



WEST VIRGINIA DEPARTMENT OF TRANSPORTATION

Division of Highways

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Earl Ray Tomblin
Governor

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Secretary of Transportation/
Commissioner of Highways

March 30, 2015

MEMORANDUM

TO: DD, CH(CR), HD, DE/M-4, D-4(RW, Rd), PP(JJW, TB), DR(Est),
DDM(AS), DDR(FT, Util, Perm), DDI(RE, RLB, JC, DK, QA/QC), DDE,
CD, DT (Des), PR(RW)

FROM: *MBZ*
DDC

SUBJECT: State Project S231-55-1.10 00
University Avenue Intersection Improvement
Design Study Final Office Review
Monongalia County

Attached for your review is an electronic copy, in pdf format, of the Design Study, dated March 2015, for the subject project as prepared by the Initial Design Unit of the Technical Section (DDC). A field review was held on Thursday, September 18, 2014.

A Design Study Final Office Review is scheduled for Wednesday, April 22, 2015, at 1:00 p.m., at 1334 Smith Street, Charleston, West Virginia, Room 11 to review and discuss the final study and Location and Design Approval.

Thank you in advance for taking the time to review the attached information. If you have any questions, please contact Steve Boggs at (304) 558-9662 or email Steve.D.Boggs@wv.gov.

MDL:Bkc

Attachment

cc: HO, DR, DDC(MDL, MW, SB), FHWA(J. Robinette) – w/o attachment

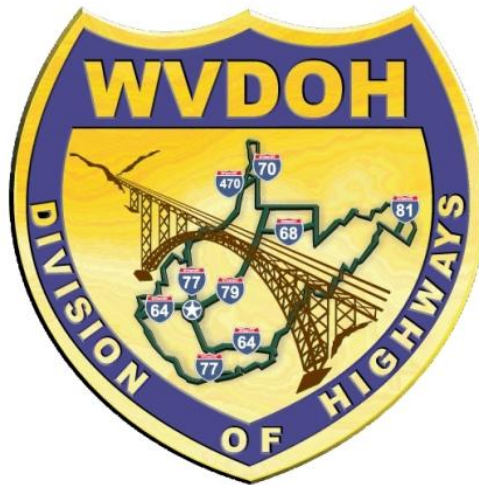
MW SB

UNIVERSITY AVENUE INTERSECTION UPGRADE STUDY

University Avenue (CR 55), Collins Ferry Road (CR 57), and Baldwin Street

Morgantown, Monongalia County

March 2015



Prepared by:

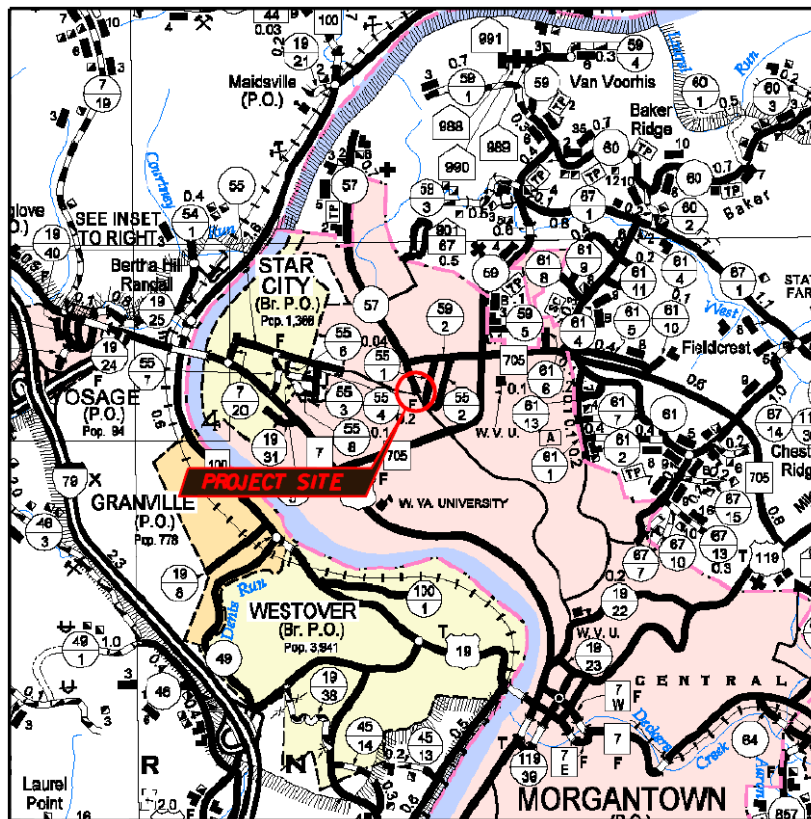
West Virginia Department of Transportation
Division of Highway
Engineering Division
Technical Section
Charleston, WV

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Project Purpose

The Traffic Engineering Division has prepared a Draft Traffic Study¹ for the intersection of University Avenue (CR 55), Collins Ferry Road (CR 57), and Baldwin Street in Morgantown, Monongalia County, WV; and developed alternatives for improvement. The purpose of this study by the Initial Design Unit of the Technical Section of Engineering Division is to determine the approximate cost, feasibility, impacts for each of these alternates, and select a preferred alternative for construction.



Location Map – CR 55 / CR 57 intersection

Intersection Upgrade Alternatives

Four alternatives were studied for this project. The first alternative proposes constructing a roundabout at the intersection. The second alternative proposes an oval roundabout with its center pushed to the northeast. The third alternative installs a traffic signal and adds additional turning lanes at the existing intersection.

¹ See Appendix 1.

The fourth alternative proposes installation of a traffic signal at the intersection, with a Collins Ferry Road and Baldwin Street realignment to form a “plus-type” intersection.

Commercial businesses with entry driveways are located in each quadrant around the intersection. Each of the alternates will have impacts to commercial businesses’ access points in the area of the intersection; all alternatives affect Sellaro Plaza, Hibachi, and West Virginia University (WVU) office building. A summary of the proposed access management and right of way impacts are included for the alternatives.

A BP service station has been removed and a Kroger Fuel Center has been constructed and recently opened. The facility is located between Collins Ferry Road and University Avenue. The driveways for this development are farther from the intersection for the Kroger than the BP. Construction plans for this development were used in determining potential impacts to this business; these items may need field verified/survey to confirm.

The location of the site is in an urban area and the four approach roads have sidewalks. Each of the alternates has incorporated sidewalks, sidewalk ramps, and cross walks at the intersection. The relocation of the sidewalk also requires installation of curb and gutter with storm drain system.

According to the available records, the existing right-of-way width of University Avenue (CR 55 between MP 0.55 to 1.35) is 50 feet and is 30 feet on Collins Ferry Road (CR 57). Baldwin Street is a Morgantown city street.

- 1. Alternative 1**² – This alternative reconfigures the existing “K” type intersection to a single lane roundabout. The alternate utilizes an inscribed circle diameter of 150 feet with an 18-foot driving lane and 10-foot truck apron within the roundabout. Approximately 150 feet of approach work (roadway widening and splitter islands) would be needed along CR 57 and CR 55 approaches; approximately 225 feet of approach work would be necessary along Baldwin Street.

² See Appendix 2, Figure 2.

See below for a summary of some of Alternative 1's design characteristics:

Right-Turn Bypass Lane – Motorists wanting to turn right from Collins Ferry Road onto westbound University Avenue would not have adequate room to enter and immediately exit the roundabout due to the proximity of the Collins Ferry Road approach with the western University Avenue approach and the intersection angle between these routes. In order to make this movement, a vehicle would need to go completely around the roundabout in order to exit. A right-turn bypass lane has been added to the roundabout to allow vehicles to make this movement without entering the roundabout.

Baldwin Street – The alternate shifted the alignment of the Baldwin Street approach to the west. This provides a more perpendicular entry to the roundabout and avoids impacting the Hibachi building.

Access Management – Driveways would need to be moved out of and away from the circulatory roadway, as driveways within the roundabout could introduce conflicts and possibly cause wrong way movements. This would impact the driveways at the following locations:

- Sellaro Plaza currently has two entrances along University Avenue and two entrances along Baldwin Street. Proposed roundabout would close one entrance along University Ave and one along Baldwin Street. The westernmost entrance along University Ave would be converted to a right-in/right-out.
- A driveway stub would be provided to undeveloped lot north of the intersection.
- The WVU Office Building has two entrances along University Avenue; the alternate would close the northern entrance to the facility.
- Hibachi Steakhouse's access along University Avenue would be converted to a right-in/right-out.

Right-of-Way – Additional permanent right of way would be needed by WVDOH at the junction for the proposed roundabout. This would likely impact the following locations:

- Sellaro Plaza - entry/exit of facility, parking lot (12 spaces).
- Kroger Fuel Center – impact to kiosk building and pylon sign.
- Frontier Communications – entry/exit of facility.
- Undeveloped lot – additional r/w area.
- WVU office building – entry/exit of facility and parking lot (11 spaces).
- Transit bus stop along University Avenue – relocation.
- Hibachi Steakhouse – entry/exit of facility, frontage sign, and parking lot (8 spaces).

Utilities – The site is located in a fully developed and urban setting with many utilities positioned in the area. Alternate 1 construction would likely require relocation/adjustment of:

- Eleven (11) utility poles with overhead cable, telephone, and/or electric lines (8 poles are within existing r/w limits & 3 poles are outside existing r/w).
- One fire hydrant (located within existing r/w).
- Two sanitary sewer manholes (located within existing r/w).
- Underground water lines, gas lines, sanitary sewer lines and telephone lines are located along each approach and may possibly be affected (located within existing r/w).

Estimated cost for Alternative 1 is as follows:

		<u>Detailed Roadway Construction</u>	
Roadway Construction	\$ 1,088,100	Clearing and Grubbing	\$ 10,000
E&C (13%)	\$ 141,500	Earthwork	\$ 23,800
Total Construction Cost	<u>\$ 1,229,600</u>	HMA Wearing & Base	\$ 172,500
		Aggregate (Base & Sh)	\$ 47,500
Future Value (2017)	\$ 1,346,000	Subgrade	\$ 31,000
Engineering	\$ 260,000	Drainage	\$ 114,900
Utilities	\$ 54,000	M.O.T.	\$ 350,000
Site Cleanup (Environmental)	\$ 100,000	Erosion Control	\$ 10,000
Right-of-Way	\$ 1,750,000	Curb & Sidewalk	\$ 125,800
Total	\$ 3,510,000	All Other Items	\$ 170,900
		Mobilization	\$ 31,700
		Total Roadway Construction	\$ 1,088,100

2. Alternative 2³ – Provides a second variation of a roundabout at the intersection. It proposes an oval shaped roundabout with its center pushed to the northeast. The alternate utilizes an inscribed circle diameter of 130 feet with a 15-foot driving lane and 10-foot truck apron within the roundabout. Approximately 150 feet of approach

³ See Appendix 2, Figure 3.

work (roadway widening and splitter islands) would be needed along CR 57 and CR 55 approaches; approximately 250 feet of approach work would be necessary along Baldwin Street.

Access Management – Similar to Alternative 1, driveways would need to be moved away from the proposed circulatory roadway. This would impact the driveways at the following locations:

- Proposed roundabout would close one entrance along University Avenue to Sellaro Plaza and convert the other one to a right-in/right-out. Both entrances along Baldwin Street would be kept.
- Accesses for the undeveloped lot, WVU Office Building, and Hibachi Steakhouse are the same as Alternative 1.

Right-of-Way – Additional permanent right of way would be needed at the junction for the proposed roundabout, which would likely impact the following locations:

- Sellaro Plaza - entry/exit of facility, parking lot (4 spaces)
- Kroger Fuel Center – pylon sign
- Frontier Communications – entry/exit of facility
- Undeveloped lot – additional r/w area.
- WVU office building - entry/exit of facility, parking lot (21 spaces)
- Transit bus stop along University Avenue
- Hibachi Steakhouse – entry/exit of facility, frontage sign, and parking lot (5 spaces)

Utilities – Alternate 2 constructions would likely require relocation/adjustment of the following utilities:

- Eleven (10) utility poles with overhead cable, telephone, and/or electric lines (7 poles are within existing r/w limits & 3 poles are outside existing r/w).
- One fire hydrant (located within existing r/w)
- Two sanitary sewer manholes (located within existing r/w)
- Underground water lines, gas lines, and sanitary sewer lines, and telephone lines are located along each approach and may possibly be affected (located within existing r/w)

Estimated cost for Alternative 2 is as follows:

		<u>Detailed Roadway Construction</u>	
Roadway Construction	\$ 1,192,200	Clearing and Grubbing	\$ 10,000
E&C (13%)	\$ 155,000	Earthwork	\$ 26,400
Total Construction Cost	\$ 1,347,200	HMA Wearing & Base	\$ 174,700
		Aggregate (Base & Sh)	\$ 50,500
Future Value (2017)	\$ 1,474,000	Subgrade	\$ 33,000
Engineering	\$ 260,000	Drainage	\$ 128,700
Utilities	\$ 54,000	M.O.T.	\$ 400,000
Site Cleanup (Environmental)	\$ 100,000	Erosion Control	\$ 10,000
Right-of-Way	\$ 1,900,000	Curb & Sidewalk	\$ 138,800
Total	\$ 3,788,000	All Other Items	\$ 185,400
		Mobilization	\$ 34,700
		Total Roadway Construction	\$ 1,192,200

3. Alternative 3⁴ – This alternative adds turn lanes to the University Avenue and Collins Ferry Road approaches and installs a traffic signal at the existing intersection. The proposed intersection modifications are summarized below:

- University Avenue westbound approach has an added 300 feet left turn lane (onto Baldwin Street) and 200 feet right turn lane (onto Collins Ferry Road)
 - It should be noted that a 300 feet right turn lane is recommended in the Traffic Study. However, to avoid the WVU office building a 200 foot lane was used in this study.
- University Avenue eastbound approach has an added 200 feet left turn lane (onto Collins Ferry Road)
- Collins Ferry Road approach has an added 300 feet left turn lane (onto EB University Avenue) and a channelized right turn lane (onto WB University Avenue)

See below for a summary of some of Alternative 3’s design characteristics:

Access Management – Driveways are not permitted within signalized intersections or adjacent turning radii. This would impact the driveways at the following locations:

- Sellaro’s Plaza eastern most entrance along University Avenue would be closed and convert the other one to a right-in/right-out.
- Accesses for the undeveloped lot, WVU Office Building, and Hibachi Steakhouse are the same as Alternative 1.

Right-of-Way – The improvement will require additional permanent right of way along the route, which would likely impact the following locations:

⁴ See Appendix 2, Figure 4.

