OLDHAM COUNTY INTERSECTION IMPROVEMENT STUDY REPORT

OLDHAM COUNTY, KENTUCKY

KY 146 and Cedar Point Road (KY 1817)

KY 329 Bypass and Arbor Ridge

KY 22 and KY 329 Bypass

KY 22 and Clore Lane / Wooldridge Ave.

Prepared For:
Oldham County Fiscal Court

Prepared By:
DLZ Kentucky, Inc.

December 2006

ACKNOWLEDGEMENTS

Contributing Organizations
Oldham County Fiscal Court
Oldham County Planning and Zoning
Kentuckiana Regional Planning and Development Agency (KIPDA)
Kentucky Transportation Cabinet (KYTC)

Committee Members
Mary Ellen Kinser, Oldham County Judge Executive
Louise Allen, AICP, Director of Oldham County Planning and Zoning
Matt Dickison, Oldham County Planning and Zoning
Brian Meade, KYTC District 5, Traffic Operations
Brent Sweger, KYTC Central Office, Planning
Jeff Wolfe, KYTC Central Office, Traffic Operations

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

SECTION 1 – INTRODUCTION AND BACKGROUND

1.0 INTRODUCTION

The Oldham County Intersection Improvement Study was conducted by DLZ Kentucky, Inc. (DLZ) for the Oldham County Fiscal Court in conjunction with the Kentuckiana Regional Planning and Development Agency (KIPDA) and the Kentucky Transportation Cabinet (KYTC) to assess potential improvements at several intersections within the county. The intersections evaluated in this study are (1) Kentucky State Route (KY) 146 and Cedar Point Road (KY 1817), (2) KY 329 Bypass and Arbor Ridge / Westwind Way, (3) KY 22 and Clore Lane / Wooldridge Avenue, and (4) KY 22 and KY 329 Bypass.

To increase capacity and manage congestion, the study team considered two alternatives for each intersection: upgraded signalized intersection and construction of a modern roundabout. The report is broken into four main sections, each of which describes an important element of the study. They are as follows:

1. Introduction and Background Information
2. Analysis of Existing Conditions
3. Analysis of Future Conditions
4. Comparison and Evaluation of Potential Intersection Improvements

1.1 PROJECT PURPOSE

The main purposes of the Oldham County Intersection Improvement Study are to:

- Identify existing and potential future traffic operations and safety problems at the four study intersections.
- Identify and evaluate potential intersection improvements.

1.2 HISTORY OF PROJECT DEVELOPMENT

With the introduction of modern roundabouts as a valuable tool for intersection control, Oldham County Fiscal Court identified several intersections within the county that currently experience congestion and/or safety problems and could benefit from the construction of a modern roundabout. These intersections were selected based on the six following criteria:

- Safety – Accident rate evaluation
- Type of intersection – The existing traffic control being used
- Highway Volumes – The number of vehicles traveling the routes
- Existing Congestion – Intersection experiencing noticeable congestion and delay
- Roundabout Size – The estimated size of a roundabout required at this location
- Roadway Improvement – Whether or not the intersection is part of a planned roadway improvement

1.3 PROJECT AREA

The project area includes the intersections of KY 146 and Cedar Point Road (KY 1817), KY 329 Bypass and Arbor Ridge / Westwind Way, KY 22 and Clore Lane / Wooldridge Lane, and KY 22 and KY 329 Bypass. Figure 1 is a location map showing the four intersections under consideration for improvement. Associated corridors and roadway segments surrounding the four study intersections were not evaluated as part of this study.

The intersection of KY 146 and Cedar Point Road is currently a stop-controlled intersection. The stop-control only occurs for southbound traffic (Cedar Point Road), which is a three-lane road with 12-foot lanes in each direction and a continuous (12-foot) left turn lane. KY 146 is currently a two-lane road with 12-foot lanes in each direction. There is a proposed development under construction to the northwest of the intersection and youth soccer fields located to the southwest. The CSX railroad is located parallel to KY 146 approximately 75 feet east of the KY 146 centerline.

The KY 329 Bypass and Arbor Ridge / Westwind Way intersection is a new intersection that will provide an additional entrance to the Arbor Ridge development. There is a proposed commercial development including gas stations, a grocery store, restaurants, and retail stores located to the north of the intersection. The intersection is a stop-controlled intersection with the eastbound and westbound movements having free flow (stop-control for northbound and southbound). Eastbound and westbound KY 329 Bypass has two through lanes, one left turn lane, and one right turn lane each (all lanes are 12 feet wide). Arbor Ridge has a constructed access that incorporates five 12-foot lanes (two entering lanes and three exiting lanes). Westwind Way incorporates a three-lane section (all lanes 12 feet) with two exiting lanes and one entering lane. Both Arbor Ridge and Westwind Way are curb and gutter sections.

Clore Lane and Wooldridge Avenue intersect KY 22 at two different locations approximately 180 feet apart (centerline to centerline). Both are currently two-lane roads that are stop-controlled with free flow movements on KY 22. KY 22 is a two-lane highway with a planned widening project to improve the traffic flow in the corridor.

The intersection of KY 22 and KY 329 Bypass is currently a 3-leg intersection that is stop-controlled. KY 329 Bypass includes one left turn lane and one right turn lane. All lanes are 12 feet wide. There is a continuous left turn lane that is not designated for use at the intersection. KY 22 is currently a two-lane highway with an eastbound left turn lane. There are plans to widen KY 22 to a 5-lane section with a continuous left turn lane. The plans are currently under design and will be incorporated into the analysis for the future conditions at this intersection. There is also a historic farm located south of the intersection. Any improvements to this intersection should be located north of the intersection to avoid impact to the farm.

SECTION 2 – EXISTING CONDITIONS

2.0 INTRODUCTION

The assessment of existing peak hour traffic conditions at the intersections is an important step in the study process. In order to perform this evaluation, existing traffic counts for the four intersections were performed by Jordon, Jones, and Goulding Associates (JJG) and provided to the project team. In addition to traffic operations, crash data was also requested from KYTC and examined to determine if safety problems exist at these intersections. This section of the report describes the methods used for evaluation and the results of the existing conditions analysis. Only peak hour analysis was performed for each intersection since traffic volumes during the peak hour are higher than any off-peak hour. Therefore, the off-peak traffic operations were not analyzed as part of this study. As a result, if road improvements accommodate peak hour traffic at an acceptable level, off peak traffic operations will also be acceptable.

2.1 EXISTING TRAFFIC VOLUMES

JJG collected existing traffic volumes for the four study intersections in June 2006. These counts were evaluated, and a peak hour traffic volume, with turning movements, for both the morning and evening was obtained (Appendix A). The peak hour turning movements were then used by DLZ for analysis. Table 1 shows the results of the peak hour turning movements as represented by a total number of vehicles entering each intersection within the peak hours.

Table 1: Existing (2006) Intersection Traffic Volumes

Intersection	AM Peak Hour Total Entering Volume	Peak Hour Factor AM (PHF)	PM Peak Hour Total Entering Volume	Peak Hour Factor PM (PHF)
KY 146 - Cedar Point Road	1260	0.83	1280	0.92
KY 329 Bypass - Arbor Ridge / Westwind Way	1000	0.83	881	0.90
KY 22 - Clore Lane	888	0.94	1075	0.92
KY 22 - KY 329 Bypass	1468	0.89	1422	0.95

The peak hour factor (PHF) also had to be considered in the analysis of each intersection. The PHF specifies how the peak hour traffic is spread throughout the hour. A value of 1.00 would imply that the traffic is equally balanced throughout the hour whereas a lower value (typically 0.98 to 0.60) would mean that there is a higher volume of traffic during a 15-minute period within the peak hour than during the rest of the peak hour. Each intersection was analyzed to determine the PHF for that intersection to be used in the analysis and is shown in Table 1.

2.2 TRAFFIC OPERATIONS

Using the peak hour turning movement counts, a computer traffic model was developed for each study intersection using the SYNCHRO software. This software develops a peak hour traffic model that accounts for interaction of movements and can reflect the impacts of minor changes in intersection geometry, traffic signal timing and phasing changes, and traffic operation strategies. Each intersection was analyzed for the existing year (2006) with information provided by JJG to determine the effectiveness of the current intersection control. The most common measure of intersection performance is Level Of Service (LOS). A brief description of LOS for signalized intersections is given in Table 2. The LOS criteria for unsignalized intersections can be found in Table 3 and are similar to that of signalized intersections.

Table 2: Level of Service Criteria - Signalized Intersections

LOS	Seconds Delay/Vehicle	Description
A	≤ 10	Most vehicles do not stop at all.
B	> 10 and ≤ 20	More vehicles stop than for LOS A.
C	> 20 and ≤ 35	The number of vehicles stopping is significant, although many pass through without stopping.
D	> 35 and ≤ 55	Many vehicles stop. Individual cycle failures are noticeable.
E	> 55 and ≤ 80	Considered being the limit of acceptable delay. Individual cycle failures are frequent.
F	> 80	Unacceptable delay.

Source: Transportation Research Board, Highway Capacity Manual, 2000

Table 3: Level of Service Criteria - Unsignalized Intersections

LOS	Seconds Delay/Vehicle	Description
A	≤ 10	Little or no delay, very low main street traffic.
B	> 10 and ≤ 15	Short traffic delays, many acceptable gaps.
C	> 15 and ≤ 25	Average traffic delays, frequent gaps still occur
D	> 25 and ≤ 35	Long traffic delays, limited number of acceptable gaps.
E	> 35 and ≤ 50	Very long traffic delays, very small number of acceptable gaps.
F	> 50	Extreme traffic delays, virtually no acceptable gaps in traffic.

Source: Transportation Research Board, Highway Capacity Manual, 2000

Each intersection was analyzed using a base model. This base model incorporated such factors as current lane configurations, posted travel speeds, intersection controls, and other characteristics specific to that intersection. The existing peak hour traffic volumes for each intersection were then input into the corresponding SYNCHRO base file and evaluated for the existing condition. Each SYNCHRO model was then used to generate an output report, which can be found in Appendix B. Table 4 summarizes the results of the analysis of the existing intersections. All values listed in Table 4 are associated with the stop-controlled leg of the intersection. For the 4-leg intersection of KY 329 Bypass and Arbor Ridge / Westwind Way, the approach experiencing the largest delay is shown.

Table 4: Existing (2006) LOS (Average Delay in Seconds)

Intersection	AM Peak Hour LOS	PM Peak Hour LOS
KY 146 - Cedar Point Road	D (34.5)	D (28.2)
KY 329 Bypass - Arbor Ridge / Westwind Way	C (21.1)	C (15.3)
KY 22 - Clore Lane	C (19.6)	C (23.9)
KY 22 - KY 329 Bypass	D (30.4)	F (163.2)

The existing conditions analysis for the intersection of KY 146 and Cedar Point Road (KY 1817) estimated that the intersection currently operates at an acceptable level although conflicting turning movement have an undesirable delay. The delay experienced on Cedar Point Road during the AM peak hour was approximately LOS D (34.5 seconds average delay) with the left turn movement experiencing a LOS F (58.2 seconds). In the PM peak hour, the intersection is estimated to operate at LOS D (28.2 seconds average delay) with the left turn movement at LOS E (45.7 seconds).

At the intersection of KY 329 Bypass and Arbor Ridge the existing conditions analysis estimated that the intersection currently operates at an acceptable level showing a LOS C (21.1 seconds) during the AM peak and LOS C (15.3 seconds) in the PM peak hour. The delay shown from the analysis is the delay associated with the southbound movement. The northbound movement experiences less delay than the southbound movement and the eastbound and westbound movements are free flow with adequate gaps for turning movements.

The existing conditions analysis for the intersection of KY 22 and Clore Lane estimated that the intersection currently operates at an acceptable level. The delay experienced on Clore Lane is LOS C (19.6 seconds) in the AM peak hour and LOS C (23.9 seconds) during the PM peak hour. The KY 22 and Wooldridge Avenue intersection operates at LOS B (12.3 seconds) during the AM peak and LOS B (13.4 seconds) in the PM peak hour. The KY 22 eastbound and westbound movements are free flow and experience little delay due to turning movements.

The existing conditions analysis for the intersection of KY 22 and KY 329 Bypass estimated that the intersection currently operates at an unacceptable level showing a LOS D (21.1 seconds average delay) during the AM peak and LOS F (163.2 seconds average delay) in the PM peak hour. These notable delays can be attributed to the KY 329 Bypass left turn movement, which is projected to operate at LOS F (59.1 seconds) in the AM and LOS F (246.3 seconds) in the PM peak hour. The increased delay to the PM peak left turn movement is caused by the increased eastbound through movement, which creates less acceptable gaps for vehicles to enter traffic flow.

2.3 CRASH DATA

In addition to the existing traffic data, crash data was requested from KYTC and evaluated to determine if crash countermeasures would be appropriate. The data provided by KYTC included accident reports for the years 2003, 2004, and 2005 for all four intersections within 500 feet of the intersection itself. The data contains accidents that have been filed under the major route number (state route number) as well as secondary names that were discussed by the project team. The data provided contained approximately 87 accidents.

Of the 87 accidents reported to KYTC and supplied to DLZ, four occurred near the KY 22 and Clore Lane / Wooldridge Avenue intersection and seven occurred near the KY 22 and KY 329 Bypass intersection, two of which were injury accidents with no fatalities. No accidents were reported for the KY 329 Bypass and Arbor Ridge intersection, as it is a new intersection. Likewise, no accidents were reported at the KY 146 and Cedar Point Road (KY 1817) intersection. Cedar Point Road was recently modified to intersect KY 146 at a location south of the original intersection. The original intersection is where the majority of the accident reports were located.

The existing statistical information at these intersections does not appear to indicate a safety problem, however, according to project team knowledge and the *Oldham County Major Thoroughfare Plan, December 2003,* the data provided may not contain a complete listing of accident reports. The *Oldham County Major Thoroughfare Plan, December 2003,* indicates that the intersections of KY 22 and Clore / Wooldridge and KY 22 and KY 329 Bypass are located along high accident segments within the county. In addition, increasing traffic and congestion at all four intersections creates the potential for an increased accident rate.

2.4 UTILITIES

Several utility companies have facilities located near the study intersections. These utilities include Louisville Gas and Electric Company (LG&E) for both gas and electric, Louisville Water District, Metropolitan Sewer District (MSD), BellSouth, and Insight Communications. These utility companies were contacted by DLZ to determine the location of any facilities they may have near the intersections in order to assess potential impacts due to improvement alternatives. LG&E, Bellsouth, Insight Communications, and Louisville Water District have responded and provided maps indicating approximate locations of facilities. The locations of utilities are shown on the concept drawings for all intersections.

At the time of this report, the Metropolitan Sewer District had not responded. Therefore, impacts to these utilities can not be determined at this time.

2.5 TRUCK TRAFFIC

The existing traffic information provided did not include the percentage of trucks in the vehicle count. The *Traffic Forecasting report 2004,* provided by the KYTC, Division of Multimodal Programs was used to estimate the percentage of truck traffic based on roadway classifications. KY 146 and KY 22 are designated as Minor Arterial roadways with nine percent truck traffic. KY 329 Bypass is designated as Other Principal Arterial roadway, which was given seven percent truck traffic. All other roadways being studied such as Cedar Point Road (KY 1817), Arbor Ridge / Westwind Way, and Clore Lane / Wooldridge Avenue were assigned a value of five percent truck traffic. These percentages are applied to the vehicle volumes to determine the volume of trucks traveling the route.

SECTION 3 – FUTURE CONDITIONS

3.0 INTRODUCTION

As a result of ongoing and planned development in Oldham County, the future traffic demands on the intersections were assessed using a revised SYNCHRO model. The revised SYNCHRO model incorporated the existing condition model as a base replacing the existing traffic volumes with projected future traffic volumes. The model representing peak hour traffic operation issues that could occur in the year 2026 without any road improvements is defined as the "No Build" scenario. Results of this analysis are presented in this section.

The "No Build" evaluation highlights potential future traffic issues that should be addressed with intersection improvements such as a signalized intersection or modern roundabout. The intersections were then analyzed for alternative intersection improvements and summarized in this section. A detailed discussion of each intersection can be found in the following sections of the report.

3.1 FUTURE TRAFFIC PROJECTIONS

Oldham County uses a three percent growth factor to predict the amount of additional traffic due to anticipated growth throughout the county. A three percent growth factor is standard for all traffic studies submitted to the Oldham County Planning and Zoning office. The data obtained by the US Census on Population Growth Estimate for Oldham County supports the use of a standard three percent growth rate. This standard three percent annual compound growth rate was applied to the existing traffic volumes at the intersection of KY 146 at Cedar Point Road (KY 1817) to obtain future traffic projections.

Due to considerable planned development north of the intersection of KY 329 Bypass and Arbor Ridge / Westwind Way, additional trips will be generated. The Institute of Traffic Engineering (ITE) trip generations were used to estimate the number of trips created based upon the various types of land development. Below is a summary of the likely land uses being developed:

Land Use	Size (Sq Ft)	Trips Generated (AM/PM)
Gas Station	4,800 square feet	54 / 68
Grocery Store	78,000 square feet	254 / 898
Restaurants	60,000 square feet	1,182 / 887
Retail Stores	58,650 square feet	122 / 408
Total		1,612 / 2,251

These trip generations were then used in addition to the three percent annual compound growth rate of existing traffic information to develop projected traffic volumes for the intersection. Trips into the intersection were then balanced to account for passby traffic flows. In addition to an increase in vehicular traffic, nearby developments are expected to produce an increase in pedestrian traffic crossing the intersection.

Future traffic volumes for the KY 22 at Clore Lane / Wooldridge Lane intersection were also calculated using the three percent annual compound growth rate similar to that of the KY 146 and Cedar Point Road intersection.

At the intersection of KY 22 and KY 329 Bypass, the existing traffic volumes were not used to project a future traffic volume due to the Old Henry Road corridor project. This major project is expected to create a diversion of traffic from KY 22 onto the "new" Old Henry Road and KY 329 Bypass. A previous study, prepared in July 2003 estimated future turning movements at the intersection of KY 22 and KY 329 Bypass. The year 2028 traffic projections for the *Old Henry Road / Crestwood Bypass Project* were used for this study and modified for a three percent annual compound growth rate to determine volumes for the year 2026.

The projected traffic volumes (year 2026) for each intersection are shown in Table 5. All traffic projections and additional information regarding future traffic volumes can be found in Appendix A.

Table 5: Future (year 2026) Projected Traffic Volumes

Intersection	AM Peak Hour Total Entering Volume	PM Peak Hour Total Entering Volume
KY 146 - Cedar Point Road	2275	2312
KY 329 Bypass - Arbor Ridge / Westwind Way	3152	3372
KY 22 - Clore Lane	1603	1941
KY 22 - KY 329 Bypass	2315	2327

3.2 FUTURE "NO-BUILD" TRAFFIC OPERATIONS

The "No Build" scenario for the year 2026 was evaluated in order to assess the need for intersection improvements. The "No Build" scenario assumes the projected population growth and development along and near the intersection and that no road improvements would be performed with the exception of currently planned improvements. Using the revised SYNCHRO model, a traffic model was run using the year 2026 traffic volumes. The future conditions model included the same road network as the existing condition with the exception of planned roadway improvements and was first analyzed using the same intersection control that currently exists. The analysis for this study was limited to peak hour traffic operations. The results of the "No Build" analysis can be seen in Table 6. The outputs generated from the SYNCHRO model are included in Appendix B.

For instances where the LOS shown is F (>max) such as the intersection of KY 22 and KY 329 Bypass, an error is given in the SYNCHRO analysis for the delay on the approach road. This error occurs when the delay calculated exceeds a specified value (in this case 9999 seconds). The analysis essentially indicates that there are no acceptable gaps during the peak hour to allow traffic to turn onto KY 22. Due to this error, ">max" is used to indicate the delay of the approach.

Table 6: Future (year 2026) No Build Level of Service (average delay in seconds)

Intersection	2026	
	AM	PM
KY 146 - Cedar Point Road	F (>max)	F (>max)
KY 329 Bypass - Arbor Ridge / Westwind Way (signal)	D (35.2)	E (58.9)
KY 22 - Clore Lane	F (385.9)	F (749.5)
KY 22 - KY 329 Bypass	F (>max)	F (>max)

The "No-Build" analysis for the KY 146 and Cedar Point Road (KY 1817) intersection estimated that the stop-controlled leg (Cedar Point Road - KY 1817) would operate at LOS F (>max) during both the AM and PM peak hours. In addition to poor operation, the additional traffic volumes create a lack of adequate gaps that may cause motorists to force a gap and potentially increase the number of accidents.

With the current and planned development near the KY 329 Bypass and Arbor Ridge / Westwind Way intersection, a traffic signal is planned for installation. As a result, the "No-Build" analysis for this intersection incorporates a traffic signal rather than the stop-control condition that currently exists. Using current lane configurations and widths, the SYNCHRO analysis estimated that the intersection would operate at LOS D (35.2 seconds delay) during the AM peak hour and LOS E (58.9 seconds delay) during the PM peak hour.

The "No-Build" analysis at the intersection of KY 22 and Wooldridge Avenue indicates that no improvements are necessary. A stop-controlled intersection is projected to operate at LOS D (27.9 seconds delay) in the AM peak hour and LOS D (32.0 seconds) during the PM peak hour. The project team decided that this was acceptable and no improvements were evaluated at this intersection. As for the intersection of KY 22 and Clore Lane, the "No-Build" analysis estimated a LOS F (385.9 seconds) during the AM peak and LOS F (749.5 seconds delay) during the PM peak hour. All analysis shown for the future condition is associated with the KY 22 and Clore Lane intersection.

It should be noted that there is a planned widening of the KY 22 corridor. The KY 22 and KY 329 Bypass intersection assumes that this widening will be in place for the future conditions. There is currently no indication that a traffic signal will be installed at this location. Therefore, the "No Build" analysis assumes that KY 22 is a 5-lane typical section with the center lane being used as a left turn lane for eastbound traffic and will be a stop-controlled intersection.

The "No-Build" analysis for the KY 22 and KY 329 Bypass intersection revealed similar results as the existing conditions only with worse delays due to increased traffic. The analysis estimated that the intersection would operate at LOS F (>max) during both the AM and PM peak hours, again attributing significant delays to the KY 329 Bypass left turn movement. In addition to poor operation, the additional traffic volumes from the *Old Henry Road / Crestwood Bypass Project* may create a lack of adequate gaps that may cause motorists to force a gap and potentially increase the number of accidents.

3.3 SIGNAL ANALYSIS

Once the "No Build" LOS was determined, each intersection was analyzed to determine what improvements were necessary to provide a LOS C or better. Additional turn lanes at all intersections yielded an acceptable level of service and required no additional through lanes.

The traffic signal improvement options considered many factors related to traffic operations and safety. The traffic analysis utilized different cycle and split timings for the AM and PM peak hour conditions to increase the efficiency of the traffic signal during each peak hour. The signals were designed in accordance with the *Highway Capacity Manual 2000* (Transportation Research Board).

