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Baker Road Intersection Improvement Study

Washtenaw County Road Commission
City of Dexter

Dexter, Michigan

June 29, 2016

INTRODUCTION

The Washtenaw County Road Commission (WCRC), in conjunction with the City of Dexter, is in the preliminary phase of planning improvements to address safety and congestion concerns at the intersections of Baker Road at Dan Hoey Road and Baker Road at Shield Road / Dongara Drive. Baker and Dan Hoey Roads are truck routes and are vital to the Dexter community.

Shield Road is under the jurisdiction of WCRC. WCRC is planning to reconstruct the Shield Road bridge over the Mill Creek in 2017. The new bridge will not have any weight limits. This may result in Shield Road seeing a small increase in traffic, as it is an important link between Baker and Parker Roads. In addition, Shield Road provides access to Dexter High School.

Dan Hoey Road is also an important link between Baker Road and Dexter-Ann Arbor Road. Dan Hoey Road is under the jurisdiction of the City of Dexter. It provides access to the Dexter Community Schools campus including Cornerstone Elementary School, Mill Creek Middle School, and a bus drop off loop serving multiple adjacent school buildings. Dan Hoey Road also provides access to the Dexter Business and Research Park which is home to over 1 million square feet of manufacturing/commercial space.

Baker Road south of the study section and up to the Dan Hoey Road intersection is under the jurisdiction of WCRC. Baker Road north of Dan Hoey Road is under the jurisdiction of the City of Dexter. Baker Road provides access to Creekside Intermediate School just north of the Dan Hoey Road intersection. Baker Road is a major north south roadway in this portion of Washtenaw County, as it provides access to I-94.

The study location and roadway jurisdictional authority bring together a diverse team of project stakeholders. The stakeholder team provided valuable information on existing conditions, as well as parameters for any reasonable alternatives. The stakeholder group included representatives form the following entities:

- Washtenaw County Road Commission
- City of Dexter
- Scio Township
- Dexter Community Schools
- Washtenaw Area Transportation Study
- Community residents

The study generates alternative improvements for these intersections, and provides a contextual evaluation of the pro/con for each. The study evaluation factors were selected based on feedback from project stakeholders as well as public feedback obtained though the study's public involvement process. The evaluation factors utilized in the study are:

- Traffic and pedestrian safety
- Traffic capacity and operations
- Non-motorized access
- Construction and maintenance costs
- Right-of-way and environmental impacts
- Opportunity for place making and aesthetic enhancements

SAFETY ANALYSIS

Traffic crash data was obtained from the Traffic Improvement Association (TIA) for the study area. The data encompassed all crashes occurring within the study area during the three full years of 2012 – 2014 as well as the first half of 2015. The crash data was analyzed to identify deficiencies in the operational and geometric features of the intersections. There were no fatal crashes or Type A injuries during the study period. There were also no crashes involving pedestrians or bicyclists.

TABLE 1: 2012-2015 Crash Data

Intersection	Crash Type							
							Injuries	
	Side Swipe Sm	Head On	Angle	Rear End	Single Vehicle	TOTAL	B-Level (Minor)	C-Level (Possible)
Baker and Dan Hoey	3	0	3	6	3	**15**	1	1
Baker and Shield	1	1	3	2	1	**8**	0	2
TOTAL	**4**	**1**	**6**	**8**	**4**	**23**	**1**	**3**
% TOTAL	**17.4%**	**4.3%**	**26.0%**	**34.7%**	**17.4%**	**100%**	**4.3%**	**13.0%**

The intersections within the study area experienced typical crash rates. At the intersection of Baker Road and Dan Hoey Road, crashes occurred at a rate of 0.73 crashes per million entering vehicles. At the intersection of Baker Road and Shield Road crashes occurred at a rate of 0.37 crashes per million entering vehicles.

A majority of the crashes at Dan Hoey Road intersection occurred on wet or icy pavement conditions. Improvements to this intersection should include an evaluation of the roadway drainage to reduce the potential for ponding or ice accumulation. The Type B injury occurred in a rear end crash between southbound vehicles on wet pavement.

At the Shield Road intersection, the angle crashes occurred during peak periods and involved a driver on Shield Road pulling out in front of a driver on Baker Road. Changing the intersection control and reducing the minor street delays are likely to help with this crash pattern.

TRAFFIC INFORMATION

Traffic data was provided by the WCRC for use on this study. Traffic data was collected in May of 2015. The average daily traffic (ADT) of Baker Road was 13,985 vehicles. The ADT of Dan Hoey Road was 5,759. The ADT of Shield road was 3,141. The morning peak occurs between 7:15am and 8:15am, and the afternoon peak occurs between 4:30 pm and 5:30 pm. Existing traffic volume data can be found in Appendix A.

