Evaluating Potential Road Diets: The Benefits of Avoiding Detailed Engineering Analysis
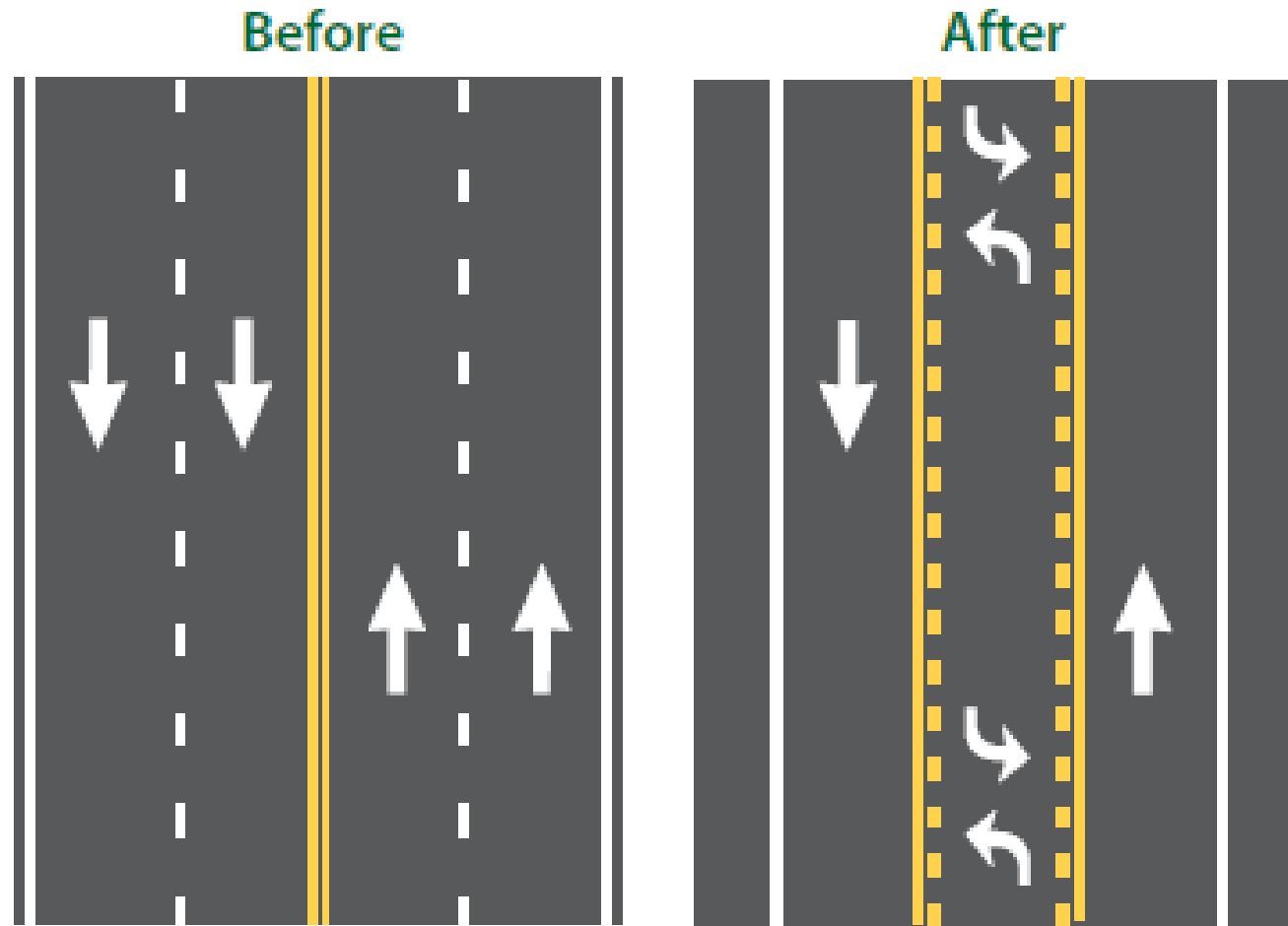
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Rutgers University

June 2018

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Background: Complete Streets and Road Diets