As part of the traffic signal option analysis, SYNCHRO software was utilized to approximate the traffic signal operations and LOS for each intersection (Table 7). The level of service criteria used is the same as the existing conditions analysis and can be found in Table 2. All SYNCHRO outputs generated can be found in Appendix B

3.4 ROUNDABOUT ANALYSIS

Modern roundabout geometry is influenced by a variety of factors related to traffic operations and safety considerations. After detailed analysis and conceptual design work, the modern roundabouts proposed for the study intersections were developed. Like the signal option, the roundabouts were designed to accommodate AM and PM peak hour year 2026 traffic volumes. All of the roundabouts were designed in accordance with the Federal Highway Administration's *Roundabouts: An Informational Guide* (FHWA, 2000) and Ourston's *Roundabout Design Guidelines* (Ourston, 2001).

As part of the analysis conducted for the roundabout options, RODEL software was used to analyze the future traffic operations and determine the LOS for each intersection (Table 7). Rodel is empirically based software specifically for the design of roundabouts. The output generated by RODEL can be found in Appendix C. LOS criteria are summarized in Table 3 for unsignalized intersections.

3.5 ALTERNATIVES LEVEL OF SERVICE

The project team discussed the operational goals for the study intersections early in the evaluation process. It was decided that each improvement option should be estimated to operate at LOS C or better, if practical.

Each intersection was evaluated to determine the level of service for the AM and PM peak hours for each alternative (Signalized, Roundabout). This evaluation is used as one criterion in the comparison of alternatives. This information can be found in Table 7 and will be referenced in subsequent sections of this report.

Table 7: Alternatives Level of Service (average delay in seconds)

Intersection	Signalized		Roundabout	
	AM	PM	AM	PM
KY 146 - Cedar Point Road	B (19.7)	B (17.1)	A (4.5)	A (5.6)
KY 329 Bypass - Arbor Ridge / Westwind Way	C (34.8)	C (33.0)	A (5.1)	A (7.9)
KY 22 - Clore Lane	C (20.4)	C (21.0)	A (4.5)	A (6.0)
KY 22 - KY 329 Bypass	B (15.2)	B (14.6)	A (3.2)	A (2.8)

Based on future (year 2026) traffic volumes

3.6 RESERVE CAPACITY ANALYSIS

The reserve capacity analysis is used to indicate the amount of additional traffic that would be required before an intersection would reach LOS E. Reserve capacities are expressed as the percentage increase in total entering traffic (beyond the 2026 projection) during the controlling peak hour. The controlling peak hour is the peak hour (AM or PM) that provides the least percentage increase in total entering traffic. For this analysis, increases were assumed to occur equally on all legs of the intersection. Table 8 indicates the percentage increase for the controlling peak hour for both alternatives before reaching LOS E and will be referenced in subsequent sections as an evaluation criterion.

Table 8: Reserve Capacity Analysis for Alternatives

Intersection	Signalized	Roundabout
KY 146 - Cedar Point Road	24% (AM)	31% (PM)
KY 329 Bypass - Arbor Ridge / Westwind Way	15% (AM)	27% (PM)
KY 22 - Clore Lane	24% (PM)	53% (PM)
KY 22 - KY 329 Bypass	69% (AM)	67% (AM)

The reserve capacity analysis indicates that both alternates for all intersections have the capacity to accept significant additional traffic volumes before reaching an LOS E. The lowest reserve capacity (KY 329 Bypass and Arbor Ridge – Signalized) is estimated to accept a 15% increase in traffic, beyond the future projected traffic volumes, prior to operating at LOS E or worse.

SECTION 4 – COMPARISON OF ALTERNATIVES

4.0 INTRODUCTION

The development and evaluation of potential road improvements at the intersection is presented in the following section of the report. These road improvements address the peak hour problems identified in the preceding sections of this report. A comparison of road improvement alternatives based on future peak hour traffic volumes for each intersection is also included. The design criteria used as a basis for alternative improvements at the intersections can be found in Appendix D.

Table 9 is a comparative matrix, which shows the major criteria used in comparing alternatives. All information contained in this section of the report can be found in summary form in Table 9. This matrix was used to provide a side-by-side comparison of alternatives based on the evaluation criteria.

Table 9 Practical Alternatives Matrix –Oldham County Alternatives.

Evaluation Criteria	Comments	KY 146 & Cedar Point Road		KY 329 Bypass & Arbor Ridge		KY 22 & Clore Lane		KY 22 & KY 329 Bypass	
		Roundabout	Signalized Intersection	Roundabout	Signalized Intersection	Roundabout	Signalized Intersection	Roundabout	Signalized Intersection
Future Traffic Operations	Total delay (Entering volume x Average delay for each intersection) AM and PM peak hours	3 hours AM 3.5 hours PM	12.5 hours AM 11 hours PM	4.5 hours AM 7.5 hours PM	30.5 hours AM 31 hours PM	2 hour AM 3.5 hours PM	9 hours AM 11 hours PM	2 hours AM 2 hours PM	10 hours AM 9.5 hours PM
	Intersection Level of Service (with average delay in seconds)	AM = A (4.5) PM = A (5.6)	AM = B (19.7) PM = B (17.1)	AM = A (5.1) PM = A (7.9)	AM = C (34.8) PM = C (33.0)	AM = A (4.5) PM = A (6.0)	AM = C (20.4) PM = C (21.0)	AM = A (3.2) PM = A (2.8)	AM = B (15.2) PM = B (14.6)
	Number of approaches operating at LOS E or worse for AM peak hour	0 out of 4	0 out of 4	0 out of 4	0 out of 4	0 out of 3	0 out of 4	0 out of 4	0 out of 4
	Number of approaches operating at LOS E or worse for PM peak hour	0 out of 4	0 out of 4	0 out of 4	0 out of 4	0 out of 3	0 out of 4	0 out of 4	0 out of 4
Safety Improvements	Based on existing crash data, crash prediction model and recent U.S. studies.	Significantly safer than signal. Injury crash rate will be about half as high as signal.	Higher injury crash rate than roundabout (about double). PDO crashes similar to roundabout.	Significantly safer than signal. Injury crash rate will be about half as high as signal.	Higher injury crash rate than roundabout (about double). PDO crashes similar to roundabout.	Significantly safer than signal. Injury crash rate will be about half as high as signal.	Higher injury crash rate than roundabout (about double). PDO crashes similar to roundabout.	Significantly safer than signal. Injury crash rate will be about half as high as signal.	Higher injury crash rate than roundabout (about double). PDO crashes similar to roundabout.
Right-of-Way Impacts	Approximate acres of new right-of-way required for each alternative as well as number of business and residential relocations for each alternative.	0.67 acres 0 relocations	0.30 acres 0 relocations	0.33 acres 0 relocations	No Right-of-Way required	0.42 acres 0 relocations	0.28 acres 0 relocations	N/A	N/A
Cost (2006 dollars)	Cost includes Construction and Engineering	TOTAL COST - $840,000 Const. - $700,000 Eng. - $140,000	TOTAL COST - $411,000 Const, - $342,000 Eng. - $69,000	TOTAL COST - $1,016,000 Const. - $846,000 Eng. - $170,000	TOTAL COST - $623,000 Const. - $519,000 Eng. - $104,000	TOTAL COST - $829,000 Const. - $691,000 Eng. - $138,000	TOTAL COST - $1,011,000 Const. - $842,000 Eng. - $169,000	TOTAL COST - $959,000 Const. - $799,000 Eng. - $160,000	TOTAL COST - $1,016,000 Const. - $846,000 Eng. - $170,000
Reserve Capacity	Amount (%) that 2026 peak hour auto traffic could increase before the intersection would reach LOS E. Assumes a proportional increase of all entering volumes simultaneously.	31% (PM).	24% (AM).	27% (PM)	15% (AM)	53% (PM)	24% (PM)	67% (AM)	69% (AM)
Accommodation of Driveway Access	Rating of how well the alternative will accommodate existing driveway access. Factors considered include ability to make left turn outs, queue blockage, additional traffic volumes, and driveway relocations.	All driveways reasonably accommodated.	All driveways reasonably accommodated but left turn conflicts will increase as volumes increase.	All driveways reasonably accommodated.	All driveways reasonably accommodated but left turn conflicts will increase as volumes increase.	All driveways reasonably accommodated.	All driveways reasonably accommodated but left turn conflicts will increase as volumes increase.	All driveways reasonably accommodated. Some require right in / right out utilizing roundabout as U-turn.	All driveways reasonably accommodated but left turn conflicts will increase as volumes increase.

Evaluation Criteria	Comments	KY 146 & Cedar Point Road		KY 329 Bypass & Arbor Ridge		KY 22 & Clore Lane		KY 22 & KY 329 Bypass	
		Roundabout	Signalized Intersection	Roundabout	Signalized Intersection	Roundabout	Signalized Intersection	Roundabout	Signalized Intersection
Truck Access	Factors considered include distance trucks must travel to utilize turnarounds and access to individual businesses.	Slightly better than the signalized alternative. Conflicts decrease since trucks can use the roundabouts as a U-turns for access.	Trucks would have direct access.	Slightly better than the signalized alternative. Conflicts decrease since trucks can use the roundabouts as a U-turns for access.	Trucks would have direct access.	Slightly better than the signalized alternative. Conflicts decrease since trucks can use the roundabouts as a U-turns for access.	Trucks would have direct access.	Slightly better than the signalized alternative. Conflicts decrease since trucks can use the roundabouts as a U-turns for access.	Trucks would have direct access.
Bicyclists and Pedestrians	Rating of the mobility, safety, and impacts on bicyclists and pedestrians of the proposed intersections.	Pedestrians and bicycles safely accommodated as long as they do not use the circulating roadway; Minor concerns related to visually impaired pedestrians.	Pedestrians and bicyclists safely accommodated with actuated signal	Pedestrians and bicycles safely accommodated as long as they do not use the circulating roadway; Minor concerns related to visually impaired pedestrians.	Pedestrians and bicyclists safely accommodated with actuated signal	Pedestrians and bicycles safely accommodated as long as they do not use the circulating roadway; Minor concerns related to visually impaired pedestrians.	Pedestrians and bicyclists safely accommodated with actuated signal	Pedestrians and bicycles safely accommodated as long as they do not use the circulating roadway; Minor concerns related to visually impaired pedestrians.	Pedestrians and bicyclists safely accommodated with actuated signal
Construction Effects on Traffic	Factors considered include the comparative duration of construction, likely lane closures, and major access restrictions.	Moderate to Major	Moderate to Major	Moderate	Moderate	Moderate to Major	Moderate to Major	Moderate to Major	Moderate to Major
Driver Familiarity	Locations where drivers' expectations may not be met	Drivers may be unfamiliar with roundabouts causing some apprehension. Other locations in the U.S. have seen drivers adapt quickly.	Driver expectations met at all locations.	Drivers may be unfamiliar with roundabouts causing some apprehension. Other locations in the U.S. have seen drivers adapt quickly.	Driver expectations met at all locations.	Drivers may be unfamiliar with roundabouts causing some apprehension. Other locations in the U.S. have seen drivers adapt quickly.	Driver expectations met at all locations.	Drivers may be unfamiliar with roundabouts causing some apprehension. Other locations in the U.S. have seen drivers adapt quickly.	Driver expectations met at all locations.
Aesthetics	Factors considered include consistency with community aesthetic goals and the aesthetic opportunities provided by each alternative.	Several opportunities for additional landscaping on central islands and splitter islands.	Minor scenic impacts will result. Limited opportunities for aesthetic enhancements in remaining ROW and an increase in the amount of paved surface.	Several opportunities for additional landscaping on central islands and splitter islands.	Minor scenic impacts will result. Limited opportunities for aesthetic enhancements in remaining ROW and an increase in the amount of paved surface.	Several opportunities for additional landscaping on central islands and splitter islands.	Minor scenic impacts will result. Limited opportunities for aesthetic enhancements in remaining ROW and an increase in the amount of paved surface.	Several opportunities for additional landscaping on central islands and splitter islands.	Minor scenic impacts will result. Limited opportunities for aesthetic enhancements in remaining ROW and an increase in the amount of paved surface.
Impacts to Utilities	Type of utility and extent of impact.	Electric, Telephone, Water – minor impact	Electric, Telephone, Water – minor impact	Minimal to no impacts	Minimal to no impacts	Telephone, Gas, Water – minor to significant impact	Telephone, Gas, Water – minor impact	N/A	N/A
Operational Cost	Cost of ongoing operations including electricity (lighting), signal adjustment, bulbs/other equipment, mowing, pavement markings, etc.	Low	Low-Moderate	Low	Low-Moderate	Low	Low-Moderate	Low	Low-Moderate

4.1 KY 146 AND CEDAR POINT ROAD (KY 1817)

4.1.1 SIGNAL ALTERNATIVE

Geometry

The proposed signalized intersection improvement has one through lane for eastbound and westbound KY 146. A left turn lane is proposed for eastbound KY 146 onto Cedar Point Road (KY 1817) and a right turn lane is proposed for westbound KY 146. Cedar Point Road will not need any improvements as it currently provides a right turn lane and a left turn lane with one entering lane at the intersection. Figure 2 shows the proposed intersection configuration at this location.

Traffic Operations

The improved signalized intersection is projected to operate at LOS B in the year 2026 with an average delay of 19.7 seconds in the AM Peak Hour. During the PM peak hour, the improved signalized intersection is estimated to operate at LOS B with an average delay of 17.1 seconds (Table 7). The majority of the delay from the AM and PM peaks can be attributed to the southbound approach (Cedar Point Road) left turn lane, which would operate at LOS E (59.4 seconds of delay) and LOS E (55.5 seconds of delay) respectively. During the AM and PM peaks, eastbound and westbound traffic show considerable higher volumes than the southbound approach, therefore, the signal was timed to allow east and west traffic to flow as freely as possible. The signal alternative would have a reserve capacity of 24 percent (Table 8) during the controlling peak hour (AM).

Safety

This intersection does not currently have a high crash frequency. The installation of an improved signalized layout at this location with the additional traffic volumes projected would create a similar situation to other signalized intersections. The addition of a pedestrian crosswalk and a signal phase that is pedestrian actuated (push button) could be incorporated on the southbound leg with minimal impacts to traffic operation due to the signal timing for eastbound and westbound traffic. There is no need to provide pedestrian access to the east side of KY 146 at this location. Pedestrian and bicycle volumes are expected to be moderate with the planned Bicycle Path along KY 146.

Right-of-Way

This alternative would require an additional 0.3 acres of right-of-way. No relocations would be required and no parking would be impacted as a result of the signal alternative.

Cost

Planning level cost estimates are in year 2006 dollars and include construction and engineering costs. An additional ten percent was included for miscellaneous construction items in order to cover any smaller construction items that have not yet been quantified. A contingency of twenty percent was also added for material cost fluctuations and unforeseen items. Planning level cost estimates can be found in Appendix E. Planning level costs would total $411,000 for this alternative and are as follows:

- Construction – $ 342,000
- Engineering – $ 69,000

Operational costs will be minimal and will include periodic maintenance.

Driveways / Access

There is currently an existing construction access located in the northwest corner of the intersection. The access to the new development would need to be located an appropriate distance from the intersection to prevent conflicts with queued traffic at the intersection. No other accesses would be affected with the signal option.

Impacts

The signal alternative would have minor impacts to existing utilities in the area, including water mains, electric, and telephone. These utilities currently lie parallel to KY 146 and would have to be relocated due to the widening (turn lanes) of KY 146. There would be no considerable impact to the development located northwest of the intersection or to the youth soccer fields located to the southwest. This option would not encroach upon the CSX Railroad Right-of-Way. Construction may cause notable delays and congestion.

Aesthetics

The signal alternative would result in minimal negative impact on the adjacent area. The additional pavement required for the intersection would reduce existing green space in the adjacent area.

4.1.2 MODERN ROUNDABOUT ALTERNATIVE

Geometry

This three-leg roundabout would require two entry lanes on the eastbound and westbound approaches (KY 146) and one entry lane on the southbound approach (Cedar Point Road). Figure 3 is a concept drawing showing the approximate layout of the roundabout option. The roundabout would contain two exiting lanes for the eastbound and westbound direction, while the northbound exit would require only one lane. The roundabout would have a diameter of 150 feet. Taper lengths for all approaches and exits would require approximately 200 feet. Crosswalks are shown for the southbound approach. There is no need to provide crosswalks to access the east side of KY 146 at this location.

Traffic Operations

The roundabout intersection would operate at a LOS A for the AM peak hour with an average delay of 4.5 seconds and LOS A with an average delay of 5.6 seconds during the PM peak hour (Table 7). This analysis was developed for the 50 percent confidence level for capacity (i.e., the capacity that is most likely to occur at the intersection). The RODEL outputs can be found in Appendix C. An analysis was performed for the 85 percent confidence level in case of unforeseen decreases in capacity. The intersection still operated at an acceptable level with LOS A in both the AM and PM peak hour. The roundabout alternative would have a reserve capacity of 31 percent (Table 8) during the PM peak.

Safety

Modern roundabouts are very safe for automobiles, pedestrians, and bicyclists. Modern roundabouts, when designed properly, are significantly safer for automobiles than signalized intersections as the injury crash rate is about half that of signalized options. Roundabouts have many safety benefits for pedestrians as well, including a reduction in the number of vehicle/pedestrian conflict points, slower vehicle speeds, and a splitter island that separates the directions of traffic and shortens the distance a pedestrian must cross. Studies have shown a substantial reduction in both the severity and number of pedestrian crashes when modern roundabouts are installed in place of other intersection controls.

Although modern roundabouts may not improve safety for bicyclists, it is generally believed that, if the proper facilities are installed, roundabouts are at least as safe as signalized intersections for bicyclists. Bicyclists should not ride within the circulating roadway (FHWA, 2000) so provisions should be made for bicyclists as the KY 146 bicycle path is planned.

Right-of-Way

This alternative would require an additional 0.7 acres of right-of-way. The additional right-of-way required would not significantly impact the proposed development located north of the intersection. This option may impact the land south of the intersection (youth soccer fields), however, it does not appear to affect the fields themselves. No relocations would be required and no parking would be impacted as a result of the roundabout alternative.

Cost

Planning level cost estimates are in year 2006 dollars and include construction and engineering costs. An additional ten percent was included for miscellaneous construction items in order to cover any smaller construction items that have not yet been quantified. A Contingency of twenty percent was also added for material cost fluctuations and unforeseen items. Planning level cost estimates can be found in Appendix E. Planning level costs will total $840,000 for this alternative and are as follows:

- Construction – $ 700,000
- Engineering – $ 140,000

Operational costs will be minimal and will include periodic maintenance.

Driveways / Access

The existing construction access northwest of the intersection would not be accommodated with this option. However, additional access points to this property may be located farther west along Cedar Point Road an appropriate distance from the splitter island to prevent conflicts with traffic approaching and leaving the intersection. No other accesses would be affected with the roundabout option.

Impacts

The roundabout alternative would have minor impacts to existing utilities in the area, similar to that of the signalized alternative. There would be minor impact to the development located northwest of the intersection as well as the youth soccer field land located to the southwest, however, the fields themselves would not be impacted. This option would not encroach upon the CSX Railroad Right-of-Way. Construction of a modern roundabout requires the use of staged construction. This typically includes three stages and is described with diagrams in Appendix F. Construction may cause notable delays and congestion.

Aesthetics

The modern roundabout alternative would provide opportunities for aesthetic enhancement. These opportunities would come from the green space in the splitter islands and the central island. Roundabouts are often used as "gateway" improvements for communities. In these instances, the central island of the roundabout can contain a variety of features to contribute to the aesthetic setting.

4.2 KY 329 BYPASS AND ARBOR RIDGE / WESTWIND WAY

4.2.1 SIGNAL ALTERNATIVE

Geometry

The proposed intersection improvement utilizing additional lanes with a traffic signal is shown in Figure 4. An additional left turn lane would be added to the eastbound direction on KY 329 Bypass. The widening would be proposed to occur to the north side of the route. The westbound direction lane configuration would remain the same as existing with the exception of shifting to the north to correspond to the widening for the additional eastbound lane. The southbound Arbor Ridge leg would be re-striped for two left turn lanes and a shared through-right turn lane while the northbound direction would utilize one left turn lane and a shared through-right turn lane.

Traffic Operations

The improved signalized intersection is projected to operate at LOS C, in the year 2026, during the AM and PM peak hour, with an average delay of 34.8 seconds and 33.0 seconds respectively (Table 7). All left turn movements experience approximately 50 seconds of delay (LOS D) during both peak times. For specific approach leg delays, refer to the SYNCHRO outputs contained in Appendix B. The signal was timed to optimize all movements within the intersection. The signal alternative would have a reserve capacity of 15 percent (Table 8) during the controlling peak hour (AM).

Safety

This intersection is a relatively new intersection and does not currently indicate a high crash frequency. The installation of a traffic signal at this location with the additional traffic volumes projected would create a similar situation to other signalized intersections. Pedestrian and bicycle traffic is expected to be moderate to high with the development and location of nearby schools. The addition of pedestrian crosswalks and a signal phase that is pedestrian actuated (push button) could be incorporated into the signal option with minimal impacts to traffic operation as the "green" time for the north and south approaches are adequate for pedestrians and bicyclists to cross the intersection.

Right-of-Way

This alternative would not require any additional right-of-way. The northbound and southbound legs have already been developed to the extent that would be used while the widening needed for the eastbound movement would occur within existing right-of-way. No parking would be impacted by the signal alternative.

Cost

Planning level cost estimates are in year 2006 dollars and include construction (with bridge widening), preliminary and construction engineering. Planning level cost estimates can be found in Appendix E. An additional ten percent was included for miscellaneous construction items in order to cover any smaller construction items that have not yet been quantified. A contingency of twenty percent was also added for material cost fluctuations and unforeseen items. Planning level costs will total $623,000 for this alternative and are as follows:

- Construction – $ 519,000
- Engineering – $ 104,000

Operational costs will be minimal and will include periodic maintenance.

Driveways / Access

Currently there are no access points located near the intersection with the exception of the Arbor Ridge Development. Any access points located within the Arbor Ridge Development would need to be adequately accommodated provided the access location proposed is an adequate distance from the intersection to prevent traffic conflicts near the intersection.

Impacts

The signal alternative would have no adverse impacts on utilities or the surrounding area. Since the intersection is new, most utilities and right-of-way were set to accommodate such facilities. The existing width of the roadway may allow easy accommodation of traffic during construction of the additional lanes.

Aesthetics

The signal alternative would result in minimal negative impact on the adjacent area. The additional pavement required for the intersection would reduce existing green space in the adjacent area.

4.2.2 MODERN ROUNDABOUT ALTERNATIVE

Geometry

This four-leg roundabout would require two entry lanes on all approaches (Figure 5). The roundabout would contain two exiting lanes for the eastbound and westbound direction, while the northbound and southbound exits would require only one lane. The roundabout would have a diameter of 150 feet. Taper lengths for all approaches and exits would require approximately 200 feet. Crosswalks have also been added to all intersection legs.

