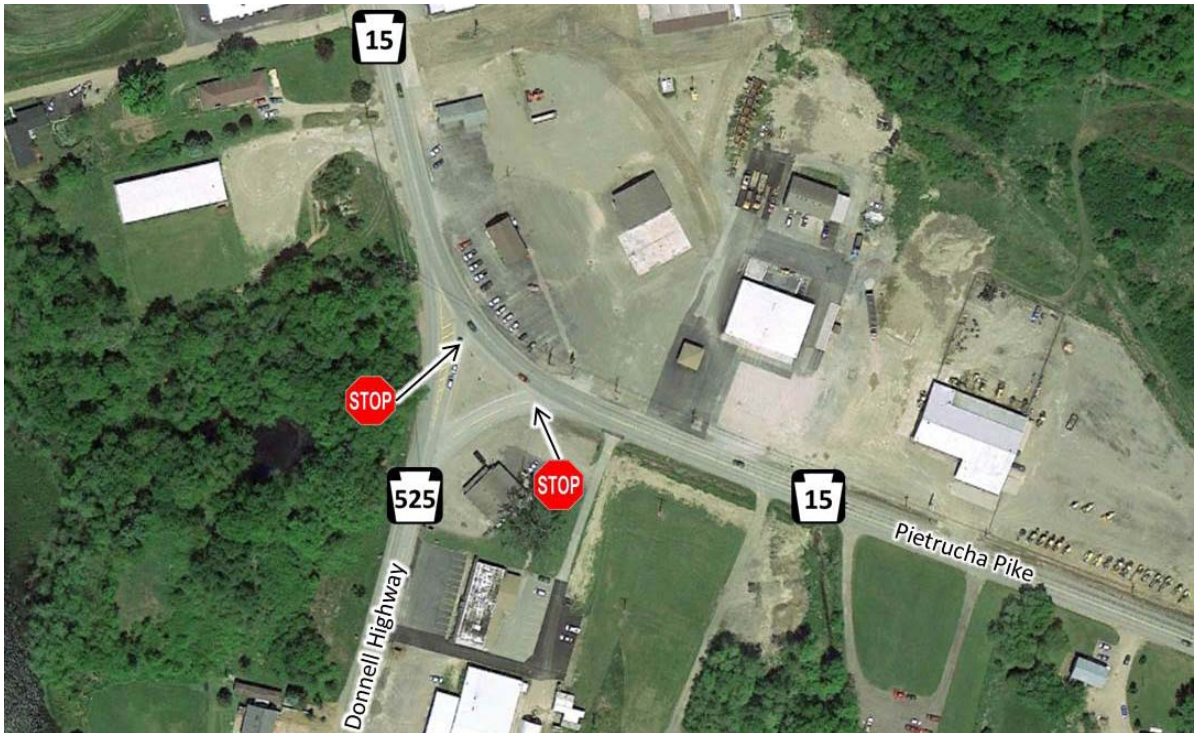
PENNDOT INTERSECTION CONTROL EVALUATION (ICE) POLICY CASE STUDY #2

PROJECT LOCATION



EXECUTIVE SUMMARY

Case Study #2 highlights the evaluation of an existing intersection experiencing operational and safety performance issues where only a select few control strategies are applicable. The purpose of this case study is to demonstrate the application of the ICE Policy where Stage 1 analyses are unable to identify a single preferred control strategy.

PROJECT DESCRIPTION

A corridor study of State Route 525 in Benner Township determined the three-legged, minor road stop-controlled intersection of SR 15/SR 525 currently operates at level-of-service (LOS) "F" during the weekday a.m. and weekday p.m. peak hours. A review of the historical crash data showed a pattern of angle crashes between minor and major approach movements. The study intersection lies just west of Bellefonte, and aside from the small residential community to the east, the surrounding area primarily consists of farmland. Land uses directly adjacent to the study intersection include low-density commercial and retail developments with unrestricted driveway access. The purpose of this evaluation is to determine if a different control strategy would help alleviate these existing issues, as well as accommodate anticipated future growth in the region.

CONDUCTING AN ICE

As a PennDOT project, the Stage 1 ICE form was completed by PennDOT staff. The preliminary analyses indicated many of the intersection control types would not be suitable given the two-lane, rural nature of SR 15 and SR 525 in the region.

