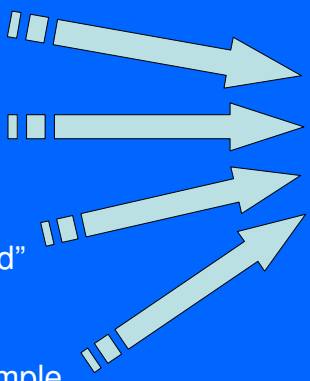
Bikeways Project
Final Presentation

Geography 364: Advanced GIS
Macalester College, St. Paul
April 20th, 2006

Objectives

- Consolidation
- Simplification/ Clarification
- Expansion of "underdeveloped" sections
- Collection of sample data



Creation of a *Manual* for the collection of MN bikeways data

Collection of Sample Data, "Testing" of the Manual

Perspective During Creation of Manual

3 distinct “Audiences”:

- Data Collectors: volunteers, laypersons (vernacular)
- Data Processors: GIS technician (easy-to-process Excel table)
- End Product Users: general public

Process

1) Decided to focus on Mac-Groveland neighborhood – an area we know well
2) Analyzed metadata, consolidated into general “attribute groups” for individuals or partners to focus on
3) Gathered sample data; expanded, clarified, simplified attributes
4) Drafted Manual sections describing the attributes and how to collect them
5) Continued to update, edit Manual

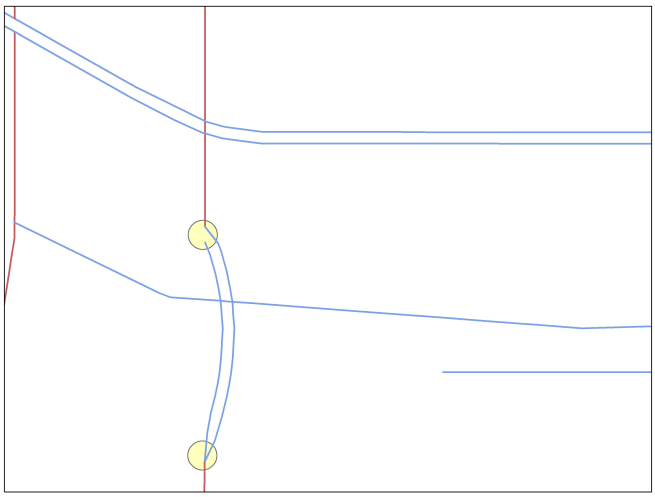
Outline of Presentation

- Presentation will follow order of Manual
  - Location, Name, Type, Active
  - Surface Quality
  - Suitability
  - Grade
  - Amenities on Recreational Bikeways
- Conclusion: Further Applications

