Memorandum

To: Ms. Susan C. Ryan
Spaulding Youth Center
72 Spaulding Road
Northfield, NH 03276

Date: July 18, 2017

Project #: 52455.00

From: Robin Bousa
Director of Transportation Systems

Evan Drew, PE
Project Engineer

Re: Spaulding Youth Center
Northfield, NH Property

Preliminary Site Access Assessment

VHB has completed a preliminary site access assessment for a proposed medical business park to be located on the Spaulding Youth Center (SYC) property located west of Shaker Road in Northfield, New Hampshire. At the time of this memorandum, a master plan is being planned to accommodate constructing up to one million square feet (sf) of medical facilities with ancillary supporting uses. Feasibility assessments (including this site access assessment) are being completed for the project to assist SYC in obtaining the zoning modifications they will need to acquire from a Town vote.

A formal traffic impact study is being prepared as part of the master planning efforts to identify potential traffic impacts on the surrounding state and local roadways. It is anticipated that the formal study will be completed midsummer and submitted to the New Hampshire Department of Transportation (NHDOT) for review. In the meantime, this memorandum was prepared to determine how access will be provided to the site, which is one concern of the Town relative to project's traffic impacts on Shaker Road and NH Route 140. The scope of work for this preliminary site access evaluation is generally limited to Shaker Road at NH Route 140 (Tilton Road) and the site driveway.

This memorandum includes the following:

- A description of the existing roadway network near the site;
- A description of the planned development program;
- Trip generation and distribution estimates for the proposed use;
- A description of the traffic volume network development;
- An evaluation of No Build and Build traffic operations at the site access points; and
- Preliminary conclusions.

Existing Conditions

The nearly 470-acre site is located in Northfield, NH and is bound by Shaker Road, Shedd Road, and Bay Hill Road to the east and south. The Winnipesaukee River and Interstate 93 (I-93) border the site to the north and west. The location of the site in relation to the local roadway system is shown in Figure 1.

Shaker Road is a Town-maintained two-lane roadway that parallels the eastern border of Northfield with the Town of Belmont. Shaker Road is primarily a rural, residential roadway that connects NH Route 140 (Tilton Road) with other

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Northfield roadways, such as Bay Hill Road and Knowles Pond Road. In the vicinity of the site, the posted speed limit is 35 miles per hour (MPH).

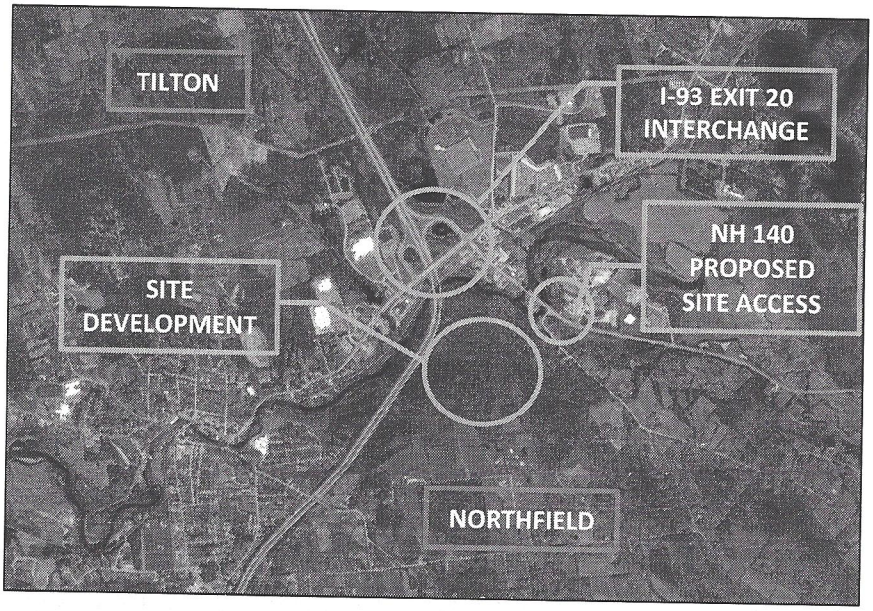


Figure 1: Site Location

NH Route 140 (Tilton Road) is a State-maintained, two-lane major collector roadway that originates in nearby Tilton at the intersection of US Route 3, NH Route 11, NH Route 132, and the northbound ramps for Exit 20 along Interstate 93, approximately half a mile north of the intersection with Shaker Road. NH Route 140 carries traffic east from Tilton through Northfield, Belmont and Gilmanton to the intersection of NH Route 11 and NH Route 28A in Alton. NH Route 140 generally carries commuting and trucking traffic, along with increased traffic for seasonal and special events, such as the NASCAR events in nearby Loudon, NH or Laconia Motorcycle Week. NH Route 140 is generally two lanes and has a posted speed limit of 35 mph west of Shaker Road and 55 mph east of Shaker Road.

The intersection of Shaker Road and NH Route 140 is an unsignalized T intersection with Shaker Road operating under stop control. A raised median divides exiting vehicles and entering vehicles on Shaker Road. All three legs to the intersection are striped to provide a single approach lane; however, the width on Shaker Road at the intersection is wide enough to allow right-turning vehicles to bypass vehicles waiting to turn left onto NH Route 140. Likewise, the shoulder width on NH Route 140 allows westbound through traffic to bypass left-turning vehicles onto Shaker Road.

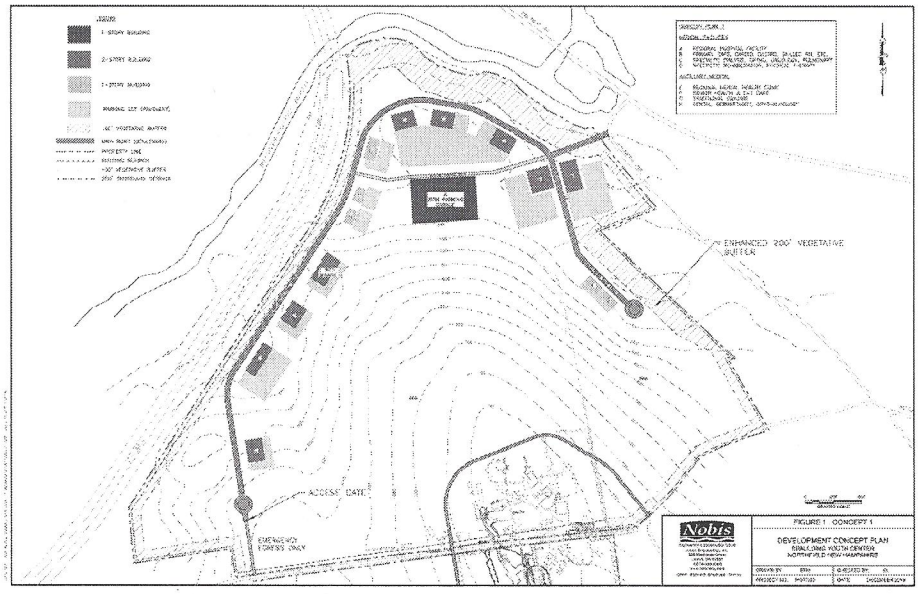
Just west of the intersection, NH Route 140 passes over the Winnipesaukee River, the natural border between Northfield and Tilton. Just south of this intersection on Shaker Road, the New Hampshire Department of Transportation (NHDOT) maintains a boat access facility on the Winnipesaukee River where the old NH Route 140 bridge existed before the roadway realignment in 1968. The proximity of the boat access and the bridge across the

Winnipesaukee River are noted as constraints that will impact and influence improvement options for the existing Shaker Road and NH Route 140 intersection.

