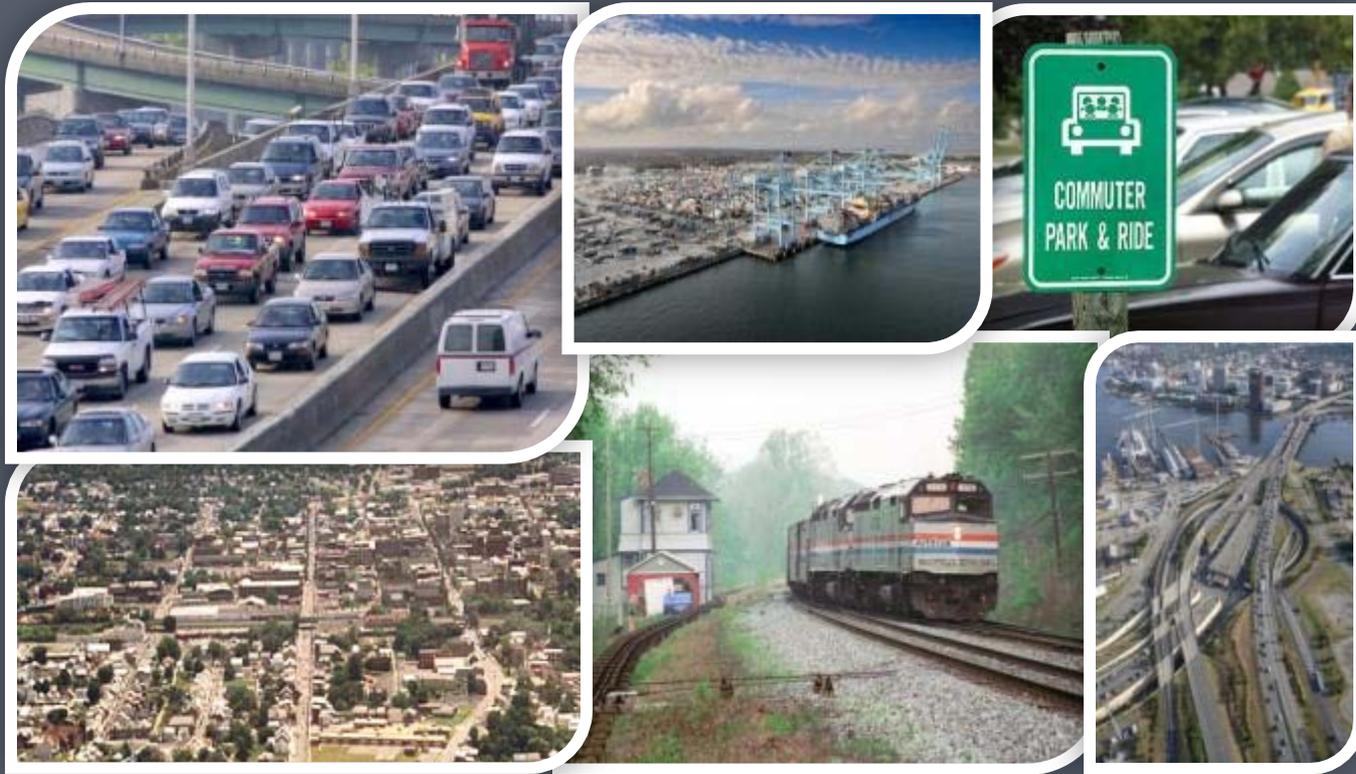


ACCESSIBILITY OF INTERMODAL CENTERS STUDY



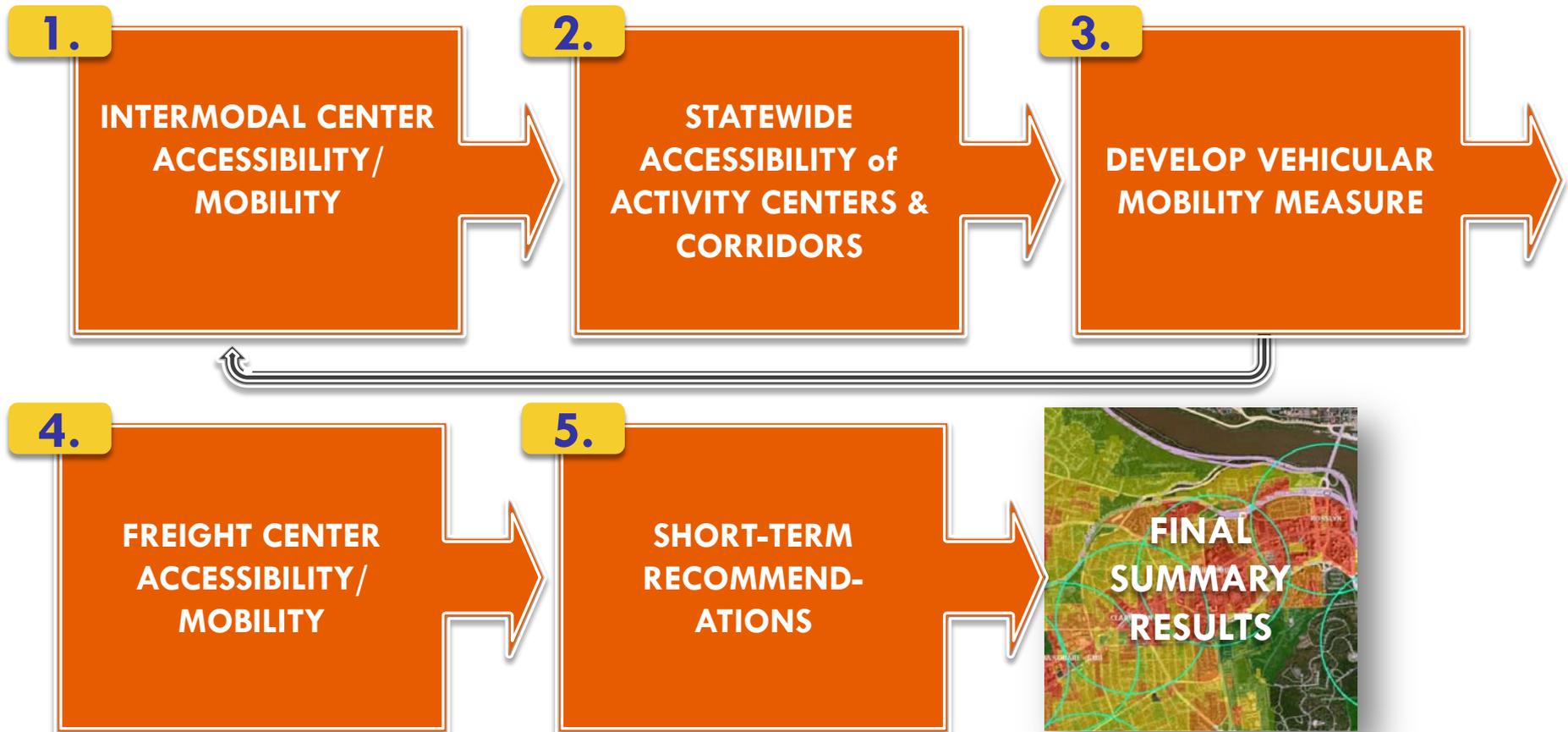
Presentation for VDOT Forum - Coordinating Transportation Planning and Land Use

