BLACK ROCK TURNPIKE
SAFETY STUDY

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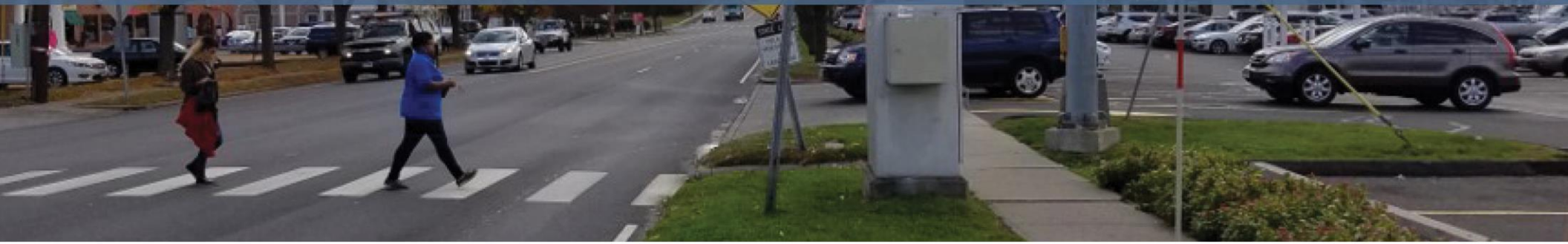
FINAL REPORT

MAY 2019



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Black Rock Turnpike Safety Study

Final Report

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1. EXECUTIVE SUMMARY

Black Rock Turnpike (Route 58) in Fairfield, CT is a multi-lane, high-conflict arterial road that provides north-south connectivity for motorists between Route 15 and Route 1/I-95. The road also serves a major regional shopping district served by transit and used by bicyclists and pedestrians. Three recent fatalities have prompted local officials to consider engineering solutions for improving safety for all users and balancing the needs of multiple modes.

The recommended concept plan for Black Rock Turnpike strives to address as many safety deficiencies as possible while still offering adequate capacity for cars and trucks. Given the regional commercial status of the corridor, the Town of Fairfield stressed the importance of not further exacerbating current levels of congestion. While some congestion, especially during peak shopping days, is inevitable, fewer crashes will reduce much of the unpredictable delay that results when the corridor is impacted by a crash. In totality, the corridor improvement plan can be best summed up as a strategic set of safety countermeasures that work in concert to reduce vehicle speed, minimize unsafe driver behavior, and offer pedestrians better protection and visibility in the public right-of-way.

The countermeasures in the Recommended Corridor Plan include:

- Lane reductions
- Modern roundabouts
- Enhanced pedestrian crossings
- Intersection modifications
- Access management
- Improved parking lot circulation

Once the project is initiated and a funding source identified, the remaining steps to implement an improvement will involve detailed design and construction. Based on the complexity of a project, an initial Preliminary Engineering phase may be required to conduct a more detailed engineering study and refine the concept plans and project scope. A preliminary engineering study can help establish the potential impacts to environmental and natural resources, identify potential property and utility impacts, and help refine the expected costs in current dollars rather than forecasting based on estimates reported in this Study, which are provided in current, 2018 dollars.

Once Preliminary Engineering is complete and the decision is made to move forward with a project, final design will take place to add detail to the plan, conduct a right of way acquisition process, address utility conflicts and possible relocations, and develop construction documentation to facilitate bidding and construction of the improvements. Generally, projects that are identified as having a low level of complexity can be designed within 12-18 months from initiation of the project by the Towns. As complexity grows, so does the timeframe required to design improvements. Design phases can potentially last three years or more for highly complex projects.

Following the completion of the design phase, projects can begin the construction phase. The steps involved in a publicly funded project include advertisement for bids to contractors, collecting bids on the work and awarding the contract, and finally conducting the construction to build the improvement. Utility relocations typically take place during construction, but in some instances a utility company may relocate facilities in advance of a project taking place once a utility agreement is in place. Generally, smaller projects are completed within one construction season between March and November. Larger projects can span several construction seasons depending on the complexity of the work, the construction staging and phasing needed to facilitate the maintenance and protection of

traffic operations during construction, and possibly the availability of funding. Projects identified as having moderate complexity can be expected to take up to two construction seasons and highly complex projects could take more than two construction seasons to build.

To assist in the budgeting of funding for the improvements, opinions of preliminary probable construction costs (OPC) were developed for the Recommended Corridor Concept. The preliminary costs have been estimated following the guidelines published by the CTDOT and are presented in 2019 dollars. Project costs may require inflation factors looking out into the future to determine actual funding needs for funding programming. The "Preliminary Cost Estimating Guidelines" provide unit costs and percentage-based lump sum costs to facilitate the estimation of project costs at the Preliminary Engineering level of project development. The approximate project costs presented in this Study are limited to the construction item costs and exclude costs related to rights of way actions and environmental remediation, and engineering. The estimates include contingency (25%) and incidentals (25%) in the total opinion of probable costs.

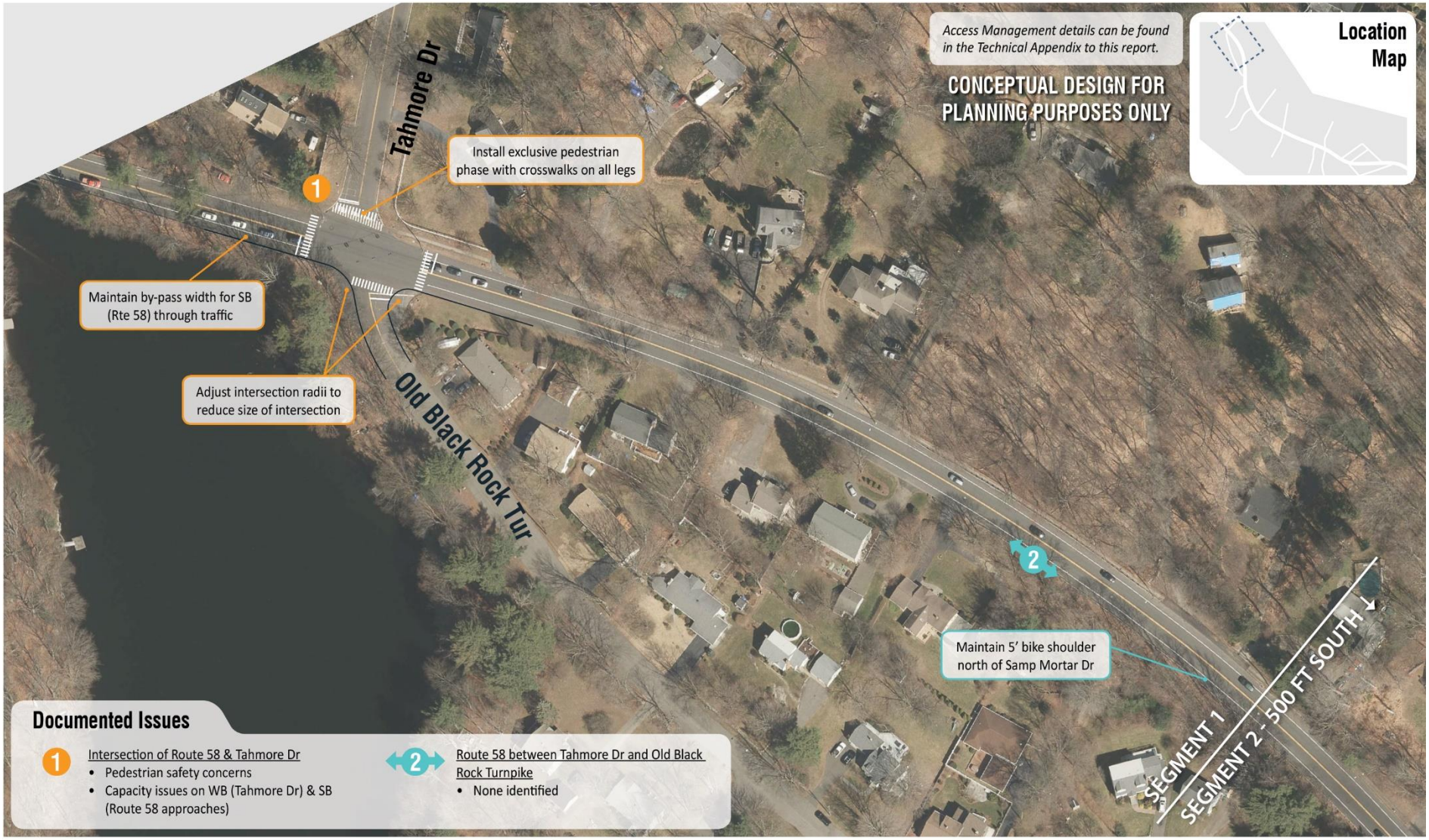
As shown in Table ES-1 below, the improvements outlined in the Recommended Corridor Concept are estimated to cost approximately $23.1 million to construct. While the Recommended Corridor Plan would provide optimum safety benefits, it is a complex project that could take many years to complete. For this reason, a Near-Term Plan was developed to include improvements to Black Rock Turnpike that would yield a high safety benefit at a significantly lower cost. This plan could also be an early phase implementation of a series of improvements in the Recommended Corridor Plan. The estimated cost for the Near-term Plan was estimated at approximately $10.1 million.

TABLE ES-1

Opinion of Probable Construction Cost Summary – Recommended Corridor Concept

	Intersection	Opinion of Probable Construction Cost
1	Black Rock Turnpike at Tahmore Drive & Old Black Rock Turnpike	$360,000
2	Black Rock Turnpike at Samp Mortar Drive	$2,273,000
3	Black Rock Turnpike at Brookside Drive and Fairfield Woods Road	$2,288,000
4	Black Rock Turnpike at Lake Hills & Black Rock Shopping Centers	$3,817,000
5	Black Rock Turnpike at Route 135 (Stillson Road) & Stillson Road	$2,327,000
6	Black Rock Turnpike at Turnpike Shopping Center & Fairway Plaza	$1,139,000
7	Black Rock Turnpike at Katona Drive & Katona Drive Extension	$3,523,000
8	Black Rock Turnpike at Burroughs Road	$2,675,000
9	Black Rock Turnpike at Tunxis Hill Cutoff, Route 732, Mortiz Pl. & Whitewood Rd.	$4,746,000
	Total	**$23,148,000**

Table ES-2 and the Figures ES-1 to ES-6 present the recommended corridor concept plan for Black Rock Turnpike in its entirety. The plan is drawn to scale and reflects a level of accuracy consistent with planning/pre-engineering studies.



Figures ES-1 to ES-6: Recommended Concept Plan

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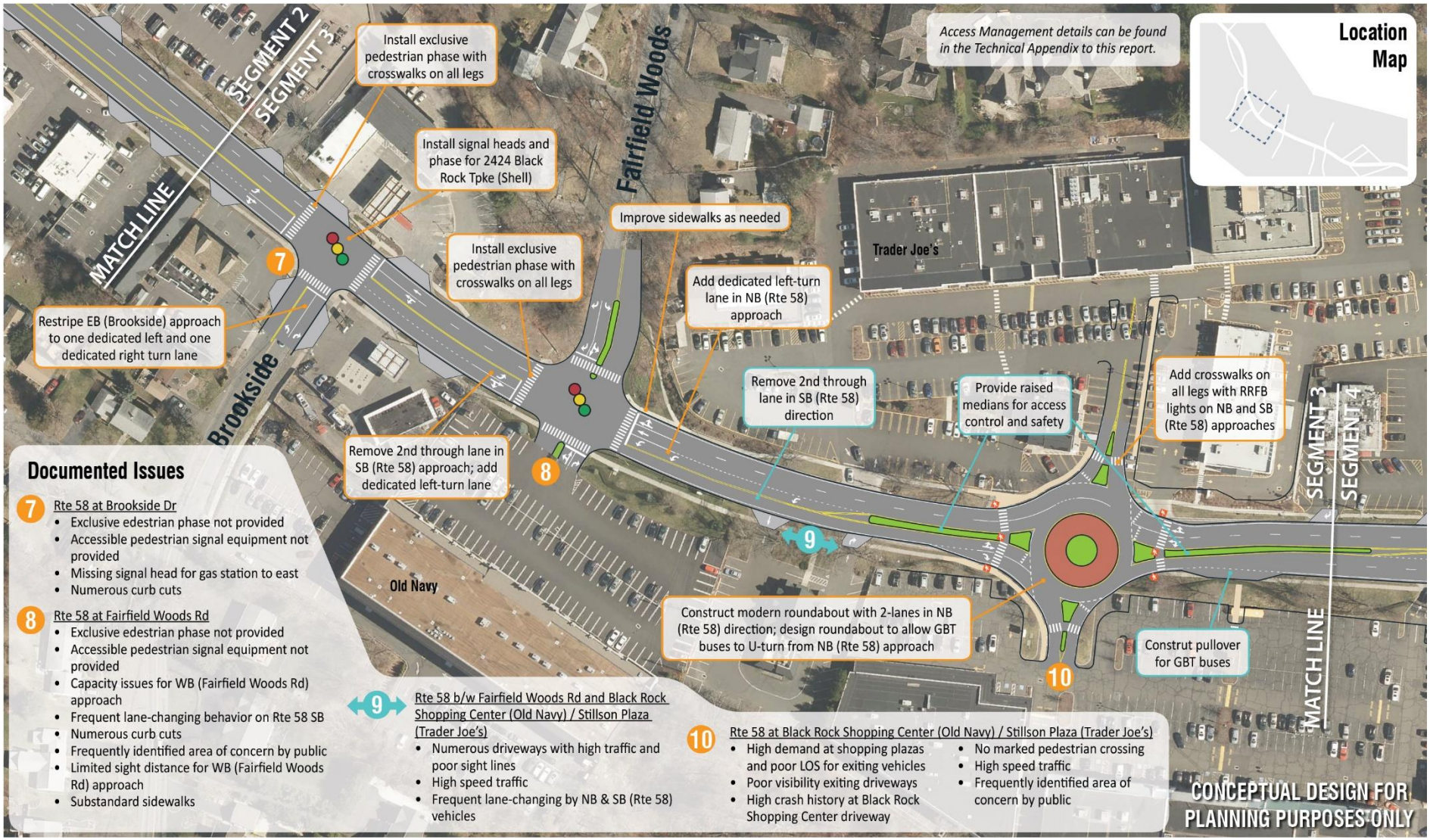

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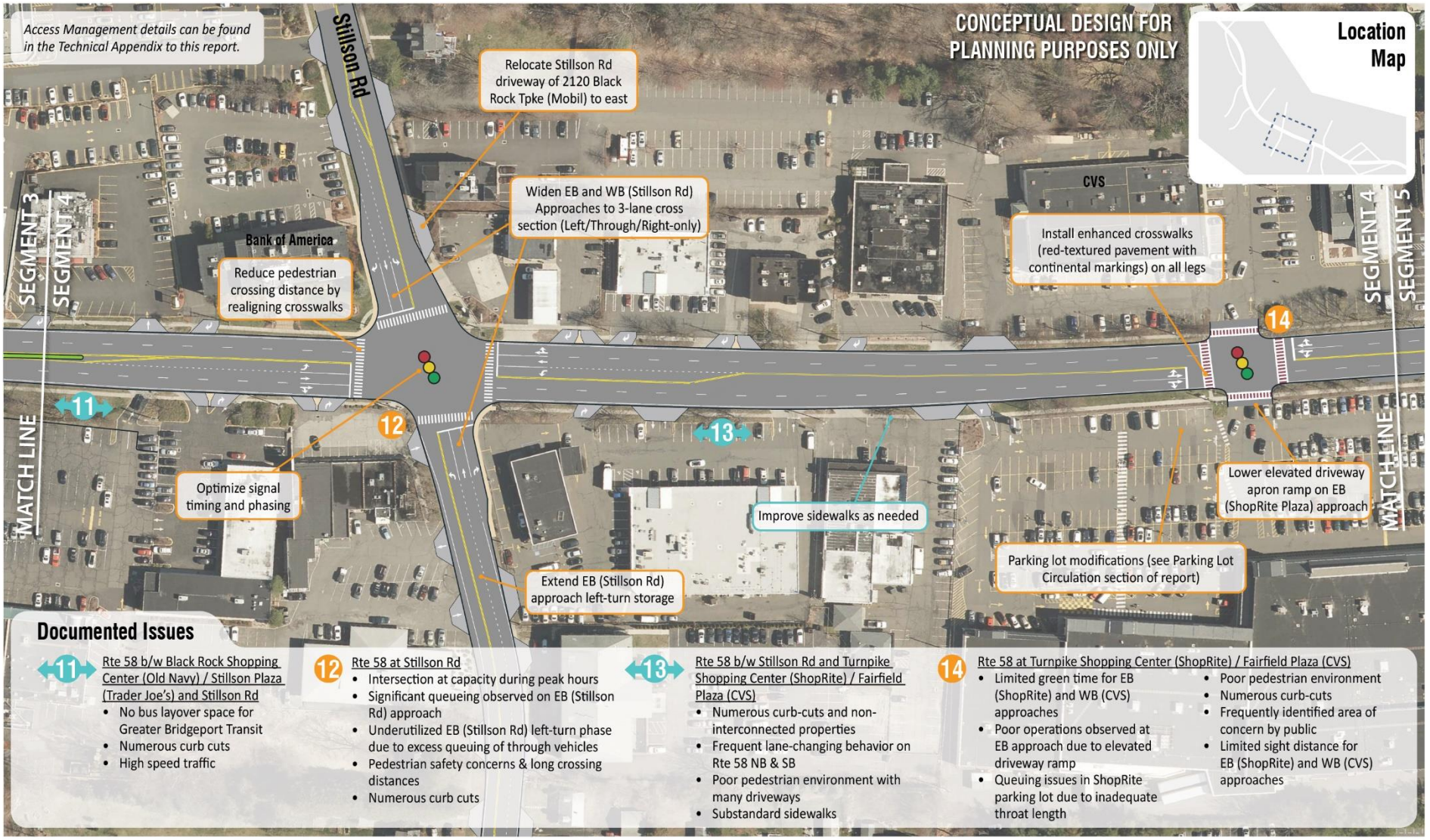

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2. INTRODUCTION

The *Black Rock Turnpike Safety Study* was prepared by a project team that consists of several organizations. The MetroCOG managed the project in coordination with the Town of Fairfield. The consultant team was led by Fitzgerald & Halliday, Inc. (FHI) with assistance from Tighe & Bond and CT Counts, LLC. In addition, key stakeholders and the public were an integral part of the project team and was actively involved throughout various study efforts. The total budget for the study was $375,000 and was fully funded by the State of Connecticut's Local Transportation Capital Improvement Program (LOTCIP).

