US Route 6 Bypass - Main Avenue
Interchange Study

Prepared for:

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Acknowledgements

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CONTENTS

Executive Summary

Who initiated the study?

This study of the US Route 6 Bypass-Main Avenue Interchange in the City of Warren and Pleasant Township was facilitated and funded by the Northwest Commission, with support from the Warren County Planning and Zoning Office. The Northwest Commission contracted with Michael Baker International, a planning and engineering firm, to help lead and carryout the study.

Why was this study initiated?

The demand for the study came in response to recent planning initiatives conducted by the Northwest Commission, including a Regional Freight Study and 2040 Long Range Transportation Plan (LRTP) that identified various improvement needs within the study corridor related to safety and mobility. The regional nature of these prior planning efforts is such that they identified general areas of concern: a more detailed level of analysis was required in order to suggest specific projects for the Transportation Improvement Program (TIP) and other funding sources.

The study is intended to help the Northwest Commission and Warren County primarily in identifying a range of improvement alternatives to provide full-access between Main Avenue (SR 1027) and US 6, where today only a partial interchange is provided. The current configuration of the US 6-Main Avenue interchange provides a westbound on-ramp from Main Avenue and an eastbound off-ramp to Main Avenue, both ramps on the western side of Main Avenue. The current configuration requires passenger cars and trucks to use Pleasant Drive (SR 3005), with residential adjacent land use, to access all points east along US 6 when originating from or destined to Main Avenue.

Who participated in the study process?

The study report was shaped through the input of a four-member steering committee comprised of the Northwest Commission, Warren County Planning and Zoning Office, and the Pennsylvania Department of Transportation (PennDOT) Engineering District 1-0. The steering committee reviewed draft study products and offered local insights and perspectives. The Warren County Planning and Zoning Office also held stakeholder meetings in April 2018 in which local municipalities and businesses provided study input.

What are the study's major findings?

The planning process identified several major findings, including:

- Collecting data on existing traffic conditions, including turning movement counts, crash data, and traffic operations.
- Identifying existing (2018) and future (horizon year 2028) traffic operation issues to determine interchange alternatives regarding capacity, congestion, and safety needs.

- Identifying future planned developments within or surrounding the study area that would bring additional traffic to the study area in the future.
- The identification of six initial alternatives for consideration by the steering committee.
- The development of two preferred alternatives for conceptual improvements to the study area:
    - Alternative A (Modified): New Ramps Servicing US 6 to the East
    - Alternative D (Modified): Right-in/Right-out Ramp Combination

What happens next?

Northwest Commission will work with the Warren County Planning and Zoning Office to review and vet the two preferred alternatives and then coordinate with PennDOT to program improvements identified to advance.

Introduction

The Northwest PA Regional Planning & Development Commission (Northwest Commission) initiated this study in February 2018. The impetus for a study of the interchange of US Route 6 and Main Avenue (SR 1027) in Warren County, PA comes in response to recent planning activities conducted by the Northwest Commission, including a Regional Freight Study and Long-Range Transportation Plan that identified various improvement needs related to safety and mobility. The regional nature of those studies and planning efforts was such that they identified general areas of concern, however a more detailed level analysis is required in order to develop specific recommendations further.

The US 6-Main Avenue interchange is a half-diamond configuration, with an on-ramp for motorists to access US 6 westbound, and an off-ramp for those traveling eastbound. The surrounding area supports a mix of land uses, including residential and commercial. Most importantly, the area supports several major shippers and receivers, including Whirley Industries, Berenfield Containers, and the Warren County Small Business Development Center, a business incubator. The lack of a full interchange has resulted in motor carriers and other traffic using Pleasant Drive (SR 3005), and a variety of other roadways in accessing US 6 eastbound. The focus of this study was to develop recommendations and alternatives for addressing the accessibility to the eastern portions of Route 6 from the interchange area and prioritize two alternatives for further study and analysis.

Understanding specific traffic issues within the study area was essential to the development of study improvement alternatives. Transportation recommendations were developed to reflect existing 2018 and future conditions. The recommendations and alternatives considered are limited to those that can be realistically and feasibly be implemented.

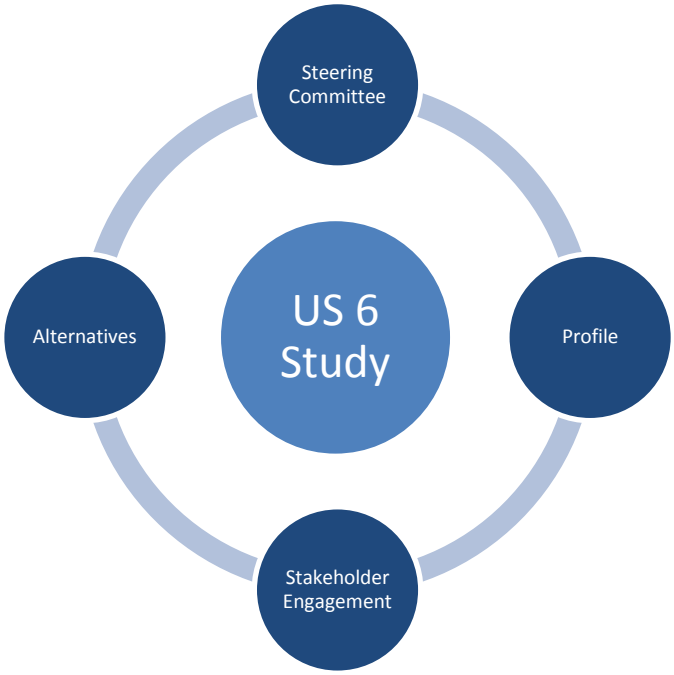
The primary end products of the project include:

1. Traffic counts and capacity analyses for study area roadways and intersections
2. Conceptual improvement alternatives that address the capacity, mobility, and safety needs within the study area
3. Sketch level cost estimates for selected transportation improvement alternatives

Methodology/Approach

The study process followed the following primary tasks, as illustrated in **Figure 1**:

Figure 1: Study Methodology



Study Steering Committee – A steering committee to guide the study process was formed at the onset of the study. The committee included representation from PennDOT District 1-0, the Warren County Planning and Zoning Office, and the Northwest Commission. A list of the study steering committee members is included in the Acknowledgements section of this report.

Study Area Profile – The study includes information regarding traffic flows and safety conditions within the study area. Morning and evening traffic counts were conducted at four intersections and traffic volumes, vehicle classification, and vehicle speeds were gathered at two locations throughout the study area to establish a traffic and safety profile. Additionally, five years of historical crash data was collected and analyzed and a field inventory was conducted.

Stakeholder Engagement – In addition to steering committee member involvement, a stakeholder meeting was held to learn more concerning current areas of concern and potential transportation improvements. The event was organized by the Warren County Planning and Zoning Office and helped shape the final study report to be reflective of concerns not only from public officials, but the local community.

Alternatives – Based on input gathered during stakeholder engagement and from the steering committee together with the findings from the study area profile analyses, alternatives were identified and vetted.

Study Area Profile

Study Area Focus

The study area consisted of the US 6 partial interchange with Main Avenue and the surrounding routes to the intersection of US 6 & Mohawk Avenue/ Pleasant Drive/Crescent Park located in the City of Warren, PA and Pleasant Township, PA, also shown in **Figure 2**:

Figure 2: Study Area

Traffic data was collected at the following four study intersections and two study segment locations, shown in **Figure 3**.

