MEMORANDUM

TO:	Mr. Frank Kovac Director of Facilities Nantucket Cottage Hospital 57 Prospect Street Nantucket, MA 02554 c/o Goulston & Storrs	**FROM:**	Vanasse & Associates, Inc. 35 New England Business Center Drive Suite 140 Andover, MA 01810-1066 (978) 474-8800
DATE:	June 9, 2016	**RE:**	6581
SUBJECT:	Four Corners Alternative Analysis Nantucket Cottage Hospital Modernization Project Nantucket, Massachusetts		

Vanasse & Associates, Inc. (VAI) has conducted an alternatives analysis of the Surfside Road/ South Prospect Street/Atlantic Avenue/Sparks Avenue intersection (a.k.a. "Four Corners") in Nantucket, Massachusetts. This analysis compares four (4) intersection improvement alternatives for the existing offset intersection geometry.

EXISTING CONDITIONS

The existing intersection is a four-legged, unsignalized intersection under all-way stop control with Atlantic Avenue and Surfside Road as the north and south legs (respectively) and Sparks Avenue and South Prospect Street as the east and west legs (respectively). The east and west legs of the intersection are offset by approximately 75 feet. The Surfside Road, Sparks Avenue and South Prospect Street approaches provide a single 11-foot wide general purpose lane. Atlantic Avenue is only 20 feet wide and provides a single 10-foot wide general purpose approach lane. Sidewalks are provided along both sides of Surfside Road and Sparks Avenue, along the east side of Atlantic Avenue and along the south side of South Prospect Street. A marked crosswalk is provided on the east leg of the intersection across Sparks Avenue with school-crossing signs.

Utility poles are located close to the exiting roadway edges and there are utility control cabinets located on the High/Middle School property at the southeast corner of the intersection. Also located in front of the High/Middle School property on Surfside Road is a significantly sized elm tree. This tree is located directly behind the existing curb line, approximately 100 feet south of Sparks Avenue.

The intersection is primarily surrounded by single family residential structures, with the exception being the Nantucket High School and Middle School located in the southeast quadrant of the intersection.

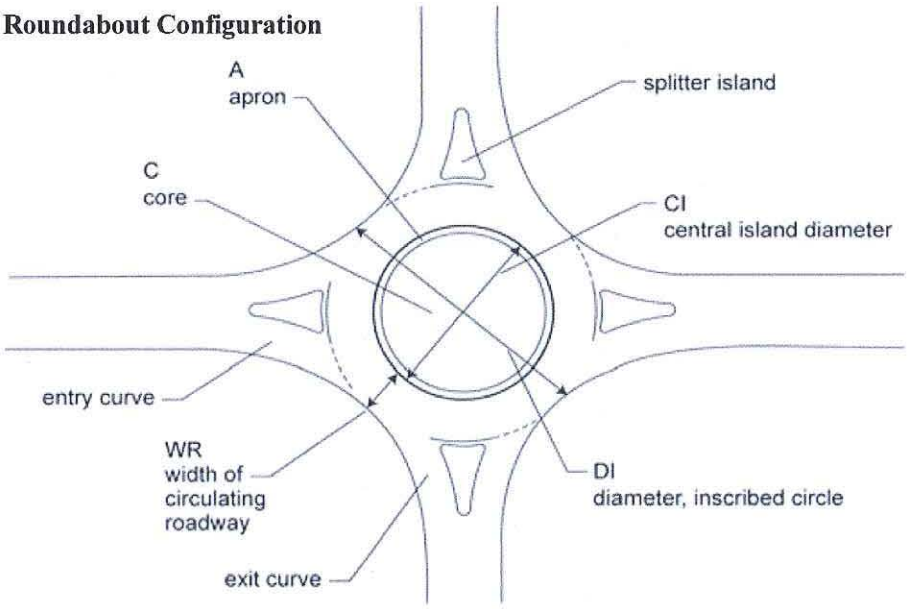
The intersection experienced a total of 6 crashes from 2009 through 2013, the most recent five-year period for which crash data is available. These crashes generally consisted of angle and rear-end type collisions. These types of crashes can be attributed to the offset intersection geometry, sight distance constraints, and minimal roadway widths. The intersection was found to have averaged less than two (2) reported motor vehicle crashes per year over the five-year review period. This crash rate is below the MassDOT statewide and Highway Division District 5 (the MassDOT Highway Division in which the

intersections are located) averages for an unsignalized intersection. No fatalities were reported at the study area intersections over the five-year review period.