Purpose and Study Area

Black Rock Turnpike is a multi-lane, high-conflict arterial road that is frequently used by transit, bicyclists and pedestrians. Three recent fatalities have prompted local officials to look to redesign this road to balance the needs of multiple modes.

Purpose

The purpose of the *Black Rock Turnpike Safety Study (Black Rock Study)* was to explore alternatives and strategies that will enhance safety for all users along the corridor, including pedestrians, bicyclists, transit users, and motorists.

This comprehensive transportation planning study assessed Black Rock Turnpike's operational and safety characteristics and developed conceptual solutions that could be implemented over near-term and longer-term timeframes. Robust public engagement guided the study process. Key objectives of the *Black Rock Turnpike Safety Study (Black Rock Study)* as outlined in MetroCOG's Request For Qualifications (RFQ) included:

- Assessment of lane layout and configuration as well as other intersection improvements,
- Analysis of traffic signal coordination throughout the corridor,
- Recommendations for bicycle, pedestrian and transit amenity improvements in the study area; including adjacent residential neighborhoods,
- Analysis of the role and use of local roads intersecting Black Rock Turnpike and evaluate all local road approaches,
- Evaluation of road widths and cross-sections,
- Analysis of the potential elimination or reduction of curb cuts throughout the study area,
- Assessment of future development in the corridor,
- Integration of current and future GBT bus routes along Black Rock Turnpike,
- Identification of the need and location of additional crosswalks in the study area, and
- Feasibility determination of bike lane installation throughout the corridor.

Study Area

The Black Rock Turnpike is a major arterial that serves one of Fairfield's largest business and commercial districts. As a state highway (Route 58), the Turnpike is a main north/south corridor in Fairfield. It provides a key connection for residential neighborhoods to retailers and services as well as a vital link between U.S. Route 1 and Interstate 95 in the south and the Merritt Parkway (Route 15) in the north. Approximately 20,000 vehicles travel along the turnpike every day and this volume of traffic combined with the road width, traffic speed, and frequent driveways have caused the Turnpike to be identified as a trouble spot by The Town of Fairfield.

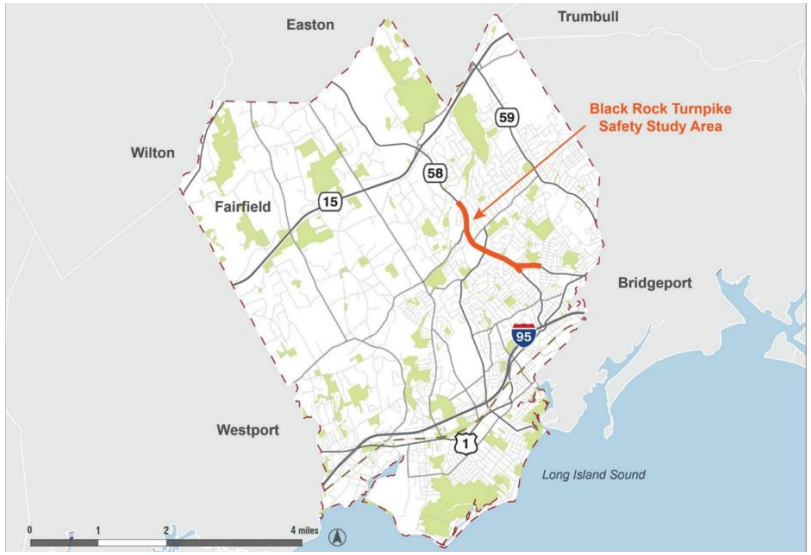


Figure 1: Town of Fairfield Transportation Network

The study area for this project focuses on the area between the Black Rock Turnpike intersection with Tahmore Drive and Old Black Rock Turnpike to the north and Tunxis Hill Road to the south. Along this segment, the road widens from a single lane in each direction to a multi-lane arterial with frequent access to adjacent land uses.

In response to public input, the project team also performed a cursory analysis of the segment of Black Rock Turnpike directly north of the study area from the intersection with Tahmore Drive to the Merritt Parkway. While this section was not part of the predetermined study area, the public expressed concern about safety issues along this part of the roadway, which primarily serves residential properties and provides access to the Merritt Parkway. It was determined that much of the safety-related issues on this segment are associated with the highway interchange, and as such, should be evaluated independently from this study.

Figure 2: Black Rock Turnpike Study Area

While this study is primarily focused on the transportation aspects of this corridor, the plan recognizes that the transportation network plays a key role in establishing the character of a community and the quality of life that is enjoyed by its residents and visitors.

Study Process

The overall approach for the *Black Rock Study* was to take a broad perspective on the role and function of Black Rock Turnpike, and through a contemporary planning process, apply innovative engineering solutions to address safety, mobility, and accessibility along the corridor.

First and foremost, the study was guided by an inclusive public engagement process. The study team listened to concerns from the public, as well as their aspirations for the future of the corridor. This

was coupled with an innovative data collection and analysis methodology to better understand and communicate the corridor's complexities. This approach ensured that the Study Team was focused on solutions that meet the needs and desires of the community.

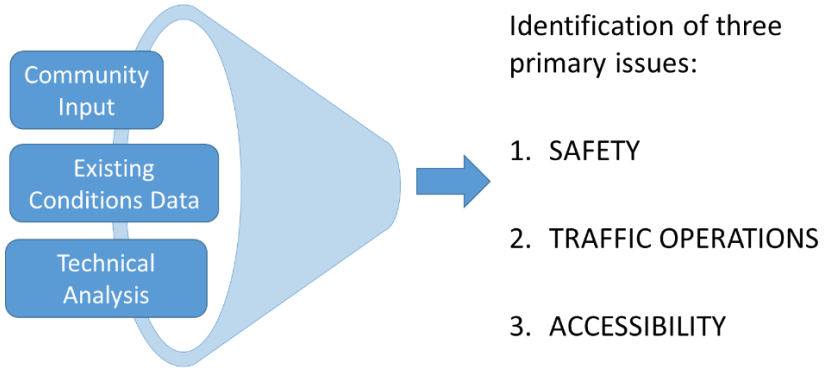


Figure 3: Black Rock Turnpike Safety Study Approach

The study included three main phases, generally described as Phase I: Discover, Phase II: Design, and Phase III: Reporting. This approach provided a simple framework for identifying the issues along Black Rock Turnpike, evaluating potential solutions, and creating a plan for the Town of Fairfield to use in updating the road over time.

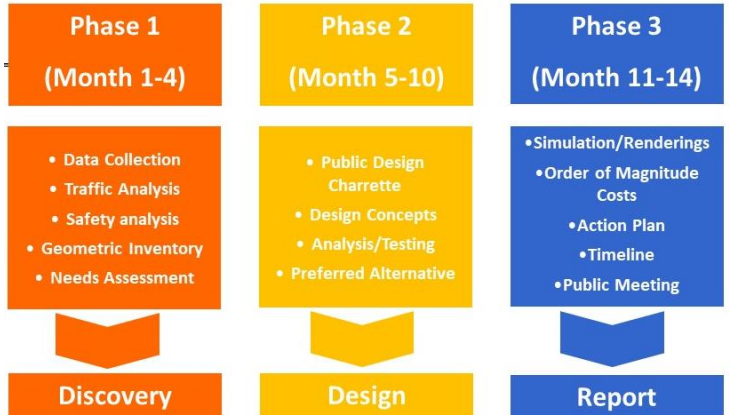


Figure 4: Black Rock Turnpike Safety Study Schedule

3. EXISTING CONDITIONS

Major Findings

A full analysis of existing and future transportation conditions on Black Rock Turnpike is presented in the Existing & Future Conditions Technical Memorandum. The following chapter reviews the major findings in that report.

Transportation Network Overview and Context

The Black Rock Turnpike is designated as an urban minor arterial throughout the corridor study area. The major intersection in the corridor, the intersection of the Black Rock Turnpike (Route 58) and Stillson Road (Route 135) is centrally located in the study area. Stillson Road is designated as a minor arterial to the northeast and southwest of the study area. Furthermore, Route 58 is intersected by Route 732 also identified as a minor arterial.

Travel patterns throughout the corridor are heavily influenced by the proximity to two major highways - I-95 to the south and the Merritt Parkway (Route 15) to the north. This proximity makes the Black Rock Turnpike a common commuting route to regional employment destinations and nearby neighborhoods. Locally, the Black Rock Turnpike provides direct access to a major commercial district in the Town of Fairfield. This access is largely provided by numerous unsignalized curb cuts in the core of the corridor between Samp Mortar Drive and Burroughs Road to the south.

Contextually, the Black Rock Turnpike passes through several types of land-uses on its 1.7-mile extent included in this study. This includes dense residential neighborhoods to the south which form some of Fairfield's densest residential neighborhoods. Within these neighborhoods are many neighborhood schools including the nearby McKinley Elementary school located near the southern end of the corridor. Furthermore, many other schools are near the Black Rock Turnpike including Fairfield Warde High School, Osborn Hill Elementary School, Holland Hill School, and Fairfield Woods Middle School.

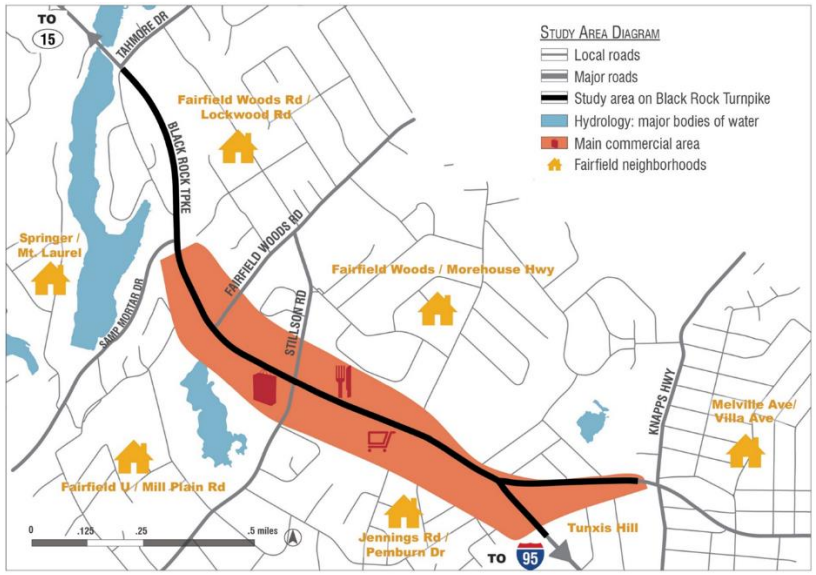


Figure 5: Black Rock Turnpike Land Use Context

North of this southern neighborhood zone is the core commercial district defined by the borders of Burroughs Road to the south and Samp Mortar Drive to the north. Within this commercial zone are typical suburban commercial developments including both large scale multi-tenant commercial plazas as well as older, and smaller, individual commercial buildings. This historical growth and development of commercial area mean that curb cuts are numerous throughout this core area and cross property connections are infrequent. Off-street parking via surface lots is prevalent throughout

this corridor and is typically provided between the Turnpike and the front of buildings.

Lastly, the zone north of Samp Mortar Drive consists of suburban residential land uses. Houses include driveways with direct access to the turnpike with ample set back from the roadway. This residential context continues to the north and extends about 16 miles north to Bethel, CT.

Road Conditions

The study area lane configuration varies between two-lanes to five-lanes. The north and south ends of the study area consist of two lanes of traffic, one in each direction, and the central portion has four lanes of traffic, with a fifth lane for left turns at the Route 135 (Stillson Road) intersection. Generally, Black Rock Turnpike has inconsistent shoulders ranging 1 foot to 10 feet wide, with wider shoulders at the north and south ends of the study corridor and narrower along the denser development in the center of the study area. Undersized shoulder widths of less than 4 feet challenges bicycle and pedestrian travel along the corridor.

Black Rock Turnpike is a road marked with numerous driveways. The number of driveways, or curb cuts, increases the number of potential conflicts, both vehicular and non-vehicular alike, while also contributing to congestion, confusion, and frustration for motorists as they attempt to find a break in traffic.

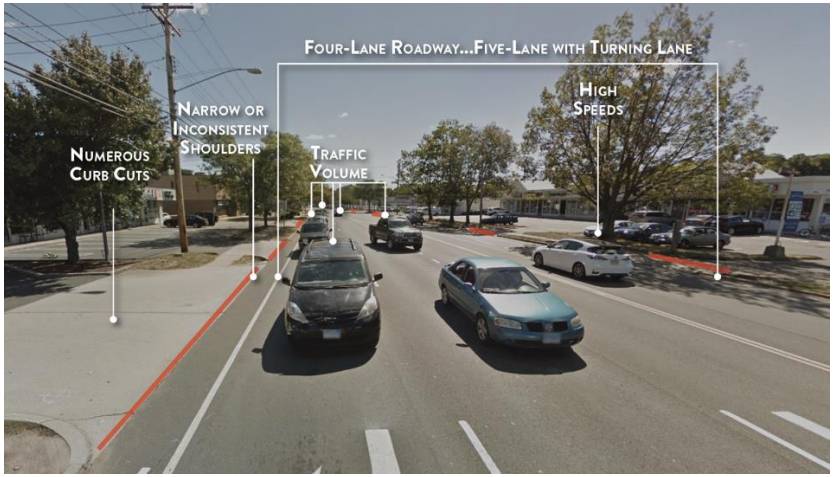


Figure 6: Black Rock Turnpike Typical Conditions

Bicycle and Pedestrian Activity

Bicycling and pedestrian use along the corridor is relatively light when compared against the volume of vehicular traffic, but non-motorized activity is present and would likely be higher if conditions to improve the comfort and safety of those travel modes were made.

Bicycling data for the study area suggested that the area along the Turnpike north of Samp Mortar Drive is more suitable for bicyclists. South of Samp Mortar Drive, where the roadway's geometry and character abruptly changes, the bicycle use along the Turnpike significantly drops. It appears that bicyclist may be bypassing Black Rock Turnpike by utilizing Pansy Road and Judd Street.

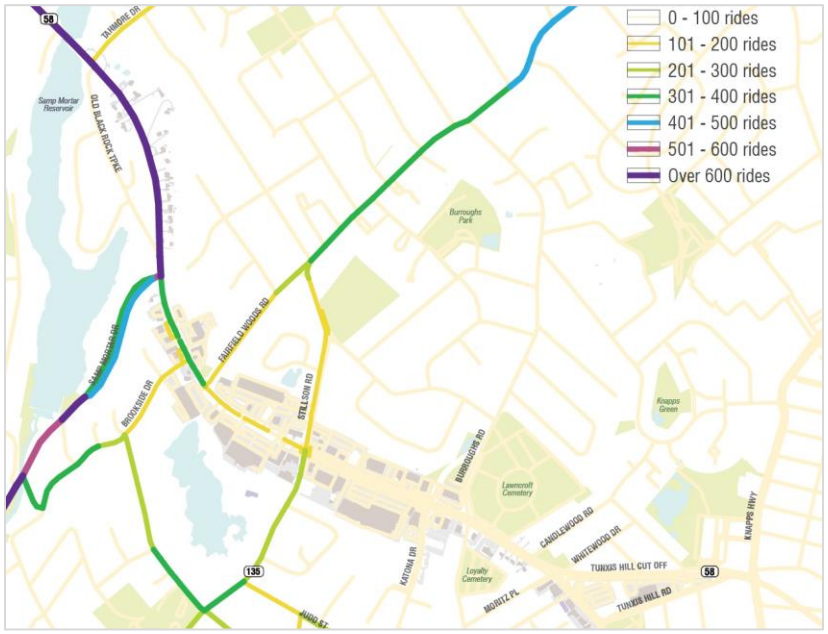


Figure 7: Bicycle Activity *(Source: Strava Data from November 1, 2014 through October 31, 2016)*

While there is relatively low bicycle ridership along the Black Rock Turnpike, it is difficult to determine whether this is because bicyclists do not prefer to take this route or whether they do not take the route due to the lack of safe and/or comfortable facilities. It's possible that bicyclists would ride on this route if facilities existed to make it safer, especially because the Turnpike does provide a convenient and quick connection between many key destinations in town.

Pedestrian traffic across Black Rock Turnpike is mostly concentrated between Fairfield Woods Road and Judd Street, which is where the main commercial shopping opportunities are located. The intersection which received the highest amount of pedestrian traffic was at Stillson Road, which is at a central point of the study area and provides access to numerous commercial businesses. Pedestrian activity during the PM hours on the weekdays is typically higher than morning hours since commercial activity increases as the day progresses. There was also more overall activity during the midday hours on the weekend when compared to any time during the weekday, which is a result of higher shopping demand.

