

Bike Network Planning:
Tools for Dealing with Connectivity and Level of Traffic Stress
AKA: Our Bag of Tricks



Pro Walk / Pro Bike / Pro Place
Tuesday, September 11, 2012
4:00 PM to 5:30
Norm Cox, PLA, ASLA
The Greenway Collaborative, Inc.
Ann Arbor, Michigan



The Purpose of GIS Assisted Network Planning

- Determine what is possible
 - Focus on near-term and mid-term projects
- Help establish what is appropriate
 - Addressing roadway conditions and context
- Identify where are improvements needed the most
 - Bang for the buck
- Communication
- Sharing information



GIS as a decision support tool not a decision making tool

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Public Input vs. Black Box

- The purpose of analysis is to help inform decisions – not make them
- Public input is just as important information as input from analysis
- In order for any plan to get approved, it needs to have support from the public and politicians
- Should integrate public input into the GIS system



There are too many variables to use GIS in a practical cost effective way to determine an "ideal" network

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Public Input Starting Point – Web Survey

- Generally our first large scale outreach is a web survey
 - Economical
 - Reach people who would never come to a meeting
 - Explore the possible
- Tease out
 - Demographics
 - Current travel patterns
 - Potential for mode shift
 - Desired facilities
 - Inhibitors: physical, policy and emotional

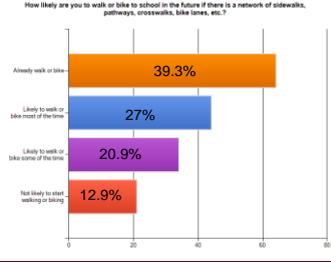



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Four Lessons from Many Web Surveys

- There is a big difference between where people currently walk & bike and where they would like to walk & bike
- There is an untapped market of recreational cyclists that are interested in using their bikes for transportation
- That market primarily desires trails, bike routes on local roads and bike lanes on lower speed roadways
- They will tell you what roads need attention

How likely are you to walk or bike to school in the future if there is a network of sidewalks, pathways, crosswalks, bike lanes, etc.?

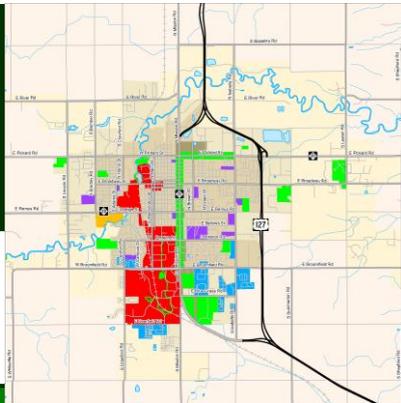


Likelihood	Percentage
Already walk or bike	39.3%
Likely to walk or bike most of the time	27%
Likely to walk or bike some of the time	20.9%
Not likely to start walking or biking	12.9%

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Web Survey – Current Destinations

- Map out key potential destinations with staff and steering committee
- Participants were asked to identify where they currently bike or walk to



Survey Results (# of people who currently bike or walk)

- Over 350
- 300 to 350
- 250 to 300
- 0 to 250

*548 people completed the survey

Other Activity Generators

- High Density Residential Areas
- Schools

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Web Survey – Desired Destinations

- Participants were asked to identify where they would like to bike or walk to
- This simple exercise can be more powerful than a latent demand analysis

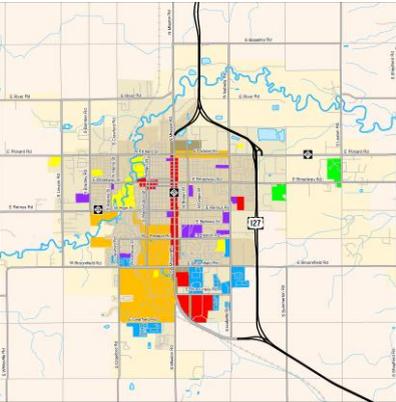
Survey Results (# of people who would like to bike or walk)

