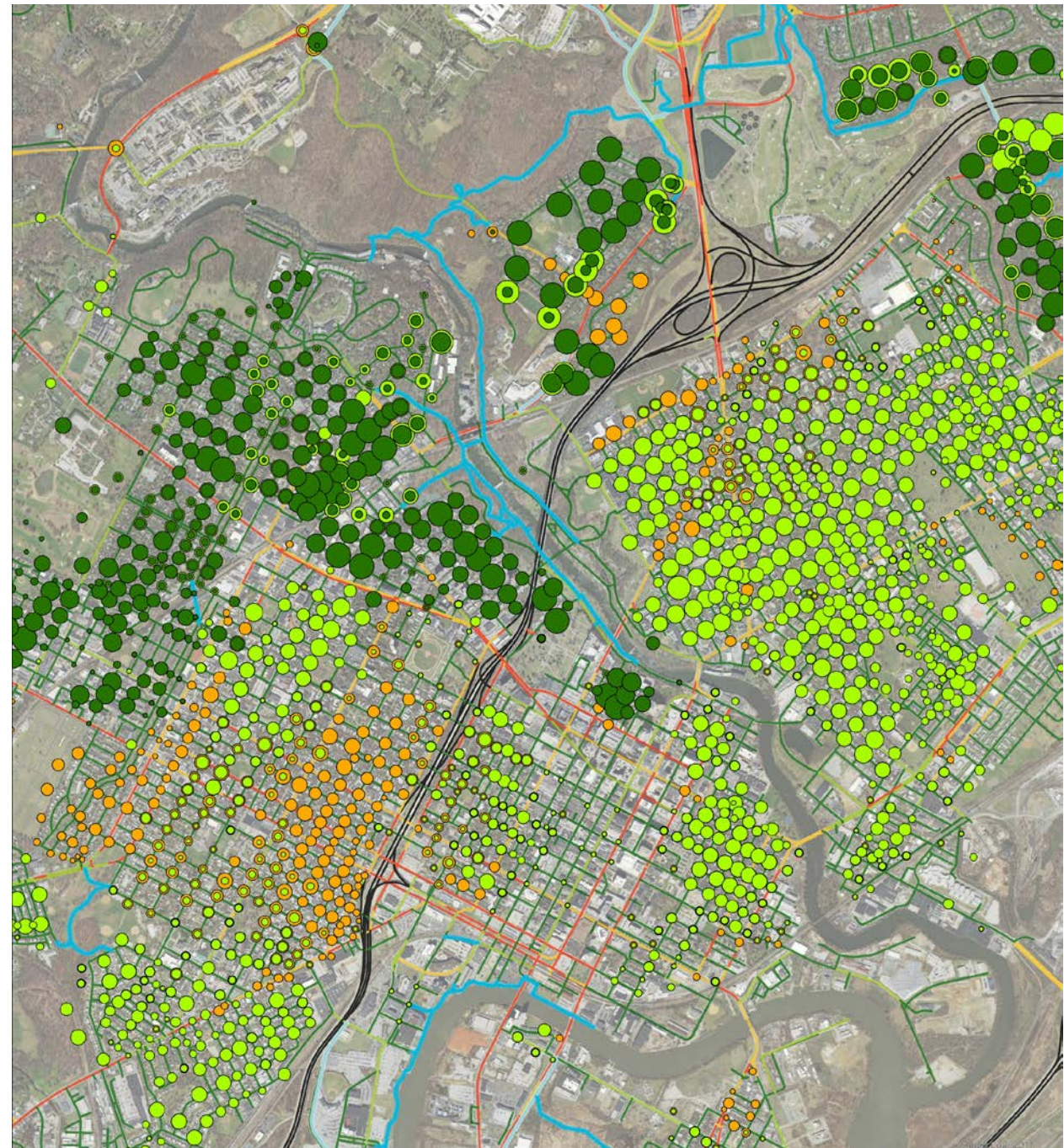


Modeling improvements in bicycle mobility

Project evaluation and prioritization
for Bike/ Ped Pool Projects



Paul Moser

*Delaware Department of Transportation
Local Systems Improvement, Planning Division*

Topics

- Brief intro to Level of Traffic Stress (LTS)
- Bicycle Mobility/ Network Connectivity Concepts
- Bicycle Travel Modeling
- 2020 NCC Prioritization Results
- Solving a 'real' problem

Level of Traffic Stress

- A metric of suitability of a roadway for cycling
- Each level relates to a ***type of rider***
- Allows us to view mobility from perspective of casual cyclists and understand ***barriers*** to a useful, connected network

- Level of Traffic Stress

- LTS1: 12-year-old child
- LTS2: typical person able to bike
- LTS3: enthusiastic and willing to tolerate some stressful roadways and intersection
- LTS4: aggressive and willing to bike anywhere

INCREASING LEVEL OF COMFORT, SAFETY, AND INTEREST IN BICYCLING FOR TRANSPORTATION

LTS 4

No bike lane on a busy street



LTS 3

Narrow bike lane or shoulder on a busy street



LTS 2

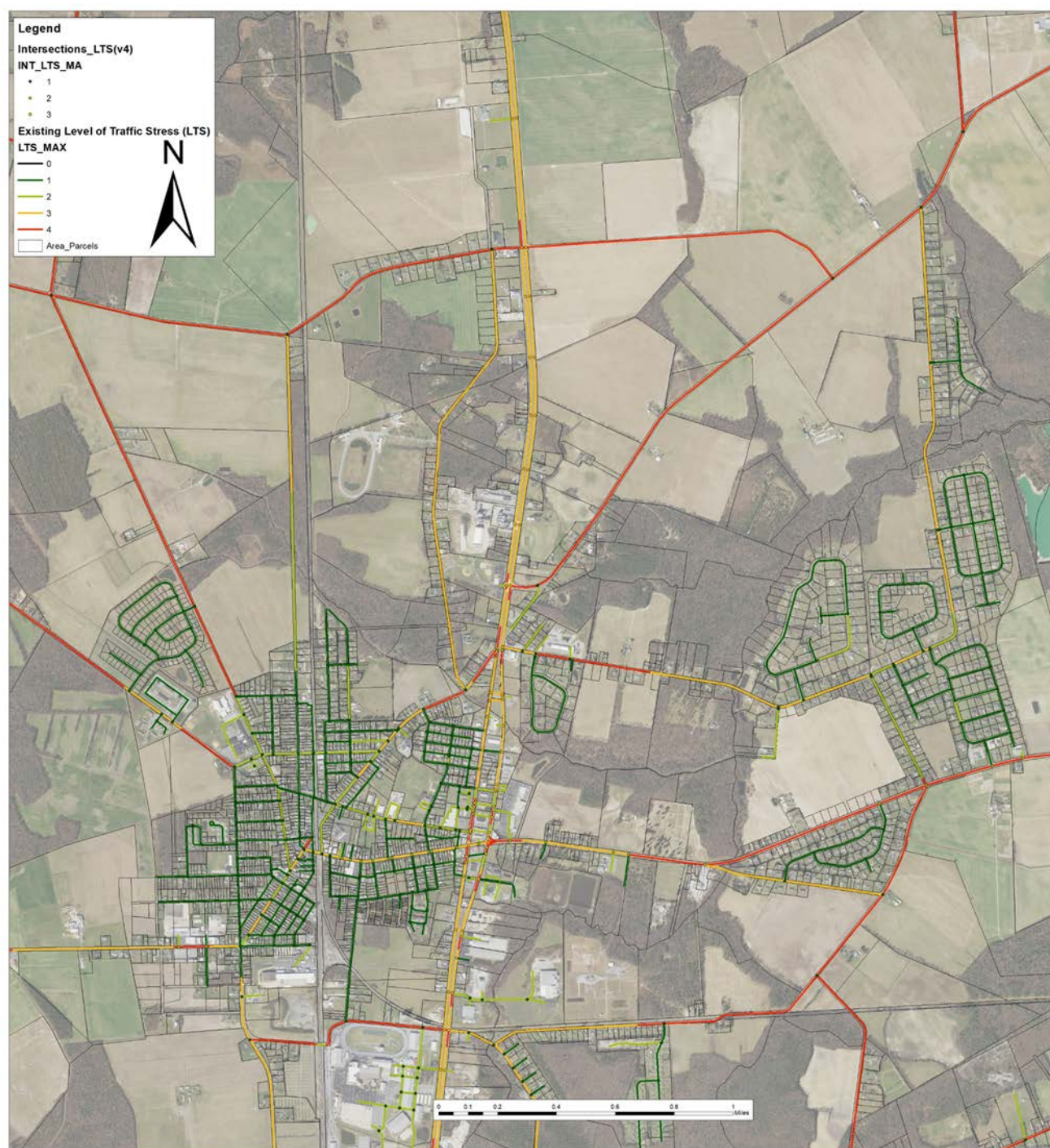
Buffered bike lane on a calm street

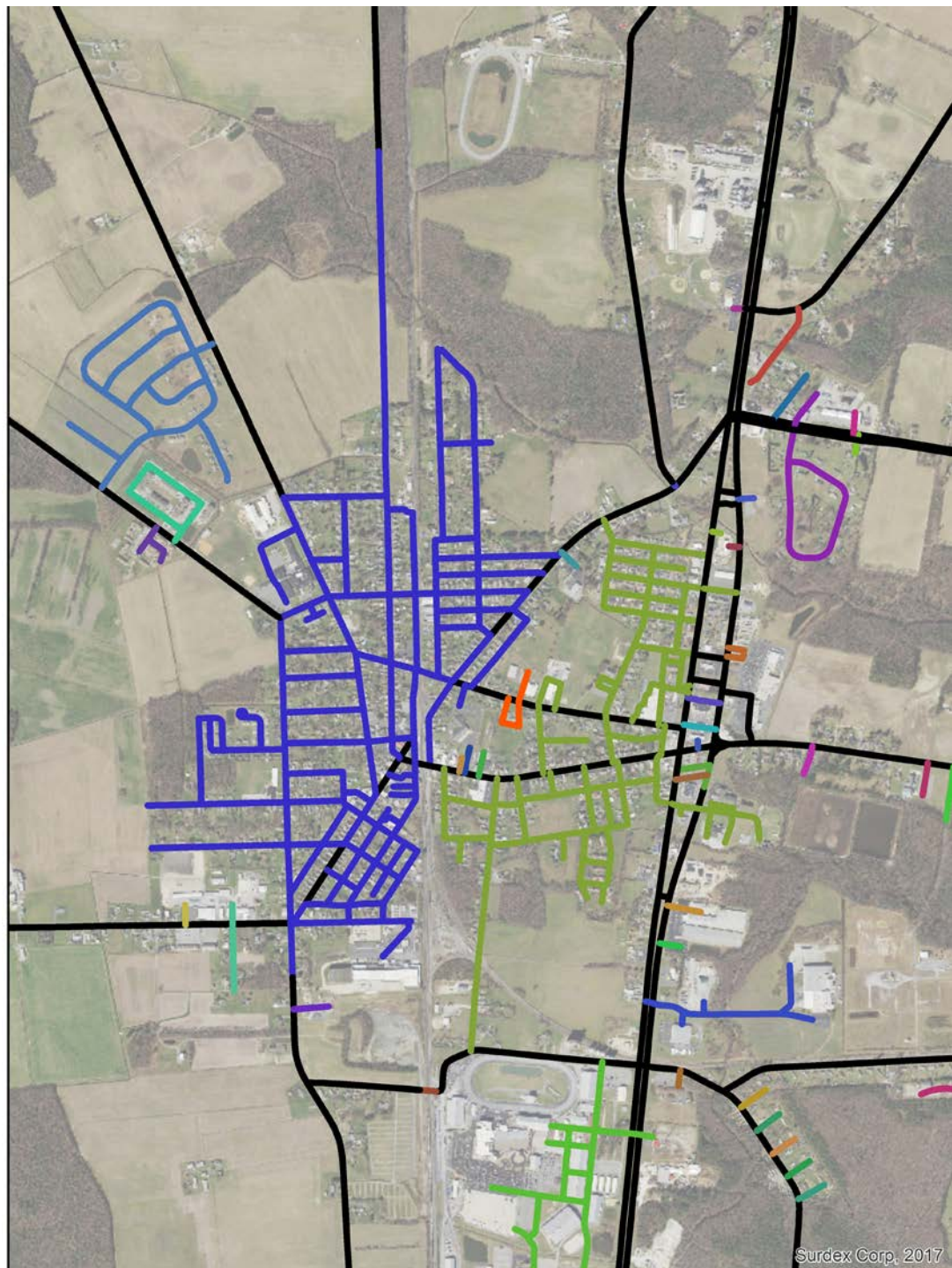
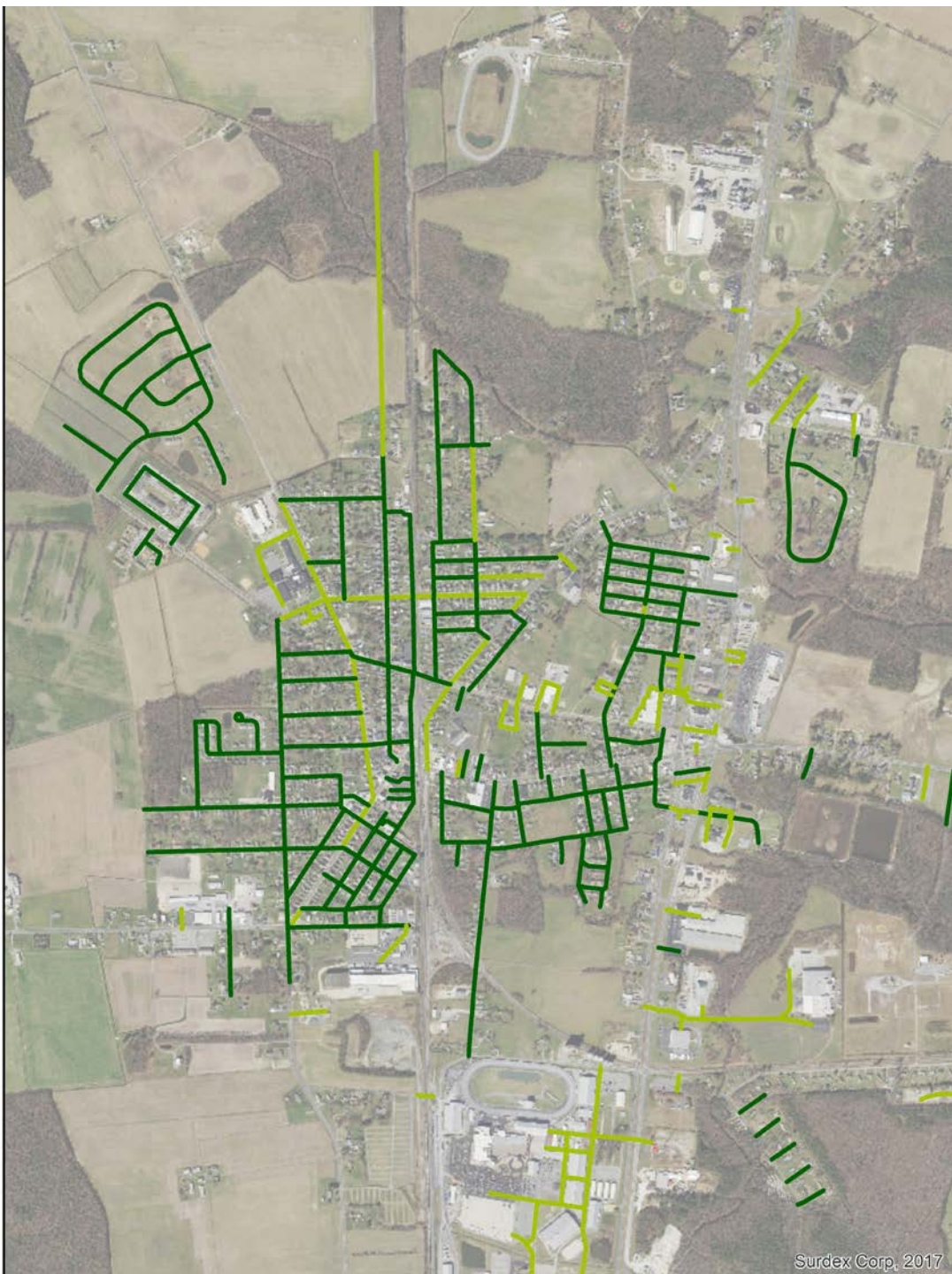