Transit Needs

Transit in the study area consists of a single bus, Route 10, operated by Greater Bridgeport Transit (GBT). Bus stops are provided throughout the corridor, most marked by a GBT sign including basic route information. Bus stops do not feature shelters or benches. All GBT buses are equipped to carry bicycles, with racks available on a first-come, first-serve basis.

Of note for a study corridor with significant retail activity is that Saturday ridership exceeds weekday (and Sunday) volume. In this case, Black Rock Turnpike functions more as a destination than an origin for transit trips.

Transit riders are also pedestrians, and thus issues pertaining to safety, comfort and accessibility at the street and sidewalk level apply to GBT bus riders. Some sidewalk gaps exist along the study corridor and numerous curb cuts affect the walking environment and safety for pedestrians.

Figure 8: Pedestrian Crossing and Typical Transit Stop

Bus layover locations are an ongoing concern for Greater Bridgeport Transit, as transit reliability is dependent on scheduled down-time for bus operators at route ends. Currently, GBT uses the turnaround loop via Fairfield Woods Road and Stillson Road to lay over; however, community pressures over the years have often forced GBT operators to move buses or find new space. GBT would benefit from a formal, agreed upon layover location to ensure reliable operation of Route 10.

Traffic

A review of the historic average daily traffic (ADT) volume data collected indicates daily traffic volumes along Black Rock Turnpike peaked around 2005 and declined until 2013. Following 2013, volumes have shown a modest increasing growth trend, averaging between 18,000 and 23,000 vehicles per day. Traffic levels during the weekday afternoon and Saturday peak hours tend to be higher than other periods throughout the week, which reflects higher percentages of retail traffic mixing with the commuter traffic. The busiest areas on Black Rock Turnpike occur proximate to the larger retail developments. Traffic is lighter north and south of the Study Area. This pattern is consistent with the intensity of land uses along Black Rock Turnpike.

Results of the traffic analysis indicate that most of the study intersections operate at a Level of Service (LOS) D or better during typical weekday morning and afternoon and at LOS B or better during typical weekday midday and Saturday peak hours. Although LOS A through D are generally deemed acceptable for developed areas, there are situations where a specific intersection approach or movement experiences LOS of E and F (the lowest), even if the total intersection does not. These occurrences typically occur during peak travel times in the morning or evening and motorists traveling along such approaches can often experience delays. In addition, the complex interaction of driveways upstream and downstream of intersections often creates congested conditions that the modeling of individual intersections does not consider. Still, the LOS analysis is a valuable tool for checking the effectiveness of signal timing and lane configurations at the major corridor intersections.

Queuing exists at specific approaches to the intersections in the central portion of the study area between the intersections with Samp Mortar Drive and the Turnpike Shopping Center and Fairway Plaza driveways. Along this segment the closely spaced intersections and high traffic volumes from the dense commercial development result in queues that extend beyond the available road storage, resulting in additional congestion that may not be fully represented in the level of service results. It is important to recognize that when conducting traffic operations modeling that several factors need to be considered when measuring the effectiveness of a roadway to efficiently move traffic. The complex operation of Black Rock Turnpike is difficult to model, and though the signal systems seems

to be capable of handling the volume of traffic, many other factors are responsible for the delay often experienced by motorists.

The vehicle speeds during the off-peak (low volume) hours of the day were consistently higher than during the peak (high volume) hours. Off-peak vehicle speeds had the highest variation from peak-hour speeds in the southbound direction, south of Stillson Road and in the northbound direction, north of Arrowhead Lane. Since commercial development and pedestrian activity also increases to the south of Stillson Road, higher vehicle speeds during the off-peak hour in this location are potentially hazardous. It should also be noted that vehicle speeds during both the peak and off-peak hours were highest at the far north and far south ends of the study area (west of Arrowhead Lane and east of Black Rock Turnpike). In the peak hours, average vehicle speeds were approximately 35mph in both locations, in both directions (southbound and northbound). In the off-peak hour, average vehicle speeds were approximately 40mph in both locations and in both directions. These higher speed conditions make pedestrian and bicycle crossings difficult and potentially hazardous. Speeds higher than 25 miles per hour are statistically proven to be responsible for serious injuries and/or fatalities when pedestrians are involved in a crash. High speed coupled with the high frequency of driveways is a recipe for diminished safety for all road users.

Safety

Across the three-year analysis period (2014-2016), there were 428 total crashes that occurred within the study area—a road segment approximately 1.73 miles in length.

A crash rate of 11.9 crashes per million vehicle-miles of travel was calculated, which is approximately two times higher than the average crash rate (5.8 crashes per million vehicle-miles) on an urban four-lane undivided roadway in Connecticut. Four-lane roads are almost always higher in crash occurrences due to the complex weaving characteristics, speed and diminished sight lines. When adjusting the crash rate for the highest crash segment of Black Rock Turnpike from the intersection with Whitewood Drive to the intersection with Samp Mortar Drive, a crash rate of 19.1 crashes per million vehicle-miles travelled was calculated. This crash rate is over three times higher than the average crash rate on a typical urban undivided roadway in Connecticut. Over the course of the three-year study period, the majority (77%) of the crashes were property-damage-only crashes. Twenty-two percent (22%) of the crashes involved an injury. There were three fatal crashes, occurring in the three-year period analyzed.

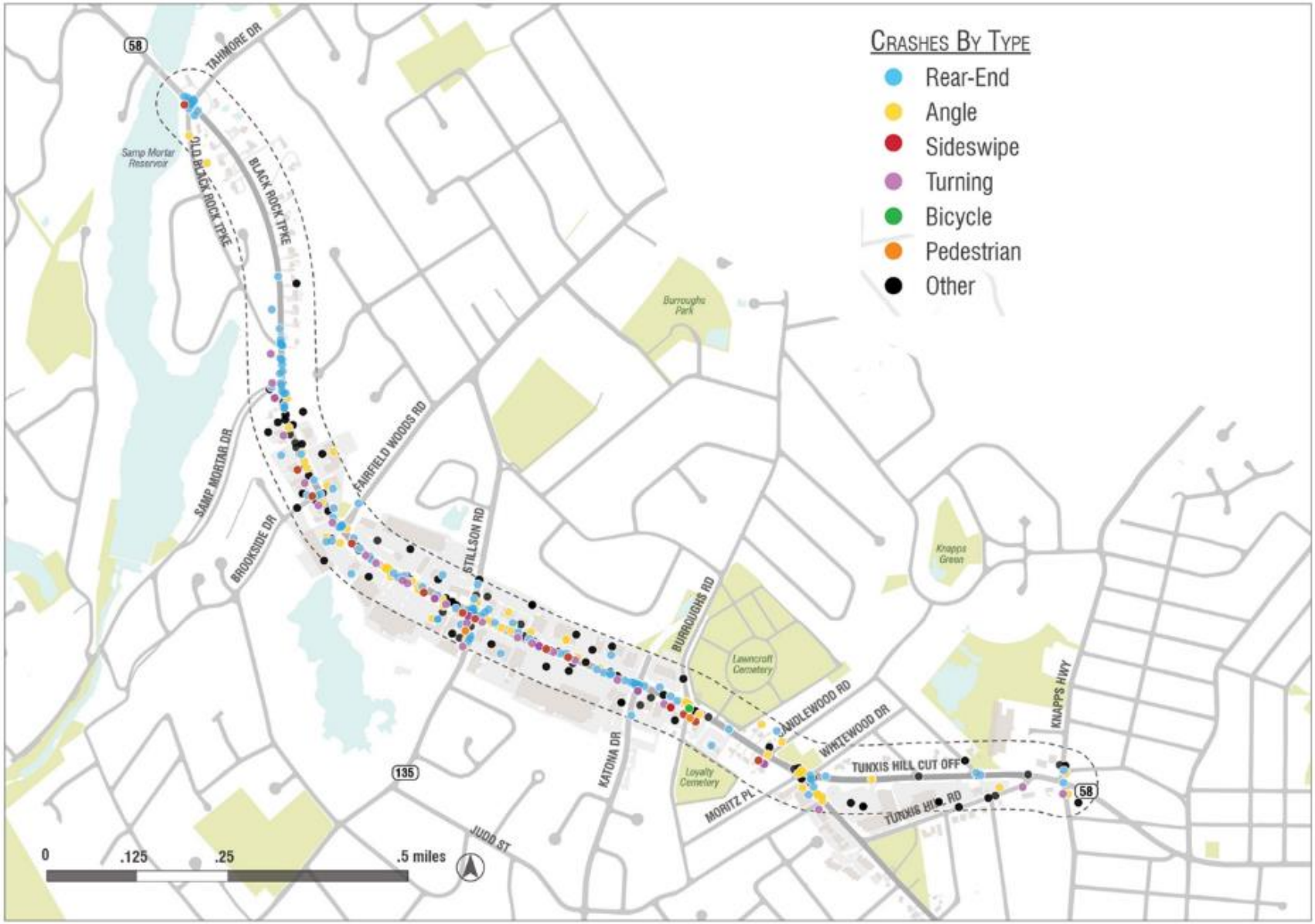


Figure 9: Locations of Crashes by Type *(Source: Connecticut Crash Data Repository, September 2017)*

For the segment of Black Rock Turnpike north of Tahmore Drive, the overall crash rate is significantly lower than the crash rate for the same period along the primary study area. The lower crash frequency does not diminish the serious consequences of the crashes that did occur; however, most of those crashes are related to the Merritt Parkway ramp system and should be more thoroughly evaluated independently from this study.

Supplemental Drone Data

In addition to the count data, the study team collected video footage of the corridor using several aerial drones. This footage was taken for approximately 15 minutes at 5:00 PM on Wednesday, October 11th. Given the complexity of traffic conflicts along this corridor, the study team used this information to confirm the traffic count data that was collected via other sources as well as to better understand complex operational characteristics. The video and data were also used to calibrate the traffic models which provided the Study Team with a higher level of confidence in the proposed concept plans.

Once collected, the drone videos were processed by Data From Sky, a company that builds software to extract the time-space-trajectories of vehicles in aerial videos. This approach provided automatic calculation of a wide range of traffic parameters, such as speed, acceleration, and detailed traffic counting that was simply not possible with conventional tools. When used as a supplement to the existing data collected, the sample video footage answered many questions that the Study Team had about how the corridor was used and provided a visual way to communicate complex operational conditions to the public.

Figure 10: Mike Gearin from PhotoFlight Aerial Media Launches a Drone

Figure 11: Drone flight coverage area

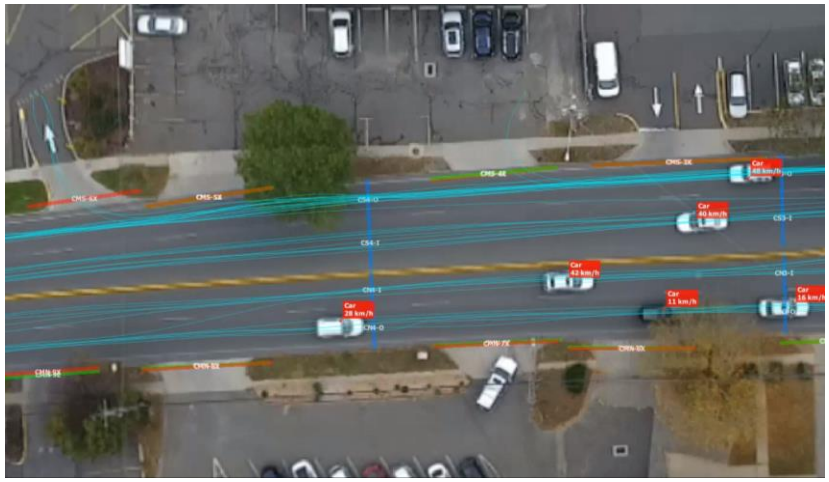


Figure 12: Screen-capture of Vehicle Trajectories along Black Rock Turnpike *(Source: PhotoFlight Aerial Media and Data From Sky, October 2018)*

Following the post processing of the aerial video, the Study Team used the software developed by Data From Sky to analyze a range of conditions that led to a more nuanced understanding of the corridor, and ultimately, a more thoughtful range of potential solutions.

The earlier data collection effort provided limited speed data at a few spot locations but didn't fully explain where high speed activity was most common. The video data provided a much clearer picture of locations where high-speed traffic occurs and where it mixes with lower-speed vehicles. Speed is the greatest contributor to crashes, both in terms of frequency as well as severity. Seeing where average speed above posted speeds was allowed for the targeted application of safety countermeasures in the recommended plan presented later in this report. Figure 13 shows a speed heat map of the corridor.

Another common issue that exists on multi-lane arterials with a high degree of driveway access is frequent lane changing behavior. Drivers who frequently change lanes to avoid slower or turning vehicles present a higher risk of collision. Using the aerial video and software analysis, the Study Team was able to track all the vehicles making a complete trip from one end of the corridor to the other and count how many times those vehicles were changing lanes.

As listed in Table 1, the southbound direction of Black Rock Turnpike experienced a higher degree of frequent lane changing behavior with at least 40% of counted vehicles making at least four lane changes, and some making as many as eight. In the northbound direction, the lane changes were less pronounced with most of the traffic making one to two lane changes between Tunxis Hill Cutoff and Brookside Drive. This data was instrumental in identifying safety countermeasures aimed at stabilizing traffic flow and reducing risky driving behavior.

	Southbound	Northbound
# lane changes	% of traffic	% of traffic
0	100%	100%
1	88%	57%
2	77%	29%
3	68%	21%
4	40%	14%
5	28%	7%
6	14%	0%
7	4%	0%
8	2%	0%

Table 1: Number of Lane Changes along Black Rock Turnpike *(Source: PhotoFlight Aerial Media and Data From Sky, October 2018)*

Figure 13: Average Vehicle Speed *(Source: PhotoFlight Aerial Media and Data From Sky, October 2018)*

Another frequent assumption is that the typical commuter hours of the day experience more 'through' traffic than other time periods. Through traffic is that which passes through the corridor without stopping along the way. This assumption sometimes leads to improper responses to corridor development because it suggests that commuter traffic be facilitated by providing greater road capacity to reduce congestion.

Along Black Rock Turnpike, the drone analysis was able to count each vehicle as it entered the video and track it until it made a turn or came to a stop in a parking lot. In the northbound direction, only 20% of entering traffic passed through the corridor to the opposite end. In fact, 52% of all northbound traffic was destined for a business along the way. In the southbound direction, those values were 28% and 35% respectively. The value of knowing this information established the need to provide safer access to commercial properties for all modes of travel as a primary objective. This section of the Turnpike is a retail destination and as such would benefit from solutions that deemphasized the high-speed and highway-centric design characteristics of the past.

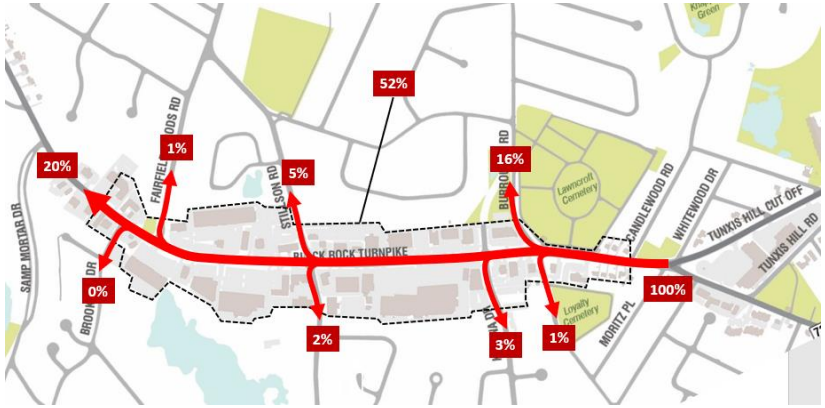


Figure 14: Northbound Travel Patterns along Black Rock Turnpike *(Source: PhotoFlight Aerial Media and Data From Sky, October 2018)*

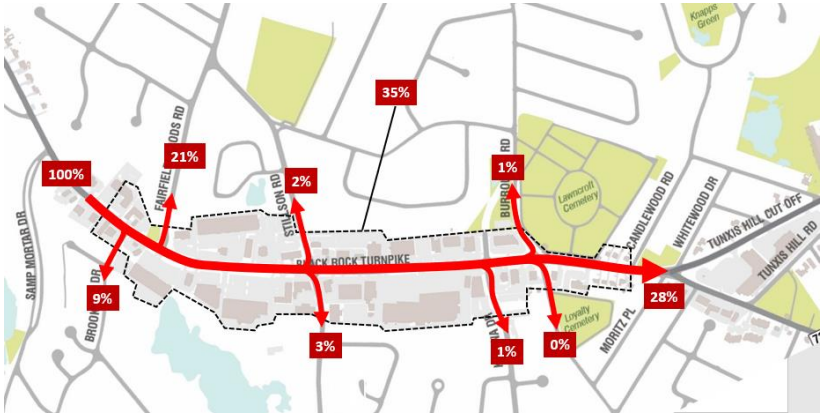


Figure 15: Southbound Travel Patterns along Black Rock Turnpike *(Source: PhotoFlight Aerial Media and Data From Sky, October 2018)*

Regarding congestion and driver delay along the Turnpike, the data suggests that human perception paints a slightly different picture than reality. Given the frequency of crashes along the corridor, extreme congestion is something that most people using the Turnpike have experienced at one time or another. However, this is not a typical condition as evidenced by the data collected in this study. Under typical PM peak hour conditions, vehicular travel time from the Tunxis Hill Cutoff to just north of Brookside Drive takes about three minutes. This time includes any stop delay experienced at traffic signals and is an average time for all vehicles that made the end-to-end trip and captured in the drone video.

