

Feasibility Study and Preferred Alternative Development for Retrofitting new Protected Bike Lanes into Downtown Washington, DC

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Outline

1. Background & Study Area
2. Process & Preliminary Alternative Development
3. The many Barriers to retrofitting Bike lanes into a CBD
- 4. Quantifying Impacts across all Transportation modes**
- 5. Weighing these Impacts against each other, for each Alternative.**



Study area

Percentage of Population Who Regularly Commute to Work by Bicycle

Legend

Percentage of Population Who Commutes to Work by Bicycle (By Block Group)

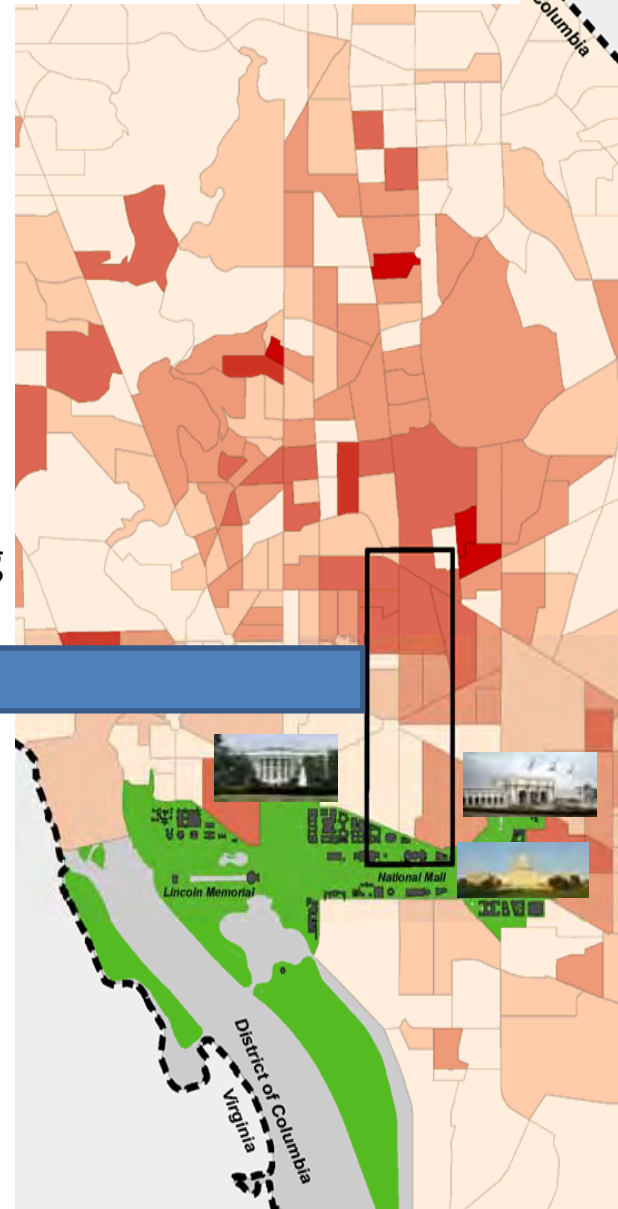
- No Data
- 0% - 2%
- 2.01% - 5%
- 5.01% - 10%
- 10.01% - 15%
- 15.01% - 20%
- > 20%
- Corridor Study Limits
- DC Boundary

Note: The average commute to work by bicycle is 3.53% in the district for 2009 - 2013.

Source: 2009 - 2013 American Community Survey 5-Year Estimates



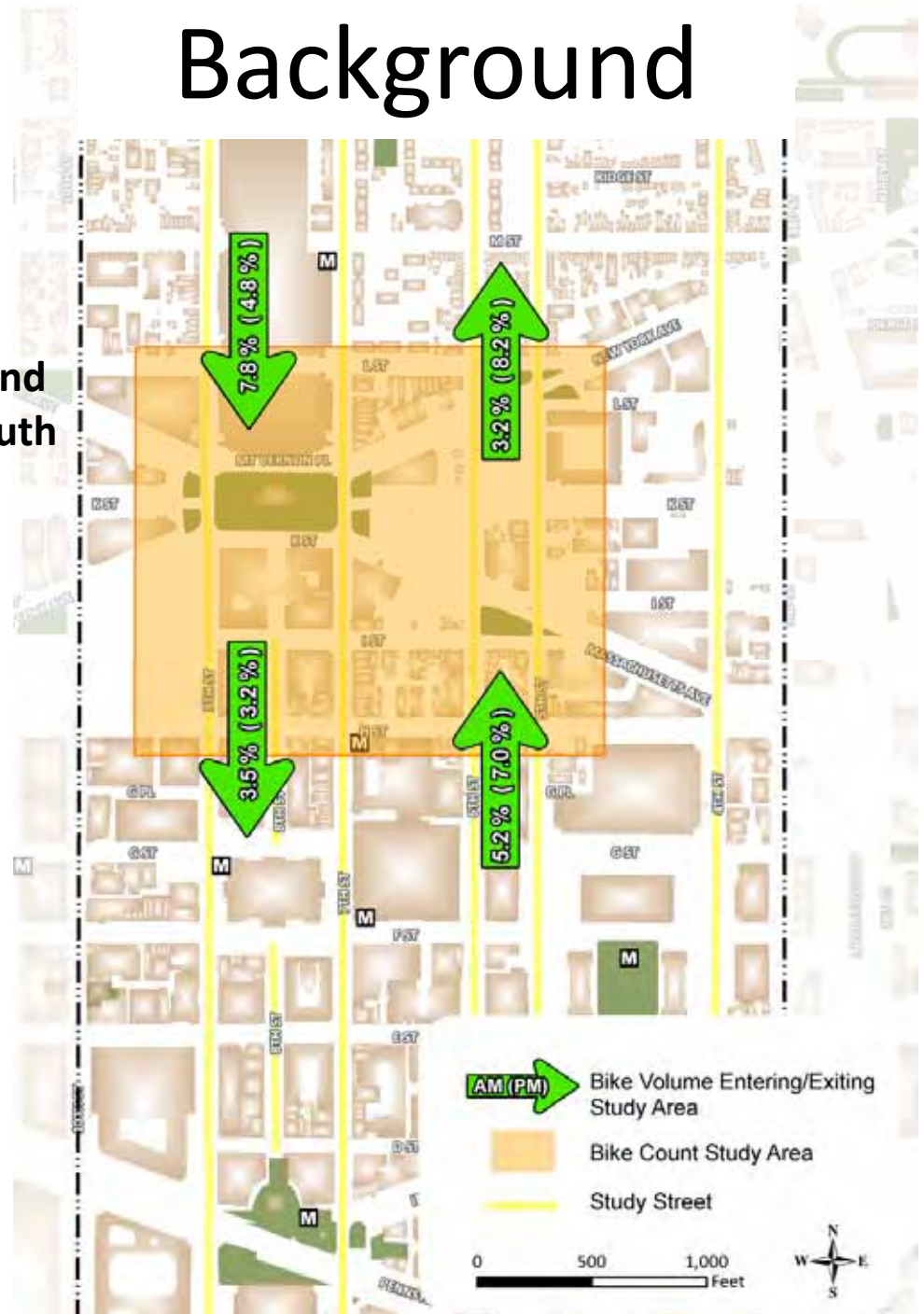
1 ½ mile long



Background



Latent Demand
for North-South
Cycling



Background

- Purpose: To improve north-south cycling mobility with protected bike facilities to access the east side of the CBD.