LTS 1

Separated bike lane







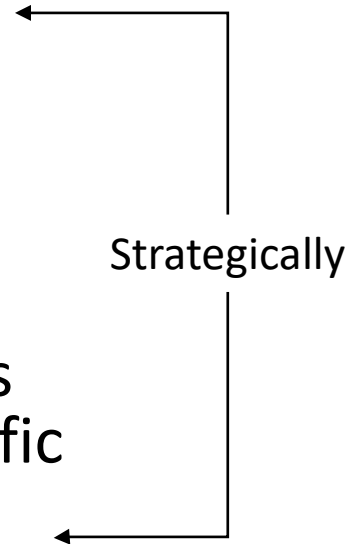
Towards a Common Operational Picture of Bicycle mobility

Problem

- Households, **within bikeable distances to common destinations**, are unable to reach them directly on **low stress** streets, pathways, or intersections.
- Bicycle mobility is **suppressed** because people do not feel comfortable riding to their destination.

Solution

- Create new connections to **facilitate potential bike trips on the low stress bicycle network**
- Provide a lower stress riding experience on existing streets (roadway improvements, traffic interventions)
- Leverage places with **existing** low-stress connectivity



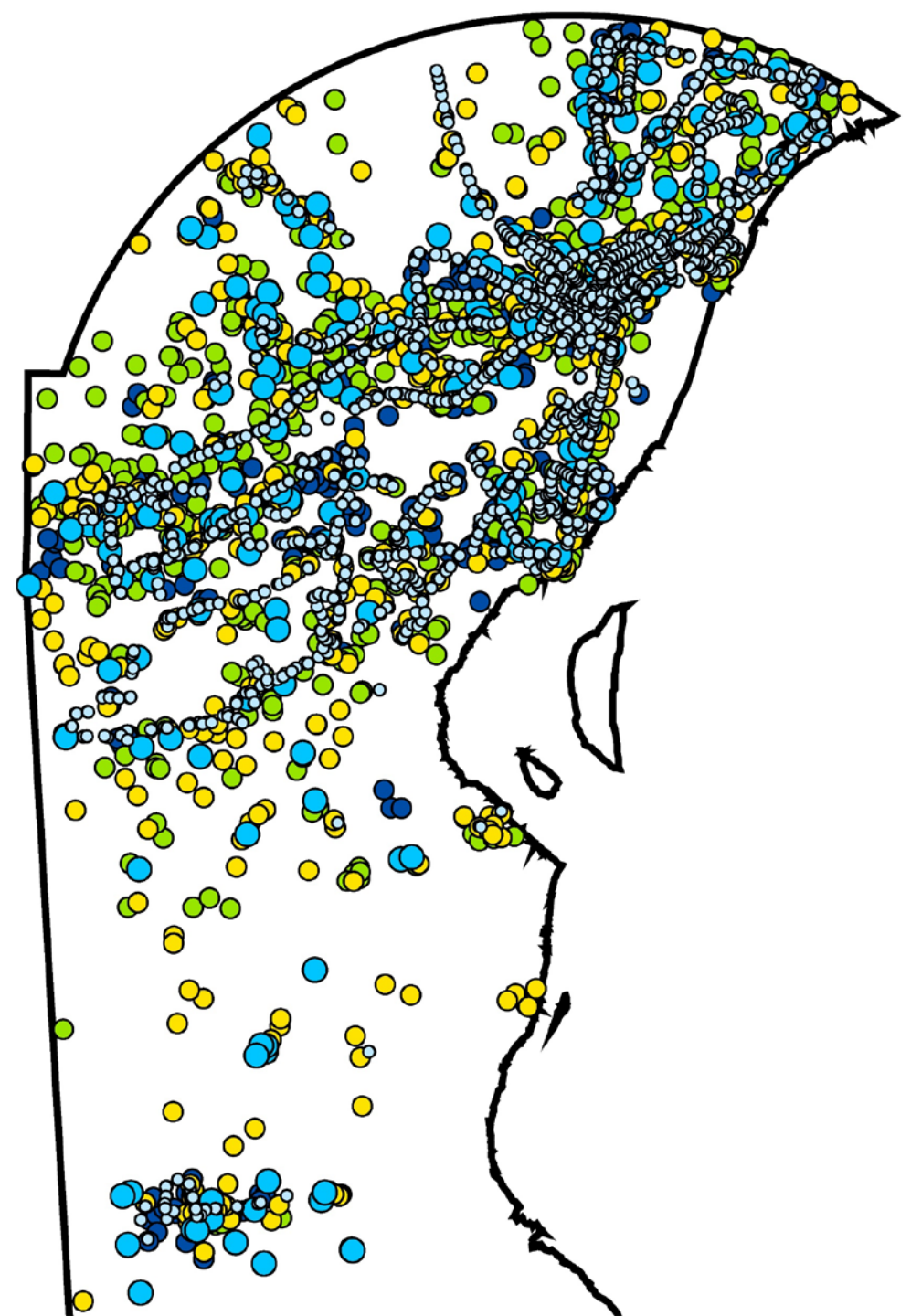
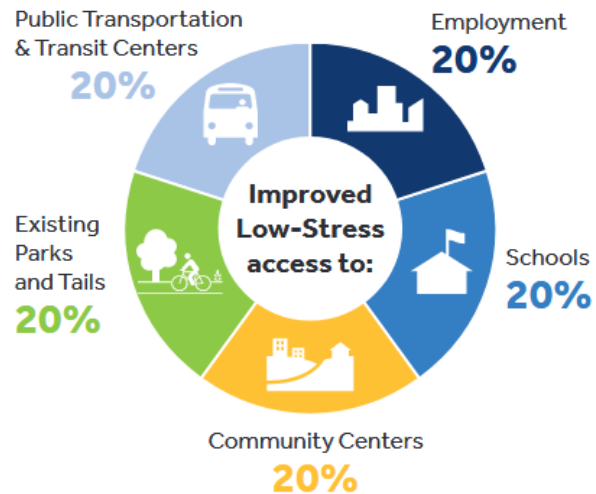
Quantify improvement to cycling mobility

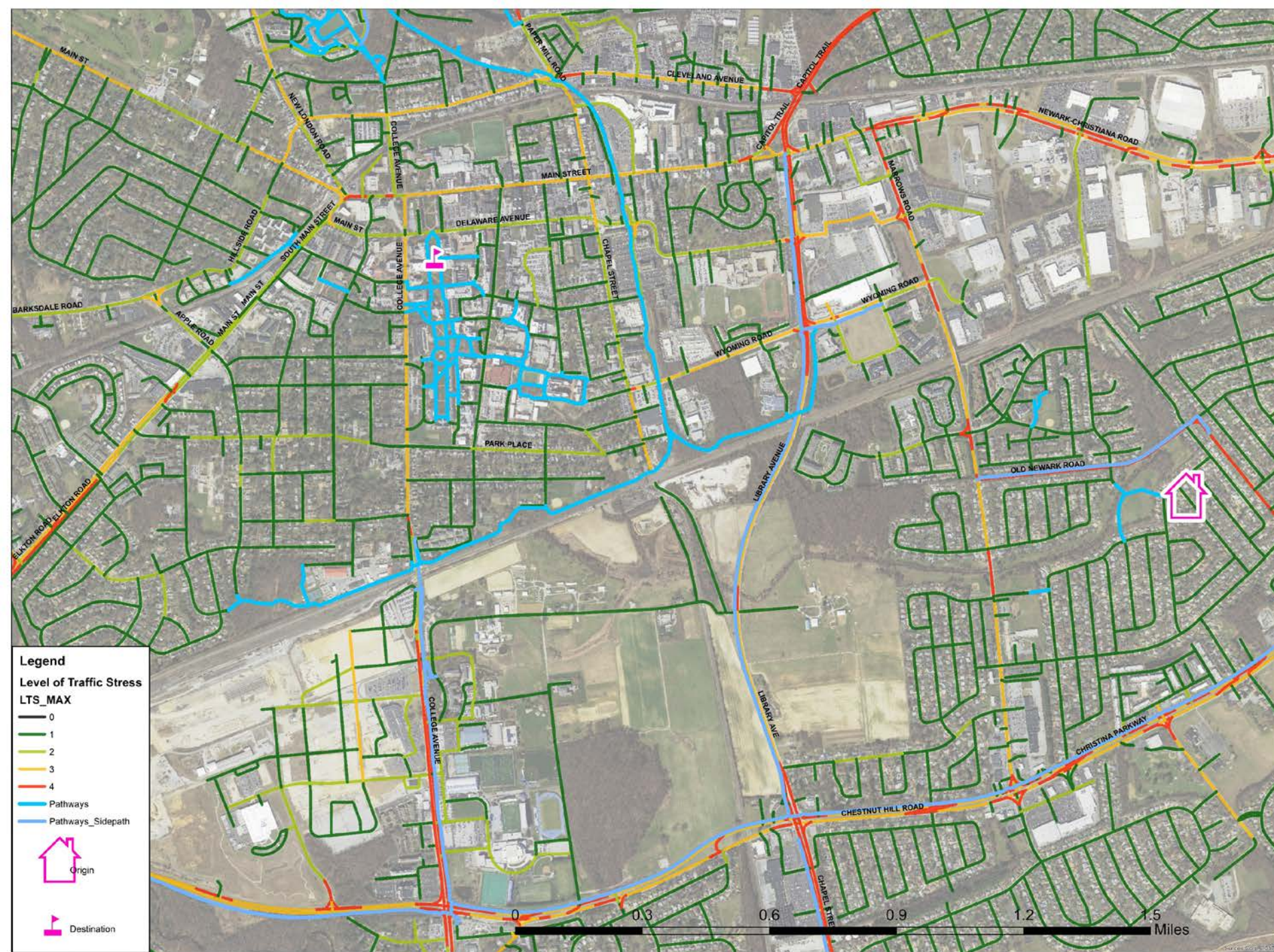
Goals and Objectives

Goal 1: Develop a Complete, Comfortable, Connected Bicycle Network

- 1.1 Increase the number of homes and destinations connected entirely by the low-stress bicycle network.