It should be noted that this time confirmed similar travel times measured with conventional data collection methods earlier in the study process. Atypical conditions, such as high demand shopping days (e.g. the Christmas holiday week) could certainly result in greater delay than was measured.

Figure 16: Screen-capture of Vehicle Trajectories along Black Rock Turnpike *(Source: PhotoFlight Aerial Media and Data From Sky, October 2018)*

Figure 17: Screen-capture of Vehicle Trajectories along Black Rock Turnpike *(Source: PhotoFlight Aerial Media and Data From Sky, October 2018)*

Another assumption requiring confirmation from the drone data was the relative usage of each travel lane by direction. The term lane utilization was used to explain how much traffic used the inside and outside (curbside) lanes. This was an important observation because on most multilane roads with frequent driveway access, the inner lanes carry lower volumes of traffic because the inner lanes serve as de facto left turn lanes when protected left turn pockets don't exist.

Based on the drone video analysis, approximately 60% to 70% of the traffic uses the curbside lane in the northbound direction. In the southbound direction, results are similar, with over 80% curbside utilization at the intersection of Fairfield Woods Road. These findings were significant because they verified that reductions in the number of travel lanes was possible along certain locations of the Turnpike. By reducing through lanes and providing protected left turn pockets, traffic flow could potentially be smoother, speeding reduced, pedestrian crossings shortened, crashes reduced, and side-street delay minimized.

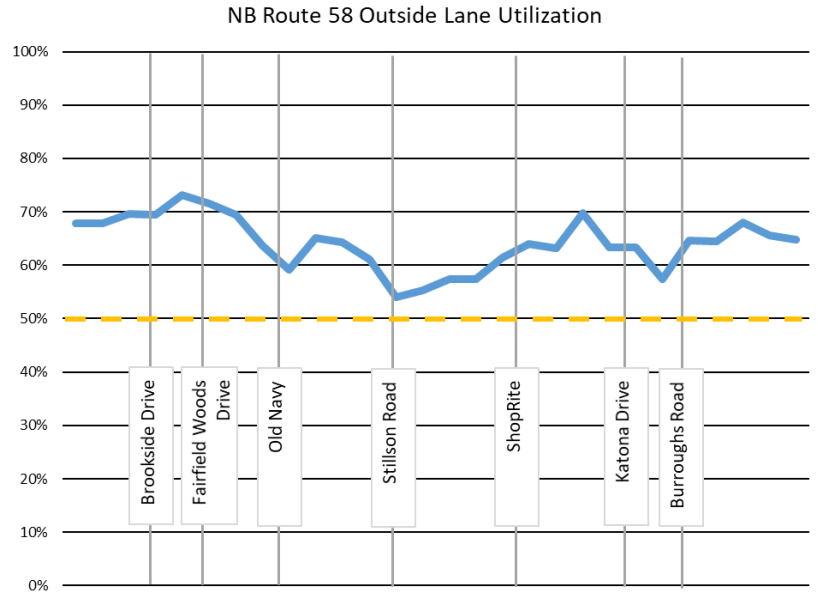


Figure 18: Northbound Lane Utilization along Black Rock Turnpike *(Source: PhotoFlight Aerial Media and Data From Sky, October 2018)*

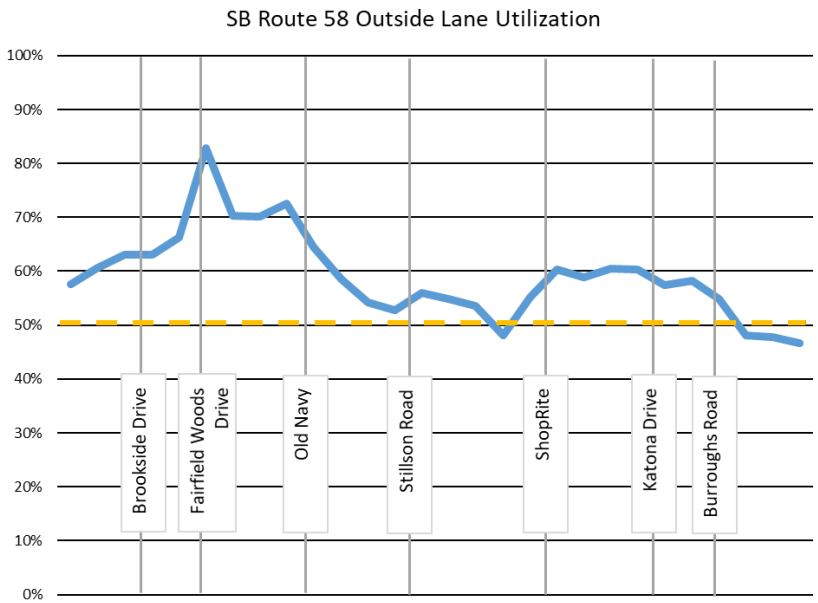


Figure 19: Southbound Lane Utilization along Black Rock Turnpike *(Source: PhotoFlight Aerial Media and Data From Sky, October 2018)*

The drone video analysis allowed the Study Team to confirm several previously observed conditions with concrete data verification. As the various traffic models used in the study were developed, the video results led to a much better calibration to real-world conditions than would have been possible with the conventional data sources available.

Conclusions

Black Rock Turnpike is a 4-lane state highway originally designed to facilitate regional travel with a modest level of access to private property. Over the years, the segment of the Turnpike between Samp Morter Drive and the Tunxis Hill Cutoff has evolved into a major commercial corridor with very high levels of access to property. The physical design of the road encourages high speed driver behavior, and the heavy traffic volume that results from a mix of shopping and commuter traffic creates an environment that is compromised for both travel mobility and accessibility to properties along the road. In fact, this segment of the Turnpike has a crash rate 2 to 3 times higher than that of a typical 4-lane urban road in Connecticut.

In addition to diminished safety and driver frustration stemming from congestion, Black Rock Turnpike also presents a hostile environment for pedestrians and bicyclists. Whether walking along the Turnpike or crossing it, pedestrians are often at a significant disadvantage. Crosswalks are infrequent and long, pedestrian visibility to motorists is low, and the frequent driveways pose a constant threat to those walking the sidewalks. Bicyclists, save the very skilled riders, appear to avoid Black Rock Turnpike in favor of other routes even though they aren't as direct.

Based on the data collected and analyses performed as part of this existing conditions evaluation, the study team concluded that Black Rock Turnpike requires a level of redesign that emphasizes safety for all users, while still maintaining adequate access to the residences and businesses along its length. In areas with high crash frequencies and/or severe crashes, near-term mitigations are necessary. In the longer-term, a more system-wide solution to dealing with a wide range of stated deficiencies may be necessary.

Figure 20: Screen capture of VISSIM traffic model calibrated with PM peak hour drone data

4. FUTURE NO-BUILD CONDITIONS

A future 20-year growth rate for traffic on Black Rock Turnpike was calculated for the purpose of developing roadway solutions that are expected to satisfy future transportation demands. Historic average daily traffic (ADT) was collected for Black Rock Turnpike and intersecting routes (e.g. Rt. 135 / Stillson Road and Rt. 732 Tunxis Hill Cut Off) from 2001 to 2013. This data was supplemented with 24-hour traffic counts collected in 2017. The annual average percent change (AAPC) from 2001 and 2017 for all count locations along Black Rock Turnpike is -0.2% per year – essentially no growth.

In addition to the traffic data, the study team conducted an interview with property owners of a significant portion of the retail space along the corridor. Their anecdotal assessment of future conditions is that the retail environment is changing due to the intense competition from online retailers. This is resulting in lower demand for space that can be used for large shopping establishments and an increase in demand for fitness centers, such as yoga studios and health clubs, which have different traffic peaking characteristics. In summary, they don't see meaningful traffic growth as a result of changing retail into the future. If anything, they see more spreading of traffic throughout the day as a possibility.

Based on the quantitative and anecdotal data, it is assumed that Black Rock Turnpike from Tahmore Drive to the Tunxis Hill Cutoff will experience a flat growth rate over the next 20 years; however, the Town of Fairfield anticipates some additional housing development near the study corridor and wishes to include some limited traffic growth in the future forecast. As a result, the study used a modest growth rate of 0.25% per year from 2017 to 2027. This growth rate was applied to the peak hour traffic data and used in traffic models to predict future peak hour operations at study area intersections.

Future Conditions Traffic Assessment

The future conditions analysis included traffic growth projections to expand the 2017 existing traffic volumes to the 2040 background traffic volumes. The Black Rock Turnpike study area intersections were analyzed under two scenarios: a 'Background' and a 'Background-Optimized' condition. The 2040 Background analysis utilizes existing road geometry and existing traffic signal settings to draw a direct comparison between existing and future conditions. The 2040 Background-Optimized analysis utilizes existing road geometry but modifies intersection signal timings and settings to provide the most efficient operations for future conditions. This optimization analysis determined if future operational issues can be mitigated through low-cost adjustments to signal operations or if additional physical improvements are needed to provide measurable capacity improvements. Although these Background analyses provide a basis for generating roadway improvements to accommodate anticipated traffic growth for the corridor, they do not factor in safety related issues, which was a primary factor in developing corridor improvements.

Background Traffic Operations

Utilizing the existing geometry and traffic signal settings established under the 2017 Existing Traffic analyses, traffic operations for the 2040 Background Traffic Volumes were evaluated for the study area intersections using Trafficware's *Synchro plus SimTraffic 10 – Traffic Signal Coordination Software,* based on the *Highway Capacity Manual (HCM) 6th Edition* methodology.

The background traffic growth slightly exacerbates existing capacity issues detailed in the Existing Conditions Technical Memo. Comparing the existing conditions to the background conditions, the following overall LOS deterioration was identified from the analyses during the specified peak hours:

- Black Rock Turnpike at Tahmore Drive: Decreased from C to D in the afternoon
- Black Rock Turnpike at Stillson Road: Decreased from D to E in the afternoon
- Black Rock Turnpike at Fairfield Woods Road: Decreased from A to B on Saturday
- Black Rock Turnpike at Turnpike Shopping Center: Decreased from B to C on Saturday
- Tunxis Hill Cutoff at Tunxis Hill Road (unsignalized): EBL decreased from C to D on Saturday

Select intersection approaches also experienced decreases in LOS, mainly at the intersections where the overall LOS experienced a decrease. These decreases are a result of the incremental growth in traffic volume, which cause incremental increases in delay and subsequent decreases in LOS. Just as with the existing conditions scenario, the most significant congestion is focused on the Black Rock Turnpike at Stillson Road (Route 135) intersection.

Background Optimized Traffic Operations

The 2040 Background Traffic Volumes were also analyzed with an optimized traffic network where the lane geometry remained unchanged, but traffic signal timings were optimized and additional coordination was added along the corridors. The purpose of the 2040 Background-Optimized traffic analysis is to determine how the existing signalization along the corridor would process expected future traffic volumes without any significant physical improvements.

The optimization process included a review of the coordinated system on the corridor, the coordinated system cycle lengths, and signal phase timing splits to balance delays on the intersection approaches to increase the efficiency of traffic operations. It also included modifications to the closed loop signal timing offsets which impact the progression of vehicles through the corridor. The optimization method was similar to the process employed by CTDOT, which monitors state-maintained closed loop systems and periodically modifies the signal timings based on current volumes to maintain operational efficiency. The optimization of the traffic signal operation included the following:

- Expansion of the existing closed loop coordination system on Route 58 (Black Rock Turnpike) to include all intersections from Tahmore Drive to Tunxis Hill Cutoff except for the intersection with Stillson Road, which runs free from coordination similar to the existing conditions
- Optimization of the study area intersection splits within existing minimums
- Optimization of the network cycle length and offsets for the coordinated system

The traffic signal optimization mitigates most of the delay caused by the additional background traffic growth. The following changes to LOS were identified from the analysis:

- Black Rock Turnpike at Tahmore Drive: Improved from D to C in the afternoon

- Black Rock Turnpike at Samp Mortar Drive: Improved from B to A midday

- Black Rock Turnpike at Fairfield Woods Road: Decreased from A to B midday

- Black Rock Turnpike at Turnpike Shopping Center: Improved from C to B on Saturday

The decrease in LOS at the intersection of Black Rock Turnpike at Fairfield Woods Road arose from a higher prioritization of other coordinated intersections in the optimization process in order to facilitate better operations along the corridor in its entirety. Significant overall intersection delays only persist at the intersection of Route 58 (Black Rock Turnpike) at Route 135 (Stillson Road) which operates at overall LOS E during the afternoon peak hour. However, there are individual movements at intersections along the corridor that operate at failing LOS E and F conditions and/or have queues extending beyond available storage. As a result, these Background Optimized analyses served as a basis for the creation of the recommended corridor concept plan, which aims to improve traffic congestion while also balancing traffic safety for all users of the corridor.

5. PUBLIC ENGAGEMENT

This Study has benefited from extensive community outreach that was intended to provide interested parties with a means to communicate their transportation needs and concerns with the project team. This input has greatly contributed to the team's understanding of the Turnpike and has guided the development of recommendations throughout the study.

The following summarizes the community engagement activities that have occurred thus far and has ensured that the *Black Rock Study* results in a plan that responds to the needs and desires of those who travel along and spend time on the Turnpike.

Committees

The *Black Rock Study* is intended to be a collaborative effort among the many stakeholders with a vested interest in the future of the Black Rock Turnpike. As such, the project team received guidance from two advisory committee, both of which met throughout the project. The responsibilities of these committee members are as follows:

- Provide insight and expertise on local conditions and issues;
- Collaborate with the project team to brainstorm potential ideas and recommendations;
- Review and provide feedback on project products before they are broadly distributed to the public; and
- Assist with the project team's public and stakeholder outreach effort by (1) identifying information resources and potential lines of communication; and (2) helping to raise awareness about community outreach efforts.

The two committees are described in further detail below.

Technical Advisory Committee

The Technical Advisory Committee (TAC) is comprised of representatives from the public organizations and agencies that are involved in the study. The project team met with the TAC three times over the course of the study to discuss technical issues about engineering, design guidelines, policies, and more.

Community Advisory Committee

The Community Advisory Committee (CAC) includes representatives from local businesses as well as community organizations, groups, and institutions with key expertise and local knowledge about the Black Rock Turnpike. The CAC met twice over the course of the study to help the team understand local conditions in the neighborhood.

Website

A publicly accessible project website accessed via http://bit.ly/blackrocksafetystudy, was developed and hosted on MetroCOG's website. The public has been encouraged to visit the website to learn more about the Black Rock Study, view meeting announcements and related materials, review published material and draft documents, and submit comments.

A significant number of comments were received via the website (blackrockstudy@fhiplan.com) and the project email that varied from questions, input, new ideas, and other considerations. The project team took this input into account throughout the Black Rock Study.

In addition, business cards with the project name, logo, and website address have been distributed to the public and available at all engagement events. Comments received over the course of the study are available in Appendix A.

Pop-Up Outreach Event

Two pop-up events were conducted on

1. Saturday, June 3rd, 2017, near the entrance/exit to ShopRite along the Black Rock Turnpike, and
2. Saturday, September 23rd at the Kiwanis Craft Fair on Town Green.

The purpose of the events was to:

- Solicit input on the community's impressions of the Turnpike's existing issues.
- Introduce the community to the project and encourage the community to attend the June and November (2017) Public Meetings.
- Distribute the URL link to the online survey (June 2017).

Online Survey

An online survey was conducted during the summer of 2017 to help the project team better understand the issues and opportunities for all those who travel along the Turnpike, including motorists, bicyclists, pedestrians, and transit users. The survey was available for the public to participate from Monday, May 22nd to Friday, July 28th and it was advertised via a press release from the Town of Fairfield; social media sites for MetroCOG and the City of Fairfield; various mailing list-serves, including the one developed for this project; the Committee members' networks; local community blogs and websites; and more.

A total of 1,069 people completed the survey, approximately 70% of whom live in Fairfield. Respondents answered questions about how and why the currently travel along the Black Rock Turnpike as well as what improvements they would like to see along the Turnpike in the future. A full compilation of results, including comments, can be found in Appendix A of the Existing and Future Conditions Technical Memorandum.

As the following graph indicates, most travelers using the Turnpike are destined for shopping or dining purposes. As a major regional retail corridor this is not surprising; however, it is important to recognize that the corridor is adjacent to several neighborhoods, so it serves as access to and from homes and employment locations.

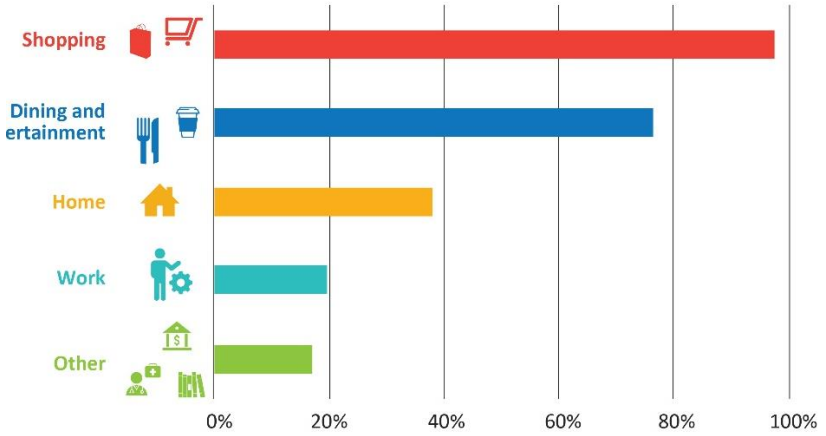


Figure 21: Trip purpose survey results

When asked how ambitious the Study Team should be regarding corridor modifications, most respondents (56%) wanted to see safety improvements and general road maintenance. Still, many respondents (39%) indicated that a new corridor vision and full redesign of the road was needed. Only 5% of respondents voted to keep the road the way it currently is.