- **Need:**

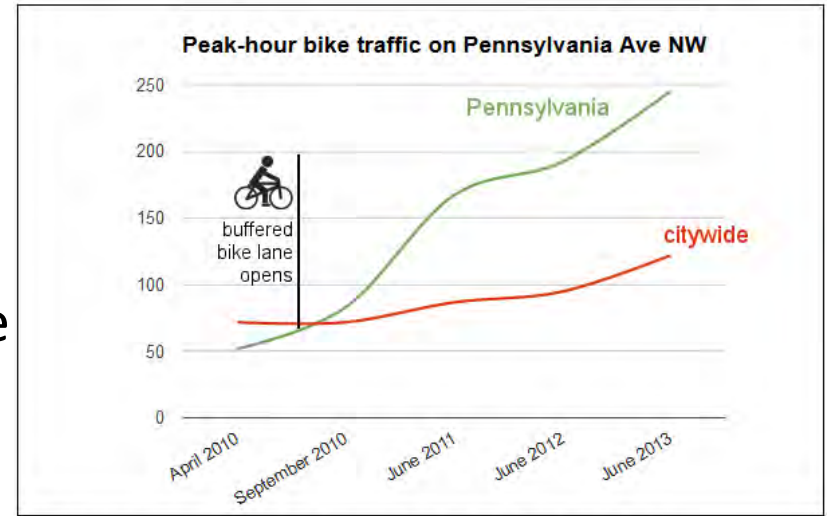
- moveDC Recommendation
- The neighborhoods in north are growing rapidly
- More people use bicycles in the Shaw/Howard University area and surrounding neighborhoods

Primary South CBD destinations

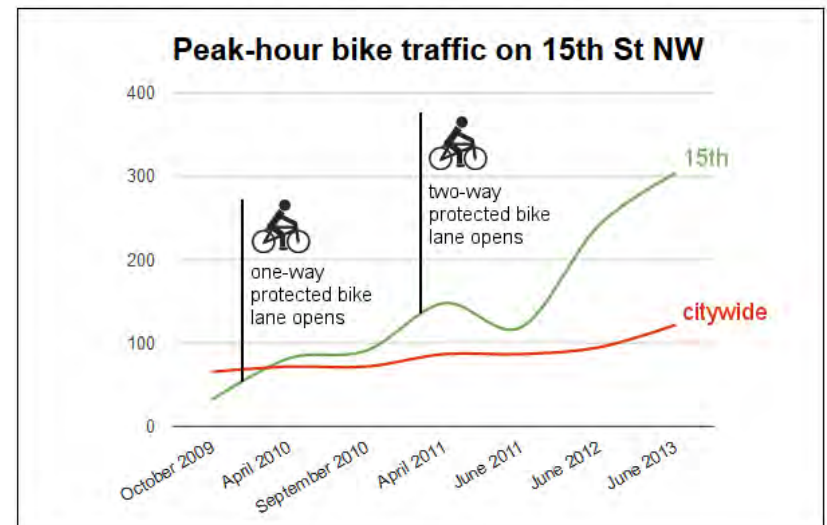
- Verizon Center
- Convention Center
- Federal Buildings
 - National Archives
 - Federal Trade Commission HQ
 - DOJ HQ
 - FBI HQ
 - SEC HQ
 - Army Corp of Engineers HQ
- Smithsonian museums
- National Mall
- District and Federal Court buildings
- DC Govt offices
- WMATA offices

Background

- Primary Objectives
 - Provide a continuous, *protected* bike facility (mainline & intersection)
 - Increases Cycling 
 - Decreases Sidewalk Cycling
 - Maintain acceptable levels of operations for traffic and buses
 - Minimize changes to parking and other curbside activity



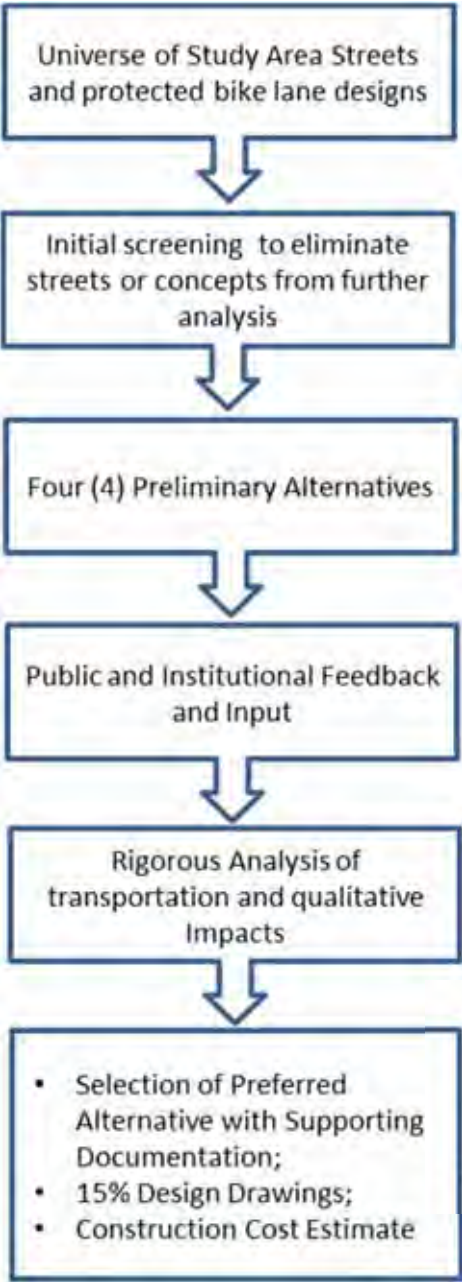
Peak-hour bike count on Pennsylvania between 6th and 7th streets. Source: DDOT.



Peak-hour bike count on 15th between T and Swann streets.

- Have had success with PBL on other streets in the District
- DDOT is being pushed for more, **but low-hanging fruit has been picked**