Figure 3-G. The categories of destinations used in project scoring for the Statewide Bicycle and Pedestrian Program





Legend

Level of Traffic Stress

LTS_MAX

- 0
- 1
- 2
- 3
- 4

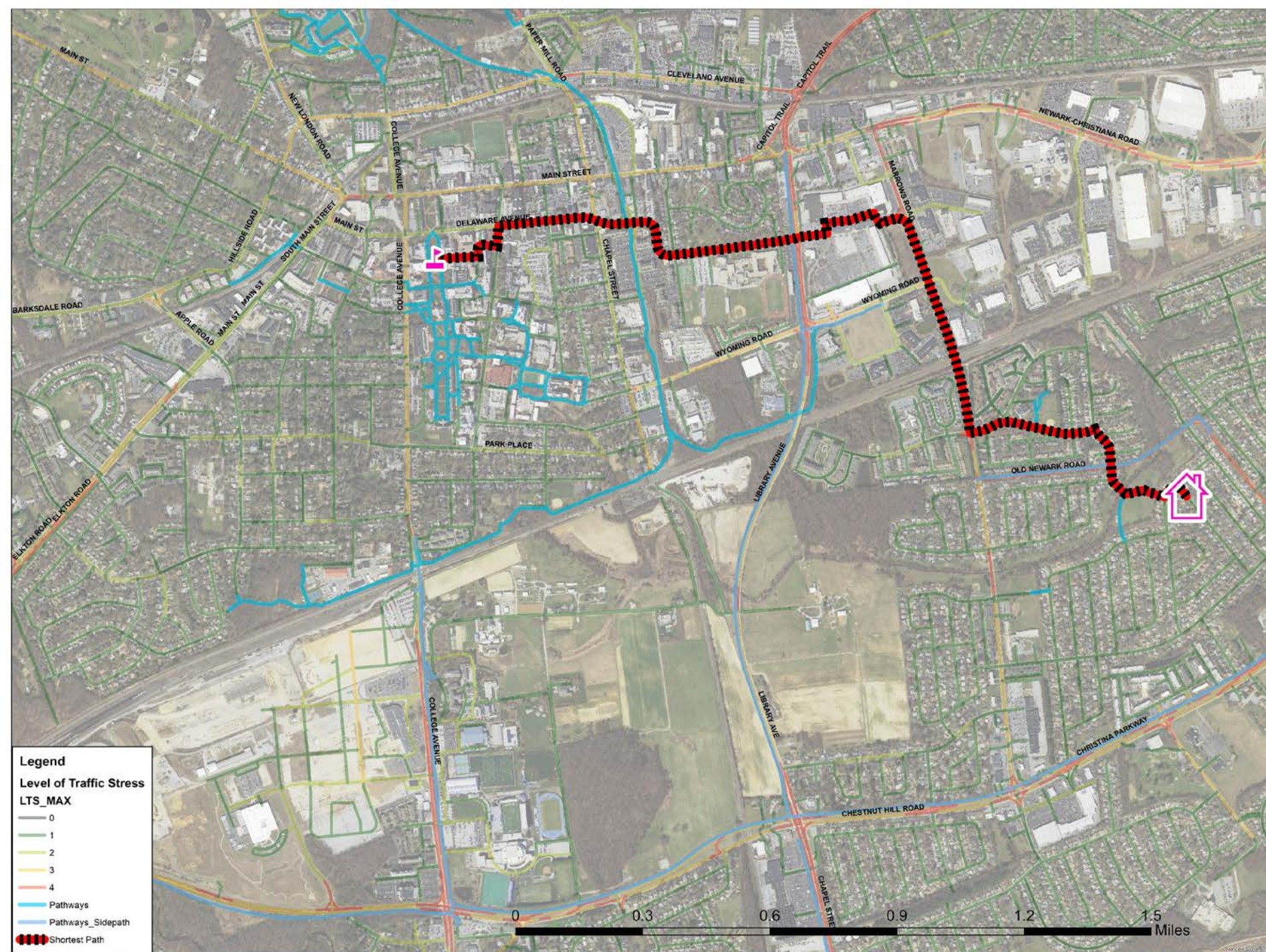
Pathways

Pathways_Sidepath

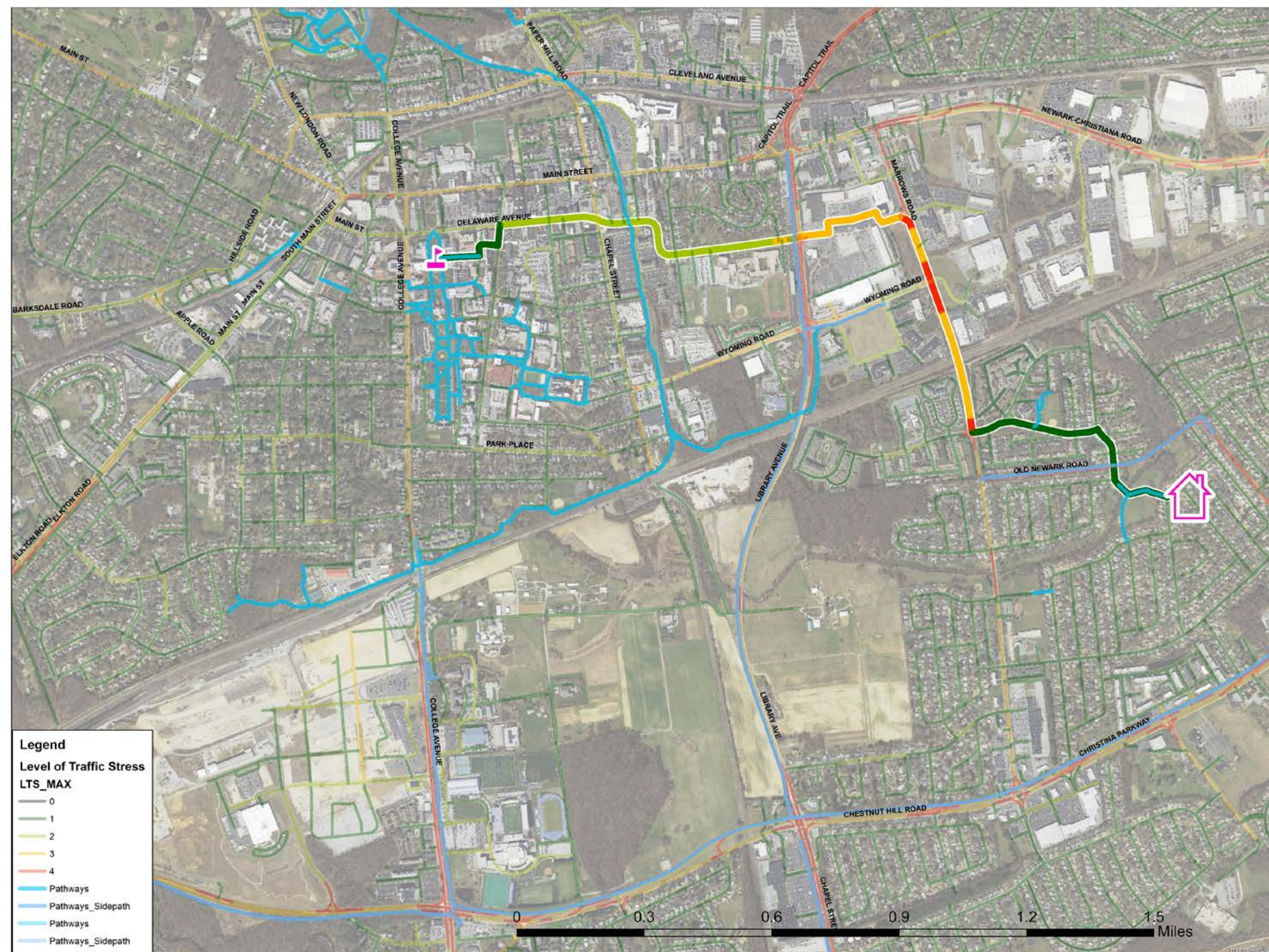
Origin

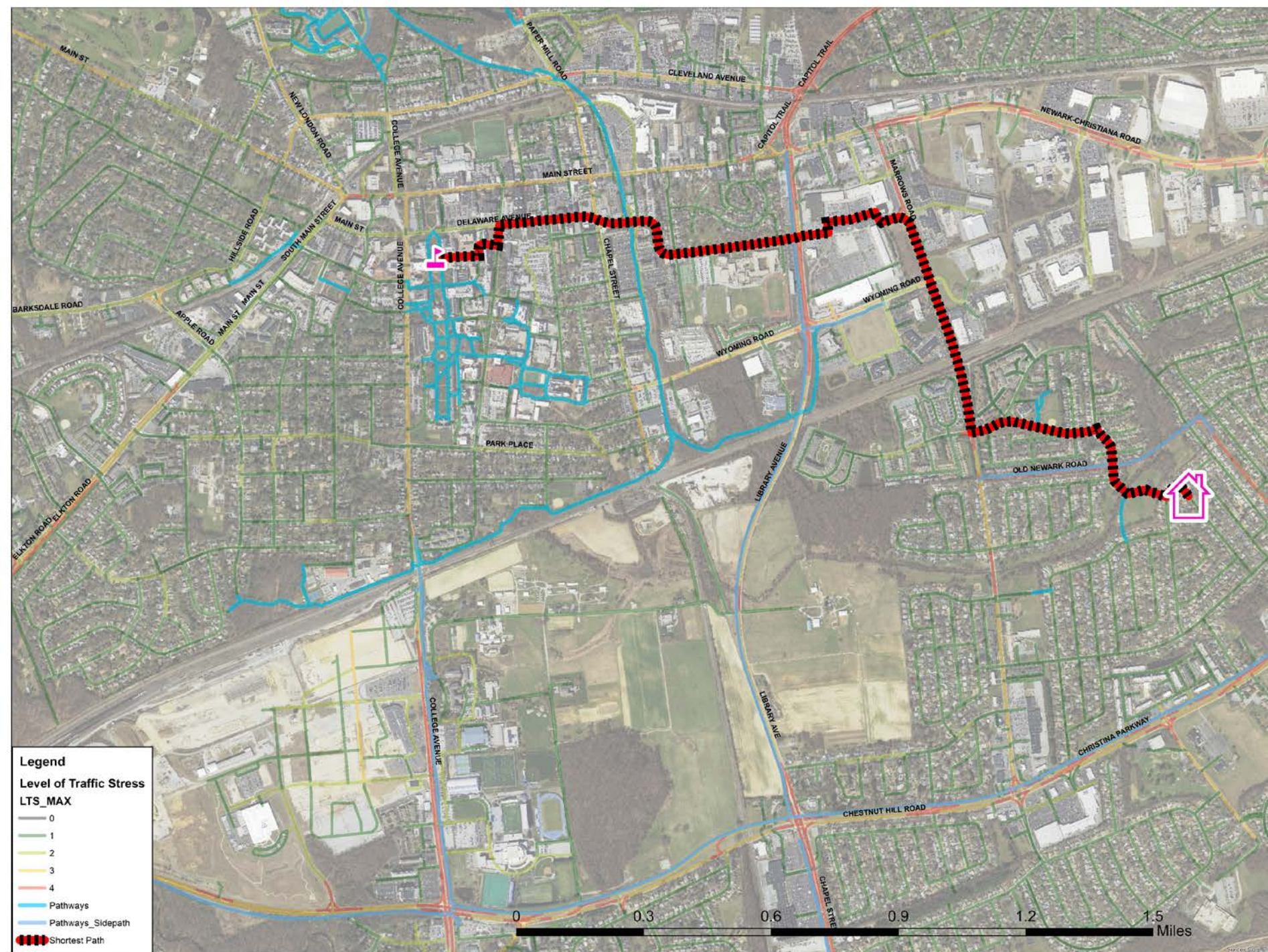
Destination

- **Shortest Path**
 - 2.5 miles
 - ~12 minute bike ride



- **Shortest Path**
 - 2.5 miles
 - ~12 minute bike ride





- **Shortest LTS 4 Path**

- 2.5 miles
- ~12 minutes

- **Shortest LTS1 Path**

- Does not exist!