Name, Segment, Type & Active

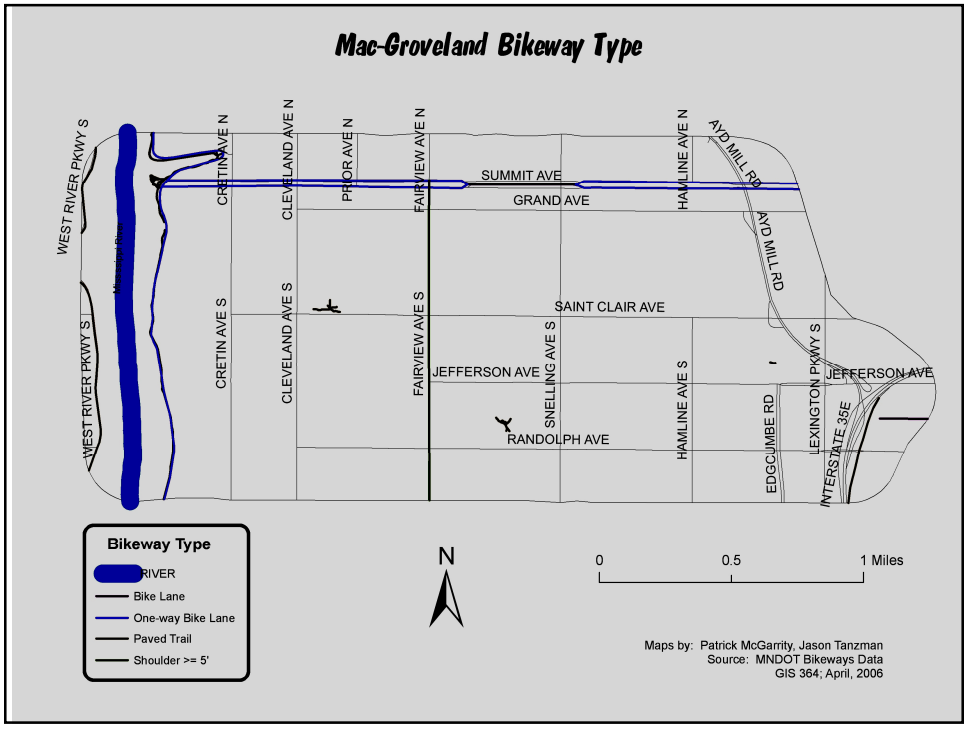
By Jason Tanzman and Patrick McGarrity

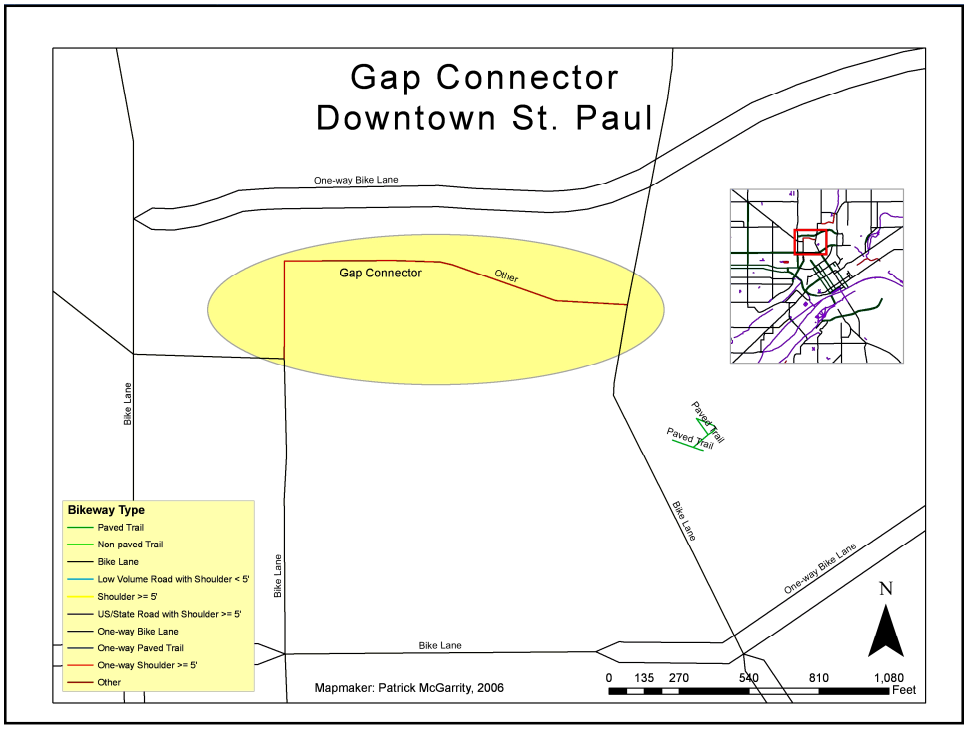
Bikeway Segments

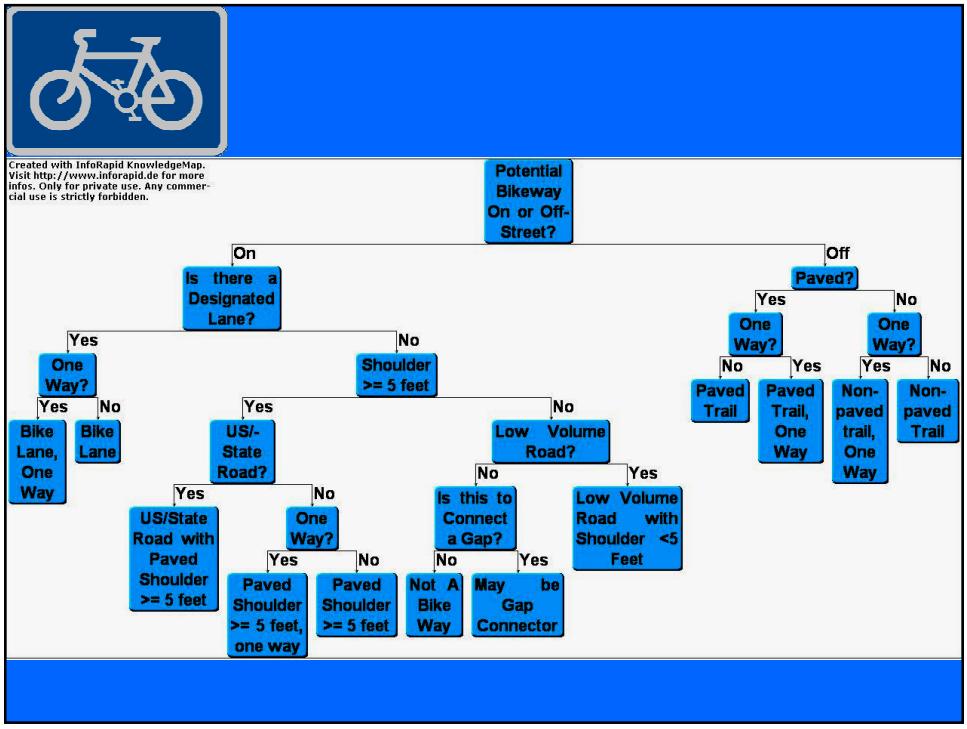


Name

Old Attribute	Old Definition	New Attribute	New Definition
Paved Trail	Paved, off-street, 8 feet or more in width.	Paved Trail	These bikeways consist of paved trails *off of city streets* …
Non-paved Trail	Off-street, 8 feet or more in width …	Non-paved Trail	These bikeways are unpaved trails …
Bike Lane	On-street, designated, 4 feet or more in width…	Bike Lane	These bikeways are on-street, are 4 feet or more in width…
Paved Shoulder >= 5 feet	Paved, 5 feet to 8 feet in width…	Paved Shoulder >= 5 Feet	These bikeways are paved and have a width of 5 to 8 feet…
Low Volume Road with Shoulder < 5 feet	County roads only, 1000 AADT or less…	Low Volume Road with Shoulder < 5 Feet	These bikeways include only *County roads* with a traffic volume of 1000 AADT or less…
US/State Road with Paved Shoulder >= 5 feet	Mn/DOT roads only, 10,000 AADT or less…	US/State Road with Paved Shoulder >= 5 Feet	These bikeways include only *MN/DOT roads* with a traffic volume of …
Paved Trail, one way direction	One-way. Paved, off-street…	Paved Trail, One-Way Direction	These bikeways must be one-way, paved, off-street,…
Non-paved Trail, one way direction	One-way. Off-street, 8 feet or more in width…	Non-paved Trail, One-Way Direction	These bikeways are one-way, unpaved…
Bike Lane, one way direction	One-way. On-street, designated, 4 feet …	Bike Lane, One-Way Direction	These bikeways are one-way, on-street…
Paved Shoulder >= 5 feet, one way direction	One-way. Paved shoulder 5 feet to 8 feet in width…	Paved Shoulder >= 5 Feet, One-Way Direction	These bikeways are one-way, paved…
Other	NA	Other	Bikeways that do not fit into any of the above categories....
NA	NA	Gap Filler	These bikeways consist of relatively short segments used to connect official bikeways…
Low Volume Road with Paved Shoulder < 5 feet, one way direction	County roads only, 1000 AADT or less. One-way. Road with paved shoulder…	NA (Deleted – deemed unnecessary)	NA
US/State Road with Paved Shoulder >= 5 feet, one way direction	Mn/DOT roads only, 10,000 AADT or less. One-way. Paved shoulder	NA (Deleted – deemed unnecessary)	NA
Sub-Standard		NA (Deleted – deemed unnecessary)	NA



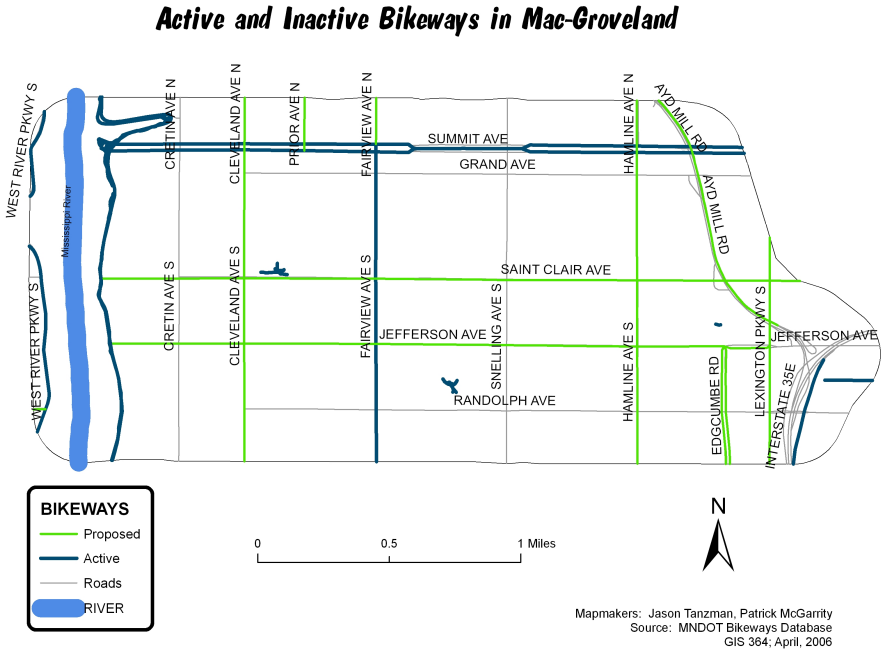

Gap Connector
Downtown St. Paul
One-way Bike Lane
Gap Connector
Other
Bike Lane
Paved Trail
Paved Trail
Bike Lane
One-way Bike Lane
Bike Lane
Bike Lane
Bikeway Type
Paved Trail
Non paved Trail
Bike Lane
Low Volume Road with Shoulder < 5'
Shoulder >= 5'
US/State Road with Shoulder >= 5'
One-way Bike Lane
One-way Paved Trail
One-way Shoulder >= 5'
Other
N
Mapmaker: Patrick McGarrity, 2006
0 135 270 540 810 1,080
Feet