Study intersection locations:

1. US 6 & Pleasant Drive/Crescent Park (SR 3005) – Signalized
2. Main Avenue (SR 1027) & Pleasant Drive (SR 3005) – Stop Controlled
3. US 6 EB Off-Ramp (SR 8008, Ramp E) & Main Avenue (SR 1027) – Stop Controlled
4. US 6 WB On-Ramp (SR8008, Ramp H) & Main Avenue (SR 1027) – Uncontrolled

Study segment locations:

1. Along Pleasant Drive (SR 3005) midblock between the Main Avenue (SR 1027) and Mohawk Avenue (SR 2003) intersections
2. Along Main Avenue just south of the at-grade railroad crossing

Figure 3: Traffic Data Collection Locations

US Route 6 (US 6) is a principal arterial highway on the National Highway System running east-west from Provincetown, MA to Bishop, CA. Nationally, it is known as the Grand Army of the Republic Highway. Within the study area, US 6 transitions from a four-lane divided, controlled access freeway on the western end to a two-lane, two-way principal arterial at the eastern end. The posted speed limit varies from west to east through the study area. It is 50 MPH crossing the Allegheny River and 40 MPH in the area of Main Avenue and through the traffic signal at Pleasant Drive. The primary focus of the study is the half-diamond interchange serving Main Avenue to/from US 6 to the west. The half-interchange consists of an EB US 6 off-ramp to Main Avenue and WB US 6 on-ramp from Main Avenue. The half interchange serves southern portions of the City of Warren, as well as Pleasant Township. All traffic from these areas to and from US 6 to the east must access US 6 at the signalized intersection of US 6 & Mohawk Avenue approximately 2000-feet to the east.

SR 1027 (Main Avenue), near the US 6 half diamond interchange, is a two-lane, two-way, urban minor arterial with 10-foot shoulders, left-turn lanes at intersections and a wide painted center lane/median. From Pleasant Drive to north of the interchange area at the intersection with Harmar Street, Main Avenue is a state road with a posted speed limit 35 MPH. From the Harmar Street intersection northward through the City of Warren, Main Avenue is a two-lane two-way local road with a posted speed limit of 25 MPH. Trucks over 5 tons are prohibited from traveling north of the Harmar Street intersection. There is a rail-road crossing of Main Avenue approximately 400-feet north of the Harmar Street intersection.

SR 3005 (Pleasant Drive) is a two-lane, two-way, urban minor arterial with 0 to 2-foot shoulders and closely spaced residential driveways. It is a state route with a posted speed limit of 35 MPH within the study area. 200-feet south of the signalized intersection with US 6, SR 3005 (Pleasant Drive) is joined with

SR 2003 (Mohawk Avenue) at a Y-intersection. Between the Y-intersection and US 6, Pleasant Drive widens to provide a right-turn lane at the intersection with US 6. This state route connects South Warren to rural areas and communities to the southwest.

SR 3005 (Crescent Park) is a two-lane, two-way, state route and city road with a posted speed limit of 35 MPH throughout the study area. From US 6 in Pleasant Township to the railroad spur at the City of Warren City border, this road is SR 3005 (a state road) and north of the railroad spur through the City of Warren is a turn-back local road. This road carries traffic in and out of the City of Warren. There is a left-turn lane on SR 3005 (Crescent Park) at the US 6 intersection. Two rail-road crossings on this road are within a short distance of the US 6 intersection; one is 100-feet north of the intersection and the other is 500-feet north of the intersection. Trucks over 5 tons are prohibited from traveling on the City owned portion of Crescent Park (i.e. north of the second railroad crossing). There are no intersections between US 6 and the weight restricted area.

Table 1 provides reportable crash data for a five-year period (2013-2017) for each study intersection. There were no reportable crashes on the roadway sections between the study intersections during the five-year analysis period.

Table 1: Reportable Crash Data at Study Intersections

Totals and Crash Severity					
Intersection #	Location	Total Crashes	Injury Crashes	Fatal Crashes	PDO Crashes
1	US 6 & Pleasant Dr./Crescent Park	6	2	0	4
2	Main Avenue & Pleasant Dr.	3	1	0	2
3	Main Avenue & US 6 EB Off -Ramp	2	0	0	2
4	Main Avenue and US 6 WB On-Ramp	0	0	0	0
Time of Day and Roadway Condition					
Intersection #	Location	Nighttime Crashes	Daytime Crashes	Icy/Snow Condition	Dry
1	US 6 & Pleasant Dr./Crescent Park	1	5	3	3
2	Main Avenue & Pleasant Dr.	3	0	1	2
3	Main Avenue & US 6 EB Off -Ramp	2	0	0	2
4	Main Avenue and US 6 WB On-Ramp	0	0	0	0
Collision Type					
Intersection #	Location	Angle Crashes	Head-On Crashes	Hit Fixed Object Crashes	
1	US 6 & Pleasant Dr./Crescent Park	5	1	0	
2	Main Avenue & Pleasant Dr.	2	0	1	
3	Main Avenue & US 6 EB Off -Ramp	1	0	1	
4	Main Avenue and US 6 WB On-Ramp	0	0	0	

Data Collection

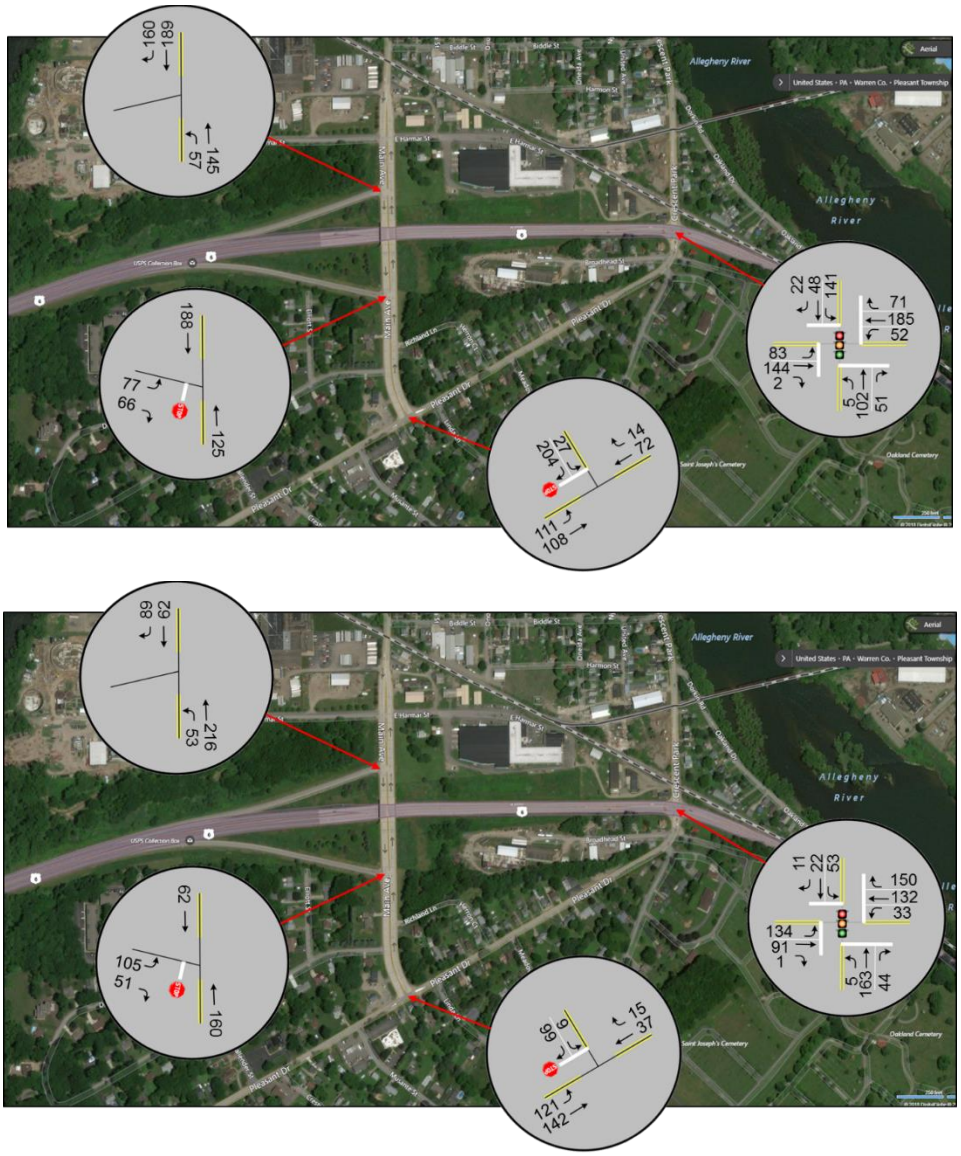
Vehicle Movements

Existing turning movement counts, including pedestrians, bicycles and heavy vehicles were completed on April 3, 2018 and April 4, 2018 at each study intersection identified previously. Peak hours were determined for the following time periods:

- Weekday A.M. Peak Period (6:00 - 9:00 A.M.)
- Weekday P.M. Peak Period (3:00 - 6:00 P.M.)