Development Program

The proposed development program calls for constructing one million square feet of medical facilities and other supporting ancillary uses. The master plan shows multiple buildings throughout the site concentrated on the north and east edges of the property. As planning progresses, the number and locations of the buildings will be refined. A preliminary concept of a potential site buildout is shown in Figure 2. Per the request of the Northfield Planning Board, primary access to the site has been limited to Shaker Road to the east. Potential secondary or emergency access could be provided along Shedd Road to the west.

Figure 2: Preliminary Site Buildout Concept (December 2016)



Trip Generation

For this preliminary site access study, trips have been estimated based on a combination of rates published by the Institute of Transportation Engineers (ITE) and other local data. Unfortunately, there are no ITE Land Use Codes (LUC) that accurately represent the proposed development program. The ITE LUC of 720, Medical-Dental Office Building is not appropriate as this LUC is based on individual buildings that are much smaller (less than 120,000 sf) than the proposed campus. Use of LUC 720 also would not incorporate the potential for internal shared trips between the facilities within a campus setting.

Therefore, the proposed trip generation estimates have been prepared using ITE LUC 610, Hospital combined with local data collected at the Robert G. Dodge Business Park located in Biddeford, ME. ITE LUC 610, Hospital has been assumed for half of the potential development (500,000 sf). The Hospital ITE data base includes facilities ranging in size from 100,000 sf to 1,800,000 sf – with 5 sites similar in size to the proposed one million square foot development program. Since this data base includes several very large hospitals, it is assumed that internal capture between uses within the facility is accounted for (which could be similar in nature to the proposed site).

The trip estimates for the remaining 500,000 sf are based on rates observed at a local medical office park in Biddeford, ME. Traffic counts collected at this site were used to develop weekday morning and weekday evening trip generation rates for this 193,000-sf park consisting of nine different buildings. Businesses within the park vary from general health care to dentists, dermatology, eye care, counseling services and a hotel. The trip generation rates developed from this location result in 2.23 trips per 1,000 sf during the weekday morning peak period and 1.89 trips per 1,000 sf during the weekday evening peak period. The weekday morning rate calculated is similar to ITE LUC 720, but the weekday evening calculated rate is lower than ITE. A technical memorandum documenting the trip generation methodology dated March 20, 2017 was submitted to the NHDOT and is provided in the technical appendix.

As seen in the following table, the trip generation estimate proposed for the Spaulding Youth Center property is expected to generate approximately 1,590 trips (1,125 entering, 465 exiting) during the weekday morning peak period and 1,410 trips (375 entering, 1,035 exiting) during the weekday evening peak period.

Table 1 - Trip Generation Estimate

		Weekday Morning Peak Hour			Weekday Evening Peak Hour		
Land Use Type	Square Footage	Total	Enter	Exit	Total	Enter	Exit
Hospital*	500,000	475	300	175	465	175	290
Business Park**	500,000	1,115	825	290	945	200	745
Total	1,000,000	1,590	1,125	465	1,410	375	1,035

* ITE Trip Generation Manual 9th Edition

** Robert G Dodge Business Park Trip Rates

Trip Distribution Gravity Model

A population-based gravity model was prepared to estimate a potential trip distribution for the proposed development. For planning purposes, populations within 15, 30, and 45 mile radii were compiled and considered to represent the core or primary business area of the model. Due to the proximity to I-93, the 15, 30, and 45-mile radius delineations would generally follow an estimated travel time window of 15, 30, and 45 minutes for communities that have access to I-93.

Community populations were weighted based on proximity to the site, as well as proximity to other potential competing medical facilities offering specialty medicine and in a large campus environment. These two factors were used to determine the likelihood of the population to work at or visit the site. It is important to note that the Town of Northfield has indicated that a secondary access via Shedd Road is not desirable at this time. Therefore, the spreadsheet separates these trips that may have used a Shedd Road access/egress if this assumption changes in the future.

Overall, the following distribution model estimates the following:

- 54 percent to/from the northwest of Shaker Road via NH 140 towards Tilton and Interstate Exit 20
- 37 percent to/from the southeast of Shaker Road via NH 140 towards Belmont
- 9 percent via Shaker Road internal to Northfield.

The origin/destination distribution analysis spreadsheet is included in the technical appendix as well as a map of the model area. Trip assignments for the site-generated traffic are provided in Figure 3.

Traffic Network Development

Weekday morning and weekday evening are the peak periods selected as the critical hours for analysis purposes. As such, weekday morning and evening peak hour turning movement counts conducted in February 2017 were used as a basis for this evaluation. The count data revealed that the peak hours for the Shaker Road intersection with NH Route 140 occur at 6:45 AM to 7:45 AM for the weekday morning and 3:45 PM to 4:45 PM for the weekday evening. Copies of the traffic counts are provided in the Appendix. For the purpose of this preliminary access study, it was assumed that the opening year of the project would be 2027 and the 10-year forecast horizon would be 2037. Therefore, to evaluate the access needs for the proposed development, the 2017 peak hour traffic volume counts were projected to the 10-year forecast horizon (2037).

Seasonal Variation

NHDOT guidelines require that private development traffic studies consider traffic operations based on "peak month" conditions. The most recent traffic data (2013-2015) from the NHDOT Urban Highway (Group 4) Averages, NHDOT Recreational Highway (Group 5) and the closest permanent count station (Count Station #039022 – Belmont, US Route 3 and NH Route 11 near Mosquito Bridge) averages were compared when evaluating seasonal adjustments required for the February 2017 counts. As seen in the following table, the seasonal adjustment factors of the permanent count station in Belmont fall between the Group 4 and Group 5 averages. During the scoping meeting, NHDOT advised VHB to use the Group 5 Peak Month Factor seasonal adjustment averages for recreational highways due to the site's proximity to NH Route 140.