https://safety.fhwa.dot.gov/road_diets/guidance/info_guide/ch1.cfm#s11

Livingston Ave, New Brunswick, NJ

- Partnership project with City of New Brunswick: $20,000
- Political concerns expressed at first meeting
- Report on costs and benefits delivered Feb 2014
- Mayor announced plan to convert street in March 2014
- Three children injured in May 2014
- City and county quickly restriped three sections near schools
- Concept Development Report done by consultant: Aug 2015, $200,000
- Two children injured, Oct 2016
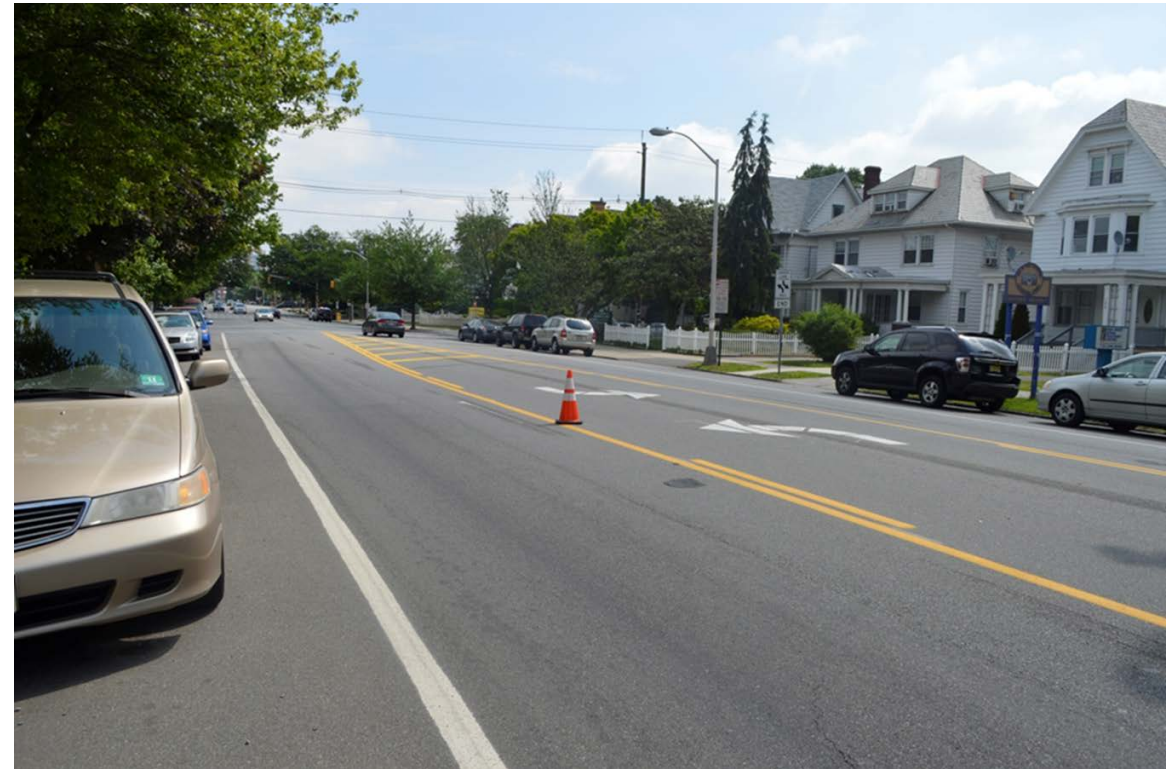
Consultant report on project

- Replicated some of our work
  - Some assumptions wrong, especially on crash reduction estimates
  - More detailed work with HCM and Synchro
  - Used dated valuation of life estimates
  - Cost of study, about $200K: more expensive than a quick restriping
  - Included some design work and estimates of costs for four alternatives.
    - Final proposed project includes new signal system, bulb-outs at pedestrian crossings, some drainage fixes, etc.

- Addition of three "road diets" seems to have not caused any traffic delays
  - Our analysis probably estimated too much delay

Concept Development Report

Livingston Avenue Complete Streets
County of Middlesex
August 7, 2015

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SUBMITTED TO:
County of Middlesex

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Current status

- In early 2017, Middlesex County engaged with an engineering design firm for final design engineering, expect to complete in early 2018

- County has $6 million in funding from FHWA for construction; mainly for cost of upgrading four traffic signals to current standards

- Studies and design have delayed a simple project by almost 4 years!
- Is there a cheaper and faster way to get these projects completed?

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How are crash benefits estimated?

- City promoted our report as finding a 19% reduction in crashes
  - This is a mis-representation of what was done
  - There is <u>insufficient evidence</u> to determine the crash benefits
- Highway Safety Manual
  - Reports crash reduction of 29% for 4-lane to 3-lane conversion
  - Based on FHWA review of six studies
    - 19% reduction for large urban areas
    - 47% for rural highways in small urban areas
- Bloomfield Ave. (Montclair, NJ) study
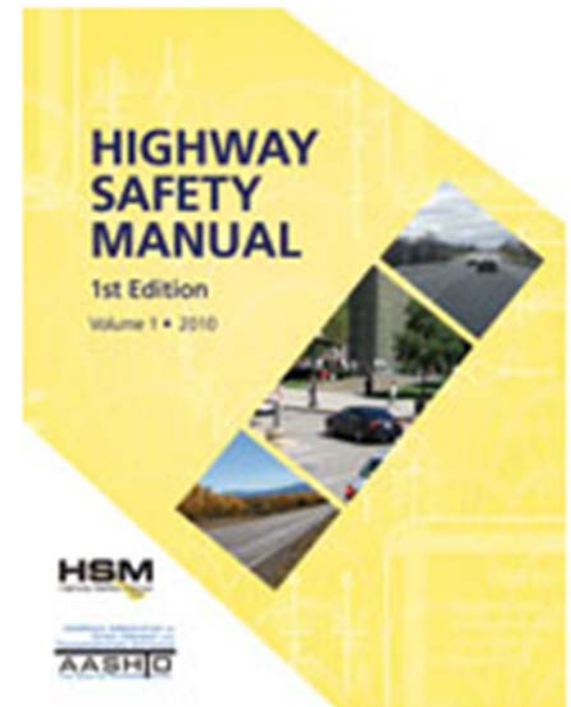
Quick and Cheap Cost-benefit Analysis

- Premise is that we don't know what our crash reduction will be

- Assume that traffic delay increases, probably more than it will
  - In most cases, the objective is to slow speeding traffic, so why is this a cost?

- What is the break-even point in which delay costs = safety benefits?