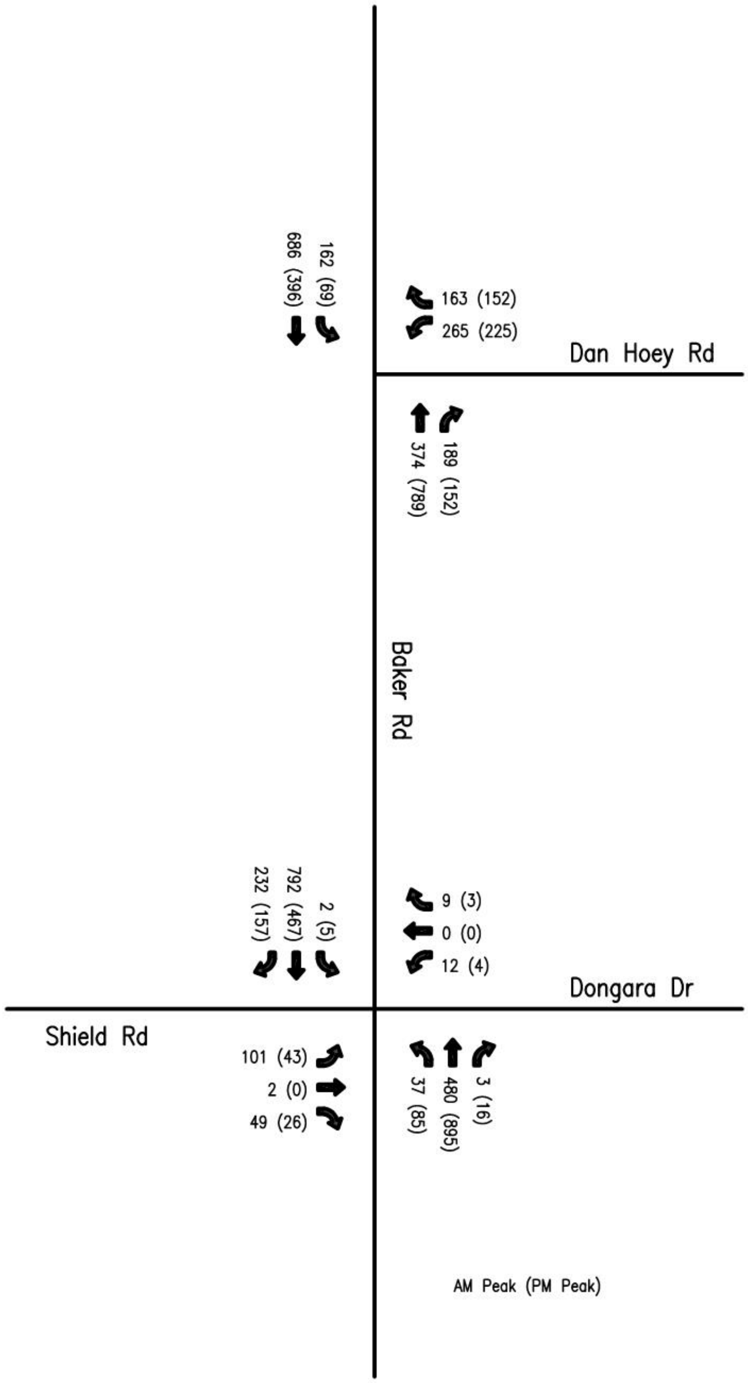

Figure 1 – Existing Traffic Volumes

In order to analyze the impacts of future roadway improvements, traffic data was projected to the horizon years of the study. This study will identify the impacts of improvements based on 2025 and 2035 traffic data. Traffic projections were based on WATS projections, which consider local and regional factors such as population, household, and employment. In order to account for the general impacts of traffic growth, a modest growth factor of 0.1% per year compounded to the projected year of 2025 was used.

In addition to the background growth, traffic generated by individual developments near the study area is anticipated. These include residential developments both north and south of the study area, along Baker Road. Just north of the study area, a 70-unit multifamily development has been proposed. Additional property adjacent to this development has also been identified for a future multifamily development. The scale of this future development is likely to be similar to the currently proposed project. South of the study area, a single family residential development is in the early stages of planning. This development may include as many as 400 homes. The traffic generated by these three potential developments was determined using procedures outlined in the Institute of Transportation Engineers (ITE) publication, Trip Generation Handbook. The data set used is the ITE Trip Generation Manual – 9th Edition.

TABLE 2: Summary of Development Generated Traffic

Development	ITE Land Use	Units	Weekday			AM Peak			PM Peak		
			Total	In	Out	Total	In	Out	Total	In	Out
A	230 - Residential Condominium / Townhouse	70	472	236	236	39	7	32	45	30	15
B	230 - Residential Condominium / Townhouse	70	472	236	236	39	7	32	45	30	15
C	210 - Single-Family Detached Housing	400	3760	1880	1880	290	73	217	366	231	135

The development-generated trips were distributed throughout the study area. For developments north of the study area it was assumed that 50% of generated trips would travel through the study area. For developments south of the study area is was assumed that 25% of the generated trips would travel through the study area. These trips were further routed through the study intersections utilizing existing traffic patterns.