DESIGN ALTERNATIVES

Four (4) design alternatives were evaluated as part of this analysis. The first three (3) alternatives reconfigure the intersection to create a "modern roundabout" type of circular intersection. The differences in these three (3) roundabout designs are in the details of the circulating roadway width, inscribed circle and center island diameters, and location of the center islands. The fourth alternative addresses the offset geometry of the existing intersection by providing an oblique four-way intersection geometry, while maintaining all-way stop control.

Standard Roundabout Configuration



Functional Class Major Street	Design Vehicle	Circle Dimensions (feet)				
		Diameter, Inscribed Circle (DI, feet)	Width, Circulating Roadway (WR, feet)	Central Island		
				Core (C, feet)	Apron (A, feet)	Total (CI, feet)
Arterial	Tractor/Trailer (WB -50)	100-130	29-35	55-95	5-10	65-100
Collector	Single Unit Truck (SU)	80-100	17-21	50-80	5-10	60-85
Local	Passenger Car (P)	45-80	16	25-60	3-5	30-65

Exhibit 6-27 from MassDOT Highway Design Guide

Alternative A – 100-foot Modern Roundabout with right-turn slip lane at Surfside Road

Alternative A reconstructs the intersection to function as a single-lane modern roundabout with a right-turn slip lane, and improved pedestrian and bicycle access. The right-turn slip lane will accommodate the Surfside Road right turns to Sparks Avenue, removing these vehicles from the roundabout and consequently improving traffic operations at the roundabout. The size of this roundabout is large enough to accommodate tractor trailer trucks (WB-50) and buses, with a 40-foot diameter center island for landscaping, a 14-foot travel lane and a 16-foot truck apron, for a total inscribed circle diameter of 100 feet. However, trucks and buses turning from Atlantic Avenue to South Prospect Street would be prohibited due to the restricted turning radius at this approach (See Exhibit A). The number of right turning vehicles at this approach is very minimal and is not anticipated to include large trucks or buses. It is expected that large vehicles could avoid this maneuver by utilizing York Street to access Prospect Street westbound through the implementation of appropriately placed signage, or by traveling through the roundabout.

Five (5) foot sidewalks and crosswalks are provided on all approaches to accommodate pedestrian access. This design is consistent with MassDOT Healthy Transportation Policy Directive and with typical bicycle accommodations at roundabouts, which offers bicyclists an option to traverse the roundabout via the sidewalk system rather than traveling through the roundabout with vehicular traffic ("share the road").

Alternative B – 100-foot Modern Roundabout

Alternative B is similar to Alternative A; however, the right-turn slip lane is removed and the geometry of the intersection is shifted to the northwest to eliminate impacts to the High/Middle School property (See Exhibit B). As compared to Alternative A, this alternative would result in a minor increase in vehicle queueing and delay on Surfside Road due to the elimination of the right-turn slip lane. The accommodation of turning movements for trucks and buses is similar to Alternative A; however, the revised geometry of the roundabout accommodates buses turning from Atlantic Avenue to South Prospect Street, prohibits tractor trailer truck (WB-50) right turns from Surfside Road to Sparks Avenue and from Atlantic Avenue to South Prospect Street and prohibits left turns from Atlantic Avenue to Sparks Avenue. This restriction is a result of minimizing impacts to the Nantucket High/Middle School property to the east of the intersection. It is expected that tractor trailer trucks could avoid these movements via alternative travel routes through the implementation of appropriately placed signage, or by traveling through the roundabout.

Five (5) foot sidewalks and crosswalks are provided on all approaches to accommodate pedestrian access. This design is consistent with MassDOT Healthy Transportation Policy Directive and with typical bicycle accommodations at roundabouts, which offers bicyclists an option to traverse the roundabout via the sidewalk system rather than traveling through the roundabout with vehicular traffic ("share the road").

