Morrill's Crossing

Application Review Correspondence

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December 8, 2005

Chairman Leslie Lowry III
Members of the Portland Planning Board
389 Congress Street
Portland, ME 04101

RE: Traffic Comments on the Morrill's Crossing Proposed Mixed Use Development – Portland, Maine; CME Project No. 04-147.

Dear Chair Lowry and Members of the Portland Planning Board:

On behalf of Hannaford Bros. Co., Creighton Manning Engineering, LLP (CME) has completed a review of the revised Traffic Impact and Access Study dated November 2005 for the Morrill's Crossing, a proposed mixed-use retail and residential project in the City of Portland. This review follows our previous reviews and comments on the October 2004 and June 2004 traffic studies. We offer the following comments for consideration:

A. Study Area:

1. The study area among the three traffic studies continues to change with each new report. No explanation has been given as to why the analyses of intersections have been deleted for this very large project. The differences include:

From June 2004 to October 2004 TIS, intersections added
- a. Forest Avenue @ Newton St/School Drwy
- b. Allen Avenue @ Northfield Green Drive/Plymouth Street

From June 2004 to October 2004 TIS, intersections deleted
- c. Forest Avenue @ Riverside Street
- d. Walton Avenue @ Ocean St
- e. Forest Ave @ Ocean St.
- f. Forest Ave @ Walton St.

From October 2004 to November 2005 TIS, intersections deleted
- g. Stevens Avenue @ Walton Street

From October 2004 to November 2005 TIS, intersections added
- h. Warren Avenue @ Hicks Street

B. Site Generated Traffic:

1. A new trip generation 'credit' is added for each successive traffic study revision to minimize the volume of traffic from the project at the study area intersections. The June 2004 study contains a 'pass-by' credit only; the October 2004 study adds a 'diverted-link' credit; now the November 2005 study adds an 'internal' credit. This gives the impression that the applicant is trying to use any and all means to reduce the volume of site traffic and to limit the impact of this project.

2. To illustrate, a 44% pass-by credit was used in June 2004 study. In the October 2004 and November 2005 studies, the pass-by credit drops to 30-35%, but a diverted link credit of 20-30% is added, as is the internal trip credit in the November 2005 study. The result is a substantial reduction in the number of 'new' trips for the Saturday peak hour from 745 vph to 505 vph.

   The total value of all credits taken to reduce the traffic impacts is extremely and unrealistically high (60% – 65%) and the true impacts of the project are not analyzed. In other words, the applicant is claiming that 65% of the site traffic is coming from traffic already passing near the project. At the very least, studies of similar land uses in the area need to be conducted for their trip reduction credits to validate the levels used for this project.

   In my analysis and review of hundreds of similar projects, I have not taken such a high credit nor seen such a high credit taken by another firm. Further, I have not seen any reviewing agency allowing such a high credit to be taken. The highest total credit in these cases has been 30% to 40%.

C. Traffic Analysis

1. The traffic analysis is flawed from the beginning and does not accurately portray the true operating characteristics of the study area intersections.

   The most significant flaw in the analysis is that for all multilane approaches at each of the intersections along Forest Avenue, the applicant claims through the analysis that vehicles use the lanes available in relatively balanced and equal distributions. This is not how the intersections operate. With lane drops and lane merges through the area the traffic uses the lanes in a highly unbalanced and unequal manner. The result is a dramatic under-reporting of the true intersection delays and queue lengths.

   For example, Figure 6 of the November 2005 traffic study indicates that the weekday design hour volume on Allen Avenue traveling southbound and turning left onto Forest Avenue and into to McDonald's is 445 vph (430+15). Downstream from this intersection, the right-most lane becomes a right turn lane onto Bishop Street and Stevens Avenue. The distribution of traffic traveling in the southbound direction on Forest Avenue at Bishop Street is approximately 67% traveling through, and 33% turning right onto Bishop Street or Stevens Avenue. The traffic study assumes that the southbound shared left/through lane on Allen Avenue at Forest Avenue is relatively even (typical default lane utilization factor of 95% is used in the analysis). However, most drivers, wishing to continue south on Forest Avenue and not turn right onto Bishop Street or Stevens Avenue, favor the left-most turn lane on Allen Avenue. Under this condition, the lane utilization factor would be closer to 77%, and, as stated above, results in dramatically longer delays and queuing than reported in the traffic study.

   This same analysis flaw is repeated for other areas that have lane drops/merges including the Forest Avenue northbound approaches, the Forest Avenue southbound approaches, and the Stevens Avenue approach to Forest Avenue. With the closely spaced offset intersections, lane drops, and merges, significant detail to the collection of traffic volumes is required in order to replicate the true operating conditions when calibrating and using the traffic analysis software. As opposed to just counting the amount of traffic on the intersection approaches as the study did, *each* lane must be counted individually and tracked through the area to see how vehicles enter and exit these compact and confusing intersections. Also, the actual queue lengths in the field need to be observed and recorded

for the calibration process. There is no indication in the studies that this or any analysis calibration was done.

2. The studies mention transit service stops and pedestrian activity exist in the area, yet they were not included in the data collection or the intersection analysis. As part of the study's recommended TDM measures, increased pedestrian traffic is being encouraged, yet, again, the pedestrians are not included in the analysis.

3. Since the intersection analysis of existing conditions is flawed, it follows that all subsequent analysis for no-build and build conditions are flawed as well. No meaningful results are contained in the study; and, therefore, the traffic impacts of the project have yet to be presented.

4. The proposed mitigation plan includes a fourth leg to the site driveway intersection at Allen Avenue. However, a fourth leg is not included in the analysis. Even if the amount of traffic from the fourth leg may be minimal, it affects the true operations of the intersection and needs to be included.

D. Safety

1. There are at least four merge/weave areas that have not been evaluated for their safety impacts. Lane reductions and lane drops within extreme short distances will lead to increased crash exposure for rear-end and sideswipe accidents for the area that already has numerous safety problems. Lane drops create uneven queuing as drivers favor the lane that continues through the downstream intersection towards their destinations versus the lane that ends in a merge or becomes a dedicated turn lane.

   In addition to the lane drop/merge areas noted in the Intersection Analysis section, the applicant is proposing to add another lane drop/merge area on the Allen Avenue approach to the site driveway. As reported in the traffic study, the queue length expected on the Allen Avenue northbound through movement at the site driveway is 295-369 feet during the PM/Saturday peak hours. The railroad tracks are only about 200 feet away meaning that traffic will queue across the tracks creating a dangerous condition. With only about 600 feet separating the site driveway and Forest Avenue, the long queue lengths do not allow traffic enough room to safely merge out of the lane drop area.

2. The study states and presents crash data that the intersection of Forest Avenue at Stevens/Bishop Street is a *high crash location*. The study further states that many of the crashes are rear-end and angle-type in nature, and then routinely dismisses them are being typical of a congested area. Without the benefit of reviewing a Collision Diagram, which is not included in the study appendices as stated in the text, it is my professional opinion through field observations that many of the crashes at this location are due to the lane drop from Allen Avenue to Stevens/Bishop Street. The high volume of traffic from the proposed project will make this *high crash location* significantly worse.

3. Numerous other intersections and links have been identified in the traffic study as being high crash locations. The recommended improvement at the Morrill Street/Forest Avenue intersection is to restrict turning movements to right in/right out during peak hours. Drivers wishing to make left turns could use Adelaide Street to access Morrill Street. Adelaide Street/Read Street/Forest Avenue is already a high crash location. This improvement will require an analysis of the condition and a discussion of impacts to the local businesses that use Morrill Street.

   No improvements are discussed at Adelaide Street/Read Street/Forest Avenue intersection which has a high crash rate.

4. The queuing for the northbound through and right turn movement on Forest Avenue at Allen Avenue is expected to be 325-350 feet during the PM peak hour under the proposed Build with mitigation condition as stated in the study. The northbound right turn lane has a storage length of approximately 80 feet before blocking the right most through lane on Forest Avenue. The distance from the stop bar to the Bishop Street/Steven Avenue intersection is 300 feet. Therefore, the right turn queue is expected to extend into the through lane. With the additional queuing expected for the through lanes, vehicles will extend south on Forest Avenue, blocking the Bishop Avenue/Stevens Avenue intersection.

5. The northbound approach of Forest Avenue to Stevens Avenue is currently two lanes wide, and is going to four lanes wide in the improvement concept. As noted earlier, Morrill Street is a high crash location. The expected queue on Forest Avenue is 325 feet. Therefore the back of queue will be right at Morrill Street. Drivers exiting Morrill Street will have difficulty turning left onto Forest Avenue and seeing approaching southbound drivers potentially increasing the frequency/severity of accidents.

6. It is noted that discussions of the queue lengths above are based on the results presented in the traffic study; however, as noted earlier, the analysis and results are flawed as the base conditions have not been accurately analyzed. Therefore, the results above can be considered to be much worse.

E. Parking

1. The traffic study states that 666 parking spaces are planned for the project and the evaluation of the adequacy of the number of parking spaces takes into account full use of the 666 spaces. However, the core parking field, central to the supermarket, retail, office, and restaurant land uses has only about 490 spaces. Drivers will not even consider parking in the apartments or the boxing areas or the recreation field due to the segregation of these lots to their destinations.

   Based on Figure 15 and 16 of the November 2005 study, the peak mid-day parking demand (peak season) of these land uses will be approximately 600-675 spaces, and 510-550 during the non-peak season. This is significantly higher than the 490 spaces to be provided in the core area. Drivers will not even consider parking in the apartments or the boxing areas or the recreation field due to the segregation of these lots to their destinations and having to walk a long way to the stores. Additionally, parking should exceed demand by approximately 10-15% to allow for drivers to quickly and conveniently find empty spaces, and to provide areas for snow storage. For these reasons, the amount of parking proposed for the project is not adequate.

F. Improvements

1. The study notes that pedestrians are likely to cross Forest Avenue for access to the site. Given that Forest Avenue is 5 to 6 lanes wide, an exclusive pedestrian phase for safe crossing is required at all intersections. All vehicular traffic movements are stopped during an exclusive pedestrian phase. At these intersections, the vehicular traffic movements will be stopped in excess of 30 seconds. This will cause extreme queues and delays throughout the network. The study did not analyze this condition and it needs to be analyzed.

2. There are no design details of the additional signal coordination with the railroad crossing nor is it known if the railroad preemption equipment/hardware can actually be installed to function properly. During a railroad preemption signal phase, the railroad gates must be lowered well in advance of any train movement. This, coupled with actual train movement across Allen Avenue, will result in extreme traffic delays that will be compounded by the high volumes from the proposed development. These delays will eventually cause Forest Avenue to bottle-neck so that the whole system shuts

down. Even if the design details can be worked out, the safety and delay consequences of adding a signal at the site driveway and coordinating with the railroad crossing far outweigh any benefits.

3. The applicant presents a mitigation plan to widen Forest Avenue to provide a four-lane roadway section from Allen Avenue to Bell Street. However, the study makes no mention of the impacts of the displaced on-street parking. Further, the widening pushes the roadway edge much closer to the building faces thus limiting the available sidewalk space. There is no mention if this concept can meet the minimum Americans with Disability Act standards for accessibility. There is no mention of fixed objects or doorways that may prevent the ADA standards being met. The viability of this concept needs to be carefully evaluated at this time.

G. Impacts

1. There are seven unsignalized intersections that will operate at unacceptable Level of Service F after development of the proposed project. The City of Portland and MDOT have adopted a standard of Level of Service D as the minimum acceptable operating condition for intersections. The traffic generated by the project will exacerbate the congestion and delay at these intersections; however, the study does not propose mitigation to address the project's impact.

H. Comparison of Volumes

1. The existing traffic volumes from the site are considered minimal given the limited use of the existing buildings on-site. Under the current *Low Impact Industrial* zoning several different land uses are allowed including warehouses, assembly, and research and development. Residential and retail trades are prohibited. The following table summarizes the trip generation of the existing, allowable uses under *Low Impact Industrial* zoning, and the proposed Morrill's Crossing development.

Table 1 – Trip Generation Comparison

	PM Peak Hour (vph)	Weekday (vpd)	Saturday Peak Hour (vph)	Saturday (vpd)
Existing[3]	85	—	5	—
Low Impact Industrial Light Industrial[1]	190	1,110	20	300
or Research and Development[2]	310	1,600	50	385
Proposed[3]				
Supermarket/Retail/	1,065	10,005	1,265	18,070
Office	25	170	10	50
Residential	15	185	20	280
Soccer Field	20	70	30	120
Total	1,125	10,430	1,325	18,520

1 – Based in ITE Land Use Code 110 – Light Industrial, 20 acres.
2 – Based in ITE Land Use Code 760 – Research and Development, 20 acres.
3 – Information provided in *Morrill's Crossing, Traffic Impact and Access Study*, prepared by VHB, November 2005.
vph: vehicles per hour; vpd: vehicles per day

As can be seen from the table, tremendous volume increases would occur with the proposed development as compared to existing conditions or allowed uses on the site.

I. Summary

Our review shows that potential traffic impacts of the project have not been accurately presented in the Study. We have requested that the Applicant provide to us the Synchro files for a complete and thorough review of the study. The files have not been sent to us. We request that the Public Hearing be continued so that the files can be sent us for our review.

Thank you for your consideration in these matters.

Sincerely,
Creighton Manning Engineering, LLP

Thomas R. Johnson, P.E., PTOE
Associate, Senior Traffic Engineer
Maine P.E. License No. 10778

c: Engineering - Hannaford Bros. Co.
Peggy McGehee - Perkins, Thompson, Hinckley & Keddy

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January 10, 2006

Ms. Sarah Hopkins
Development Review Services Manager
Department of Planning & Development
City of Portland
389 Congress Street
Portland, Maine 04101

Subject: Peer Traffic Review for Morrill's Crossing/Packard Development Project

Dear Sarah:

As a follow-up to my January 9, 2006 letter to you, the following outlines my responses to comments submitted by Creighton Manning Engineering, LLP (CME) dated December 8, 2005. My responses reflect the order of comments in the CME letter.

A. Study Area

1. The study area for the traffic study was identified at a project level scoping meeting and meets methods established by the Maine Department of Transportation (MaineDOT). Accordingly, I find the study area to be acceptable.

B. Site Generated Traffic

1. The VHB traffic study attempts to estimate traffic generation levels by accounting for various trip types that are considered to be accepted engineering methods. Pass-By Trips, Diverted Trips, and Internal Capture Trips were accounted for in the analysis and resulted in a more accurate estimate of traffic conditions in the study area. I find the trip generation estimate to be acceptable.

2. The Pass-By Trip percentages used in the November 2005 Traffic Impact Study are based upon suggested percentages by the Institute of Transportation Engineers and seem reasonable.

C. Traffic Analysis

1. Unequal lane distribution within the Morrill's Corner area is a concern, which is why I have asked the applicant to prepare a traffic simulation model. I would note that under the Build with Mitigation Scenario, the volume distribution issue is not relevant for inbound Forest Avenue due to the provision of two inbound travel lanes through the Steven Avenue intersection. The unequal distribution on Allen Avenue to inbound

Forest Avenue will continue to be an issue and the analysis will need to reflect this condition.

2. It is my understanding that pedestrian volumes were recorded at the study intersections and included if counted.

3. I have asked the applicant to create an existing conditions traffic simulation model that is calibrated to existing characteristics. The model will serve as the base model for evaluating future conditions.

4. I concur with this comment. The applicant should revise their analysis to account for traffic from Paul White Tile.

D. Safety

1. The applicant is being required to evaluate locations in the study area that meet MaineDOT criteria for potential unsafe conditions. Queuing is a concern and I will rely on the simulation model results to assist in determining whether conditions will be acceptable.

2. The applicant will be providing collision diagrams for this location. Additionally, I have asked the applicant to obtain additional crash data for the Portland Police Department for post MaineDOT improvement conditions.

3. I concur with this comment.

4. As stated previously, queuing is a key concern and the applicant will need to clearly document that it will not be problematic.

5. Conditions at Morrill's Street will need to be evaluated and a mitigation plan developed as appropriate.

6. As stated previously, a comprehensive traffic simulation model is being requested and the results of the model will be a key factor in determining whether acceptable queue conditions will be provided.

E. Parking

1. I have no comment at this time.

F. Improvements

1. The use of an exclusive pedestrian phase at this location is not practical and therefore I find the analysis of concurrent pedestrian operations to be reasonable.

2. I have asked for additional information from the applicant on train crossings on Allen Avenue.

3. I concur with this comment.

G. Impacts

1. I concur that mitigation strategies should be identified at locations that operate at poor levels of service.

H. Comparison of Volumes

1. I have no comment.

Please do not hesitate to call should you have any questions.

Sincerely,

WILBUR SMITH ASSOCIATES

Thomas A. Errico, P.E.
Senior Transportation Engineer

Transportation
Land Development
Environmental
Services

imagination | innovation | energy Creating results for our clients and benefits for our communities

January 17, 2006

Vanasse Hangen Brustlin, Inc.

Ref: 07334.00

Mr. Kevin Beal, Chair
City of Portland Planning Board
389 Congress Street
Portland, Maine 04101

Re: Response to Comments
Morrill's Crossing Traffic Study
Portland, Maine

Dear Mr. Beal:

Vanasse Hangen Brustlin, Inc. (VHB) has received and reviewed the traffic study comment letter submitted on behalf of Hannaford Bros. Co. (Hannaford) by Creighton Manning Engineering, LLP (CME) of Albany, NY. The following letter provides responses to each of the major comments raised by Hannaford's traffic consultant, Mr. Thomas R. Johnson, PE, PTOE of CME.

Additionally, it is worth noting that the City's Acting Traffic Engineer, Mr. Thomas A. Errico, PE, of Wilbur Smith Associates has submitted comment letters both addressing his review of the traffic study as well as responding to the CME letter from the City's perspective.

Before responding to the issues raised, it is important to point out that the traffic study being reviewed by the Board has been prepared in accordance with the City's and the Maine Department of Transportation's (MDOT) guidelines. While we recognize that there have been multiple versions of traffic studies authored for this parcel of land, prior versions of the traffic study focused on different mixes of land uses, sizes of buildings, and sets of off-site mitigation. In each case, the development program at this site has been evaluated and reevaluated from both the developer's perspective and the City's perspective throughout the re-zoning process. This process has changed the development from its original proposal of a retail-only development, to an office and retail development, and finally into the development of the current mixed-use project that is before the Planning Board now for review.

The other issue that should be considered in reviewing both this study and these responses is that there has been a significant amount of time between the initial submission of a traffic study to the City in support of the rezoning request back in 2002 and the current submission. Through that time, we are all aware that traffic conditions have changed in the Morrill's Corner area. With each submission, information was updated, evaluated, and re-evaluated so as to present the most up-to-date information possible to the various stakeholders and decision-makers. For example, the initial traffic study submitted for this parcel considered the Morrill's Corner and Allen's Corner roadway improvement projects to be constructed at some point in the future. However, over time, these improvements were constructed and traffic has been traveling through these locations for some time. For this reason, the most recent version of the traffic study (and the study that was reviewed by the City Council when the rezoning of the property was under their consideration) included totally updated traffic information that documented not only the beneficial impacts of the improvements on traffic flow, but also included real numbers – not projections – so that the City could make an informed decision on the projects impacts.

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Therefore, any reference to prior versions of a traffic study submitted to the City is largely irrelevant. Those traffic studies were for alternative development scenarios, had different off-site mitigation measures being proposed, included historical traffic information that has since been updated for the current project, and ultimately did not represent the impacts of the project that is currently under review by the City.

1. *This review follows our previous reviews and comments on the October 2004 and June 2004 traffic studies.* ***(VHB: For the purpose of clarity, the previous sentence was taken from introductory paragraph.)*** *The study area among the three traffic studies continues to change with each new report. No explanation has been given as to why the analyses of intersections have been deleted for this very large project.* ***(Hannaford's traffic consultant provides examples of intersections that were added or subtracted from the study areas that were analyzed as part of the traffic studies.)***

In accordance with MDOT standards[1], intersections to be included in the study area include those meeting certain criteria. Since the actual project has changed several times (both in its size, land-use composition, and the amount of traffic it will be generating), it stands to reason that the impact area should be expanded or reduced based on the project's area wide impacts.

The current November 2005 traffic study under review by the City includes all those locations that should be studied (based on the MDOT and City requirements). This study area was confirmed at the September 15, 2005 Scoping Meeting held between the City, the Applicant, abutters, and other interested individuals. In fact, at the request of a member of the public, the study area was expanded at this scoping meeting to include the intersection of Hicks Road and Warren Avenue – which would have normally not been considered in the development of this study.

In his January 10, 2006 letter, Mr. Errico concurs with our finding and states that the selected study area used in the November 2005 traffic study for this project is acceptable.

For informative purposes, the MDOT criteria include, **"intersections where, during any one-hour period, traffic attributable to the proposed development equals or exceeds: (a) 25 vehicles in a left-turn-only lane; (b) 35 vehicles in a through lane, right-turn lane, or a combined through and right-turn lane; or (c) 35 vehicles (multiplying the left-turn volume by 1.5) in a combined left-turn and through lane, or a combined left-turn, through and right-turn lane" are required to be studied."**

2. *A new trip generation 'credit' is added for each successive traffic study revision to minimize the volume of traffic from the project at the study area intersections. The June 2004 study contains a 'pass-by' credit only; the October 2004 study adds a 'diverted-link' [sic] credit; now the November 2005 study adds an 'internal' credit. This gives the impression that the applicant is trying to use any and all means to reduce the volume of site traffic and to limit the impact of this project.*

As noted previously, the development being considered on this site has been continually evolving to the current development program. While the June 2004 study and October 2004 study both referenced different traffic generation methodologies and volumes, they also referred to different development programs on the site.

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[1] Traffic Movement Permit; State of Maine, Department of Transportation, Traffic Engineering Division; April 2000.

The November 2005 traffic study currently under review utilizes the appropriate traffic generation methodologies and applies them based on standard traffic engineering procedures published by the Institute of Transportation Engineers (ITE)[2] to develop an accurate estimate of the proposed development. Because of the mixed use nature of this project (one incorporating housing, retail, recreational, and office uses on one site), ITE recommends that an internal capture rate be applied.

Ultimately, in his January 10, 2006 letter, Mr. Errico concurs with our estimates and states that the selected trip generation estimates used in the November 2005 traffic study for this project are acceptable.

3. *To illustrate, a 44% pass-by credit was used in [the] June 2004 study. In the October 2004 and November 2005 studies, the pass-by credit drops to 30-35%, but a diverted link credit of 20-30% is added, as is the internal trip credit in the November 2005 study. The result is a substantial reduction in the number of 'new' trips for the Saturday peak hour from 745 vph to 505 vph.*

   The total value of all credits taken to reduce the traffic impacts is extremely and unreasonably high (60%-65%) and the true impacts of the project are not analyzed. In other words, the applicant is claiming that 65% of the site traffic is coming from traffic already passing near the project. At the very least, studies of similar land uses in the area need to be conducted for their trip reduction credits to validate the levels used for this project.

   In my analysis and review of hundreds of similar projects, I have not taken such a high credit nor seen such a high credit taken by another firm. Further, I have not seen any reviewing agency allowing such a high credit to be taken. The highest total credit in these cases has been 30% to 40%.

The percentage of primary, pass-by, and diverted linked trips associated with the retail portion of the development was prepared, documented, and shown to be entirely consistent with ITE and general traffic engineering practice. To highlight this lack of understanding, we refer to the comment about not having seen a reviewing agency allow such a high credit to be taken for a retail development. While it may be true that Mr. Johnson has not seen this in his dealings in the State of New York, the Hannaford consultant along with the Planning Board need look no further than the recent July 2003 Traffic Impact Study prepared for his client when they proposed to develop the Hannaford Supermarket located on Riverside Street in Portland, Maine. In this study, Hannaford's consultant utilized an identical 30 percent pass-by rate and a 35 percent diverted linked rate in estimating the impacts of the proposed supermarket. Additionally, the traffic study submitted and approved by the City of Portland Planning Board for the Somerset Marketplace development on Marginal Way also used an identical pass-by and diverted linked rate.

Ultimately, supporting documentation for this approach was submitted as part of the Sections 1-6 submission and approved for use by the City at the Scoping Meeting held on September 15, 2005. Mr. Errico concludes in his January 10, 2006 letter to the Planning Board that these percentages are reasonable.

4. *The traffic analysis is flawed from the beginning and does not accurately portray the true operating characteristics of the study area intersections.*

[2] Trip Generation Handbook; Institute of Transportation Engineers (ITE); Washington, DC; March 2001.

The most significant flaw in the analysis is that for all multilane approaches at each of the intersections along Forest Avenue, the applicant claims through the analysis that vehicles use the lanes available in relatively balanced and equal distributions. This is not how the intersections operate. With lane drops and lane merges through the area the traffic uses the lanes in a highly unbalanced and unequal manner. The result is a dramatic under-reporting of the true intersection delays and queue lengths.

For example, Figure 6 of the November 2005 traffic study indicates that the weekday design hour volume on Allen Avenue traveling southbound and turning left onto Forest Avenue and into to McDonald's is 445 vph (430+15). Downstream from this intersection, the right-most lane becomes a right turn lane onto Bishop Street and Stevens Avenue. The distribution of traffic traveling in the southbound direction on Forest Avenue at Bishop Street is approximately 67% traveling through, and 33% turning right onto Bishop Street or Stevens Avenue. The traffic study assumes that the southbound shared left/through lane on Allen Avenue at Forest Avenue is relatively even (typical default lane utilization factor of 95% is used in the analysis). However, most drivers, wishing to continue south on Forest Avenue and not turn right onto Bishop Street or Stevens Avenue, favor the left-most turn lane on Allen Avenue. Under this condition, the lane utilization factor would be closer to 77%, and, as stated above, results in dramatically longer delays and queuing than reported in the traffic study.

This same analysis flaw is repeated for other areas that have lane drops/merges including the Forest Avenue northbound approaches, the Forest Avenue southbound approaches, and the Stevens Avenue approach to Forest Avenue. With the closely spaced offset intersections, lane drops, and merges, significant detail to the collection of traffic volumes is required in order to replicate the true operating conditions when calibrating and using the traffic analysis software. As opposed to just counting the amount of traffic on the intersection approaches as the study did, ***each*** *lane must be counted individually and tracked through the area to see how vehicles enter and exit these compact and confusing intersections. Also, the actual queue lengths in the field need to be observed and recorded for the calibration process. There is no indication in the studies that this or any analysis calibration was done.*

As part of the initial review of traffic conditions in the field, VHB identified that there are several lane drops in and around the Morrill's Corner area of the City, particularly along Forest Avenue. Lane drops in and of themselves are not problematic; it is when they are not designed and/or constructed in a safe and well thought-out manner that they result in poor traffic operations. In this specific case, the lane drop that exists on the inbound side of Forest Avenue as drivers approach Stevens Avenue in two lanes and are forced to split either to Stevens Avenue or Forest Avenue in their own lane is problematic for the existing commuters who use these roadways.

The single largest improvement being offered by the development's roadway improvement package focuses on eliminating this lane drop and providing drivers with the ability to travel inbound in two consistent lanes until such a point that the two lanes can properly transition to one single lane.

At the request of the City's traffic engineer, VHB has reviewed the impacts associated with this lane drop phenomenon and attempted to calibrate the existing and no build conditions of the assessment to account for its presence. The end result is that the Existing and No-Build traffic scenarios operate in a slightly worse manner than was initially presented in the November 2005 traffic study. **However, it is extremely important to point out that this only serves to magnify the benefits of the proposed off-site mitigation package to the City. Moreover, during the morning commuter peak hours –when the majority of the existing traffic heading into the downtown Portland area is at its greatest – is when the project will be generating its least volume of traffic – thereby providing additional benefits to the City and those who commute along Forest Avenue.**

To demonstrate the extent by which the results would have been altered by performing the analysis in the manner suggested by Hannaford's traffic consultant, the applicant has attached a summary table to this letter showing the analysis results for Existing conditions (with an adjusted lane utilization factor applied) and the Build condition with the applicant's suggested Mitigation in place and no factors applied.

5. *The studies mention transit service stops and pedestrian activity exist in the area, yet they were not included in the data collection or the intersection analysis. As part of the study's recommended TDM measures, increased pedestrian traffic is being encouraged, yet, again, the pedestrians are not included in the analysis.*

As part of the traffic counting efforts conducted for this project, observations of pedestrian activity were performed at several study area intersections to determine the level of usage and patterns of travel that they were using. In general, the pedestrian activity in and around the Morrill's Corner area is minimal with little or no activity observed crossing either Forest Avenue or Allen Avenue near the signals. It would appear that part of this low occurrence of crossings is a result of the poor conditions of the crossing equipment and the current state of the pedestrian striping along this stretch of roadway. In fact, most of the crossing activity was noted to occur at mid-block locations (not near the signals), presumably because pedestrians found it easier to cross in these locations as opposed to crossing at the signals.

Regardless, the applicant has been working with both the City and METRO to account for and incorporate upgraded pedestrian and transit amenities into the design of both the on-site and off-site roadway improvements. While no projection or credit has been taken for the likely reductions in vehicular traffic arriving and departing from the site resulting from these benefits, clearly the incorporation and consideration of these various forms of alternative modes of transportation will further improve the projected vehicular operating conditions in and around the Morrill's Corner area.

Furthermore, the design improvements to the system have considered the likely increased usage of pedestrians and bicyclists by providing concurrent pedestrian crossings at each signalized intersections as well as providing a bicycle lane along Forest Avenue – which do not currently exist.

6. *Since the intersection analysis of existing conditions is flawed, it follows that all subsequent analysis for no-build and build conditions are flawed as well. No meaningful results are contained in the study; and, therefore, the traffic impacts of the project have yet to be presented.*

Similar to the response to Comment 4, the applicant has adjusted the Existing and No-Build conditions to account for the lane utilization factors suggested by Hannaford's consultant. In doing so, the end result only serves to magnify the benefits being offered by the Build conditions assessment which was correctly and adequately modeled.

7. *The proposed mitigation plan includes a fourth leg to the site driveway intersection at Allen Avenue. However, a fourth leg is not included in the analysis. Even if the amount of traffic from the fourth leg may be minimal, it affects the true operations of the intersection and needs to be included.*

This statement is incorrect and misleading. The appendix material submitted in support of this application clearly shows a single eastbound lane opposite the site driveway. Hannaford's traffic consultant is referred to pages 9-10 for each peak hour analysis worksheet under the Build with Mitigation condition in the Synchro analysis output, which is included in the Technical Appendix.

8. *There are at least four merge/weave areas that have not been evaluated for their safety impacts. Lane reductions and lane drops within extreme short distances will lead to increased crash exposure for rear-end and sideswipe accidents for the area that already has numerous safety problems. Lane drops create uneven queuing as drivers favor the lane that continues through the downstream intersection towards their destinations versus the lane that ends in a merge or becomes a dedicated turn lane.*

   In addition to the lane drop/merge areas noted in the Intersection Analysis section, the applicant is proposing to add another lane drop/merge area on the Allen Avenue approach to the site driveway. As reported in the traffic study, the queue length expected on the Allen Avenue northbound through movement at the site driveway is 295-369 feet during the PM/Saturday peak hours. The railroad tracks are only about 200 feet away meaning that traffic will queue across the tracks creating a dangerous condition. With only about 600 feet separating the site driveway and Forest Avenue, the long queue lengths do not allow traffic enough room to safely merge out of the lane drop area.

As discussed previously, the applicant is proposing to eliminate the existing lane drops and merges along Forest Avenue as part of the off-site mitigation plan. One of the benefits of the off-site transportation improvement plan is the reduction/elimination of merge and weaving sections, which are expected to result in a reduction in the number of crashes at these locations.

With respect to the lane drop being created along Allen Avenue, this is a mischaracterization of this condition. With only one lane of traffic from Forest Avenue feeding the two lanes along Allen Avenue coupled with the fact that these single lanes will be operating under their own signal phases, drivers will not be weaving along Allen Avenue between Forest Avenue and the site driveway.

In addition to roadway geometric improvements, the applicant has proposed to coordinate the four traffic signals in the Morrill's Corner area and connect this system to the control boxes for the railroad crossings of Allen Avenue and Forest Avenue. This system will reduce the delay for vehicles traveling along Forest Avenue, minimize the queue lengths between all locations, and limit the impact of a train crossing on vehicular traffic flow.

In the example described by Hannaford's traffic consultant, this improved system will force vehicles along Allen Avenue between Forest Avenue and the site drive to clear while prohibiting vehicles in the Morrill's Corner area and north of the site from accessing this section of Allen Avenue in advance of the railroad crossing gates being lowered. Once the train has passed and the crossing gates have been lifted, the system will normalize over the course of one to three signal phases as it currently does.

9. *The study states and presents crash data that the intersection of Forest Avenue at Stevens [Avenue]/Bishop Street is a* ***high crash location****. The study further states that many of the crashes are rear-end and angle-type in nature, and then routinely dismisses them are being typical of a congested area. Without the benefit of reviewing a Collision Diagram, which is not included in the study appendices as stated in the text, it is my professional opinion through field observations that many of the crashes at this location are due to the lane drop from Allen Avenue to Stevens [Avenue]/Bishop Street. The high volume of traffic from the proposed project will make this* ***high crash location*** *significantly worse.*

We wholeheartedly agree with the statement that the *existing* lane-drop along inbound Forest Avenue, as drivers pass Stevens Avenue, has added to the high crash designation of this location. The proposed off-site improvements to be provided by the applicant will eliminate this existing lane-drop along Forest Avenue and, therefore, eliminate the likely cause of several of these collisions.

10. *Numerous other intersections and links have been identified in the traffic study as being high crash locations. The recommended improvement at the Morrill Street/Forest Avenue intersection is to restrict turning movements to right in/right out during peak hours. Drivers wishing to make left turns could use Adelaide Street to access Morrill Street. Adelaide Street/Read Street/Forest Avenue is already a high crash location. This improvement will require an analysis of the condition and a discussion of impacts to the local businesses that use Morrill Street.*

    No improvements are discussed at [the] Adelaide Street/Read Street/Forest Avenue intersection which has a high crash rate.

Initially, the MDOT was considering improving the intersection of Adelaide Street/Read Street/Forest Street through a BTIP project which has since been placed on the states "deferred" list – meaning that it will not be constructed in the near future. It was the applicant's opinion, supported by the City, that these improvements, when constructed, would address the high crash issues inherent in the design of this location.

In addition, the City and State were considering the creation of a new signal at Bell Street farther inbound along Forest Street. This improvement, coupled with the one-way designation of Read Street away from Forest Street, would improve/eliminate the high crash designation at the Adelaide/Read/Forest intersection. VHB will work with the City and Planning Board to advance this issue further.