Propensity Score

For $L_{LTS1} < 3$ mi, and relative detour $< 20\%$

$$P =$$

For $L_{LTS1} < 3$ mi, and relative detour $> 20\%$

$$p = e^{-1.4 \cdot 10^{-3} (L_{LTS1} - 1.2 \cdot L_{Shortest})}$$

For $L_{LTS1} > 3$ mi, and relative detour $> 20\%$

$$P = e^{-1.4 \cdot 10^{-3} (L_{LTS1} - 1.2 \cdot L_{Shortest}) \cdot \left(\frac{D_{max} - L_{LTS1}}{D_{max} - D_{min}} \right)}$$

Legend

Level of Traffic Stress

LTS_MAX

0

1

2

3

4

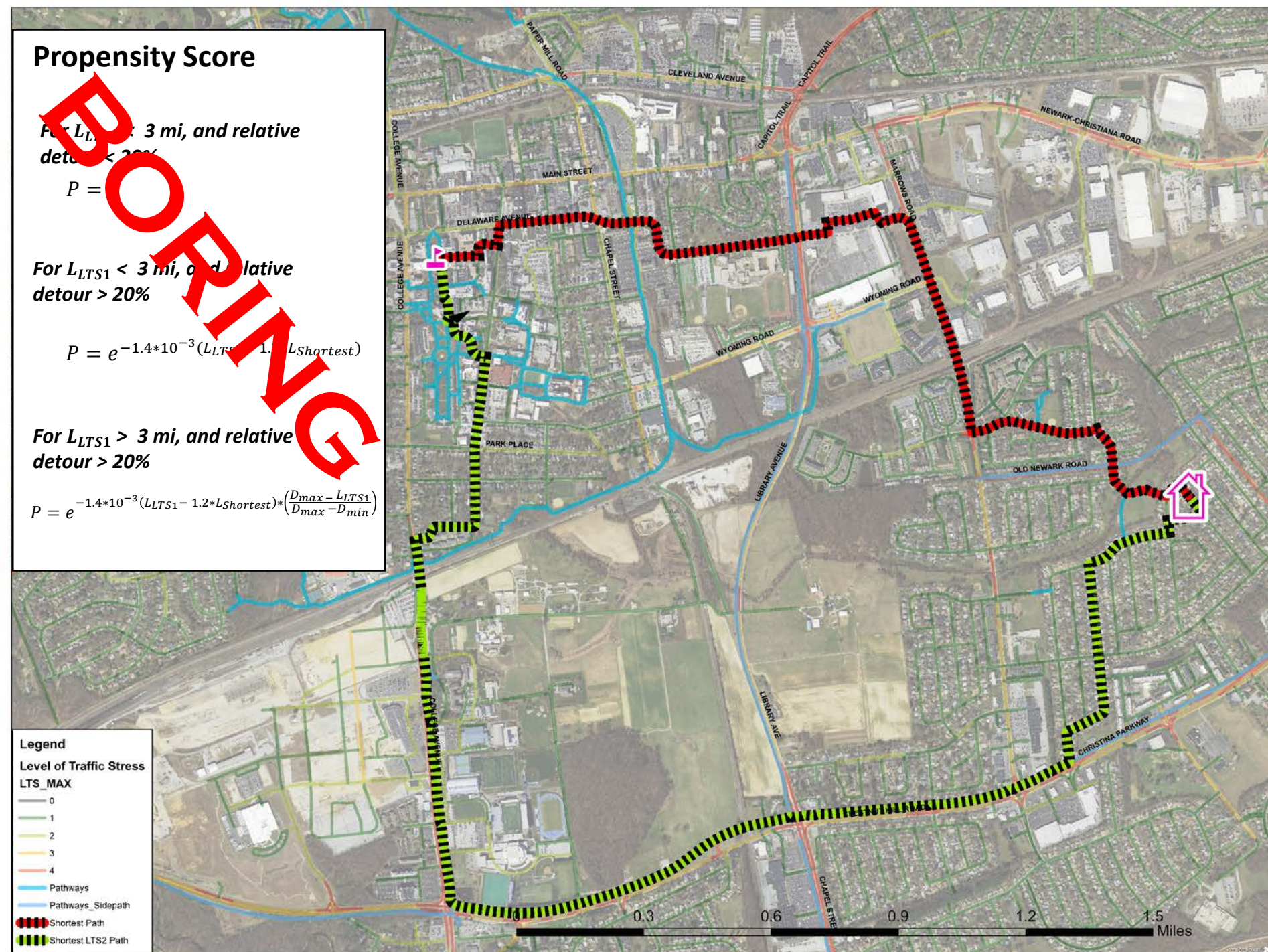
Pathways

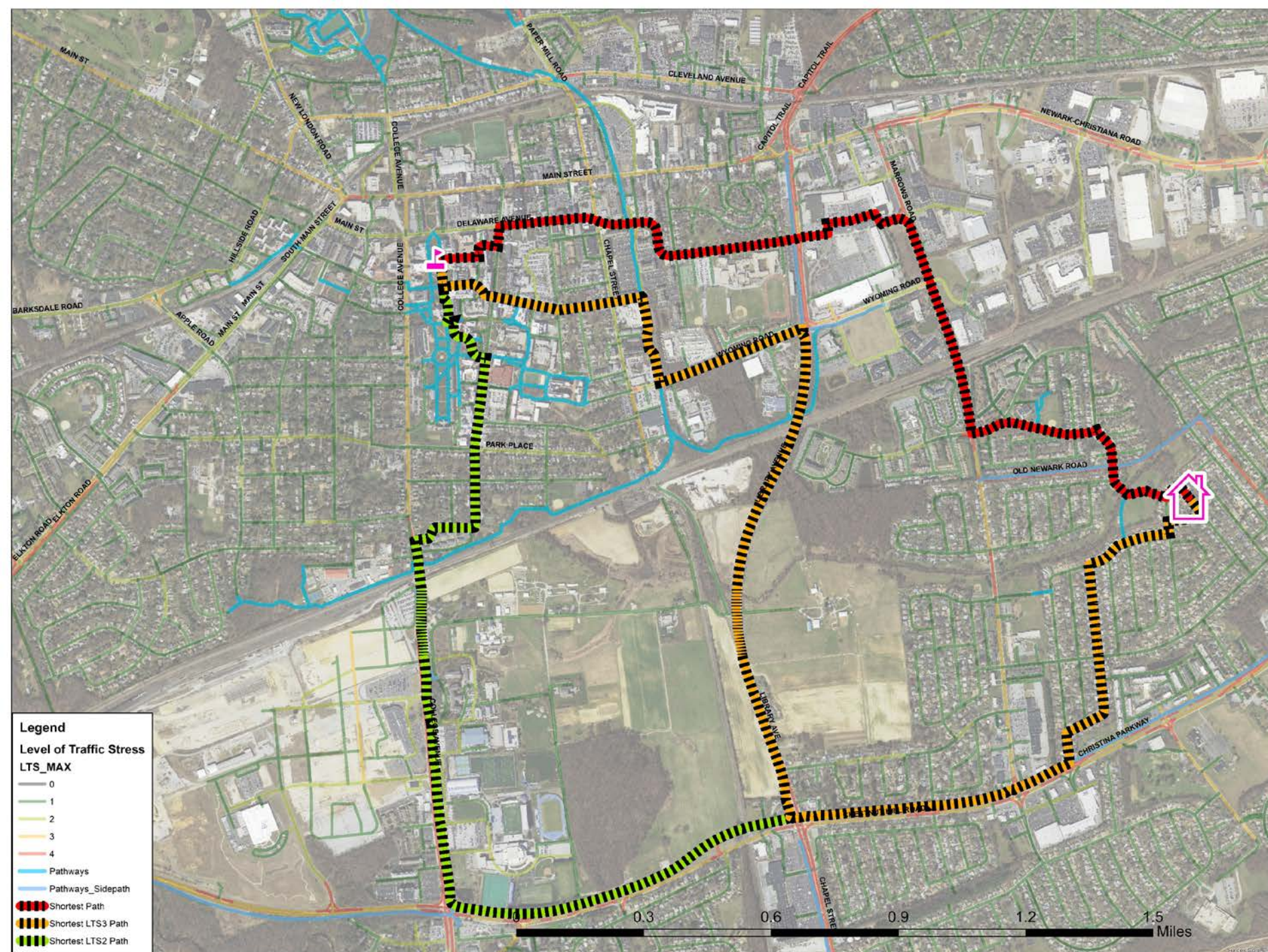
Pathways_Sidepath

Shortest Path

Shortest LTS2 Path

- **Shortest LTS 4 Path**
 - 2.5 miles
 - ~12 minutes
- **Shortest LTS2 Path**
 - 4.2 miles
 - 68% detour
 - ~21 minutes
 - **P = 0.359**
- **Shortest LTS1 Path**
 - Does not exist!
 - **P = 0**





