CHAPTER 3 – ALTERNATIVES

This chapter discusses the alternatives considered and examines the engineering aspects for feasible alternatives to address project objectives in Chapter 1 of this report.

3.1. Alternatives Considered and Eliminated from Further Study

The following alternatives were considered and are recommended for elimination from further study based on a review of the project needs and the resulting project objectives.

3.1.1. Area 3: Juncture of East Main Street, University Avenue, and Union Street

- Alternative 3A, Raise the Inner Loop at East Main Street to Grade (multiple options) - These alternatives consider complete reconstruction of the grade separated interchange and raising the Inner Loop to grade through the East Main Street juncture. Various sub alternatives have been developed that address some of the project needs related to operations, safety and accessibility, however no consensus solution has been found to date that is supported by the transportation agencies. Overall, East Main Street (along with University Avenue) at this juncture accommodates heavy commuter turning movements to/from the Inner Loop to the north, along with heavy inbound/outbound commuter traffic on East Main Street. Physical constraints and the complexity/volume of the traffic movements have inhibited the ability to develop consensus on urban scale designs.

  Terminating the Inner Loop expressway just south of East Main Street presents a logical terminus for the facility as mainline Inner Loop traffic volumes increase north of East Main Street. The elimination of this alternative from further study does include the needed transition of extending the slip ramps to Area 1. This alternative is recommended to be dropped from further consideration at this time.

Raising the eastern portion of the Inner Loop through the East Main Street/University Avenue area has two inevitable outcomes:

- Inner Loop through traffic will add approximately 600-700 vehicles per hour through this complex four-intersection juncture.
- South Union Street will become a two-way road; increasing traffic and turning movements at various intersections.

These two factors alone create operational complexities at this four-intersection juncture that may result in impacts to adjacent properties. As part of the Go/No Go decision, preliminary analysis identified two (2) traditional intersection alternatives that maintained levels of operation; however, would require notable widening on the existing Inner Loop/East Main Street ramps and the section of University Avenue between East Main Street and South Union Street. While this widening is needed to accommodate the at-grade Inner Loop, the widening in and of itself resulted in less than desirable conditions such as:

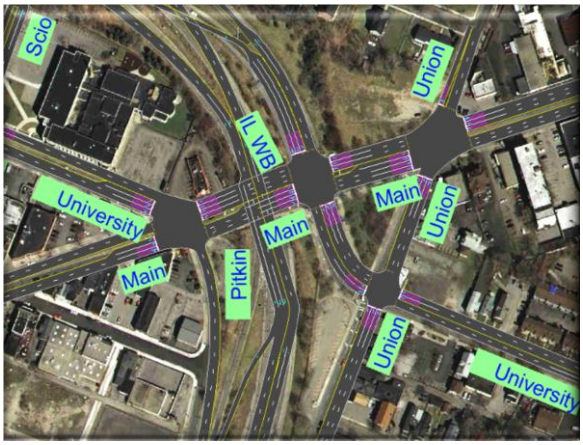
- Limited intersection spacing causing queuing and driver confusion which does not address the current safety concerns.
- Pedestrian/bicycle access along East Main Street would be negatively affected.
- Traffic operations – volume to capacity ratios, lane utilization factors and storage still a concern.

A subsequent review of other alternatives developed by the Advisory Committee members was undertaken. In addition, input from the involved agencies related to signal operations (lost time, lane utilization, and heavy vehicle factors) have been adjusted to better reflect current operations. Each alternative assessed for the East Main Street/University Avenue juncture have:

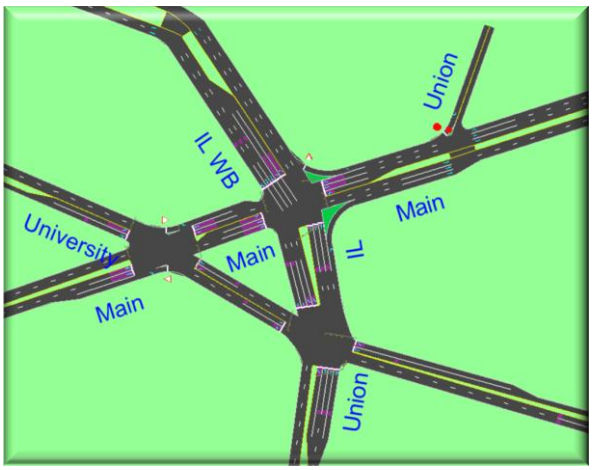
- Varying degrees of impact to adjacent properties or neighborhoods (ROW, parcel access, increased volumes, etc.)
- Additional travel lanes will increase pedestrian exposure and conflicts.
- Physical constraints in intersection spacing remain (without considerable impacts to adjacent properties).

Of the dozen alternatives considered and evaluated, three options surfaced. Evaluations of each alternative considered are provided in the appendix. The three options are as follows:

Option 1 (no change at Main Street) or Existing Conditions – This option is the no-build or null scenario for this comparison. This option is the baseline comparison scenario using the year 2035 traffic volumes with no geometric changes along the East Main Street corridor and University Avenue area. The East Main Street/ University Avenue area is a complex juncture of East Main Street, University Avenue (east and west ends), Inner Loop Ramps, North Union Street, South Union Street, and Pitkin Street. These streets all merge and form four (4) closely spaced, traffic signal controlled intersections. These four intersections are currently operating with one master controller to address progression and minimize queuing. The stretch of East Main Street is seven (7) lanes wide with left turn and right turn lanes at each intersection. All four intersections are projected to continue operating at overall Level "D" or better with no movements falling below level "E" by the year 2035 (design year) with one exception. This exception is at the intersection of East Main Street and North Union Street; the westbound approach during the evening peak hour is shown to operate at Level of Service F with queuing in excess of 600 feet and a high volume to capacity ratio. In fact, the four intersections are shown to have a volume to capacity ratio of 1.14 or over capacity conditions during peak intervals. In addition, there are safety concerns related to the limited storage between intersections that are causing driver confusion and impromptu lane changes that result in crashes. The physical constraints at this juncture do not provide adequate decision making distances, causing confusion, and abnormal lane utilization.