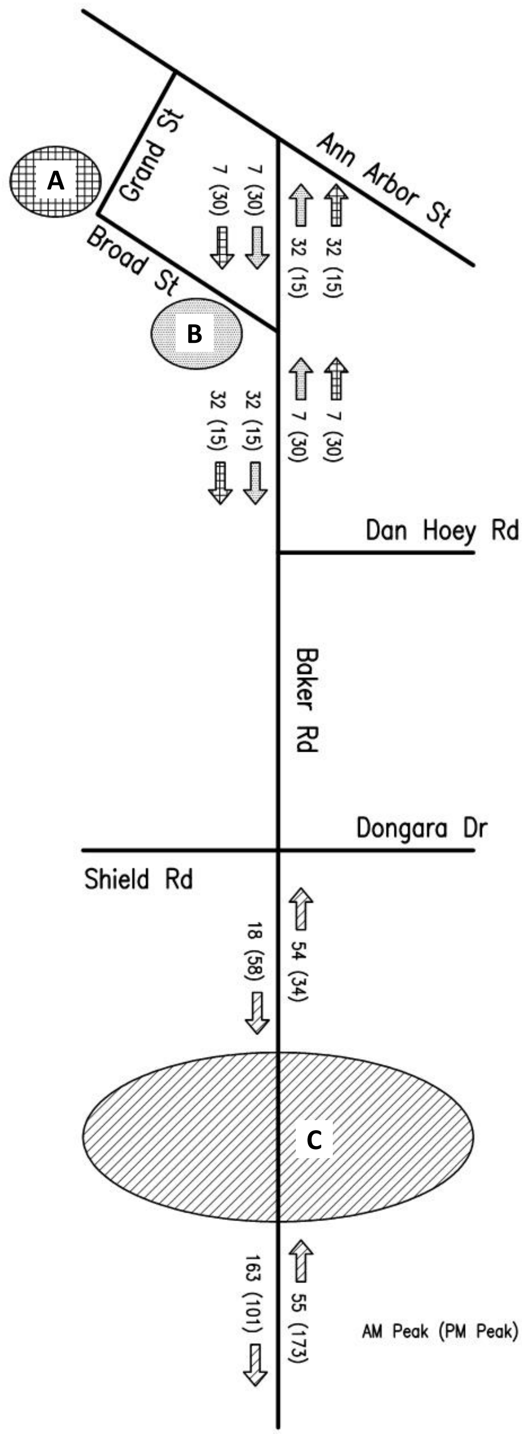

Figure 2 – Development Generated Volumes

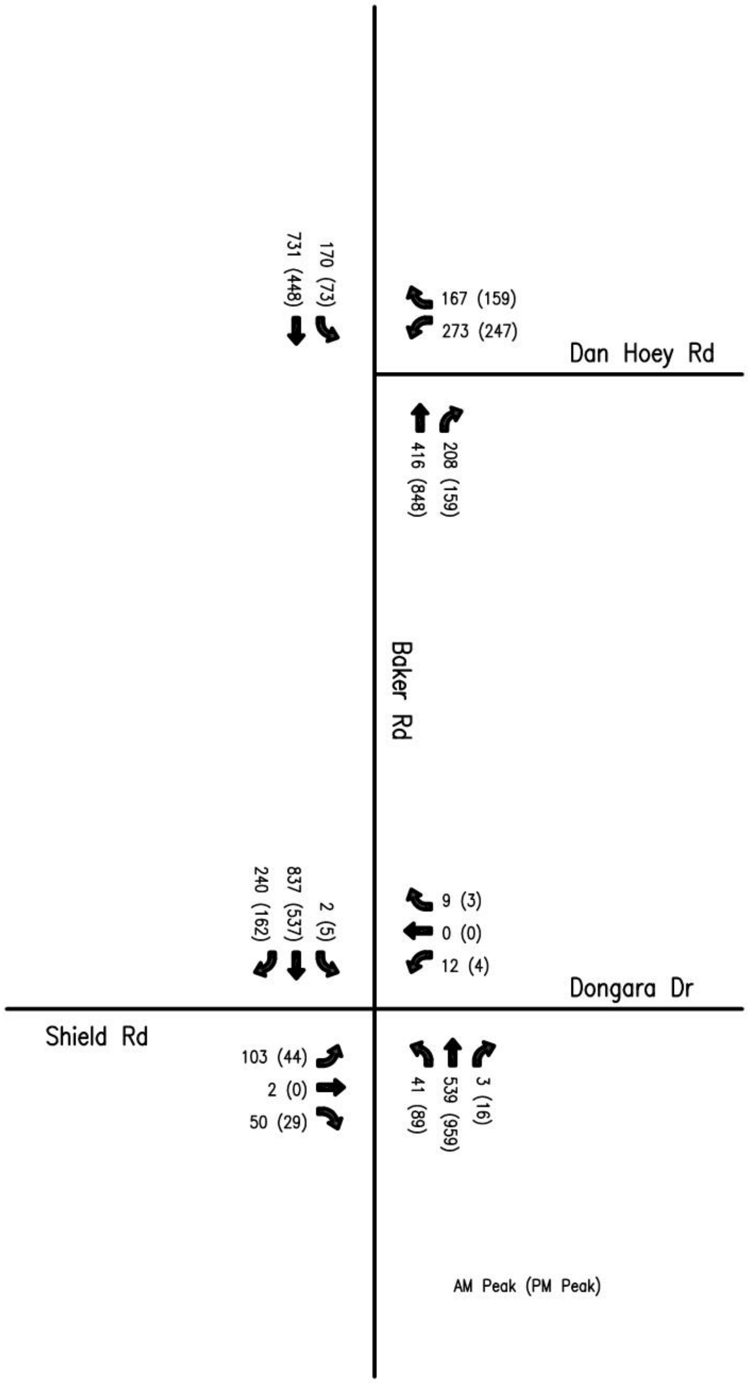

Figure 3 – 2025 Traffic Volumes

To project the traffic growth further into the future, a growth factor of 0.13% per year compounded between the year 2025 and 2035 was used.

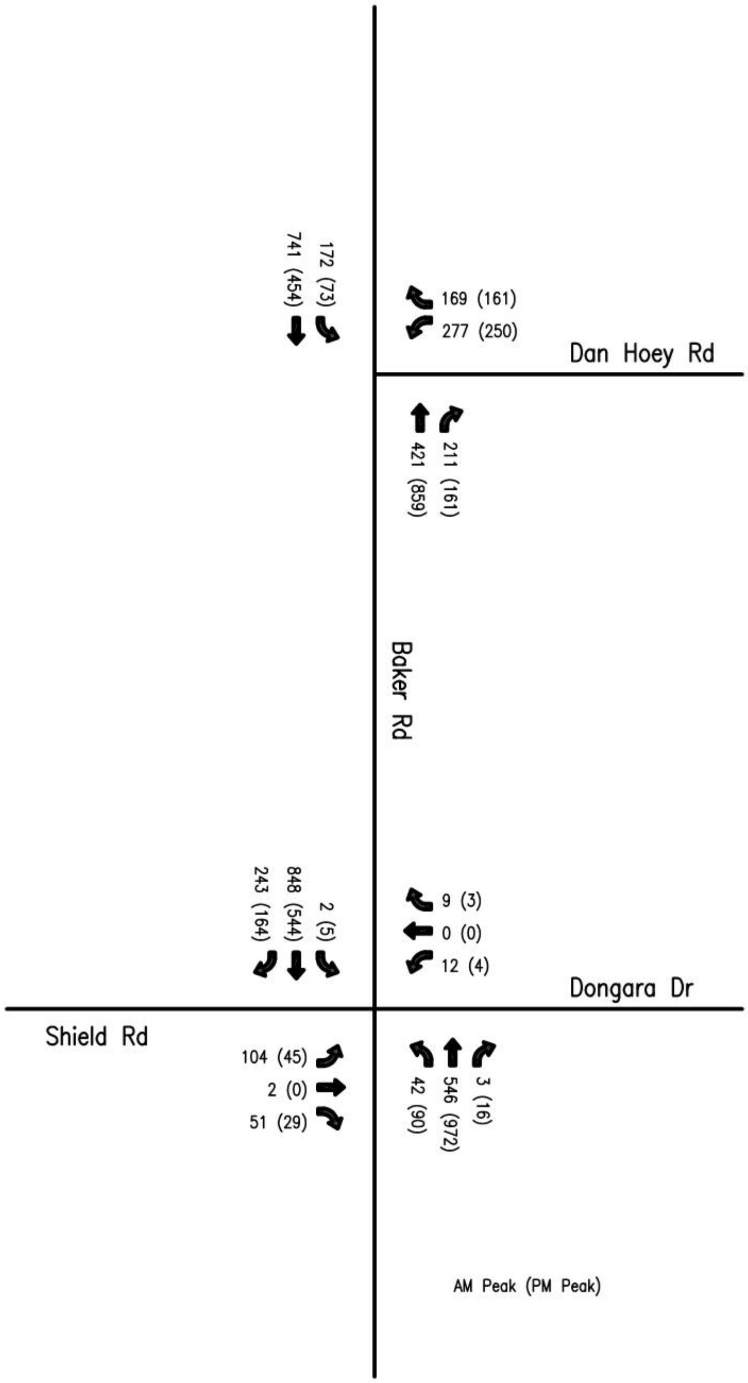

Figure 4 – 2035 Traffic Volumes

As discussed more fully in the next section, the alternatives evaluated in this study include two roadway configurations. In addition to the offset tee intersections that are the current configuration, we also evaluated alternatives that realigned the Shield Road approach to Baker Road to become the eastbound leg of the intersection at Dan Hoey. Traffic volumes were restated through the study area for the analysis of the realignment of Shield Rd.