Process & Universe of Options



Protected Bike Lanes opposing sides



Protected two-way bike lanes



Protected Contraflow Lane

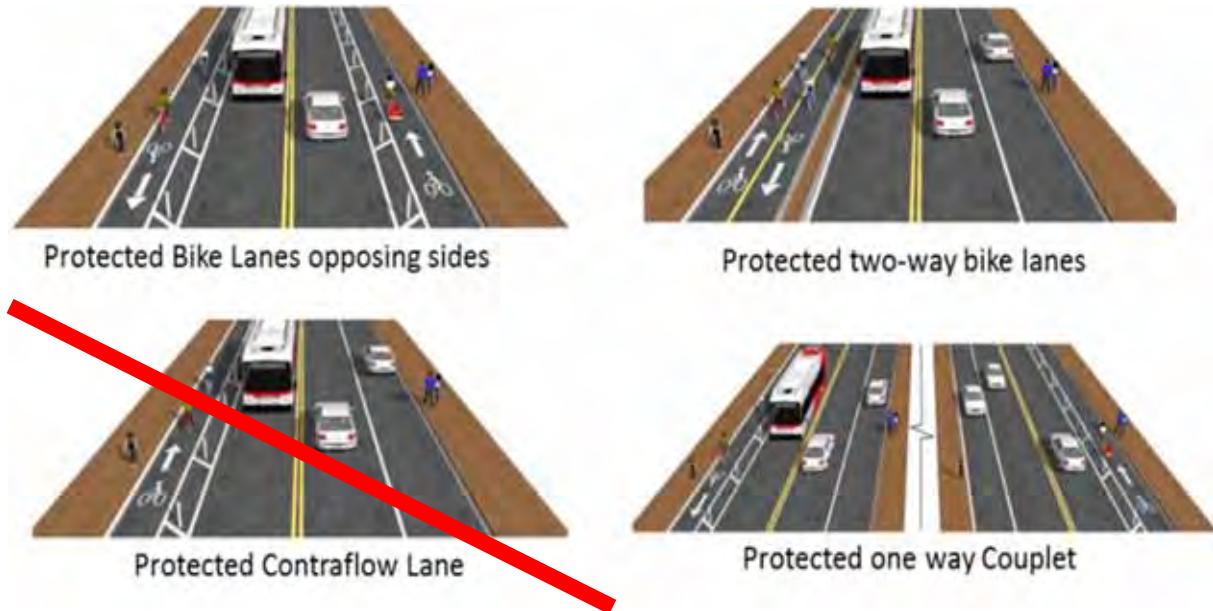


Protected one way Couplet

- 4th Street
- 5th Street
- 6th Street
- 7th Street
- 8th Street
- 9th Street



Process – Initial Screen is needed



Initial Cut focused on:

- Design option Suitability
- Discontinuity of route:
- Existing heavy curbside Bus boarding

- ~~4th Street~~
- 5th Street
- 6th Street
- ~~7th Street~~
- ~~8th Street~~
- 9th Street
- ~~West Side~~

Leaves 5 street sides available

Quantifying Inter-related Metrics

ITERATIVE PROCESS TO OPTIMIZE

- Primary Transportation-related impacts to evaluate include:

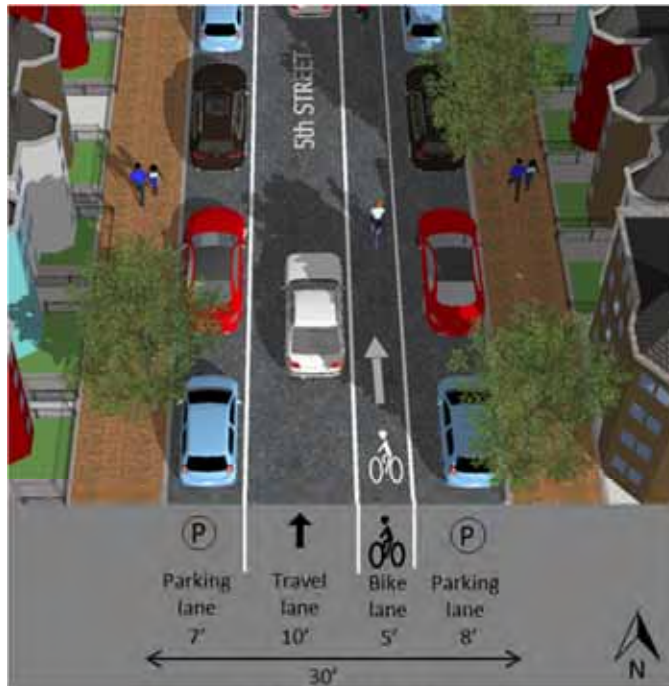
1. Cyclist Safety (protection) *Developed new protected turn phases*
2. Parking *Measured Utilization for 4 periods*
3. Loading and Special Events *Located all loading zones and laybys*
4. Traffic *Modeled Traffic and Arterial Travel Time*
 1. Bus operations *Counted bus routes/hour and boardings*
 2. Emergency Vehicle Access

8' to 11' need for one-way to two-way protected bikes lanes - effectively replace 1 travel and/or parking lane.

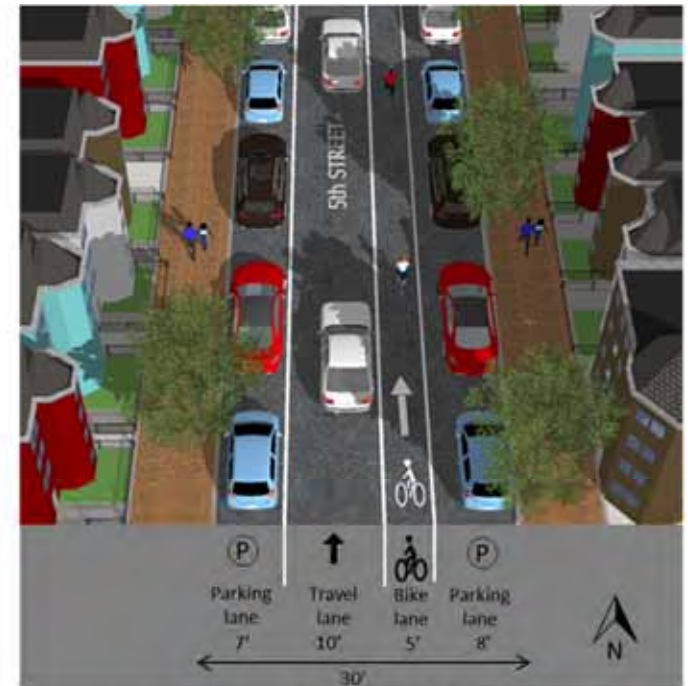
4 Preliminary Alts

- **No Build** (Existing Conditions)
- **Alternative 1:** 5th Street/6th Street protected bike lane couplet
- **Alternative 2:** 6th Street protected bike lane, 1-way each side
- **Alternative 3:** 6th Street 2-way protected bike lanes on east side
- **Alternative 4:** 9th Street 2-way protected bike lanes on east side

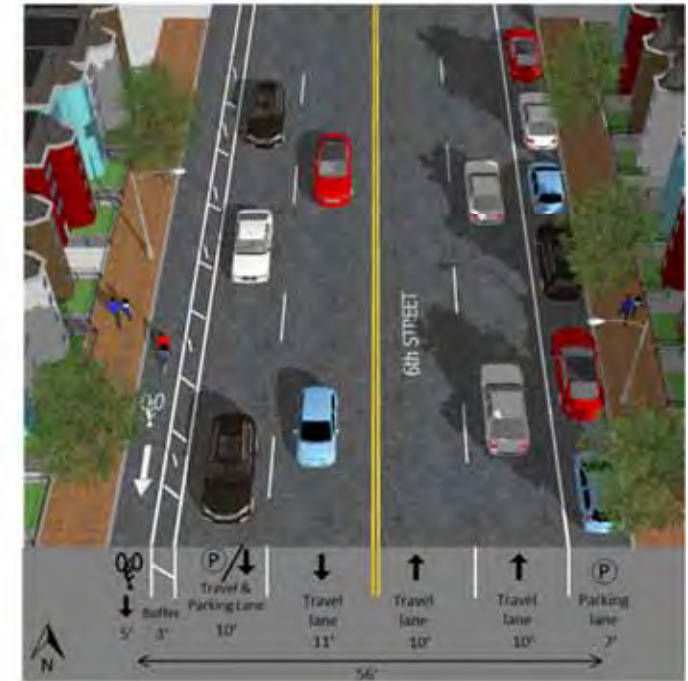
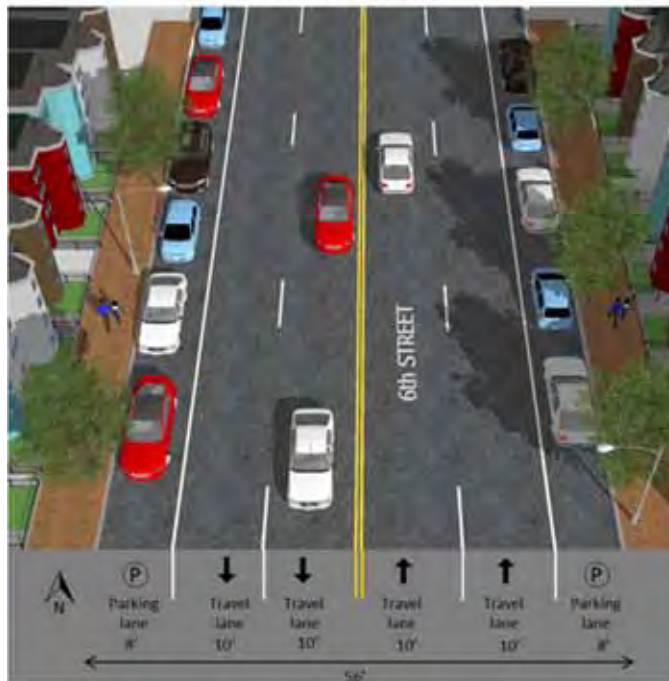
Alt 1



