Intersection Control Evaluation Report

SR-60 and Theodore Street

California State Polytechnic University, Pomona

Senior Project

Intersection Control Evaluation Report Single Point Urban Interchange (SPUI)

This report conforms to the Caltrans Traffic Operations Policy Directive 13-02.

Intersection Control Evaluation (ICE) is a directive issued by the California Department of Transportation (Caltrans) for all proposed highway intersection projects, whether new or for improvement. ICE is performed during the early stages of a project, allocating time to study which types of intersection control alternatives would work. Control types listed by ICE include stop, signal, roundabout and lane configuration changes. Each is to get ample time for consideration.

Project	SR-60 Theodore Ave Interchange Project
Alternative	Partial Clover Interchange (Parclo)
Clients	Caltrans and City of Moreno Valley
Location	An interchange at State Route 60 with Theodore Ave in the City of Moreno Valley, California.
Number of Intersections	4
Current Control(s)	Stop Signs

Need for Control

The project site is located in a heavily traveled corridor within the City of Moreno Valley. The interchange serves as an arterial between future residential expansion and future commercial properties. There will be significant truck and passenger vehicle volume increases for this interchange. Therefore, it is necessary to assess the feasibility of various control types for this project.

The four study intersections include

- Theodore Street and Eucalyptus
- Theodore Street and SR-60 Eastbound ramps
- Theodore Street and SR-60 Westbound ramps
- Theodore Street and Ironwood Avenue

The images below describe the existing configurations of the 4 study intersections.

Figure 1. Overview image of the intersections under consideration, numbered 1-4. The SPUI alternative replaces the intersections numbered 2 and 3.

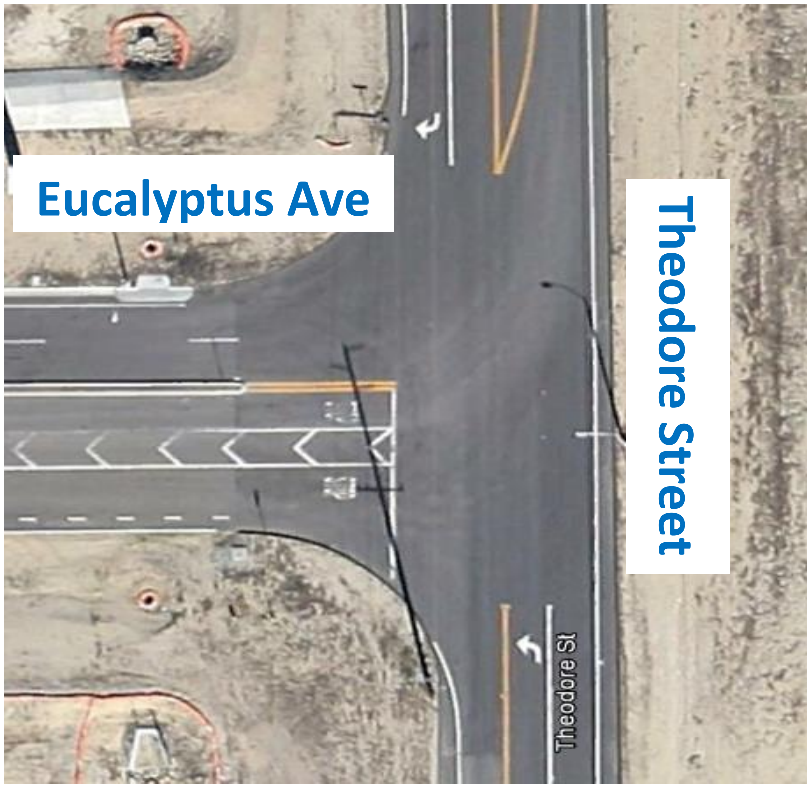

Figure 2. Intersection 1. Theodore Street and Eucalyptus Avenue.

Figure 3. Intersection 2. Theodore Street and EB Ramp of SR-60.

Figure 4. Intersection 3. Theodore Street and WB Ramp of SR-60.

Figure 5. Intersection 4. Theodore Street and Ironwood Avenue.

Alternative Description

A Single Point Urban Interchange (SPUI) will replace the existing ramp intersections. The SPUI is where the grade of the cross street is changed to pass over or under a freeway. It combines two separate diamond ramp interchanges into one large at-grade intersection. The amount of Right of Way required for this type of alternative requires about the same amount as the contact diamond. However, the bridge for an overpass SPUI can become quite large. This feature is an advantage because the SPUI has the capacity to withstand higher volumes of traffic. However, at the same time, its size is also its downfall because it is not pedestrian and bicycle traffic friendly. Traffic analysis show that, with the help of a signal control, the level of service is better improved than that of the no build condition. Geometrically, the interchange can be well accommodated for regular and large truck traffic if including retaining walls at the bridge.

The table below summarizes the intersections control type and level of service using the 2040 projected peak hour volumes.

Table 1. Summary of Intersection Control Types and Level of Service.

Intersection	Control Type	Level of Service	
		A.M.	P.M.
Eucalyptus Ave. & Theodore St.	Stop	F	F
	Yield	F	F
	Signalized	C	C
EB/WB SR60 & Theodore St.	Stop	N/A	N/A
	Yield	F	F
	Signalized	B	D
Ironwood Ave. & Theodore St.	Stop	A	A
	Yield	A	A
	Signalized	A	A

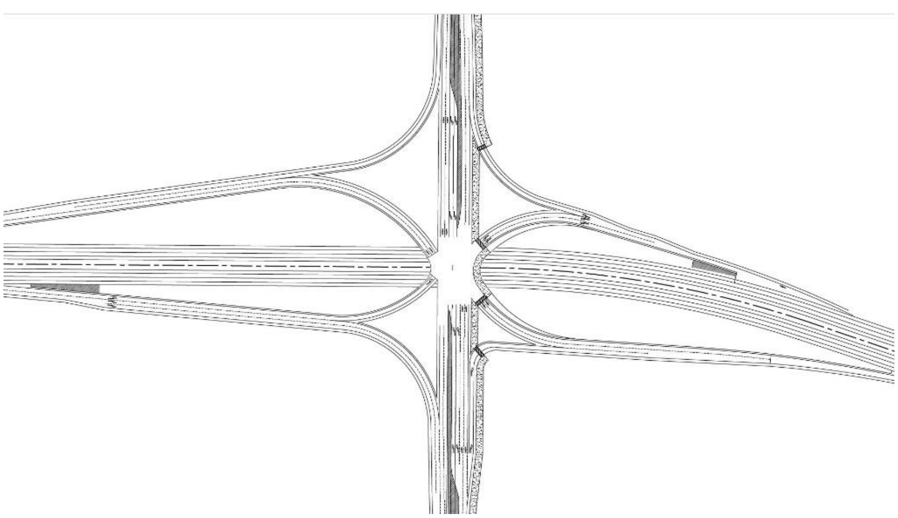

Figure 6. SPUI model in AutoCAD.

Step 1 – Configuration Assessment

The following control types were assessed at the 3 intersections on Theodore Street.

- **Stop Control**
  A stop controlled intersection involves placing stop signs at the intersection, forcing vehicles to stop and pass with caution before proceeding through the intersection. The current control is of this type. This alternative will be considered further in engineering analysis.

- **Roundabout Control**
  Yield control involves slowing vehicle speed to a safe level while making them pay attention to other vehicles in the intersection. One type of yield control is the roundabout, a typically circular road where vehicles can enter and exit from different roads. A roundabout can be implemented at this intersection. There is enough right of way to design a traditional roundabout, possibly with an increase of interior lanes and a road diet of the surrounding area. This alternative will be considered further in engineering analysis.

- **Signalized Control**
  A signalized control uses traffic lights to coordinate movements in an intersection. A signal can be implemented at this intersection. Determining correct timing and/or coordination with other signals is an important factor. This alternative will be considered further in engineering analysis.

Step 2 – Engineering Analysis

Intersection 1 – Theodore Street and Eucalyptus Avenue

- **Stop Control**
  A traffic simulation was run using a stop controlled intersection for entry points. The image below describes the optimized lane configuration and stop sign locations. The intersection is optimized to be an all-way stop control. Predicted 2040 peak hour traffic volumes were used.

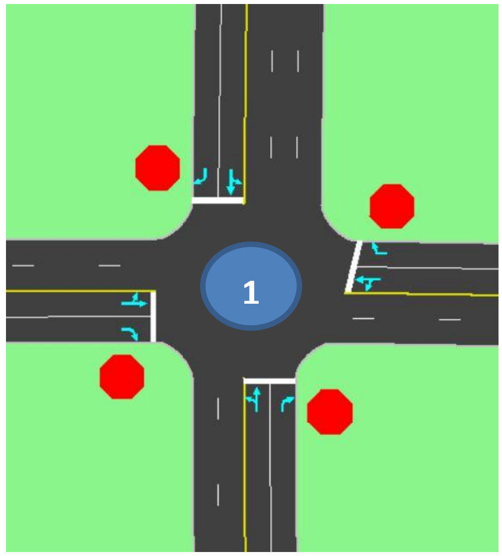

Figure 7. A stop control simulation using projected 2040 volumes.

Results from the Synchro analysis concluded that the stop-controlled intersection will breakdown. The Level of Service at this intersection during peak hours are in the table below. Because the AM and PM peak hours show a level of service of F, this alternative will not be considered.

Table 2. Level of Service of Stop Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
F	F

- **Roundabout Control**
  A traffic simulation was run using a traditional roundabout using yield control for entry points. Lanes from all streets were reduced to two before entering the two lane roundabout. Predicted 2040 peak hour traffic volumes were used.

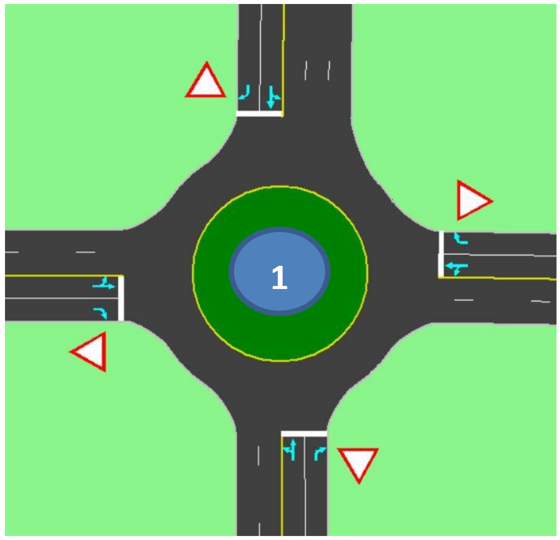

Figure 8. Roundabout simulation using projected 2040 values.

Results from the Synchro analysis concluded that the roundabout will breakdown. The Level of Service at this intersection during peak hours are in the table below. Because the AM and PM peak hours show a level of service of F, this alternative will not be considered.

Table 3. Level of Service of Yield Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
F	F

- **Signalized**
  A traffic simulation was run using a signalized control. Signals were implemented at this intersection, with a change of lane configurations of the surrounding streets and an optimization in phasing/timing of the signal. Predicted 2040 peak hour traffic volumes were used.

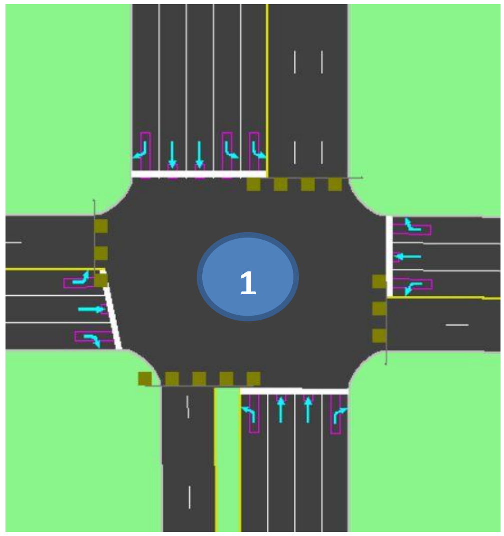

Figure 9. Signalized intersection using projected 2040 PM traffic volumes.

Results from the Synchro analysis concluded that signalized control can handle the input. The Level of Service at this intersection during peak hours are in the table below. Because the AM and PM peak hour shows a level of service of C, this alternative will be used.

Table 4. Level of Service of Signal Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
C	C

Intersection 2/3 – Theodore Street and SR60 Ramps

- **Stop Control**

A traffic simulation was run using an un-signalized control using stop control for entry points. Lanes from all streets were configured to determine optimal usage. Predicted 2040 peak hour traffic volumes were used. Results from this analysis concluded that the roundabout will breakdown. The Level of Service at this intersection could not be evaluated through Synchro because the intersection has too many legs for HCM analysis. Furthermore, the SPUI has several points of conflict where drivers may become confused and potentiall collide. Therefore, an un-signalized control using stop control would not be recommended.

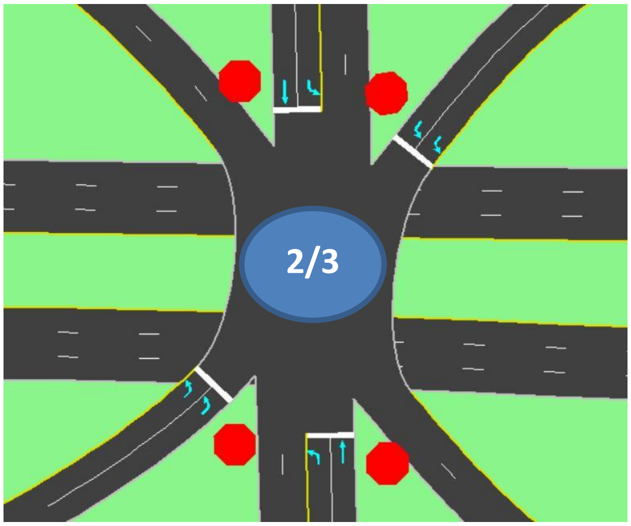

Figure 10. A stop control simulation using projected 2040 volumes.

Table 5. Level of Service of Stop Controlled Intersection at Theodore and SR-60 Ramps.

AM Level of Service	PM Level of Service
N/A	N/A

- **Roundabout Control**

  A traffic simulation was run using a traditional roundabout using yield control for entry points. Lanes from all streets were reduced to two before entering the two lane roundabout. Existing and predicted 2040 peak hour traffic volume was used. Results from this analysis concluded that the roundabout will breakdown. Therefore, this alternative will not be considered.

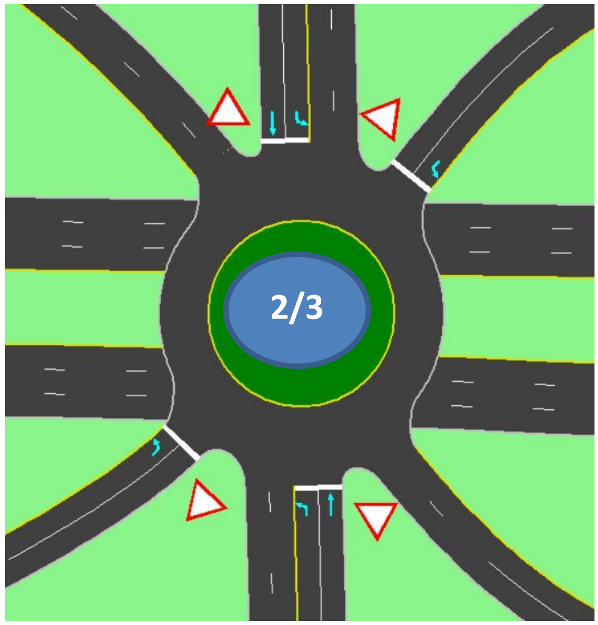

Figure 11. Roundabout simulation using projected 2040 values.

Table 6. Level of Service of Yield Controlled Intersection at Theodore and SR-60 Ramps.

AM Level of Service	PM Level of Service
F	F

- **Signalized**
  A traffic simulation was run using a signalized control. Signals were implemented at this intersection, with a change of lane configurations of the surrounding streets and an optimization in phasing/timing of the signal. Predicted 2040 peak hour traffic volumes were used. Results from this analysis concluded that signalized control can handle the input. The Level of Service at this intersection during peak hours reaches a B in the AM peak hour and a D in the PM peak hour. This is an improvement from the existing conditions at a LOS of F for AM and PM peak hours.