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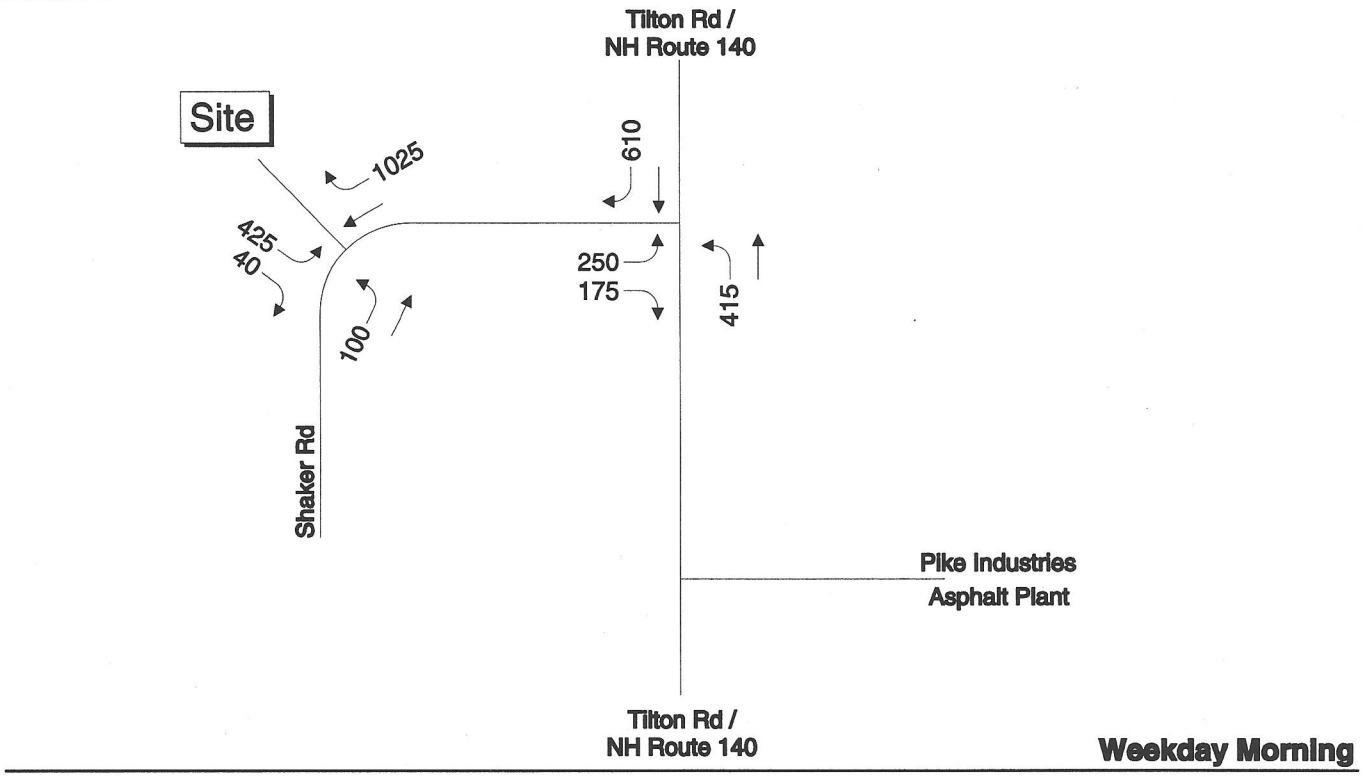

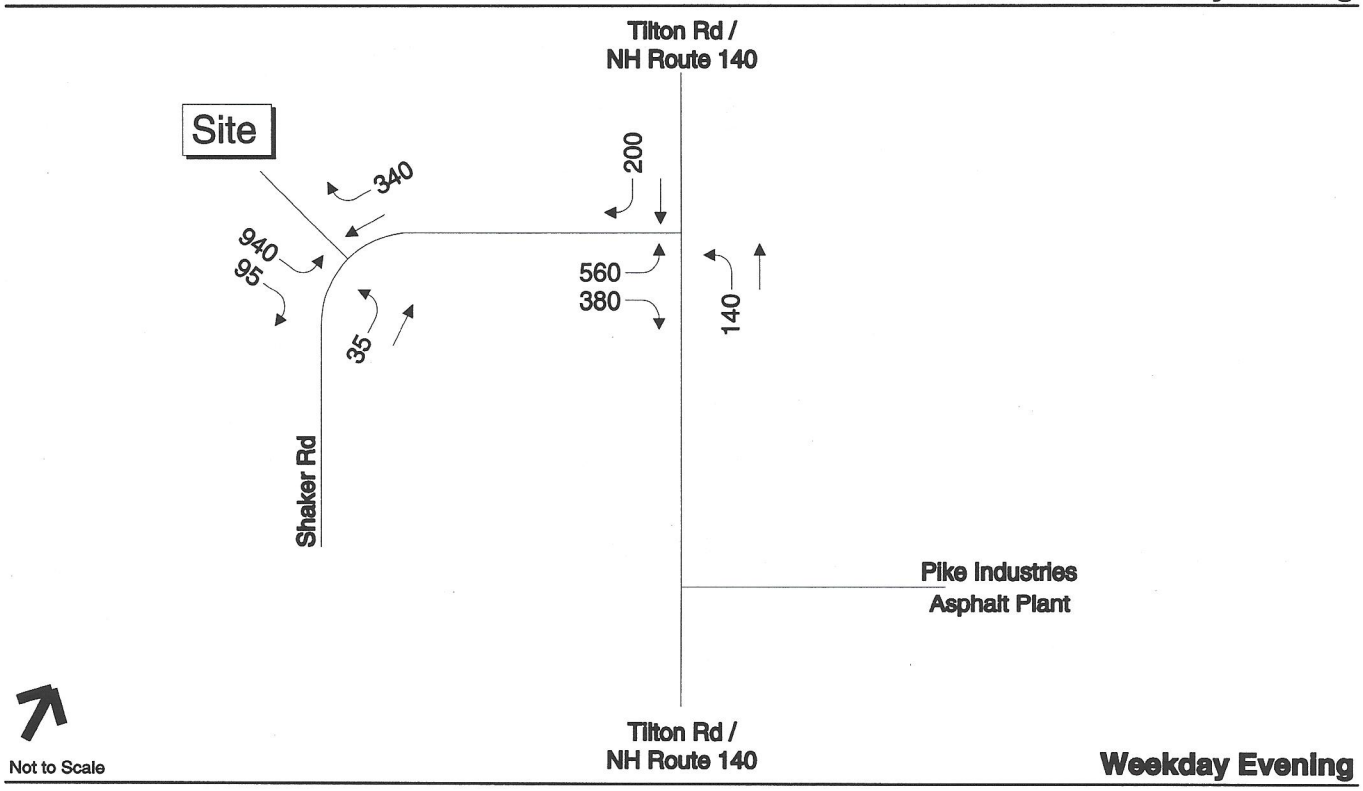

Figure 3
Trip Assignment
Peak Hour Traffic Volumes

Table 2 - Comparison of Peak Month Adjustment Factors^

	Group 4 Averages - Peak Factors				Group 5 Averages - Peak Factors				Belmont Averages - Peak Factors			
Month	AM	Mid	PM	Sat Mid	AM	Mid	PM	Sat Mid	AM	Mid	PM	Sat Mid
Feb 2013	1.08	1.16	1.12	1.34	1.31	1.64	1.44	1.24	1.19	1.38	1.24	1.52
Feb 2014	1.15	1.23	1.19	1.09	1.30	1.59	1.46	1.66	1.22	1.30	1.25	1.15
Feb 2015	1.17	1.27	1.17	1.12	1.48	1.79	1.57	1.87	1.24	1.39	1.24	1.21
3 Year Average	1.14	1.22	1.16	1.18	**1.36**	**1.67**	**1.49**	**1.59**	1.21	1.36	1.24	1.29

^ Analysis performed before the release of 2016 Seasonal Adjustment information by the NHDOT, Bureau of Traffic. The Belmont Permanent Count Station was reclassified as a Group 5 – Recreational Highway between the 2015 and 2016 Seasonal Adjustment releases.