• **Shortest LTS 4 Path**

- 2.5 miles
- P = 1

• **Shortest LTS3 Path**

- 3.9 miles
- 56% relative detour
- P = 0.496

• **Shortest LTS2 Path**

- 4.2 miles
- 68% detour
- P = 0.359

• **Shortest LTS1 Path**

- Does not exist!
- P = 0

$P_{weighted} = P_{LTS1} * 1 + P_{LTS2} * 0.75 + P_{LTS3} * 0.5$

- Weighted Propensity score for this O-D pair

$P_{weighted} = 0.496$ out of 2.25 potential points

- Detour is a KILLER to bicycle/ pedestrian mobility. Directness is crucial

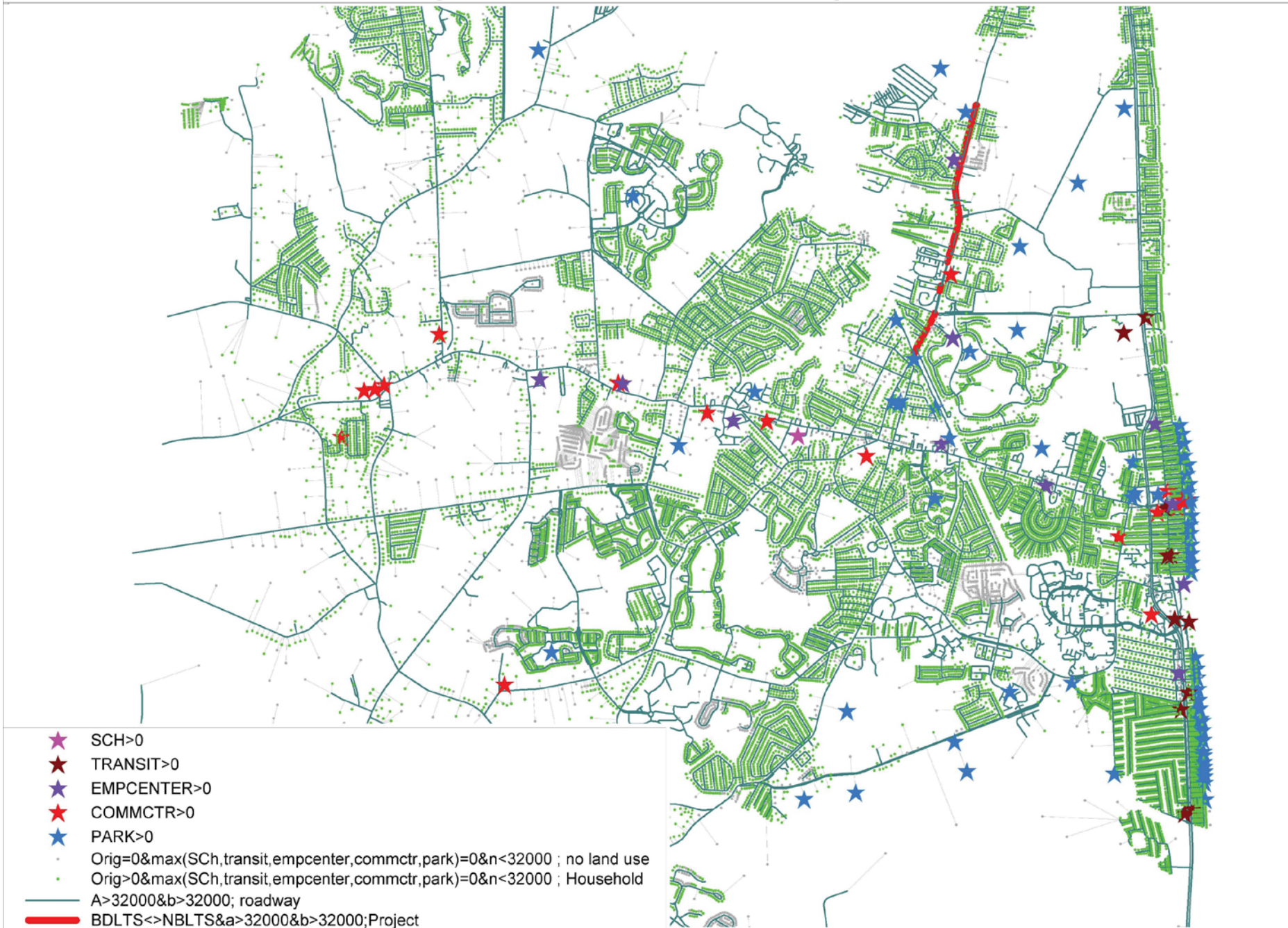
Legend

Level of Traffic Stress
LTS_MAX

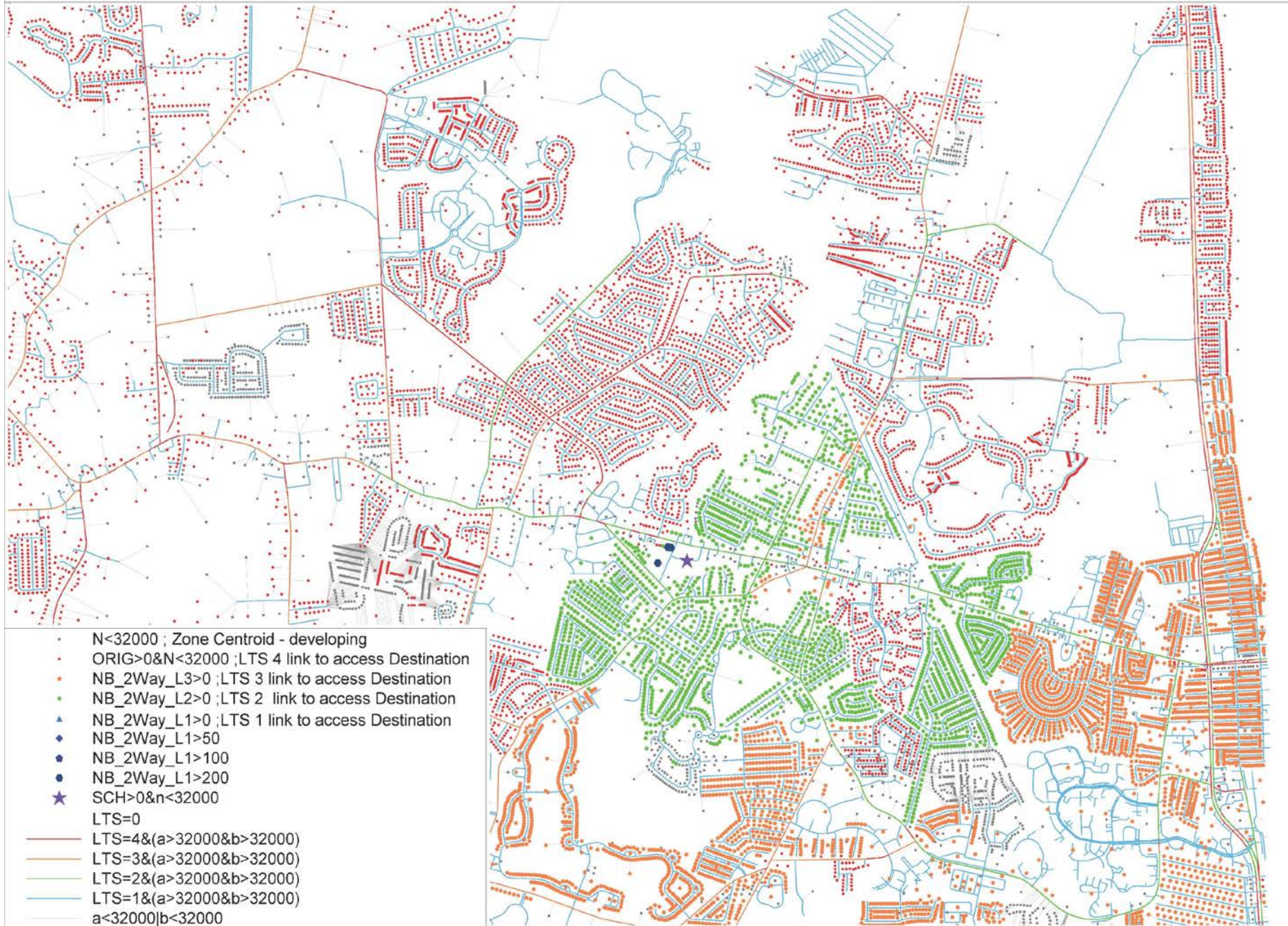
- 0
- 1
- 2
- 3
- 4

Pathways
Pathways_Sidepath
Shortest Path
Shortest LTS3 Path
Shortest LTS2 Path

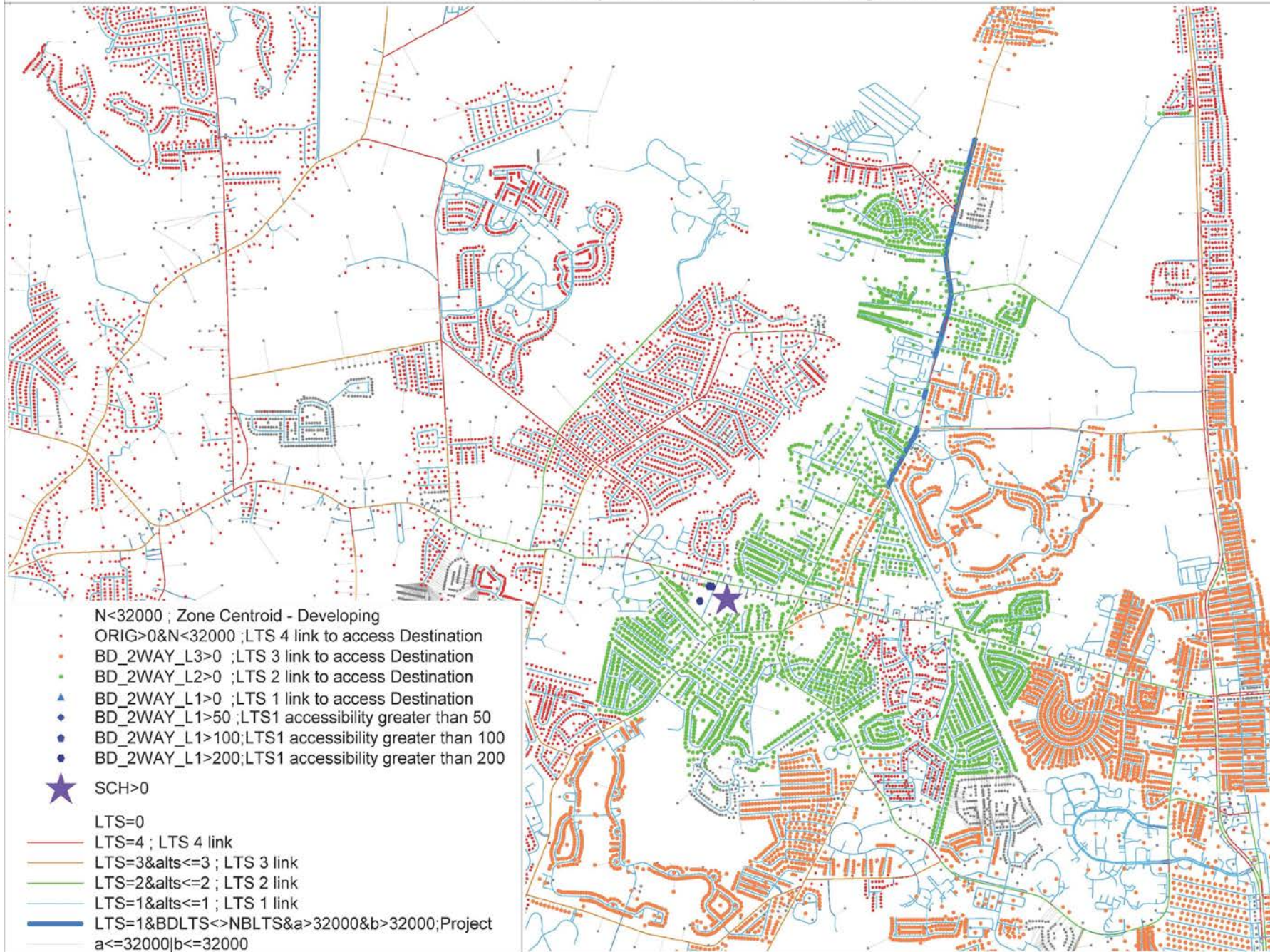
Project and Destination Locations_Project 1



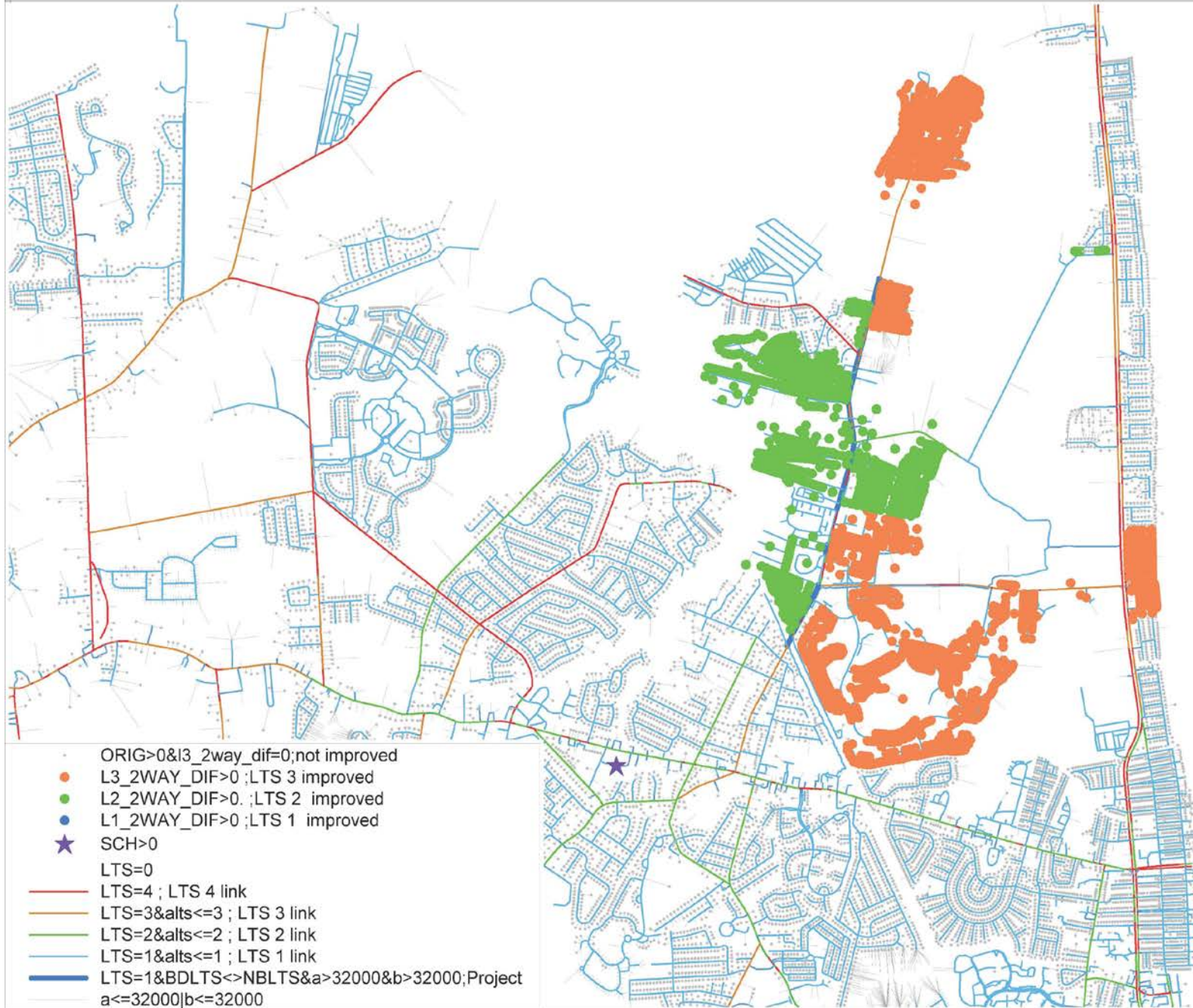
No build zone Accessibility to School by LTS