Alternative C – 70-foot Mini Roundabout with right-turn slip lane at Atlantic Avenue

Alternative C reconstructs the intersection to function as a single-lane "mini" modern roundabout with improved pedestrian and bicycle access. This alternative also provides a right-turn slip lane to accommodate Atlantic Avenue right turns to South Prospect Street for passenger cars and buses. This slip lane is necessary to accommodate right turns from Atlantic Avenue to South Prospect Street due to the restricted existing roadway configuration approaching the intersection. The size of this roundabout is significantly smaller than a single lane modern roundabout, with a 38-foot diameter center island and a 16-foot travel lane for a total inscribed circle diameter of 70 feet. To accommodate larger design vehicles, the center island and median delta islands at the approaches to the roundabout would be constructed of mountable materials (i.e. stamped concrete, pavement, cobbles) and pavement markings to

allow trucks and buses to maneuver through the roundabout. Trucks (WB-50) could be accommodated on all movements except right turns from Surfside Road to Sparks Avenue and from Atlantic Avenue to South Prospect Street; and left turns from South Prospect Street to Atlantic Avenue. The number of turning vehicles at both of these approaches is very minimal and are not anticipated to include large trucks. It is expected that trucks could avoid these movements via alternative travel routes through the implementation of appropriately placed signage. However, mini roundabouts are not well suited for large vehicles including trucks and buses. Large vehicles would occupy most of the circle when turning, limiting access to the roundabout to other entering vehicles and significantly reduce the capacity of the mini roundabout.

Five (5) foot sidewalks and crosswalks are provided on all approaches to accommodate pedestrian access. This design is consistent with MassDOT Healthy Transportation Policy Directive and with typical bicycle accommodations at roundabouts, which offers bicyclists an option to traverse the roundabout via the sidewalk system rather than traveling through the roundabout with vehicular traffic ("share the road").

Alternative D – Oblique Intersection with right-turn slip lane at Surfside Road

This alternative realigns South Prospect Street and South Street from their existing off-set condition to form a more traditional oblique stop-controlled intersection. This alternative would improve intersection safety over the existing conditions, as the offset configuration would be eliminated and sight distances would be improved. This alternative provides a short right-turn slip lane to accommodate Surfside Road right turns to Sparks Avenue, removing these vehicles from the intersection. However, in order to retain the existing elm tree, the right turn lane is shortened such that, during peak traffic hours, this lane will be blocked by the queue of northbound traffic going straight and left. Buses can be accommodated on all movements at the proposed intersection with the exception of right turns from Atlantic Avenue to South Prospect Street, which would require the buses to track into the opposing travel lane on South Prospect Street to complete the right turn. This intersection is not well suited for tractor trailer trucks turning at the intersection. Similar to the roundabout designs, this alternative provides 5 foot sidewalks and crosswalks on all approaches to accommodate pedestrian access.

TRAFFIC OPERATIONS ANALYSIS

Traffic operations analysis for the Four Corners intersection utilizes traffic volume projections presented in the Traffic Impact Assessment prepared by Vanasse & Associates, Inc., dated December 2015, for the Nantucket Hospital Modernization project. Level-of-service (LOS), vehicle queue analyses and overall intersection delay analyses for the subject intersection were conducted for the 2022 Build average and peak-month conditions under the existing intersection configuration and for each of the proposed alternatives utilizing the Synchro computer model for the all-way stop conditions, the Sidra computer model for the single lane roundabout alternatives and the Vissim microsimulation for the mini roundabout alternative.

The Alternatives analysis results for average and peak-month conditions are summarized in Table 1. The LOS results summarized for the mini roundabout, Alternative C, in Table 1 have been approximated based on the approach delay output provided by the Vissim microsimulation and no V/C ratio is provided by the Vissim simulation. The detailed analysis results are presented in the Appendix.

As shown in Table 1:

- If left under its existing configuration, the intersection is expected to operate at an overall LOS "C" in the morning and evening peak hours during the average month conditions and LOS "E" and "F" in the morning and evening peak hours during the peak month conditions, respectively;

- Alternative A is expected to operate at an overall LOS "A" in the morning and evening peak hours during both the average and peak-month conditions;

- Alternative B is expected to operate at an overall LOS "A" in the morning and evening peak hours during the average month conditions and at an overall LOS "B" in the morning and evening peak hours during the peak month conditions;

- Alternative C is expected to operate at an overall LOS "B" in the morning and evening peak hours during the average month conditions and LOS "E" and "D" in the morning and evening peak hours during the peak month conditions, respectively;

- Alternative D is expected to operate at an overall LOS "C" in the morning and evening peak hours during the average month conditions and LOS "E" and "F" in the morning and evening peak hours during the peak month conditions, respectively.