Traffic Operations

The roundabout intersection would operate at a LOS A for the AM and PM peak hour with an average delay of 5.1 seconds and 7.9 seconds respectively. The RODEL outputs can be found in Appendix C. The intersection would operate at LOS A during both the AM and PM peak hour at the 85 percent confidence level. The roundabout alternative would have a reserve capacity of 27 percent (Table 8) during the PM peak.

Safety

As a general rule, modern roundabouts are very safe for automobiles, pedestrians, and bicyclists. Modern roundabouts, when designed properly, are significantly safer for automobiles than signalized intersections as the injury crash rate is about half that of signalized options. Roundabouts have many safety benefits for pedestrians as well, including a reduction in the number of vehicle/pedestrian conflict points, slower vehicle speeds, and a splitter island that separates the directions of traffic and shortens the distance a pedestrian must cross.

Right-of-Way

This alternative would require an additional 0.3 acres of right-of-way. The additional right-of-way required would not impact the proposed development located north of the intersection. No relocations would be required as a result of the roundabout alternative. No parking would be impacted by the roundabout alternative.

Cost

Planning level cost estimates are in year 2006 dollars and include construction and engineering costs. An additional ten percent was included for miscellaneous construction items in order to cover any smaller construction items that have not yet been quantified. A contingency of twenty percent was also added for material cost fluctuations and unforeseen items. Planning level cost estimates can be found in Appendix E. Planning level costs will total $1,016,000 for this alternative and are as follows:

- Construction – $ 846,000
- Engineering – $ 170,000

Operational costs will be minimal and will include periodic maintenance.

Driveways / Access

The roundabout alternative would have similar impacts as the signalized alternative at this location. Since there are no current access locations near the intersection, any new access points would be adequately accommodated.

Impacts

The roundabout alternative would have minimal adverse impacts on utilities or the surrounding area. The impacts are similar to that of the signalized alternative. Construction of a modern roundabout requires the use of staged construction. This typically includes three stages and is described with diagrams in Appendix F. The existing width of the roadway may allow easy accommodation of traffic during construction of the additional lanes.

Aesthetics

The modern roundabout alternative would provide opportunities for aesthetic enhancement. These opportunities would come from the green space in the splitter islands and the central island. Roundabouts are often used as "gateway" improvements for developments. In these instances, the central island of the roundabout can contain a variety of features to contribute to the aesthetic setting.

4.3 KY 22 AND CLORE / WOOLDRIDGE

Two different signal configurations and three different roundabout configurations were initially evaluated and presented to the project team. The signal configurations presented included one with Clore Lane and Wooldridge Avenue as separate intersections while the second utilized a four-leg intersection with realignment of both Clore and Wooldridge.

The roundabout options considered included a double roundabout (one at each intersection), a four-leg roundabout (realignment of both Clore and Wooldridge), and a three-leg roundabout at Clore Lane with a stop-controlled "T" intersection at Wooldridge. In order to reduce ROW impacts, the project team decided to proceed with analysis for the improvements at Clore Lane only with Wooldridge remaining a stop-controlled "T" intersection. This is the case for both the signalized and roundabout alternatives.

4.3.1 SIGNAL ALTERNATIVE

Geometry

The proposed intersection improvement utilizing additional turn lanes is shown in Figure 6. Only one additional lane (eastbound left turn lane) is needed along KY 22 to produce acceptable traffic operations. Clore Lane would remain a two-lane road with a slight alignment correction to create a perpendicular intersection. Widening for this option is minimal and should be covered under the current design for KY 22 widening.

Traffic Operations

The improved signalized intersection is projected to operate at LOS C, in the year 2026, during the AM and PM peak hour, with an average delay of 20.4 seconds and 21.0 seconds respectively (Table 7). The signal was timed to accommodate eastbound and westbound traffic. The signal alternative would have a reserve capacity of 24 percent (Table 8) during the controlling peak hour (PM).

Safety

The *Oldham County Major Thoroughfare Plan,* indicates that this intersection is located along a high crash frequency segment. The installation of a traffic signal at this location may reduce the number of accidents, however, with the additional traffic volumes projected accident rates would be similar to other signalized intersections within the corridor due to limited sight distance from sharp horizontal and vertical curves. The addition of pedestrian crosswalks and a signal phase that is pedestrian actuated (push button) could be incorporated into the signal option with minimal impacts to traffic operation as pedestrian and bicycle volumes are expected to be low.

Right-of-Way

This alternative would require an additional 0.3 acres of right-of-way. The right-of-way required is based on current property line locations. The existing right-of-way may be modified as a result of the planned widening project. Impacts will need to be re-evaluated once the widening project is complete. No relocations would be required and no parking would be impacted as a result of the signal alternative.

Cost

Planning level cost estimates are in year 2006 dollars and include construction and engineering costs. An additional ten percent was included for miscellaneous construction items in order to cover any smaller construction items that have not yet been quantified. A contingency of twenty percent was also added for material cost fluctuations and unforeseen items. Planning level cost estimates can be found in Appendix E. Planning level costs will total $1,011,000 for this alternative and are as follows:

- Construction – $ 842,000
- Engineering – $ 169,000

Operational costs will be minimal and will include periodic maintenance.

Driveways / Access

No driveways or accesses would be affected as a result of the signalized option. The access to the property located in the northeast corner of the intersection would largely remain the same.

Impacts

The signal alternative would have minor impacts to existing utilities in the area including telephone, gas mains, and water mains. These utilities are located parallel to KY 22 and may require relocation due to widening for additional turn lanes. Construction may cause notable delays and congestion.

Aesthetics

The signal alternative would result in minimal negative impact on the adjacent area. The additional pavement required for the intersection would reduce existing green space in the adjacent area.

4.3.2 MODERN ROUNDABOUT ALTERNATIVE

Geometry

The KY 22 and Clore Lane intersection would be constructed as a three-leg roundabout requiring two entry lanes for both eastbound and westbound and one entry lane for the southbound leg (Clore Lane). In addition, two exit lanes would be provided eastbound and westbound and one exit lane would be provided on the southbound leg as shown in Figure 7. The roundabout would have a diameter of 150 feet. Taper lengths for Clore Lane, eastbound KY 22 approaches and exits and eastbound KY 22 exit would require approximately 200 feet. Crosswalks have also been added to all intersection legs. In order to provide access onto and off of Wooldridge Avenue, a taper of 33 feet was required for westbound KY 22 approach. This taper length will still provide an acceptable LOS.

Traffic Operations

The roundabout intersection would operate at a LOS A during the AM and PM peak hour with an average delay of 4.5 seconds and 6.0 seconds respectively (Table 7). The RODEL outputs can be found in Appendix C. The intersection would operate at LOS A during both the AM and PM peak hour for the 85 percent confidence level. The roundabout alternative would have a reserve capacity of 53 percent (Table 8) during the PM peak.

Safety

As a general rule, modern roundabouts are very safe for automobiles, pedestrians, and bicyclists. Modern roundabouts, when designed properly, are significantly safer for automobiles than signalized intersections as the injury crash rate is about half that of signalized options.

Right-of-Way

This alternative would require an additional 0.4 acres of right-of-way. The right-of-way required is based on current property line locations. The existing right-of-way may be modified as a result of the planned widening project. Impacts will need to be re-evaluated once the widening project is complete. No relocations would be required and no parking would be impacted as a result of the roundabout alternative.

Cost

Planning level cost estimates are in year 2006 dollars and include construction and engineering costs. An additional ten percent was included for miscellaneous construction items in order to cover any smaller construction items that have not yet been quantified. A contingency of twenty percent was also added for material cost fluctuations and unforeseen items. Planning level cost estimates can be found in Appendix E. Planning level costs will total $829,000 for this alternative and are as follows:

- Construction – $ 691,000
- Engineering – $ 138,000

Operational costs will be minimal and will include periodic maintenance.

Driveways / Access

The current access to the business located in the northeast corner of the intersection would need to be moved to the north to avoid conflict with the splitter island needed for the roundabout. However, this would not adversely impact the visibility of the business. No other accesses are located near this intersection.

Impacts

The roundabout alternative would have minor impacts to existing utilities in the area including telephone, gas mains, and water mains though more significant than the signalized option. Construction of a modern roundabout requires the use of staged construction. This typically includes three stages and is described with diagrams in Appendix F. Construction may cause notable delays and congestion.

Aesthetics
The modern roundabout alternative would provide opportunities for aesthetic enhancement. These opportunities are similar to those mentioned above for the KY 146 and Cedar Point Road (KY 1817) roundabout option.

4.4 KY 22 AND KY 329 BYPASS

4.4.1 SIGNAL ALTERNATIVE

Geometry
The proposed intersection improvements are shown in Figure 8. The improvement assumes that the planned KY 22 widening project will be completed (five-lane typical section). An additional right turn lane would be added to the westbound approach to accommodate heavy right turn movements. The continuous left turn lanes for the eastbound and southbound movements would be designated as left turn lanes.

Traffic Operations
The improved signal intersection is projected to operate at LOS B, in the year 2026, during both the AM and PM peak hours, with an average delay of 15.2 seconds and 14.6 seconds respectively (Table 7). The signal was timed for optimal delay on all approaches. The signal alternative would have a reserve capacity of 69 percent (Table 8) during the controlling peak hour (AM).

Safety
The crash analysis showed seven accidents occurring at this intersection over a three-year period. The installation of a signal is likely to improve safety at this intersection with the elimination of the stop controlled intersection. The installation of a modified signal layout at this location with the additional traffic volumes projected would create a similar situation to other signalized intersections within the corridor. The addition of pedestrian crosswalks and a signal phase that is pedestrian actuated (push button) could be incorporated into the signal option with minimal impacts to traffic operation as pedestrian and bicycle volumes are expected to be low.

Right-of-Way
Right-of-way for this alternative was not estimated due to the planned widening of KY 22 and the right-of-way requirements needed for the widening. Impacts will need to be re-evaluated once the widening project is complete.

Cost
Planning level cost estimates are in year 2006 dollars and include construction and engineering costs. An additional ten percent was included for miscellaneous construction items in order to cover any smaller construction items that have not yet been quantified. A contingency of twenty percent was also added for material cost fluctuations and unforeseen

items. Planning level cost estimates can be found in Appendix E. Planning level costs will total $1,016,000 for this alternative and are as follows:

- Construction – $ 846,000
- Engineering – $ 170,000

Operational costs will be minimal and will include periodic maintenance.

Driveways / Access
Driveways and accesses near the intersection would be adequately accommodated with the use of the continuous left turn lane that will provide a refuge for traffic wanting to travel eastbound. Depending on the results of the KY 22 widening project, these current driveways may be relocated or may be eliminated. Driveways will need to be re-evaluated once the KY 22 widening project is completed.

Impacts
The majority of impacts to existing utilities are a result of modifications to KY 22. Due to the planned widening of KY 22 in this area, utilities will be relocated accordingly and will therefore have no bearing on the intersection alternative selected.

Aesthetics
The signal alternative would result in minimal negative impact on the adjacent area. The additional pavement required for the intersection would reduce existing green space in the adjacent area.

4.4.2 MODERN ROUNDABOUT ALTERNATIVE

Geometry
This three-leg roundabout would require two entry lanes on all approaches (Figure 9). The roundabout would contain two exiting lanes for the eastbound and westbound direction, while the northbound exit would require only one lane. The roundabout would have a diameter of 150 feet. Taper lengths for all approaches would require approximately 200 feet.

Traffic Operations
The roundabout intersection would operate at a LOS A during the AM and PM peak hour with an average delay of 3.2 seconds and 2.8 seconds respectively (Table 7). The RODEL outputs can be found in Appendix C. The intersection would operate at LOS A in both the AM and PM peak hour for the 85 percent confidence level. The roundabout alternative would have a reserve capacity of 67 percent (Table 8) during the AM peak.

Safety
As a general rule, modern roundabouts are very safe for automobiles, pedestrians, and bicyclists. Modern roundabouts, when designed properly, are significantly safer for automobiles than signalized intersections as the injury crash rate is about half that of signalized options.

Right-of-Way

Right-of-way for this alternative was not estimated due to the planned widening of KY 22 and the right-of-way requirements needed for the widening. Due to the location of the roundabout, there is a potential for two relocations. Impacts will need to be re-evaluated once the widening project is complete.

Cost

Planning level cost estimates are in year 2006 dollars and include construction and engineering costs. An additional ten percent was included for miscellaneous construction items in order to cover any smaller construction items that have not yet been quantified. A contingency of twenty percent was also added for material cost fluctuations and unforeseen items. Planning level cost estimates can be found in Appendix E. Planning level costs will total $959,000 for this alternative and are as follows:

- Construction – $ 799,000
- Engineering – $ 160,000

Operational costs will be minimal and will include periodic maintenance.

Driveways / Access

Driveways and accesses near the intersection would need to be modified to right-in / right-out accesses to avoid the splitter islands required for the roundabout. Properties located to the east of the intersection would be able to use the roundabout as a U-turn to continue in an eastbound direction. Access to the property located immediately to the northwest of the intersection would be relocated to provide a right-in / right-out access on KY 329 Bypass utilizing the roundabout as a U-turn. Additional properties located to the west of the intersection would be able to maintain full access. Depending on the results of the KY 22 widening project, these current accesses may be relocated or may be eliminated. Driveways will need to be re-evaluated once the KY 22 widening project is completed.

Impacts

The majority of impacts to existing utilities are a result of modifications to KY 22. Due to the planned widening of KY 22 in this area, utilities will be relocated accordingly and will therefore have no bearing on the intersection alternative selected. Construction of a modern roundabout requires the use of staged construction. This typically includes three stages and is described with diagrams in Appendix F. Additional impacts along KY 329 Bypass should be coordinated with the utility company during the construction of improvements to KY 22.

Aesthetics

The modern roundabout alternative would provide opportunities for aesthetic enhancement. These opportunities are similar to those mentioned above for the KY 146 and Cedar Point Road (KY 1817) roundabout option.

SECTION 5 – RECOMMENDATIONS

5.0 INTRODUCTION

This section of the report presents recommendations based on the comparison criteria for each intersection. All criteria should be carefully considered at each intersection prior to making a decision to proceed with construction for the best alternative.

5.1 KY 146 AND CEDAR POINT ROAD (KY 1817)

The roundabout alternative is the recommended alternative for this intersection. In addition to being a prime location for the installation of a roundabout, the safety benefits gained by incorporating a roundabout are substantial. With the proposed development located northwest of the intersection and the soccer fields to the southwest, pedestrians can be easily accommodated. The severity of vehicular accidents is likely to be reduced significantly. The right of way impacts associated with the roundabout are minimal and the cost differential can be justified by the foreseen increase in safety for the intersection. The roundabout alternative also improves traffic operations and will provide a location for aesthetic enhancements between the cities of LaGrange and Buckner.

5.2 KY 329 BYPASS AND ARBOR RIDGE / WESTWIND WAY

Due to the development to the north and the agreement between the developer and Oldham County, the installation of a traffic signal with the "No-Build" scenario is the recommended alternative at this location. The KY 329 Bypass was built with traffic signals in mind and therefore requires little additional construction in order to install a traffic signal. The cost associated with the signalized "No-Build" scenario is approximately $150,000 for construction only. While the left turn lane onto Arbor Ridge does not operate at an acceptable level during future peak hours, the ability to provide permitted left turns during green time will improve operations during off-peak hours rather than incorporating a dual left turn. Since there is little construction associated with the traffic signal, there are minimal to no impacts on surrounding utilities and property and the cost differential clearly favors the signalized alternative. If safety becomes a concern in the future, due to increasing development and pedestrian traffic, or Oldham County expresses a desire for aesthetic enhancements, a roundabout can be considered at that time.

5.3 KY 22 AND CLORE / WOOLDRIDGE

At this intersection, the roundabout alternative is recommended. Both require approximately the same amount of right of way and cost estimates are comparable. The signalized intersection will create a conflict with Wooldridge Avenue due to queued vehicles. A right turn lane will be added to Wooldridge Avenue with the roundabout located at Clore Lane to allow vehicles to turn right, utilize the roundabout as a U-turn, then proceed in a westerly direction. Safety will be significantly better with the roundabout as crash severity will be decreased and traffic operations will be improved. The roundabout will also present an opportunity for aesthetic enhancements. Vertical sight distance remains an issue, and should be field surveyed prior to incorporating any improvements.

5.4 KY 22 AND KY 329 BYPASS

For the intersection of KY 22 and KY 329 Bypass, the signalized intersection and modern roundabout are nearly the same for construction cost. The roundabout, however, will have more significant right of way impacts with the possibility of two relocations. The roundabout is the recommended alternate from a traffic operations perspective and will promote a safer intersection. The incorporation of a roundabout at this intersection will require close coordination with KYTC and the design consultant for the KY 22 widening project. Depending on the status of the widening project, the traffic signal may be the better alternative, since it only requires the addition of a right turn lane beyond what is proposed with the KY 22 widening project. A decision should be made for this intersection in a timely manner so that it may be considered and possibly incorporated by KYTC into the KY 22 widening design plans.

SECTION 6 – REFERENCES

American Association of State Highway and Transportation Officials, "A Policy of Geometric Design of Highways and Streets," Washington D.C., 2004.

Federal Highway Administration, "Roundabouts: An Informational Guide," Washington D.C.: United States Department of Transportation, 2000.

Ourston Roundabout Engineering, "Roundabout Design Guidelines," 2001.

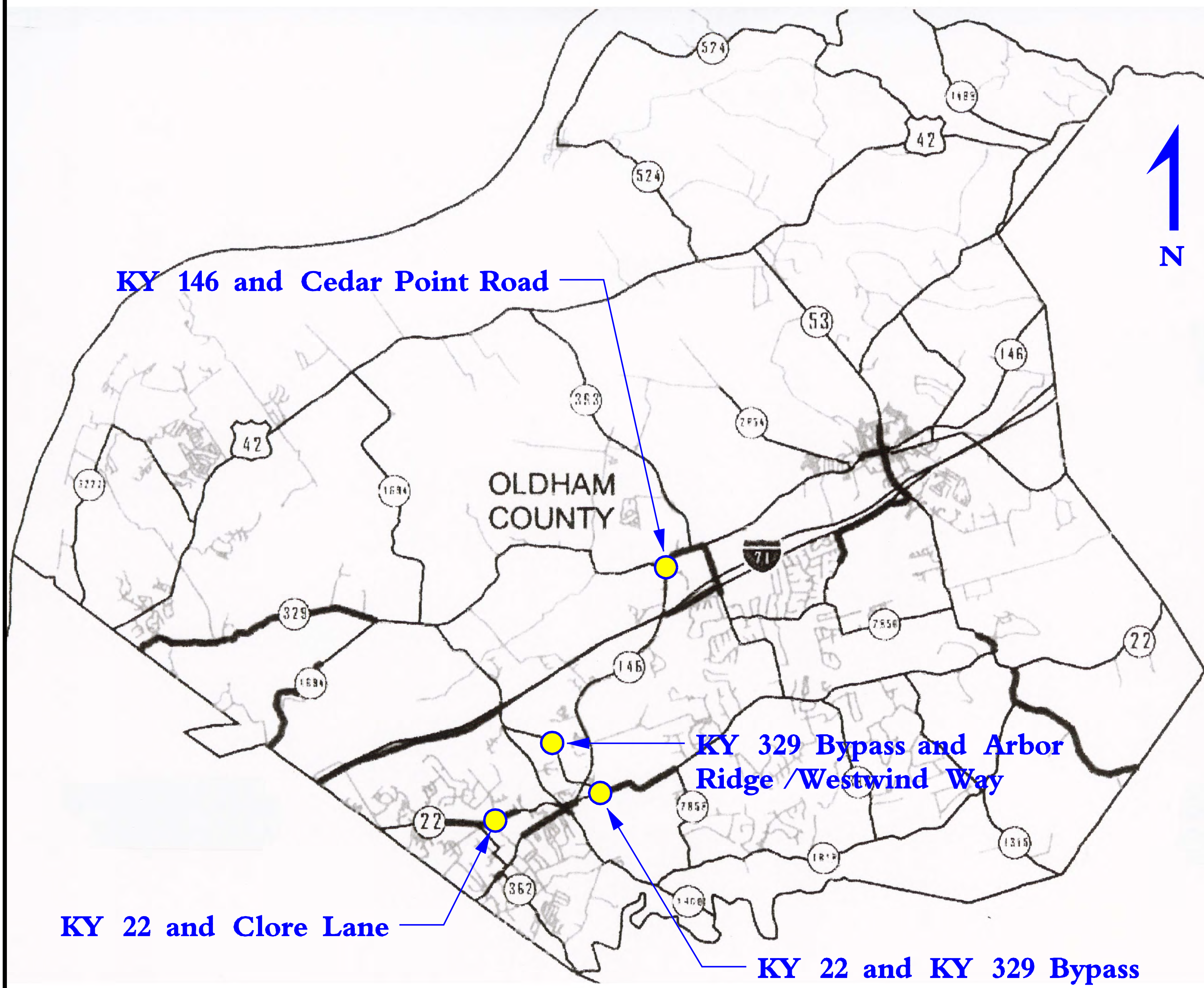
Transportation Research Board, "Highway Capacity Manual, Special Report 208," 1998.

Institute of Transportation Engineers, "Trip Generation Handbook, Second Edition," June 2004.

US Census Bureau, Population Division, "Table 1: Annual Estimates of the Population for Counties of Kentucky: April 1, 2000 to July 1, 2005 (Co-EST2005-01-21). March 16,2006.

Kentucky Transportation Cabinet, "Old Henry Road – Crestwood Connector, KY 22 at KY 329 Bypass.