Growth

Historical growth trends were obtained from five NHDOT Count Stations: #039022 (Belmont – US Route 3 / NH Route 11 West of Union Road), #039053 (Belmont – NH Route 140 at Gilmanton Town Line), #163051 (Franklin – US Route 3 / NH Route 11 at Tilton Town Line), #343002 (Northfield – I-93 Between Exits 18 and 19), and #451001 (Tilton – I-93 Between Exits 19 and 20). The annual growth rates from all five local count stations average to about one percent, annually. No site-specific developments in Northfield or the other surround communities that would have a regional impact were identified.

Traffic Networks

The existing conditions weekday morning and evening peak hour volumes counted in February are provided in Figure 4. The February counts were seasonally adjusted as described above to peak month conditions and factored for growth to reflect the 10-year forecast (2037) traffic volumes. The 2037 No Build traffic volume networks are provided in Figure 5.

The trips generated by the proposed development were added to the 2037 No Build peak hour traffic volumes to establish the 2037 Build networks. The 2037 Build traffic volume networks are shown in Figure 6.

Conceptual Access Plan

The preferred development access concept relocates Shaker Road (through Property #R14-6) to align with the existing unsignalized intersection of NH Route 140 and the Pike Industries driveway (approximately 750 feet east) to form a four-way fully signalized intersection. Consideration was given to modifying the existing Shaker Road intersection with NH Route 140 to a signalized intersection, but expansion of NH Route 140 (Tilton Road) at this location would require widening the existing bridge across the Winnipesaukee River and modifying the existing boat access facility.

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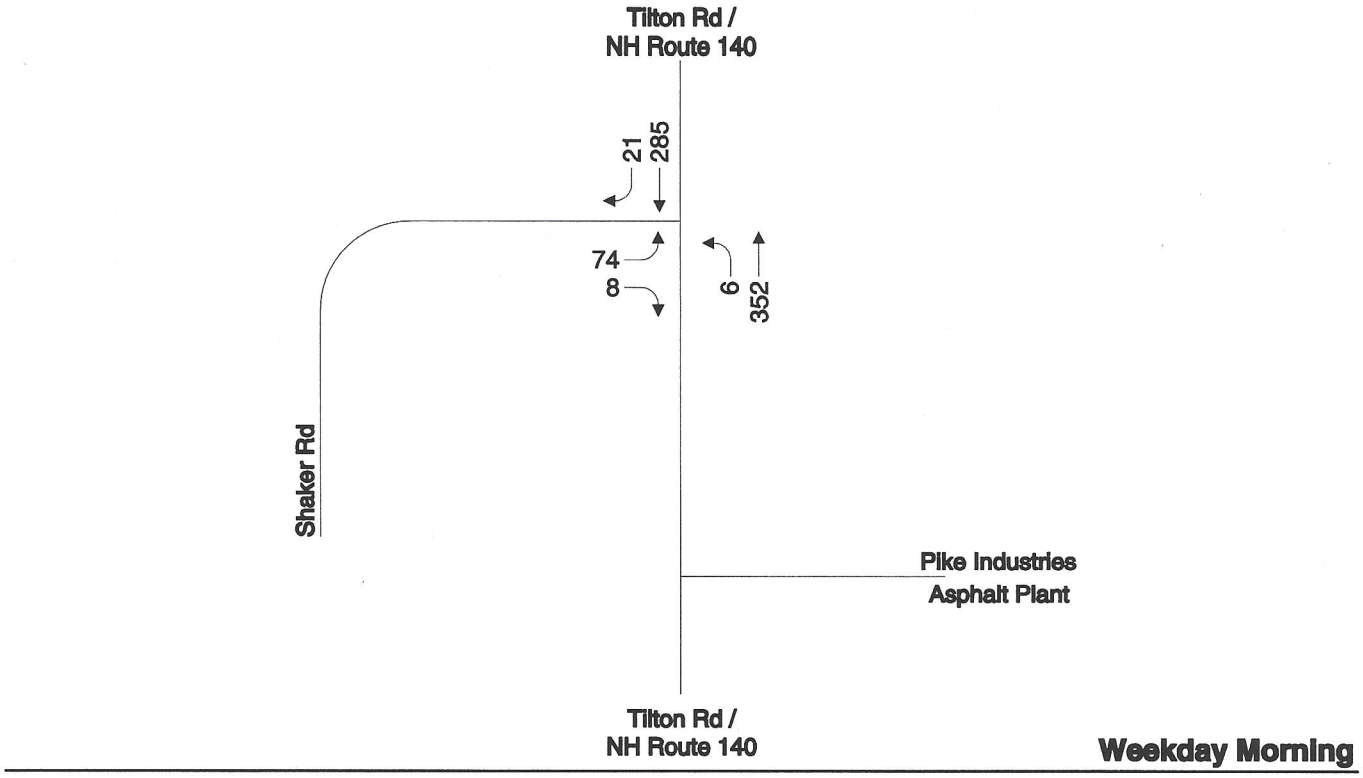