Build Accessibility to School by LTS_Project 1

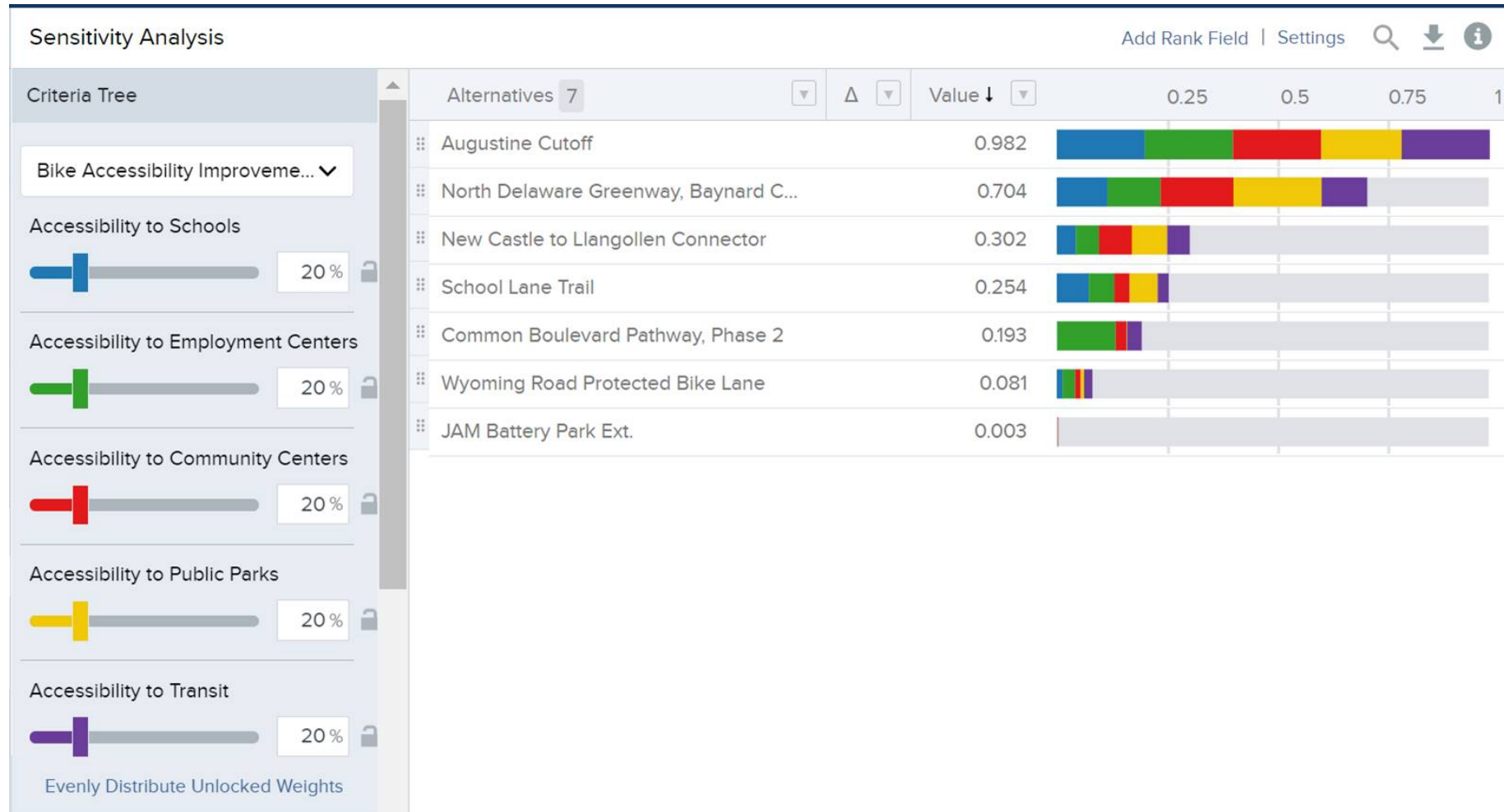


Zone Accessibility Improvement by LTS to School _Project 1

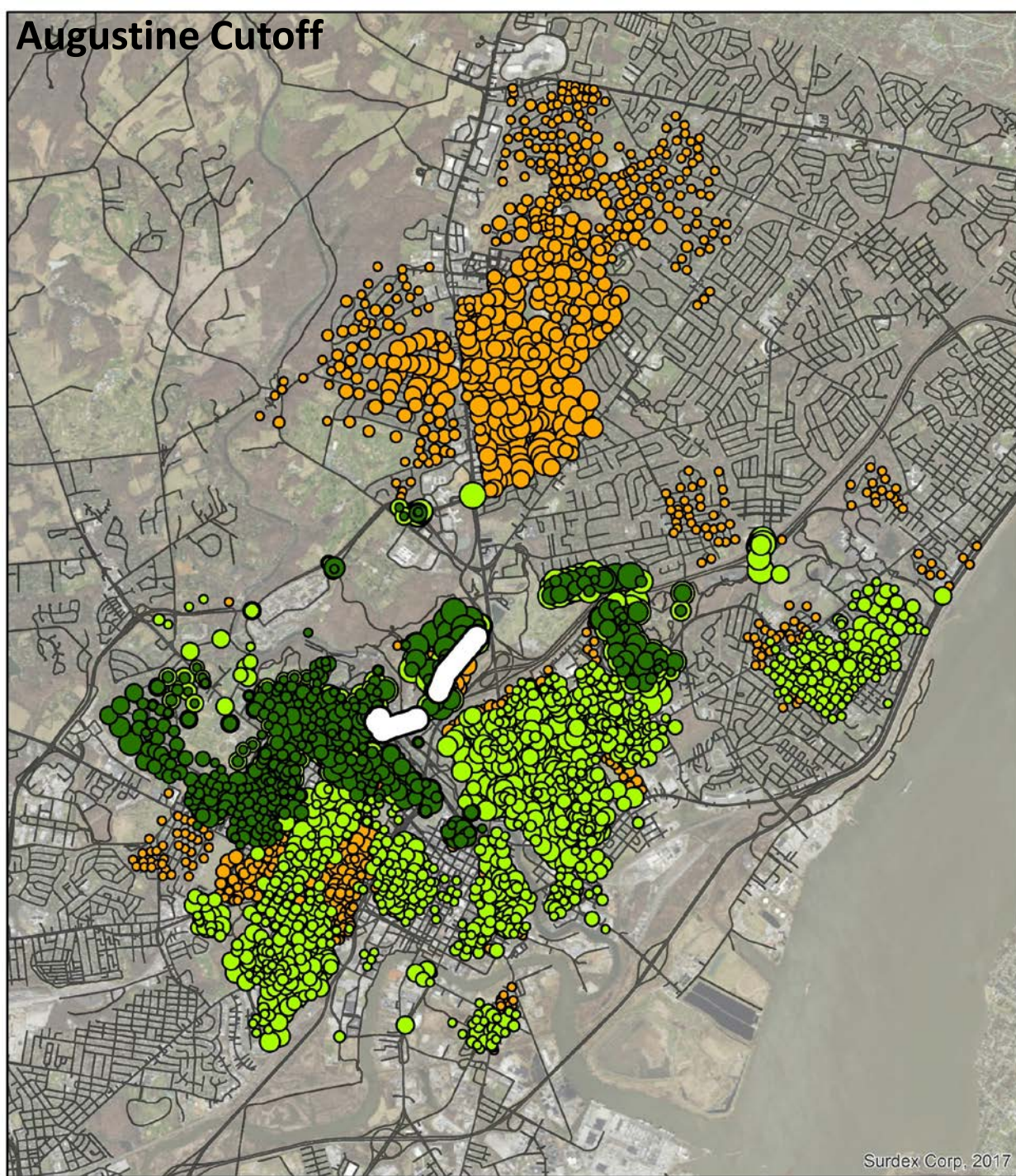


RAW													
Scenario	LTS Level	SCH	COM	EMP	BUS	Park							
NCC_NB	LTS1	1866.14	1332.95	851.27	10026.18	2034.4							
	LTS2	8985.68	7952.54	6613.99	23231.03	8358.73							
	LTS3	15922.82	15193.81	12860.96	39974.19	14824.22	IMPROVEMENT						
	LTS4	70092.13	71389.74	74094.26	131996.3	70772.59	Scenario	LTS Level	SCH	COM	EMP	BUS	Park
NCC_PROJ1	LTS1	1866.14	1333.38	851.32	10029.15	2034.99	NCC_PROJ1	LTS1	0	430	50	2970	590
	LTS2	8985.82	7953.55	6614.23	23233.06	8360.05		LTS2	140	1010	240	2030	1320
	LTS3	15922.81	15193.81	12860.96	39974.24	14824.23		LTS3	0	0	0	50	10
	LTS4	70092.16	71389.91	74094.33	131996.39	70772.63		Scenario	LTS Level	SCH	COM	EMP	BUS
NCC_PROJ2	LTS1	1873.81	1356.95	858.46	10058.23	2060.87	NCC_PROJ2	LTS1	7670	24000	7190	32050	26470
	LTS2	9036.17	8005.96	6660.41	23330.73	8429.57		LTS2	50490	53420	46420	99700	70840
	LTS3	15984.08	15268.25	12942.78	40105.48	14927.76		LTS3	61260	74440	81820	131290	103540
	LTS4	70092.23	71390.01	74095.34	131996.5	70774.14		Scenario	LTS Level	SCH	COM	EMP	BUS
CC_PROJ3Update	LTS1	1870.65	1332.21	851.97	10025.75	2033.92	NCC_PROJ3	LTS1	4510	0	700	0	0
	LTS2	9089.18	7998.58	6712.88	23329.35	8451.07		LTS2	103500	46040	98890	98320	92340
	LTS3	16015.43	15221.12	12892.40	39996.71	14895.19		LTS3	92610	27310	31440	22520	70970
	LTS4	70169.04	71447.61	74155.72	132028.24	70843.13		Scenario	LTS Level	SCH	COM	EMP	BUS
NCC_PROJ4	LTS1	1865.38	1332.74	850.85	10021.4	2033.91	NCC_PROJ4	LTS1	0	0	0	0	0
	LTS2	9212.57	8237.34	6838.19	23601.05	8739.16		LTS2	226890	284800	224200	370020	380430
	LTS3	15988.92	15216.03	12905.77	40127.12	14910.33		LTS3	66100	22220	44810	152930	86110
	LTS4	70094.97	71393.57	74096.02	131996.41	70777.04		Scenario	LTS Level	SCH	COM	EMP	BUS
NCC_PROJ5	LTS1	1866.14	1332.95	851.27	10026.18	2034.4	NCC_PROJ5	LTS1	0	0	0	0	0
	LTS2	8987.07	7976.97	6769.84	23320.01	8360.76		LTS2	1390	24430	155850	88980	2030
	LTS3	15924.27	15222.79	13045.73	40065.18	14826.55		LTS3	1450	28980	184770	90990	2330
	LTS4	70092.91	71391.52	74098.98	131997.47	70773.64		Scenario	LTS Level	SCH	COM	EMP	BUS
NCC_PROJ6	LTS1	1889.42	1343.53	897.18	10099.9	2053.37	NCC_PROJ6	LTS1	23280	10580	45910	73720	18970
	LTS2	9098.29	8051.8	6727.35	23478.77	8487.28		LTS2	112610	99260	113360	247740	128550
	LTS3	16411.53	15566.8	13230.18	40804.75	15191.8		LTS3	488710	372990	369220	830560	367580
	LTS4	70094.98	71391.62	74094.77	131996.31	70774.96		Scenario	LTS Level	SCH	COM	EMP	BUS
NCC_PROJ7	LTS1	1869.08	1336.67	859.55	10045.14	2035.6	NCC_PROJ7	LTS1	2940	3720	8280	18960	1200
	LTS2	9008.77	7968.87	6660.69	23288.53	8372.26		LTS2	23090	16330	46700	57500	13530
	LTS3	15928.63	15196.12	12864.11	39977.06	14826.83		LTS3	5810	2310	3150	2870	2610
	LTS4	70092.13	71389.74	74094.26	131996.3	70772.59							