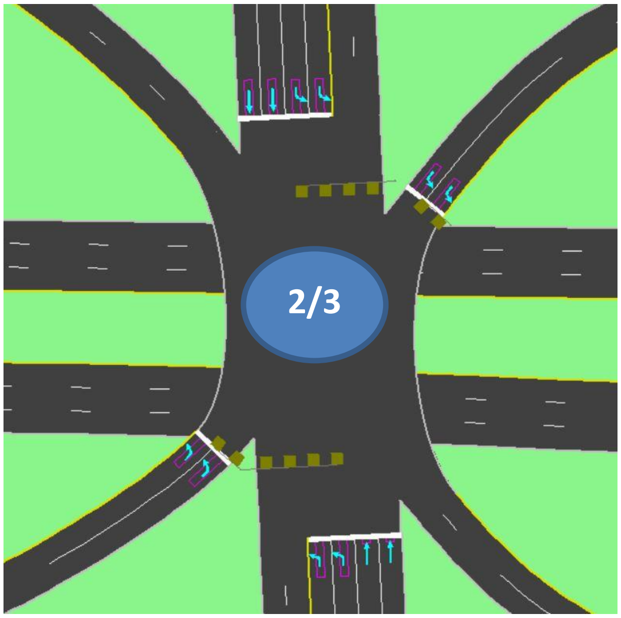

Figure 12. Signalized intersection using projected 2040 PM traffic volumes.

Table 7. Level of Service of Signalized Controlled Intersection at Theodore and SR-60 Ramps.

AM Level of Service	PM Level of Service
B	D

Intersection 4 – Theodore Street and Ironwood Avenue

- **Stop Control**

A traffic simulation was run using an un-signalized control using stop control for entry points. Lanes from all streets were configured to determine optimal usage. Predicted 2040 peak hour traffic volumes were used. Results from this analysis concluded that the stop control will breakdown. The Level of Service at this intersection during peak hours reaches an A. Therefore, this alternative will be considered.

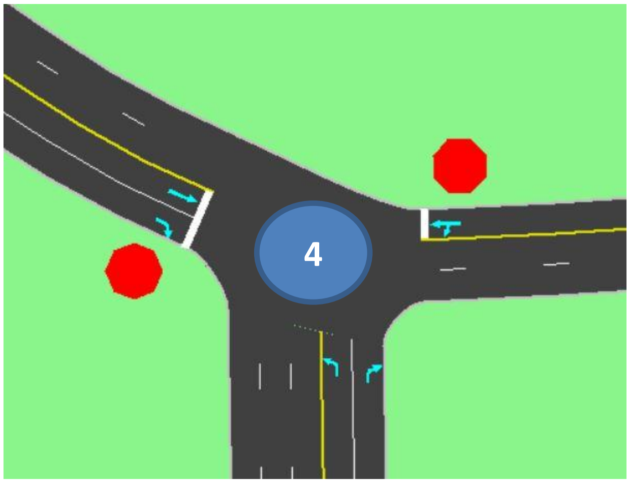

Figure 13. A stop control simulation using projected 2040 volumes.

Table 8. Level of Service of Stop Controlled Intersection at Theodore and Ironwood Avenue.

AM Level of Service	PM Level of Service
A	A

- **Roundabout Control**
  A traffic simulation was run using a traditional roundabout using yield control for entry points. Lanes from all streets were reduced to two before entering the two lane roundabout. Existing and predicted 2040 peak hour traffic volume was used. Results from this analysis concluded that the roundabout will receive a Level of Service of A. Therefore, this alternative will be considered.

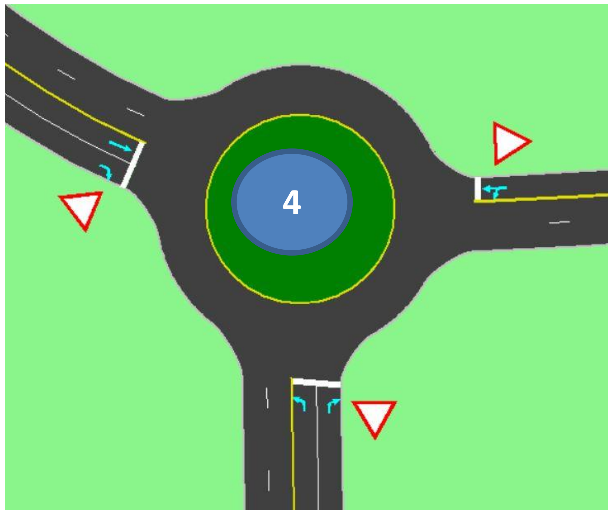

Figure 14. Roundabout simulation using projected 2040 values.

Table 9. Level of Service of Yield Controlled Intersection at Theodore and Ironwood Avenue.

AM Level of Service	PM Level of Service
A	A

- **Signalized**
  A traffic simulation was run using a signalized control. Signals were implemented at this intersection, with a change of lane configurations of the surrounding streets and an optimization in phasing/timing of the signal. Predicted 2040 peak hour traffic volumes were used. Results from this analysis concluded that signalized control can handle the input. The Level of Service at this intersection during peak hours reaches an A. Therefore, this alternative will be considered.

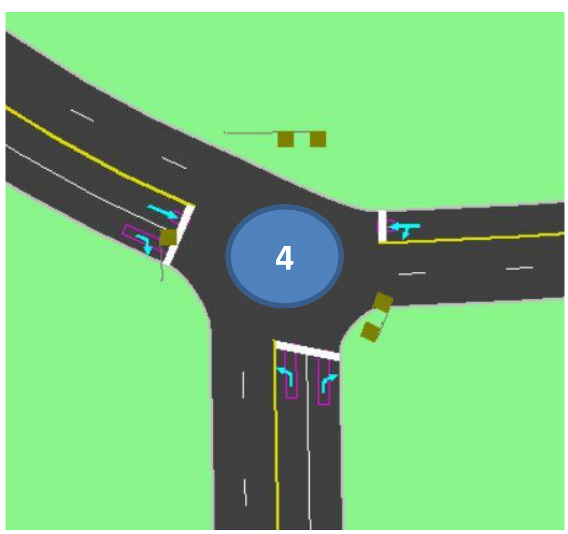

Figure 15. Signalized intersection using projected 2040 PM traffic volumes.

Table 9. Level of Service of Signalized Controlled Intersection at Theodore and Ironwood Avenue.

AM Level of Service	PM Level of Service
A	A

Evaluation Summary

Stop control, roundabout control, and non-traditional control at intersections 1 and 2 are not likely to work due to high volumes that are projected to exist within the life of the proposed project, year 2040. Therefore, these alternatives will be rejected for these two intersections. Since the level of service for Intersection 3 will continue as a stop control with the same lane configurations.

Based on an evaluation using predicted traffic conditions, signalized control for all intersections is the likely candidate to be chosen for the SPUI and therefore recommended for the project.

Table 5. Recommended Intersection Controls with Peak Hour Level of Service.

Intersection	Recommended Control	Level of Service	
		AM	PM
Eucalyptus Ave & Theodore St.	Signalized	C	C
EB/WB SR60 & Theodore St.	Signalized	B	D
Ironwood Ave. & Theodore St.	Stop	A	A

Intersection Control Evaluation Report Diverging Diamond Interchange (DDI)

This report conforms to the Caltrans Traffic Operations Policy Directive 13-02.

Intersection Control Evaluation (ICE) is a directive issued by the California Department of Transportation (Caltrans) for all proposed highway intersection projects, whether new or for improvement. ICE is performed during the early stages of a project, allocating time to study which types of intersection control alternatives would work. Control types listed by ICE include stop, signal, roundabout and lane configuration changes. Each is to get ample time for consideration.

Project	SR-60 Theodore Ave Interchange Project
Alternative	Diverging Diamond Interchange (DDI)
Clients	Caltrans and City of Moreno Valley
Location	An interchange at State Route 60 with Theodore Ave in the City of Moreno Valley, California.
Number of Intersections	4
Current Control(s)	Stop Signs

Need for Control

The project site is located in a heavily traveled corridor within the City of Moreno Valley. The interchange serves as an arterial between future residential expansion and future commercial properties. There will be significant truck and passenger vehicle volume increases for this interchange. Therefore, it is necessary to assess the feasibility of various control types for this project.

The four study intersections include

- Theodore Street and Eucalyptus
- Theodore Street and SR-60 Eastbound ramps
- Theodore Street and SR-60 Westbound ramps
- Theodore Street and Ironwood Avenue

The images below describe the existing configurations of the 4 study intersections.

Figure 1. Overview image of the intersections under consideration, numbered 1-4. The DDI alternative replaces the intersections numbered 2 and 3.

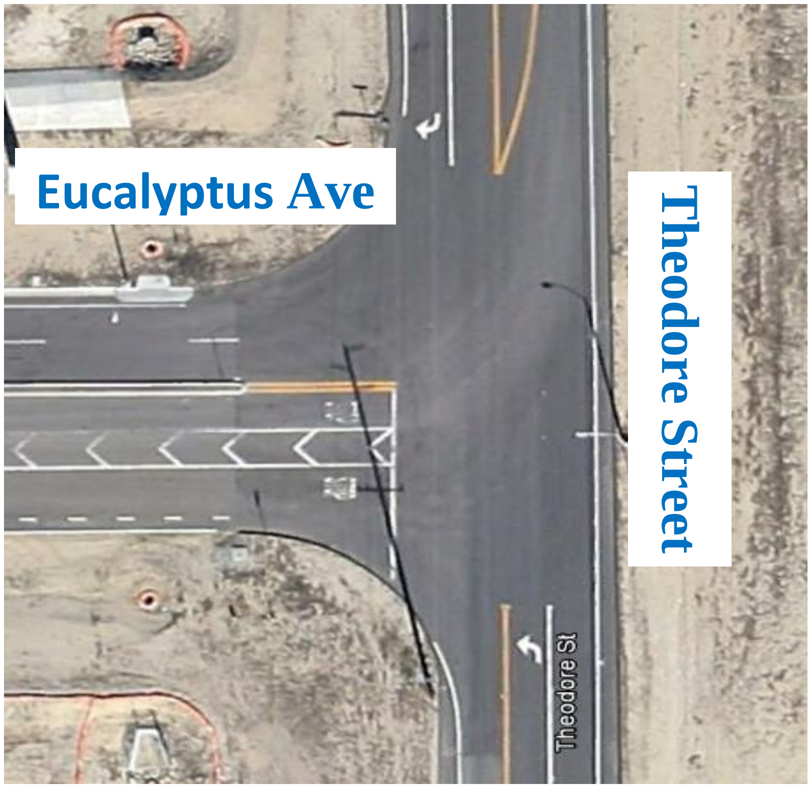

Figure 2. Intersection 1. Theodore Street and Eucalyptus Avenue.

Figure 3. Intersection 2. Theodore Street and EB Ramp of SR 60.

Figure 4. Intersection 3. Theodore Street and WB Ramp of SR 60.

Figure 5. Intersection 4. Theodore Street and Ironwood Avenue.

Alternative Description

A Diverging Diamond Interchange (DDI) will replace the existing ramp intersections. A DDI design takes the local road approaches leading to the ramp intersections and creates a crossover movement. This allows for large volumes of vehicles to be able to turn left onto the highway without having a conflict movement. The cross over movement only needs two phases at the signalized intersection. This is opposed to other intersections that may require four or more phases. Another advantage to a DDI is that I takes up the same amount of right of way as a spread diamond.

The table below summarizes the intersections control type and Level of Service using the 2040 projected peak hour volumes. A DDI is itself a special type of control device and therefore a traditional ICE was not performed for the following intersections: EB SR60 & Theodore St. and WB SR60 & Theodore St.

Table 6. Summary of Intersection Control Types and Levels of Service.

Intersection No.	Intersection Name	Control Type	Level of Service	
			A.M.	P.M.
1	Eucalyptus Ave. & Theodore St.	Stop	F	F
		Yield	F	F
		Signalized	C	C
2	EB SR60 & Theodore St.	Stop	N/A	N/A
		Yield	N/A	N/A
		Signalized	B	C
3	WB SR60 & Theodore St.	Stop	N/A	N/A
		Yield	N/A	N/A
		Signalized	A	A
4	Ironwood Ave. & Theodore St.	Stop	A	A
		Yield	A	A
		Signalized	A	A

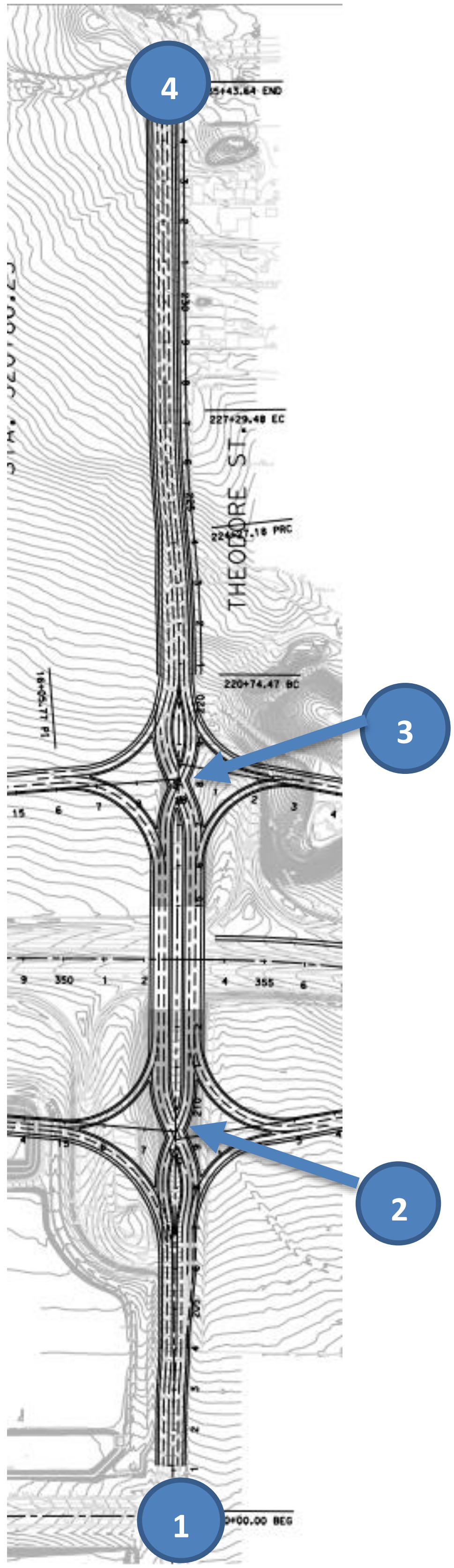

Figure 7. DDI model in AutoCAD.

Step 1 – Configuration Assessment

The following control types were assessed at intersections 1 and 4 on Theodore Street.

- **Stop Control**
  A stop controlled intersection involves placing stop signs at the intersection, making vehicles that pass through it have to stop and pass with caution. The current control is of this type. This alternative will be considered further in engineering analysis.

- **Roundabout Control**
  Yield control involves slowing vehicle speed to a safe level while making them pay attention to other vehicles in the intersection. One type of yield control is the roundabout, a typically circular road where vehicles can enter and exit from different roads. A roundabout can be implemented at this intersection. There is enough right of way to design a traditional roundabout, possibly with an increase of interior lanes and a road diet of the surrounding area. This alternative will be considered further in engineering analysis.

- **Signalized Control**
  A signalized control uses traffic lights to coordinate movements in an intersection. A signal can be implemented at this intersection. Determining correct timing and/or coordination with other signals is an important factor. This alternative will be considered further in engineering analysis.

Step 2 – Engineering Analysis

Intersection 1 – Theodore Street and Eucalyptus Avenue

- **Stop Control**
  A traffic simulation was run using a stop controlled intersection for entry points. The image below describes the optimized lane configuration and stop sign locations. The intersection is optimized to be an all-way stop control. Predicted 2040 peak hour traffic volumes were used.

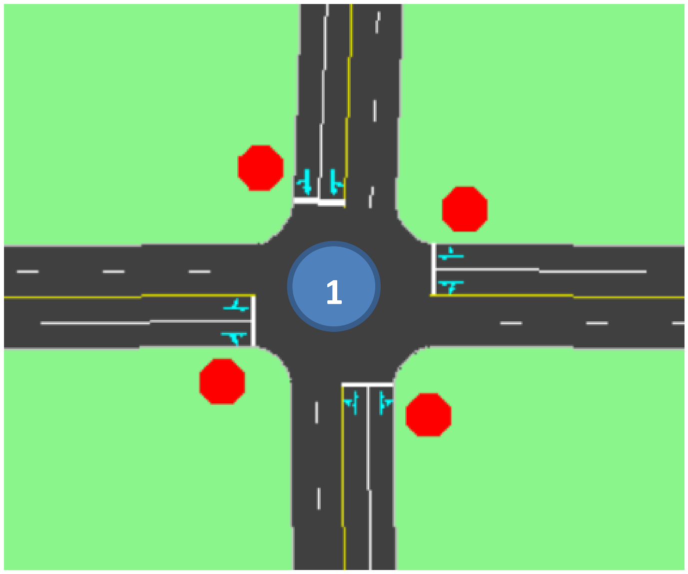

Figure 8. A stop control simulation using projected 2040 volumes.