The turning movement counts and crash history at the intersection lent themselves to three intersection control strategies:

- Two-way Stop-Control (existing)
- Traffic Signal
- Roundabout

The existing two-way stop-control control strategy was included in the analyses in the event neither of the two proposed control strategies offered improvements to existing conditions or further vetting showed they were not viable. However, as the preliminary analyses conducted in Stage 1 did not establish a clear preferred control strategy, the three control strategies were recommended for additional analysis under ICE Stage 2.

Stage 2 analyses were conducted by PennDOT's on-call consultants. The operational analyses showed both the traffic signal and roundabout would perform adequately under existing and projected design year (2032) traffic volumes. After applying the PennDOT HSM Analysis Tool for the three control strategies, the roundabout was projected to provide the greatest safety B/C ratio. In addition, the roundabout was preferred by the Centre County Metropolitan Planning Organization (CCMPO). As such, it was recommended as the control strategy to be advanced. The recommendation was approved by the District 2 DTE.

Project Location: Benner Township
County: Centre
PennDOT District: District 2
Project Type: Corridor Improvement Project
Project Setting: Rural Community
Existing Intersection Control: Stop-control
Outcome: Roundabout Minor Road
Stages: 2

Pennsylvania Department of Transportation
Intersection Control Evaluation (ICE) Form
Stage I: Screening

To fulfill the requirements of Stage 1 (Screening) of PennDOT's ICE procedures, complete the following form and append all supporting documentation. Completed forms can be submitted to the District Traffic Engineer (DTE) for the project's location.

Project Information

Project Name	Case Study #2	Project Setting	Rural Community	Project ICE Reference Number	XXXX-XXXX
Submitted By	XXX	Agency/Company	PennDOT	Email	XXXX.XXXX@state.pa.us
Project Purpose and Goals (*What is the catalyst for this project and what are the intended outcomes?*)	A corridor study of State Route 15 in Benner Township evidenced the stop-controlled intersection of SR 15/SR 525 currently operates at level-of-service (LOS) "F" during the weekday a.m. and weekday p.m. peak hours. A review of the historical crash data also evidenced a pattern of angle crashes between minor and major approach movements. The intent of this evaluation is to determine if an alternative control strategy would help alleviate these existing issues, as well as accommodate anticipated future growth.				
Project Setting Description (*Describe the area surrounding the intersection*)	The SR 15/SR 525 study intersection is a three-legged intersection that lies just west of Bellefonte. Aside from the small residential community to the north, the surrounding area primarily consists of farmland. Land uses directly adjacent to the study intersection include low-density commercial and retail developments with unrestricted driveway access.				
County	Centre	Project Locality (Township/Borough/City)	Brenner Township		
PennDOT District	District 2	Project Type (select most appropriate)	Corridor Improvement Project		
Multimodal Context (*Describe pedestrian, bicycle, and transit activity in the area and the potential for activity based on surrounding land uses and development pattern*)	Given the proximity to Bellefonte and rural nature of the study intersection, no pedestrian or bicycle infrastructure is present in the immediate vicinity. Existing pedestrian and bicyclist volumes at the study intersection are low to nonexistent. No transit routes operate in the vicinity of the study intersection.				

Basic Intersection Information

Major Street

Major Street Route Number(s)	15	Major Street Route Name(s)	Pietrucha Pike			SR Segment #	10	SR Offset	0
Primary Functional Classification	Minor Arterial	Secondary Functional Class. (if app.)				Existing AADT	20,000	Existing Control	Two-way Stop-Controlled
Major Street Ownership	PennDOT			Sidewalks are present along:	Neither side of the roadway				
Crosswalks? ☐	On-Street Bike Facilities? ☐	Multi-Use Path? ☐		Scheduled Bus Service? ☐		Bus stop at intersection? ☐			

Approach #1	Number of Lanes (Count Shared Lanes as Through):	Left-Turn		Through	1	Right-Turn	1	
	AM Peak Hour Traffic Volumes:	Left-Turn		Through	398	Right-Turn	225	
	PM Peak Hour Traffic Volumes:	Left-Turn		Through	527	Right-Turn	339	
Approach #2	Number of Lanes (Count Shared Lanes as Through):	Left-Turn	1	Through	1	Right-Turn		
	AM Peak Hour Traffic Volumes:	Left-Turn	31	Through	516	Right-Turn		
	PM Peak Hour Traffic Volumes:	Left-Turn	24	Through	354	Right-Turn		

