INTRODUCTION

The communities of Rye Brook, New York and Greenwich, Connecticut have come together to try to develop a consensus built interchange improvement plan for the interchange of King Street and the Merritt/Hutchinson River Parkways. This interchange has been the subject of study and ongoing discussions for many years with only a few small improvements made to it. As a result of continued concerns about the safety of the interchange the communities of Rye Brook and Greenwich came together to jointly fund a public process intended to develop a consensus built plan to improve operations on King Street in the vicinity of the its interchange with the Hutchinson River and Merritt Parkway interchange. This process included the establishment of a project Advisory Committee (AC) whose members included individuals from the local neighborhood groups and both staff and elected officials from each of the communities. Additionally, there were public meetings held to encourage the citizens of each community to participate in the process. Following are the steps that were undertaken in conjunction with the AC and the local citizenry:

Determine initial issues
Develop project goals and objectives
Develop long list of alternatives
Screen alternatives for detailed analysis
Analyze screened alternatives
Develop locally preferred alternative

The following text highlights the process and its results.

PUBLIC/STAKEHOLDER INVOLVEMENT

The entire process of developing a consensus improvement plan for the King Street interchange is how we involved to local people and the local officials. This was further complicated because the interchange is located between not only two separate communities but also two states. To bring a unified approach to the project, a project Advisory Committee was established with representation from both communities. Included on the AC were representatives of the following groups:

Village of Rye Brook Officials
Town of Greenwich Officials
Glenville Civic Association
King Merritt Community, Inc.
King Street Area Homeowners Association
Northwest Greenwich Association
Bellefair Homeowners Association
Doral Greens Homeowners Association
The Arbors Homeowners Association
Northwest Greenwich Association

The individuals on this committee dedicated numerous hours of service toward developing the consensus plan and their efforts are truly appreciated.

The AC met numerous times during the process and began the project by developing a mission statement which reads as follows:

Develop a consensus plan to make the King Street Interchange safer and more user friendly while preserving the residential integrity of the neighboring communities.

This mission statement was then further developed into a set of project goals and objectives that could be used to measure the success of any of the proposed alternatives. These goals and objectives as well as the mission statement were presented in the first public meeting and refined based on comments received. The goals and objectives that were agreed upon are as follows and reflect no particular order of importance:

Improve safety
Preserve the residential integrity of the neighboring communities
Better accommodate pedestrians and bicycles
Minimize property acquisition
Better accommodate turns
Clarity of directions
Minimize pavement
Improve traffic operations
Improve Parkway acceleration and deceleration lanes
Consider a phased or staged implementation of improvements

This discussion that follows will include where and how the public participated along with the technical process that was undertaken.

EXISTING CONDITIONS

While this project is public involvement focused, a limited amount of analysis was required to quantify how the existing interchange operates and may operate in the future. **Figure 1** represents the study area for this project. This section describes the general characteristics of the key roadways in the study area.

King Street (NY 120A)

King Street is a major north-south roadway in the vicinity of the Merritt Parkway/Hutchinson River Parkway interchange (Exit 27). The roadway has a four lane cross-section at the interchange. Immediately north of the interchange is the Westchester County Airport which serves as a major destination for many motorists. At the Merritt Parkway/Hutchinson River Parkway interchange, King Street has stop or yield sign controlled intersections. The following intersections were analyzed in this study:

- King Street/North Ridge Street/Merritt Parkway SB Off-Ramp;
- King Street/Glen Ridge Street; and,
- King Street/Hutchinson River Parkway NB Off-Ramp.