- Data collected for 10 streets in New Jersey by students in my class
  - These were from list of streets where road diets were being advocated
  - 30 minute traffic counts during evening peak
    - Some were done after major snow storm
  - Safety data downloaded by visually counting crashes from https://www.njvoyager.org/App/
    - 3 year averages, some averaged 5 years; 5 fatalities on 10 roads (one with 2 fatalities)

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Assumptions used

- US DOT provides estimates of
  - Valuation of a statistical Life (VSL)
  - Travel time costs
- These are in TIGER cost/benefit guidance and as separate memos on USDOT website
- Provides range of values, plus escalation rates over time

US DOT estimates

- US DOT Value of Statistical Life

DOT value of life measure (low) 2012	$5,200,000	$5,484,218
DOT value of life measure (high) 2012	$12,900,000	$13,605,078
DOT value of life measure (average) 2012	$9,100,000	$9,597,381
Value of life annual escalation rate		1.07%

- US DOT Value of Travel Time
  - Based on US median household income, 2010
  - 50% for personal travel, 100% for business travel

Median HH income, NJ 2010	$71,637
Median HH income, US 2010	$53,046
Median HH income annual escalation rate	1.60%

Other assumptions

- Construction costs:
  - Low: $100,000/mile (FHWA), Medium: $500,000, High: $5 million
- Cost escalation over time: 1.6%
- Discount rate: 4.0%, assume 20 years
- Vehicle occupancy: 1.2, buses: 25
- Shoulder adjustment, 4.8x 30 min. count
- AM usage 0.75 of PM usage, assume additional x3 increment for rest of day

- <u>Speed changes</u>: most streets are posted at 25mph, assume reduction to 20mph.
  - Most streets also have speeding, should this be considered in estimates?
  - Does not account for signal delay, actual speeds may be lower, so travel time difference may be a lot less
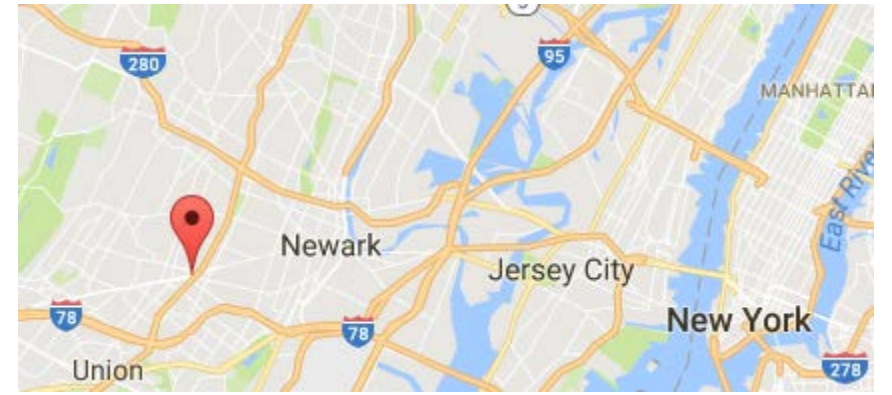
Break even crash reduction, NJ/US incomes, plus off-peak traffic	High VSL values/construction cost	Medium VSL values/construction cost	Low VSL values/construction cost	High VSL values/low construction cost	Medium VSL values/low construction cost
Springfield Ave, Irvington Township, between Becker Terr.	43.2%	41.3%	63.2%	29.2%	39.7%
	35.7%	31.1%	46.9%	21.7%	29.5%
JFK Boulevard, Jersey City, between Sip Ave. and	27.8%	29.4%	47.5%	20.5%	28.5%
	22.5%	22.0%	35.3%	15.3%	21.2%
JFK Boulevard, Bayonne, between 15th and 31st St	62.6%	48.0%	71.9%	32.6%	44.7%
	54.3%	36.6%	53.6%	24.3%	33.3%
Raritan Ave (SR 27), Highland Park, between N. 8th Ave and Columbia	28.3%	21.8%	35.0%	14.3%	20.2%
	24.7%	16.7%	26.1%	10.6%	15.0%
SR 27, Elizabeth, NJ, between Westfield Ave and Fairmount Ave	90.9%	71.3%	106.7%	48.8%	66.6%
	78.5%	54.3%	79.5%	36.4%	49.7%
SR 27, Rahway, between W Lake Ave and Linden Ave.	33.8%	38.4%	62.7%	27.1%	37.7%
	26.8%	28.7%	46.5%	20.1%	27.9%
South Livingston Ave, Livingston, NJ, between Mt. Pleasant Ave. and	83.4%	68.2%	100.1%	47.7%	64.3%
	71.2%	51.8%	74.5%	35.5%	47.9%
Ave C, Bayonne, between 17th and 33rd St.	99.4%	84.5%	132.1%	57.5%	79.7%
	84.7%	64.1%	98.3%	42.8%	59.3%
Central Ave, East Orange City, between South Clinton St. and	42.9%	45.3%	72.5%	31.9%	44.1%
	34.7%	34.0%	53.8%	23.7%	32.7%
Morris Ave., Union, NJ, between Milburn Ave. and Liberty Ave.	41.5%	48.4%	78.5%	34.4%	47.6%
	32.6%	36.1%	58.2%	25.5%	35.3%