Option 4B (w/o North Union) – MCDOT Traffic Signal Modifications – This option brings the Inner Loop up to grade at the current intersection locations. The introduction of reconnecting University Avenue remains; however, the North and South Union connection is severed. Major operational signal modifications presented by Monroe County Department of Transportation are included in this option. This option includes operating the three major intersections on three separate traffic signal controllers versus the current one-master controller. This option allows for better optimization of intersection operations and reduction in travel lanes.

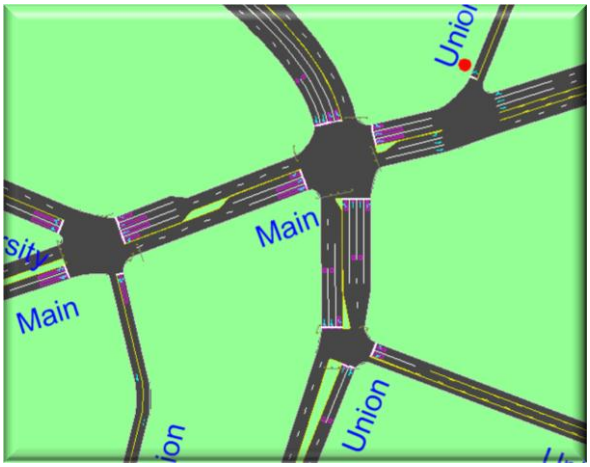


This option has the following to offer:

- Additional auxiliary/through lanes at Inner Loop/University Ave intersection;

- Eliminates one traffic signal at North Union Street, providing notable delay reductions to over 2,300 vehicles per hour;
- 50% reduction in queuing (PM Peak) on the westbound East Main Street approach to the Inner Loop ramps;
- Eliminates one eastbound through travel lane on East Main Street;
- Eliminates Pitkin Street approach;
- Reduces number of travel lanes on University (west end);
- Reconnects the University Avenue corridor;
- Requires widening of University Avenue at South Union to provide a westbound left turn lane. This widening will impact properties at the north and south corners of the intersection.
- Provides channelized right turn flows;
- Simplifies intersection geometry and number of driver decision points. This option addresses some of the current safety concerns;
- Improves volume to capacity ratios during the critical evening peak hour;
- Additional travel lanes will increase pedestrian exposure and conflicts.

Option 5 – T-University Avenue – This option notably simplifies the area and signal operations by eliminating the traffic signal at North Union St, aligning South Union with the East Main Street Inner Loop ramps and realigning University Avenue to form a T-intersection with South Union Street.



This option has the following to offer:

- Additional through lanes at Inner Loop/University Ave intersection;
- Eliminates a traffic signal at North Union Street, providing notable delay reductions to over 2,300 vehicles per hour;
- North Union Street neighborhood will experience longer delays;
- 50% reduction in queuing (PM Peak) on the westbound East Main Street approach to the Inner Loop ramps;
- Traffic signal at University/ Pitkin/Main Street could be replaced by a roundabout;
- Eliminates one eastbound through travel lane on East Main Street;
- Converts Pitkin Street to two-way operation;
- Reduces number of travel lanes on University Avenue (west end);
- Allows for better transition to the proposed University Avenue 3-lane section (east end);
- Simplifies intersection geometry and number of driver decision points. This option better addresses current safety concerns (driver confusion, lane changes, rear-ending, etc.);
- Improves volume to capacity ratios during the critical evening peak hour;
- Does not reconnect the University Avenue corridor.

Overall intersection operations can be maintained or improved with these alternatives. However, these alternatives present varying degrees of impact to adjacent neighbors, traffic operations and circulation in the immediate area. The impacts are minimized with the three options (versus other alternatives considered) and overall traffic operations can be maintained. Option 5 T-University Avenue provides the greatest benefits by addressing capacity while minimizing current safety patterns. Detailed assessment of these and all other alternatives assessed and how they compare to the challenges outlined above are provided in Appendix D – Main Street Alternatives.

Various sub alternatives have been developed that come close to addressing the project needs related to operations, safety and accessibility, however no consensus solution has been found to date that is supported by the transportation agencies. This alternative was dropped from consideration at

this time. It should be noted that raising the Inner Loop from Monroe Avenue to Charlotte Street will not preclude any of the potentially alternatives identified at the Juncture of East Main Street, University Avenue, Union Street and the Inner Loop Ramps. In addition, raising the Inner Loop from Monroe to Charlotte may alter (better distribute) travel patterns in the immediate area and may allow some of these intersection options to function at better levels acceptable to the transportation agencies.

3.2. Feasible Alternatives

3.2.1. Area 1: Inner Loop Expressway from Charlotte Street to Monroe Avenue

- Alternative 1A Remove the Inner Loop - This alternative considers complete reconstruction and bringing the Inner Loop to grade between Monroe Avenue and Charlotte Street, using the existing South Union Street configuration. This alternative, in many ways, is a "re-establish the street grid system" approach whereby South Union Street runs again north/south basically on its old alignment and the southern portion turns east/west by the National Museum of Play to I-490. This alternative would eliminate the existing retaining walls and bridges at East Avenue, Broad Street and possibly Monroe Avenue along with reducing pavement maintenance from ten lanes to five lanes.

- Alternative 1B Maintain/Rehabilitate Existing Expressway - Under this alternative, the basic infrastructure would be retained and maintenance and rehabilitation efforts would be performed by primarily the State, along with City and County forces to extend the service life of the existing pavement, structures and adjoining service roads and intersections. Overall the existing facility is an expensive long term facility to maintain with its expressway and frontage road layout, high retaining walls and crossing bridges at East Avenue and Broad Street. The original facility was built in 1965 and eventually will need significant investment.

Alternative 1A: Converting the Inner Loop expressway to a community-scale urban boulevard in Area 1 can take various shapes including general alignment options, intersection treatments and geometric requirements.

General Alignment Concepts – there are two general alignments that were reviewed – The Western Alignment which basically would follow the Pitkin Street Corridor, and the Eastern Alignment which would follow the South Union Street Corridor. The Eastern Alignment provides better connection to existing intersections with Monroe Avenue and the East Main Street juncture and appears to better facilitate community cohesion and redevelopment. This alignment provides improved access and the greatest area for future development on vacated lands and is therefore recommended.

