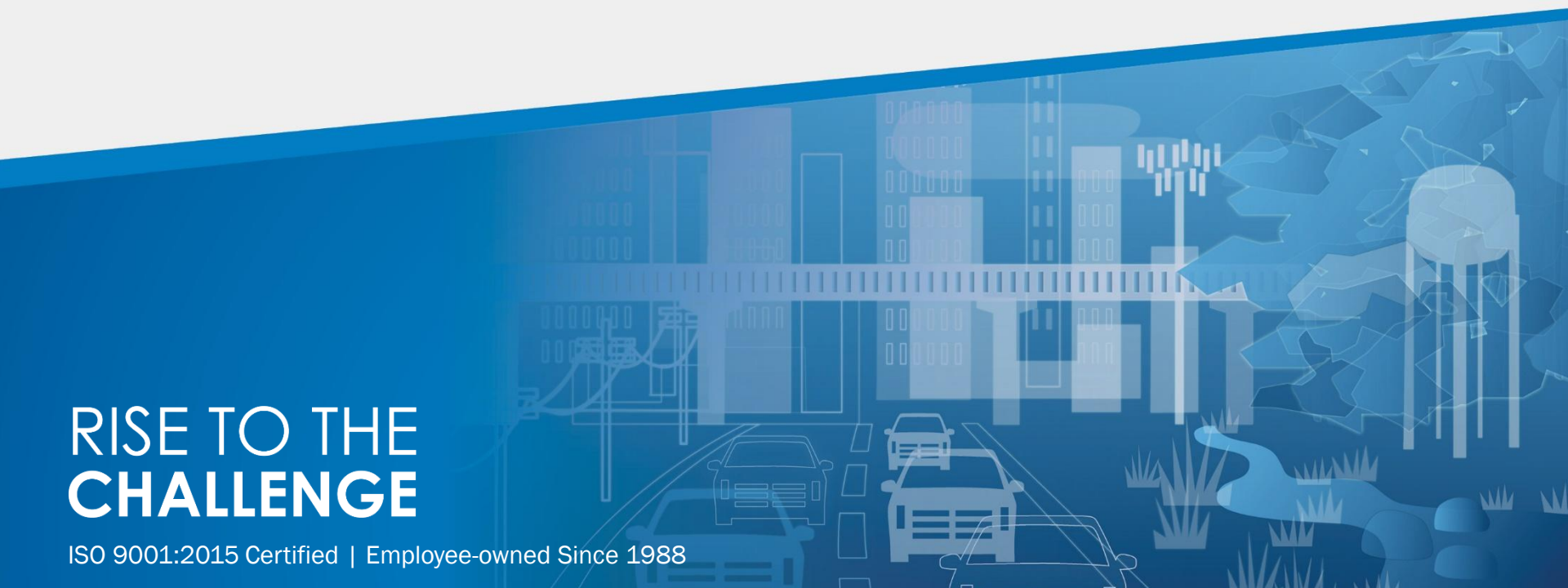
ASHE Back-to-Basics
7/7/2026

Transportation Impact Studies

Building Consensus



RISE TO THE CHALLENGE

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Ian Preston, PE

Project Manager – KCI Technologies

Thanks for tuning in!

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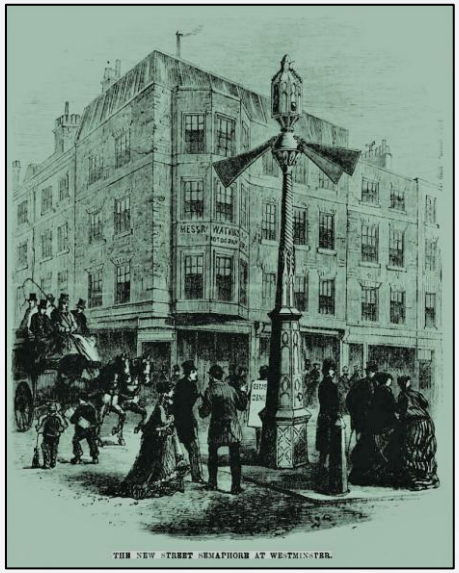
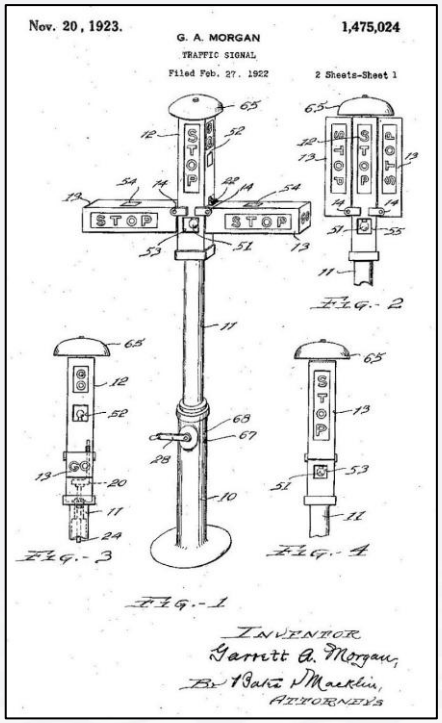
History of the Traffic Signal (related!)

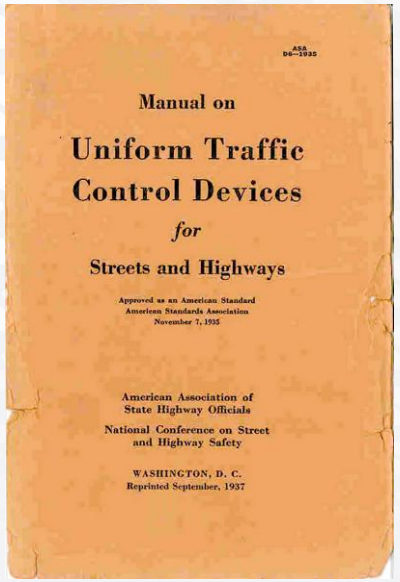
- 1868 – the first traffic signal outside House of Parliament in London.
- 1912 – first electric traffic light in Cleveland.
- 1917 – first interconnected signal system in Salt Lake City
- 1920 – first 4-way, 3-color traffic light in Detroit and first automated traffic signals in Los Angeles
- 1923 – patent for a 3-position traffic signal

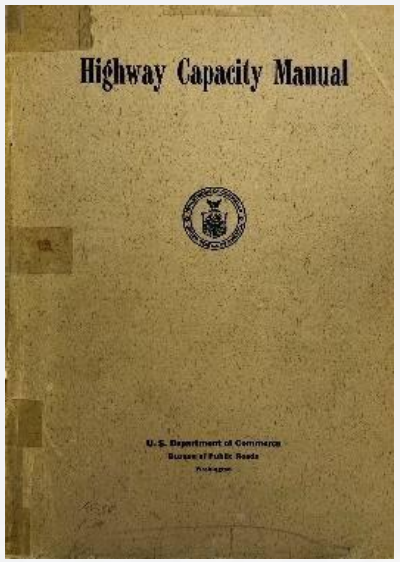




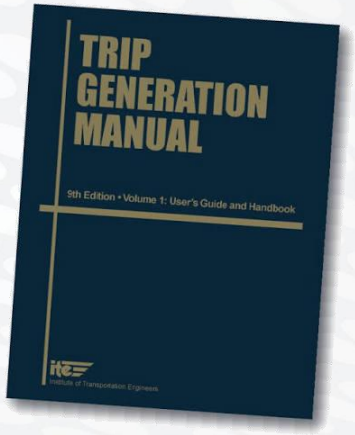
History of the Traffic Study

- 1885 – manual tallies of horse-drawn vehicles in NYC
- 1903 – William Phelps Eno's *Rules of the Road,* including the first traffic regulations and formal descriptions of stop signs, pedestrian crosswalks and safety islands (adopted by NYC in 1909 and later London + Paris)
- 1910s – 1920s – Advent of the mass-produced automobile and first traffic signal implementations.
- 1935 – first *Manual on Uniform Traffic Control Devices* (MUTCD)
- 1941 – First Edition of ITE's *Traffic Engineering Handbook*
- 1950s – mathematical traffic flow models (macroscopic and microscopic), first practical application of capacity for roadway and intersection analysis.