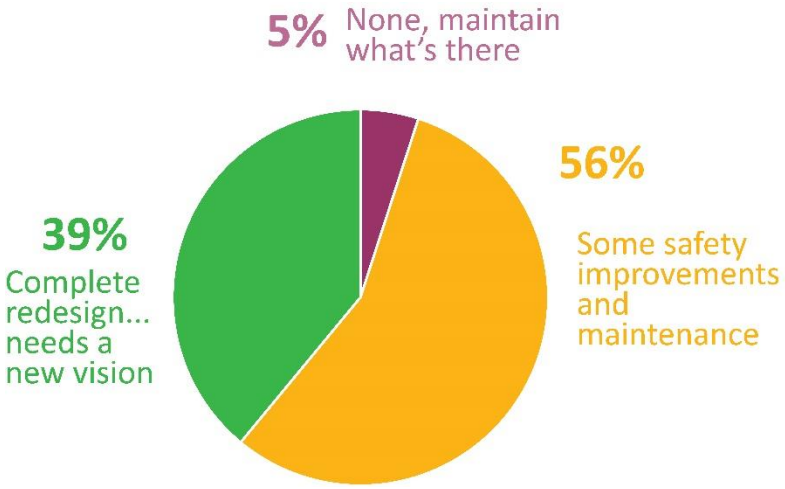


Figure 22: Survey response for how ambitious the corridor plan should be

While a full range of improvements was desired, most respondents wanted to maximize safety while relieving congestion.

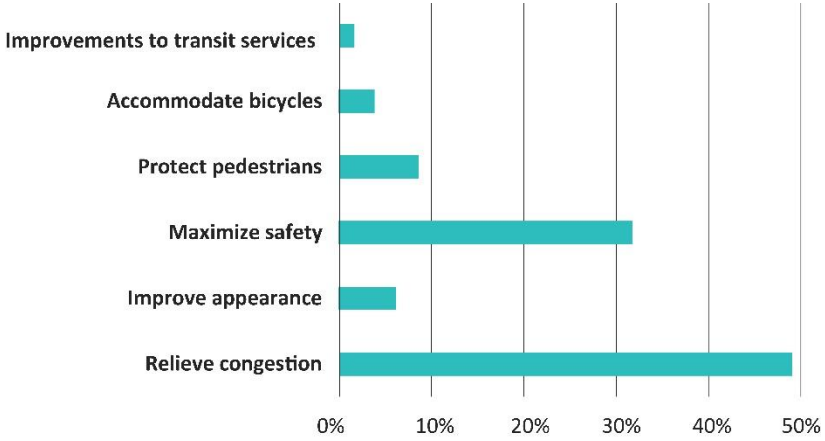


Figure 23: Survey response for study objectives

Public Meeting #1

Three public meetings were held over the course of the study. The first public meeting was held on Wednesday, June 7th, 2017 at 7:00 PM at All-Purpose Room at Osborn Hill School. The meeting included a presentation and small group breakout sessions for an interactive activity aimed at helping the Study Team understand the issues along the corridor.

Figure 24: Small Group Working Session, June 7th Public Meeting

Public Meeting #2

The second public meeting was held on Thursday, November 16th, 2017 at 7:00 PM at the All-Purpose Room at Osborn Hill School. After a presentation on the corridor needs and opportunities, the audience was polled to get a sense for the types of improvements that they wanted the Study Team to evaluate for Black Rock Turnpike.

Based on a polling exercise at the meeting, there was general acceptance of a range of potential solutions for Black Rock Turnpike. Potential improvements that the public was strongly in favor of is as follows:

- Access Management – the practice of consolidating driveways and controlling access in order to improve safety
- Road Diet – reducing the width of a road by narrowing lanes or removing travel lanes
- Enhanced Crosswalks – Installing high visibility pedestrian crossings using special pavement, lighting, landscaping and refuge islands

Potential improvements that the public was generally in favor of, but had some reservations is as follows:

- Median Barriers – Using raised medians to restrict left turns in and out of driveways to improve safety and traffic flow
- Roundabouts – a traffic control device that calms traffic, reduces crashes, and allows for lane reductions

Potential improvements that the public was not in favor of is as follows:

- Bicycle Lanes – providing a dedicated lane for bicycle travel

Public Meeting #3

The third and final public meeting was held on Thursday, November 5th, 2018 at 7:00 PM at the All-Purpose Room at Osborn Hill School. The purpose of the meeting was to present the concepts to the public and document their feedback. The event was well attended and there was generally positive reaction to the concept plans. No significant revisions to the recommendations were necessary as a result of the meeting.

Property Owner Meetings

The Study Team met with Kleban Properties on two occasions during the study. The first meeting provided feedback on corridor growth potential which was helpful in determining a future year traffic forecast. The second meeting was for the purpose of reviewing the initial concept plans and getting feedback on how the major retail establishments on the Turnpike would operate under some of the proposals. The meeting resulted in several modifications to the initial concept plan.

6. CONCEPTS

Initial Concept

The initial concept for Black Rock Turnpike was developed with the primary purpose of addressing the safety issues in the corridor. This concept plan was tested using PM peak hour data from the traffic count program and the drone analysis. A computer traffic simulation model was developed to guide the design of the improvements.

The initial concept was developed with optimum safety as the goal. As such, the concept had some drawbacks regarding traffic congestion and property access. As the Study Team met with affected stakeholders and the public, it became clear that some of the recommendations would not receive community support and would need to be removed from the plan. The initial concept can be found in Appendix B to this report, so that all ideas to address safety deficiencies in the corridor remain documented.

Recommended Plan Components

The recommended concept plan for Black Rock Turnpike strives to address as many safety deficiencies as possible while still offering adequate capacity for cars and trucks. Given the regional commercial status of the corridor, the Town of Fairfield stressed the importance of not further exacerbating current levels of congestion. While some congestion (especially during peak shopping days) is inevitable, it is expected that fewer crashes will reduce some of the unpredictable delay occurring along the corridor. In totality, the corridor improvement plan can be best summed up as a strategic set of safety countermeasures that work in concert to reduce vehicle speed, minimize unsafe driver behavior, and offer pedestrians better protection and visibility in the public right-of-way. The important elements of the plan are detailed in the following sections.

Lane reductions

Reducing the number of lanes on 4-lane roads can have a dramatic effect on reducing the number of crashes. There are several noteworthy benefits of reducing the number of lanes:

- Reduced lane changing behavior
- Improved lines of sight for drivers exiting driveways
- Consistent and safe traffic speed
- Reduced crossing distance for pedestrians
- Improved ingress/egress at driveways

Although a conventional road diet (reducing 4 lanes to 2 lanes plus a two-way-left-turn-lane) was not possible for the entire length of Black Rock Turnpike, the reduction of a travel lane entering the corridor from both the north and south is possible. The value of establishing single lane approaches to the corridor is that traffic enters at a controlled rate of speed which sets the tone for safer driving behavior. The abrupt change of environment from low density residential land uses to the north and south, to high density commercial requires physical design interventions aimed at reducing vehicular speed and requiring maximum driver attention. Detailed traffic analysis performed in this study proved that limited lane reductions can be effective at achieving these objectives.

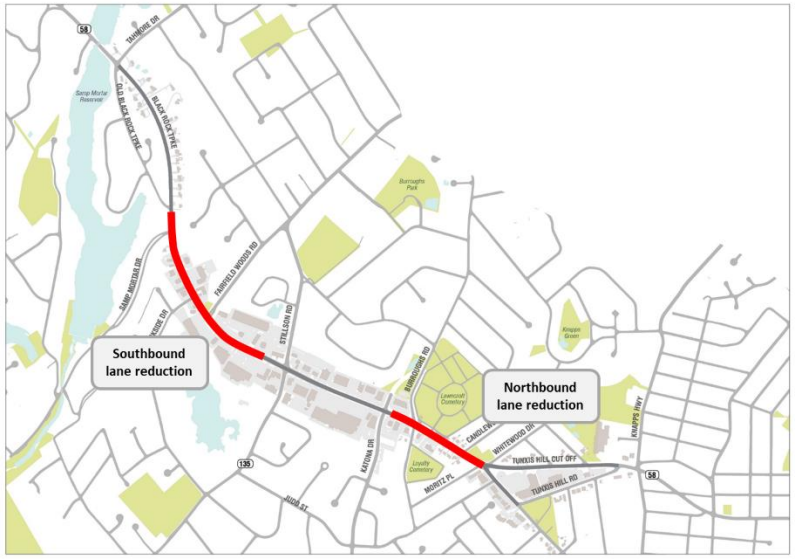


Figure 25: Lane reduction segments

Modern roundabouts

Another traffic control feature that is recommended for strategic locations along the Black Rock corridor is the modern roundabout. A roundabout is a type of circular intersection but is quite unlike a neighborhood traffic circle or large rotary. Roundabouts have been proven safer and more efficient than other types of circular intersections.[1] Roundabouts have the following noteworthy benefits:

- Promote slower vehicle speeds
- Reduced vehicle queuing
- Safer pedestrian crossings
- Reduced crash potential
- Allows for potential lane reductions

In the initial concept design, three locations were identified for possible roundabout applications. These locations were as follows:

1. At the Tunxis Hill Cutoff
2. At Katona Drive
3. At the Old Navy/Trader Joe's driveway

After reviews with property owners and thorough evaluation of potential impacts, the Katona drive roundabout was eliminated from the recommended plan. This was largely due to the roundabout's inability to process weekend shopping traffic.

A roundabout at the Tunxis Hill Cutoff serves as a corridor gateway treatment. This complex intersection would benefit from a simplified roundabout and would facilitate a lane reduction northbound to Burroughs Road and southbound approaching the roundabout. This segment of the Turnpike was determined to consist of high-speed traffic and limited pedestrian crossing opportunities. The roundabout establishes a transition from the lower density residential corridors to the east and south, to the conflict-rich commercial environment to the north. Given the concentration of bicycle and pedestrian crashes near the Burroughs and Katona intersections, establishment of slower traffic and safer driver behavior was a top priority.

The second location for a roundabout is at the driveways with Old Navy Plaza and Trader Joe's. These offset driveways prove challenging for drivers to enter and exit across multiple traffic lanes filled with high speed traffic. The proposed roundabout at this location would serve to slow vehicles travelling along the Turnpike, while providing improved access to adjacent properties. This

[1] https://safety.fhwa.dot.gov/intersection/innovative/roundabouts/

roundabout would require significant redesign of adjacent parking lots and would likely result in the loss of several parking spots. The tradeoffs include:

- Slower traffic speed
- Reduced crashes at the driveways
- Safer pedestrian crossing opportunities
- A turnaround and staging area for Greater Bridgeport Transit District buses

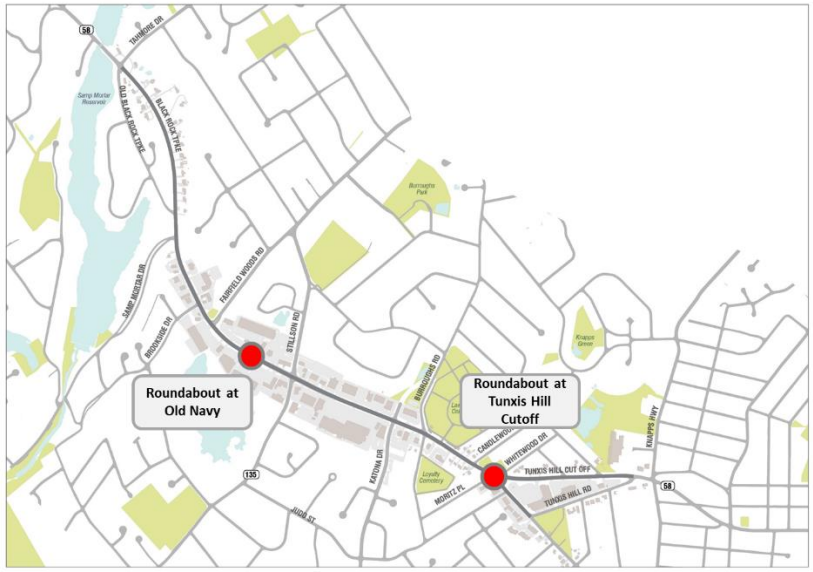


Figure 26: Modern roundabout locations

Pedestrian crossings

One of the most frequent comments received from members of the public was that crossing Black Rock Turnpike is challenging, both in terms of the infrequency of crossings as well as the perceived lack of safe and comfortable accommodations. A priority for this corridor plan was to improve conditions for all people using he Turnpike, and to the extent possible, lessen the need for cars to make short trips.

Although the sidewalks along the Turnpike are generally in good shape, and crosswalks exist at signalized intersections, the overall feeling from pedestrians was that designated crossings are too infrequent and are not always located at places people wish to cross. In the following figure, the four locations that were deemed to need enhanced pedestrian accommodation are shown. They are:

1. At the Tahmore Drive intersection – shorten crosswalks and include them on all four legs with an exclusive pedestrian signal phase
2. Between Old Navy and Trader Joes's – Reduced travel lanes and a median refuge island, combined with a high visibility crosswalk and HAWK signal
3. Between Shop Rite and CVS – High visibility crosswalks
4. At the Tunxis Hill Cutoff intersection – new pedestrian crosswalks integrated with the proposed roundabout

Figure 27: Enhanced pedestrian crossing locations

Figure 28: Intersection modification locations

Intersection modifications

For intersections that remain signal controlled, modifications are proposed to enhance operations corridor wide. Many of the recommendations provide dedicated left and/or right turn pockets to provide safer and more efficient use of intersection capacity.

Additionally, separate closed loop coordination systems on Black Rock Turnpike are provided for the intersections from Tahmore Drive to Fairfield Woods Road; and from the Turnpike Shopping Center and Fairway Plaza Driveways to Burroughs Road. All intersections were adjusted for optimized splits, cycle lengths and offsets.

Access Management

The high number of driveways along Black Rock Turnpike creates significant safety challenges because the road is designed to facilitate vehicular mobility but also serve access to the numerous residential and commercial properties adjacent to the road. This is of concern because curb cuts (driveways) increase conflicts between higher speed through traffic and slower speed drivers turning in and out of parking lots.

In addition to the location of a high concentration of curb cuts between Stillson Road and Burroughs Road, people expressed concern over the Old Navy plaza and Trader Joe's driveways between Fairfield Woods Road and Stillson Road. Crash data at this location indicated that this area experiences the greatest number of driveway-related crashes in the corridor.

During the online public survey, many respondents stated that the high number of driveways contributed to a stressful driving environment as turning traffic causes some drivers to abruptly change lanes. Public comments expressed a desire for the project to consider cross property connections wherever feasible.

Access Management is the proactive management of property access points to promote safer and more efficient traffic operations. The approach of this project with regards to access management was to:

1. Establish opportunities for cross-property connections wherever possible,
2. Eliminate redundant access points on single parcels whenever feasible,
3. Restrict access of driveways to right-in or right-out to minimize risky left-turning movements.

Appendix C details the access management recommendations for the corridor in greater detail. As Black Rock Turnpike continues to be developed over time, this plan can serve as a guide for the Town of Fairfield to use when dealing with property owners and the CT Department of Transportation. While making access modifications can be challenging and take many years, it is one of the more cost effective and beneficial solutions to addressing safety and congestion in the corridor.

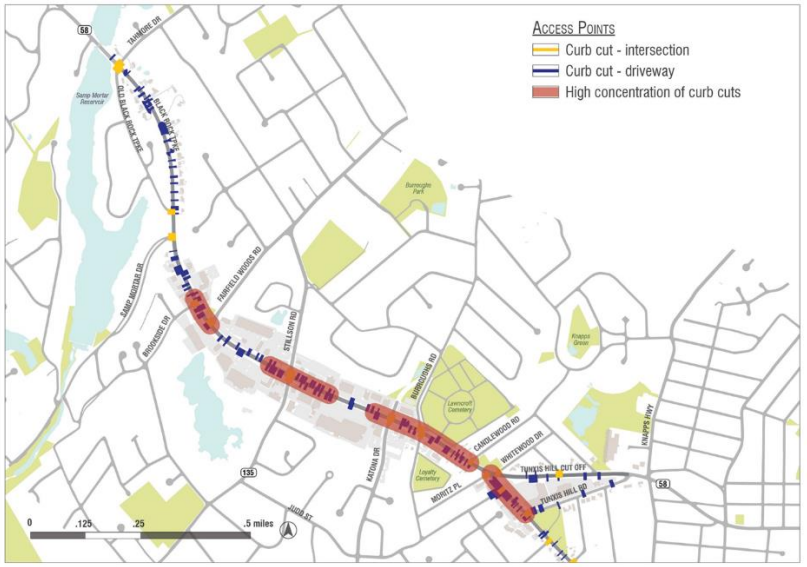


Figure 29: Locations for access management

Parking lot circulation

While not part of the public right of way, parking lots adjacent to Black Rock Turnpike can influence safety and operations along the corridor. Good parking lot design allows vehicles to enter and exit safely, without blocking intersections. They should also be designed to protect pedestrians by minimizing conflicts with other vehicles. Parking lots also offer an opportunity to reduce the number of driveways by providing good internal circulation and access across adjacent properties. As traditional brick and mortar retail continues to evolve over time, and as new car technologies gain adoption, the conventional wisdom that governs parking demand is sure to change. As this happens, property owners should consider modifying their parking lots to support the access management recommendations in this plan. Some initial ideas for modification of parking lots at Stillson Plaza, Enterprise 3 Shopping Center, and the Turnpike Shopping

Center were explored; however, more detailed engineering would need to be performed in the future.