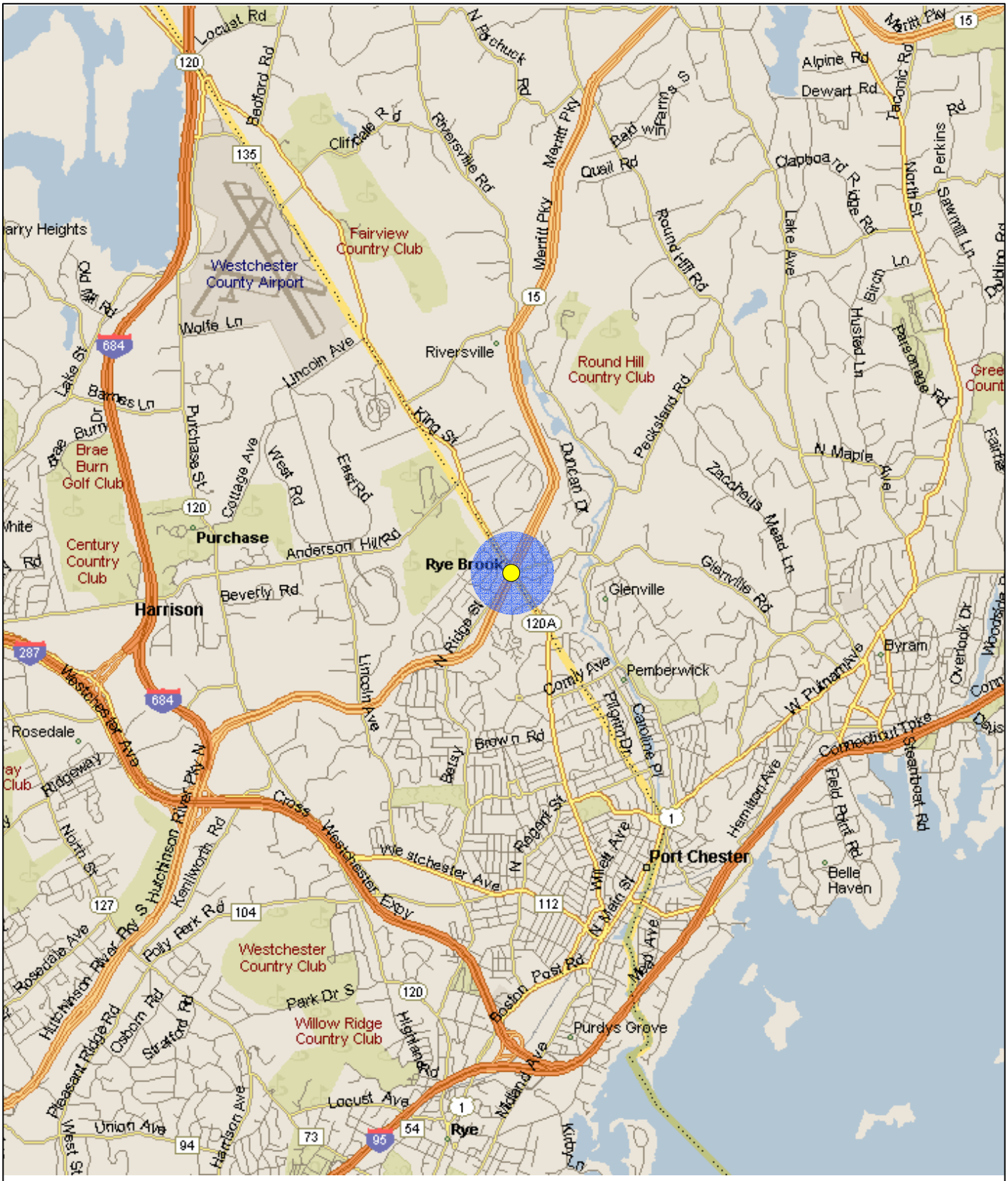
Existing (2004) Traffic Volumes

Manual turning movement counts were conducted by Wilbur Smith Associates at the three study intersections during the A.M. (7:00 to 9:00 A.M.) and P.M. (4:00 to 6:00 P.M.) time periods. These counts were conducted on Wednesday, February 4, and Thursday, February 5, 2004.

Figures 2 and 3 represent existing (2004) peak hour traffic volumes at the three study area intersections during the A.M. and P.M. peak hour periods respectively.

Existing (2004) Levels of Service

"Level of Service" (LOS) is the standard measure used to quantify the operational performance of highway facilities as perceived by the user. The Levels of Services A, B, C, D, E and F are the six possible LOS ratings where "A" indicates excellent conditions with free flow, "E" indicates intolerable conditions with unstable flow, and "F" indicates that demand exceeds capacity.



STUDY AREA

Kings Street Interchange Study
Rye Brook, NY & Greenwich, CT

ENGINEERS
PLANNERS
ECONOMISTS

Wilbur Smith Associates

FIGURE 1

Table 1 summarizes qualitative differences between the LOS ratings.

Table 1
Qualitative Level of Service Descriptions

Level of Service	Traffic Operations
LOS A	Free flow conditions, vehicles are completely unimpeded, and minimal delay at intersections
LOS B	The ability to maneuver in a traffic stream is only slightly restricted and there are insignificant delays at intersections.
LOS C	Traffic flow is stable but the ability to maneuver and change lanes is more restricted than LOS B. Vehicles begin to back-up at intersections.
LOS D	A small increase in traffic may cause substantial increases in delay at intersections and decreases of travel speeds on road segments.
LOS E	Significant delays at intersections with road segment travel speeds at approximately 1/3 of the posted speed.
LOS F	Extremely slow travel speeds, high delays, and extensive vehicle back-ups at intersections

Source: Highway Capacity Manual, 2000 Edition, Transportation Research Board, Washington, D.C.