A comparison of these results indicates that Alternative A is expected to operate better than the existing conditions and Alternatives B, C and D during the average and peak month conditions. Alternatives B and C are expected to operate comparably and better than the existing conditions and Alternative D during the average month conditions. However, during peak month conditions, Alternative C traffic is expected to proceed at a reduced rate (LOS "E") in the morning and evening peak hours. Alternative D is not expected to provide any operational improvement over the existing conditions.

Table 1
LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

Intersection Alternative Peak Hour/Movement	2022 Design-Year Average Month Build Volumes, Existing Geometry				2022 Design-Year Average Month Build Volumes, Proposed Geometric Improvements				2022 Design-Year Peak Month Build Volumes, Existing Geometry				2022 Design-Year Peak Month Build Volumes, Proposed Geometric Improvements			
	V/C[a]	Delay[b]	LOS[c]	Queue[d] 95th Percentile	V/C	Delay	LOS	Queue 95th Percentile	V/C	Delay	LOS	Queue 95th Percentile	V/C	Delay	LOS	Queue 95th Percentile
Existing Conditions Alternative – All-Way Stop:																
Weekday Morning																
Surfside Road NB	0.66	20	C	5	--	--	--	--	0.98	62	F	13	--	--	--	--
South Prospect Street EB	0.52	16	C	3	--	--	--	--	0.82	37	E	9	--	--	--	--
Atlantic Avenue SB	0.17	11	B	1	--	--	--	--	0.27	15	C	12	--	--	--	--
Sparks Avenue WB	0.62	19	C	5	--	--	--	--	0.93	55	F	2	--	--	--	--
Overall	--	**18**	**C**	--	--	--	--	--	--	**50**	**E**	--	--	--	--	--
Weekday Evening																
Surfside Road NB	0.65	20	C	5	--	--	--	--	1.02	71	F	14	--	--	--	--
South Prospect Street EB	0.63	19	C	5	--	--	--	--	1.02	71	F	13	--	--	--	--
Atlantic Avenue SB	0.32	13	B	2	--	--	--	--	0.86	23	C	10	--	--	--	--
Sparks Avenue WB	0.54	17	C	4	--	--	--	--	0.54	49	E	4	--	--	--	--
Overall	--	**18**	**C**	--	--	--	--	--	0.86	**59**	**F**	--	--	--	--	--
Alternative A – Single Lane Roundabout with Slip Lane																
Weekday Morning																
Surfside Road NB	--	--	--	--	0.23	3	A	1	--	--	--	--	0.30	4	A	2
South Prospect Street EB	--	--	--	--	0.35	8	A	2	--	--	--	--	0.47	11	B	3
Atlantic Avenue SB	--	--	--	--	0.09	6	A	1	--	--	--	--	0.12	7	A	1
Sparks Avenue WB	--	--	--	--	0.42	9	A	3	--	--	--	--	0.55	12	B	4
Overall	--	--	--	--	--	**6**	**A**	--	--	--	--	--	--	**8**	**A**	--
Weekday Evening																
Surfside Road NB	--	--	--	--	0.22	3	A	1	--	--	--	--	0.28	4	A	2
South Prospect Street EB	--	--	--	--	0.46	7	B	3	--	--	--	--	0.64	17	C	4
Atlantic Avenue SB	--	--	--	--	0.22	7	A	1	--	--	--	--	0.31	9	A	2
Sparks Avenue WB	--	--	--	--	0.34	8	A	2	--	--	--	--	0.45	10	A	3
Overall	--	--	--	--	--	--	**A**	--	--	--	--	--	--	**10**	**A**	--
Alternative B – Single Lane Roundabout																
Weekday Morning																
Surfside Road NB	--	--	--	--	0.48	10	B	3	--	--	--	--	0.63	15	B	5
South Prospect Street EB	--	--	--	--	0.35	8	A	2	--	--	--	--	0.47	11	B	3
Atlantic Avenue SB	--	--	--	--	0.09	6	A	1	--	--	--	--	0.12	7	A	1
Sparks Avenue WB	--	--	--	--	0.42	9	A	3	--	--	--	--	0.55	12	B	4
Overall	--	--	--	--	--	**9**	**A**	--	--	--	--	--	--	**12**	**B**	--
Weekday Evening																
Surfside Road NB	--	--	--	--	0.44	10	A	3	--	--	--	--	0.56	14	B	4
South Prospect Street EB	--	--	--	--	0.46	11	B	3	--	--	--	--	0.64	17	C	5
Atlantic Avenue SB	--	--	--	--	0.22	7	A	1	--	--	--	--	0.31	9	A	2
Sparks Avenue WB	--	--	--	--	0.34	8	A	2	--	--	--	--	0.45	10	A	3
Overall	--	--	--	--	--	**9**	**A**	--	--	--	--	--	--	**13**	**B**	--