Minor Street

Existing ☑ New ☐

Minor Street Route Number(s)	525	Minor Street Route Name(s)	Donnell Highway			SR Segment #	84	SR Offset	457
Primary Functional Classification	Minor Arterial	Secondary Functional Class. (if app.)				Existing AADT (if available)		14,000	
Minor Street Ownership	PennDOT			Sidewalks are present along:	Neither side of the roadway				
Crosswalks? ☐	On-Street Bike Facilities? ☐	Multi-Use Path? ☐		Scheduled Bus Service? ☐		Bus stop at intersection? ☐			

Approach #1	Number of Lanes (Count Shared Lanes as Through):	Left-Turn		Through	1	Right-Turn		
	AM Peak Hour Traffic Volumes:	Left-Turn	254	Through		Right-Turn	20	
	PM Peak Hour Traffic Volumes:	Left-Turn	199	Through		Right-Turn	25	
Approach #2	Number of Lanes (Count Shared Lanes as Through):	Left-Turn		Through		Right-Turn		
	AM Peak Hour Traffic Volumes:	Left-Turn		Through		Right-Turn		
	PM Peak Hour Traffic Volumes:	Left-Turn		Through		Right-Turn		
Approach #3	Number of Lanes (Count Shared Lanes as Through):	Left-Turn		Through		Right-Turn		
	AM Peak Hour Traffic Volumes:	Left-Turn		Through		Right-Turn		
	PM Peak Hour Traffic Volumes:	Left-Turn		Through		Right-Turn		

Crash History (Existing Intersections Only)

Append the most recent five-years of crash data for the intersection from the CDART. If the crash data evidences any issues relating to safety performance, discuss briefly here:

The most recent five (5) years of crash data evidenced seven angle crashes occurred between major street and minor street movements. Four of these crashes occurred between northbound left-turns on SR 525 (stop-controlled) and westbound through movements on SR 15 (uncontrolled). These crashes may occur to due the inability of vehicles on the minor approach to find an acceptable gap in traffic and the limited intersection sight distance (as noted in the corridor study).

Screening Evaluation

Provide a brief justification as to why each of the following control strategies should be advanced or not. Justification should consider potential environmental impacts.

Note: FHWA's CAP-X tool is helpful for assessing the viability of alternative intersection forms.

Control Strategy	Strategy Viable?	Justification	Strategy to be Advanced?
Two-way Stop-Controlled	Yes	As the existing control strategy, a two-way stop-controlled intersection should only be considered "viable" if no other intersection control strategies are anticipated to improve operations and safety performance.	Yes
All-way Stop-Controlled	No	Given the existing traffic volumes on the major approaches, converting the existing intersection to all-way stop-controlled would increase control delays at the intersection to unacceptable levels.	No
Signalized Control	Yes	Introducing a traffic signal at the study intersection could potentially help reduce delays to minor street movements. The green time provided to the minor street may help reduce angle crashes resulting from delays (inability to find an acceptable gap in traffic).	Yes
Roundabout	Yes	Introducing a roundabout the study intersection could potentially help reduce delays and alleviate the likelihood of angle crashes between major street and minor street movements.	Yes
Median U-Turn	No	The existing SR 15 is a two-lane, rural roadway with no median. To develop this intersection type, significant widening would be required near the intersection. Several private businesses are located adjacent to the roadway on the eastern leg of SR 15.	No
Restricted Crossing U-Turn (RCUT) Signalized	No	Given the rural nature of the intersection and relatively low traffic volumes, introducing two new signals and widening SR 15 to develop a signalized RCUT intersection would likely have a low cost-benefit ratio.	No
Restricted Crossing U-Turn (RCUT) Unsignalized	No	The existing SR 15 is a two-lane, rural roadway with no median. To develop this control type, significant widening would be required near the intersection. Several private businesses are located adjacent to the roadway on the eastern leg of SR 15.	No