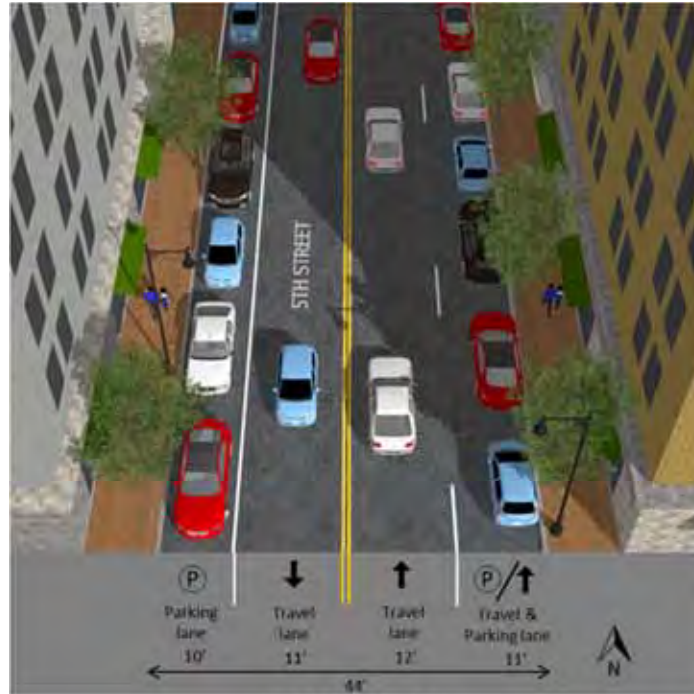
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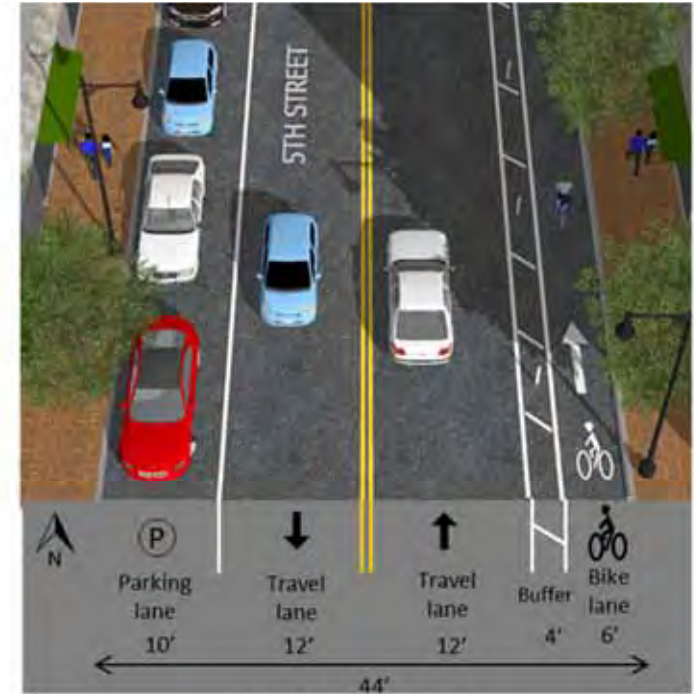
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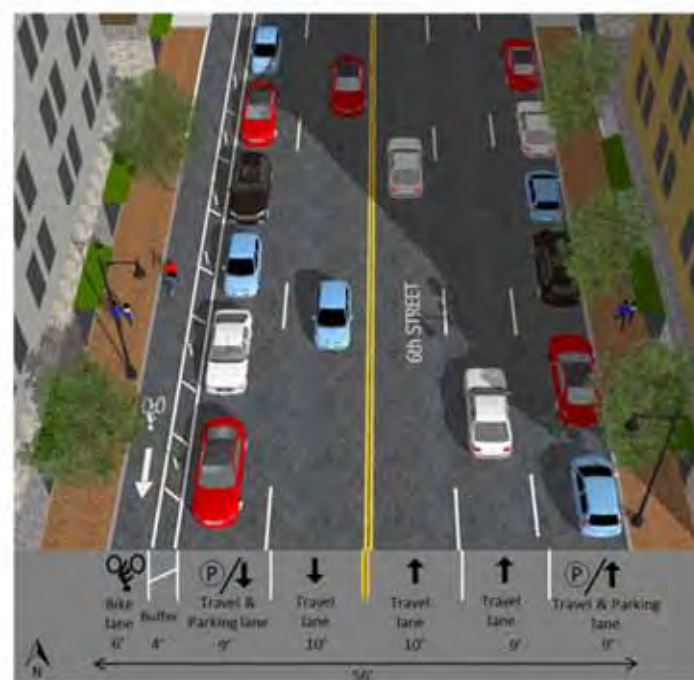
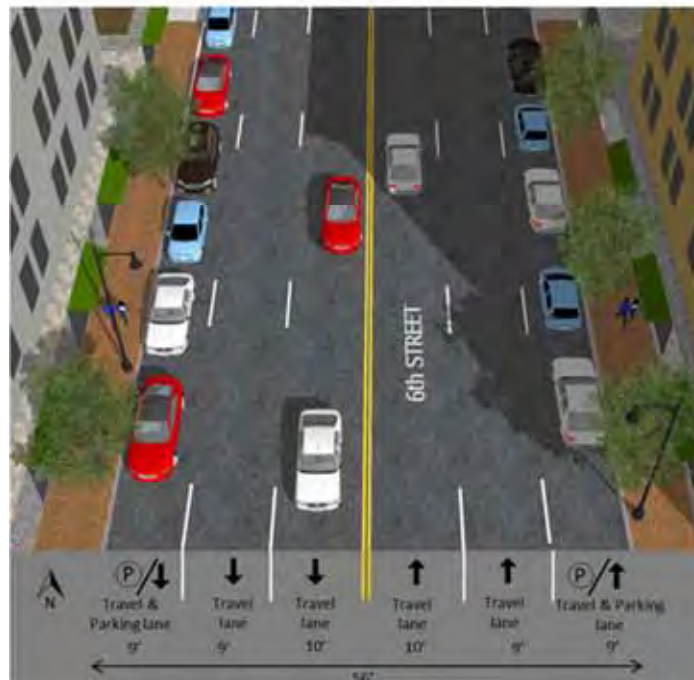
Alt 1