- Sellaro Plaza – entry/exit of facility, parking lot (4 spaces)
- Kroger Fuel Center – kiosk building, parking lot, and pylon sign
- Frontier Communications – entry/exit of facility
- undeveloped lot – additional r/w area.
- WVU office building – entry/exit of facility, parking lot (25 spaces)
- Transit bus stop along University Avenue
- Tudor’s Biscuit World – entry/exit, parking lot
- First Exchange Bank – entry/exit, parking lot (14 spaces)
- Hibachi Steakhouse – entry/exit, frontage sign, and parking lot (6 spaces)

Utilities – Construction of Alternate 3 would likely require relocation/adjustment of the following utilities:

- Fourteen (14) utility poles with overhead cable, telephone, and/or electric lines (all poles are within existing r/w limits)
- One fire hydrant (located within existing r/w)
- Four sanitary sewer manholes (located within existing r/w)
- Underground water lines, gas lines, and sanitary sewer lines, and telephone lines are located along each approach and may possibly be affected (located within existing r/w)

Estimated cost for Alternative 3 is as follows:

		<u>Detailed Roadway Construction</u>	
Roadway Construction	\$ 997,100	Clearing and Grubbing	\$ 10,000
E&C (13%)	\$ 129,700	Earthwork	\$ 19,900
Total Construction Cost	\$ 1,126,800	HMA Wearing & Base	\$ 80,400
		Aggregate (Base & Sh)	\$ 21,100
Future Value (2017)	\$ 1,233,000	Subgrade	\$ 13,900
Engineering	\$ 260,000	Drainage	\$ 161,200
Utilities	\$ 90,000	M.O.T.	\$ 125,000
Site Cleanup (Environmental)	\$ 100,000	Traffic Signal	\$ 175,000
Right-of-Way	\$ 1,800,000	Erosion Control	\$ 10,000
Total	\$ 3,483,000	Curb & Sidewalk	\$ 191,700
		All Other Items	\$ 159,900
		Mobilization	\$ 29,000
		Total Roadway Construction	\$ 997,100

4. Alternative 4⁵ – This alternative proposes installation of a traffic signal at the intersection with a Collins Ferry Road/Baldwin Street realignment to form a “plus-type” intersection. The proposed intersection modifications are summarized below:

⁵ See Appendix 2, Figure 5.

- University Avenue westbound approach has an added 300 feet left turn lane (onto Baldwin Street)
- University Avenue eastbound approach has an added 200 feet left turn lane (onto Collins Ferry Road)
- Collins Ferry Road approach realigned with a 150 feet right turn lane (onto WB University Avenue) and a combination left (onto EB University Avenue)/thru lane (onto Baldwin Street)

Access Management – Driveways are not permitted within signalized intersections or adjacent turning radii. This would impact the driveways at the following locations:

- Sellaro Plaza’s eastern most entrance along University Avenue would be closed and western entrance is converted to right-in/right-out.
- Accesses for the undeveloped lot, WVU Office Building, and Hibachi Steakhouse are the same as Alternative 1.

Right-of-Way – Additional permanent right of way would be needed at the intersection, which would likely impact the following locations:

- Sellaro Plaza – entry/exit of facility, parking lot (4 spaces)
- Frontier Communications – entry/exit of facility
- Undeveloped lot – additional r/w area.
- WVU office building – entry/exit of facility, parking lot (15 spaces)
- Transit bus stop along University Avenue
- Tudor’s Biscuit World – entry/exit, parking lot
- First Exchange Bank – entry/exit, parking lot (14 spaces)
- Hibachi Steakhouse – entry/exit, frontage sign, and parking lot (6 spaces)

Utilities – Construction would likely require relocation/adjustment of:

- Eleven (11) utility poles with overhead cable, telephone, and/or electric lines (all poles are within existing r/w limits).
- One fire hydrant (located within existing r/w)
- Three sanitary sewer manholes (located within existing r/w)
- Underground water lines, gas lines, and sanitary sewer lines, and telephone lines are located along each approach and may possibly be affected (located within existing r/w)

Estimated cost for Alternative 4 is as follows:

		<u>Detailed Roadway Construction</u>	
Roadway Construction	\$ 1,024,200	Clearing and Grubbing	\$ 10,000
E&C (13%)	\$ 133,200	Earthwork	\$ 19,900
Total Construction Cost	\$ 1,157,400	HMA Wearing & Base	\$ 87,400
		Aggregate (Base & Sh)	\$ 22,900
Future Value (2017)	\$ 1,267,000	Subgrade	\$ 15,100
Engineering	\$ 260,000	Drainage	\$ 144,000
Utilities	\$ 54,000	M.O.T.	\$ 175,000
Site Cleanup (Environmental)	\$ 100,000	Traffic Signal	\$ 175,000
Right-of-Way	\$ 1,350,000	Erosion Control	\$ 10,000
Total	\$ 3,031,000	Curb & Sidewalk	\$ 168,700
		All Other Items	\$ 166,400
		Mobilization	\$ 29,800
		Total Roadway Construction	\$ 1,024,200

Alternatives Comparison and Summary

See below for a conceptual cost of all alternatives:

	ALTERNATIVES			
	1	2	3	4
	Roundabout	Oval Roundabout	Traffic Signal	Traffic Signal "plus type"
Impact Length (ft)	1,175	1,250	1,050	1,100
# of Parcels Impacted	8	8	13	11
Roadway	\$ 1,088,100	\$ 1,192,200	\$ 997,100	\$ 1,024,200
E&C (13%)	\$ 141,500	\$ 155,000	\$ 129,700	\$ 133,200
2015 Construction Cost	\$ 1,229,600	\$ 1,347,200	\$ 1,126,800	\$ 1,157,400
Future Value (2017)	\$ 1,346,000	\$ 1,474,000	\$ 1,233,000	\$ 1,267,000
Engineering	\$ 260,000	\$ 260,000	\$ 260,000	\$ 260,000
Utility	\$ 54,000	\$ 54,000	\$ 90,000	\$ 54,000
Site Impact (Environmental)	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000
Right-of-Way (**)	\$ 1,750,000	\$ 1,900,000	\$ 1,800,000	\$ 1,350,000
Total	\$ 3,510,000	\$ 3,788,000	\$ 3,483,000	\$ 3,031,000

** Right of Way cost may be higher than listed. See Right-of-Way comments 5 & 6 **

See below for Level of Service (LOS) and delay comparison:

		Existing		Alt 1 & 2		Alt 3 & 4	
		Roundabout		Traffic Signal			
		LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)
University Ave	- Eastbound	A	9	A	10	C	25
University Ave	- Westbound	A	8	B	11	C	20
Baldwin St	- Northbound	C	18	A	7	D	35
Collins Ferry Road	- Southbound	F	349	A	7	C	33
Overall Intersection		-	-	A	10	C	25

Data from Traffic Study - See Appendix 1 for additional information/details

A decision matrix was developed for the intersection. The purpose of the table is to provide a comparative analysis that measures and weighs a various number of major design decision options. The Initial Design Unit has compiled the results of a variety of comparison factors into the matrix that includes key decision measures, assigned percentages, and weighted values:

Alternative Decision Matrix University Avenue / Collins Ferry Road / Baldwin Street					
Criteria	Weight	ALTERNATIVES			
		1	2	3	4
		Roundabout	Oval Roundabout	Traffic Signal	Traffic Signal "plus type"
Cost	20%	3	2	3	4
LOS / Delay	20%	5	5	3	3
EMS & Ped Safety	25%	4	4	2	2
Vehicle Safety	25%	5	5	3	3
O & M Cost	5%	4	4	3	3
Aesthetics	5%	5	5	3	3
Total Score: Higher is Better	100%	4.3	4.1	2.75	2.95

Legend: 0=Very Poor, 1=Poor, 2=Below Avg, 3=Average, 4=Above Avg, 5=Excellent

It is understood that differing weights and factors could be used herein. The results of each numeric factor are based on results of this report, available averages, nationwide statistics, and DDC’s professional judgment for this particular project.

Conclusion

The preceding sections of this report analyzed the feasibility of a traffic signal or a roundabout at the intersection of University Avenue, Collins Ferry Road, and Baldwin Street. While the roundabout alternates have a higher cost than those of a traffic signal,

they provide the most capacity and operational safety for this project location. Our investigation and study recommends a roundabout for this intersection. It is recommended to proceed with final layout of the roundabout, including geometric design modifications and details.

APPENDIX “1”

Traffic Study

**TRAFFIC STUDY
INTERSECTION OF UNIVERSITY AVENUE
AND COLLINS FERRY
MORGANTOWN, MONONGALIA COUNTY**

MAY 2014



**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
TRAFFIC ENGINEERING DIVISION**

TRAFFIC STUDY
Intersection of University Avenue with Collins Ferry Road
Morgantown, Monongalia County

INTRODUCTION

A traffic study for the intersection of University Avenue and Collins Ferry Road was requested by District Four due to their concern of intersection operation. In response to this request, a traffic study was conducted by the Traffic Engineering Division. Following are the findings of that study.

PHYSICAL CONDITIONS

The intersection is a “K” type intersection located at milepost 1.10 on University Avenue (CR 55). University Avenue is the major route in the intersection with Collins Ferry Road (CR 57) and Baldwin Street being minor approaches.

Collins Ferry Road approaches from the north with Baldwin Street approaching from the west. Currently, the intersection is two-way stop controlled with stop signs on Collins Ferry Road and Baldwin Street while traffic travels unimpeded on University Avenue.. University Avenue is a north-south roadway and approaches the intersection from the south and also from the north but to the west of the Collins Ferry Road approach. University Avenue, Collins Ferry Road, and Baldwin Street are all two lane two way roads and there are no auxiliary lanes at the intersection. The right turn movement from Collins Ferry Road is a channelized movement that does not enter the intersection.

Commercial development is prevalent in the area near the intersection. A BP gas station is located in the triangular lot to the north of the intersection bound by Collins Ferry Road and University Avenue. DOH has been advised that Kroger plans to construct

TRAFFIC STUDY

Intersection of University Avenue with Collins Ferry Road
Morgantown, Monongalia County

a new gas station at this location and replace the existing business. To the east of the intersection, WVU owns a large office building that parallels University Avenue. To the west of the intersection, there is a Hibachi Steakhouse, First Exchange Bank, and a small strip development building containing a variety of small businesses.

The speed limit is 25 mph on all approaches. Sight distance is adequate on all approaches to the intersection. Turning maneuvers at the intersection can be difficult at the intersection since the corner radii are not designed to accommodate large vehicles.

TRAFFIC CONDITIONS

A turning movement count was conducted at the intersection on December 9, 2008 between the hours of 7:00 a.m. to 10:00 a.m., 11:00 a.m. to 1:00 p.m., and 2:00 p.m. to 6:00 p.m. The peak hour for the intersection was found to be between the hours of 5:00 p.m. to 6:00 p.m., during which time 1024 vehicles entered the intersection. This includes 366 vehicles on the University Avenue approach from the northwest, 464 vehicles on University Avenue from the south, 173 on Collins Ferry Road from the north, and 21 vehicles from the west on Baldwin Street. A peak hour count was also conducted in-house on April 23, 2014. Refer to Appendix A at the end of this report for both turning movement distributions.

A comparison was made of the traffic volume at the intersection with the warrants for a traffic signal contained in the Manual on Uniform Traffic Control Devices, (MUTCD), which is published by the Federal Highway Administration and legally adopted by the State of West Virginia as the official criteria for the installation of all traffic control devices. The principal requirement for the installation of a traffic signal is

traffic volume. The MUTCD specifies one primary warrant consisting of two conditions, either of which must be met for at least eight hours before a traffic signal can be installed. Warrant 1, Condition A, “Minimum Vehicular Volume Warrant”, requires that there be 500 vehicles per hour on University Avenue, at which time there must be 150 vehicles per hour on either Collins Ferry Road or Baldwin Street. Warrant 1, Condition B, “Interruption of Continuous Traffic Warrant”, requires that there be 750 vehicles per hour on University Avenue at which time there must be 75 vehicles per hour on either Collins Ferry Road or Baldwin Street. The volume of vehicles entering the intersection met Condition A and Condition B for the required eight hours. Warrant data can be found at the end of Appendix A.

CRASH CONDITIONS

Collision data was researched for the intersection for a three year period of January 1, 2011, through July 31, 2013. During this time, eleven collisions were recorded at the intersection. The most common collision was of the right angle type. Provided below is a table summarizing the collision types. A total of 4C type injuries occurred from the eleven collisions. The crash rate for this intersection has been calculated at 0.77 per million entering vehicles. The full crash history summary is listed in Appendix B.

Summary		
Total	11	
Right angle	5	45%
Rear end	1	9%
Angle	3	27%
Head-on	1	9%
SVC	1	9%

CAPACITY ANALYSIS

The intersection was analyzed using HCS 2010 traffic modeling software, which is based upon the 2010 Highway Capacity Manual. This method of analysis makes it possible to evaluate many different combinations of traffic volume and intersection configurations by calculating the average delay per vehicle with its respective Level of Service (LOS). LOS varies from “A”, which has unimpeded traffic flow, to “F” which has severely impeded traffic flow.

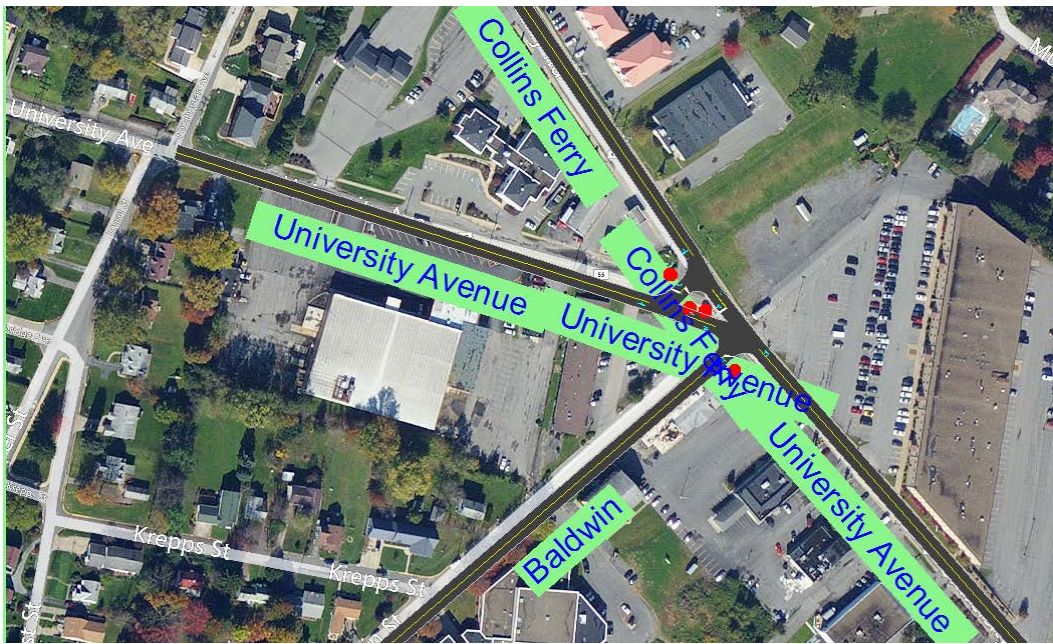


Figure 1 - Existing Configuration

The analysis shows that with the current intersection configuration with two-way stop control, the Collins Ferry Road approach operates at LOS “F” with an average delay of approximately 120 seconds per vehicle. The analysis further indicates that the Baldwin Street approach operates at LOS “C” with an average delay of approximately 16

seconds per vehicle. Eastbound and Westbound traffic on University Avenue operate at LOS “A” and are only impeded by occasional left turning traffic.

