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Memorandum

To: Andrew Vorce, AICP, Director
Michael Burns, ACIP, Transportation Planner
Nantucket Planning & Economic
Development Commission
2 Fairgrounds Road
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Date: March 11, 2010

Project 11183.00
No.:

From: Joseph Magni, P.E. - Project Manager
Matthew Hayes, P.E. - Project Engineer
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Re: Four Corners Intersection,
Alternative Roundabout Evaluation
Nantucket, Massachusetts

INTRODUCTION

The Town of Nantucket, through its Board of Selectmen, has retained Vanasse Hangen Brustlin, Inc. (VHB) to analyze an additional roundabout alternative for the intersection of Prospect Street, Atlantic Avenue, Sparks Avenue and Surfside Road, known locally as Four Corners. In June 2008, VHB prepared a technical memorandum to identify existing intersection deficiencies, develop and analyze a variety of alternatives, and present recommendations. Since all improvement options developed as part of that study encroached on the school property located on the southeast corner of the intersection, this technical memorandum explores an additional roundabout option that avoids impacts to the school property.

ALTERNATIVES PREVIOUSLY CONSIDERED

Three alternatives to improve operations at the study location were previously considered:

- **Alternative 1 (120' diameter roundabout)** - The roundabout would be large enough to accommodate a WB-50 design vehicle (tractor-trailer) while maintaining a large center island for landscaping with a 7-foot truck apron. All approaches would have splitter islands capable of providing sufficient pedestrian refuge; however, only two approaches would have crosswalks: Sparks Avenue and Surfside Road. In order to provide crosswalks on all approaches, a sidewalk easement would be necessary on the northwest corner or the splitter island on Atlantic Avenue would need to be constructed as mountable for larger vehicles. This alternative would avoid impacts to the elm tree on the Surfside Road approach, and would maintain the current telephone control cabinets on the southeast corner. Three houses owned by the hospital, including 1 Surfside Road, would require relocation. Two additional houses would no longer be in conformance with the 10-foot setback zoning requirements. Several utility poles would require relocation. This option is VHB's preferred alternative.
- **Alternative 2 (100' diameter roundabout)** - This alternative is similar to the Alternative 1 with the exception of a reduced circle diameter. Reducing the diameter would not significantly impact vehicular levels of service. Because the overall circle diameter would be

smaller, truck maneuvers can be more difficult. The center island would be 26 feet smaller with a 14-foot truck apron. The splitter islands would be constructed to be all or partially mountable to accommodate larger vehicles. This treatment reduces the amount of protection for pedestrians as they cross the roadways because the crosswalks would pass behind the splitter islands, instead of through them. This alternative would require the removal of two houses owned by the hospital and the porch of the house at 61 Prospect Street. It is likely that this house would no longer conform with the 10-foot zoning setback requirement. This option would avoid impacts to the elm tree and maintain the telephone control cabinets. Two utility poles would require relocation. After reviewing the 2008 study, the Town's preferred option was Alternative 2, shown in Figure 1.

- **Alternative 3 (4-Way Stop)** - This alternative is similar to the concept presented in the 2005 Mid-Island Study¹. It would realign Prospect Street and Sparks Avenue to form a more traditional all-way stop-controlled intersection. However, the original concept was deficient in that it could not accommodate larger vehicles and the slip lane on Surfside Road was too short to be beneficial. The slip lane would need to extend to Vesper Lane such that northbound right turns can by-pass the queue of the left and through traffic on Surfside Road. To avoid the elm tree, the slip lane would need to be located on the school property, eliminating access to the school parking lot from Surfside Road; however, there would be no loss of parking spaces if the parking lot entrance were relocated to Sparks Avenue. The extension of the slip lane would necessitate the relocation of the current school crosswalk on Surfside Road at Vesper Lane. Alternative 3 would also realign Prospect Street and Sparks Avenue more severely than shown in the original concept to facilitate turning movements by larger vehicles. The realignment of these roadways would require the relocation of two houses owned by the hospital on Prospect Street and the potential construction of a retaining wall for the home at 77 Sparks Avenue. This option would provide crosswalks on all four approaches. Approximately four utility poles would be relocated but the elm tree and telephone control cabinets would be untouched.