As requested by the City's traffic engineer, the applicant will be submitting a complete set of recommendations for the unsignalized intersections that highlight the likely causes of the collisions as well as the suggested recommendations to address these unsafe conditions.

11. *The queuing for the northbound through and right turn movement[s] on Forest Avenue at Allen Avenue is expected to be 325-350 feet during the PM peak hour under the proposed Build with mitigation condition as*

stated in the study. The northbound right turn lane has a storage length of approximately 80 feet before blocking the right most through lane on Forest Avenue. The distance from the stop bar to the Bishop Street/Steven Avenue intersection is 300 feet. Therefore, the right turn queue is expected to extend into the through lane. With the additional queuing expected for the through lanes, vehicles will extend south on Forest Avenue, blocking the Bishop Avenue [sic]/Stevens Avenue intersection.

This is a somewhat misleading statement. The northbound right-turn lane of Forest Avenue at Allen Avenue has a storage length of approximately 185 feet (not the 80 feet suggested by Hannaford's consultant). Additionally, the Synchro analysis reports that queue lengths for the northbound right turns on Forest Avenue are expected to be approximately 325 feet during the evening peak hour (not the 325-350 feet as suggested).

Ultimately, this is a timed queue which will be alleviated when the two signals along Forest Avenue (at Allen Avenue and at Stevens Avenue) are coordinated. Essentially, the queue shown will not block adjacent intersections except when the northbound movements at *both* intersections are moving – therefore not interfering with other movements at the intersections.

12. *The northbound approach of Forest Avenue to Stevens Avenue is currently two lanes wide, and is going to four lanes wide in the improvement concept. As noted earlier, Morrill Street is a high crash location. The expected queue on Forest Avenue is 325 feet. Therefore the back of queue will be right at Morrill Street. Drivers exiting Morrill Street will have difficulty turning left onto Forest Avenue and seeing approaching southbound drivers potentially increasing the frequency/severity of accidents.*

This is also a misleading statement. The northbound (or outbound) approach of Forest Avenue at Morrill Street is currently two lanes wide and will remain two lanes wide with the suggested off-site roadway improvements in place.

Regardless, the northbound approach of Forest Avenue at Stevens Avenue/Bishop Street has a storage length of approximately 325 feet. During the evening peak hour, the queue on this approach is expected to reach Morrill Street, allowing vehicles exiting Morrill Street to continue to enter Forest Avenue to turn right or left. However, if the peak hour restrictions prohibiting left turns at this location during the peak hours were implemented (as highlighted in Comment 10), this potential safety issue would be addressed.

13. *It is noted that discussions of the queue lengths above are based on the results presented in the traffic study; however, as noted earlier, the analysis and results are flawed as the base conditions have not been accurately analyzed. Therefore, the results above can be considered to be much worse.*

The applicant has submitted a revised traffic model to the City detailing the modifications to the Existing and Build traffic conditions. The end result of these modifications highlight that the existing conditions are worse than what was originally submitted and reviewed, but that the Build Condition with Mitigation is still valid. Ultimately, the modifications to the existing conditions assessment only serves to highlight the benefit that the applicants mitigation plan will have on area traffic flow by eliminating several of the inherent flaws in the current transportation network.

14. *The traffic study states that 666 parking spaces are planned for the project and the evaluation of the adequacy of the number of parking spaces takes into account full use of the 666 spaces. However, the core parking*

field, central to the supermarket, retail, office, and restaurant land uses has only about 490 spaces. Drivers will not even consider parking in the apartments or the boxing areas or the recreation field due to the segregation of these lots to their destinations.

Based on Figure[s] 15 and 16 of the November 2005 study, the peak mid-day parking demand (peak season) of these land uses will be approximately 600-675 spaces, and 510-550 during the non-peak season. This is significantly higher than the 490 spaces to be provided in the core area. Drivers will not even consider parking in the apartments or the boxing areas or the recreation field due to the segregation of these lots to their destinations and having to walk a long way to the stores. Additionally, parking should exceed demand by approximately 10-15% to allow for drivers to quickly and conveniently find empty spaces, and to provide areas for snow storage. For these reasons, the amount of parking proposed for the project is not adequate.

The peak parking demand was estimated for each land use individually using rates published by ITE[3] and then added together for each hour of the day. This is a conservative estimate, as mixed-use developments such as the proposed site are conducive for shared parking. As defined by the Urban Land Institute (ULI)[4]:

Shared parking is the use of a parking space to serve two or more individual land uses without conflict or encroachment. The ability to share parking spaces is the result of two conditions: (1) variations in the accumulation of vehicles by hour, by day, or by season at the individual land uses, and (2) relationships among the land uses that result in visiting multiple land uses on the same auto trip.

In this study, reductions for shared parking were not used in order to present a worst-case scenario and, thus, a conservative look at the parking demand for the site. ULI research on sites similar in land use to the proposed site has shown that between 12 and 30 percent of the parking demand could be reduced due to shared parking during the peak season. At a minimum, applying this data would result in a substantial decrease in the number of spaces that would be required at any one time.

Furthermore, in the study no credit was taken for transit-oriented trips that would be accommodated by the two bus stops located on the site. These shoppers, employees and residents who arrive and depart the site via the bus represent vehicular trips and parking spaces that can be subtracted from the primary trips and base parking spaces.

15. *The study notes that pedestrians are likely to cross Forest Avenue for access to the site. Given that Forest Avenue is 5 to 6 lanes wide, an exclusive pedestrian phase for safe crossing is required at all intersections. All vehicular traffic movements are stopped during an exclusive pedestrian phase. At these intersections, the vehicular traffic movements will be stopped in excess of 30 seconds. This will cause extreme queues and delays throughout the network. The study did not analyze this condition and it needs to be analyzed.*

It is important to point out that these signals are currently programmed to provide concurrent pedestrian crossings at all locations throughout the Morrill's Corner area. It is our professional opinion that concurrent

[3] Parking Generation; Second Edition; Institute of Transportation Engineers (ITE); Washington, DC; 1987.
[4] Shared Parking; Second Edition; Urban Land Institute (ULI); Washington, DC; 2005.

pedestrian phasing at the signalized intersections is the safest and most efficient means of handling the volume of pedestrians in the vicinity of the Morrill's Corner area.

This standard traffic engineering concept was found to be acceptable by the City's traffic engineer in his January 10, 2006 letter.

If CME is suggesting that the pedestrian crossings be altered from their existing concurrent phasing operations to a less effective exclusive pedestrian phasing, we wholeheartedly agree that end result would be the creation of extreme queues and delays throughout the roadway network. It is for this reason that these suggestions were not made.

16. *There are no design details of the additional signal coordination with the railroad crossing nor is it known if the railroad preemption equipment/hardware can actually be installed to function properly. During a railroad preemption signal phase, the railroad gates must be lowered well in advance of any train movement. This, coupled with actual train movement across Allen Avenue, will result in extreme traffic delays that will be compounded by the high volumes from the proposed development. These delays will eventually cause Forest Avenue to bottle-neck so that the whole system shuts down. Even if the design details can be worked out, the safety and delay consequences of adding a signal at the site driveway and coordinating with the railroad crossing far outweigh any benefits.*

As stated in the response to Comment 8, the applicant has proposed to coordinate the four traffic signals in the Morrill's Corner area and connect this system to the control boxes for the railroad crossings of Allen Avenue and Forest Avenue. The engineering details of this design will be provided in the design phase of this project.

It is also important to note that the mere development of this project will not create additional train crossings along Allen Avenue. Our focus has been to make sure that the train crossings that do occur do so in a safe and efficient manner. There is no denying that these crossings create some driver delays in and around the Morrill's Corner area. In fact, they create impacts all along the rail line when a train crosses a major roadway corridor.

Furthermore, VHB was asked by the City to prepare and provide the results of a detailed investigation as to when and how often trains cross Allen Avenue over the course of a week. In response to this request, VHB has provided additional train crossing information to the City detailing how often, what time of the day, and for how long these crossings take (e.g., how long are the gates in their down position?). As part of this review, VHB identified 27 train crossings along Allen Avenue between Wednesday, December 7 and Tuesday, December 13, 2005 (or an average of about four crossings per day). The average time that the gates were down was approximately three minutes. In all these cases, there is only one instance where a train was documented crossing Allen Avenue during the weekday evening peak commuter hour (Friday, December 9, 2005 at 4:08 PM when the gates were lowered for three minutes). The remaining 26 train crossing events were documented to occur outside of evening commuter peak hour.

Of note is that these train crossings, however frequent or infrequent, occur for an average of about three minutes each – or less time than it takes for two complete light cycle phases to take place at the existing intersection of Allen Avenue at Forest Avenue.

The bottom line is that these train crossings will stop traffic along Allen Avenue with or without this project. This project will bring along with it updated train pre-emption equipment, safer crossing equipment for both *pedestrians and motorists and will certainly not exacerbate these conditions any more than currently exist along* area roadways. In fact, as discussed previously, these improvements will provide opportunities to improve traffic flow along Forest Avenue with the crossings occurring.

17. *The applicant presents a mitigation plan to widen Forest Avenue to provide a four-lane roadway section from Allen Avenue to Bell Street. However, the study makes no mention of the impacts of the displaced on-street parking. Further, the widening pushes the roadway edge much closer to the building faces thus limiting the available sidewalk space. There is no mention if this concept can meet the minimum Americans with Disability Act standards for accessibility. There is no mention of fixed objects or doorways that may prevent the ADA standards [from] being met. The viability of this concept needs to be carefully evaluated at this time.*

Regarding parking, the applicant has made a recommendation that the seven or eight unmarked on-street parking spaces which currently exist along Forest Avenue be restricted between the hours of 6:00 – 9:00 AM and 3:00 – 6:00 PM during the weekdays.

Regarding sidewalks, as shown on the conceptual plan, the applicant has proposed to provide a seven-foot sidewalk along both sides of Forest Avenue, matching the existing sidewalk width that was constructed as part of the recent MDOT transportation improvement project in the area. Alternately, the applicant has recommended a six-foot sidewalk as part of cross-section modification that would include a three-foot shoulder suitable for bicycle travel. In both cases, the proposed sidewalk would certainly be wide enough to meet ADA standards, even with a fixed object or doorway present.

18. *There are seven unsignalized intersections that will operate at unacceptable Level of Service F after development of the proposed project. The City of Portland and MDOT have adopted a standard of Level of Service D as the minimum acceptable operating condition for intersections. The traffic generated by the project will exacerbate the congestion and delay at these intersections; however, the study does not propose mitigation to address the project's impacts.*

In discussing this issue with the City's Traffic Engineer, the Level of Service F standard has been applied to signalized intersections throughout the City of Portland and is not applied to unsignalized intersections. Additionally, while the Maine Department of Transportation has adopted this standard, they also recognize that the level of impact from developments, such as the one under review, at unsignalized intersections is unrealistic in some cases. For this reason, they provide language in their permit that states:

> **"In the case of unsignalized intersections, if traffic with the development in place would not meet the warrant criteria for signalization or auxiliary turning lanes, as set forth in the edition of Federal Highway Administration's "Manual on Uniform Traffic Control Devices"...then the Department may reduce the mitigation requirement for those measures so long as the resulting traffic conditions provide for safe movement."**

Of the seven locations highlighted by CME, all of them are unsignalized locations. These impacts are summarized on pages 34-35 of the November 2005 Traffic Impact and Access Study and focus on the

operations at each of the seven unsignalized intersections raised by Hannaford's consultant. The specific unsignalized intersections studied include the following:

- Forest Avenue at Newton Street
- Forest Avenue at Morrill Street
- Forest Avenue at Read Street/Adelaide Street
- Forest Avenue at Bell Street
- Allen Avenue at Woodlawn Avenue
- Allen Avenue at Plymouth Street/Northfield Green
- Warren Avenue at Hicks Street

Generally, each of these unsignalized intersections exists on what can be defined as an arterial roadway that carries a significant volume of commuter traffic during the weekday evening conditions. In an urban environment, such as Portland, it is not uncommon for drivers on the side streets to wait some period of time for an adequate break in the traffic stream during these peak hours.

It is important to understand the traffic operational characteristics used in the engineering models to predict the delays at unsignalized intersections are based on a series of conservative assumptions and calculations. Furthermore, the delays shown in the tables assume that only the side streets are inconvenienced. Mainline traffic will continue to flow through these intersections in an unaffected, free-flow, manner.

As part of this review, as requested by the City, VHB visited and investigated each of these locations to determine if potential actions could be implemented to address the delays experienced by those few motorists waiting to turn left or right onto the mainline roadway and any identifiable safety deficiencies. This investigation focused on the following possible solutions, but also considered other options (where available):

Signalization – Signals provide the greatest level of control at a given intersection by clearly defining the right of way to drivers on the mainline and on the side streets. According to the Federal Highway Administration and the MDOT, signals may only be constructed if at least one of the various volume-based and safety-based criteria for signalization is met. If they are not met, then signals are not considered appropriate and cannot be installed. In many cases, the low-volume nature of these side streets does not trigger the need for the installation of traffic signals.

Turn Lanes – At most unsignalized locations where traffic signals are not warranted, it is usually more appropriate to upgrade the intersections to provide additional turning lanes and/or wider approach lanes on the side streets. These turn lanes are provided so that right-turning motorists do not have to wait behind those drivers seeking to turn left onto a busy street and/or to address potential safety issues that have been documented at specific locations. Similarly, these also could include providing turn lanes along the mainline corridor so that drivers waiting to turn left into a side street are not blocking those drivers seeking to travel through the intersection. In many cases, these types of improvements are aimed at improving the safety at intersections as well as facilitating traffic flow through those locations that have a large volume of turning traffic.

Movement Restrictions – Finally, another option worth considering focuses on restricting turning movements at those locations which are deemed problematic and/or unsafe. Typically, this involves restricting certain low-

volume movements at an intersection. It is critical that alternative routes are provided to motorists when these options are considered.

As requested by the City, VHB offers the following operational review of each intersection and provides an aerial image of each specific location for reference purposes.

Forest Avenue at Newton Street

There currently is a pedestrian signal at this intersection which provides breaks in the traffic stream to let students and residents cross Forest Avenue. Based on the observed and projected volumes at this location, traffic signals are not warranted (except for pedestrian crossings, given the proximity of the school to this location). A review of the recent MDOT crash data indicates that this location is well below the state's 1.00 CRF threshold and, therefore, is not considered a high crash location.

Under future conditions, it is projected that between 15 and 30 left-turns will occur at this intersection from the side street movements. Because there are limited opportunities to widen Newton Street (given the proximity of residential properties on each corner) and/or the School Driveway (given the proximity of the fire station on the corner), there does not appear to be any reasonable means or methods to minimize or eliminate the delay experienced by the side-street drivers at this intersection without significantly impacting the adjacent property owners.

Forest Avenue at Morrill Street

The five left turns and 35 right turns that exit Morrill Street during the weekday evening peak commuter hour currently operates at LOS F and is projected to remain at this level under the future conditions. Based on our review of the MDOT crash rate statistics, there were 12 collisions at this intersection over the most-recent three-year period available (from 2002-2004).

The proposed improvements along Forest Avenue suggested by the applicant are expected to reduce the congestion at this location and, in turn, will likely improve the overall safety of this intersection by reducing the number of congestion-related collisions that have historically occurred here.

VHB reviewed this intersection to determine if any feasible improvements could be implemented at this location to reduce the delay experienced along Morrill Street. Based on our review, due to the limited right of way at this intersection and the proximity of buildings located immediately adjacent to the intersection, there are limited options available to provide a wider approach. As shown in the attached figure, there are two options worth considering at this intersection to reduce the delay for side street drivers. The first alternative is to restrict left-turns from Morrill Street onto Forest Avenue during the peak evening commuter hour (between 4:00 and 6:00 PM). This restriction would only impact five motorists during this peak hour and would require them to make a left turn at either Bell Street or Read Street – outside of the influence of the Stevens Avenue signal. The other option worth considering would be to flare the right-turn corner at Morrill Street and Forest Avenue to provide the opportunity for motorists turning right to by-pass those motorists seeking to turn left at the intersection.

Forest Avenue at Adelaide Street/Read Street/parking lot driveway and at Bell Street

As part of the Forest Avenue BTIP proposal, this intersection would be expected to be both widened and have the traffic flow restricted along Read Street (so that it would travel one-way away from Forest Avenue). Specifically, the BTIP proposal calls for the widening of Forest Avenue to provide four lanes of traffic flow along this corridor and the traffic signalization of Bell Street with associated minor geometric improvements. Currently, there is one through lane in each direction along Forest Avenue with an exclusive left-turn lane from Forest Avenue (inbound) to Read Street.

There are a number of options worth considering at these intersections. The first option is to continue to pursue the benefits afforded by the BTIP application. Clearly, those improvements would provide the greatest level of control and operational benefits to this area. The applicant will continue to work with the City to advocate these improvements.

Should the BTIP project not move forward, the applicant has developed a series of potential other actions that would be worth considering. These actions include:

- *Restricting left-turns from Read Street to Forest Avenue* – Given the acute angle that Read Street enters the intersection and the low volume of traffic that seeks to make this movement, it would appear reasonable that this movement could be restricted during peak hours. These turns would then take place at the Bell Street intersection with Forest Avenue and would do so under much more favorable geometric conditions.
- *Close Adelaide Street at Read Street* – By dead-ending the Adelaide Street corridor at Read Street, the fifth leg of this intersection would be removed and, therefore, reduce the number of vehicle conflicts at this intersection. These movements could then take place either at Bell Street or other locations along Forest Avenue.
- *Make Read Street one-way away from Forest Avenue* – as suggested in the BTIP proposal, the Read Street corridor could be converted to a one-way flow away from Forest Avenue. In concert with this action, the Bell Street intersection with Forest Avenue would be upgraded to provide separate right- and left-turn lanes. Signalization would not be required at this intersection if this improvement was made.

Allen Avenue at Woodlawn Avenue

As stated in the traffic report, the applicant is proposing to provide a one-way connection from the Woodlawn Avenue neighborhood into the site via Morrill Street. This connection would serve two purposes. First, to allow convenient access from the neighborhood into the development and, second, to provide access to those residents who live in the neighborhood to access Allen Avenue via the site's signalized access driveway. As noted, there are only 30 motorists that exit Woodlawn Avenue during the peak hour conditions – so the resulting impact at the signal would be minimal.

Allen Avenue at Plymouth Street/Northfield Green

According to discussions with the City, this intersection will be signalized in the near future as part of a separate project unrelated to the Morrill's Crossing development. This signalization will improve the operating levels at this intersection to acceptable standards.

Warren Avenue at Hicks Street

Based on traffic count information at this intersection, only five left turns were observed taking place during the evening peak hour (no left turns were observed during the Saturday midday peak hour). Motorists who elect to make this movement do so out of convenience as there are connections within this neighborhood that also provide access to Forest Avenue. In reviewing the operational deficiencies at this intersection, there does not appear to be any reasonable mitigation that could be implemented at this location to address this operational deficiency short of restricting left-turns out of Hick Street during the peak hour conditions.

In summary, the applicant is willing to coordinate these improvements with the City as the process moves forward. Each alternative appears to offer some benefit to the overall traffic operations at these intersections.

19. *The existing traffic volumes from the site are considered minimal given the limited use of the existing buildings on-site. Under the current* ***Low Impact Industrial*** *zoning several different land uses are allowed including warehouses, assembly, and research and development. Residential and retail trades are prohibited. The following table summarizes the trip generation of the existing, allowable uses under* ***Low Impact Industrial*** *zoning, and the proposed Morrill's Crossing development.* ***(Hannaford's traffic consultant provides a table comparing peak hour and daily traffic volumes for the existing traffic counts, 20 acres of light industrial[5], 20 acres of research and development[6], and the estimated trips for the proposed site.)***

    As can be seen from the table, tremendous volume increases would occur with the proposed development as compared to existing conditions or allowed uses on the site.

The site is no longer zoned Low Impact Industrial. The proposed uses are permitted uses under the terms of the conditional rezoning.

Conclusion

I trust that this information addresses Hannaford's traffic consultant's comments relating to this project and the accompanying traffic study. Should you have any questions related to these responses, please let me know. We are eager to address all of the Planning Board's traffic safety and operational questions and look forward to presenting this information to the Board.

[5] Trip Generation – Seventh Edition; Institute of Transportation Engineers (ITE); Washington, DC; 2003.
[6] Ibid.

Regards,

VANASSE HANGEN BRUSTLIN, INC.

Robert L. Nagi, PE, PTOE
Principal/Project Manager

Attachments

Copies: City of Portland Planning Board (6)
Sarah Hopkins, City of Portland
Tom Errico, Wilbur Smith Associates
Tom Gorrill, Gorrill-Palmer Consulting Engineers, Inc.

Attachments

™ Comment 4

Comment 4

Signalized Intersection Capacity Analyses Summary

Location	Peak Hour	2004 Existing			2004 Existing [d]			2007 Build with Mitigation		
		v/c [a]	Delay [b]	LOS [c]	v/c	Delay	LOS	v/c	Delay	LOS
Forest Avenue at Warren Avenue	Weekday Evening	0.77	19	B	0.77	19	B	0.83	20	B
	Saturday Midday	0.71	16	B	0.71	16	B	0.76	17	B
Forest Avenue at Allen Avenue	Weekday Evening	0.86	36	D	0.87	37	D	0.97	37	D
	Saturday Midday	0.75	27	C	0.77	28	C	0.82	27	C
Forest Avenue at Stevens Ave/Bishop St	Weekday Evening	0.86	25	C	0.86	25	C	0.84	19	B
	Saturday Midday	0.77	18	B	0.77	18	B	0.71	12	B
Allen Avenue at Washington Avenue	Weekday Evening	0.75	40	D	0.75	40	D	0.86	39	D
	Saturday Midday	0.67	33	C	0.67	33	C	0.80	34	C

a volume to capacity ratio
b average delay per vehicle in seconds
c level of service
d analysis includes lane utilization factor adjustments

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January 9, 2006

Ms. Sarah Hopkins
Development Review Services Manager
Department of Planning & Development
City of Portland
389 Congress Street
Portland, Maine 04101

Subject: Peer Traffic Review for Morrill's Crossing/Packard Development Project

Dear Sarah:

The following presents my initial comments relative to the review of traffic information transmitted to us in conjunction with the Packard Development project at Morrill's Corner. Our initial review is based upon a Traffic Impact Study (with attached Technical Appendix and Improvement Plan), Morrill's Crossing, dated November 2005 prepared by Vanasse Hangen Brustlin, Inc. I want to emphasize that my review is not complete, and further comments should be expected. Related to this is the recent receipt of the traffic simulation results, which has not been reviewed. I would also note that I will be responding to comments submitted by Creighton Manning Engineering, LLP. My initial comments are summarized as follows.

1. The study area for the traffic study was identified at a project level scoping meeting and meets methods established by the Maine Department of Transportation (MaineDOT). Accordingly, I find the study area to be acceptable.

2. From a traffic volume and analysis perspective, intersection turning movement counts are the most relevant. Accordingly, I would ask that the applicant provide a historical perspective on the various intersection turning movement volumes collected over the last several years. I would suggest that this be provided in tabular form with dates of counts, day of week information, peak hour information, and supporting commentary.

3. Turning Movement count reports should be provided for the intersections of Forest Avenue/Read Street/Adelaide Street and Forest Avenue/Bell Street.

4. Some of the intersection turning movement volumes do not balance between intersections. As an example: volumes on inbound Forest Avenue between Warren Avenue and Allen Avenue vary by approximately 115 vehicles. Traffic volumes between intersections should reasonably balance.

5. Some of the turning movement volumes at the Allen's Corner intersection on Figure 7 do not seem to match data from the turning movement count reports. An explanation should be provided.

6. The report notes general pedestrian and bicycle deficiencies. I would ask that the applicant document specific deficiencies.

7. The applicant should provide recent information on train activity at the Allen Avenue crossing. I would like to see crossing information over an extended period of time.

8. Four locations within the study area were identified as having potential safety problems as defined by MaineDOT methods. For the Forest Avenue/Stevens Avenue/Bishop Street and Washington Avenue/Allen Avenue intersections, I would suggest that the applicant obtain crash data from the Portland Police Department during the time period following recent improvements to determine if safety problems have been corrected. For the Forest Avenue/Morrill Street and Forest Avenue/Read Street/Adelaide Street intersections, details of improvement strategies should be fully developed. Additionally, collision diagrams should be provided.

9. The City no longer expects funding through the PACTS BTIP process for the Forest Avenue improvement project, and the study should account for this.

10. The City is in the process of installing a traffic signal at the Allen Avenue/Plymouth Street intersection. The signal should be operational within the next month and therefore all analyses should reflect this condition.

11. Historical Growth assumptions within the study area should be discussed, particularly declining traffic volumes documented in the report. This effort should include both daily and peak hour volumes.

12. I concur with the trip generation methods. However, I would suggest (if available) that the applicant provide information on trip generation activity at a typical Stop N' Shop supermarket for comparison purposes. Additionally, the applicant should confirm that improvements to the existing Bruno's Restaurant will not increase seating capacity and therefore traffic levels.

13. The applicant should provide parking demand information in tabular form for each hour (not just the percent) for review purposes with hourly parking totals. I plan on reviewing parking demand issues after receiving the table summary.

14. At this time the City does not expect BTIP funding to improve the Forest Avenue/Adelaide Street/Read Street intersection. Accordingly, the applicant should identify improvements that mitigate deficiencies.

15. In conjunction with the proposed Traffic Demand Management Plan, the City may want to request annual progress reports on the plan for City review and comment.

16. At the Allen Avenue/Site Drive intersection it is recommended that a raised island be provided that physically prevents driveway movements near the intersection.

17. The applicant shall provide information on proposed site layout changes at Paul White Tile as part of the Allen Avenue improvements.

18. The applicant shall provide a graphic that illustrates the turning adequacy of bus movements through the traffic circle near Morrill Street. Additionally, the applicant should implement design treatments that minimize illegal movements to Morrill Street.

19. The improvement plan should provide details on how Forest Avenue will transition from two lanes to one in the inbound direction.

20. The applicant needs to fully explore and provide alternatives for the provision of four travel lanes on Forest Avenue as it relates to the loss of on-street parking.

21. Peak hour factors computed during the conduct of the turning movement counts should be used in the capacity analysis calculations.

22. The capacity analysis calculations take credit for right-turn on red movements at the Forest Avenue/Allen Avenue intersection. Right-turn-on-red movements are prohibited for northbound right turns. The analysis should be revised to reflect this prohibition.

23. The volume-to-capacity ratio for the Forest Avenue/Allen Avenue intersection exceeds 1.0 for the Build with Mitigation Scenario during the Weekday time period. Volume-to-capacity computations should be less than 1.0 at all study intersections.

24. The applicant should provide information on existing storage lane capacities at the study intersections such that a determination on storage lane adequacy can be determined. Additionally, 95th% queues should be used for the determination of lane storage adequacy.

25. The applicant should identify a mitigation plan for the Forest Avenue/Riverton School/Newton Street intersection.

26. I am concerned about vehicle queuing at the Morrill's Corner intersections and will rely on the SimTraffic results to determine whether conditions are acceptable. As indicated previously, that review will be conducted in the near future.

As noted earlier, additional comments will be provided in the near future particularly related to the site plan, parking, and traffic simulation. Please do not hesitate to call should you have any questions.

Sincerely,

WILBUR SMITH ASSOCIATES

Thomas A. Errico, P.E.
Senior Transportation Engineer

Transportation
Land Development
Environmental
Services

imagination | innovation | energy Creating results for our clients and benefits for our communities

February 6, 2006

Vanasse Hangen Brustlin, Inc.

Ref: 07334.00

Ms. Sarah Hopkins
Development Review Services Manager
Department of Planning & Development
City of Portland
389 Congress Street
Portland, Maine 04101

Re: Response to Comments
Morrill's Crossing Traffic Study
Portland, Maine

Dear Sarah:

Vanasse Hangen Brustlin, Inc. (VHB) has received and reviewed the peer traffic review letter submitted on behalf of the City of Portland by the City's traffic reviewer, Mr. Thomas A. Errico, PE of Wilbur Smith Associates. VHB has since met with Mr. Errico and other members of the City staff on several occasions to review these and other comments with him.

The following provides detailed responses to comments 1-18 and 24 from Mr. Errico's letter dated January 9, 2006. At the request of Mr. Errico, VHB is currently in the process of gathering additional data on traffic operations through the Morrill's Corner area which will be summarized and submitted to the City under separate cover. This additional data is required in order to provide responses to Comments 19-24 and 26.

The following letter provides responses to the comments raised by Mr. Errico (numbered and shown in italics).

1. *The study area for the traffic study was identified at a project level scoping meeting and meets methods established by the Maine Department of Transportation (MaineDOT). Accordingly, I find the study area to be acceptable.*

No response is necessary.

2. *From a traffic volume and analysis perspective, intersection turning movement counts are the most relevant. Accordingly, I would ask that the applicant provide a historical perspective on the various intersections turning movement volumes collected over the last several years. I would suggest that this be provided in tabular form with dates of counts, day of week information, peak hour information, and supporting commentary.*

We concur that the peak hour traffic counts are the most relevant aspect of reviewing this project. All roadway and intersection analyses and, in turn, all off-site roadway improvements are designed around the peak hour

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impacts. A table summarizing the dates of traffic counts conducted in the vicinity of the project, the day of the week those counts were conducted, and the volumes observed is attached to this letter (see Comment 2 Attachment). Also included with the Table is a brief summary of the traffic volume information in relation to what general construction was on-going in the region.

It is VHB's opinion that the November 2004 traffic counts are representative of the current traffic volumes in and around the study area. This was confirmed in discussions with Mr. Errico prior to undertaking the November 2004 traffic counts.

3. *Turning Movement count reports should be provided for the intersections of Forest Avenue/Read Street/Adelaide Street and Forest Avenue/Bell Street.*

The traffic count reports for these two locations were inadvertently omitted from the Technical Appendix to the traffic study. The turning movement count sheets are attached to this letter (Comment 3 Attachment).

4. *Some of the intersection turning movement volumes do not balance between intersections. As an example: volumes on inbound Forest Avenue between Warren Avenue and Allen Avenue vary by approximately 115 vehicles. Traffic volumes between intersections should reasonably balance.*

VHB has reviewed all the volumes presented in the report and found only this one instance where the volumes would be expected to balance. VHB will correct this minor imbalance as part of the resubmission of the traffic model. Ultimately, this will not likely have a significant impact on area-wide intersection operations.

5. *Some of the turning movement volumes at the Allen's Corner intersection on Figure 7 do not seem to match data from the turning movement count reports. An explanation should be provided.*

VHB reviewed this intersection and compared them with the turning movement data provided in the Technical Appendix of the traffic study. There are only two movements that are inconsistent. In both cases, these were for movements that are not critical to the overall intersection operation. Therefore, in correcting this information, there is no change in the operational level of service or the findings of this report.

Again, this will be corrected and included in the final traffic model to be presented in the next submission.

6. *The report notes general pedestrian and bicycle deficiencies. I would ask that the applicant document specific deficiencies.*

VHB conducted a detailed inventory of the pedestrian and bicycle environment recently. Attached to this letter is a figure which provides a summary of general pedestrian deficiencies in the area (Comment 6 Attachment). For the most part, the general pedestrian deficiencies observed included:

- Non-ADA compliant ramps
- Non-ADA compliant railroad crossings
- Worn and faded pedestrian crosswalk pavement markings
- Broken sidewalks/asphalt

There are no formal bicycle amenities provided throughout the Morrill's Corner area along either Forest Avenue or Allen Avenue.

7. *The applicant should provide recent information on train activity at the Allen Avenue crossing. I would like to see crossing information over an extended period of time.*

VHB investigated the train crossing information as requested. VHB is providing information on how often, what time of day, and for how long these crossings restricted vehicular traffic flow. The specific details of this information are provided as an attachment to this letter (Comment 7 Attachment). The following summarizes these findings and observations:

VHB identified 27 train crossings along Allen Avenue between Wednesday, December 7 and Tuesday, December 13, 2005 (or an average of about four crossings per day). The average time that the gates were down was approximately three minutes. In all cases, there was only one instance where a train was documented crossing Allen Avenue during the peak evening commuter hour (Friday, December 9, 2005 at 4:08 PM when the gates were down for three minutes). The remaining 26 train crossing events were documented to occur outside of the evening peak hour.

Of note is that these train crossings, however frequent or infrequent, occur for an average of about three minutes each – or less time than it takes for two complete light cycle phases to take place at the existing intersection of Allen Avenue at Forest Avenue.

VHB also noted that, when a train crosses Allen Avenue, it generally takes between two and three signal cycles to normalize traffic patterns along Forest Avenue. Allen Avenue takes generally between three and five signal cycles to normalize after a train crossing occurs under the existing lane geometry.

With the updated train crossing equipment, improved pre-emption equipment and phasing, as well as the addition of a new lane of traffic in each direction along Allen Avenue, it is VHB's opinion that traffic flow along Allen Avenue will remain unchanged from its current operations and, in fact, will improve in many instances. Ultimately, the upgraded crossing and pre-emption equipment will lead to an improved level of safety for all users throughout the Morrill's Corner area with respect to train crossings.

8. *Four locations within the study area were identified as having potential safety problems as defined by MaineDOT methods. For the Forest Avenue/Stevens Avenue/Bishop Street and Washington Avenue/Allen Avenue intersections, I would suggest that the applicant obtain crash data from the Portland Police Department during the time period following recent improvements to determine if safety problems have been corrected. For the Forest Avenue/Morrill Street and Forest Avenue/Read Street/Adelaide Street intersections, details of improvement strategies should be fully developed. Additionally, collision diagrams should be provided.*

Detailed crash information and collision diagrams were provided to the City Traffic Engineer on Friday, January 13, 2006. The applicant has also been researching crash data from the Portland Police Department as requested and will summarize and provide to the City shortly for review when it is provided to VHB.

Strategies for alleviating these high crash locations are provided below:

Forest Avenue at Stevens Avenue/Bishop Street – The proposed roadway project at this location will serve to eliminate one of the primary safety issues at this location. The elimination of the Forest Avenue inbound lane-drop will serve to provide smoother traffic flow along this stretch of roadway.

Washington Avenue at Allen Avenue (Allen's Corner) – While no strategies are being provided at this point in time, the recent upgrade of the intersection (completed in 2004) was done, in part, to address safety issues at this location. VHB is researching recent data from the City of Portland Police Department to identify if any improvements to the safety issues inherent with the prior design have been alleviated with these improvements.