Break even crash reduction, NJ/US incomes, no off-peak traffic	High VSL values/construction cost	Medium VSL values/construction cost	Low VSL values/construction cost	High VSL values/low construction cost	Medium VSL values/low construction cost
Springfield Ave, Irvington	24.9%	16.4%	23.7%	10.9%	14.9%
Township, between Becker Terr.	22.1%	12.7%	17.7%	8.2%	11.1%
JFK Boulevard, Jersey City,	14.9%	11.5%	17.7%	7.7%	10.6%
between Sip Ave. and	12.9%	8.8%	13.2%	5.7%	7.9%
JFK Boulevard, Bayonne, between	42.4%	20.3%	27.4%	12.4%	17.0%
15th and 31st St	39.3%	16.1%	20.6%	9.3%	12.8%
Raritan Ave (SR 27), Highland Park,	19.5%	9.3%	13.3%	5.4%	7.7%
between N. 8th Ave and Columbia	18.2%	7.4%	10.1%	4.1%	5.8%
SR 27, Elizabeth, NJ, between	60.6%	30.0%	40.5%	18.5%	25.3%
Westfield Ave and Fairmount Ave	56.0%	23.7%	30.5%	13.9%	19.0%
SR 27, Rahway, between W Lake	16.8%	14.8%	23.3%	10.1%	14.0%
Ave and Linden Ave.	14.2%	11.2%	17.3%	7.5%	10.4%
South Livingston Ave, Livingston,	53.7%	28.2%	37.8%	18.0%	24.3%
NJ, between Mt. Pleasant Ave. and	49.2%	22.2%	28.4%	13.5%	18.3%
Ave C, Bayonne, between 17th and	63.6%	34.9%	49.9%	21.7%	30.1%
33rd St.	58.2%	27.4%	37.5%	16.3%	22.6%
Central Ave, East Orange City,	22.9%	17.7%	27.0%	11.9%	16.4%
between South Clinton St. and	19.9%	13.5%	20.2%	8.9%	12.3%
Morris Ave., Union, NJ, between	19.9%	18.5%	29.1%	12.8%	17.7%
Milburn Ave. and Liberty Ave.	16.6%	13.9%	21.7%	9.5%	13.1%

Break even crash reduction, NJ/US incomes, plus off-peak traffic, add one fatality	High VSL values/construction cost	Medium VSL values/construction cost	Low VSL values/construction cost	High VSL values/low construction cost	Medium VSL values/low construction cost
Springfield Ave, Irvington Township, between Becker Terr.	23.3%	22.7%	36.2%	15.7%	21.8%
	19.2%	17.1%	26.9%	11.7%	16.2%
JFK Boulevard, Jersey City, between Sip Ave. and	19.2%	20.5%	33.6%	14.2%	19.9%
	15.6%	15.4%	25.0%	10.6%	14.8%
JFK Boulevard, Bayonne, between 15th and 31st St	22.1%	17.3%	27.3%	11.5%	16.1%
	19.1%	13.2%	20.4%	8.6%	12.0%
Raritan Ave (SR 27), Highland Park, between N. 8th Ave and Columbia	15.2%	11.7%	18.9%	7.7%	10.8%
	13.3%	8.9%	14.1%	5.7%	8.1%
SR 27, Elizabeth, NJ, between Westfield Ave and Fairmount Ave	35.7%	28.6%	45.1%	19.1%	26.7%
	30.8%	21.8%	33.6%	14.3%	19.9%
SR 27, Rahway, between W Lake Ave and Linden Ave.	27.1%	30.9%	51.0%	21.7%	30.3%
	21.5%	23.1%	37.8%	16.1%	22.5%
South Livingston Ave, Livingston, NJ, between Mt. Pleasant Ave. and	26.2%	22.2%	35.1%	15.0%	20.9%
	22.3%	16.8%	26.1%	11.1%	15.5%
Ave C, Bayonne, between 17th and 33rd St.	39.1%	33.7%	54.4%	22.6%	31.8%
	33.3%	25.6%	40.5%	16.8%	23.7%
Central Ave, East Orange City, between South Clinton St. and	25.6%	27.4%	44.8%	19.1%	26.6%
	20.7%	20.5%	33.3%	14.2%	19.8%
Morris Ave., Union, NJ, between Milburn Ave. and Liberty Ave.	28.9%	34.0%	56.1%	24.0%	33.4%
	22.7%	25.3%	41.6%	17.8%	24.8%