Results from the Synchro analysis concluded that the stop-controlled intersection will breakdown. The Level of Service at this intersection during peak hours are in the table below. Because the AM peak hour shows a Level of Service of F, this alternative will not be considered.

Table 7. Level of Service of Stop Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
F	F

- **Roundabout Control**
  A traffic simulation was run using a traditional roundabout using yield control for entry points. Lanes from all streets were reduced to two before entering the two lane roundabout. Predicted 2040 peak hour traffic volumes were used.

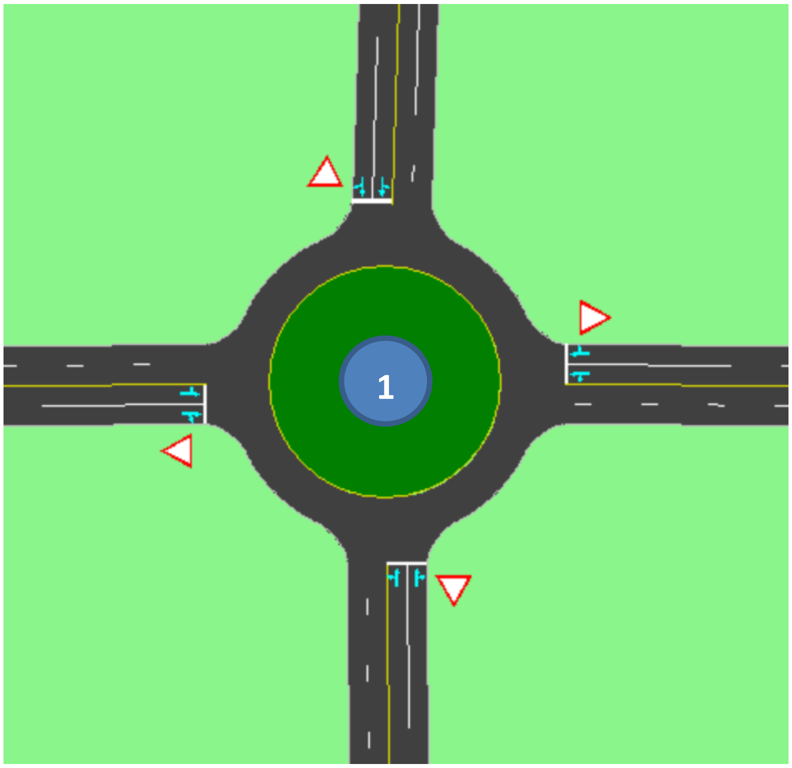

Figure 9. Roundabout simulation using projected 2040 values.

Results from the Synchro analysis concluded that the roundabout will breakdown. The Level of Service at this intersection during peak hours are in the table below. Because the AM peak hour shows a Level of Service of F, this alternative will not be considered.

Table 8. Level of Service of Yield Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
F	F

- **Signalized**
  A traffic simulation was run using a signalized control. Signals were implemented at this intersection, with a change of lane configurations of the surrounding streets and an optimization in phasing/timing of the signal. Predicted 2040 peak hour traffic volumes were used.

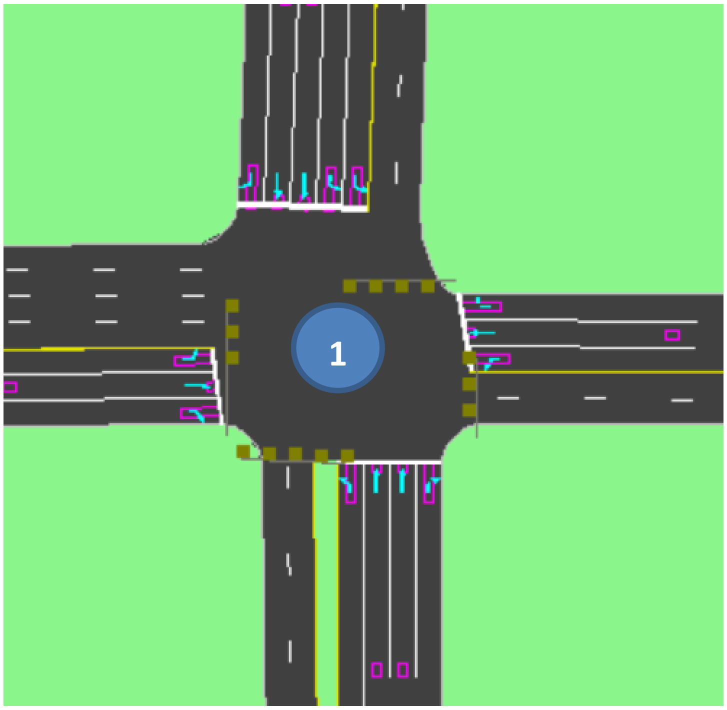

Figure 10. Signalized intersection using projected 2040 PM traffic volumes.

Results from the Synchro analysis concluded that signalized control can handle the input. The Level of Service at this intersection during peak hours are in the table below. Because the AM peak hour shows a Level of Service of C, this alternative will be used.

Table 9. Level of Service of Signal Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
C	C

Intersection 2 – Theodore Street and SR60 EB

- **DDI Intersection Control**
  A diverging diamond interchange is a special type of control device where the two directions of traffic on the local road. After the cross over the vehicles are on the opposite side of the road from where they started. This allows for a high volume of turning movements to have free movements to the highway ramps. The crossover intersections allows for two-phase signals. This helps to reduce the delay time of when compared to a traditional intersection.

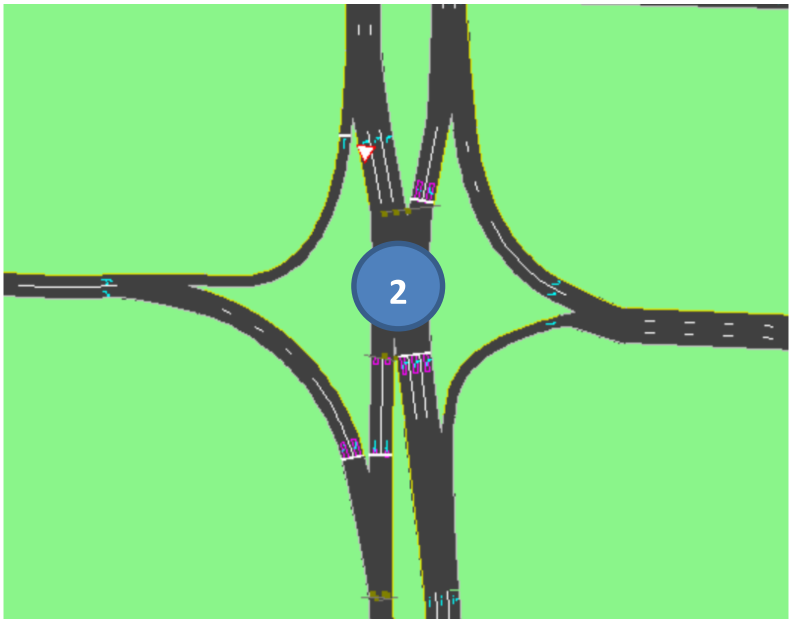

Figure 11. A simulation of a DDI Intersection control using projected 2040 volumes.

Intersection 3 – Theodore Street and SR60 WB

- **DDI Intersection Control**

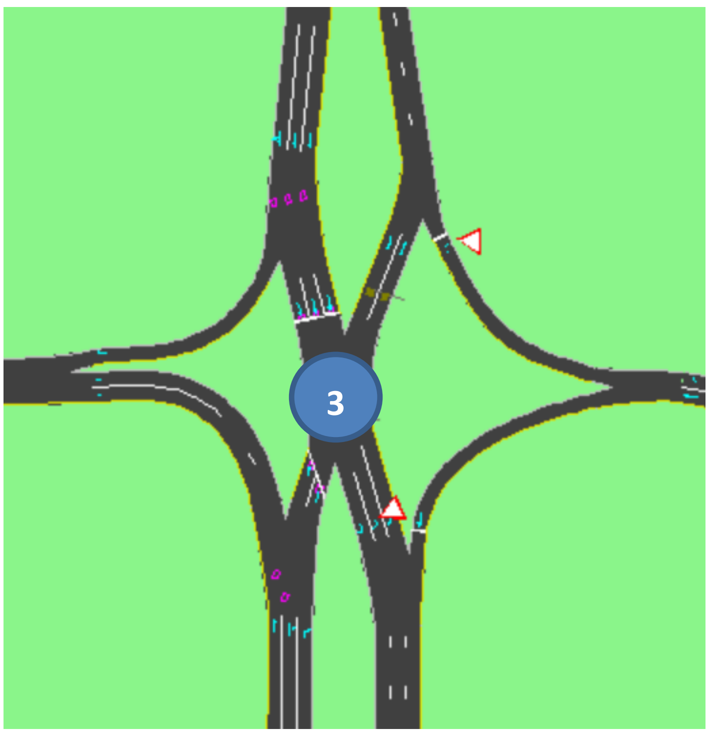

Figure 14. A DDI intersection control simulation using projected 2040 volumes.

Intersection 4 – Theodore Street and Ironwood Avenue

- **Stop Control**

A traffic simulation was run using an unsignalized control using stop control for entry points. Lanes from all streets were configured to determine optimal usage. Predicted 2040 peak hour traffic volumes were used. Results from this analysis concluded that the roundabout will breakdown. The Level of Service at this intersection during peak hours reaches an A. Therefore, this intersection does not require any change from its original configuration.

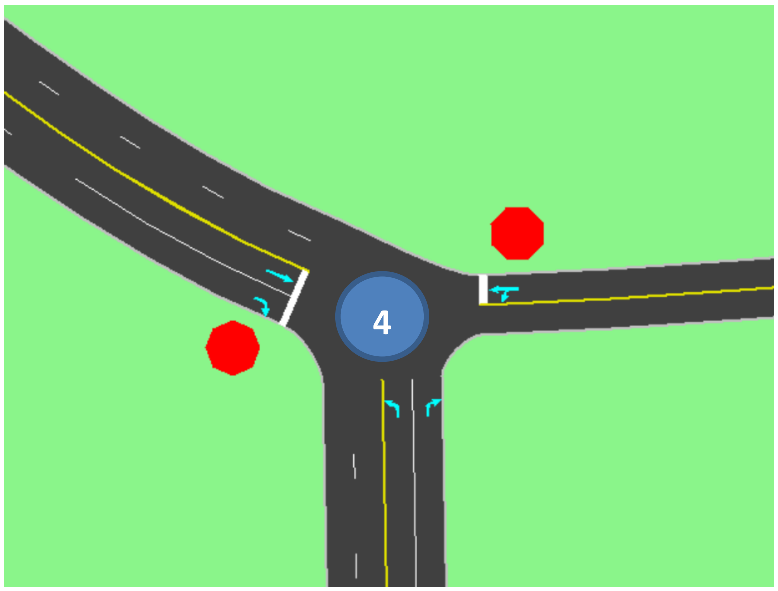

Figure 17. A stop control simulation using projected 2040 volumes.

- **Roundabout Control**

  A traffic simulation was run using a traditional roundabout using yield control for entry points. Lanes from all streets were reduced to two before entering the two lane roundabout. Existing and predicted 2040 peak hour traffic volume was used. Results from this analysis concluded that the roundabout will receive a Level of Service of A. Therefore, this alternative will be considered.

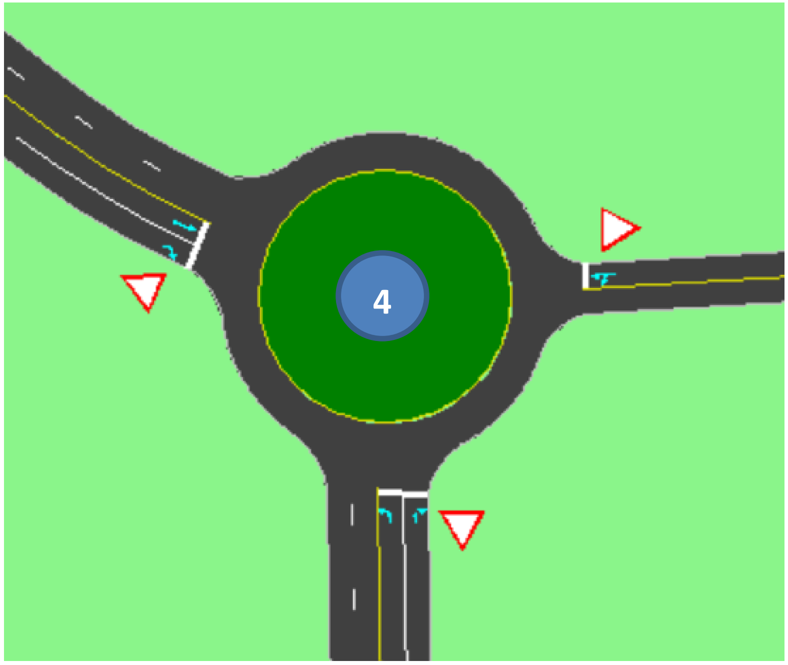

Figure 18. Roundabout simulation using projected 2040 values.

- **Signalized**
  A traffic simulation was run using a signalized control. Signals were implemented at this intersection, with a change of lane configurations of the surrounding streets and an optimization in phasing/timing of the signal. Predicted 2040 peak hour traffic volumes were used. Results from this analysis concluded that signalized control can handle the input. The Level of Service at this intersection during peak hours achieve an A.

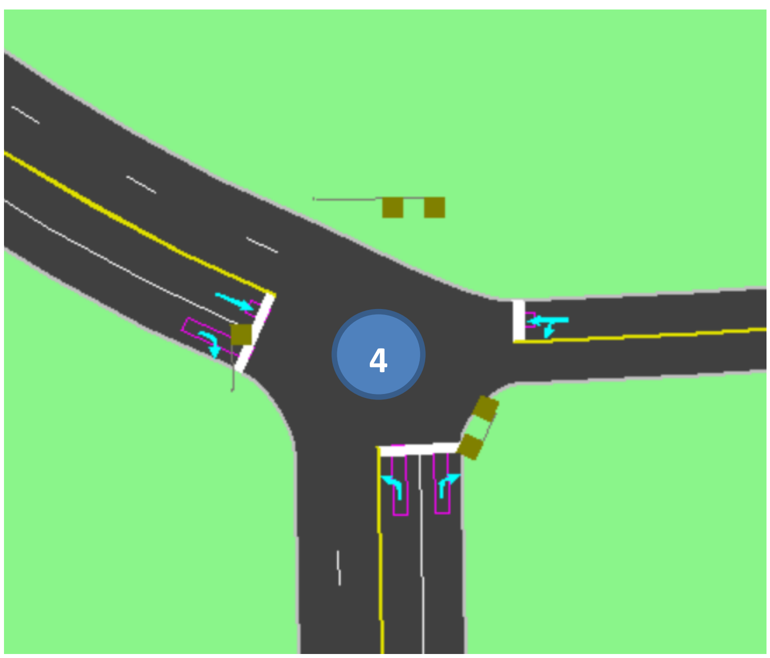

Figure 19. Signalized intersection using projected 2040 PM traffic volumes.

Evaluation Summary

Based on the Synchro analysis the Roundabout and stop control are not suitable for intersection 1. For intersection 4 the current stop control still receives an A grade and does not need to be changed to a roundabout or signal control. Intersections 2 and 3 use the DDI as a special intersection control. The crossover movements only require a two-phase signal. This reduces delay time. In table 5 below the recommendations for the intersection control are shown with their respective LOS grade.

Table 10. Recommended Intersection Controls with Peak Hour Level of Service.

Intersection	Recommended Control	Level of Service	
		AM	PM
Eucalyptus Ave & Theodore St.	Signal	C	C
EB SR60 & Theodore St.	DDI	B	C
WB SR60 & Theodore St.	DDI	A	A
Ironwood Ave. & Theodore St.	Stop	A	A

Intersection Control Evaluation Report Continuous Flow Interchange (CFI)

This report conforms to the Caltrans Traffic Operations Policy Directive 13-02.