FIGURES



DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300 (Fax) 695-1497

FIGURE 1
PROJECT LOCATION MAP

LEGEND

- CENTER LINES
- PROPOSED LANE MARKINGS
- PROPOSED EDGE OF PVMT / CURBING
- PROPOSED RIGHT OF WAY
- PROPOSED TRUCK APRON
- EXISTING OVERHEAD UTILITY
- EXISTING UNDERGROUND TELEPHONE
- PROPERTY LINE
- EXISTING WATER MAIN
- EXISTING GAS MAIN

GRAPHIC SCALE
0 50' 100'
SCALE 1" = 100'

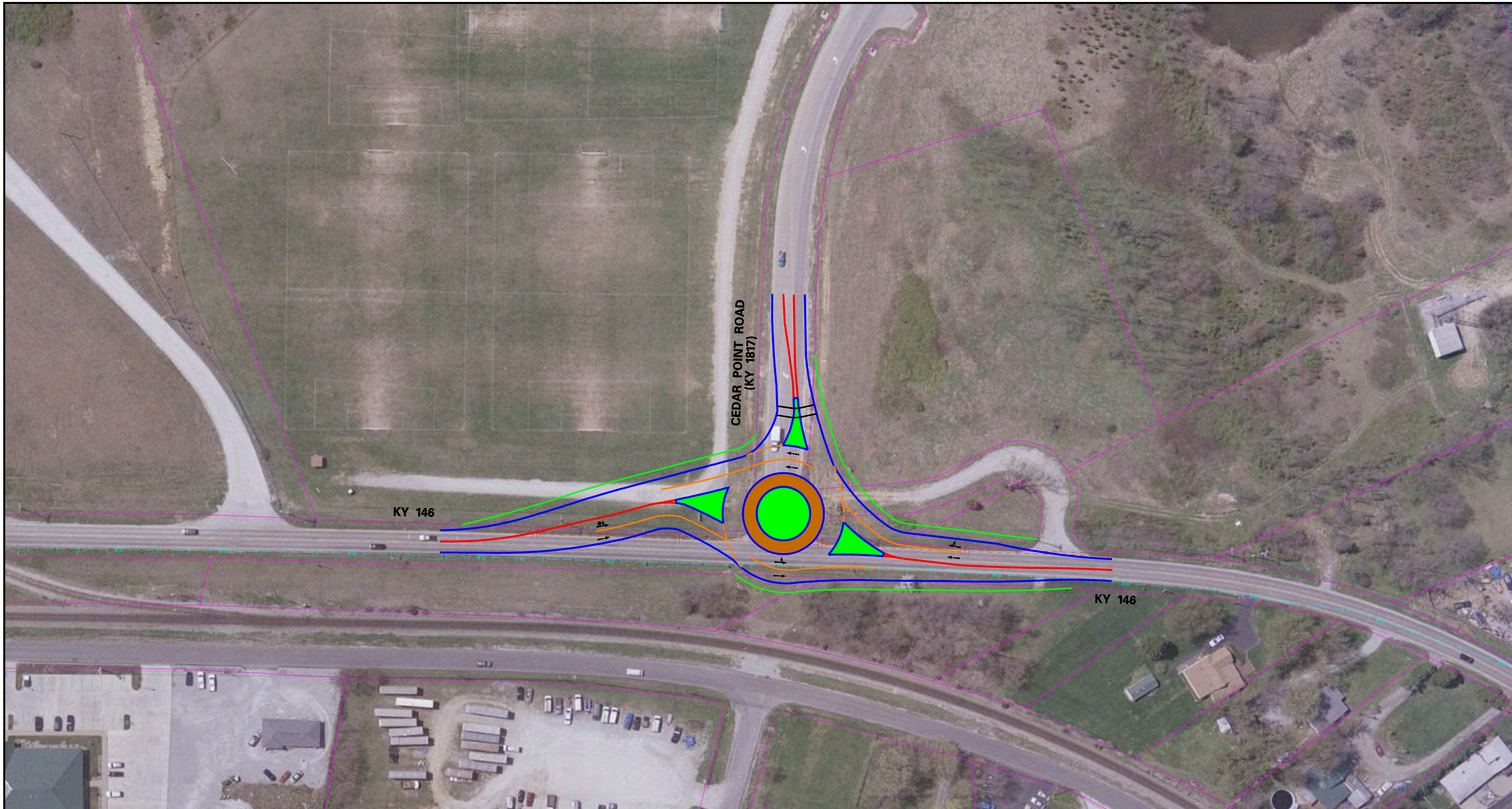
FIGURE 2

KY 146 @ CEDAR POINT ROAD SIGNAL OPTION

OLDHAM COUNTY KENTUCKY Established Since 1824

DLZ

DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300 (Fax) 695-1497



LEGEND

- CENTER LINES
- PROPOSED LANE MARKINGS
- PROPOSED EDGE OF PVMT / CURBING
- PROPOSED RIGHT OF WAY
- PROPOSED TRUCK APRON
- EXISTING OVERHEAD UTILITY
- EXISTING UNDERGROUND TELEPHONE
- PROPERTY LINE
- EXISTING WATER MAIN
- EXISTING GAS MAIN

GRAPHIC SCALE
0 50' 100'
SCALE 1" = 100'

FIGURE 3

KY 146 @ CEDAR POINT ROAD
ROUNDABOUT OPTION

DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300 (Fax) 695-1497

GRAPHIC SCALE

0 100' 200'

SCALE 1" = 200'

LEGEND

- CENTER LINES
- PROPOSED LANE MARKINGS
- PROPOSED EDGE OF PVMT / CURBING
- PROPOSED RIGHT OF WAY
- PROPOSED TRUCK APRON
- EXISTING OVERHEAD UTILITY
- EXISTING UNDERGROUND TELEPHONE
- PROPERTY LINE
- EXISTING WATER MAIN
- EXISTING GAS MAIN

FIGURE 4
KY 329 BYPASS @ ARBOR RIDGE / WESTWIND WAY
SIGNAL OPTION

OLDHAM COUNTY KENTUCKY Established Since 1824

DLZ

DLZ KENTUCKY, INC.

201 BRIGHTON PARK BLVD.

FRANKFORT, KY 40601

(502) 695-2300 (Fax) 695-1497

GRAPHIC SCALE
0 100' 200'
SCALE 1" = 200'

LEGEND

- CENTER LINES
- PROPOSED LANE MARKINGS
- PROPOSED EDGE OF PVMT / CURBING
- PROPOSED RIGHT OF WAY
- PROPOSED TRUCK APRON
- EXISTING OVERHEAD UTILITY
- EXISTING UNDERGROUND TELEPHONE
- PROPERTY LINE
- EXISTING WATER MAIN
- EXISTING GAS MAIN

FIGURE 5
KY 329 BYPASS @ ARBOR RIDGE / WESTWIND WAY
ROUNDABOUT OPTION

OLDHAM COUNTY KENTUCKY Established Since 1824

DLZ

DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300 (Fax) 695-1497

GRAPHIC SCALE
0 50' 100'
SCALE 1" = 100'

LEGEND

- CENTER LINES
- PROPOSED LANE MARKINGS
- PROPOSED EDGE OF PVMT / CURBING
- PROPOSED RIGHT OF WAY
- PROPOSED TRUCK APRON
- EXISTING OVERHEAD UTILITY
- EXISTING UNDERGROUND TELEPHONE
- PROPERTY LINE
- EXISTING WATER MAIN
- EXISTING GAS MAIN

FIGURE 6

KY 22 @ CLORE LANE
SIGNAL OPTION

DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300 (Fax) 695-1497

GRAPHIC SCALE
0 50' 100'
SCALE 1" = 100'

LEGEND

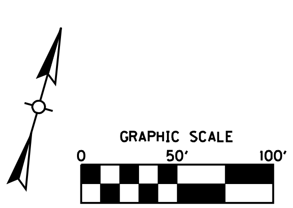
- CENTER LINES
- PROPOSED LANE MARKINGS
- PROPOSED EDGE OF PVMT / CURBING
- PROPOSED RIGHT OF WAY
- PROPOSED TRUCK APRON
- EXISTING OVERHEAD UTILITY
- EXISTING UNDERGROUND TELEPHONE
- PROPERTY LINE
- EXISTING WATER MAIN
- EXISTING GAS MAIN

FIGURE 7

KY 22 @ CLORE LANE ROUNDABOUT OPTION

OLDHAM COUNTY KENTUCKY Established Since 1824

DLZ
DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300 (Fax) 695-1497



LEGEND

- CENTER LINES
- PROPOSED LANE MARKINGS
- PROPOSED EDGE OF PVMT / CURBING
- PROPOSED RIGHT OF WAY
- PROPOSED TRUCK APRON
- EXISTING OVERHEAD UTILITY
- EXISTING UNDERGROUND TELEPHONE
- PROPERTY LINE
- EXISTING WATER MAIN
- EXISTING GAS MAIN

FIGURE 8

KY 22 @ KY 329 BYPASS SIGNAL OPTION

DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300 (Fax) 695-1497

LEGEND

- CENTER LINES
- PROPOSED LANE MARKINGS
- PROPOSED EDGE OF PVMT / CURBING
- PROPOSED RIGHT OF WAY
- PROPOSED TRUCK APRON
- EXISTING OVERHEAD UTILITY
- EXISTING UNDERGROUND TELEPHONE
- PROPERTY LINE
- EXISTING WATER MAIN
- EXISTING GAS MAIN

GRAPHIC SCALE 0 50' 100'
SCALE 1" = 100'

FIGURE 9

KY 22 @ KY 329 BYPASS ROUNDABOUT OPTION

OLDHAM COUNTY Established Since 1824 KENTUCKY

DLZ
DLZ KENTUCKY, INC.
201 BRIGHTON PARK BLVD.
FRANKFORT, KY 40601
(502) 695-2300 (Fax) 695-1497

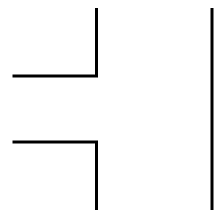
APPENDIX A

KY 146 and Cedar Point Road (KY 1817)

Existing Year - 2006

KY 22 Southbound			
	Right	Through	Left
AM	46	510	0
PM	57	355	0

		AM	PM
Cedar Eastbound	Left	78	54
	Through	0	0
	Right	96	56

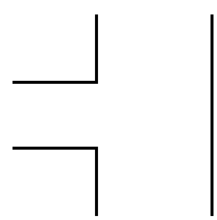


KY 22 Northbound			
	Left	Through	Right
AM	47	483	0
PM	105	653	0

Future Year - 2026

KY 22 Southbound			
	Right	Through	Left
AM	83	921	0
PM	103	641	0

		AM	PM
Cedar Eastbound	Left	141	98
	Through	0	0
	Right	173	101



KY 22 Northbound			
	Left	Through	Right
AM	85	872	0
PM	190	1179	0

KY 329 Bypass and Arbor Ridge / Westwind Way

Existing Year - 2006

Arbor Ridge Southbound			
	Right	Through	Left
AM	46	0	45
PM	11	0	20

KY 329 Bypass Eastbound		AM	PM
	Left	1	36
	Through	307	423
	Right	2	15

AM	PM		KY 329 Bypass Westbound
18	26	Right	
506	326	Through	
20	7	Left	

Westwind Way Northbound			
	Left	Through	Right
AM	20	0	35
PM	8	0	9

Future Year - 2026

Arbor Ridge Southbound			
	Right	Through	Left
AM	542	28	349
PM	488	35	640

KY 329 Bypass Eastbound		AM	PM
	Left	312	715
	Through	462	500
	Right	3	16

AM	PM		KY 329 Bypass Westbound
526	536	Right	
763	387	Through	
30	9	Left	

Westwind Way Northbound			
	Left	Through	Right
AM	30	54	53
PM	9	26	11

KY 22 and Clore Lane

Existing Year - 2006

Clore Lane Southbound			
	Right	Through	Left
AM	66	0	109
PM	55	0	57

KY 22 Eastbound		AM	PM
	Left	10	76
	Through	356	413
	Right	0	0

AM	PM		KY 22 Westbound
19	65	Right	
328	409	Through	
0	0	Left	

Future Year - 2026

Clore Lane Southbound			
	Right	Through	Left
AM	119	0	197
PM	99	0	103

KY 22 Eastbound		AM	PM
	Left	18	137
	Through	643	746
	Right	0	0

AM	PM		KY 22 Westbound
34	117	Right	
592	739	Through	
0	0	Left	

KY 22 and Wooldridge Avenue

Existing Year - 2006

KY 22 Eastbound		AM	PM
	Left	0	0
	Through	352	409
	Right	4	4

AM	PM		KY 22 Westbound
0	0	Right	
394	464	Through	
9	9	Left	

Wooldridge Avenue Southbound			
	Left	Through	Right
AM	4	0	9
PM	4	0	9

Future Year - 2026

KY 22 Eastbound		AM	PM
	Left	0	0
	Through	739	883
	Right	7	5

AM	PM		KY 22 Westbound
0	0	Right	
889	838	Through	
16	7	Left	

Wooldridge Avenue Southbound			
	Left	Through	Right
AM	7	0	16
PM	7	0	16

KY 22 and KY 329 Bypass

Existing Year - 2006

KY 329 Bypass Southbound			
	Right	Through	Left
AM	131	0	84
PM	141	0	259

KY 22 Eastbound		AM	PM
	Left	221	177
	Through	162	441
	Right	0	0

AM	PM		KY 22 Westbound
540	183	Right	
330	221	Through	
0	0	Left	

Future Year - 2026

KY 329 Bypass Southbound			
	Right	Through	Left
AM	105	0	525
PM	240	0	650

KY 22 Eastbound		AM	PM
	Left	100	99
	Through	340	523
	Right	0	0

AM	PM		KY 22 Westbound
690	495	Right	
555	320	Through	
0	0	Left	

OLDHAM COUNTY INTERSECTION IMPROVEMENT STUDY
OLDHAM COUNTY FISCAL COURT
Oldham County, Kentucky

APPENDIX B

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	78	96	47	483	510	46
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83
Hourly flow rate (vph)	94	116	57	582	614	55
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1337	642	670			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1337	642	670			
tC, single (s)	6.4	6.2	4.2			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.3			
p0 queue free %	40	75	94			
cM capacity (veh/h)	156	469	888			

Direction, Lane #	EB 1	EB 2	NB 1	SB 1
Volume Total	94	116	639	670
Volume Left	94	0	57	0
Volume Right	0	116	0	55
cSH	156	469	888	1700
Volume to Capacity	0.60	0.25	0.06	0.39
Queue Length 95th (ft)	80	24	5	0
Control Delay (s)	58.2	15.2	1.7	0.0
Lane LOS	F	C	A	
Approach Delay (s)	34.5		1.7	0.0
Approach LOS	D			

Intersection Summary			
Average Delay	5.5		
Intersection Capacity Utilization	72.0%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	54	56	105	653	355	57
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	59	61	114	710	386	62
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1355	417	448			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1355	417	448			
tC, single (s)	6.4	6.2	4.2			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.3			
p0 queue free %	60	90	89			
cM capacity (veh/h)	145	630	1076			

Direction, Lane #	EB 1	EB 2	NB 1	SB 1
Volume Total	59	61	824	448
Volume Left	59	0	114	0
Volume Right	0	61	0	62
cSH	145	630	1076	1700
Volume to Capacity	0.40	0.10	0.11	0.26
Queue Length 95th (ft)	44	8	9	0
Control Delay (s)	45.7	11.3	2.6	0.0
Lane LOS	E	B	A	
Approach Delay (s)	28.2		2.6	0.0
Approach LOS	D			

Intersection Summary			
Average Delay	4.0		
Intersection Capacity Utilization	75.7%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	141	173	85	872	921	83
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83
Hourly flow rate (vph)	170	208	102	1051	1110	100
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2415	1160	1210			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2415	1160	1210			
tC, single (s)	6.4	6.2	4.2			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.3			
p0 queue free %	0	11	81			
cM capacity (veh/h)	29	235	553			

Direction, Lane #	EB 1	EB 2	NB 1	SB 1
Volume Total	170	208	1153	1210
Volume Left	170	0	102	0
Volume Right	0	208	0	100
cSH	29	235	553	1700
Volume to Capacity	5.93	0.89	0.19	0.71
Queue Length 95th (ft)	Err	184	17	0
Control Delay (s)	Err	77.3	6.9	0.0
Lane LOS	F	F	A	
Approach Delay (s)	4532.6		6.9	0.0
Approach LOS	F			

Intersection Summary			
Average Delay	628.5		
Intersection Capacity Utilization	121.9%	ICU Level of Service	H
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	98	101	190	1179	641	103
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	107	110	207	1282	697	112
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2447	753	809			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2447	753	809			
tC, single (s)	6.4	6.2	4.2			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.3			
p0 queue free %	0	73	74			
cM capacity (veh/h)	25	405	787			

Direction, Lane #	EB 1	EB 2	NB 1	SB 1
Volume Total	107	110	1488	809
Volume Left	107	0	207	0
Volume Right	0	110	0	112
cSH	25	405	787	1700
Volume to Capacity	4.31	0.27	0.26	0.48
Queue Length 95th (ft)	Err	27	26	0
Control Delay (s)	Err	17.2	11.8	0.0
Lane LOS	F	C	B	
Approach Delay (s)	4932.8		11.8	0.0
Approach LOS	F			

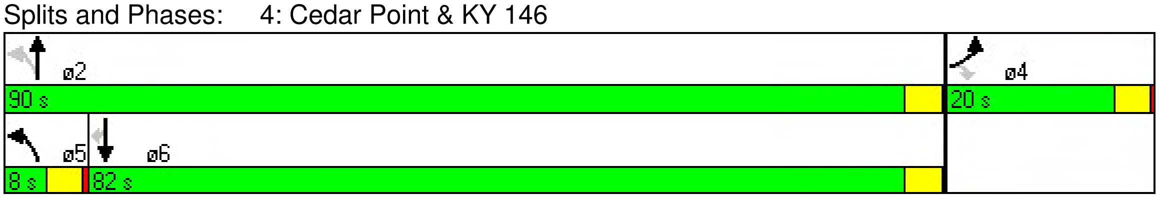
Intersection Summary			
Average Delay	431.6		
Intersection Capacity Utilization	128.0%	ICU Level of Service	H
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	400	0	200			200
Storage Lanes	1	1	1			1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15	9	15			9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected	0.950		0.950			
Satd. Flow (prot)	1719	1538	1656	1743	1743	1482
Flt Permitted	0.950		0.101			
Satd. Flow (perm)	1719	1538	176	1743	1743	1482
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		185				91
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	45			45	45	
Link Distance (ft)	464			937	333	
Travel Time (s)	7.0			14.2	5.0	
Volume (vph)	141	173	85	872	921	83
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83
Heavy Vehicles (%)	5%	5%	9%	9%	9%	9%
Adj. Flow (vph)	170	208	102	1051	1110	100
Lane Group Flow (vph)	170	208	102	1051	1110	100
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Minimum Split (s)	20.0	20.0	8.0	20.0	20.0	20.0
Total Split (s)	20.0	20.0	8.0	90.0	82.0	82.0
Total Split (%)	18.2%	18.2%	7.3%	81.8%	74.5%	74.5%
Maximum Green (s)	16.0	16.0	4.0	86.0	78.0	78.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
Walk Time (s)	5.0	5.0		5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0		11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0		0	0	0
Act Effct Green (s)	16.0	16.0	86.0	86.0	78.0	78.0
Actuated g/C Ratio	0.15	0.15	0.78	0.78	0.71	0.71
v/c Ratio	0.68	0.54	0.53	0.77	0.90	0.09
Control Delay	59.4	14.6	13.1	11.5	24.6	1.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	59.4	14.6	13.1	11.5	24.6	1.4
LOS	E	B	B	B	C	A
Approach Delay	34.7			11.7	22.7	
Approach LOS	C			B	C	
Queue Length 50th (ft)	115	14	14	331	553	2
Queue Length 95th (ft)	173	66	23	397	665	13
Internal Link Dist (ft)	384			857	253	

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Turn Bay Length (ft)	400		200			200
Base Capacity (vph)	250	382	191	1363	1236	1077
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.68	0.54	0.53	0.77	0.90	0.09

Intersection Summary	
Area Type: Other	
Cycle Length: 110	
Actuated Cycle Length: 110	
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBT, Start of Green	
Natural Cycle: 90	
Control Type: Pretimed	
Maximum v/c Ratio: 0.90	
Intersection Signal Delay: 19.7	Intersection LOS: B
Intersection Capacity Utilization 71.0%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 4: Cedar Point & KY 146



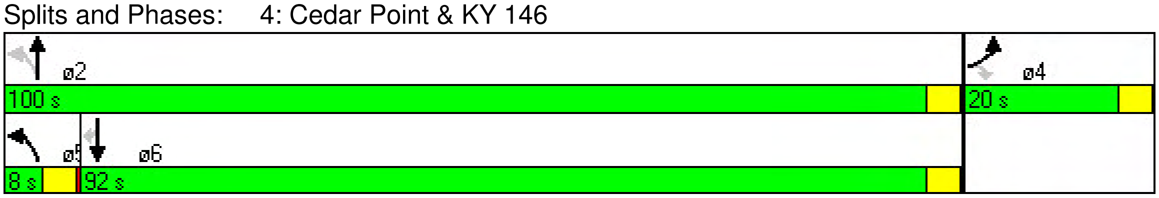
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	400	0	200			200
Storage Lanes	1	1	1			1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15	9	15			9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected	0.950		0.950			
Satd. Flow (prot)	1719	1538	1656	1743	1743	1482
Flt Permitted	0.950		0.312			
Satd. Flow (perm)	1719	1538	544	1743	1743	1482
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		110				112
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	45			45	45	
Link Distance (ft)	464			937	333	
Travel Time (s)	7.0			14.2	5.0	
Volume (vph)	98	101	190	1179	641	103
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	5%	5%	9%	9%	9%	9%
Adj. Flow (vph)	107	110	207	1282	697	112
Lane Group Flow (vph)	107	110	207	1282	697	112
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Minimum Split (s)	20.0	20.0	8.0	20.0	20.0	20.0
Total Split (s)	20.0	20.0	8.0	100.0	92.0	92.0
Total Split (%)	16.7%	16.7%	6.7%	83.3%	76.7%	76.7%
Maximum Green (s)	16.0	16.0	4.0	96.0	88.0	88.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
Walk Time (s)	5.0	5.0		5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0		11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0		0	0	0
Act Effct Green (s)	16.0	16.0	96.0	96.0	88.0	88.0
Actuated g/C Ratio	0.13	0.13	0.80	0.80	0.73	0.73
v/c Ratio	0.47	0.37	0.44	0.92	0.55	0.10
Control Delay	55.5	12.3	5.8	21.8	9.0	1.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	55.5	12.3	5.8	21.8	9.0	1.0
LOS	E	B	A	C	A	A
Approach Delay	33.6			19.6	7.9	
Approach LOS	C			B	A	
Queue Length 50th (ft)	78	0	30	608	210	0
Queue Length 95th (ft)	137	53	46	#1205	295	14
Internal Link Dist (ft)	384			857	253	

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Turn Bay Length (ft)	400		200			200
Base Capacity (vph)	229	300	472	1394	1278	1117
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.37	0.44	0.92	0.55	0.10

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Natural Cycle: 90
Control Type: Pretimed
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 17.1 Intersection LOS: B
Intersection Capacity Utilization 74.1% ICU Level of Service D
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 4: Cedar Point & KY 146



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	1	307	2	20	506	18	20	0	35	45	0	46
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Hourly flow rate (vph)	1	370	2	24	610	22	24	0	42	54	0	55
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	631			372			781	1052	185	887	1033	305
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	631			372			781	1052	185	887	1033	305
tC, single (s)	4.3			4.3			7.6	6.6	7.0	7.6	6.6	7.0
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.0	3.4	3.6	4.0	3.4
p0 queue free %	100			98			90	100	95	75	100	92
cM capacity (veh/h)	901			1134			253	215	816	218	221	682