Level of Service (LOS) for both signalized and stop-controlled intersections is measured in terms of average delay per vehicle. The delay, referred to as "control delay", includes the time required to slow down when approaching an intersection, the time a vehicle is stopped, the time required for a line of vehicles (the queue) to move up to the intersection, and the time required to accelerate.

Level of Service (LOS) for both signalized and stop-controlled intersections is measured in terms of average delay per vehicle. The delay, referred to as "control delay", includes the time required to slow down when approaching an intersection, the time a vehicle is stopped, the time required for a line of vehicles (the queue) to move up to the intersection, and the time required to accelerate.

Table 2 presents the relationship between LOS and control delay as specified in the 2000 Edition of the Highway Capacity Manual (HCM). The Level of Service methodology as documented in the HCM is widely accepted in the transportation planning and traffic engineering field and by the Federal Highway Administration (FHWA).

Table 2
Intersection Level of Service Criteria (seconds)

LOS	Characteristics	Stop Controlled	Traffic Signal
A	Little or no delay	< 10	< 10
B	Short delays	> 10 and < 15	> 10 and < 20
C	Average delays	>15 and < 25	>20 and < 35
D	Long delays	> 25 and < 35	> 35 and < 55
E	Very Long delays	> 35 and < 50	> 55 and < 80
F	Extreme delays	> 50	> 80

Source: Highway Capacity Manual, 2000 Edition, Transportation Research Board, Washington, D.C.

Table 3 presents the levels of service for the three study area intersections during the A.M. and P.M. peak hour conditions.

Table 3
Levels of Service - Existing (2004) Condition

Study Intersection	Existing (2004)	
	A.M. Peak	P.M. Peak
King St./North Ridge St./Merritt Parkway SB Off-Ramp		
Left from North Ridge Street EB	E	D
Right from North Ridge Street EB	B	B
Right from Merritt Parkway WB	B	B
King Street/Glen Ridge Road		
Left from King Street SB	C	C
Glen Ridge Road WB Approach	F	C
King Street/Hutchinson River Parkway NB Off-Ramp		
Left from King Street NB	A	A
Hutchinson River Parkway NB Off-Ramp Approach	F	C

Source: Wilbur Smith Associates

As indicated in Table 3, the left turn movement from North Ridge Street operates at LOS E and LOS D during the A.M. and P.M. peak hour periods respectively under existing (2004) conditions.

The Glen Ridge Road and Hutchinson River Parkway NB Off-Ramp approaches on King Street operate at LOS F during the A.M. peak hour period. During the P.M. peak hour period, the Glen Ridge Road and Hutchinson River Parkway NB Off-Ramp approaches on King Street operate at LOS C and LOS B respectively due to low volumes on the side street approaches.

FUTURE NO BUILD CONDITIONS

In order to understand what future condition might be in the interchange area, traffic was grown at two percent to reflect additional growth in the area. This study did not include a detailed review of future traffic conditions but the assumed growth was deemed appropriate for this type of study. Using the future no build traffic volumes, level of service calculations were again run. **Table 4** presents the future (2014) levels of service for the three study area intersections during the A.M. and P.M. peak hour conditions.

Table 4
Levels of Service - Future (2014) No Build Condition

Study Intersection	Future No Build	
	A.M. Peak	P.M. Peak
King St./North Ridge St./Merritt Parkway SB Off-Ramp		
Left from North Ridge Street EB	F	E
Right from North Ridge Street EB	B	C
Right from Merritt Parkway WB	C	B
King Street/Glen Ridge Road		
Left from King Street SB	E	E
Glen Ridge Road WB Approach	F	C
King Street/Hutchinson River Parkway NB Off-Ramp		
Left from King Street NB	A	A
Hutchinson River Parkway NB Off-Ramp Approach	F	E

Source: Wilbur Smith Associates

As indicated in Table 4, the left turn movement from North Ridge Street is anticipated to operate at LOS F and LOS E during the A.M. and P.M. peak hour periods respectively under future (2014) conditions.

The Glen Ridge Road and Hutchinson River Parkway NB Off-Ramp approaches on King Street are anticipated to operate at LOS F during the A.M. peak hour period. During the P.M. peak hour period, the Glen Ridge Road and Hutchinson River Parkway NB Off-Ramp approaches on King Street are anticipated to operate at LOS C and LOS E respectively under the future (2014) condition.

