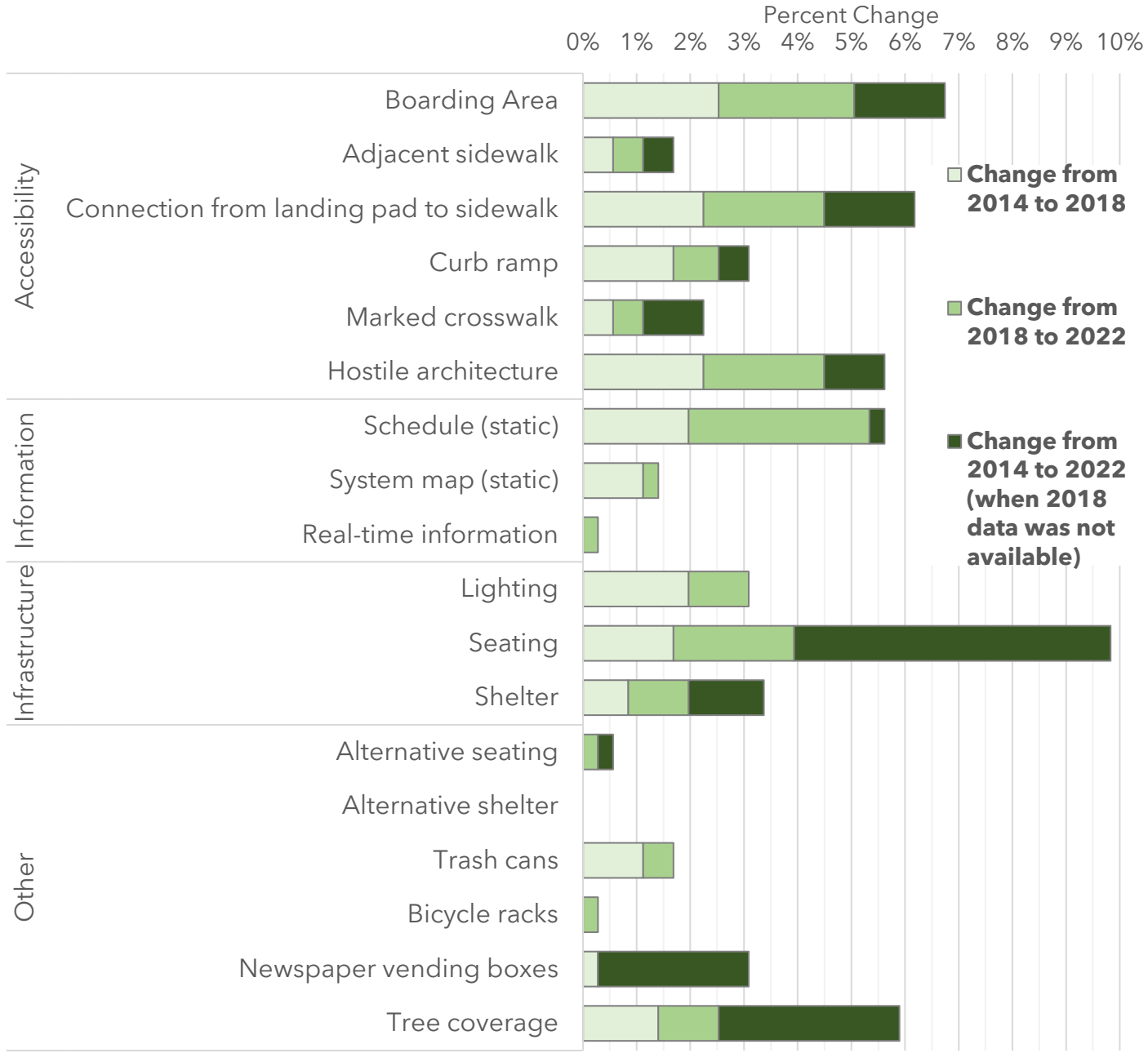
Independent Variable	2018		2022		2022 (*excluding ridership*)	
	Seating	Shelter	Seating	Shelter	Seating	Shelter
Average Daily Ridership (log)	1.352	1.179	1.196	1.122	0.000	0.000
Weekly Bus Trips (log)	2.055	2.241	2.405	2.081	2.158	1.632
Population (log)	0.912	0.768	2.616	1.752	1.614	1.483
Non-white Population	0.037	0.672	1.012	1.049	1.014	1.032
Shared Stop	3.284	2.974	5.753	4.128	6.224	4.989
Stop Adjacent to Retail	1.100	0.856	3.012	2.234	3.024	2.732
		p<0.01		*p<0.05*		*p<0.10*

- Binomial logistic regression was used to see what was correlated with bus stop amenities
- Focused on seating and shelter because of sample size and direct relationship with bus operations

- Three iterations:
  - Most recent data (2022)
  - Pre-pandemic data (2018)
  - Recent data without ridership (larger sample size in regression)
- Shared bus stops and additional bus service were the only consistently significant variables

Amenity Growth

- Seating saw the largest overall increase
- Accessibility-related amenities were the largest category of growth
- Nothing was correlated with change to amenities besides bus stops shared between agencies



Moving Forward

Takeaways

- Local context matters: SF had many more bus stop amenities than Northern Virginia
- Shared stops are most likely to have more amenities
  - Possibly because the most advanced guidance (WMATA) appears to dictate decisions when stops are shared
  - Increased guidance around shared stops and agency-jurisdiction policy conflict would be useful addition to policies
- Bus stop amenity change is slow but almost 10% of sample stops gained seating over the last 10 years

What could be improved?

- Survey different geographic regions (in and out of the US)
- Evaluate full population of stops over time
  - Sample limited evaluation methods
- Better understanding of how limitations with Google Street View data affect analysis of transportation imagery

Questions?

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