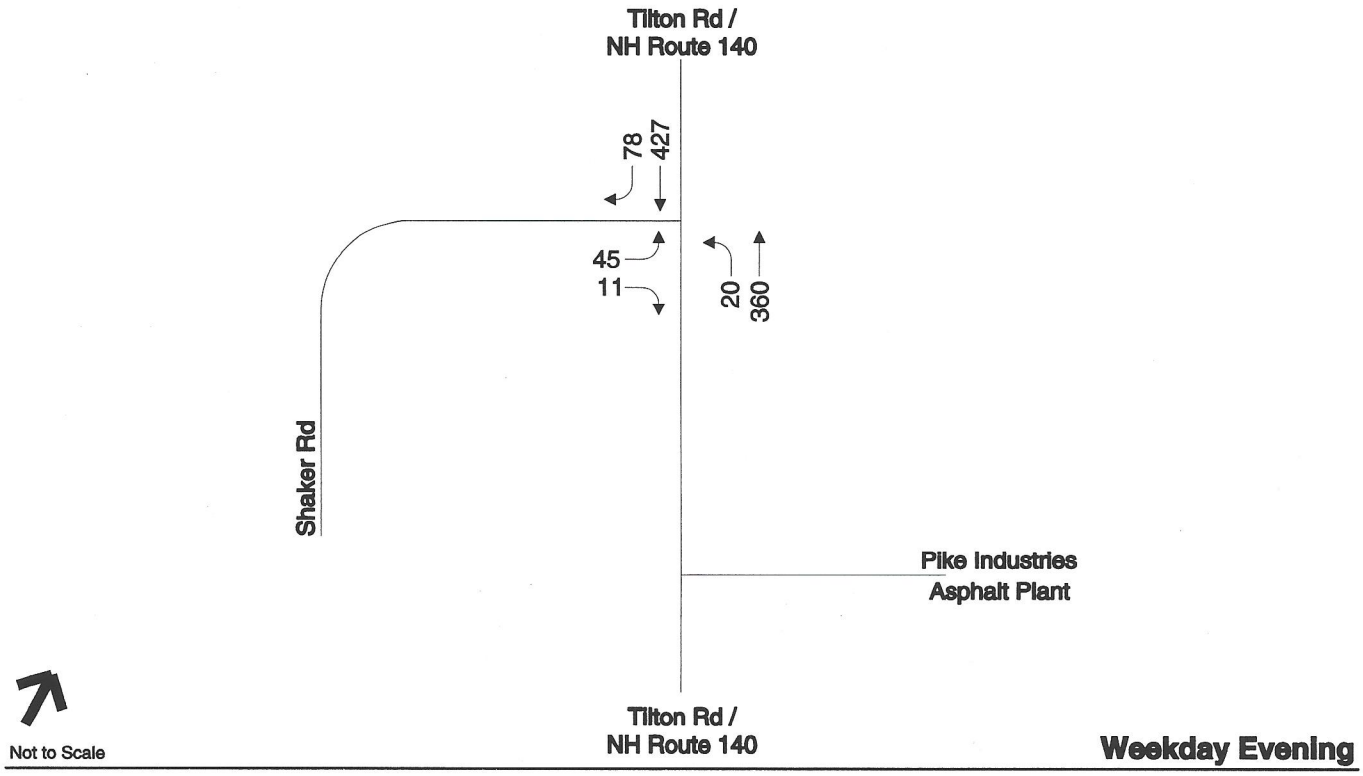
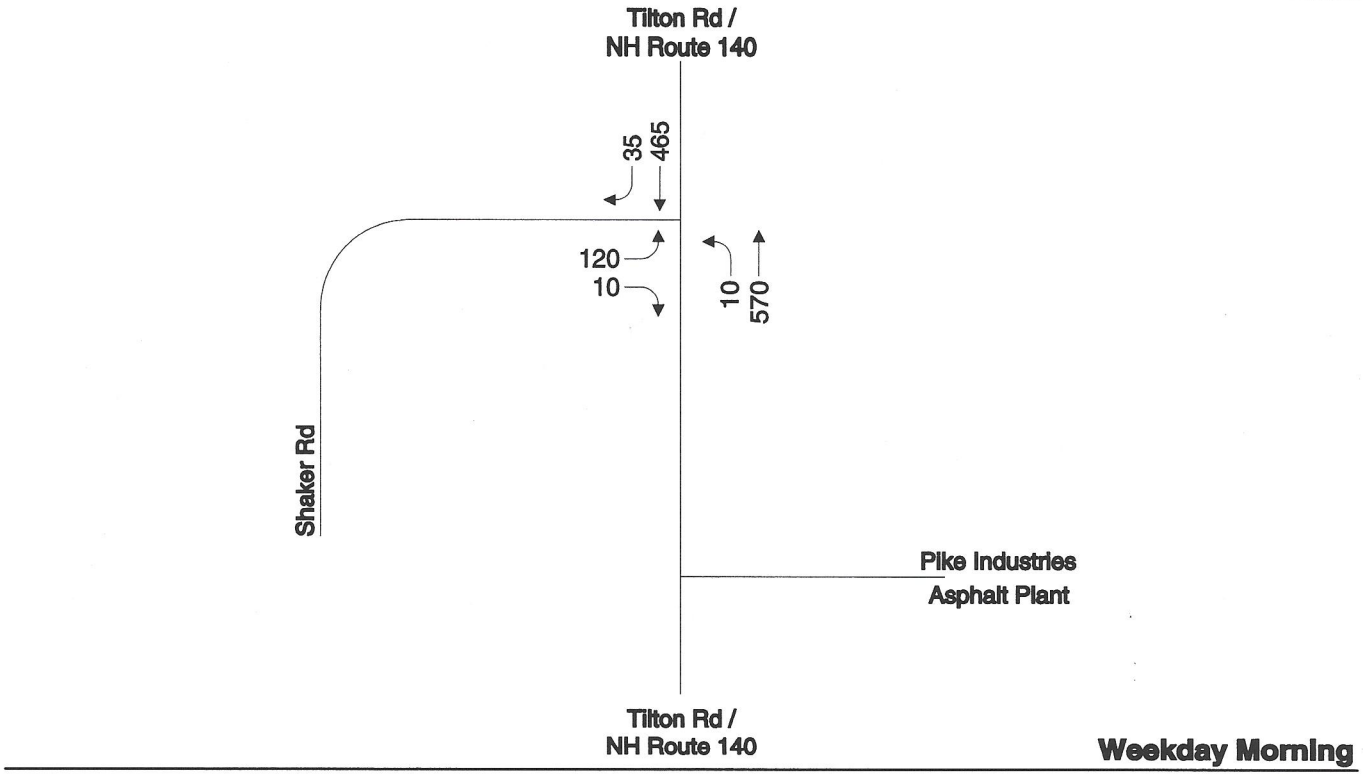