Morrill Street at Forest Avenue – As will be noted later in this response, the primary cause of delay and safety concerns at this location is the left-turning traffic into and out of Morrill Street – particularly during the peak traffic hours. It is recommended that left turns out of Morrill Street be restricted during peak commuter hours to alleviate both the delays at this intersection, but more importantly address the safety issue inherent with the current design of the intersection.

Forest Avenue at Read Street/Adelaide Street – Again, as will be noted later in this response, the odd configuration of this intersection, coupled with the high crash designation supports the concept of addressing the pre-existing safety and operational issues at this intersection. After reviewing the BTIP proposal and investigating the causes of the high crash designation at this location, VHB recommends that the City pursue the following alternative to address both the high crash designation as well as the operational issues at this intersection (which is graphically shown in the Comment 8 Attachment):

- Make Read Street and Adelaide Street one-way heading away from Forest Avenue to Bell Street (although maintain two-way traffic flow for the majority of Adelaide Street as shown in the graphic).
- Widen Bell Street to provide separate right- and left-turn lanes at Forest Avenue.

Ultimately, these improvements should be considered with or without the proposed Morrill's Crossing project as these are conditions that exist today – without the project in place. While the majority of the later two recommendations are mainly restrictive in nature (and do not require any significant capital expenditures to implement) the applicant will work with the City to advance these concepts to a greater degree if so directed.

9. *The City no longer expects funding through the PACTS BTIP process for the Forest Avenue improvement project, and the study should account for this.*

While the project remains on the MDOT's "Deferred List" as a potential future project, the DPW and City Traffic Engineer noted that it was not something that should be considered in the preparation of this traffic study. For this reason, VHB noted that it is a potential project, but took no "credit" for its benefits when creating the traffic study.

However, the Forest Avenue roadway improvements being recommended by the applicant are consistent with the City's and PACTS' original plan (including the four-lane cross-section along Forest Avenue inbound of the train crossings). If the Morrill's Crossing project were to advance with the proposed roadway improvements along Forest Avenue in place, a large portion of the BTIP project would have been, essentially, completed.

10. *The City is in the process of installing a traffic signal at the Allen Avenue/Plymouth Street intersection. The signal should be operational within the next month and therefore all analyses should reflect this condition.*

VHB was initially advised to prepare the traffic study under the assumption that this signal would not be installed. As directed by Mr. Errico, VHB will include a signal at Allen Avenue/Plymouth Street in the updated model.

11. *Historical Growth assumptions within the study area should be discussed, particularly declining traffic volumes documented in the report. This effort should include both daily and peak hour volumes.*

As shown in Table 2 of the Traffic Study, there appears to be some indication from the data that daily traffic volumes might be declining slightly in the vicinity of Morrill's Corner over the past four years. However, peak hour traffic volumes have remained relatively consistent between June 2004 and November 2005.

Even with an apparent decline in daily volumes, the relative stability of the peak hour volumes, or minor increases (as highlighted in the response to Comment 2, earlier in this letter) may indicate that the Forest Avenue corridor is continuing to see some minor level of growth along it.

Some reasons for the apparent daily decline in traffic volumes might be related to improved alternative routes into the City of Portland – namely the upgrades of Congress Street and Washington Street (at Allen's Corner). With these improved routes into the City, there could be a likely shift in driver tendencies to use these alternative commuter routes into and out of the City. Other changes to the regional traffic network include construction and opening of the Exit 47 (formerly known as "Exit 7B") interchange – providing drivers the ability to avoid some of the traditional commuting routes into and out of the City.

Ultimately, in the face of the potential decline or stability in the volumes, the traffic study utilized a one percent per year growth rate to provide some reasonable estimate of potential new traffic on area roadways.

12. *I concur with the trip generation methods. However, I would suggest (if available) that the applicant provide information on trip generation activity at a typical Stop N' Shop supermarket for comparison purposes. Additionally, the applicant should confirm that improvements to the existing Bruno's Restaurant will not increase seating capacity and therefore traffic levels.*

VHB has collected trip generation data at Stop & Shop supermarkets throughout the northeast United States for a number of years. Tabular comparisons of ITE theoretical rates and Stop & Shop observed rates and of the estimated site-generated trips for this project using this data are attached to this letter (Comment 12. Attachment).

Of particular note is that the observed Stop & Shop peak hour traffic generation is universally lower than the theoretical ITE Supermarket rates, which were used in the development of the traffic study currently under review.

As the table shows, the peak hour trips estimated using theoretical ITE regression equations are more than one trip per 1,000 square feet (sf) greater than those observed at similar Stop & Shop supermarket sites in New England. In other words, the traffic study has assumed there will be about 75 to 85 additional peak hour trips on the roadway than will likely be observed when the store is completed and operational. This is the equivalent of building in a "factor of safety" into the analysis results presented in the study.

With respect to the increase in size of Bruno's restaurant and its traffic impact, the additional square footage was included to the retail portion of the project. Ultimately, the minor expansion will consist of adding kitchen and storage space.

13. *The applicant should provide parking demand information in tabular form for each hour (not just the percent) for review purposes with hourly parking totals. I plan on reviewing parking demand issues after receiving the table summary.*

A detailed parking summary / evaluation are provided under separate cover.

14. *At this time the City does not expect BTIP funding to improve the Forest Avenue/Adelaide Street/Read Street intersection. Accordingly, the applicant should identify improvements that mitigate deficiencies.*

As noted in the response to Comment 8, there are number of options worth considering at these intersections to improve operational and safety purposes. After reviewing the BTIP proposal and investigating the causes of the delays at this location, VHB recommends that the City pursue the following alternative to address both the high crash designation as well as the operational issues at this intersection (which was previously shown graphically in the Comment 8 Attachment):

- Make Read Street and Adelaide Street one-way heading away from Forest Avenue to Bell Street (although maintain two-way traffic flow for the majority of Adelaide Street as shown in the graphic).
- Modify Bell Street to provide separate right- and left-turn lanes at Forest Avenue.

15. *In conjunction with the proposed Traffic Demand Management Plan, the City may want to request annual progress reports on the plan for City review and comment.*

The applicant would be willing to incorporate this if so directed.

16. *At the Allen Avenue/Site Drive intersection it is recommended that a raised island be provided that physically prevents driveway movements near the intersection.*

As stated previously, it is our opinion that a raised island will introduce a physical object into the Allen Avenue corridor which could be problematic for wintertime plowing operations as well as providing a fixed object in the travel way for passenger vehicles to contend with. This will also require minor additional widening along Allen Avenue to incorporate this median divider along this route. VHB believes the scored concrete with left-turn restrictions is adequate.

17. *The applicant shall provide information on proposed site layout changes at Paul White Tile as part of the Allen Avenue improvements.*

An exhibit showing the proposed site plan modifications to the Paul White Tile site is included (Comment 17 Attachment)

18. *The applicant shall provide a graphic that illustrates the turning adequacy of bus movements through the traffic circle near Morrill Street. Additionally, the applicant should implement design treatments that minimize illegal movements to Morrill Street.*

VHB has been working with the METRO to design the desired bus route serving the Morrill's Crossing site. An exhibit showing the turning radius movement for a bus is included as an attachment to this letter (Comment 18 Attachment). The cul-de-sac radii have been revised to meet the METRO's specifications. The one way connection between Morrill Street has been designed to discourage or prevent illegal movements to Morrill Street through physical restrictions, signage, and pavement markings.

Note: Comments 19 thru 24 and Comment 26 will be thoroughly addressed as part of the new capacity analysis and simulation that are currently being prepared.

25. *The applicant should identify a mitigation plan for the Forest Avenue at Riverton School/Newton Street intersection.*

There currently exists a pedestrian signal at this intersection which provides breaks in the traffic stream to let students and residents cross Forest Avenue. Based on the observed and projected volumes at this location, traffic signals are not warranted (except for pedestrian crossings, given the proximity of the school to this location). A review of the recent MDOT crash data indicates that the critical rate factor at this location is well below the state's 1.00 CRF threshold, therefore this intersection is not considered a high crash location.

Under future conditions, it is projected that between 15 and 30 left turns will occur at this intersection from the side street movements. Because there are limited opportunities to widen Newton Street (given the proximity of residential properties on each corner) and/or the School Driveway (given the proximity of the fire station on the corner), there does not appear to be any reasonable means or methods to minimize or eliminate the delay experienced by the side-street drivers at this intersection without significantly impacting the adjacent property owners.

I trust that this letter address these specific comments about traffic. Should you have any questions related to these responses, please feel free to contact me directly.

Very truly yours,

VANASSE HANGEN BRUSTLIN, INC.

Robert L. Nagi, PE, PTOE
Principal – Transportation Systems

Copies: City of Portland Planning Board (6 copies)
Tom Errico, Wilbur Smith Associates
Tom Gorrill, Gorrill-Palmer Consulting Engineers, Inc.

Attachments

- Comment 2
- Comment 3
- Comment 6
- Comment 12
- Comment 14
- Comment 17
- Comment 18

Comment 2

Historical Traffic Comparison – Forest Avenue at Allen Avenue

Date	Day	Forest Avenue (East of Allen Avenue) [a]	Forest Avenue (West of Allen Avenue)	Allen Avenue (North of Forest Avenue)
September 30, 2003	Tuesday	2,890	2,649	1,625
May 19, 2004	Tuesday	2,900	2,736	1,272
October 5, 2004	Tuesday	3,034	2,739	1,706

a vehicles per hour

Comment 3

TDC
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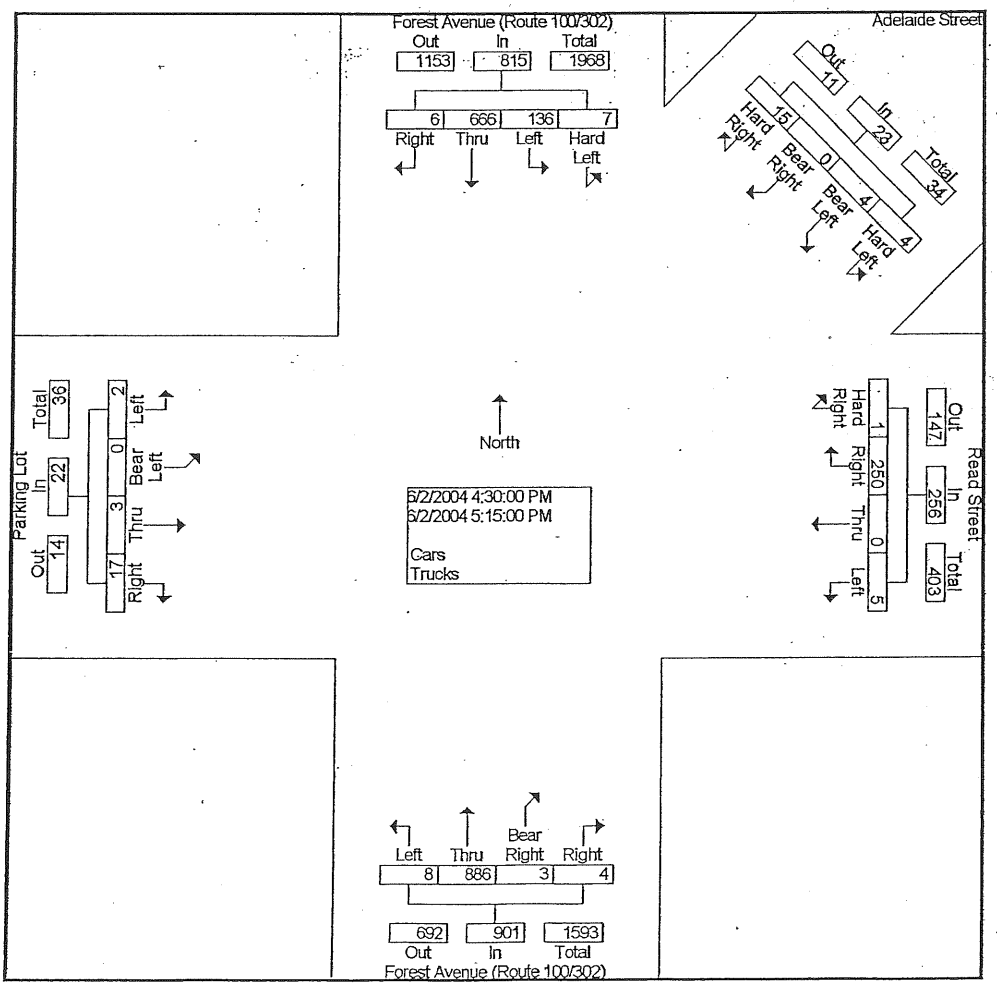
J/S/NE: Forest Avenue/Adelaide Street
J/W: Read Street/Parking Lot
State: Portland, ME
lient: VHB/J. Quitter

File Name : 03012BB
Site Code : 00007334
Start Date : 6/2/2004
Page No : 1

	Forest Avenue (Route 100/302) From North					Adelaide Street From Northeast					Read Street From East					Forest Avenue (Route 100/302) From South					Parking Lot From West					
Start Time	Right	Thru	Left	Hard Left	App. Total	Hard Right	Bear Right	Bear Left	Hard Left	App. Total	Hard Right	Right	Thru	Left	App. Total	Right	Bear Right	Thru	Left	App. Total	Right	Thru	Bear Left	Left	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																									
Intersection	04:30 PM																								
Volume	6	666	136	7	815	15	0	4	4	23	1	250	0	5	256	4	3	886	8	901	17	3	0	2	22	2017
Percent	0.7	81.7	16.7	0.9		65.2	0.0	17.4	17.4		0.4	97.7	0.0	2.0		0.4	0.3	98.3	0.9		77.3	13.6	0.0	9.1		
04:45 Volume	2	176	35	1	214	1	0	0	1	2	0	65	0	1	66	2	0	280	1	283	6	1	0	1	8	573
Peak Factor																										0.880
High Int.	04:45 PM					05:00 PM					04:30 PM					04:45 PM					04:45 PM					
Volume	2	176	35	1	214	6	0	2	1	9	0	82	0	2	84	2	0	280	1	283	6	1	0	1	8	
Peak Factor					0.952					0.639					0.762					0.796					0.688	



TDC
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N/S/NE: Forest Avenue/Adelaide Street
E/W: Read Street/Parking Lot
City/State: Portland, ME
Client: VHB/J. Quitter

File Name : 03012BB
Site Code : 00007334
Start Date : 6/2/2004
Page No : 1

Groups Printed- Cars

	Forest Avenue (Route 100/302) From North				Adelaide Street From Northeast				Read Street From East				Forest Avenue (Route 100/302) From South				Parking Lot From West				
Start Time	Right	Thru	Left	Hard Left	Hard Right	Bear Right	Bear Left	Hard Left	Hard Right	Right	Thru	Left	Right	Bear Right	Thru	Left	Right	Thru	Bear Left	Left	Int. Total
04:00 PM	2	150	26	2	2	0	1	0	0	52	0	1	1	0	126	1	3	1	0	0	368
04:15 PM	2	176	37	0	2	0	0	1	0	67	0	0	2	0	131	0	4	0	0	0	422
04:30 PM	1	153	41	3	2	0	1	2	0	80	0	2	1	1	157	1	3	0	0	1	449
04:45 PM	2	175	34	1	1	0	0	1	0	65	0	1	2	0	279	1	6	1	0	1	570
Total	7	654	138	6	7	0	2	4	0	264	0	4	6	1	693	3	16	2	0	2	1809
05:00 PM	1	168	39	2	6	0	2	1	1	53	0	2	1	2	230	2	5	0	0	0	515
05:15 PM	2	166	18	0	6	0	1	0	0	49	0	0	0	0	215	4	3	2	0	0	466
05:30 PM	1	146	24	1	1	0	0	0	0	49	0	0	0	0	151	2	3	0	0	0	378
05:45 PM	3	139	27	0	2	0	0	0	0	41	0	0	0	0	124	3	2	0	0	0	341
Total	7	619	108	3	15	0	3	1	1	192	0	2	1	2	720	11	13	2	0	0	1700
Grand Total	14	1273	246	9	22	0	5	5	1	456	0	6	7	3	1413	14	29	4	0	2	3509
Apprch %	0.9	82.6	16.0	0.6	68.8	0.0	15.6	15.6	0.2	98.5	0.0	1.3	0.5	0.2	98.3	1.0	82.9	11.4	0.0	5.7	
Total %	0.4	36.3	7.0	0.3	0.6	0.0	0.1	0.1	0.0	13.0	0.0	0.2	0.2	0.1	40.3	0.4	0.8	0.1	0.0	0.1	

	Forest Avenue (Route 100/302) From North					Adelaide Street From Northeast					Read Street From East					Forest Avenue (Route 100/302) From South					Parking Lot From West					
Start Time	Right	Thru	Left	Hard Left	App. Total	Hard Right	Bear Right	Bear Left	Hard Left	App. Total	Hard Right	Right	Thru	Left	App. Total	Right	Bear Right	Thru	Left	App. Total	Right	Thru	Bear Left	Left	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																										
Intersection	04:30 PM																									
Volume	6	662	132	6	806	15	0	4	4	23	1	247	0	5	253	4	3	881	8	896	17	3	0	2	22	2000
Percent	0.7	82.1	16.4	0.7		65.2	0.0	17.4	17.4		0.4	97.6	0.0	2.0		0.4	0.3	98.3	0.9		77.3	13.6	0.0	9.1		
04:45 Volume	2	175	34	1	212	1	0	0	1	2	0	65	0	1	66	2	0	279	1	282	6	1	0	1	8	570
Peak Factor																										0.877
High Int.	04:45 PM					05:00 PM					04:30 PM					04:45 PM					04:45 PM					
Volume	2	175	34	1	212	6	0	2	1	9	0	80	0	2	82	2	0	279	1	282	6	1	0	1	8	
Peak Factor					0.950					0.639					0.771					0.794					0.688	

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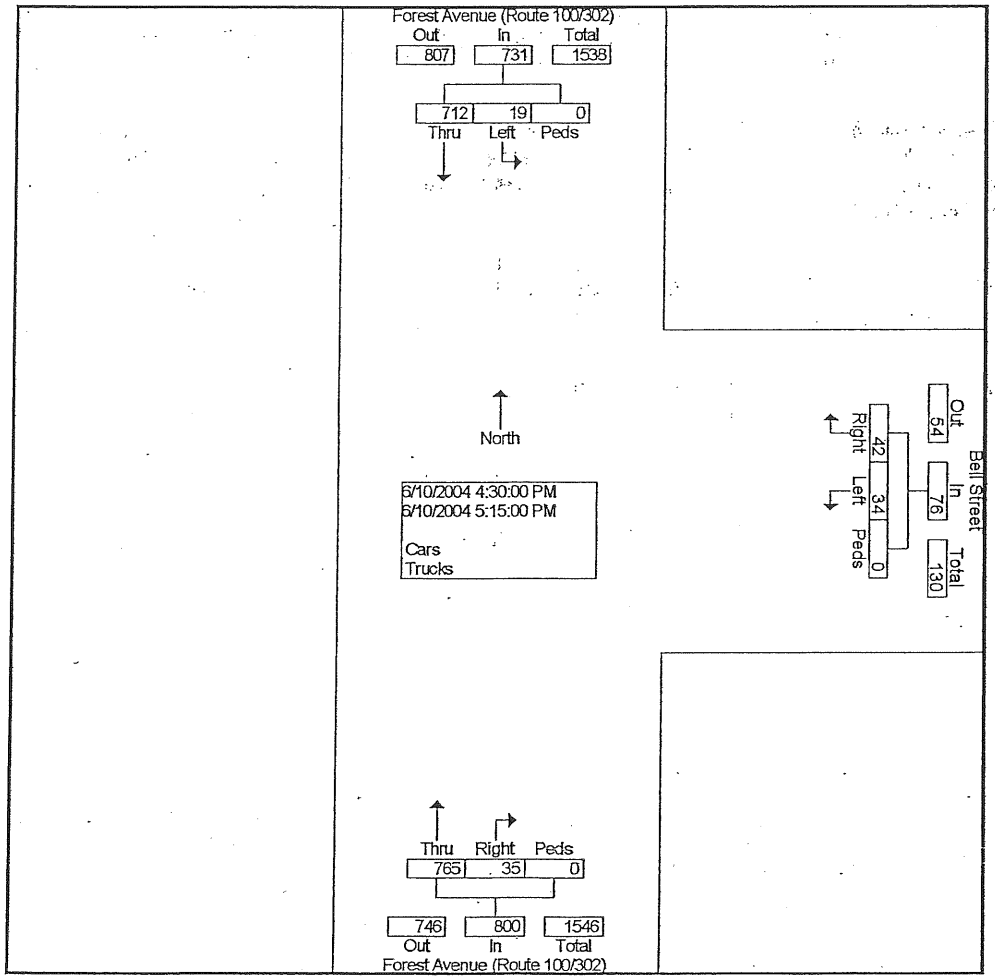
N/S: Forest Avenue (Route 100/302)
E: Bell Street
City: State: Portland, ME
Client: VHB/J. Quitter

File Name : 03012AA
Site Code : 00007334
Start Date : 6/10/2004
Page No : 1

	Forest Avenue (Route 100/302) From North					Bell Street From East					Forest Avenue (Route 100/302) From South					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																
Intersection	04:30 PM															
Volume	0	712	19	0	731	42	0	34	0	76	35	765	0	0	800	1607
Percent	0.0	97.4	2.6	0.0		55.3	0.0	44.7	0.0		4.4	95.6	0.0	0.0		
04:45 Volume	0	184	4	0	188	13	0	4	0	17	5	225	0	0	230	435
Peak Factor																0.924
High Int.	04:30 PM					05:15 PM					04:45 PM					
Volume	0	180	8	0	188	13	0	12	0	25	5	225	0	0	230	
Peak Factor					0.972					0.760					0.870	



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N/S: Forest Avenue (Route 100/302)
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State: Portland, ME
Client: VHB/J. Quitter

File Name : 03012AA
Site Code : 00007334
Start Date : 6/10/2004
Page No : 1

Groups Printed- Cars

	Forest Avenue (Route 100/302) From North				Bell Street From East				Forest Avenue (Route 100/302) From South				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
04:00 PM	0	164	6	0	5	0	7	0	6	115	0	0	303
04:15 PM	0	184	3	0	7	0	9	0	6	124	0	0	333
04:30 PM	0	177	8	0	4	0	10	0	9	138	0	0	346
04:45 PM	0	183	4	0	12	0	4	0	5	224	0	0	432
Total	0	708	21	0	28	0	30	0	26	601	0	0	1414
05:00 PM	0	174	4	0	11	0	8	0	10	206	0	0	413
05:15 PM	0	171	2	0	13	0	12	0	10	194	0	0	402
05:30 PM	0	153	3	0	6	0	7	0	4	166	0	0	339
05:45 PM	0	142	5	0	7	0	7	0	6	147	0	0	314
Total	0	640	14	0	37	0	34	0	30	713	0	0	1468
Grand Total	0	1348	35	0	65	0	64	0	56	1314	0	0	2882
Apprch %	0.0	97.5	2.5	0.0	50.4	0.0	49.6	0.0	4.1	95.9	0.0	0.0	
Total %	0.0	46.8	1.2	0.0	2.3	0.0	2.2	0.0	1.9	45.6	0.0	0.0	

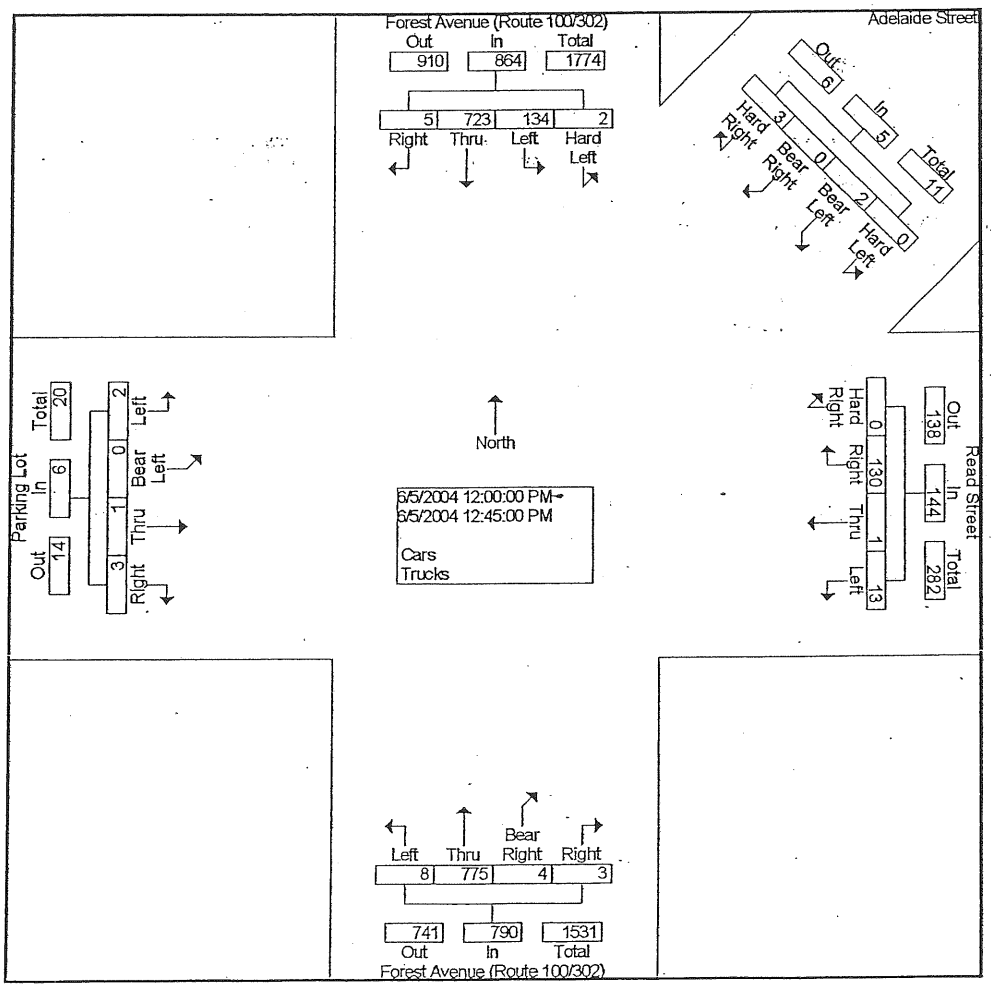
	Forest Avenue (Route 100/302) From North					Bell Street From East					Forest Avenue (Route 100/302) From South					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																
Intersection	04:30 PM															
Volume	0	705	18	0	723	40	0	34	0	74	34	762	0	0	796	1593
Percent	0.0	97.5	2.5	0.0		54.1	0.0	45.9	0.0		4.3	95.7	0.0	0.0		
04:45 Volume	0	183	4	0	187	12	0	4	0	16	5	224	0	0	229	432
Peak Factor																0.922
High Int.	04:45 PM					05:15 PM					04:45 PM					
Volume	0	183	4	0	187	13	0	12	0	25	5	224	0	0	229	
Peak Factor					0.967					0.740					0.869	

TDC
Transportation Data Corporation
P.O. Box 734 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

N/S/NE: Forest Avenue/Adelaide Street
E/W: Read Street/Parking Lot
City/State: Portland, ME
Client: VHB/J. Quitter

File Name : 03012BBB
Site Code : 00007334
Start Date : 6/5/2004
Page No : 1

	Forest Avenue (Route 100/302) From North					Adelaide Street From Northeast					Read Street From East					Forest Avenue (Route 100/302) From South					Parking Lot From West					
Start Time	Right	Thru	Left	Hard Left	App. Total	Hard Right	Bear Right	Bear Left	Hard Left	App. Total	Hard Right	Right	Thru	Left	App. Total	Right	Bear Right	Thru	Left	App. Total	Right	Thru	Bear Left	Left	App. Total	Int. Total
Peak Hour From 11:00 AM to 01:45 PM - Peak 1 of 1																										
Intersection	12:00 PM																									
Volume	5	723	134	2	864	3	0	2	0	5	0	130	1	13	144	3	4	775	8	790	3	1	0	2	6	1809
Percent	0.6	83.7	15.5	0.2		60.0	0.0	40.0	0.0		0.0	90.3	0.7	9.0		0.4	0.5	98.1	1.0		50.0	16.7	0.0	33.3		
12:30 Volume	2	187	40	0	229	0	0	1	0	1	0	40	0	4	44	2	1	194	0	197	0	0	0	1	1	472
Peak Factor																										0.958
High Int.	12:45 PM					12:00 PM					12:30 PM					12:00 PM					12:45 PM					
Volume	1	203	32	0	236	2	0	0	0	2	0	40	0	4	44	0	0	204	2	206	2	1	0	0	3	
Peak Factor					0.915					0.625					0.818					0.959					0.500	



TDC
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Office: 508-651-1610 Fax: 508-651-1229

N/S/NE: Forest Avenue/Adelaide Street
E/W: Read Street/Parking Lot
City, State: Portland, ME
Client: VHB/J. Quitter

File Name : 03012BBB
Site Code : 00007334
Start Date : 6/5/2004
Page No : 1

Groups Printed- Cars

	Forest Avenue (Route 100/302) From North				Adelaide Street From Northeast				Read Street From East				Forest Avenue (Route 100/302) From South				Parking Lot From West				
Start Time	Right	Thru	Left	Hard Left	Hard Right	Bear Right	Bear Left	Hard Left	Hard Right	Right	Thru	Left	Right	Bear Right	Thru	Left	Right	Thru	Bear Left	Left	Int. Total
11:00 AM	0	142	23	0	1	0	0	0	0	25	0	2	0	1	137	0	0	0	0	1	332
11:15 AM	0	158	28	0	1	1	0	0	0	27	0	2	2	2	164	1	1	1	0	1	389
11:30 AM	1	177	26	0	2	0	1	1	0	40	1	1	0	1	199	2	1	0	0	2	455
11:45 AM	0	154	34	1	1	0	0	0	0	36	0	0	1	0	192	1	2	0	0	1	423
Total	1	631	111	1	5	1	1	1	0	128	1	5	3	4	692	4	4	1	0	5	1599
12:00 PM	2	188	28	1	2	0	0	0	0	24	0	4	0	0	201	2	0	0	0	0	452
12:15 PM	0	142	34	1	1	0	0	0	0	40	1	1	1	0	192	3	1	0	0	1	418
12:30 PM	2	186	40	0	0	0	1	0	0	40	0	4	2	1	193	0	0	0	0	1	470
12:45 PM	1	201	32	0	0	0	1	0	0	25	0	4	0	3	184	3	2	1	0	0	457
Total	5	717	134	2	3	0	2	0	0	129	1	13	3	4	770	8	3	1	0	2	1797
01:00 PM	2	189	29	0	0	0	0	0	0	33	1	4	1	0	165	2	0	1	1	1	429
01:15 PM	1	198	28	0	0	0	0	0	0	25	0	0	0	0	156	0	2	0	0	0	410
01:30 PM	2	175	41	0	0	0	0	0	0	31	2	0	2	0	152	0	0	1	0	1	407
01:45 PM	2	172	28	0	2	0	1	0	0	26	0	0	2	1	166	1	0	1	0	1	403
Total	7	734	126	0	2	0	1	0	0	115	3	4	5	1	639	3	2	3	1	3	1649
Grand Total	13	2082	371	3	10	1	4	1	0	372	5	22	11	9	2101	15	9	5	1	10	5045
Apprch %	0.5	84.3	15.0	0.1	62.5	6.3	25.0	6.3	0.0	93.2	1.3	5.5	0.5	0.4	98.4	0.7	36.0	20.0	4.0	40.0	
Total %	0.3	41.3	7.4	0.1	0.2	0.0	0.1	0.0	0.0	7.4	0.1	0.4	0.2	0.2	41.6	0.3	0.2	0.1	0.0	0.2	

	Forest Avenue (Route 100/302) From North					Adelaide Street From Northeast					Read Street From East					Forest Avenue (Route 100/302) From South					Parking Lot From West					
Start Time	Right	Thru	Left	Hard Left	App. Total	Hard Right	Bear Right	Bear Left	Hard Left	App. Total	Hard Right	Right	Thru	Left	App. Total	Right	Bear Right	Thru	Left	App. Total	Right	Thru	Bear Left	Left	App. Total	Int. Total
Peak Hour From 11:00 AM to 01:45 PM - Peak 1 of 1																										
Intersection	12:00 PM																									
Volume	5	717	134	2	858	3	0	2	0	5	0	129	1	13	143	3	4	770	8	785	3	1	0	2	6	1797
Percent	0.6	83.6	15.6	0.2		60.0	0.0	40.0	0.0		0.0	90.2	0.7	9.1		0.4	0.5	98.1	1.0		50.0	16.7	0.0	33.3		
12:30 Volume	2	186	40	0	228	0	0	1	0	1	0	40	0	4	44	2	1	193	0	196	0	0	0	1	1	470
Peak Factor																										0.956
High Int.	12:45 PM					12:00 PM					12:30 PM					12:00 PM					12:45 PM					
Volume	1	201	32	0	234	2	0	0	0	2	0	40	0	4	44	0	0	201	2	203	2	1	0	0	3	
Peak Factor					0.917					0.625					0.813					0.967					0.500	