Intersection Control Evaluation (ICE) is a directive issued by the California Department of Transportation (Caltrans) for all proposed highway intersection projects, whether new or for improvement. ICE is performed during the early stages of a project, allocating time to study which types of intersection control alternatives would work. Control types listed by ICE include stop, signal, roundabout and lane configuration changes. Each is to get ample time for consideration.

Project	SR-60 Theodore Ave Interchange Project
Alternative	Continuous Flow Intersection (CFI)
Clients	Caltrans and City of Moreno Valley
Location	An interchange at State Route 60 with Theodore Ave in the City of Moreno Valley, California.
Number of Intersections	4
Current Control(s)	Stop Signs

Need for Control

The project site is located in a heavily traveled corridor within the City of Moreno Valley. The interchange serves as an arterial between future residential expansion and future commercial properties. There will be significant truck and passenger vehicle volume increases for this interchange. Therefore, it is necessary to assess the feasibility of various control types for this project.

The four study intersections include

- Theodore Street and Eucalyptus
- Theodore Street and SR-60 Eastbound ramps
- Theodore Street and SR-60 Westbound ramps
- Theodore Street and Ironwood Avenue

The images below describe the existing configurations of the 4 study intersections.

Figure 1. Overview image of the intersections under consideration, numbered 1-4. The CFI alternative replaces the intersections numbered 2 and 3.

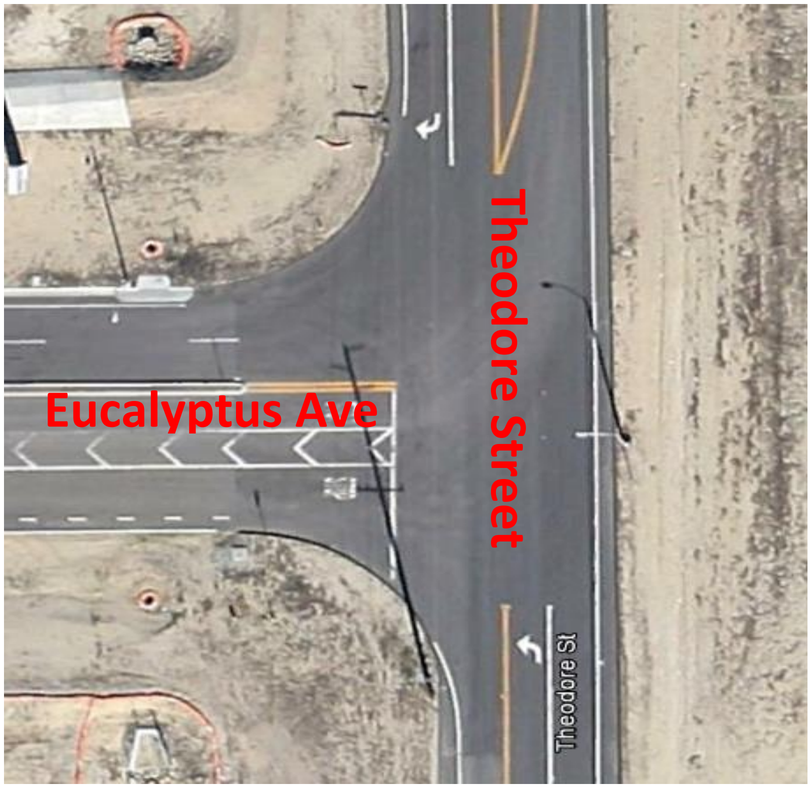

Figure 2. Intersection 1. Theodore Street and Eucalyptus Avenue.

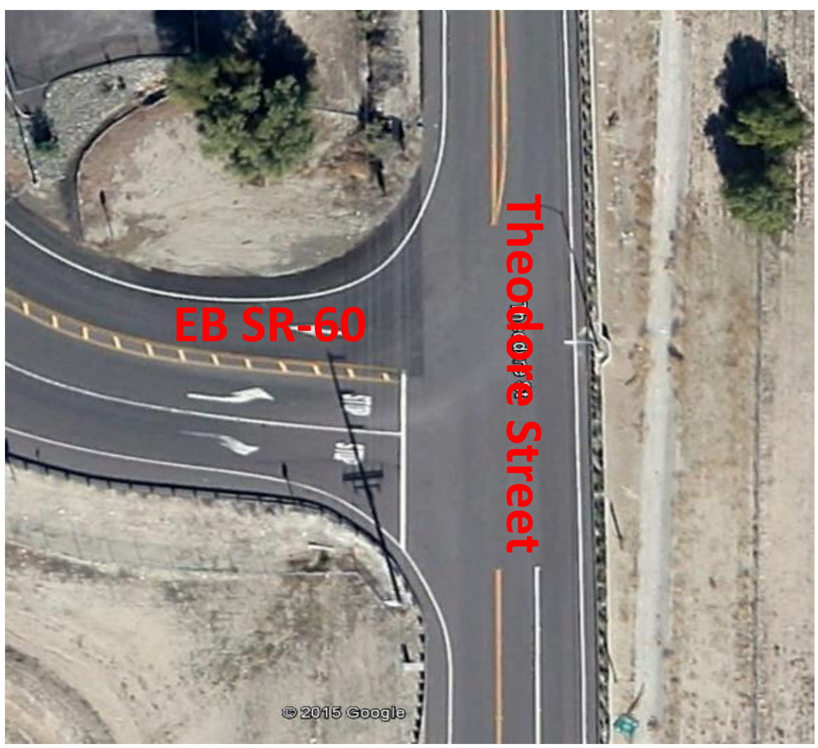

Figure 3. Intersection 2. Theodore Street and EB Ramp of SR-60.

Figure 4. Intersection 3. Theodore Street and WB Ramp of SR-60.

Figure 5. Intersection 4. Theodore Street and Ironwood Avenue.

Alternative Description

A continuous flow intersection (CFI) will replace the existing ramp intersections. The continuous flow intersection is used for an at-grade road junction. The CFI has turn lanes which cross to the opposite side of traffic before the signal. This allows the next intersection to proceed without having a left turn signal, allowing a more optimized flow. These turn lanes are separated from the through traffic usually with a concrete barrier or a traffic island. This type of intersection can require a significant amount of right of way acquisition depending on configuration.

The table below summarizes the intersections control type and Level of Service using the 2040 projected peak hour volumes.

Table 11. Summary of Intersection Control Types and Level of Service.

Intersection	**Control Type**	**Level of Service**	
		A.M.	P.M.
Eucalyptus Ave. & Theodore St.	Stop	F	F
	Yield	F	F
	Signalized	C	D
EB SR-60 & Theodore St.	Signalized	C	D
WB SR-60 & Theodore St.	Signalized	A	A
Ironwood Ave. & Theodore St.	Stop	A	A
	Yield	A	A
	Signalized	A	A

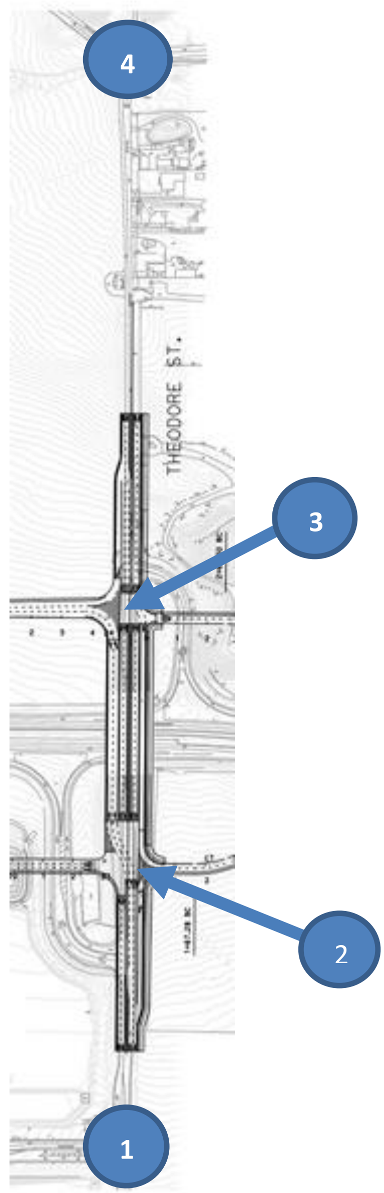

Figure 6. CFI model in AutoCAD.

Step 1 – Configuration Assessment

The following control types were assessed at 2 intersections on Theodore Street.

- **Stop Control**
  A stop controlled intersection involves placing stop signs at the intersection, making vehicles that pass through it have to stop and pass with caution. The current control is of this type. This alternative will be considered further in engineering analysis.

- **Roundabout Control**

Yield control involves slowing vehicle speed to a safe level while making them pay attention to other vehicles in the intersection. One type of yield control is the roundabout, a typically circular road where vehicles can enter and exit from different roads. A roundabout can be implemented at this intersection. There is enough right of way to design a traditional roundabout, possibly with an increase of interior lanes and a road diet of the surrounding area. This alternative will be considered further in engineering analysis.

- **Signalized Control**
  A signalized control uses traffic lights to coordinate movements in an intersection. A signal can be implemented at this intersection. Determining correct timing and/or coordination with other signals is an important factor. This alternative will be considered further in engineering analysis.

<u>Step 2 – Engineering Analysis</u>

Intersection 1 – Theodore Street and Eucalyptus Avenue

- **Stop Control**
  A traffic simulation was run using a stop controlled intersection for entry points. The image below describes the optimized lane configuration and stop sign locations. The intersection is optimized to be an all-way stop control. Predicted 2040 peak hour traffic volumes were used.

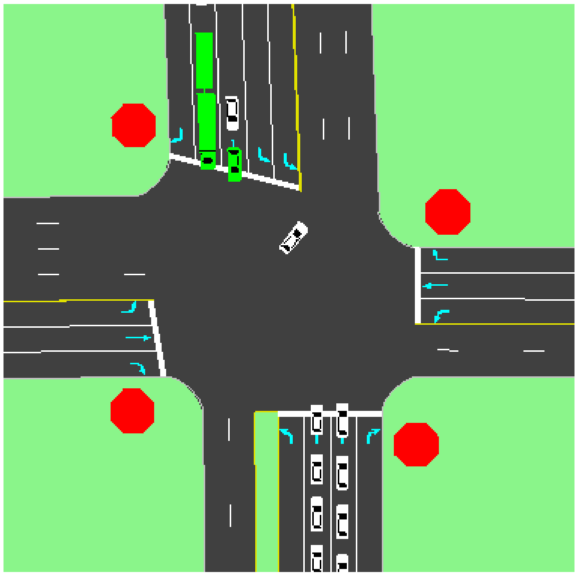

Figure 7. A stop control simulation using projected 2040 volumes.

Results from the Synchro analysis concluded that the stop-controlled intersection will breakdown. The Level of Service at this intersection during peak hours are in the table below. Because the AM peak hour shows a Level of Service of F, this alternative will not be considered.

Table 12. Level of Service of Stop Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
F	F

- **Roundabout Control**
  A traffic simulation was run using a traditional roundabout using yield control for entry points. Lanes from all streets were reduced to two before entering the two lane roundabout. Predicted 2040 peak hour traffic volumes were used.

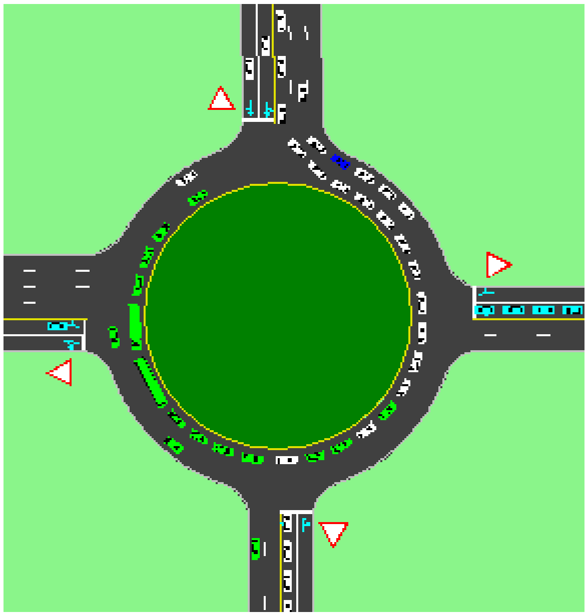

Figure 8. Roundabout simulation using projected 2040 values.

Results from the Synchro analysis concluded that the roundabout will breakdown. The Level of Service at this intersection during peak hours are in the table below. Because the AM peak hour shows a Level of Service of F, this alternative will not be considered.

Table 13. Level of Service of Yield Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
F	F

- **Signalized**
  A traffic simulation was run using a signalized control. Signals were implemented at this intersection, with a change of lane configurations of the surrounding streets and an optimization in phasing/timing of the signal. Predicted 2040 peak hour traffic volumes were used.

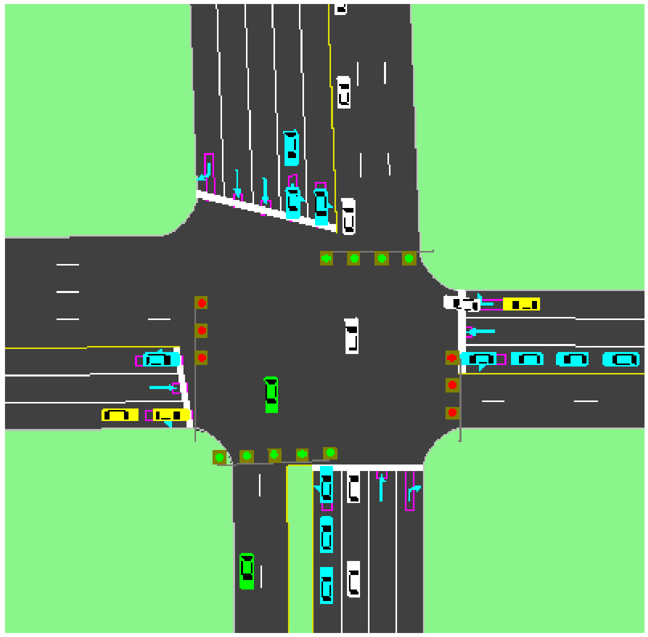

Figure 9. Signalized intersection using projected 2040 PM traffic volumes.

Results from the Synchro analysis concluded that signalized control can handle the input. The Level of Service at this intersection during peak hours are in the table below. Because the AM peak hour shows a Level of Service of C, this alternative will be used.

Table 14. Level of Service of Signal Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
C	D

Intersection 2 – Theodore Street and SR-60 EB

Intersection two has a special intersection geometry which allows only for signalized in order to optimize the Level of Service.

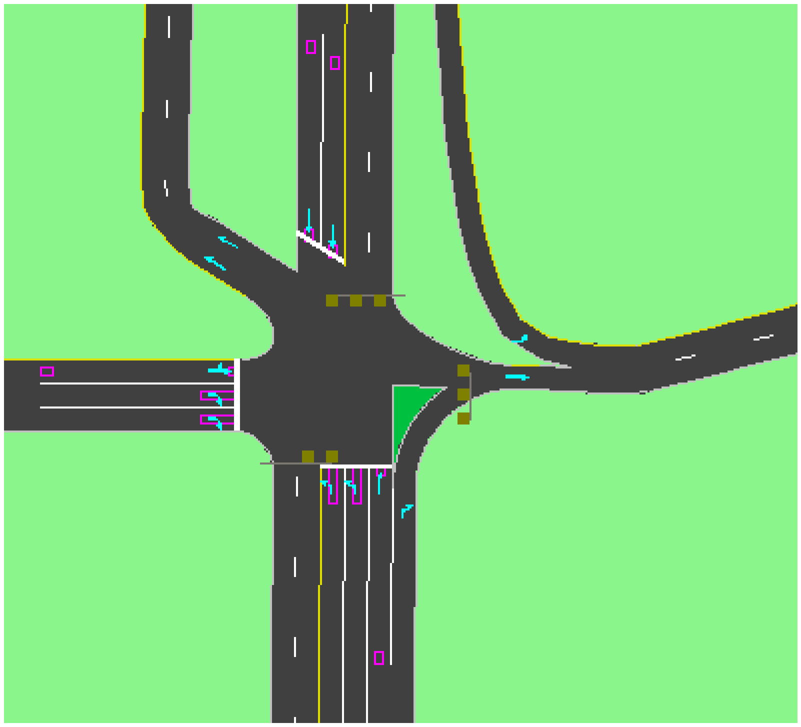

Figure 10. Signalized intersection using projected 2040 PM traffic volumes.