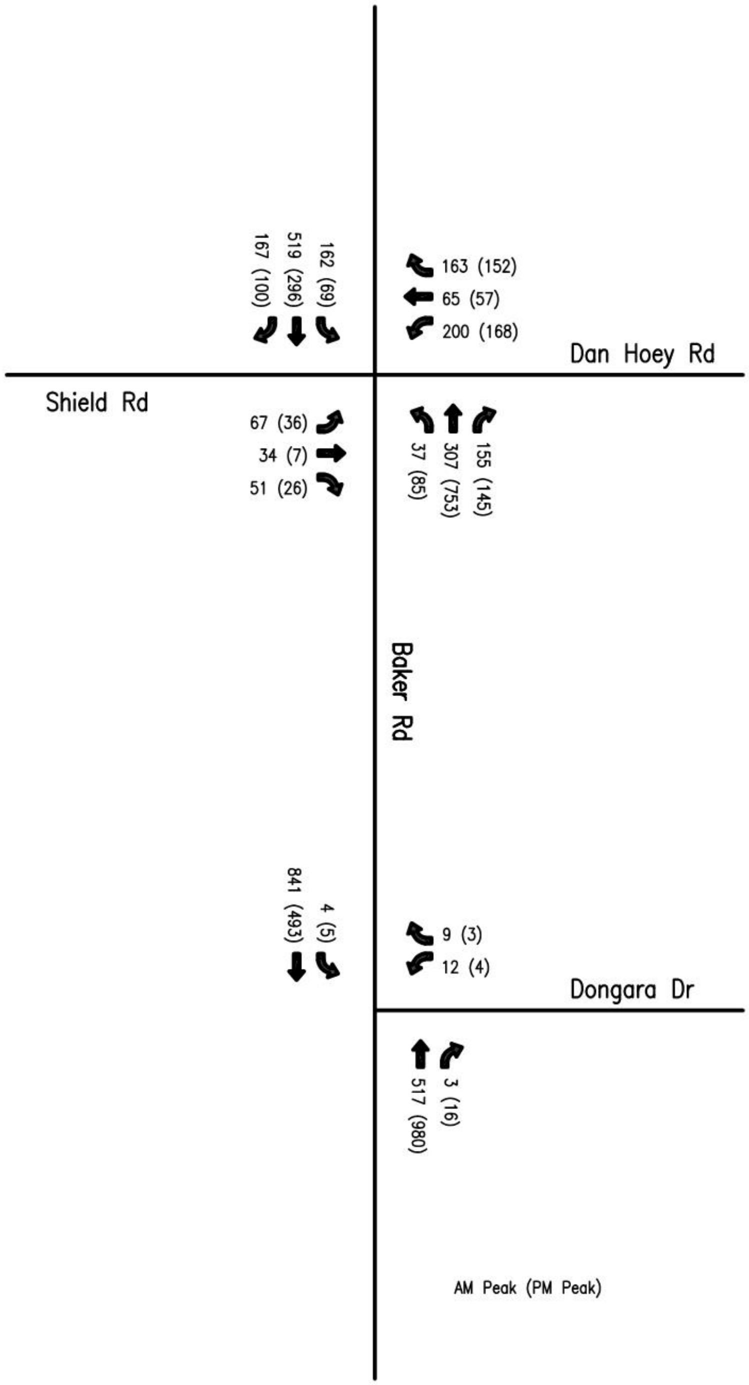

Figure 5 – 2015 Realignment Traffic Volumes

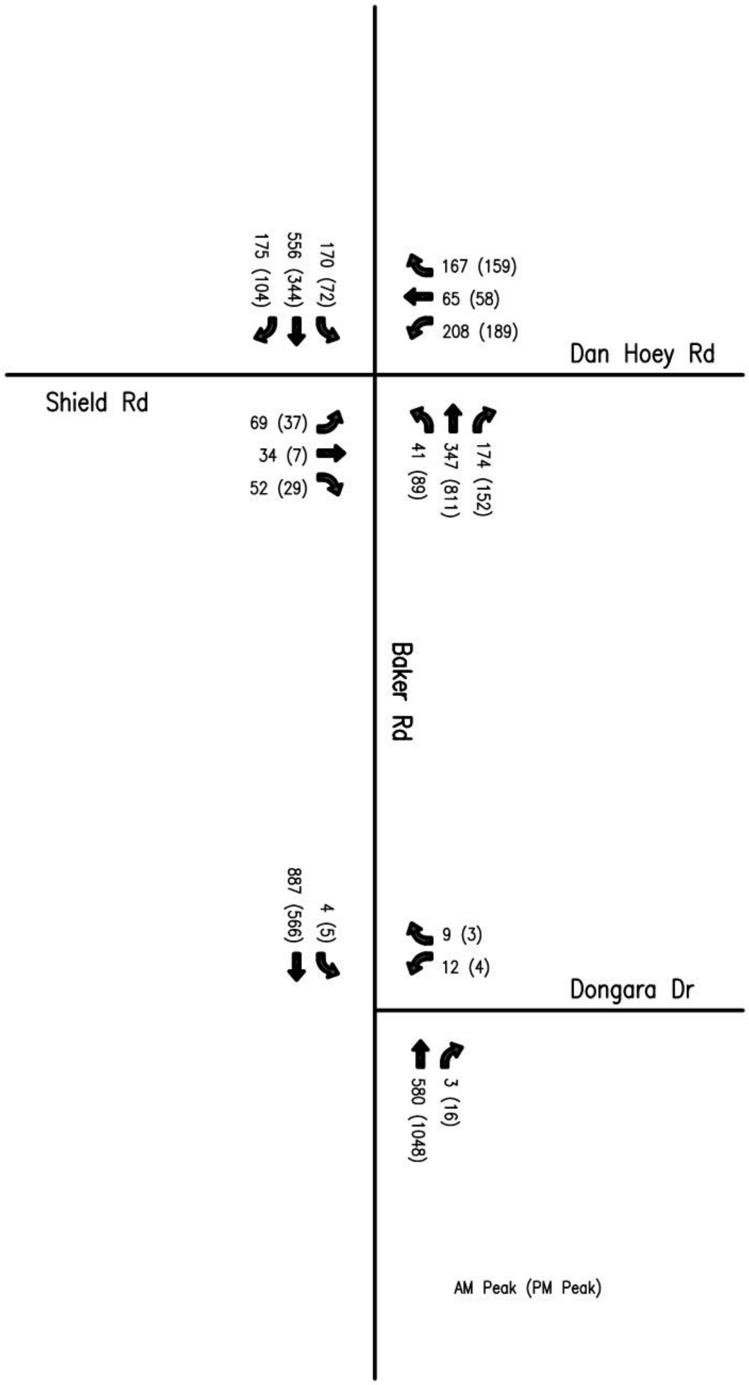

Figure 6 – 2025 Realignment Traffic Volumes

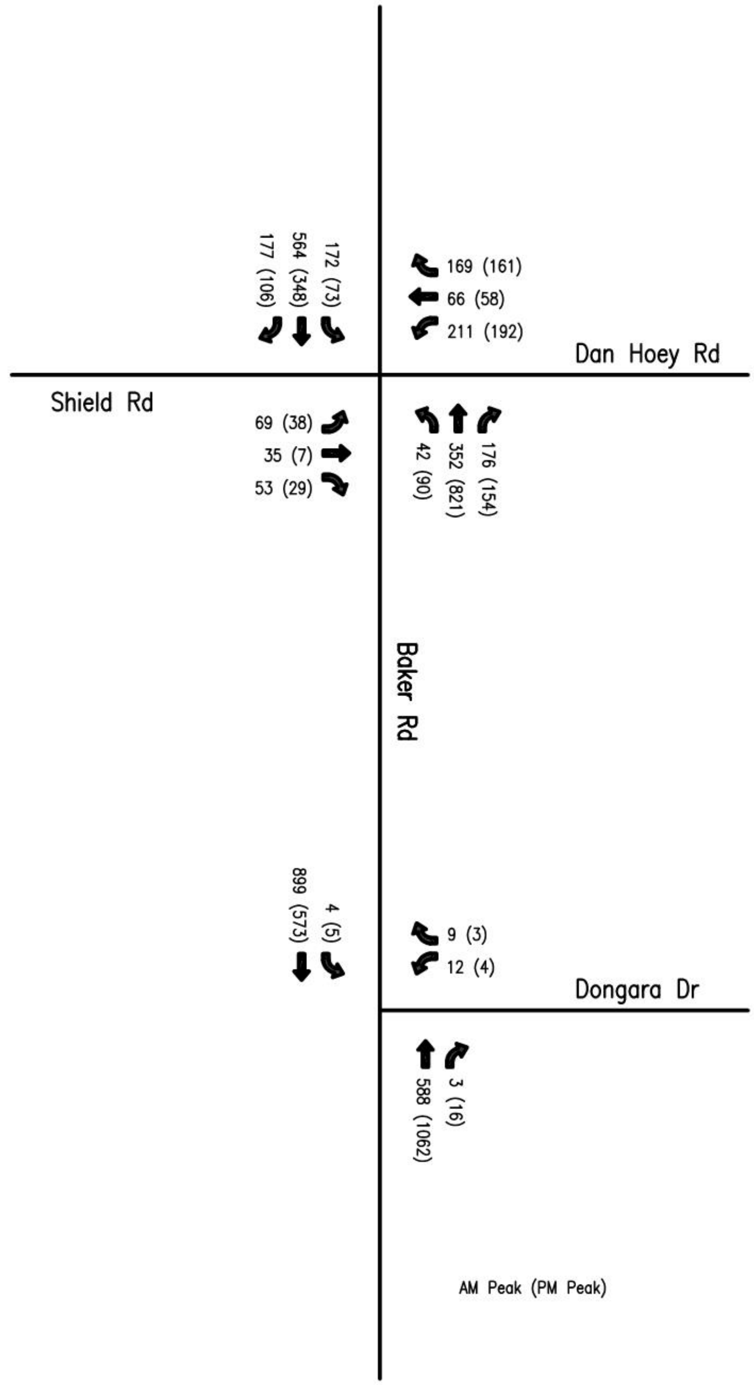

Figure 7 – 2035 Realignment Traffic Volumes

EXISTING CORRIDOR SECTIONS

South of the study area, Baker Road is a two-lane roadway with a 50 mph speed limit. Traveling north towards the study area, the speed limit drops to 40 mph and then 30 mph as Baker Road approaches the intersection at Shield Road. Between the two study intersections the two-lane section is widened to develop a northbound auxiliary right turn lane at the intersection with Dan Hoey Road. North of the study area, Baker Road is a three lane roadway with a 30 mph speed limit. The study area is a transitional zone between the more rural development to the south and the urban development patterns to the north.

PRELIMINARY ALTERNATIVES

Preliminary alternatives were identified at the stakeholder kick off meeting. These alternatives represent a variety of intersection controls. Alternatives also include options maintaining the existing alignment as well as options that relocate Shield Road to align with Dan Hoey.

- No build
- No changes to intersection controls, just geometric changes to improve operations
- Maintain Dan Hoey Road as signal, add signal to Shield/Dongara
- Maintain Dan Hoey Road as signal, modify Shield/Dongara to a one-lane roundabout or compact urban roundabout
- Maintain Shield/Dongara as STOP control, modify Dan Hoey Road to a one-lane roundabout or compact urban roundabout
- Add signal to Shield/Dongara, modify Dan Hoey Road to a one-lane roundabout or compact urban roundabout
- Modify both Dan Hoey Road and Shield Road to one-lane roundabouts or compact urban roundabouts
- Relocate Shield Road to align with Dan Hoey Road, operate under signal control
- Relocate Shield Road to align with Dan Hoey Road, modify to a one-lane roundabout or compact urban roundabout

The preliminary alternatives were narrowed to a short list for further study using a two-step process. The stakeholders individually ranked and rated the evaluation factors. This exercise allowed for priorities to be established without considering particular alternatives. Public involvement was used to further determine priorities. A public meeting held on October 14, 2015 served as a forum for displaying various alternatives as well as gathering information on the existing conditions and priorities for any future improvements. A variety of exhibits were created to represent components of various preliminary alternatives. These exhibits and a summary of the feedback received at this meeting have been included in Appendix B. Comments received from the public were reviewed to identify comments that aligned with the evaluation factors. Stakeholder and public input were used to determine the priority rankings for the study evaluation factors.

Table 2: Evaluation Factor Rankings

Evaluation Factor	Stakeholder Ranking	Public Ranking
Traffic and pedestrian safety	1	2
Traffic capacity and operations	2	1
Non-motorized access	3	4
Construction and maintenance costs	4	3
Right-of-way and environmental impacts	5	5
Opportunity for place making and aesthetic enhancements	6	6

The ranking exercises indicate a high priority should be assigned to traffic capacity and operations. This was especially important to the public meeting attendees. The close spacing of these intersections has the potential to negatively impact the capacity for thru traffic on Baker. The potential impacts on Baker Road are best minimized by using consistent intersection treatments at both of the intersections. For this reason, the following alternatives were removed from further consideration:

- No changes to intersection controls, just geometric changes to improve operations