LONG LIST OF ALTERNATIVES

With the development of goals and objectives and an understanding of the existing issues along King Street and its interchange with the Merritt and Hutchinson River Parkways, an initial set of alternatives was developed. These alternatives were developed as a result of the public input at the initial public meeting in conjunction with the AC. These alternatives include the following.

- Fully Directional (Cloverleaf) Interchange
  - New Cloverleaf
  - Modified Existing Cloverleaf
- Diamond Interchange
  - Typical Diamond
  - Modified Diamond
- Single Point Interchange
- Dual Roundabout Interchange

Following are the concept drawings for each of these alternatives are presented below with a brief discussion.

New Cloverleaf

The original design of the interchange was a full cloverleaf. Some express a desire to reconstruct the interchange in its original form. From a technical and funding standpoint, it a full interchange were to be redeveloped, it would need to meet current design standards and would create significant impacts. In order to insure each alternative was give equal weight in this initial phase a full cloverleaf was developed as shown on **Figure 2**. This alternative will require that several properties will need to be acquired to meet current standards. This alternative with require not traffic signals on King Street, will require several existing streets to be cul-de-saced and require a new, wider bridge on King Street.

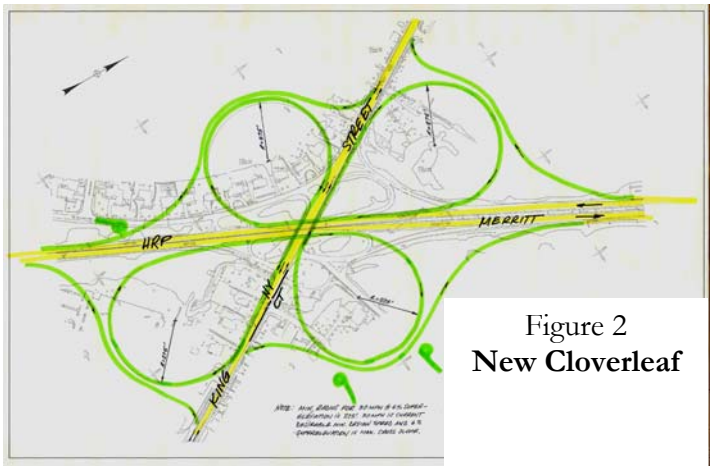


Figure 2
New Cloverleaf

Modified Existing Cloverleaf

The modified existing cloverleaf alternative was an attempt to try to improve operations on both the Parkways and King Street while not impacting so many properties as the full cloverleaf alternative as shown on **Figure 3**. The key features of this alternative are:

- Does not meets current design standards
- Maintains all existing roadway connections
- Improves operations on Parkway
- Requires two traffic signals on King Street.
- Wider bridge on King Street.
- Land taking required.

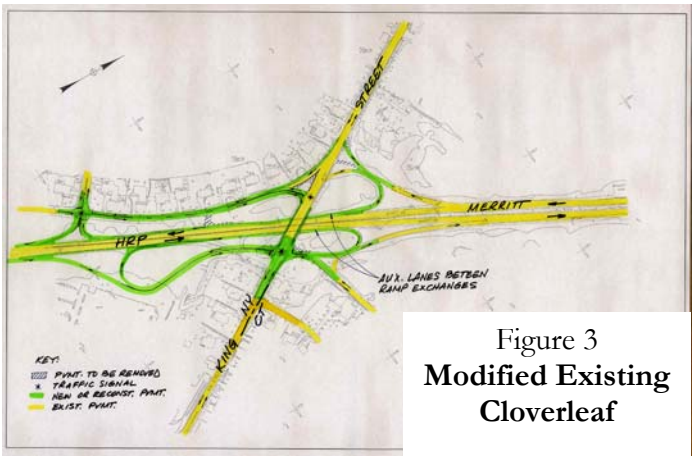


Figure 3
Modified Existing Cloverleaf

Typical Diamond Interchange

Another type of interchange that was discussed was a diamond interchange. This type provides the best operational characteristics on the Parkway but requires two traffic signals on King Street and requires some of the existing roadway connections to be lost. The characteristics of this interchange concept at shown on **Figure 4** with the following characteristics.