See notes at end of table.

Table 1 (Continued)
LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

Intersection Alternative Peak Hour/Movement	2022 Design-Year Average Month Build Volumes, Existing Geometry				2022 Design-Year Average Month Build Volumes, Proposed Geometric Improvements				2022 Design-Year Peak Month Build Volumes, Existing Geometry				2022 Design-Year Peak Month Build Volumes, Proposed Geometric Improvements			
	V/C[a]	Delay[b]	LOS[c]	Queue[d] Ave/95th	V/C	Delay	LOS	Queue 95th Percentile	V/C	Delay	LOS	Queue Ave/95th	V/C	Delay	LOS	Queue 95th Percentile
Alternative C – Miniature Roundabout																
Weekday Morning																
Surfside Road NB	--	--	--	--	--	9	A	7	--	--	--	--	--	18	C	32
South Prospect Street EB	--	--	--	--	--	6	A	4	--	--	--	--	--	15	B	34
Atlantic Avenue SB	--	--	--	--	--	9	A	3	--	--	--	--	--	16	C	4
Sparks Avenue WB	--	--	--	--	--	11	B	7	--	--	--	--	--	42	E	54
Overall	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weekday Evening																
Surfside Road NB	--	--	--	--	--	7	A	6	--	--	--	--	--	20	C	25
South Prospect Street EB	--	--	--	--	--	12	B	12	--	--	--	--	--	34	D	28
Atlantic Avenue SB	--	--	--	--	--	6	A	3	--	--	--	--	--	12	B	6
Sparks Avenue WB	--	--	--	--	--	7	A	6	--	--	--	--	--	9	A	7
Overall	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Alternative D – Realigned Intersection All-Way STOP																
Weekday Morning																
Surfside Road NB	--	--	--	--	0.66	20	C	5	--	--	--	--	0.98	62	F	13
South Prospect Street EB	--	--	--	--	0.52	16	C	3	--	--	--	--	0.82	37	E	9
Atlantic Avenue SB	--	--	--	--	0.17	11	B	1	--	--	--	--	0.27	15	C	12
Sparks Avenue WB	--	--	--	--	0.62	19	C	5	--	--	--	--	0.93	55	F	2
Overall	--	--	--	--	--	**18**	**C**	--	--	--	--	--	--	**50**	**E**	--
Weekday Evening																
Surfside Road NB	--	--	--	--	0.65	20	C	5	--	--	--	--	1.02	71	F	14
South Prospect Street EB	--	--	--	--	0.63	19	C	5	--	--	--	--	1.02	71	F	13
Atlantic Avenue SB	--	--	--	--	0.32	13	B	2	--	--	--	--	0.86	23	C	10
Sparks Avenue WB	--	--	--	--	0.54	17	C	4	--	--	--	--	0.54	49	E	4
Overall	--	--	--	--	--	**18**	**C**	--	--	--	--	--	0.86	**59**	**F**	--

[a]Volume to Capacity
[b]Control (signal) delay per vehicle in seconds.
[c]Level-of-Service.
[d]Queue length in cars for Average 95th percentile conditions.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.