- Maintain Dan Hoey Road as signal, modify Shield/Dongara to a one-lane roundabout or compact urban roundabout
- Maintain Shield/Dongara as STOP control, modify Dan Hoey Road to a one-lane roundabout or compact urban roundabout
- Add signal to Shield/Dongara, modify Dan Hoey Road to a one-lane roundabout or compact urban roundabout

In addition to capacity and operations, a high priority was assigned to traffic and pedestrian safety. This was the top stakeholder priority. The preliminary alternatives included two realignment options. The difference between these alternatives was the intersection treatment at the intersection with Dan Hoey Road. Constructing a roundabout at this intersection will minimize serious accidents and provide for continuous traffic flow at this busy location. For this reason, the following alternative was removed from further consideration:

- Relocate Shield Road to align with Dan Hoey Road, operate under signal control

Of the remaining alternatives, two include roundabout intersections. Two types of roundabouts were considered for these intersections. A roundabout has a diameter of 100’, wide curbed splitter islands on the approaches and a landscaped central island. A compact urban roundabout has a diameter of 70’, narrow curbed splitter islands and a traversable paved central island. Safety features of the larger roundabout include more vehicular path deflection to better reduce speeds and a pedestrian refuge area in the splitter islands. The compact urban roundabout provides these benefits to a lesser degree and minimizes costs and right-of-way impacts by reducing the foot print. With a higher priority given to traffic and pedestrian safety the roundabout alternatives will move forward using the larger roundabout footprint.

Detailed intersection analysis will further evaluate the following alternatives:

- No build
- Maintain Dan Hoey Road as signal, add signal to Shield/Dongara
- Modify both Dan Hoey Road and Shield Road to one-lane roundabouts
- Relocate Shield Road to align with Dan Hoey Road, modify to a one-lane roundabout

INTERSECTION ANALYSIS

The intersections within the study area were analyzed according to the methodologies published in the Highway Capacity Manual, 2010 edition. For this project, Synchro Version 8 software was used to conduct the analysis for traditional signalized intersections. Roundabout intersections were analyzed using RODEL™ software. Software printouts for the evaluations of intersections have been included in Appendix C for Synchro and Appendix D for RODEL. These software packages compute delay values based on factors such as number and type of lanes, intersection controls such as STOP signs or traffic signals, traffic volumes, pedestrian volumes, signal timing characteristics, roadway grade, speed limit, etc. This analysis determines the average delay experienced by vehicles. This value is an average across the entire peak hour, vehicles arriving during the busiest portion of the peak hour or arriving in a clustered group of vehicles instead of in a random pattern could experience longer delays. On the other hand, vehicles arriving during a lighter portion of the peak hour could experience a shorter delay. The average delay is used to determine the corresponding level of service (LOS) values for each intersection movement as well as the intersection as a whole.

The LOS of an intersection is based on factors such as number and types of lanes, intersection controls such as STOP signs or traffic signals, traffic volumes, pedestrian volumes, etc. LOS is expressed as a letter grade, in a range from A through F. In this context, 'A' represents the best conditions, with very little or no average delay to vehicles. LOS 'F' is the worst of conditions, equated with very large average delays and few gaps of acceptable length. The following tables identify level of service criteria for signalized and un-signalized intersections.