Created with InfoRapid KnowledgeMap.
Visit http://www.inforapid.de for more infos. Only for private use. Any commercial use is strictly forbidden.
Potential Bikeway On or Off-Street?
On
Is there a Designated Lane?
Yes
One Way?
Yes
Bike Lane, One Way
No
Bike Lane
No
Shoulder >= 5 feet
Yes
US/-State Road?
Yes
US/State Road with Paved Shoulder >= 5 feet
No
One Way?
Yes
Paved Shoulder >= 5 feet, one way
No
Paved Shoulder >= 5 feet
No
Low Volume Road?
No
Is this to Connect a Gap?
No
Not A Bike Way
Yes
May be Gap Connector
Yes
Low Volume Road with Shoulder <5 Feet
Off
Paved?
Yes
One Way?
No
Paved Trail
Yes
Paved Trail, One Way
No
One Way?
Yes
Non-paved trail, One Way
No
Non-paved Trail

Crosswalk for “Active” Attribute

Old Attribute	Old Definition	Old Field Length	Old Field Type	New Attribute	New Definition	New Field Length	New Field Type
ACTIVE	0 = FALSE – proposed/planned trail 1 = TRUE – existing trail	1	SHORT INTEGER	Active	Y = Yes, the Bikeway is active N = No, it is a proposed Bikeway	1	STRING

- Proposed by whom?
- How would an organization using this guide seek out information on non-active bikeways?
- To which groups/organizations is data on proposed bikeways relevant?



Problems & Issues

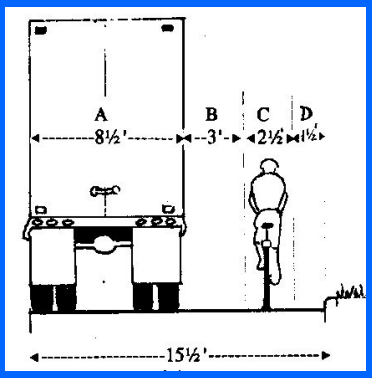
- Value of Proposed Bikeways
- "Other" type
- Bridges
- Gap Connectors

Surface Attributes

- **SHLD_TYPE**
- **SHLD_RUMB**
- **SHLD_DRAIN**

Surface Use Attributes:

- **SHLD_BUS**
- **SHLD_PK**
- **SHLD_PW**



http://www.webs1.uidaho.edu/niatt_labmanual/Chapters/roadwaydesign/theoryandconcepts/ImageFiles/BikeLane.jpg

Surface Quality/1

Surface Attributes Crosswalk

Old Attribute	Definition	New Attribute	Definition
SHLD-TYPE	Shoulder surface type ex. none, aggregate, bituminous	Surface Type	Material used for bike lane (not specifically the shoulder) ex. Dirt, concrete, asphalt, crushed rock, gravel, Mtn bike trail
SHLD-RUMB	Shoulder rumble stripped (Y or N)	Shoulder Rumble Strip	Shoulder rumble stripped (Y or N)
SHLD-PARK SHLD-BUS Notes in SOURCE_KEY	Motor vehicle parking ex. Unrestricted, No Parking – Anytime Shoulder bus only (Y or N) NA	Shoulder Usage: Parking Bus Plowed	Motor vehicle parking allowed (Y or N) Bikeway utilized by buses (Y or N) Plowed (Y or N)
NA	NA	Shoulder Drain-gutter	Drain gutter present (Y or N)

Surface Quality/2

SHLD_TYPE

- Shoulder Type: A categorical attribute describing the material used for the bikeway surface
  - Concrete
  - Asphalt*
  - Crushed Rock
  - Gravel
  - Dirt
  - Mt. Bike trail

Surface Quality/3

SHLD_RUMB

- Shoulder Rumble: A binomial attribute answering the question-Is there a rumble strip in the bikeway?
  - Yes (Y/1)
  - No (N/0)

Surface Quality/4

SHLD_DRAIN

- Shoulder Drain-Gutter: A binomial attribute answering the question – Is there a drain-gutter in the bike lane?
  - Yes (Y/1)
  - No (N/0)

Surface Quality/5

SHLD_BUS

- Shoulder Bus: A binomial attribute answering the question – Is the bike lane also designated for bus use?
  - Yes (Y/1)
  - No (N/0)

Surface Quality/6

SHLD_PK

- Shoulder Parking: A binomial attribute answering the question – Is the bikelane also designated for on-street parking?
  - Yes (Y/1)
  - No (N/0)

Surface Quality/7

SHLD_PW

- Shoulder Plow: A binomial attribute answering the question – Is the bikeway plowed during the winter?
  - Yes (Y/1)
  - No (N/0)

Surface Quality/8

Suggested Attributes

- SHLD_DATE: Shoulder date – the date of creation/last resurfacing of the bikeway. (DD/MM/YY)

  -No references, contact Bob Works at MNDot or your local transportation department

Surface Quality/9

Data Collection Sheet

Surface Type Dirt ___ Concrete ___ Asphalt ___

Gravel __ Crushed Rock ___ (Mountain Bike Trail) ___

Shoulder Rumble Stripping Yes ___ No ___

Shoulder Usage

On-street Parking Yes ___ No ___
Bus Use Yes ___ No ___
Plowed Yes ___ No ___

Shoulder Drainage Yes ___ No ___

Creation Date (and/or Resurfacing Date)* _____ Creation Date _____ Resurfacing Date

Pavement Condition Rating 1 ___ 2___ 3___ 4___ 5___

Surface Quality/10

Mac-Groveland

NAME	SUR_TYPE	SHLD_RUMB	SHLD_BUS	SHLD_PK	SHLD_PW	SHLD_DRAIN	*DATE_CR
Summit Ave	asphalt	N	N	Y		N	
Fairview Ave S	asphalt	N	N	N		N	
River Rd	asphalt	N	N	N		Y	
Grand Ave	asphalt	N	Y	Y		Y	
Saint Clair Ave	asphalt	N	Y	Y		N	
Jefferson Ave	asphalt	N	N	Y		Y	
Randolph Ave	asphalt	N	Y	Y		Y	
Cretin Ave S	asphalt	N	Y	Y		Y	
Cleveland Ave S	asphalt	N	Y	N		N	
Prior Ave N	asphalt	N	N	Y		N	
Snelling Ave S	asphalt	N	Y	Y		Y	
Hamline Ave S	asphalt	N	N	Y		Y	
Edgecumbe Rd	asphalt	N	N	Y		N	
Ayd Mill Rd	asphalt	N	N	N		N	
Lexington Parkway S	asphalt	N	N	Y		N	