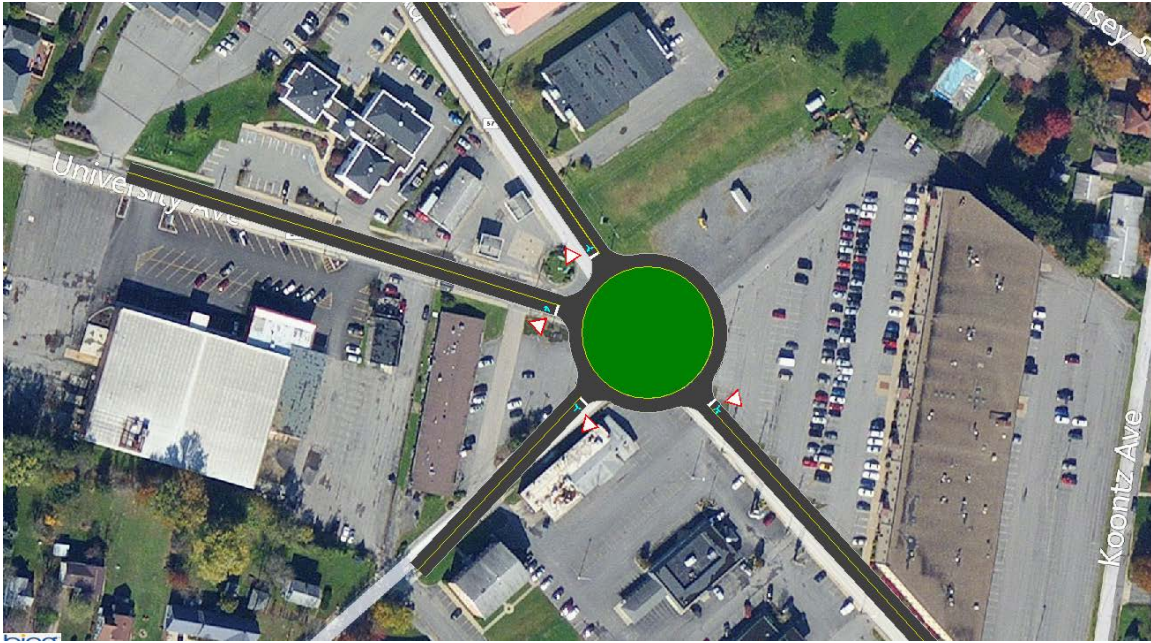


Figure 2 - Roundabout Configuration

Additional analysis was performed using HCS to estimate the impact of constructing a roundabout. A roundabout is a type of circular intersection in which traffic is slowed and flows continuously in one direction around a central island. In a roundabout, entering traffic must always yield to traffic already within the circle. Roundabouts have been shown to be very effective at reducing intersection crashes and can operate more efficiently than traffic signals in many instances.

Based upon additional HCS analyses, construction of a one-lane roundabout would improve the intersection LOS to “A” with delays of approximately 9 second per vehicle. The approach lane has a shared left-through-right configuration. Under the roundabout scenario, all approaches operate at LOS “A” except for the WB movement of University Avenue that would operate at a LOS “B”.



Figure 3 - Signal Configuration

As a means of comparison, further analysis shows that if a traffic signal was installed, the overall intersections LOS would be “C” with delays of approximately 25 seconds per vehicle. The figure above shows what a desirable layout would be for this intersection if a signal was installed. Left turn lanes would need to be constructed on both University Avenue approaches while the configuration on Baldwin Street could remain as a combination left, right, and through lane. The configuration on Collins Ferry Road could remain but the approach should be realigned to eliminate the skew and intersect closer to 90 degrees and to create a longer right turn lane. The heaviest delay would be northbound on Baldwin Street, with delays of approximately 35 seconds per vehicle. With the installation of a traffic signal, University Avenue would operate at LOS “C” with delays of approximately 22 seconds per vehicle.

The analysis for the traffic signal was based upon an intersection configuration with realignment to modify the intersection closer to a “plus” type. As previously stated, left turn lanes would be needed on both University Avenue approaches to the intersection. The recommended storage capacity based upon the analysis is 200 feet for eastbound approach and 300 feet for the westbound approach. The recommended storage length of the right turn lane on Collins Ferry Road is 150 feet. The HCM comparison and analysis is located in Appendix C.

A signal could also be installed at this intersection without moving the road in any direction, but would be considered undesirable. Three more options for a signal have been analyzed using Synchro 8. Synchro 8 allows the intersection to be analyzed to incorporate the strange layout into the calculations for LOS, but requires the results not be based upon the HCM, but is a reasonable approximation. The full comparison chart is located in Appendix D. Below are three figures that show different configurations for the approach lanes. The LOS for the existing with signal is an E with 57 seconds of delay. The LOS with the first set of improvements is a C with 21 seconds of delay. The second set of improvements yields a LOS of B with 17 seconds of delay. If a signal had to be installed with “K” type layout it is recommended that one of the improved approach layouts is used. The third signal is the best but also takes the most surrounding land because of the extra right turn lane.

TRAFFIC STUDY

Intersection of University Avenue with Collins Ferry Road
Morgantown, Monongalia County

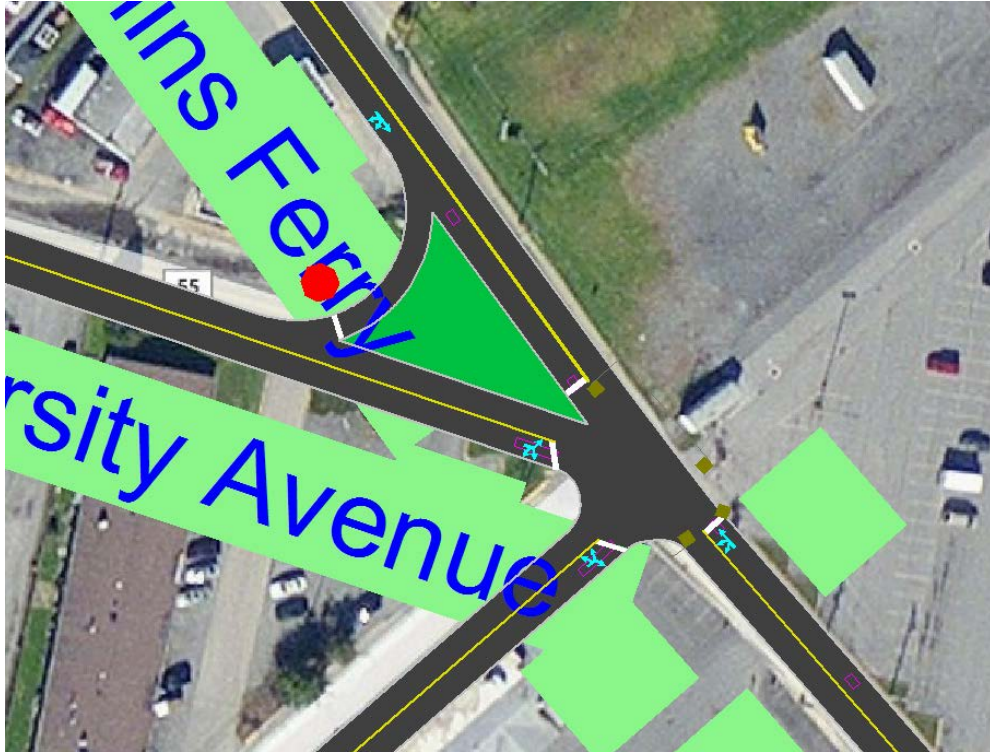


Figure 4 - Existing with Signal

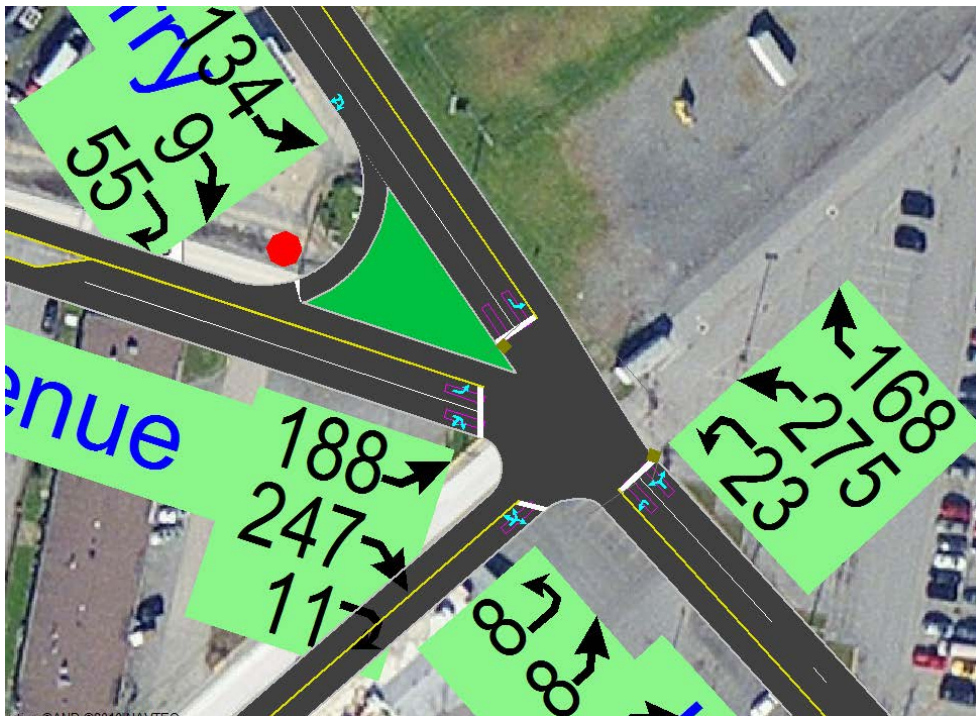


Figure 5 - Signal with Added University Lefts and Right on Collins Ferry

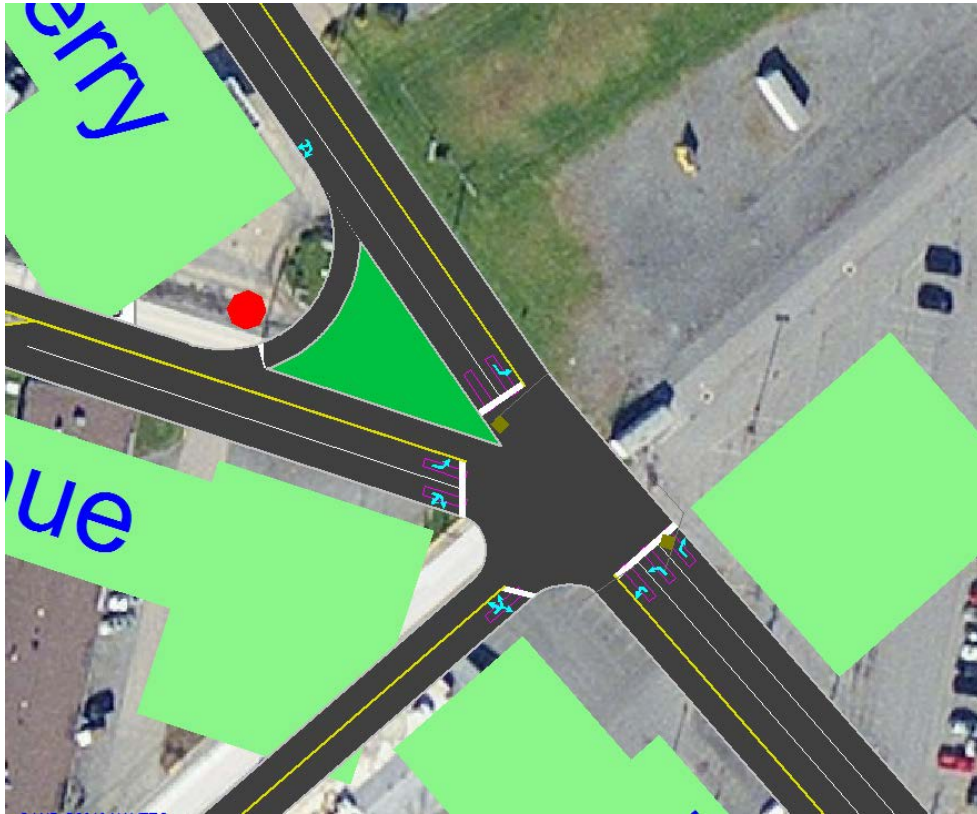


Figure 6 - Best Signal Option with As-Is Layout

TRAFFIC STUDY

Intersection of University Avenue with Collins Ferry Road
Morgantown, Monongalia County

RECOMMENDATIONS

- 1.) After reviewing three different configurations, and multiple layouts for a signal, it is recommended that a roundabout be constructed at the intersection. The study shows that a roundabout would operate well with significant improvement compared with the existing intersection LOS. From a preliminary review, it appears that construction of a roundabout is feasible at this location.
- 2.) If it is determined that a roundabout is not feasible, further consideration is necessary to determine if a signal should be installed in conjunction with construction of auxiliary lanes on University Avenue. Based upon the intersection capacity analyses and the odd intersection geometry, a roundabout is preferable to a traffic signal.