Intersection Treatment – intersection traffic control was considered at each of the intersections to determine if a traffic signal control or a roundabout may be appropriate. Preliminary evaluations indicate that roundabouts are best suited at the intersection of Inner Loop and South Union Street and at the South Union Street / Charlotte Street location. Provision of roundabouts at each of these locations provides a clear terminus of the Inner Loop and the entrance to a new community. All other intersections may function best with a traffic signal. Further evaluation of the traffic control features will be undertaken in the next step of the project, especially considering the Broad Street and East Avenue intersections.

Minimum Geometric Requirements – detailed analysis was undertaken to determine the mainline geometric features necessary at each of the intersections. The majority of the South Union corridor will operate with one through lane in each direction. It is anticipated that both roundabouts will be single lane. Left turn lanes are recommended at the major signalized intersections of Broad Street and East Avenue. Left turn lanes at the minor side streets/alleys may be considered. It is envisioned that a center median or continuous center turn lanes may be appropriate between intersections.

Other factors such as on-street parking, bicycle facilities, pedestrian crossings, transit amenities and median treatments are anticipated and recommended. Detailed evaluation of these features will be

completed during the preliminary engineering phase. The conceptual alignment, intersection treatments and minimum geometric requirements is shown in Exhibit 3.4

The proposed project for Area 1 Inner Loop from Charlotte Street to Monroe Avenue under Alternative 1A includes the elimination of the expressway system and the creation of a community-scale urban boulevard that can accommodate the projected traffic, allow for economic re-development and enhance community cohesion. The project will eliminate the need to maintain, rehabilitate or replace:

- Three (3) traffic signals;
- Three (3) multi-span bridges;
- 70,000 square feet of retaining walls;
- Minimum of four (4) lane miles of the Inner Loop expressway system;
- Three (3) miles of highway shoulders, along with guide rail and other highway features.

Alternative 1B: To maintain/rehabilitate the existing Inner Loop Expressway means the basic infrastructure would be retained and maintenance and rehabilitation efforts would be performed primarily by the State, along with City and County forces, to extend the service life of the existing pavement, structures and adjoining service roads and intersections.

Overall the existing expressway system and frontage road layout will require on-going and long term investment to maintain the excessive road layout (four/six lane expressway plus two/three lane frontage roads), high retaining walls and rehabilitate or replace the bridges at East Avenue and Broad Street. While the bridges and retaining walls have not yet reached their life span, the cost to replace the Inner Loop in its current state has been estimated to be 1.3 times higher than to replace it with a more efficient at-grade boulevard. This option also would not address non-standard or non-conforming design features.

Maintaining the existing transportation network as is does not consider the broader community needs that include providing facilities for non-motorized users; breaking down superblocks that inhibit accessibility to neighborhoods and nearby businesses and civic places; does not allow for optimal use of the most valuable real estate in the Center City; and does not consider the importance of reconnecting the neighborhoods and Center City to ensure long term sustainability.

The recommended alternative to transform the limited access expressway to an urban scale boulevard will ultimately reduce the life-cycle costs to FHWA, NYSDOT, Monroe County and the City of Rochester, which all maintain or fund repairs and improvements in the southeast section. The poor condition of the infrastructure plus the community barrier this expressway has caused has produced lost opportunities for economic growth and continued growth in the community.

With respect to travel performance, the project can achieve the above, while adding little (2.2 seconds) delay per vehicle during the evening peak travel period by the year 2035. The Level of Service at the remaining three (3) reconfigured traffic signal control intersections will operate at LOS C with no traffic movements below LOS D. Energy consumption, as well as vehicle emissions, are projected to be reduced. These changes will also reduce the number and type of traffic accidents. With traffic potentially re-distributing along the new grid system, positive safety and capacity side effects on other nearby intersections maybe experienced. Thus, overall travel safety will be improved.

3.2.2. Area 2: Inner Loop Ramp to I-490

Two feasible options remain for this area which are, do nothing or build a new ramp connection from I-490.

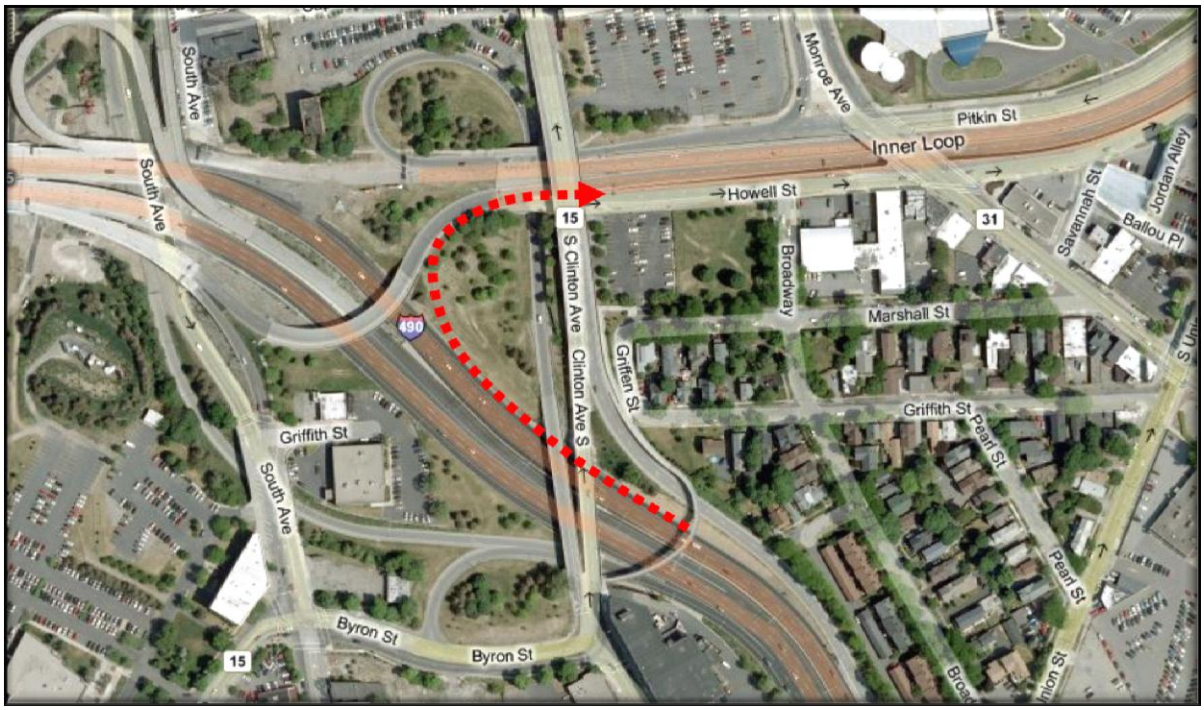
- Alternative 2A New I-490 Ramp - This alternative considers a new ramp connection from I-490 to the Inner Loop. The ramp would be placed immediately west (downstream) of the present two-lane Clinton Avenue exit to downtown. Construction of this ramp is considered feasible per the detailed evaluation completed with this study.