Wednesday, April 2, 2014

Vlad Gavrilovic, AICP - Renaissance Planning Group

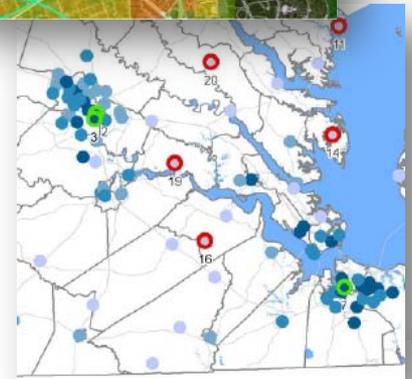
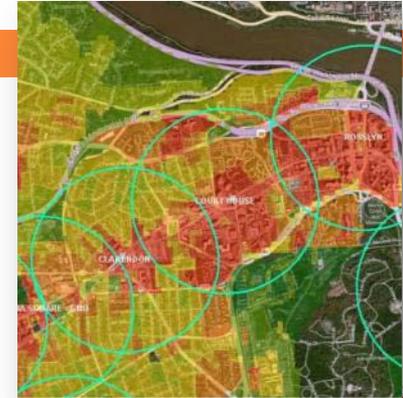
Tasks in the Scope of Work

- Analyze the Accessibility (& mobility) of areas across the Commonwealth as part of VDOT Business Plan
- Recommend short term improvements to the most critical Intermodal Centers



Center & Corridor Accessibility (Task 2)

- Analyzed the Accessibility (& mobility) of Virginia Centers & Corridors
 - 319 Activity Centers
 - 12 COSS (broken down into 49 Segments)
 - Baseline for quantifying accessibility & mobility



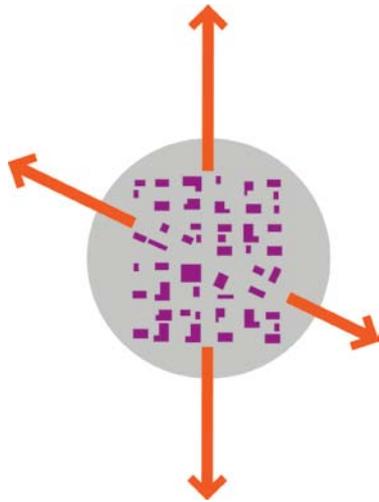
Measuring Accessibility & Mobility

- Developing the Measures
 - Accessibility Measures
 - Activity Density
 - Network Density
 - Network Connectivity
 - Mobility Measure
 - INRIX and TTI data

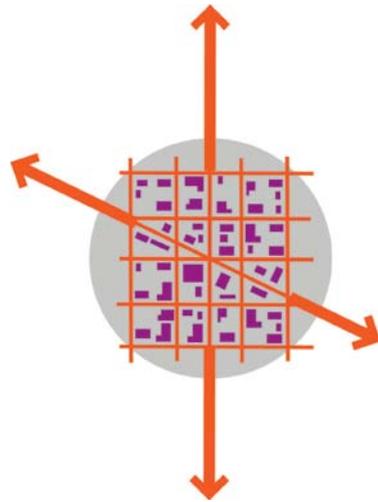
Accessibility & Mobility

ACCESSIBILITY

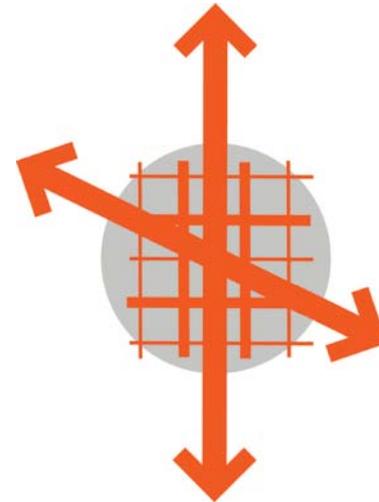
MOBILITY



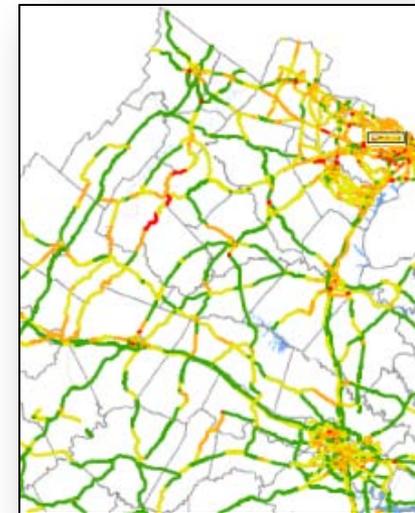
**ACTIVITY
DENSITY:**
POPULATION +
JOBS



NETWORK DENSITY
(e.g. INTERSECTIONS/
ACRE)



**NETWORK
PERFORMANCE**
(e.g. TRAVEL TIME)



**TRAVEL TIME
INDEX**

Measuring Accessibility:

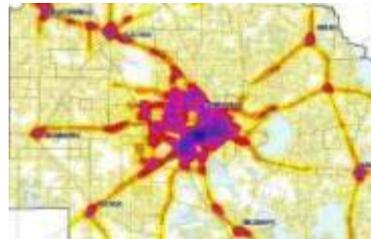
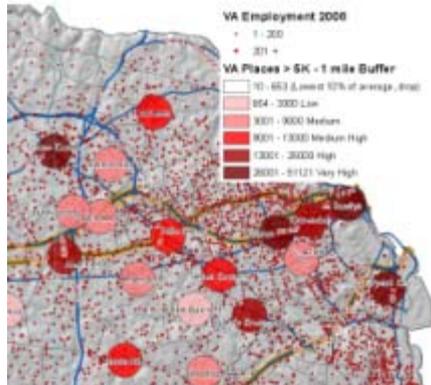
1. Activity Density

Need a fixed geography in order to be able to compare:



Number of activities per mile circle

Number of activities within a 45 minute drive



Used Census & LEHD data for block level population/employment figures:



Measuring Accessibility:

2. Network Density

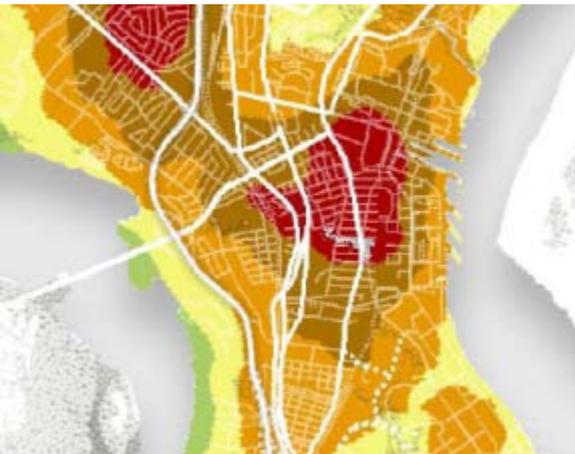
Examples: Bike & Transit Accessibility



**“Bikable”
roadways in an
area**



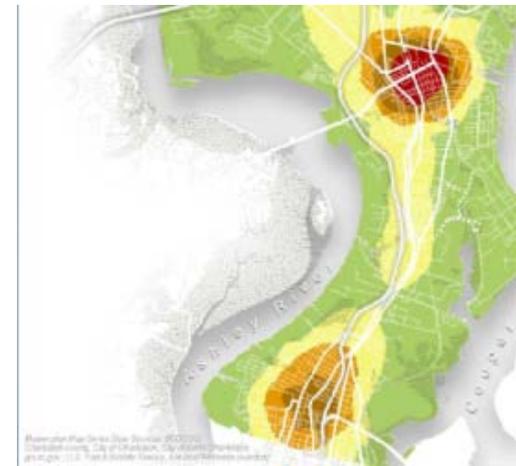
**Bus network
and bus stops
per grid cell**



**Density of
Bikable
roadways**

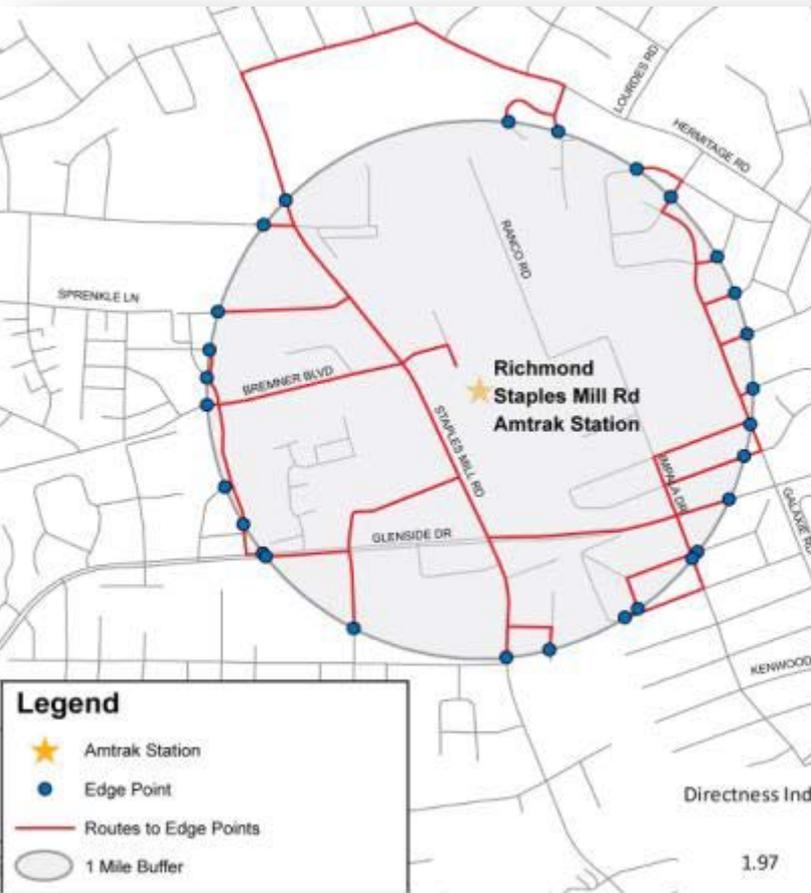


**Accessibility
to a bus stop**



Measuring Accessibility:

3. Network Connectivity

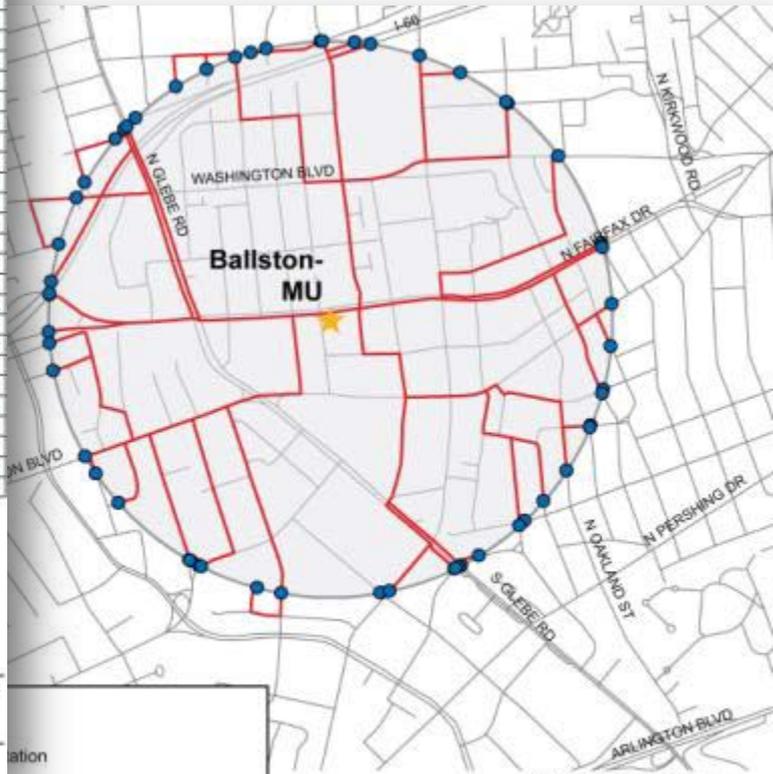


Edge Point	Driving Distance (mi)	Straight Line Distance	Directness
1	0.50	0.50	1.00
2	0.51	0.50	1.01
3	0.51	0.50	1.02
4	0.53	0.50	1.07
5	0.53	0.50	1.07
6	0.59	0.50	1.17
7	0.64	0.50	1.28
8	0.71	0.50	1.42
9	0.72	0.50	1.45
10	0.79	0.50	1.58
11	0.79	0.50	1.58
12	0.79	0.50	1.59
13	0.80	0.50	1.60
14	0.93	0.50	1.86
15	0.93	0.50	1.87
16	0.94	0.50	1.89
17	1.06	0.50	2.12
18	1.11	0.50	2.22
19	1.14	0.50	2.28
20	1.14	0.50	2.29
21	1.22	0.50	2.45
22	1.35	0.50	2.70
23	1.44	0.50	2.88
24	1.48	0.50	2.96
25	1.50	0.50	3.00
26	1.57	0.50	3.14
27	1.61	0.50	3.23
28	1.74	0.50	3.48