History of the Traffic Study (continued)



- 1950s – 1960s: Post WWII urbanization
  - Urban sprawl and suburbanization fueled by the Interstate Highway System and the Highway Trust Fund.
  - "Traffic Studies" in this era were mostly concerned with annual traffic count statistics and roadway capacity.
- 1970s – 1980s: Traffic Congestion and Capacity Constraints
  - Formally mandated impact assessments as a prerequisite for zoning and land development approvals.
  - 1976: First Edition of ITE's *Trip Generation Manual*
- 1987 – Highway Capacity Software
- 1990s – 2000s:
  - Synchro macroscopic software
  - Vissim microscopic simulation
- 2016 – California officially abandons Level of Service metrics in favor of Vehicle Miles Traveled (VMT)
  - Who's next…?
  - Context sensitive design, pedestrian and bike LOS, complete streets

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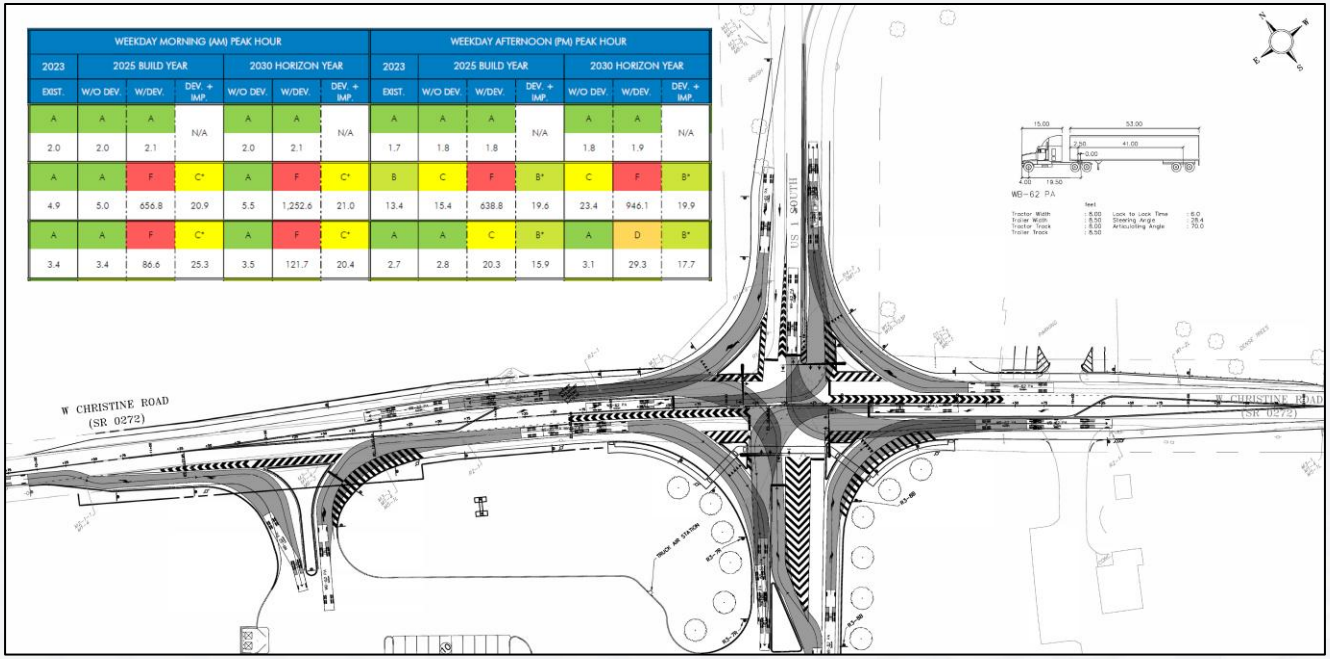
What is a TIS?

- Largely interchangeable terms:
  - Transportation Impact Study
  - Traffic Impact Study
  - Traffic Impact Assessment
- Goal of a TIS is to build consensus on transportation impacts of a project and the solutions, whether it's institutional, municipal, or a private development.
  - Safety first!



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When is a TIS Required?

- Reasons to conduct a TIS
  - DOT threshold for a new driveway to state roadway
  - Municipal Subdivision and Land Development Ordinance
  - Voluntary/planning ☺
    - A planning study can be just that for a municipality. TIS usually means some type of approval or permit is required, otherwise we would just call it a corridor study or planning study.
  - "Impact" – TIS is associated with new or redistributed traffic in the roadway network
- PennDOT
  - *As part of the HOP process, applicants may be tasked with identifying impacts of the proposed access on the transportation system in the surrounding area and identifying mitigations to offset that impact through development of a Transportation Impact Study (TIS) or a Transportation Impact Assessment (TIA).*

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TIS Basics

1. Due Diligence
2. Scoping
3. Data Collection
4. Analysis
5. Identification of required mitigation and recommended improvements
6. Development of report and supporting documentation
7. Multi-Agency Review Process

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1. Due Diligence

- Investigate ordinance requirements
- Review of publicly available traffic data and previous studies
- Trip generation analysis
- Traffic impact fees
- Start narrowing down potential issues
- Help clients avoid problem projects
  - Many projects will die in this phase. That's good!
- Identify concerns/issues that merit additional investigation before a formal TIS
  - Viability of improvements at a single intersection and potential grant funding could determine go v. no-go
- Due diligence could include data collection & limited analysis

2. Scoping

- Critical step for introducing stakeholders and building bridges
- Typically includes a formal submission/application documenting the parameters for a TIS
  - Scoping submission could also make the case that no TIS is required, or a more limited site access evaluation
- Typically includes:
  - Trip generation tables with any proposed pass-by or internalization methodology
  - Study area map with proposed study intersections and time periods
  - Review of the existing roadway network including any known constraints/concerns
  - Review of multimodal transportation infrastructure
  - Site plan depicting proposed access driveways and internal circulation
- May include:
  - Municipality
  - DOT
  - MPO
  - Developer/Owner
  - Neighboring municipalities!
  - Representative for any concurrent projects
- If you think off-site improvements are a possibility or the project is contentious in any way, have a meeting!

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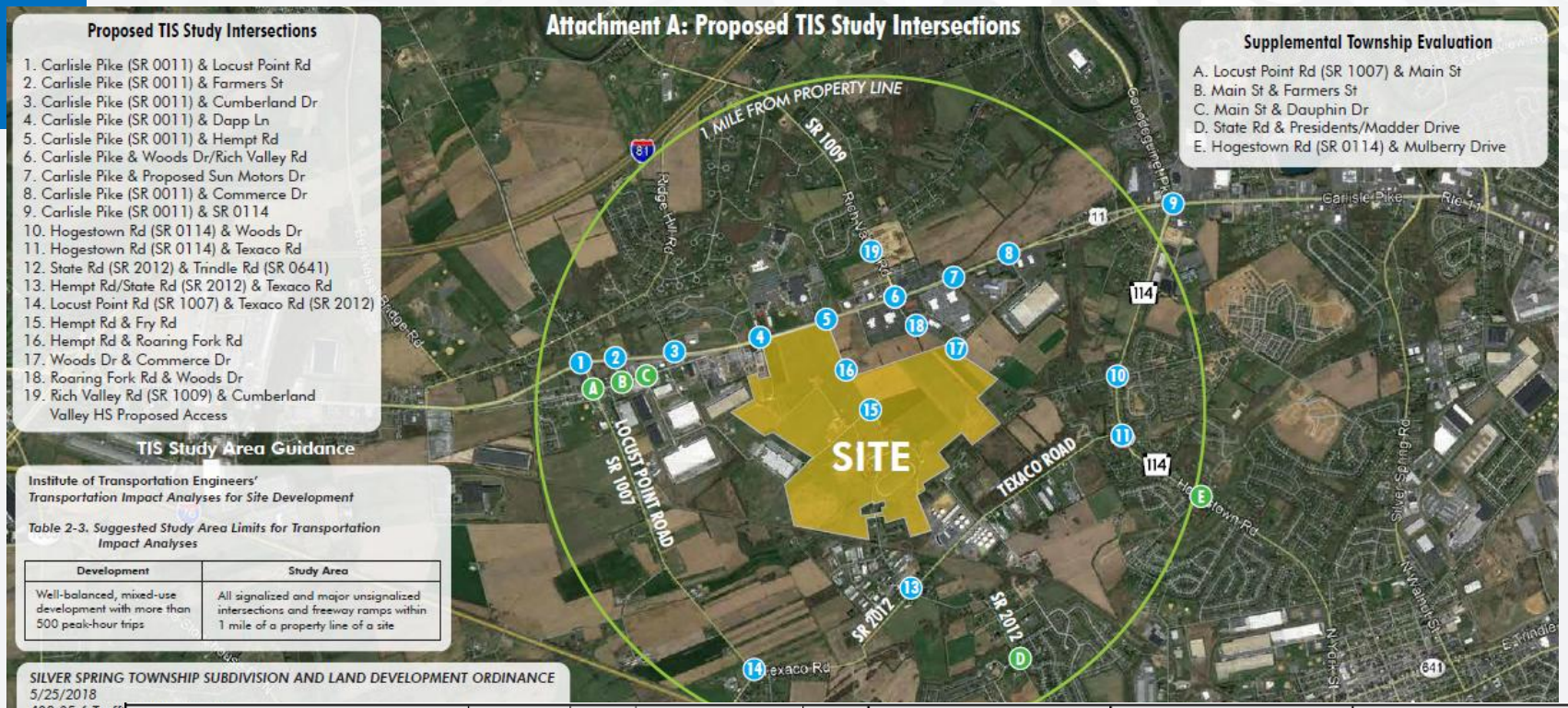
2. Scoping – Sample Documentation