- Alternative 2B No Ramp Connection from I-490 – Maintain existing access to the general area via the Goodman Street exit. This no build option should be retained for future consideration. Currently, the Inner Loop has direct connections for three of the four movements with I-490 (eastbound ingress, and eastbound/westbound egress), however lacks a direct westbound connector ramp. Access is provided via the Goodman Street exit and the Broadway frontage road (through city neighborhoods) to Union Street / Inner Loop.

Currently the interchange between I-490 and the southeast connection with the Inner Loop is a partial interchange. The Inner Loop exit ramp from I-490 westbound is missing. I-490 access to this area is via the Goodman Street exit and then traffic proceeds along Broadway to South Union Street. The possibility of upgrading the I-490 interchange to a full directional interchange was investigated. Exhibit 3.1 shows the general area where this new ramp would be constructed. Exhibit 3.2 shows a general concept of this new ramp and its relationship to other streets and expressway ramps in the area.

Exhibit 3.1 – Ramp Location

Exhibit 3.2 – Ramp Concept



Merging a new I-490 westbound off-ramp with the existing I-490 eastbound off-ramp to the Inner Loop, would require the eastbound off-ramp to be reduced from two lanes to one lane. These improvements would also require the elimination of the slip ramp from the eastbound I-490 off-ramp to the Inner Loop at Howell Street, and the raising of the Inner Loop to grade at Monroe Avenue. The ramp, according to AASHTO, would be classified as a loop ramp and therefore was compared to the design standards (Exhibit 3.3) for a ramp from NYSDOT Highway Design Manual to determine any Non-Standard and Non-Conforming Features.

Non-Standard Features:

- *Design Speed:* The ramp would have a design speed of 15, 20, or 25 mph depending on the super-elevation that can be achieved; the recommended standard is 25 mph. I-490 in this section has a posted speed limit of 40 mph, but ramps at this interchange are posted for speeds of 20 mph (Inner Loop westbound to I-490 eastbound) and 30 mph (I-490 eastbound to Inner Loop eastbound). The proposed 25 mph ramp speed is thus compatible with other ramps within this same interchange.
- *Grade:* may not be an issue, but cannot be ruled out without doing a detailed design evaluation. Based on plans from the I-490 project, the grade would be around 4.5%, the standard is a maximum grade of 7%.

Non-Conforming Features:

- *Super-elevation Transition:* This is an issue with the Inner Loop bridge that goes over the Inner Loop ramp to South Clinton Avenue. Normally a ramp would start to transition out of super-elevation in this area, but because of the bridge, it holds a constant cross slope, and forces the transition further out into the tangent section.

Other Features

- *Exit Ramp Spacing*: between the new I-490 westbound off-ramp and the existing I-490 off-ramp to South Clinton Avenue was reviewed. The minimum exit spacing according to AASHTO should be a minimum of 1000 feet between successive exit ramps. The spacing between the new ramp and the existing ramp is approximately 1005 feet.
- *Inner Loop Interchange with Monroe Avenue/Chestnut Street:* The new ramp would require the grade separation and interchange with Monroe Avenue be removed and replaced with an at-grade, traffic signal controlled intersection. There is insufficient distance between the merge point

of the off-ramps to the Inner Loop and the Monroe Avenue exit ramp to allow traffic to merge and weave under the existing conditions and this would be resolved with the improvements.

An analysis was undertaken to determine the possible diversion of I-490 westbound traffic that may use this new ramp in the year 2035 and its impacts on traffic operations. The full assessment is provided in Appendix C. This analysis indicates the following:

- The new off-ramp is estimated to divert between 300 to 450 vehicles during the morning peak travel hour and 300 to 400 vehicles during the evening peak hour in the year 2035. Traffic diverted to this ramp would be from both the I-490 westbound off-ramps to Goodman Street and South Clinton Avenue.
- Analysis of this traffic on a raised Inner Loop found that it would not have a notable impact. All intersections were found to continue to operate at LOS "C" with no turning movement below LOS "D".
- Analysis of traffic diverted from I-490 also found no notable traffic impact on the surrounding network.
- The diverted traffic from the existing two off-ramps at Goodman Street and South Clinton Avenue would be expected to improve traffic operations at the intersections of these off-ramps and along adjacent roadway sections.
- Requires raising the section of the Inner Loop from the ramp connection to Monroe/Chestnut interchange to grade due to weaving on the eastbound slip ramp to Monroe.

There are a number of benefits to providing a direct route to this section of the City. These include:

- Promote further economic development;
- Reduction in traffic along South Clinton Avenue (north of I-490 in Downtown) where drivers must traverse other CBD streets to reach their destination;
- Reduction of traffic on Broadway that would further encourage economic development by allowing it to be converted to two way traffic operations; and,
- Reduction in traffic on the southern section of South Union Street.

3.2.3. Area 3: Juncture of East Main Street, University Avenue, Union Street

At this time, there is one feasible alternative for consideration, maintain the current grade separated interchange. Under this alternative, the existing infrastructure would be retained as-is and routine maintenance and rehabilitation efforts would be performed by State, City and County forces to extend the service life of the existing pavement, structures and intersection operations. Should the Inner Loop be raised to grade from Charlotte Street to Monroe Avenue, then downscaled ramp connections to the northerly Inner Loop would include retaining the East Main Street to northerly Inner Loop connection, while re-aligning the eastbound/southbound ramps.