- over 350
- 300 to 350
- 250 to 300
- 0 to 250

*548 people completed the survey

Other Activity Generators

- High Density Residential Areas
- Schools



Web Survey – Walking and Bicycling for Transportation

Transportation Trips:

- WALK daily or weekly for transportation
 - 12% current
 - 34% if facilities available
- BIKE daily or weekly
 - 16% current
 - 34% if facilities were available
- Also find that a significant percentage are already walking and bicycling for recreation, fitness or pleasure

	Daily	Weekly	Monthly	Rarely	Never	Response Count
Walk for fun and/or exercise	34.9% (88)	33.0% (86)	17.0% (44)	11.3% (29)	4.0% (10)	258
Walk for transportation	2.6% (7)	9.2% (24)	9.7% (25)	48.8% (126)	37.2% (96)	196
Bicycle for fun and/or exercise	13.0% (34)	30.8% (82)	14.0% (36)	10.7% (28)	22.2% (58)	258
Bicycle for transportation	4.6% (12)	11.9% (31)	6.2% (16)	20.3% (53)	58.0% (150)	194
Run/Jog for fun and/or exercise	16.7% (43)	14.6% (38)	7.6% (20)	19.7% (51)	40.4% (104)	196

	Daily	Weekly	Monthly	Rarely	Never	Response Count
Walk for fun and/or exercise	44.7% (88)	28.9% (57)	10.2% (20)	9.6% (19)	6.6% (13)	197
Walk for transportation	12.4% (24)	21.6% (42)	19.6% (39)	26.2% (51)	20.1% (39)	194
Bicycle for fun and/or exercise	20.0% (37)	32.0% (54)	16.0% (33)	6.0% (11)	14.0% (25)	200
Bicycle for transportation	10.0% (33)	21.9% (41)	14.3% (30)	20.4% (40)	26.8% (52)	196
Run/Jog for fun and/or exercise	22.2% (42)	15.9% (30)	8.5% (16)	12.7% (24)	40.7% (77)	189

Web Survey – Off Road Trails

- A paved pathway that is located away from the roadway that are at least 10' wide
- Found along utility corridors, abandoned rail corridors and undeveloped land
- 83.1% would be comfortable riding a bike on an off-road Trail



1. Would you be comfortable riding a bike on an Off-road Trail?

	Response Percent	Response Count
Most Likely Yes	83.1%	182
I Am Not Sure	6.6%	12
Probably Not	3.0%	7
Definitely Not	6.6%	12

answered question 183
skipped question 28

Web Survey – Local Bike Route on a Residential Road

- Residential or local road that is 2 lane road, 25 mph and may include short connecting pathways
- Routes includes wayfinding signage to near-by destinations
- 74% would be comfortable riding a bike on a Local Bike Route on a Residential Road



2. Would you be comfortable riding a bike on a Local Bike Route on a Residential Road?

	Response Percent	Response Count
Most Likely Yes	74.0%	124
I Am Not Sure	13.3%	24
Probably Not	5.0%	9
Definitely Not	7.7%	14

answered question 181
skipped question 32

Web Survey – Bike Lane on a Minor Road

- Travel lane dedicated to bicycle travel that are at least 5' wide where bicycle travel the same direction as motor vehicle traffic
 - 2 to 3 lane road
 - 35 mph
 - few trucks
- 50% would be comfortable riding a bike in a Bike Lane on a Minor Road



3. Would you be comfortable riding a bike in a Bike Lane on a Minor Road?

	Response Percent	Response Count
Most Likely Yes	50.8%	88
I Am Not Sure	24.3%	44
Probably Not	12.2%	22
Definitely Not	12.7%	23

answered question 181
skipped question 32

Web Survey – Bike Lane on a Major Road

- Travel lane dedicated to bicycle travel that are at least 5' wide where bicycle travel the same direction as motor vehicle traffic
 - 4 to 5 lane road
 - 45 mph or greater
 - Truck traffic
- 32% would be comfortable riding a bike in a Bike Lane on a Major Road