Surface Quality/11

The Bicycle Level of Service Model

- Published in *Transportation Research Record 1578* by the Transportation Research Board of the National Academy of Sciences, 1997
- Anchorage AK, Arlington TX, Baltimore MD, Birmingham AL, Buffalo NY, Houston TX, Philadelphia PA, DelDOT, NYDOT, MeDOT
- Extensive guidance has come from Ed Barsotti, Executive Director of the League of Illinois Bicyclists

The Formula

- **BLOS = 0.507 ln(Vol_{15}/L_n) + 0.199 SP_t $(1+10.38HV)^2$ + 7.066$(1/PR_5)^2$ - 0.005 W_e^2 + 0.760**

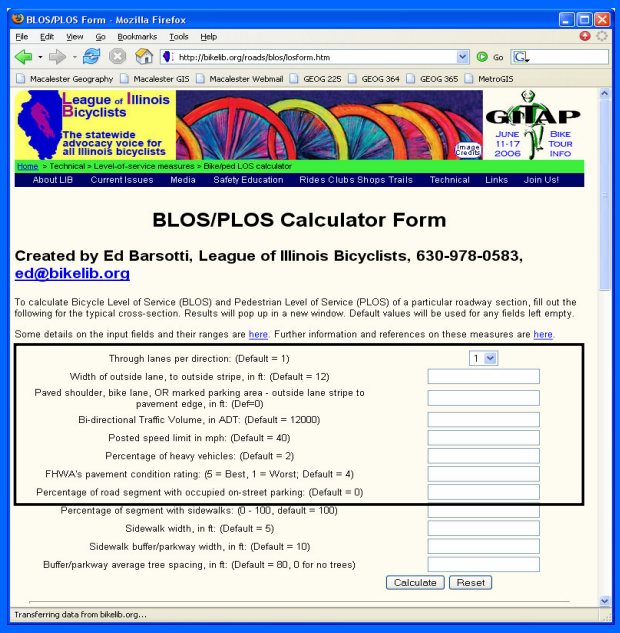
- Vol_{15} = volume of directional traffic in 15 minutes = (AADT * D * Kd) / (4 * PHF)
  - AADT = Annual Average Daily Traffic on the segment
  - D = Directional Factor
  - K_d = Peak to Daily Factor
  - PHF = Peak Hour Factor

  L_n = number of directional through lanes
  SP_t = effective speed limit = 1.1199 ln(SP_p-20) + 0.8103, where SP_p is the posted speed limit
  HV = percentage of heavy vehicles
  PR_5 = FHWA's 5-point pavement surface condition rating (5=best)
  W_e = average effective width of outside through lane:
  - $W_e = W_v$ - (10' * OSPA) when $W_t = 0$
  - $W_e = W_v$ + WI (1 - 2 * OSPA) when $W_t > 0$ & $W_{ps} = 0$
  - $W_e = W_v + W_t$ - 2 (10' * OSPA) when $W_t > 0$, $W_{ps} > 0$, and a bike lane exists.

  W_t = total width of outside lane (and shoulder) pavement
  OSPA = fraction of segment with occupied on-street parking
  W_t = width of paving between outside lane stripe and edge of pavement
  W_{ps} = width of pavement striped for on-street parking
  W_v = effective width as a function of traffic volume
  - $W_v = W_t$ if AADT>4000 veh/day
  - $W_v = W_t$ (2 - (AADT/4000)) if AADT<4000 and road is undivided and unstriped.

- Formula from "The Road Network is the Bicycle Network: Bicycle Suitability Measures for Roadways and Sidepaths" by Ed Barsotti. http://bikelib.org/roads/roadnet.htm

Existing Resources



http://bikelib.org/roads/blos/losform.htm

Attributes Used in the Model

Proposed Attribute	Old Definition	Old Field Length	Old Field Type	New Attribute	New Definition	New Field Length	New Field Type
Road_Peak Road_Off	Traffic volume peak and off peak	?	Long Integer	Road_AADT	Bi-Directional annual average daily traffic	5	Long Integer
Road_Speed	Road speed limit in mph	2	Short Integer	Same attribute used			
Lane_Numb	Number of lanes	1	Short Integer	Lane_Numb	Number of lanes on roadway segment, both directions	1	Short Integer
Lane_Width	Width of traffic lane, in feet	3	Short Integer	Lane_Width	Width from outside lane to pavement edge, in feet. Include width of right-most lane and striped paved shoulders, bike lanes, or striped parking	3	Short Integer

Proposed Attribute	Old Definition	Old Field Length	Old Field Type	New Attribute	New Definition	New Field Length	New Field Type
Shld_Width	Shoulder width	?	Float	Shld_Width	Paved shoulder, bike lane, or marked parking area, outside lane stripe to pavement edge, in feet. Besides a paved shoulder or a bike lane, this width may also be or include marked parking spots	3	Float
Shld_Park	Shoulder motor vehicle parking, e.g. Unrestricted, No Parking, etc.	24	String	Shld_Park	Percentage of road segment with occupied on-street parking	2	Short Integer
Road_Comm	Heavy Commercial Traffic (Y or N)	1	String	Road_HAADT	Pecentage of AADT which is Heavy Commercial AADT	2	Float
None Proposed				Park_Width	Width of pavement striped for on-street parking, in feet	3	Float

Suitability / 5

Proposed Attribute	Old Definition	Old Field Length	Old Field Type	New Attribute	New Definition	New Field Length	New Field Type
None Proposed				Pave_Cond	The FHWA's pavement condition rating from 1(poor) to 5(new). If this data is not available to you, you can make a judgment call using FHWA's Present Serviceability Rating system (referenced in the manual)	1	Short Integer
None Proposed				BLOS_Score	Based on roadway attributes, suitability rates from A-F	1 Set up as domain in geodatabase	String

Suitability / 6

Data Collection

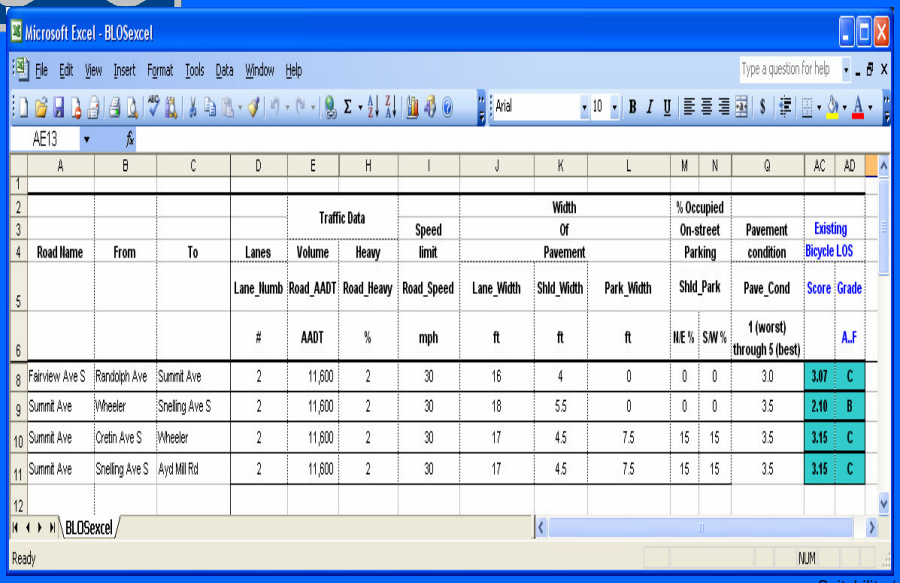
- Determining on-street parking from DEMs
- Using traffic volume data of comparable roads, when none is available
- Constants Used

  K = The normal peak hour volume for both directions of travel divided by the AADT. Normal ranges are from 6-18%.