The A.M. and P.M. peak hour turning movements for each study intersection are shown in **Figure 4**.

Figure 4: Weekday Peak Hour Turning Movement Counts



Two Automated Traffic Recorder (ATR) counts were completed at the previously identified locations from March 30, 2018 through April 4, 2018. In addition to traffic volume, both the vehicle classification and speeds were recorded at each location in each direction. **Table 2** provides the average daily traffic (ADT) (vpd, vehicles per day), heavy vehicle percentage, and 85th percentile speed at each ATR location.

Table 2: ATR Volume, Heavy Vehicle %, & Speed

ATR Location		Weekday		Weekend		85th Percentile Speed
		ADT	HV %	ADT	HV %	
1	**SR 3005 (Pleasant Drive)**	**2052**	**5.2%**	**1805**	**1.8%**	**41 MPH**
	Eastbound	1370	4.7%	1205	1.8%	42 MPH
	Westbound	683	6.4%	601	1.9%	40 MPH
2	**SR 1027 (Main Avenue)**	**4977**	**2.4%**	**3152**	**1.5%**	**29 MPH**
	Northbound	1837	2.9%	1063	2.8%	30 MPH
	Southbound	3141	2.2%	2089	0.9%	29 MPH

Field Inventory

A field visit and inventory was conducted to more clearly understand the specific issues and physical features within the study area. As part of the field inventory, sight distance and grades were measured for each study intersection approach. No sight distance constraints were observed at any of the study intersections. The intersection approach grades are provided in **Table 3**.

Table 3: Study Intersection Approach Roadway Grades

Location	Approach	Grade
Main Avenue and US 6 WB On- Ramp	SB	2.6%
	NB	-2.9%
Main Avenue and US 6 EB Off-Ramp	SB	0.4%
	NB	0.1%
	EB	3.0%
Main Avenue and Pleasant Drive	SB	-0.6%
	EB	3.9%
	WB	-3.0%
US 6 and Pleasant Drive	EB and WB	0.0%
	SB	0.0%
	NB	-3.9%
Pleasant Drive and Mohawk Ave	Pleasant Drive, NB	-7.0%
	Mohawk Ave, NB	-10.7%
	Pleasant Drive, SB	5.2%

Existing Study Area Conditions

Capacity Analysis

Capacity analyses for signalized and stop-controlled intersections were completed following the 2010 Highway Capacity Manual (HCM) methodologies using Synchro 10 software for the study area intersections. The capacity analyses calculate the control delay for vehicles per lane group at each intersection, which is also aggregated into an average control delay for the overall intersection. Control delay measures the average additional delay incurred by vehicles as a result of the traffic control device (e.g., stop control, signal, roundabout, etc.), and control delay includes stopped time as well as acceleration and deceleration delay. Level of service (LOS) is determined based on the control delay using the following thresholds established in the 2010 HCM as indicated in **Table 4**.

Table 4: 2010 HCM LOS Thresholds

Level of Service	Control Delay (seconds per vehicle)	
	Stop Control	Signal
A	≤ 10	≤ 10
B	> 10 – 15	> 10 – 20
C	> 15 – 25	> 20 – 35
D	> 25 – 35	> 35 – 55
E	> 35 – 50	> 55 – 80
F	> 50 or v/c > 1.0	> 80 or v/c > 1.0

v/c = volume to capacity ratio
Source: *Highway Capacity Manual*, 2010

The existing counts were used to determine the intersection LOS to evaluate whether there were any operational or capacity deficiencies at the study intersections. The results of the existing A.M. and P.M. peak hour LOS analysis are shown in **Figure 5** and **Figure 6,** respectively.

All stop controlled study intersections operate at LOS A, and the signalized intersection of US 6 and Pleasant Drive operates at LOS C during the both A.M. and P.M. peak hours.

Figure 5: Existing Morning Study Intersection LOS

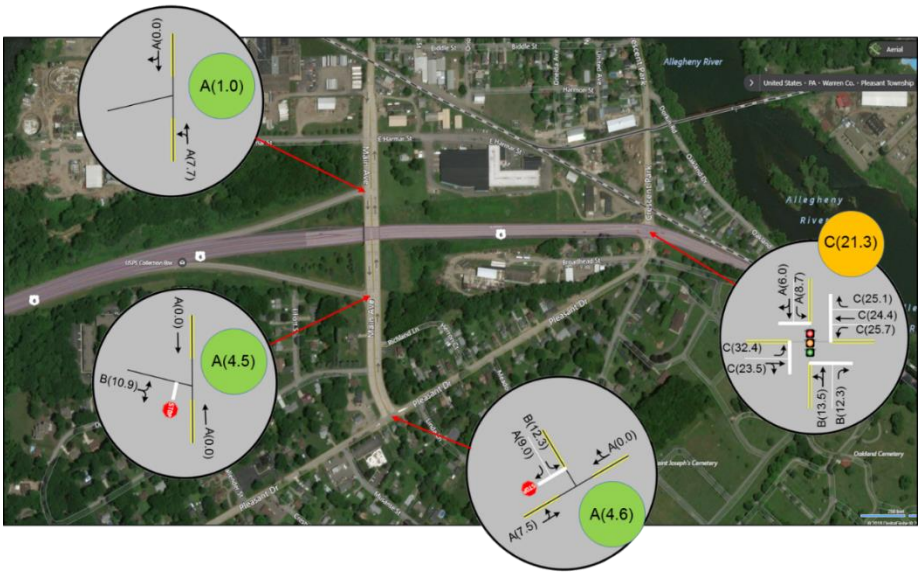
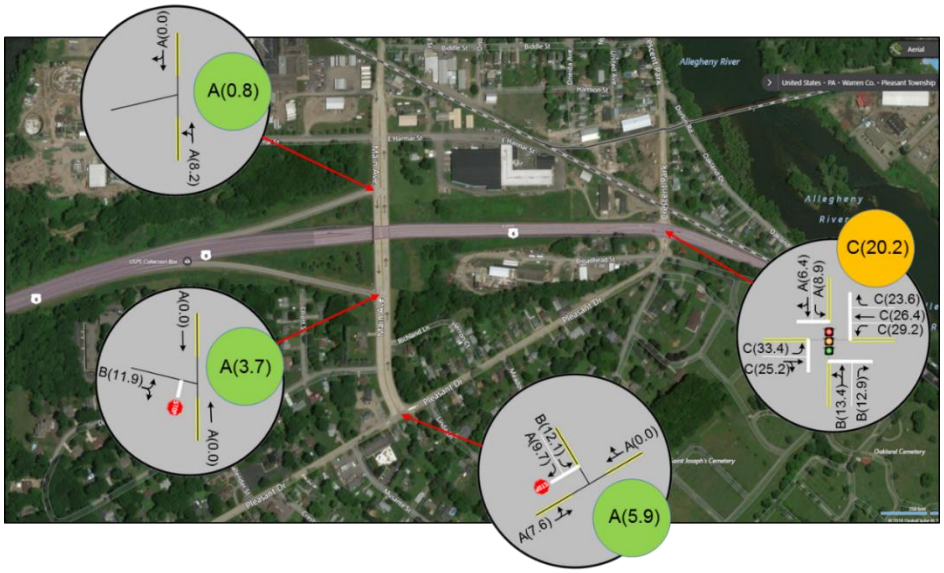


Figure 6: Existing Afternoon Study Intersection LOS



Turn Lane Analysis

A turn-lane analysis for right-turn lanes and left-turn lanes was conducted at the two stop-controlled study intersections to evaluate whether there is an existing capacity demand for the addition of a turn lane at either of the intersections. As a result of the analysis, it was determined that no additional turn lanes were warranted at the stop-controlled intersections.