3.2.4 Preferred Alternative

The preferred alternative includes:

- Area 1 - Remove the Inner Loop by transforming it to a community-scale urban boulevard from Monroe Avenue to Charlotte Street. This may or may not include the Monroe Avenue bridge. Pending funding availability this section can be constructed in two phases, if necessary. This alternative includes re-establishment of the street grid system.
- Area 2 – Construct the new I-490 westbound ramp connection. This ramp can only be built if the Inner Loop and Monroe Avenue are at grade.

Feasible alternatives for Areas 1 and 2, including the no-build option for both segments will remain viable options for further consideration through the design report phase. A decision will be made after

evaluation of the impacts, comments on the draft design approval document, and comments received from the public information meetings. The preferred alternative specifically focuses on Areas 1 and 2 which remove the Inner Loop by transforming it into a community-scale urban boulevard along the South Union Street alignment. This alternative allows for re-establishing the street grid system in the area including Charlotte Street, East Avenue, Broad Street, and Woodbury Boulevard. The preferred alternative includes modification of the I-490/Inner Loop southern interchange to relocate the primary westbound access from the Goodman Street/Broadway ramps to the new ramp just past Clinton Avenue. The Area 1 effort can be developed independently of the termini option at I-490 and will address the corridor long term infrastructure needs and is consistent with community plans.

The conceptual rendering of Area 1 is shown below.

CONCEPTUAL ALIGNMENT

3.2.5. Design Criteria for Feasible Alternative(s)

The design standards for the maintain/rehabilitate option is documented in Section 2.3.3.2. Design standards for an at-grade arterial and the I-490 ramp connection are shown in Exhibits 3.4 and 3.5 below. NYSDOT design criteria for a functional class of "Urban Principal Arterial Other" are being used for this alternative.

Exhibit 3.4 – Critical Design Elements for Howell Street, South Union Street, & Pitkin Street (Arterial)

PIN:	4940.T7	NHS (Y/N):	No
Route No. & Name:	Howell Street South Union Street Pitkin Street	Functional Class:	Urban Principal Arterial Other
Project Type:	Reconstruction	Design Class:	Urban Arterial
% Trucks:	3.7%	Terrain:	Level
ADT:	14,700	Truck Access/Qualifying Hwy.	Neither

	Element	Standard	Proposed Condition
1	Design Speed (1)	40 mph HDM Section 2.7.2.2 A	40 mph
2	Lane Width	Travel Lane: 11 ft (minimum) Wide Travel Lane: 12 ft (min.); 14 ft (des.) Turning Lane: 11 ft (minimum); 12 ft (desirable) Parking Lane: 8 ft (minimum); 12 ft (desirable) Cont. Lt. Turn Median: 11 ft (min); 16 ft (des.) HDM Sections 2.7.2.2 B, Exhibit 2-4 Bike Lane: 5 ft HDM Section 17.4.7, Exhibit 17-3, 17-4	11 ft 14 ft 12 ft 10 ft -
3	Shoulder Width	Median: 0 ft (minimum); 2 ft (desirable) HDM Sections 2.7.2.2 C, Exhibit 2-4	0 ft
4	Bridge Roadway Width	NA	NA
5	Maximum Grade	7% HDM Section 2.7.2.2 E, Exhibit 2-4	7.0% (Max)
6	Horizontal Curvature	533 ft @ e=4.0% HDM Section 2.7.2.2 F	533 ft @ e= 4.0%
7	Superelevation Rate	4.0% Maximum HDM Section 2.7.2.2 G	4.0% (max.)
8	Stopping Sight Distance	305 ft (Minimum) (Crest) (SSD) HDM Section 2.7.2.2 H, Exhibit 2-4 305 ft (Minimum) (Sag) (HSD) HDM Section 2.7.2.2 H, Appendix 5B	305 ft (min.)
9	Horizontal Clearance	(From Face of Curb) 0 ft w/ barrier; 1.5 ft w/o barrier, 3 ft at intersections HDM Section 2.7.2.2 I	0 ft w/ barrier; 1.5 ft w/o barrier, 3 ft at intersections
10	Vertical Clearance	NA	NA
11	Pavement Cross Slope	1.5% Min. to 2% Max. HDM Section 2.7.2.2 K	2.0%
12	Rollover	4.0% between lanes; 8% at edge of traveled way HDM Section 2.7.2.2 L	4.0%
13	Structural Capacity	NA	NA

Exhibit 3.4 – Critical Design Elements for Howell Street, South Union Street, & Pitkin Street (Arterial)			
PIN:	4940.T7	NHS (Y/N):	No
Route No. & Name:	Howell Street South Union Street Pitkin Street	Functional Class:	Urban Principal Arterial Other
Project Type:	Reconstruction	Design Class:	Urban Arterial
% Trucks:	3.7%	Terrain:	Level
ADT:	14,700	Truck Access/Qualifying Hwy.	Neither

	Element	Standard	Proposed Condition
14	Level of Service	NA	NA
15	Control of Access	NA	NA
16	Pedestrian Accommodation	5' Sidewalk Complies with HDM Chapter 18 and ADAAG	5 ft (min.)
17	Median Width	NA	NA

Note:

1. With the new roadway being in a developing area, the minimum design speed of 40 mph will be used.

Exhibit 3.5 – Critical Design Elements for I-490 WB Ramp to Howell Street			
PIN:	4940.T7	NHS (Y/N):	Yes
Route No. & Name:	I-490 WB Ramp to Howell Street	Functional Class:	Urban Principal Arterial Interstate
Project Type:	New	Design Class:	Ramp (Loop)
% Trucks:	5%	Terrain:	Level
ADT:	4,500	Truck Access/Qualifying Hwy.	Qualifying Highway