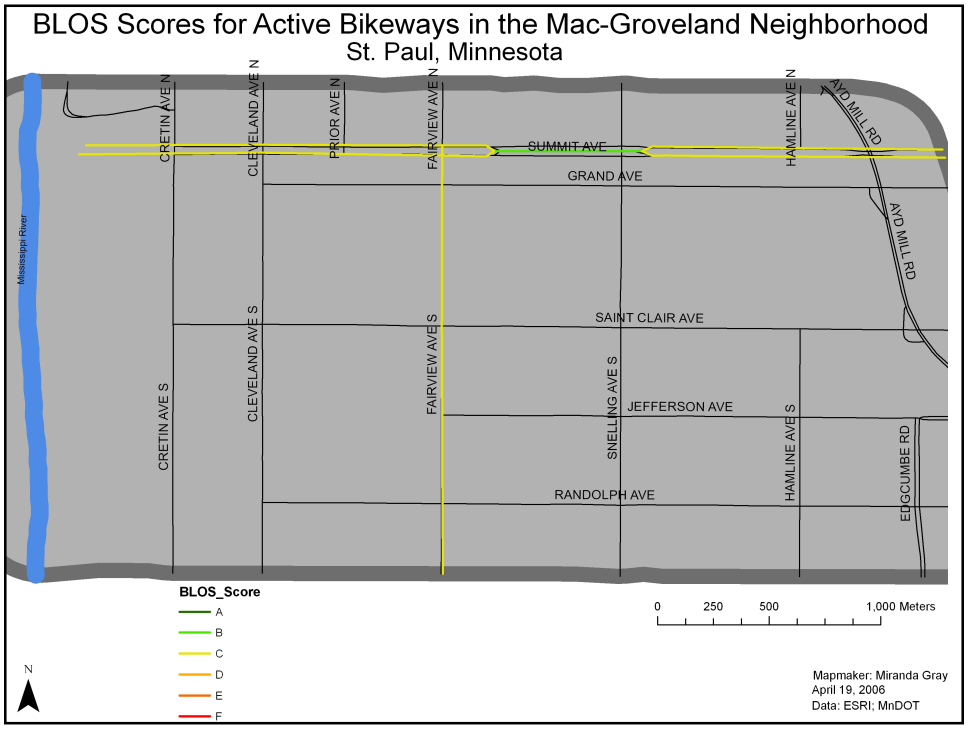
  D = Directional Factor

  (Information from the Southern California Association of Governments, http://www.scag.ca.gov)

Calculating the BLOS



	Road Name	From	To	Lanes	Volume	Heavy	Speed limit	Lane_Width	Shld_Width	Park_Width	Shld_Park	Pave_Cond	Score	Grade
				Lane_Numb	Road_AADT	Road_Heavy	Road_Speed							
				#	AADT	%	mph	ft	ft	ft	N/E %	S/W %	1 (worst) through 5 (best)		A..F
8	Fairview Ave S	Randolph Ave	Summit Ave	2	11,600	2	30	16	4	0	0	0	3.0	3.07	C
9	Summit Ave	Wheeler	Snelling Ave S	2	11,600	2	30	18	5.5	0	0	0	3.5	2.10	B
10	Summit Ave	Cretin Ave S	Wheeler	2	11,600	2	30	17	4.5	7.5	15	15	3.5	3.15	C
11	Summit Ave	Snelling Ave S	Ayd Mill Rd	2	11,600	2	30	17	4.5	7.5	15	15	3.5	3.15	C


BLOS Scores for Active Bikeways in the Mac-Groveland Neighborhood
St. Paul, Minnesota
CRETIN AVE N
CLEVELAND AVE N
PRIOR AVE N
FAIRVIEW AVE N
HAMLINE AVE N
AYD MILL RD
SUMMIT AVE
GRAND AVE
Mississippi River
SAINT CLAIR AVE
CRETIN AVE S
CLEVELAND AVE S
FAIRVIEW AVE S
SNELLING AVE S
JEFFERSON AVE
HAMLINE AVE S
EDGCUMBE RD
RANDOLPH AVE
BLOS_Score
A
B
C
D
E
F
0 250 500 1,000 Meters
N
Mapmaker: Miranda Gray
April 19, 2006
Data: ESRI; MnDOT

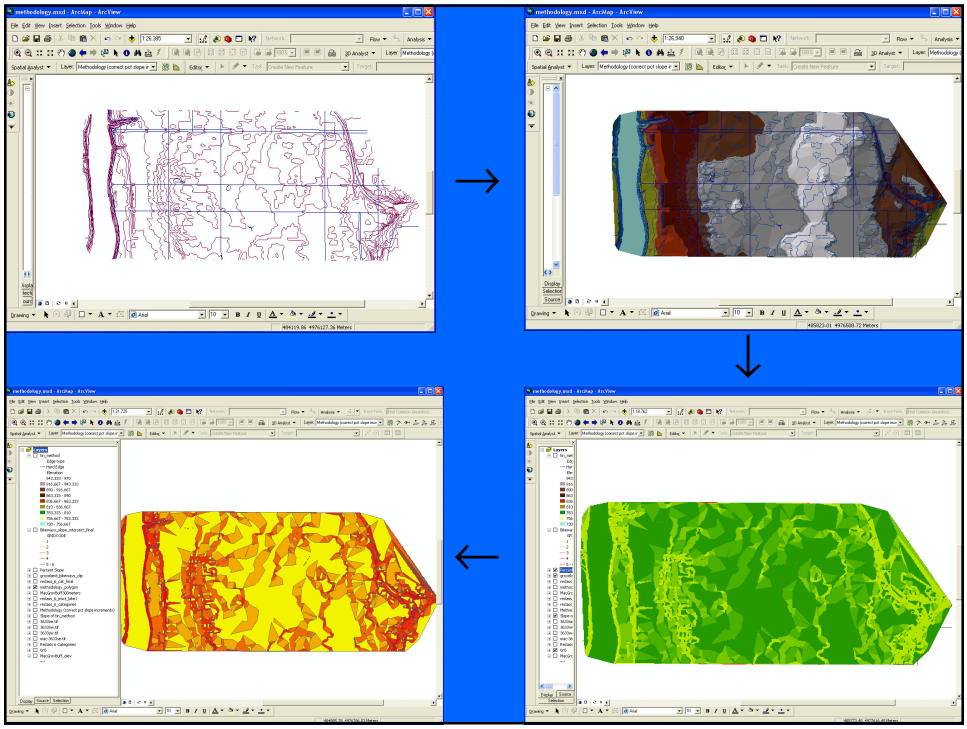

Gradient
GRADE STEEPENS
2 MILES
Gradient (1)