ALTERNATIVE 4 (NEW)

The Town provided VHB a sketch of a new roundabout alternative. The objective of this alternative, hereafter referred to as Alternative 4, is to avoid encroachment onto the school property by shifting the center of the intersection approximately 20 feet to the northwest. Alternative 4 would have the same overall dimensions as Alternative 2; however, there would be no slip lane for the Surfside Road northbound approach. Figure 2 graphically depicts some of the elements associated with this alternative, including:

- Retaining the elm tree and telephone control cabinets;
- Relocating three utility poles and one fire hydrant;
- Impacting three hospital-owned structures; and
- Requiring a right-of-way easement/taking from private abutter.

¹ *Traffic Study & Strategy for the Mid-Island Area*. July 8, 2005. Greenman-Pedersen, Inc. Stoneham, Massachusetts.

As in Alternative 2, the southbound right-turn from Atlantic Avenue to Prospect Street would have a tight corner radius due to the angle between the roadways and the need to minimize property impacts. Passenger vehicles would not fully enter the circulating roadway and trucks must loop around the center island to complete the movement. The number of vehicles affected by this condition is low and should not be a factor in the traffic operations of the roundabout. However, Alternative 4 also has a tight radius on the southeast corner of the intersection due to the angle between Surfside Road and Sparks Avenue. Again, passenger vehicles would not enter the circulating roadway and trucks must loop around the center island to complete the movement. This geometry may be problematic with the significant northbound right turn volume. Although entering vehicles are required to yield to circulating vehicles, where there is physical pavement width to "bypass" the circle, drivers (unlawfully) could make a right-turn without yielding. Driver frustration resulting from long vehicle queues during peak periods can increase this occurrence.

CAPACITY ANALYSES

Since the submittal of the previous memo, there has been a new software version of SIDRA² released. Alternative 2 has been re-analyzed using the new software and results are not significantly different from previous results. The three peak periods analyzed for Alternative 2 and Alternative 4 were weekday morning, weekday evening and Saturday mid-day. Table 1 summarizes the results of the analyses.

Both roundabout alternatives are projected to operate at excellent levels of service with projected 2014 traffic volumes. With Alternative 2, Prospect Street may experience vehicle queue lengths in excess of 200 feet during peak travel times. Because Alternative 4 does not have the slip-lane on Surfside Road, queue lengths on that approach may reach more than 300 feet. A 300-foot queue on Surfside Road would extend past Vesper Lane and the entrance to the school parking lot. Even with the long vehicle queues projected for both alternatives, a delay time of 20 seconds or less to reach the intersection is expected.

² SIDRA INTERSECTION, version 4.0.16.1074. Akcelik & Associates Pty Ltd. Greyhorn, Victoria, Australia. 2000-2010

Table 1: Capacity Analysis Summary – 2014 Volumes

	Alternative 2				Alternative 4			
	V/C ¹	Delay ²	LOS ³	95 th Queue ⁴	V/C	Delay	LOS	95 th Queue
Weekday Morning								
Surfside Road	0.57	4.3	A	77	0.78	11.6	B	325
Sparks Avenue	0.56	7.4	A	146	0.57	7.5	B	158
Atlantic Avenue	0.29	5.1	B	56	0.29	5.1	B	56
Prospect Street	0.65	8.5	B	197	0.65	8.5	B	198
Overall	0.65	6.3	A		0.78	9.0	A	
Weekday Evening								
Surfside Road	0.53	4.0	A	67	0.74	10.4	B	281
Sparks Avenue	0.57	7.9	A	151	0.58	8.0	A	162
Atlantic Avenue	0.50	7.5	B	120	0.51	7.6	B	122
Prospect Street	0.84	21.3	C	358	0.84	21.3	C	358
Overall	0.84	10.3	B		0.84	12.2	B	
Saturday Middy								
Surfside Road	0.70	5.6	A	115	0.81	11.8	B	363
Sparks Avenue	0.55	7.1	A	139	0.56	7.2	A	152
Atlantic Avenue	0.36	5.3	B	70	0.36	5.3	B	71
Prospect Street	0.73	12.4	B	253	0.73	12.5	B	255
Overall	0.73	7.8	A		0.81	10.0	A	