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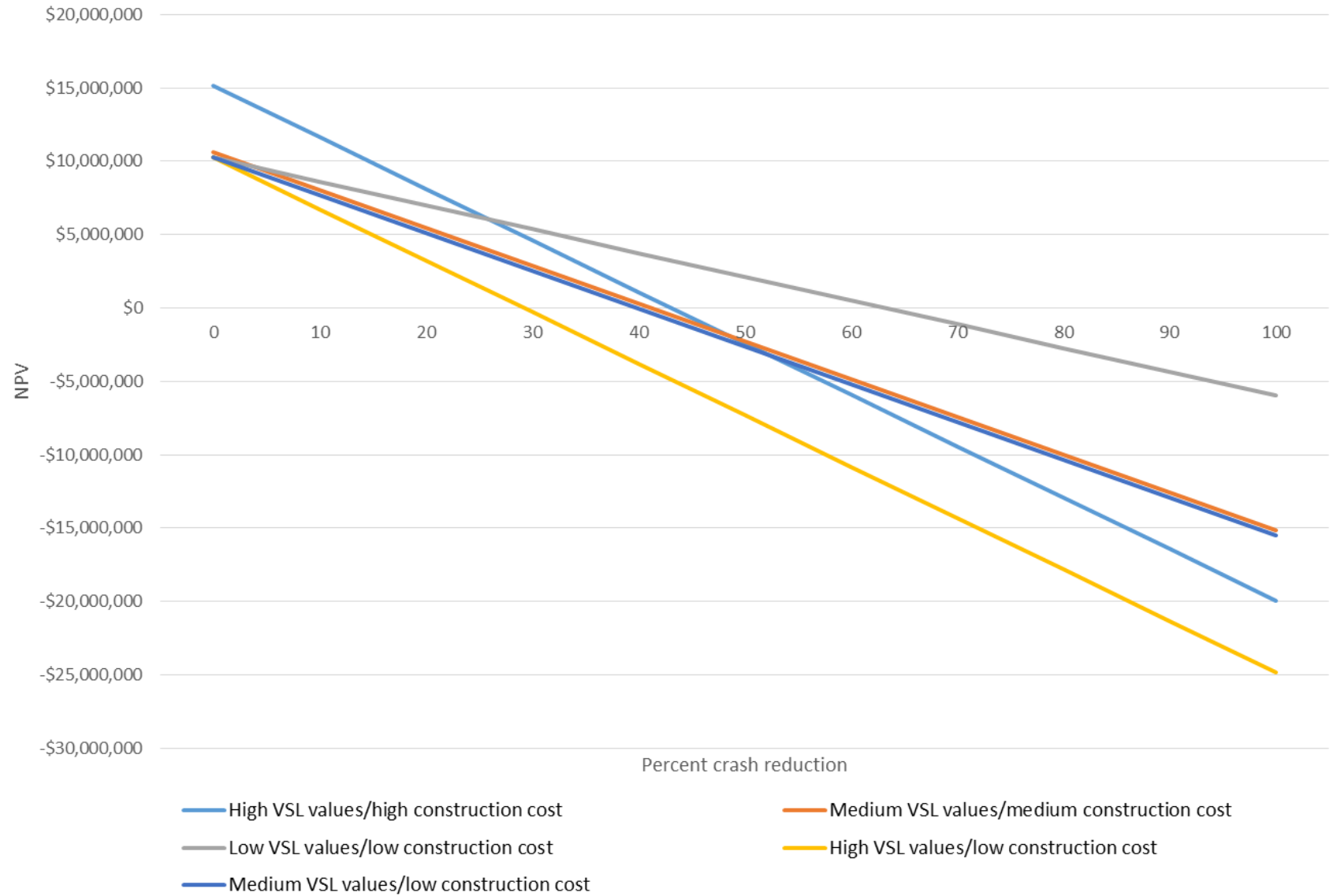Edward J. Bloustein School
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Springfield Ave, Irvington Township, between Becker Terr. And Washington Ave