FINDINGS AND RECOMMENDATIONS

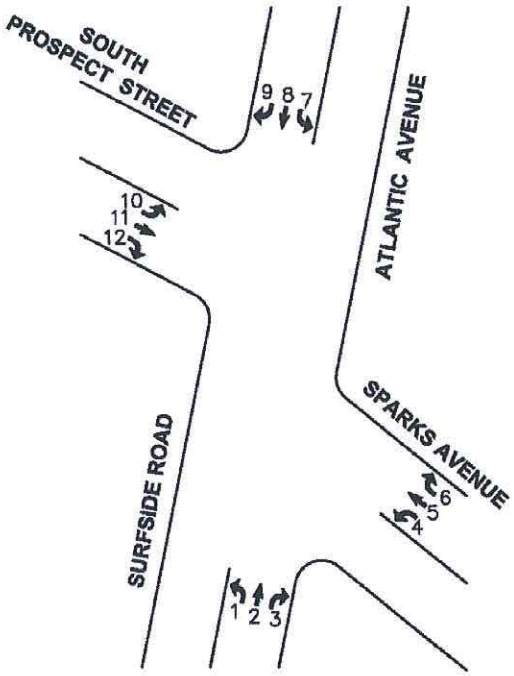
Evaluation Categories

The proposed alternatives have been evaluated based on the criteria below. A summary comparing the criteria for each alternative is provided in the appendix.

Traffic Operations – This category identifies level of service (LOS) for traffic operations for each alternative.

Pedestrian and Bicycle Accommodations – As previously identified, all of the design alternatives include sidewalks and crosswalks at the intersection to accommodate pedestrian access and will maintain continuity along the existing bicycle routes through this intersection using "share the road" signing and striping applications.

Vehicle Movements – All of the alternatives are designed to allow passenger vehicles to make all movements. However, each alternative varies in the ability to process movements of tractor trailer trucks (WB-50) and school buses. This category identifies the movements, as numbered in the adjacent "Turning Movement Diagram", which can or cannot be performed by these larger vehicles.



TURNING MOVEMENT DIAGRAM
NOT TO SCALE

Utility Impacts – All of the alternatives will impact the existing utility lines to some extent. This category identifies the number of existing utility poles that are impacted, and whether or not the existing utility control cabinets located on the Nantucket High/Middle School property are impacted.

Tree Removal – As identified in the existing conditions, there is a significantly sized elm tree located in front of the High/Middle School property on Surfside Road. This tree is located directly behind the existing curb line, approximately 100 feet south of Sparks Avenue.

Property Impact – This summarizes the number of Nantucket Cottage Hospital (NCH) and Non-NCH properties impacted, square footage of properties that need to be taken, and the number of structures that need to be taken to implement each alternative. Property lines used for this evaluation were obtained from assessors plans and are approximate only. In addition to the properties being taken, there will be temporary property impacts during construction that have not been included in this evaluation. However, it is anticipated that all alternatives would have similar temporary impacts.

Acquisition Costs – These costs are to be used to compare "order of magnitude" differences for each alternative. Assessed property values have been obtained and used to provide these costs for comparative

purposes only. These costs should not to be used for budgeting purposes; additional design and appraisals will be required to develop accurate budgeting costs.

Construction Costs –These are approximate costs based on the conceptual level design developed for the alternatives. This identifies the appropriate "order of magnitude" costs that should be considered when comparing alternatives at this conceptual level of design.

Alternatives Summary

Based on the information presented herein, Alternatives A and B (single lane roundabout), when compared to the other alternatives are expected to provide superior intersection operations during the peak month periods (approximately 3 months of the year); however, would result in greater impacts to abutting properties including the Nantucket High/Middle School and a number of private properties; and consequently, significantly higher construction/right-of-way costs. Alternative C (mini roundabout) would operate comparably to Alternatives A & B during the average month conditions (approximately 9 months of the year) and would result in significantly less impact to abutting properties; and consequently, significantly lower construction/right-of-way costs. However, Alternative C is expected to operate at or near vehicle capacity (LOS "E/D") in the morning and evening peak hours during peak month conditions. Alternative D is not expected to provide any operational improvement over the existing conditions.

Alternative A – 100-foot Modern Roundabout with right-turn slip lane at Surfside Road

Single lane modern roundabouts (4-leg roundabout) will generally operate satisfactorily with daily traffic volumes up to approximately 15,000 to 25,000 vehicles per day (vpd) according to the National Cooperative Highway Research Program (NCHRP) Report 672, Roundabouts: An Informational Guide, Second Edition. The daily traffic volumes for the existing and projected design year (2022) for both the average and peak month conditions are:

Existing Average/Peak Month	10,844/13,822 vpd
2022 Average/Peak Month	12,333/15,522 vpd

Based on the daily traffic volumes, a single lane modern roundabout would provide adequate capacity and operations for the 4-Corners intersection.