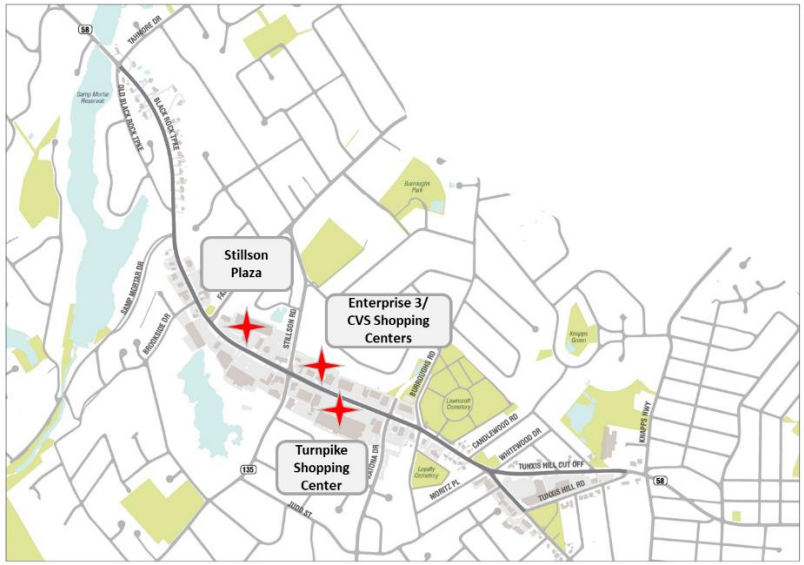


Figure 30: Parking lot modification locations

Modifications to the main access at the Turnpike Shopping Center is recommended. Observations by community members and the project team indicate queuing challenges at the intersection, even while the traffic model suggests adequate Level of Service. Direct observation and comments from the public pointed to issues with the driveway and lot design which prevents the traffic signal from operating efficiently. This is largely due to three reasons: 1) the presence of an existing raised driveway apron requiring vehicles to slow as they proceed over the apron, 2) the lack of sufficient driveway throat length which causes vehicles to spill into the intersection, and 3) the limited storage for vehicles waiting to exit the shopping center. The following figure includes some ideas for alleviating these issues.

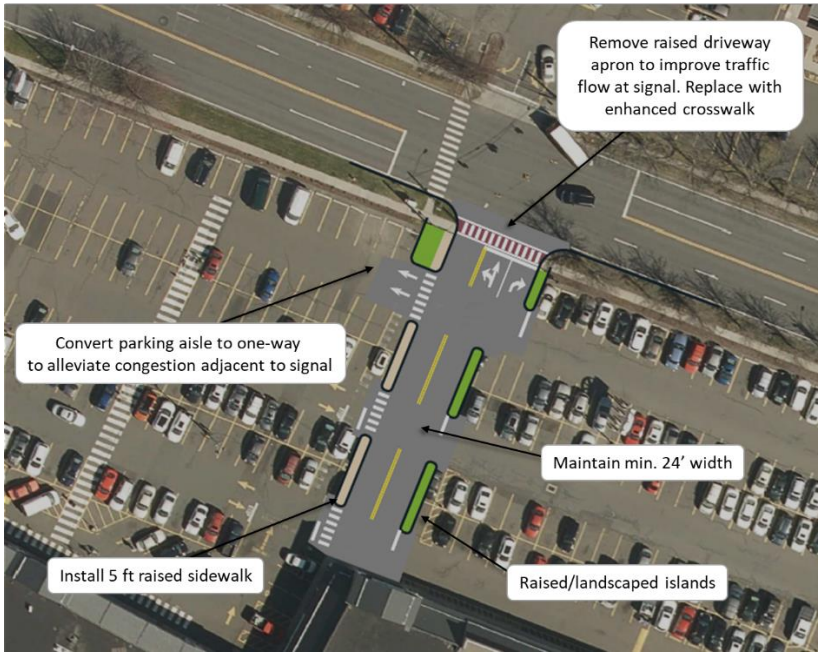


Figure 31: Driveway and parking lot recommendations for Turnpike Shopping Center

The Enterprise 3 Shopping Center represents smaller parcels without direct access to a traffic signal – meaning that vehicles traveling southbound must make a left-turn onto the turnpike at one of the several unsignalized driveways in this area. Enhancing and formalizing the connections to the parking lot behind the Enterprise 3 Shopping Center and associated properties is a key recommendation for facilitating good access management on the Turnpike. Figure 32 shows some ideas for cross-property connections and access management recommendations for this series of parking lots.

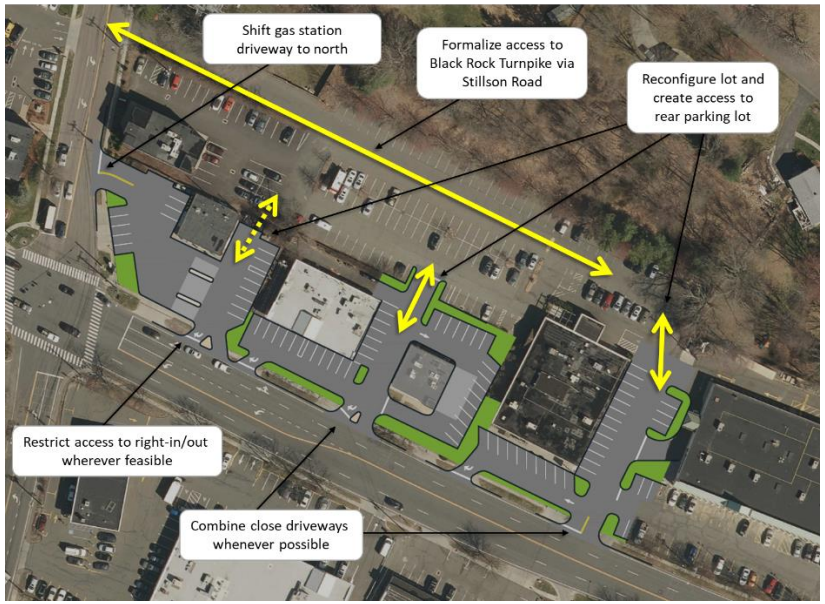


Figure 32: Driveway and parking lot recommendations for 2120 Black Rock Turnpike (Mobil) and 1968 Black Rock Turnpike (CVS)

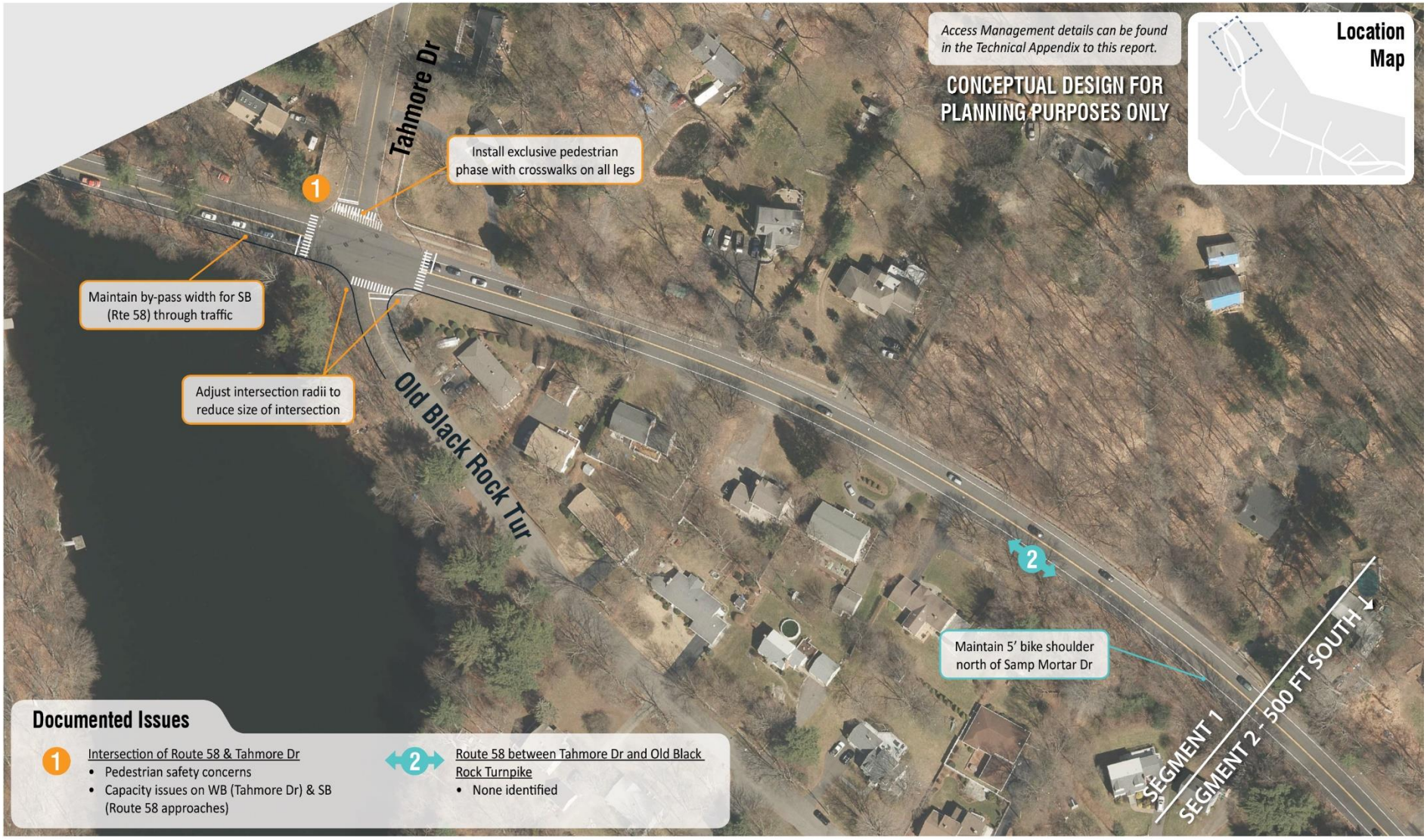
At Stillson Plaza, the construction of a modern roundabout would require property that would impact the number of parking spaces that are currently provided. As the roundabout is intended to significantly improve access in and out of the plaza, circulation within the parking lot should be redesigned to improve both safety and efficiency of space. In the following figure some initial ideas for reallocating parking and providing logical circulation patterns are provided for future consideration.

Figure 33: Driveway and parking lot recommendations for Stillson Plaza

Recommended Concept Plan

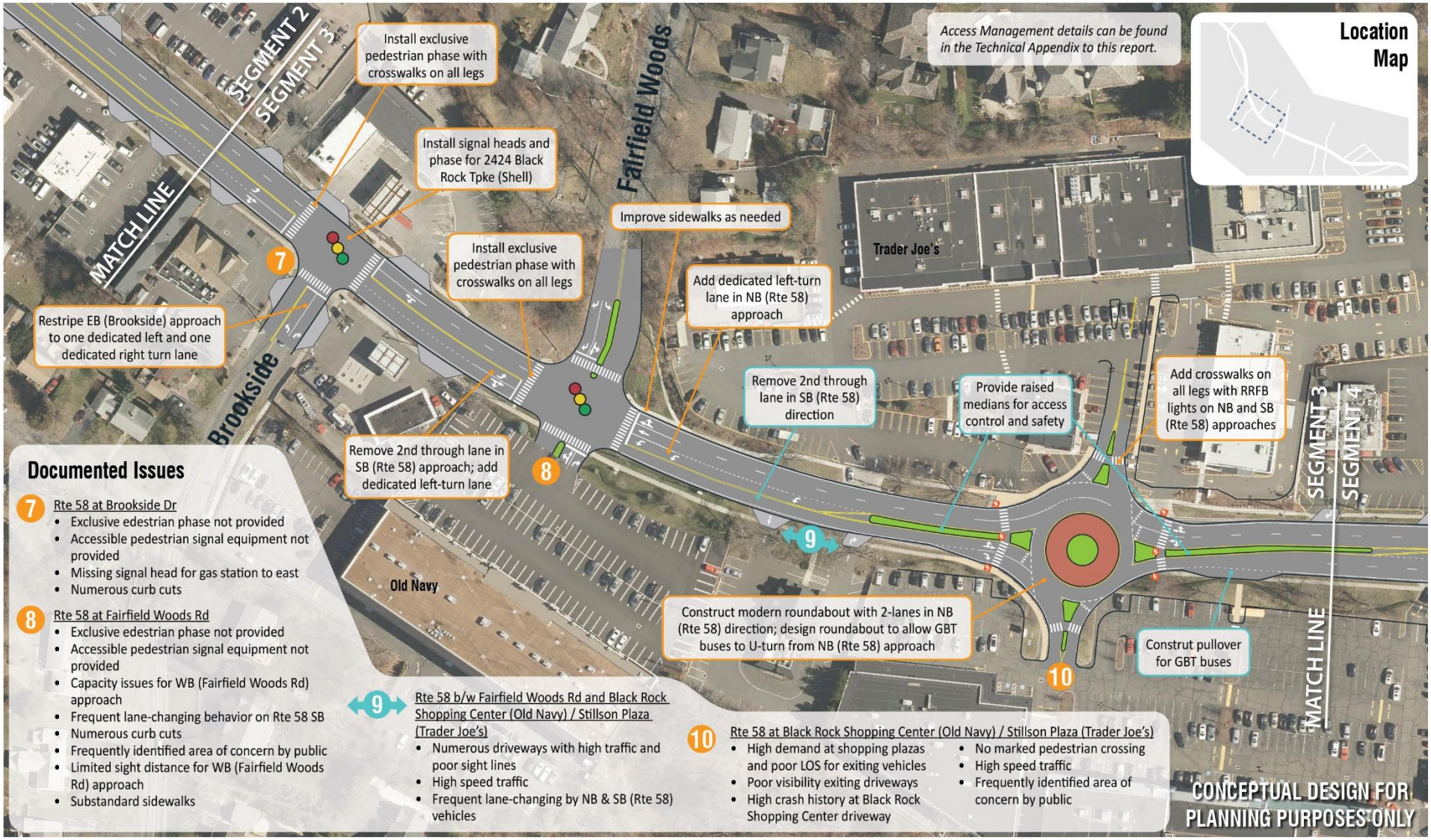
Table 2 and the corresponding figures on the following pages present the recommended corridor concept plan for Black Rock Turnpike in its entirety. The plan is drawn to scale and reflects a level of accuracy consistent with planning/pre-engineering studies. Future implementation of the recommendations will require more detailed design engineering; however, the plan that follows is sufficient for assuring general project feasibility and reasonable cost estimates.

All figures are sequential, starting at the northern end of the study area and progress south. All figures have match lines to indicate where the next image matches with the prior.