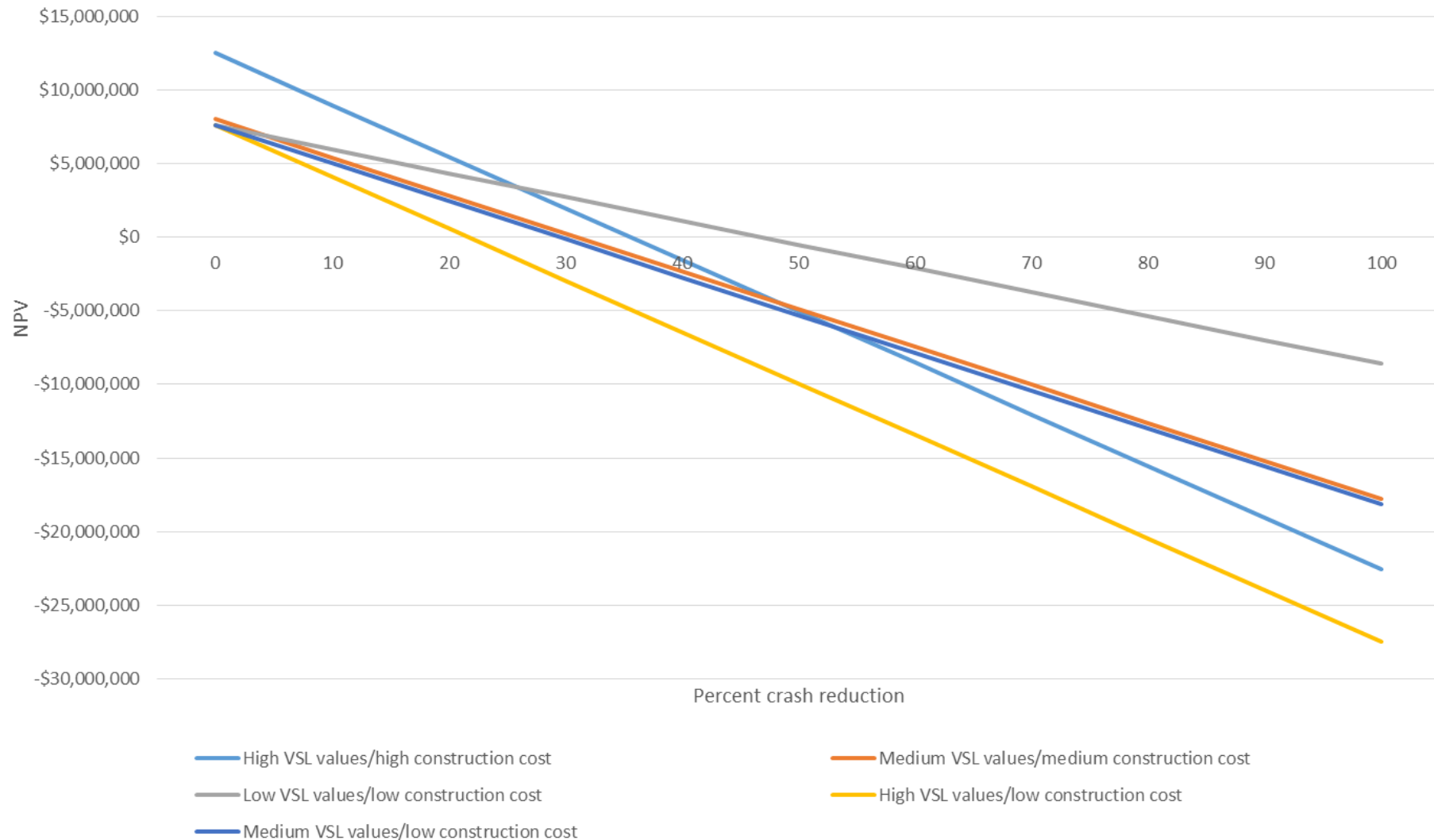Springfield Ave, Irvington Township, between Becker Terr. And Washington Ave.
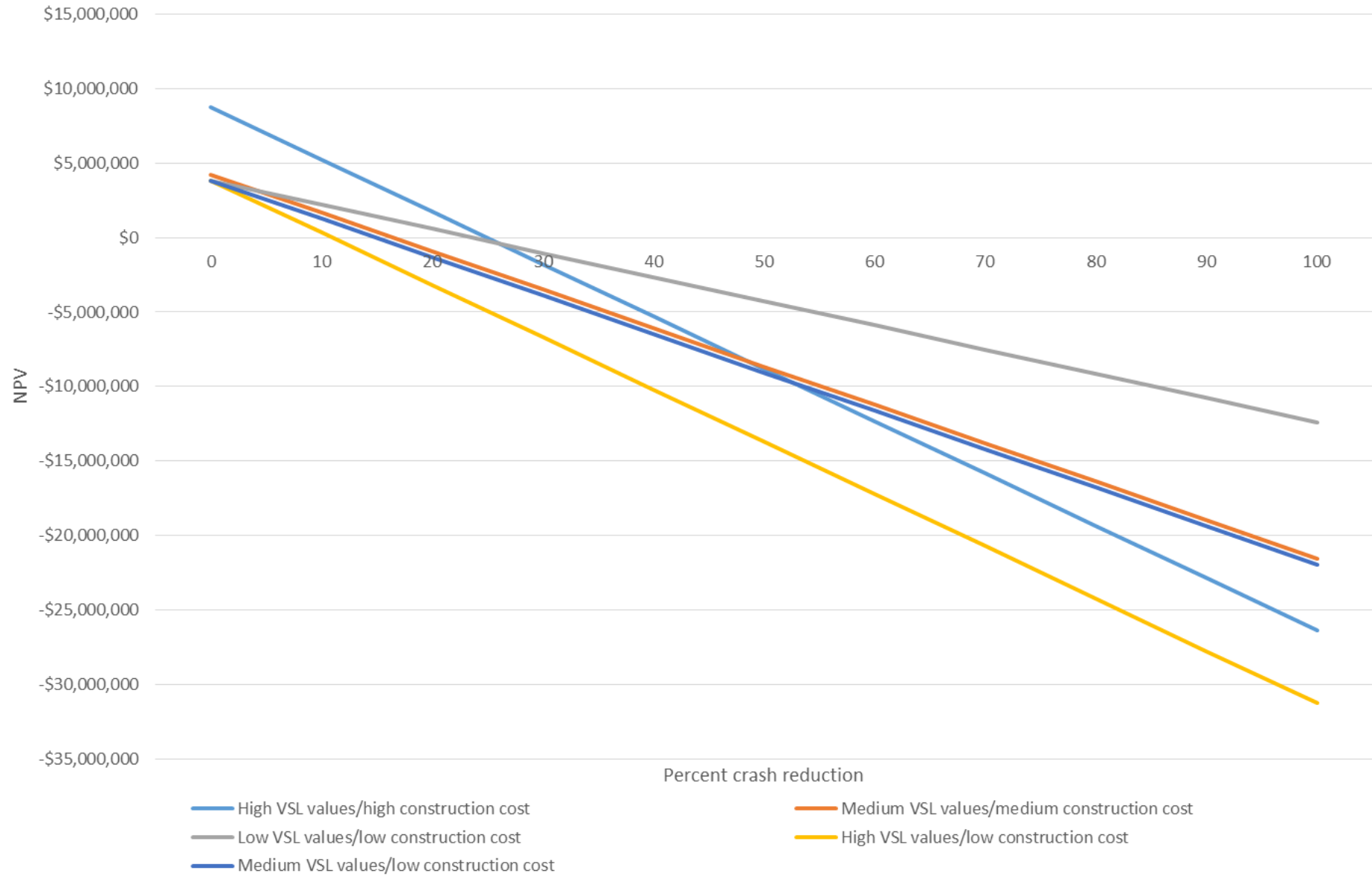NJ value of time
NPV vs. percent crash reduction