	Element	Standard	Proposed Condition
1	Design Speed	25 mph HDM Section 2.7.5.2 A	25 mph (Posted) 20 mph (Posted, Advisory)
2	Lane Width	19 ft HDM Sections 2.7.5.2 B, Exhibit 2-9	19 ft
3	Shoulder Width	0 ft (minimum); 2 ft (desirable) HDM Sections 2.7.5.2 C, Exhibit 2-9	Left: 3 ft Right 8 ft
4	Bridge Roadway Width	30 ft HDM Section 2.7.5.2 D; BM 2.3.1, Table 2-1	30 ft (min.)
5	Maximum Grade	7% HDM Section 2.7.5.2 E, Exhibit 2-9	7.0% (Max)
6	Horizontal Curvature	144 ft @ e=6.0% HDM Section 2.7.5.2 F	191 @ e= 5.76%
7	Super-elevation Rate	6.0% Maximum HDM Section 2.7.5.2 G	6.0% (max.)
8	Stopping Sight Distance	155 ft (Minimum) (Crest) (SSD) HDM Section 2.7.5.2 H, Exhibit 2-9 155 ft (Minimum) (Sag) (HSD) HDM Section 2.7.5.2 H, Appendix 5B	155 ft (min.)
9	Horizontal Clearance	Rt: Shoulder Width or 6.0 ft (min) Lt: 3.0 ft (min) [Under structures, add 4.0 ft, beyond shoulder, to pier or abutment.] HDM Section 2.7.5.2 I	Rt: 8 ft Lt: 3 ft
10	Vertical Clearance	14'-0" (minimum); 14'-6" (desirable) HDM Section 2.7.5.2 J; BM 2.4.1, Table 2-2	14'-0" (min.)
11	Pavement Cross Slope	1.5% Min. to 2% Max. HDM Section 2.7.5.2 K	2.0%
12	Rollover	4.0% between lanes; 8% at edge of traveled way HDM Section 2.7.5.2 L	4.0%
13	Structural Capacity	HL-93 & the NYS Design Permit Vehicle HDM Section 2.7.5.2 M, BM 2.6.1	HL-93 & NYS Design Permit Vehicle
14	Level of Service	C, may be D if heavy development necessitates	C
15	Control of Access	NA	NA
16	Pedestrian Accommodation	5' Sidewalk Complies with HDM Chapter 18 and ADAAG	5 ft (min.) @ Cross Road
17	Median Width	NA	NA

**Denotes non-standard feature.

3.3. Engineering Considerations

3.3.1. Operations (Traffic and Safety) & Maintenance

3.3.1.1. Functional Classification and National Highway System

This project will change the functional classification of the highway. The preferred alternative of raising the Inner Loop will abandon the existing highway system and convert South Union Street to a two-way boulevard (minor arterial or a principal arterial street). While the classification of South Union Street may not change, identification of the terminus of the Inner Loop and its current functional classification will need to be modified.

3.3.1.2. Control of Access

It is envisioned that no, or partial, control of access will be provided along various sections of the at-grade boulevard.

3.3.1.3. Traffic Control Devices

New traffic signals are proposed at the following intersections:

- Inner Loop @ Monroe Avenue/Chestnut Street
- South Union Street @ Broad Street
- South Union Street @ East Avenue

Existing Traffic Signal Modifications are proposed at the following intersections:

- South Union Street @ Monroe Avenue
- East Main Street @ Pitkin Street

Roundabouts (single lane) are proposed at the following intersections:

- Inner Loop @ South Union Street
- South Union Street @ Charlotte Street

All other intersections within the study limits will remain as is.

3.3.1.4. Intelligent Transportation Systems (ITS)

Intelligent Transportation System (ITS) improvements to include the integration of the new urban boulevard will be identified in cooperation with State and County officials during the preliminary design phase.

3.3.1.5. Speeds and Delay

The raised Inner Loop is anticipated to become a boulevard (conversion of South Union Street) and will be a City street posted with a speed limit of 30 MPH. While travel speeds may be lower than on the previous expressway, overall traffic operations should function better on the arterial network and accessibility for pedestrian and bicycle traffic will be notably improved.

3.3.1.6. Traffic Volumes

The projected traffic volumes are not anticipated to change or increase as a direct result of the preferred alternative. Instead, Inner Loop traffic will be rerouted to the new at-grade boulevard and then redistributed along the new reconnected street grid system. A summary of the traffic volumes is shown in Exhibit 3.6. Refer to Appendix E for traffic flow diagrams.

Exhibit 3.6 - Traffic Volume Summary

	Null Condition			Preferred Alternative Raising the Inner Loop		
	ETC +20 (2035)			ETC +20 (2035)		
	ADT	DHV	DDHV	ADT	DHV	DDHV
Inner Loop Expressway						
South of East Main Street	7,920	680	425	--	--	--
North of Monroe Avenue	11,935	800	540	--	--	--
South Union Street						
South of University Avenue	6,350	635	635	6,500	650	650
North of Howell Street	4,900	490	490	14,700	1,470	760
Pitkin Street						
South of East Main Street	2,300	235	235	1,700	170	170
North of Monroe Ave	2,700	270	270	--	--	--

3.3.1.7. Level of Service and Mobility

Area 1 – Inner Loop from Charlotte Street to Monroe Avenue

For this preliminary evaluation, it was assumed that traditional intersections with traffic signal control would be used. Preliminary assessment of roundabouts along this section indicates they may be appropriate; however, detailed evaluation to identify geometric parameters will be completed as a next step. Review of the initial analysis and traffic volumes indicates that the weekday evening peak travel period is the controlling factor requiring the most travel lanes to accommodate future traffic. Thus the weekday evening peak travel hour was analyzed to determine the minimum number of travel lanes necessary to accommodate future volumes and provide acceptable intersection operations.

An initial attempt was made to reduce the new at-grade boulevard to one travel lane in each direction with a center turn lane. This however, did not work at all of the intersections due to traffic volumes, which in cases resulted in failing traffic operations and vehicle queues extending through adjacent intersections. This initial analysis indicates the following minimum requirements:

Southbound Traffic – A single through travel lane will be adequate, with left turn lanes as needed. The southbound approach to Monroe/Chestnut will require a second through lane (through/right turn travel lane).

Northbound Traffic – A single northbound travel lane is adequate from Monroe Avenue to Broad Street, with left turn lanes as needed. From Broad Street to University Avenue, two (2) northbound travel lanes are required with left turn lanes as needed.

Intersecting Side Streets

Charlotte Street at South Union Street – provide a single lane in each direction (eastbound and westbound) with the possible need for a traffic signal or roundabout at the South Union Street intersection.