Richmond Staples Mill Amtrak Station = 1.97

$$\text{Directness Index} = \frac{\text{Total Driving Distance}}{\text{Total Straightline Distance}}$$

$$1.97 = \frac{27.60}{14.00}$$



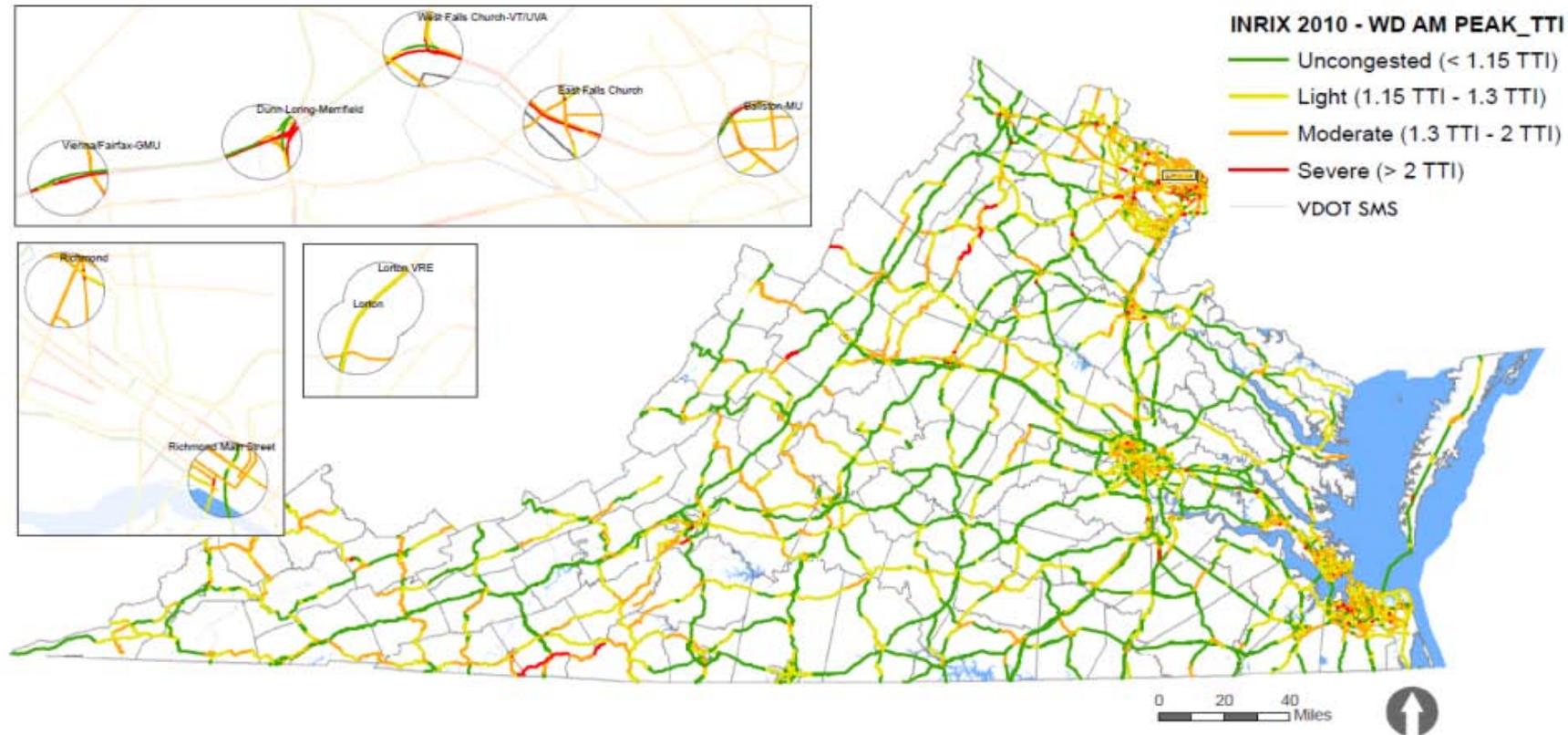
Ballston Metro Station = 1.32

$$\text{Directness Index} = \frac{\text{Total Driving Distance}}{\text{Total Straightline Distance}}$$

$$1.32 = \frac{37.60}{28.50}$$

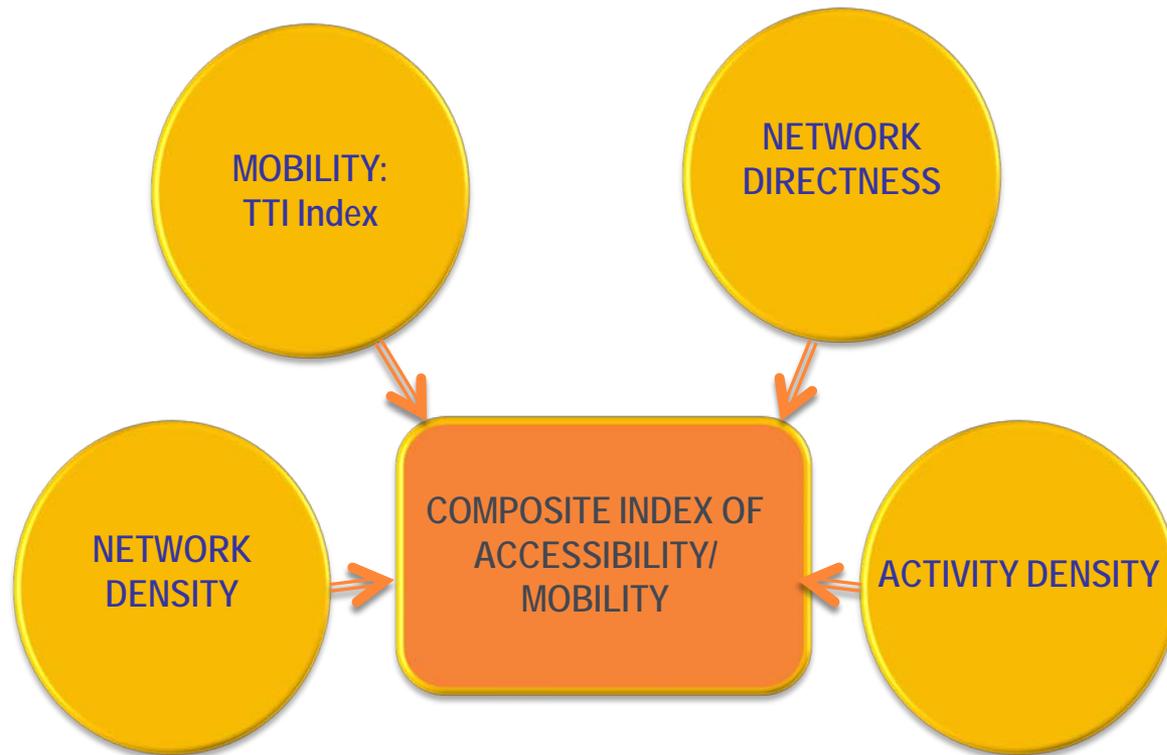
Measuring Mobility:

Data Source: INRIX data with TTI attributed, processed by VDOT. Data coverage limited to primary roads and interstates. Best results at the 10 mile diameter (vs 1 mile).



Putting it all together:

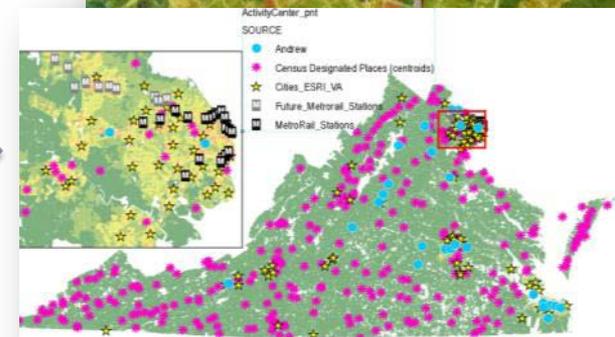
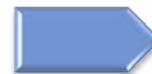
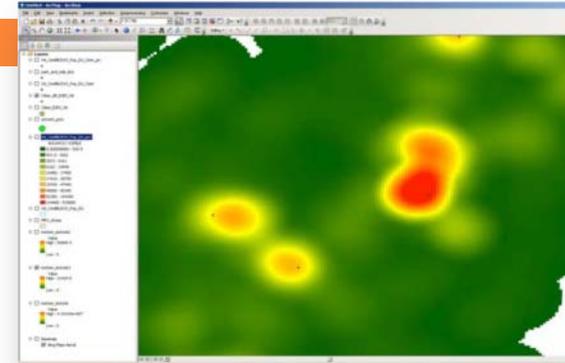
By combining all of the above methodologies, a composite index of relative accessibility/mobility can be developed:



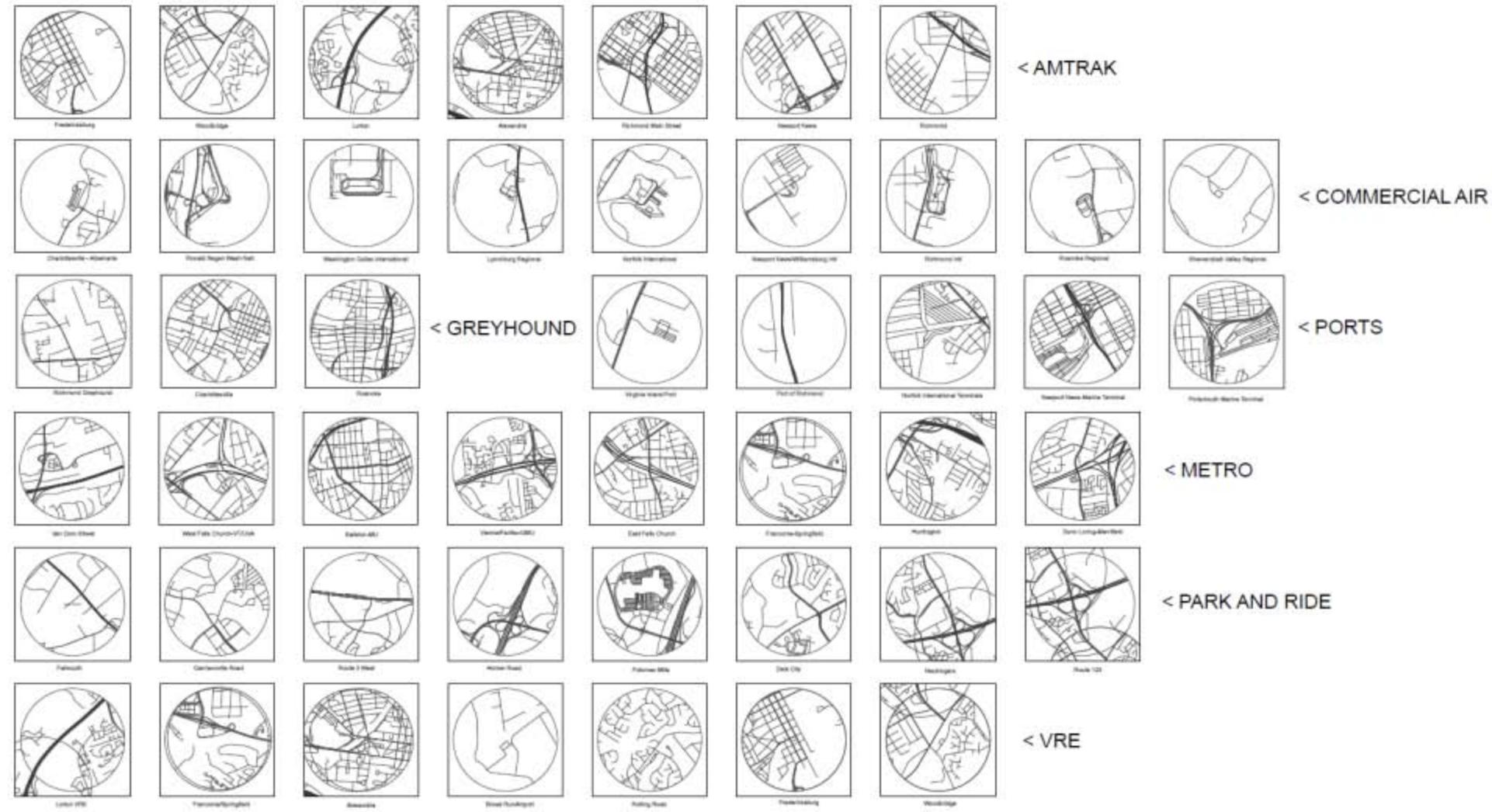
HOWEVER: it is relative to a particular Mode of Travel