DESCRIPTION	SOURCE	LUC	VARIABLE		DAILY TRIPS	WEEKDAY AM PEAK HOUR			WEEKDAY PM PEAK HOUR			SATURDAY MIDDAY PEAK HOUR		
						IN	OUT	TOTAL	IN	OUT	TOTAL	IN	OUT	TOTAL
Discount Club (Costco Wholesale), Total Trips	ITE, 11th Edition	857	161,141	SF	6,842	79	50	129	338	337	675	503	523	1026
- Pass By, Discount Club	*ITE, 11th Edition*		*34% PM, 25% SAT*						*115*	*115*	*230*	*126*	*131*	*257*
= New Trips; Discount Club	Total Trips - Pass-By					79	50	129	223	222	445	377	392	769
Members-Only Gasoline/Service Station	ITE, 11th Edition	944	24	VFP	4,128	124	123	247	167	167	334	153	153	306
- Internal Trips (Costco Wholesale <-> Costco Gas)	*Costco/Kittelson*		*34% PM, 35% SAT**						*57*	*57*	*114*	*54*	*54*	*108*
- Pass By, Gas/Service Station	*Costco/Kittelson*		*63% AM, 49% PM, 45% SAT***			*78*	*77*	*156*	*82*	*82*	*164*	*69*	*69*	*138*
= New Trips; Fuel Station	Total Trips - Internal - Pass-By					46	46	91	28	28	56	30	30	60
Costco Wholesale Club w/Fuel Station, Total Trips					10,970	203	173	376	505	504	1,009	656	676	1,332
Total Pass-By Trips						*78*	*77*	*156*	*197*	*197*	*394*	*195*	*200*	*395*
Total Internal Trips									*57*	*57*	*114*	*54*	*54*	*108*
Total New Trips						125	96	220	251	250	501	407	422	829

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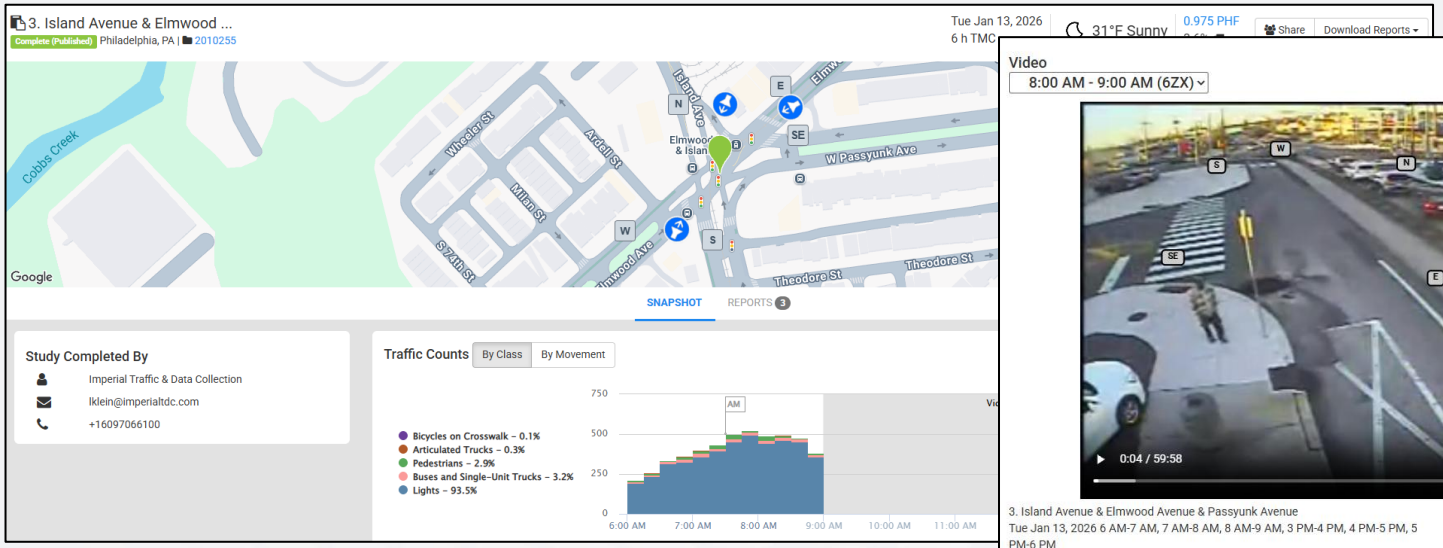
3. Traffic Data Collection

- Review of available traffic data
  - 3 years is a typical guidance for acceptable traffic data (if no major developments or roadway projects would impact counts)
  - Typical time periods – 6-9 AM, 3-6 PM, 11 AM – 2 PM (Saturday)
  - 12-hour counts for traffic signal warrant evaluation
- Options for intersection counts range from clipboards/tallies, Jamar count boards Miovision cameras
- Automated Traffic Recorder (ATR) – for 24-hour directional roadway counts, using tubes or cameras
- Sometimes traffic data collection will be part of due diligence
- Other traffic data to obtain – planned developments discussed at scoping meeting, crash data, proposed improvements by others



4. Analysis

- Trip Generation/Distribution
- Capacity/Level of Service
  - Based on equations in *Highway Capacity Manual*
- Crash/Safety and Sight Distance
- Auxiliary Turn Lane Warrants
- Traffic Signal Warrants
  - Based on MUTCD
- Gap Studies
- Microscopic simulation?

Peak Hour	Weekday Morning (AM)													Weekday Afternoon (PM)											
Year	2023	2033 Interim Year					2042 Build Year					2047 Horizon Year			2023	2033 Interim Year					2042 Build Year					2047 Horizon Year		
Scenario	EXIST.	NO-BUILD	BUILD (1)	BUILD (2)	BUILD (3)	BUILD (3) + IMP	NO-BUILD	BUILD (1)	BUILD (3)	BUILD (4)	BUILD (4) + IMP	NO-BUILD	BUILD (4)	BUILD (4) + IMP	EXIST.	NO-BUILD	BUILD (1)	BUILD (2)	BUILD (3)	BUILD (3) + IMP	NO-BUILD	BUILD (1)	BUILD (2)	BUILD (3)	BUILD (4)	BUILD (4) + IMP	NO-BUILD	BUILD (4)	BUILD (4) + IMP
Lewisberry Road/Old Trail Road (SR 0382) & I-83 SB Ramps Signalized	A	A	A	B	B	B	A	B	B	B	N/A	A	B	N/A	B	B	C	C	C	C	B	C	C	C	N/A	C	C	N/A
	8.9	9.5	10.0	10.2	10.6	10.6	9.8	10.2	10.8	11.6		9.9	11.7		15.3	17.7	20.2	21.0	25.0	25.2	19.4	22.7	25.5	30.5		20.6	32.5	
Old Trail Road (SR 0382) & Pines Road (SR 1009)/I-83 NB Off Ramp Signalized	C	D	E	E	F	D	E	E	D	E	B	E	F	B	C	C	C	C	D	C	C	C	C	D	C	C	E	C
	30.2	48.9	62.2	73.4	98.5	26.5*	55.1	70.0	31.6*	45.5*	13.4**	58.9	51.0*	14.2**	23.2	27.1	29.3	31.3	39.9	20.4*	28.5	30.9	23.1*	32.3*	17.0**	29.3	35.7*	18.0**
Pines Road (SR 1009) & Valley Green Road Unsignalized	A	A	A	A	A	N/A	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A	N/A	A	A	A	A	N/A	A	A	N/A
	3.2	3.3	2.7	2.3	2.0		3.4	2.8	2.1	1.7		3.4	1.8		3.9	4.0	3.5	3.1	2.7		4.0	3.5	2.7	2.4		4.0	2.4	
Pines Road (SR 1009) & Valley Road/Broadway Ave (SR 0262) Unsignalized	A	A	A	A	A	N/A	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A	N/A	A	A	A	A	N/A	A	A	N/A
	3.3	3.3	3.3	3.3	3.3		3.4	3.4	3.3	3.3		3.4	3.3		5.1	5.2	5.2	5.2	5.1		5.2	5.2	5.1	5.1		5.2	5.1	
Valley Green Road & Palmer Drive Unsignalized	A	A	A	A	A	N/A	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A	N/A	A	A	A	A	N/A	A	A	N/A
	1.6	1.6	1.5	1.5	1.5		1.6	1.5	1.5	1.5		1.6	1.5		1.2	1.1	1.1	1.1	1.1		1.2	1.1	1.1	1.1		1.3	1.2	
Valley Green Road & Byron Nelson Circle Unsignalized	A	A	A	A	A	N/A	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A	N/A	A	A	A	A	N/A	A	A	N/A
	2.3	2.2	2.1	2.3	2.5		2.3	2.1	2.6	3.0		2.2	3.0		2.7	2.6	2.5	2.6	2.9		2.7	2.5	2.9	3.3		2.6	3.2	
Whisler Road (SR 1011) & Paddletown Road Unsignalized	A	A	A	A	A	N/A	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A	N/A	A	A	A	A	N/A	A	A	N/A
	0.5	0.5	4.9	4.9	4.9		0.5	4.8	4.8	4.8		0.5	4.8		0.6	0.6	4.8	4.8	4.8		0.6	4.7	4.7	4.7		0.6	4.6	
Whisler Road (SR 1011) & York Haven Road (SR 0382) Unsignalized	A	A	A	A	A	A	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A	A	A	A	A	A	N/A	A	A	N/A
	1.1	1.1	1.9	1.9	1.9	1.9	1.1	1.9	1.9	1.9		1.1	1.9		0.9	0.9	1.6	1.6	1.6	1.6	1.0	1.6	1.6	1.6		1.0	1.6	
Pines Road (SR 1009) & Scarlet Oak Drive/Fox Farm Access Unsignalized	A	A	A	A	A	A	A	A	A	A	N/A	A	A	N/A	A	A	A	A	A	A	A	A	A	A	N/A	A	A	N/A
	3.3	3.3	4.4	5.4	6.5	3.6	3.2	4.3	3.6	4.2		3.3	4.2		1.4	1.4	2.0	3.5	4.9	4.0	1.3	2.0	4.1	4.7		1.4	4.7	
Paddletown Road & Tynio Access Unsignalized	N/A	N/A	A	A	A	N/A	N/A	A	A	A	N/A	N/A	A	N/A	N/A	N/A	A	A	A	N/A	N/A	A	A	A	N/A	N/A	A	N/A
			5.9	5.9	5.9			5.9	5.9	5.9			5.9				3.1	3.1	3.1			3.1	3.1	3.1			3.1	