4. Would you be comfortable riding a bike in a Bike Lane on a Major Road?

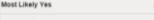
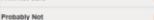
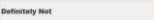
	Response Percent	Response Count
Most Likely Yes	32.0%	58
I Am Not Sure	22.1%	40
Probably Not	22.1%	40
Definitely Not	23.0%	43

answered question 181
skipped question 32

Web Survey – Regional Bike Route on Rural Road

- Bike Routes that is designated with signage where bicyclist ride in the roadway with the flow of traffic
 - 2 lanes
 - 45 to 55 mph
 - No paved shoulder
- 21 % would be comfortable riding a bike on a Regional Bike Route on a Rural Road



1. Would you be comfortable riding a bike on a Regional Bike Route on a Rural Road?		Response Percent	Response Count
Most Likely Yes		21.0%	38
I Am Not Sure		33.3%	42
Probably Not		33.3%	42
Definitely Not		32.8%	59
answered question			181
skipped question			32

Web Survey – Roadside Pathways

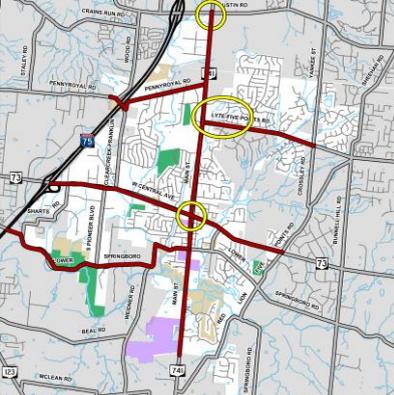
- 48.7% of respondents are uncomfortable or somewhat uncomfortable on a roadside pathway with frequent intersecting driveways and/or roadways
- 46.8% of respondents are uncomfortable or somewhat uncomfortable on a roadside pathway when the pathway is right next to the roadway

28. What is your comfort level using a roadside pathway in the following contexts:

	Uncomfortable	Somewhat Uncomfortable	Somewhat Comfortable	Comfortable	Not Applicable or Not Sure	Response Count
With frequent intersecting driveways and/or roadways	15.2% (82)	33.5% (181)	26.8% (145)	21.3% (115)	3.3% (18)	541
When the pathway is right next to the roadway	19.6% (105)	27.2% (146)	24.3% (130)	25.9% (139)	3.0% (16)	536
When there is a strip of grass between the road and pathway	2.0% (11)	6.9% (37)	18.2% (98)	69.1% (372)	3.7% (20)	538
When there is a strip of grass and trees between the road and pathway	3.0% (16)	4.9% (26)	9.9% (53)	77.9% (417)	4.3% (23)	535
					answered question	542
					skipped question	177

Web Survey – Places of Concern

- Lyle Five Points
 - Sidewalk Gaps
 - Bike Lanes
 - Road Crossings
- SR 73
 - Sidewalk Gaps
 - Safety
 - Bicycle and Pedestrian Friendly
- SR 741
 - Road Crossings
 - Intersections
 - Traffic
 - Sidewalk
 - Conflicting comments regarding existing bike lanes
- Lower Springboro Road
 - Dangerous, Narrow Road
- Pennyroyal
 - Bike facilities and sidewalks
- Intersection of SR 741 and SR 73
- Intersection SR 741 and Austin Road
- Settlers Walk Area needs safer road crossings



Understanding the System User

- Before the first workshop you now have a good idea of
 - Where people want to walk and bike
 - What type of facilities will attract new users
 - General potential for mode shift
 - What are the specific places and areas that need attention
- We also typically address a number of other issues in the survey



Most importantly, we have shown that there is not one ultimate solution that will work for all bicyclists

Anatomy of a Bicycle and Pedestrian Network

- Primary Roads
 - Some more auto centric corridors
 - Others more bicycle & pedestrian centric corridors
- Neighborhood Connectors
 - Local roads
 - Short connecting pathways
- Off-Road Trails
 - From dirt foot trails to paved shared use trails
- Each has its own GIS