Table 3: Level of Service Criteria For Signalized Intersections

Level of Service	Average Delay/Vehicle (seconds)	Description
A	Less than or equal to 10	Most vehicles do not stop at all. Most arrive during the green phase. Little or no delay.
B	> 10 to 20	More vehicles stop than for LOS A. Still good progression through lights. Short traffic delays.
C	> 20 to 35	Significant numbers of vehicles stop, although many pass through without stopping.
D	> 35 to 55	Many vehicles stop. Individual signal cycle failures are noticeable. Progression is intermittent.
E	> 55 to 80	Considered to be the limit of acceptable delay. Individual cycle failures are frequent and progression is poor.
F	>80	Extreme and unacceptable traffic delays.

SOURCE: Transportation Research Board, Highway Capacity Manual 2010.

Table 4: Level of Service Criteria For Unsignalized Intersections (Including Roundabouts)

Level of Service	Average Delay/Vehicle (seconds)	Description
A	0 to 10	Little or no delay, very low main street traffic
B	> 10 to 15	Short traffic delays, many acceptable gaps
C	> 15 to 25	Average traffic delays, frequent gaps still occur
D	> 25 to 35	Longer traffic delays, limited number of acceptable gaps
E	> 35 to 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 2010.

An intersection LOS 'D' is considered by many traffic safety professionals to be the minimum acceptable condition in an urban/suburban area. For rural areas, most highway agencies consider LOS 'C' the minimum. Given the location of the study intersections, on the border of an urban area, LOS 'D' was utilized as the study goal.

Baker Road at Dan Hoey Road

This intersection, located at the city limits, forms a tee with Dan Hoey Road on the east side of Baker Road. Baker Road is a posted 30 mph speed limit. South of the intersection Baker Road has a two-lane cross section with an auxiliary right turn lane at the intersection. North of the intersection, Baker Road has a three lane cross section. Dan Hoey Road is a two-lane road posted at 35 mph. An east bound auxiliary right turn lane is provided at the intersection. The intersection is under signal control. A cemetery is located in the northeast quadrant of the intersection. The remaining adjacent properties are residential, some of which are owned by the school district. Table 5 shows the intersection LOS and corresponding delays for the existing conditions.

Table 5: Existing Conditions Level of Service: Baker Road at Dan Hoey Road

	NB		SB		WB		Overall Intersection	
	Delay (Sec.)	LOS	Delay (Sec.)	LOS	Delay (Sec.)	LOS	Delay (Sec.)	LOS
2015 AM Peak	8.9	A	15.2	B	22.6	C	15.0	B
2015 PM Peak	17.4	B	10.9	B	23.1	C	17.3	B

Under existing conditions, the intersection of Baker Road and Dan Hoey Road operates at a LOS B during peak periods. Two signal poles and a tight curb radius in the southeast quadrant have a negative impact on operations as larger vehicles cross left of center to complete turning movements. This is exemplified by the severe rutting to be seen back of curb in this quadrant.

Three alternatives were evaluated at this intersection and are illustrated in Appendix A. The first alternative maintains signalized control of the intersection. Minor intersection improvements include revising the southeast curb radius to provide better accommodation for large vehicles. This option would add pedestrian facilities, including sidewalks and signalized pedestrian crossings.

The second alternative would reconstruct the intersection to add a roundabout. The roundabout would be designed with an approximate 100' inscribed circle diameter and geometry that will accommodate large vehicles. Pedestrian facilities for this option would include sidewalks and pedestrian crossings with median refuge islands.

The third alternative would also reconstruct the intersection to add a roundabout. As in the second alternative, the roundabout would be designed with an approximate 100' inscribed circle diameter and geometry that will accommodate large vehicles. In order to accommodate the heavy southbound traffic in the AM peak period, two lanes will be provided for entry and circulation in the southbound direction. The inside lane will accommodate southbound left-turning vehicles allowing southbound thru vehicles to use the outside lane. Additionally, heavy northbound traffic during the PM peak hours necessitates a northbound right-turn bypass lane. This alternative realigns Shield Road through the school district property to become the fourth leg of this intersection. Pedestrian facilities for this option would include sidewalks and pedestrian crossings with median refuge islands.

Table 6: Future Conditions Level of Service: AM Peak Hour Baker Road at Dan Hoey Road

		NB		SB		EB		WB		Overall Intersection	
		Delay (Sec.)	LOS	Delay (Sec.)	LOS	Delay (Sec.)	LOS	Delay (Sec.)	LOS	Delay (Sec.)	LOS
2025	No Build	9.3	A	17.3	B	n/a	n/a	23.1	C	16.0	B
	Alternative 1 – Signal	6.3	A	15.4	B	n/a	n/a	30.0	C	15.8	B
	Alternative 2 - Roundabout	7.6	A	26.7	D	n/a	n/a	7.0	A	16.2	C
	Alternative 3 - Realignment	5.2	A	5.8	A	5.7	A	7.4	A	6.0	A
2035	No Build	9.4	A	17.9	B	n/a	n/a	23.3	C	16.3	B
	Alternative 1 – Signal	6.3	A	15.8	B	n/a	n/a	30.3	C	16.0	B
	Alternative 2 - Roundabout	7.7	A	29.4	D	n/a	n/a	7.1	A	17.6	C
	Alternative 3 - Realignment	5.2	A	6.0	A	5.8	A	7.6	A	6.1	A

Table 7: Future Conditions Level of Service: PM Peak Hour Baker Road at Dan Hoey Road

		NB		SB		EB		WB		Overall Intersection	
		Delay (Sec.)	LOS	Delay (Sec.)	LOS	Delay (Sec.)	LOS	Delay (Sec.)	LOS	Delay (Sec.)	LOS
2025	No Build	21.5	C	13.2	B	n/a	n/a	25.1	C	20.3	C
	Alternative 1 – Signal	12.7	B	11.6	B	n/a	n/a	32.1	C	17.5	B
	Alternative 2 - Roundabout	22.2	C	6.6	A	n/a	n/a	14.5	B	16.4	C
	Alternative 3 - Realignment	14.2	B	4.0	A	4.3	A	19.6	C	12.3	B
2035	No Build	22.6	C	13.3	B	n/a	n/a	25.4	C	21.0	C
	Alternative 1 – Signal	13.1	B	11.9	B	n/a	n/a	32.4	C	17.8	B
	Alternative 2 - Roundabout	24.0	C	6.7	A	n/a	n/a	15.3	C	17.5	C
	Alternative 3 - Realignment	15.2	C	4.0	A	4.3	A	21.3	C	13.2	B

With existing geometric and operational conditions, this intersection operates at LOS B in the AM peak hour and LOS C in the PM peak hour for both analysis years. With the various geometric improvements, the LOS of most individual movements and approaches will be improved. Operations at this intersection will also be improved by geometric changes to the southeast quadrant with adjustments to the curb line and signal poles. These changes will improve maneuverability of large vehicles and reduce left of center travel through this intersection.

Alternative 1 optimizes the signal timings to reduce delay for the Baker Road approaches. This will slightly increase the delay for the westbound approach, however, this approach will still operate at a LOS C. Alternative 1 also includes changes to the curb in the southeast quadrant in order to better accommodate larger vehicles. While not reflected in the delay and LOS results, this change will improve operations by minimizing the number of vehicles that need to travel left of center to turn at this intersection.