TDC
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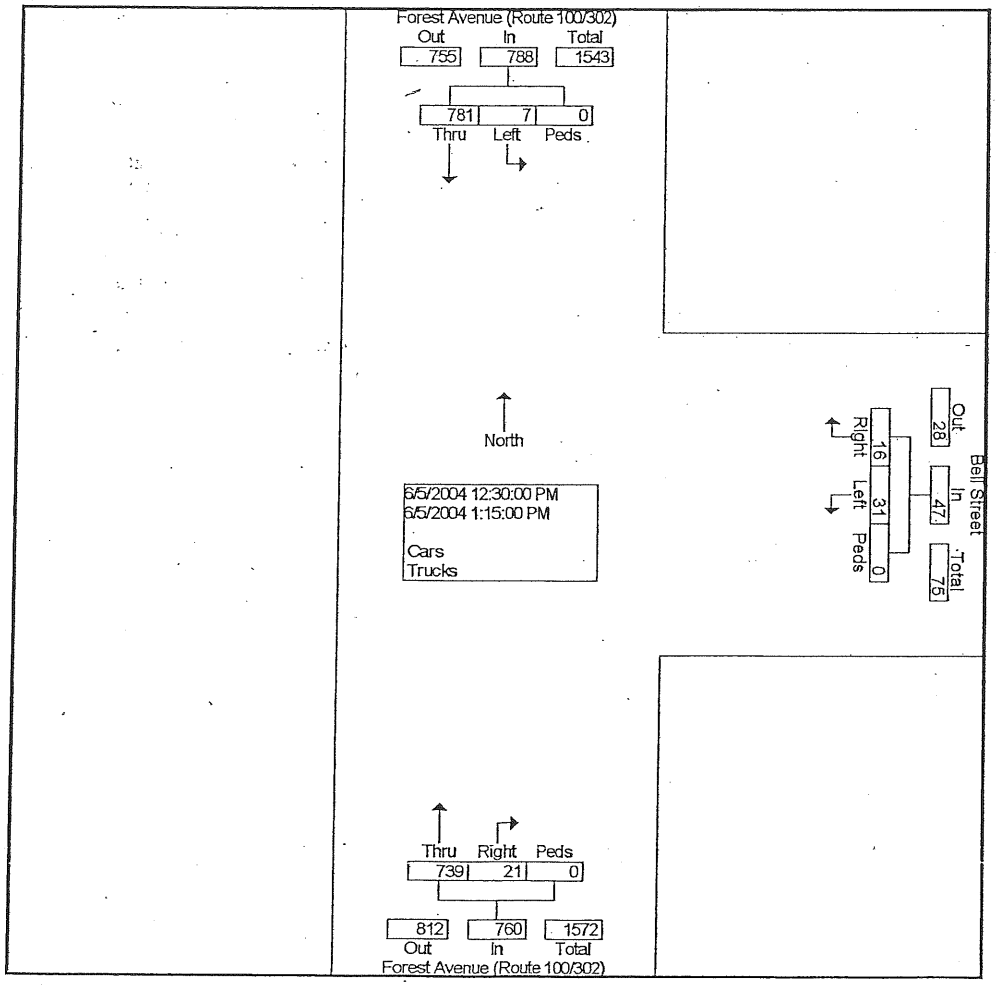
N/S: Forest Avenue (Route 100/302)
E/W: Bell Street
City/State: Portland, ME
Client: VHB/J. Quitter

File Name : 03012AAA
Site Code : 00007334
Start Date : 6/5/2004
Page No : 1

	Forest Avenue (Route 100/302) From North					Bell Street From East					Forest Avenue (Route 100/302) From South					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 11:00 AM to 01:45 PM - Peak 1 of 1																
Intersection	12:30 PM															
Volume	0	781	7	0	788	16	0	31	0	47	21	739	0	0	760	1595
Percent	0.0	99.1	0.9	0.0		34.0	0.0	66.0	0.0		2.8	97.2	0.0	0.0		
12:45 Volume	0	207	1	0	208	5	0	16	0	21	7	190	0	0	197	426
Peak Factor																0.936
High Int.	12:45 PM					12:45 PM					12:30 PM					
Volume	0	207	1	0	208	5	0	16	0	21	6	201	0	0	207	
Peak Factor					0.947					0.560					0.918	



TDC
Transportation Data Corporation
P.O. Box 734 Natick, MA 01760
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N/S: Forest Avenue (Route 100/302)
E/W: Bell Street
City, State: Portland, ME
Client: VHB/J. Quitter

File Name : 03012AAA
Site Code : 00007334
Start Date : 6/5/2004
Page No : 1

Groups Printed- Cars

	Forest Avenue (Route 100/302) From North				Bell Street From East				Forest Avenue (Route 100/302) From South				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
11:00 AM	0	159	2	0	3	0	5	0	2	145	0	0	316
11:15 AM	0	170	7	0	3	0	5	0	11	174	0	0	370
11:30 AM	0	180	4	0	9	0	8	0	3	187	0	0	391
11:45 AM	0	165	4	0	4	0	7	0	6	189	0	0	375
Total	0	674	17	0	19	0	25	0	22	695	0	0	1452
12:00 PM	0	183	2	0	4	0	4	0	3	191	0	0	387
12:15 PM	0	137	3	0	4	0	8	0	3	187	0	0	342
12:30 PM	0	180	4	0	2	0	1	0	6	200	0	0	393
12:45 PM	0	205	1	0	5	0	16	0	7	190	0	0	424
Total	0	705	10	0	15	0	29	0	19	768	0	0	1546
01:00 PM	0	198	0	0	6	0	5	0	5	181	0	0	395
01:15 PM	0	192	2	0	3	0	9	0	3	162	0	0	371
01:30 PM	0	167	4	0	3	0	5	0	6	152	0	0	337
01:45 PM	0	167	7	0	2	0	5	0	9	174	0	0	364
Total	0	724	13	0	14	0	24	0	23	669	0	0	1467
Grand Total	0	2103	40	0	48	0	78	0	64	2132	0	0	4465
Apprch %	0.0	98.1	1.9	0.0	38.1	0.0	61.9	0.0	2.9	97.1	0.0	0.0	
Total %	0.0	47.1	0.9	0.0	1.1	0.0	1.7	0.0	1.4	47.7	0.0	0.0	

	Forest Avenue (Route 100/302) From North					Bell Street From East					Forest Avenue (Route 100/302) From South					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 11:00 AM to 01:45 PM - Peak 1 of 1																
Intersection	12:30 PM															
Volume	0	775	7	0	782	16	0	31	0	47	21	733	0	0	754	1583
Percent	0.0	99.1	0.9	0.0		34.0	0.0	66.0	0.0		2.8	97.2	0.0	0.0		
12:45 Volume	0	205	1	0	206	5	0	16	0	21	7	190	0	0	197	424
Peak Factor																0.933
High Int.	12:45 PM					12:45 PM					12:30 PM					
Volume	0	205	1	0	206	5	0	16	0	21	6	200	0	0	206	
Peak Factor					0.949					0.560					0.915	

Comment 6

406 Curb Ramps

406.1 General. *Curb ramps* on *accessible* routes shall comply with 406, 405.2 through 405.5, and 405.10.

406.2 Counter Slope. Counter slopes of adjoining gutters and road surfaces immediately adjacent to the *curb ramp* shall not be steeper than 1:20. The adjacent surfaces at transitions at *curb ramps* to *walks*, gutters, and streets shall be at the same level.

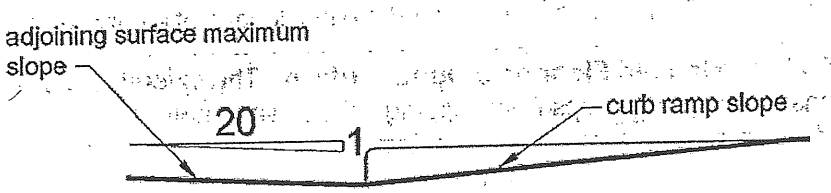


Figure 406.2
Counter Slope of Surfaces Adjacent to Curb Ramps

406.3 Sides of Curb Ramps. Where provided, *curb ramp* flares shall not be steeper than 1:10.

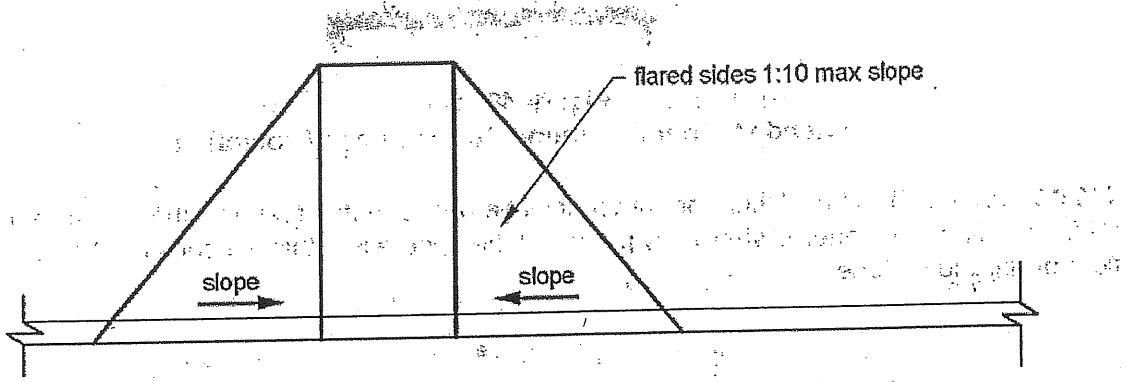


Figure 406.3
Sides of Curb Ramps

406.4 Landings. Landings shall be provided at the tops of *curb ramps*. The landing clear length shall be 36 inches (915 mm) minimum. The landing clear width shall be at least as wide as the *curb ramp*, excluding flared sides, leading to the landing.

EXCEPTION: In *alterations*, where there is no landing at the top of *curb ramps*, *curb ramp* flares shall be provided and shall not be steeper than 1:12.

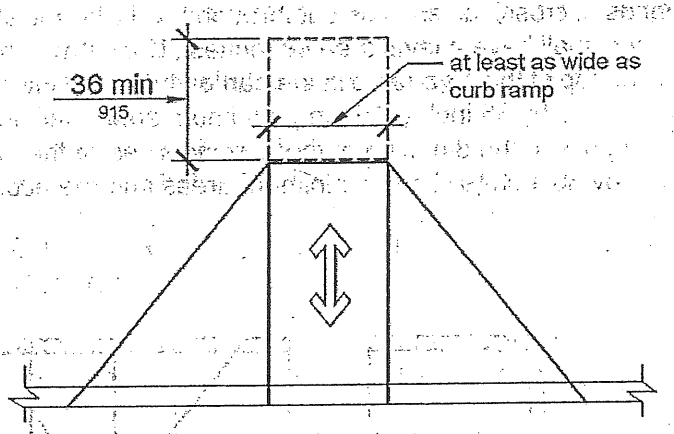


Figure 406.4
Landings at the Top of Curb Ramps

406.5 Location. *Curb ramps* and the flared sides of *curb ramps* shall be located so that they do not project into vehicular traffic lanes, parking *spaces*, or parking access aisles. *Curb ramps* at *marked crossings* shall be wholly contained within the markings, excluding any flared sides.

406.6 Diagonal Curb Ramps. Diagonal or corner type *curb ramps* with returned curbs or other ll-defined edges shall have the edges parallel to the direction of pedestrian flow. The bottom of agonal *curb ramps* shall have a clear *space* 48 inches (1220 mm) minimum outside active traffic lanes of the roadway. Diagonal *curb ramps* provided at *marked crossings* shall provide the 48 inches (1220 mm) minimum clear *space* within the markings. Diagonal *curb ramps* with flared sides shall have a segment of curb 24 inches (610 mm) long minimum located on each side of the *curb ramp* and within the *marked crossing*.

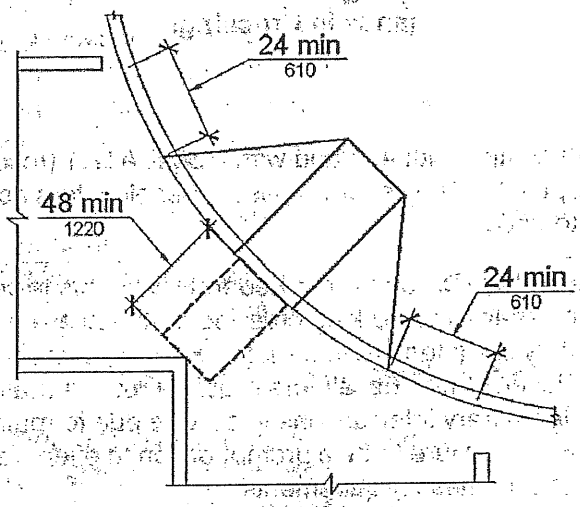


Figure 406.6
Diagonal or Corner Type Curb Ramps

406.7 Islands. Raised islands in crossings shall be cut through level with the street or have *curb ramps* at both sides. Each *curb ramp* shall have a level area 48 inches (1220 mm) long minimum by 36 inches (915 mm) wide minimum at the top of the *curb ramp* in the part of the island intersected by the crossings. Each 48 inch (1220 mm) minimum by 36 inch (915 mm) minimum area shall be oriented so that the 48 inch (1220 mm) minimum length is in the direction of the *running slope* of the *curb ramp* it serves. The 48 inch (1220 mm) minimum by 36 inch (915 mm) minimum areas and the *accessible* route shall be permitted to overlap.

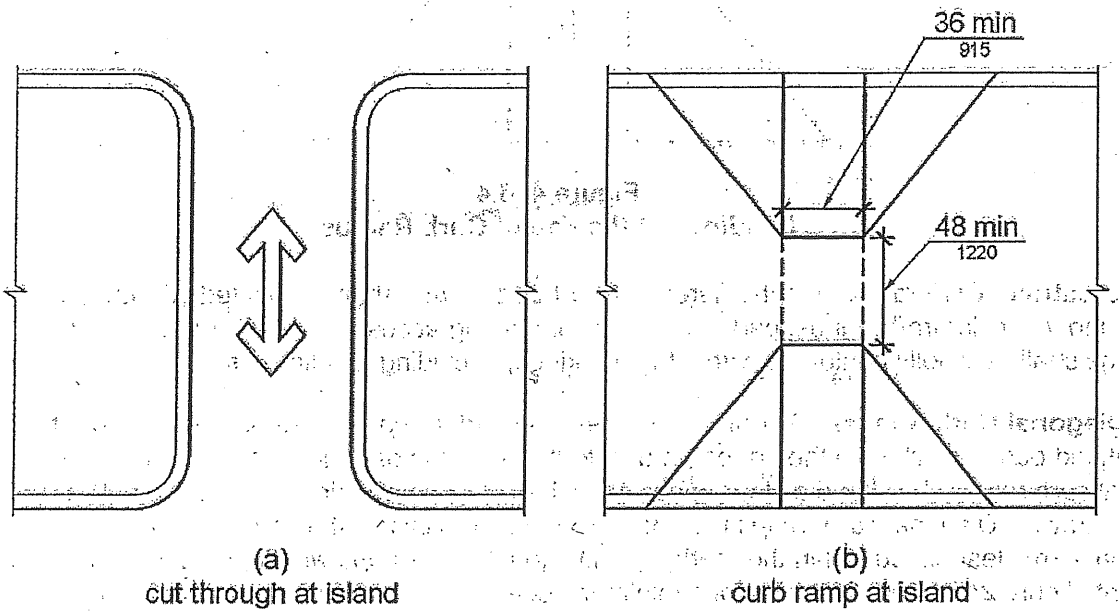


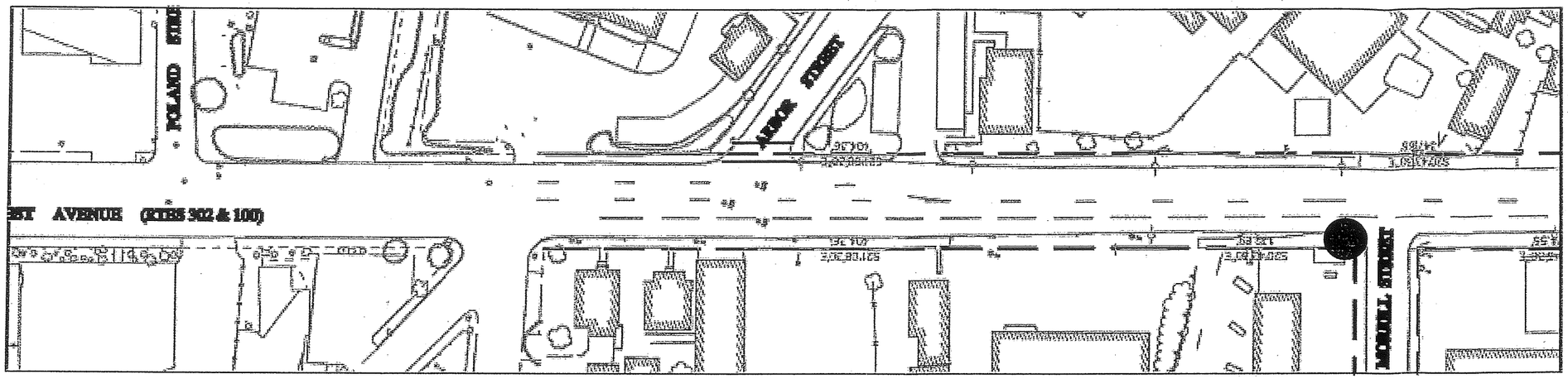
Figure 406.7
Islands in Crossings

407 Elevators

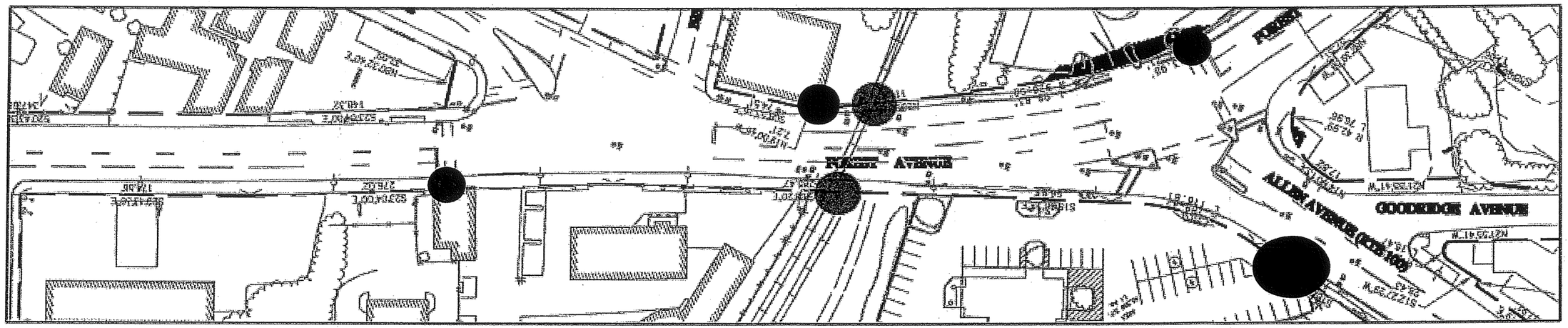
407.1 General. Elevators shall comply with 407 and with ASME A17.1 (incorporated by reference, see "Referenced Standards" in Chapter 1). They shall be passenger elevators as classified by ASME A17.1. Elevator operation shall be automatic.

Advisory 407.1 General: The ADA and other Federal civil rights laws require that accessible features be maintained in working order so that they are accessible to and usable by those people they are intended to benefit. Building owners should note that the ASME Safety Code for Elevators and Escalators requires routine maintenance and inspections. Isolated or temporary interruptions in service due to maintenance or repairs may be unavoidable; however, failure to take prompt action to effect repairs could constitute a violation of Federal laws and these requirements.

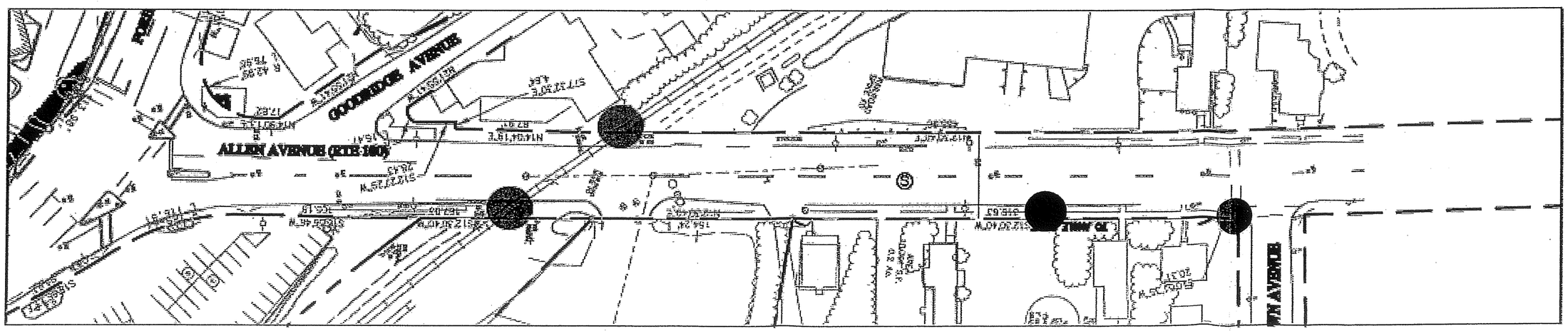
407.2 Elevator Landing Requirements. Elevator landings shall comply with 407.2.



Poland Street to Morrill Street



Morrill Street to Allen Avenue



LEGEND

- Non-ADA Compliant Wheelchair Ramps and Pedestrian Crossings
- Railroad Crossing Non-ADA Compliant
- Sidewalk in Poor Condition
- No Striped Crossing

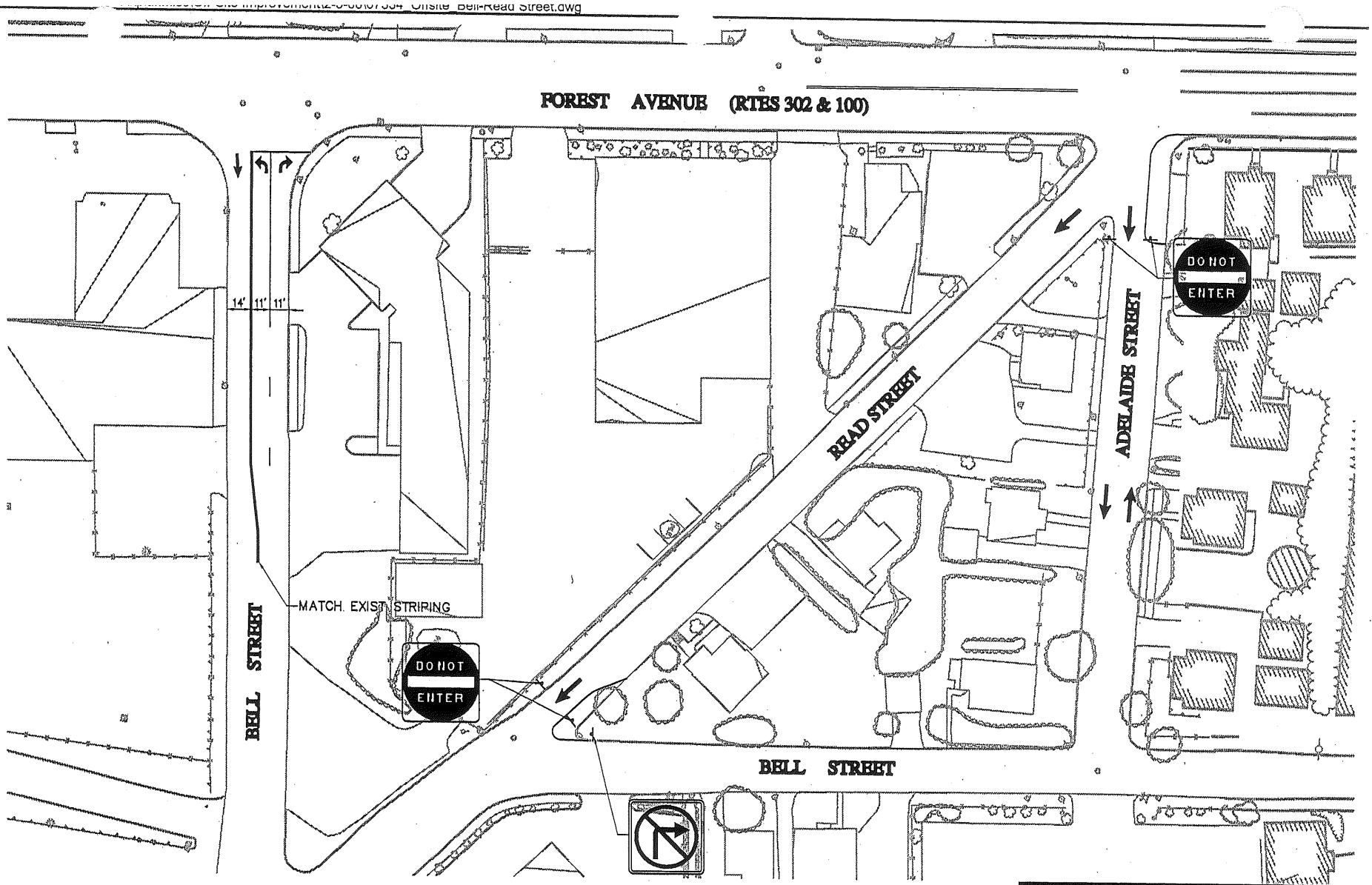
Comment 7

Rail Preemption Log
Morrill's Corner, Portland Maine
Logged by Local Traffic Signal Controller
Forest Avenue at Allen Avenue

Allen Avenue Train Event

Date	Time	Duration (minutes)	
Wed 12/7	9:04 AM	4	
	12:10 PM	2	
	12:34 PM	2	
	12:48 PM	3	
	6:13 PM	1	
Thursday 12/8	9:27 AM	2	
	8:44 PM	4	
Friday 12/9	12:04 PM	4	
	4:08 PM	3	< Occurred during traditional Evening commuter peak ho
	8:11 PM	4	
Saturday 12/10	6:23 AM	3	
	7:54 AM	4	
	8:05 AM	1	
	11:44 AM	3	
	12:14 PM	3	
	3:27 PM	2	
	11:22 PM	2	
Sunday 12/11	9:24 AM	4	
	11:05 AM	3	
	2:52 PM	2	
Monday 12/12	7:44 AM	4	
	12:12 PM	4	
	8:24 PM	3	
Tuesday 12/13	7:24 AM	5	
	12:08 PM	4	
	8:21 PM	4	
	10:24 PM	2	
		3.037037037	<= Average time gates are down.

Comment 8



Vanasse Hangen Brustlin, Inc.

0 40 80 Feet

Proposed Traffic Improvements
Forest Street @ Bell Street and Read Street
Portland, Maine

Comment 12

Trip Rate Comparison – ITE Theoretical vs. Stop & Shop Observed

Data Source	Weekday Daily	Weekday Evening Peak Hour	Saturday Daily	Saturday Midday Peak Hour
ITE Theoretical [a]	86.36	10.01	177.62	10.57
S&S Observed [b]	95.92	8.83	107.10	9.50

a based on ITE LUC 850 (Supermarket – regression) for 71,445 sf of gross floor area. Saturday daily projections are presented as projected by ITE, but include a sample size of only two stores.
b based on empirical data collected at Stop & Shop supermarkets throughout the northeast United States

Trip Generation Comparison – ITE Equations vs. Stop & Shop Empirical Rates

		Supermarket		
Time Period	Movement	ITE [a]	Empirical S&S [b]	Trip Difference [c]
Weekday Daily [d]	Enter	3,085	3,430	-345
	Exit	3,085	3,430	-345
	Total	6,170	6,860	-690
Weekday Evening Design Hour [e]	Enter	365	315	50
	Exit	350	315	35
	Total	715	630	85
Saturday Daily [d]	Enter	6,345	3,825	2,520
	Exit	6,345	3,825	2,520
	Total	12,690	7,650	5,040
Saturday Midday Design Hour [e]	Enter	385	340	45
	Exit	370	340	30
	Total	755	680	75

a based on ITE LUC 850 (Supermarket – regression) for 71,445 sf of gross floor area. Saturday daily projections are presented as projected by ITE, but include a sample size of only two stores.
b based on empirical data collected at Stop & Shop supermarkets throughout the northeast United States
c difference in gross trips
d vehicles per day
e vehicles per hour

Trip Generation
Stop & Shop Supermarket
Stores > 70,000 square feet

LOCATION : Portland, ME
PROJECT # : 07334.00

Weekday Daily

Average Trip Ends vs. 1000 sf of Gross Floor Area			Pass-by Trips vs. New Trips		
avg. rate	1000 sf of area	Trip Ends	Total Trips	Pass-by Trips	New Trips
95.92	71.445	6853			
Distribution	Enter	3427	3427	994	2433
50% enter	Exit	3427	3427	994	2433
50% exit	TOTAL	6853	6853	1987	4866

Saturday Daily

Average Trip Ends vs. 1000 sf of Gross Floor Area			Pass-by Trips vs. New Trips		
avg. rate	1000 sf of area	Trip Ends	Total Trips	Pass-by Trips	New Trips
107.1	71.445	7652			
Distribution	Enter	3826	3826	1110	2716
50% enter	Exit	3826	3826	1110	2716
50% exit	TOTAL	7652	7652	2219	5433

Weekday Evening

Average Trip Ends vs. 1000 sf of Gross Floor Area			Pass-by Trips vs. New Trips		
avg. rate	1000 sf of area	Trip Ends	Total Trips	Pass-by Trips	New Trips
8.83	71.445	631			
Distribution	Enter	315	315	139	177
50% enter	Exit	315	315	139	177
50% exit	TOTAL	631	631	278	353

Saturday Midday

Average Trip Ends vs. 1000 sf of Gross Floor Area			Pass-by Trips vs. New Trips		
avg. rate	1000 sf of area	Trip Ends	Total Trips	Pass-by Trips	New Trips
9.5	71.445	679			
Distribution	Enter	339	339	98	241
50% enter	Exit	339	339	98	241
50% exit	TOTAL	679	679	197	482

STOP & SHOP TRAFFIC COUNTING PROGRAM

SITE LOCATION: **Bristol, Rhode Island**

SQUARE FOOTAGE OF THE SITE

Sales:	63,128
Mezzanine:	12,175
Total Building:	75,303

WEEKDAY DAILY
(Friday April 10, 1994)

	OBSERVED TRIPS	RATE
IN	3,340	44.35
OUT	2,815	37.38
TOTAL	6,155	81.74

SATURDAY DAILY
(Saturday April 11, 1994)

	OBSERVED TRIPS	RATE
IN	4,115	54.65
OUT	3,440	45.68
TOTAL	7,555	100.33

WEEKDAY EVENING PEAK HOUR
OF THE ADJACENT STREET
(Friday April 10, 1994)

	OBSERVED TRIPS	RATE
IN	335	4.45
OUT	260	3.45
TOTAL	595	7.90

SATURDAY MIDDAY PEAK HOUR
OF THE GENERATOR
(Saturday April 11, 1994)

	OBSERVED TRIPS	RATE
IN	365	4.85
OUT	310	4.12
TOTAL	675	8.96

Based on: ATR data collected by Vanasse Hangen Brustlin, Inc.

STOP & SHOP TRAFFIC COUNTING PROGRAM

SITE LOCATION: **Stoughton, Massachusetts**

SQUARE FOOTAGE OF THE SITE:

Sales:	59,987
Mezzanine:	12,500
Total Building:	72,487

WEEKDAY DAILY
(Friday Feb. 4, 1994)

	OBSERVED TRIPS	RATE
IN	3,720	51.32
OUT	3,430	47.32
TOTAL	7,150	98.64

SATURDAY DAILY
(Saturday Feb. 5,1994)

	OBSERVED TRIPS	RATE
IN	3,975	54.84
OUT	3,845	53.04
TOTAL	7,820	107.88

WEEKDAY EVENING PEAK HOUR
OF THE ADJACENT STREET
(Friday Feb.4,1994)

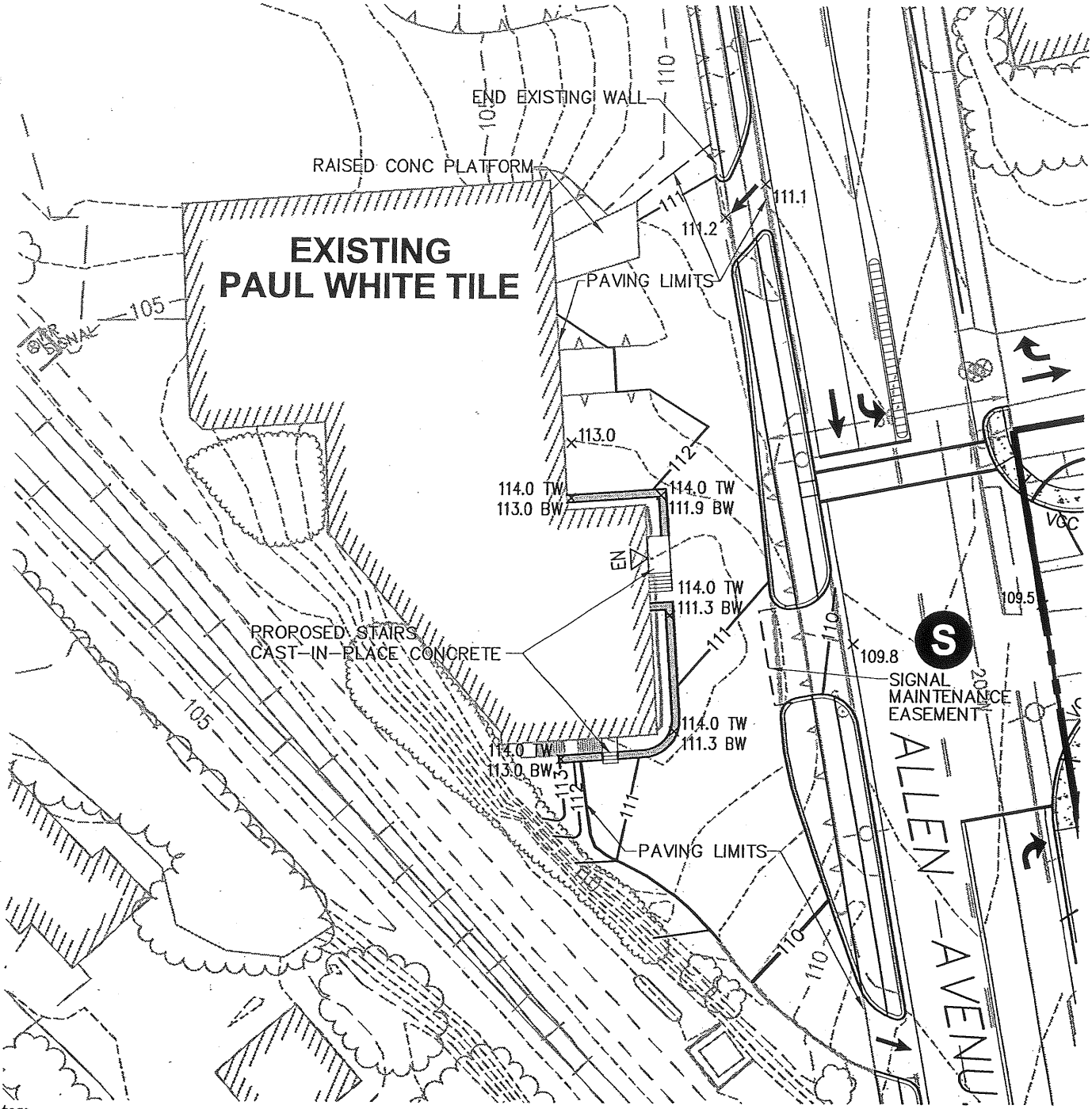
	OBSERVED TRIPS	RATE
IN	320	4.41
OUT	320	4.41
TOTAL	640	8.83

SATURDAY MIDDAY PEAK HOUR
OF THE GENERATOR
(Saturday Feb. 5, 1994)

	OBSERVED TRIPS	RATE
IN	395	5.45
OUT	345	4.76
TOTAL	740	10.21

Based on: ATR Data collected by Robert D. Vanasse and Associates

Comment 17



Notes:

1) THE PAVEMENT SECTIONS WITHIN THE PAVING LIMITS WILL BE 3 INCHES OF BITUMINUOS (1½" SURFACE COURSE OVER 1½" BINDER COURSE) OVER 6 INCHES OF COMPACTED GRAVEL

2) RETAINING WALLS SHALL BE SEGMENTAL BLOCK, WITH A SPLIT-FACE FINISH, AND BE LESS THAN 4 FEET IN HEIGHT

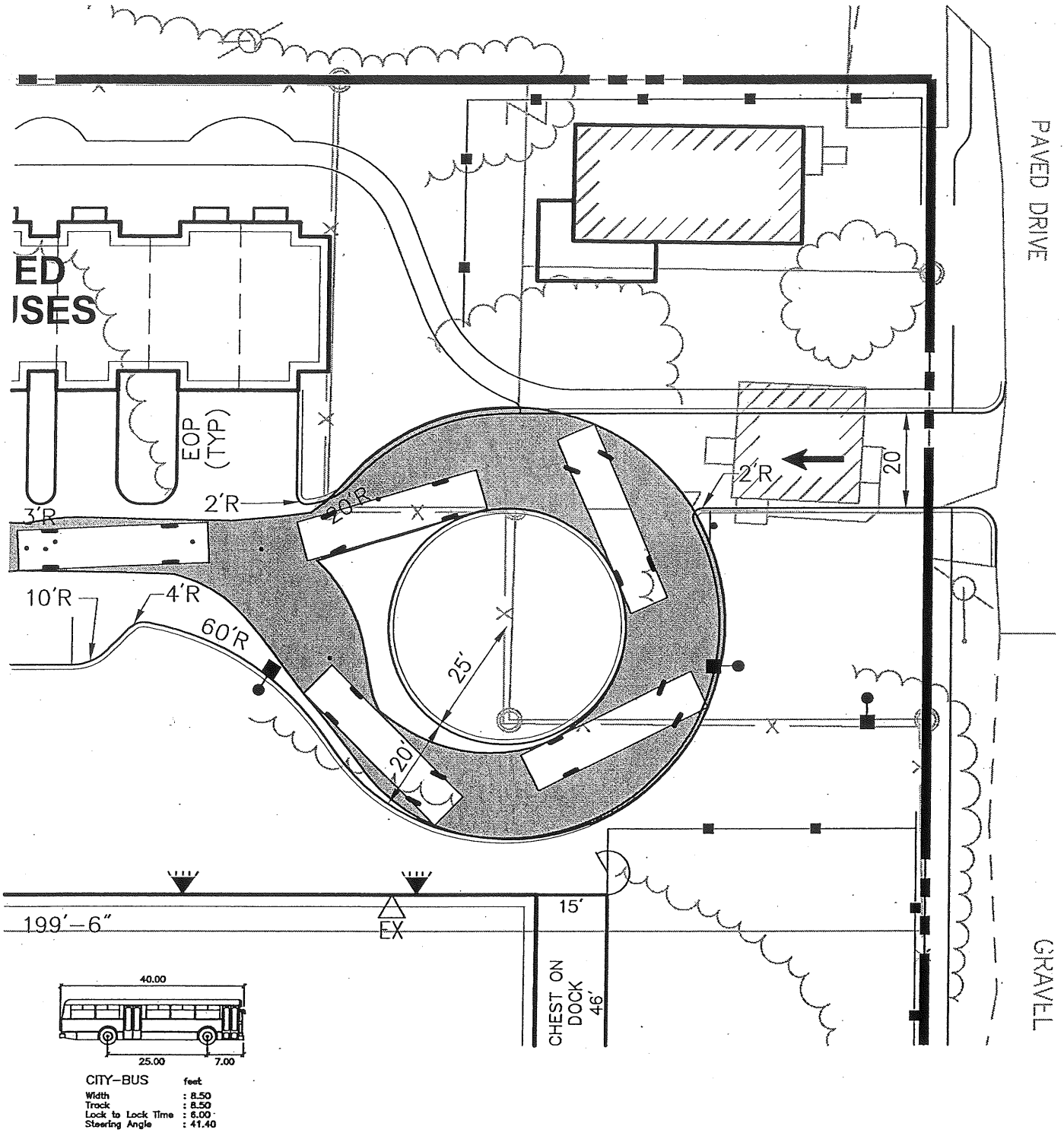
Vanasse Hangen Brustlin, Inc.