- Meets current design standards
- Simplifies operations on Parkway
- Two traffic signals on King Street.
- Removes egress (left/right turn to King Street.) from Glen Ridge Road
- Removes all movements between King Street. and North Ridge Street.
- Wider bridge on King Street.
- Minimum land taking

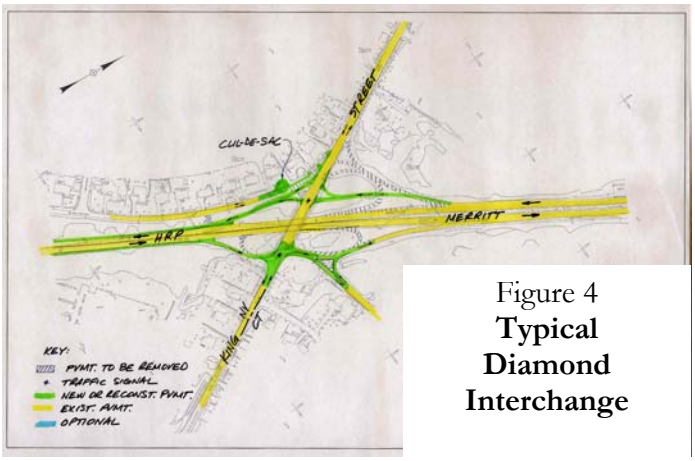


Figure 4
Typical Diamond Interchange

Modified Diamond Interchange

While the diamond interchange creates optimal operations on the Parkway, it created several issues with access to and from the local neighborhoods. This alternative attempted to use the benefits of diamond interchange while maintaining local access on King Street. The changes in this alternative include full access to North Ridge Road but access to Glenn Ridge Road was not possible in this alternative. The characteristics of the alternative are shown below and shown on **Figure 5**.

- Simplifies operations on Parkway
- Two traffic signals on King Street.
- Removes egress (left/right turn to King Street.) from Glen Ridge Road.
- Wider bridge on King Street
- Likely land taking

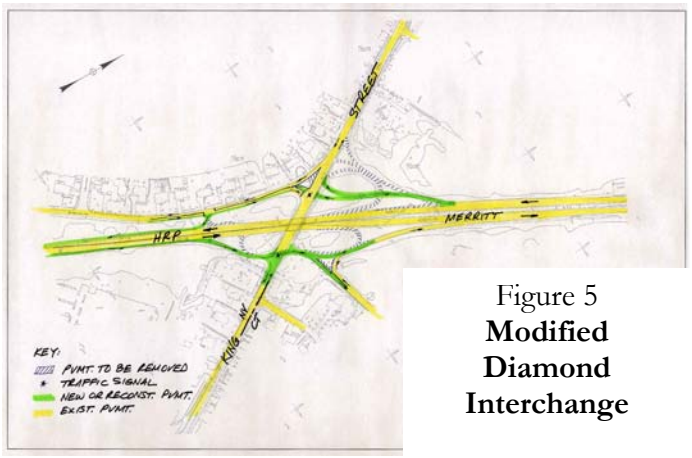


Figure 5
Modified Diamond Interchange

Single Point Interchange

Again recognizing that the diamond interchange ramps are the best operations for the Parkway but the two traffic signals on King Street can create operational issues and congestion. A single point interchange combines the best operations of diamond interchange with only one traffic signal on King Street as shown on **Figure 6**. The characteristics of this interchange are as follows:

- Simplifies operations on Parkway
- One traffic signal on King Street
- Removes all movements between Glen Ridge Road and King Street.
- Removes all movements between King Street and North Ridge Street
- Wider bridge on King Street
- Likely land taking

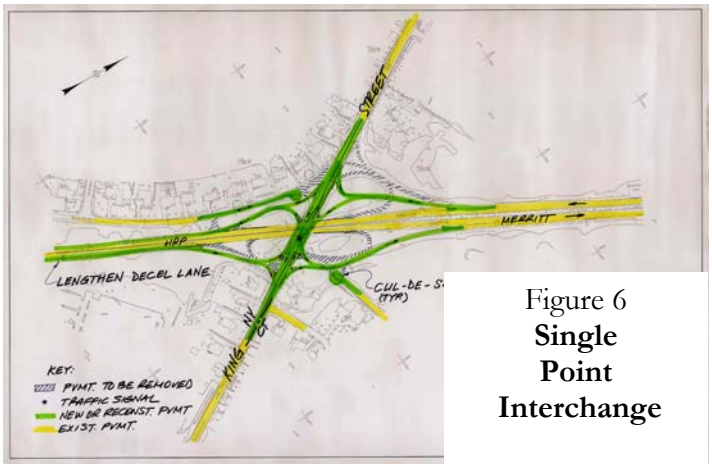


Figure 6
Single Point Interchange

Dual Roundabout Interchange

Another modification to the typical diamond interchange is the dual roundabout interchange. The concept of roundabouts is seeing resurgence over the last several years. The interchange concept uses the same diamond ramps as the diamond interchange but instead of traffic signals, roundabouts are used. Figure X shows how this concept could look. This assumes that there are two, two lane roundabouts with the following characteristics;