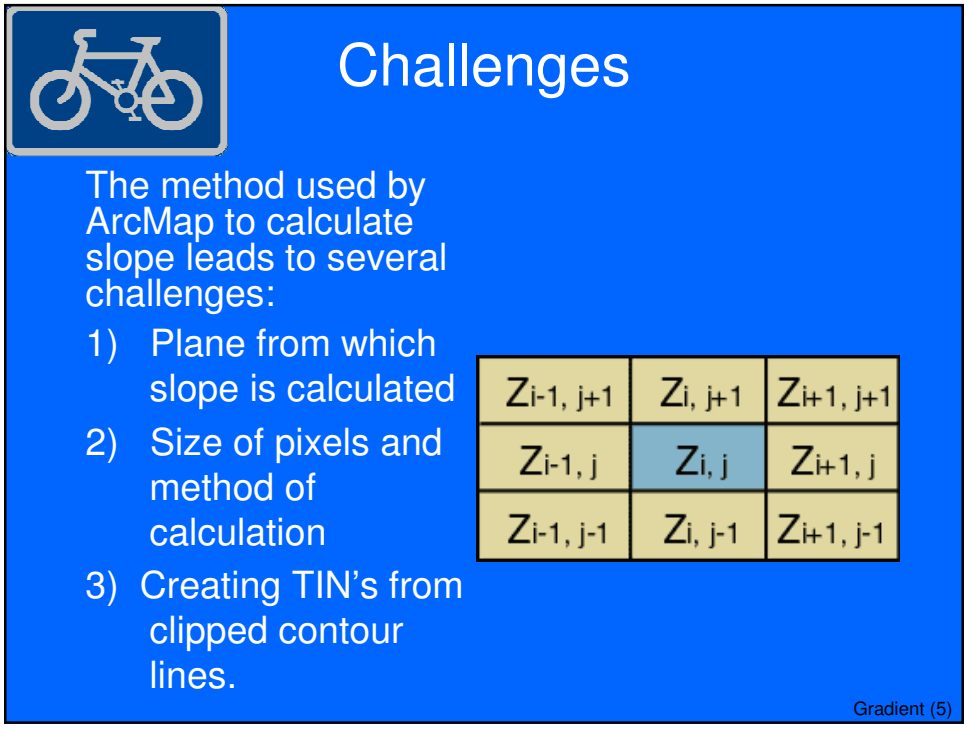
Outline

- Grade: change in vertical and horizontal distances between points
- Why is grade important?
- Attribute Data

Methodology

- Goal: calculate % gradient for bikeways in Mac-Groveland
- Contour lines → TIN → Slope → Reclassify → Convert Raster to Feature → Intersect with Bikeways





Challenges

The method used by ArcMap to calculate slope leads to several challenges:

1) Plane from which slope is calculated
2) Size of pixels and method of calculation
3) Creating TIN's from clipped contour lines.

$Z_{i-1, j+1}$	$Z_{i, j+1}$	$Z_{i+1, j+1}$
$Z_{i-1, j}$	$Z_{i, j}$	$Z_{i+1, j}$
$Z_{i-1, j-1}$	$Z_{i, j-1}$	$Z_{i+1, j-1}$

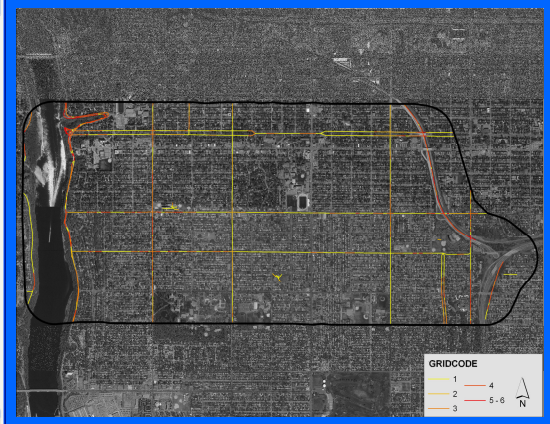
Gradient (5)

Output

Attributes of reclass_6_insct_bike1

FID	Shape*	FID_grovel	OBJECTID	SOURCE	SIDE	GRIDCODE	TYPE
0	Polyline	0	6042	St. Paul	NA	5	Paved Trail
1	Polyline	0	6042	St. Paul	NA	4	Paved Trail
2	Polyline	0	6042	St. Paul	NA	1	Paved Trail
3	Polyline	0	6042	St. Paul	NA	1	Paved Trail
4	Polyline	0	6042	St. Paul	NA	4	Paved Trail
5	Polyline	0	6042	St. Paul	NA	1	Paved Trail
6	Polyline	0	6042	St. Paul	NA	3	Paved Trail
7	Polyline	0	6042	St. Paul	NA	1	Paved Trail
8	Polyline	0	6042	St. Paul	NA	4	Paved Trail
9	Polyline	0	6042	St. Paul	NA	1	Paved Trail
10	Polyline	0	6042	St. Paul	NA	4	Paved Trail
11	Polyline	0	6042	St. Paul	NA	3	Paved Trail
12	Polyline	0	6042	St. Paul	NA	4	Paved Trail
13	Polyline	0	6042	St. Paul	NA	1	Paved Trail
14	Polyline	0	6042	St. Paul	NA	2	Paved Trail
15	Polyline	0	6042	St. Paul	NA	1	Paved Trail
16	Polyline	0	6042	St. Paul	NA	3	Paved Trail
17	Polyline	0	6042	St. Paul	NA	5	Paved Trail
18	Polyline	0	6042	St. Paul	NA	2	Paved Trail
19	Polyline	0	6042	St. Paul	NA	4	Paved Trail
20	Polyline	0	6042	St. Paul	NA	3	Paved Trail
21	Polyline	0	6042	St. Paul	NA	6	Paved Trail
22	Polyline	1	6043	St. Paul	NA	1	Paved Trail
23	Polyline	1	6043	St. Paul	NA	3	Paved Trail
24	Polyline	1	6043	St. Paul	NA	5	Paved Trail
25	Polyline	1	6043	St. Paul	NA	5	Paved Trail
26	Polyline	1	6043	St. Paul	NA	5	Paved Trail
27	Polyline	1	6043	St. Paul	NA	3	Paved Trail
28	Polyline	1	6043	St. Paul	NA	4	Paved Trail
29	Polyline	1	6043	St. Paul	NA	6	Paved Trail
30	Polyline	1	6043	St. Paul	NA	4	Paved Trail
31	Polyline	1	6043	St. Paul	NA	5	Paved Trail
32	Polyline	1	6043	St. Paul	NA	5	Paved Trail
33	Polyline	1	6043	St. Paul	NA	3	Paved Trail
34	Polyline	1	6043	St. Paul	NA	4	Paved Trail
35	Polyline	1	6043	St. Paul	NA	1	Paved Trail
36	Polyline	1	6043	St. Paul	NA	5	Paved Trail
37	Polyline	1	6043	St. Paul	NA	1	Paved Trail