Results from the Synchro analysis concluded that signalized control can handle the input. The Level of Service at this intersection during peak hours are in the table below. Because the AM peak hour shows a Level of Service of C, this alternative will be used.

Table 5. Level of Service of Signal Controlled Intersection at Theodore and SR-60 EB Ramp.

AM Level of Service	PM Level of Service
C	D

Intersection 3 – Theodore Street and SR-60 WB

Intersection three has a special intersection geometry which allows only for signalized in order to optimize the Level of Service.

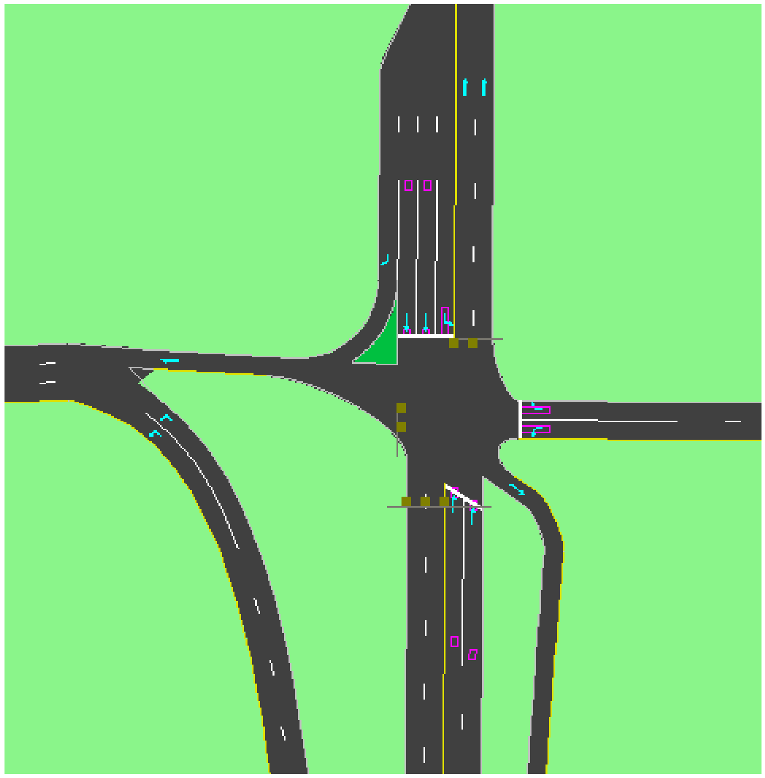

Figure 11. Signalized intersection using projected 2040 PM traffic volumes.

Results from the Synchro analysis concluded that signalized control can handle the input. The Level of Service at this intersection during peak hours are in the table below. Because the AM peak hour shows a Level of Service of A, this alternative will be used.

Table 6. Level of Service of Signal Controlled Intersection at Theodore and SR-60 WB Ramp.

AM Level of Service	PM Level of Service
A	A

Intersection 4 – Theodore Street and Ironwood Avenue

- **Stop Control**
  A traffic simulation was run using a stop controlled intersection for entry points. The image below describes the optimized lane configuration and stop sign locations. The intersection is optimized to be a two-way stop control. Predicted 2040 peak hour traffic volumes were used.

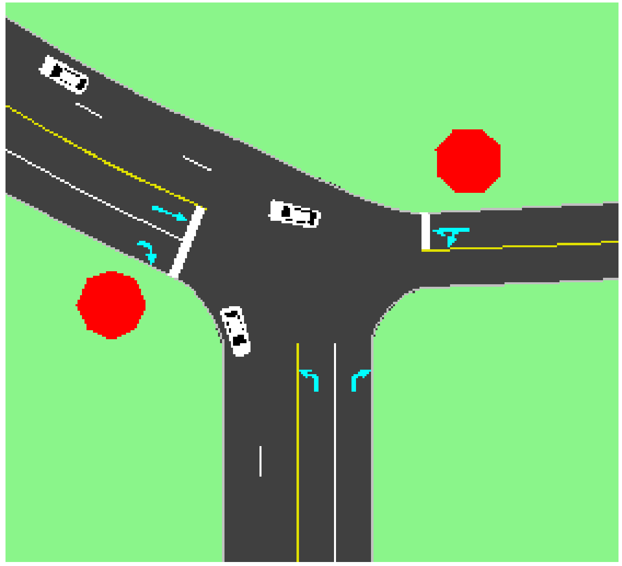

Figure 12. A stop control simulation using projected 2040 volumes.

Results from the Synchro analysis concluded that the stop-controlled intersection will breakdown. The Level of Service at this intersection during peak hours are in the table below. Because the AM peak hour shows a Level of Service of A, this alternative will be considered.

Table 7. Level of Service of Stop Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
A	A

- **Roundabout Control**
  A traffic simulation was run using a traditional roundabout using yield control for entry points. Lanes from all streets were reduced to two before entering the two lane roundabout. Predicted 2040 peak hour traffic volumes were used.

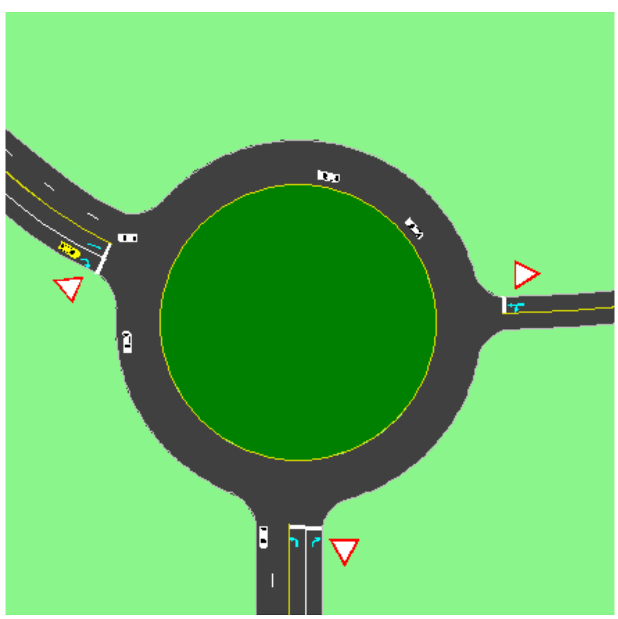

Figure 13. Roundabout simulation using projected 2040 values.

Results from the Synchro analysis concluded that the roundabout will breakdown. The Level of Service at this intersection during peak hours are in the table below. Because the AM peak hour shows a Level of Service of A, this alternative will be considered.

Table 8. Level of Service of Yield Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
A	A

- **Signalized**
  A traffic simulation was run using a signalized control. Signals were implemented at this intersection, with a change of lane configurations of the surrounding streets and an optimization in phasing/timing of the signal. Predicted 2040 peak hour traffic volumes were used.

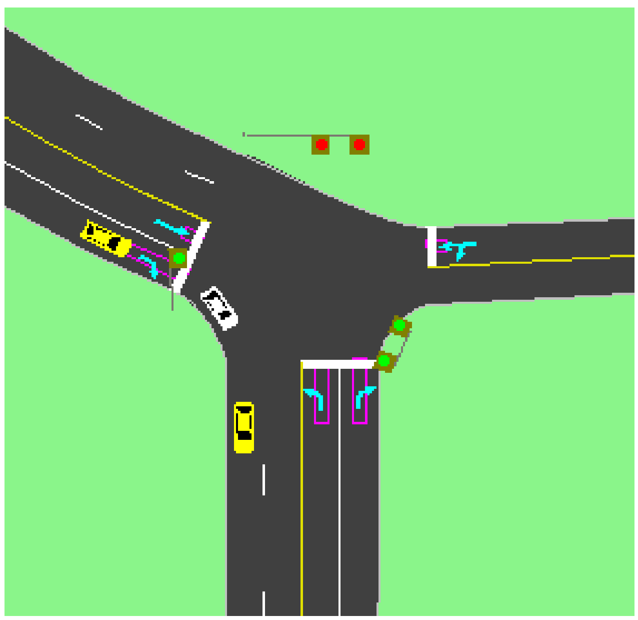

Figure 14. Signalized intersection using projected 2040 PM traffic volumes.

Results from the Synchro analysis concluded that signalized control can handle the input. The Level of Service at this intersection during peak hours are in the table below. Because the AM peak hour shows a Level of Service of A, this alternative will be considered.

Table 9. Level of Service of Signal Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
A	A

Evaluation Summary

Stop control, roundabout control and non-traditional control at intersections 1 is not likely to work due to high volumes that are projected to exist within the life of the proposed project, year 2040. Therefore, these alternatives will be rejected.

Based on an evaluation using predicted traffic conditions, signalized control for all intersections is the likely candidate to be chosen for the CFI and therefore recommended for the project.

Table 10. Recommended Intersection Controls with Peak Hour Level of Service.

Intersection	Recommended Control	Level of Service	
		AM	PM
Eucalyptus Ave & Theodore St.	Signalized	C	D
EB SR-60 & Theodore St.	Signalized	C	D
WB SR-60 & Theodore St.	Signalized	A	A
Ironwood Ave. & Theodore St.	Stop	A	A

Intersection Control Evaluation Report Spread Diamond Interchange (SDI)

This report conforms to the Caltrans Traffic Operations Policy Directive 13-02.

Intersection Control Evaluation (ICE) is a directive issued by the California Department of Transportation (Caltrans) for all proposed highway intersection projects, whether new or for improvement. ICE is performed during the early stages of a project, allocating time to study which types of intersection control alternatives would work. Control types listed by ICE include stop, signal, roundabout and lane configuration changes. Each is to get ample time for consideration.

Project	SR-60 Theodore Ave Interchange Project
Alternative	Spread Diamond Interchange (SDI)
Clients	Caltrans and City of Moreno Valley
Location	An interchange at State Route 60 with Theodore Ave in the City of Moreno Valley, California.
Number of Intersections	4
Current Control(s)	Stop Signs

Need for Control

The project site is located in a heavily traveled corridor within the City of Moreno Valley. The interchange serves as an arterial between future residential expansion and future commercial properties. There will be significant truck and passenger vehicle volume increases for this interchange. Therefore, it is necessary to assess the feasibility of various control types for this project.

The four study intersections include

- Theodore Street and Eucalyptus
- Theodore Street and SR-60 Eastbound ramps
- Theodore Street and SR-60 Westbound ramps
- Theodore Street and Ironwood Avenue

The images below describe the existing configurations of the 4 study intersections.

Figure 1. Overview image of the intersections under consideration, numbered 1-4. The SDI alternative replaces the intersections numbered 2 and 3.

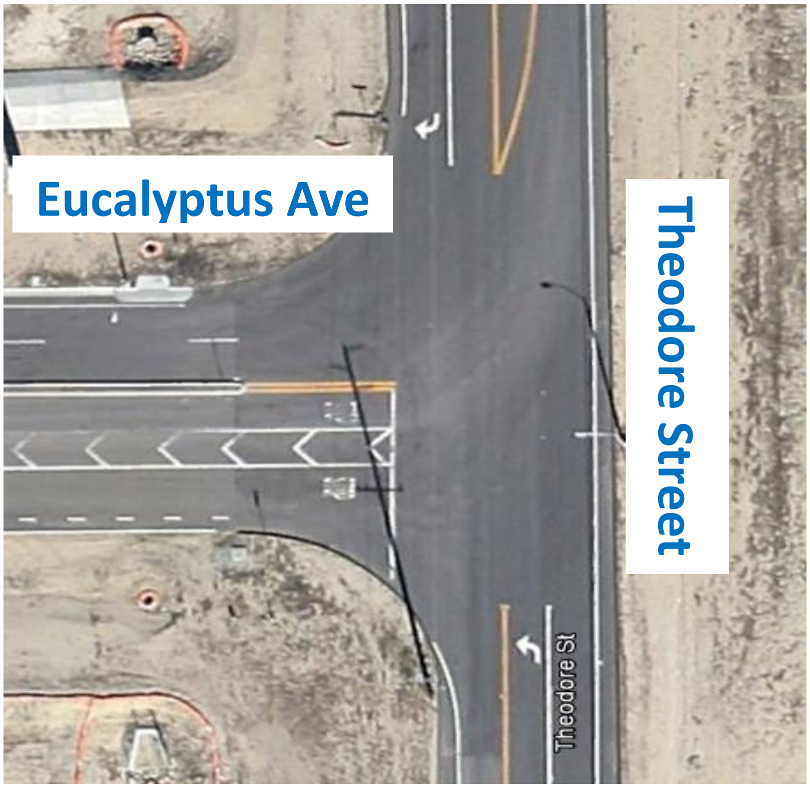

Figure 2. Intersection 1. Theodore Street and Eucalyptus Avenue.

Figure 3. Intersection 2. Theodore Street and EB Ramp of SR-60.

Figure 4. Intersection 3. Theodore Street and WB Ramp of SR-60.

Figure 5. Intersection 4. Theodore Street and Ironwood Avenue.

<u>Alternative Description</u>

A Spread Diamond Interchange (SDI) will replace the existing ramp intersections. The SDI is where the grade of the cross street is changed to pass over or under a freeway. The ramp terminals are spread in order to achieve maximum sight distance and minimum intersection cross slope, proportionate with construction and right of way costs, travel distance, and general appearance. A spread diamond has the advantage of flatter ramp grades, greater crossroads left-turn storage capacity, and the flexibility of permitting the construction of future loop ramps if required. Traffic analysis show that, with the help of a signal control, the Level of Service is better improved than that of the no build condition. Geometrically, the interchange can be well accommodated for regular and large truck traffic if including retaining walls at the bridge.
The table below summarizes the intersections control type and Level of Service using the 2040 projected peak hour volumes.

Table 15. Summary of Intersection Control Types and Levels of Service.

Intersection No.	**Intersection**	**Control Type**	**Level of Service**	
			A.M.	P.M.
1	Eucalyptus Ave. & Theodore St.	Stop	F	F
		Yield	F	F
		Signalized	B	D
2	EB SR-60 & Theodore St.	Stop	F	D
		Yield	D	F
		Signalized	A	D
3	WB SR-60 & Theodore St.	Stop	F	B
		Yield	D	F
		Signalized	D	D
4	Ironwood Ave. & Theodore St.	Stop	A	A
		Yield	A	A
		Signalized	A	A

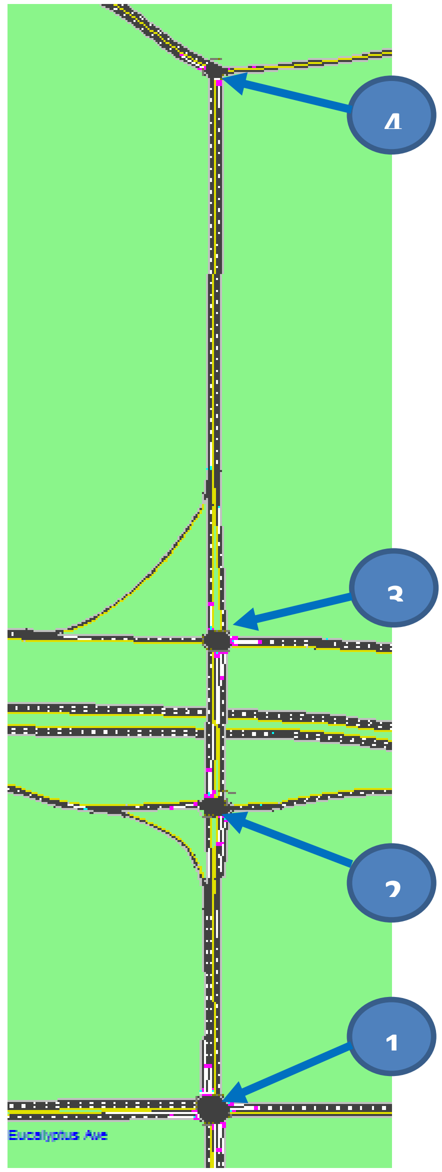

Figure 6. SDI model in Synchro.

Step 1 – Configuration Assessment

The following control types were assessed at the 4 intersections on Theodore Street.

- **Stop Control**
  A stop controlled intersection involves placing stop signs at the intersection, making vehicles that pass through it have to stop and pass with caution. The current control is of this type. This alternative will be considered further in engineering analysis.