- Simplifies operations on Parkway
- No traffic signals on King Street
- Removes egress (left/right turn to King Street.) from Glen Ridge Road
- Wider bridge may not be required
- Likely land taking

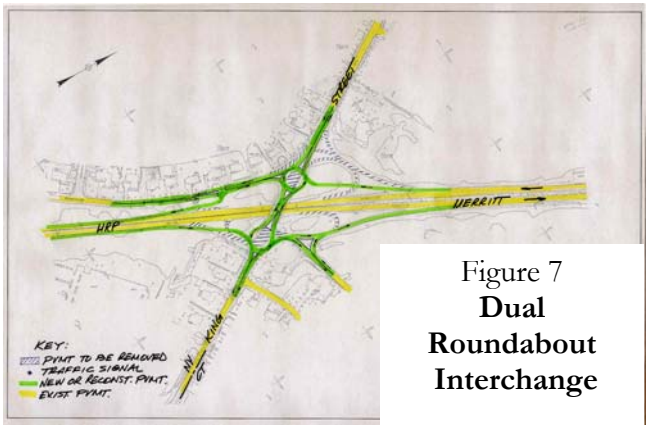


Figure 7
Dual Roundabout Interchange

SCREENING OF LONG LIST OF ALTERNATIVES

These alternatives were presented to both the AC and the public and they were asked which they thought best met the goals and objectives for this project. During the discussions, it became apparent that closing off access to any of the existing streets would not be acceptable. Discussion also focused on additional property taking and it was indicated minimum or no property taking was the desired result.

A significant amount of discussion occurred relative to the bridge itself and in particular the existing and potential routing of trucks along King Street. A large constituency indicated that under no circumstances did they want the bridge replaced. After further discussion, it was determined that the concern was a new bridge would result in the removal of the existing weight restriction which would then make it easier and legal for heavier trucks to use King Street. It was acknowledge by all participants that additional truck traffic on King Street was not desirable.

Based on this input and a review of the alternatives presented, for the initial screening process the paramount goals and objectives were:

- Maintain the existing connections to North Ridge and Glen Ridge Roads
- Minimize or eliminate the need for property taking
- Minimize or no impact to the existing bridge

These three goals eliminated the cloverleaf interchange (met none of these three), the single point interchange (met only one of the three) and the diamond interchange (met only one of the three). A lot of discussion ensued about the modified diamond interchange specifically could it be modified to include restoring the existing connection to Glen Ridge Road. When it was determined that this connection could not be maintained under this concept, it was also eliminated. The modified

existing cloverleaf maintained all the connections but clearly would have impacts to the bridge and would require property. The dual roundabout as originally proposed did not have access to Glen Ridge Road either but after discussion, it was determined that this movement might be able to be added back into the concept and would therefore be worth carrying forward with such a modification.

The final decision was to carry forward both the modified existing cloverleaf and the dual roundabout with modifications in conjunction with the no build alternative.

ANALYSIS OF SHORT LIST OF ALTERNATIVES

Given the three primary objectives of the initial screening process, each alternative was reviewed to see if modifications would improve upon each. While the modified existing cloverleaf remained in its original form, the dual roundabout was modified to include connections to Glen Ridge Road. Additionally, two roundabout alternatives were developed, one maintaining the existing location of the bridge and a second to try to further minimize the amount of property taken to construct. Both of these alternatives are shown below (**Figures 8 and 9**).