APPENDIX A

TRAFFIC STUDY

Intersection of University Avenue with Collins Ferry Road
Morgantown, Monongalia County

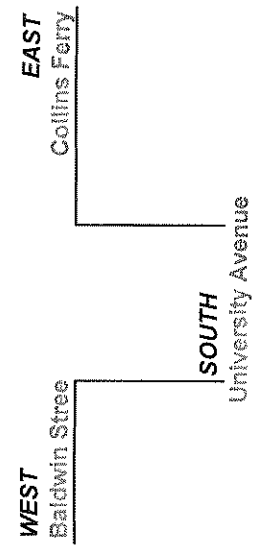
VEHICLE AND PEDESTRIAN VOLUME SUMMARY

STREET	University Avenue				University Avenue				Baldwin Street				Collins Ferry				Total						
	NORTH (SB)		SOUTH (NB)		WEST (EB)		EAST (WB)		WEST (EB)		EAST (WB)		TOT		TOT		N-S	E-W	ALL				
	L	T	R	TOT	L	T	R	TOT	L	T	R	TOT	L	T	R	TOT							
3:15	54	69	5	128	4	9	61	43	113	1	7	3	19	29	0	39	4	11	54	1	241	83	324
3:30	57	69	3	129	0	6	68	45	119	0	0	1	17	18	2	28	3	14	45	1	248	63	311
3:45	34	53	3	90	0	5	84	41	130	0	0	4	6	10	0	39	1	15	55	0	220	65	285
4:00	43	56	0	99	0	3	62	39	104	0	1	0	4	5	0	28	1	15	44	1	203	49	252
4:15	30	64	1	95	0	4	58	34	96	0	0	1	3	4	3	35	5	12	52	0	191	56	247
4:30	30	53	0	83	0	0	84	36	120	0	0	0	1	1	2	51	7	17	75	0	203	76	279
4:45	34	50	1	85	0	1	86	32	119	1	0	1	6	7	1	35	6	13	54	2	204	61	265
5:00	30	79	1	110	0	3	81	42	126	0	1	2	5	8	1	38	5	21	64	3	236	72	308
Peak Hour	188	247	11	446	4	23	275	168	466	1	8	8	46	62	2	134	9	55	198	3	912	260	1172

University Avenue
NORTH

CITY	Morgantown	INTERSECTION	University and Collins Ferry
COUNTY	Monongalia	DATE	4/23/2014
DISTRICT	Four	WEATHER	

85% SPEED > 4	
POPULATION <	



VEHICLE AND PEDESTRIAN VOLUME SUMMARY

STREET	Collins Ferry Rd.			Baldwin St.			University Ave.			University Ave.			Total					
	From North			From South			From East			From West			Total					
	L	T	R	L	T	R	L	T	R	L	T	R	L	T	R	N-S	E-W	ALL
6 AM - 7 AM																		
7 AM - 8 AM	120	4	12	2	3	14	4	192	103	299	84	246	7	337	155	636	791	
8 AM - 9 AM	129	12	6	2	2	7	5	104	88	197	101	256	9	366	158	563	721	
9 AM - 10 AM	78	6	13	0	0	5	5	147	96	248	85	191	5	281	102	529	631	
10 AM - 11 AM																		
11 AM - Noon	140	7	18	2	0	17	6	198	137	341	87	282	10	379	184	720	904	
Noon - 1 PM	162	8	19	2	0	21	11	224	162	397	131	281	4	416	212	813	1025	
1 PM - 2 PM																		
2 PM - 3 PM	124	10	22	1	2	16	11	206	129	346	142	248	6	396	175	742	917	
3 PM - 4 PM	117	15	31	1	5	28	23	231	125	379	94	240	5	339	197	718	915	
4 PM - 5 PM	141	10	30	0	0	8	13	284	192	489	114	220	2	336	189	825	1014	
5 PM - 6 PM	131	18	24	0	1	20	15	255	194	464	138	216	12	366	194	830	1024	
6 PM - 7 PM																		
Peak Hour	131	18	24	0	1	20	15	255	194	464	138	216	12	366	194	830	1024	

Collins Ferry Rd.

NORTH

CITY	Morgantown	INTERSECTION	University Ave. and Collins Ferry
COUNTY	Monongalia	DATE	7/23/2012
DISTRICT	4	WEATHER	

85% SPEED > 40 MPH	
POPULATION < 10,000	

WEST

University Ave.

EAST

University Ave.

SOUTH

Baldwin St.

WARRANT 1 -- EIGHT-HOUR VEHICULAR VOLUME

Major Street	University Avenue
Minor Street	Collins Ferry Rd.
Jurisdiction	Monongalia County
85% Speed > 40 mph	Yes
Population < 10K	No
# of Lanes on Major Street	1
# of Lanes on Minor Street	1
Minor St. Right Turns Discounted	YES
Have five (5) correctable crashes occurred in 1 year?	NO

	HOUR	MAJOR ST VOLUME	MINOR ST VOLUME		
	6-7 AM	0	0		
	7-8 AM	636	120		
	8-9 AM	563	129		
	9-10 AM	529	78		
	10-11 AM	0	0		
	11-12 PM	720	140		
	12-1 PM	813	162		
	1-2 PM	0	0		
	2-3 PM	742	124		
	3-4 PM	718	117		
	4-5 PM	825	141		
	5-6 PM	830	131		
	6-7 PM	0	0		

FINDINGS:

Condition 'A' Satisfied	YES
Condition 'B' Satisfied	YES
Combination 'A' & 'B' Satisfied	YES
WARRANT 1 Satisfied?	YES

COMMENTS:

Turns and through not counted on Collins Ferry

**WARRANT 1 -- EIGHT-HOUR VEHICULAR VOLUME
CONDITION 'A' -- MINIMUM VEHICULAR VOLUME**

Major Street	University Avenue
Minor Street	Collins Ferry Rd.
Jurisdiction	Monongalia County
85% Speed > 40 mph	Yes
Population < 10K	No
# of Lanes on Major Street	1
# of Lanes on Minor Street	1
Minor St. Right Turns Discounted	YES
Major St. Warranting Volume	500
Minor St. Warranting Volume	150
30% Warrant Volume Reduction	YES

HOUR	MAJOR STREET VOLUME	MINOR STREET VOLUME	MAJOR ST WARRANT VOLUME	MINOR ST WARRANT VOLUME	HOUR MET
6-7 AM	0	0	350	105	NO
7-8 AM	636	120	350	105	YES
8-9 AM	563	129	350	105	YES
9-10 AM	529	78	350	105	NO
10-11 AM	0	0	350	105	NO
11-12 PM	720	140	350	105	YES
12-1 PM	813	162	350	105	YES
1-2 PM	0	0	350	105	NO
2-3 PM	742	124	350	105	YES
3-4 PM	718	117	350	105	YES
4-5 PM	825	141	350	105	YES
5-6 PM	830	131	350	105	YES
6-7 PM	0	0	350	105	NO

FINDINGS:

Number of Hours Condition 'A' Met	8
Condition 'A' Satisfied?	YES

COMMENTS:

**WARRANT 1 -- EIGHT-HOUR VEHICULAR VOLUME
CONDITION 'B' -- INTERRUPTION OF CONTINUOUS TRAFFIC**

Major Street	University Avenue
Minor Street	Collins Ferry Rd.
Jurisdiction	Monongalia County
85% Speed > 40 mph	Yes
Population < 10K	No
# of Lanes on Major Street	1
# of Lanes on Minor Street	1
Minor St. Right Turns Discounted	YES
Major St. Warranting Volume	750
Minor St. Warranting Volume	75
30% Warrant Volume Reduction	YES

HOUR	MAJOR STREET VOLUME	MINOR STREET VOLUME	MAJOR ST WARRANT VOLUME	MINOR ST WARRANT VOLUME	HOUR MET
6-7 AM	0	0	525	53	NO
7-8 AM	636	120	525	53	YES
8-9 AM	563	129	525	53	YES
9-10 AM	529	78	525	53	YES
10-11 AM	0	0	525	53	NO
11-12 PM	720	140	525	53	YES
12-1 PM	813	162	525	53	YES
1-2 PM	0	0	525	53	NO
2-3 PM	742	124	525	53	YES
3-4 PM	718	117	525	53	YES
4-5 PM	825	141	525	53	YES
5-6 PM	830	131	525	53	YES
6-7 PM	0	0	525	53	NO

FINDINGS:

Number of Hours Condition 'B' Met	9
Condition 'B' Satisfied?	YES

COMMENTS:

**WARRANT 1 -- EIGHT-HOUR VEHICULAR VOLUME
COMBINATION OF CONDITION 'A' & 'B' (80% VOLUME)**

Major Street	University Avenue
Minor Street	Collins Ferry Rd.
Jurisdiction	Monongalia County

CONDITION 'A'

HOUR	MAJOR STREET VOLUME	MINOR STREET VOLUME	MAJOR ST WARRANT VOLUME	MINOR ST WARRANT VOLUME	HOUR MET
6-7 AM	0	0	280	84	NO
7-8 AM	636	120	280	84	YES
8-9 AM	563	129	280	84	YES
9-10 AM	529	78	280	84	NO
10-11 AM	0	0	280	84	NO
11-12 PM	720	140	280	84	YES
12-1 PM	813	162	280	84	YES
1-2 PM	0	0	280	84	NO
2-3 PM	742	124	280	84	YES
3-4 PM	718	117	280	84	YES
4-5 PM	825	141	280	84	YES
5-6 PM	830	131	280	84	YES
6-7 PM	0	0	280	84	NO

CONDITION 'B'

HOUR	MAJOR STREET VOLUME	MINOR STREET VOLUME	MAJOR ST WARRANT VOLUME	MINOR ST WARRANT VOLUME	HOUR MET
6-7 AM	0	0	420	42	NO
7-8 AM	636	120	420	42	YES
8-9 AM	563	129	420	42	YES
9-10 AM	529	78	420	42	YES
10-11 AM	0	0	420	42	NO
11-12 PM	720	140	420	42	YES
12-1 PM	813	162	420	42	YES
1-2 PM	0	0	420	42	NO
2-3 PM	742	124	420	42	YES
3-4 PM	718	117	420	42	YES
4-5 PM	825	141	420	42	YES
5-6 PM	830	131	420	42	YES
6-7 PM	0	0	420	42	NO

FINDINGS:

Number of Hours Combination A&B Met	8
Combination of A&B Satisfied?	YES

COMMENTS:

WARRANT 7 -- CRASH EXPERIENCE

Major Street	University Avenue
Minor Street	Collins Ferry Rd.
Jurisdiction	Monongalia County
Have five (5) correctable crashes occurred in 1 year?	NO

CONDITION 'A'

HOUR	MAJOR STREET VOLUME	MINOR STREET VOLUME	MAJOR ST WARRANT VOLUME	MINOR ST WARRANT VOLUME	HOUR MET
6-7 AM	0	0	350	105	NO
7-8 AM	636	120	350	105	YES
8-9 AM	563	129	350	105	YES
9-10 AM	529	78	350	105	NO
10-11 AM	0	0	350	105	NO
11-12 PM	720	140	350	105	YES
12-1 PM	813	162	350	105	YES
1-2 PM	0	0	350	105	NO
2-3 PM	742	124	350	105	YES
3-4 PM	718	117	350	105	YES
4-5 PM	825	141	350	105	YES
5-6 PM	830	131	350	105	YES
6-7 PM	0	0	350	105	NO

CONDITION 'B'

HOUR	MAJOR STREET VOLUME	MINOR STREET VOLUME	MAJOR ST WARRANT VOLUME	MINOR ST WARRANT VOLUME	HOUR MET
6-7 AM	0	0	525	53	NO
7-8 AM	636	120	525	53	YES
8-9 AM	563	129	525	53	YES
9-10 AM	529	78	525	53	YES
10-11 AM	0	0	525	53	NO
11-12 PM	720	140	525	53	YES
12-1 PM	813	162	525	53	YES
1-2 PM	0	0	525	53	NO
2-3 PM	742	124	525	53	YES
3-4 PM	718	117	525	53	YES
4-5 PM	825	141	525	53	YES
5-6 PM	830	131	525	53	YES
6-7 PM	0	0	525	53	NO

FINDINGS:

Condition A Satisfied?	8
Condition B Satisfied?	9
WARRANT 7 Satisfied?	NO

COMMENTS:

APPENDIX B

Crash Record Number	County	Highway C Route	Subroute	MP	Intersectin	Date	Time of Ge	Number of	Number of	Collision Type
R201126376	Monongali County/HA	57	0	1	UNIVERSIT	9/6/2011	1500	0	1C	Right Angle
R201228561	Monongali County/HA	57	0	1	UNIVERSIT	10/5/2012	1040	0	0	0 Angle
R201324525	Monongali County/HA	57	0	1	UNIVERSIT	9/3/2013	1221	0	0	0 Right Angle
R201139117	Monongali County/HA	55	0	110	COLLINS FE	12/31/2011	1809	0	0	0 Rear End
R201325170	Monongali County/HA	55	0	110	COLLINS FE	9/9/2013	945	0	1C	SVC
R201300739	Monongali County/HA	55	0	110	COLLINS FE	1/12/2013	1835	0	0	0 Angle
R201220432	Monongali County/HA	55	0	110	COLLINS FE	7/20/2012	1843	0	0	0 Right Angle
R201323038	Monongali County/HA	55	0	110	COLLINS FE	8/24/2013	1430	0	0	0 Angle
R201232181	Monongali County/HA	55	0	110	COLLINS FE	11/8/2012	1725	0	0	0 Right Angle
R201309364	Monongali County/HA	55	0	110	COLLINS FE	4/10/2013	1715	0	1C	Right Angle
R201226865	Monongali County/HA	55	0	111	BALDWIN :	9/17/2012	1954	0	1C	Head-On

Summary

Total 11

Right angle	5	45%
Rear end	1	9%
Angle	3	27%
Head-on	1	9%
SVC	1	9%

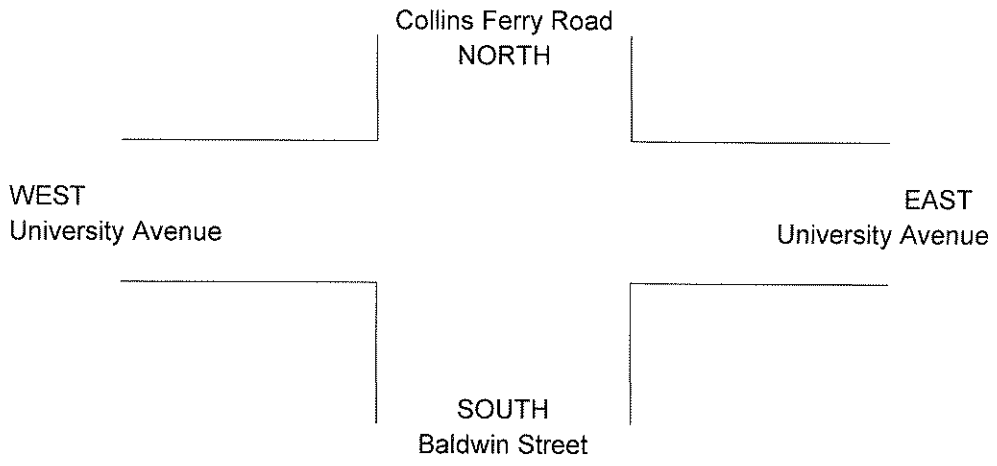
Left turn into Collins Ferry Road
Left turn into Collins Ferry Road
Left turn into Collins Ferry Road
SB on University
Crash with Bike
Lost control - Driver error

APPENDIX C

TRAFFIC STUDY

Intersection of University Avenue with Collins Ferry Road
Morgantown, Monongalia County

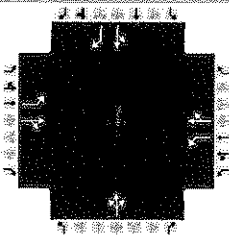
Comparison of Collins Ferry and University Avenue



	Delay (s)	LOS	95% Queue (cars)(ft)
Roundabout	10	A	-
EB	10	A	2.8 (70)
WB	11	B	3.3 (83)
NB	7	A	0.3 (8)
SB	7	A	1 (25)
Signal	24.9	C	-
EB	25	C	7.4 (185)
WB	20	C	11.4 (285)
NB	35	D	2.3 (58)
SB	33	C	5.3 (133)
Existing (Two-way Stop)	-	-	-
EB	9	A	0.69 (18)
WB	8	A	0.06 (1.5)
NB	18	C	0.68 (17)
SB	349	F	22 (550)

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information			
Agency	WV DOH			Duration, h	1.00		
Analyst	DLD	Analysis Date	Apr 23, 2014	Area Type	Other		
Jurisdiction	Mononglia County	Time Period	3:15 - 4:15	PHF	1.00		
Intersection	Collins Ferry	Analysis Year	2014	Analysis Period	1> 5:00		
File Name	Streets1 (Collins).xus						
Project Description	Signal Analysis						



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	188	247	11	23	275	168	8	8	46	134	9	55