(1) - 100% Tynio - 0% Fox Farm Build
(2) - 100% Tynio - 20% Fox Farm Build
(3) - 100% Tynio - 50% Fox Farm Build
(4) - 100% Tynio - 100% Fox Farm Build

+IMP - Including Proposed Improvements
* - Single-Lane Roundabout
** - Two-Lane Roundabout

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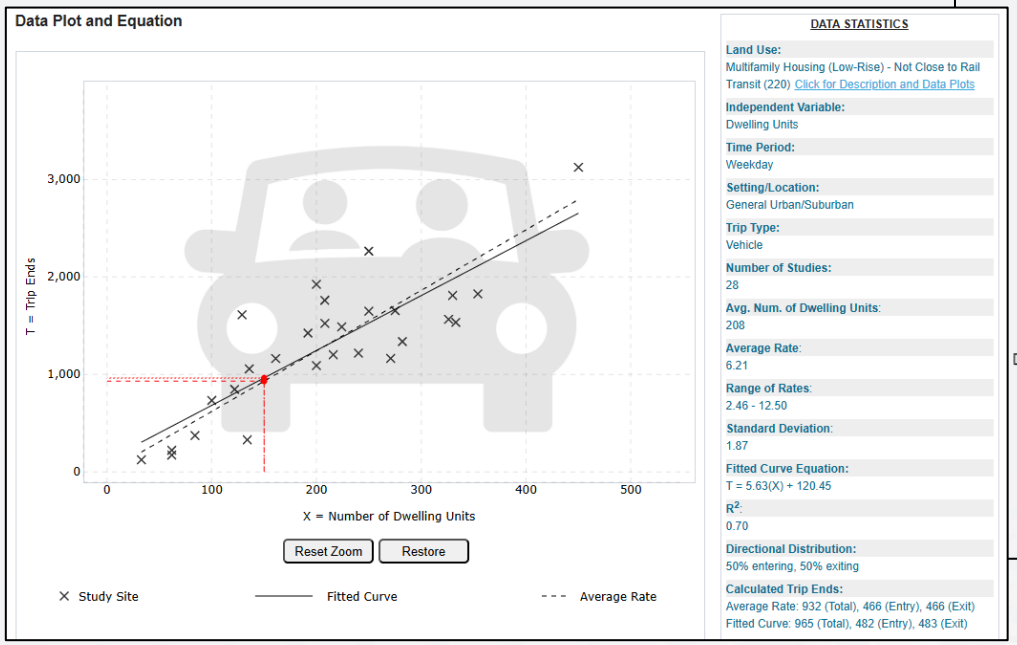
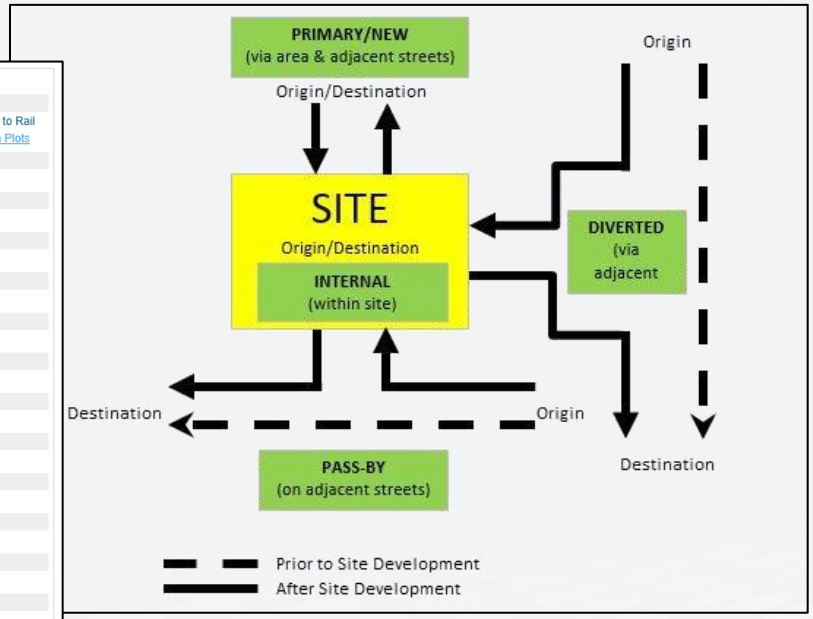
Analysis - Trip Generation

- ITE Trip Generation Manual
  - Independent Variable
  - Rates vs. linear regression equations
  - Living document!
- Pass-By, Diverted Link and Internal Trips
  - Definition of each could differ based on study area & roadway connectivity.





Analysis - Trip Distribution

- Two main methods for new trip distribution
  - Existing traffic count data with consideration of convenience, interchange locations, etc.
  - Gravity Model

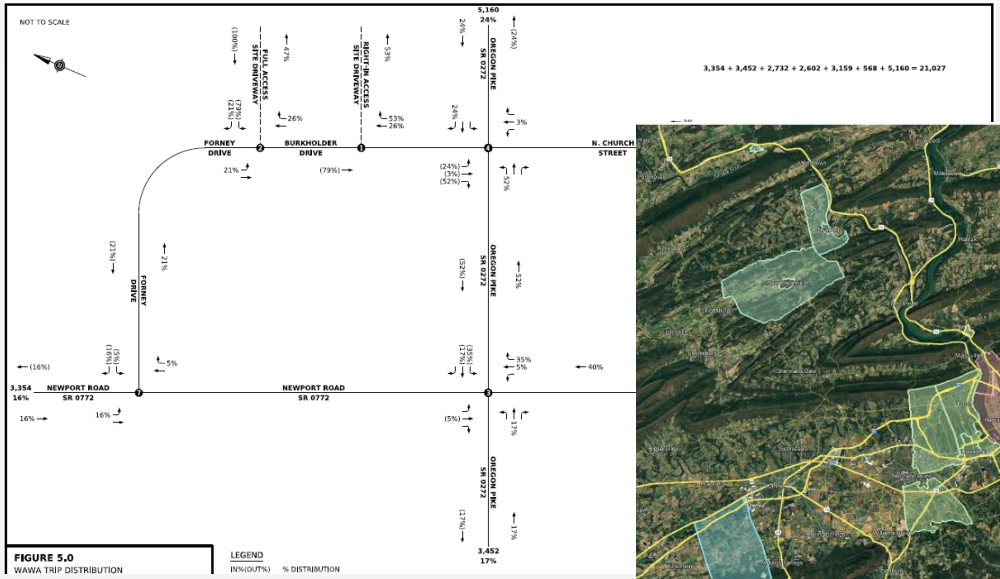
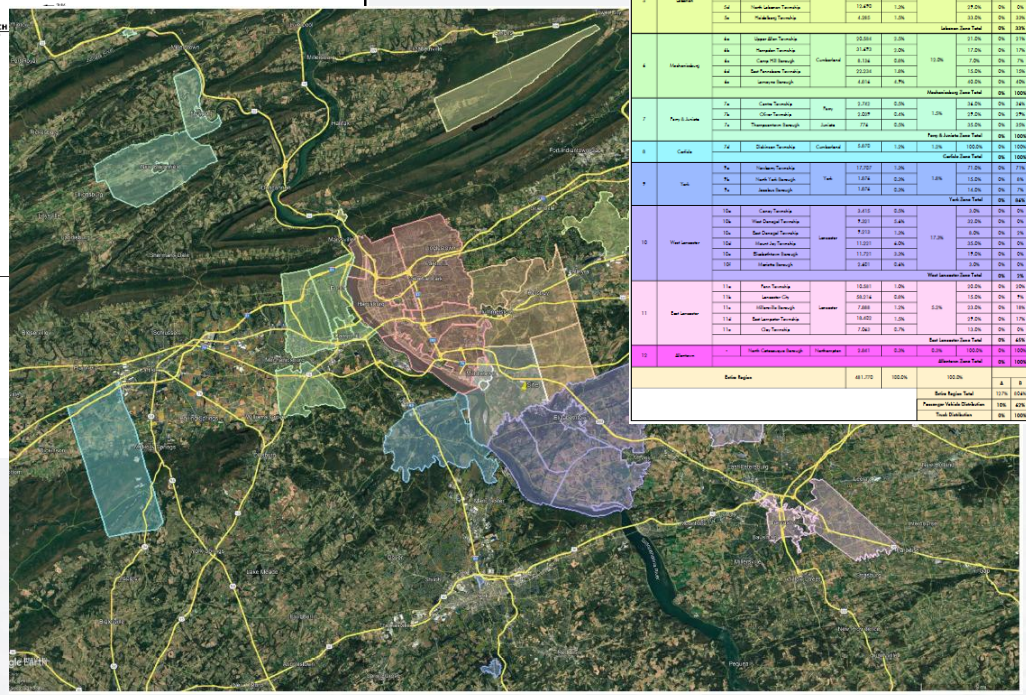
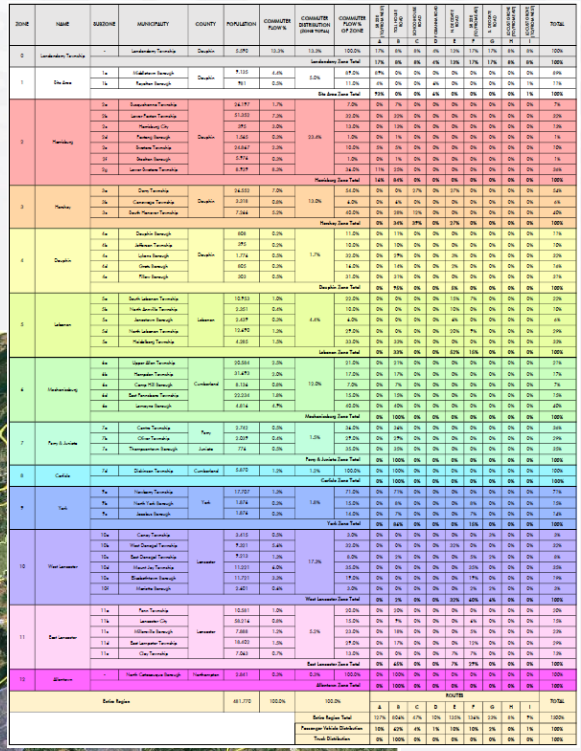