Activity Center Methodology

- Developed a “heat map” of population & employment density statewide
- Located Activity Centers at centroids of population/employment density
- Culled 319 centers statewide to ensure good geographic coverage and rural to urban representation

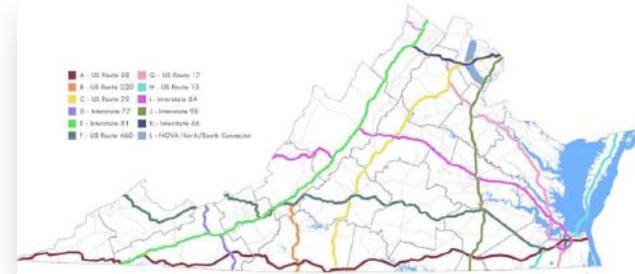


Street Maps



COSS Methodology

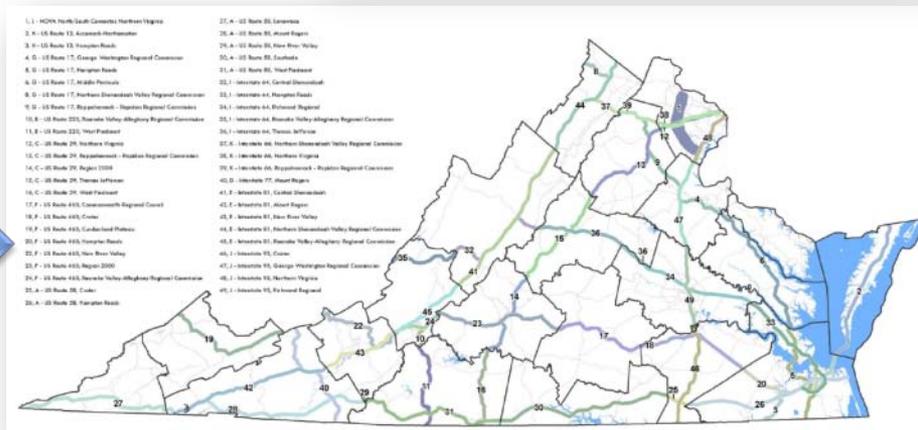
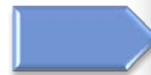
□ From 12 Corridors of Statewide Significance



□ Plus 21 Planning District Commissions Statewide

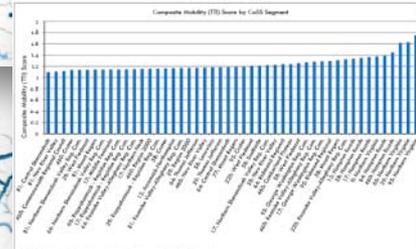
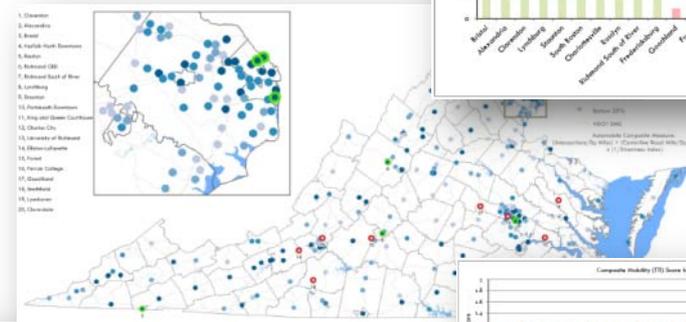
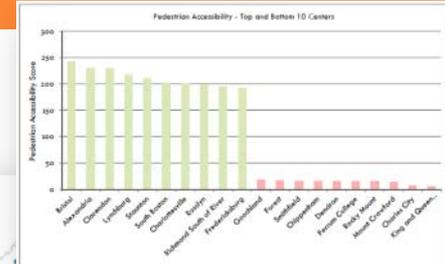


□ Developed 49 COSS Segments (broken down by PDC boundaries)



How are the results summarized?

- Top 10 / bottom 10 scores for each center by mode
- All scores for each COSS segment by mode
- Summary “accessibility scores” for all centers, COSS segments and by PDC



	Accessibility	Walkability	Transit	Public	MT	TM	Sum
Northern Virginia	3.02	1.97	2.90	0.97	1.64	-3.26	7.23
Redwood Regional	1.35	0.25	1.63	1.17	1.18	-0.52	5.06
Middle Peninsula	0.60	0.50	0.71	2.00	0.99	0.70	2.90
Hempden Roads	1.97	0.89	1.79	0.31	0.12	1.77	2.88
George Washington Reg. Cen.	0.08	0.51	0.96	2.02	1.01	-0.74	3.90
Center	0.25	0.17	0.17	0.12	0.88	0.53	1.12
Markus Skandouah Valley Reg. Cen.	-0.56	0.24	0.05	-0.45	0.76	0.61	0.76
Thomas Jefferson	-0.56	-1.06	-0.15	0.45	0.96	0.56	0.23
Central Alexandria	0.63	0.50	-0.25	0.54	0.82	0.84	0.92
Rosslyn Valley-Alexandria Reg. Cen.	0.63	0.51	0.60	-0.77	1.06	0.98	-0.02
Rappahannock - Rapidan Reg. Cen.	-0.56	-2.82	-0.54	1.11	0.83	0.64	-1.35
New River Valley	-0.36	0.20	0.16	0.91	1.09	0.68	-1.84
Commonwealth Reg. Cen.	-0.27	0.96	0.70	0.41	0.66	1.32	-1.00
Mount Rogers	0.44	1.20	0.27	0.95	1.16	-0.16	-1.93
Carroll Plateau	-0.54	0.67	-0.57	-0.95	-1.16	-0.11	-2.19
Region 2000	-0.57	-0.71	-0.51	-0.53	-0.89	0.52	-2.36
Accession/Harborfront	-0.76	0.73	0.70	0.73	0.02	-0.45	-2.39
West Piedmont	-0.36	0.90	0.50	0.77	1.08	-0.81	-2.38
Lepanto	0.65	0.74	-0.77	-0.90	1.24	0.52	-3.33
Seafields	-0.76	-0.31	-0.79	0.73	0.66	0.91	-3.23

Activity units per acre used to classify Activity Centers

Summary Activity Scores by Center (partial)

Sample of Activity Scores (population + employment)

The scores show how the places can be organized by Center Types (methodology from DRPT)

Sample findings:

- Tyson's densest in State
- Staunton denser than Newport News or Virginia Beach

Potential Multimodal Center (1 mile diameter)	Employment (2008)	Population (2010)	Population/Employment Ratio	Total Activity Units (Jobs + People)	Activity Units/Acre	Multimodal Center Type
Tysons Corner	50,491	419	0.01	50,910	101	P6 Urban Core
Ballston	27,902	14,202	0.51	42,104	84	
Rosslyn	24,385	16,688	0.68	41,073	82	
Crystal City	24,704	12,377	0.50	37,081	74	
Norfolk	30,917	4,582	0.15	35,499	71	
Alexandria	15,587	9,489	0.61	25,076	50	P5 Urban Center
Clarendon	13,231	10,598	0.80	23,829	47	
Richmond	14,513	8,989	0.62	23,502	47	
Charlottesville	12,496	4,046	0.32	16,542	33	P4 Large Town or Suburban Center
Roanoke	12,956	2,295	0.18	15,251	30	
Fairfax	10,088	4,488	0.44	14,576	29	
Blacksburg	10,360	3,709	0.36	14,069	28	
Winchester	4,581	4,933	1.08	9,514	19	
Reston	2,406	6,134	2.55	8,540	17	
Fredericksburg	4,918	3,143	0.64	8,061	16	
Manassas	2,371	3,965	1.67	6,336	13	
Salem	2,910	3,205	1.10	6,115	12	
Petersburg	4,038	2,035	0.50	6,073	12	
Staunton	2,536	3,300	1.30	5,836	12	
Front Royal	2,525	3,211	1.27	5,736	11	
Newport News	3,555	2,027	0.57	5,582	11	
Bristol	4,033	1,245	0.31	5,278	11	
Virginia Beach	2,509	2,034	0.81	4,543	9	
Galax	2,581	1,326	0.51	3,907	8	
Dunn Loring	854	2,382	2.79	3,236	6	
South Boston	871	1,185	1.36	2,056	4	P2 Small Town or Suburban Center
Crozet	284	1,697	5.98	1,981	4	
Chester	704	883	1.25	1,587	3	
Lake Monticello	6	1,187	197.83	1,193	2	
Bluefield	388	768	2	1,156	2	
Timberlake	409	717	2	1,126	2	
Aquia Harbour	1	742	742	743	1	P1 Rural or Village Center
Forest	484	115	0	599	1	
Poquoson	6	577	96	583	1	
Great Falls	1	455	455	456	1	

Summary Accessibility Scores by Center (partial)

Scores normalized using
Standard Deviations

Activity Center	Pedestrian	Bicycle	Auto	Rail	Air	TTT	Transit	Sum
Alexandria	3.09	2.68	3.04	5.54	0.53	-1.35	4.53	18.07
King St/Eisenhower Ave	0.11	-0.69	0.34	9.95	0.52	-1.25	4.53	13.53
Clarendon	3.09	2.54	3.37	0.44	0.77	-1.41	4.60	13.40
Fredericksburg	2.27	1.55	2.02	4.86	0.94	-0.28	0.04	11.40
Richmond	2.19	0.38	2.56	3.20	1.20	-0.16	1.00	10.36
Rosslyn	2.41	0.57	2.56	0.40	0.99	-1.42	4.60	10.12
Charlottesville	2.46	1.39	2.13	1.40	0.77	0.10	1.50	9.74
Alexandria Old Town North	1.37	0.39	1.24	2.96	0.56	-1.32	4.53	9.73
Richmond South of River	2.35	1.61	2.45	1.23	1.20	-0.13	1.00	9.72
Colonial Beach	0.95	1.56	0.91	-0.35	0.94	5.39	-0.06	9.35
Ballston - MU	1.83	0.91	2.06	0.47	0.65	-1.44	4.60	9.09
Fan District	1.92	2.30	1.90	0.33	1.19	-0.16	1.00	8.48
Richmond West	2.11	1.45	1.98	0.76	1.19	-0.16	1.00	8.34
Montrose	1.70	2.35	1.67	0.49	1.23	-0.13	1.00	8.31
Pentagon City/Crystal City	0.71	1.06	1.34	0.94	0.82	-1.34	4.60	8.13
Lynchburg	2.84	1.98	2.44	0.95	-0.98	0.36	-0.03	7.58
Alexandria North	0.39	0.93	0.60	1.81	0.63	-1.34	4.53	7.56
Columbia Pike	0.85	0.74	0.76	0.82	0.77	-1.37	4.60	7.17
Harrisonburg	2.05	2.00	2.19	-0.44	0.76	0.19	0.30	7.05
East Falls Church	0.96	0.73	1.35	0.25	0.53	-1.56	4.60	6.88
Ashland	0.30	0.87	0.30	4.24	1.17	0.39	-0.42	6.86
Staunton	2.68	1.36	2.37	-0.03	0.00	0.70	-0.33	6.74
Bristol	3.36	2.23	2.84	-0.44	-1.88	0.46	-0.30	6.27
Hopewell	1.99	1.13	2.06	-0.30	1.17	0.64	-0.42	6.27
Culpeper	1.15	1.38	0.95	1.00	0.53	0.53	0.30	6.00

Note that the summary score doesn't represent any weighting by mode

Note potential 'take-aways', eg:

- Fredericksburg more "accessible" than Rosslyn?
- Charlottesville more "accessible" than Crystal City?

Summary Accessibility Scores by Corridor Segment

Scores normalized using Standard Deviations

CoSS Segment	Pedestrian	Bicycle	Auto	Rail	Air	TTI	Transit	Sum
29: Northern Virginia	3.06	1.30	2.92	1.00	1.00	-2.79	3.71	10.21
66: Northern Virginia	3.07	1.37	2.95	1.04	1.04	-2.71	3.25	10.00
95: Northern Virginia	2.15	0.63	2.40	1.15	1.15	-3.67	4.22	8.03
95: Richmond Regional	0.92	0.42	1.15	1.27	1.27	-0.37	0.71	5.37
95: George Washington Regional Commission	-0.22	0.04	-0.03	2.37	2.37	-0.20	-0.33	4.00
17: Middle Peninsula	-0.57	0.35	-0.60	2.24	2.24	0.70	-0.42	3.96
64: Richmond Regional	0.43	0.12	0.63	1.35	1.35	0.04	0.01	3.93
0: Northern Virginia	0.56	1.07	0.52	1.14	1.14	-0.95	0.14	3.62
460: Roanoke Valley-Alleghany Regional Commission	1.70	1.58	1.55	-0.80	-0.80	-0.29	0.36	3.28
64: Hampton Roads	1.31	-0.33	1.46	0.55	0.55	-1.06	0.28	2.76
17: George Washington Regional Commission	-0.30	-0.47	-0.38	2.20	2.20	-0.33	-0.33	2.57
220: Roanoke Valley-Alleghany Regional Commission	1.62	0.81	1.25	-0.80	-0.80	-0.58	0.32	1.81
460: Hampton Roads	1.33	1.23	0.95	-0.30	-0.30	-1.48	0.33	1.76
64: Thomas Jefferson	-0.54	-0.45	-0.29	1.15	1.15	0.52	-0.24	1.31
29: Rappahannock - Rapidan Regional Commission	-0.44	-1.07	-0.40	1.30	1.30	0.62	-0.41	0.90
95: Crater	-0.22	0.07	-0.02	0.50	0.50	0.37	-0.31	0.88
460: Mount Rogers	-1.12	-3.21	-1.44	-0.95	-0.95	8.94	-0.44	0.83