1 V/C -- Volume-to-capacity ratio.

2 Average Intersection delay, expressed in seconds per vehicle.

3 LOS -- Level-of-Service.

4 95th queue expressed in feet

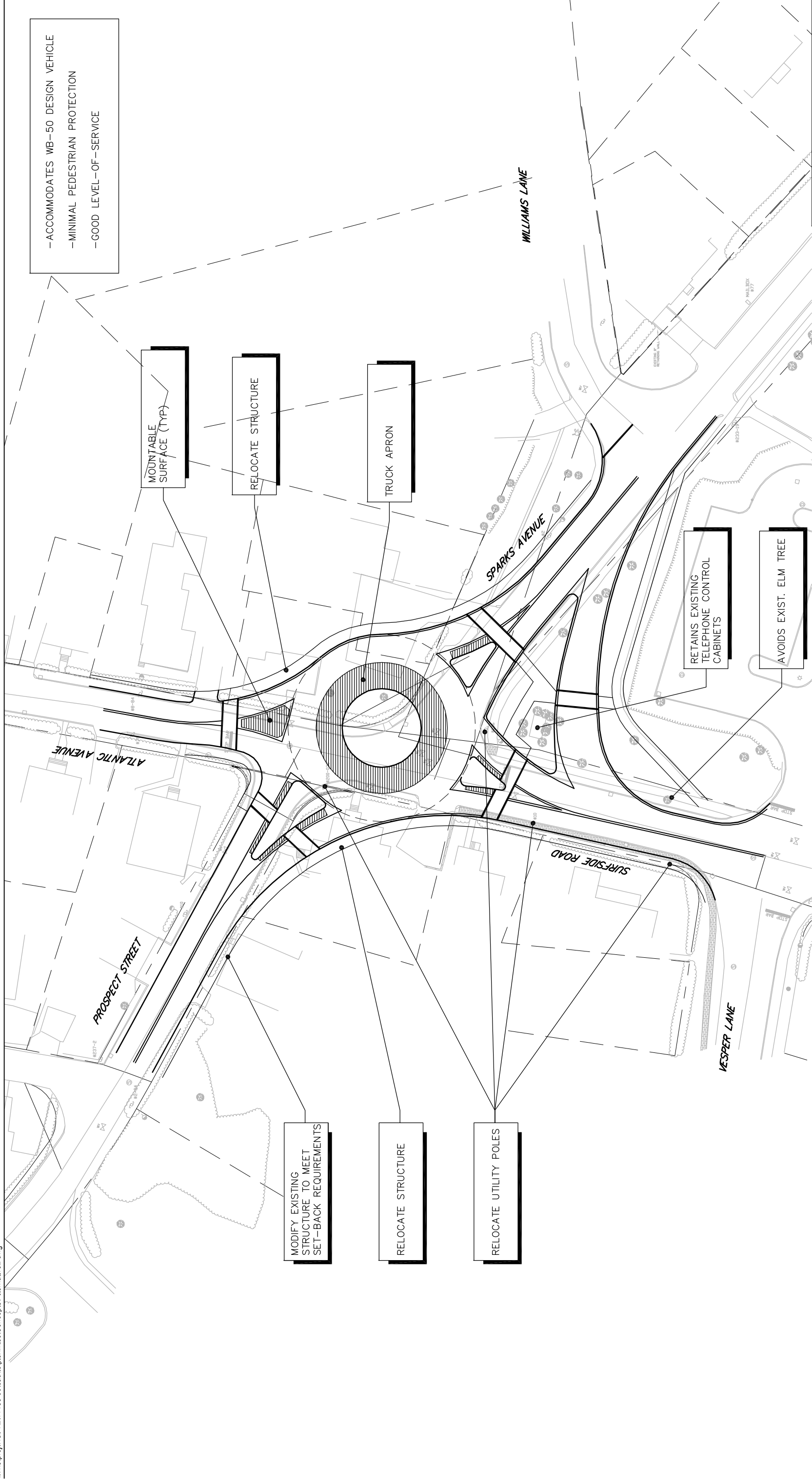
CONCLUSION

Table 2 compares the existing configuration of the intersection, the components of the three previous design alternatives, and the proposed alternative. Based on a review of the data provided above and the previous study (i.e., existing geometry, traffic volumes, pedestrian activity, crash data, and utility constraints) VHB still recommends Alternative 1 as the preferred alternative. Although it requires the relocation of three residential structures and potential zoning waivers for two additional structures, the 120-foot diameter roundabout would ensure a design that will accommodate vehicle and pedestrian traffic well into the future, while at the same time, fit into the character of the surrounding community. Acknowledging the Town’s desire to minimize property impacts and cost, Alternative 2 is preferable to Alternative 4. Relocating the roundabout to reduce impacts to the school property, as would be the case with Alternative 4, would result in difficult geometry for a movement with substantial traffic volume.

Improvement Options	Description	Advantages	Disadvantages											Construction Cost
				Pedestrian Safety	Reduces Traffic Congestion (Level-of-Service)	Accommodates Large Vehicles (WB-50)	Areas for Landscaping	Avoids Elm Tree	Avoids Telephone Control Cabinets	Relocate Existing Structures (# of Houses)	10-foot Set-back Zoning Requirement Violation (# of Properties)	Utility Pole Relocation (# of Poles)	Construction Cost	
Do Nothing	Retain existing/off-set geometry and all-way stop control at intersection.	No Cost	Unsafe and poor level of service.	X	X	X	X	√	√	○	○	○	None	