FIGURE 5.0
WAWA TRIP DISTRIBUTION





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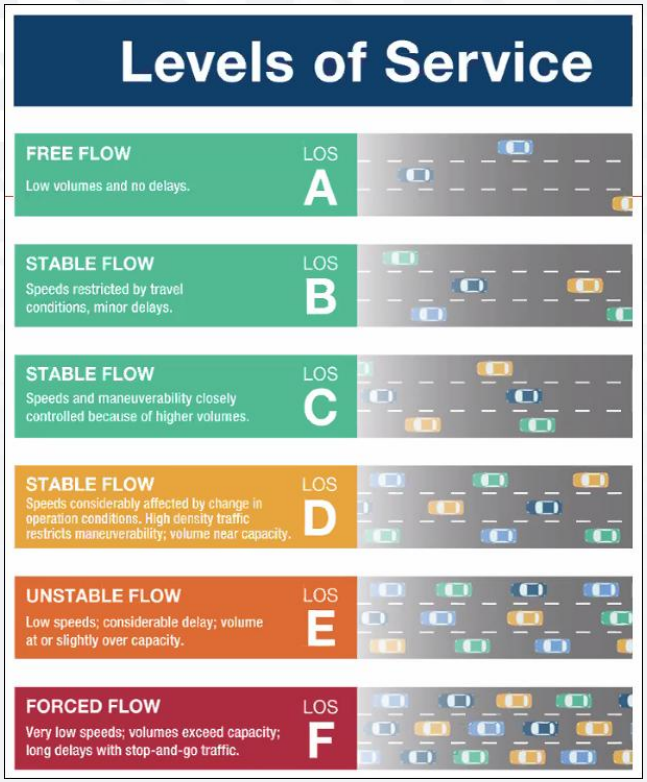
Analysis - Trip Assignment

- Result of the trip generation and distribution is trip assignment, which gives us the future design or horizon year volumes to analyze.

Analysis - Level of Service (LOS)

- Links qualitative and quantitative measures of roadway and intersection traffic flow
- Critiques of LOS – does NOT measure:
  - Multimodal users (transit, walking, biking)
  - Duration of congestion
  - Economic benefits of busy, if congested, retail areas
  - Economic costs of building wide roads for peak times
  - Tradeoffs of higher LOS, include safety risks, air pollution, heat islands, loss of habitat and trees, and housing displacement.
  - Long-term induced travel demand
- For dense urban areas, vehicular LOS has already gone away to some extent. Reviews are much more likely to focus on Complete Streets and ADA implementation.
- For suburban and rural areas, vehicular LOS isn't going anywhere soon. It's just one metric but it's useful for describing and evaluating intersection capacity.



LOS	Signalized Intersection	Unsignalized Intersection
A	≤10 sec	≤10 sec
B	10–20 sec	10–15 sec
C	20–35 sec	15–25 sec
D	35–55 sec	25–35 sec
E	55–80 sec	35–50 sec
F	>80 sec	>50 sec

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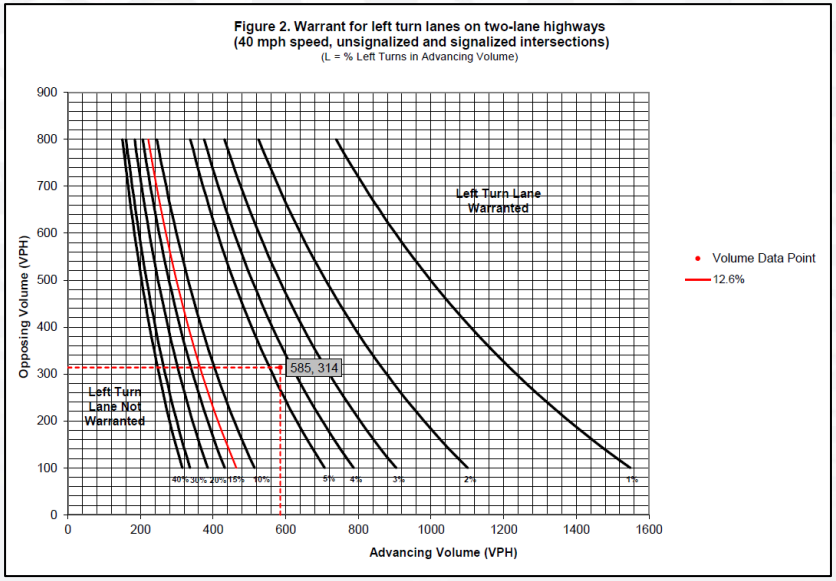
Analysis - Warrants

- Turn Lane Warrant methodology
- Traffic signal warrant methodology



Hourly Distribution of Entering and Exiting Vehicle Trips by Land Use			
Source: ITE *Trip Generation Manual*, 11th Edition			
Land Use Code	945		
Land Use	Convenience Store/Gas Station		
Subcategory	GFA (2-4k)		
Setting	General Urban/Suburban		
Time Period	Weekday		
# Data Sites	38		
	% of 24-Hour Vehicle Trips		
Time	Total	Entering	Exiting
12:00 - 1:00 AM	0.9%	0.9%	0.9%
1:00 - 2:00 AM	0.5%	0.5%	0.5%
2:00 - 3:00 AM	0.5%	0.4%	0.5%
3:00 - 4:00 AM	0.5%	0.5%	0.6%
4:00 - 5:00 AM	1.0%	1.0%	1.1%
5:00 - 6:00 AM	2.3%	2.3%	2.2%
6:00 - 7:00 AM	4.6%	4.7%	4.5%
7:00 - 8:00 AM	6.2%	6.2%	6.1%
8:00 - 9:00 AM	5.9%	5.8%	5.9%
9:00 - 10:00 AM	5.0%	5.0%	5.1%
10:00 - 11:00 AM	5.2%	5.2%	5.2%
11:00 - 12:00 PM	5.3%	5.3%	5.2%
12:00 - 1:00 PM	5.8%	5.8%	5.8%
1:00 - 2:00 PM	5.4%	5.4%	5.3%
2:00 - 3:00 PM	5.9%	6.1%	5.8%
3:00 - 4:00 PM	6.5%	6.5%	6.4%
4:00 - 5:00 PM	7.1%	7.2%	7.1%
5:00 - 6:00 PM	6.9%	7.0%	6.9%
6:00 - 7:00 PM	6.5%	6.5%	6.6%
7:00 - 8:00 PM	5.3%	5.3%	5.3%
8:00 - 9:00 PM	4.4%	4.3%	4.5%
9:00 - 10:00 PM	3.7%	3.7%	3.7%
10:00 - 11:00 PM	2.8%	2.7%	2.8%
11:00 - 12:00 AM	1.9%	1.8%	1.9%

TRAFFIC SIGNAL WARRANT ANALYSIS FINDINGS

	Applicable?	Warrant Met?
Warrant 1, Eight-Hour Vehicular Volume	Yes	Yes
Warrant 2, Four-Hour Vehicular Volume	Yes	Yes
Warrant 3, Peak Hour	Yes	No
Warrant 4, Pedestrian Volume	No	N/A
Warrant 5, School Crossing	No	N/A
Warrant 6, Coordinated Signal System	No	N/A
Warrant 7, Crash Experience	No	N/A
Warrant 8, Roadway Network	No	N/A
Warrant 9, Intersection Near a Grade Crossing	No	N/A
Warrant PA-1, ADT Volume Warrant	No	N/A
Warrant PA-2, Midblock and Trail Crossings	No	N/A

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Analysis - Gap Studies

- Evaluation of gaps for two-way stop-controlled intersections
- Typically for failing left turn movements when a traffic signal is not warranted.
- Drivers adapt – gap study and crash study are critical to consider together

Directions: *Eastbound & Westbound (Combined Gaps for Through/Left from Mi*

	Gap Interval (Seconds)																			
Interval Start	1	3	5	7	9	11	13	15	17	19										
	3	5	7	9	11	13	15	17	19	21										
12:00 PM	11	9	1	3	2	1	1	3	1	1										
12:15 PM	6	4	3	5	3	1	2	0	0	1										
12:30 PM	8	10	5	1	1	4	2	2	1	2										
12:45 PM	8	6	4	3	3	2	0	1	2	0										
Total Gaps in Bin/Range	33	29	13	12	9	8	5	6	4	4										
Cumulative Total (Includes Gaps of X Sec+)	160	127	98	85	73	64	56	51	45	41										
Gap Multiplier (7 second critical gap acceptance + 4 sec follow-up gap)	0			1		2		3												
# Gaps * Multiplier	0	0	0	12	9	16	10	18	12	16										
Capacity for Left/Through Movements				21		26		30		36									20	168
Capacity for Minor Approach Left/Through Movements	301																			

SR 2027 Eastbound ATR Location for Gap Evaluation

Note that any closer to the intersection of Zimmerman Dr itself is not suitable for collection of gap data as slow/stopped vehicles lead to inaccurate results.