Note potential 'take-aways', eg:

- Despite low TTI, NoVA, Richmond and Hampton Roads segments rank highly
- Rt. 17/Middle Peninsula has high rank because of rail, air (100-120 mile proximity)
- Other segments rank well because of high TTI (e.g. 460/Mt. Rogers)

Conclusions

□ Correlation between modes:

- Bicycle + Pedestrian Modes - Metro centers prominent in top 5
- Transit (Bus) + Auto (1 mile) Urban intermodal centers appear in both measures

□ Accessibility is not Mobility:

- Centers with the highest Accessibility are NOT always the ones with highest Mobility:
 - Congestion reduces the mobility of accessible centers in highly urbanized areas.
 - Conversely, centers in rural areas with high mobility ratings might not be accessible.

How the Measures were Used:

EXAMPLE:

VIENNA/GMU METRO STATION

The accessibility analysis showed this Center to have a relatively low Auto Mobility index combined with a relatively high Auto Accessibility index



Opportunity for high benefit if improvements are made!

Vienna/Fairfax –GMU Metro Station

Recommendations

1.) Priority vanpools, carpools, and car share access

Benefit: Decreases single occupancy vehicle trips to station

2.) Safe pedestrian passages during construction

Benefit: Improves real and perceived safety for pedestrians

3.) Signage/maps for current GMU and trail access

Benefit: Builds interest and access while anticipating long term plans

4.) Encourage use of Metro through ITS signage

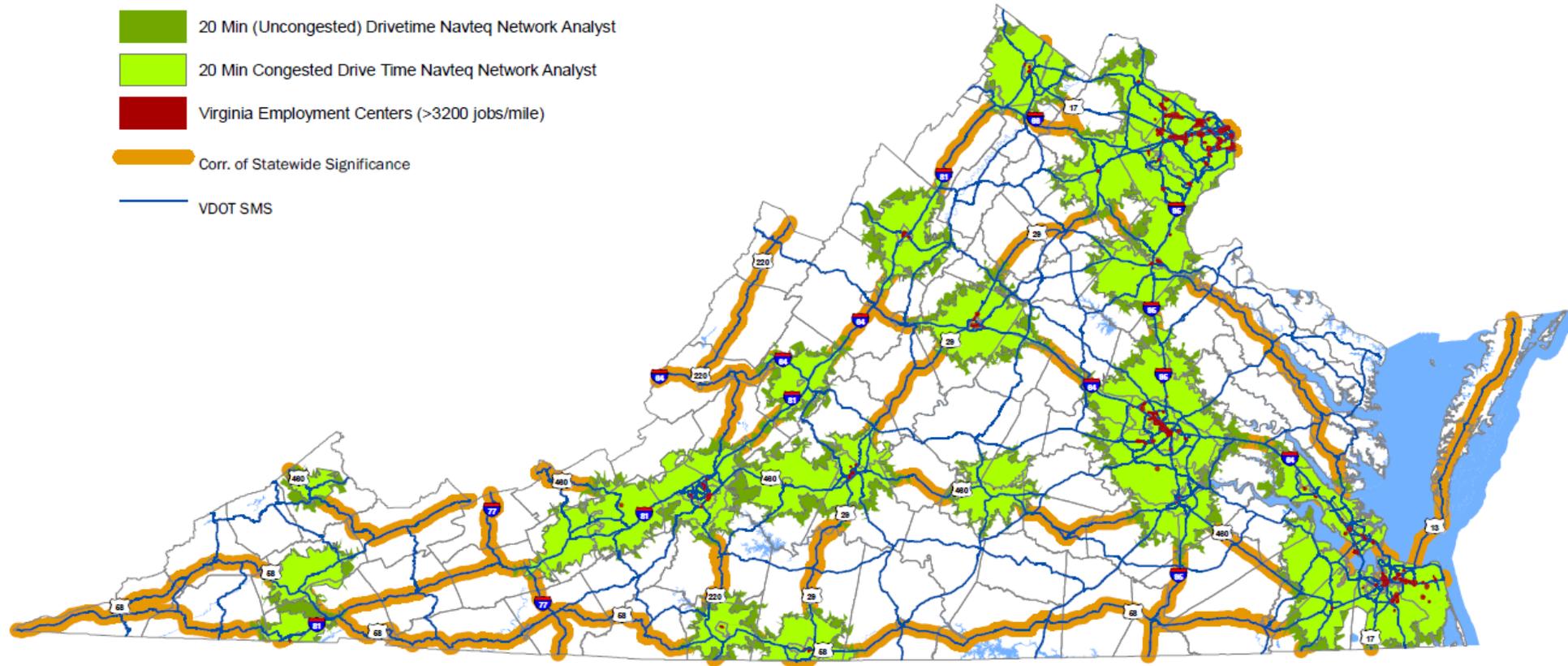
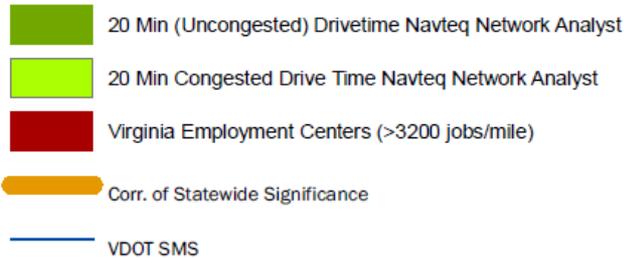
Benefit: Encourages use of Metro during periods of high congestion

5.) Improve Sutton Rd from Chain Bridge Rd to Blake Ln to a standard two-lane urban collector and consolidate entrances for access control.

Benefit: Provides additional roadway capacity for commuters from the existing and proposed residential developments north of Maple Avenue to access the Vienna Metro Station.



Vehicular Accessibility to Employment Centers



Fun Facts (using GIS network analyst to calculate drive times based on POSTED SPEEDS & on TTI data for congestion factors):

- 81.8% of Virginians live within a 20 minute drive time of an employment rich area (FREEFLOW)
- 79.1% of Virginians live within a 20 minute drive time of an employment rich area (ADJUSTED FOR CONGESTION FACTORS)

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