Springfield Ave, Irvington Township, between Becker Terr. And Washington Ave.
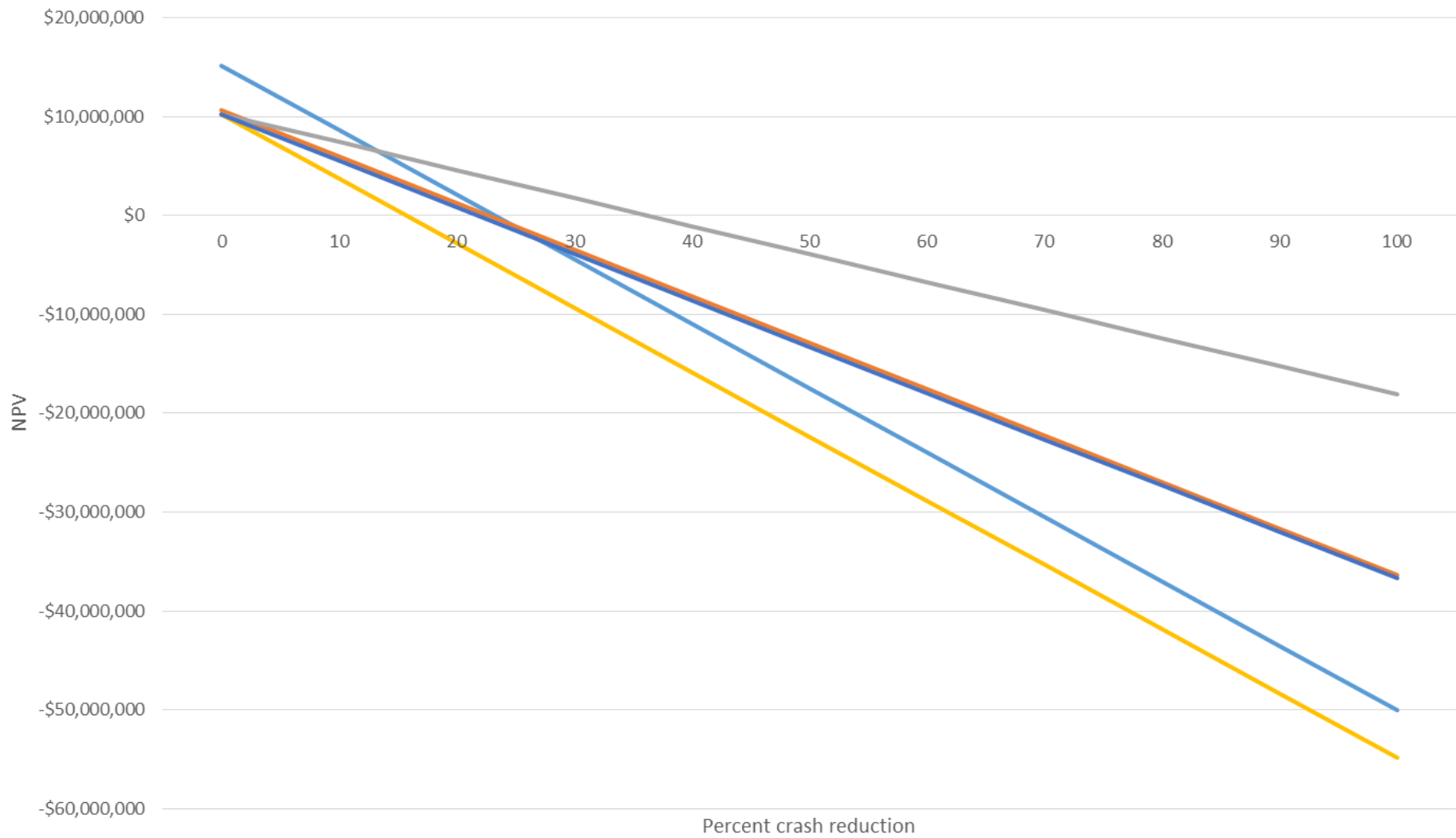US value of time
NPV vs. percent crash reduction

Springfield Ave, Irvington Township, between Becker Terr. And Washington Ave,
NJ value of time, no off-peak travel time
NPV vs. percent crash reduction

Springfield Ave, Irvington Township, between Becker Terr. And Washington Ave.
Add one fatality to initial condition
NJ value of time

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Trade offs between time and safety

- Slope of lines
- Represents benefit for every 1% reduction in crashes

Slopes	High VSL	Medium VSL	Low VSL
Based on data collected	-$350,920	-$257,803	-$162,236
Add one fatality to initial conditions	-$651,331	-$469,721	-$283,332

Conclusions

- Limitations: There are many other non-quantifiable benefits
  - Quality of life, development potential, emissions and noise reduction

- This is useful as a screening tool to highlight uncertainties in crash reduction
  - Can provide guidance on prioritizing projects
  - Highlights political trade-offs
    - Crash and injuries avoided versus time-savings for drivers?
  - Emphasis should be on avoiding costly analysis so projects get done

Questions?