Driveway Reconstruction Exhibit
Paul White Tile Property
Morrill's Crossing
Portland, Maine

Comment 17

0 20 40 Feet

Comment 18



Vanasse Hangen Brustlin, Inc.

Bus Route Turning Movement
Townhouse Cul-de-Sac
Morrill's Crossing
Portland, Maine

Comment 18

0 15 30 Feet

Transportation
Land Development
Environmental
Services

VHB Vanasse Hangen Brustlin, Inc.

101 Walnut Street
P. O. Box 9151
Watertown, MA 02471-9151
617 924 1770
FAX 617 924 2286

Memorandum

To: Sarah Hopkins
Development Review Services Manager
Department of Planning & Development
City of Portland
389 Congress Street
Portland, Maine 04101

Date: February 7, 2006

Project No.: 07334.00

From: Robert L. Nagi, PE, PTOE
Principal – Transportation Systems

Re: Morrill's Crossing
Parking Demand

Vanasse Hangen Brustlin, Inc. (VHB) has provided detailed responses to Comments 1-12, 14-18, and 25 from Mr. Thomas A. Errico's January 9, 2006 comment letter on transportation issues. The following memorandum provides a detailed response to Comment 13 on parking demands at the Morrill's Crossing development.

Institute of Transportation Engineers (ITE)

The Traffic Impact and Access Study[1] identified the projected parking generation for the proposed Morrill's Crossing development for typical weekdays and weekends during the peak and non-peak seasons. These parking generation projections were derived from the ITE Parking Generation[2] manual. The results shown in the report indicate that there is an adequate parking supply for the proposed development uses, with the exception of four hours per day on Saturdays and Sundays during the month of December.

While the ITE provides a reasonable assessment of the likely parking demands for the project site, it is limited in that the ITE parking rates calculate cumulative parking space demand by time of day. It does not attempt to model the effects of shared parking throughout the site, as should be with a mixed use development such as Morrill's Crossing.

For reference, the ITE parking section from the TIAS and its accompanying Appendix materials with a tabular breakdown of the parking demand in spaces (not percentage) is attached (TIAS Parking).

Urban Land Institute (ULI)

Since the submission of the November 2005 study, the Urban Land Institute (ULI) published an updated edition of the Shared Parking[3] manual. This manual outlines a more appropriate methodology for determining parking demand for a mixed-use development like Morrill's Crossing, as ULI looks not only at parking demand by land use but also considers shared parking between different land uses.

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[1] Morrill's Crossing – Traffic Impact and Access Study; Portland Maine; Vanasse Hangen Brustlin, Inc. (VHB); November 2005.

[2] Parking Generation; 3rd Edition; Institute of Transportation Engineers (ITE); Washington, DC; 2004.

[3] Shared Parking; 2nd Edition; Urban Land Institute (ULI); Washington, DC; 2005.

Using procedures outlined in the ULI manual, the peak parking demands for the development were estimated. The seasonal variation in the peak parking demand for the project is attached to this memorandum. Clearly, the month of December (Peak Season) has the highest estimated parking demand, with approximately 100 more spaces needed than any other month of the year. The attached graphic also shows that November has the highest demand for the remaining 11 months of the year.

Based on this information, a more detailed review of the parking requirements has been completed for November (assumed to represent the worst case "Non-Peak Season") and December (the "Peak Season"). The detailed parking demand (by spaces) for these uses is included in the attachments.

In reviewing the site plan and understanding how several of the planned uses are anticipated to operate, VHB has assumed that the parking supply and demand for the townhouses, apartments (adjacent to the boxing club), and the boxing club were excluded from these projections. For instance, the townhouse parking (two spaces per unit; one garage space and one driveway space) has not been included in the 666-space total. Also of note, the 34 spaces in the area of the apartments to the rear of the site exceed the demand for these apartments and 25 spaces have been reserved for the boxing club.

Ultimately, the remainder of the on-site parking will be available to all users on the site including the mix of retail, restaurant, and apartments above the retail. The following describes the non-peak season and peak season parking projections for the development according to the ULI procedures:

November (Non-Peak Season)

The weekday and weekend hourly (10:00 AM-8:00 PM) parking demand, by use, for the month of November (Non-Peak Season) is attached to this memorandum. The hourly demand in both graphic and tabular form is included. As shown in the attachments, the peak demand of 468 spaces occurs at 2:00 PM on the weekend. Another attached graphic illustrates where parking spaces are provided for each use during the November weekend condition.

December (Peak Season)

The weekday and weekend hourly (10:00 AM-8:00 PM) parking demand, by use, for the month of December (Peak Season) is attached to this memorandum. The hourly demand in both graphic and tabular form is included. As shown in the attachments, the peak demand of 603 spaces occurs at 2:00 PM on the weekend. Another attached graphic illustrates where parking spaces are provided for each use during the December weekend condition.

Recommendation

Based on these findings, Packard has agreed to implement a parking management plan during the peak December season which will require all retail employees to park in designated areas outside of the main parking field. These areas are shown graphically in the attachments. With this parking management plan in place, there will be adequate parking in the primary parking field for the retail, restaurant, supermarket, and apartment users during the peak season. During the remainder of the year, there is adequate parking provided in the primary parking field for customers, residents and employees.

Conclusion

Based on the projections outlined in the ULI's Shared Parking manual as well as the previous ITE information presented in the traffic study, it is clear that adequate parking is provided for the Morrill's Crossing site. For 11 months of the year, a surplus of parking is provided. For the

December Peak Season, adequate parking is provided with the retail employee parking management plan in place.

Copies: City of Portland Planning Board (6 copies)
Tom Errico, Wilbur Smith Associates
Tom Gorrill, Gorrill-Palmer Consulting Engineers, Inc.
Alexander Jaegerman, Planning Division Director
John Peverada, Parking Manager

Attachments

- TIAS Parking
- ULI Seasonal Demand
- ULI November Hourly Demand
- ULI December Hourly Demand

TIAS Parking

On-site Parking Assessment

Under the current proposal, the proposed project will provide 666 parking spaces on site. The following text presents an assessment of the adequacy of the proposed parking supply based on information provided by the Institute of Transportation Engineers (ITE), the Urban Land Institute (ULI), as well as empirical parking data collected at existing Stop & Shop supermarket sites.

ITE Parking Generation

In order to estimate the number of parking spaces required by the proposed redevelopment project, parking generation estimates for the various land uses were derived from the ITE Parking Generation[1] manual using the programmed square footage and/or number of residential units of the buildings under consideration.

In sum, the proposed new development will consist of the following land uses and sizes:

- 65,821-sf supermarket (with an additional 5,624 sf of non-sales mezzanine space)
- 63,765 sf of additional retail
- 23 apartment units
- 20 townhouses
- 2 single-family houses
- 15,462 sf of additional office space
- 15,090 sf of boxing club space (with an additional 11,922 sf of ancillary space)
- 1 multi-purpose field

One of the additional benefits of a mixed use development is the ability of the site amenities to support multiple uses. For example, parking spaces used by retail and office uses generally peak in the middle of the day, while parking demand for the residential users generally peaks in the evening. For this reason, a parking space that is used by an office tenant during the typical work day can be used by a resident of the site during the evening.

For this reason, the temporal parking demands for the various land uses on the site were overlaid to determine the overall peak parking demand

[1] Parking Generation; 3rd Edition; Institute of Transportation Engineers (ITE); Washington, DC; 2004.

Land Use: 850
Supermarket

The following table present the time-of-day distributions of parking demand for all sites that included at least five hours of continuous count data.

Based on Vehicles per 1,000 Sq. ft. GFA	Suburban Weekday		Suburban Saturday		Rural Saturday	
Hour Beginning	Percent of Peak Period	Number of Data Points	Percent of Peak Period	Number of Data Points	Percent of Peak Period	Number of Data Points
12:00–4:00 a.m.	–	0	–	0	–	0
5:00 a.m.	–	0	–	0	–	0
6:00 a.m.	–	0	–	0	–	0
7:00 a.m.	–	0	–	0	–	0
8:00 a.m.	–	0	–	0	–	0
9:00 a.m.	–	0	–	0	64	1
10:00 a.m.	58	2	–	0	83	1
11:00 a.m.	66	2	–	0	80	1
12:00 p.m.	93	4	91	2	85	1
1:00 p.m.	100	4	100	2	93	1
2:00 p.m.	90	4	95	2	96	1
3:00 p.m.	94	4	98	2	100	1
4:00 p.m.	97	4	89	2	93	1
5:00 p.m.	82	5	72	2	99	1
6:00 p.m.	62	4	72	2	96	1
7:00 p.m.	47	1	–	0	81	1
8:00 p.m.	–	0	–	0	–	0
9:00 p.m.	–	0	–	0	–	0
10:00 p.m.	–	0	–	0	–	0
11:00 p.m.	–	0	–	0	–	0

* Subset of database

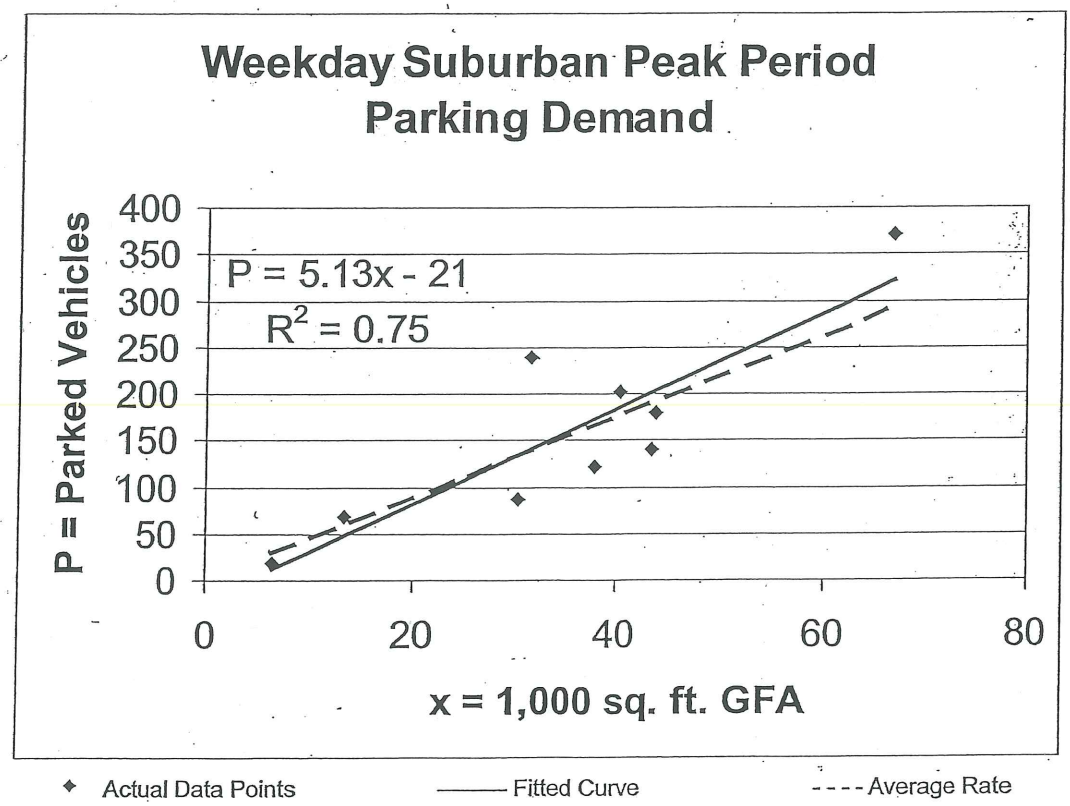
Additional Data

Monthly parking variation cannot be derived from the available data. However, the following supermarket sales information (averaged for the period 1999 through 2003 from the U.S. Census) is provided as a reference to peak month activity. The supermarkets that compose the U.S. Census data set may not have the same land use characteristics as sites contained in the ITE *Parking Generation* database for this land use.

Land Use: 850
Supermarket

Average Peak Period Parking Demand vs: 1,000 sq. ft. GFA
On a: Weekday
Location: Suburban

Statistic	Peak Period Demand
Peak Period	1:00–5:00 p.m.
Number of Study Sites	9
Average Size of Study Sites	35,000 sq. ft. GFA
Average Peak Period Parking Demand	4.36 vehicles per 1,000 sq. ft. GFA
Standard Deviation	1.60
Coefficient of Variation	37%
Range	2.73–7.59 vehicles per 1,000 sq. ft. GFA
85th Percentile	5.45 vehicles per 1,000 sq. ft. GFA
33rd Percentile	3.20 vehicles per 1,000 sq. ft. GFA



Land Use: 820
Shopping Center

The following tables present the time-of-day distributions for parking demand.

December

Hour Beginning	Monday–Thursday		Friday		Saturday	
	Percent of Peak Period	Number of Data Points	Percent of Peak Period	Number of Data Points	Percent of Peak Period	Number of Data Points
12:00–4:00 a.m.	–	0	–	0	–	0
5:00 a.m.	–	0	–	0	–	0
6:00 a.m.	–	0	–	0	–	0
7:00 a.m.	9	1	–	0	–	0
8:00 a.m.	16	1	55	1	–	0
9:00 a.m.	62	4	76	3	–	0
10:00 a.m.	64	5	77	6	78	10
11:00 a.m.	91	7	92	6	94	10
12:00 p.m.	87	5	100	6	100	10
1:00 p.m.	84	9	100	6	93	10
2:00 p.m.	100	9	90	6	95	10
3:00 p.m.	95	10	88	6	94	10
4:00 p.m.	85	7	87	6	87	10
5:00 p.m.	91	8	87	6	81	10
6:00 p.m.	96	6	85	6	69	10
7:00 p.m.	95	6	84	6	–	0
8:00 p.m.	–	0	87	4	–	0
9:00 p.m.	–	0	–	0	–	0
10:00 p.m.	–	0	–	0	–	0
11:00 p.m.	–	0	–	0	–	0

* Subset of database

Non-December

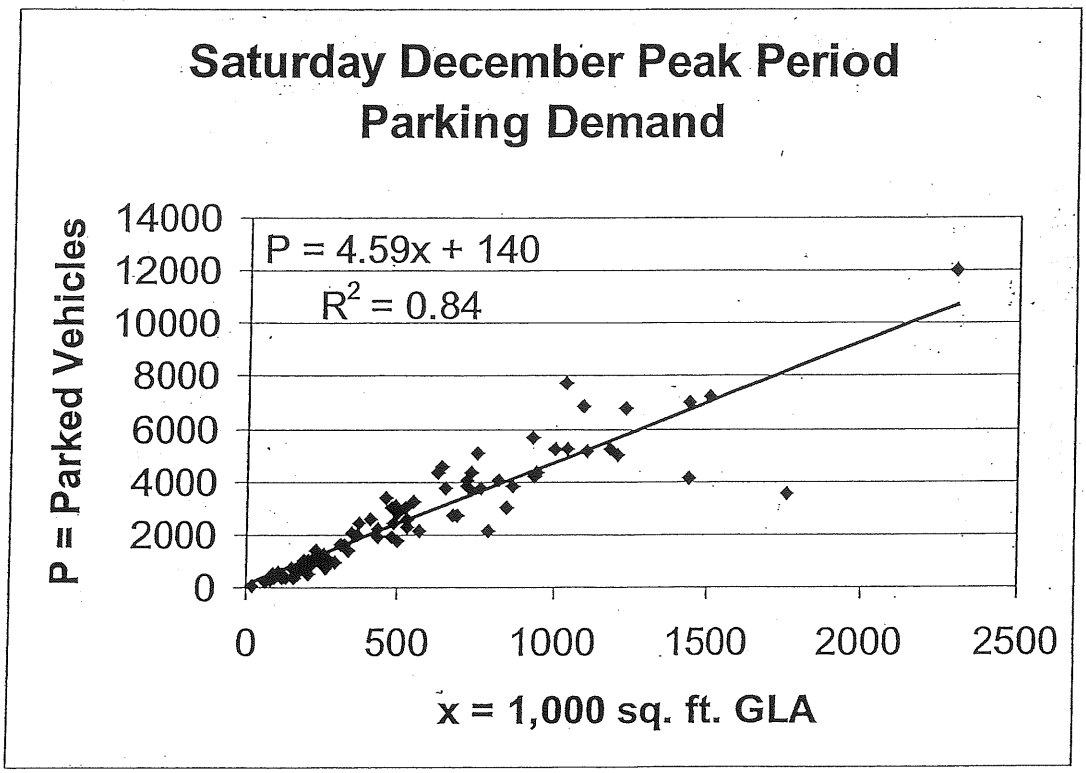
Hour Beginning	Monday–Thursday		Friday		Saturday	
	Percent of Peak Period	Number of Data Points	Percent of Peak Period	Number of Data Points	Percent of Peak Period	Number of Data Points
12:00–4:00 a.m.	–	0	–	0	–	0
5:00 a.m.	–	0	–	0	–	0
6:00 a.m.	–	0	–	0	–	0
7:00 a.m.	5	1	–	0	13	1
8:00 a.m.	18	2	–	0	27	2
9:00 a.m.	38	3	–	0	61	3
10:00 a.m.	53	3	59	5	75	6
11:00 a.m.	86	4	74	6	90	7
12:00 p.m.	100	4	94	7	100	7
1:00 p.m.	98	4	85	8	99	7
2:00 p.m.	91	4	74	8	98	7
3:00 p.m.	86	4	68	8	88	6
4:00 p.m.	81	4	67	8	68	5
5:00 p.m.	57	3	70	7	56	4
6:00 p.m.	69	3	76	7	73	2
7:00 p.m.	82	2	100	3	52	1
8:00 p.m.	70	2	91	3	53	1
9:00 p.m.	42	2	–	0	44	1
10:00 p.m.	10	1	–	0	29	1
11:00 p.m.	–	0	–	0	–	0

* Subset of database

Land Use: 820
Shopping Center

Average Peak Period Parking Demand vs: 1,000 sq. ft. GLA
On a: Saturday (December)

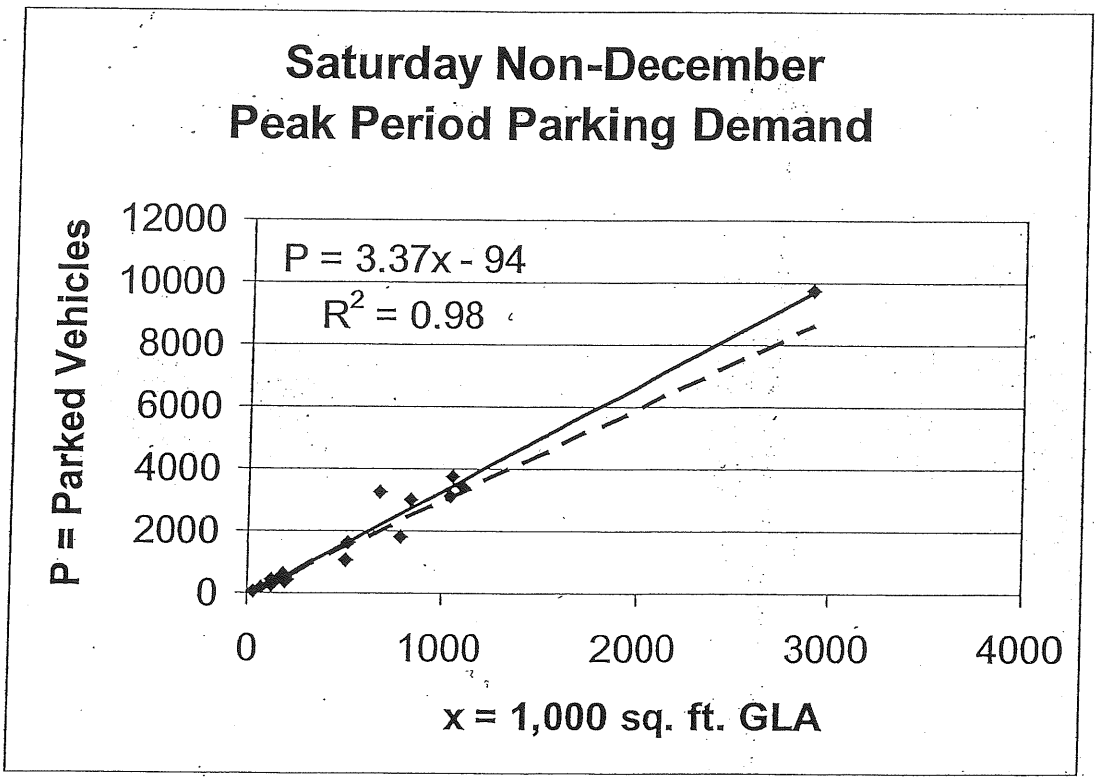
Statistic	Peak Period Demand
Peak Period	11:00 a.m.–6:00 p.m.
Number of Study Sites	82
Average Size of Study Sites	558,000 sq. ft. GLA
Average Peak Period Parking Demand	4.74 vehicles per 1,000 sq. ft. GLA
Standard Deviation	1.19
Coefficient of Variation	25%
95% Confidence Interval	4.48–5.00 vehicles per 1,000 sq. ft. GLA
Range	2.01–7.50 vehicles per 1,000 sq. ft. GLA
85th Percentile	5.92 vehicles per 1,000 sq. ft. GLA
33rd Percentile	4.23 vehicles per 1,000 sq. ft. GLA



Land Use: 820
Shopping Center

Average Peak Period Parking Demand vs: 1,000 sq. ft. GLA
On a: Saturday (Non-December)

Statistic	Peak Period Demand
Peak Period	1:00–2:00 p.m.
Number of Study Sites	20
Average Size of Study Sites	549,000 sq. ft. GLA
Average Peak Period Parking Demand	2.97 vehicles per 1,000 sq. ft. GLA
Standard Deviation	0.71
Coefficient of Variation	24%
95% Confidence Interval	2.66–3.28 vehicles per 1,000 sq. ft. GLA
Range	1.85–4.82 vehicles per 1,000 sq. ft. GLA
85th Percentile	3.56 vehicles per 1,000 sq. ft. GLA
33rd Percentile	2.65 vehicles per 1,000 sq. ft. GLA



Land Use: 932
High-Turnover (Sit-Down) Restaurant

Additional Data

The National Restaurant Association identifies August as the most popular month to eat out and Saturday as the most popular day of the week for dining out.[1]

Monthly parking variation cannot be derived from the available data. However, the following full service restaurant sales information (averaged for the period 1999 through 2003 from the U.S. Census) is provided as a reference to peak month activity. The full service restaurants that compose the U.S. Census data set may not have the same land use characteristics as sites contained in the ITE *Parking Generation* database for this land use.

Full Service Restaurant Sales Variation Data

Month	Percent of Average Month Full Service Restaurant Sales (%)
January	90
February	90
March	101
April	99
May	104
June	103
July	105
August	107
September	98
October	102
November	98
December	103

SOURCE: *Unadjusted and Adjusted Estimates of Monthly Retail and Food Services Sales by Kinds of Business: 1999-2003.* Monthly Retail Service Branch, U.S. Census. August 2004, NAICS Code 722. (www.census.gov/mrts/www/mrts.html)

Study Sites/Years

High-Turnover (Sit-Down) Restaurant without Bar/Lounge (Family Restaurant)

Bossier City, LA (1978); Cupertino, CA (1982); Sunnyvale, CA (1982); Anaheim, CA (1983); Orange, CA (1983); Tustin, CA (1983); Anaheim, CA (1984); Dewitt, NY (1984); Fayetteville, NY (1984); Naugatuck, CT (1984); Syracuse, NY (1984); Waterbury, CT (1984); Glenview, IL (1986); Oklahoma City, OK (1986); Oklahoma City, OK (1987); Syracuse, NY (1987); Syracuse, NY (1988); Seattle, WA (1999); Clearwater, FL (2001); Tampa, FL (2001); Tampa, FL (2002); Carpentersville, IL (2003); Indianapolis, IN (2003); Long Beach, CA (2003); Los Angeles, CA (2003); Mooresville, IN (2003); Oak Lawn, IL (2003); Pasadena, CA (2003); Santa Monica, CA (2003); Springfield, PA (2003); Tampa, CA (2003)

High-Turnover (Sit-Down) Restaurant with Bar/Lounge

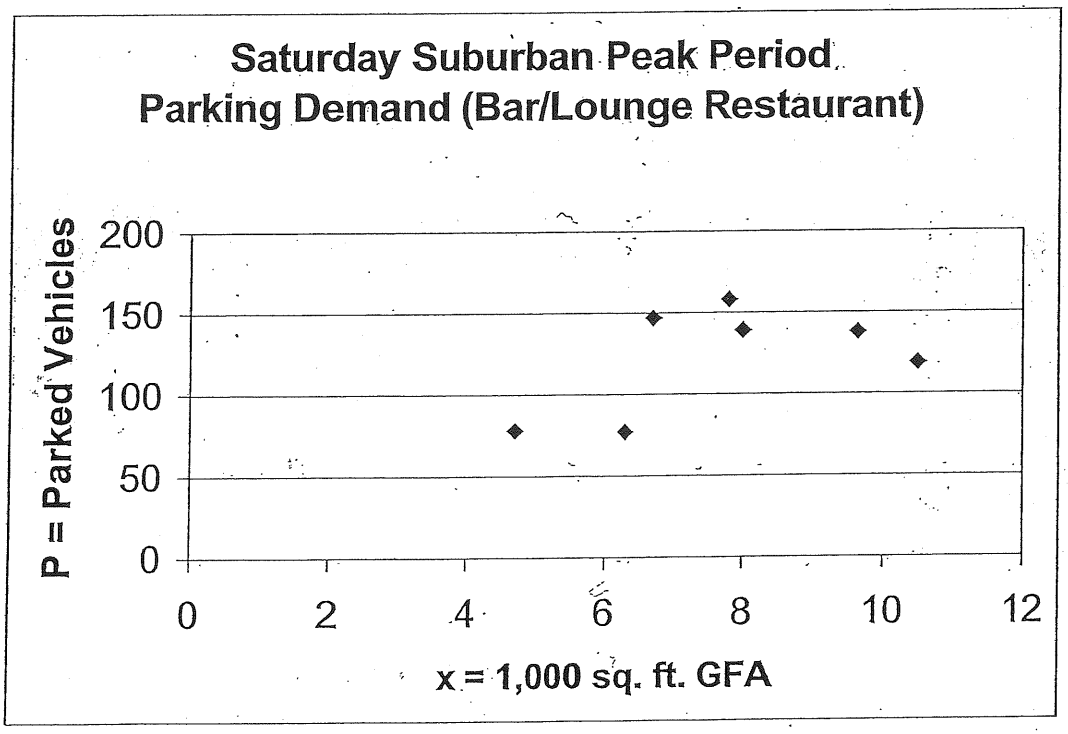
Beaverton, OR (1994); Hillsboro, OR (1994); Lake Oswego, OR (1994); Portland, OR (1994); Tampa, FL (2001, 2002); Los Angeles, CA (2003); Bedford Park, IL (2003); Burbank, CA (2003); Burbank, IL (2003); West Dundee, IL (2003); Greenwood, IN (2003); Indianapolis, IN (2003); Andover, MA (2003); Methuen, MA (2003); West Norriton, PA (2003); Wayne, PA (2003)

[1] National Restaurant Association. www.restaurant.org/faq.cfm

Land Use: 932
High-Turnover (Sit-Down) Restaurant

Average Peak Period Parking Demand vs: 1,000 sq. ft. GFA
On a: Saturday
Land Use Code Subset: Restaurant With Bar or Lounge
Location: Suburban

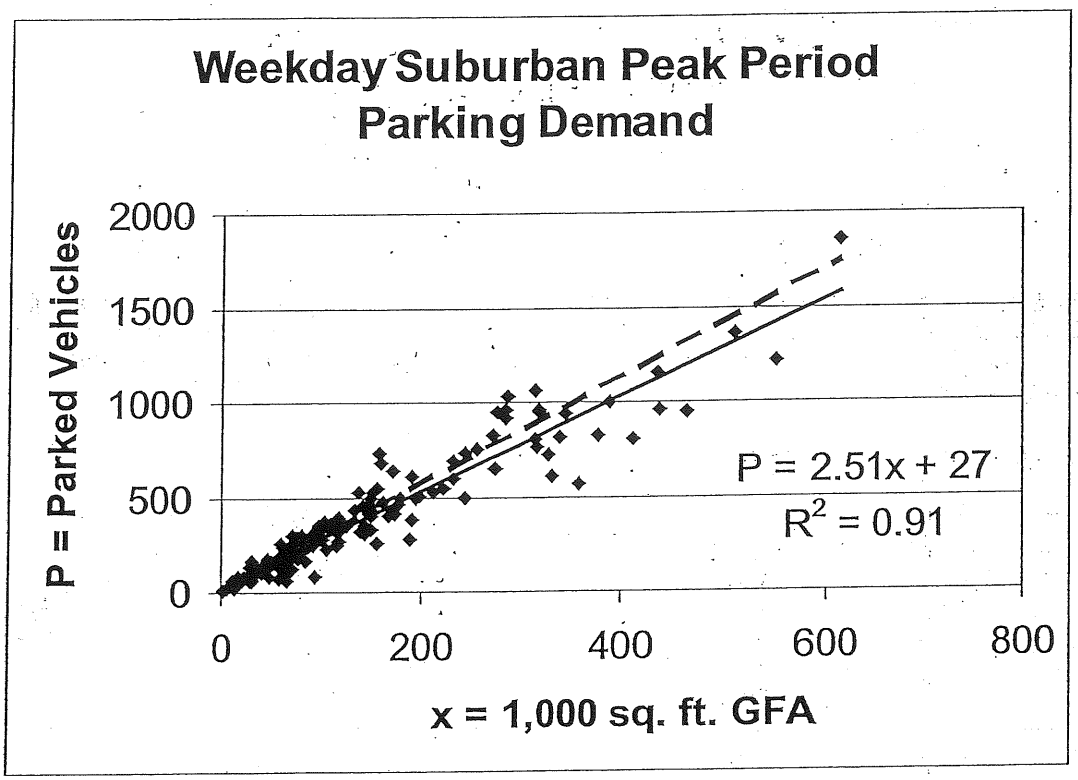
Statistic	Peak Period Demand
Peak Period	6:00–9:00 p.m.
Number of Study Sites	7
Average Size of Study Sites	7,900 sq. ft. GFA
Average Peak Period Parking Demand	16.3 vehicles per 1,000 sq. ft. GFA
Standard Deviation	4.0
Coefficient of Variation	24%
Range	11.3–21.9 vehicles per 1,000 sq. ft. GFA
85th Percentile	20.4 vehicles per 1,000 sq. ft. GFA
33rd Percentile	14.3 vehicles per 1,000 sq. ft. GFA