Figure 4
Raw Data
Peak Hour Traffic Volumes



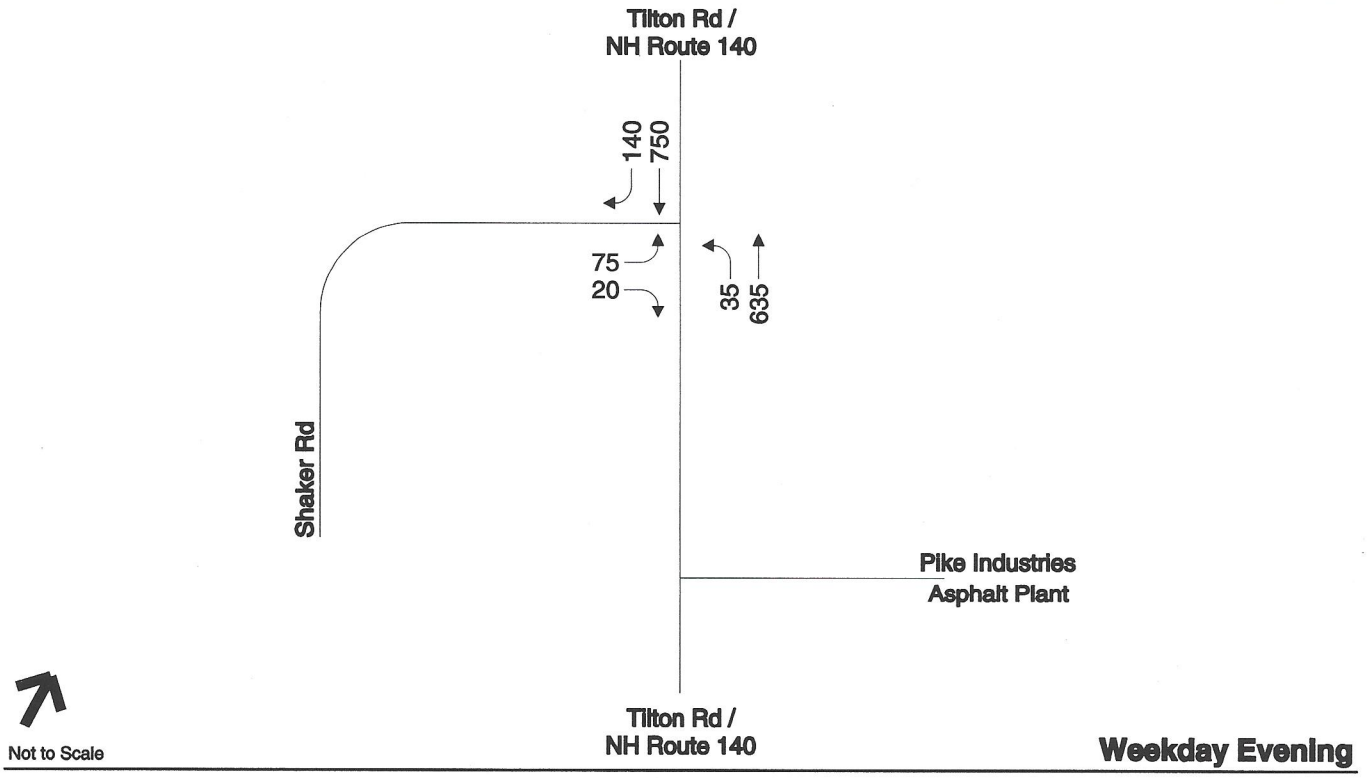


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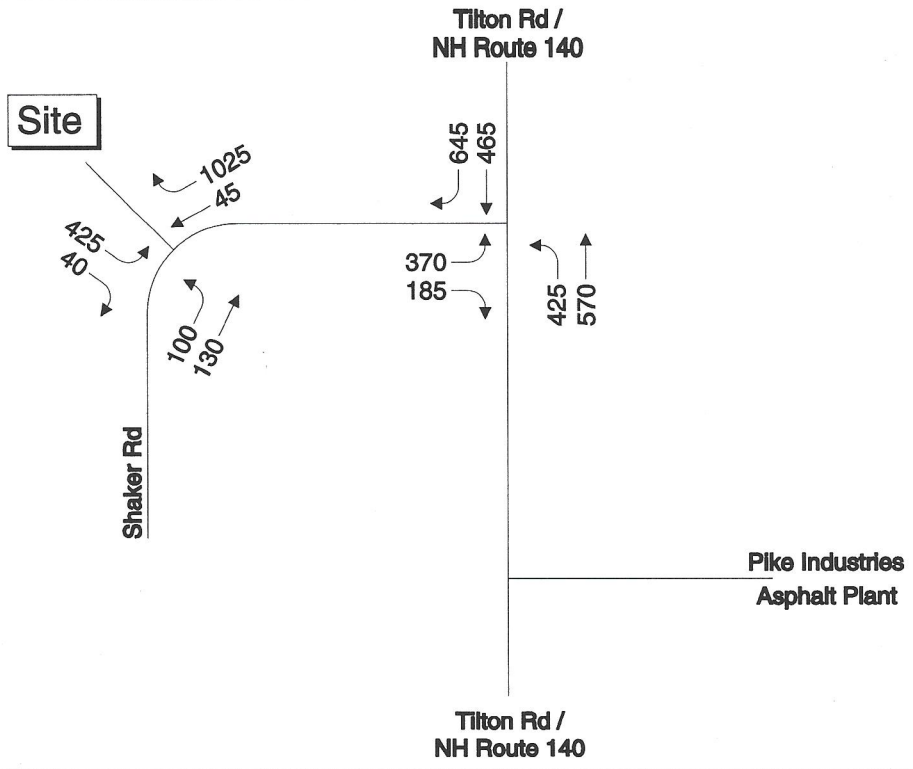
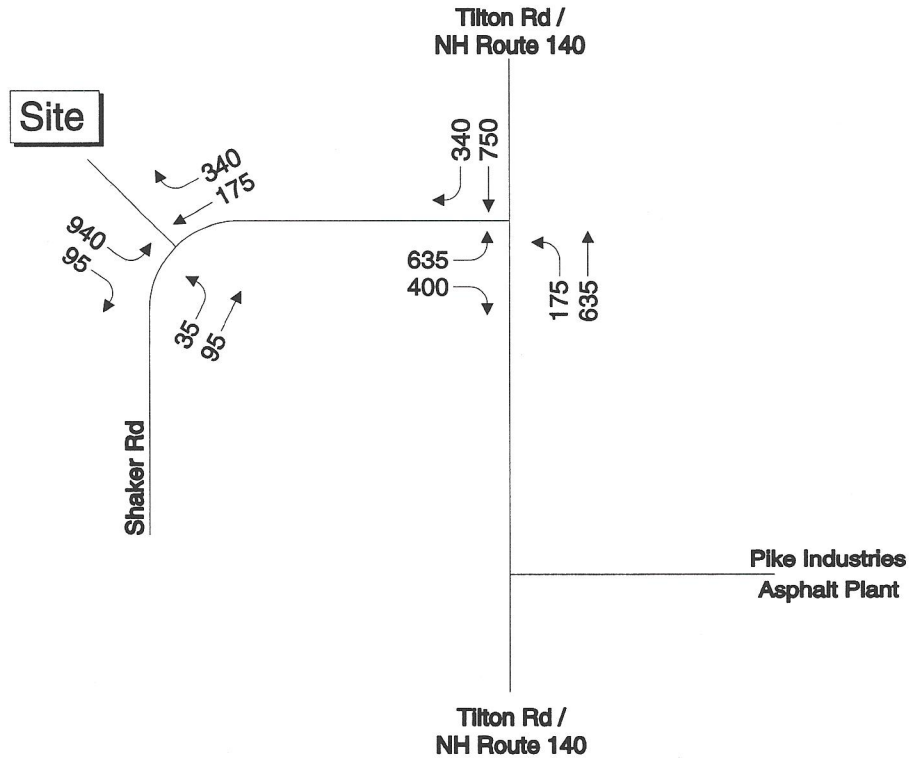
Figure 5
2037 No Build
Peak Hour Traffic Volumes



Weekday Morning



Not to Scale

Weekday Evening

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Figure 6
2037 Build
Peak Hour Traffic Volumes

Based on preliminary analyses (presented later herein), NH Route 140 would be expanded to allow for a 100-foot eastbound left turn lane into the Pike Industries driveway, and an approximately 550-foot eastbound right turn lane and 350-foot westbound left turn lane into Shaker Road. The new Shaker Road approach to the intersection would provide a left turn lane, a shared left-through lane and a right turn lane with storage of approximately 350 feet.

With the primary traffic flow on Shaker Road being vehicles entering and exiting the site (versus through traffic on Shaker Road), the preferred access concept realigns Shaker Road such that it becomes the minor street approach to the intersection. The stop-controlled approach from Shaker Road would provide separate left turn and right turn lanes with roughly 350 feet of stacking room. The mainline would provide a single through lane in each direction and a 100-foot westbound left-turn lane for vehicles traveling to Shaker Road.

Under the proposed access concept, access to the boat facility could be maintained from NH Route 140 or could be provided via a forth leg from the Shaker Road/site driveway intersection (potentially allowing for expansion of the facility). The new roadway between the existing NH Route 140 and existing Shaker Road would require clearing, environmental mitigation, and a new box culvert or pipe arch structure for passing over an existing creek paralleling NH Route 140 along the acquired property line.

The conceptual site access drawing is provided in Figure 7. Traffic volume networks reflecting the preferred access plan are shown in Figure 8.

Traffic Analyses

Signalized and unsignalized intersection capacity analyses were performed for the study area intersections. Levels of service (LOS) were calculated based on the criteria published in the 2000 Highway Capacity Manual[1]. Level of service is the term that defines the conditions that may occur on a given roadway or at an intersection when accommodating various traffic volume loads. Levels of service range from A to F with LOS A representing the best operating conditions and LOS F representing the worst. Copies of the level of service calculations have been provided in the Appendix.