Jughandle	No	The operational and safety performance issues identified at the study intersection do not stem from major street left-turns.	No
Displaced Left-Turn	No	This control strategy is not applicable given the study intersection contains three approaches.	No
Continuous Green Tee	No	Introducing a continuous green tee intersection would require the restriction of access to several of the existing developments along SR 15. Rerouting trips to adjacent intersections to perform U-turn maneuvers to access these sites is not a desired outcome of any intersection improvements.	No
Quadrant Roadway	No	The operational and safety performance issues identified at the study intersection do not stem from major street left-turns. Furthermore, developing this control strategy would impact several local businesses.	No
Other			

Resolution				
To be filled out by PennDOT District Traffic Engineer or designee only.				
Project Determination	Multiple Viable Alternatives Identified: Continue to Stage 2			
Comments				
DTE or Designee Name *(Type)*		Signature		Date

Pennsylvania Department of Transportation
Intersection Control Evaluation (ICE) Form
Stage 2: Initial Control Strategy Assessment

To fulfill the requirements of Stage 2 (Intersection Control Strategy) of PennDOT's ICE procedures, complete the following form and append all supporting documentation. Completed forms can be submitted to the District Traffic Engineer (DTE) for the project's location.

Project Information

Project Name	Case Study #2	Project ICE Reference Number	XXXX-XXXX
Submitted By: XXX	Agency/Company: PennDOT	Email	XXXX.XXXX@state.pa.us

List all viable intersection control strategies identified in Phase 1 (Screening):

Two-way Stop-Controlled	Signalized Control	Roundabout

Operational Analysis

Summarize the results of the peak hour analysis performed for each control strategy. Select analysis year based on guidance in the ICE procedures document.

Overall Intersection Performance

Opening Year

Control Strategy	Analysis Year: 2017 — Peak Hour Analyzed: Weekday AM Peak — LOS	V/C	Delay (sec.)	All queues accommodated?	Peak Hour Analyzed: Weekday PM Peak — LOS	V/C	Delay (sec.)	All queues accommodated?
Two-way Stop-Controlled	F	0.94	79.3	Yes	F	0.96	84.2	Yes
Signalized Control	B	0.65	13.0	Yes	B	0.60	11.4	Yes
Roundabout	B	0.72	12.0	Yes	B	0.77	12.4	Yes

Design Year

Control Strategy	Analysis Year: 2037 — Peak Hour Analyzed: Weekday AM Peak — LOS	V/C	Delay (sec.)	All queues accommodated?	Peak Hour Analyzed: Weekday PM Peak — LOS	V/C	Delay (sec.)	All queues accommodated?
Two-way Stop-Controlled	F	1.81	424.2	Yes	F	1.85	445.0	Yes
Signalized Control	C	0.81	20.2	Yes	B	0.70	14.6	Yes
Roundabout	C	0.78	19.3	Yes	C	0.94	23.5	Yes

Provide any additional discussion necessary regarding the results of the operational analysis:

Both the traffic signal and roundabout operate acceptably under year 2017 traffic volumes and can accommodate future design year growth. To achieve these levels of operation under signalized control, an exclusive eastbound right-turn lane and a westbound left-turn lane should be provided.

Costs

Remaining cognizant of the current level of detail of each control strategy's conceptual design, provide a cost estimate for each. You may want to account for preliminary engineering, required right-of-way acquisitions, construction, and a contingency.

Control Strategy	Cost ($)	Estimate Includes:	Control Strategy	Cost ($)	Estimate Includes:
Two-way Stop-Controlled	$0	PE, ROW, Construction, Contingency			
Signalized Control	$400,000	PE, ROW, & Construction			
Roundabout	$750,000	PE, ROW, & Construction			

Safety Performance

Apply the PennDOT HSM Analysis Tool and provide the "Safety B/C" ratio provided by the tool's output. You may wish to append the complete output to this form. For intersection types not accommodated in the tool, manually apply crash modification factors detailed in the ICE policy document or qualitatively describe safety impacts.

Control Strategy	Anticipated Impact on Safety Performance	Predicted Total Crashes	Predicted Fatal & Injury Crashes	Safety B/C
Two-way Stop-Controlled	No anticipated changes to safety performance.	5.37	2.97	1.00
Signalized Control	Installing a traffic signal would decrease the likelihood of angle crashes at the intersection, as minor street movements would be provided a protected phase for completing their maneuver. The propensity for rear-end crashes may increase on the major street approaches; however, these are generally lower in severity relative to angle crashes due to the impact location on the vehicle.	2.25	0.63	3.43
Roundabout	Installing a roundabout would reduce the number and severity of conflict points, as well as promote lower speeds through the intersection. As a result, the number of high severity angle crashes would be anticipated to be reduced.	0.97	0.39	10.17

Multimodal Accommodations

Note the existing/anticipated level of pedestrian/bicyclist activity at the study intersection during the peak hours of the typical day.