The roundabout option in Alternative 2 provides reduced overall intersection delay at this intersection. With this option the intersection operates at a LOS C in the PM Peak for both the 2025 and 2035 analysis years. During both analysis years and both peak periods all approaches operate at acceptable LOS values. Delay is reduced in westbound approach direction. In the PM peak hour, the northbound approach experiences increased delay over the no improvement condition, however, the LOS remains unchanged at LOS C. In the AM peak hour, the southbound approach delay is increased and the approach operates at a LOS D during both analysis years.

The roundabout in Alternative 3 adds the eastbound approach leg with the Shield Rd. realignment. The overall intersection operates at LOS A for the AM and PM peak hours in the 2025 condition, and LOS B for the AM and PM peak hours in the 2035 forecast. The additional approach leg modestly increases delay in the southbound and westbound approach directions compared to Alternative 2. However, the overall intersection delay is decreased in all scenarios compared to Alternative 2.

Baker Road at Shield Road

This four approach intersection has Shield road on the west side of Baker Road and Dongara Drive (a private road) on the east side. Baker Road has a two lane cross section and a posted 30 mph speed limit. Shield Road is a two-lane road posted at 45 mph. The intersection is unsignalized with the Shield and Dongara approaches under stop control. Also note that there is a pronounced grade for the Shield approach up to the intersection. The property in the northwest quadrant is owned by the school district. The remaining adjacent properties are residential. Table 8 shows the intersection LOS and corresponding delays for the existing conditions.

Table 8: Existing Conditions Level of Service: Baker Road at Shield Road

	NB LT		SB LT		EB		WB	
	Delay (Sec.)	LOS	Delay (Sec.)	LOS	Delay (Sec.)	LOS	Delay (Sec.)	LOS
2015 AM Peak	9.9	B	8.9	A	**380.9**	**F**	**46.8**	**E**
2015 PM Peak	9.1	A	10.6	B	**209.6**	**F**	**57.8**	**F**

Under existing conditions, the Baker Road approaches to Shield Road are free flow with slight delays for vehicles making left turns. Limited gaps and high percentages of left turns onto Baker cause substantial delays for the stop controlled approaches. The Shield Road approach is operating at an average delay of almost 6.5 minutes during the AM peak hours and 3.5 minutes during the PM peak hours. As discussed above, this delay appears to be contributing to an angle crash pattern as drivers grow impatient waiting for an acceptable gap in traffic.

Three alternatives were evaluated at this intersection and are illustrated in Appendix A. The first alternative would modify the intersection to be under signalized control. Intersection improvements include revising the Shield Road approach to provide improved alignment for left turning vehicles. This option would add pedestrian facilities, including sidewalks and signalized pedestrian crossings.

The second alternative would reconstruct the intersection to add a roundabout. The roundabout would be designed with an approximate 100' inscribed circle diameter and geometry that will accommodate large vehicles. Pedestrian facilities for this option would include sidewalks and pedestrian crossings with median refuge islands. An additional right-turn only lane would be provided in the southbound direction for vehicles performing a right-turn to Shield Road.

The third alternative would realign the Shield Road approach through the school district property to become the fourth leg of the Dan Hoey intersection. The remaining approaches of the intersection would be unsignalized with the Dongara Road approach under stop control. Pedestrian facilities for this option are provided along Shield Road and now new facilities will be added at this intersection.

Table 9: Future Conditions Level of Service: AM Peak Hour Baker Road at Shield Road

		NB		SB		EB		WB		Overall Intersection	
		Delay (Sec.)	LOS	Delay (Sec.)	LOS	Delay (Sec.)	LOS	Delay (Sec.)	LOS	Delay (Sec.)	LOS
2025	No Build	10.1 (LT)	B	9.2 (LT)	A	**575.5**	**F**	**62.5**	**F**	**882.8**	**F**
	Alternative 1 – Signal	6.3	A	10.8	B	51.6	D	31.5	C	13.0	B
	Alternative 2 - Roundabout	6.7	A	9.1	B	6.7	A	4.6	A	8.0	A
	Alternative 3 - Realignment	Free	A	9.4 (LT)	A	n/a	n/a	21.3	C	0.4	A
2035	No Build	10.2 (LT)	A	9.2 (LT)	B	**632.4**	**F**	**67.4**	**F**	**883.0**	**F**
	Alternative 1 – Signal	6.5	A	11.4	B	51.5	D	31.4	C	13.4	B
	Alternative 2 - Roundabout	6.8	A	9.3	A	6.8	A	4.6	A	8.3	A
	Alternative 3 - Realignment	Free	A	9.5 (LT)	A	n/a	n/a	21.7	C	0.4	A

Table 10: Future Conditions Level of Service: PM Peak Hour Baker Road at Shield Road

		NB		SB		EB		WB		Overall Intersection	
		Delay (Sec.)	LOS	Delay (Sec.)	LOS	Delay (Sec.)	LOS	Delay (Sec.)	LOS	Delay (Sec.)	LOS
2025	No Build	9.5 (LT)	A	10.9 (LT)	B	**398.9**	**F**	**79.7**	**F**	18.9	C
	Alternative 1 – Signal	10.3	A	7.3	A	35.0	D	32.9	C	10.1	B
	Alternative 2 - Roundabout	31.0	D	5.4	A	4.6	A	6.0	A	20.1	C
	Alternative 3 - Realignment	Free	NA	11.4 (LT)	B	n/a	n/a	30.3	D	0.2	A
2035	No Build	9.5 (LT)	A	11.0 (LT)	B	**446.9**	**F**	**84.6**	**F**	21.2	C
	Alternative 1 – Signal	10.6	B	7.5	A	35.1	D	32.9	C	10.4	B
	Alternative 2 - Roundabout	34.7	D	5.5	A	4.6	A	6.0	A	22.2	C
	Alternative 3 - Realignment	Free	A	11.6 (LT)	B	n/a	n/a	31.1	D	0.2	A

With existing geometric and operational conditions, this intersection operates at LOS F in the AM peak hours and LOS C in the PM peak hours for both analysis years. With the various geometric improvements, the LOS of the side street approaches will be significantly improved. Changing the operations for Baker Road from an uncontrolled approach will increase delay for thru vehicles during both peak hours.

Introducing a signal to the intersection in alternative 1 substantially improves overall intersection performance. The addition of the signal increases the delays for the Baker Road approaches, which were previously uncontrolled. These minor increases in delay are overshadowed by the improvements to LOS in the westbound and eastbound direction, resulting in overall intersection performance improving from LOS F to LOS B in the AM peak hours and LOS C to LOS B in the PM peak hours.

The roundabout option in Alternative 2 slightly increases overall intersection delay in the PM Peak compared to the existing condition at this intersection. During the PM Peak this alternative has more impact on the heavy northbound traffic volumes, resulting in LOS D for this approach and increasing overall delay. The delays for the eastbound and westbound approaches are significantly decreased. Whereas the minor street approaches operate at LOS C or D under Alternative 1, the LOS is improved to a LOS A under Alternative 2. Additionally, the roundabout improves overall intersection delay by approximately 5 seconds in the AM peak period for both the 2025 and 2035 conditions, compared to Alternative 1. This improvement reflects the improved operations for the heavy eastbound approach.