East Avenue at South Union Street – Analysis with opposing left turn lanes and only a single through/right turn lane on East Avenue in both directions indicates the eastbound approach would operate under failing conditions and the westbound approach at LOS of “E”. With the limited right-of-way on East Avenue, it does not appear possible to widen East Avenue to provide opposing left turn lanes and provide two through travel lanes in each direction. Thus, it is proposed that the lane configuration on East Avenue remain as currently provided. The City of Rochester is currently in the process of narrowing East Avenue to a three lane section. Raising the Inner Loop to an at-grade boulevard will require the current four lane section on East Avenue.

Broad Street at South Union Street – This existing six lane road can be reduced to two (2) eastbound lanes (separate left and right turn lane) and a single (1) westbound lane, under traffic signal control. Consideration should be given to a second westbound (Broad Street) turn lane into the parking garage. The recently completed Broad Street/Court Street/Chestnut Street Improvement Project recommendations are consistent with this assessment, but may need to be modified to ultimately accommodate two-way traffic on Union Street.

Inner Loop and Monroe / Chestnut –To maintain non-failing traffic operations at this intersection requires:

- Chestnut approach - Two (2) southbound through lanes, a separate left turn lane plus the free flowing right turn lane on Chestnut Street (a reduction of one lane on this approach in comparison to existing). Only one (1) northbound lane is required under this intersection layout with a left turn lane for traffic entering the parking garage.
- Monroe Avenue approach - will work with a single northbound through/right turn lane and a separate left turn lane.
- Eastbound Inner Loop approach - requires a separate left, a through and a right turn lane.
- Westbound Inner Loop approach - requires a separate left turn lane, a through lane and a through/right turn lane.
- Further lane reductions may result if the I-490 off-ramp is not constructed.

Roundabouts - Initial analysis of possibly using single lane roundabouts at the primary intersections in this section of the corridor were considered. The initial results indicate they would work at most intersections; however, because of the entry angle and volume at the Monroe/Chestnut Street, backups may occur. Similar concerns may result at the intersection of South Union Street and East Avenue. Roundabouts at the Charlotte Street intersection would provide a distinctive entry treatment to the new raised boulevard. Similarly, a roundabout at the Inner Loop/ Howell Street juncture with South Union Street would provide a definitive end to the expressway system and entry to the new at-grade boulevard. Further detailed analysis will be required to determine whether a roundabout should be considered at any or all of these intersections.

Other Side Streets – it is anticipated that Lafayette Park, Buena Place, Canfield Place, Chapman Alley, Savannah Street, Gardiner Park, Dryer Alley, Haags Alley, Parker Alley, Richmond Street and Vine Street will operate at acceptable operating levels with the current stop sign control. While two-way operation is proposed along South Union Street, delays exiting the side streets may increase; however, volumes are not anticipated to increase to levels that may warrant additional traffic control. Individual intersection geometric features and pedestrian accommodations will be addressed during the design stage. Significant number of National Registered Historical Places or potentially eligible sites surrounds these streets; hence, no additional major reconnections (i.e., Park Avenue and Canfield Place) are recommended at this time.

Detailed analysis is provided in Appendix E – Minimum Lane Requirements.

3.3.1.8. Safety Considerations, Accident History and Analysis

Safety benefits can be derived by calculating the projected reduction in accidents as a direct result of the proposed improvements or project, and the severity distribution is checked for significance as compared to the statewide norm (this is an important statistical assessment step). The safety benefits are then calculated by comparing before accident experience with the after projection. Accident costs are updated periodically (6/13/2008) by the NYSDOT, which were used in this calculation. The safety benefits evaluation methodology is documented in the New York State Department of Transportation “Highway Safety Improvement Program Procedures & Techniques”. Form TE 164, provided in Appendix B, has been used for this project.

Consideration was given to the unique nature of this project. The TE 164 evaluation methodology was developed for more straight forward highway safety projects; hence, liberty was taken to extrapolate the methodology to resemble this project. Calculating estimated accident costs for the year 2035 with no improvement (base condition) is pretty straight forward. However considering the Inner Loop

project is eliminating an expressway, its ramps/merge/diverge points of access and creating a brand new arterial/boulevard with significantly different geometric characteristics, assumptions were made in developing a reasonable estimate. The following basic assumptions for the three corridors were made:

Pitkin Street – for purposes of estimating safety benefits, Pitkin Street will most likely be converted into an alley way to provide access to adjacent existing and potential new developments in the area only. Major signalized intersections at East Avenue and at Broad Street will be eliminated. No connection south/west of Broad Street is anticipated. With these changes, it was assumed that all the accident patterns observed would be reduced. The significance check of severity distribution for current accident occurrences indicates "no" significance. Based on average accident costs, an Estimated Annual Safety Benefit of $184,304 may result.

Inner Loop & South Union Street – for purposes of estimating safety benefits, the statistical data for both the Inner Loop and South Union Street were combined. The proposed improvement includes bringing the current Inner Loop (limited access, high speed, expressway) to an at grade configuration along the South Union Street corridor. South Union Street will be converted to a two-way boulevard, all on/off access ramps will be eliminated, and improved geometric intersection alignments are assumed with left turn lanes, medians, and possible roundabouts along the new South Union Street corridor. Considering this new arterial maybe a hybrid of the corridors, current ADT estimates and number of accidents for both the Inner Loop expressway and South Union Street were combined. Accident reduction includes only the expressway/ramps accidents. No other reductions are assumed considering the improved geometric characteristics will reduce accidents, however higher volumes and two way operations may off-set these reductions. The significance check of severity distribution for current accident occurrences indicates "no" significance. Based on average accident costs, an Estimated Annual Safety Benefit of $762,934 may result.

3.3.1.9. Impacts on Police, Fire Protection and Ambulance Access

The impact of the preferred alternative on emergency vehicles that routinely use this route will be minimal and temporary during the construction phase of the project. With the re-established grid street system, improved circulation and access may result.

3.3.1.10. Parking Regulations and Parking Related Issues

No changes are proposed at this time. Detailed evaluation will be undertaken during the design phase of the project.

3.3.1.11. Lighting

Detailed lighting plan will be developed during the design phase of the project.