Spectrum of Non-motorized Routes

PRIMARY LINKS	NEIGHBORHOOD CONNECTORS	OFF-ROAD TRAILS
<p>SPECIAL FACILITIES SYSTEM</p> <p>Complete Streets that may include the following:</p> <ul style="list-style-type: none"> Bike Lanes & Sidewalks Subways Shared Shoulders Planar/grade Adjustments Road Crossing Improvements 	<p>Complete Streets that may include the following:</p> <ul style="list-style-type: none"> Guided Routes Shared Routes Bike and Pedestrian Boulevards Neighborhood Endpoints Crossing Improvements where Neighborhood Connectors Intersect Primary Roadways 	<ul style="list-style-type: none"> Foot Trails Suburban/Urban Trails Half-Suburban Trails Road Crossing Improvements where Trails Intersect Primary Roadways
<p>CONNECTOR AREAS</p> <ul style="list-style-type: none"> Urban and suburban local and residential roads Connecting pathways through neighborhood parks and streets Provide alternative routes to busy Primary Links Rural corridors typically have shared shoulders 	<ul style="list-style-type: none"> Urban and suburban local and residential roads Connecting pathways through neighborhood parks and streets Provide alternative routes to busy Primary Links 	<ul style="list-style-type: none"> Water parks Recreation areas Abandoned rail corridors Active rail corridors Recreation corridors
<p>TRAIL CHARACTERISTICS</p> <ul style="list-style-type: none"> Daily transportation to work and for personal business Use of daily transportation, Safe Routes to School and other to/from recreation 	<ul style="list-style-type: none"> Use of daily transportation, Safe Routes to School and other to/from recreation Use depends on location Recreation destination 	
<p>TRAIL CHARACTERISTICS</p> <ul style="list-style-type: none"> Users typically aggregated into mode specific facilities such as sidewalks and bike lanes Exposure to high speed and high volume of motorized vehicle traffic Use as direct a part of travel as using a motor vehicle 	<ul style="list-style-type: none"> Users of a shared space, sidewalks may or may not be present Exposure to high speed and high volume of motorized vehicle traffic In some cases travel via neighborhood connectors may be longer than the same trip via primary links 	<ul style="list-style-type: none"> Non-motorized users separated from motorized vehicle traffic Exposure to high speed and high volume of motorized traffic at various crossings Segments of trail depend on the route and other resources it connects

Anatomy of a Bicycle and Pedestrian Network

- Provide a system that works for a variety of user types under a number of different circumstances
 - Get to work quickly
 - Independent mobility for a 12 year old
- Wayfinding is key for neighborhood connector routes to work well



Burgh Historical Park 1.5

Primary Road Database Conventions

- Use road centerline data for all improvements within a road ROW
- Tie to standard road referencing systems
- Use right side / left side based on line direction to record things like sidewalks
- This permits mapping sidewalks at a number of scales
- Typically use state or regional base data so we can look beyond municipal boundaries



For network planning what is important is that there is a path along side the road, the nature of the setback, the width of the path and how many driveways it crosses. The exact location of the centerline does not matter

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Off-Road Trail Database Conventions

- Housed in a separate layer from the roadways
- Depth of information collected depends on the budget
- Need to at least address function – is it a true shared-use path or just a local trail or walkway?



Not all shared-use paths will function the same in a transportation network

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Intersection Database Conventions

- Point based
- Generally different databases for signalized vs. un-signalized intersections
- May be just as simple as identifying a crosswalk opportunity
- May want to collect some qualitative information – difficult to know where to stop in that regard

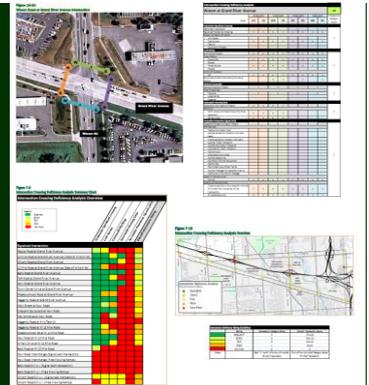


Setting up a database for an intersection can be rather complex

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Tying GIS into Other Databases

- Some items like ADA assessments for crosswalks, a different database approach is likely warranted
- May choose to have the summary assessment in a mapable format
- Needless to say, this can get very labor intensive and expensive in a hurry



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Cost Benefit

- Always ask – did we really use the data
- The inventory should be proportional to the recommendations
 - Avoid analysis paralysis
 - Don't do detailed inventory on local roads
- Focus on those things that can be changed
 - Will the surface condition effect your road recommendations or just the phasing of your recommendations?