Alternative A would appropriately accommodate pedestrian and bicycle traffic with sidewalks and crosswalks providing continuity through the roundabout. The roundabout's raised delta islands would provide refuge for pedestrians crossing each leg of the roundabout and shorten crossing distances, a pedestrian safety benefit. An additional pedestrian crossing will be introduced with the implementation of the right-turn slip lane from Surfside Road to Sparks Avenue; thereby increasing pedestrian-vehicle conflicts.

Alternative A would accommodate tractor trailer trucks and buses through all movements at the proposed roundabout with the exception of right turns from Atlantic Avenue to South Prospect Street. It is expected that large vehicles could avoid this maneuver by utilizing York Street to access Prospect Street westbound through the implementation of appropriately placed signage, or by traveling through the roundabout.

Alternative A would require the relocation of five utility poles and the relocation of the exiting telephone cabinets on the southeast corner of the intersection. It is expected that the telephone cabinet relocation

would significantly increase the construction cost and increase the potential for construction schedule delays that are often presented when working in and around private utilities.

Alternative A would require the removal of the existing elm tree on the southeast corner of the intersection and may face community opposition.

Alternative A would impact five (5) private properties, require the acquisition of approximately 14,900 square feet (SF) of land and removal of two (2) residential structures. Additionally, approximately 6,100 SF of the Nantucket High/Middle School property would be required to accommodate the proposed geometry. The estimated total value of property (assessed value) to be taken for the roundabout is $1.21 million, of which the High/Middle School property accounts for $245,000.

Alternative A estimated construction cost (not including soft costs) is $900,000.

Alternative B – 100-foot Modern Roundabout

Based on the daily traffic volumes, a single lane modern roundabout would provide adequate capacity and operations for the 4-Corners intersection.

Alternative B would appropriately accommodate pedestrian and bicycle traffic with sidewalks and crosswalks providing continuity through the roundabout. The roundabout's raised delta islands would provide refuge for pedestrians crossing each leg of the roundabout and shorten crossing distances, a pedestrian safety benefit.

Alternative B would accommodate school buses through all movements at the proposed roundabout. Tractor trailer trucks can be accommodated on all movements except right turns from Surfside Road to Sparks Avenue and from Atlantic Avenue to South Prospect Street; and left turns from Atlantic Avenue to Sparks Avenue. It is expected that tractor trailers could avoid these movements via alternative travel routes through the implementation of appropriately placed signage, or by traveling through the roundabout.

Alternative B would require the relocation of five utility poles.

Alternative B would retain the existing elm tree on the southeast corner of the intersection.

Alternative B would impact seven (7) private properties, require the acquisition of approximately 29,700 SF of land and removal of five (5) residential structures. The Nantucket High/Middle School property would not be impacted to accommodate the proposed geometry. The estimated total value of private property (assessed value) to be taken for the roundabout is $2.23 million.

Alternative B estimated construction cost (not including soft costs) is $750,000.

Alternative C – 70-foot Mini Roundabout with right-turn slip lane at Atlantic Avenue

Mini roundabouts (4-leg roundabout) will generally operate satisfactorily with daily traffic volumes up to approximately 12,000 to 16,000 vehicles per day (vpd) according to the National Cooperative Highway Research Program (NCHRP) Report 672, Roundabouts: An Informational Guide, Second Edition. As noted above, the daily traffic volumes for the existing and projected design year (2022) for both the average and peak month conditions are:

Existing Average/Peak Month	10,844/13,822 vpd
2022 Average/Peak Month	12,333/15,522 vpd

Based on the daily traffic volumes, a mini roundabout would provide adequate capacity and operations for the 4-Corners intersection during the average month conditions (approximately 9 months of the year).; However, during the peak month conditions (approximately 3 months of the year), the traffic at the mini roundabout would proceed at a reduced rate under the 2022 design year,; specifically, during the morning and evening peak hours when operations are expected to reduce to LOS "E" and "D", respectively.