Future Conditions

This study uses an analysis period of 10 years when developing future traffic volumes and conditions. Therefore, the future year for analysis is the design horizon year of 2028 so as to evaluate the long-term impacts of various interchange reconfigurations within the study area.

Annual Background Growth

Future base traffic volumes were projected by applying an annual growth rate developed using the PennDOT Growth Factors published for August 2017 to July 2018. The annual compounded growth rate calculated from the PennDOT Growth Factors for Warren County rural non-interstate roads is 0.39%. For the proposed design horizon year of 2028, the annual growth rate of 0.39% is compounded over 10 years to yield a growth factor of 4.0%.

Nearby Proposed Developments

Growth in the area surrounding the US 6-Main Avenue interchange study area is minimal. Communication with the steering committee revealed there are no known proposed developments which would have significant traffic generation.

Design Year Traffic Volumes

2028 design year projected traffic volumes were determined using the growth factor of 4.0% with no additional trips added for 'known' developments since none were identified. Design year LOS analyses for the four study intersections indicated that all intersections are projected to continue to operate at their current level of operation; LOS A for all Main Avenue intersections and LOS C for the signalized intersection at US 6 & Pleasant Drive/Crescent Park.

Stakeholder Engagement

The study included community outreach that directly engaged invited members of the community to gather meaningful input on the current issues relative to travel within the study area and surrounding community. The results of the stakeholder engagement activities are summarized on the following pages.

Overview

In April 2018, targeted stakeholder interviews and focus group meetings were held to identify transportation issues and opportunities with an emphasis on improving traffic flow in an area immediately surrounding the US 6 interchange. The outcomes and key findings identified through stakeholder outreach are summarized on the following pages.

Stakeholder Interviews

Pleasant Township Supervisors

- Within Pleasant Township and the City of Warren, there is noticeable trucking activity (both long- and short-haul) occurring at all hours of the day.
- Whirley Industries is a major freight generator, with trucks moving in and out of their facility around 30 times a day.
- US 6 is a major east-west roadway and most of the trucks must go through the intersection of US 6 and Main Avenue.
- To connect to US 6 going east, trucks must go through a residential section in Pleasant Township. The combination of truck traffic and the roadway's vertical curvature has contributed to noise complaints from residents.
- The intersection of US 6 and Mohawk Avenue is challenging to navigate; there are multiple roadways intersecting.
- All the roadways in study area are posted. Some truck drivers have been observed trying to find short cuts around the posted weight limits.
- The intersection of Main Avenue and Pleasant Drive can get backed up during peak morning and afternoon hours and it poses as a safety issue. A motorist could spend up to 10 minutes at that intersection waiting to safely turn.
- There is a railroad crossing north of the interchange and it is active. It occasionally causes traffic backups.
- Traffic conditions are exacerbated in winter months.
- Pleasant Drive is shaded and in the winter months it can be very icy. There are crashes along the roadway because of this. The roadways at the intersection of US 6 and Mohawk Avenue are lower priority roads for snow-removal maintenance.

City of Warren

- There is a concern that there will be issues acquiring any needed right-of-way on the southeastern quadrant of the interchange to complete the diamond.
- There appears to be enough area within the southwestern quadrant to include a cloverleaf for eastbound access. The posted speed limit is 40 MPH so speed should not be as big of a concern.
- Over the past few years, there has been a noticeable increase in the volume of truck traffic exiting US 6 and turning onto Crescent Park. That road is posted, with weight restrictions that truckers either ignore or are unaware of. Most of these trucks are traveling westbound, turning right onto Crescent Park, then turn left onto Pennsylvania Avenue into downtown Warren. Truckers are using their vehicle GPS, not truck-specific GPS (which accounts for road restrictions).
- After the new Hickory Street bridge was constructed, there has been greater truck usage. It was built to better accommodate trucks.

- Because truckers are ignoring the weight postings, there have been discussions about increased enforcement. The scale for weighing trucks hasn't been calibrated and as a result the police department hasn't been weighing trucks.
- There are turning radius issues; some of the narrower streets in downtown Warren aren't designed or constructed for big trucks. Most of the trucks causing this issue are passing through to get onto US 62.
- There was once talk of constructing a Market Street Bridge to provide a bypass around the downtown from US 6 to US 62. The comprehensive plan from the 1960s recommended this bridge. PennDOT said only one bridge improvement could be made (either replace the Hickory Street bridge at its current location or build the Market Street bridge). It was decided to replace the Hickory Street bridge.
- The higher truck trip generators are at Whirley Industries and the Incubator. Warren Hospital also has a mobile imaging trailer.
- From an emergency services perspective, the interchange at US 6 and Main Avenue would be a more direct route. There is a lot of parking on Crescent Avenue and people will park there and walk across the bridge to work downtown. Many who work at the hospital also park there and the area gets congested.
- St. Clair Street has issues. The intersection of St. Clair Street and Main Avenue is not stop-controlled. Motorists often drive aggressively through the intersection. It is unsafe and causes backups. There is parking along St. Clair Street due to its proximity to the hospital.
- An improved interchange would be beneficial for industries located nearby, but for trucks passing through or going north, the predominant traffic issues would be the same. Signage improvements and enforcement of weight restrictions would be helpful.
- There is an average of 500 to 1,000 trucks going through Market Street and Pennsylvania Avenue due to United Refining Co.
- There is at least one train going in per day to United Refining Co. The NW Commission's recent Regional Freight Study would have more information on rail impacts.
- The Market/Pennsylvania Avenue intersection is being studied for potential signalization. There are also two betterment projects planned for Warren.
- The water treatment plant was a major truck generator during the fracking boom a few years ago. Residents were complaining about Jake Brakes making noise. However, the water treatment plant is not in service anymore.

Stakeholder Focus Group Meeting

WCCBI/Business Stakeholder – Focus Group #1

- Businesses regularly have to navigate drivers to their facilities off of US 6. The enhanced 911 has messed up GPS routes. Navigating the area is a big issue for drivers not familiar with the area.

- Businesses have to pay higher freight rates because there aren't any major highways that connect to the area.
- Whirley Industries contracts out all of its freight activity. Many truckers will pick up a load from Cardinal, then go to Whirley or Superior and pick up for them to maximize the movement of goods.
- There are no safety issues with trains crossing in the study area.
- The intersection of Liberty Street and Pennsylvania Avenue is challenging. It is not signaled and is confusing for drivers and pedestrians alike.
- One employee had issues with trucks heading to the water treatment plant. Her children would wait for the school bus and it was dangerous. Now that the water treatment plant is closed, it isn't an issue. However, the City and Township need to think about what will happen if the natural gas sector booms again.

WCCBI/Business Stakeholder – Focus Group #2

- For Superior Tire, a lot of their commodities travel east into Sheffield and onto I-80. Traveling through Pleasant Township is an issue. There is also the limitation of driving over 2 sets of railroad tracks, with trains carrying hazardous materials to and from United Refining Co.
- Many drivers get lost trying to find business locations.
- Superior Tire is opening a distribution center in the incubator and they have a 10-year agreement with the WCCBI. Their company is averaging 4-6% growth per year.
- They are anticipating an increase in truck movement once they have their distribution center up and running.
- There is restricted truck access on Pennsylvania Avenue and on connecting roads to US 6. This makes it difficult for truckers.
- Superior Tire has raw materials arriving from all over the country. The majority of materials arrive to the area via US 6 eastbound.

Review of Alternatives

Overview/Intro

When developing improvement alternatives for the study area, an effort was made to meet two needs driving the project:

1. Create efficient connectivity from local traffic generators to US 6 in both directions
2. Reduce truck traffic through the residential areas along Pleasant Drive (SR 3005)

To fulfill these two key needs, a total of six alternatives were initially developed and presented to the steering committee for consideration. The six initial alternatives are summarized below in **Table 5** and more detailed descriptions of each are provided thereafter.