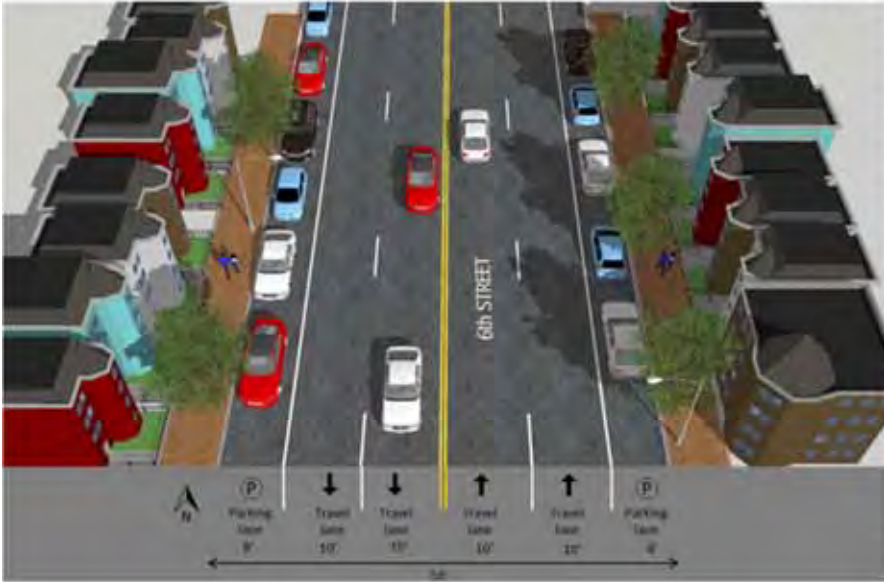
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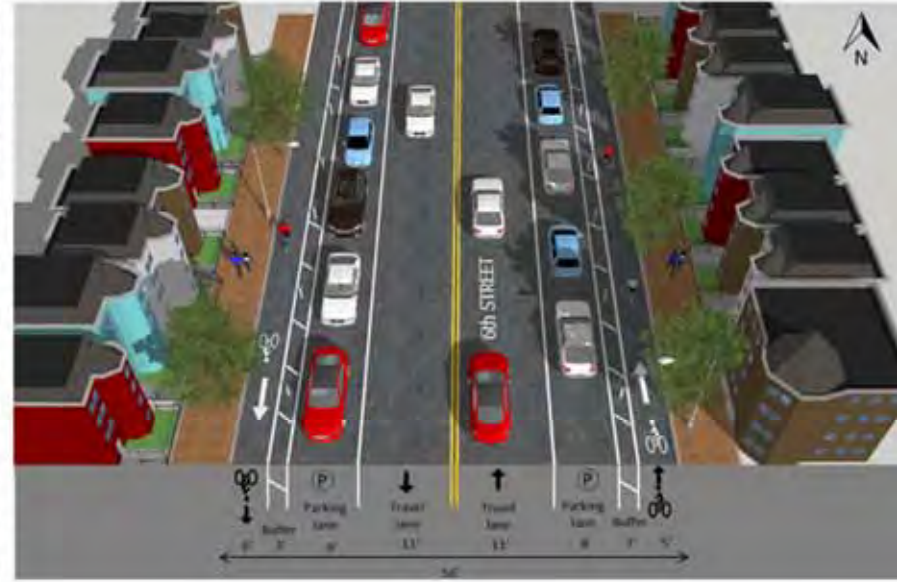
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Alt 2



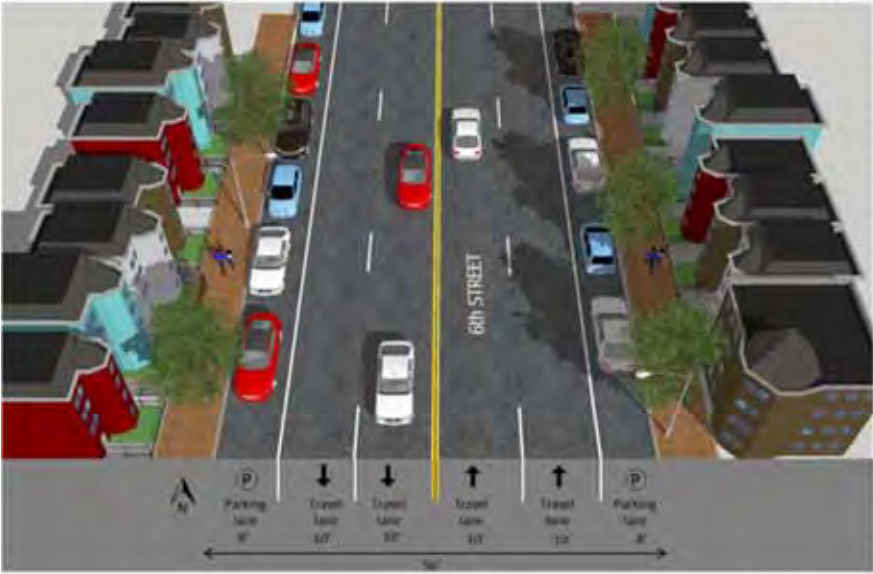
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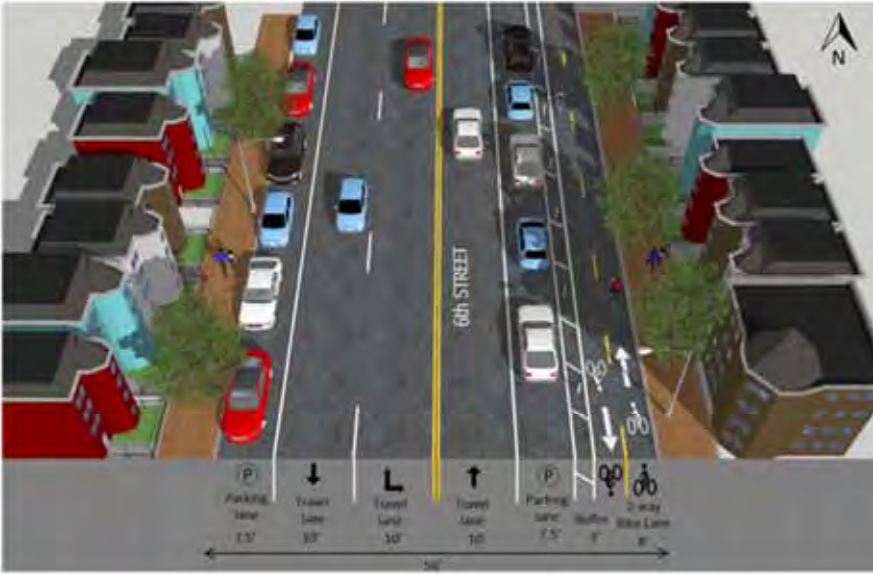
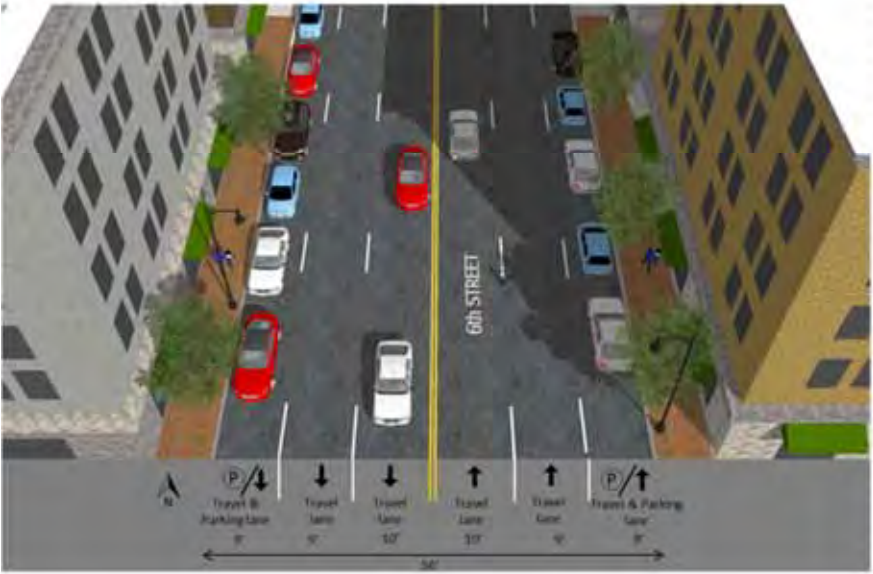
PROPOSED