Mini roundabouts are also particularly sensitive to increases in heavy vehicular traffic as larger vehicles will occupy the entire mini roundabout to maneuver and preclude vehicles on all other approaches from entering. Significant (40%) increases to the overall intersection delay can be expected with minor (2%) percentage increases in heavy vehicular traffic.

Alternative C would appropriately accommodate pedestrian and bicycle traffic with sidewalks and crosswalks providing continuity through the roundabout. However, the mini roundabout's flush delta islands would not provide pedestrians crossing the roundabout legs with refuge and longer crossing distances will be required.

Alternative C would accommodate school buses through all movements at the proposed mini roundabout. Tractor trailer trucks can be accommodated on all movements except right turns from Surfside Road to Sparks Avenue and from Atlantic Avenue to South Prospect Street; and left turns from South Prospect Street to Atlantic Avenue. It is expected that tractor trailers could avoid these movements with alternative travel routes through the implementation of appropriately placed signage.

Alternative C would require the relocation of five utility poles.

Alternative C would retain the existing elm tree on the southeast corner of the intersection.

Alternative C would impact six (6) private properties, require the acquisition of approximately 8,300 square feet (SF) of land and the removal of one residential structure. Additionally, approximately 100 SF of the Nantucket High/Middle School property would be required to accommodate the proposed geometry. The estimated total value of property (assessed value) to be taken for the mini roundabout is $464,000, of which the High/Middle School property accounts for $4,000.

Alternative C estimated construction cost (not including soft costs) is $650,000.

Alternative D – Oblique Intersection with right-turn slip lane at Surfside Road

Based on the daily traffic volumes, the oblique intersection alternative would not improve traffic operations over existing conditions at the intersection. The realigned alternative would not provide adequate capacity or operations for the 4-Corners intersection. The realigned intersection would improve safety at the intersection as it will align the currently offset roadways and improve sight lines.

Alternative D would appropriately accommodate pedestrian and bicycle traffic with sidewalks and crosswalks providing continuity through the intersection. An additional pedestrian crossing would be introduced with the implementation of the right-turn slip lane from Surfside Road to Sparks Avenue; thereby increasing pedestrian-and vehicle conflicts.

Alternative D would accommodate buses through all movements at the proposed intersection with the exception of right turns from Atlantic Avenue to South Prospect Street. It is expected that buses could avoid this maneuver by utilizing York Street to access Prospect Street westbound through the implementation of appropriately placed signage. This intersection is not well suited for tractor trailer trucks turning at the intersection.

Alternative D would require the relocation of five utility poles and relocation of the exiting telephone cabinets on the southeast corner of the intersection. It is expected that the telephone cabinet relocation would significantly increase the construction cost and increase the potential for construction schedule delays that are often presented when working in and around private utilities.

Alternative D would retain the existing elm tree on the southeast corner of the intersection.

Alternative D would impact three (3) private properties and require the acquisition of approximately 4,100 SF of land and the removal of no residential structures. Approximately 2,300 SF of the Nantucket school property would be required to accommodate the proposed geometry. The estimated total value of property (assessed value) to be taken for the oblique intersection is $170,000, of which the High/Middle School property accounts for $90,000.

Alternative D estimated construction cost (not including soft costs) is $600,000.

Conclusion

Alternatives A and B (single lane roundabout), when compared to the other alternatives are expected to provide superior intersection operations during the peak month periods (approximately 3 months of the year); however, would result in greater impacts to abutting properties including the Nantucket High/Middle School and a number of private properties; and consequently, significantly higher construction/right-of-way costs. Alternative C (mini roundabout) would operate comparably to Alternatives A & B during the average month conditions (approximately 9 months of the year) and would result in significantly less impact to abutting properties; and consequently, significantly lower construction/right-of-way costs. However, during peak month conditions (approximately 3 months of the year), Alternative C traffic is expected to proceed at a reduced rate (LOS "E/D") in the morning and evening peak hours. Alternative D is not expected to provide any operational improvement over the existing conditions.

At the cost of increased traffic delay during and beyond the design year, the mini roundabout alternative would require significantly less property impacts, accommodate large vehicles on all movements of the intersection and provide improved pedestrian and bicycle accessibility, similar to the single lane roundabout (Alternatives A & B). Additionally, Alternative C would limit impacts to the Nantucket High/Middle School property, save the previously discussed elm tree and retain the utility cabinets on the southeast corner of the intersection.