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1
Volume Total	1	185	185	2	24	305	305	22	66	110
Volume Left	1	0	0	0	24	0	0	0	24	54
Volume Right	0	0	0	2	0	0	0	22	42	55
cSH	901	1700	1700	1700	1134	1700	1700	1700	451	332
Volume to Capacity	0.00	0.11	0.11	0.00	0.02	0.18	0.18	0.01	0.15	0.33
Queue Length 95th (ft)	0	0	0	0	2	0	0	0	13	35
Control Delay (s)	9.0	0.0	0.0	0.0	8.2	0.0	0.0	0.0	14.4	21.1
Lane LOS	A				A				B	C
Approach Delay (s)	0.0				0.3				14.4	21.1
Approach LOS									B	C

Intersection Summary			
Average Delay	2.9		
Intersection Capacity Utilization	31.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	36	423	15	7	326	26	8	0	9	20	0	11
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	40	470	17	8	362	29	9	0	10	22	0	12
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	391			487			767	965	243	717	959	196
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	391			487			767	965	243	717	959	196
tC, single (s)	4.3			4.3			7.6	6.6	7.0	7.6	6.6	7.0
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.0	3.4	3.6	4.0	3.4
p0 queue free %	96			99			97	100	99	93	100	98
cM capacity (veh/h)	1115			1025			273	238	748	297	240	804

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	40	313	173	8	241	150	19	34
Volume Left	40	0	0	8	0	0	9	22
Volume Right	0	0	17	0	0	29	10	12
cSH	1115	1700	1700	1025	1700	1700	411	383
Volume to Capacity	0.04	0.18	0.10	0.01	0.14	0.09	0.05	0.09
Queue Length 95th (ft)	3	0	0	1	0	0	4	7
Control Delay (s)	8.3	0.0	0.0	8.5	0.0	0.0	14.2	15.3
Lane LOS	A			A			B	C
Approach Delay (s)	0.6			0.2			14.2	15.3
Approach LOS							B	C

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	28.8%	ICU Level of Service	A
Analysis Period (min)	15		

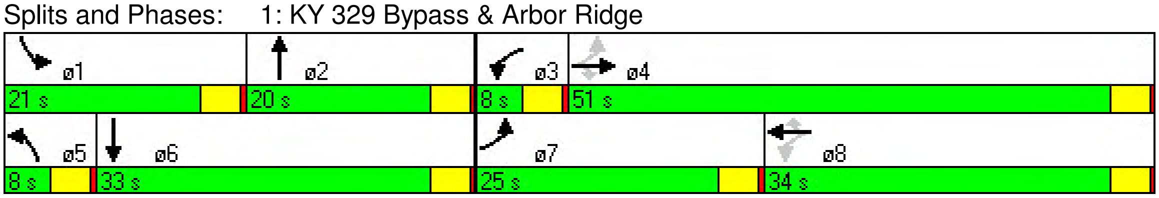
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		200	200		200	0		0	0		0
Storage Lanes	1		1	1		1	1		0	2		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt			0.850			0.850		0.926			0.857	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1656	3312	1482	1656	3312	1482	1719	1676	0	3335	1551	0
Flt Permitted	0.118			0.443			0.950			0.950		
Satd. Flow (perm)	206	3312	1482	772	3312	1482	1719	1676	0	3335	1551	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			4			591		42			400	
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
Link Speed (mph)		45			45			45			45	
Link Distance (ft)		1594			1491			682			289	
Travel Time (s)		24.2			22.6			10.3			4.4	
Volume (vph)	312	462	3	30	763	526	30	54	53	349	28	542
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Heavy Vehicles (%)	9%	9%	9%	9%	9%	9%	5%	5%	5%	5%	5%	5%
Adj. Flow (vph)	376	557	4	36	919	634	36	65	64	420	34	653
Lane Group Flow (vph)	376	557	4	36	919	634	36	129	0	420	687	0
Turn Type	pm+pt		Perm	pm+pt		Perm	Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8						
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0		8.0	20.0	
Total Split (s)	25.0	51.0	51.0	8.0	34.0	34.0	8.0	20.0	0.0	21.0	33.0	0.0
Total Split (%)	25.0%	51.0%	51.0%	8.0%	34.0%	34.0%	8.0%	20.0%	0.0%	21.0%	33.0%	0.0%
Maximum Green (s)	21.0	47.0	47.0	4.0	30.0	30.0	4.0	16.0		17.0	29.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Walk Time (s)		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	
Pedestrian Calls (#/hr)		0	0		0	0		0			0	
Act Effct Green (s)	55.0	47.0	47.0	34.0	30.0	30.0	4.0	16.0		17.0	29.0	
Actuated g/C Ratio	0.55	0.47	0.47	0.34	0.30	0.30	0.04	0.16		0.17	0.29	
v/c Ratio	0.90	0.36	0.01	0.12	0.92	0.74	0.52	0.43		0.74	0.94	
Control Delay	51.3	17.7	9.0	13.7	50.0	9.6	73.8	30.2		48.3	36.3	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	51.3	17.7	9.0	13.7	50.0	9.6	73.8	30.2		48.3	36.3	
LOS	D	B	A	B	D	A	E	C		D	D	
Approach Delay		31.2			33.1			39.7			40.9	
Approach LOS		C			C			D			D	
Queue Length 50th (ft)	184	115	0	10	297	20	23	50		132	203	
Queue Length 95th (ft)	#302	140	5	22	#348	76	#60	95		168	#362	
Internal Link Dist (ft)		1514			1411			602			209	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (ft)	200		200	200		200						
Base Capacity (vph)	418	1557	699	298	994	858	69	303		567	734	
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Reduced v/c Ratio	0.90	0.36	0.01	0.12	0.92	0.74	0.52	0.43		0.74	0.94	

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 90
Control Type: Pretimed
Maximum v/c Ratio: 0.94
Intersection Signal Delay: 35.2 Intersection LOS: D
Intersection Capacity Utilization 83.4% ICU Level of Service E
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: KY 329 Bypass & Arbor Ridge



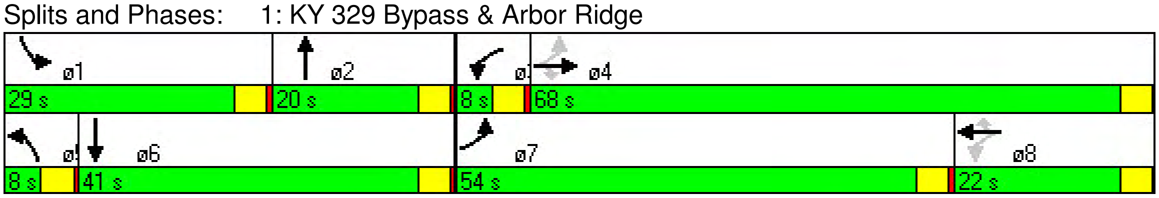
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		200	200		200	0		0	0		0
Storage Lanes	1		1	1		1	1		0	2		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt			0.850			0.850		0.956			0.860	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1656	3312	1482	1656	3312	1482	1719	1730	0	3335	1556	0
Flt Permitted	0.182			0.444			0.950			0.950		
Satd. Flow (perm)	317	3312	1482	774	3312	1482	1719	1730	0	3335	1556	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			18			487		12			542	
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
Link Speed (mph)		45			45			45			45	
Link Distance (ft)		1594			1491			682			289	
Travel Time (s)		24.2			22.6			10.3			4.4	
Volume (vph)	715	500	16	9	387	536	9	26	11	640	35	488
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	9%	9%	9%	9%	9%	9%	5%	5%	5%	5%	5%	5%
Adj. Flow (vph)	794	556	18	10	430	596	10	29	12	711	39	542
Lane Group Flow (vph)	794	556	18	10	430	596	10	41	0	711	581	0
Turn Type	pm+pt		Perm	pm+pt		Perm	Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8						
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0		8.0	20.0	
Total Split (s)	54.0	68.0	68.0	8.0	22.0	22.0	8.0	20.0	0.0	29.0	41.0	0.0
Total Split (%)	43.2%	54.4%	54.4%	6.4%	17.6%	17.6%	6.4%	16.0%	0.0%	23.2%	32.8%	0.0%
Maximum Green (s)	50.0	64.0	64.0	4.0	18.0	18.0	4.0	16.0		25.0	37.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Walk Time (s)		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	
Pedestrian Calls (#/hr)		0	0		0	0		0			0	
Act Effct Green (s)	72.0	64.0	64.0	22.0	18.0	18.0	4.0	16.0		25.0	37.0	
Actuated g/C Ratio	0.58	0.51	0.51	0.18	0.14	0.14	0.03	0.13		0.20	0.30	
v/c Ratio	1.11	0.33	0.02	0.06	0.90	0.95	0.18	0.18		1.07	0.69	
Control Delay	96.7	18.6	6.2	22.4	75.7	35.8	66.6	39.4		101.3	9.1	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	96.7	18.6	6.2	22.4	75.7	35.8	66.6	39.4		101.3	9.1	
LOS	F	B	A	C	E	D	E	D		F	A	
Approach Delay		63.8			52.2			44.7			59.8	
Approach LOS		E			D			D			E	
Queue Length 50th (ft)	~685	134	0	3	182	94	8	21		~327	23	
Queue Length 95th (ft)	#933	174	13	11	#277	#340	28	57		#448	141	
Internal Link Dist (ft)		1514			1411			602			209	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (ft)	200		200	200		200						
Base Capacity (vph)	718	1696	768	164	477	630	55	232		667	842	
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Reduced v/c Ratio	1.11	0.33	0.02	0.06	0.90	0.95	0.18	0.18		1.07	0.69	

Intersection Summary

Area Type: Other
Cycle Length: 125
Actuated Cycle Length: 125
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 140
Control Type: Pretimed
Maximum v/c Ratio: 1.11
Intersection Signal Delay: 58.9 Intersection LOS: E
Intersection Capacity Utilization 92.3% ICU Level of Service F
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: KY 329 Bypass & Arbor Ridge



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		200	200		200	0		0	0		0
Storage Lanes	2		1	1		1	1		0	2		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt			0.850			0.850		0.926			0.857	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3213	3312	1482	1656	3312	1482	1719	1676	0	3335	1551	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3213	3312	1482	1656	3312	1482	1719	1676	0	3335	1551	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			4			586		48			367	
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
Link Speed (mph)		45			45			45			45	
Link Distance (ft)		1594			1491			682			289	
Travel Time (s)		24.2			22.6			10.3			4.4	
Volume (vph)	312	462	3	30	763	526	30	54	53	349	28	542
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Heavy Vehicles (%)	9%	9%	9%	9%	9%	9%	5%	5%	5%	5%	5%	5%
Adj. Flow (vph)	376	557	4	36	919	634	36	65	64	420	34	653
Lane Group Flow (vph)	376	557	4	36	919	634	36	129	0	420	687	0
Turn Type	Prot		Perm	Prot		Perm	Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8						
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0		8.0	20.0	
Total Split (s)	21.0	44.0	44.0	8.0	31.0	31.0	8.0	20.0	0.0	18.0	30.0	0.0
Total Split (%)	23.3%	48.9%	48.9%	8.9%	34.4%	34.4%	8.9%	22.2%	0.0%	20.0%	33.3%	0.0%
Maximum Green (s)	17.0	40.0	40.0	4.0	27.0	27.0	4.0	16.0		14.0	26.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Walk Time (s)		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	
Pedestrian Calls (#/hr)		0	0		0	0		0			0	
Act Effct Green (s)	17.0	40.0	40.0	4.0	27.0	27.0	4.0	16.0		14.0	26.0	
Actuated g/C Ratio	0.19	0.44	0.44	0.04	0.30	0.30	0.04	0.18		0.16	0.29	
v/c Ratio	0.62	0.38	0.01	0.49	0.92	0.74	0.47	0.38		0.81	0.97	
Control Delay	38.6	17.6	9.3	64.6	46.9	9.6	63.0	24.6		50.4	43.5	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	38.6	17.6	9.3	64.6	46.9	9.6	63.0	24.6		50.4	43.5	
LOS	D	B	A	E	D	A	E	C		D	D	
Approach Delay		26.0			32.4			32.9			46.1	
Approach LOS		C			C			C			D	
Queue Length 50th (ft)	102	107	0	21	264	20	20	40		120	205	
Queue Length 95th (ft)	135	134	5	#53	#331	77	#51	82		#158	#368	
Internal Link Dist (ft)		1514			1411			602			209	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (ft)	200		200	200		200						
Base Capacity (vph)	607	1472	661	74	994	855	76	337		519	709	
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Reduced v/c Ratio	0.62	0.38	0.01	0.49	0.92	0.74	0.47	0.38		0.81	0.97	

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green

Natural Cycle: 90

Control Type: Pretimed

Maximum v/c Ratio: 0.97

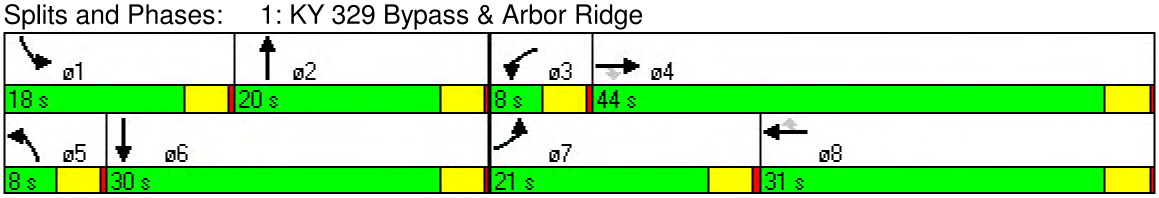
Intersection Signal Delay: 34.8 Intersection LOS: C

Intersection Capacity Utilization 75.0% ICU Level of Service D

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: KY 329 Bypass & Arbor Ridge



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		200	200		200	0		0	0		0
Storage Lanes	2		1	1		1	1		0	2		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt			0.850			0.850		0.956				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3213	3312	1482	1656	3312	1482	1719	1730	0	3335	1810	1538
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3213	3312	1482	1656	3312	1482	1719	1730	0	3335	1810	1538
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			18			596		12				542
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
Link Speed (mph)		45			45			45			45	
Link Distance (ft)		1594			1491			682			289	
Travel Time (s)		24.2			22.6			10.3			4.4	
Volume (vph)	715	500	16	9	387	536	9	26	11	640	35	488
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	9%	9%	9%	9%	9%	9%	5%	5%	5%	5%	5%	5%
Adj. Flow (vph)	794	556	18	10	430	596	10	29	12	711	39	542
Lane Group Flow (vph)	794	556	18	10	430	596	10	41	0	711	39	542
Turn Type	Prot		Perm	Prot		Perm	Prot			Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8						6
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0		8.0	20.0	20.0
Total Split (s)	34.0	46.0	46.0	9.0	21.0	21.0	8.0	20.0	0.0	30.0	42.0	42.0
Total Split (%)	32.4%	43.8%	43.8%	8.6%	20.0%	20.0%	7.6%	19.0%	0.0%	28.6%	40.0%	40.0%
Maximum Green (s)	30.0	42.0	42.0	5.0	17.0	17.0	4.0	16.0		26.0	38.0	38.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
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)	30.0	42.0	42.0	5.0	17.0	17.0	4.0	16.0		26.0	38.0	38.0
Actuated g/C Ratio	0.29	0.40	0.40	0.05	0.16	0.16	0.04	0.15		0.25	0.36	0.36
v/c Ratio	0.86	0.42	0.03	0.13	0.80	0.81	0.15	0.15		0.86	0.06	0.60
Control Delay	46.9	23.9	8.4	51.7	55.0	13.1	54.2	31.3		49.8	22.3	5.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	46.9	23.9	8.4	51.7	55.0	13.1	54.2	31.3		49.8	22.3	5.2
LOS	D	C	A	D	D	B	D	C		D	C	A
Approach Delay		37.1			30.9			35.8			30.3	
Approach LOS		D			C			D			C	
Queue Length 50th (ft)	260	139	0	7	147	0	7	17		236	17	0
Queue Length 95th (ft)	#361	186	14	24	#220	#138	24	49		#331	40	73
Internal Link Dist (ft)		1514			1411			602			209	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (ft)	200		200	200		200						
Base Capacity (vph)	918	1325	604	79	536	739	65	274		826	655	902
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.86	0.42	0.03	0.13	0.80	0.81	0.15	0.15		0.86	0.06	0.60

Intersection Summary

Area Type: Other

Cycle Length: 105

Actuated Cycle Length: 105

Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green

Natural Cycle: 90

Control Type: Pretimed

Maximum v/c Ratio: 0.86

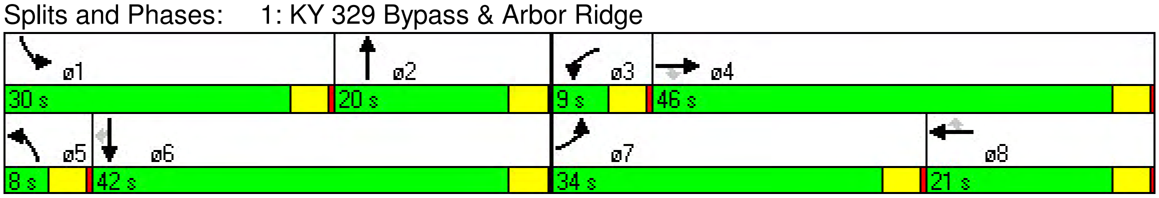
Intersection Signal Delay: 33.0 Intersection LOS: C

Intersection Capacity Utilization 66.9% ICU Level of Service C

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: KY 329 Bypass & Arbor Ridge



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	10	356	328	19	109	66
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	387	357	21	118	72
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	377				776	367
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	377				776	367
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	99				67	89
cM capacity (veh/h)	1144				358	672

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	398	377	190
Volume Left	11	0	118
Volume Right	0	21	72
cSH	1144	1700	435
Volume to Capacity	0.01	0.22	0.44
Queue Length 95th (ft)	1	0	54
Control Delay (s)	0.3	0.0	19.6
Lane LOS	A		C
Approach Delay (s)	0.3	0.0	19.6
Approach LOS			C

Intersection Summary			
Average Delay	4.0		
Intersection Capacity Utilization	43.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	352	4	9	394	4	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	383	4	10	428	4	10
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			387		833	385
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			387		833	385
tC, single (s)			4.2		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.3		3.5	3.3
p0 queue free %			99		99	99
cM capacity (veh/h)			1134		332	656

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	387	438	14
Volume Left	0	10	4
Volume Right	4	0	10
cSH	1700	1134	505
Volume to Capacity	0.23	0.01	0.03
Queue Length 95th (ft)	0	1	2
Control Delay (s)	0.0	0.3	12.3
Lane LOS		A	B
Approach Delay (s)	0.0	0.3	12.3
Approach LOS			B

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	38.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	76	413	409	65	57	55
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	83	449	445	71	62	60
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	515				1094	480
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	515				1094	480
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	92				71	90
cM capacity (veh/h)	1016				215	580

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	532	515	122
Volume Left	83	0	62
Volume Right	0	71	60
cSH	1016	1700	311
Volume to Capacity	0.08	0.30	0.39
Queue Length 95th (ft)	7	0	45
Control Delay (s)	2.2	0.0	23.9
Lane LOS	A		C
Approach Delay (s)	2.2	0.0	23.9
Approach LOS			C

Intersection Summary			
Average Delay	3.5		
Intersection Capacity Utilization	67.9%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	409	4	9	464	4	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	445	4	10	504	4	10
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			449		971	447
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			449		971	447
tC, single (s)			4.2		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.3		3.5	3.3
p0 queue free %			99		98	98
cM capacity (veh/h)			1075		275	605

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	449	514	14
Volume Left	0	10	4
Volume Right	4	0	10
cSH	1700	1075	442
Volume to Capacity	0.26	0.01	0.03
Queue Length 95th (ft)	0	1	2
Control Delay (s)	0.0	0.3	13.4
Lane LOS		A	B
Approach Delay (s)	0.0	0.3	13.4
Approach LOS			B

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	41.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	18	643	592	34	197	119
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	20	699	643	37	214	129
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	680				1400	662
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	680				1400	662
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	98				0	72
cM capacity (veh/h)	880				149	457

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	718	680	343
Volume Left	20	0	214
Volume Right	0	37	129
cSH	880	1700	200
Volume to Capacity	0.02	0.40	1.72
Queue Length 95th (ft)	2	0	587
Control Delay (s)	0.6	0.0	385.9
Lane LOS	A		F
Approach Delay (s)	0.6	0.0	385.9
Approach LOS			F

Intersection Summary			
Average Delay	76.3		
Intersection Capacity Utilization	73.2%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	739	7	16	889	7	16
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	803	8	17	966	8	17
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			811		1808	807
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			811		1808	807
tC, single (s)			4.2		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.3		3.5	3.3
p0 queue free %			98		91	95
cM capacity (veh/h)			785		83	377

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	811	984	25
Volume Left	0	17	8
Volume Right	8	0	17
cSH	1700	785	182
Volume to Capacity	0.48	0.02	0.14
Queue Length 95th (ft)	0	2	12
Control Delay (s)	0.0	0.7	27.9
Lane LOS		A	D
Approach Delay (s)	0.0	0.7	27.9
Approach LOS			D

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	69.6%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	137	746	739	117	103	99
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	149	811	803	127	112	108
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	930				1976	867
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	930				1976	867
tC, single (s)	4.2				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.3				3.5	3.3
p0 queue free %	79				0	69
cM capacity (veh/h)	707				53	348

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	960	930	220
Volume Left	149	0	112
Volume Right	0	127	108
cSH	707	1700	90
Volume to Capacity	0.21	0.55	2.43
Queue Length 95th (ft)	20	0	505
Control Delay (s)	5.7	0.0	749.5
Lane LOS	A		F
Approach Delay (s)	5.7	0.0	749.5
Approach LOS			F

Intersection Summary			
Average Delay	80.6		
Intersection Capacity Utilization	114.6%	ICU Level of Service	H
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	883	5	7	838	7	16
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	960	5	8	911	8	17
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			965		1889	962
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			965		1889	962
tC, single (s)			4.2		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.3		3.5	3.3
p0 queue free %			99		90	94
cM capacity (veh/h)			686		75	306

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	965	918	25
Volume Left	0	8	8
Volume Right	5	0	17
cSH	1700	686	158
Volume to Capacity	0.57	0.01	0.16
Queue Length 95th (ft)	0	1	14
Control Delay (s)	0.0	0.3	32.0
Lane LOS		A	D
Approach Delay (s)	0.0	0.3	32.0
Approach LOS			D

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	59.7%	ICU Level of Service	B
Analysis Period (min)	15		