Table 3 summarizes the intersection level of service results and queues for the No Build conditions. Tables 4 and 5 provide a summary of the results for the Build condition with the preferred access alternative.

No Build Conditions

NH Route 140 (Tilton Road) at Shaker Road

The Shaker Road approach to the intersection with NH Route 140 (Tilton Road) is projected to operate at LOS F by the forecast year 2037 without the proposed development with average delays approximating 1.5 to 2 minutes per vehicle during the weekday morning and evening peak hours. The maximum queue is anticipated to occur during the weekday morning peak hour when the 95th percentile queue is projected to be 7 vehicles for the Shaker Road left turn onto NH Route 140.

[1] Highway Capacity Manual, Federal Highway Administration, Transportation Research Board, 2000.

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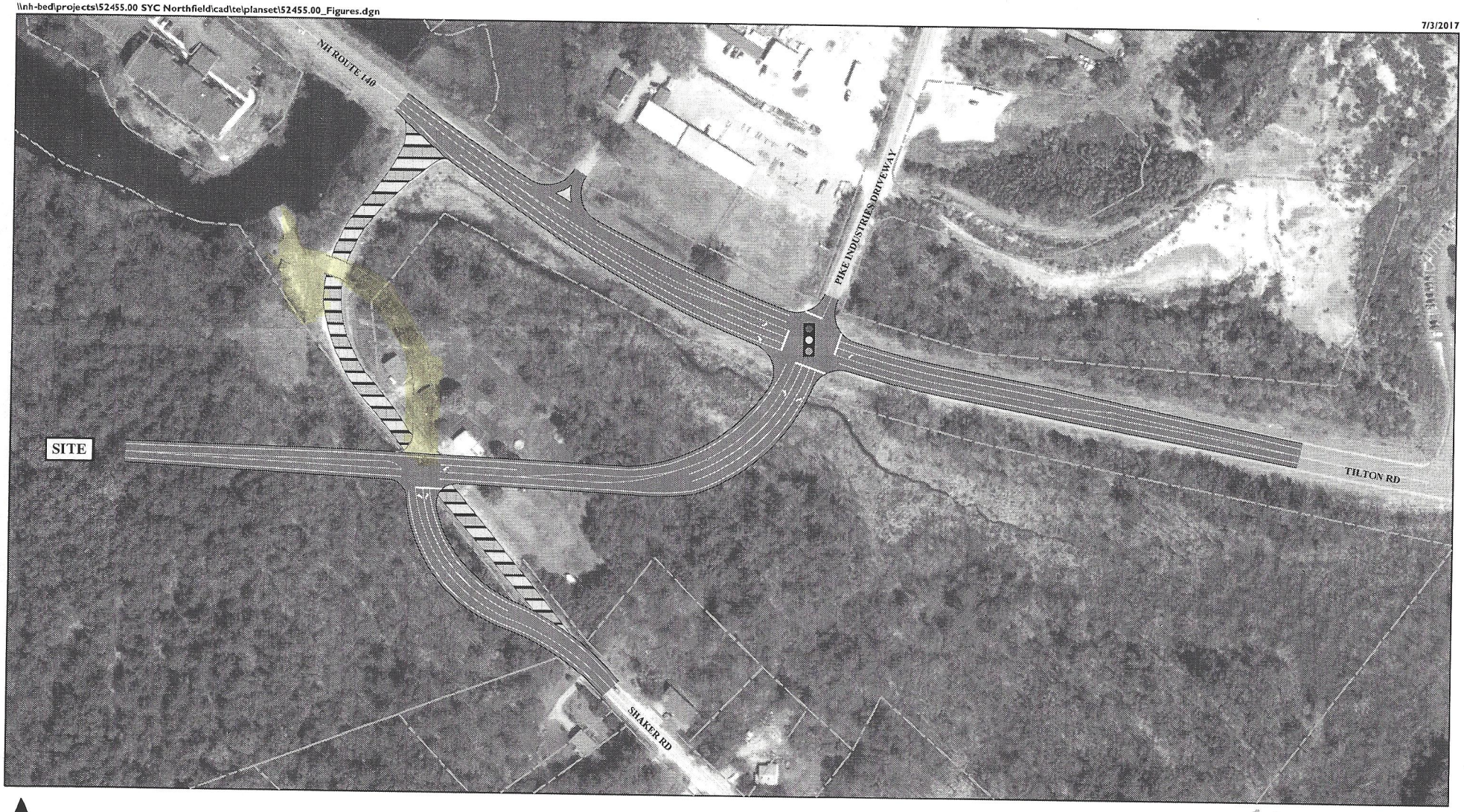

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Figure 7
Conceptual Site Access Plan

Northfield, NH

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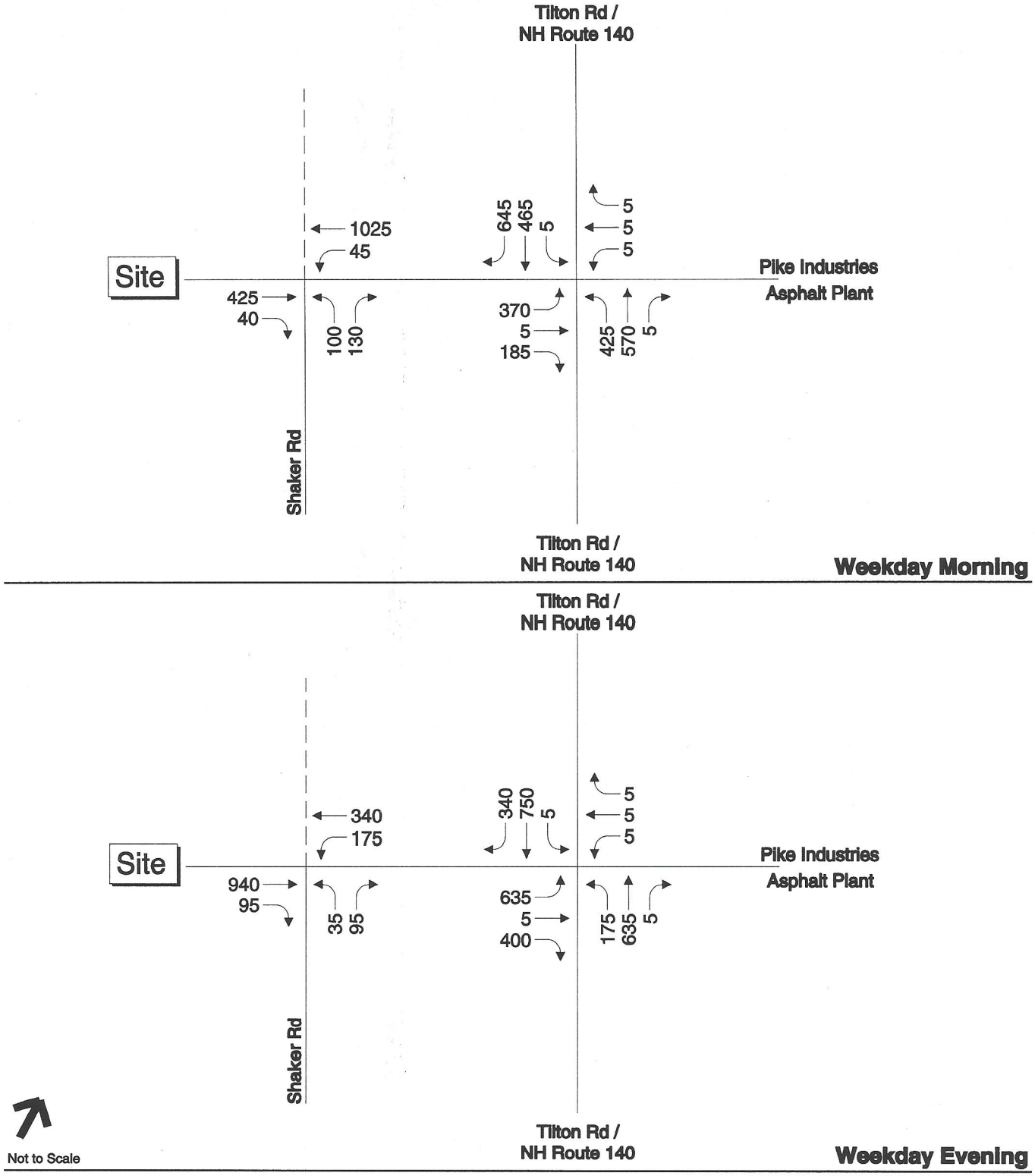