Alternative 3 removes the eastbound approach leg with the realignment of Shield Rd, while maintaining STOP control on the westbound approach. The overall intersection operates at LOS A with very little delay. Southbound left-turns are unsubstantially affected compared to the "No Build" option. Compared to the signalized intersection in Alternative 1, vehicles exiting Dongara Rd. from the west experience slightly higher delays in the AM peak hours.

ALTERNATIVE EVAULATION

Traffic and pedestrian safety

All three alternatives were designed to improve safety and maximize the safety benefits of the selected intersection type. The traffic and pedestrian safety ranking of the alternatives, from best to worst, is as follows,

1. Alternative 2 - Roundabout
   Traffic safety benefits from slower traffic speeds and the one-way flow of the roundabouts. Head-on and angle crash types are minimized. Pedestrians cross one direction of traffic at a time at crossings pulled away from the distraction of the intersection.

2. Alternative 1 – Signal
   Traffic safety benefits from the improved large vehicle turn maneuvers at Dan Hoey as well as the signal installation at Shield. Shield Drivers will no longer rely solely on gap perception in order to turn onto Baker. Signalized pedestrian crossings with push buttons will provide adequate time for pedestrian crossing.

3. Alternative 3 - Realignment
   Traffic safety benefits are offset by the horizontal alignment of the realigned portion of Shield. The alignment will require a slower posted speed and curve super elevation. The intersection queue may extend into the super elevated curve, which may become problematic in the winter. Traffic safety benefits from slower traffic speeds and the one-way flow of the roundabouts. Head-on and angle crash types at this intersection are minimized. Shield Drivers will no longer rely solely on gap perception in order to turn onto Baker. Pedestrians cross one lane of traffic at a time at crossings pulled away from the distraction of the intersection.

4. No Build
   Pre-existing crash patterns are anticipated to persist into the future, with the potential of increasing frequency and rate as congestion increases in future years.

Traffic capacity and operations

As described above all alternatives provide acceptable operations during both peak hours. The traffic operations of each alternative is improved over the ‘do nothing’ condition. The traffic capacity and operations ranking of the alternatives is as follows,

1. Alternative 3 - Realignment
   Realigning Shield Road to align with Dan Hoey balances the traffic volumes at this intersection and is well accommodated by a roundabout. Removing the Shield approach at the Dongara intersection removes some of the conflicting traffic for the minor roadway approach.

2. Alternative 1 – Signal
   The intersection at Dan Hoey benefits from the modest geometric improvements and optimizing the signal. The intersection at Shield is greatly improved by the addition of a signal. By optimizing the corridor, traffic flow intrusions by these closely spaces signals can be minimized.

3. Alternative 2 - Roundabout

The roundabout alternative provides adequate approach and intersection levels of service. Baker road traffic sees a slight increase in delay. This delay is offset by a substantial improvement in the level of service for stop controlled approaches.

4. No Build
   Pre-existing levels of service are anticipated to persist into the future, with slowly increasing congestion in future years.

Non-motorized access

All three alternatives will add pedestrian facilities to this corridor. Pedestrian crossings will be located to optimize pedestrian visibility and safety. Other non-motorized facilities can be incorporated during the design phase. The traffic capacity and operations ranking of the alternatives is as follows,

1. Alternative 2 - Roundabout
   This alternative will include pedestrian facilities on both sides of Baker Road between the two intersections. Pedestrian crossings will be provided at both intersections.

2. Alternative 1 – Signal
   This alternative will include pedestrian facilities on both sides of Baker Road between the two intersections. Signalized pedestrian crossings will be provided at both intersections.

3. Alternative 3 - Realignment
   This alternative will provide pedestrian facilities at the intersection with Dan Hoey and extending onto the high school property.

4. No Build
   The pre-existing conditions of no pedestrian facilities south of Dan Hoey limits the access of school age children to the Dexter Schools campus.

Construction and maintenance costs

There are both short term construction costs and long term maintenance costs associated with each alternative. The construction and maintenance costs ranking of the alternatives is as follows,

1. No Build
   Preliminary Construction Costs = $0
   Maintenance Costs = High

2. Alternative 2 - Roundabout
   Preliminary Construction Costs = $1,133,000
   Maintenance Costs = Low

3. Alternative 1 – Signal
   Preliminary Construction Costs = $1,142,000
   Maintenance Costs = High

4. Alternative 3 - Realignment
   Preliminary Construction Costs = $1,902,000
   Maintenance Costs = Low

Right-of-way and environmental impacts

Expanding the intersections to provide increases in the maneuverability of large vehicles will increase the amount of impervious surface and has the potential to require additional right-of-way. The right-of-way and environmental impacts ranking of the alternatives is as follows.

1. No Build
   Obviously, no additional right-of-way is needed in the absence of construction. However, there are operation problems with large trucks at the intersection of Baker / Dan Hoey Roads, as evidenced by the rutting back of curb in the southeast corner.

2. Alternative 1 – Signal
   Adjusting the southeast quadrant curb line at the Dan Hoey intersection will require additional right-of-way from one parcel.

3. Alternative 2 - Roundabout
   Construction of two roundabouts intersections will require small triangles of right-of-way from each corner parcel.

4. Alternative 3 - Realignment
   Construction of one roundabout intersection will require small triangles of right-of-way from each corner parcel. The realignment will take place entirely outside of existing right-of-way and will require a large amount of additional right-of-way.

Opportunity for place making and aesthetic enhancements

The alternatives vary in the ability to provide aesthetic enhancements. In many cases the ability to add these elements is hindered by the remaining right-of-way. The Opportunity for place making and aesthetic enhancements ranking of the alternatives is as follows.

1. Alternative 3 - Realignment
   Constructing a new approach to the Dan Hoey intersection provides opportunity for a gateway type enhancement in this area. The roundabout provided further opportunity for landscaping enhancements.

2. Alternative 2 - Roundabout
   The two roundabouts provide opportunity for landscaping enhancement and can be used together to provide a gateway entrance to the community.

3. Alternative 1 – Signal
   Opportunities for aesthetic enhancements are limited to streetscaping adjacent to the roadway.

4. No Build
   Opportunities for aesthetic enhancements are limited to streetscaping adjacent to the roadway.

CONCLUSIONS AND RECOMENDATIONS

We recommend that the intersections of Baker Road at Dan Hoey Road and Baker Road at Shield Road be reconstructed to add one-lane roundabouts.

The realignment alternative (Alternative 3) provides unique opportunities for place making and improved operations. However, this option also has large right-of-way impacts and is substantially more expensive than other alternatives. The realignment alternative (Alternative 3) is not recommended as the negative performance in key areas outweigh the other unique positive characteristics of this alternative.

The remaining in two alternatives performed exceptionally well across all of the study evaluation factors. Both signals (Alternative 1) and roundabouts (Alternative 2) will improve non-motorized access along the corridor. The costs associated with the alternatives are nearly even. The signal alternative (Alternative 1) provides slightly better operations and has less right-of-way impacts. The roundabout alternative includes more place making opportunities and places a higher emphasis on traffic and pedestrian safety.

The project stakeholders emphasized safety as the primary concern in the study area, a concern shared by OHM. By reducing speeds and minimizing crossing lengths, the roundabout alternative provides improved safety for pedestrians and vehicles at both intersections.