Some clients / projects want a high level of analysis to help prioritize projects, others are more focused on public input

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Near-term Bike Lane via Lane Narrowing

- Provides a good perspective on the low hanging fruit
- Should cross reference with NFC, truck routes and bus routes



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Near-term Bike Lane via 4 to 3 Lane Conversion

- Other issues to consider are the number and nature of signalized intersections

Rating	ADT
A - High Potential	<15,000
B - Moderate Potential	15,000-17,500
C - Marginal Potential	17,500-20,000
D - Low Potential	20,000+

Potential Roadway Conversions

- Composite map – often add this information to visioning workshop maps so people can understand what is possible
- May have other conversion options

- Lane Narrowing or 4 to 3 Lane Conversion
- Reconfiguration of On-Street Parking
- Traffic Lane/Parking Lane Elimination
- Existing Bike Lane

* No Potential Roadway Conversions on Far East End of the City

Slopes

- Can be a significant issue in some places
- My have different solution on the downhill vs. the uphill side of the same street

% Grade
20.0000
12.0000
8.3300
4.0000

Mapping Context

- The existing and future context will inform a transportation project's design
- For long-life projects like road reconstruction and bridges must look 25+ years ahead

LANDSCAPE TYPES:

- Downtown
- Commercial Strip
- Campus
- General Urban
- Rural Agricultural
- Rural Residential
- Suburban
- Suburban Fringe/Transitional

In-Road Bicycle Quality of Service

- General picture of the existing conditions
- Helps determine where things are needed the most

Without Bike Lane	With Bike Lane	ADT	Speed Limit
A	A	0-5,000	25
B	A	5,000-10,000	30
C	B	10,000-15,000	35
D	C	15,000-20,000	40
E	C	20,000-25,000	45
F	D	25,000-30,000	50
G	D	over 35,000	50

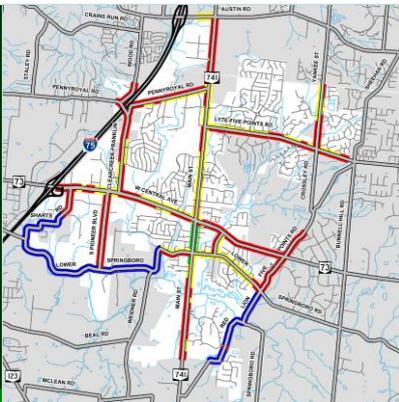
Sidewalk Quality of Service

A – Facility with Vertical Buffer
B – Facility with Buffer
C – Facility along Curb
D – No Facility, but Passable
E – No Facility, Not Passable

Focuses on issues we can change rather than issues mostly out of our control such as traffic volume and percent truck traffic

Sidewalk Quality of Service

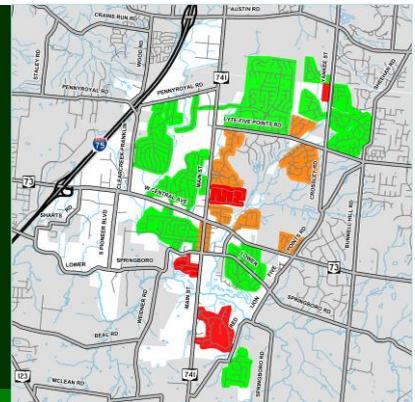
- Quantitative and Qualitative
- Can use to determine where we need to add street trees
- Also can use to see where a bike lane could help pedestrian comfort



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Neighborhood Sidewalk Coverage