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NPV with 19% crash reduction, NJ/US incomes, plus off-peak traffic	High VSL values/construction cost	Medium VSL values/construction cost	Low VSL values/construction cost	High VSL values/low construction cost	Medium VSL values/low construction cost
Springfield Ave, Irvington Township, between Becker Terr. And Washington	$8,478,596	$5,747,811	$7,163,583	$3,578,596	$5,347,811
	$5,845,522	$3,114,736	$4,530,508	$945,522	$2,714,736
JFK Boulevard, Jersey City, between Sip Ave. and Communipaw Ave.	$5,949,368	$5,065,143	$8,376,069	$1,049,368	$4,665,143
	$2,352,313	$1,468,087	$4,779,014	($2,547,687)	$1,068,087
JFK Boulevard, Bayonne, between 15th and 31st St	$7,125,303	$3,462,966	$3,922,672	$2,225,303	$3,062,966
	$5,767,892	$2,105,555	$2,565,261	$867,892	$1,705,555
Raritan Ave (SR 27), Highland Park, between N. 8th Ave and Columbia St.	$3,251,233	$683,882	$2,267,391	($1,648,767)	$283,882
	$1,989,698	($577,652)	$1,005,856	($2,910,302)	($977,652)
SR 27, Elizabeth, NJ, between Westfield Ave and Fairmount Ave	$8,367,853	$4,459,805	$4,667,335	$3,467,853	$4,059,805
	$6,920,032	$3,011,984	$3,219,514	$2,020,032	$2,611,984
SR 27, Rahway, between W Lake Ave and Linden Ave.	$10,803,350	$10,181,145	$13,760,986	$5,903,350	$9,781,145
	$5,706,078	$5,083,872	$8,663,714	$806,078	$4,683,872
South Livingston Ave, Livingston, NJ, between Mt. Pleasant Ave. and Civic	$8,842,745	$5,016,316	$5,307,614	$3,942,745	$4,616,316
	$7,168,388	$3,341,960	$3,633,257	$2,268,388	$2,941,960
Ave C, Bayonne, between 17th and 33rd St.	$9,405,097	$5,524,094	$5,759,380	$4,505,097	$5,124,094
	$7,685,205	$3,804,202	$4,039,488	$2,785,205	$3,404,202
Central Ave, East Orange City, between South Clinton St. and West Market St.	$10,659,361	$8,501,398	$10,505,068	$5,759,361	$8,101,398
	$6,991,059	$4,833,096	$6,836,766	$2,091,059	$4,433,096
Morris Ave., Union, NJ, between Milburn Ave. and Liberty Ave.	$15,530,887	$14,664,707	$17,994,153	$10,630,887	$14,264,707
	$9,395,937	$8,529,756	$11,859,202	$4,495,937	$8,129,756

NPV with 19% crash reduction, NJ/US incomes, no off-peak traffic	High VSL values/high construction cost	Medium VSL values/med construction cost	Low VSL values/low construction cost	High VSL values/low construction cost	Medium VSL values/low construction cost
Springfield Ave, Irvington Township, between Becker Terr. And Washington	$2,070,552	($660,233)	$755,539	($2,829,448)	($1,060,233)
	$1,100,472	($1,630,314)	($214,541)	($3,799,528)	($2,030,314)
JFK Boulevard, Jersey City, between Sip Ave. and Communipaw Ave.	($2,804,690)	($3,688,915)	($377,989)	($7,704,690)	($4,088,915)
	($4,129,921)	($5,014,146)	($1,703,220)	($9,029,921)	($5,414,146)
JFK Boulevard, Bayonne, between 15th and 31st St	$3,821,808	$159,470	$619,177	($1,078,192)	($240,530)
	$3,321,709	($340,629)	$119,078	($1,578,291)	($740,629)
Raritan Ave (SR 27), Highland Park, between N. 8th Ave and Columbia St.	$181,070	($2,386,281)	($802,772)	($4,718,930)	($2,786,281)
	($283,706)	($2,851,057)	($1,267,548)	($5,183,706)	($3,251,057)
SR 27, Elizabeth, NJ, between Westfield Ave and Fairmount Ave	$4,844,329	$936,282	$1,143,812	($55,671)	$536,282
	$4,310,922	$402,874	$610,404	($589,078)	$2,874
SR 27, Rahway, between W Lake Ave and Linden Ave.	($1,601,745)	($2,223,951)	$1,355,890	($6,501,745)	($2,623,951)
	($3,479,688)	($4,101,894)	($522,052)	($8,379,688)	($4,501,894)
South Livingston Ave, Livingston, NJ, between Mt. Pleasant Ave. and Civic	$4,767,908	$941,479	$1,232,776	($132,092)	$541,479
	$4,151,039	$324,611	$615,908	($748,961)	($75,389)
Ave C, Bayonne, between 17th and 33rd St.	$5,219,442	$1,338,438	$1,573,724	$319,442	$938,438
	$4,585,797	$704,794	$940,080	($314,203)	$304,794
Central Ave, East Orange City, between South Clinton St. and West Market St.	$1,731,912	($426,051)	$1,577,619	($3,168,088)	($826,051)
	$380,432	($1,777,531)	$226,139	($4,519,568)	($2,177,531)
Morris Ave., Union, NJ, between Milburn Ave. and Liberty Ave.	$600,422	($265,759)	$3,063,687	($4,299,578)	($665,759)
	($1,659,823)	($2,526,004)	$803,442	($6,559,823)	($2,926,004)