Land Use: 701
Office Building

Average Peak Period Parking Demand vs: 1,000 sq. ft. GFA
On a: Weekday
Location: Suburban

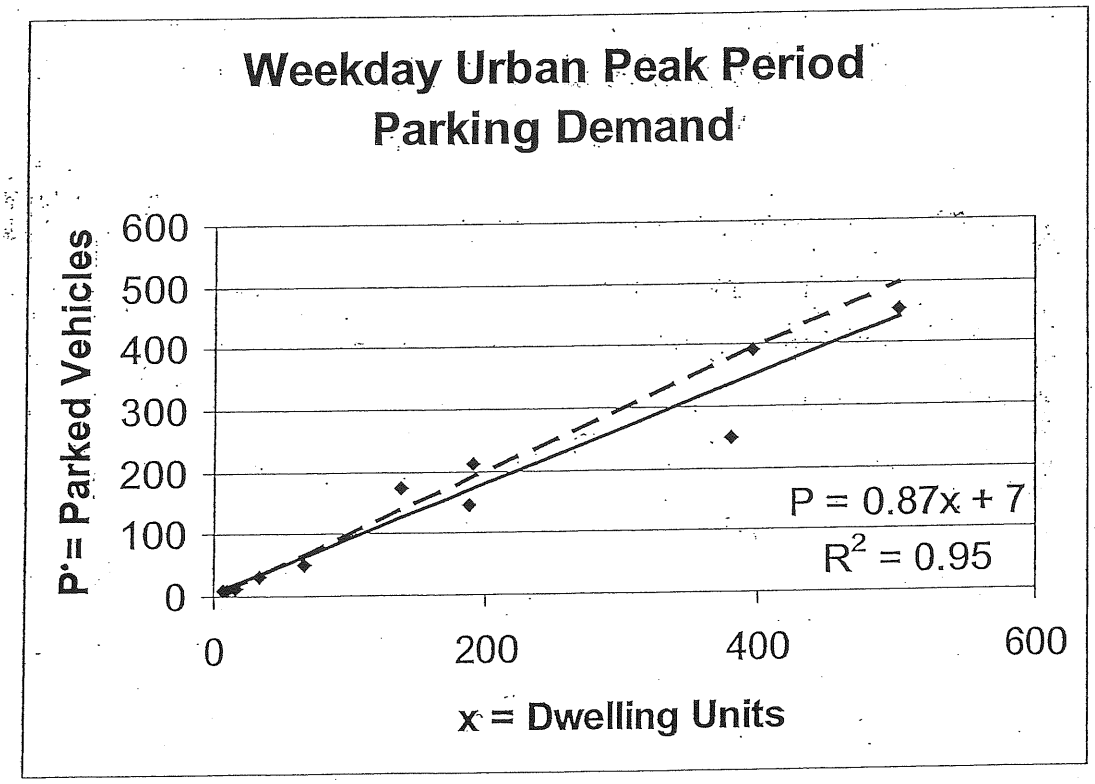
Statistic	Peak Period Demand
Peak Period	9:00 a.m.–12:00 p.m.; 2:00–4:00 p.m.
Number of Study Sites	173
Average Size of Study Sites	136,000 sq. ft. GFA
Average Peak Period Parking Demand	2.84 vehicles per 1,000 sq. ft. GFA
Standard Deviation	0.72
Coefficient of Variation	25%
95% Confidence Interval	2.73–2.95 vehicles per 1,000 sq. ft. GFA
Range	0.86–5.58 vehicles per 1,000 sq. ft. GFA
85th Percentile	3.44 vehicles per 1,000 sq. ft. GFA
33rd Percentile	2.57 vehicles per 1,000 sq. ft. GFA



Land Use: 221
Low/Mid-Rise Apartment

Average Peak Period Parking Demand vs: Dwelling Units
On a: Weekday
Location: Urban

Statistic	Peak Period Demand
Peak Period	9:00 p.m.–5:00 a.m.
Number of Study Sites	12
Average Size of Study Sites	165 dwelling units
Average Peak Period Parking Demand	1.00 vehicles per dwelling unit
Standard Deviation	0.22
Coefficient of Variation	22%
Range	0.66–1.43 vehicles per dwelling unit
85th Percentile	1.17 vehicles per dwelling unit
33rd Percentile	0.92 vehicles per dwelling unit



Land Use: 492
Health/Fitness Club

Land Use Description

Health/fitness clubs are privately owned facilities that primarily focus on individual fitness or training. Typically these clubs provide exercise classes, weightlifting, fitness and gymnastics equipment; spas; locker rooms; and small restaurants or snack bars. This land use may also include small facilities (ancillary to fitness activity) such as swimming pools, whirlpools, saunas, tennis, racquetball and handball courts and limited retail. These facilities are membership clubs that may allow access to the general public for a fee. Racquet/tennis club (Land Use 491), athletic club (Land Use 493) and recreational community center (Land Use 495) are related uses.

Database Description

The database consisted of all suburban sites with the exception of two urban sites. Parking demand rates at the two urban sites were similar to those of the suburban sites and therefore the data were combined and analyzed together.

- Average parking supply ratios: 5.9 spaces per 1,000 sq. ft. GFA (nine study sites) and 0.15 spaces per member (five study sites).
- Average employee density: 0.57 per 1,000 sq. ft. GFA (nine study sites).

The majority of the data were collected during the winter.

Parking demand counts were submitted for only single hour observations between 6:00 and 7:00 p.m. for 14 of the 20 study sites. Multi-hour continuous counts at the other six study sites indicate the peak period was typically in the same hour as the single counts. The following table presents time-of-day distribution of parking demand for the study sites.

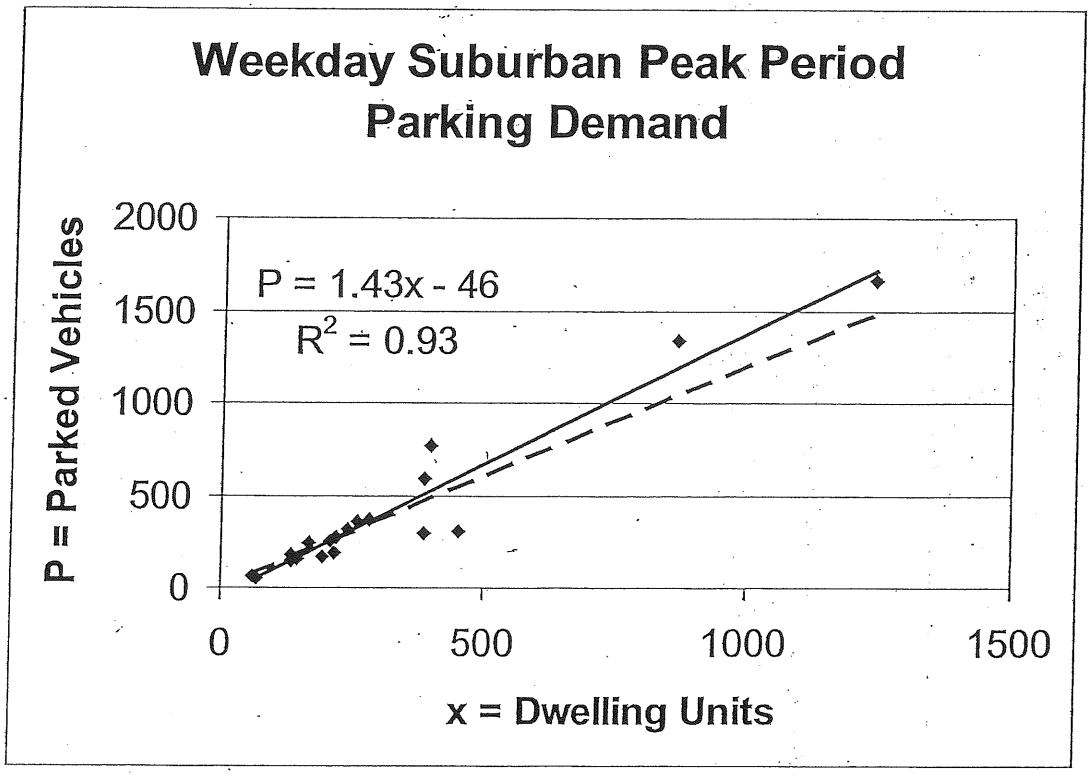
Based on Vehicles per GFA	Weekday Data	
Hour Beginning	Percent of Peak Period	Number of Data Points*
12:00–4:00 a.m.	–	0
5:00 a.m.	–	0
6:00 a.m.	–	0
7:00 a.m.	–	0
8:00 a.m.	–	0
9:00 a.m.	–	0
10:00 a.m.	86	2
11:00 a.m.	71	2
12:00 p.m.	53	2
1:00 p.m.	49	2
2:00 p.m.	42	2
3:00 p.m.	49	2
4:00 p.m.	76	4
5:00 p.m.	88	7
6:00 p.m.	100	20
7:00 p.m.	77	5
8:00 p.m.	62	2
9:00 p.m.	–	0
10:00 p.m.	–	0
11:00 p.m.	–	0

* Subset of database

Land Use: 221
Low/Mid-Rise Apartment

Average Peak Period Parking Demand vs: Dwelling Units
On a: Weekday
Location: Suburban

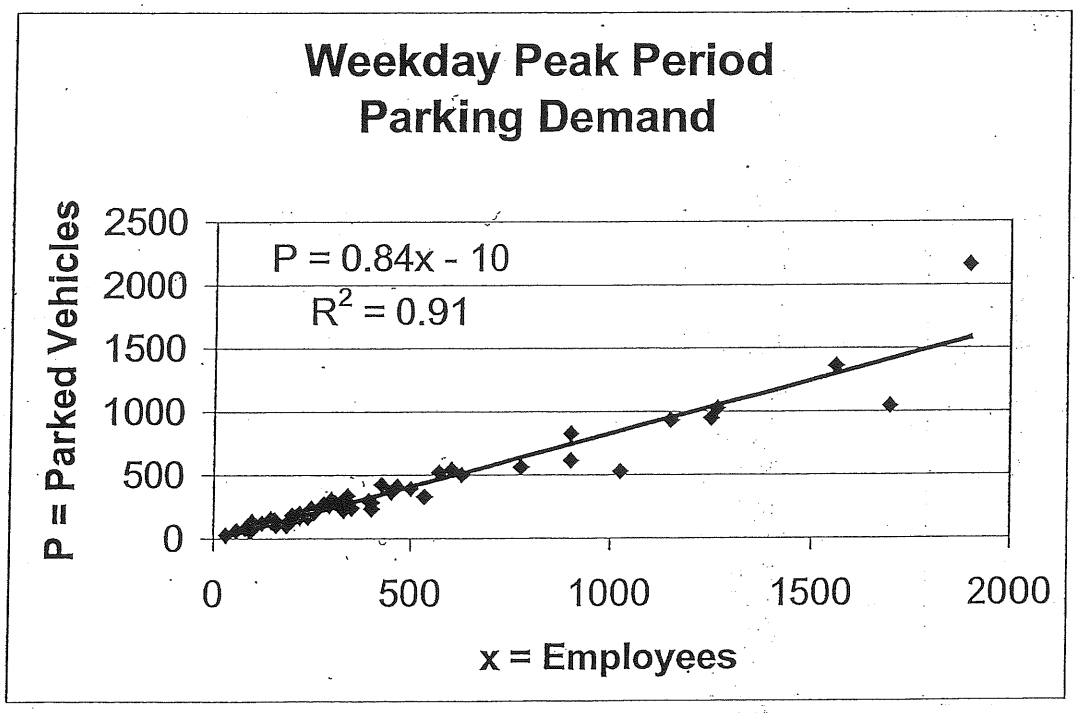
Statistic	Peak Period Demand
Peak Period	12:00–5:00 a.m.
Number of Study Sites	19
Average Size of Study Sites	320 dwelling units
Average Peak Period Parking Demand	1.20 vehicles per dwelling unit
Standard Deviation	0.32
Coefficient of Variation	26%
Range	0.68–1.94 vehicles per dwelling unit
85th Percentile	1.46 vehicles per dwelling unit
33rd Percentile	1.09 vehicles per dwelling unit



Land Use: 701
Office Building

Average Peak Period Parking Demand vs: Employees
On a: Weekday

Statistic	Peak Period Demand
Peak Period	9:00 a.m.–12:00 p.m.; 2:00–4:00 p.m.
Number of Study Sites	58
Average Size of Study Sites	440 employees
Average Peak Period Parking Demand	0.83 vehicles per employee
Standard Deviation	0.16
Coefficient of Variation	19%
95% Confidence Interval	0.79–0.87 vehicles per employee
Range	0.52–1.35 vehicles per employee
85th Percentile	0.98 vehicles per employee
33rd Percentile	0.76 vehicles per employee

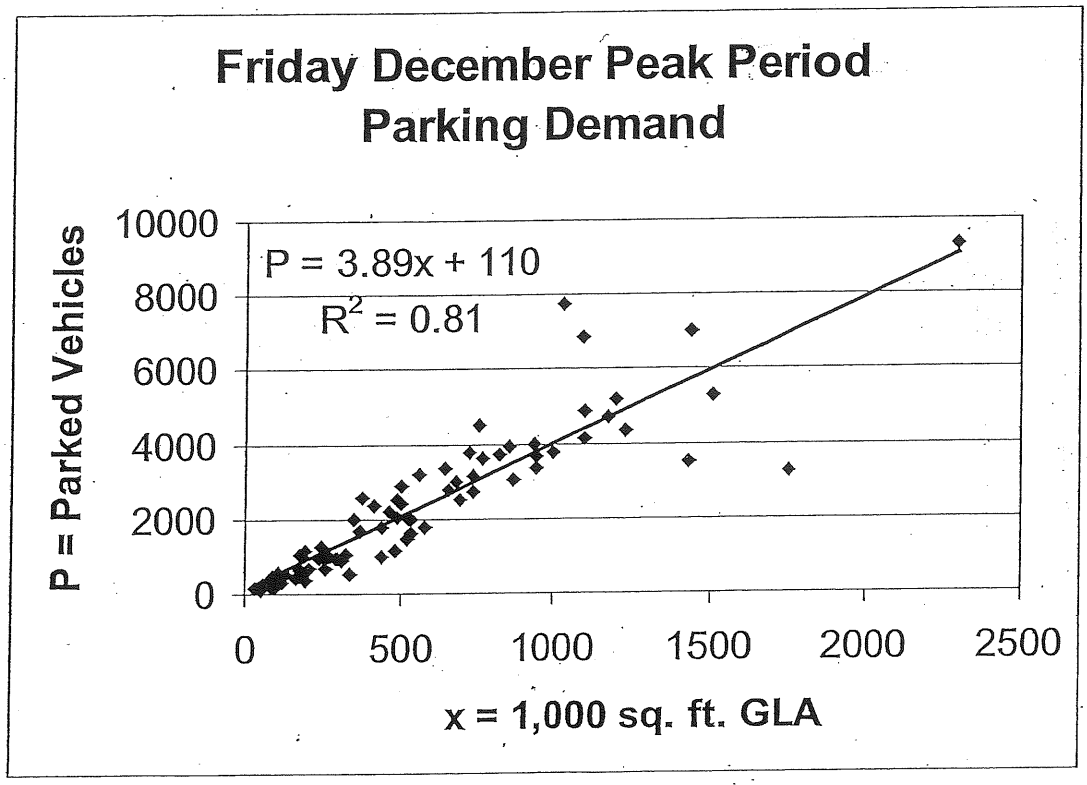


◆ Actual Data Points ——— Fitted Curve/Average Rate

Land Use: 820
Shopping Center

Average Peak Period Parking Demand vs: 1,000 sq. ft. GLA
On a: Friday (December)

Statistic	Peak Period Demand
Peak Period	11:00 a.m.–8:00 p.m.
Number of Study Sites	80
Average Size of Study Sites	533,000 sq. ft. GLA
Average Peak Period Parking Demand	4.01 vehicles per 1,000 sq. ft. GLA
Standard Deviation	1.24
Coefficient of Variation	31%
95% Confidence Interval	3.74–4.28 vehicles per 1,000 sq. ft. GLA
Range	1.47–7.50 vehicles per 1,000 sq. ft. GLA
85th Percentile	5.24 vehicles per 1,000 sq. ft. GLA
33rd Percentile	3.51 vehicles per 1,000 sq. ft. GLA



Morrill's Crossing - Portland, ME
Parking Generation Summary
07334.00

Land Use	ITE Land Use Code		size [ksf/units/members]	Weekday		Saturday	
	Trip Generation	Parking Generation		Average	Seasonal Peak	Average	Seasonal Peak
Retail [a]	820	820	68.057	181	256	203	323
Apartments [b]	220	221	23	23	23	24	24
Townhouses [c]	230	230	20	*0*	*0*	*0*	*0*
Single Family [d]	210	210	2	*0*	*0*	*0*	*0*
Restaurant [e]	932	932	5.472	*n/a* [a]	*n/a* [a]	*n/a* [a]	*n/a* [a]
Office [f]	710	701	19.272	55	55	9	9
Supermarket [g]	850	850	71.445	312	341	340	371
Soccer Field [h]	488	*n/a*	1	23	0	23	0
Boxing Club [i]	492	492	50	7	7	5	5
Total Expected:				601	682	604	732

a - assumed Monday - Thursday as Average; assumed as 62.585 sf of retail and 5.472 sf of restaurant

b - assumed to be urban; average and seasonal peak rates assumed to be the same

c - assumed to self-contain required parking

d - assumed to self-contain required parking

e - Parking Generation refers to High-Turnover (Sit-Down) restaurant and Quiaity restaurant as coincident land uses;
assumed to be in a suburban location, with bar/lounge service; average calculated using table value; peak calculated using month/year data

f - data assumed to be non-seasonal dependent; Saturday rates calculated to be appriximately 16 percent of weekday rates, based on Trip Generation values

g - assumed to be in a suburban location; peak values obtained by determining multiplier for December months; size = 65,821 sales sf + 5,624 non-sales sf

h - assumes 11 players per team, 2 coaches, 2 assistants, 1 referee, and 22 spectators; assumes a 2.1 VOR; average and seasonal peak assumed to be the same

i - assumed to most closely resemble land use code 492 (health/fitness club); average and seasonal peak assumed to be the same
Saturday rates calculated to be appriximately 63 percent of weekday rates, based on Trip Generation values

Weekday - Non-Peak Season

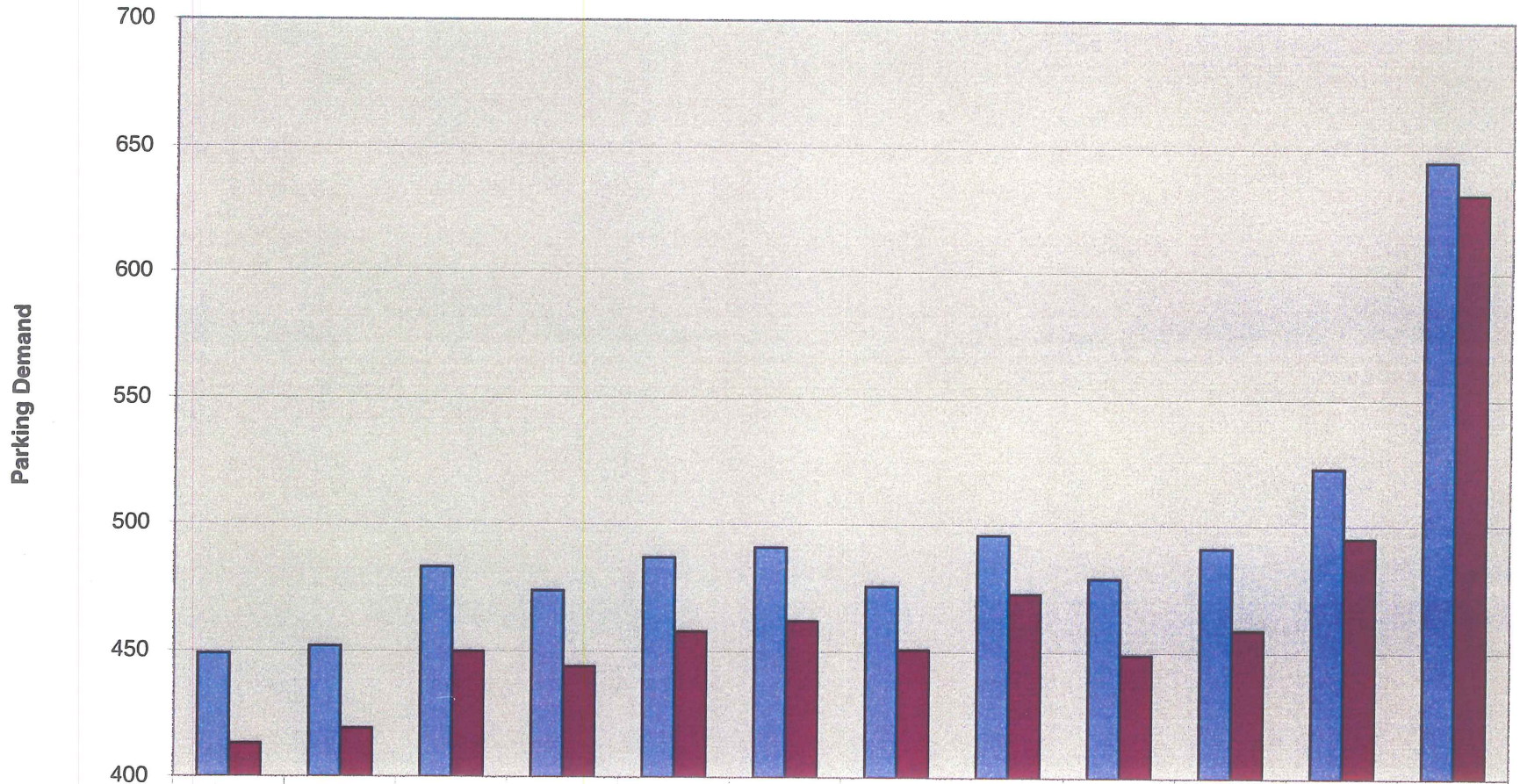
TOD	820-Shopping Center	181	701-Office	55	850-Supermarket	312	488-Soccer Field	23	495-Sports Club	7	221-Apartments	23	230-Townhouses	210-Single-Family
12:00a-4:00a	0	0	0	0	0	0	0	0	0	0	0	0	98	
5:00a	0	0	0	0	0	0	0	0	0	0	0	0	100	
6:00a	0	0	6	3	0	0	0	0	0	0	0	0	84	
7:00a	9	16	56	31	0	0	0	0	0	0	0	0	62	
8:00a	16	29	86	47	0	0	0	0	0	0	0	0	41	
9:00a	62	112	97	53	0	0	0	0	0	0	0	0	34	
10:00a	64	116	100	55	58	181	58	14	86	6	86	20	42	
11:00a	91	165	98	54	66	206	66	15	71	5	71	16	31	
12:00n	87	157	87	48	93	290	93	22	53	4	53	12	30	
1:00p	84	152	75	41	100	312	100	23	49	3	49	11	31	
2:00p	100	181	84	46	90	281	90	21	42	3	42	10	33	
3:00p	95	172	87	48	94	293	94	22	49	3	49	11	37	
4:00p	85	154	75	41	97	303	97	23	76	5	76	17	45	
5:00p	91	165	43	24	82	256	82	19	88	6	88	20	51	
6:00p	96	174	18	10	62	193	62	14	100	7	100	23	69	
7:00p	95	172	0	0	47	147	47	11	77	5	77	18	72	
8:00p	0	0	0	0	0	0	0	0	62	4	62	14	60	
9:00p	0	0	0	0	0	0	0	0	0	0	0	0	89	
10:00p	0	0	0	0	0	0	0	0	0	0	0	0	92	
11:00p	0	0	0	0	0	0	0	0	0	0	0	0	94	

Saturday - Non-Peak Season

TOD	820-Shopping Center	203	701-Office	9	850-Supermarket	340	488-Soccer Field	23	495-Sports Club	5	221-Apartments	24	230-Townhouses	210-Single-Family
12:00a-4:00a	0	0	0	0	0	0	0	0	0	0	0	0	95	
5:00a	0	0	0	0	0	0	0	0	0	0	0	0	100	
6:00a	0	0	0	0	0	0	0	0	0	0	0	0	98	
7:00a	0	0	0	0	0	0	0	0	0	0	0	0	94	
8:00a	0	0	0	0	0	0	0	0	0	0	0	0	89	
9:00a	0	0	0	0	0	0	0	0	0	0	0	0	59	
10:00a	78	158	86	8	0	0	0	0	86	4	86	21	71	
11:00a	94	191	97	9	0	0	0	0	71	4	71	17	67	
12:00n	100	203	100	9	91	309	91	21	53	3	53	13	66	
1:00p	93	189	98	9	100	340	100	23	49	2	49	12	64	
2:00p	95	193	87	8	95	323	95	22	42	2	42	10	64	
3:00p	94	191	0	0	98	333	98	23	49	2	49	12	69	
4:00p	87	177	0	0	89	303	89	21	76	4	76	18	73	
5:00p	81	164	0	0	72	245	72	17	88	4	88	21	78	
6:00p	69	140	0	0	72	245	72	17	100	5	100	24	80	
7:00p	0	0	0	0	0	0	0	0	77	4	77	18	83	
8:00p	0	0	0	0	0	0	0	0	62	3	62	15	84	
9:00p	0	0	0	0	0	0	0	0	0	0	0	0	87	
10:00p	0	0	0	0	0	0	0	0	0	0	0	0	89	
11:00p	0	0	0	0	0	0	0	0	0	0	0	0	95	

ULI Seasonal Demand

ULI Shared Parking Demand



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Weekday	449	452	483	474	487	491	476	496	479	491	523	645
Weekend	413	419	450	444	458	462	451	473	449	459	495	632

Month

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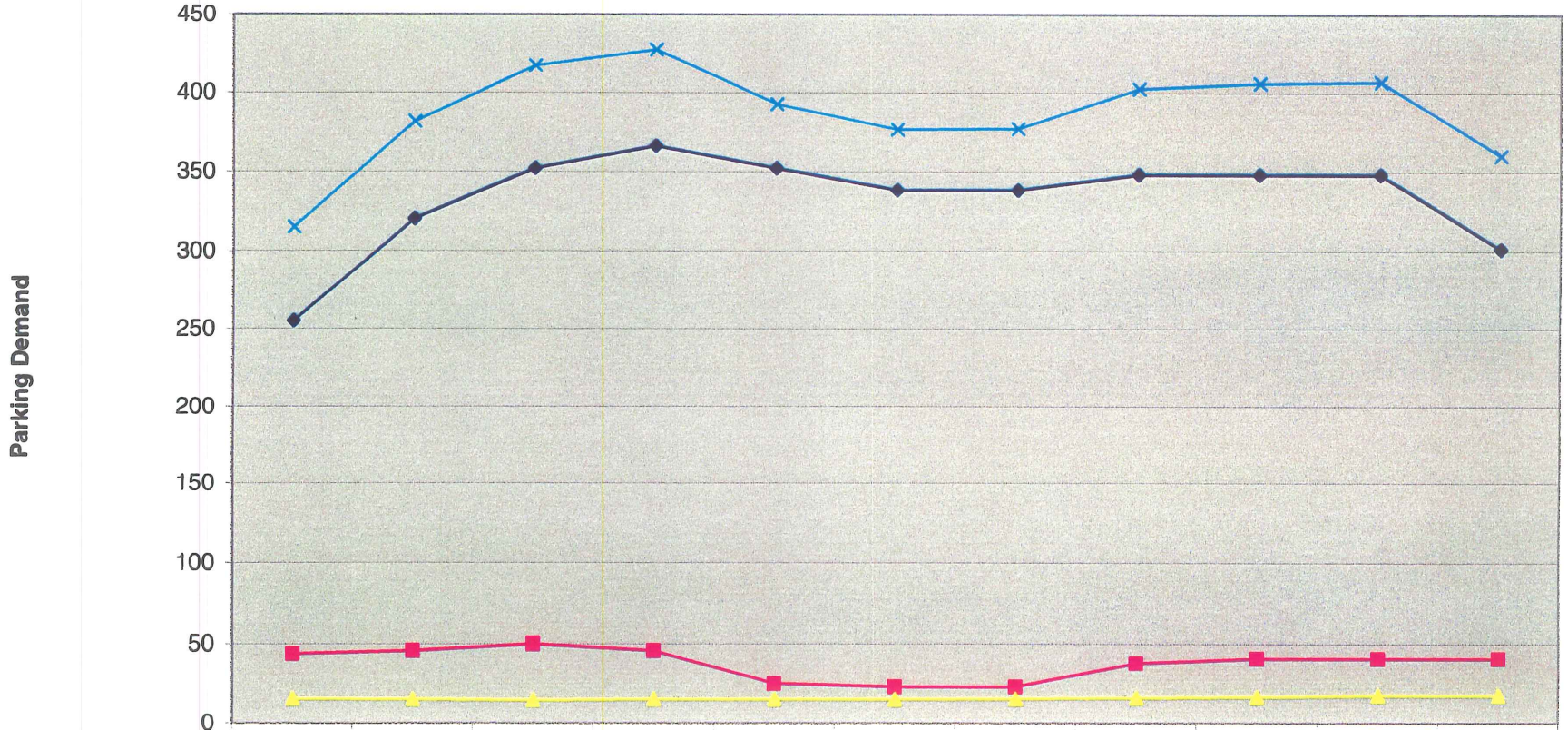
ULI November Hourly Demand

Morrill's Parking Demand - Weekday November



	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
Retail	255	320	352	366	352	338	338	348	348	348	301
Restaurant	44	46	50	46	25	23	23	38	41	41	41
Apartments	16	15	15	15	15	15	16	16	17	18	18
Sum	315	381	417	427	392	376	377	402	406	407	360

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Morrill's Parking Demand - Weekday November

Time	Site	Retail			Restaurant			Apartments					Sum
		Customer	Employee	Total	Customer	Employee	Total	Guest	Reserved	Resident	Total	Adjusted	
10:00	421	183	72	255	36	8	44	1	23	9	33	16	315
11:00	486	239	81	320	38	8	46	1	23	8	32	15	381
12:00	508	267	85	352	42	8	50	1	23	7	31	15	417
13:00	523	281	85	366	38	8	46	1	23	8	32	15	427
14:00	498	267	85	352	21	4	25	1	23	8	32	15	392
15:00	479	253	85	338	19	4	23	1	23	8	32	15	376
16:00	473	253	85	338	19	4	23	1	23	9	33	16	377
17:00	474	267	81	348	31	7	38	1	23	10	34	16	402
18:00	463	267	81	348	34	7	41	2	23	10	35	17	406
19:00	452	267	81	348	34	7	41	3	23	11	37	18	407
20:00	400	225	76	301	34	7	41	3	23	11	37	18	360

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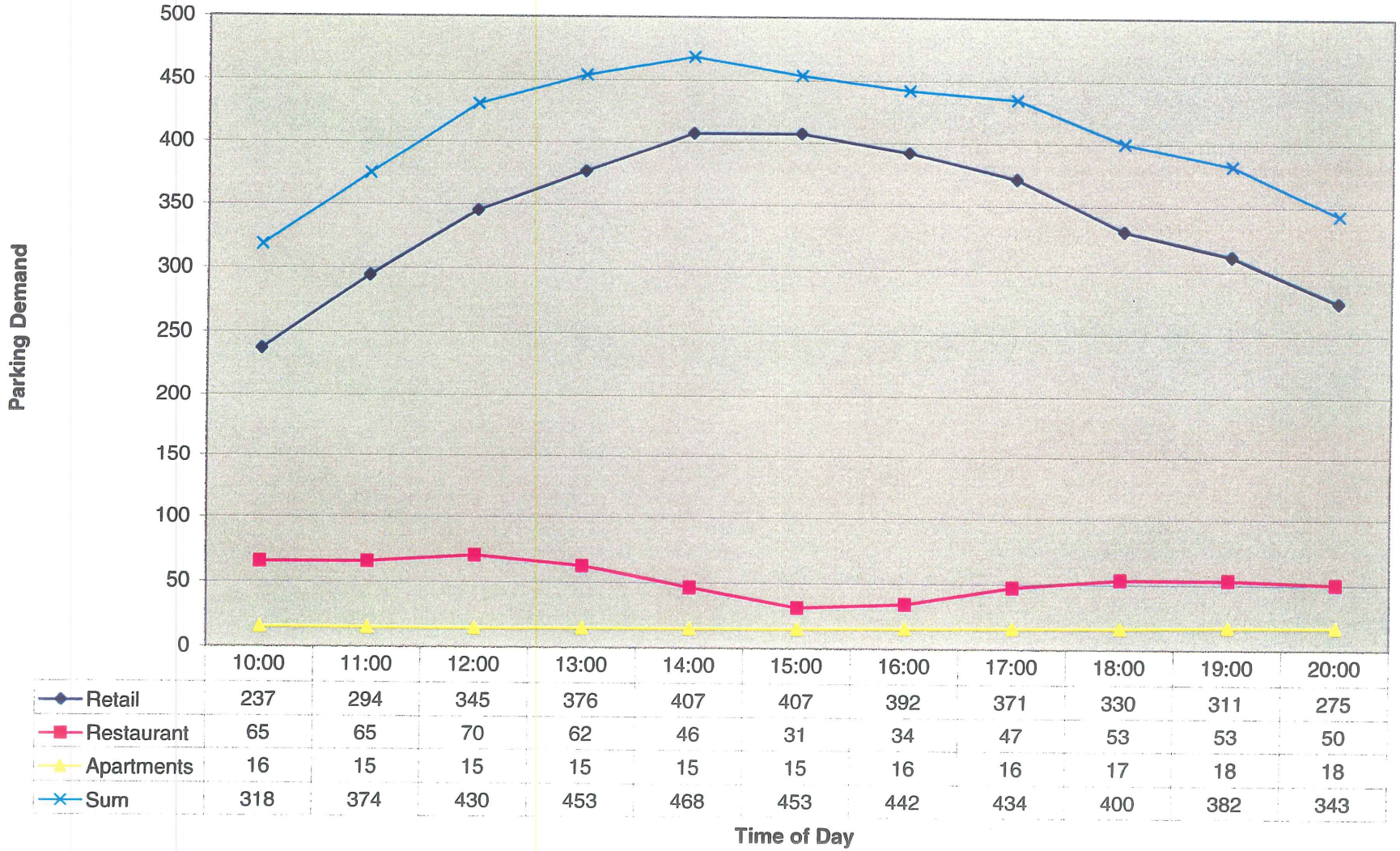
Morrill's Parking Demand - Weekend November