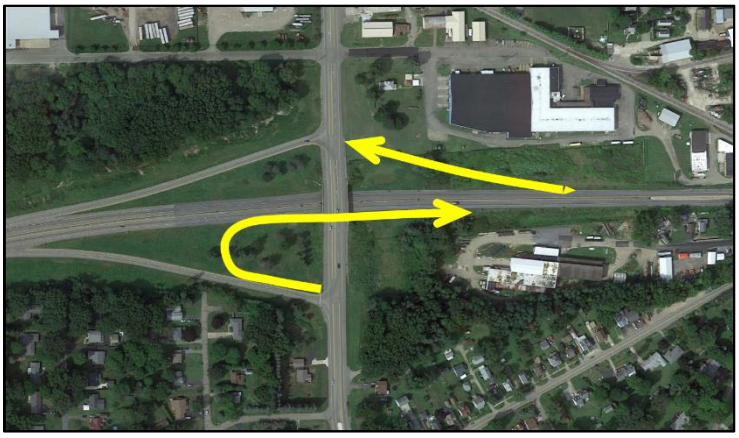
Table 5: Initial Alternatives Considered

	Alternative Description
A	New ramps servicing US 6 to the east
B	Keep ramps and add at-grade intersection with 'loop-ramp' and westbound left-turn lane
C	At-grade intersection modifying eastbound off-ramp to loop two-way T-intersection and remove westbound on-ramp
D	At-grade intersection modifying westbound on-ramp to loop two-way T-intersection with eastbound bypass island (Florida T-intersection)
E	At-grade intersection using roundabout at ramps, keep Main Avenue overpass
F	Full at-grade roundabout and eliminate Main Avenue overpass

Alternative A – New ramps servicing US 6 to the east

The concept of creating a full access interchange linking US Route 6 and Main Avenue (SR 1027) would maintain the controlled access/freeway nature of US 6 through this area. This improvement would see the development of a directional off-ramp in the northeast quadrant of the interchange connecting westbound US 6 with Main Avenue and a loop on-ramp in the southwest quadrant of the interchange connecting Main Avenue with eastbound US 6. This option would provide the most efficient connection between US 6 and Main Avenue. The existing cross-sections of US 6 and Main Avenue could accommodate the turning and acceleration/deceleration lane configurations that would be required. The ramps themselves, however, would require new construction and earthwork. Significant pavement marking and advance signing changes would be required on US 6.

Figure 7: Alternative A Concept Sketch



The pros and cons of this alternative include:

Pros:

- Maintains controlled access
- Capacity of highway is maintained

- No signal or turning on US 6 – less crash potential
- Provides expedited emergency /ambulance access to/from Warren General Hospital to points to/from the east

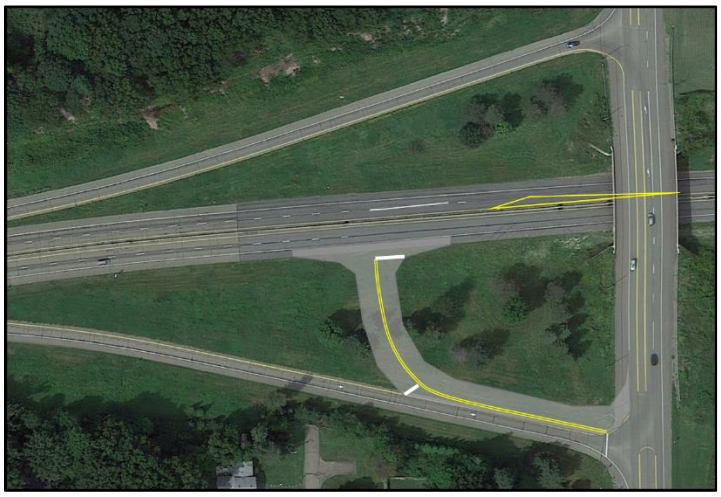
Cons:

- Expensive
- Drainage concerns
- Eastbound acceleration ramp ends at a signalized intersection

Alternative B – Keep ramps and add at-grade intersection with 'loop ramp' and WB left turn lane

This proposed new at-grade intersection 'loop ramp' would feature a two-way connector from US 6 to Main Avenue in the southwest quadrant of the interchange, tying in with the existing eastbound off-ramp alignment. An at-grade intersection with US 6 at the ramp connection would require removal of a portion of the existing median barrier and the restriping of US 6 to provide for a westbound left turn lane. The connection with Main Avenue at the existing off-ramp intersection would require modifications to the lane configurations on Main Avenue. The existing cross-sections of US 6 and SR 1027 could accommodate the turning lane configurations that would be required. The ramp/connector road itself, however, would require new construction and earthwork. Some pavement marking and advance signing changes would be required on US 6.

Figure 8: Alternative B Concept Sketch



The pros and cons of this alternative include:

Pros:

- Can be constructed within the existing right-of-way
- No apparent construction impediments

- Provides access to Main Avenue to and from east US 6
- The existing cross section of Main Avenue and US 6 can accommodate the turn lanes required

Cons:

- Breaks control of access and median barrier
- Introduces left-turn stopped traffic on westbound US 6
- Located on inside of curve of US 6 – cross traffic or signal introduce potential sight distance concerns
- Existing median barrier may block view of some oncoming traffic for some movements
- Introduces an additional conflict point for potential crashes on the existing off-ramp

Alternative C – At-grade intersection modifying EB off-ramp to loop two-way T-intersection and remove WB on-ramp

This alternative is similar to Alternative B, in that it features a two-way connector road between Main Avenue and US 6 and creates a full T-intersection with US 6. However, in this alternative, the existing on and off-ramps would be eliminated and all traffic flow between the two roadways would occur at the newly created T-intersection. It is anticipated that the eastbound reduction to one lane, which currently occurs in the vicinity of the proposed T-intersection, would occur west of the newly created intersection. The additional existing width on US 6 would then be striped for a deceleration lane for right-turn traffic at the new intersection.

Figure 9: Alternative C Concept Sketch

The pros and cons of this alternative include:

Pros:

- Can be constructed within the existing right-of-way
- No apparent construction impediments

- Provides access to Main Avenue to and from east US 6
- The existing cross section of Main Avenue and US 6 can accommodate the turn lanes required

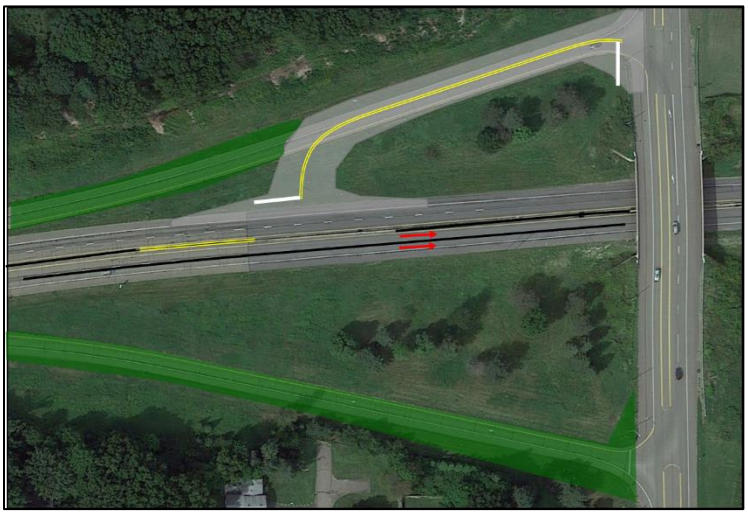
Cons:

- Breaks control of access and median barrier
- Introduces left-turn stopped traffic on westbound US 6
- Located on inside of curve of US 6 – cross traffic or signal introduce potential sight distance concerns
- Existing median barrier may block view of some oncoming traffic for some movements

Alternative D – At-grade intersection modifying WB on-ramp to loop two-way T-intersection with EB bypass island (Florida T-intersection)

This alternative would feature the removal of the westbound on-ramp and the eastbound off-ramps and the construction of a two-way connector road from US 6 to Main Avenue in the northwest quadrant of the interchange. An at-grade intersection with a channelized eastbound on/off left turn lane would be introduced on US 6. This configuration of a T-intersection is frequently referred to as a Florida T-intersection and typically includes the use of a raised island between the channelized left-turn lane and the through lane of the primary roadway (in this case, EB US 6). Creating a Florida T intersection at this location would require the removal of portions of the existing median barrier along US 6. Similar to Alternative C, it is anticipated that the eastbound reduction to one lane on US 6, which currently occurs in the vicinity of the proposed T-intersection, would occur prior to the intersection and the existing inside lane would become the channelized left-turn lane.