Alt 3



EXISTING



PROPOSED



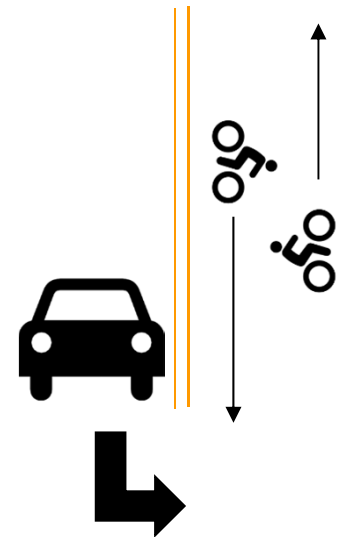
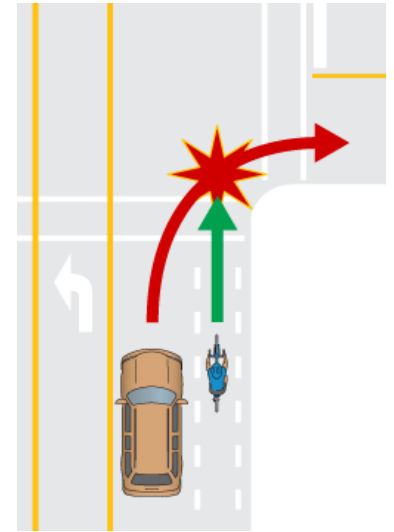
Quantifying Impacts – Cyclists Safety

- Protection from Main line travel
 - Alt 1: 70% protection
 - Alt 2: 80% protection
 - Alt 3: 90% protection
 - Alt 4: 100% Protection
- Why aren't they all 100% protected?
 - Laybys (hotel and loading)
 - Driveways (parking garage and DCFD)
 - Insufficient road width to provide buffer (5th St.)



Quantifying Impacts – Cyclists Safety

- Protection from Main line travel
 - Buffer with hard/soft protection
- Protection at intersections
 - Heavy right-and left-turns into a bike lanes
 - >100 turns per hour
 - **>250 turns per hour**
 - All left turns against a two-way bike lane
 - **Most critical need because driver is blind to approaching cyclist traveling in same direction.**



Quantifying Impacts – Cyclists Safety

Alt 1: heaviest turns are about 100 veh/hr

Alternative 1 Impact to Intersection	Is Heavy Turn Movement Protected?			
	NBL	SBL	NBR	SBR
6th Street & S Street	no		n/a	
6th Street & Rhode Island Avenue			n/a	
6th Street & M Street		n/a		
6th Street & New York Avenue		n/a	n/a	
6th Street & K Street		n/a	n/a	
6th Street & Massachusetts Avenue				no
6th Street & F Street				no
6th Street & E Street	no			no
6th Street & Pennsylvania Avenue		n/a		no
5th Street & New York Avenue	n/a		no	
5th Street & L Street (S)		no		
5th Street & K Street			no	
5th Street & H Street			no	
5th Street & D Street				n/a
5th Street & I Street (S)				n/a

Alt 2: 1 right-turn protected (250/hr)

Alternative 2 Impact to Intersection	Is Heavy Turn Movement Protected?			
	NBL	SBL	NBR	SBR
6th Street & S Street	no		no	
6th Street & Rhode Island Avenue			no	
6th Street & M Street		no		
6th Street & New York Avenue		no	yes	
6th Street & K Street		no	no	
6th Street & Massachusetts Avenue				no
6th Street & F Street				no
6th Street & E Street	no			no
6th Street & Pennsylvania Avenue		no		no

Alt 3: All left turns & 1 right-turn protected (250/hr)

Alternative 3 Impact to Intersection	Is Heavy Turn Movement Protected?			
	NBL	SBL	NBR	SBR
6th Street & S Street	n/a		no	
6th Street & Rhode Island Avenue			no	
6th Street & M Street		yes		
6th Street & New York Avenue		yes	yes	
6th Street & K Street		yes	no	
6th Street & Massachusetts Avenue				n/a
6th Street & F Street				n/a
6th Street & E Street	n/a			n/a
6th Street & Pennsylvania Avenue		yes		n/a

Alt 4: Bike Phase – all turns protected

Alternative 4 Impact to Intersection	Is Heavy Turn Movement Protected?			
	NBL	SBL	NBR	SBR
9th Street & Florida Avenue		yes		
9th Street & K Street		yes		
9th Street & I Street		yes		
9th Street & H Street				yes
9th Street & D Street		yes		
9th Street & Pennsylvania Avenue		yes		

Quantifying Impacts – Traffic

- Given proposed phasing, turn protections and new lane-use for each Alternative, traffic was modeled for changes in LOS and corridor travel time.
 - North-south timings were adjusted as needed, but several east-west streets are primary arterials and are coordinated
 - The opportunity to adjust splits is limited.
 - Cycle length remained same in all Alts tested