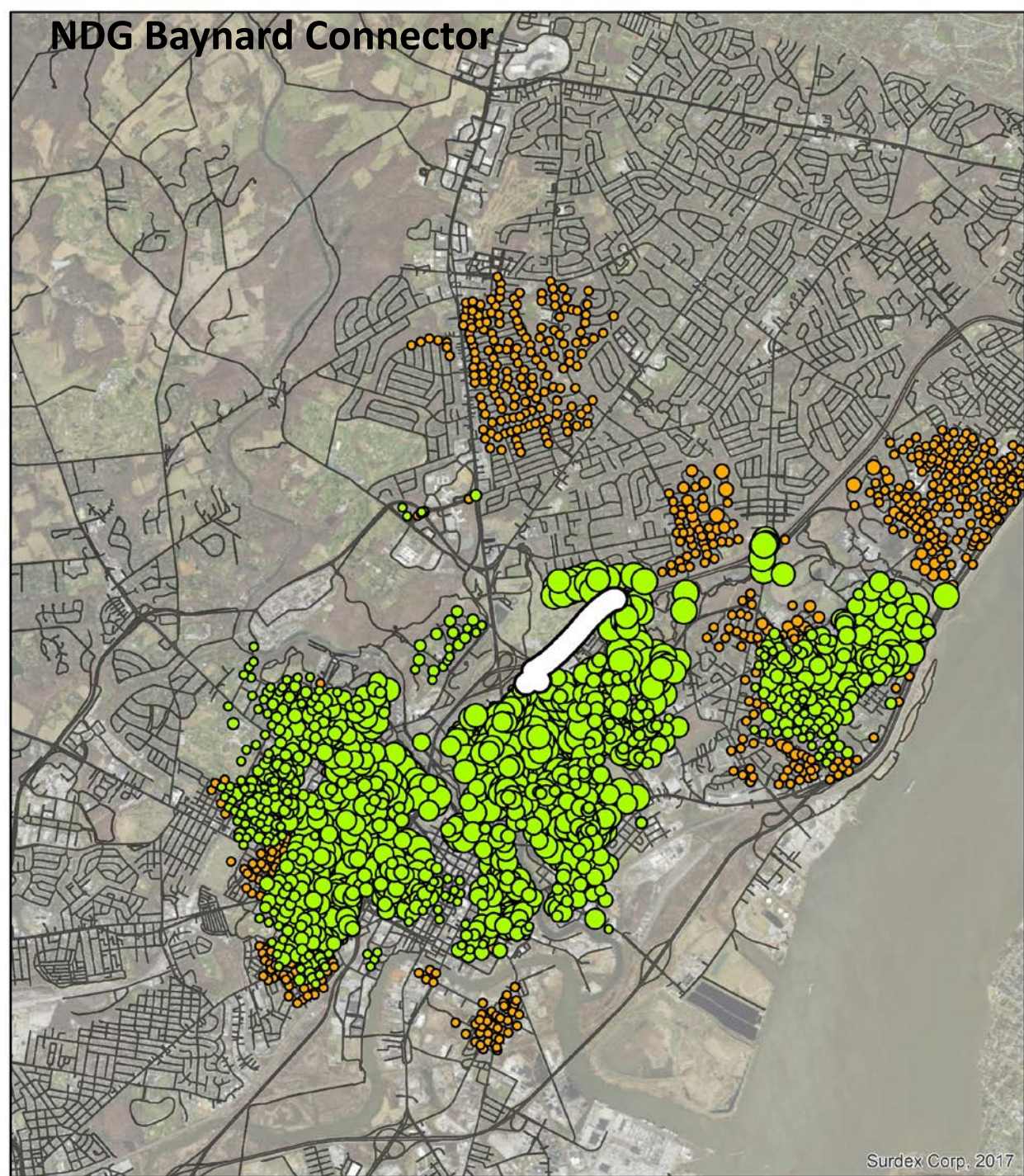
2020 New Castle County Priority Projects, from WILMAPCO



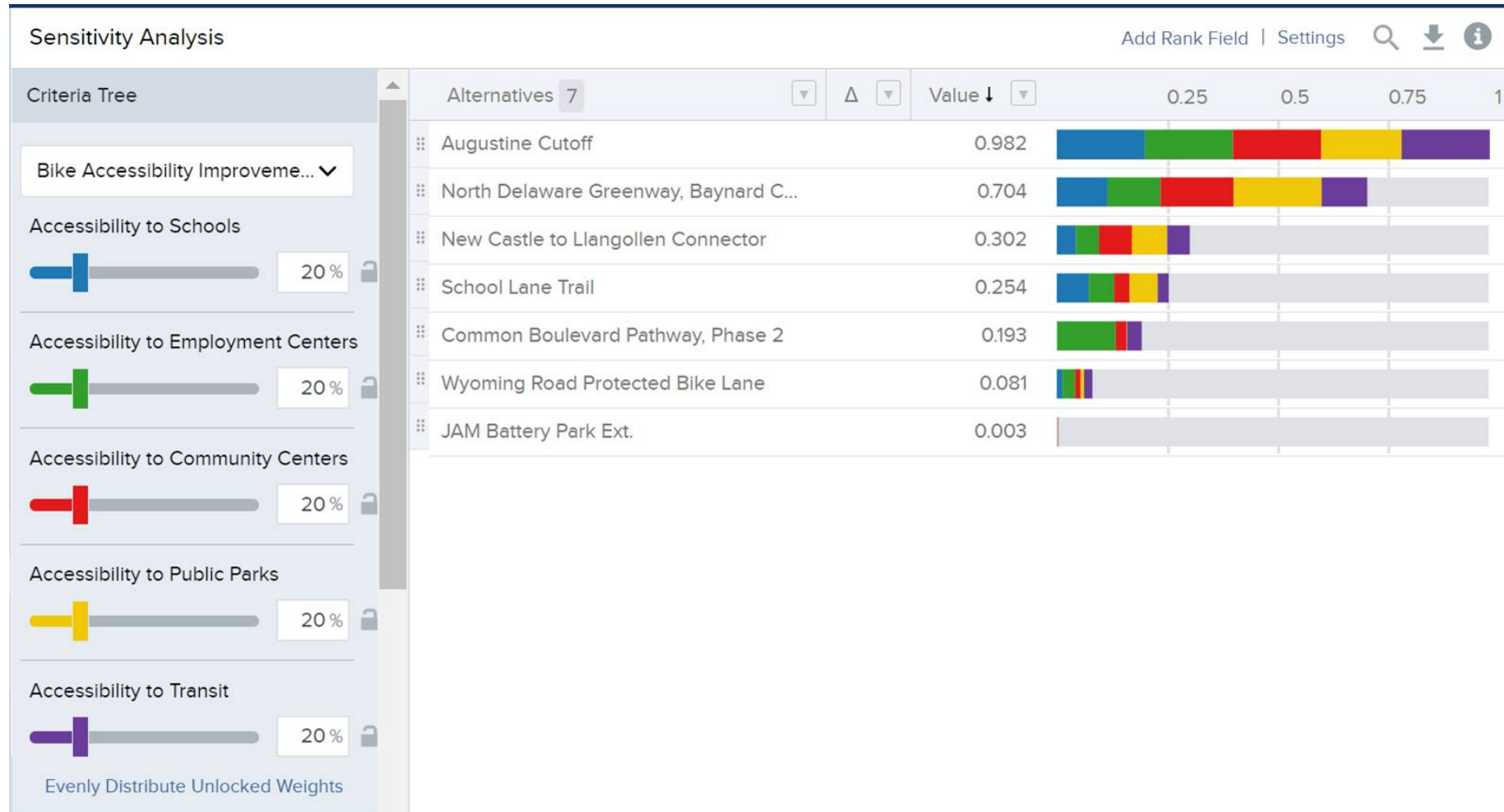
Augustine Cutoff



NDG Baynard Connector



2020 New Castle County Priority Projects, from WILMAPCO



School Lane Trail

Project Challenges: Potential wetland impacts.

Programmatic Factors: A relatively straight forward project with a mature concept. Feasibility study conducted from Delaware Bicycle Council Innovation Grant.

Ranking: 4th out of 7. Modest connectivity improvements, localized around the Penn Acres, Penn Acres South, and Wilmington Manner Gardens neighborhoods. This area is separated from New Castle by LTS2 or greater intersections, so aside from the directly adjacent neighborhoods, most connectivity gain is in the LTS2 and LTS3 network.

Recommended DeIDOT Path Forward: Initiate wetland delineation study to further explore feasibility.



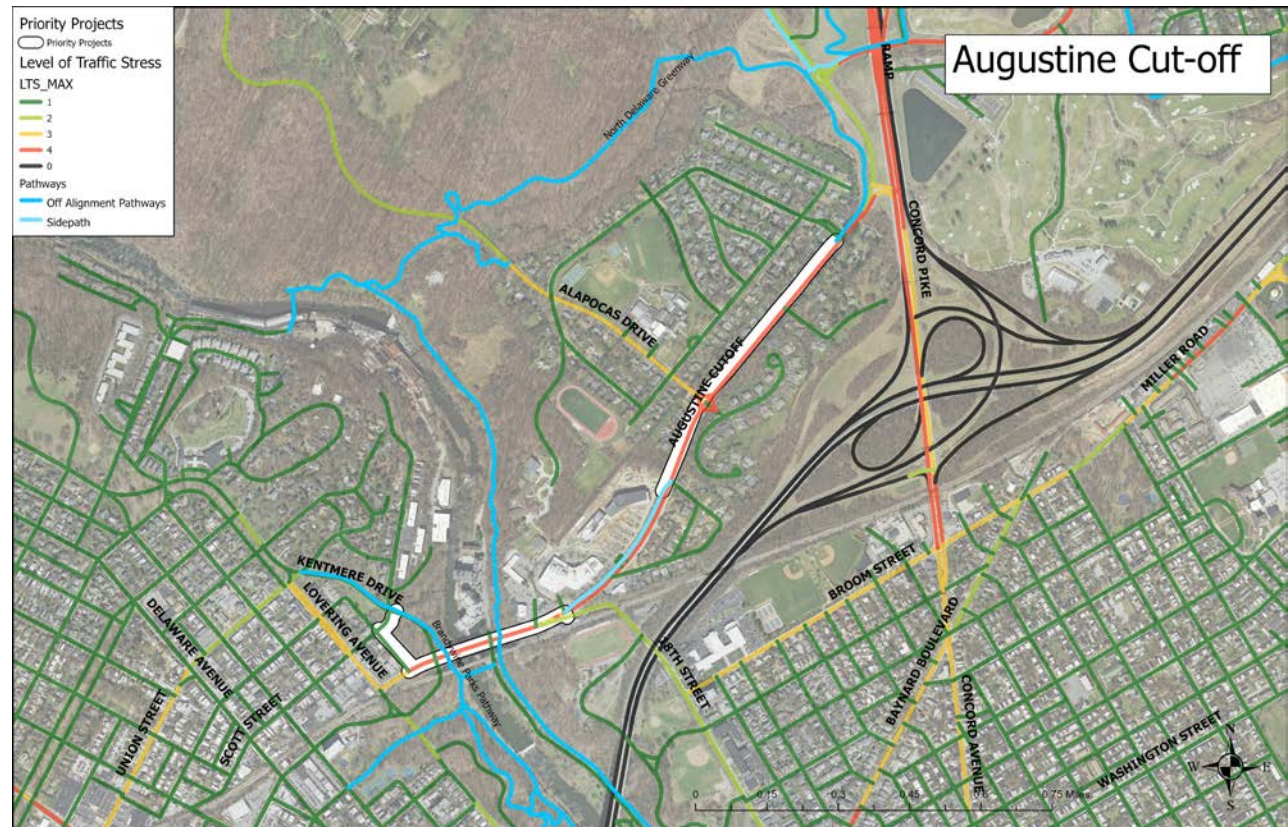
Augustine Cutoff Pathway

Project Challenges: Grading challenges at intersection approaches. ROW needs to be verified near intersections. Potential impacts to private property situated in the ROW. Potential impacts to the typical section of Augustine Cutoff.

Programmatic Factors: Feasibility Study was conducted from a Delaware Bicycle Council Innovation Grant. No public workshops were held. Believed to be a contentious project concept.

Ranking: 1st out of 7. This project creates a significant direct connection between the North Delaware Greenway/ Blue Ball Properties Pathway Network, Alapocas, and the Forty Acres Neighborhood. Reduces the stressful elevation changes of riding the North Delaware Greenway along the Brandywine.

Recommended DeIDOT Path Forward: Conduct public workshop to finalize concept study and initiate project development.



Why does it matter?