3.3.1.12. Ownership and Maintenance Jurisdiction

The construction of the Inner Loop was funded by the Federal Highway Administration with the property acquisition funded by the New York State Department of Transportation and the City of Rochester. As the Inner Loop has met its life expectancy, it is anticipated that the real estate transfer process will be straight forward and primarily include negotiations between NYSDOT and the City of Rochester. It has been noted that the NYS Property Executive Review Group (PERG) in Albany will need to approve the real estate transfer. A draft Memorandum of Understanding (MOU) outlining design, construction, maintenance, and funding for the construction of the project has been developed (Appendix I). The MOU is the initial step in the real estate transfer process which is anticipated to occur concurrently with the preliminary design.

3.3.1.13. Constructability Review

The appropriate agencies will review the project scoping and design documents for constructability.

3.3.2. Multimodal

3.3.2.1. Pedestrians

Pedestrian facilities constructed or altered as part of the project will, to the maximum extent feasible, be accessible and useable by people with disabilities. New pedestrian facilities are warranted and highly recommended along all roads and intersections within the study limit. High visibility pedestrian crosswalks are proposed at all signalized intersections along South Union Street. Count down pedestrian push buttons at the signalized intersections are recommended. Every attempt should be made to identify appropriate locations for curb extensions or providing median islands to reduce the pedestrian walking distance at all locations. Special attention will also be made at unsignalized and potential midblock locations. Pedestrian accessibility in the area will be greatly enhanced with the elimination of the Inner Loop expressway barrier by providing additional east/west connections.

3.3.2.2. Bicyclists

Federal and NYSDOT policy is to consider providing safe and adequate accommodations for bicycling on highway and street projects. The safety of motorists and bicyclists should be enhanced by Department projects. Consideration has been given to all types of bicyclists with varying degrees of proficiency. Bicyclists range from small children to experienced adults, from daily commuters to occasional recreational users. The preferred alternative is to reconnect the local grid street system that will provide improved accessibility between the Center City and adjacent neighborhoods through new east/west connections. Bicycle lanes are recommended along South Union. Retrofitting bicycle lanes on other side streets should be considered, when appropriate. Bicycle accessibility will be greatly enhanced with the preferred alternative to transform the Inner Loop expressway into a community-scale urban boulevard.

3.3.2.3. Transit

RGRTA will need to reroute various existing RTS bus routes to the new at-grade boulevard if transit service is desired with the reconnected street grid system, alternative routes and local stops along the new boulevard will be identified during the design phase in cooperation with RGRTA.

3.3.2.4. Airports, Railroad Stations, and Ports

No changes are proposed.

3.3.2.5. Access to Recreation Areas (Parks, Trails, Waterways, and State Lands)

The preferred alternative calls for abandoning the existing Inner Loop expressway. This vacated land totaling approximately 9.4 acres of potential redevelopment may offer opportunities for neighborhood or pocket parks to be considered. Public access, pedestrian and bicycle links should be provided.

3.3.3. Infrastructure

3.3.3.1. Proposed Highway Section

The preferred alternative with an at-grade arterial will take on the shape of a three to five lane boulevard. Based on the spacing of intersections and adjacent parcel access, center medians and left turn lanes will be available. Other roadside treatments may also include: recessed parking, bike lanes, high visibility crossing locations and other pedestrian amenities and streetscape features. Intersection control will be further evaluated at the next phase of the project. Application of traditional traffic signal control at each major intersection may be appropriate. The posted speed limit along the new arterial/boulevard will be 30 MPH.

3.3.3.2. Special Geometric Design Elements

It is anticipated that the new boulevard will be designed to meet standards; any special design elements will be identified at a later phase. No Non-Standard or Non-Conforming features are anticipated at this time.

3.3.3.3. Pavement and Shoulder

Pavement and shoulder, life cycle alternatives, special pavement treatments will be determined at a later time.

3.3.3.4. Drainage Systems

The type of drainage system, description of any special features, SPDES measures, and any modifications to standard drainage design practices, such as modification of the design storm will be addressed in the next phase of the project.

3.3.3.5. Geotechnical

Geotechnical needs and consideration will be determined at the next phase of the project.

3.3.3.6. Structures

The primary alternative considered for each of the Inner Loop bridges: Bridge removal (Inner Loop abandoned). It is assumed that the Inner Loop would be abandoned and filled in stages, and that traffic would be rerouted using on-site detours (Pitkin Street and South Union Street) until at-grade streets are reconstructed. The costs associated with traffic control are included in the highway reconstruction estimates. Bridge removal costs are summarized below in Exhibit 3.7. These costs assume that the upper 3 feet of the existing substructures will be removed, and the remainder will be abandoned below grade.

Exhibit 3.7 – Bridge Removal Cost

BIN	Feature Carried/Crossed	Bridge Removal Cost (2015 $)
1050139	Inner Loop over Ramp LB	-
1077590	South Clinton Avenue over Inner Loop	-
1021630	Monroe Avenue over Inner Loop	$326,000
1050149	Broad Street over Inner Loop	$423,000
1050150	Steam Pipe Bridge over Inner Loop	$34,000
1035240	East Avenue over Inner Loop	$297,000
1050160	East Main Street over Inner Loop	-
1073830	Ramp to E. Main Street over Inner Loop	-

The primary alternative considered for the retaining walls: Wall removal/abandonment (Inner Loop abandoned).It is assumed that the top 3 feet of the retaining walls would be demolished and the remainder of the walls would be abandoned in place below grade. The estimated cost for this alternative is $160,000 (2015 $).

3.3.3.7. Hydraulics of Bridges and Culverts

There are no bridges or culverts within the project limits.

3.3.3.8. Guide Railing, Median Barriers and Impact Attenuators

All guiderail within the project limits including bridge railing will be evaluated during final design for conformance to design standards and replaced or repaired, if necessary.

3.3.3.9. Utilities

All utilities within the project limits will be evaluated during final design for conformance to design standards and replaced or repaired, if necessary.

3.3.3.10. Railroad Facilities

There are no railroad facilities in the project limits.

3.3.4. Landscape and Environmental Enhancements

Significant opportunity exists with the preferred alternative to enhance and increase the green space and landscaping as a part of the overall enhancement and aesthetic improvement efforts for this project. Detailed landscaping plan will be developed during the next phase of the project.

3.3.5. Miscellaneous - No additional items.