Figure 10: Alternative D Concept Sketch



The pros and cons of this alternative include:

Pros:

- Can be constructed within the existing right-of-way
- No apparent construction impediments
- Provides access to Main Avenue to and from east US 6
- The existing cross section of Main Avenue and US 6 can accommodate the turn lanes required
- The existing cross section of US 6 under Main Avenue underpass can accommodate geometric changes and sight distance needed
- Not as many cross-traffic conflict points as a traditional intersection

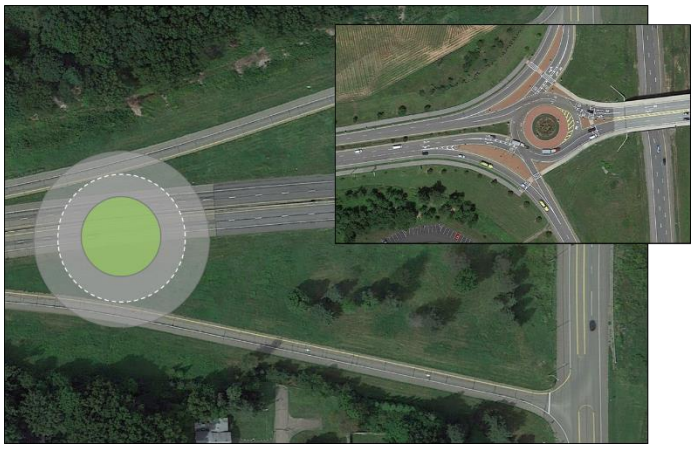
Cons:

- Breaks control of access and median barrier

Alternative E – At-grade intersection using roundabout at ramps, keep Main Avenue overpass

This alternative as proposed would connect all turning movements between Main Avenue and US 6 with a roundabout at the confluence of the existing eastbound off-ramp, westbound on-ramp, and eastbound and westbound US 6 mainlines. The existing Main Avenue overpass would be retained for Main Avenue through traffic. Both EB US 6 and WB US 6 traffic to Main Avenue would utilize the existing off-ramp and similarly all Main Avenue traffic accessing US 6 EB or WB would utilize the existing on-ramp and circle the roundabout to proceed in the desired direction.

Figure 11: Alternative E Concept Sketch



The pros and cons of this alternative include:

Pros:

- Can be constructed within the existing right-of-way
- No apparent construction impediments

- Provides access to Main Avenue to and from east US 6
- Not as many cross-traffic conflict points as a traditional intersection
- Provides operational traffic calming and self-enforcing end of expressway nature of US 6 EB

Cons:

- Breaks control of access and median barrier
- Reduces travel speeds to a typical design speed of 25 MPH through the roundabout

Alternative F – Full at-grade roundabout and eliminate overpass

This alternative entails replacing the existing Main Avenue overpass and ramps with an at-grade roundabout to connect all movements between US 6 and Main Avenue. The alternative would provide the desired vehicular access to east US 6 from Main Avenue but would create new impediments to pedestrian access along Main Avenue between Pleasant Drive and the City of Warren.

Figure 12: Alternative F Concept Sketch

The pros and cons of this alternative include:

Pros:

- Can be constructed within the existing right-of-way
- Can be considered a gateway entrance to community
- Provides access to Main Avenue to and from east US 6
- Not as many cross-traffic conflict points as a traditional intersection
- Provides operational traffic calming and self-enforcing end of expressway nature of US 6 EB

Cons:

- Expensive – bridge removal, earthwork
- Breaks control of access and median barrier
- Reduces travel speeds to a typical design speed of 25 MPH through the roundabout

- Eliminates direct access to Warren from Pleasant Drive for pedestrians (must walk around roundabout and cross US 6)
- Possible drainage concerns in northeast quadrant of existing interchange

Alternatives Advanced for Consideration

Based on input from the steering committee, the two alternatives advanced for consideration are:

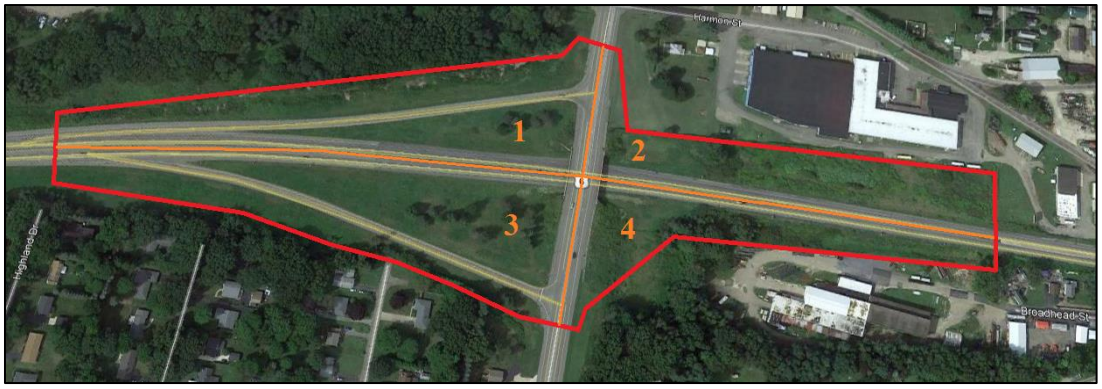
- **Alternative A (Modified)** – New ramps servicing US 6 to the east
  - Modification includes using ramp design criteria to more closely match arterial design criteria rather than freeway design criteria
- **Alternative D (Modified)** – At-grade intersection modifying WB on-ramp to loop two-way T-intersection with EB bypass island (Florida T-intersection)
  - Modification includes retaining the existing EB off-ramp alignment and building cloverleaf ramps, designed to arterial criteria, on the insides of the existing ramps on the west side of the Main Avenue overpass.

US 6 and Main Avenue (SR 1027) are both state routes carrying vehicles in and out of the City of Warren and the Pleasant Township area. Creating a more efficient connection between these two state routes would improve traffic operations in the study area, and provide a direct link to US 6 for truck traffic currently servicing industries with heavy shipping requirements located near the study interchange. Providing a connection from Main Avenue to east US 6 would also create an environment more conducive to the residential developments on Pleasant Drive (SR 3005), which is currently serving as a connector road between the industries and US 6 to the east. Additionally, anecdotal input obtained during the stakeholder interview indicated that there is currently some confusion among truckers unfamiliar with the area regarding the designated truck route from east US 6 to the industries near Main Avenue; with many truckers using city streets via Crescent Park and others missing the Pleasant Drive connection at the Mohawk Avenue Y-intersection and ending up on Mohawk Avenue. Both alternatives being advanced for consideration address these underlying concerns. Additionally, both alternatives provide a more direct access to Warren General Hospital, located on Main Avenue approximately 2000-feet north of the interchange, for emergency vehicles coming from the east via US 6.

Both alternatives being advanced will redirect traffic traveling between Main Avenue and east US 6 from Pleasant Drive to US 6 at the signalized intersection, thus reducing the number of turning vehicles/side street vehicles at the intersection. As a result, the signal should be retimed and optimized to account for the roadway and traffic changes within the study area.