Signal Information												
Cycle, s	94.9	Reference Phase	2									
Offset, s	0	Reference Point	End									
Uncoordinated	Yes	Simult. Gap E/W	On									
Force Mode	Fixed	Simult. Gap N/S	On	Green	43.9	19.9	16.1	0.0	0.0	0.0	0.0	0.0
				Yellow	4.0	4.0	4.0	0.0	0.0	0.0	0.0	0.0
				Red	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		12.0		11.0
Phase Duration, s		48.9		48.9		21.1		24.9
Change Period, (Y+Rc), s		5.0		5.0		5.0		5.0
Max Allow Headway (MAH), s		6.4		6.4		6.3		6.2
Queue Clearance Time (gs), s		38.0		21.0		5.3		9.0
Green Extension Time (ge), s		5.9		9.5		0.4		1.5
Phase Call Probability		1.00		1.00		0.80		0.99
Max Out Probability		0.63		0.16		0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	188	258		23	443		62			143	55	
Adjusted Saturation Flow Rate (s), veh/h/ln	959	1736		1136	1634		1532			1672	1469	
Queue Service Time (gs), s	17.0	8.9		1.2	19.0		3.3			7.0	2.9	
Cycle Queue Clearance Time (gc), s	36.0	8.9		10.1	19.0		3.3			7.0	2.9	
Green Ratio (g/C)	0.46	0.46		0.46	0.46		0.17			0.21	0.21	
Capacity (c), veh/h	328	803		495	756		260			350	308	
Volume-to-Capacity Ratio (X)	0.573	0.321		0.046	0.586		0.238			0.408	0.179	
Available Capacity (ca), veh/h	390	915		568	861		565			616	542	
Back of Queue (Q), veh/ln (95th percentile)	7.4	6.2		0.6	11.4		2.3			5.3	1.9	
Queue Storage Ratio (RQ) (95th percentile)	0.00	0.00		0.00	0.00		0.00			0.00	0.00	
Uniform Delay (d1), s/veh	32.0	16.1		19.3	18.8		34.1			32.4	30.8	
Incremental Delay (d2), s/veh	3.4	0.5		0.1	1.6		1.0			1.6	0.6	
Initial Queue Delay (d3), s/veh	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Control Delay (d), s/veh	35.4	16.6		19.3	20.4		35.1			34.1	31.4	
Level of Service (LOS)	D	B		B	C		D			C	C	
Approach Delay, s/veh / LOS	24.5		C	20.4		C	35.1		D	33.3		C
Intersection Delay, s/veh / LOS	24.9						C					

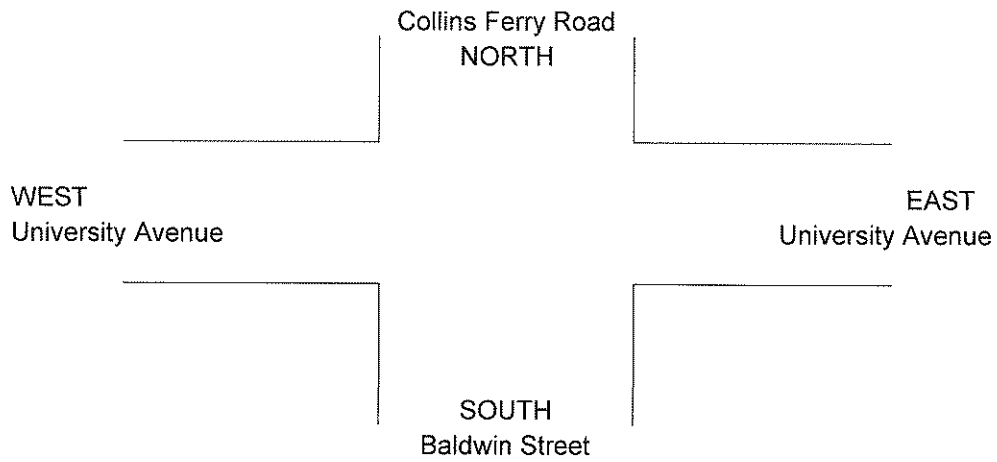
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.2	A	1.3	A	0.6	A	0.8	A

ROUNDBOUT REPORT																
General Information							Site Information									
Analyst	DLD						Intersection	University and Collins Ferry								
Agency or Co.	WVDOH						E/W Street Name	University Avenue								
Date Performed	4/23/2014						N/S Street Name									
Time Period	3:15-4:15						Analysis Year	2014								
Peak Hour Factor	1.00						Project ID	Roundabout Simulation								
Project Description:																
Volume Adjustment and Site Characteristics																
	EB				WB				NB				SB			
	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	U
Number of Lanes (N)	0	1	0		0	1	0		0	1	0		0	1	0	
Lane Assignment	LTR				LTR				LTR				LTR			
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Volume (V), veh/h	188	247	11	0	23	275	168	0	8	8	46	0	134	9	55	0
Heavy Veh. Adj. (f_{HV}), %	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Pedestrians Crossing	0				0				0				0			
Critical and Follow-Up Headway Adjustment																
	EB				WB				NB				SB			
	Left	Right	Bypass		Left	Right	Bypass		Left	Right	Bypass		Left	Right	Bypass	
Critical Headway (sec)	5.1929	5.1929	5.1929		5.1929	5.1929	5.1929		5.1929	5.1929	5.1929		5.1929	5.1929	5.1929	
Follow-Up Headway (sec)	3.1858	3.1858	3.1858		3.1858	3.1858	3.1858		3.1858	3.1858	3.1858		3.1858	3.1858	3.1858	
Flow Computations																
	EB				WB				NB				SB			
	Left	Right	Bypass		Left	Right	Bypass		Left	Right	Bypass		Left	Right	Bypass	
Circulating Flow (V_c), pc/h	171				210				586				315			
Exiting Flow (V_{ex}), pc/h	440				348				375				44			
Entry Flow (V_e), pc/h	459				480				64				204			
Entry Volume veh/h	446				466				62				198			
Capacity and v/c Ratios																
	EB				WB				NB				SB			
	Left	Right	Bypass		Left	Right	Bypass		Left	Right	Bypass		Left	Right	Bypass	
Capacity (C_{PCE}), pc/h	952				916				629				825			
Capacity (c), veh/h	925				889				611				801			
v/c Ratio (X)	0.48				0.52				0.10				0.25			
Delay and Level of Service																
	EB				WB				NB				SB			
	Left	Right	Bypass		Left	Right	Bypass		Left	Right	Bypass		Left	Right	Bypass	
Lane Control Delay (d), s/veh	9.9				11.0				7.1				7.2			
Lane LOS	A				B				A				A			
Lane 95% Queue	2.7				3.1				0.3				1.0			
Approach Delay, s/veh	9.86				11.04				7.07				7.20			
Approach LOS, s/veh	A				B				A				A			
Intersection Delay, s/veh	9.73															
Intersection LOS	A															

TWO-WAY STOP CONTROL SUMMARY								
General Information				Site Information				
Analyst	DLD			Intersection	University and Collins Ferry			
Agency/Co.	WVDOH			Jurisdiction	Monongalia			
Date Performed	4/23/2014			Analysis Year	2012			
Analysis Time Period	3:15-4:15							
Project Description Existing								
East/West Street: University Avenue				North/South Street: Collins Ferry and Baldwin St.				
Intersection Orientation: East-West				Study Period (hrs): 1.00				
Vehicle Volumes and Adjustments								
Major Street	Eastbound			Westbound				
Movement	1	2	3	4	5	6		
	L	T	R	L	T	R		
Volume (veh/h)	188	247	11	23	275	168		
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00		
Hourly Flow Rate, HFR (veh/h)	188	247	11	23	275	168		
Percent Heavy Vehicles	0	--	--	0	--	--		
Median Type	Undivided							
RT Channelized			0			0		
Lanes	0	1	0	0	1	0		
Configuration	LTR			LTR				
Upstream Signal		0			0			
Minor Street	Northbound			Southbound				
Movement	7	8	9	10	11	12		
	L	T	R	L	T	R		
Volume (veh/h)	8	8	46	134	9	55		
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00		
Hourly Flow Rate, HFR (veh/h)	8	8	46	134	9	55		
Percent Heavy Vehicles	0	0	0	0	0	0		
Percent Grade (%)	0			0				
Flared Approach		N			N			
Storage		0			0			
RT Channelized			0			0		
Lanes	0	1	0	0	1	1		
Configuration		LTR		LT		R		
Delay, Queue Length, and Level of Service								
Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR	LTR			LT	R	
v (veh/h)	188	23	62			143	55	
C (m) (veh/h)	1128	1318	386			156	690	
v/c	0.17	0.02	0.16			0.92	0.08	
95% queue length	0.60	0.05	0.57			11.75	0.26	
Control Delay (s/veh)	8.8	7.8	16.1			162.1	10.7	
LOS	A	A	C			F	B	
Approach Delay (s/veh)	--	--	16.1			120.1		
Approach LOS	--	--	C			F		

APPENDIX D

Comparison of Collins Ferry and University Avenue















	Delay (s)	LOS	95% Queue (ft)
No Added Lanes	57	E	-
EB	74	E	#465
WB	54	D	#508
NB	2	A	#201
SB	44	D	12
Signal (LT Added to University EB+WB, Right turn lane also added on Collins Ferry)	21	C	-
EB	18	B	177
WB	24	C	#318
NB	5	A	20
SB	23	C	131
Signal (Previous + RT Lane added to WB University)	17	B	-
EB	16	B	62
WB	19	B	209
NB	4	A	0
SB	19	B	45

Synchro 8 Analysis

Lanes, Volumes, Timings

1: Baldwin & University Avenue & Collins Ferry

5/22/2014

												
Lane Group	EBL	EBR	EBR2	SET	SER	SER2	NWL2	NWL	NWT	NEL2	NEL	NER
Lane Configurations	T			P					L		T	
Volume (vph)	188	247	11	134	9	55	23	275	168	8	8	46
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0			100			0			0	0
Storage Lanes	1	0			0			0			1	0
Taper Length (ft)	25							25			25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.922			0.956							0.900	
Flt Protected	0.979								0.969		0.987	
Satd. Flow (prot)	1681	0	0	1781	0	0	0	0	1805	0	1655	0
Flt Permitted	0.979								0.969		0.987	
Satd. Flow (perm)	1681	0	0	1781	0	0	0	0	1805	0	1655	0
Right Turn on Red			Yes			Yes						Yes
Satd. Flow (RTOR)	121			18							121	
Link Speed (mph)	25			25					25		25	
Link Distance (ft)	405			469					625		739	
Travel Time (s)	11.0			12.8					17.0		20.2	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	188	247	11	134	9	55	23	275	168	8	8	46
Shared Lane Traffic (%)												
Lane Group Flow (vph)	446	0	0	198	0	0	0	0	466	0	62	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Right	Right	Left	Right	Right	Left	Left	Left	Left	Left	Right
Median Width(ft)	12			0					0		12	
Link Offset(ft)	0			0					0		0	
Crosswalk Width(ft)	16			16					16		16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9	9		9	9	15	15		15	15	9
Number of Detectors	1			2			1	1	2	1	1	
Detector Template	Left			Thru			Left	Left	Thru	Left	Left	
Leading Detector (ft)	20			100			20	20	100	20	20	
Trailing Detector (ft)	0			0			0	0	0	0	0	
Detector 1 Position(ft)	0			0			0	0	0	0	0	
Detector 1 Size(ft)	20			6			20	20	6	20	20	
Detector 1 Type	CI+Ex			CI+Ex			CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0			0.0			0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0			0.0			0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0			0.0			0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(ft)				94					94			
Detector 2 Size(ft)				6					6			
Detector 2 Type				CI+Ex					CI+Ex			
Detector 2 Channel												
Detector 2 Extend (s)				0.0					0.0			
Turn Type	Prot			NA			Split	Split	NA	Prot	Prot	
Protected Phases	1						2	2	2	4	4	
Permitted Phases				3								
Detector Phase	1			3			2	2	2	4	4	

Lanes, Volumes, Timings

1: Baldwin & University Avenue & Collins Ferry

5/22/2014

Lane Group	EBL	EBR	EBR2	SET	SER	SER2	NWL2	NWL	NWT	NEL2	NEL	NER
Switch Phase												
Minimum Initial (s)	10.0			10.0			10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	20.5			20.5			20.5	20.5	20.5	20.5	20.5	
Total Split (s)	23.7			20.5			30.3	30.3	30.3	20.5	20.5	
Total Split (%)	24.9%			21.6%			31.9%	31.9%	31.9%	21.6%	21.6%	
Maximum Green (s)	19.2			16.0			25.8	25.8	25.8	16.0	16.0	
Yellow Time (s)	3.5			3.5			3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	1.0			1.0			1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	0.0			0.0					0.0		0.0	
Total Lost Time (s)	4.5			4.5					4.5		4.5	
Lead/Lag	Lead			Lead			Lag	Lag	Lag	Lag	Lag	
Lead-Lag Optimize?	Yes			Yes			Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0			3.0			3.0	3.0	3.0	3.0	3.0	
Recall Mode	Min			None			Min	Min	Min	Min	Min	
Walk Time (s)	5.0			5.0			5.0	5.0	5.0	5.0	5.0	
Flash Dont Walk (s)	11.0			11.0			11.0	11.0	11.0	11.0	11.0	
Pedestrian Calls (#/hr)	0			0			0	0	0	0	0	
Act Effct Green (s)	19.2			13.5					25.1		10.0	
Actuated g/C Ratio	0.22			0.16					0.29		0.12	
v/c Ratio	0.95			0.67					0.88		0.21	
Control Delay	73.6			43.8					54.2		2.1	
Queue Delay	0.0			0.0					0.0		0.0	
Total Delay	73.6			43.8					54.2		2.1	
LOS	E			D					D		A	
Approach Delay	73.6			43.8					54.2		2.1	
Approach LOS	E			D					D		A	
90th %ile Green (s)	19.2			16.0			25.8	25.8	25.8	10.0	10.0	
90th %ile Term Code	Max			Max			Max	Max	Max	Min	Min	
70th %ile Green (s)	19.2			16.0			25.8	25.8	25.8	10.0	10.0	
70th %ile Term Code	Max			Max			Max	Max	Max	Min	Min	
50th %ile Green (s)	19.2			14.0			25.8	25.8	25.8	10.0	10.0	
50th %ile Term Code	Max			Gap			Max	Max	Max	Min	Min	
30th %ile Green (s)	19.2			11.7			25.8	25.8	25.8	10.0	10.0	
30th %ile Term Code	Max			Gap			Max	Max	Max	Min	Min	
10th %ile Green (s)	19.2			10.0			22.4	22.4	22.4	10.0	10.0	
10th %ile Term Code	Max			Min			Gap	Gap	Gap	Min	Min	
Stops (vph)	284			165					401		1	
Fuel Used(gal)	9			3					9		0	
CO Emissions (g/hr)	651			223					640		29	
NOx Emissions (g/hr)	127			43					125		6	
VOC Emissions (g/hr)	151			52					148		7	
Dilemma Vehicles (#)	0			0					0		0	
Queue Length 50th (ft)	183			94					241		0	
Queue Length 95th (ft)	#465			#201					#508		12	
Internal Link Dist (ft)	325			389					545		659	
Turn Bay Length (ft)												
Base Capacity (vph)	470			347					543		407	
Starvation Cap Reductn	0			0					0		0	
Spillback Cap Reductn	0			0					0		0	