SR 2027 Westbound ATR Location for Gap Evaluation

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5. Required Mitigation

- Improvements to mitigate LOS/capacity deficiencies
- Consider multimodal improvements/links and safety for all users
- Consideration of municipal comprehensive plan, capital improvement plans, etc.
- Prepare to face public skepticism – be prepared for every question/concern
- Traffic engineer helps find common ground between municipality that has a wish list of improvements and project owner that has cost/time constraints. Get creative!

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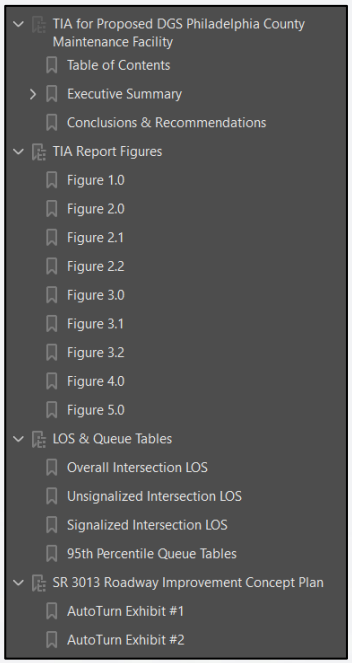
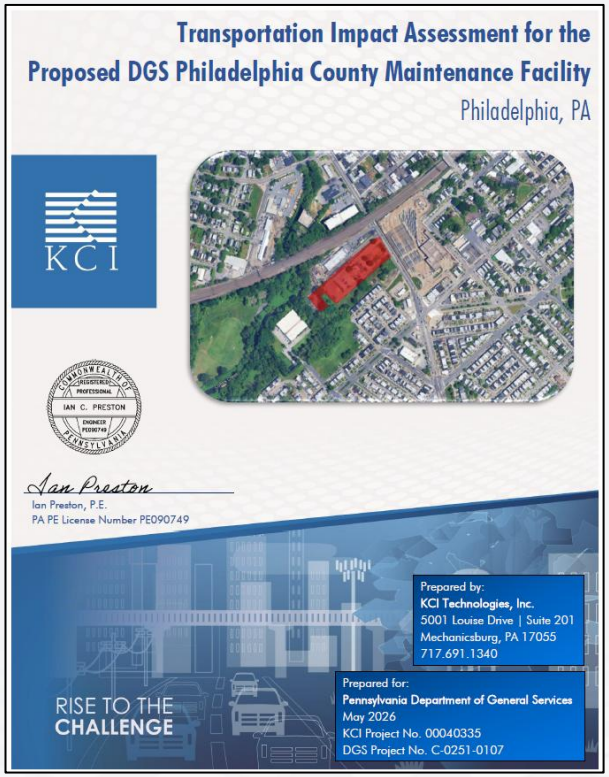
6. TIS: The Report

- Executive summary should be VERY east to understand
- Report itself might be 5-30 pages with hundreds of pages of appendices + supporting documentation.
- Clean presentation = clean reviews
  - Narrow down the scope of each review cycle to focus on critical issues & mitigation
- Detailed concept plans that vet constructability and impacts





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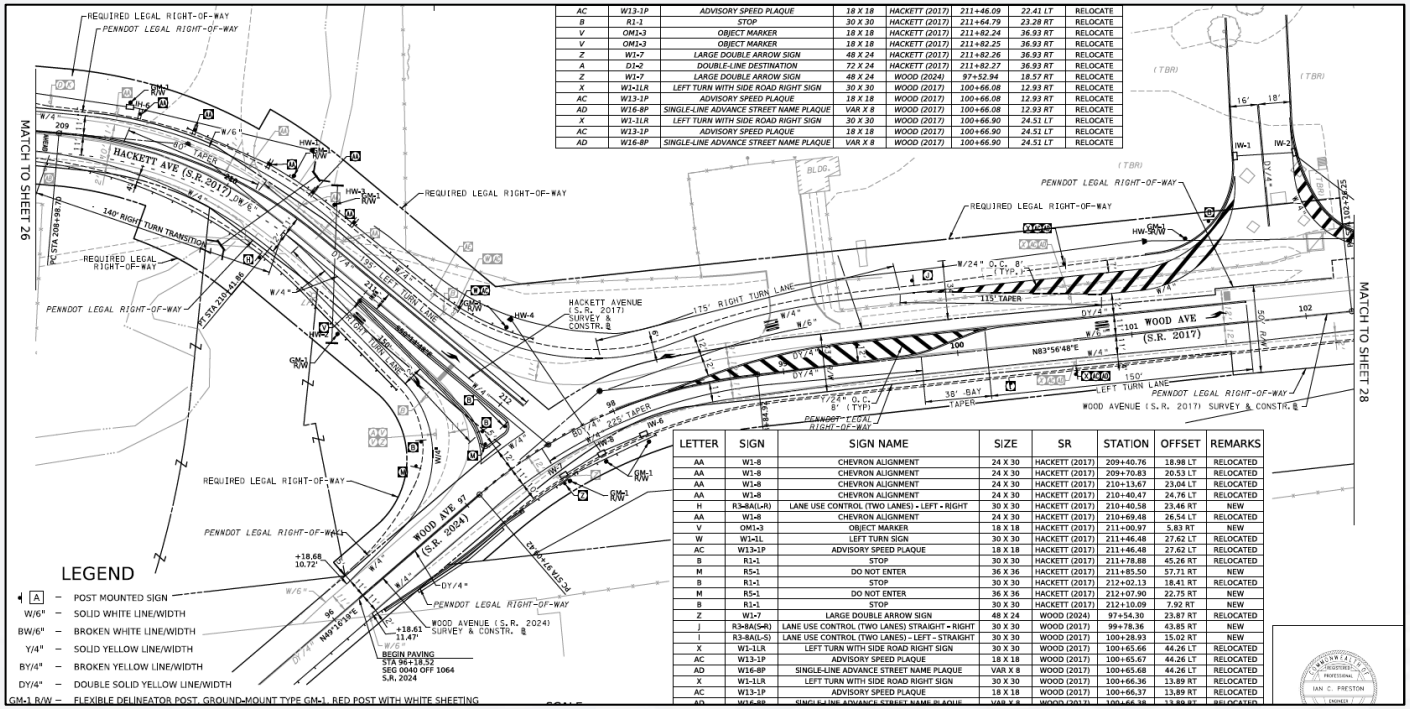
7. Multi-Agency Review Process

- Each review cycle of the TIS is a chance to build consensus between the project owner, municipality, DOT and other stakeholders.
- Meetings to discuss comments are good, but…
- Sometimes will need to lean on either municipal or DOT reviews to address comments from the other agency/entity. Think about the order of operations and keep the process moving forward with defined objectives.
- The art of the comment response letter
- Role of post-development agreements



AC	W13-1P	ADVISORY SPEED PLAQUE	18 X 18	HACKETT (2017)	211+46.09	22.41 LT	RELOCATE
B	R1-1	STOP	30 X 30	HACKETT (2017)	211+64.79	23.28 RT	RELOCATE
V	OM1-3	OBJECT MARKER	18 X 18	HACKETT (2017)	211+82.24	36.93 RT	RELOCATE
V	OM1-3	OBJECT MARKER	18 X 18	HACKETT (2017)	211+82.25	36.93 RT	RELOCATE
Z	W1-7	LARGE DOUBLE ARROW SIGN	48 X 24	HACKETT (2017)	211+82.26	36.93 RT	RELOCATE
A	D1-2	DOUBLE-LINE DESTINATION	72 X 24	HACKETT (2017)	211+82.27	36.93 RT	RELOCATE
Z	W1-7	LARGE DOUBLE ARROW SIGN	48 X 24	WOOD (2024)	97+52.94	18.57 RT	RELOCATE
X	W1-1LR	LEFT TURN WITH SIDE ROAD RIGHT SIGN	30 X 30	WOOD (2017)	100+66.08	12.93 RT	RELOCATE
AC	W13-1P	ADVISORY SPEED PLAQUE	18 X 18	WOOD (2017)	100+66.08	12.93 RT	RELOCATE
AD	W16-8P	SINGLE-LINE ADVANCE STREET NAME PLAQUE	VAR X 8	WOOD (2017)	100+66.08	12.93 RT	RELOCATE
X	W1-1LR	LEFT TURN WITH SIDE ROAD RIGHT SIGN	30 X 30	WOOD (2017)	100+66.90	24.51 LT	RELOCATE
AC	W13-1P	ADVISORY SPEED PLAQUE	18 X 18	WOOD (2017)	100+66.90	24.51 LT	RELOCATE
AD	W16-8P	SINGLE-LINE ADVANCE STREET NAME PLAQUE	VAR X 8	WOOD (2017)	100+66.90	24.51 LT	RELOCATE