- **Roundabout Control**
  Yield control involves slowing vehicle speed to a safe level while making them pay attention to other vehicles in the intersection. One type of yield control is the roundabout, a typically circular road where vehicles can enter and exit from different roads. A roundabout can be

implemented at this intersection. There is enough right of way to design a traditional roundabout, possibly with an increase of interior lanes and a road diet of the surrounding area. This alternative will be considered further in engineering analysis.

- **Signalized Control**
  A signalized control uses traffic lights to coordinate movements in an intersection. A signal can be implemented at this intersection. Determining correct timing and/or coordination with other signals is an important factor. This alternative will be considered further in engineering analysis.

<u>Step 2 – Engineering Analysis</u>

Intersection 1 – Theodore Street and Eucalyptus Avenue

- **Stop Control**
  A traffic simulation was run using a stop controlled intersection for entry points. The image below describes the optimized lane configuration and stop sign locations. The intersection is optimized to be an all-way stop control. Predicted 2040 peak hour traffic volumes were used.

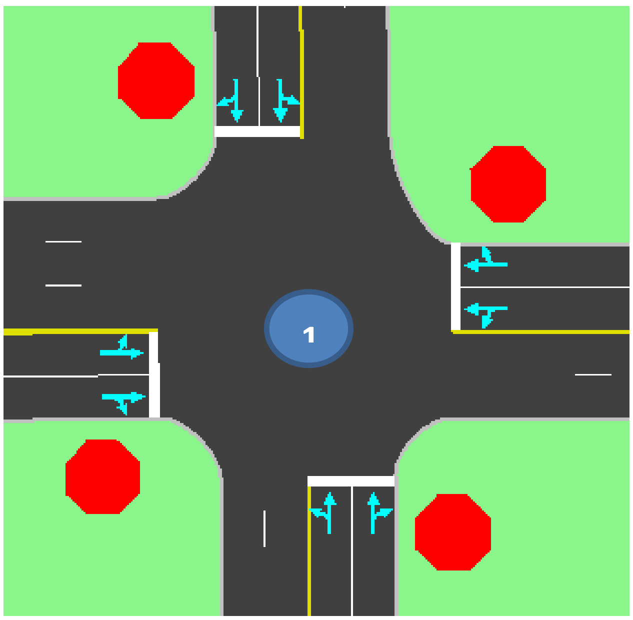

Figure 7. A stop control simulation at the intersection of Theodore and Eucalyptus using projected 2040 volumes.

Results from the Synchro analysis concluded that the stop-controlled intersection will breakdown. The Levels of Service at this intersection during peak hours are in the table below. Because both the AM and PM peak hours show levels of service of F, this alternative will not be considered.

Table 16. Level of Service of Stop Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
F	F

- **Roundabout Control**
  A traffic simulation was run using a traditional roundabout using yield control for entry points. Lanes from all streets were reduced to two before entering the two lane roundabout. Predicted 2040 peak hour traffic volumes were used.

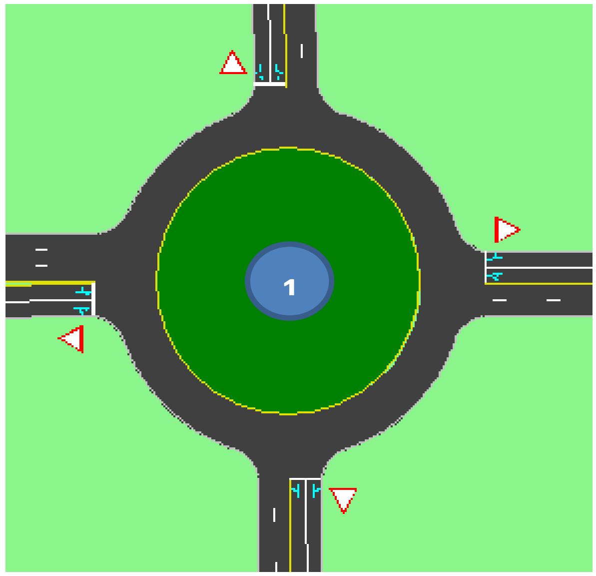

Figure 8. Roundabout simulation at the intersection of Theodore and Eucalyptus using projected 2040 values.

Results from the Synchro analysis concluded that the roundabout will breakdown. The Level of Service at this intersection during peak hours are in the table below. Because both the AM and PM peak hours show levels of service of F, this alternative will not be considered.

Table 17. Level of Service of Yield Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
F	F

- **Signalized**
  A traffic simulation was run using a signalized control. Signals were implemented at this intersection, with a change of lane configurations of the surrounding streets and an optimization in phasing/timing of the signal. Predicted 2040 peak hour traffic volumes were used.

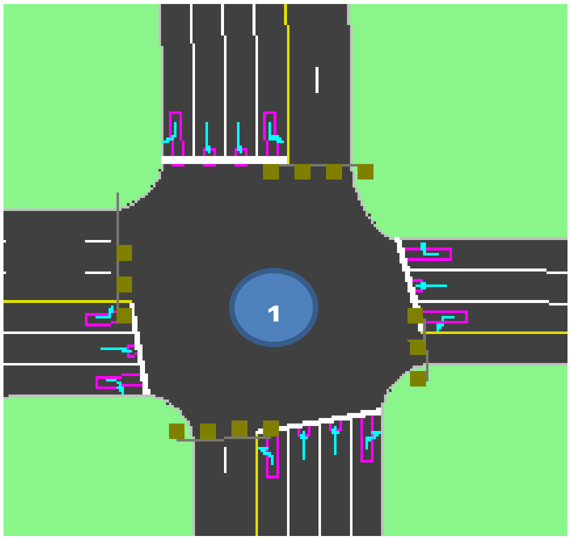

Figure 9. Signalized intersection at the intersection of Theodore and Eucalyptus using projected 2040 PM traffic volumes.

Results from the Synchro analysis concluded that signalized control can handle the input. The Level of Service at this intersection during peak hours are in the table below. Because the AM and PM peak hours show levels of service of B and D, respectively, this alternative will be considered.

Table 18. Level of Service of Signal Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
B	D

Intersection 2 – Theodore Street and SR-60 EB

- **Stop Control**
  A traffic simulation was run using a stop controlled intersection for entry points. The image below describes the optimized lane configuration and stop sign locations. The intersection is optimized to be an all-way stop control. Predicted 2040 peak hour traffic volumes were used.

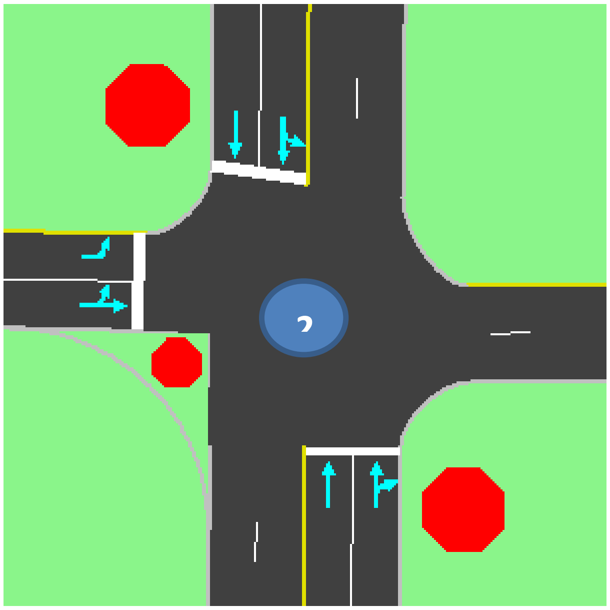

Figure 10. A stop control simulation at the intersection of Theodore and Eastbound SR-60 using projected 2040 volumes.

Results from the Synchro analysis concluded that the stop-controlled intersection can handle the input. The Level of Service at this intersection during peak hours are in the table below. Because the AM and PM peak hours show levels of service of C and D, respectively, this alternative will be considered.

Table 5. Level of Service of Stop Controlled Intersection at Theodore and Eastbound SR-60.

AM Level of Service	PM Level of Service
F	B

- **Roundabout Control**
  A traffic simulation was run using a traditional roundabout using yield control for entry points. Lanes from all streets were reduced to two before entering the two lane roundabout. Predicted 2040 peak hour traffic volumes were used.

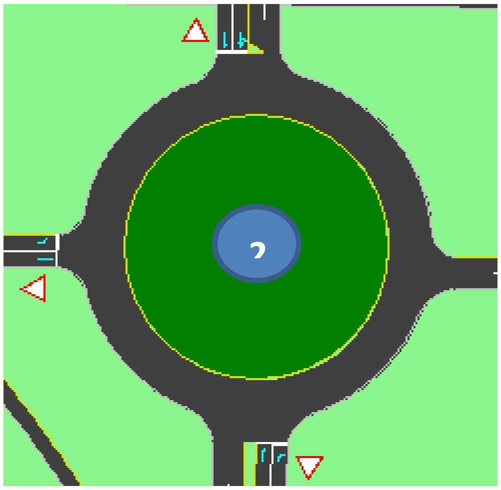

Figure 11. Roundabout simulation at the intersection of Theodore and Eastbound SR-60 using projected 2040 values.

Results from the Synchro analysis concluded that the roundabout will breakdown. The Level of Service at this intersection during peak hours are in the table below. Because the PM peak hour shows a Level of Service of F, this alternative will not be considered.

Table 6. Level of Service of Yield Controlled Intersection at Theodore and Eastbound SR-60.

AM Level of Service	PM Level of Service
D	F

- **Signalized**
  A traffic simulation was run using a signalized control. Signals were implemented at this intersection, with a change of lane configurations of the surrounding streets and an optimization in phasing/timing of the signal. Predicted 2040 peak hour traffic volumes were used.

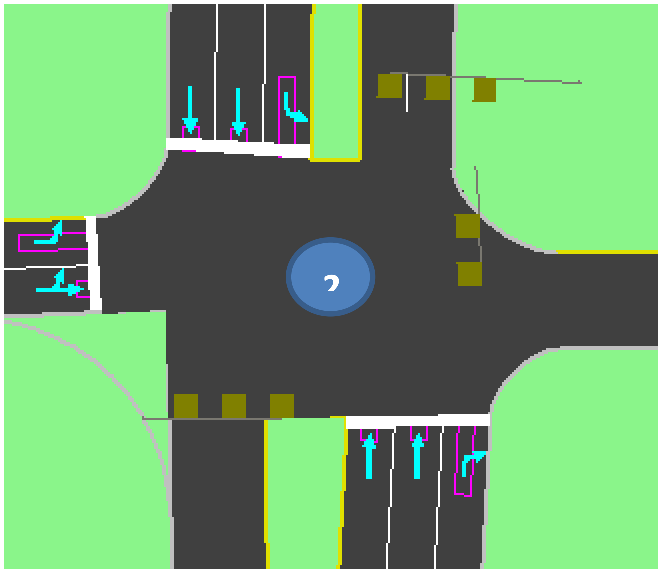

Figure 12. Signalized intersection at the intersection of Theodore and Eastbound SR-60 using projected 2040 PM traffic volumes.

Results from the Synchro analysis concluded that signalized control can handle the input. The Level of Service at this intersection during peak hours are in the table below. Because the AM and PM peak hours show levels of service of A and D, respectively, this alternative will be considered.

Table 7. Level of Service of Signal Controlled Intersection at Theodore and Eastbound SR-60.

AM Level of Service	PM Level of Service
A	D

Intersection 3 – Theodore Street and SR-60 WB

- **Stop Control**

A traffic simulation was run using a stop controlled intersection for entry points. The image below describes the optimized lane configuration and stop sign locations. The intersection is optimized to be an all-way stop control. Predicted 2040 peak hour traffic volumes were used.

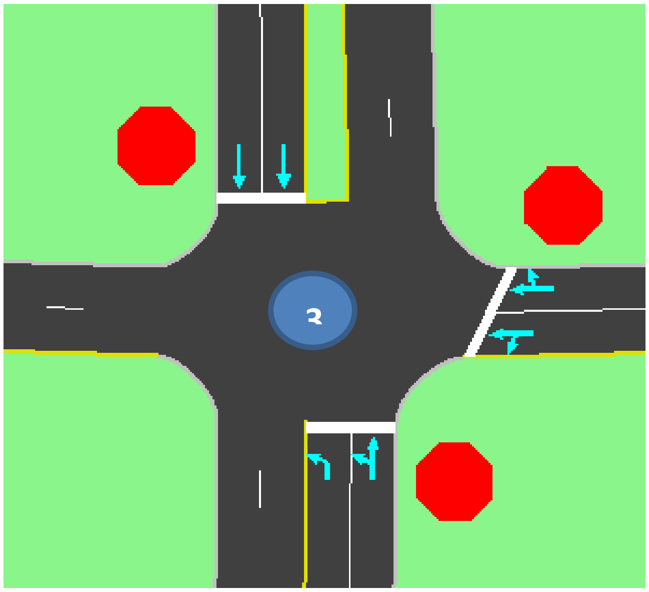

Figure 13. A stop control simulation at the intersection of Theodore and Westbound SR-60 using projected 2040 volumes.

Results from the Synchro analysis concluded that the stop-controlled intersection can handle the input. The Levels of Service at this intersection during peak hours are in the table below. Because both the AM and PM peak hours show levels of service of B, this alternative will be considered.

Table 8. Level of Service of Stop Controlled Intersection at Theodore and Westbound SR-60.

AM Level of Service	PM Level of Service
F	D

- **Roundabout Control**
  A traffic simulation was run using a traditional roundabout using yield control for entry points. Lanes from all streets were reduced to two before entering the two lane roundabout. Predicted 2040 peak hour traffic volumes were used.

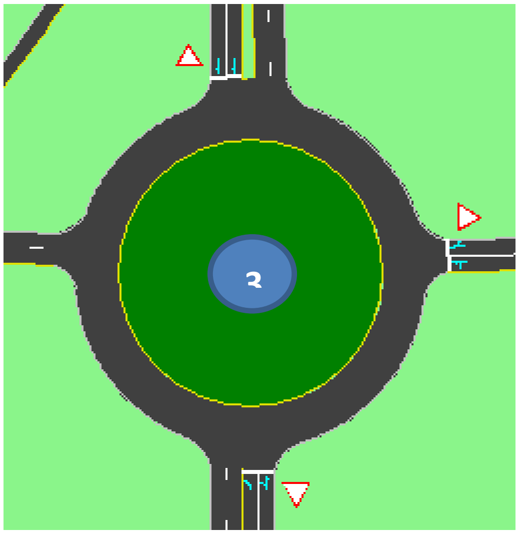

Figure 14. Roundabout simulation at the intersection of Theodore and Westbound SR-60 using projected 2040 values.

Results from the Synchro analysis concluded that the roundabout will breakdown. The Level of Service at this intersection during peak hours are in the table below. Because the PM peak hour shows a Level of Service of F, this alternative will not be considered.

Table 9. Level of Service of Yield Controlled Intersection at Theodore and Westbound SR-60.

AM Level of Service	PM Level of Service
D	F

- **Signalized**
  A traffic simulation was run using a signalized control. Signals were implemented at this intersection, with a change of lane configurations of the surrounding streets and an optimization in phasing/timing of the signal. Predicted 2040 peak hour traffic volumes were used.

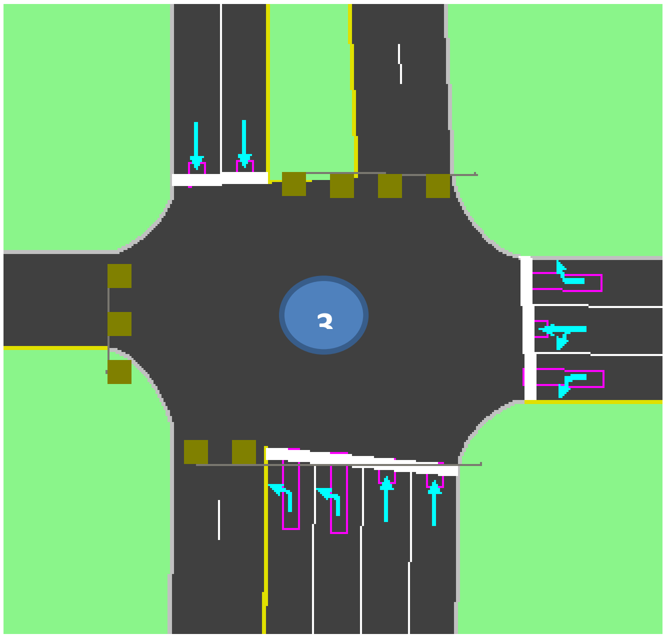

Figure 15. Signalized intersection at the intersection of Theodore and Westbound SR-60 using projected 2040 PM traffic volumes.