Lanes, Volumes, Timings

1: Baldwin & University Avenue & Collins Ferry

5/22/2014



Lane Group	EBL	EBR	EBR2	SET	SER	SER2	NWL2	NWL	NWT	NEL2	NEL	NER
Storage Cap Reductn	0			0					0		0	
Reduced v/c Ratio	0.95			0.57					0.86		0.15	

Intersection Summary

Area Type: Other
 Cycle Length: 95
 Actuated Cycle Length: 85.9
 Natural Cycle: 95
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.95
 Intersection Signal Delay: 57.1
 Intersection Capacity Utilization 85.9%
 Analysis Period (min) 60
 90th %ile Actuated Cycle: 89
 70th %ile Actuated Cycle: 89
 50th %ile Actuated Cycle: 87
 30th %ile Actuated Cycle: 84.7
 10th %ile Actuated Cycle: 79.6
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 1: Baldwin & University Avenue & Collins Ferry

Phase	Duration	Phase	Duration	Phase	Duration	Phase	Duration
Ø1	23.7 s	Ø2	30.3 s	Ø3	20.5 s	Ø4	20.5 s

Lanes, Volumes, Timings

1: Baldwin & University Avenue & Collins Ferry

5/22/2014

Lane Group	EBL	EBR	EBR2	SBL	SBR	SBR2	NWL2	NWL	NWR	NEL2	NEL	NER
Lane Configurations												
Volume (vph)	188	247	11	134	9	55	23	275	168	8	8	46
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200	0		0	300			0	0		0	0
Storage Lanes	1	1		1	1			2	0		1	0
Taper Length (ft)	25			25				25			25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fr		0.850			0.850			0.943			0.900	
Fit Protected	0.950			0.950			0.950	0.970			0.987	
Satd. Flow (prot)	1770	1583	0	1770	1583	0	1770	1704	0	0	1655	0
Fit Permitted	0.950			0.950			0.950				0.943	
Satd. Flow (perm)	1770	1583	0	1770	1583	0	1770	1757	0	0	1581	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		108			108			108			108	
Link Speed (mph)	25			25				25			25	
Link Distance (ft)	730			729				625			739	
Travel Time (s)	19.9			19.9				17.0			20.2	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	188	247	11	134	9	55	23	275	168	8	8	46
Shared Lane Traffic (%)												
Lane Group Flow (vph)	188	258	0	134	64	0	23	443	0	0	62	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Right	Right	Left	Right	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)	12			12				24			12	
Link Offset(ft)	0			0				0			0	
Crosswalk Width(ft)	16			16				16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9	9	15	9	9	15	15	9	15	15	9
Number of Detectors	1	1		1	1		1	1		1	1	
Detector Template	Left	Right		Left	Right		Left	Left		Left	Left	
Leading Detector (ft)	20	20		20	20		20	20		20	20	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	20		20	20		20	20		20	20	
Detector 1 Type	CI+Ex	CI+Ex		CI+Ex	CI+Ex		CI+Ex	CI+Ex		CI+Ex	CI+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Turn Type	Prot	Perm		Perm	Perm		Prot	Perm		Perm	Perm	
Protected Phases	1						5					
Permitted Phases		6		3	3			2		4	4	
Detector Phase	1	6		3	3		5	2		4	4	
Switch Phase												
Minimum Initial (s)	10.0	4.0		10.0	10.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	20.5	20.5		20.5	20.5		20.5	20.5		20.5	20.5	
Total Split (s)	20.6	32.4		20.5	20.5		20.5	32.4		32.4	32.4	
Total Split (%)	19.5%	30.6%		19.4%	19.4%		19.4%	30.6%		30.6%	30.6%	

Lanes, Volumes, Timings

1: Baldwin & University Avenue & Collins Ferry

5/22/2014

Lane Group	EBL	EBR	EBR2	SBL	SBR	SBR2	NWL2	NWL	NWR	NEL2	NEL	NER
Maximum Green (s)	16.1	27.9		16.0	16.0		16.0	27.9		27.9	27.9	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lead/Lag	Lead	Lag		Lead	Lead		Lead	Lag		Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Min	None		None	None		None	None		None	None	
Walk Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)	14.3	38.0		13.0	13.0		7.2	20.4			6.4	
Actuated g/C Ratio	0.22	0.59		0.20	0.20		0.11	0.32			0.10	
v/c Ratio	0.48	0.26		0.38	0.16		0.12	0.70			0.24	
Control Delay	31.7	8.4		31.9	2.9		34.2	23.4			4.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0			0.0	
Total Delay	31.7	8.4		31.9	2.9		34.2	23.4			4.6	
LOS	C	A		C	A		C	C			A	
Approach Delay	18.2			22.5				23.9			4.6	
Approach LOS	B			C				C			A	
90th %ile Green (s)	16.1	35.9		15.5	15.5		8.1	27.9		6.1	6.1	
90th %ile Term Code	Max	Hold		Gap	Gap		Gap	Max		Gap	Gap	
70th %ile Green (s)	16.1	33.9		12.8	12.8		7.2	25.0		5.5	5.5	
70th %ile Term Code	Max	Hold		Gap	Gap		Gap	Gap		Gap	Gap	
50th %ile Green (s)	13.7	38.9		11.1	11.1		0.0	20.7		5.5	5.5	
50th %ile Term Code	Gap	Hold		Gap	Gap		Skip	Gap		Gap	Gap	
30th %ile Green (s)	11.1	32.2		10.0	10.0		0.0	16.6		5.5	5.5	
30th %ile Term Code	Gap	Hold		Min	Min		Skip	Gap		Gap	Gap	
10th %ile Green (s)	10.0	25.4		0.0	0.0		0.0	10.9		0.0	0.0	
10th %ile Term Code	Min	Hold		Skip	Skip		Skip	Gap		Skip	Skip	
Stops (vph)	154	87		109	4		23	283			4	
Fuel Used(gal)	3	2		2	0		0	6			0	
CO Emissions (g/hr)	208	166		148	31		26	388			32	
NOx Emissions (g/hr)	40	32		29	6		5	76			6	
VOC Emissions (g/hr)	48	39		34	7		6	90			8	
Dilemma Vehicles (#)	0	0		0	0		0	0			0	
Queue Length 50th (ft)	72	28		52	0		9	126			0	
Queue Length 95th (ft)	177	122		131	19		38	#318			20	
Internal Link Dist (ft)	650			649				545			659	
Turn Bay Length (ft)	200				300							
Base Capacity (vph)	508	961		504	528		504	928			840	
Starvation Cap Reductn	0	0		0	0		0	0			0	
Spillback Cap Reductn	0	0		0	0		0	0			0	
Storage Cap Reductn	0	0		0	0		0	0			0	
Reduced v/c Ratio	0.37	0.27		0.27	0.12		0.05	0.48			0.07	

Intersection Summary

Area Type: Other

Cycle Length: 105.9

Lanes, Volumes, Timings

1: Baldwin & University Avenue & Collins Ferry

5/22/2014

Actuated Cycle Length: 64.2

Natural Cycle: 85

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.70

Intersection Signal Delay: 20.5

Intersection LOS: C

Intersection Capacity Utilization 63.0%

ICU Level of Service B

Analysis Period (min) 60

90th %ile Actuated Cycle: 83.6

70th %ile Actuated Cycle: 77.4

50th %ile Actuated Cycle: 69

30th %ile Actuated Cycle: 61.2

10th %ile Actuated Cycle: 29.9

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Baldwin & University Avenue & Collins Ferry

Phase	Split	Phase	Split
φ1	20.5 s	φ2	32.4 s
φ3	20.5 s	φ4	32.4 s
φ5	20.5 s	φ6	32.4 s

University Lefts
+ Right

Lanes, Volumes, Timings

1: Baldwin & University Avenue & Collins Ferry

5/22/2014

Lane Group	EBL	EBR	EBR2	SBL	SBR	SBR2	NWL2	NWL	NWR	NEL2	NEL	NER
Lane Configurations												
Volume (vph)	188	247	11	134	9	55	23	275	168	8	8	46
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200	0		0	300			300	300		0	0
Storage Lanes	1	1		1	1			2	0		1	0
Taper Length (ft)	25			25				25			25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850			0.850				0.850		0.900	
Flt Protected	0.950			0.950			0.950	0.950			0.987	
Satd. Flow (prot)	1770	1583	0	1770	1583	0	1770	1770	1583	0	1655	0
Flt Permitted	0.950						0.950				0.943	
Satd. Flow (perm)	1770	1583	0	1863	1583	0	1770	1863	1583	0	1581	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		108			108				168		108	
Link Speed (mph)	25			25				25			25	
Link Distance (ft)	730			729				625			739	
Travel Time (s)	19.9			19.9				17.0			20.2	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	188	247	11	134	9	55	23	275	168	8	8	46
Shared Lane Traffic (%)												
Lane Group Flow (vph)	188	258	0	134	64	0	23	275	168	0	62	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Right	Right	Left	Right	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)	12			12				24			12	
Link Offset(ft)	0			0				0			0	
Crosswalk Width(ft)	16			16				16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9	9	15	9	9	15	15	9	15	15	9
Number of Detectors	1	1		1	1		1	1	1	1	1	
Detector Template	Left	Right		Left	Right		Left	Left	Right	Left	Left	
Leading Detector (ft)	20	20		20	20		20	20	20	20	20	
Trailing Detector (ft)	0	0		0	0		0	0	0	0	0	
Detector 1 Position(ft)	0	0		0	0		0	0	0	0	0	
Detector 1 Size(ft)	20	20		20	20		20	20	20	20	20	
Detector 1 Type	CI+Ex	CI+Ex		CI+Ex	CI+Ex		CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Turn Type	Prot	Perm		Perm	Perm		Prot	Perm	Perm	Perm	Perm	
Protected Phases	1						5					
Permitted Phases		6		3	3			2	2	4	4	
Detector Phase	1	6		3	3		5	2	2	4	4	
Switch Phase												
Minimum Initial (s)	10.0	4.0		10.0	10.0		4.0	4.0	4.0	4.0	4.0	
Minimum Split (s)	20.5	20.5		20.5	20.5		20.5	20.5	20.5	20.5	20.5	
Total Split (s)	20.6	32.4		20.5	20.5		20.5	32.4	32.4	32.4	32.4	
Total Split (%)	19.5%	30.6%		19.4%	19.4%		19.4%	30.6%	30.6%	30.6%	30.6%	

Lanes, Volumes, Timings
 1: Baldwin & University Avenue & Collins Ferry

5/22/2014

Lane Group	EBL	EBR	EBR2	SBL	SBR	SBR2	NWL2	NWL	NWR	NEL2	NEL	NER
Maximum Green (s)	16.1	27.9		16.0	16.0		16.0	27.9	27.9	27.9	27.9	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.5	4.5		4.5	4.5		4.5	4.5	4.5	4.5	4.5	
Lead/Lag	Lead	Lag		Lead	Lead		Lead	Lag	Lag	Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	Min	None		None	None		None	None	None	None	None	
Walk Time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0		11.0	11.0	11.0	11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0	0	0	0	
Act Effct Green (s)	13.8	32.2		12.5	12.5		7.1	15.2	15.2		6.4	
Actuated g/C Ratio	0.25	0.58		0.22	0.22		0.13	0.27	0.27		0.11	
v/c Ratio	0.43	0.27		0.32	0.15		0.10	0.54	0.30		0.23	
Control Delay	26.5	8.8		26.8	2.8		30.2	25.2	5.8		4.3	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0		0.0	
Total Delay	26.5	8.8		26.8	2.8		30.2	25.2	5.8		4.3	
LOS	C	A		C	A		C	C	A		A	
Approach Delay	16.3			19.0				18.5			4.3	
Approach LOS	B			B				B			A	
90th %ile Green (s)	16.1	29.4		14.9	14.9		8.1	21.4	21.4	6.1	6.1	
90th %ile Term Code	Max	Hold		Gap	Gap		Gap	Gap	Gap	Gap	Gap	
70th %ile Green (s)	15.2	25.7		11.9	11.9		7.0	17.5	17.5	5.5	5.5	
70th %ile Term Code	Gap	Hold		Gap	Gap		Gap	Gap	Gap	Gap	Gap	
50th %ile Green (s)	12.7	32.1		10.2	10.2		0.0	14.9	14.9	5.5	5.5	
50th %ile Term Code	Gap	Hold		Gap	Gap		Skip	Gap	Gap	Gap	Gap	
30th %ile Green (s)	10.6	27.5		10.0	10.0		0.0	12.4	12.4	0.0	0.0	
30th %ile Term Code	Gap	Hold		Min	Min		Skip	Gap	Gap	Skip	Skip	
10th %ile Green (s)	10.0	23.2		0.0	0.0		0.0	8.7	8.7	0.0	0.0	
10th %ile Term Code	Min	Hold		Skip	Skip		Skip	Gap	Gap	Skip	Skip	
Stops (vph)	149	95		107	4		23	217	25		4	
Fuel Used(gal)	3	2		2	0		0	4	1		0	
CO Emissions (g/hr)	193	170		138	31		25	259	83		32	
NOx Emissions (g/hr)	37	33		27	6		5	50	16		6	
VOC Emissions (g/hr)	45	39		32	7		6	60	19		7	
Dilemma Vehicles (#)	0	0		0	0		0	0	0		0	
Queue Length 50th (ft)	62	27		45	0		8	91	0		0	
Queue Length 95th (ft)	161	125		119	18		35	209	55		20	
Internal Link Dist (ft)	650			649				545			659	
Turn Bay Length (ft)	200				300		300	300	300			
Base Capacity (vph)	579	969		606	587		575	1054	969		941	
Starvation Cap Reductn	0	0		0	0		0	0	0		0	
Spillback Cap Reductn	0	0		0	0		0	0	0		0	
Storage Cap Reductn	0	0		0	0		0	0	0		0	
Reduced v/c Ratio	0.32	0.27		0.22	0.11		0.04	0.26	0.17		0.07	

Intersection Summary

Area Type: Other
 Cycle Length: 105.9

Lanes, Volumes, Timings
 1: Baldwin & University Avenue & Collins Ferry

5/22/2014

Actuated Cycle Length: 56
 Natural Cycle: 85
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.54
 Intersection Signal Delay: 17.0
 Intersection LOS: B
 Intersection Capacity Utilization 52.7%
 ICU Level of Service A
 Analysis Period (min) 60
 90th %ile Actuated Cycle: 76.5
 70th %ile Actuated Cycle: 68.1
 50th %ile Actuated Cycle: 61.3
 30th %ile Actuated Cycle: 46.5
 10th %ile Actuated Cycle: 27.7

Splits and Phases: 1: Baldwin & University Avenue & Collins Ferry

φ1 20.5 s	φ2 22.4 s	φ3 20.5 s	φ4 32.4 s
φ5 20.5 s	φ6 22.4 s		

APPENDIX “2”