	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
Retail	237	294	345	376	407	407	392	371	330	311	275
Restaurant	65	65	70	62	46	31	34	47	53	53	50
Apartments	16	15	15	15	15	15	16	16	17	18	18
Sum	318	374	430	453	468	453	442	434	400	382	343

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Morrill's Parking Demand - Weekend November

Time	Site	Retail			Restaurant			Apartments					Sum
		Customer	Employee	Total	Customer	Employee	Total	Guest	Reserved	Resident	Total	Adjusted	
10:00	350	155	82	237	54	11	65	1	23	9	33	16	318
11:00	410	202	92	294	54	11	65	1	23	8	32	15	374
12:00	464	248	97	345	59	11	70	1	23	7	31	15	430
13:00	482	279	97	376	51	11	62	1	23	8	32	15	453
14:00	495	310	97	407	39	7	46	1	23	8	32	15	468
15:00	480	310	97	407	24	7	31	1	23	8	32	15	453
16:00	473	295	97	392	27	7	34	1	23	9	33	16	442
17:00	475	279	92	371	36	11	47	1	23	10	34	16	434
18:00	439	248	82	330	42	11	53	2	23	10	35	17	400
19:00	415	233	78	311	42	11	53	3	23	11	37	18	382
20:00	369	202	73	275	39	11	50	3	23	11	37	18	343

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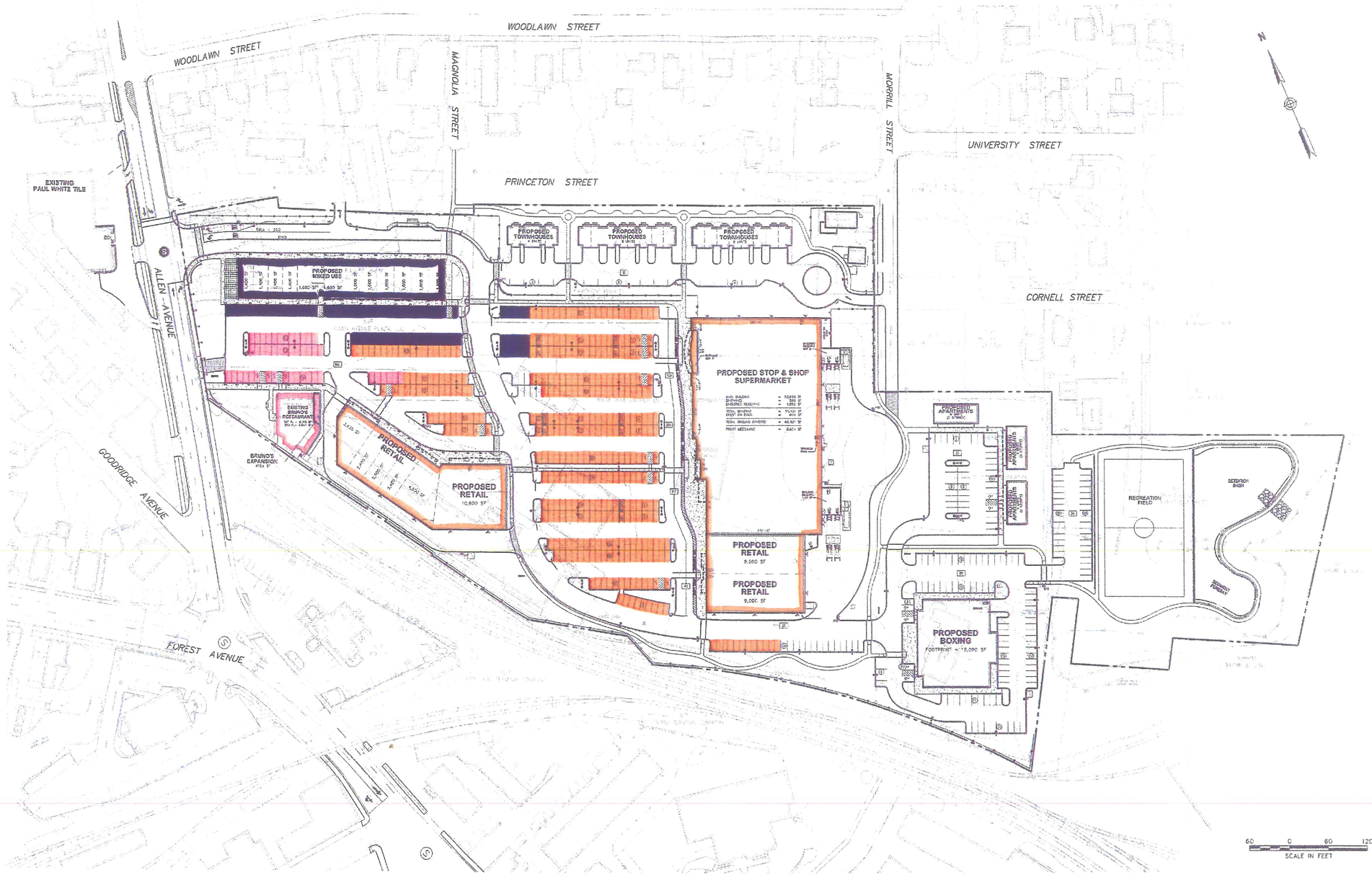
VHB
Vanasse Hangen Brustlin, Inc.

Transportation
Land Development
Environmental Services

101 Walnut Street, P.O. Box 9151
Watertown, Massachusetts 02471
617 924 1770 • FAX 617 924 2286



60 0 60 120
SCALE IN FEET

= Restaurant = 46 spaces
= Mixed Use = 73 spaces (58 retail + 16 residential)
= Retail = 349 spaces
468 spaces

- NOVEMBER WEEKEND -

1	RESPONSE TO COMMENTS	1/31/06
No.	Revision	Date

Designed by: DMF | Drawn by: BKF | Checked by: KSS
Date Amended to: BKF | Approved by:
Scale: 1" = 60' | Date: June 30, 2005

Project Title:
Morrill's Crossing

Allen Avenue
Portland, Maine

Site Plan Approval

Not Approved for Construction

Overall Site Plan

Drawing Number:
C-2

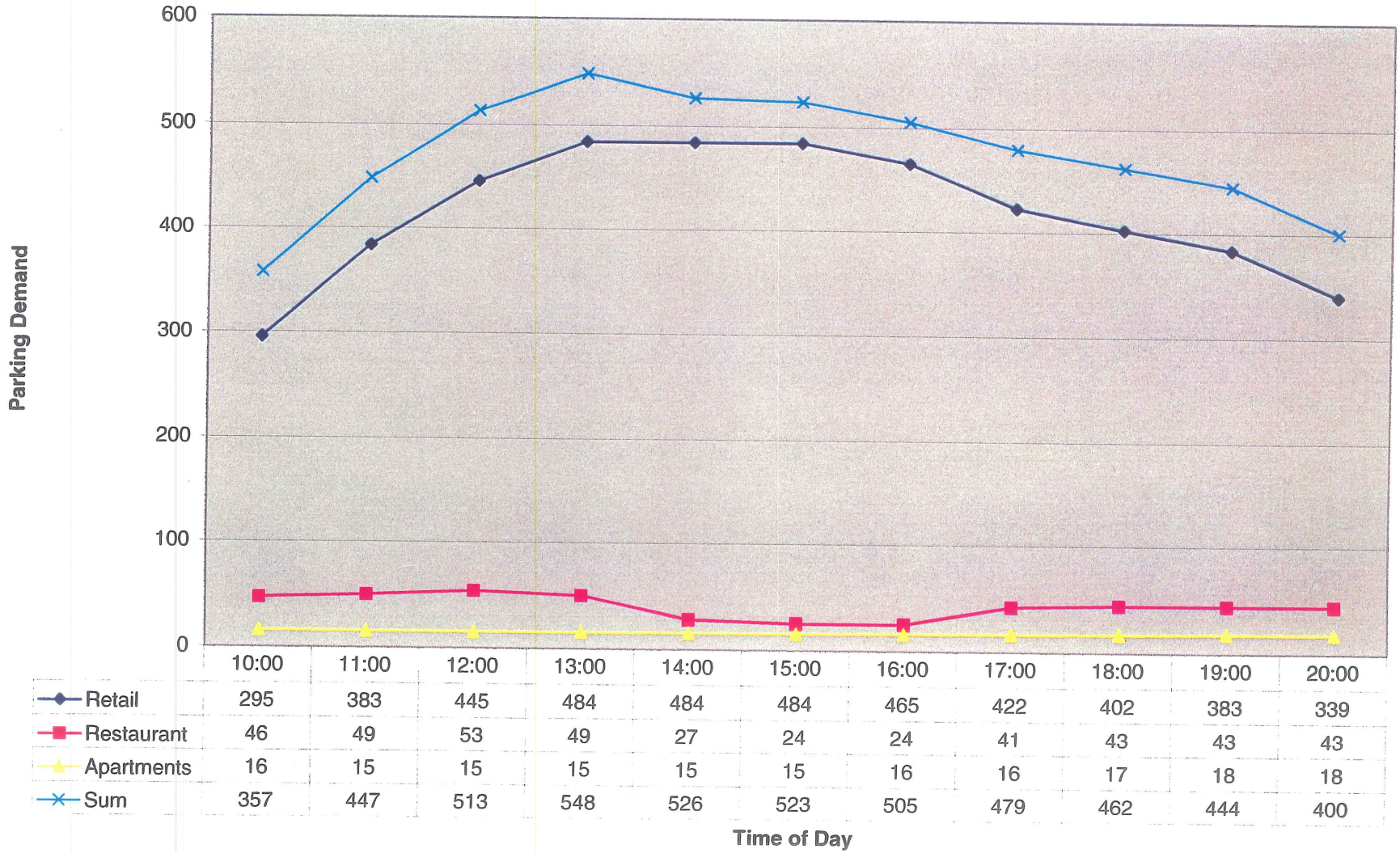
Sheet 2 of 16

Project Number:
07334.00

07334-DSP.dwg

ULI December Hourly Demand

Morrill's Parking Demand - Weekday Peak December



	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
Retail	295	383	445	484	484	484	465	422	402	383	339
Restaurant	46	49	53	49	27	24	24	41	43	43	43
Apartments	16	15	15	15	15	15	16	16	17	18	18
Sum	357	447	513	548	526	523	505	479	462	444	400

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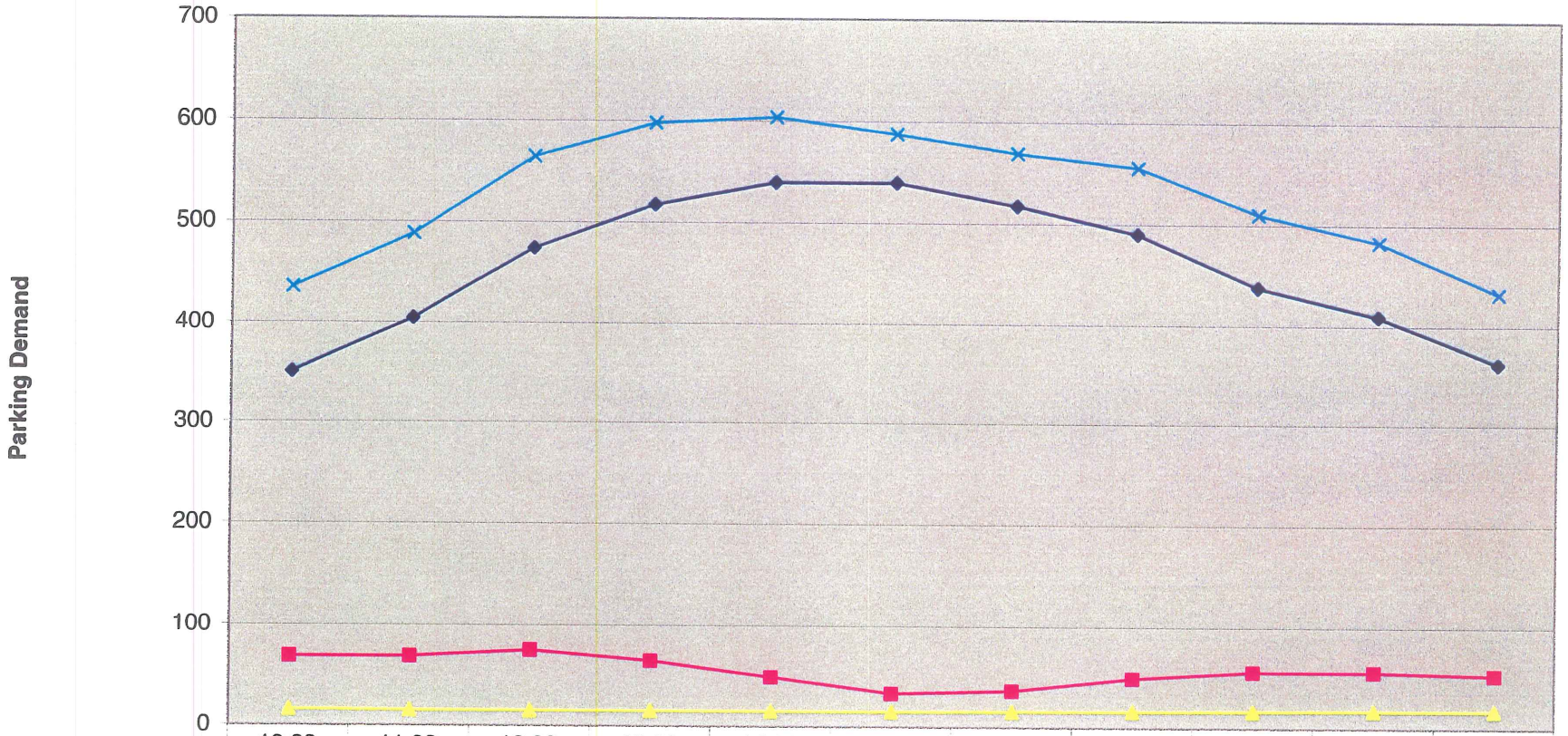
Morrill's Parking Demand - Weekday Peak December

Time	Site	Retail			Restaurant			Apartments					Sum
		Customer	Employee	Total	Customer	Employee	Total	Guest	Reserved	Resident	Total	Adjusted	
10:00	464	215	80	295	38	8	46	1	23	9	33	16	357
11:00	553	293	90	383	41	8	49	1	23	8	32	15	447
12:00	605	351	94	445	45	8	53	1	23	7	31	15	513
13:00	645	390	94	484	41	8	49	1	23	8	32	15	548
14:00	633	390	94	484	23	4	27	1	23	8	32	15	526
15:00	627	390	94	484	20	4	24	1	23	8	32	15	523
16:00	602	371	94	465	20	4	24	1	23	9	33	16	505
17:00	553	332	90	422	34	7	41	1	23	10	34	16	479
18:00	521	312	90	402	36	7	43	2	23	10	35	17	462
19:00	491	293	90	383	36	7	43	3	23	11	37	18	444
20:00	442	254	85	339	36	7	43	3	23	11	37	18	400

Morrill's Parking Demand - Weekend Peak December



	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
Retail	350	404	474	517	539	539	517	490	437	409	361
Restaurant	69	69	75	65	49	33	36	49	56	56	53
Apartments	16	15	15	15	15	15	16	16	17	18	18
Sum	435	488	564	597	603	587	569	555	510	483	432

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Morrill's Parking Demand - Weekend Peak December

Time	Site	Retail			Restaurant			Apartments					Sum
		Customer	Employee	Total	Customer	Employee	Total	Guest	Reserved	Resident	Total	Adjusted	
10:00	468	258	92	350	58	11	69	1	23	9	33	16	435
11:00	525	302	102	404	58	11	69	1	23	8	32	15	488
12:00	599	366	108	474	64	11	75	1	23	7	31	15	564
13:00	627	409	108	517	54	11	65	1	23	8	32	15	597
14:00	632	431	108	539	42	7	49	1	23	8	32	15	603
15:00	615	431	108	539	26	7	33	1	23	8	32	15	587
16:00	601	409	108	517	29	7	36	1	23	9	33	16	569
17:00	597	388	102	490	38	11	49	1	23	10	34	16	555
18:00	550	345	92	437	45	11	56	2	23	10	35	17	510
19:00	517	323	86	409	45	11	56	3	23	11	37	18	483
20:00	459	280	81	361	42	11	53	3	23	11	37	18	432

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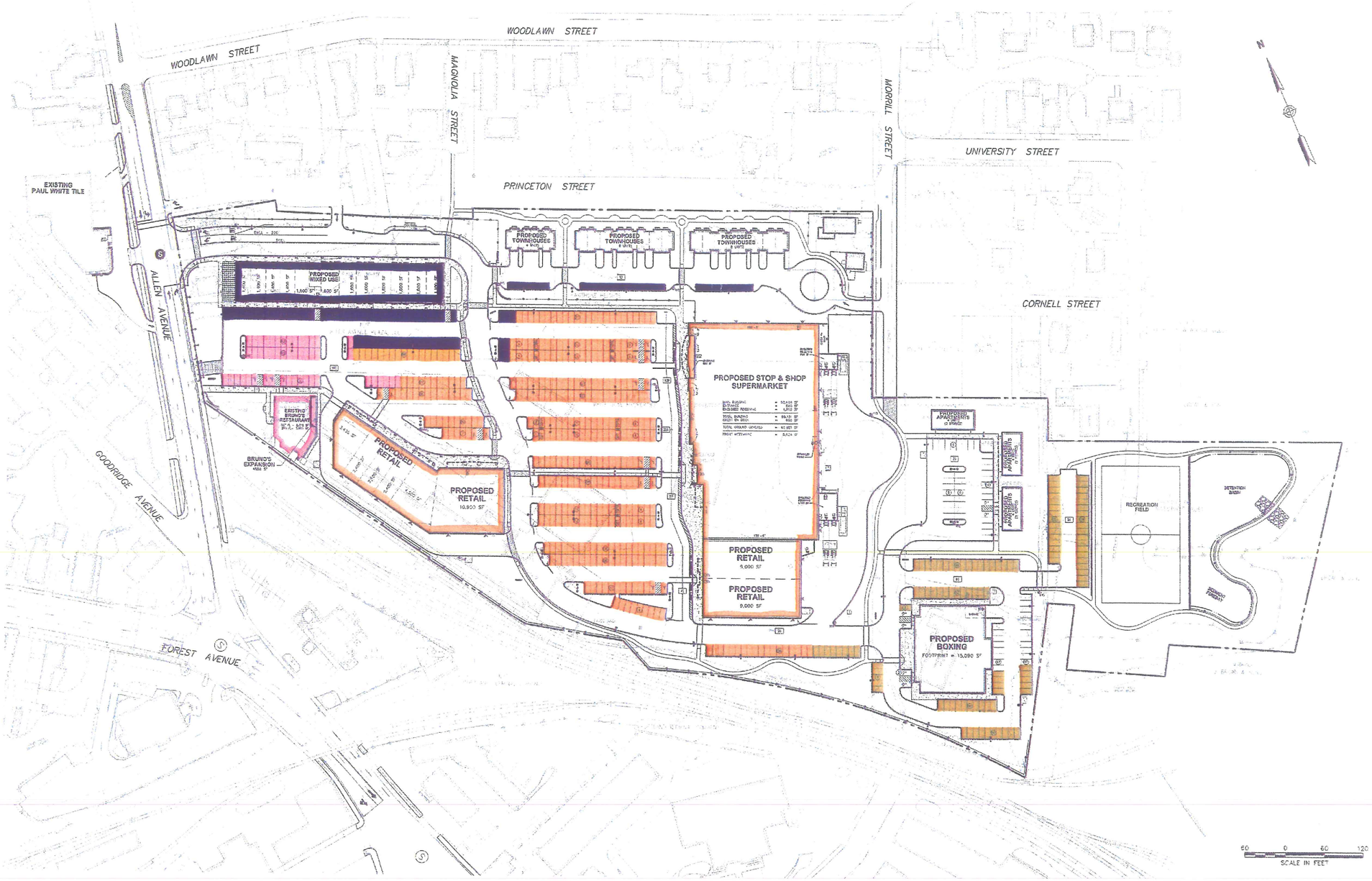
101 Walnut Street, P.O. Box 9151
Watertown, Massachusetts 02471
617 924 1770 • FAX 617 924 2286



= Restaurant = 49 spaces
= Mixed Use = 76 spaces (61 retail + 15 residential)
= Retail = 370 spaces
= Retail Employee = 108 spaces
603 spaces

- DECEMBER WEEKEND -

No.	Revisions	Date	Appvd.
1	RESPONSE TO COMMENTS	1/12/06	

Designed by DHE | Drawn by BHT | Checked by KSS
End checked by BHT | Approved by
Scale 1" = 60' | Date June 30, 2005

Project Title
Morrill's Crossing

Allen Avenue
Portland, Maine

Drawing Title
Site Plan Approval

Not Approved for Construction

Overall Site Plan

Drawing Number
C-2

Sheet 2 of 16

Project No./File
07334-09

07334-OSP.dwg

Transportation
Land Development
Environmental
Services

VHB imagination | innovation | energy Creating results for our clients and benefits for our communities

February 22, 2006

Vanasse Hangen Brustlin, Inc.

Ref: 07334.00

Ms. Sarah Hopkins
Development Review Services Manager
Department of Planning & Development
City of Portland
389 Congress Street
Portland, Maine 04101

Re: Response to Comments
Morrill's Crossing Traffic Study
Portland, Maine

Dear Sarah:

Vanasse Hangen Brustlin, Inc. (VHB) has provided detailed responses to Comments 1-18, and 25 from Mr. Thomas A. Errico's January 9, 2006 comment letter on transportation issues. The following memorandum provides detailed responses to Comments 19-24 and 26 of this same letter.

Background

Based on a number of comments and suggestions made by Mr. Errico and others, the applicant has gathered additional traffic-related information in and around the Morrill's Corner area. This additional data was gathered so as to better calibrate the existing "real world" conditions with those "theoretical" conditions modeled in the simulation programs. As part of this effort, VHB collected actual saturation flow rates[1] (as opposed to theoretical values), made observations of existing vehicle queuing through the Morrill's Corner area, and documented lane utilization of the various approaches to the intersections. Attached to this letter is a summary of the means and methods used by VHB to document the saturation flow rates as well as the results of those observations.

With this additional information, the traffic models originally presented were then calibrated to represent what was observed and to portray and project future conditions based on the observations made by professional staff from VHB. The end result is a traffic model that accurately represents the current traffic conditions within the Morrill's Corner area as well as defines the future transportation network both with and without the development of the Morrill's Crossing project. It is important to note that the previously submitted analysis was correct in its assumptions, however this revised evaluation provides a more accurate calibration of existing, and likely future, conditions.

The following letter provides responses to the comments raised by Mr. Errico (numbered and shown in italics).

[1]Saturation flow rate: the rate at which vehicles can travel through an intersection assuming that the green signal is available at all times. For example, a saturation flow rate of 1900 indicates that up to 1,900 vehicles could travel through an intersection in one hour.

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19. *The improvement plan should provide details on how Forest Street will transition from two lanes to one in the inbound direction.*

An exhibit showing how Forest Street will transition from two lanes to one in the inbound direction is attached to this letter (see Comment 19 Attachment). The inbound Forest Avenue corridor is proposed to be two lanes from its intersection with Stevens Avenue to a point just past Read Street. Once past Read Street, the Forest Avenue corridor will transition from two lanes to one lane over the course of approximately 125 feet.

This two-lane configuration would provide a consistent flow of traffic in two lanes as motorists traveled inbound past Stevens Avenue without any forced merge or lane drop occurring. Once past Read Street, drivers would gradually transition into one consistent lane along Forest Avenue as they do today.

20. *The applicant needs to fully explore and provide alternatives for the provision of four travel lanes on Forest Avenue as it relates to the loss of on-street parking.*

Currently, there are five unmarked parking spaces provided along the inbound side of Forest Avenue that would be impacted by the proposed roadway widening project. Based on observations, these spaces are predominantly used by patrons of Samuels, a restaurant/pub located along Forest Avenue.

As was discussed with the City of Portland staff and supported by the Maine Department of Transportation (MDOT) staff, it is proposed that this on-street parking be removed permanently so as to provide a consistent two-lane inbound traffic flow at all hours of the day along Forest Avenue. This recommendation is consistent with the City's prior BTIP plans (which would have eliminated these same spaces).

While consideration has been given to temporary restrictions based on the time of day and traffic flow along this stretch of roadway, the City, MDOT and applicant all agree that the elimination of these parking spaces is the proper long-term approach from an engineering and safety perspective.

The applicant will continue to work with the owner of Samuel's to locate alternative parking opportunities in the immediate vicinity of their business.

21. *Peak hour factors computed during the conduct of the turning movement counts should be used in the capacity analysis calculations.*

The original data collected for this project included peak hour factors for each individual lane group based on observed traffic counts. As traffic levels increase along a specific approach, it is reasonable to assume that the overall intersection saturation level will increase. This will, in turn, affect the peak hour factors of the approaches to an intersection. Peak hour factors will continue to increase towards a 0.92 default rate as suggested in the Highway Capacity Manual[2]. In cases where a specific movement is projected to operate at congested levels, it is reasonable to assume that the peak hour factors will further increase to 0.95 and then 0.98 to model the effect of congestion on these movements. This

[2] t 9-2, page 9-9; *Highway Capacity Manual (HCM2000)*; Transportation Research Board/National Research Council; Washington, D.C.; 2000.

practice has been accepted in the past by the State of Maine and is commonly used in similar situations when evaluating corridors that experience some peak hour congestion.

In light of the concern raised by Mr. Errico, VHB has eliminated the few instances where the peak hour factor was increased from 0.95 to 0.98. Ultimately, this factor adjustment does not impact the overall level of service results for any of the intersections – all locations continue to operate at LOS D or better.

22. *The capacity analysis calculations take credit for right-turn on red movements at the Forest Avenue/Allen Avenue intersection. Right-turn-on-red movements are prohibited for northbound right turns. The analysis should be revised to reflect this prohibition.*

This change has been made and is reflected in the accompanying analysis results. Under future conditions with the proposed improvements in place, these right turn on red movements are proposed to be permissible.

23. *The volume-to-capacity ratio for the Forest Avenue/Allen Avenue intersection exceeds 1.0 for the Build with Mitigation Scenario during the Weekday time period. Volume-to-capacity computations should be less than 1.0 at all study intersections.*

A table showing the updated signalized analysis results is attached to this letter (see Comment 23 Attachment). The table shows that all volume-to-capacity ratios are 1.0 or lower for all movements under the Build with Mitigation condition. Changes to the previous analyses include a balanced traffic volume network, the inclusion of observed saturation flow rates and lane utilization factors, the reduction of peak hour factors that had been increased to be greater than 0.95, the modification of lane configuration on the NB Allen Avenue approach at the site driveway, and the subsequent adjustments to the phasing, timing and offsets at the signalized intersections.

24. *The applicant should provide information on existing storage lane capacities at the study intersections such that a determination on storage lane adequacy can be determined. Additionally, 95th% queues should be used for the determination of lane storage adequacy.*

A table showing the updated evening peak hour vehicular queue results is attached to this letter (see Comment 24 Attachment). The table presents both existing storage lane capacities (under current conditions) and proposed storage lane capacities (under the Build with Mitigation scenario). It also shows the average and 95th percentile queues for each individual movement based on the Synchro reports generated by this new analysis.

Almost universally, the charts indicate that there will be either an elimination of, or a significant reduction of, the average vehicle queuing when comparing the Existing conditions with the Build with Mitigation condition. While there are a few locations that exhibit 95th percentile queues in excess of the lane storage abilities under the Build with Mitigation condition, they are less than the corresponding 95th percentile queues show in the Existing conditions analysis results.

Based on a meeting held on Friday, February 17, 2006 with the MDOT staff and the City, VHB will be providing additional information regarding this topic. This additional information will be based on the results of the SimTraffic software, which is a traffic simulation model that has been used by MDOT

as an alternate means of estimating queues where there are closely spaced signalized intersections. The results of this simulation analysis will be provided under separate cover.

26. *I am concerned about vehicle queuing at the Morrill's Corner intersections and will rely on the SimTraffic results to determine whether conditions are acceptable. As indicated previously, that review will be conducted in the near future.*

As noted in the response to Comment 24 and as requested by MDOT and the City at the meeting held on Friday, February 17, 2006, VHB will provide an estimate vehicular queue summary based on the SimTraffic traffic simulation model to the City for their review under separate cover.

****

In response to Mr. Errico's February 10, 2006 letter, we were pleased that many of his concerns have been addressed to his satisfaction. The following brief responses are intended to supplement and clarify our initial responses for the City's consideration:

2. *From a traffic volume and analysis perspective, intersection turning movement counts are the most relevant. Accordingly, I would ask that the applicant provide a historical perspective on the various intersections turning movement volumes collected over the last several years. I would suggest that this be provided in tabular form with dates of counts, day of week information, peak hour information, and supporting commentary.*

Additional information is attached. While we do not see the relevance of this information to the project before the planning board, we have provided it for review purposes.

18. *The applicant shall provide a graphic that illustrates the turning adequacy of bus movements through the traffic circle near Morrill Street. Additionally, the applicant should implement design treatments that minimize illegal movements to Morrill Street.*

The driveway has been reduced in width from 20 feet down to 16 feet per agreement with the City.

25. *The applicant should identify a mitigation plan for the Forest Avenue at Riverton School/Newton Street intersection.*

The applicant is willing to discuss reasonable contributions towards this important project.

****

Finally, as referenced earlier in this letter, VHB has since met with Mr. Errico and MDOT staff on Friday February 17, 2006 to review the off-site concept plans and results of the traffic study. While the meeting was very positive, and the roadway improvements being suggested were supported by MDOT, VHB has agreed to provide an additional few pieces of information to the City and MDOT in support of the traffic report findings.

Should you have any questions related to these responses, please feel free to contact me directly. We are eager to address all of your questions and concerns prior to the next scheduled Planning Board traffic workshop on March 7, 2006.

Regards,

VANASSE HANGEN BRUSTLIN, INC.

Robert L. Nagi, PE
Principal

Copies: City of Portland Planning Board (6)
Sarah Hopkins, City of Portland
Tom Errico, Wilbur Smith Associates
Tom Gorrill, Gorrill-Palmer Consulting Engineers, Inc.

Attachments

- Saturation Flow Rates
- Lane Utilization Factors
- Comment 19
- Comment 23
- Comments 24 & 26
- Comment 2

Saturation Flow Rates

VHB conducted video observations and recordings of the three "traditional" Morrill's Corner intersections (Forest at: Allen Avenue; Warren Avenue; and Stevens Avenue) on Tuesday January 31 thru Friday February 3, 2006.

As these videos were brought back to the office, VHB then conducted a series of saturation flow studies using these video recordings, per the standard procedure outlined by ITE in the Manual of Transportation Engineering Studies.

Under the Existing conditions, the Saturation Flow Rate (SFR) was applied to the Synchro analysis using an iterative process of modifying the Ideal SFR until the Synchro-calculated SFR (prot) and/or SFR (perm) matched the calculated mean SFR that was based on data recorded in the field. The results of this process are attached.

Saturated Flow Rates

LANE WINDOW	EBL	EBT	EBR
Saturated Flow Rate (prot)	3433	3539	1583

The saturated flow rates are the actual maximum flow rate for this lane group after adjusting for all of the interference factors. The saturated flow rates represent the number of lanes multiplied by the Ideal Saturated Flow Rate and interference factors due to heavy vehicles, buses, parking maneuvers, lane widths, area type, grade, and turning movements.

There is a permitted and a protected saturated flow rate. For left and through lane groups the permitted saturated flow rate is used when left turns are permitted and the protected saturated flow rate is used when left turns are protected. For right turn lane groups, the permitted flow rate is used with permitted and free right turn phases. The protected flow rate is used with protected and overlapping right turn phases.

The Saturated Flow rates are used in capacity and delay calculations, and for optimization calculations.

These fields are calculated but can be overridden.

The saturation flow rate is based on:

S = So * N * Fw * Fn * Fhv * Fg * Fp * Fbb * Fa * Flu * Flt * Frt * FLpb * FRpb

S = saturation flow rate for the subject lane group, expressed as a total for all lanes in the lane group, veh/h'

So = base saturatiion flow rate per lane, pc/h/In,

N = number of lanes in the lane group,

Fw = adjustment factor for the lane width,

Fhv = adjustment factor for heavy vehicles in the traffic stream,

Fg = adjustment factor for approach grade,

Fp = adjustment factor for the existence of a parking lane and parking activity adjacent to the lane group,

Fbb = adjustment factor for the blocking effect of local buses that stop within the intersection area,

Fa = adjustment factor for area type,

Flu = adjustment factor for lane utilization,

Flt = adjustment factor for left turns in the lane group,

Frt = adjustment factor for right turns in the lane group,

FLpb = pedestrian adjustment factor for left-turn movements, and

FRpb = pedestrian/bicycle adjustment factor for right-turn movements.