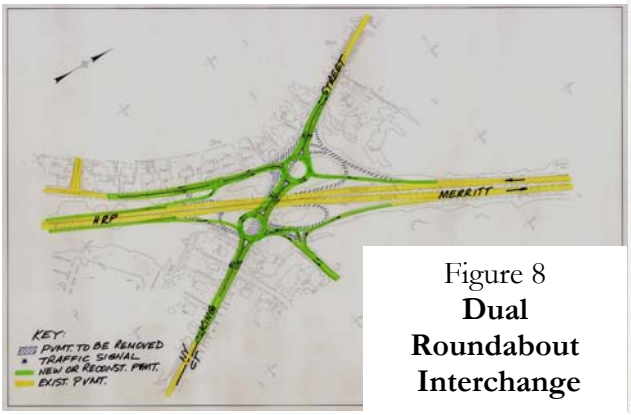


Figure 8
Dual Roundabout Interchange

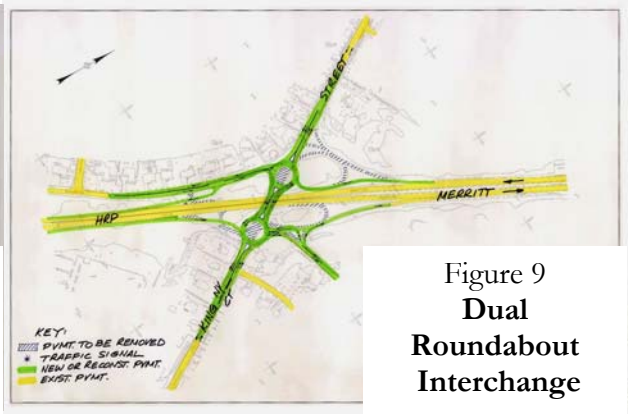


Figure 9
Dual Roundabout Interchange

Having selected and refined these concepts, more detailed evaluation of each one was completed and measured against the original goals and objectives as modified as a result of the ongoing dialogue between the public and the AC.

Screened Interchange Concepts Future (2014) Levels of Service

Two interchange alternatives were considered – Modified Cloverleaf and Roundabout. The Modified Cloverleaf Interchange provides traffic signals at the King Street and Merritt Parkway/Hutchinson River Parkway interchange ramps. The Modified Cloverleaf Interchange warrants a six lane cross-section on the bridge. The Roundabout interchange concept considers a two lane roundabout at the King Street/Merritt Parkway/Hutchinson River Parkway off-ramp intersections.

Table 5 presents the future (2014) levels of service for the study area intersections during the A.M. and P.M. peak hour conditions.

Table 5
Future (2014) Levels of Service – Interchange Alternatives

Study Intersection	Modified Cloverleaf		Dual Lane Roundabout	
	A.M. Peak	P.M. Peak	A.M. Peak	P.M. Peak
King St./N. Ridge St./Merritt Pkwy. SB Off-Ramp				
OVERALL INTERSECTION	**B**	**B**	**A**	**A**
King Street NB Approach	A	A	A	A
King Street SB Approach	A	A	A	A
North Ridge Street EB Approach	D	D	A	A
Merritt Pkwy. WB Off Ramp Approach	-	-	B	A
King St./Glen Ridge Rd./Hutchinson River Pkwy NB				
OVERALL INTERSECTION	**C**	**B**	**A**	**A**
King Street NB Approach	D	C	A	A
King Street SB Approach	A	A	A	A
Hutchinson River Pkwy EB Approach	D	D	A	A
Glen Ridge Road WB Approach	D	C	A	A

Source: Wilbur Smith Associates

As indicated in Table 5, under the modified cloverleaf interchange concept, the overall intersection level of service is LOS C or better under the future (2014) conditions. Each of the individual approaches is anticipated to operate at LOS D or better. It is important to note that a six lane cross section is required on the Merritt Parkway Bridge as part of the modified cloverleaf interchange concept.

The dual lane roundabout concept is anticipated to operate at an overall LOS A under the future (2014) conditions. Each of the individual approaches is anticipated to operate at LOS B or better. The dual lane roundabout consists of a four lane cross section on the Merritt Parkway Bridge.

The dual roundabout interchange clearly meets more of the goals and objectives than either the no-build or the modified cloverleaf. While there was a consensus in the AC and the public that the two lane dual roundabout was the accepted solution, there were still several groups that, while they were supportive of the dual roundabout concept, they still had concerns about impacts to the bridge and local properties. There were questions about the dual roundabouts and how well they would accommodate pedestrians and bicyclists. Additionally some of the AC members were not sure if the roundabouts would preserve the residential integrity of the neighborhood.

Screening Matrix

In an attempt to compare the final alternatives, a summary matrix was prepared in conjunction with the AC and the public. Some of these goals are quantitative while others are qualitative. Those that are qualitative were reviewed by the AC and at the public meeting. The following table is a summary of this effort.