Plan Sheets

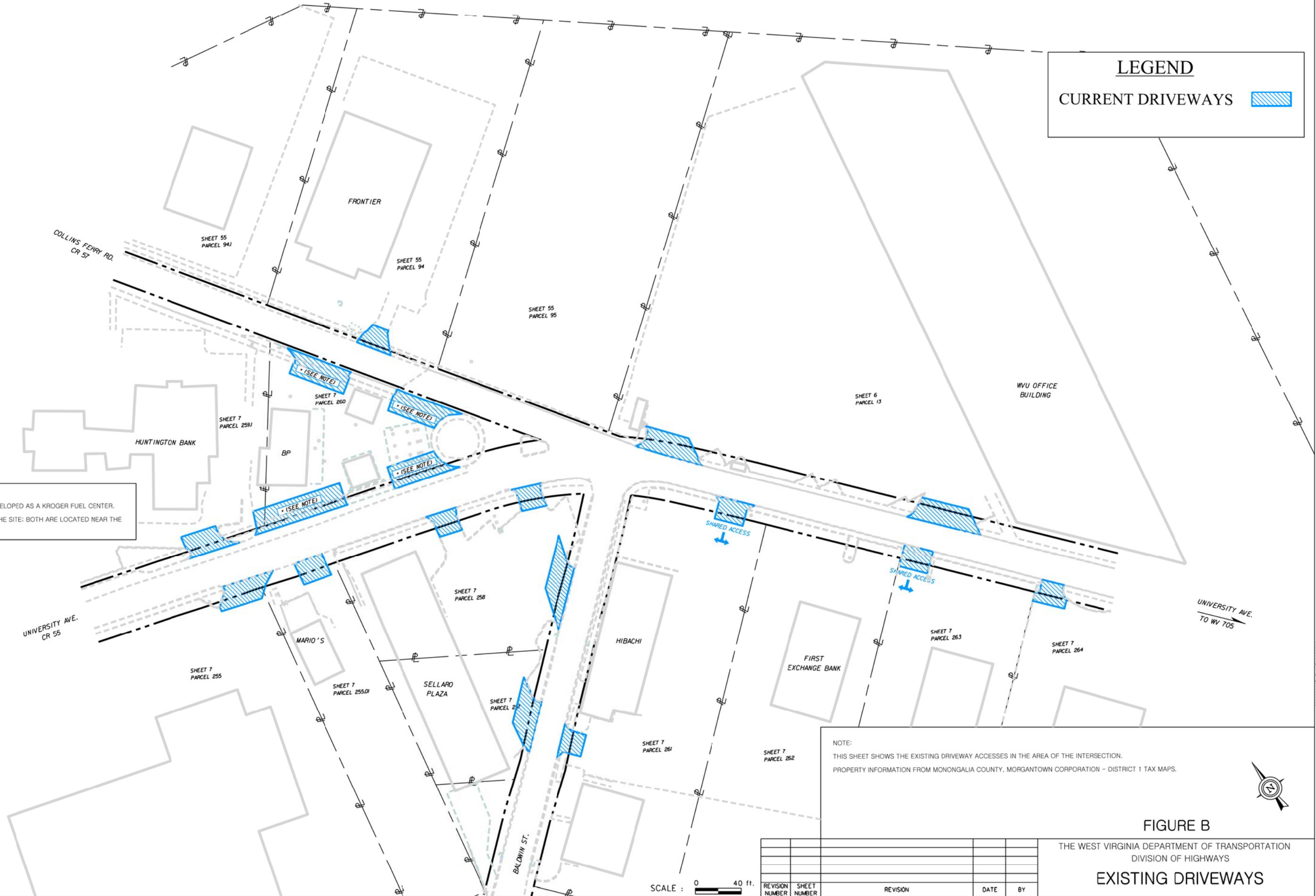
Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	4				MONONGALIA		

LEGEND

CURRENT DRIVEWAYS

* NOTE:
 THE BP PROPERTY HAS BEEN RECENTLY REDEVELOPED AS A KROGER FUEL CENTER.
 THERE ARE NOW ONLY TWO ENTRANCES TO THE SITE: BOTH ARE LOCATED NEAR THE WESTERN PROPERTY LINE.

NOTE:
 THIS SHEET SHOWS THE EXISTING DRIVEWAY ACCESSES IN THE AREA OF THE INTERSECTION.
 PROPERTY INFORMATION FROM MONONGALIA COUNTY, MORGANTOWN CORPORATION - DISTRICT 1 TAX MAPS.



REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

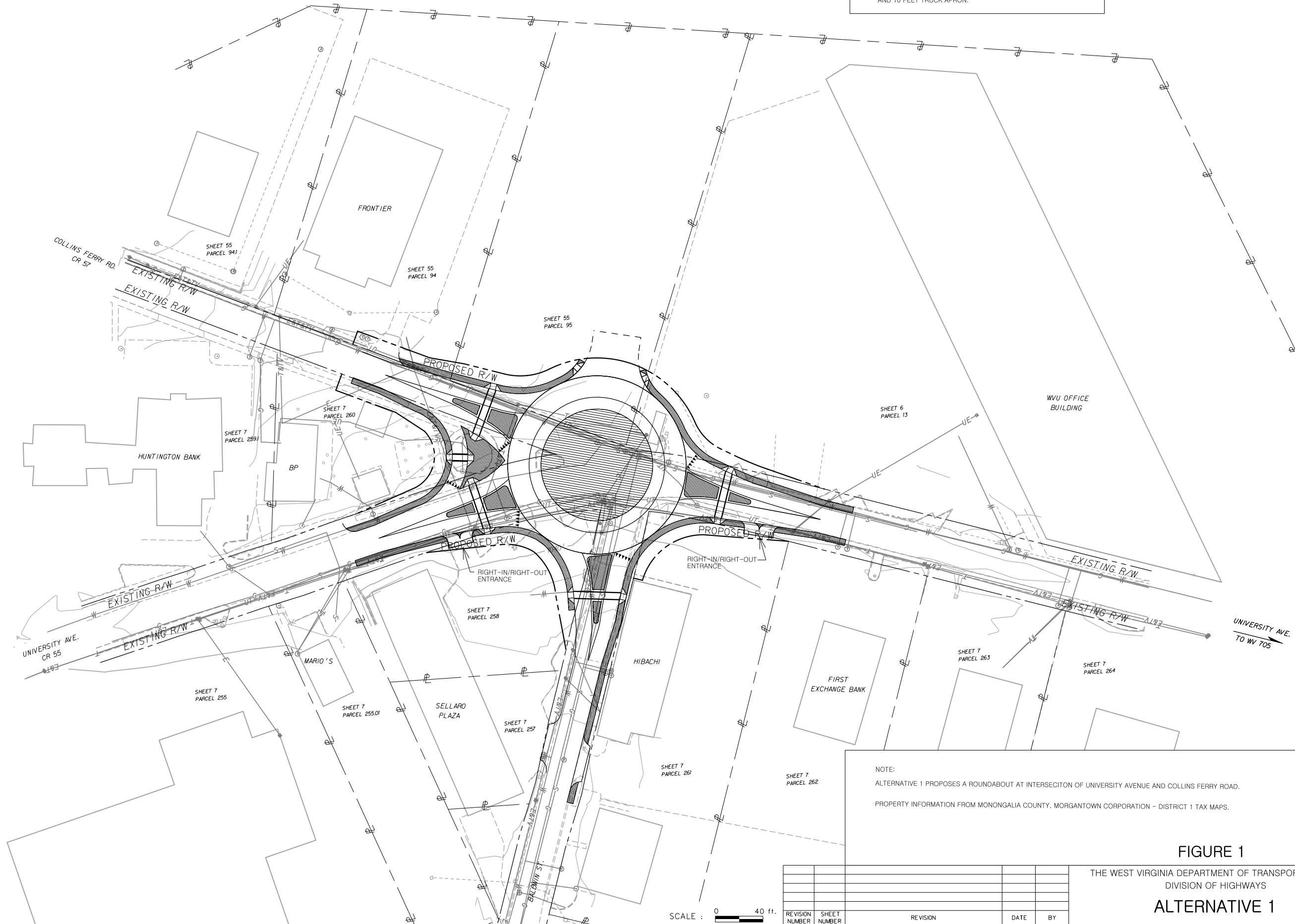
FIGURE B

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
 DIVISION OF HIGHWAYS

EXISTING DRIVEWAYS

DESIGN CRITERIA:
 SINGLE-LANE ROUNDABOUT UTILIZED WITH
 INSCRIBED CIRCLE DIAMETER OF 150 FEET.
 ROUNDABOUT HAS A 18 FEET TRAVEL LANE
 AND 10 FEET TRUCK APRON.

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	4				MONONGALIA		



NOTE:
 ALTERNATIVE 1 PROPOSES A ROUNDABOUT AT INTERSECTION OF UNIVERSITY AVENUE AND COLLINS FERRY ROAD.
 PROPERTY INFORMATION FROM MONONGALIA COUNTY, MORGANTOWN CORPORATION - DISTRICT 1 TAX MAPS.



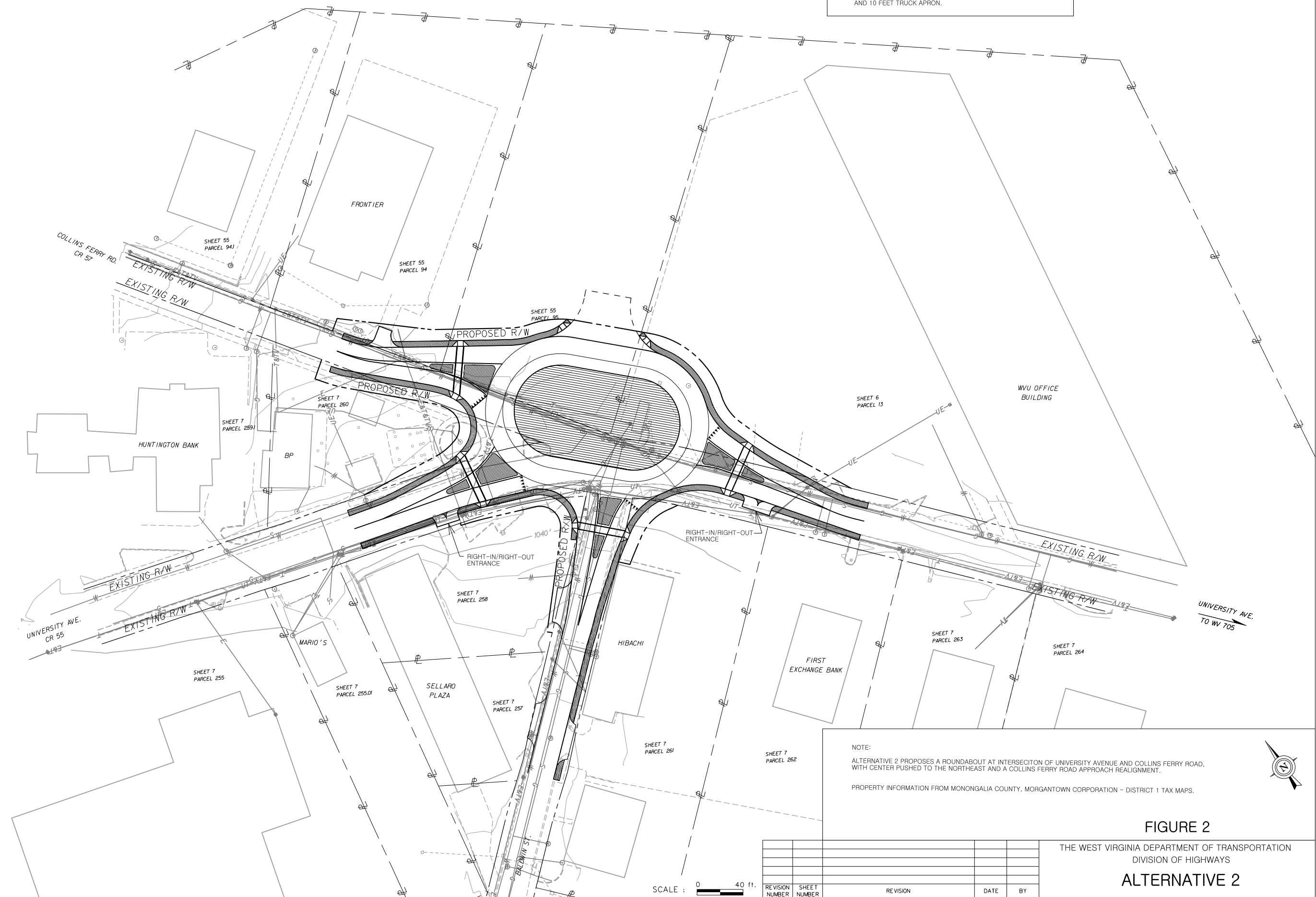
FIGURE 1
 THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
 DIVISION OF HIGHWAYS
ALTERNATIVE 1

SCALE : 0 40 ft.

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

DESIGN CRITERIA:
 SINGLE-LANE OVAL ROUNDABOUT UTILIZED WITH
 INSCRIBED CIRCLE DIAMETER OF 130 FEET.
 ROUNDABOUT HAS A 15 FEET TRAVEL LANE
 AND 10 FEET TRUCK APRON.

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	4				MONONGALIA		



NOTE:
 ALTERNATIVE 2 PROPOSES A ROUNDABOUT AT INTERSECTION OF UNIVERSITY AVENUE AND COLLINS FERRY ROAD,
 WITH CENTER PUSHED TO THE NORTHEAST AND A COLLINS FERRY ROAD APPROACH REALIGNMENT.
 PROPERTY INFORMATION FROM MONONGALIA COUNTY, MORGANTOWN CORPORATION - DISTRICT 1 TAX MAPS.