Record: 0 Show: All Selected Records: (0 out of 431 Selected) Options



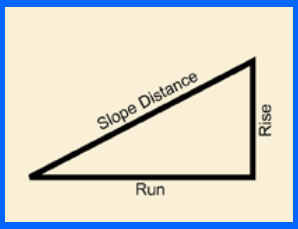
Gradient (6)

Calculate Grade Without GIS

- Lack of hardware and / or knowledge of GIS
- Alternative methods chosen based on experience of volunteers
- Trigonometric Levelling vs. Topographic Interpolation

Gradient (7)

Trigonometric Leveling



- Use of GPS units to measure elevation and location
- Formula for Percent Grade

  $\frac{\text{Vertical Distance}}{\text{Horizontal Distance}} \times 100$

- Challenges:

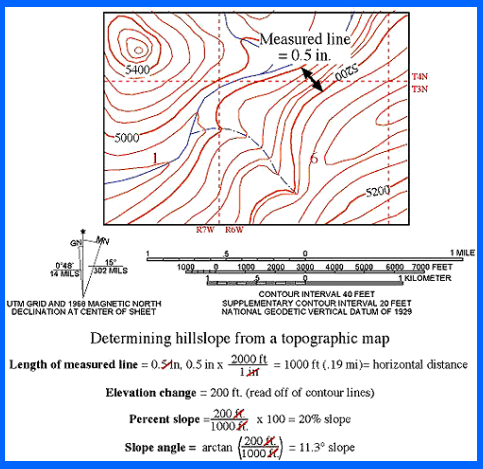
1) Accuracy of GPS Units
2) Human Error
3) Straight Line Distance

Gradient (8)

Topographic Interpolation

- Use topo maps to determine grade
- Same formula
- Simple Calculations
- Challenges:

1) Same as above
2) Straight line between contours



Determining hillslope from a topographic map

Length of measured line = 0.5 in, 0.5 in x $\frac{2000 \text{ ft}}{1 \text{ in}}$ = 1000 ft (.19 mi)= horizontal distance

Elevation change = 200 ft. (read off of contour lines)

Percent slope = $\frac{200 \text{ ft}}{1000 \text{ ft}}$ x 100 = 20% slope

Slope angle = arctan $\left(\frac{200 \text{ ft}}{1000 \text{ ft}}\right)$ = 11.3° slope

Gradient (9)

The Creation of an Amenities Layer

"It would be really helpful, especially when I am biking with my daughter, if there were trail maps that showed me where there is a pretty spot or where we could have a picnic." -Mike Taylor (personal communication)

Definitions

- Recreational Amenities
  Something that conduces to comfort, convenience, or enjoyment that serves cyclists biking on recreational bike paths.

- Recreational Bicycle Paths
  "Bicycle paths are specially designed for cyclists and are generally located away from all automobile traffic. They may be reserved for cyclists only or they may be open to other road users, such as pedestrians or rollerbladers. Signs similar to those used on road are always posted on cycling paths and, when possible, markings are also used." (as defined by AASHTO)

The Recreational Bikeway Amenities Model

-This model was based on recreational facilities in Orange County, California, Chicago, Illinois and Portland, Oregon as well as AASHTO standards.

- A large amount of guidance was drawn from *"A Pedestrian and Bicycle Planning Guide to Best Practices"* a study completed by the Victoria Transport Policy Institute.

- In addition, person communication with Saint Paul Parks and Recreation as well as numerous recreational bikeways users.

Amenities Generated

Motor Vehicle Parking	Drinking Fountains
Information Centers	Benches
Signage	Picnic Areas
Restrooms (Toilets)	Picnic Tables
Lighting	Scenic Overlook
Bike Racks	Telephones

An Example of Attributes for each Amenity

Motor Vehicle Parking

Location	Where is the parking lot located?
Pay	Does it cost money to park? (Yes or No)
Cost	How much does it cost to park? (In dollars/hour).
Spaces	How many spaces are in the lot?
Overnight	Can you park overnight in the lot? (Yes/No)
Handicapped Accessible	Are these parking locations handicapped accessible? (according to ADA standards)
Notes	Any other relevant and important information

Restrooms

Location	Where is the restroom located
Type	What type of restroom is it? (Port-a- potty, building or other)
Male Facilities	Are there male facilities? (Yes or No)
Female Facilities	Are there female facilities? (Yes or No)
Baby Changing Facilities	Are there baby changing facilities? (Yes or No)
Handicapped Accessible	Is the restroom handicapped accessible? (according to ADA standards)
Notes	Any other relevant and important information

The Manual for Amenities on Recreational Bikeways

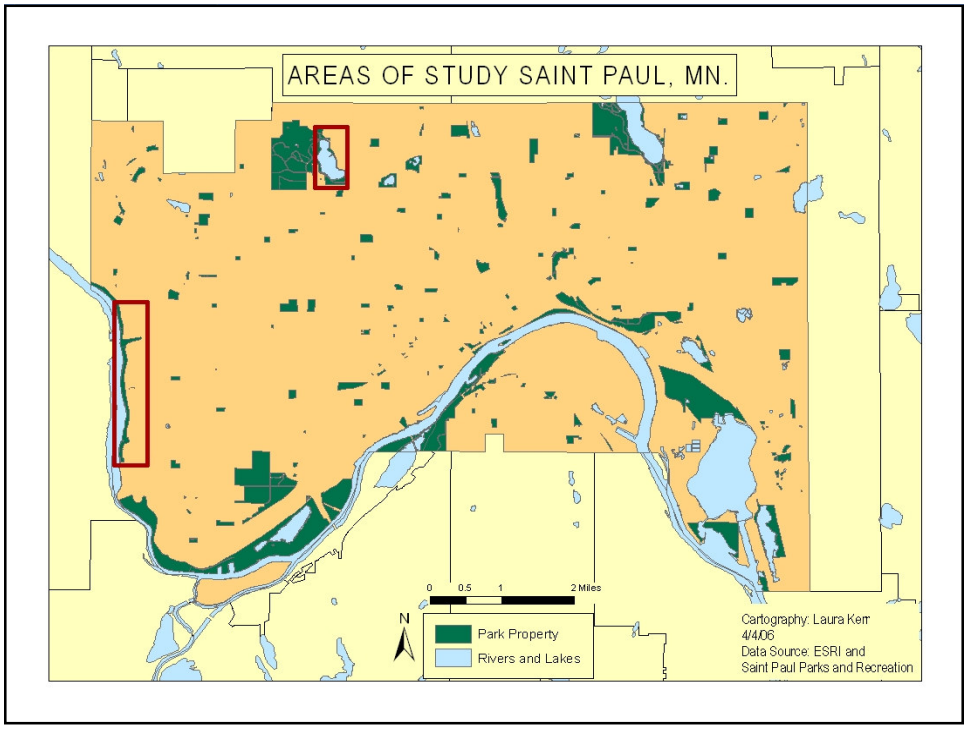
- Data Collection Process
  - Sources
    - Secondary Sources
    - Primary Sources