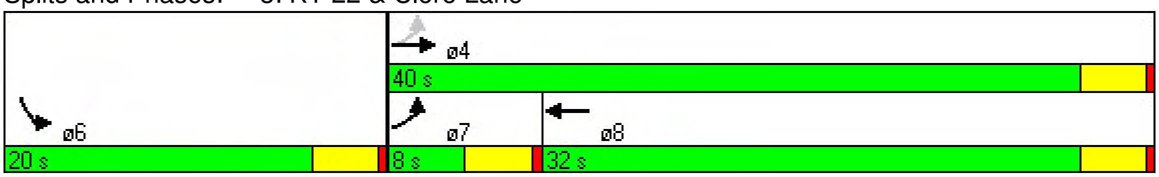
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15			9	15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.993		0.949	
Flt Protected	0.950				0.970	
Satd. Flow (prot)	1656	1743	1731	0	1666	0
Flt Permitted	0.160				0.970	
Satd. Flow (perm)	279	1743	1731	0	1666	0
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			6		49	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		45	45		45	
Link Distance (ft)		220	1276		1093	
Travel Time (s)		3.3	19.3		16.6	
Volume (vph)	18	643	592	34	197	119
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	9%	9%	9%	9%	5%	5%
Adj. Flow (vph)	20	699	643	37	214	129
Lane Group Flow (vph)	20	699	680	0	343	0
Turn Type	pm+pt					
Protected Phases	7	4	8		6	
Permitted Phases	4					
Minimum Split (s)	8.0	20.0	20.0		20.0	
Total Split (s)	8.0	40.0	32.0	0.0	20.0	0.0
Total Split (%)	13.3%	66.7%	53.3%	0.0%	33.3%	0.0%
Maximum Green (s)	4.0	36.0	28.0		16.0	
Yellow Time (s)	3.5	3.5	3.5		3.5	
All-Red Time (s)	0.5	0.5	0.5		0.5	
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Walk Time (s)		5.0	5.0		5.0	
Flash Dont Walk (s)		11.0	11.0		11.0	
Pedestrian Calls (#/hr)		0	0		0	
Act Effct Green (s)	36.0	36.0	28.0		16.0	
Actuated g/C Ratio	0.60	0.60	0.47		0.27	
v/c Ratio	0.08	0.67	0.84		0.71	
Control Delay	5.5	12.0	26.0		27.3	
Queue Delay	0.0	0.0	0.0		0.0	
Total Delay	5.5	12.0	26.0		27.3	
LOS	A	B	C		C	
Approach Delay		11.8	26.0		27.3	
Approach LOS		B	C		C	
Queue Length 50th (ft)	3	146	201		95	
Queue Length 95th (ft)	9	251	#395		#205	
Internal Link Dist (ft)		140	1196		1013	
Turn Bay Length (ft)						
Base Capacity (vph)	259	1046	811		480	

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Starvation Cap Reductn	0	0	0		0	
Spillback Cap Reductn	0	0	0		0	
Storage Cap Reductn	0	0	0		0	
Reduced v/c Ratio	0.08	0.67	0.84		0.71	

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green
Natural Cycle: 60
Control Type: Pretimed
Maximum v/c Ratio: 0.84
Intersection Signal Delay: 20.4 Intersection LOS: C
Intersection Capacity Utilization 58.7% ICU Level of Service B
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: KY 22 & Clore Lane



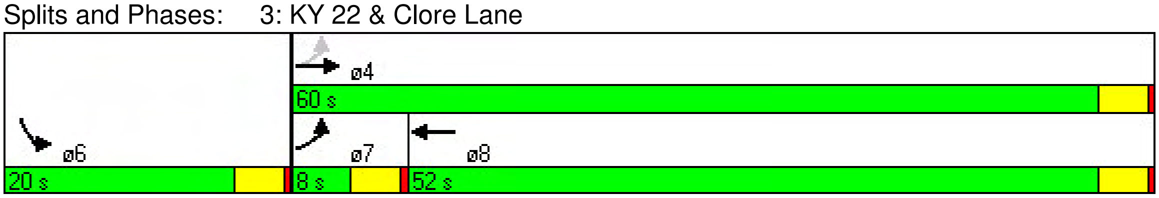
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15			9	15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.982		0.934	
Flt Protected	0.950				0.975	
Satd. Flow (prot)	1656	1743	1712	0	1648	0
Flt Permitted	0.110				0.975	
Satd. Flow (perm)	192	1743	1712	0	1648	0
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			18		54	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		45	45		45	
Link Distance (ft)		220	1276		1093	
Travel Time (s)		3.3	19.3		16.6	
Volume (vph)	137	746	739	117	103	99
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	9%	9%	9%	9%	5%	5%
Adj. Flow (vph)	149	811	803	127	112	108
Lane Group Flow (vph)	149	811	930	0	220	0
Turn Type	pm+pt					
Protected Phases	7	4	8		6	
Permitted Phases	4					
Minimum Split (s)	8.0	20.0	20.0		20.0	
Total Split (s)	8.0	60.0	52.0	0.0	20.0	0.0
Total Split (%)	10.0%	75.0%	65.0%	0.0%	25.0%	0.0%
Maximum Green (s)	4.0	56.0	48.0		16.0	
Yellow Time (s)	3.5	3.5	3.5		3.5	
All-Red Time (s)	0.5	0.5	0.5		0.5	
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Walk Time (s)		5.0	5.0		5.0	
Flash Dont Walk (s)		11.0	11.0		11.0	
Pedestrian Calls (#/hr)		0	0		0	
Act Effct Green (s)	56.0	56.0	48.0		16.0	
Actuated g/C Ratio	0.70	0.70	0.60		0.20	
v/c Ratio	0.72	0.66	0.90		0.59	
Control Delay	27.2	10.1	27.6		29.0	
Queue Delay	0.0	0.0	0.0		0.0	
Total Delay	27.2	10.1	27.6		29.0	
LOS	C	B	C		C	
Approach Delay		12.7	27.6		29.0	
Approach LOS		B	C		C	
Queue Length 50th (ft)	20	190	360		75	
Queue Length 95th (ft)	#62	303	#657		146	
Internal Link Dist (ft)		140	1196		1013	
Turn Bay Length (ft)						
Base Capacity (vph)	208	1220	1034		373	

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Starvation Cap Reductn	0	0	0		0	
Spillback Cap Reductn	0	0	0		0	
Storage Cap Reductn	0	0	0		0	
Reduced v/c Ratio	0.72	0.66	0.90		0.59	

Intersection Summary	
Area Type: Other	
Cycle Length: 80	
Actuated Cycle Length: 80	
Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green	
Natural Cycle: 80	
Control Type: Pretimed	
Maximum v/c Ratio: 0.90	
Intersection Signal Delay: 21.0	Intersection LOS: C
Intersection Capacity Utilization 75.4%	ICU Level of Service D
Analysis Period (min) 15	

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: KY 22 & Clore Lane



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	221	162	330	540	84	131
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	248	182	371	607	94	147
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	978				1049	371
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	978				1049	371
tC, single (s)	4.2				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.4
p0 queue free %	63				39	78
cM capacity (veh/h)	679				155	660

Direction, Lane #	EB 1	WB 1	WB 2	SB 1	SB 2
Volume Total	430	371	607	94	147
Volume Left	248	0	0	94	0
Volume Right	0	0	607	0	147
cSH	679	1700	1700	155	660
Volume to Capacity	0.37	0.22	0.36	0.61	0.22
Queue Length 95th (ft)	42	0	0	82	21
Control Delay (s)	10.0	0.0	0.0	59.1	12.0
Lane LOS	B			F	B
Approach Delay (s)	10.0	0.0		30.4	
Approach LOS				D	

Intersection Summary			
Average Delay	7.1		
Intersection Capacity Utilization	60.9%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	177	441	221	183	259	141
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	186	464	233	193	273	148
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	425				1069	233
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	425				1069	233
tC, single (s)	4.2				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.4
p0 queue free %	83				0	81
cM capacity (veh/h)	1098				197	789

Direction, Lane #	EB 1	WB 1	WB 2	SB 1	SB 2
Volume Total	651	233	193	273	148
Volume Left	186	0	0	273	0
Volume Right	0	0	193	0	148
cSH	1098	1700	1700	197	789
Volume to Capacity	0.17	0.14	0.11	1.38	0.19
Queue Length 95th (ft)	15	0	0	397	17
Control Delay (s)	4.1	0.0	0.0	246.3	10.6
Lane LOS	A			F	B
Approach Delay (s)	4.1	0.0		163.2	
Approach LOS				F	

Intersection Summary			
Average Delay	47.7		
Intersection Capacity Utilization	69.0%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	100	340	555	690	525	105
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	112	382	624	775	590	118
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1399				1427	699
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1399				1427	699
tC, single (s)	4.3				7.0	7.1
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.4
p0 queue free %	75				0	68
cM capacity (veh/h)	450				89	366

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	112	191	191	416	983	590	118
Volume Left	112	0	0	0	0	590	0
Volume Right	0	0	0	0	775	0	118
cSH	450	1700	1700	1700	1700	89	366
Volume to Capacity	0.25	0.11	0.11	0.24	0.58	6.65	0.32
Queue Length 95th (ft)	24	0	0	0	0	Err	34
Control Delay (s)	15.6	0.0	0.0	0.0	0.0	Err	19.4
Lane LOS	C					F	C
Approach Delay (s)	3.6			0.0		8335.7	
Approach LOS						F	

Intersection Summary			
Average Delay	2269.1		
Intersection Capacity Utilization	82.2%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	99	523	320	495	650	240
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	104	551	337	521	684	253
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	858				1081	429
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	858				1081	429
tC, single (s)	4.3				7.0	7.1
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.4
p0 queue free %	86				0	55
cM capacity (veh/h)	736				173	555

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	104	275	275	225	633	684	253
Volume Left	104	0	0	0	0	684	0
Volume Right	0	0	0	0	521	0	253
cSH	736	1700	1700	1700	1700	173	555
Volume to Capacity	0.14	0.16	0.16	0.13	0.37	3.96	0.45
Queue Length 95th (ft)	12	0	0	0	0	Err	59
Control Delay (s)	10.7	0.0	0.0	0.0	0.0	Err	16.8
Lane LOS	B					F	C
Approach Delay (s)	1.7			0.0		7307.2	
Approach LOS						F	

Intersection Summary			
Average Delay	2795.2		
Intersection Capacity Utilization	76.3%	ICU Level of Service	D
Analysis Period (min)	15		

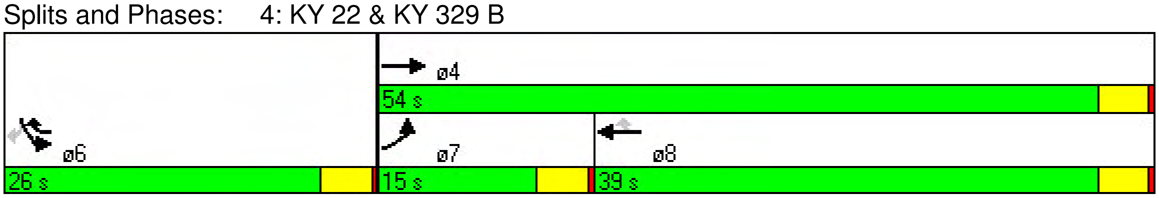
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	300			300	0	0
Storage Lanes	1			1	2	1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15			9	15	9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.97	1.00
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1656	3312	3312	1482	3213	1482
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1656	3312	3312	1482	3213	1482
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				382		118
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		45	45		45	
Link Distance (ft)		1257	381		276	
Travel Time (s)		19.0	5.8		4.2	
Volume (vph)	100	340	555	690	525	105
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	112	382	624	775	590	118
Lane Group Flow (vph)	112	382	624	775	590	118
Turn Type	Prot			pm+ov		Perm
Protected Phases	7	4	8	6	6	
Permitted Phases				8		6
Minimum Split (s)	8.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	15.0	54.0	39.0	26.0	26.0	26.0
Total Split (%)	18.8%	67.5%	48.8%	32.5%	32.5%	32.5%
Maximum Green (s)	11.0	50.0	35.0	22.0	22.0	22.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Walk Time (s)		5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)		11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)		0	0	0	0	0
Act Effct Green (s)	11.0	50.0	35.0	61.0	22.0	22.0
Actuated g/C Ratio	0.14	0.62	0.44	0.76	0.28	0.28
v/c Ratio	0.49	0.18	0.43	0.63	0.67	0.24
Control Delay	40.0	6.6	16.8	4.6	30.1	6.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	40.0	6.6	16.8	4.6	30.1	6.1
LOS	D	A	B	A	C	A
Approach Delay		14.2	10.0		26.1	
Approach LOS		B	B		C	
Queue Length 50th (ft)	53	37	109	48	134	0
Queue Length 95th (ft)	102	55	150	104	186	36
Internal Link Dist (ft)		1177	301		196	
Turn Bay Length (ft)	300			300		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Base Capacity (vph)	228	2070	1449	1221	884	493
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.49	0.18	0.43	0.63	0.67	0.24

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green
Natural Cycle: 50
Control Type: Pretimed
Maximum v/c Ratio: 0.67
Intersection Signal Delay: 15.2 Intersection LOS: B
Intersection Capacity Utilization 54.9% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 4: KY 22 & KY 329 B



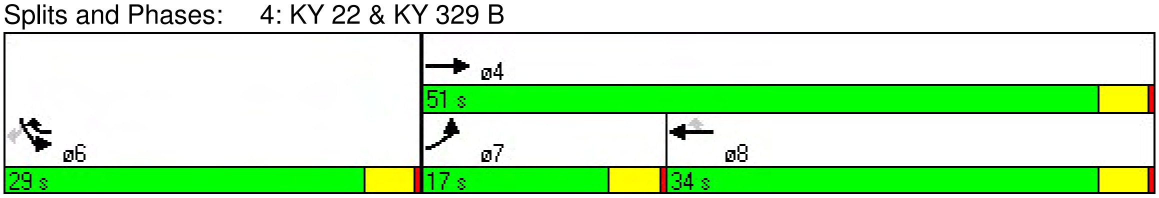
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	300			200	0	0
Storage Lanes	1			1	2	1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15			9	15	9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.97	1.00
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1656	3312	3312	1482	3213	1482
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1656	3312	3312	1482	3213	1482
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				479		253
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		45	45		45	
Link Distance (ft)		1257	381		276	
Travel Time (s)		19.0	5.8		4.2	
Volume (vph)	99	523	320	495	650	240
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	104	551	337	521	684	253
Lane Group Flow (vph)	104	551	337	521	684	253
Turn Type	Prot			pm+ov		Perm
Protected Phases	7	4	8	6	6	
Permitted Phases				8		6
Minimum Split (s)	8.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	17.0	51.0	34.0	29.0	29.0	29.0
Total Split (%)	21.3%	63.8%	42.5%	36.3%	36.3%	36.3%
Maximum Green (s)	13.0	47.0	30.0	25.0	25.0	25.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Walk Time (s)		5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)		11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)		0	0	0	0	0
Act Effct Green (s)	13.0	47.0	30.0	59.0	25.0	25.0
Actuated g/C Ratio	0.16	0.59	0.38	0.74	0.31	0.31
v/c Ratio	0.39	0.28	0.27	0.43	0.68	0.40
Control Delay	34.8	8.6	18.1	1.6	28.2	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.8	8.6	18.1	1.6	28.2	5.0
LOS	C	A	B	A	C	A
Approach Delay		12.8	8.1		21.9	
Approach LOS		B	A		C	
Queue Length 50th (ft)	47	65	60	5	152	0
Queue Length 95th (ft)	94	92	91	27	211	50
Internal Link Dist (ft)		1177	301		196	
Turn Bay Length (ft)	300			200		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Base Capacity (vph)	269	1946	1242	1219	1004	637
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.39	0.28	0.27	0.43	0.68	0.40

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green
Natural Cycle: 50
Control Type: Pretimed
Maximum v/c Ratio: 0.68
Intersection Signal Delay: 14.6 Intersection LOS: B
Intersection Capacity Utilization 42.9% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 4: KY 22 & KY 329 B



APPENDIX C

KY 146 AND CEDAR POINT ROAD (KY 1817) **AM PEAK**

```
*******************************************************************************
*                                                                             *
*  28:9:06           OLDHAM COUNTY KY 146 AT CEDAR POINT ROAD            44  *
*                                                                             *
*******************************************************************************
*                                                 *                           *
* E    (m)    4.5    8.5    8.5                   * TIME PERIOD     min    90 *
* L'   (m)   40.00  40.00  40.00                  * TIME SLICE      min    15 *
* V    (m)    3.60   3.60   3.60                  * RESULTS PERIOD  min 15 75 *
* RAD  (m)   20.00  20.00  20.00                  * TIME COST      $/hr 15.00 *
* PHI  (d)   30.00  30.00  30.00                  * FLOW PERIOD     min 15 75 *
* DIA  (m)   45.00  45.00  45.00                  * FLOW TYPE   pcu/veh   VEH *
* GRAD SEP       0      0      0                  * FLOW PEAK  am/op/pm    AM *
*                                                 *                           *
*******************************************************************************
* LEG NAME *PCU *VEH TURNS (1st exit, 2nd..U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                            *    *  *               *         *
* CEDER  SB*1.05*  173  141    0             *1.0 *50*0.75 1.125 0.75*15 45 75 *
* KY 146 EB*1.09*  872   85    0             *1.0 *50*0.75 1.125 0.75*15 45 75 *
* KY 146 WB*1.09*   83  921    0             *1.0 *50*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*******************************************************************************
*                                                          *                  *
* FLOW        veh      314    957   1004                   * AVEDEL  s   4.5 *
* CAPACITY    veh      747   1882   1918                   * LOS   SIG     A *
* AVE DELAY  mins     0.14   0.06   0.07                   * LOS UNSIG     A *
* MAX DELAY  mins     0.21   0.09   0.09                   *                  *
* AVE QUEUE   veh        1      1      1                   * VEHIC HRS   2.9 *
* MAX QUEUE   veh        1      1      1                   * COST    $    43 *
*                                                          *                  *
*******************************************************************************
```

KY 146 AND CEDAR POINT ROAD (KY 1817) PM PEAK

```
********************************************************************************
*                                                                              *
*  28:9:06           OLDHAM COUNTY KY 146 AT CEDAR POINT ROAD              45  *
*                                                                              *
********************************************************************************
*                                                   *                          *
* E    (m)    4.5    8.5    8.5                     * TIME PERIOD     min    90  *
* L'   (m)   40.00  40.00  40.00                    * TIME SLICE      min    15  *
* V    (m)    3.60   3.60   3.60                    * RESULTS PERIOD  min 15 75  *
* RAD  (m)   20.00  20.00  20.00                    * TIME COST      $/hr 15.00  *
* PHI  (d)   30.00  30.00  30.00                    * FLOW PERIOD     min 15 75  *
* DIA  (m)   45.00  45.00  45.00                    * FLOW TYPE   pcu/veh   VEH  *
* GRAD SEP       0      0      0                    * FLOW PEAK  am/op/pm    PM  *
*                                                   *                          *
********************************************************************************
* LEG NAME *PCU *VEH TURNS (1st exit, 2nd..U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                            *    *  *               *         *
* CEDER  SB*1.05*  101   98    0             *1.0 *50*0.75 1.125 0.75*15 45 75 *
* KY 146 EB*1.09* 1179  190    0             *1.0 *50*0.75 1.125 0.75*15 45 75 *
* KY 146 WB*1.09*  103  641    0             *1.0 *50*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
********************************************************************************
*                                                             *                *
* FLOW        veh     199   1369    744                       * AVEDEL  s   5.6 *
* CAPACITY    veh     910   1912   1843                       * LOS   SIG     A *
* AVE DELAY  mins    0.08   0.12   0.05                       * LOS UNSIG     A *
* MAX DELAY  mins    0.11   0.18   0.07                       *                *
* AVE QUEUE   veh       0      3      1                       * VEHIC HRS   3.6 *
* MAX QUEUE   veh       0      4      1                       * COST    $    54 *
*                                                             *                *
********************************************************************************
```

KY 329 BYPASS AND ARBOR RIDGE / WESTWIND WAY AM PEAK

```
*******************************************************************************
*                                                                             *
*  14:9:06            OLDHAM COUNTY ARBOR RIDGE   KY 329                89  *
*                                                                             *
*******************************************************************************
*                                                  *                          *
* E    (m)    8.50   8.50   8.50   8.50            * TIME PERIOD    min     90  *
* L'   (m)   15.00  35.00  15.00  20.00            * TIME SLICE     min     15  *
* V    (m)    7.30   3.60   7.30   3.60            * RESULTS PERIOD min  15 75  *
* RAD  (m)   20.00  20.00  20.00  20.00            * TIME COST     $/hr  15.00  *
* PHI  (d)   30.00  30.00  30.00  30.00            * FLOW PERIOD    min  15 75  *
* DIA  (m)   45.00  45.00  45.00  45.00            * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP       0      0      0      0            * FLOW PEAK am/op/pm     AM  *
*                                                  *                          *
*******************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                            *    *  *               *         *
*WB KY 329 *1.05*  526  763  30   0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*SB ARBOR  *1.05*  542  28   349  0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*EB KY 329 *1.05*  3    462  312  0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*NB ARBOR  *1.05*  53   54   30   0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*******************************************************************************
*                                                           *                 *
* FLOW        veh    1319    919    777    137              *                 *
* CAPACITY    veh    2072   1432   2063   1078              * AVDEL s     5.1 *
* AVE DELAY  mins    0.08   0.13   0.05   0.06              * L  O  S       A *
* MAX DELAY  mins    0.12   0.20   0.06   0.09              * VEH HRS     4.5 *
* AVE QUEUE   veh       2      2      1      0              * COST  $    66.9 *
* MAX QUEUE   veh       2      3      1      0              *                 *
*                                                           *                 *
*******************************************************************************
```

KY 329 BYPASS AND ARBOR RIDGE / WESTWIND WAY PM PEAK

```
********************************************************************************
*                                                                              *
*  14:9:06             OLDHAM COUNTY ARBOR RIDGE   KY 329                 90  *
*                                                                              *
********************************************************************************
*                                                  *                           *
* E    (m)    8.50   8.50   8.50   8.50            * TIME PERIOD    min     90  *
* L'   (m)   15.00  35.00  15.00  20.00            * TIME SLICE     min     15  *
* V    (m)    7.30   3.60   7.30   3.60            * RESULTS PERIOD min  15 75  *
* RAD  (m)   20.00  20.00  20.00  20.00            * TIME COST     $/hr  15.00  *
* PHI  (d)   30.00  30.00  30.00  30.00            * FLOW PERIOD    min  15 75  *
* DIA  (m)   45.00  45.00  45.00  45.00            * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP       0      0      0      0            * FLOW PEAK am/op/pm     PM  *
*                                                  *                           *
********************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                            *    *  *               *         *
*WB KY 329 *1.05*  536  387  9    0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*SB ARBOR  *1.05*  488  35   640  0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*EB KY 329 *1.05*  16   500  715  0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*NB ARBOR  *1.05*  11   26   9    0          *1.00*50*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
********************************************************************************
*                                                           *                  *
* FLOW        veh     932   1163   1231     46              *                  *
* CAPACITY    veh    1794   1728   1846    587              * AVDEL s     5.8 *
* AVE DELAY  mins    0.07   0.11   0.10   0.12              * L  O  S       A *
* MAX DELAY  mins    0.10   0.17   0.16   0.18              * VEH HRS     5.5 *
* AVE QUEUE   veh       1      2      2      0              * COST  $    82.1 *
* MAX QUEUE   veh       1      3      3      0              *                  *
*                                                           *                  *
********************************************************************************
```