A high-level preliminary environmental screening was conducted for the four quadrants of the existing interchange to consider the viability of the alternatives being advanced for further consideration. The area outlined in **Figure 13** was evaluated to screen the potential environmental impacts that may need to be considered in more detail as the selected alternative moves forward.

Figure 13: Environmental Screening Area



The findings of the preliminary environmental screening are:

- Significant wetland potential within quadrants 2 and 4
    - Wetland delineation and report submission to the DEP would be required for project activities within this area.
        - The positive identification of wetlands within the project area would require a Department of Environmental Protection (DEP) Chapter 105 permit to be obtained prior to construction. Wetland mitigation would be required for impacts to wetlands greater than 0.05 acres.
- Facilities associated with hazardous waste production are located adjacent to quadrants 1, 2, and 4.
    - A Phase I Environmental Site Assessment is recommended for any property acquisition associated with this project.
- Noise impacts should be considered to residential properties south of quadrant 3.
- A 1983 archaeological survey was conducted for the area north of the exit ramp in quadrant 3, also including all of quadrants 1, 2, and 4 (shown in **Figure 14**).
    - Additional archaeological work may be avoided if project activities stay within the delineation of the 1983 survey area.
    - Any project activities outside of this survey area will likely require a Phase I archaeological survey to be conducted due to the proximity of nearby recorded archaeological sites.

Figure 14: 1983 Archaeological Survey Area

Wetland impact regulations were sourced from 25 PA Code Chapter 105 and PA Bulletin Doc. No. 96-147. The PA Department of Environmental Protection's eMapPA and the U.S. Environmental Protection Agency's NEPAssist were consulted for data regarding hazardous waste facilities. Pennsylvania's Cultural Resources Geographic Information System, a partnership between the PA Historical & Museum Commission and PennDOT, was referenced for information on historic and archaeological resources.

Alternative A (Modified) — New Ramps Servicing US 6 to the East

As highlighted in **Figure 15**, the Alternative A proposed ramps connecting Main Avenue to east US 6 are proposed in the northeast and southwest quadrants of the existing interchange. A WB US 6 off-ramp is proposed as a directional off-ramp within the posted 40 MPH section of US 6. The existing width of US 6 is sufficient to accommodate the width of the deceleration lane to the diverging point of the ramp gore. This new off-ramp would intersect opposite the existing US 6 WB on-ramp to form a four-leg intersection. Projected design year, 2028, traffic volumes suggest that the ramp be stop controlled at the Main Avenue intersection.

A EB US 6 on-ramp is proposed in the southwest quadrant as a loop ramp tying in with US 6 west of the Main Avenue overpass. The loop ramp will be designed to meet criteria of an arterial tie-in rather than a freeway tie-in to ensure motorists do not accelerate for a merge condition right into the signalized intersection of US 6 and Pleasant Drive/Crescent Park. The new EB on-ramp (loop ramp) will exit Main Avenue adjacent to the existing EB off-ramp at an expanded T-intersection. There is sufficient width on existing Main Avenue to add a NB left-turn lane for access to the proposed ramp.

It is anticipated that the eastbound reduction to one lane which currently occurs in the vicinity of the proposed loop ramp yield/merge would occur farther to the west of the newly created ramp. Revising the

pavement markings and signing to create a lane drop at the existing EB off-ramp could be considered. The existing width of US 6 EB is sufficient to accommodate the merge yield lane of the proposed loop ramp.

It is likely that the construction of the directional ramp in the northeast quadrant will require purchase of additional right-of-way. The proposed loop ramp in the southwest quadrant is within existing right-of-way.

The existing WB on-ramp and EB off-ramp are to remain.

US 6 EB On-Ramp

- Construct loop ramp in southwest quadrant
- Relocate eastbound lane reduction westward
- Design merge/yield condition to meet arterial rather than freeway criteria
- Revise pavement markings on existing US 6 to accommodate merge/yield lane of new ramp
- Revise NB Main Avenue painted median to left turn lane
- Revise nearby signal phasing and timings to account for the new approach

US 6 WB Off-Ramp

- Construct directional ramp in northeast quadrant
- Revise pavement markings on existing US 6 to continue single lane through-traffic farther west and accommodate deceleration lane of ramp within existing US 6 pavement width
- Install stop control at ramp intersection with Main Avenue

Figure 15: Alternative A (Modified) Concept Sketch

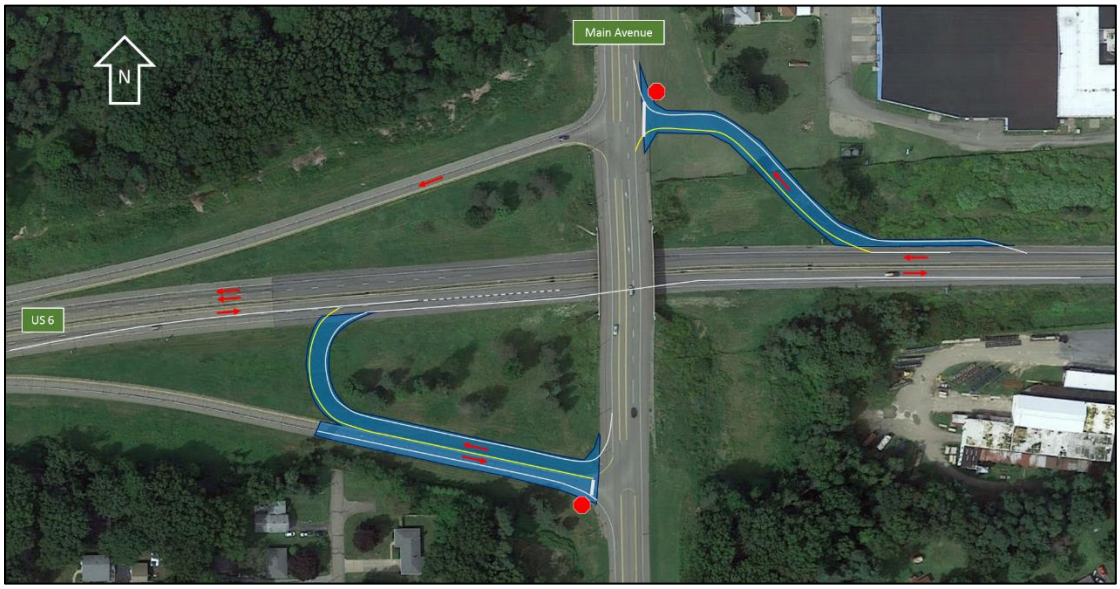


Table 6 provides a sketch level cost estimate for Alternative A (Modified), with the total design and construction cost being approximately $1.87 million. In addition to the construction cost, additional money would be needed for right-of-way acquisition for the WB off-ramp to Main Avenue.

Table 6: Alternative A (Modified) Cost Estimate

ITEM	UNIT	QUANTITY	UNIT PRICE ($)	COST ($)
Roadway				
CLASS 1 EXCAVATION	CY	1,000	20	20,000
SUPERPAVE WEAR. CRSE., 2"	SY	4,600	12	55,200
SUPERPAVE BINDER CRSE, 3"	SY	4,600	11	50,600
SUPERPAVE BASE CRSE, 6"	SY	4,600	35	161,000
SUBBASE (NO. 2A)	SY	4,600	15	69,000
SELECTED BORROW	CY	12,500	30	375,000
CLEARING AND GRUBBING	LS	1	10000	10,000
AIR POLLUTION CONTROL	LS	1	1000	1,000
PROJECT FIELD OFFICE	LS	1	10000	10,000
EROSION CONTROL	LS	1	10,000	10,000
UNFORSEEN WATER	LS	1	1,000	1,000
Other				
STORMWATER MANAGEMENT BASIN	LS	1	200,000	200,000
CONTINGENICIES (40%)				385,120
SUBTOTAL				1,347,920
INSPECTION & MOBILIZATION (16%)				215,667
CONSTRUCTION TOTAL				**1,563,587**
DESIGN COST (20%)				312,717
TOTAL COST*				**1,876,305**

*Does not include right-of-way acquisition cost

Alternative D (Modified) — Right-in/Right-out Ramp Combination

As highlighted in **Figure 16**, the Alternative D proposed right-in/right-out ramps connecting Main Avenue to east US 6 are proposed in the northwest and southwest quadrants of the existing interchange. The EB on-ramp would be the same as that proposed in Alternative A (Modified). The WB US 6 off-ramp is proposed as a cloverleaf style off-ramp within the posted 40 MPH section of US 6. As in Alternative A, the existing width of US 6 is sufficient to accommodate the width of the deceleration lane to the diverging point of the ramp gore. The ramp intersection with Main Avenue in this alternative will occur at the location of the existing US 6 WB on-ramp to form a T- intersection. Projected design year, 2028, traffic volumes suggest that the ramp be stop controlled at the Main Avenue intersection. Construction of the off-ramp will require the removal and reconstruction of a portion of the existing WB US 6 on-ramp so as to tie alignments together.