Criteria	No-Build	Modified Cloverleaf	Dual Roundabout
Improve Safety	No	+	++
Number of Traffic Signals	0	2	0
Meets Current Standards	No	No	Yes
Land Taking	No	Yes	Limited
Lanes on Bridge	4	6	4
Traffic Operations King St.	F	B	B
Better Accommodate Turns	No	Yes	Yes
Improve Parkway Acceleration and Deceleration Lanes	No	+	++
Preserve Residential Integrity	Yes	No	Maybe
Bicycle Friendly	No	No	Maybe
Pedestrian Friendly	Yes	Yes	Maybe
Access to Glen Ridge Rd	Yes	Yes	Yes
Access to North Ridge St	Yes	Yes	Yes
Minimize Pavement	Yes	No	Yes
Heavy Trucks (above existing load limit)	Not Permitted	Permitted	Permitted but Discouraged
Clarity of Directions	Possible	Yes	Yes

While most everyone agreed that the roundabout would discourage truck traffic and reduce the speed of traffic, some were still were adamant about the need to maintain the existing bridge and the weight restriction. Because there were concerns about the possibility of widening and/or replacing the existing bridge with a two lane dual roundabout, a capacity analyses of a single lane dual roundabout interchange was completed. The idea was that a narrower section may be able to be constructed without affecting the bridge and requiring less property.

Table 6 presents the existing (2004) and future (2014) levels of service for the study area intersections during the A.M. and P.M. peak hour conditions.

Table 6
Levels of Service – Single Lane Roundabout Concept

Study Intersection	Existing (2004)		Future (2014)	
	A.M. Peak	P.M. Peak	A.M. Peak	P.M. Peak
King St./N. Ridge St./Merritt Pkwy. SB Off-Ramp				
OVERALL INTERSECTION	**B**	**A**	**F**	**B**
King Street NB Approach	C	A	F	A
King Street SB Approach	A	A	A	C
North Ridge Street EB Approach	A	A	A	A
Merritt Pkwy. WB Off Ramp Approach	A	A	B	A
King St./Glen Ridge Rd./Hutchinson River Pkwy				
OVERALL INTERSECTION	**F**	**B**	**F**	**F**
King Street NB Approach	F	C	F	F
King Street SB Approach	A	A	A	B
Hutchinson River Pkwy EB Approach	B	A	E	A
Glen Ridge Road WB Approach	A	A	A	A

Source: Wilbur Smith Associates

As indicated in Table 6, with a single lane roundabout concept, the King Street/Glen Ridge Road/Hutchinson River Parkway intersection operates at LOS F under existing (2004). Under the future (2014) conditions, the King Street/North Ridge Street/Merritt Parkway intersection is anticipated to operate at LOS F during the A.M. peak hour period. The King Street/Glen Ridge Road/Hutchinson River Parkway intersection is anticipated to operate at LOS F during the A.M. and P.M. peak hour periods under the future (2014) conditions.

DEVELOP LOCALLY PREFERRED ALTERNATIVE

Based on the work of, the AC, the public and the local officials, the following statement highlights the locally preferred alternative to improve safety and operations at the King Street Interchange is:

The consensus of the AC and the public is that a dual roundabout interchange replace the existing interchange at King Street and the Merritt/Hutchinson River Parkway. Because a subset of the AC endorses only a roundabout concept that does not require any work on the existing bridge, both a two lane dual roundabout interchange and a single lane dual roundabout were analyzed. It is the consensus of these groups that that if the concerns about the potential capacity issues with a single lane dual roundabout interchange can be overcome then a total consensus would be

established. A total consensus may also be achieved by having a two lane roundabout south of the bridge and a single lane roundabout north of the bridge.

NEXT STEPS

The next step would be to forward the recommendation for a dual roundabout interchange to the New York State Department of Transportation for their concurrence and a request for them to move forward with the next phase of development, appropriate environmental documentation and preliminary design. To insure that this next phase meets the expectations of the work already done, the following steps should be taken:

- Complete an updated traffic study to include
  - Updated accident analysis
  - Updated traffic counts to include, AM peak, off-peak, and PM peak periods for:
    - Cars
    - Trucks
    - Pedestrians
    - Bicyclists
  - Updated existing capacity analysis
  - Detailed analysis of future corridor traffic volumes including potential build out options based on the Greenwich and Rye Brook master plans
  - Updated future no-build traffic capacity analysis
- Consider development of an origin and destination study for motorist north and south of the interchange
- Continue with the strong public participation process already begun
- Use the existing Advisory Committee for the ongoing public participation process
- Further develop the three potential dual roundabout options (one lane, two lane and two lane south and one lane north) insuring that
  - Minimal or no property acquisition is required,
  - All the existing movements are permitted; and
  - The existing bridge does not need to replaced or widened.
- Develop appropriate environmental documentation
- Develop appropriate accommodations for pedestrians and bicyclists
- Develop appropriate accommodations for emergency vehicles.