Alternative 1 120' Roundabout	Circular, raised, often landscaped island that forms a hub for traffic to flow around it, with splitter islands used to channelize traffic and provide pedestrian protection	Additional feature intersection on Nantucket; creates potential landscaping area, good level of service, increased safety.	Impacts to Hospital Property, High Cost	√	√	√	√	√	√	X (3 Houses)	X (3 Properties)	X (5 Poles)	High	
Alternative 2 100' Roundabout (Option previously preferred by Town)	Circular, raised, often landscaped island that forms a hub for traffic to flow around it.	Additional feature intersection on Nantucket; creates potential landscaping area, good level of service, increased safety.	Impacts to Hospital Property, High Cost, Splitter Islands not used for pedestrian protection	○	√	√	√	√	√	X (2 Houses)	X (1 Porch)	X (4 Poles)	High	
Alternative 3 Traditional 4-way Stop with Northbound Slip-Lane	Realign Prospect Street and Sparks Avenue to form traditional intersection geometry	Eases Turning Movements for larger vehicles; Reduces risk of right-angle crashes	Poor level of service; impacts to Hospital and School Properties; retaining wall for private abutter	○	X	○	X	√	√	X (2 Houses)	○	X (3 Poles)	Moderate	
Alternative 4 (New) 100' Roundabout with no Impacts to School Property	Circular, raised, often landscaped island that forms a hub for traffic to flow around it.	Additional feature intersection on Nantucket; creates potential landscaping area, good level of service, increased safety.	Impacts to Hospital Property, High Cost, Splitter Islands not used for pedestrian protection; Easement/Taking required from private abutter; NB right-turn does not enter circle	○	√	√	√	√	√	X (2 Houses)	X (1 Porch)	X (3 Poles)	High	