The EB US 6 on-ramp is proposed in the southwest quadrant as a loop ramp tying in with US 6 west of the Main Avenue overpass. The loop ramp will be designed to meet criteria of an arterial tie-in rather than a freeway tie-in to ensure motorists do not accelerate for a merge condition right into the signalized intersection of US 6 and Pleasant Drive/Crescent Park. The EB on-ramp (loop ramp) will exit Main Avenue

adjacent to the existing EB off-ramp at an expanded T-intersection. There is sufficient width on existing Main Avenue to add a NB left-turn lane for access to the proposed ramp.

It is anticipated that the eastbound reduction to one lane which currently occurs in the vicinity of the proposed loop ramp yield/merge would occur farther to the west of the newly created ramp. Revising the pavement markings and signing to create a lane drop at the existing EB off-ramp could be considered. The existing width of US 6 EB is sufficient to accommodate the merge yield lane of the proposed loop ramp.

The existing EB off-ramp is to remain.

US 6 EB On-Ramp

- Construct loop ramp in southwest quadrant
- Relocate eastbound lane reduction westward
- Design merge/yield condition to meet arterial rather than freeway criteria
- Revise pavement markings on existing US 6 to accommodate merge/yield lane of new ramp
- Revise NB Main Avenue painted median to left turn lane
- Revise nearby signal phasing and timings to account for the new approach

US 6 WB Off-Ramp

- Construct WB loop off-ramp in southwest quadrant
- Reconstruct WB directional on- ramp in southwest quadrant to new alignment
- Revise pavement markings on existing US 6 to continue single lane through-traffic farther west and accommodate deceleration lane of off-ramp and acceleration lane of WB on-ramp within existing US 6 pavement width
- Install stop control at ramp intersection with Main Avenue

Figure 16: Alternative D (Modified) Concept Sketch

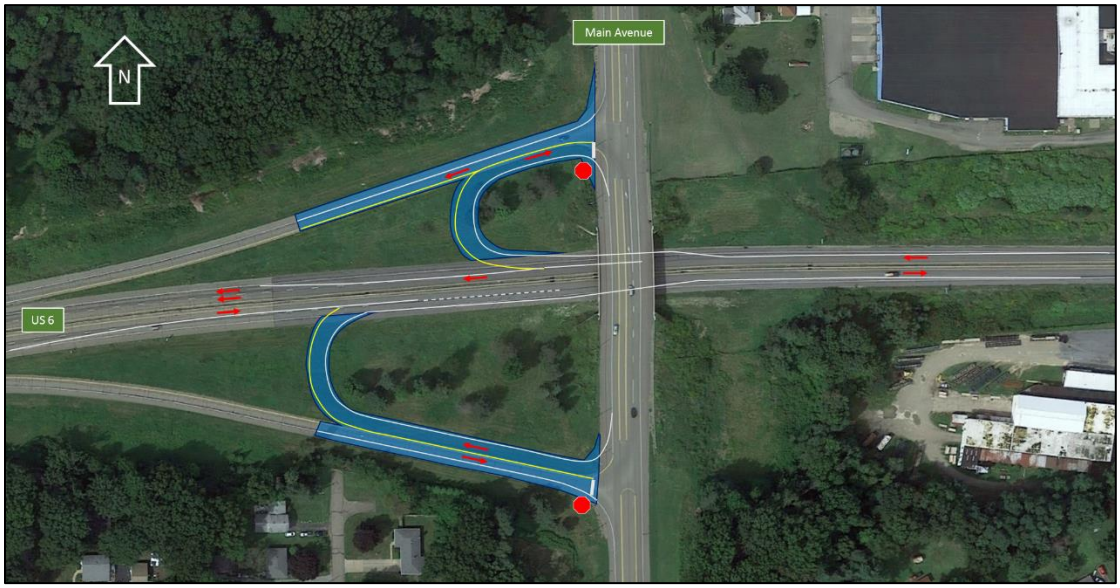


Table 7 provides a sketch level cost estimate for Alternative D (Modified), with the total design and construction cost being approximately $1.55 million.

Table 7: Alternative D (Modified) Cost Estimate

ITEM	UNIT	QUANTITY	UNIT PRICE ($)	COST ($)
Roadway				
CLASS 1 EXCAVATION	CY	1,800	20	36,000
SUPERPAVE WEAR. CRSE., 2"	SY	6,000	12	72,000
SUPERPAVE BINDER CRSE, 3"	SY	6,000	11	66,000
SUPERPAVE BASE CRSE, 6"	SY	6,000	35	210,000
SUBBASE (NO. 2A)	SY	6,000	15	90,000
SELECTED BORROW	CY	3,000	30	90,000
CLEARING AND GRUBBING	LS	1	10000	10,000
AIR POLLUTION CONTROL	LS	1	1000	1,000
PROJECT FIELD OFFICE	LS	1	10000	10,000
EROSION CONTROL	LS	1	10,000	10,000
UNFORSEEN WATER	LS	1	1,000	1,000
Other				
STORMWATER MANAGEMENT BASIN	LS	1	200,000	200,000
CONTINGENICIES (40%)				318,400
SUBTOTAL				1,114,400
INSPECTION & MOBILIZATION (16%)				178,304
CONSTRUCTION TOTAL				**1,292,704**
DESIGN COST (20%)				258,541
TOTAL COST				**1,551,245**

Next Steps

As the planning process segues from planning to implementation, there will be an important transition. Warren County Planning Commission will continue to work with the Northwest Commission to ensure that the alternative selected from those being proposed by this study report are considered along with other transportation infrastructure priorities being contemplated within the county and region.

The region's 25-year long range transportation plan – the Regional Long-Range Transportation Plan (LRTP) – serves as the "gatekeeper" for projects being considered for programming. As such, it is the primary vehicle for advancing proposed projects from a conceptual status to preliminary engineering and construction. The update of the plan is slated to begin in July 2018. The preferred alternative identified as a result of the US Route 6 Bypass-Main Avenue Interchange study will be considered and prioritized against other candidate projects throughout the region as part of the larger LRTP update.

The end of this study comes at a time when the Northwest RPO is preparing to adopt the 2019 Transportation Improvement Program (TIP). Warren County Planning Commission will work with the Northwest Commission and other partners in advocating for interchange improvements through the

regional planning process described above. For the more complex recommendations being proposed, this could come in the form of a line item within the LRTP's investment plan, or portfolio of proposed projects.

From there, the preferred interchange could be considered for placement on the 2021 Twelve Year Program, the development of which will begin in Spring 2019.

Additionally, a Point of Access (POA) Request Report will need to be developed and approved by the Federal Highway Administration (FHWA) and PennDOT for major modifications of an existing interchange within controlled right-of-way. The POA process could be initiated by one of the municipalities in coordination with PennDOT and FHWA. The requirements for the POA are outlined in PennDOT Publication 10X Appendix Q. A Conceptual POA could incorporate portions of this study to avoid duplication of effort. The development and approval of the conceptual POA Request Report could allow the RPO to allocate the appropriate funding for the project.

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INTERNATIONAL

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