KY 22 AND CLORE LANE **AM PEAK**

```
*****************************************************************************
*                                                                           *
*  14:9:06            OLDHAM COUNTY CLORE LANE & KY 22                 63  *
*                                                                           *
*****************************************************************************
*                                                 *                         *
* E    (m)    8.40   4.50   8.40                  * TIME PERIOD    min     90  *
* L'   (m)   10.00  10.00  10.00                  * TIME SLICE     min     15  *
* V    (m)    3.60   3.60   3.60                  * RESULTS PERIOD min  15 75  *
* RAD  (m)   20.00  20.00  20.00                  * TIME COST     $/hr  15.00  *
* PHI  (d)   30.00  30.00  30.00                  * FLOW PERIOD    min  15 75  *
* DIA  (m)   45.00  45.00  45.00                  * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP       0      0      0                  * FLOW PEAK am/op/pm     AM  *
*                                                 *                         *
*****************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                            *    *  *               *         *
*WB KY 22  *1.05*  34   592   0             *1.00*50*0.75 1.125 0.75*15 45 75 *
*SB CLORE  *1.05*  119  197   0             *1.00*50*0.75 1.125 0.75*15 45 75 *
*EB KY 22  *1.05*  643  18    0             *1.00*50*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*****************************************************************************
*                                                            *               *
* FLOW        veh     626    316    661                      *               *
* CAPACITY    veh    1574    915   1463                      * AVDEL s    4.5 *
* AVE DELAY  mins    0.06   0.10   0.07                      * L  O  S      A *
* MAX DELAY  mins    0.08   0.14   0.10                      * VEH HRS    2.0 *
* AVE QUEUE   veh       1      1      1                      * COST  $   29.8 *
* MAX QUEUE   veh       1      1      1                      *               *
*                                                            *               *
*****************************************************************************
```

KY 22 AND CLORE LANE **PM PEAK**

```
*******************************************************************************
*                                                                             *
*  14:9:06              OLDHAM COUNTY CLORE LANE & KY 22                 63  *
*                                                                             *
*******************************************************************************
*                                                  *                          *
* E    (m)    8.40   4.50   8.40                   * TIME PERIOD    min     90  *
* L'   (m)   10.00  10.00  10.00                   * TIME SLICE     min     15  *
* V    (m)    3.60   3.60   3.60                   * RESULTS PERIOD min  15 75  *
* RAD  (m)   20.00  20.00  20.00                   * TIME COST     $/hr  15.00  *
* PHI  (d)   30.00  30.00  30.00                   * FLOW PERIOD    min  15 75  *
* DIA  (m)   45.00  45.00  45.00                   * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP       0      0      0                   * FLOW PEAK am/op/pm     PM  *
*                                                  *                          *
*******************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                            *    *  *               *         *
*WB KY 22  *1.05*  117  739    0             *1.00*50*0.75 1.125 0.75*15 45 75 *
*SB CLORE  *1.05*  99   103    0             *1.00*50*0.75 1.125 0.75*15 45 75 *
*EB KY 22  *1.05*  746  137    0             *1.00*50*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*******************************************************************************
*                                                           *                 *
* FLOW        veh     856    202    883                     *                 *
* CAPACITY    veh    1500    834   1521                     * AVDEL s     5.6 *
* AVE DELAY  mins    0.09   0.09   0.09                     * L  O  S       A *
* MAX DELAY  mins    0.13   0.13   0.13                     * VEH HRS     3.0 *
* AVE QUEUE   veh       1      0      1                     * COST  $    45.3 *
* MAX QUEUE   veh       2      0      2                     *                 *
*                                                           *                 *
*******************************************************************************
```

KY 22 AND KY 329 BYPASS **AM PEAK**

```
*****************************************************************************
*                                                                           *
*  28:9:06           OLDHAM COUNTY KY 22 AT KY 329 BYPASS              155  *
*                                                                           *
*****************************************************************************
*                                                 *                         *
* E    (m)    8.5    8.5   8.5                    * TIME PERIOD     min    90  *
* L'   (m)   20.00  20.00  20.00                  * TIME SLICE      min    15  *
* V    (m)    7.30   7.3    7.3                   * RESULTS PERIOD  min 15 75  *
* RAD  (m)   20.00  20.00  20.00                  * TIME COST      $/hr 15.00  *
* PHI  (d)   30.00  30.00  30.00                  * FLOW PERIOD     min 15 75  *
* DIA  (m)   45.00  45.0   45.0                   * FLOW TYPE   pcu/veh   VEH  *
* GRAD SEP      0      0      0                   * FLOW PEAK  am/op/pm    AM  *
*                                                 *                         *
*****************************************************************************
* LEG NAME *PCU *VEH TURNS (1st exit, 2nd..U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                            *    *  *               *         *
* KY 329 SB*1.07*  105  525    0             *1.0 *50*0.75 1.125 0.75*15 45 75 *
* KY 22  EB*1.09*  340  100    0             *1.0 *50*0.75 1.125 0.75*15 45 75 *
* KY 22  WB*1.09*  690  555    0             *1.0 *50*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*****************************************************************************
*                                                           *               *
* FLOW         veh     630    440   1245                    * AVEDEL  s   3.2 *
* CAPACITY     veh    1907   1903   2230                    * LOS   SIG     A *
* AVE DELAY  mins    0.05   0.04   0.06                     * LOS UNSIG     A *
* MAX DELAY  mins    0.06   0.05   0.09                     *               *
* AVE QUEUE   veh       0      0      1                     * VEHIC HRS   2.0 *
* MAX QUEUE   veh       1      0      2                     * COST    $    31 *
*                                                           *               *
*****************************************************************************
```

KY 22 AND KY 329 BYPASS **PM PEAK**

```
*****************************************************************************
*                                                                           *
*  28:9:06            OLDHAM COUNTY KY 22 AT KY 329 BYPASS             155  *
*                                                                           *
*****************************************************************************
*                                                *                          *
* E    (m)    8.5    8.5   8.5                   * TIME PERIOD     min    90  *
* L'   (m)   20.00  20.00  20.00                 * TIME SLICE      min    15  *
* V    (m)    7.30   7.3    7.3                  * RESULTS PERIOD  min 15 75  *
* RAD  (m)   20.00  20.00  20.00                 * TIME COST      $/hr 15.00  *
* PHI  (d)   30.00  30.00  30.00                 * FLOW PERIOD     min 15 75  *
* DIA  (m)   45.00  45.0   45.0                  * FLOW TYPE   pcu/veh   VEH  *
* GRAD SEP      0      0      0                  * FLOW PEAK  am/op/pm    PM  *
*                                                *                          *
*****************************************************************************
* LEG NAME *PCU *VEH TURNS (1st exit, 2nd..U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                            *    *  *               *         *
* KY 329 SB*1.07*  240  650    0             *1.0 *50*0.75 1.125 0.75*15 45 75 *
* KY 22  EB*1.09*  523   99    0             *1.0 *50*0.75 1.125 0.75*15 45 75 *
* KY 22  WB*1.09*  495  320    0             *1.0 *50*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*          *    *                            *    *  *               *         *
*****************************************************************************
*                                                           *               *
* FLOW         veh     890    622    815                    * AVEDEL  s   2.8 *
* CAPACITY     veh    2096   1807   2231                    * LOS   SIG     A *
* AVE DELAY  mins    0.05   0.05   0.04                     * LOS UNSIG     A *
* MAX DELAY  mins    0.07   0.07   0.06                     *                 *
* AVE QUEUE   veh       1      1      1                     * VEHIC HRS   1.8 *
* MAX QUEUE   veh       1      1      1                     * COST    $    27 *
*                                                           *               *
*****************************************************************************
```

OLDHAM COUNTY INTERSECTION IMPROVEMENT STUDY
OLDHAM COUNTY FISCAL COURT
Oldham County, Kentucky

APPENDIX D

Design Criteria

Following are guidelines specified in the Kentucky Transportation Cabinet Highway Design Manual regarding geometric design criteria for state roadways. Each roadway that is part of this study is listed below with the related Common Geometric Practices Exhibit.

As-built drawings were unavailable for this study, therefore, no existing information is listed for the intersections.

Route Number / Name	Roadway Classification	Exhibit Number
State Route (KY) 146	Rural Collector	700-02
KY 329 Bypass	Rural Collector	700-02
KY 22	Rural Collector	700-02
Cedar Point Road (KY 1817)	Rural Local	700-01
Arbor Ridge / Westwind Way	Rural Local	700-01
Clore Lane / Wooldridge Avenue	Rural Local	700-01

COMMON GEOMETRIC PRACTICES
RURAL LOCAL ROADS

	TERRIAN	UNDER 50 A.D.T.	50-250 A.D.T.	250-400 A.D.T.	400-1500 A.D.T.	1500-2000 A.D.T.	OVER 2000 A.D.T.
		TRAFFIC VOLUME					
MINIMUM DESIGN SPEED (M.P.H.) ⑥ ⑦	LEVEL	30		40	50		
	ROLLING	20	30		40		
	MOUNTAIN	20			30		

	DESIGN SPEED	UNDER 400 A.D.T.	400-1500 A.D.T.	1500-2000 A.D.T.	OVER 2000 A.D.T.
PAVEMENT WIDTH (FEET) ④ ⑧	15 MPH	18	20 ⑨	20	22
	20 MPH			22	24 ⑪
	25 MPH				
	30 MPH				
	40 MPH				
	45 MPH	20	22		
	50 MPH				
	55 MPH	22		24 ⑪	
	60 MPH				
MIN. GRADED SHOULDER WIDTH (FEET) ⑤	ALL SPEEDS	2	5 ⑨⑩	6	8
MIN. CLEAR ROADWAY WIDTH OF NEW AND RECONSTRUCTED BRIDGES	ALL SPEEDS	APPROACH ROADWAY WIDTH			

	DESIGN SPEED	eMAX. 4%	eMAX. 6%	eMAX. 8%
MINIMUM RADIUS (FEET)	20 MPH	125	115	105
	25 MPH	205	185	170
	30 MPH	300	275	250
	35 MPH	420	380	350
	40 MPH	565	510	465
	45 MPH	730	660	600
	50 MPH	930	835	760

NORMAL PAVEMENT CROSS SLOPES ③	RATE OF CROSS SLOPE = 2%	
NORMAL SHOULDER CROSS SLOPES	EARTH = 8%	PAVED = 4%

	M.P.H.	20	25	30	35	40	45	50
MAXIMUM GRADE (PERCENT)	LEVEL	8	7					6
	ROLLING	11		10			9	8
	MOUNTAIN	16	15	14		13	12	10
MINIMUM STOPPING SIGHT DISTANCE ①	(FEET)	115	155	200	250	305	360	425
MINIMUM PASSING SIGHT DISTANCE ②	(FEET)	710	900	1090	1280	1470	1625	1835

① MINIMUM STOPPING SIGHT DISTANCE BASED ON HEIGHT OF EYE OF 3.5 FT AND HEIGHT OF OBJECT OF 2.0 FT. CONSIDER BOTH HORIZONTAL AND VERTICAL ALIGNMENT.

② MINIMUM PASSING SIGHT DISTANCE BASED ON HEIGHT OF EYE OF 3.5 FT AND HEIGHT OF OBJECT OF 3.5 FT. CONSIDER BOTH HORIZONTAL AND VERTICAL ALIGNMENTS.

③ NORMAL PAVEMENT CROSS SLOPES ON BRIDGES IS 2%.

④ CONSIDER CURVE WIDENING ON PROJECTS WITH SIGNIFICANT TRUCK VOLUMES.

⑤ WIDEN 3 FT FOR GUARDRAIL.

⑥ WHERE SELECTED DESIGN SPEED IS > 50 MPH, USE COMMON GEOMETRIC PRATICES EXHIBIT 500-02 FOR RURAL COLLECTOR ROADS.

⑦ DOCUMENT AND RETAIN JUSTIFICATION FOR A DESIGN SPEED LESS THAN THE REGULATORY OR POSTED SPEED IN THE PROJECT FILES.

⑧ FOR ROADS < 400 ADT, REFER TO AASHTO'S "GEOMETRIC DESIGN GUIDELINES FOR VERY LOW-VOLUME LOCAL ROADS (ADT≤400)".

⑨ FOR ROADS IN MOUNTAINOUS TERRAIN WITH DESIGN VOLUME OF 400 TO 600 VEH/DAY, USE 18 FT TRAVELED WAY WIDTH AND 2 FT SHOULDER WIDTH.

⑩ MAY BE ADJUSTED TO ACHIEVE A MINIMUM ROADWAY WIDTH OF 30 FT FOR DESIGN SPEEDS > THAN 40 MPH.

⑪ WHERE THE WIDTH OF THE TRAVELED WAY IS SHOWN AS 24 FT, THE WIDTH MAY REMAIN AT 22 FT ON RECONSTRUCTED HIGHWAYS WHERE SAFETY RECORDS AND ALIGNMENT ARE SATISFACTORY.

COMMON GEOMETRIC PRACTICES
RURAL COLLECTOR ROADS

<table>
<tr><td></td><td></td><td colspan="4">TRAFFIC VOLUME</td></tr>
<tr><td></td><td>TERRIAN</td><td>UNDER 400 A.D.T.</td><td colspan="2">400-2000 A.D.T.</td><td>OVER 2000 A.D.T.</td></tr>
<tr><td rowspan="3">MINIMUM DESIGN SPEED (M.P.H.) ⑦</td><td>LEVEL</td><td>40</td><td colspan="2">50</td><td>60</td></tr>
<tr><td>ROLLING</td><td>30</td><td colspan="2">40</td><td>50</td></tr>
<tr><td>MOUNTAIN</td><td>20</td><td colspan="2">30</td><td>40</td></tr>
<tr><td rowspan="10">PAVEMENT WIDTH (FEET) ① ⑧</td><td>DESIGN SPEED</td><td>UNDER 400 A.D.T.</td><td>400-1500 A.D.T.</td><td>1500-2000 A.D.T.</td><td>OVER 2000 A.D.T.</td></tr>
<tr><td>20 MPH</td><td rowspan="5">20 ⑨</td><td rowspan="3">20</td><td rowspan="7">22</td><td rowspan="9">24</td></tr>
<tr><td>25 MPH</td></tr>
<tr><td>30 MPH</td></tr>
<tr><td>35 MPH</td><td rowspan="6">22</td></tr>
<tr><td>40 MPH</td></tr>
<tr><td>45 MPH</td><td rowspan="2">20</td></tr>
<tr><td>50 MPH</td></tr>
<tr><td>55 MPH</td><td rowspan="2">22</td><td rowspan="2">24</td></tr>
<tr><td>60 MPH</td></tr>
<tr><td>MINIMUM GRADED SHOULDER WIDTH (FEET) ⑥</td><td>ALL SPEEDS</td><td>2</td><td>5 ⑩</td><td>6</td><td>8</td></tr>
<tr><td>MIN. CLEAR ROADWAY WIDTH OF NEW AND RECONSTRUCTED BRIDGES</td><td>ALL SPEEDS</td><td colspan="4">APPROACH ROADWAY WIDTH</td></tr>
</table>

<table>
<tr><td rowspan="10">MINIMUM RADIUS (FEET)</td><td>DESIGN SPEED</td><td>eMAX. 4%</td><td>eMAX. 6%</td><td>eMAX. 8%</td></tr>
<tr><td>20 MPH</td><td>125</td><td>115</td><td>105</td></tr>
<tr><td>25 MPH</td><td>205</td><td>185</td><td>170</td></tr>
<tr><td>30 MPH</td><td>300</td><td>275</td><td>250</td></tr>
<tr><td>35 MPH</td><td>420</td><td>380</td><td>350</td></tr>
<tr><td>40 MPH</td><td>565</td><td>510</td><td>465</td></tr>
<tr><td>45 MPH</td><td>730</td><td>660</td><td>600</td></tr>
<tr><td>50 MPH</td><td>930</td><td>835</td><td>760</td></tr>
<tr><td>55 MPH</td><td>1190</td><td>1065</td><td>965</td></tr>
<tr><td>60 MPH</td><td>1505</td><td>1340</td><td>1205</td></tr>
<tr><td>NORMAL PAVEMENT CROSS SLOPES ④</td><td colspan="4">RATE OF CROSS SLOPE = 2%</td></tr>
<tr><td>NORMAL SHOULDER CROSS SLOPES</td><td colspan="2">EARTH = 8%</td><td colspan="2">PAVED = 4%</td></tr>
</table>

<table>
<tr><td rowspan="4">MAXIMUM GRADE (PERCENT) ⑤</td><td>M.P.H.</td><td>20</td><td>25</td><td>30</td><td>35</td><td>40</td><td>45</td><td>50</td><td>55</td><td>60</td></tr>
<tr><td>LEVEL</td><td colspan="6">7</td><td colspan="2">6</td><td>5</td></tr>
<tr><td>ROLLING</td><td colspan="2">10</td><td colspan="2">9</td><td colspan="2">8</td><td colspan="2">7</td><td>6</td></tr>
<tr><td>MOUNTAIN</td><td>12</td><td>11</td><td colspan="4">10</td><td colspan="2">9</td><td>8</td></tr>
<tr><td>MINIMUM STOPPING SIGHT DISTANCE ②</td><td>(FEET)</td><td>115</td><td>155</td><td>200</td><td>250</td><td>305</td><td>360</td><td>425</td><td>495</td><td>570</td></tr>
<tr><td>MINIMUM PASSING SIGHT DISTANCE ③</td><td>(FEET)</td><td>710</td><td>900</td><td>1090</td><td>1280</td><td>1470</td><td>1625</td><td>1835</td><td>1985</td><td>2135</td></tr>
</table>

① WIDEN PAVEMENT ON CURVES IN ACCORDANCE WITH APPROVED DESIGN STANDARDS. REFER TO CURRENT STANDARD DRAWING FOR ADDITIONAL DETAIL.

② MINIMUM STOPPING SIGHT DISTANCE BASED ON HEIGHT OF EYE OF 3.5 FT AND HEIGHT OF OBJECT OF 2.0FT. CONSIDER BOTH HORIZONTAL AND VERTICAL ALIGNMENTS.

③ MINIMUM PASSING SIGHT DISTANCES BASED ON HEIGHT OF EYE 3.5 FT AND HEIGHT OF OBJECT OF 3.5 FT. CONSIDER BOTH HORIZONTAL AND VERTICAL ALIGNMENTS.

④ NORMAL PAVEMENT CROSS SLOPES ON BRIDGES IS 2%.

⑤ MAY USE ONE PERCENT STEEPER MAXIMUM GRADES ON SHORT LENGTHS (LESS THAN 500 FT) AND ON ONE-WAY DOWN GRADES.

⑥ WIDEN 3 FT FOR GUARDRAIL.

⑦ DOCUMENT AND RETAIN JUSTIFICATION FOR A DESIGN SPEED LESS THAN THE REGULATORY OR POSTED SPEED IN THE PROJECT FILES.

⑧ ON ROADWAYS TO BE RECONSTRUCTED, A 22 FT TRAVELLED WAY MAY BE RETAINED WHERE THE SAFETY RECORDS AND ALIGNMENT ARE SATISFACTORY.

⑨ 18 FT MINIMUM WIDTH MAY BE USED FOR ROADWAYS WITH DESIGN VOLUMES UNDER 250 A.D.T.

⑩ SHOULDER WIDTH MAY BE REDUCED FOR DESIGN SPEEDS GREATER THAN 30 MPH PROVIDED A MINIMUM ROADWAY WIDTH OF 30 FT IS MAINTAINED.

OLDHAM COUNTY INTERSECTION IMPROVEMENT STUDY
OLDHAM COUNTY FISCAL COURT
Oldham County, Kentucky

APPENDIX E

OLDHAM COUNTY INTERSECTION IMPROVEMENT STUDY

COST ESTIMATE SUMMARY

KY 146 and Cedar Point Road (KY 1817)

	Signalized	Roundabout
Construction Cost	$ 411,000	$ 840,000
Right of Way Impacts	0.30 acres	0.67 acres

KY 329 Bypass and Arbor Ridge / Westwind Way

	Signalized	Roundabout
Construction Cost	$ 623,000	$ 1,016,000
Right of Way Impacts	None	0.33 acres

KY 22 and Clore Lane / Wooldridge Ave.

	Signalized	Roundabout
Construction Cost	$ 1,011,000	$ 829,000
Right of Way Impacts	0.28 acres	0.42 acres

KY 22 and KY 329 Bypass

	Signalized	Roundabout
Construction Cost	$ 1,016,000	$ 959,000
Right of Way Impacts *	N/A	N/A

*Right-of-way not estimated due to KY 22 widening project

All construction cost estimates rounded to the nearest $1,000

OLDHAM COUNTY INTERSECTION IMPROVEMENT STUDY
KY 146 AND CEDAR POINT ROAD

SIGNALIZED ALTERNATIVE

DLZ
ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

ITEM NO.	DESCRIPTION	Quantity	Unit	Unit Cost	Cost
	CLEARING AND GRUBBING (0.64 AC)	1	LS	$1,900.00	$1,900.00
	PAVEMENT MILLING AND TEXTURING	334	TN	$40.00	$13,360.00
	EARTHWORK	460	CY	$20.00	$9,200.00
	1.5 " ASPHALT OVERLAY	334	TN	$65.00	$21,710.00
	8" AGGREGATE BASE	633	TN	$25.00	$15,825.00
	15" ASPHALT PAVEMENT	1135	TN	$65.00	$73,775.00
	TRAFFIC SIGNAL	1	LS	$60,000.00	$60,000.00
	LIGHTING	1	LS	$12,000.00	$12,000.00
	SIGNING/PAVEMENT MARKING	1	LS	$30,000.00	$30,000.00
	RESTORATION (SEED AND MULCH)	2564	SY	$0.50	$1,282.00
	MAINTENANCE OF TRAFFIC	1	LS	$20,000.00	$20,000.00
	MISC ITEMS (10%)	1	LS	$25,905.20	$25,905.20
				SUBTOTAL	$284,957.20
	CONTINGENCY (20%) ±				$56,991.44
				CONSTRUCTION TOTAL	$341,948.64
	ENGINEERING FEES (20%)				$68,389.73
				TOTAL	$410,338.37

NOTE: Driveway work, ROW acquisition costs, landscaping and utility costs are not included in the estimate.