√ = Positive Impact/Yes
 ○ = No Impact/Maybe
 X = Negative Impact/No

Table 2
 Four Corners Intersection
 Nantucket, MA
 Comparison of Alternatives



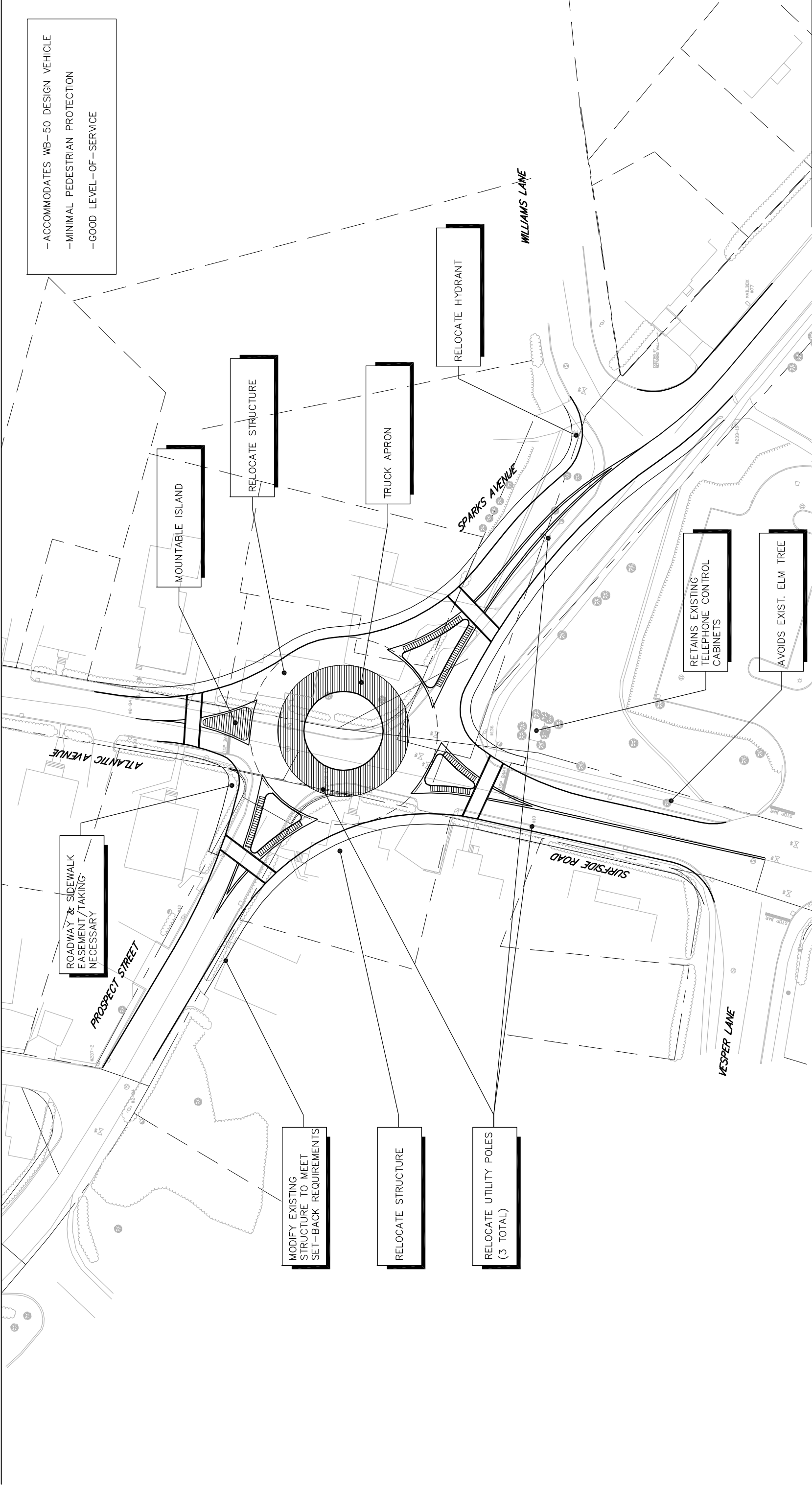
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Figure 1

Alternative 2 (See Note 1)
Four Corners Intersection
Nantucket, Massachusetts

NOTES

1. This was the Town's Preferred Option from the previous study.



- ACCOMMODATES WB-50 DESIGN VEHICLE
 - MINIMAL PEDESTRIAN PROTECTION
 - GOOD LEVEL-OF-SERVICE

ROADWAY & SIDEWALK EASEMENT/TAKING NECESSARY

MOUNTABLE ISLAND

RELOCATE STRUCTURE

TRUCK APRON

RELOCATE HYDRANT

WILLIAMS LANE

SPARKS AVENUE

RETAINS EXISTING TELEPHONE CONTROL CABINETS

AVOIDS EXIST. ELM TREE

PROSPECT STREET

ATLANTIC AVENUE

SURFSIDE ROAD

VESPER LANE

MODIFY EXISTING STRUCTURE TO MEET SET-BACK REQUIREMENTS

RELOCATE STRUCTURE

RELOCATE UTILITY POLES (3 TOTAL)

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Figure 2

Alternative 4 (New)
 Four Corners Intersection
 Nantucket, Massachusetts