LETTER	SIGN	SIGN NAME	SIZE	SR	STATION	OFFSET	REMARKS
AA	W1-8	CHEVRON ALIGNMENT	24 X 30	HACKETT (2017)	209+40.76	18.98 LT	RELOCATED
AA	W1-8	CHEVRON ALIGNMENT	24 X 30	HACKETT (2017)	209+70.83	20.53 LT	RELOCATED
AA	W1-8	CHEVRON ALIGNMENT	24 X 30	HACKETT (2017)	210+13.67	23.04 LT	RELOCATED
AA	W1-8	CHEVRON ALIGNMENT	24 X 30	HACKETT (2017)	210+40.47	24.76 LT	RELOCATED
H	R3-8A(L-R)	LANE USE CONTROL (TWO LANES) - LEFT - RIGHT	30 X 30	HACKETT (2017)	210+40.58	23.46 RT	NEW
AA	W1-8	CHEVRON ALIGNMENT	24 X 30	HACKETT (2017)	210+69.48	26.54 LT	RELOCATED
V	OM1-3	OBJECT MARKER	18 X 18	HACKETT (2017)	211+00.97	5.83 RT	NEW
W	W1-1L	LEFT TURN SIGN	30 X 30	HACKETT (2017)	211+46.48	27.62 LT	RELOCATED
AC	W13-1P	ADVISORY SPEED PLAQUE	18 X 18	HACKETT (2017)	211+46.48	27.62 LT	RELOCATED
B	R1-1	STOP	30 X 30	HACKETT (2017)	211+78.88	45.26 RT	RELOCATED
M	R5-1	DO NOT ENTER	36 X 36	HACKETT (2017)	211+85.50	57.71 RT	NEW
B	R1-1	STOP	30 X 30	HACKETT (2017)	212+02.13	18.41 RT	RELOCATED
M	R5-1	DO NOT ENTER	36 X 36	HACKETT (2017)	212+07.90	22.75 RT	NEW
B	R1-1	STOP	30 X 30	HACKETT (2017)	212+10.09	7.92 RT	NEW
Z	W1-7	LARGE DOUBLE ARROW SIGN	48 X 24	WOOD (2024)	97+54.30	23.87 RT	RELOCATED
J	R3-8A(S-R)	LANE USE CONTROL (TWO LANES) STRAIGHT - RIGHT	30 X 30	WOOD (2017)	99+78.36	43.85 RT	NEW
I	R3-8A(L-S)	LANE USE CONTROL (TWO LANES) - LEFT - STRAIGHT	30 X 30	WOOD (2017)	100+28.93	15.02 RT	NEW
X	W1-1LR	LEFT TURN WITH SIDE ROAD RIGHT SIGN	30 X 30	WOOD (2017)	100+65.66	44.26 LT	RELOCATED
AC	W13-1P	ADVISORY SPEED PLAQUE	18 X 18	WOOD (2017)	100+65.67	44.26 LT	RELOCATED
AD	W16-8P	SINGLE-LINE ADVANCE STREET NAME PLAQUE	VAR X 8	WOOD (2017)	100+65.68	44.26 LT	RELOCATED
X	W1-1LR	LEFT TURN WITH SIDE ROAD RIGHT SIGN	30 X 30	WOOD (2017)	100+66.36	13.89 RT	RELOCATED
AC	W13-1P	ADVISORY SPEED PLAQUE	18 X 18	WOOD (2017)	100+66.37	13.89 RT	RELOCATED
AD	W16-8P	SINGLE-LINE ADVANCE STREET NAME PLAQUE	VAR X 8	WOOD (2017)	100+66.38	13.89 RT	RELOCATED

Reality #1: Some Studies Have a Desired Outcome

- Sometimes the owner of the project has a detailed master plan and they have strong thoughts regarding site access, traffic control, and budget for off-site improvements.
  - Be sensitive to owner's constraints and objectives.
  - Identify concerns early.
  - Lean on ordinances and DOT requirements.
  - When something doesn't work, come to the owner with a solution,
- Better case is that project owner engaged the engineer early in the process.
  - In these instances, traffic engineer's job is to guide the project owner through the process and provide guidance on site access + required mitigation and permitting.
  - Time and impacts to other property owners are often a bigger concern than cost.
  - Offer realistic guidance but owner typically wants to understand risk.
  - TIS is an opportunity to identify constraints or roadblocks to a project early enough to plan and consider changes.

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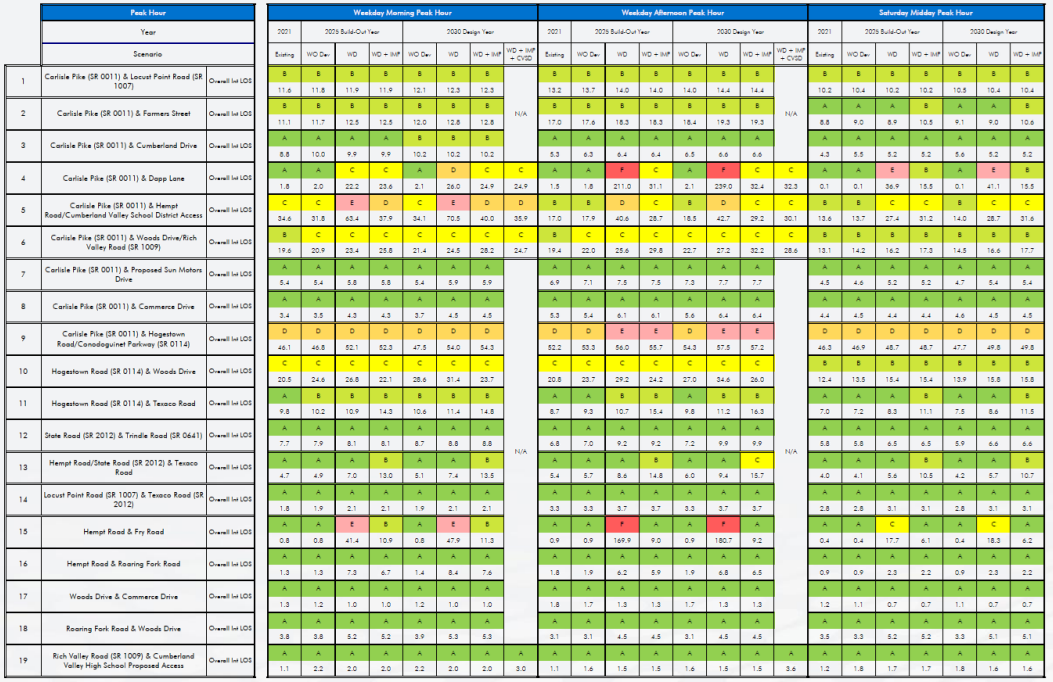
Reality #2: On a challenging project, most time will be spent resolving a handful of specific issues

- TIS with 19 intersections… most of the time/reviews are spent on 3 intersections.
- Municipal ordinance requirements for traffic studies are often… in need of an update.
- Best to comply with ordinance and PennDOT requirements
  - If it's not possible, time to think outside of the box.
  - If waivers are required, identify early and try to find common ground + common sense solutions.
- TIS is an iterative process – tell a story!