OLDHAM COUNTY INTERSECTION IMPROVEMENT STUDY
KY 146 AND CEDAR POINT ROAD

ROUNDABOUT ALTERNATIVE

DLZ
ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

ITEM NO.	DESCRIPTION	Quantity	Unit	Unit Cost	Total Amount Bid
	CLEARING AND GRUBBING (0.98 AC)	1	LS	$3,000.00	$3,000.00
	PAVEMENT REMOVAL	3092	SY	$8.00	$24,736.00
	EARTHWORK	1960	CY	$20.00	$39,200.00
	8" AGGREGATE BASE	2430	TN	$25.00	$60,750.00
	15" ASPHALT PAVEMENT	4356	TN	$65.00	$283,140.00
	CURB AND GUTTER	1472	LF	$22.00	$32,384.00
	12" STORM SEWER	50	LF	$70.00	$3,500.00
	LIGHTING	1	LS	$12,000.00	$12,000.00
	SIGNING/PAVEMENT MARKING	1	LS	$50,000.00	$50,000.00
	RESTORATION (SEED AND MULCH)	2455	SY	$0.50	$1,227.50
	MAINTENANCE OF TRAFFIC	1	LS	$20,000.00	$20,000.00
	MISC ITEMS (10%)	1	LS	$52,993.75	$52,993.75
	SUBTOTAL				$582,931.25
	CONTINGENCY (20%) ±				$116,586.25
	CONSTRUCTION TOTAL				$699,517.50
	ENGINEERING FEES (20%)				$139,903.50
	TOTAL				$839,421.00

NOTE: Driveway work, ROW acquisition costs, landscaping and utility costs are not included in the estimate.

OLDHAM COUNTY INTERSECTION IMPROVEMENT STUDY
KY 329 BYPASS AND ARBOR RIDGE / WESTWIND WAY

DLZ
ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

SIGNALIZED ALTERNATIVE

ITEM NO.	DESCRIPTION	Quantity	Unit	Unit Cost	Total Amount Bid
	CLEARING AND GRUBBING	1	LS	$2,000.00	$2,000.00
	PAVEMENT MILLING AND TEXTURING	1372	TN	$40.00	$54,880.00
	EARTHWORK	150	CY	$20.00	$3,000.00
	1.5" ASPHALT SURFACE	0	TN	$65.00	$0.00
	8" AGGREGATE BASE	1081	TN	$25.00	$27,025.00
	15" ASPHALT PAVEMENT	1940	TN	$65.00	$126,100.00
	CURB AND GUTTER	50	LF	$22.00	$1,100.00
	TRAFFIC SIGNAL	1	LS	$100,000.00	$100,000.00
	LIGHTING	1	LS	$12,000.00	$12,000.00
	SIGNING/PAVEMENT MARKING	1	LS	$40,000.00	$40,000.00
	RESTORATION (SEED AND MULCH)	3200	SY	$0.50	$1,600.00
	MAINTENANCE OF TRAFFIC	1	LS	$25,000.00	$25,000.00
	MISC ITEMS (10%)	1	LS	$39,270.50	$39,270.50
	SUBTOTAL				$431,975.50
	CONTINGENCY (20%) ±				$86,395.10
	CONSTRUCTION TOTAL				$518,370.60
	ENGINEERING FEES (20%)				$103,674.12
	TOTAL				$622,044.72

NOTE: Driveway work, ROW acquisition costs, landscaping and utility costs are not included in the estimate.

OLDHAM COUNTY INTERSECTION IMPROVEMENT STUDY
KY 329 BYPASS AND ARBOR RIDGE / WESTWIND WAY

ROUNDABOUT ALTERNATIVE

ITEM NO.	DESCRIPTION	Quantity	Unit	Unit Cost	Total Amount Bid
	CLEARING AND GRUBBING (0.87 AC)	1	LS	$2,600.00	$2,600.00
	PAVEMENT REMOVAL	6668	SY	$8.00	$53,344.00
	EARTHWORK	3150	CY	$20.00	$63,000.00
	8" AGGREGATE BASE	2574	TN	$25.00	$64,350.00
	15" ASPHALT PAVEMENT	4615	TN	$65.00	$299,975.00
	CURB AND GUTTER	2069	LF	$22.00	$45,518.00
	12" STORM SEWER	200	LF	$70.00	$14,000.00
	LIGHTING	1	LS	$12,000.00	$12,000.00
	SIGNING/PAVEMENT MARKING	1	LS	$60,000.00	$60,000.00
	RESTORATION (SEED AND MULCH)	2330	SY	$0.50	$1,165.00
	MAINTENANCE OF TRAFFIC	1	LS	$25,000.00	$25,000.00
	MISC ITEMS (10%)	1	LS	$64,095.20	$64,095.20
	SUBTOTAL				$705,047.20
	CONTINGENCY (20%) ±				$141,009.44
	CONSTRUCTION TOTAL				$846,056.64
	ENGINEERING FEES (20%)				$169,211.33
	TOTAL				$1,015,267.97

NOTE: Driveway work, ROW acquisition costs, landscaping and utility costs are not included in the estimate.

OLDHAM COUNTY INTERSECTION IMPROVEMENT STUDY
KY 22 AND CLORE LANE / WOOLDRIDGE AVENUE

SIGNALIZED ALTERNATIVE

DLZ
ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

ITEM NO.	DESCRIPTION	Quantity	Unit	Unit Cost	Total Amount Bid
	CLEARING AND GRUBBING (0.81 AC)	1	LS	$2,400.00	$2,400.00
	PAVEMENT REMOVAL	4034	SY	$8.00	$32,272.00
	EARTHWORK	3775	CY	$20.00	$75,500.00
	8" AGGREGATE BASE	2604	TN	$25.00	$65,100.00
	15" ASPHALT PAVEMENT	4670	TN	$65.00	$303,550.00
	TRAFFIC SIGNAL	1	LS	$60,000.00	$60,000.00
	LIGHTING	1	LS	$18,000.00	$18,000.00
	SIGNING/PAVEMENT MARKING	1	LS	$30,000.00	$30,000.00
	RESTORATION (SEED AND MULCH)	2590	SY	$0.50	$1,295.00
	MAINTENANCE OF TRAFFIC	1	LS	$50,000.00	$50,000.00
	MISC ITEMS (10%)	1	LS	$63,811.70	$63,811.70
				SUBTOTAL	$701,928.70
	CONTINGENCY (20%) ±				$140,385.74
				CONSTRUCTION TOTAL	$842,314.44
	ENGINEERING FEES (20%)				$168,462.89
				TOTAL	$1,010,777.33

NOTE: Driveway work, ROW acquisition costs, landscaping and utility costs are not included in the estimate.

OLDHAM COUNTY INTERSECTION IMPROVEMENT STUDY
KY 22 AND CLORE LANE / WOOLDRIDGE AVENUE

DLZ
ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

ROUNDABOUT ALTERNATIVE

ITEM NO.	DESCRIPTION	Quantity	Unit	Unit Cost	Total Amount Bid
	CLEARING AND GRUBBING (0.92 AC)	1	LS	$2,750.00	$2,750.00
	PAVEMENT REMOVAL	2187	SY	$8.00	$17,496.00
	EARTHWORK	3185	CY	$20.00	$63,700.00
	8" AGGREGATE BASE	1964	TN	$25.00	$49,100.00
	15" ASPHALT PAVEMENT	3519	TN	$65.00	$228,735.00
	CURB AND GUTTER	1630	LF	$22.00	$35,860.00
	12" STORM SEWER	100	LF	$70.00	$7,000.00
	LIGHTING	1	LS	$18,000.00	$18,000.00
	SIGNING/PAVEMENT MARKING	1	LS	$50,000.00	$50,000.00
	RESTORATION (SEED AND MULCH)	1365	SY	$0.50	$682.50
	MAINTENANCE OF TRAFFIC	1	LS	$50,000.00	$50,000.00
	MISC ITEMS (10%)	1	LS	$52,332.35	$52,332.35
	SUBTOTAL				$575,655.85
	CONTINGENCY (20%) ±				$115,131.17
	CONSTRUCTION TOTAL				$690,787.02
	ENGINEERING FEES (20%)				$138,157.40
	TOTAL				$828,944.42

NOTE: Driveway work, ROW acquisition costs, landscaping and utility costs are not included in the estimate.

OLDHAM COUNTY INTERSECTION IMPROVEMENT STUDY
KY 22 AND KY 329 BYPASS

SIGNALIZED ALTERNATIVE

DLZ
ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

ITEM NO.	DESCRIPTION	Quantity	Unit	Unit Cost	Total Amount Bid
	CLEARING AND GRUBBING (0.97 AC)	1	LS	$2,900.00	$2,900.00
	PAVEMENT REMOVAL	4225	SY	$8.00	$33,800.00
	8" AGGREGATE BASE	2975	TN	$25.00	$74,375.00
	15" ASPHALT PAVEMENT	5334	TN	$65.00	$346,710.00
	TRAFFIC SIGNAL	1	LS	$90,000.00	$90,000.00
	LIGHTING	1	LS	$12,000.00	$12,000.00
	SIGNING/PAVEMENT MARKING	1	LS	$40,000.00	$40,000.00
	RESTORATION (SEED AND MULCH)	2437	SY	$0.50	$1,218.50
	MAINTENANCE OF TRAFFIC	1	LS	$40,000.00	$40,000.00
	MISC ITEMS (10%)	1	LS	$64,100.35	$64,100.35
	SUBTOTAL				$705,103.85
	CONTINGENCY (20%) ±				$141,020.77
	CONSTRUCTION TOTAL				$846,124.62
	ENGINEERING FEES (20%)				$169,224.92
	TOTAL				$1,015,349.54

NOTE: Driveway work, ROW acquisition costs, landscaping and utility costs are not included in the estimate.

OLDHAM COUNTY INTERSECTION IMPROVEMENT STUDY
KY 22 AND KY 329 BYPASS

ROUNDABOUT ALTERNATIVE

ITEM NO.	DESCRIPTION	Quantity	Unit	Unit Cost	Total Amount Bid
	CLEARING AND GRUBBING (1.0 AC)	1	LS	$3,000.00	$3,000.00
	PAVEMENT REMOVAL	4225	SY	$8.00	$33,800.00
	8" AGGREGATE BASE	2635	TN	$25.00	$65,875.00
	15" ASPHALT PAVEMENT	4730	TN	$65.00	$307,450.00
	CURB AND GUTTER	1930	LF	$35.00	$67,550.00
	12" STORM SEWER	200	LF	$70.00	$14,000.00
	LIGHTING	1	LS	$12,000.00	$12,000.00
	SIGNING/PAVEMENT MARKING	1	LS	$60,000.00	$60,000.00
	RESTORATION (SEED AND MULCH)	2330	SY	$0.50	$1,165.00
	MAINTENANCE OF TRAFFIC	1	LS	$40,000.00	$40,000.00
	MISC ITEMS (10%)	1	LS	$60,484.00	$60,484.00
	SUBTOTAL				$665,324.00
	CONTINGENCY (20%) ±				$133,064.80
	CONSTRUCTION TOTAL				$798,388.80
	ENGINEERING FEES (20%)				$159,677.76
	TOTAL				$958,066.56

NOTE: Driveway work, ROW acquisition costs, landscaping and utility costs are not included in the estimate.

OLDHAM COUNTY INTERSECTION IMPROVEMENT STUDY
OLDHAM COUNTY FISCAL COURT
Oldham County, Kentucky

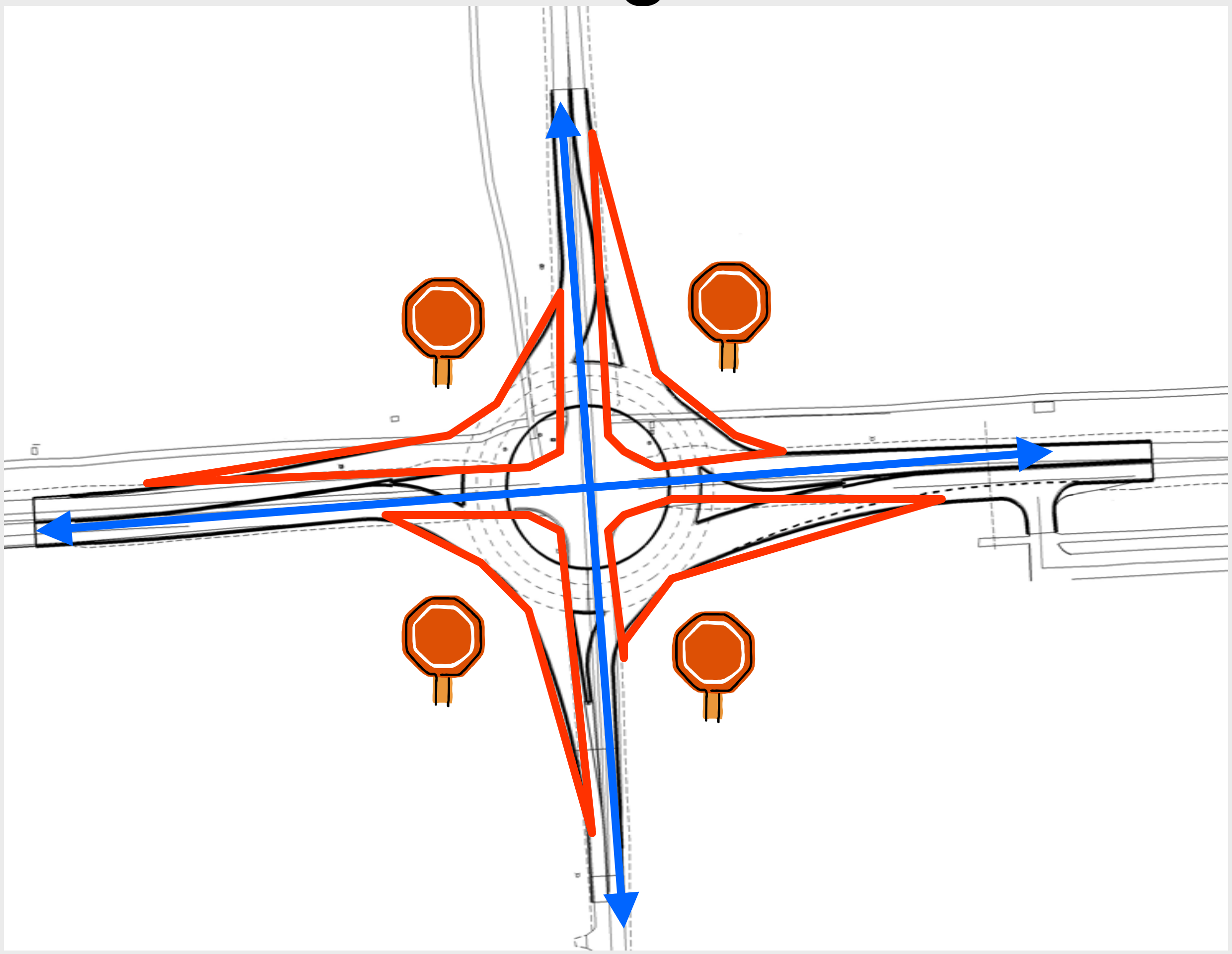
APPENDIX F

Maintenance of Traffic

- Stage 1:
  - Construction of outside portion of roundabout in all quadrants.
  - Use of stop control or temporary signals is necessary
- Stage 2:
  - Construction of the remaining roundabout including central island and approach tapers
  - Traffic uses circulating road
  - Use stop control or temporary signals
- Stage 3:
  - Complete remaining portions of circulating roadway

- Other Options include part width construction (For 2 lane roundabouts)
- If roundabout is not centered on intersection and/or if intersection is skewed, more complicated.

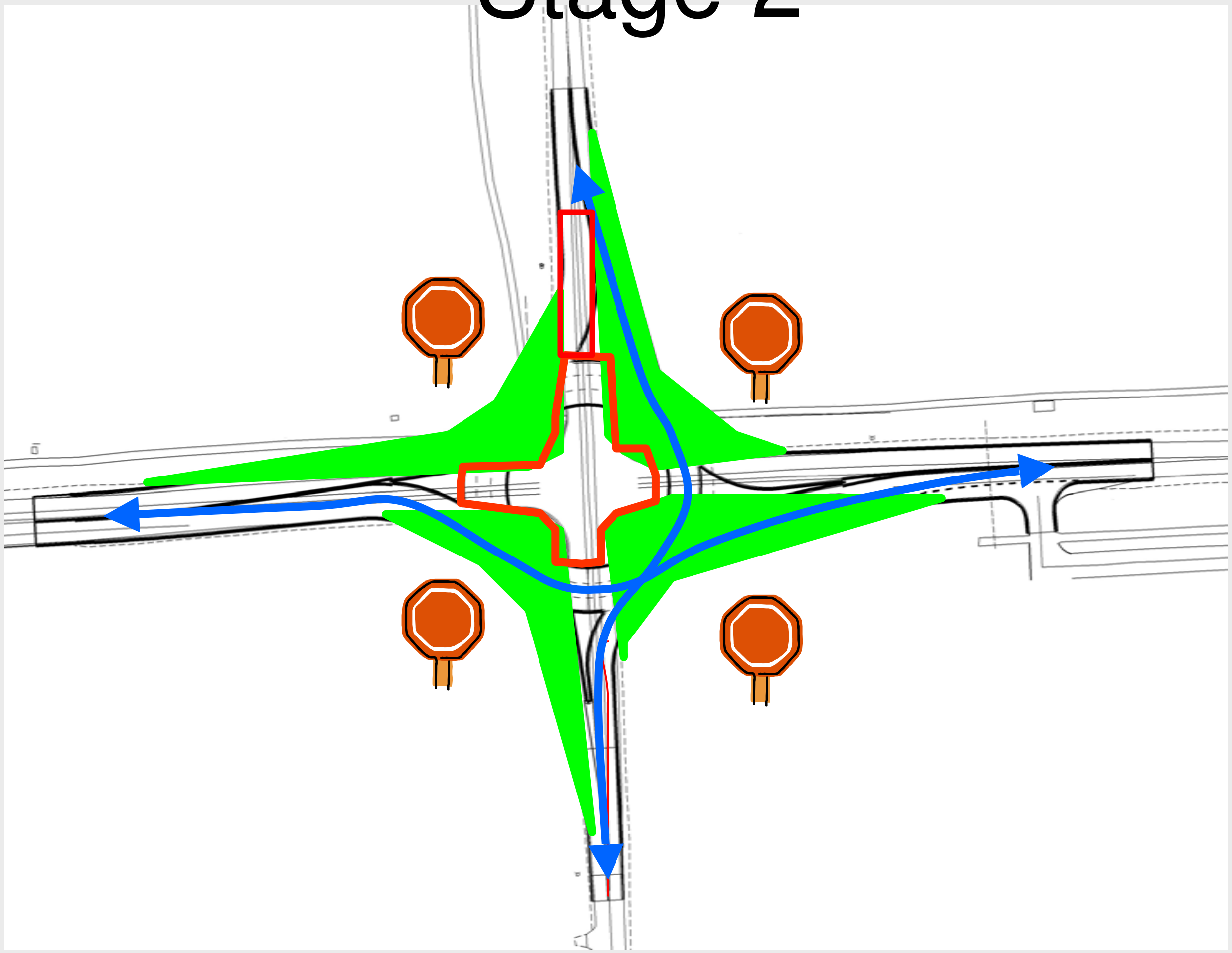
Stage 1



- Construct in 4 corners outside traveled portion of roadway

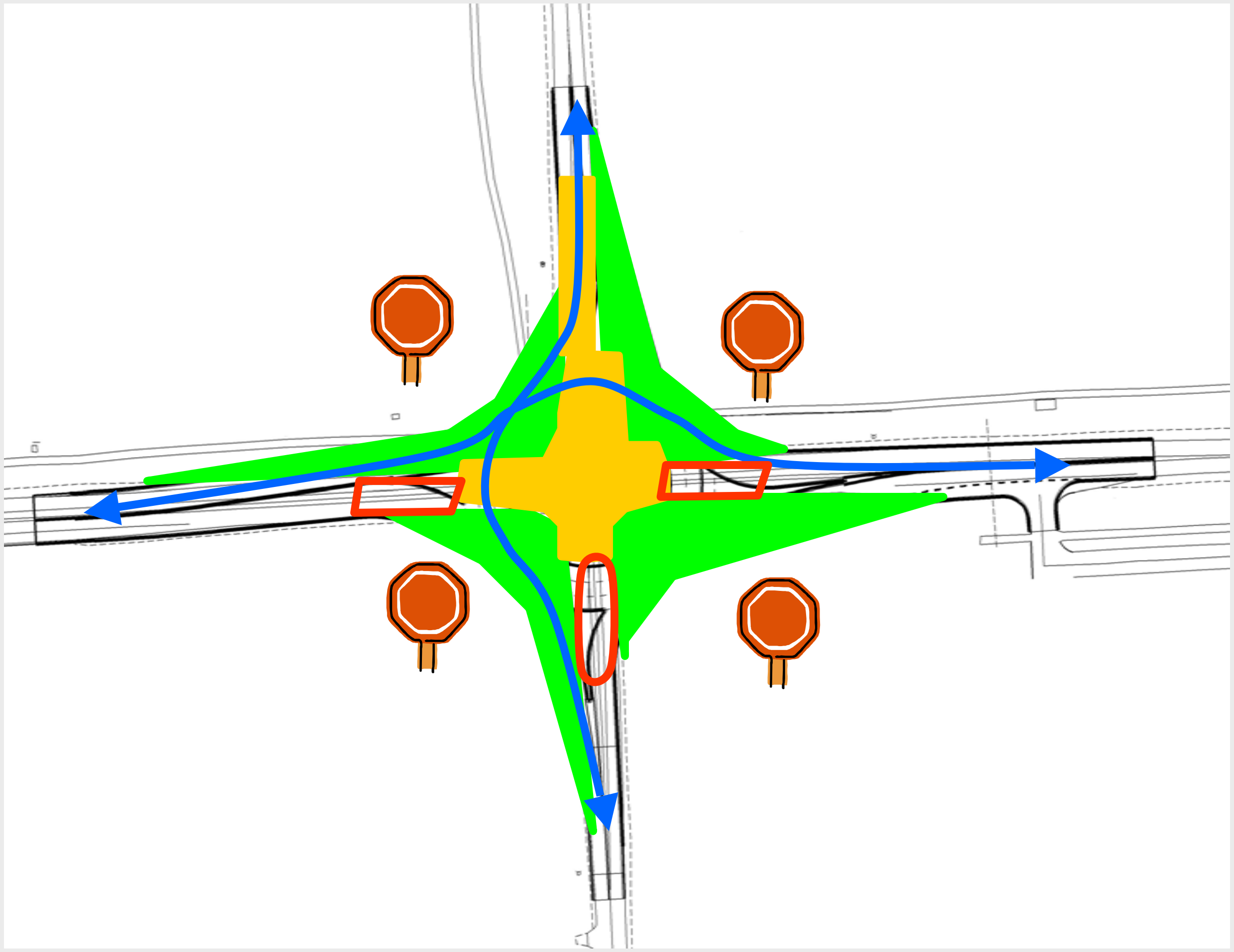
DLZ

Stage 2



- Construct central island

Stage 3



- Construct remaining portions of circulating roadway

DLZ