	AM Peak Hour		PM Peak Hour	
	Major Street	**Minor Street**	**Major Street**	**Minor Street**
# of ped. crossings (both approaches, if app.):				
# of bicyclists (both approaches, if app.):				

Summarize the ability of each viable control strategy to accommodate the existing/anticipated level of:

Control Strategy	Pedestrians and Bicycles	Transit Services	Freight Needs
Two-way Stop-Controlled	The uncontrolled major street approaches may present difficulties for pedestrians and bicyclists. Drivers may not expect peds/bikes	No existing or anticipated transit services in site vicinity	A WB-67 is accomodated by the existing configuration.
Signalized Control	Provided the traffic signal includes phasing for pedestrian and bicyclist crossings, the low level of bike/ped volumes can easily	No existing or anticipated transit services in site vicinity	A WB-67 is accomodated.
Roundabout	Pedestrian crossings would be located across the legs of the roundabout, which limits crossing distances to a single lane.	No existing or anticipated transit services in site vicinity	A WB-67 is accomodated.

Environmental, Utility, and Right-of-Way Impacts	
Summarize any issues related to environmental, utility, or right-of-way (to include relocations) impacts specific to each control strategy.	
Two-way Stop-Controlled	None. This is the existing control strategy, and no improvements would be required.
Signalized Control	Minimal impacts anticipated. Only minor row-of-way acquisitions anticipated to accommodate the signal infrastructure. Some right-of-way would be required to accommodate an exclusive southbound right-turn lane given the queues shown in the operational analysis.
Roundabout	Given the large footprint of the existing stop-controlled intersection, a 150-160 ft. ICD roundabout could be designed on the existing footprint with minor acquisitions of ROW to the west of the intersection. The land to the west currently lies unoccupied/undeveloped.

Public Input/Feedback	
Summarize public input received or any stakeholder considerations regarding the control strategies:	The results of the SR 15 corridor study were presented to the Centre County Metropolitan Planning Organization (CCMPO), as well as to members of the public in attendance, highlighting the need for improvements to the study intersection based on both operational and safety performance. Planning-level concepts for the two control strategies (not including the existing two-way stop-control) were outlined. Both members of the CCMPO and public shared their anecdotal experiences with the intersection and expressed interest in potential improvements. The

Benefit-Cost Analysis

Apply the PennDOT ICE Tool and provide the "Net Present Value" and "Benefit-Cost Ratio" from the "Output" tab for each control strategy. The "Benefit-Cost Ratio" is only applicable for improvements to an existing intersection.

Control Strategy	Net Present Value	Benefit-Cost Ratio
Two-way Stop-Controlled	$19,614,900	-
Signalized Control	$37,600,671	39.12
Roundabout	$20,652,753	38.28

Control Strategy Evaluation

Provide a brief justification as to why each of the following is either viable or not viable. If a single control strategy is recommended, select it as the only control strategy to be advanced.

Control Strategy	Strategy Viable?	Justification	Strategy to be Advanced?
Two-way Stop-Controlled	No	Both the traffic signal and roundabout control strategies are anticipated to improve both operations and safety performance substantially compared to the existing, two-way stop-control. In addition, this control strategy will not adequately accommodate future growth.	No
Signalized Control	Yes	While a traffic signal would be anticipated to operate acceptably under both existing and future design year traffic volumes, the roundabout provides the greatest potential for reducing the high severity angle crashes occurring at the intersection.	No
Roundabout	Yes	As shown through the application of the PennDOT HSM tool, the installation of a single-lane roundabout provides the greatest anticipated reduction to crashes at the intersection. Members of the Waterford Council also expressed interest in a roundabout as a means of controlling vehicle speeds as they approach town. The operational analyses show a roundabout is anticipated to operate acceptably under both existing and future conditions.	Yes

Resolution

To be filled out by PennDOT District Traffic Engineer or designee only

Project Determination	Identified Control Strategy Approved	
Comments		
DTE or Designee Name	Signature	Date