Results from the Synchro analysis concluded that signalized control can handle the input. The Levels of Service at this intersection during peak hours are in the table below. Because both the AM and PM peak hours show levels of service of D, this alternative will be considered.

Table 10. Level of Service of Signal Controlled Intersection at Theodore and Westbound SR-60.

AM Level of Service	PM Level of Service
D	D

Intersection 4 – Theodore Street and Ironwood Avenue

- **Stop Control**
  A traffic simulation was run using a stop controlled intersection for entry points. The image below describes the optimized lane configuration and stop sign locations. The intersection is optimized to be an all-way stop control. Predicted 2040 peak hour traffic volumes were used.

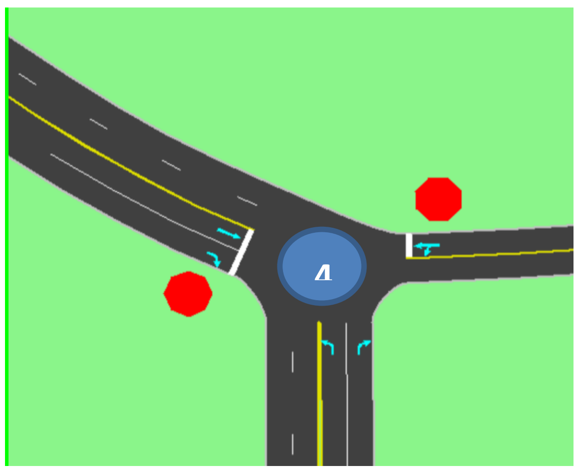

Figure 16. A stop control simulation at the intersection of Theodore and Ironwood using projected 2040 volumes.

Results from the Synchro analysis concluded that the stop-controlled intersection can handle the input. The Level of Service at this intersection during peak hours are in the table below. Because both the AM and PM peak hours show levels of service of A, this alternative will be considered.

Table 11. Level of Service of Stop Controlled Intersection at Theodore and Ironwood.

AM Level of Service	PM Level of Service
A	A

- **Roundabout Control**
  A traffic simulation was run using a traditional roundabout using yield control for entry points. Lanes from all streets were reduced to two before entering the two lane roundabout. Predicted 2040 peak hour traffic volumes were used.

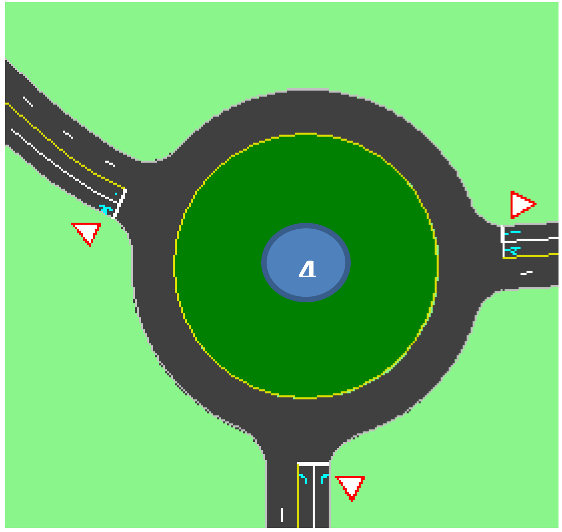

Figure 17. Roundabout simulation the intersection of Theodore and Ironwood using projected 2040 values.

Results from the Synchro analysis concluded that the roundabout will breakdown. The Level of Service at this intersection during peak hours are in the table below. Because both the AM and PM peak hours show levels of service of A, this alternative will be considered.

Table 12. Level of Service of Yield Controlled Intersection at Theodore and Ironwood.

AM Level of Service	PM Level of Service
A	A

- **Signalized**
  A traffic simulation was run using a signalized control. Signals were implemented at this intersection, with a change of lane configurations of the surrounding streets and an optimization in phasing/timing of the signal. Predicted 2040 peak hour traffic volumes were used.

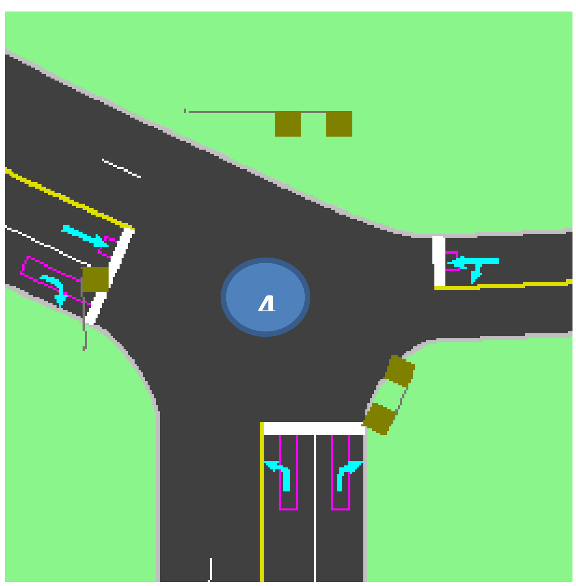

Figure 18. Signalized intersection the intersection of Theodore and Ironwood using projected 2040 PM traffic volumes.

Results from the Synchro analysis concluded that signalized control can handle the input. The Level of Service at this intersection during peak hours are in the table below. Because both the AM and PM peak hour shows a Level of Service of A, this alternative will be considered.

Table 12. Level of Service of Signal Controlled Intersection at Theodore and Ironwood.

AM Level of Service	PM Level of Service
A	A

Evaluation Summary

Stop control, roundabout control and non-traditional control at intersections 1, 2 and 3 are not likely to work due to high volumes that are projected to exist within the life of the proposed project, year 2040. Therefore, these alternatives will be rejected.

Based on an evaluation using predicted traffic conditions, signalized control for intersections 1, 2, and 3 are the likely candidates to be chosen for the SDI and therefore recommended for the project. Intersection 4's LOS does not change with the existing lane configuration and control type. Therefore, intersection 4 will stay stop controlled.

Table 13. Recommended Intersection Controls with Peak Hour Level of Service.

Intersection No.	Intersection	Recommended Control	Level of Service	
			AM	PM
1	Eucalyptus Ave & Theodore St.	Signal	B	C
2	EB SR-60 & Theodore St.	Signal	A	C
3	WB SR-60 & Theodore St.	Signal	D	D
4	Ironwood Ave. & Theodore St.	Stop	A	A

Intersection Control Evaluation Report Partial Clover Interchange (ParClo)

This report conforms to the Caltrans Traffic Operations Policy Directive 13-02.

Intersection Control Evaluation (ICE) is a directive issued by the California Department of Transportation (Caltrans) for all proposed highway intersection projects, whether new or for improvement. ICE is performed during the early stages of a project, allocating time to study which types of intersection control alternatives would work. Control types listed by ICE include stop, signal, roundabout and lane configuration changes. Each is to get ample time for consideration.

Project	SR-60 Theodore Ave Interchange Project
Alternative	Partial Clover Interchange (ParClo)
Clients	Caltrans and City of Moreno Valley
Location	An interchange at State Route 60 with Theodore Ave in the City of Moreno Valley, California.
Number of Intersections	4
Current Control(s)	Stop Signs

Need for Control

The project site is located in a heavily traveled corridor within the City of Moreno Valley. The interchange serves as an arterial between future residential expansion and future commercial properties. There will be significant truck and passenger vehicle volume increases for this interchange. Therefore, it is necessary to assess the feasibility of various control types for this project.

The four study intersections include

- Theodore Street and Eucalyptus
- Theodore Street and SR-60 Eastbound ramps
- Theodore Street and SR-60 Westbound ramps
- Theodore Street and Ironwood Avenue

The images below describe the existing configurations of the 4 study intersections.

Figure 1. Overview image of the intersections under consideration, numbered 1-4. The ParClo alternative replaces the intersections numbered 2 and 3.

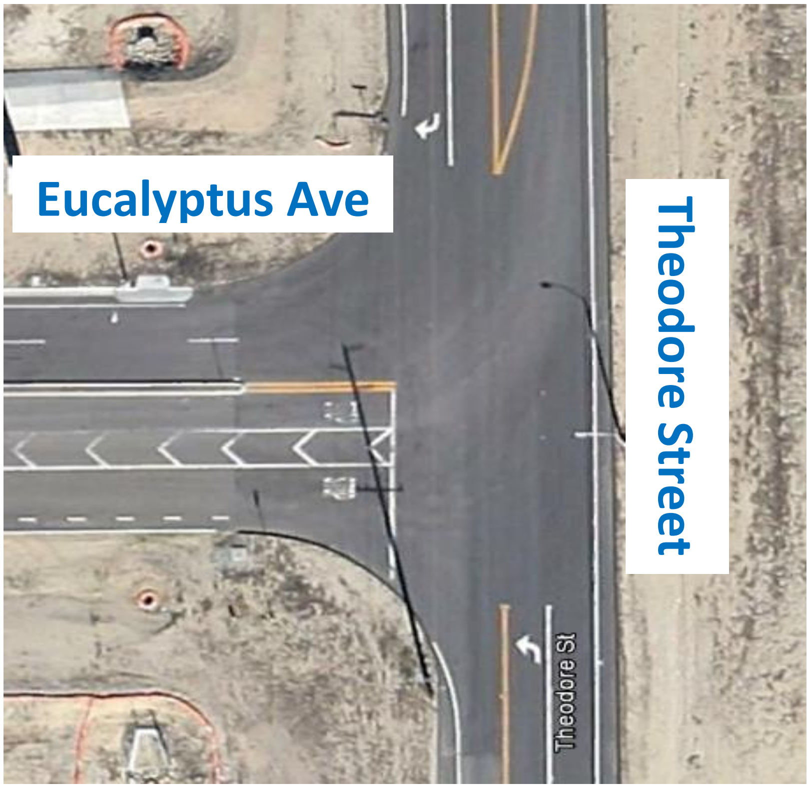

Figure 2. Intersection 1. Theodore Street and Eucalyptus Avenue.

Figure 3. Intersection 2. Theodore Street and EB Ramp of SR-60.

Figure 4. Intersection 3. Theodore Street and WB Ramp of SR-60.

Figure 5. Intersection 4. Theodore Street and Ironwood Avenue.

Alternative Description

A partial clover (ParClo) will replace the existing ramp intersections. The ParClo is where the grade of the cross street is changed to pass over a freeway. Some ramp terminals are spread in order to achieve maximum sight distance and minimum intersection cross slope, proportionate with construction and right of way costs, travel distance, and general appearance. Some ramp terminals are clovers in order to avoid right of way accusation costs. Traffic analysis show that, with the help of a signal control, the Level of Service is better improved than that of the no build condition. Geometrically, the interchange can be well accommodated for regular and large truck traffic if including retaining walls at the bridge.

The table below summarizes the intersections control type and Level of Service using the 2040 projected peak hour volumes.5

Table 19. Summary of Intersection Control Types and Levels of Service.

Intersection No.	**Intersection**	**Control Type**	**Level of Service**	
			A.M.	P.M.
1	Eucalyptus Ave. & Theodore St.	Stop	F	F
		Yield	F	F
		Signalized	C	C
2	EB SR-60 & Theodore St.	Stop	F	F
		Yield	F	F
		Signalized	D	B
3	WB SR-60 & Theodore St.	Stop	F	F
		Yield	F	F
		Signalized	C	C
4	Ironwood Ave. & Theodore St.	Stop	A	A
		Yield	A	A
		Signalized	A	A

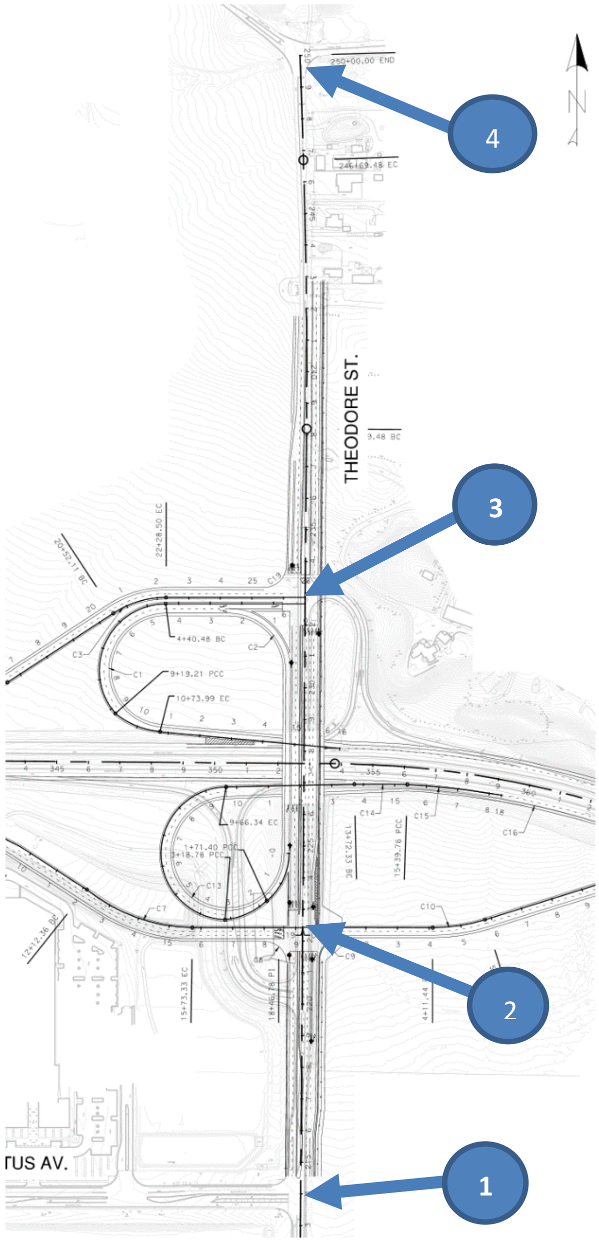

Figure 6. ParClo model in AutoCAD.

Step 1 – Configuration Assessment

The following control types were assessed at the 4 intersections on Theodore Street.

- **Stop Control**
  A stop controlled intersection involves placing stop signs at the intersection, making vehicles that pass through it have to stop and pass with caution. The current control is of this type. This alternative will be considered further in engineering analysis.

- **Roundabout Control**
  Yield control involves slowing vehicle speed to a safe level while making them pay attention to other vehicles in the intersection. One type of yield control is the roundabout, a typically circular road where vehicles can enter and exit from different roads. A roundabout can be implemented at this intersection. There is enough right of way to design a traditional roundabout, possibly with an increase of interior lanes and a road diet of the surrounding area. This alternative will be considered further in engineering analysis.

- **Signalized Control**
  A signalized control uses traffic lights to coordinate movements in an intersection. A signal can be implemented at this intersection. Determining correct timing and/or coordination with other signals is an important factor. This alternative will be considered further in engineering analysis.

<u>Step 2 – Engineering Analysis</u>

Intersection 1 – Theodore Street and Eucalyptus Avenue

- **Stop Control**
  A traffic simulation was run using a stop controlled intersection for entry points. The image below describes the optimized lane configuration and stop sign locations. The intersection is optimized to be an all-way stop control. The roadway should be 4 lanes across for pedestrian crossing safety. Predicted 2040 peak hour traffic volumes were used.

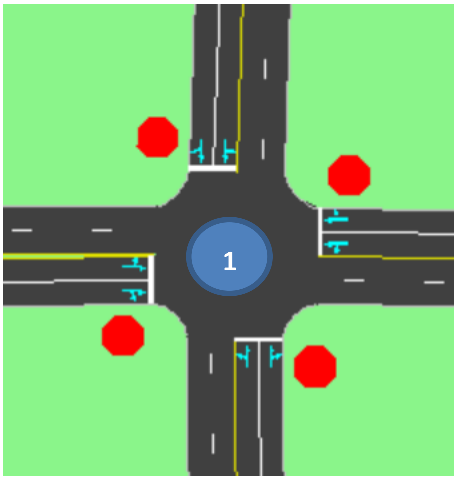

Figure 7. A stop control simulation at the intersection of Theodore and Eucalyptus using projected 2040 volumes.

Results from the Synchro analysis concluded that the stop-controlled intersection will breakdown this intersection. The Level of Service at this intersection during peak hours are in the table below. There are too many vehicles for only 2 lanes in both directions. A queue will form instantly due to large vehicular volume. The number of lanes is not advised to go over 2 for a stop controlled intersection. It should be 2 lanes maximum to reduce conflict points and limit pedestrian crossing distance. Because the peak hours display a Level of Service of F at the optimized lane configuration, this alternative will not be considered.