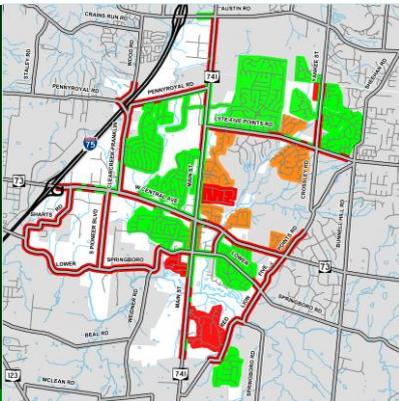
- Generally can not afford to do sidewalk inventory for all local roads



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Sidewalk Connectivity

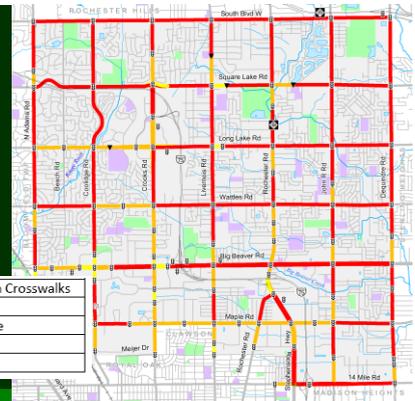
- Simple view of easy or difficult it would be to get from the middle of a neighborhood to any other part of town
- Could add crosswalks to be an even better idea



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Crosswalk Spacing Analysis

- Needs to be contrasted with demand to be effective
- There may be places where long distance between crosswalks is OK



Rating	Distance between Crosswalks
A	0 to 1/8 Mile
B	1/8 Mile to 1/4 Mile
C	1/4 Mile to 1/2 Mile
D	Over 1/2 Mile

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Road Crossing Difficulty Assessment

- Begins to lead towards what type of crossing improvements may be appropriate



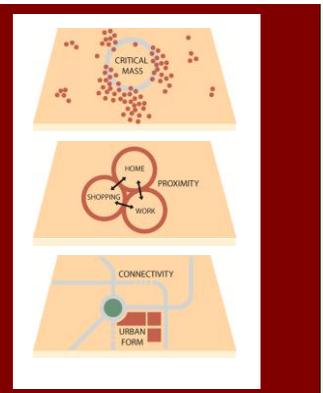
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Rating	Lanes	ADT	Speed Limit
A	2	0-5,000	<30
B	3	5,000-10,000	30
C	4	10,000-15,000	35
D	5	15,000-20,000	40
E	6	20,000+	45+

*Select most restrictive

Determining Relative Demand

- Research has shown that urban form influences mode choice and total miles traveled
- The most important factors are:
 - Population Density
 - Land Use Diversity
 - Street Network
- But other factors come into play including:
 - Special generators
 - Job density
 - Transit



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Relative Demand Analysis

- Using a grid analysis we assign values:
 - Population density
 - Land Use Diversity
 - Activity Generators
 - Connectivity
 - Transit Routes
- Take into account surrounding cells by an inverse distance weighting calculation

Relative Demand Score (Local Comparison)

- High Demand
- Moderate Demand
- Medium Demand
- Low Demand
- Very Low Demand

Relative Demand Analysis

- Good for contrast deficiency analysis with relative demand
- But costly to prepare
- Does not really address network
- Generally, not worth the time

Relative Demand

- High Demand
- Moderate Demand
- Medium Demand
- Low Demand
- Very Low Demand

Intersection Deficiency Analysis

Overall Intersection Rating

- Excellent
- Good
- Fair
- Poor
- Very Poor

Other Options

- In addition to web survey findings, mapping out:
 - employment,
 - population density
 - land use
 - Crashes
 - Transit
 may be sufficient

Jobs

- 200 and over
- 100 to 200
- 50 to 100
- 1 to 50

Block Size Analysis

- The "grain" of the urban fabric is key
- Our favorite analysis
- Can see travel impediments

Rating

Block Size in Acres

- A 0 to 15 Acres
- B 15 to 50 Acres
- C 50 to 100 Acres
- D Over 100 Acres

Sidepath Suitability Analysis

- Can be a controversial analysis
- May be better to just place dots at the conflict points