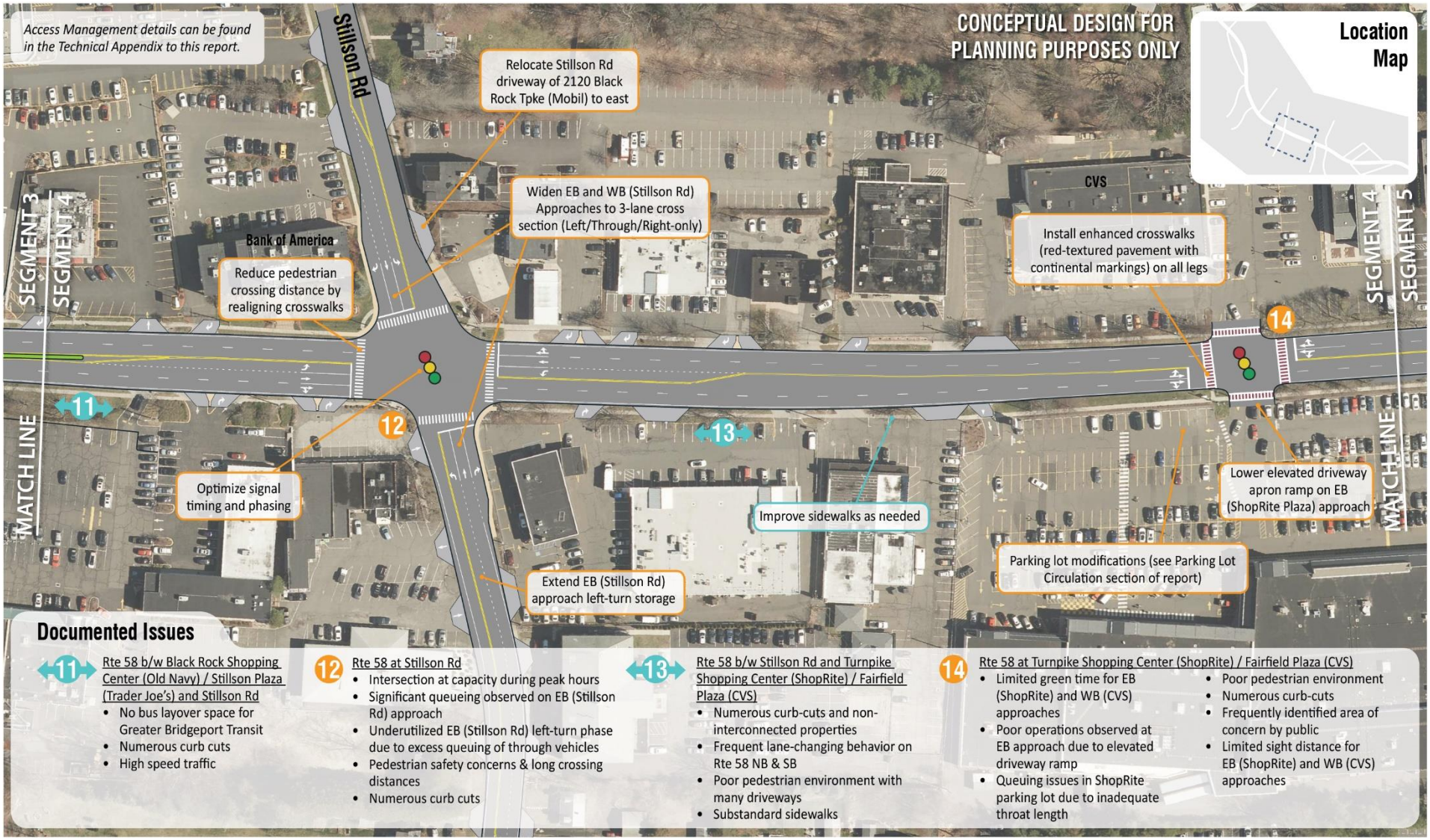


Figures 34 to 39: Recommended Concept Plan

Figures 34 to 39: Recommended Concept Plan

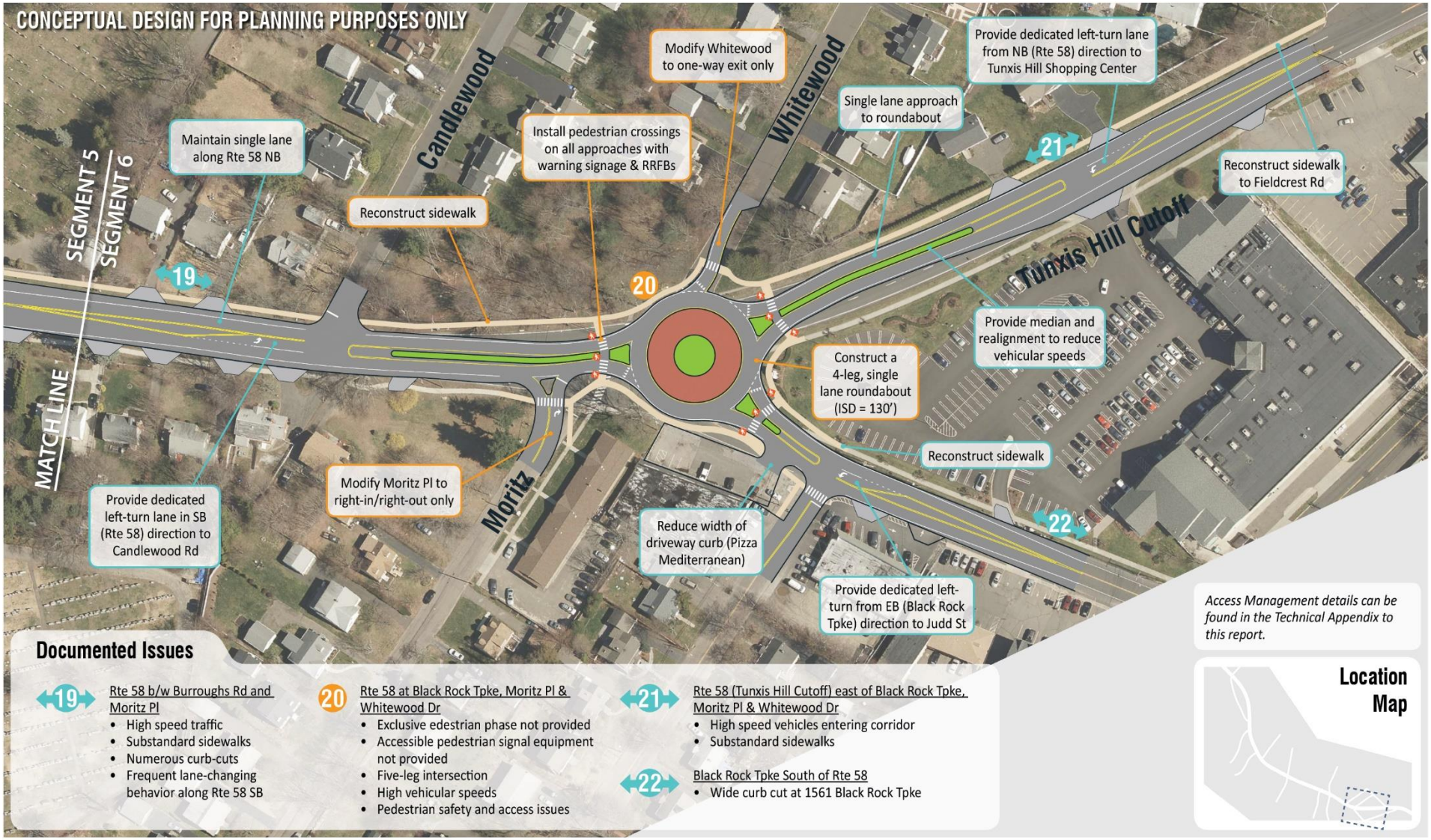


Figures 34 to 39: Recommended Concept Plan



Figures 34 to 39: Recommended Concept Plan

Figures 34 to 39: Recommended Concept Plan



Figures 34 to 39: Recommended Concept Plan

Near-Term Plan

The Recommended Corridor Concept Plan is a complex project overall and would likely require multiple construction seasons to complete. The entire project would need to be constructed in phases to minimize disruption to businesses and the traveling public, not to mention funding is unlikely to be obtained all at once. For these reasons, a Near-Term Plan was developed which includes several improvements from the Recommended Corridor Concept Plan that provide a high level of safety benefit for a lower overall cost. This Near-Term Plan can be considered the initial phase of the project.

The key differences between the Recommended Corridor Concept Plan and the Near-Term Plan are as follows:

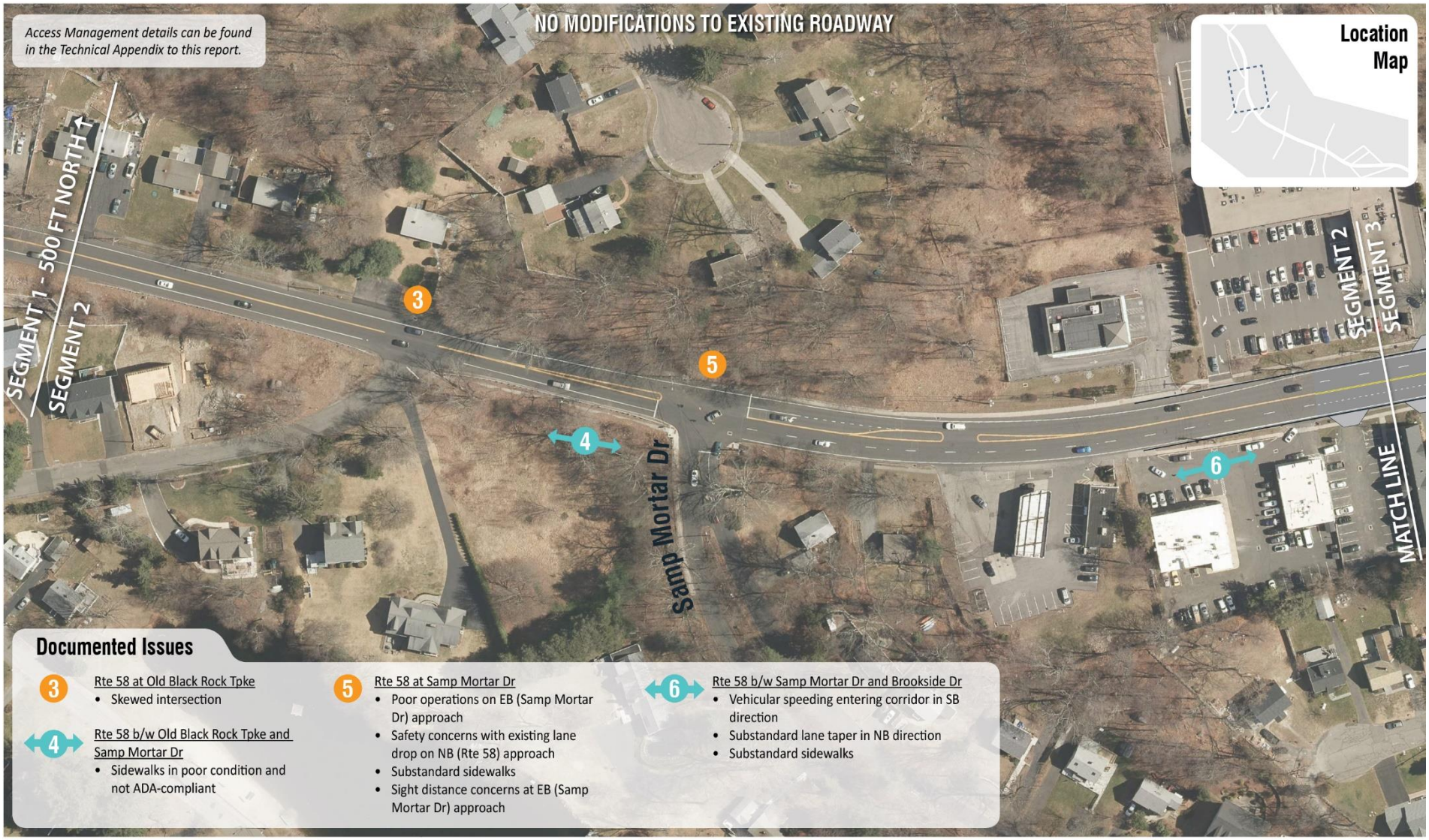
- No recommendations between Tahmore Drive and Brookside Drive;
- Instead of a modern roundabout at the Black Rock Shopping Center and Stillson Plaza driveways, a raised median is included along with an enhanced pedestrian crossing;
- No dedicated right turn pockets on the Stillson Road approaches to Black Rock Turnpike.

The important elements of the Near-Term Plan are the single lane approaches to the corridor. In the southbound direction, just north of Brookside Drive, one of the two through travel lanes terminates to an exclusive left turn pocket. The single through lane extends to just north of the Stillson Avenue intersection. This recommendation is important for reducing the heavy turn conflicts at Brookside Drive and Fairfield Woods Road, and encouraging slower vehicle speeds through this segment of the corridor.

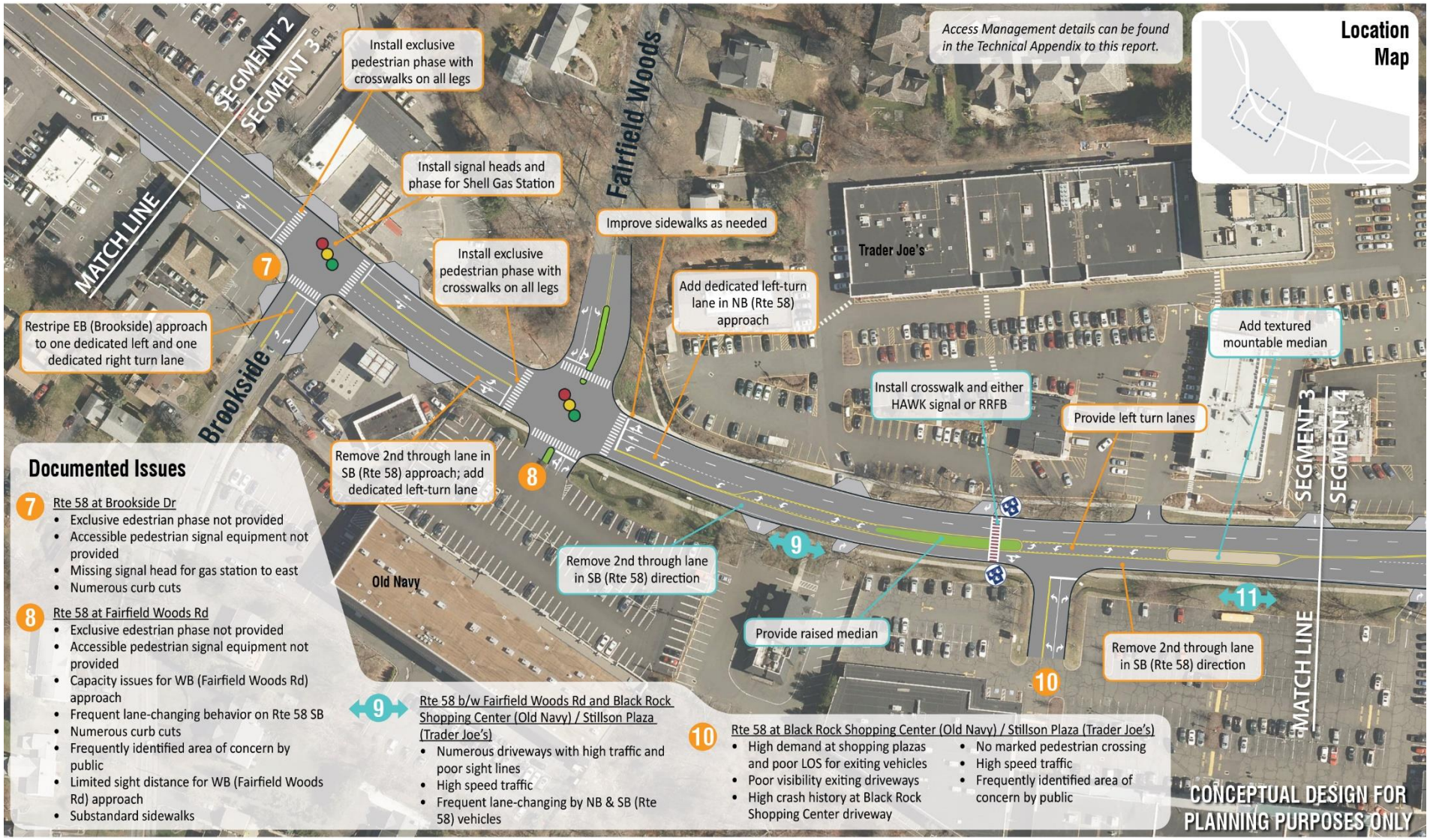
In the northbound direction, the installation of a modern roundabout at the Tunxis Hill Cutoff establishes a strong gateway feature at the transition area between residential and commercial land uses. The roundabout improves operations at this intersection, but more importantly, allows for a single northbound lane to be carried through Katona Drive. By utilizing dedicated turn pockets and maintaining a single through lane, vehicle speeding is discouraged and risky lane changing behavior minimized. Due to the number of severe crashes in this area, several involving vulnerable users, speed control measures are highly recommended.

The table on the following page, and the subsequent illustrations, provide more details about the Near-Term Plan.

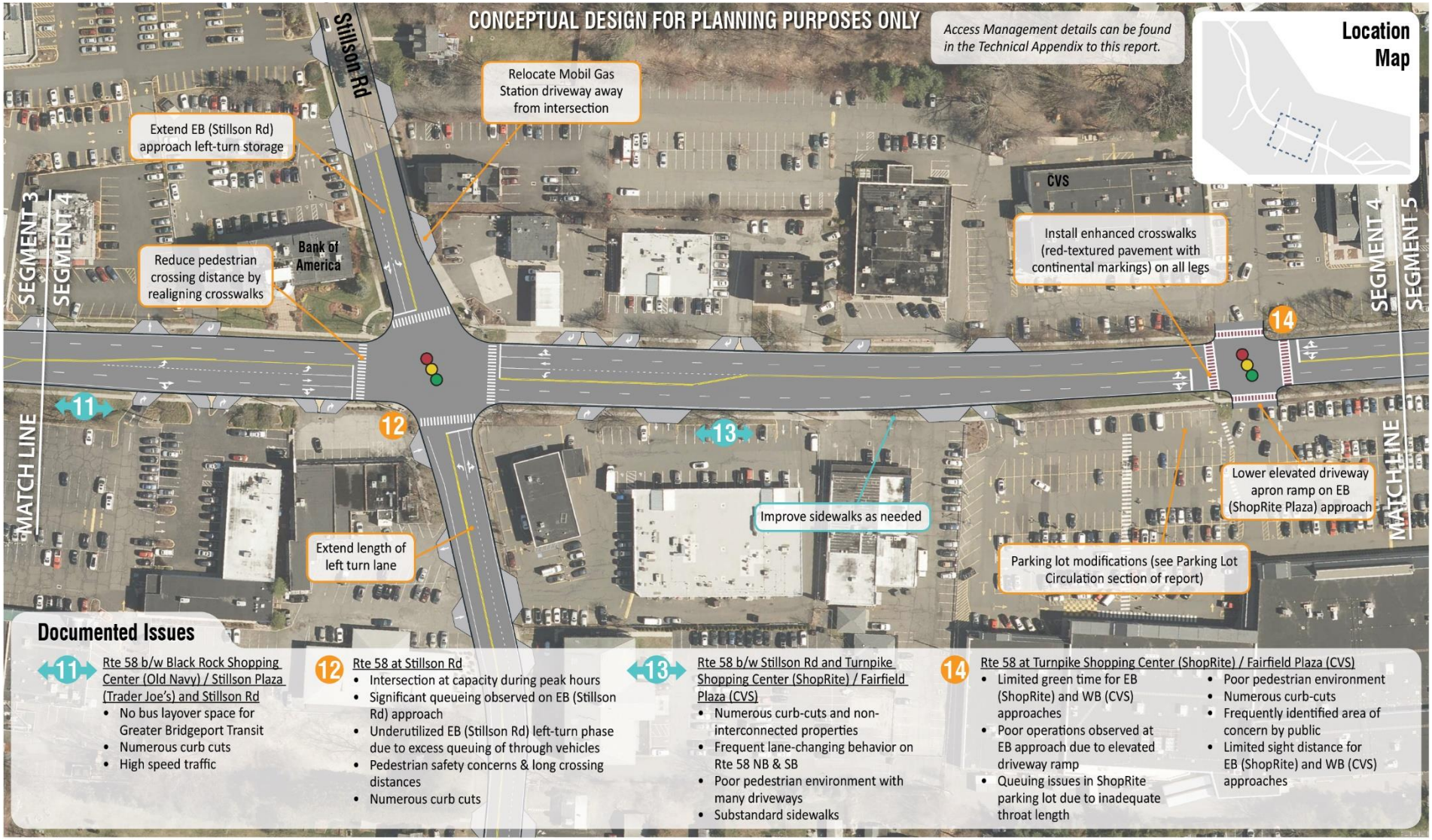
Figures 40 to 45: Near-Term Concept Plan



Figures 40 to 45: Near-Term Concept Plan



Figures 40 to 45: Near-Term Concept Plan



Figures 40 to 45: Near-Term Concept Plan

Figures 40 to 45: Near-Term Concept Plan

Figures 40 to 45: Near-Term Concept Plan

7. ANALYSIS

This chapter summarizes the traffic assessment that was performed for the Recommended Corridor Concept Plan developed for the Black Rock Turnpike Corridor Study. Detailed tables, figures, and traffic model reports can be found in Appendix D.