- A narrative, meaningful, and quantitative way to approach bicycle mobility at an institutional level
- Allows us to **compare** the **value** of bicycle related projects
- Creates a process for **managing public and legislative project requests**
- A great tool for assisting in local planning

Things we are **not** currently doing

- Comprehensively developing a 100 yr statewide bicycle masterplan
- Modeling pedestrian travel (goal for 2021-2022)
- Prioritizing projects based on bicycle access to Wawa

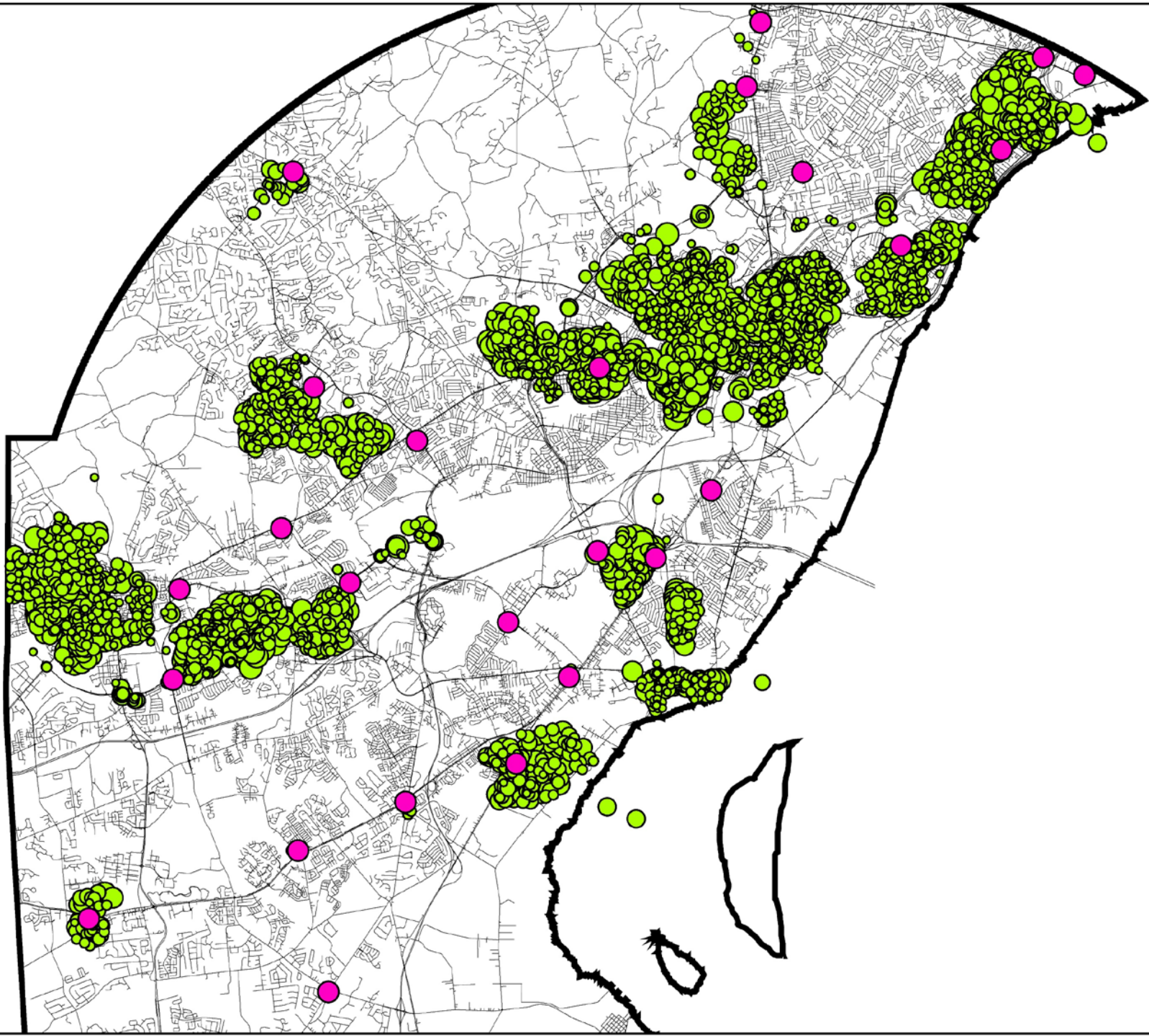


POTENTIAL BIKE TRIPS TO WAWA

Not Preferential Treatment. Just an Example [©]

... a pathway to connect my neighborhood to the Wawa





POTENTIAL BIKE TRIPS TO WAWA

Not Preferential Treatment. Just an Example

... a pathway to connect my neighborhood to the Wawa

Existing LTS2 Connectivity to New Castle County Wawa locations



POTENTIAL BIKE TRIPS TO WAWA

Not Preferential Treatment. Just an Example

7 Wawas in a 3 mile radius...
but no one in here can reach one??

... a pathway to connect my neighborhood to the Wawa

Claymont has BEST LTS2 connectivity to Wawa locations

- Surrounded by densely populated, relatively well-connected low-stress streets
- But it's an island...



POTENTIAL BIKE TRIPS TO WAWA

Not Preferential Treatment. Just an Example[®]

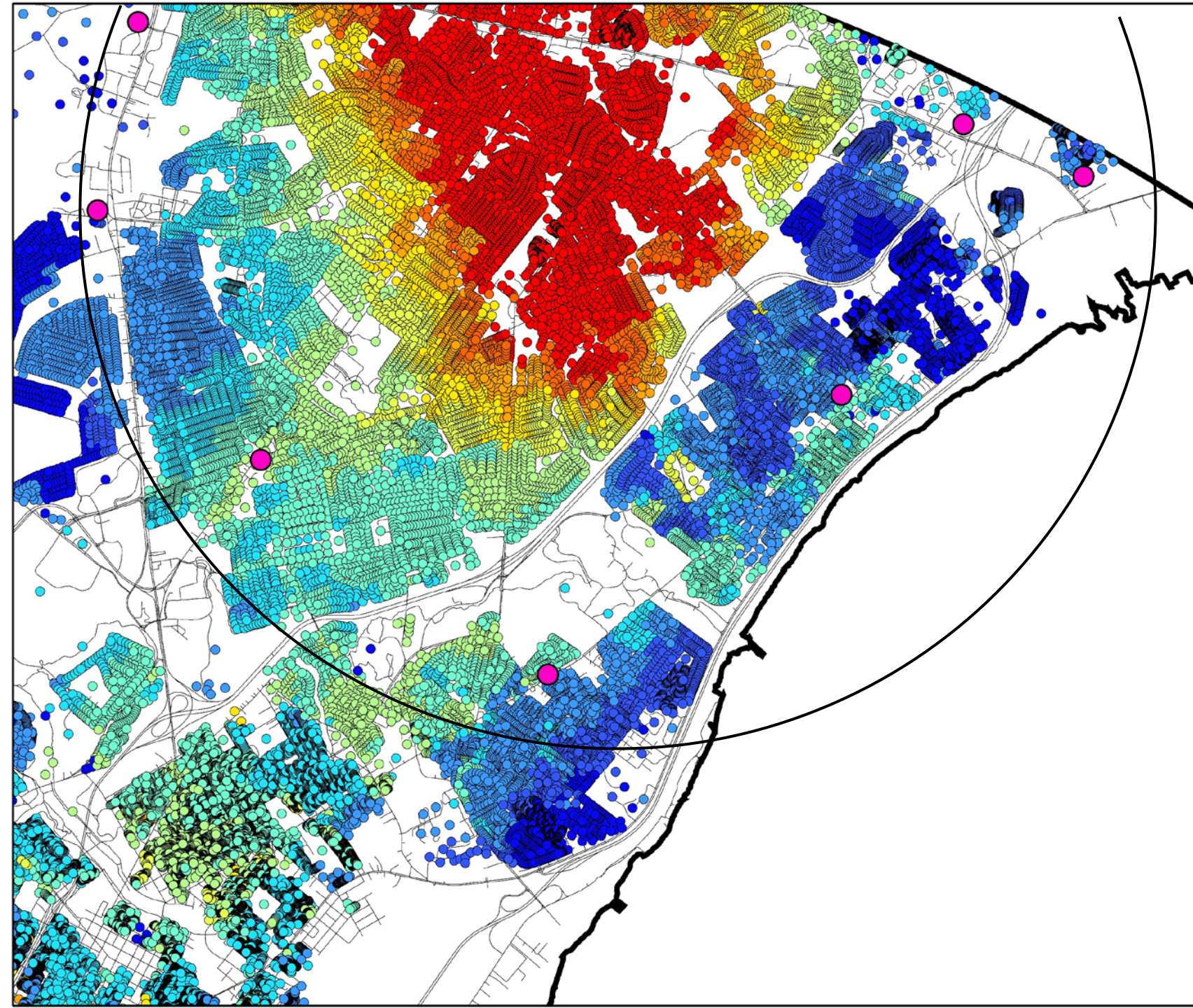
... a pathway to connect
my neighborhood to the
Wawa

P_u = Unrealized Potential

P_u = Highest Possible Connectivity Score – Existing LTS2 Connectivity Score

Red = Lots of potential, but poorly
connected

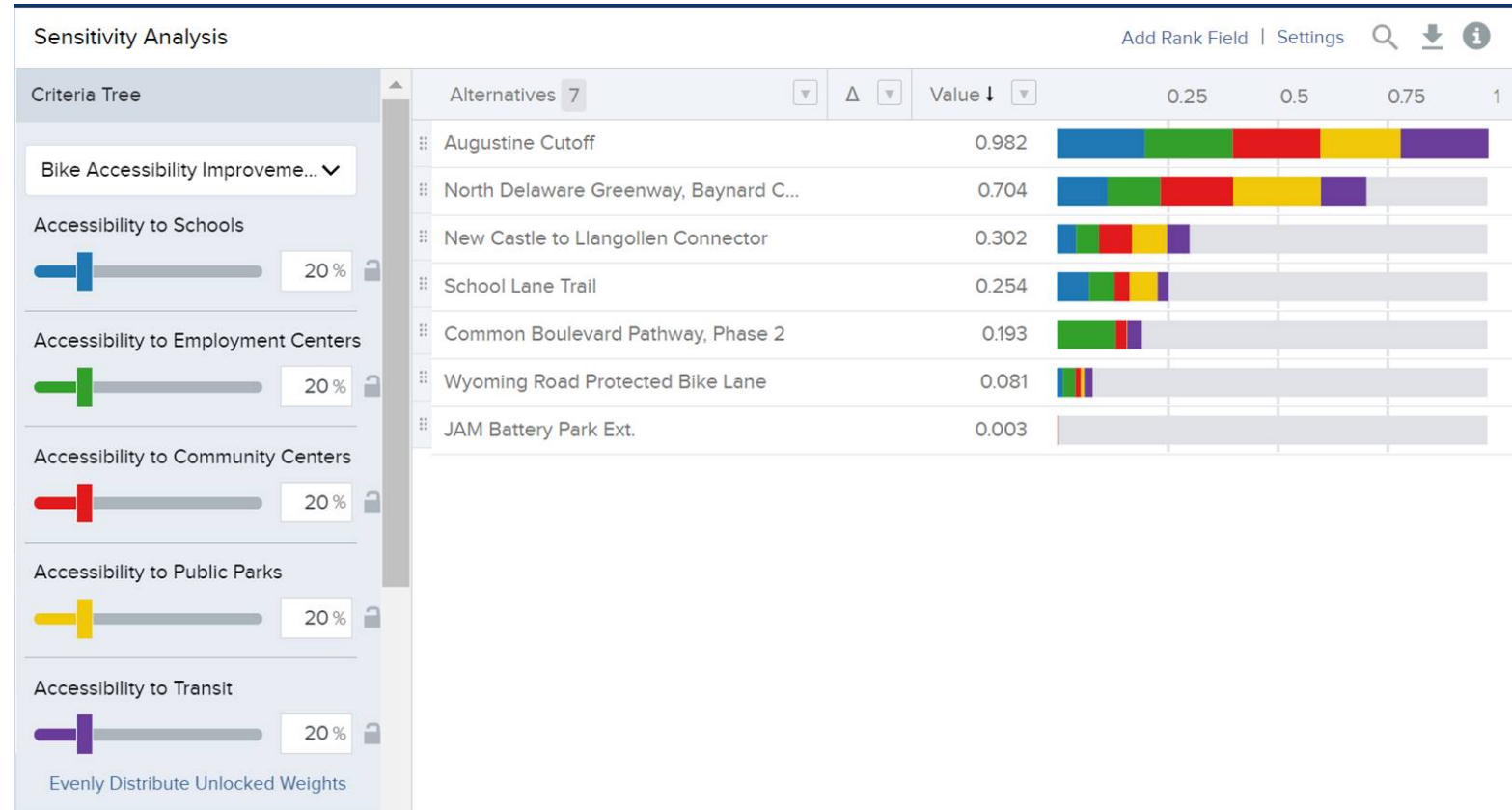
Blue = Well connected, realized
potential (or low potential)



Questions?

Path forward:

- **School Lane Trail** – initiate wetland study, begin project development
- **Augustine Cutoff** – finalize concept study and continue project development from there



Paul Moser

Paul.moser@delaware.gov

302-760-2114