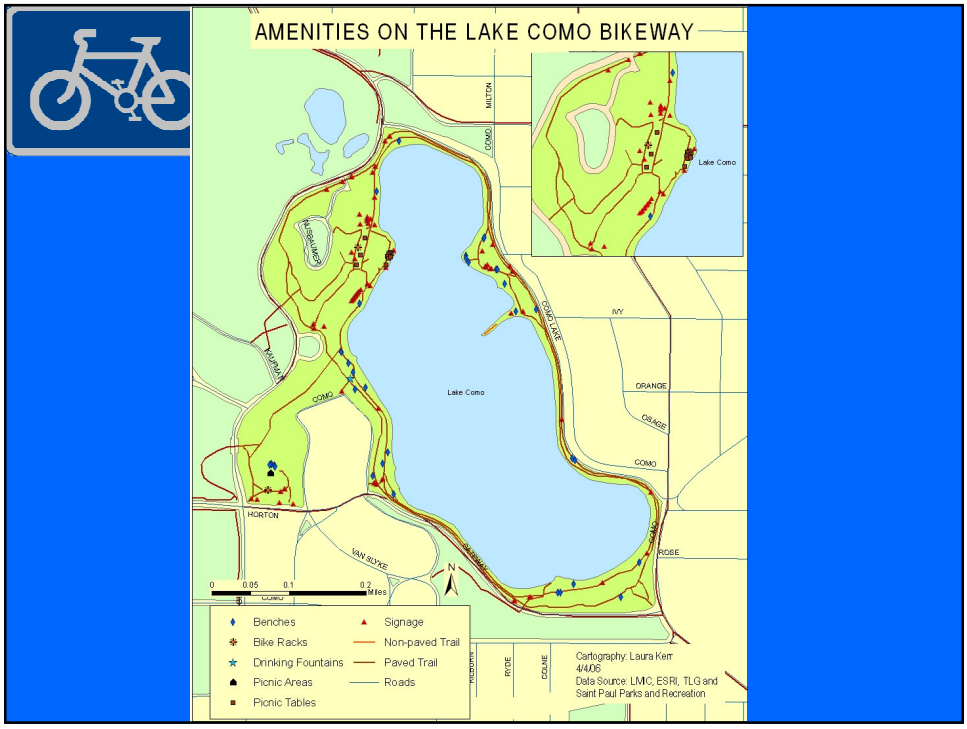
The Manual: Primary Data Collection

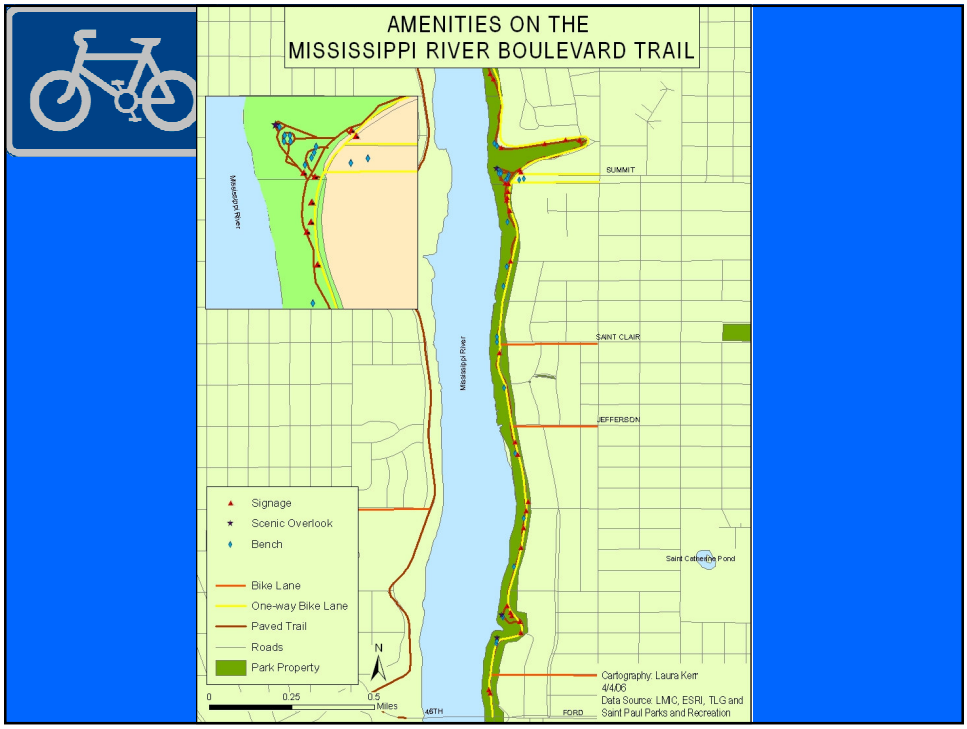
- With GPS Unit
  - Location data is easy to collect
- Without GPS Unit
  - The process becomes more complicated
  - Gathering information about other amenities is still easy

Methodology

- Sample Study Areas
  - Mississippi River Boulevard (from Ford Parkway to the Lake Street Bridge- on the Saint Paul side)
  - Lake Como
- Data Collection Process
  - Finding and collecting secondary data
    - Saint Paul Parks and Recreation: Brian Balfanz
  - Collecting primary data
- Challenges Faced
  - Creating uniform unique IDs for each amenity
  - “In proximity” to bikeways


AREAS OF STUDY SAINT PAUL, MN.
0 0.5 1 2 Miles
N
Park Property
Rivers and Lakes
Cartography: Laura Kerr
4/4/06
Data Source: ESRI and
Saint Paul Parks and Recreation


AMENITIES ON THE LAKE COMO BIKEWAY
Lake Como
MILTON
COMO
IVY
COURT LAKE
ORANGE
COMO
HORTON
VAN BUYCK
ROSE
0 0.05 0.1 0.2 Miles
N
Benches
Bike Racks
Drinking Fountains
Picnic Areas
Picnic Tables
Signage
Non-paved Trail
Paved Trail
Roads
Cartography: Laura Kerr
4/4/06
Data Source: LMIC, ESRI, TLG and
Saint Paul Parks and Recreation



Recommendations for the Future

- Continued data collection in Twin Cities and beyond, throughout Minnesota.
- Constant reanalysis of the suitability of amenities, attributes and manual.
- Creation of an amenities on commuter bikeways layer

Further Applications

- "Disengage" – send Manual to others
  - Groups that know about the bikeways project
  - Groups that do not know about it
- Apply Manual (data collection processes) to outside the Macalester-Groveland area
- Move beyond even the Twin Cities
  - Apply Manual to Outstate Minnesota
  - Get others involved
  - Receive feedback from data collectors, end users

Conclusion