	Peak Hour		Weekday Morning Peak Hour								Weekday Afternoon Peak Hour								Saturday Midday Peak Hour							
	Year		2021	2025 Build-Out Year			2030 Design Year				2021	2025 Build-Out Year			2030 Design Year				2021	2025 Build-Out Year			2030 Design Year			
	Scenario		Existing	WO Dev	WD	WD + IMP	WO Dev	WD	WD + IMP	WD + IMP + CV5D	Existing	WO Dev	WD	WD + IMP	WO Dev	WD	WD + IMP	WD + IMP + CV5D	Existing	WO Dev	WD	WD + IMP	WO Dev	WD	WD + IMP
1	Carlisle Pike (SR 0011) & Locust Point Road (SR 1007)	Overall Int LOS	B	B	B	B	B	B	B		B	B	B	B	B	B	B		B	B	B	B	B	B	B	
			11.6	11.8	11.9	11.9	12.1	12.3	12.3		13.2	13.7	14.0	14.0	14.0	14.4	14.4		10.2	10.4	10.2	10.2	10.5	10.4	10.4	
2	Carlisle Pike (SR 0011) & Farmers Street	Overall Int LOS	B	B	B	B	B	B	B	N/A	B	B	B	B	B	B	B	N/A	A	A	A	B	A	A	B	
			11.1	11.7	12.5	12.5	12.0	12.8	12.8		17.0	17.6	18.3	18.3	18.4	19.3	19.3		8.8	9.0	8.9	10.5	9.1	9.0	10.6	
3	Carlisle Pike (SR 0011) & Cumberland Drive	Overall Int LOS	A	A	A	A	B	B	B		A	A	A	A	A	A	A		A	A	A	A	A	A	A	
			8.8	10.0	9.9	9.9	10.2	10.2	10.2		5.3	6.3	6.4	6.4	6.5	6.6	6.6		4.3	5.5	5.2	5.2	5.6	5.2	5.2	
4	Carlisle Pike (SR 0011) & Dapp Lane	Overall Int LOS	A	A	C	C	A	D	C	C	A	A	F	C	A	F	C	C	A	A	E	B	A	E	B	
			1.8	2.0	22.2	23.6	2.1	26.0	24.9	24.9	1.5	1.8	211.0	31.1	2.1	239.0	32.4	32.3	0.1	0.1	36.9	15.5	0.1	41.1	15.5	
5	Carlisle Pike (SR 0011) & Hempt Road/Cumberland Valley School District Access	Overall Int LOS	C	C	E	D	C	E	D	D	B	B	D	C	B	D	C	C	B	B	C	C	B	C	C	
			24.6	31.8	63.4	37.9	34.1	70.5	40.0	35.9	17.0	17.9	40.6	28.7	18.5	42.7	29.2	30.1	13.6	13.7	27.4	31.2	14.0	28.7	31.6	
6	Carlisle Pike (SR 0011) & Woods Drive/Rich Valley Road (SR 1009)	Overall Int LOS	B	C	C	C	C	C	C	C	B	C	C	C	C	C	C	C	B	B	B	B	B	B	B	
			19.6	20.9	23.4	25.8	21.4	24.5	28.2	24.7	19.4	22.0	25.6	29.8	22.7	27.2	32.2	28.6	13.1	14.2	16.2	17.3	14.5	16.6	17.7	
7	Carlisle Pike (SR 0011) & Proposed Sun Motors Drive	Overall Int LOS	A	A	A	A	A	A	A		A	A	A	A	A	A	A		A	A	A	A	A	A	A	
			5.4	5.4	5.8	5.8	5.4	5.9	5.9		6.9	7.1	7.5	7.5	7.3	7.7	7.7		4.5	4.6	5.2	5.2	4.7	5.4	5.4	
8	Carlisle Pike (SR 0011) & Commerce Drive	Overall Int LOS	A	A	A	A	A	A	A		A	A	A	A	A	A	A		A	A	A	A	A	A	A	
			3.4	3.5	4.3	4.3	3.7	4.5	4.5		5.3	5.4	6.1	6.1	5.6	6.4	6.4		4.4	4.5	4.4	4.4	4.6	4.5	4.5	
9	Carlisle Pike (SR 0011) & Hogestown Road/Conodoguinet Parkway (SR 0114)	Overall Int LOS	D	D	D	D	D	D	D		D	D	E	E	D	E	E		D	D	D	D	D	D	D	
			46.1	46.8	52.1	52.3	47.5	54.0	54.3		52.2	53.3	56.0	55.7	54.3	57.5	57.2		46.3	46.9	48.7	48.7	47.7	49.8	49.8	
10	Hogestown Road (SR 0114) & Woods Drive	Overall Int LOS	C	C	C	C	C	C	C		C	C	C	C	C	C	C		B	B	B	B	B	B	B	
			20.5	24.6	26.8	22.1	28.6	31.4	23.7		20.8	23.7	29.2	24.2	27.0	24.6	26.0		12.4	13.5	15.4	15.4	13.9	15.8	15.8	
11	Hogestown Road (SR 0114) & Texaco Road	Overall Int LOS	A	B	B	B	B	B	B		A	A	B	B	A	B	B		A	A	A	B	A	A	B	
			9.8	10.2	10.9	14.3	10.6	11.4	14.8		8.7	9.3	10.7	15.4	9.8	11.2	16.3		7.0	7.2	8.3	11.1	7.5	8.6	11.5	
12	State Road (SR 2012) & Trindle Road (SR 0641)	Overall Int LOS	A	A	A	A	A	A	A		A	A	A	A	A	A	A		A	A	A	A	A	A	A	
			7.7	7.9	8.1	8.1	8.7	8.8	8.8	N/A	6.8	7.0	9.2	9.2	7.2	9.9	9.9	N/A	5.8	5.8	6.5	6.5	5.9	6.6	6.6	
13	Hempt Road/State Road (SR 2012) & Texaco Road	Overall Int LOS	A	A	A	B	A	A	B		A	A	A	B	A	A	C		A	A	A	B	A	A	B	
			4.7	4.9	7.0	13.0	5.1	7.4	13.5		5.4	5.7	8.6	14.8	6.0	9.4	15.7		4.0	4.1	5.6	10.5	4.2	5.7	10.7	
14	Locust Point Road (SR 1007) & Texaco Road (SR 2012)	Overall Int LOS	A	A	A	A	A	A	A		A	A	A	A	A	A	A		A	A	A	A	A	A	A	
			1.8	1.9	2.1	2.1	1.9	2.1	2.1		3.3	3.3	3.7	3.7	3.3	3.7	3.7		2.8	2.8	3.1	3.1	2.8	3.1	3.1	
15	Hempt Road & Fry Road	Overall Int LOS	A	A	E	B	A	E	B		A	A	F	A	A	F	A		A	A	C	A	A	C	A	
			0.8	0.8	41.4	10.9	0.8	47.9	11.3		0.9	0.9	169.9	9.0	0.9	180.7	9.2		0.4	0.4	17.7	6.1	0.4	18.3	6.2	
16	Hempt Road & Roaring Fork Road	Overall Int LOS	A	A	A	A	A	A	A		A	A	A	A	A	A	A		A	A	A	A	A	A	A	
			1.3	1.3	7.3	6.7	1.4	8.4	7.6		1.8	1.9	6.2	5.9	1.9	6.8	6.5		0.9	0.9	2.3	2.2	0.9	2.3	2.2	
17	Woods Drive & Commerce Drive	Overall Int LOS	A	A	A	A	A	A	A		A	A	A	A	A	A	A		A	A	A	A	A	A	A	
			1.3	1.2	1.0	1.0	1.2	1.0	1.0		1.8	1.7	1.3	1.3	1.7	1.3	1.3		1.2	1.1	0.7	0.7	1.1	0.7	0.7	
18	Roaring Fork Road & Woods Drive	Overall Int LOS	A	A	A	A	A	A	A		A	A	A	A	A	A	A		A	A	A	A	A	A	A	
			3.8	3.8	5.2	5.2	3.9	5.3	5.3		3.1	3.1	4.5	4.5	3.1	4.5	4.5		3.5	3.3	5.2	5.2	3.3	5.1	5.1	
19	Rich Valley Road (SR 1009) & Cumberland Valley High School Proposed Access	Overall Int LOS	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
			1.1	2.2	2.0	2.0	2.2	2.0	2.0	3.0	1.1	1.6	1.5	1.5	1.6	1.5	1.5	3.6	1.2	1.8	1.7	1.7	1.8	1.6	1.6	

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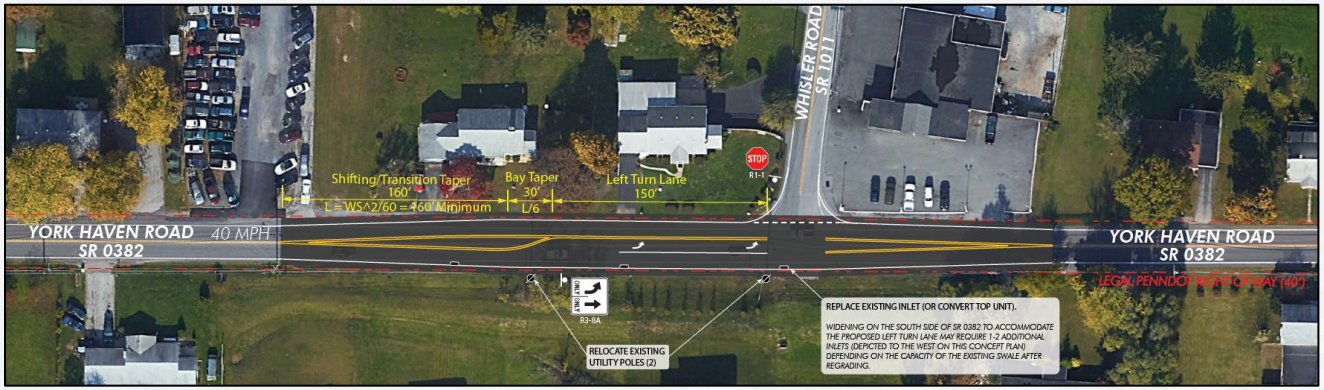
Reality #3: Litigation is the least desirable outcome

- Litigation involving land development & associated traffic study is usually the least desirable outcome for both parties and typically reflects political pressure.
- Traffic engineer/TIS plays a critical role on projects with municipal or public opposition.
  - Demonstrating that legitimate transportation concerns are thoughtfully addressed.
  - Help to find compromise/common ground and identify additional improvements/community benefits that could be linked to the project, even if they might not be required mitigation for capacity/LOS.
- Complying with ordinance and PennDOT requirements is the fast path to approval
  - If it's not possible, time to think outside of the box.
  - If waivers are required, identify early and try to find common ground + common sense solutions.
- No hard feelings
  - Everyone is representing their own interests.
  - TIS plays a critical role in finding the overlap between each entity's interests and moving a project forward.



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