Grade

Minor Driveways

- A 0
- B 0-20
- C 21-30
- D 31+

Major Driveways

- 1-2
- 3
- Or combo of both not exceed score of 2
- Or combo of both not exceed score of 3
- Or combo of both not exceed score of 4

Neighborhood Connector Route Identification

- Do this the old fashioned way, we sketch some preliminary ideas in and then refine with the public
- Use low volume, low speed local roads
- Combine with trails and neighborhood pathways
- Look for options where it would be more convenient to bike than drive
- Ground truth

Existing Trail

Proposed Trails

Proposed Neighborhood Connector Route

Coordinate with Road Crossing Improvements

- Provide safe ways to cross busy roads between signals
- Solutions depend on road crossing difficulty
- Coordinate neighborhood connector routes, transit and crossing locations



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Prioritize Neighborhood Connector Routes

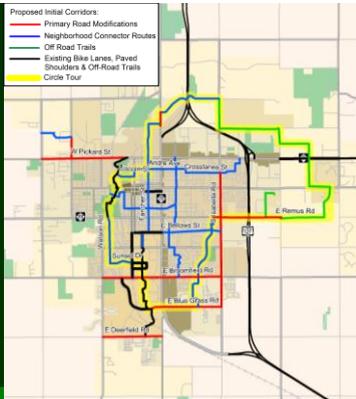
- Connect key cultural destinations
- The priority route may be an urban greenway
- Think community branding and tourism
- By providing Active Transportation Hubs at key locations may be able to attract a new demographic
- Think funding



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Initial Primary Corridors – Completed System

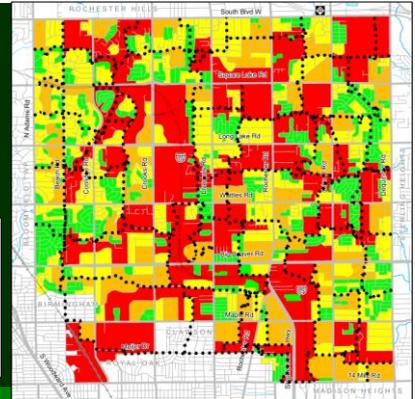
- Provide neighborhood connectors that link into the priority route
- Expand system with improvements to primary road system
- Link into regional trails and bike routes



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Improving Block Size

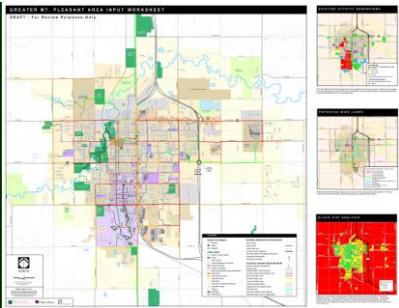
- Cross check routes
 - Reducing block size
 - Linking destinations
 - Solving safety issues



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Public Engagement – Workshop Visioning Maps

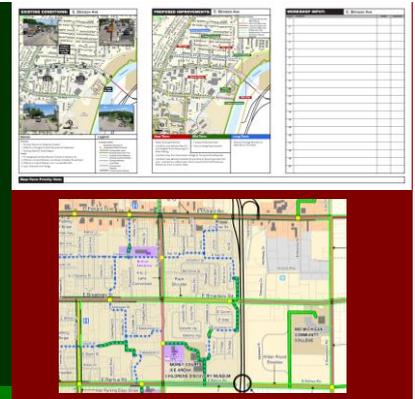
- A delicate balancing act of providing information to participants but not overwhelming them
- Illustrate what is possible and provide enough context so they can show what is desirable
- Use directed exercises



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Public Engagement – Preliminary Plan Workshop Maps

- Show public input from the previous meeting informed the draft proposals
- Provide ways to both make informed comments on proposals but also to reach consensus



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Documenting Plans

- At the end of the day you will need to present a compelling vision
 - Report maps
 - Summary posters
 - Websites
 - Google Earth



Most importantly, freely share your data

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Questions or Comments



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