Table 20. Level of Service of Stop Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
F	F

- **Roundabout Control**
  A traffic simulation was run using a traditional roundabout using yield control for entry points. Lanes from all streets were reduced to two before entering the two lane roundabout. Predicted 2040 peak hour traffic volumes were used.

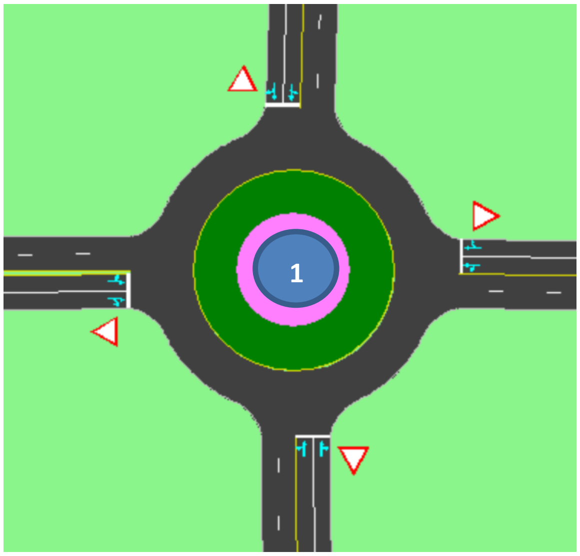

Figure 8. Roundabout simulation at intersection of Theodore and Eucalyptus using projected 2040 values.

Results from the Synchro analysis concluded that the roundabout will breakdown at the southern approach. The Level of Service at this intersection during peak hours are in the table below. Because the peak hour Level of Service is an F, this alternative will not be considered.

Table 21. Level of Service of Yield Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
F	F

- **Signalized**
  A traffic simulation was run using a signalized control. Signals were implemented at this intersection, with a change of lane configurations of the surrounding streets and an optimization in phasing/timing of the signal. Predicted 2040 peak hour traffic volumes were used.

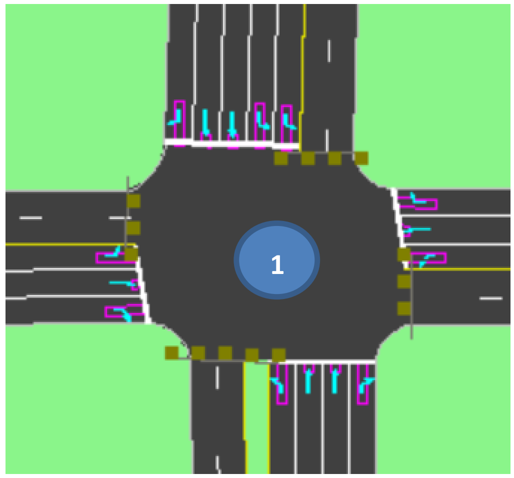

Figure 9. Signalized at the intersection of Theodore and Eucalyptus using projected 2040 PM traffic volumes.

Results from the Synchro analysis concluded that signalized control can handle the input. The Level of Service at this intersection during peak hours are in the table below. The peak hour Level of Service is a C. The minimum acceptable Level of Service is a D, so this intersection can be controlled with a signal.

Table 22. Level of Service of Signal Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
C	C

Intersection 2 – Theodore Street and SR-60 Eastbound Ramps

- **Stop Control**
  A traffic simulation was run using a stop controlled intersection for entry points. The image below describes the optimized lane configuration and stop sign locations. The intersection is optimized to be an all-way stop control. The roadway should be 4 lanes across for pedestrian crossing safety. Predicted 2040 peak hour traffic volumes were used.

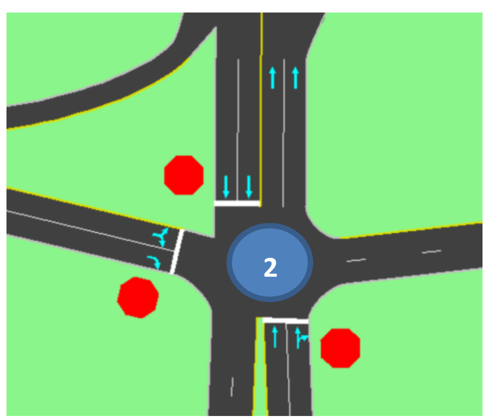

Figure 10. A stop control simulation at the intersection of Theodore and SR-60 Eastbound Ramps using projected 2040 volumes.

Results from the Synchro analysis concluded that the stop-controlled intersection will breakdown this intersection as well as effecting its adjacent intersection to the south at Theodore St and Eucalyptus Ave. Under stop controls, the queue will back up into the intersection of Theodore St and Eucalyptus Ave, not allowing vehicles to move forward. The Level of Service at this intersection during peak hours are in the table below. Because the peak hours display a Level of Service of F, this alternative will not be considered.

Table 5. Level of Service of Stop Controlled Intersection at Theodore and SR-60 Eastbound Ramps.

AM Level of Service	PM Level of Service
F	F

- **Roundabout Control**
  A traffic simulation was run using a traditional roundabout using yield control for entry points. Lanes from all streets were reduced to two before entering the two lane roundabout. Predicted 2040 peak hour traffic volumes were used.

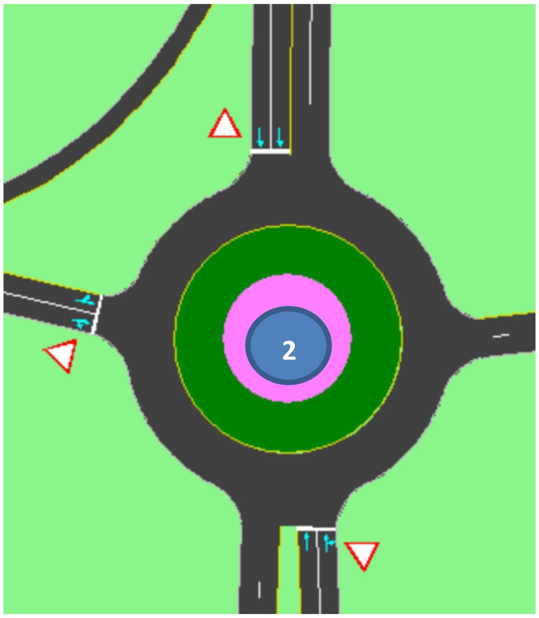

Figure 11. Roundabout simulation at the intersection of Theodore and SR-60 Eastbound Ramps using projected 2040 volumes.

Results from the Synchro analysis concluded that the roundabout will breakdown at the SR-60 eastbound off-ramp. The ramp's queue will reach the freeway causing backup on the mainline. The Level of Service at this intersection during peak hours are in the table below. Because the peak hour Level of Service is an F, this alternative will not be considered.

Table 6. Level of Service of Yield Controlled Intersection at Theodore and SR-60 Eastbound Ramps.

AM Level of Service	PM Level of Service
F	F

- **Signalized**
  A traffic simulation was run using a signalized control. Signals were implemented at this intersection, with a change of lane configurations of the surrounding streets and an

optimization in phasing/timing of the signal. Predicted 2040 peak hour traffic volumes were used.

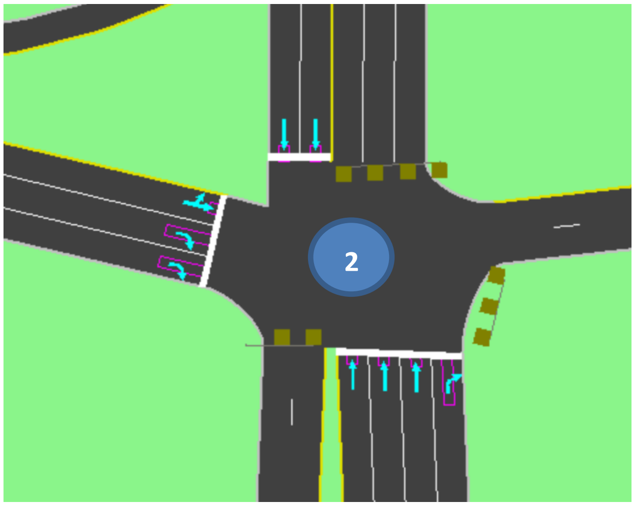

Figure 12. Signalized control the intersection of Theodore and SR-60 Eastbound Ramps using projected 2040 volumes.

Results from the Synchro analysis concluded that signalized control can handle the input. The Level of Service at this intersection during peak hours are in the table below. Because the PM peak hour shows a Level of Service of C, this alternative will be used. A level of C is an acceptable Level of Service.

Table 7. Level of Service of Signal Controlled Intersection at Theodore and SR-60 Eastbound Ramps.

AM Level of Service	PM Level of Service
B	C

Intersection 3 – Theodore Street and SR-60 Westbound Ramps

- **Stop Control**
  A traffic simulation was run using a stop controlled intersection for entry points. The image below describes the optimized lane configuration and stop sign locations. The intersection is optimized to be an all-way stop control. The roadway should be 4 lanes across for pedestrian crossing safety. Predicted 2040 peak hour traffic volumes were used.

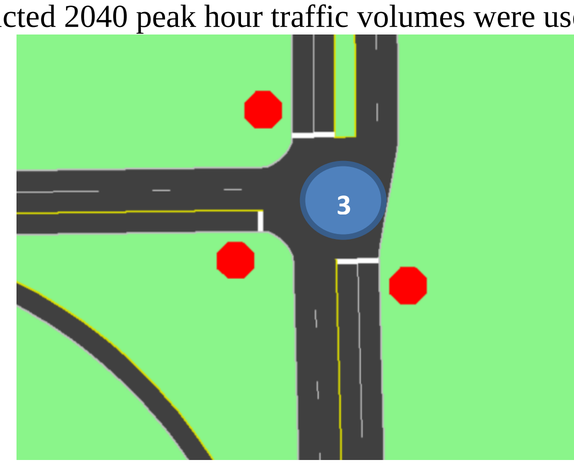

Figure 13. A stop control simulation at the intersection of Theodore and SR-60 Westbound Ramps using projected 2040 volumes.

Results from the Synchro analysis concluded that the stop-controlled intersection will breakdown. The Level of Service at this intersection during peak hours are in the table below. The simulation displayed that 2 lanes in each direction does not cater to the large volume of vehicles. Because the peak hours have a Level of Service of F, this alternative will not be considered.

Table 8. Level of Service of Stop Controlled Intersection at Theodore and SR-60 Westbound Ramps.

AM Level of Service	PM Level of Service
F	F

- **Roundabout Control**
  A traffic simulation was run using a traditional roundabout using yield control for entry points. Lanes from all streets were reduced to two before entering the two lane roundabout. Predicted 2040 peak hour traffic volumes were used.

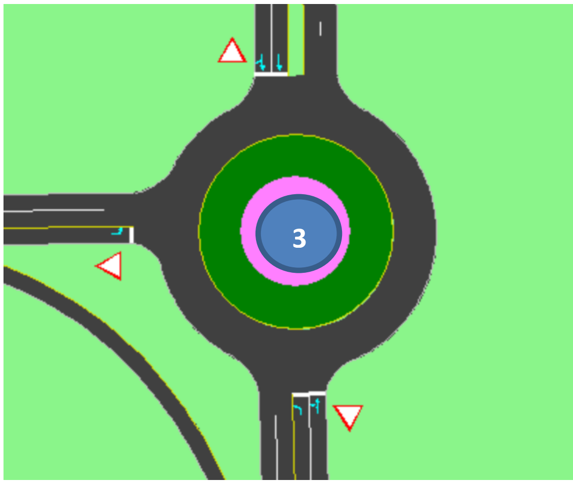

Figure 14. Roundabout simulation at the intersection of Theodore and SR-60 Westbound Ramps using projected 2040 volumes.

Results from the Synchro analysis concluded that the roundabout will breakdown at the southern approach on Theodore St. The Level of Service at this intersection during peak hours are in the table below. Because the peak hour Level of Service is an F, this alternative will not be considered.

Table 9. Level of Service of Yield Controlled Intersection at Theodore and SR-60 Westbound Ramps.

AM Level of Service	PM Level of Service
F	F

- **Signalized**
  A traffic simulation was run using a signalized control. Signals were implemented at this intersection, with a change of lane configurations of the surrounding streets and an

optimization in phasing/timing of the signal. Predicted 2040 peak hour traffic volumes were used.

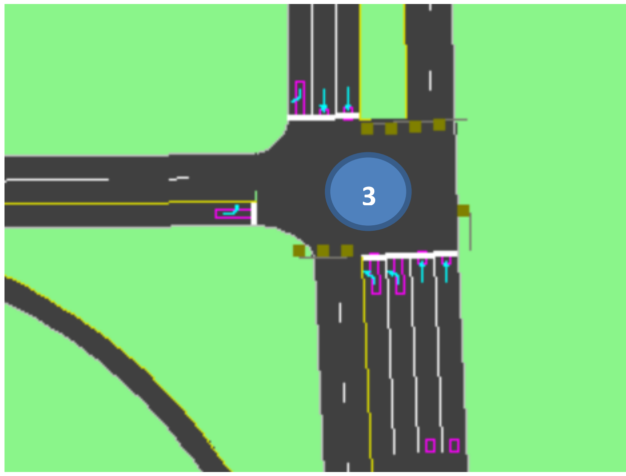

Figure 15. Signalized at the intersection of Theodore and SR-60 Westbound Ramps using projected 2040 volumes.

Results from the Synchro analysis concluded that signalized control can handle the input. The Level of Service at this intersection during peak hours are in the table below. The AM peak hour shows a Level of Service of D. The minimum acceptable Level of Service is a D, so this intersection can be controlled with a signal.

Table 10. Level of Service of Signal Controlled Intersection at Theodore and SR-60 Westbound Ramps.

AM Level of Service	PM Level of Service
D	B

Intersection 4 – Theodore St to Ironwood Ave

- **Stop Control**
  A traffic simulation was run using a stop controlled intersection for entry points. The image below describes the optimized lane configuration and stop sign locations. The intersection is optimized to be a 2-way stop control. Predicted 2040 peak hour traffic volumes were used.

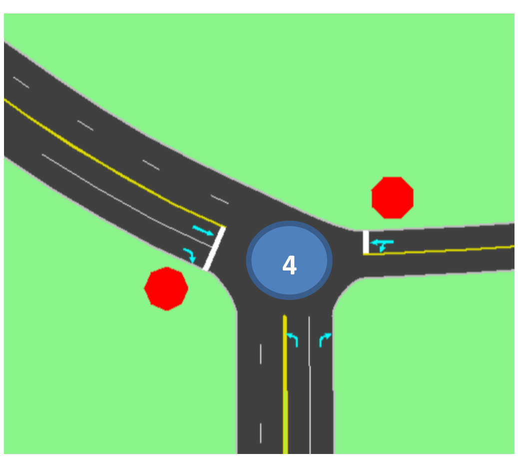

Figure 16. Stop control simulation at the intersection of Theodore and Ironwood using projected 2040 volumes.

Results from the Synchro analysis concluded that the stop-controlled intersection will work with the existing lane configuration and stop sign locations. The Level of Service at this intersection during peak hours are in the table below. Because the peak hours display a Level of Service of A, this alternative will be used.

Table 11. Level of Service of Stop Controlled Intersection at Theodore and Eucalyptus.

AM Level of Service	PM Level of Service
A	A

No other form of intersection control will be evaluated because the existing configuration works and will require no additional work or cost.

Evaluation Summary

Stop control, roundabout control and non-traditional control at intersections 1, 2 and 3 are not likely to work due to high volumes that are projected to exist within the life of the proposed project, year 2040. Therefore, these alternatives will be rejected.

Based on an evaluation using predicted traffic conditions, signalized control for intersections 1, 2, and 3 are the likely candidates to be chosen for the ParClo and therefore recommended for the project. Intersection 4's LOS does not change with the existing lane configuration and control type. Therefore, intersection 4 will stay stop controlled.

Table 12. Recommended Intersection Controls with Peak Hour Level of Service.

Intersection No.	Intersection	Recommended Control	Level of Service	
			AM	PM
1	Eucalyptus Ave & Theodore St.	Signal	C	C
2	EB SR-60 & Theodore St.	Signal	D	B
3	WB SR-60 & Theodore St.	Signal	C	C
4	Ironwood Ave. & Theodore St.	Stop	A	A