Quantifying Impacts – Traffic

Alternative 1

- 2 Overall failing *intersection* LOS
- 5 Failing *approach* LOS

Alternative 2

- 0 Overall failing *intersection* LOS
- 1 Failing *approach* LOS

Alternative 3

- 0 Overall failing *intersection* LOS
- 3 Failing *approach* LOS

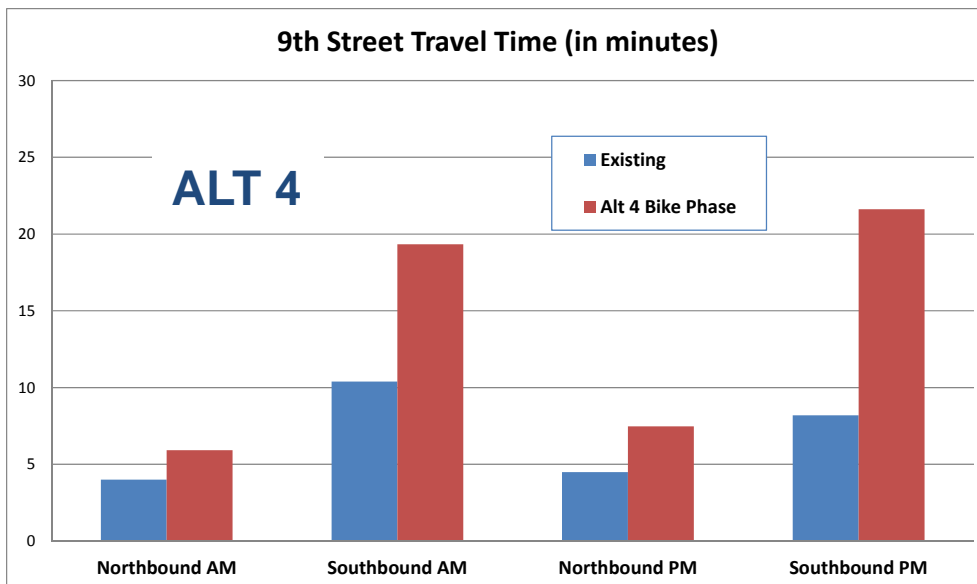
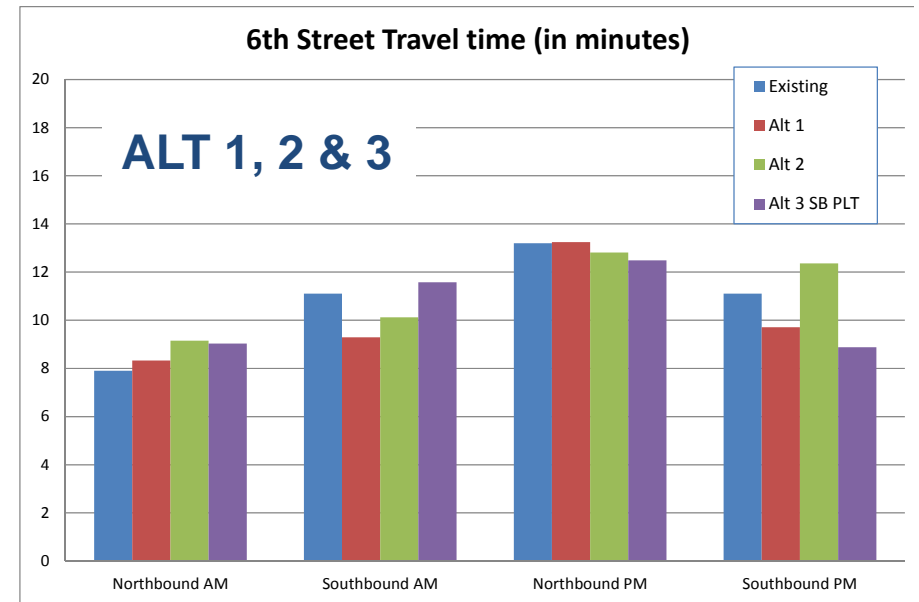
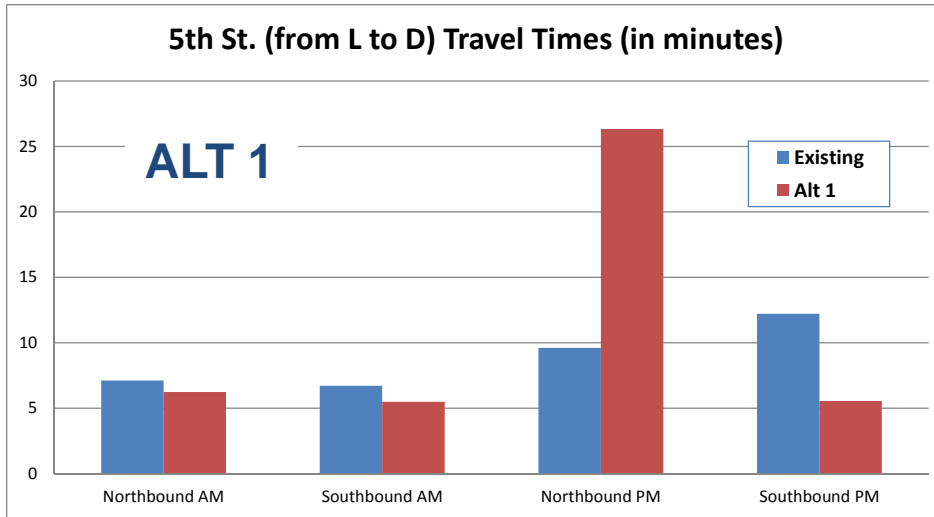
Alternative 4

- 2 Overall failing *intersection* LOS
- 4 Failing *approach* LOS



LOS Doesn't tell
the whole story...

Quantifying Impacts – Traffic



6th Street has best performance

Quantifying Impacts – Curbside Parking

- Alt 1
 - 70 Commercial Spaces; 114 Residential Spaces
- Alt 2
 - Negligible Impact
- Alt 3
 - Negligible Impact
- Alt 4
 - 39 Commercial Spaces

All available residential and commercial spaces are effectively 100% utilized

Quantifying Impacts – Buses

Alternative 1

- Increases to travel time impact bus scheduling and on-time performance
- Few Buses and low ridership

Alternative 2

- No Impacts to stops or scheduling

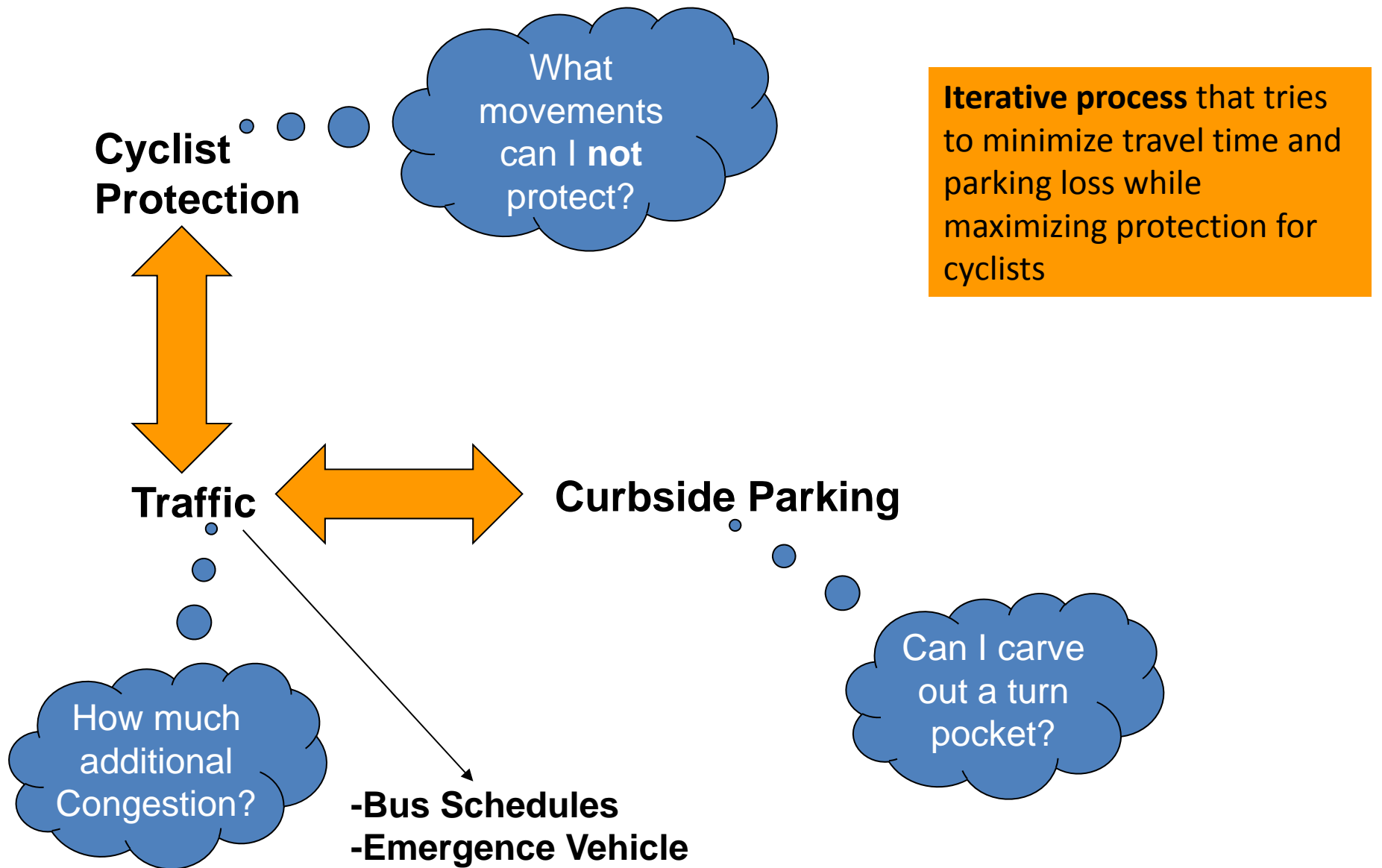
Alternative 3:

- No Impacts to stops or scheduling

Alternative 4

- No impact to stop; all buses run on west side.
- Increases to travel time impact bus scheduling and on-time performance - Buses run every 3 to 5 minutes

Weighing the Impacts – looking for slack



Weighing the Impacts – Results

Compare each Alternative with original Project goals

Alternative	Cyclist Protection		Traffic		Parking		Buses
Alt 1	Red	White	Red	White	Red	White	Yellow
Alt 2	Orange	White	Green	White	Green	White	Green
Alt 3	Yellow	White	Green	White	Green	White	Green
Alt 4	Green	White	Red	White	Yellow	White	Red

Next Steps: Work with Stakeholders to push this closer to green

Can any non-green metric be mitigated?

- Divergence?
- Bus Reroute?
- Layby Removal
- Parking Removal

Questions



Other supporting Info

Outreach Summary

Nearly 5,000 comments were submitted from members of the community, parishioners of the churches, and users of the streets in the eastern downtown area of the District. The majority of comments showed support for bike lanes in a 52% to 48% split with the latter in favor of the no-build option. The most favored option is Alternative 3, the bi-directional protected lanes on the east side of 6th Street NW, which gained 40% of the overall preferences expressed. This was favored largely because of the minimal impacts on church parking, traffic congestion, travel time, and the ability to function as a full-time protected bicycle facility. The second most favored is Alternative 2, the separated curb-side protected lanes on 6th Street NW, for which 34% of people expressed a preference. However, the suggestion for Sunday parking to occur within the protected facility (in Alternative 2) was viewed unfavorably by most commenters.

Alternative 1:

Northbound Traffic along 5th – congestion at New York Ave. Replacing 2 NB lanes with one in the PM peak hour causes massive delays from New York Ave, south to D Street; these delays impact the limited bus service on 5th Street, as well as emergency vehicle operations. Conceivably, these delays could cause some traffic to divert to NB 6th Street, where there is space capacity.

Lack of protection along 5th Street from L to RIA. 30' width prevents incorporating protection without removing all of the northbound curbside residential parking.

The median along RIA, prevents the PBL from reaching FLA Ave. Could be mitigated with a median break, but would also need additional protection in the form of a signal.

Unprotected northbound right turns at New York Ave. **heavy right turn could not be protected without further increasing already-substantial delays in NB 5th Street traffic.**

Permanent loss of 5th Street 77 commercial parking spaces in the CBD– 16 full time back in spaces and 61 restricted in the afternoon peak period only.

Generally, southbound 6th Street performed well from a traffic standpoint and no parking was removed.

Full-time parking was converted to peak hour-restricted along Southbound 6th Street from R Street to L Street.

Several locations on 6th Street require lengthy unprotected sections downtown

Alternative 2:

Fourteen heavy turning movements were identified along 6th Street that could be the source for bike-vehicle conflicts. Of these, only one was mitigated in this alternative.

No curbside parking is removed in this alternative. Traffic along northbound and southbound 6th can generally be mitigated. **However, traffic flow comes at the expense of not being able to protect cyclists from heavy right-turning and left-turning movements.** Protecting many of these movements from cyclist conflict would impact traffic operations significantly.

Both the east and west side of 6th Street has multiple lengthy laybys/driveways where vertical protection from the main line would have to be removed.

4 continuous blocks of 6th Street southbound allow back-in diagonal parking on Sundays, utilizing two of the existing 3 southbound lanes. Options for cycling southbound under these conditions include: utilizing the remaining travel lane in mixed traffic, while diagonal parking occupies the protected bike lanes or removing the allowance of diagonal Sunday parking.

Alternative 3:

Fourteen heavy turning movements along 6th Street were identified that could be the source for bike-vehicle conflicts. Of these, all but three were mitigated in this alternative.

The west side of 6th Street has multiple lengthy laybys/driveways where vertical protection from the main line would have to be removed.

4 continuous blocks of 6th Street southbound allow back-in diagonal parking on Sundays, utilizing two of the existing 3 southbound lanes. However, this alternative requires two southbound travel lanes – one thru-right and one left only. A design option for mitigating this would be to limit parking at intersection approaches to parallel only, such that two approach lanes remain.

Alternative 4:

All east-side full-time street parking is lost for the peak commuting hours.

Cyclist protection from heavy vehicle turn movements is entirely mitigated via a bike-only phase. However, this accommodation comes at the expense of heavy increases in traffic congestion particularly in the southern part of 9th Street. **Traffic congestion cannot be mitigated, because all southbound travel lanes all at capacity currently,** as 9th Street provides a direct connection I-395 (which means traffic is unlikely to divert to other parallel streets).

The aforementioned traffic congestion results in increased delay for both emergency vehicles and for bus scheduling and operations. Buses operate generally every 3 to 5 minutes in the peak commuting hours along southbound 9th street. **Heavy travel time increases were adversely affect bus service.**

Impacts to multiple transportation modes were measured for each alternative and then weighed against the no-build alternative. Generally speaking, no performance metric was weighted more heavily than any other. However, some performance metrics overlapped – for example, a heavy impact to traffic would also impact emergency vehicle response time and bus scheduling/operations. Additionally, both parking and traffic are generally constrained in many areas; for example, while impacted vehicle traffic could divert from 5th to 6th, if 5th street were chosen, it is unlikely that 9th Street traffic would divert to other parallel routes, because of its direct connection to I-395. Similarly, on-street parking utilization showed constrained parking facilities – high utilization rates downtown and in the northern residential areas showed that replacing a large number lost spaces would prove infeasible.

While no alternative can fit seamlessly into the existing transportation network without impacting any mode, based on a rigorous impact analysis of critical transportation elements, **this study recommends Alternative 3.**

Other factors

Alternative	Cost in \$
Alternative 0 (no-build)	\$0
Alternative 1	\$360,000
Alternative 2	\$350,000
Alternative 3	\$760,000
Alternative 4	\$780,000