Figure 8
Build with Proposed Access Plan
Peak Hour Traffic Volumes

Table 3 – 2037 No Build Unsignalized Intersection Capacity Analysis Summary

Location / Movement	Period	Demand*	Delay^	LOS+	95th Queue~
NH 140 at Shaker Road					
Left turn from Shaker Road	AM	120	102	F	175
Left turn from Shaker Road	PM	75	134	F	150

* Demand in vehicles per hour.

^ Delay in seconds per vehicle.

\+ Level of service.

~ Queue measured in feet.

Build Conditions

NH Route 140 (Tilton Road) at Shaker Road and Pike Industries

In the preferred concept, the relocated intersection of Shaker Road and NH Route 140 is aligned across from the existing Pike Industries driveway and will be signalized. The full geometric improvements of this intersection are described earlier. This proposed signalized intersection is located far enough from the US 3 / NH 11 / NH 132 corridor (over half a mile) that this intersection is intended to operate under actuated-uncoordinated (free) conditions.

Overall, the proposed signalized intersection is expected to operate at a LOS C in the 2037 morning peak hour with an average vehicle delay of 30 seconds and a LOS D in the 2037 evening peak hour with an average vehicle delay of 39 seconds. The capacity analysis, delay, LOS and queueing results for this intersection are shown in Table 4.

Site Driveway at Shaker Road

The new intersection of Shaker Road realigned with the site driveway creates an unsignalized T-intersection. Left-turns from Shaker Road westbound (mainline) are projected to operate at LOS B or better with minor delays and minimal standing queues during the peak hours. Left-turns into the site from Shaker Road northbound (side street) are projected to operate at a LOS F during the 2037 peak hours; the maximum 95th percentile queues are projected to be approximately 225 feet and 100 feet respectively during the morning and evening conditions respectively. Left and right-turn lane storage on Shaker Road northbound has been conceptually designed to accommodate the 95th percentile queue so that right-turning vehicles will not incur additional delay associated with left-turn traffic. It is important to note that although the left-turns into the site from the side street are anticipated to operate at LOS F, this result does not necessarily indicate that the projected operations are unacceptable or that additional improvements are necessary. Left-turns from side streets at unsignalized intersections commonly experience delays during peak hour conditions (with substantially less delay during the off-peak conditions). In this case, traffic volumes are not anticipated to meet signal warrant levels at this location. Therefore, the proposed lane geometry and stop-control for the minor street movement appear to be appropriate for the projected volumes.

Table 4 – 2037 Build Signalized Intersection Capacity Analysis Summary

NH 140 at Realigned Shaker Rd	AM Peak Hour				PM Peak Hour			
Approach and Movement	v/c*	Delay^	LOS+	Avg/95th Queue~	v/c	Delay	LOS	Avg/95th Queue~
NH 140 Eastbound		24	C			33	C	
Left	0.10	47	D	<25 / <25	0.11	54	D	<25 / <25
Through	0.77	34	C	250 / 500	0.94	45	D	475 / 850
Right	0.65	17	B	150 / 350	0.23	5	A	0 / 25
NH 140 Westbound		31	C			30	C	
Left	0.93	57	E	250 / 475	0.86	74	E	125 / 275
Through / Right	0.56	12	B	125 / 400	0.66	18	B	225 / 550
Shaker Road Northbound		38	D			52	D	
Left	0.74	49	D	125 / 250	0.90	65	E	225 / 425
Left / Through	0.73	48	D	125 / 250	0.91	66	E	225 / 425
Right	0.13	16	B	0 / 25	0.57	31	C	125 / 200
Pike Industries Development								
Left / Through / Right	0.15	47	D	<25 / 25	0.17	53	D	<25 / 25
Overall Intersection	0.79	30	C		0.89	39	D	

* Volume demand to capacity ratio.

^ Delay in seconds per vehicle.

+ Level of service. ~ Queue measured in feet.

Note: Pike Industries was not counted for this study; volume inputs were set to 5 vehicles for each movement to produce approximate results.

Table 5 – 2037 Build Unsignalized Intersection Capacity Analysis Summary

Location / Movement	Period	Demand*	Delay^	LOS+	95th Queue~
Shaker Road at Site Driveway					
Left-turn from Shaker Road WB	AM	45	9	A	<25
Left from Shaker Road NB		100	98	F	300
Left-turn from Shaker Road WB	PM	175	13	B	50
Left from Shaker Road NB		35	58	F	100

* Demand in vehicles per hour.

^ Delay in seconds per vehicle.

+ Level of service. ~ Queue measured in feet.

Conclusion

Upon completion of this preliminary site access assessment, it has been concluded that:

- Access to the Spaulding Youth Center development site appears to be feasible via a single driveway from Shaker Road and NH Route 140 (Tilton Road).
- Mitigation required at the existing unsignalized intersection of Shaker Road at NH Route 140 (Tilton Road) would have impacts on the existing boat access facility on Shaker Road as well as the NH Route 140 bridge over the Winnipesaukee River north of the intersection.
- Upon Spaulding Youth Center's acquisition of Property #R14-6, a new Shaker Road approach to NH Route 140 could be realigned across from the existing Pike Industries driveway (currently unsignalized). This new 4-way intersection could be signalized with geometric improvements to accommodate the full 2037 build-out of the Spaulding Youth Center development.
- The development of the site driveway in conjunction with the realignment of Shaker Road would result in a new unsignalized intersection with free movements to/from the SYC site and a stop-controlled approach from Shaker Road, and potentially the Winnipesaukee River boat access facility.
- A forthcoming expanded traffic impact study will encompass additional critical intersections in the region of the proposed development, including I-93 Exit 19 and Exit 20. Analysis from the regional traffic impact study may impact the localized results of this access study, requiring modifications to the findings cited herein.