Recommended Corridor Concept Plan Traffic Assessment

The Study Team analyzed the 2040 Background Traffic Volumes on a revised traffic network that reflected the conceptual improvements to the study area intersections and roadways. It incorporated extensive physical changes to the corridor as well as changes to the traffic signal settings. From a traffic capacity standpoint, the major changes are as follows:

- Modification to the lane use on the main line, side street, and driveway approaches to provide a single Black Rock Turnpike through lane where possible to calm traffic flow and increase traffic safety
- Construction of a modern roundabout at the Old Navy and Trader Joe's Plaza Driveways
- Construction of a modern roundabout at the Tunxis Hill Cutoff Intersection and realignment of Moritz Place to be a two-way stop controlled intersection
- Provide separate closed loop coordination systems on Route 58 (Black Rock Turnpike) for the intersections from Tahmore Drive to Fairfield Woods Road and from the Turnpike Shopping Center and Fairway Plaza Driveways to Burroughs Road
- Optimization of the study area intersection splits within existing minimums
- Optimization of the intersection/network cycle lengths and associated offsets

A high-level summary of the expected traffic operations under the Recommended Corridor Concept are provided below. Improvements in the plan target capacity issues where possible, but operational efficiency is balanced with other safety benefits. The following operating conditions were identified from the analysis:

- Overall intersection LOS maintained an acceptable LOS C or better with the exception of the Black Rock Turnpike at Route 135 (Stillson Road), which operates at overall LOS D in the morning, afternoon and Saturday midday peaks.
- Movements and approaches operate acceptably at LOS D or better, with the exception of the following movements, which operate at LOS E during the identified peak hour:
    - Brookside Drive Left Turns in the afternoon
    - Fairfield Woods Road Through-Left Movements in the midday, afternoon, and Saturday midday and Fairfield Woods Road Right Turns in the afternoon and Saturday midday
    - Black Rock Turnpike at Stillson Road - Black Rock Turnpike Northbound and Southbould Left Turns in the afternoon and Saturday midday

For these specific approaches (previous page), the safety improvements and/or the optimization of the traffic signal timing for the forecasted 2040 volumes reduce the operational efficiency for these select approaches in favor of the Black Rock Turnpike main line through movements.

- Design queues for the Black Rock Turnpike Northbound Through-Right Movements at Katona Drive extend beyond available storage during the Saturday midday peak due to the reduction of a through travel lane on Black Rock Turnpike.

- In addition to the queues that extend beyond available storage, there are select movements that experience queues that are within available storage, but extend over approximately 500 feet due to the proposed improvements, including:

    - Black Rock Turnpike at Tahmore Drive – Black Rock Turnpike Southbound Approach in the morning, afternoon, and Saturday midday

    - Black Rock Turnpike at Samp Mortar Drive – Black Rock Turnpike Southbound Throughs in the afternoon and Saturday midday

    - Black Rock Turnpike at Burroughs Road – Black Rock Turnpike Northbound Through-Left in the morning, afternoon, and Saturday midday

8. IMPLEMENTATION PLAN

Following the initiation of a project and identification of a funding source, the remaining steps to implement an improvement will involve detailed design and construction. Based on the complexity of a project, an initial Preliminary Engineering phase may be required to conduct a more detailed engineering study and refine the concept plans and project scope. A preliminary engineering study can help establish the potential impacts to environmental and natural resources, identify potential property and utility impacts, and help refine the expected costs in current dollars rather than forecasting based on estimates reported in this Study, which are provided in current, 2018 dollars. There would also be continued public engagement throughout the design process.

Once Preliminary Engineering is complete and the decision is made to move forward with a project, final design will take place to add detail to the plan, conduct a right of way acquisition process, address utility conflicts and possible relocations, and develop construction documentation to facilitate bidding and construction of the improvements. Generally, projects that are identified as having a low level of complexity can be designed within 12-18 months from initiation of the project by the Towns. As complexity grows, so does the timeframe required to design improvements. Design phases can potentially last three years or more for highly complex projects. The following sections detail the permitting and compliance issues that will need to be incorporated during the design processes.

Permitting and Compliance

The following sections detail the various permitting and compliance activities that need to be considered as the Study recommendations move into the design and implementation stages. Each section describes the purpose and need for the permitting/compliance activity as well as the locations where they need to be considered. Included are sections on Environmental Permitting, Federal Funding and Preservation Compliance, Stormwater Permitting, and CTDOT Construction and Development Permitting.

Environmental Permitting

Improvement projects should assess natural resources within the project area study area including, but not limited to: 1) Threatened and Endangered Species and Critical Habitats, 2) Floodplains, and 3) Wetlands. Work proposed within these mapped resource areas would likely require obtaining permits from local, state, and federal regulatory entities. The environmental permits anticipated for the conceptual improvements are described in the following sections. Funding sources also play a role in which environmental permits may be required for future work.

Threatened and Endangered Species and Critical Habitats

The Threatened and Endangered Species information is available through the CTDEEP Natural Diversity Data Base (NDDB). There is one NDDB area mapped within the study area in the vicinity of the Mill River Crossing (NDDB map provided in Appendix E). Improvements proposed within the mapped NDDB areas will be required to coordinate with CTDEEP to determine what species may be affected by the project and any preventative or mitigative measures needed in the project design/schedule/approach. To request an NDDB state listed species review, the NDDB review request form package must be completed and submitted to CTDEEP. NDDB mapping is updated on an annual basis, so projects should be re-screened if they move forward in the future. As such, the improvements to the Black Rock Turnpike at Tahmore Drive may require a NDDB review request.

Preparation of a NDDB form submittal is estimated to take approximately two weeks, with an estimated agency review time of one to three months.

Floodplains

Floodplains are limited to the areas adjacent to and feeding the Mill River in the northern end of the study area (Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) maps provided in Appendix E). Improvements proposed within the mapped floodway and 100-year floodplains will be required to obtain a Flood Management Certification approval. Areas of 500-year floodplain also exist within the study area, and these will need to be considered during design and permitting. It is assumed that since the work is proposed on state roadways, that state funding would be used, and the applicant for permits would be CTDOT. Depending upon the impacts and extent of the work, this permit could be a CTDEEP Individual Flood Management Certification or CTDOT Flood Management General Certification (CTDOT applicant and minimal impacts). Based upon a review of the mapping, only the improvements to the Black Rock Turnpike at Tahmore Drive intersection may require floodplain permitting.

Preparation of a Flood Management permit package is estimated to take approximately six weeks, with an estimated agency review time of four to six months. If CTDOT is the permit applicant, there would be no municipal floodplains permits required.

Wetlands

There are mapped wetlands surrounding the Mill River as described in the Floodplains section above and along smaller streams, ponds, and wet areas within the study area. To determine if a project requires a wetlands permit, wetlands must be delineated in the field by a professional soil scientist, as well as waterbodies and watercourses. For purposes of this study, concepts within mapped wetland areas, waterbodies or watercourses have been identified as having the potential for wetland permitting needs.

Based upon the review of the study area, it is expected that only the improvements to the Black Rock Turnpike and Tahmore Drive intersection may require wetlands permitting and impact to the wetlands is likely to be limited. In addition, it is unlikely that the wetlands located to the north and west of Katona Drive Extension and Burroughs Road and those located northwest of the Black Rock Turnpike and Samp Mortar Drive intersection will be impacted by the proposed improvements. Notwithstanding, the following is provided to give a general overview of wetlands permitting requirements should any wetlands be impacted by the proposed improvements.

Improvements proposed within the mapped wetland resource areas have the potential to be required to obtain an Inlands Wetlands and Watercourses permit through CTDEEP. If there are activities that alter or fill wetlands or watercourses, a United States Army Corps. of Engineers (USACE) Section 404 permit would be required. Generally, for USACE Section 404 approval, if impacts are less than 5,000 square feet (sf), then submitting a Self-Verification (SV) form to USACE would be needed. If impacts are greater than 5,000 sf and less than one acre, then a Pre-Construction Notification (PCN) would be needed. If the extent of the work within wetlands and watercourses causes greater impacts than one acre, an individual Section 404 permit would be required. Authorization would likely be through General Permit (GP) No. 18, however, if authorization under a different GP was required, then thresholds may be different than those outlined above.

In addition to the USACE Section 404 permit, a Water Quality Certification (WQC) approval under Section 401 of the Federal Clean Water Act would be needed. If authorization under GP 18 is sought, WQC approval would be granted as part of the SV approval process, if SV applies to the project. If the PCN is being sought and the project

has under 0.5 acres of impact, the CTDEEP Connecticut Addendum Army Corps of Engineers General Permit State of CT (CT Addendum) would be required for the WQC. If impacts are over 0.5 acres, an individual WQC through CTDEEP would be required. If USACE Section 404 approval were through a GP other than GP 18, then Section 401 WQC thresholds may change. If a USACE Section 404 permit is needed, the CTDEEP General Permit for Water Resource Construction Activities will also apply if the project has under one acre of wetland and watercourse impacts.

If CTDOT is the permit applicant, there would be no municipal wetlands permits required, as CTDOT coordinates with the municipalities during the design process.

Preparation of the SV form submittal is estimated to take approximately two weeks, with no agency review time. Preparation of the PCN, General Permit for Water Resource Construction Activities permit, and/or CT Addendum packages are estimated to take approximately six weeks, with an estimated agency review time of four to six months. Preparation of Individual USACE and/or Individual WQC permit packages are estimated to take approximately twelve weeks, with an estimated agency review time of eight to twelve months.

Federal Funding and Preservation Compliance

Depending upon the funding source for projects, federal and/or state-level environmental documentation would be required. If federal funding is used, and if impacts are minimal, a Categorical Exclusion (CE) would likely satisfy the federal requirements. If the project has federal funding and greater impacts are anticipated, then the preparation of an Environmental Assessment (EA) may be necessary. If state funding is involved, to satisfy Connecticut Environmental Policy Act (CEPA) state environmental documentation requirements, a Post Scoping Notice or an Environmental Impact Evaluation (EIE) would be required. As the project advances into conceptual design and additional project details are known, a determination should be made about the applicability of NEPA and CEPA and the proper class of documentation. Opportunities for streamlining the environmental documentation process should be used, if available (e.g., preparation of a combined NEPA/CEPA document).

If federal funds are used for the improvements, the project would be subject to Section 4(f) of the US Department of Transportation Act to determine if the improvements would have any impact to publicly-owned public parks, recreation areas, and wildlife or waterfowl refuges, or any publicly or privately-owned historic site listed or eligible for listing on the National Register of Historic Places. Similarly, Section 106 of the National Historic Preservation Act requires that federal agencies consider the effects of their actions on properties listed in, or eligible for listing in, the National Register of Historic Places. A review shows that Whitewood Knoll is the only park located within the study area and there are no listed sites on the National Register of Historic Places or within the Town of Fairfield list of Historic Properties. As such, the improvements to the Black Rock Turnpike at Tunxis Hill Cutoff, Moritz Place, and Whitewood Drive may require a review for compliance with Section 4(f). As the improvements are advanced into conceptual design and additional project details are known an assessment should be undertaken to determine what documentation is required in order to comply with Section 4(f) of the US Department of Transportation Act and consultation should be conducted with the CT State Historic Preservation Office to determine if there will be any impacts to historic places.

Stormwater Permitting

It is unknown which concepts and segments will be constructed together, however if the soil disturbance proposed for a project is

over one acre, a CTDEEP General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities (Stormwater GP) would be required. With CTDOT as the applicant, this project would be classified as a locally exempt project. Any concepts that require the Stormwater GP, even if located outside of a mapped NDDB area, must also request the NDDB review and include the CTDEEP response in the stormwater permit package.

Preparation of the Stormwater GP package is estimated to take approximately six weeks. This permit filing must be submitted to CTDEEP 60 days before the start of construction if the soil disturbance area is between one and twenty acres. If the project's soil disturbance is greater than 20 acres, the permit should be submitted 90 days before the start of construction. CTDEEP has the 60- or 90-day timeframe to review the filing and provide any feedback to the applicant.

If CTDOT is the permit applicant, there would be no municipal stormwater permits required. If soil disturbance for the project is less than one acre, and a CTDEEP wetlands permit is required, no municipal stormwater permits would be needed.

CTDOT Improvement Construction & Development Permitting

In addition to the permitting for natural resources, CTDOT will require permits for developments and construction of improvements within the State right-of-way for Municipal roadway improvements and driveways to developments that are not included within the scope of a CTDOT project. The permits include encroachment permits and signal revision permits for any Municipal roadway and development driveway improvements and Office of State Traffic Administration (OSTA) permits for revisions to large developments that exceed the OSTA size limits and or those that are currently certified by OSTA. Depending on the scope of the work and the entity, the Municipality or a private developer performing the design, funding for the permits may come from public and/or private resources.

Construction & Opinions of Probable Construction Cost

Following the completion of the design phase, the projects will begin the construction phase. The steps involved in a publicly funded project include advertisement for bids to contractors, collecting bids on the work and awarding the contract, and finally conducting the construction to build the improvement. Utility relocations typically take place during construction, but in some instances a utility company may relocate facilities in advance of a project taking place once a utility agreement is in place. Generally, smaller projects are completed within one construction season between March and November. Larger projects can span several construction seasons depending on the complexity of the work, the construction staging and phasing needed to facilitate the maintenance and protection of traffic operations during construction, and possibly the availability of funding. Projects identified as having Moderate Complexity can be expected to take up to two construction seasons and highly complex projects could take more than two construction seasons to build.

To assist in the budgeting of funding for the improvements, opinions of preliminary probable construction costs (OPC) were developed for the Recommended Corridor Concept. The preliminary costs have been estimated following the guidelines published by the CTDOT and are presented in 2019 dollars. Project costs may require inflation factors looking out into the future to determine actual funding needs for funding programming. The "Preliminary Cost Estimating Guidelines" provide unit costs and percentage based lump sum costs to facilitate the estimation of project costs at the Preliminary

Engineering level of project development. The approximate project costs presented in this Study are limited to the construction item costs and exclude costs related to rights of way actions and environmental remediation, and engineering. The estimates include contingency (25%) and incidentals (25%) in the total opinion of probable costs.

As shown in Table 4 below, the improvements outlined in the Recommended Corridor Concept are estimated to cost approximately $23.1 million to construct. Table 5 lists the estimate costs for the Near-term Plan, which comes to about $10.1 million. The tables also present estimated construction costs for each intersection area to allow for estimates for projects including multiple intersections. The full OPC for each intersection including items, quantities, and unit costs are provided in Appendix F.

TABLE 4

Opinion of Probable Construction Cost Summary – Recommended Corridor Concept

	Intersection	Opinion of Probable Construction Cost
1	Black Rock Turnpike at Tahmore Drive & Old Black Rock Turnpike	$360,000
2	Black Rock Turnpike at Samp Mortar Drive	$2,273,000
3	Black Rock Turnpike at Brookside Drive and Fairfield Woods Road	$2,288,000
4	Black Rock Turnpike at Lake Hills & Black Rock Shopping Centers	$3,817,000
5	Black Rock Turnpike at Route 135 (Stillson Road) & Stillson Road	$2,327,000
6	Black Rock Turnpike at Turnpike Shopping Center & Fairway Plaza	$1,139,000
7	Black Rock Turnpike at Katona Drive & Katona Drive Extension	$3,523,000
8	Black Rock Turnpike at Burroughs Road	$2,675,000
9	Black Rock Turnpike at Tunxis Hill Cutoff, Route 732, Mortiz Pl. & Whitewood Rd.	$4,746,000
	Total	**$23,148,000**

TABLE 5

Opinion of Probable Construction Cost Summary – Near-Term Concept

	Intersection	Opinion of Probable Construction Cost
1	Black Rock Turnpike at Tahmore Drive & Old Black Rock Turnpike	$360,000
2	Black Rock Turnpike at Samp Mortar Drive	$0
3	Black Rock Turnpike at Brookside Drive and Fairfield Woods Road	$1,471,000
4	Black Rock Turnpike at Lake Hills & Black Rock Shopping Centers	$967,000
5	Black Rock Turnpike at Route 135 (Stillson Road) & Stillson Road	$330,000
6	Black Rock Turnpike at Turnpike Shopping Center & Fairway Plaza	$521,000
7	Black Rock Turnpike at Katona Drive & Katona Drive Extension	$942,000
8	Black Rock Turnpike at Burroughs Road	$761,000
9	Black Rock Turnpike at Tunxis Hill Cutoff, Route 732, Mortiz Pl. & Whitewood Rd.	$4,746,000
	Total	**$10,098,000**