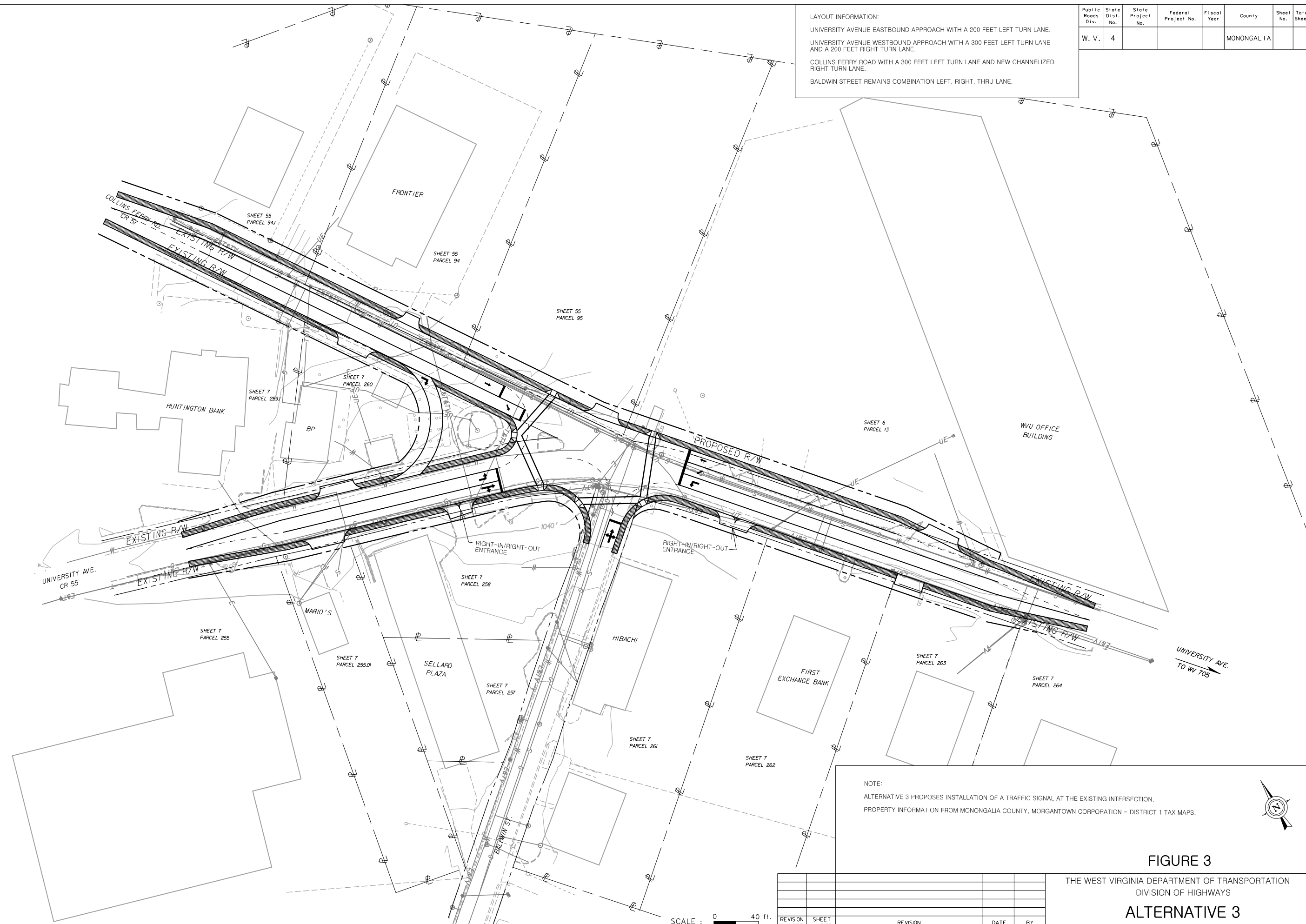
FIGURE 2
 THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
 DIVISION OF HIGHWAYS
ALTERNATIVE 2

SCALE : 0 40 ft.

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

LAYOUT INFORMATION:
 UNIVERSITY AVENUE EASTBOUND APPROACH WITH A 200 FEET LEFT TURN LANE.
 UNIVERSITY AVENUE WESTBOUND APPROACH WITH A 300 FEET LEFT TURN LANE AND A 200 FEET RIGHT TURN LANE.
 COLLINS FERRY ROAD WITH A 300 FEET LEFT TURN LANE AND NEW CHANNELIZED RIGHT TURN LANE.
 BALDWIN STREET REMAINS COMBINATION LEFT, RIGHT, THRU LANE.

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	4				MONONGALIA		



NOTE:
 ALTERNATIVE 3 PROPOSES INSTALLATION OF A TRAFFIC SIGNAL AT THE EXISTING INTERSECTION.
 PROPERTY INFORMATION FROM MONONGALIA COUNTY, MORGANTOWN CORPORATION - DISTRICT 1 TAX MAPS.



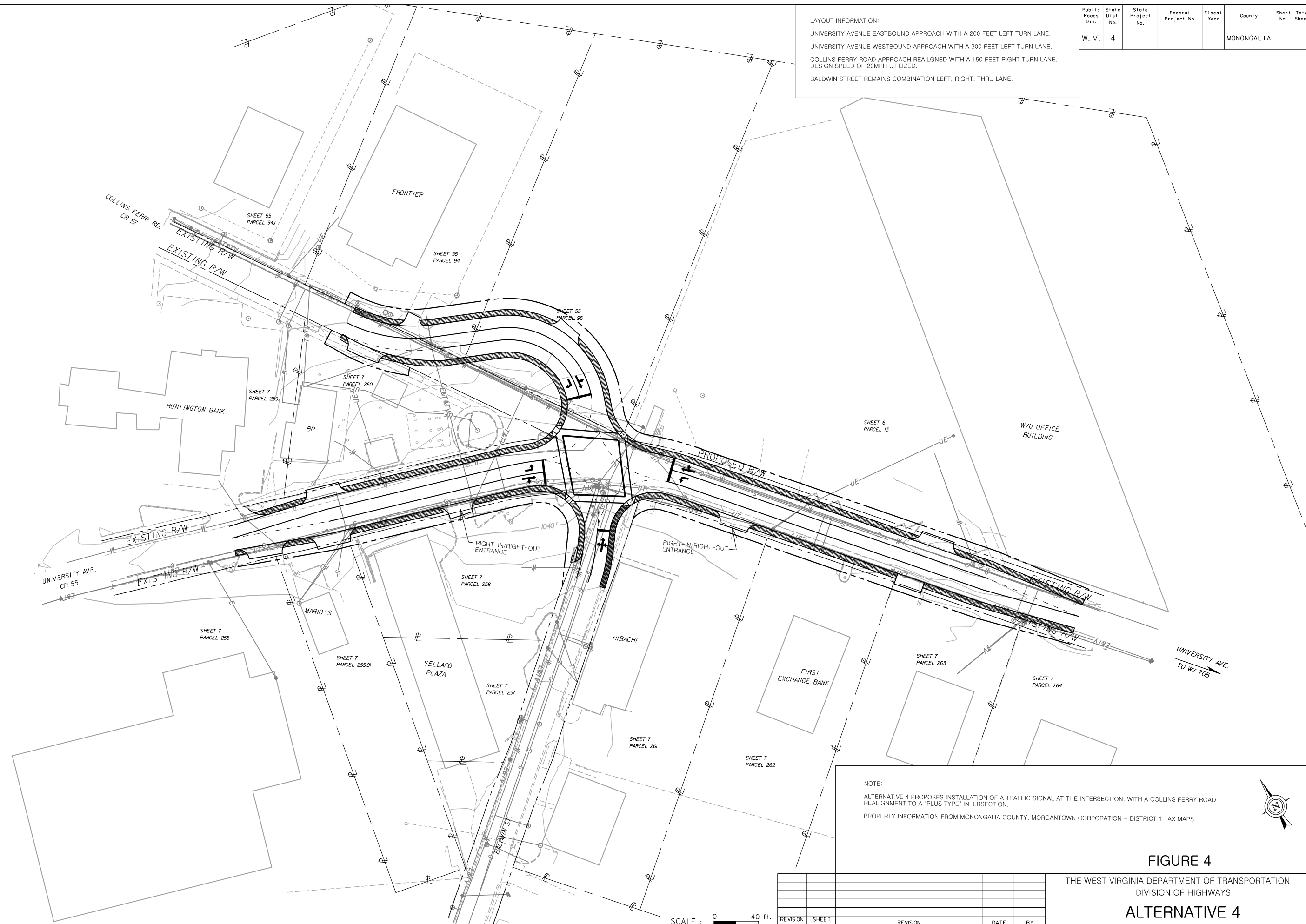
FIGURE 3
 THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
 DIVISION OF HIGHWAYS
ALTERNATIVE 3

SCALE : 0 40 ft.

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

LAYOUT INFORMATION:
 UNIVERSITY AVENUE EASTBOUND APPROACH WITH A 200 FEET LEFT TURN LANE.
 UNIVERSITY AVENUE WESTBOUND APPROACH WITH A 300 FEET LEFT TURN LANE.
 COLLINS FERRY ROAD APPROACH REALIGNED WITH A 150 FEET RIGHT TURN LANE.
 DESIGN SPEED OF 20MPH UTILIZED.
 BALDWIN STREET REMAINS COMBINATION LEFT, RIGHT, THRU LANE.

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	4				MONONGALIA		



NOTE:
 ALTERNATIVE 4 PROPOSES INSTALLATION OF A TRAFFIC SIGNAL AT THE INTERSECTION, WITH A COLLINS FERRY ROAD REALIGNMENT TO A "PLUS TYPE" INTERSECTION.
 PROPERTY INFORMATION FROM MONONGALIA COUNTY, MORGANTOWN CORPORATION - DISTRICT 1 TAX MAPS.



FIGURE 4
 THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
 DIVISION OF HIGHWAYS
ALTERNATIVE 4

SCALE : 0 40 ft.

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

APPENDIX “3”

Site Photos



Looking west along University Avenue toward intersection with Collins Ferry Road



Looking south along Collins Ferry Road toward intersection with University Avenue



Looking east along University Avenue toward intersection with Collins Ferry Road



Looking across University Avenue toward Baldwin Street

APPENDIX “4”

Field Review / Comments

A Field Review for the project was held on Thursday, September 18, 2014 at 11:00 am.
The following personnel attended this review:

Steve Boggs	Technical Section	558-9662
Mark White	Technical Section	558-9625
Don Meadows	Traffic Engineering	558-9453
Deanna Deliere	Traffic Engineering	558-9455
Brian Carr	Planning	558-9580
Elwood Penn	Planning	558-9618
Chuck Bartley	Right-of-Way	558-9324
Hamilton Duncan	FHWA	357-5329
Joe Waterman	Utilities	558-9631
Chad Lowther	Review Section	558-9737

COMMENTS

Joe Waterman, Engineering Division – Utilities (comment via memorandum, 9/25/14)

Based on the plans, the following utility relocation cost should be included for the subject project:

Alternative 1 = \$54,000 (Electric = \$4,000, Telephone = \$10,000, Water = \$20,000, Sanitary S. = \$20,000)
Alternative 2 = \$54,000 (Electric = \$4,000, Telephone = \$10,000, Water = \$20,000, Sanitary S. = \$20,000)
Alternative 3 = \$90,000 (Electric = \$10,000, Telephone = \$20,000, Water = \$30,000, Sanitary S. = \$30,000)
Alternative 4 = \$54,000 (Electric = \$4,000, Telephone = \$10,000, Water = \$20,000, Sanitary S. = \$20,000)

Chuck Bartley, Right-of-Way Division (comment via memorandum, 9/26/14)

The following comments are based on a review of the Design Study and field observations. They are as follows:

1. Please show and label the existing bus stop. It should be in the narrative the relocation of the bus stop will be accommodated either in the design or as part of the construction process.
2. The temporary construction easement for Alternative 1 for Sellaro Plaza encompasses the entire parking area for the plaza. This TCE would effectively force closure of the plaza during construction and close all business operations within the plaza. The Right of Way Division feels this is unacceptable for this area.
3. Please show and label the commercial signs that would be impacted on the various alternatives. These items would be paid for as right of way impacts.
4. The access points for the commercial establishments could be configured to the driveway manual standards and become compliant as part of the design process. In addition, the possibility of right-in/right-out access could also maintain some of the multiple access to these parcels.

5. The purchase of the BP Station parcel by Kroger cannot be fully and accurately estimated until the new development is completed. The estimate submitted takes into account the area shown as proposed right of way and some potential damages to the property residue. If this parcel was to become landlocked or a total take, an additional \$1,000,000 could be added to the right of way cost.
6. The current vacant parcel between the Frontier & WVU parcels will be estimated based on the proposed right of way and assumed access to the property. Should this parcel not have access and become landlocked an additional \$1,000,000 or more could be added to the total right of way cost.
7. Please note the retaining wall for the parking to the doctor's office at the western end of Collins Ferry Road on Alternative 3. Any right of way take could be behind the retaining wall and have significant impact on the amount of parking for this parcel.
8. Sellaro Plaza has only 37 total parking spaces, including two handicap, for six businesses. Any loss of parking spaces would have a detrimental effect on this property and could possibly put it out of compliance with the city. This should be taken into consideration and verified.

The Right of Way cost estimates are as follows:

- 1) \$1,750,000
- 2) \$1,900,000
- 3) \$1,800,000
- 4) \$1,350,000

As noted in the report, the Kroger Fuel Center has subsequently been developed and completed since the project's field review. A copy of the proposed site plan is included with the site photos; by comparing it to the design alternates herein, the impacts to this development are:

Alt 1 – Impact to the kiosk building & pylon sign

Alt 2 – Impact to the pylon sign

Alt 3 – Impact to kiosk building, parking lot, and pylon sign

Alt 4 - none

The proposed alternates may be shifted, to avoid/minimize these impacts. This issue will need to be address during final design.

Brian Carr, Planning Division (comment via e-mail, 9/22/14)

I just want to repeat what I tried to convey at the field visit. Morgantown is a very bike/ped oriented area and the issue is very high on the MPO's list of priorities. I just want to make sure that all possible accommodations with regards to sidewalks and bike lanes are available and considered where reasonably possible. It does seem that the sidewalks are there but it would be nice to note it in the report. I did not notice any mention of it in the report although it seems to be shown in the diagrams. Furthermore, I realize that a dedicated bike lane is not prudent through this roundabout (or whatever solution is ultimately selected) but any note of why no additional bike accommodations

are considered would be helpful. The attached link is Morgantown's Bike Plan. <http://planttogether.org/MMMPO%20Bicycle%20Plan%20Adopted.pdf> They did not identify this corridor as part of their bike plan but did mention this intersection for improvement.

I also want to reiterate that if this project is taken before the PRC for review and it is decided to be "cancelled" due to severe increase in cost (which I understand may be necessary), the MPO will not take this lightly. As we have found with another project that was recently up for cancellation, the MPO refused to do so and the project is still required to be carried over in the STIP. The MPO and the City of Morgantown has recognized this intersection as a problem area and desire some kind of action as noted in their plan. I just wanted to keep you apprised of how Morgantown and the MPO react to these types of circumstances.

Deanna Deliere, Traffic Engineering Division - Operations (hard copy plan sheets, 10/23/15)

Marked up plan sheets with information on access points for commercial business operations was given to DDC and will be placed in the project file. They recommend a driveway access for the undeveloped lot and that a right-in/right-out entrances be used at Sellaro Plaza and Hibachi locations. The study has incorporated these comments into the plan sheets.

Sajid Barlas, Material Division – Environmental & Coatings Group (comment via e-mail, 3/23/15)

I understand BP station has been removed & Kroger Fuel Center is in operation. However there is still a chance that some of the residual contamination may still be present and may become an issue during the construction. Based on this new information I would like to revise my estimate to \$100,000.00 for each alternate. This cost is to cover any environmental study may be necessary in future & to cover any surprises during the construction.

Tim Currey, Engineering Division - Environmental (comment via e-mail, 3/20/15)

This project will be processed as a Programmatic Categorical Exclusion for Environmental Section clearance of the National Environmental Policy Act (NEPA) and related requirements.

The following checklist represents the potential environmental concerns known at the time of completion of this design study report. As more information is obtained potential impacts or concerns may change.

Environmental Concerns	YES	NO	MAYBE
Historic Resource Concerns	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Archaeology Concerns	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Wetland Concerns	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Residential/Business Concerns	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Mussel Survey Necessary	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Endangered Species	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Public Involvement	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Section 4 (f) Issues	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
FHWA Approval of CE	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>