Location: **Forest Avenue & Warren in Portland, ME**

Direction: **SB Forest** Lane: **All Lanes**

Date: **2/2/2006** Time: **4PM-6PM** City: **Portland, ME**

Observers: Barry Hoyle Weather **Partly Cloudy- 30's**

Grade: % Lane Width ft. Area: Other:

Obs No.	Time (seconds) between 4th vehicle and			
	7th veh.	8th veh.	9th veh.	10th veh.
1	6.4			
2				11.2
3	7.2			
4		8.9		
5	6.8			
6		8.8		
7				12.1
8	5.8			
9		6.9		
10			8.8	
11	6.7			
12		8.9		
13			10.1	
14				11.7
15	6			
16			8.6	
17		6.9		
18			8.9	
19	5.2			
20		7.1		
21		7.2		
22	5.9			
23			9.5	
24			10.7	
25				12.5
26				11.7
27			10.1	
28			10.3	
29				11.3
30				13.1
Column Sums	50	54.7	77	83.6

Mean Saturation Flow Rate **1810**

Location: **Forest Avenue & Allen Avenue in Portland, ME**

Direction: **NB Forest** Lane: **Through Lanes**

Date: **2/1/2006** Time: **4PM-6PM** City: **Portland, ME**

Observers: Barry Hoyle Weather **Partly Cloudy- 30's**

Grade: % Lane Width ft. Area: Other:

Obs No.	Time (seconds) between 4th vehicle and			
	7th veh.	8th veh.	9th veh.	10th veh.
1			8.2	
2		7.4		
3		7.9		
4		7.2		
5	4.8			
6			8.7	
7				10.7
8		8.4		
9				11.5
10	6.8			
11		7.9		
12	5.9			
13	5.5			
14		6.7		
15			9.9	
16	5.9			
17			9.8	
18				9.1
19	6.6			
20			7.9	
21			8.5	
22	4.6			
23		6.5		
24		7.2		
25			8.7	
26	6			
27				12.3
28				9.7
29			8.3	
30			8.6	
Column Sums	46.1	59.2	78.6	53.3

Mean Saturation Flow Rate **1972**

Location: Forest Avenue & Bishop/Stevens in Portland, ME

Direction: NB Forest Lane: Left/Through Lanes

Date: 1/30/2006 Time: 4PM-6PM City: Portland, ME

Observers: Barry Hoyle Weather Partly Cloudy- 30's

Grade: % Lane Width ft. Area: Other:

Obs No.	Time (seconds) between 4th vehicle and			
	7th veh.	8th veh.	9th veh.	10th veh.
1	8.5			
2		8.7		
3	7.1			
4				11.1
5			9.8	
6				12.3
7	7.9			
8			9.9	
9	7.9			
10	5.8			
11		8.4		
12	7.2			
13			9.6	
14			10.4	
15	6.1			
16		8.6		
17		7.9		
18			10.8	
19			9.7	
20				10.9
21		8.4		
22			9.7	
23			8.5	
24		6.6		
25			9.7	
26				11.6
27		7.6		
28				12
29				10.3
30	6.3			
Column Sums	56.8	56.2	88.1	68.2

Mean Saturation Flow Rate 1743

Lane Utilization Factors

The video recordings were also used to count individual lane volumes, which in turn were used to calculate Lane Utilization Factors (LUFs) for SB Forest thru movements at Allen, NB Forest thru movements at Allen, and WB Allen lefts at Forest (as these groups of lanes have the highest observed lane imbalance of those in the traditional Morrill's Corner area). The LUFs were applied to the aforementioned lane groups for the Existing, No-Build and Build Synchro analyses in the existing conditions. The LUFs were disregarded in the Build with Mitigation analyses, as the existing lane drops are to be eliminated as part of the proposed roadway improvements.

Lane Utilization Factor

LANE WINDOW	EBL	EBT	EBR
Lane Utilization Factor	0.97	0.95	1.00

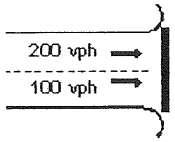
When there is more than one lane in a lane group, the traffic will not use all the lanes equally. The Lane Utilization Factor affects the Saturated Flow Rate. The Lane Utilization Factor is calculated automatically to the following values:

Table 4-1, Lane Utilization Factors

Lane Group Movements	# of Lanes	Lane Utilization Factor
Thru or shared	1	1.00
Thru or shared	2	0.95
Thru or shared	3	0.91
Thru or shared	4+	0.86
Left	1	1.00
Left	2	0.97
Left	3+	0.94
Right	1	1.00
Right	2	0.88
Right	3	0.76

If there is an exclusive turning lane plus a shared turning lane, then all of the lanes will be placed in the through lane group to calculate this factor.

This field can be overridden. If for example there is a busy shopping center entrance, just after this intersection, on the right side, most of the vehicles will be using the right lane and cause a lower lane utilization factor. If the actual per lane volumes are know, the Lane Utilization factor can be calculated per the following example:



$$fLU = \frac{\text{Total App. Vol.}}{(\text{No. of Lanes}) \times (\text{High Lane Vol.})} = \frac{(100 + 200)}{(2 \times 200)} = 0.75$$

fLU = Lane Utilization Factor

NOTE

The fLU is a macroscopic adjustment and will only affect the saturation flow rates. Changes to this value have no impact on the simulated results in SimTraffic. To account for unbalanced flow in SimTraffic, be sure to code in the geometric condition that is causing this, such as a downstream lane taper.

Data Analysis at the intersection of Forest Avenue & Allen Avenue in Portland, ME

Time Period	SB Forest Avenue (Route 302)				NB Forest Avenue (Route 302/100)				WB Allen Avenue (Route 100)				EB McDonald's Lot			Totals
	Left	Thru	Thru	Right	Right	Thru	Thru	Left	Left	Left	Thru	Right	Right	Thru	Left	
4:15 PM	94	162	21	1	128	156	194	4	51	58	2	84	6	2	8	971
4:30 PM	78	139	56	0	106	126	160	12	41	35	4	78	2	2	3	842
4:45 PM	79	159	52	3	114	143	203	7	44	52	5	91	2	6	3	963
5:00 PM	80	126	38	2	125	103	187	2	26	35	2	76	2	2	7	813
5:15 PM	76	164		0	109	77	154	3	52	42	5	75	5	5	4	771
5:30 PM	84	133		1	145	100	200	11	50	44	1	99	9	8	6	891
5:45 PM	72	166		3	119	88	187	13	45	27	2	81	3	3	3	812
6:00 PM	48	170		0	149	57	170	4	36	40	0	69	6	7	8	764
Totals	611	586	167	10	995	850	1455	56	345	333	21	653	35	35	42	

633

Thru lanes could not be separated due to poor night vision on EB starting at 5PM

Comment 19

See attached roadway plans showing the transitions along Forest Avenue inbound from two-lanes down to one-lane.

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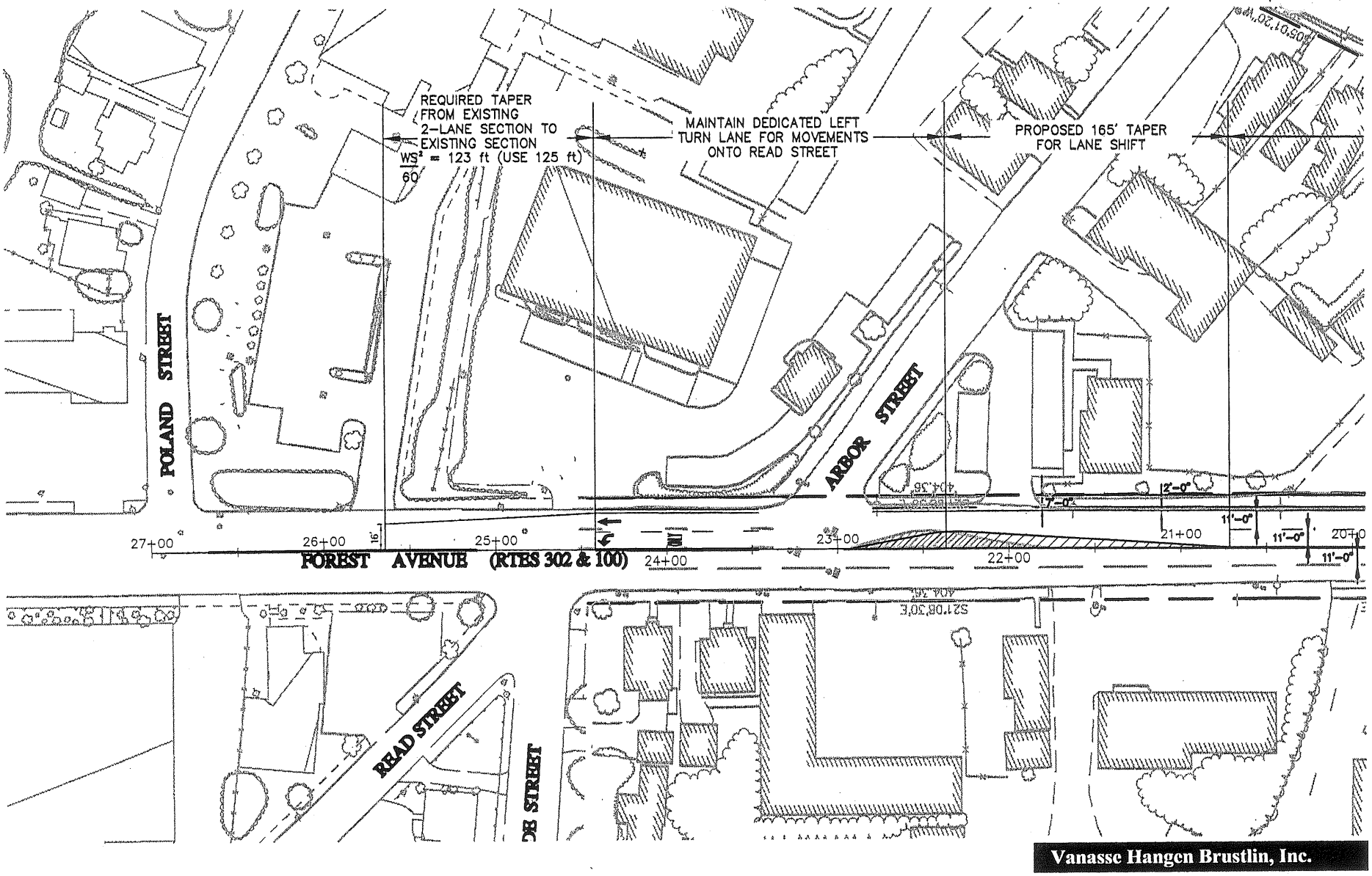


Vanasse Hangen Brustlin, Inc.

0 40 80 Feet

Comment 19 Exhibit
Forest Avenue Transistion
Morrill's Crossing
Portland, Maine

Comment 23

See attached highway capacity worksheets and summaries for Existing and Build with Mitigation analysis.

Signalized Intersection Capacity Analyses Summary

Location	Time Period	2004 Existing			2007 No-Build			2007 Build			2007 Build with Mitigation		
		v/c [a]	Delay [b]	LOS [c]	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS
Forest Avenue at Warren Avenue	Weekday Evening	0.72	17	B	0.77	19	B	0.77	20	B	0.76	19	B
	Saturday Midday	0.70	15	B	0.72	17	B	0.72	23	C	0.77	19	B
Forest Avenue at Allen Avenue	Weekday Evening	0.83	37	D	0.84	39	D	0.95	49	D	0.97	36	D
	Saturday Midday	0.77	28	C	0.79	29	C	0.87	37	D	0.88	31	C
Forest Avenue at Stevens Ave/Bishop St	Weekday Evening	0.99	43	D	1.02	48	D	1.07	58	E	0.86	19	B
	Saturday Midday	0.76	17	B	0.79	19	B	0.84	21	C	0.71	12	B
Allen Avenue at Plymouth St/Northfield Green Dr	Weekday Evening	0.58	4	A	0.63	5	A	0.69	6	A	0.69	6	A
	Saturday Midday	0.57	4	A	0.63	6	A	0.70	7	A	0.70	7	A
Allen Avenue at Washington Avenue	Weekday Evening	0.75	40	D	0.77	42	D	0.86	48	D	0.86	39	D
	Saturday Midday	0.67	33	C	0.71	35	C	0.78	41	D	0.80	34	C
Allen Avenue at Site driveway	Weekday Evening	n/a			n/a			n/a			0.90	25	C
	Saturday Midday										0.89	30	C

a volume to capacity ratio
b average delay per vehicle in seconds
c level of service
n/a not applicable; intersection is not signalized under these conditions

Unsignalized Intersection Capacity Analyses Summary

Location	Movement	Peak Hour	2004 Existing Condition				2007 No-Build Condition				2007 Build Condition				2007 Build with Mitigation Condition			
			Dem [a]	v/c [b]	Delay [c]	LOS [d]	Dem	v/c	Delay	LOS	Dem	v/c	Delay	LOS	Dem	v/c	Delay	LOS
Forest Avenue at Newton Street/School driveway	EB L/T/R	Weekday Evening	56	0.75	98	F	56	0.82	122	F	56	0.91	154	F	56	0.91	154	F
		Saturday Midday	41	0.30	29	D	41	0.32	32	D	41	0.36	37	E	41	0.36	37	E
	WB L/T/R	Weekday Evening	25	0.77	189	F	25	0.87	233	F	30	1.43	493	F	30	1.43	493	F
		Saturday Midday	40	0.49	54	F	40	0.53	61	F	50	0.89	141	F	50	0.89	141	F
Forest Avenue at Morrill Street	WB L/R	Weekday Evening	40	28.87	Err	F	40	41.35	Err	F	40	63.91	Err	F	35	0.15	17	C
		Saturday Midday	10	0.76	460	F	10	1.59	1213	F	10	4.25	Err	F	5	0.01	12	B
Forest Avenue at Adelaide St/Read St	WB L/T/R	Weekday Evening	285	Err	Err	F	295	Err	Err	F	315	Err	Err	F	0	0.00	0	A
		Saturday Midday	158	4.76	Err	F	156	9.22	Err	F	188	40.59	Err	F	0	0.00	0	A
Forest Avenue at Bell Street	WB L/R	Weekday Evening	80	0.51	48	E	80	0.56	56	F	80	0.60	64	F	400	1.19	144	F
		Saturday Midday	45	0.62	70	F	45	0.69	85	F	45	0.75	104	F	238	1.16	132	F
Allen Avenue at Woodlawn Avenue	WB L/R	Weekday Evening	30	0.38	64	F	30	0.54	110	F	30	1.89	848	F	30	0.23	34	D
		Saturday Midday	30	0.41	71	F	30	0.54	111	F	30	11.76	Err	F	30	0.60	118	F
Warren Avenue at Hicks St/auto body driveway	NB L/T/R	Weekday Evening	6	0.08	53	F	6	0.09	57	F	6	0.10	61	F	6	0.10	61	F
		Saturday Midday	0	0.00	0	A	0	0.00	0	A	0	0.00	0	A	0	0.00	0	A
	SB L/T/R	Weekday Evening	46	0.20	20	C	46	0.21	21	C	46	0.22	21	C	46	0.22	21	C
		Saturday Midday	45	0.11	14	B	45	0.11	14	B	45	0.11	15	B	45	0.11	15	B
Allen Avenue at Site driveway	WB L/R	Weekday Evening	20	0.22	36	E	20	0.24	41	E	583	15.49	Err	F	n/a			
		Saturday Midday	1	0.03	34	D	1	0.04	38	E	651	16.47	Err	F				

a demand in vehicles per hour for unsignalized intersections; the demand applies to only the most critical street approach or lane group
b volume-to-capacity ratio for the critical movement
delay of critical approach in seconds per vehicle
level of service of the critical movement
EB = Eastbound; WB = Westbound; NB = Northbound; SB = Southbound; L = Left; T = Through; R = Right

Lane Group	EBT	EBR	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	146	744	20	515	1122	966
v/c Ratio	0.63	0.74	0.08	0.73	0.39	0.72
Control Delay	54.5	19.0	37.8	31.3	3.3	28.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.5	19.0	37.8	31.3	3.3	28.2
Queue Length 50th (ft)	79	263	9	253	90	251
Queue Length 95th (ft)	#185	439	20	425	112	352
Internal Link Dist (ft)	445		188		584	705
Turn Bay Length (ft)		200		250		
Base Capacity (vph)	273	1123	284	881	2979	1673
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.53	0.66	0.07	0.58	0.38	0.58

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	18	18	48	235	248	397	26	1263	644	453	1174
v/c Ratio	0.13	0.13	0.29	0.69	0.72	0.42	0.21	0.80	0.68	1.06	0.81
Control Delay	49.5	49.2	18.6	51.9	54.1	13.8	51.6	33.5	13.9	99.8	24.6
Queue Delay	0.0	0.0	0.5	1.2	1.5	0.0	0.0	66.7	1.0	0.0	4.3
Total Delay	49.5	49.2	19.1	53.1	55.6	13.8	51.6	100.2	14.9	99.8	28.9
Queue Length 50th (ft)	12	12	0	154	164	112	18	498	195	~361	530
Queue Length 95th (ft)	33	33	31	242	255	194	46	616	286	#528	#750
Internal Link Dist (ft)		152			327			304			584
Turn Bay Length (ft)	75		75			150	75		185	250	
Base Capacity (vph)	150	158	178	371	371	940	162	1582	953	428	1450
Starvation Cap Reductn	0	0	0	0	0	0	0	477	122	0	0
Spillback Cap Reductn	0	0	26	35	35	0	0	0	0	0	205
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.11	0.32	0.70	0.74	0.42	0.16	1.14	0.77	1.06	0.94

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	NBT	SBT	SBR	NEL
Lane Group Flow (vph)	133	1421	1071	516	579
v/c Ratio	0.57	0.68	1.11	0.56	0.89
Control Delay	53.8	17.2	85.9	16.4	60.0
Queue Delay	1.1	1.5	96.8	4.3	4.8
Total Delay	55.0	18.7	182.7	20.7	64.9
Queue Length 50th (ft)	87	333	854	204	203
Queue Length 95th (ft)	123	432	#1134	316	#302
Internal Link Dist (ft)	1038	436	304		1207
Turn Bay Length (ft)					
Base Capacity (vph)	271	2084	968	925	654
Starvation Cap Reductn	0	0	161	324	0
Spillback Cap Reductn	38	446	0	0	41
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.57	0.87	1.33	0.86	0.94

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	EBR	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	151	767	20	531	1178	1012
v/c Ratio	0.68	0.74	0.09	0.80	0.43	0.77
Control Delay	58.9	19.9	39.1	35.5	3.6	30.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	58.9	19.9	39.1	35.5	3.6	30.0
Queue Length 50th (ft)	86	294	9	268	91	270
Queue Length 95th (ft)	#203	476	21	442	112	367
Internal Link Dist (ft)	445		188		584	705
Turn Bay Length (ft)		200		250		
Base Capacity (vph)	241	1077	240	818	2891	1588
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.63	0.71	0.08	0.65	0.41	0.64

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	18	18	48	246	259	418	26	1314	670	483	1215
v/c Ratio	0.14	0.13	0.30	0.71	0.75	0.43	0.21	0.87	0.73	1.03	0.84
Control Delay	49.8	49.5	18.7	54.0	56.5	14.2	51.6	39.3	16.5	92.3	26.4
Queue Delay	0.0	0.0	0.6	2.0	2.7	0.0	0.0	117.6	1.6	0.0	8.1
Total Delay	49.8	49.5	19.3	56.0	59.1	14.2	51.6	156.8	18.1	92.3	34.4
Queue Length 50th (ft)	12	12	0	162	172	125	18	537	208	411	581
Queue Length 95th (ft)	33	33	31	254	#281	210	46	652	307	#573	#796
Internal Link Dist (ft)		152			327			304			584
Turn Bay Length (ft)	75		75			150	75		185	250	
Base Capacity (vph)	148	155	176	364	364	979	164	1506	928	467	1454
Starvation Cap Reductn	0	0	0	0	0	0	0	464	118	0	0
Spillback Cap Reductn	0	0	28	40	40	0	0	0	0	0	213
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.12	0.32	0.76	0.80	0.43	0.16	1.26	0.83	1.03	0.98

Intersection Summary

Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	NBT	SBT	SBR	NEL
Lane Group Flow (vph)	133	1474	1109	538	607
v/c Ratio	0.58	0.71	1.15	0.58	0.93
Control Delay	53.9	17.8	101.5	17.0	65.4
Queue Delay	1.4	3.2	91.4	5.3	12.8
Total Delay	55.3	21.0	192.9	22.2	78.2
Queue Length 50th (ft)	87	354	~909	217	215
Queue Length 95th (ft)	123	460	#1191	336	#325
Internal Link Dist (ft)	1038	436	304		1207
Turn Bay Length (ft)					
Base Capacity (vph)	271	2082	968	924	654
Starvation Cap Reductn	0	0	148	316	0
Spillback Cap Reductn	45	490	0	0	50
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.59	0.93	1.35	0.88	1.00

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	49	20	1027	905
v/c Ratio	0.27	0.12	0.65	0.56
Control Delay	14.5	14.4	5.6	4.0
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.5	14.4	5.6	4.0
Queue Length 50th (ft)	8	3	117	86
Queue Length 95th (ft)	16	14	302	205
Internal Link Dist (ft)	938	531	983	388
Turn Bay Length (ft)				
Base Capacity (vph)	262	247	1569	1609
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.19	0.08	0.65	0.56

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	473	494	140	399	212	951	100	642	347
v/c Ratio	0.76	0.77	0.57	0.78	0.71	0.79	0.60	0.77	0.40
Control Delay	54.5	44.1	56.9	48.4	60.5	40.7	68.9	48.1	8.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.5	44.1	56.9	48.4	60.5	40.7	68.9	48.1	8.4
Queue Length 50th (ft)	185	347	105	280	158	358	77	247	45
Queue Length 95th (ft)	#280	#559	171	390	259	#496	#159	#350	127
Internal Link Dist (ft)		854		619		2871		262	
Turn Bay Length (ft)	200		100		100		100		100
Base Capacity (vph)	684	675	359	654	360	1276	182	919	888
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.73	0.39	0.61	0.59	0.75	0.55	0.70	0.39

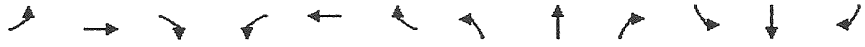
Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	EBR	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	151	785	20	546	1234	1076
v/c Ratio	0.71	0.77	0.09	0.82	0.45	0.80
Control Delay	62.2	21.9	39.8	37.5	3.7	31.6
Queue Delay	0.0	0.0	0.0	0.0	0.2	0.0
Total Delay	62.2	21.9	39.8	37.5	3.9	31.6
Queue Length 50th (ft)	95	355	10	305	97	312
Queue Length 95th (ft)	#203	503	21	460	120	399
Internal Link Dist (ft)	445		188		584	705
Turn Bay Length (ft)		200		250		
Base Capacity (vph)	232	1065	231	804	2891	1567
Starvation Cap Reductn	0	0	0	0	764	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.65	0.74	0.09	0.68	0.58	0.69

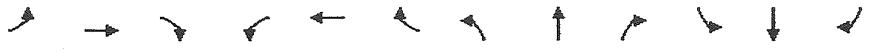
Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1863	1900	1900	2083	1900
Lane Width	12	14	16	12	12	12	12	12	12	12	12	12
Total Lost time (s)		3.0	3.0		3.0		3.0	3.0			3.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95			0.95	
Frt		1.00	0.85		0.99		1.00	1.00			0.99	
Flt Protected		0.95	1.00		0.98		0.95	1.00			1.00	
Satd. Flow (prot)		1915	1812		1682		1787	3500			3875	
Flt Permitted		0.72	1.00		0.87		0.95	1.00			0.93	
Satd. Flow (perm)		1445	1812		1489		1787	3500			3624	
Volume (vph)	125	5	675	5	5	1	535	1200	10	10	850	65
Peak-hour factor, PHF	0.86	0.86	0.86	0.55	0.55	0.55	0.98	0.98	0.98	0.86	0.86	0.86
Adj. Flow (vph)	145	6	785	9	9	2	546	1224	10	12	988	76
RTOR Reduction (vph)	0	0	16	0	2	0	0	1	0	0	5	0
Lane Group Flow (vph)	0	151	769	0	18	0	546	1233	0	0	1071	0
Heavy Vehicles (%)	1%	1%	1%	9%	9%	9%	1%	1%	1%	1%	1%	1%
Turn Type	Perm		pm+ov	Perm			Prot			Perm		
Protected Phases		8	5		4		5	2			6	
Permitted Phases	8	8	8	4	4			2		6	6	
Actuated Green, G (s)		11.3	43.3		11.3		32.0	69.2			32.2	
Effective Green, g (s)		13.3	47.3		13.3		34.0	71.2			34.2	
Actuated g/C Ratio		0.15	0.52		0.15		0.38	0.79			0.38	
Clearance Time (s)		5.0	5.0		5.0		5.0	5.0			5.0	
Vehicle Extension (s)		2.5	2.5		2.5		2.5	3.0			3.0	
Lane Grp Cap (vph)		212	1007		219		671	2754			1370	
v/s Ratio Prot			c0.29				0.31	0.35				
v/s Ratio Perm		0.10	0.14		0.01						c0.30	
v/c Ratio		0.71	0.76		0.08		0.81	0.45			0.78	
Uniform Delay, d1		36.8	17.2		33.3		25.4	3.2			24.9	
Progression Factor		1.00	1.00		1.00		1.00	1.00			1.00	
Incremental Delay, d2		10.1	3.3		0.1		7.3	0.1			3.0	
Delay (s)		46.8	20.5		33.5		32.7	3.3			27.8	
Level of Service		D	C		C		C	A			C	
Approach Delay (s)		24.8			33.5			12.3			27.8	
Approach LOS		C			C			B			C	

Intersection Summary				
HCM Average Control Delay	19.9	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.77			
Actuated Cycle Length (s)	90.5	Sum of lost time (s)	6.0	
Intersection Capacity Utilization	81.2%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				

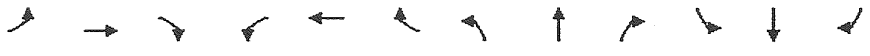


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	2023	2012	2261	1900	2496	1900	1897	1900	1900
Lane Width	12	12	12	12	12	12	12	12	12	11	11	11
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Util. Factor	1.00	1.00	1.00	*0.99	*0.99	1.00	1.00	*0.79	1.00	1.00	*0.65	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1900	1615	1884	1883	1884	1805	3944	1599	1725	2357	
Flt Permitted	0.95	1.00	1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1805	1900	1615	1884	1883	1884	1805	3944	1599	1725	2357	
Volume (vph)	15	15	40	595	15	525	25	1205	810	540	970	20
Peak-hour factor, PHF	0.83	0.83	0.83	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	18	18	48	607	15	536	26	1230	827	551	990	20
RTOR Reduction (vph)	0	0	45	0	0	77	0	0	0	0	1	0
Lane Group Flow (vph)	18	18	3	304	318	459	26	1230	827	551	1009	0
Heavy Vehicles (%)	0%	0%	0%	1%	0%	2%	0%	0%	1%	1%	1%	0%
Turn Type	Split		Prot	Split		pm+ov	Prot		pm+ov	Prot		
Protected Phases	3	3	3	4	4	1	5	2	4	1	6	
Permitted Phases		3				4		2	2		6	
Actuated Green, G (s)	5.4	5.4	5.4	20.2	20.2	47.0	4.2	39.1	59.3	26.8	61.7	
Effective Green, g (s)	6.9	6.9	6.9	21.7	21.7	50.0	5.7	41.1	62.8	28.3	63.7	
Actuated g/C Ratio	0.06	0.06	0.06	0.20	0.20	0.45	0.05	0.37	0.57	0.26	0.58	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5.0	4.5	4.5	5.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	2.0	2.0	3.0	3.0	2.0	3.0	
Lane Grp Cap (vph)	113	119	101	372	371	908	94	1474	913	444	1365	
v/s Ratio Prot	c0.01	0.01	0.00	0.16	0.17	0.13	0.01	0.31	c0.18	c0.32	0.43	
v/s Ratio Perm						0.11			0.34			
v/c Ratio	0.16	0.15	0.03	0.82	0.86	0.51	0.28	0.83	0.91	1.24	0.74	
Uniform Delay, d1	48.8	48.8	48.4	42.3	42.7	21.2	50.2	31.4	21.0	40.8	17.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.7	0.6	0.1	13.0	17.4	0.2	0.6	5.7	12.3	126.4	2.1	
Delay (s)	49.5	49.4	48.5	55.3	60.1	21.4	50.8	37.1	33.3	167.2	19.2	
Level of Service	D	D	D	E	E	C	D	D	C	F	B	
Approach Delay (s)		48.9			40.9			35.7			71.4	
Approach LOS		D			D			D			E	

Intersection Summary			
HCM Average Control Delay	48.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	93.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR	SBR2	NEL	NER
Lane Configurations									
Ideal Flow (vphpl)	1900	1900	1900	1917	1693	1900	1900	1900	1900
Lane Width	12	12	11	11	11	11	11	12	12
Total Lost time (s)	3.0			3.0	3.0	3.0		3.0	
Lane Util. Factor	1.00			0.95	1.00	1.00		0.97	
Frt	0.98			1.00	1.00	0.85		1.00	
Flt Protected	0.96			1.00	1.00	1.00		0.95	
Satd. Flow (prot)	1751			3486	1620	1546		3502	
Flt Permitted	0.96			1.00	1.00	1.00		0.95	
Satd. Flow (perm)	1751			3486	1620	1546		3502	
Volume (vph)	85	15	0	1450	1070	525	10	580	0
Peak hour factor, PHF	0.75	0.75	0.95	0.95	0.92	0.92	0.92	0.89	0.89
Adj. Flow (vph)	113	20	0	1526	1163	571	11	652	0
RTOR Reduction (vph)	0	0	0	0	0	1	0	0	0
Lane Group Flow (vph)	133	0	0	1526	1163	581	0	652	0
Heavy Vehicles (%)	2%	2%	1%	1%	1%	1%	1%	0%	0%
Turn Type						Perm			
Protected Phases	3			2	6			4	
Permitted Phases					6	6			
Actuated Green, G (s)	12.2			62.0	62.0	62.0		18.0	
Effective Green, g (s)	14.2			64.0	64.0	64.0		20.0	
Actuated g/C Ratio	0.13			0.60	0.60	0.60		0.19	
Clearance Time (s)	5.0			5.0	5.0	5.0		5.0	
Vehicle Extension (s)	2.5			3.0	3.0	3.0		2.5	
Lane Grp Cap (vph)	232			2081	967	923		653	
v/s Ratio Prot	c0.08			0.44	c0.72			c0.19	
v/s Ratio Perm						0.38			
v/c Ratio	0.57			0.73	1.20	0.63		1.00	
Uniform Delay, d1	43.7			15.5	21.6	13.9		43.6	
Progression Factor	1.00			1.00	1.00	1.00		1.00	
Incremental Delay, d2	2.8			2.3	101.2	1.4		34.6	
Delay (s)	46.5			17.8	122.8	15.3		78.2	
Level of Service	D			B	F	B		E	
Approach Delay (s)	46.5			17.8	86.9			78.2	
Approach LOS	D			B	F			E	

Intersection Summary			
HCM Average Control Delay	58.2	HCM Level of Service	E
HCM Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	107.2	Sum of lost time (s)	9.0
Intersection Capacity Utilization	95.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			



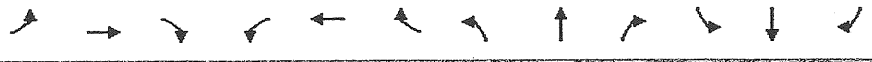
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.91			0.91			1.00			1.00	
Flt Protected		0.98			0.98			1.00			1.00	
Satd. Flow (prot)		1700			1703			1893			1874	
Flt Permitted		0.89			0.94			0.94			0.98	
Satd. Flow (perm)		1541			1627			1782			1837	
Volume (vph)	10	0	20	5	0	10	40	1000	15	15	925	20
Peak-hour factor, PHF	0.61	0.61	0.61	0.75	0.75	0.75	0.93	0.93	0.93	0.95	0.95	0.95
Adj. Flow (vph)	16	0	33	7	0	13	43	1075	16	16	974	21
RTOR Reduction (vph)	0	31	0	0	12	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	18	0	0	8	0	0	1134	0	0	1010	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			2			1			1	
Permitted Phases	2			2			1			1		
Actuated Green, G (s)		5.7			5.7			76.0			76.0	
Effective Green, g (s)		6.7			6.7			77.0			77.0	
Actuated g/C Ratio		0.07			0.07			0.86			0.86	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		115			122			1530			1577	
v/s Ratio Prot												
v/s Ratio Perm		c0.01			0.00			c0.64			0.55	
v/c Ratio		0.16			0.07			0.74			0.64	
Uniform Delay, d1		38.9			38.6			2.5			2.0	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.7			0.2			3.3			2.0	
Delay (s)		39.5			38.8			5.7			4.0	
Level of Service		D			D			A			A	
Approach Delay (s)		39.5			38.8			5.7			4.0	
Approach LOS		D			D			A			A	

Intersection Summary				
HCM Average Control Delay	6.0	HCM Level of Service	A	
HCM Volume to Capacity ratio	0.69			
Actuated Cycle Length (s)	89.7	Sum of lost time (s)	6.0	
Intersection Capacity Utilization	87.6%	ICU Level of Service	E	
Analysis Period (min)	15			

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	11	10	10	10	12
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Util. Factor	0.97	1.00		1.00	1.00		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.95		1.00	0.97		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3351	1790		1711	1812		1728	3407		1668	3336	1599
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3351	1790		1711	1812		1728	3407		1668	3336	1599
Volume (vph)	475	355	170	125	315	70	235	785	80	95	605	360
Peak-hour factor, PHF	0.93	0.93	0.93	0.89	0.89	0.89	0.92	0.92	0.92	0.95	0.95	0.95
Adj. Flow (vph)	511	382	183	140	354	79	255	853	87	100	637	379
RTOR Reduction (vph)	0	12	0	0	6	0	0	6	0	0	0	141
Lane Group Flow (vph)	511	553	0	140	427	0	255	934	0	100	637	238
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	1%	1%	1%	1%	1%	1%
Turn Type	Prot			Prot			Prot			Prot		pm+ov
Protected Phases	7	4		3	8		5	2		1	6	7
Permitted Phases												6
Actuated Green, G (s)	19.3	39.0		14.8	34.5		19.4	35.7		9.4	25.7	45.0
Effective Green, g (s)	21.3	41.0		16.8	36.5		21.4	37.7		11.4	27.7	49.0
Actuated g/C Ratio	0.18	0.34		0.14	0.31		0.18	0.32		0.10	0.23	0.41
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	600	617		242	556		311	1080		160	777	699
v/s Ratio Prot	c0.15	c0.31		0.08	0.24		c0.15	c0.27		0.06	0.19	0.06
v/s Ratio Perm												0.09
v/c Ratio	0.85	0.90		0.58	0.77		0.82	0.86		0.62	0.82	0.34
Uniform Delay, d1	47.3	36.9		47.7	37.4		46.9	38.2		51.7	43.2	23.9
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	11.2	15.5		3.3	6.3		15.4	7.4		7.4	6.8	0.3
Delay (s)	58.5	52.4		51.1	43.6		62.3	45.6		59.1	50.0	24.2
Level of Service	E	D		D	D		E	D		E	D	C
Approach Delay (s)		55.3			45.5			49.1			42.1	
Approach LOS		E			D			D			D	

Intersection Summary				
HCM Average Control Delay	48.3	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.86			
Actuated Cycle Length (s)	118.9	Sum of lost time (s)	6.0	
Intersection Capacity Utilization	79.0%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1927	1900	1900	2155	1900
Lane Width	12	14	16	12	12	12	11	11	12	12	11	12
Total Lost time (s)		3.0	3.0		3.0		3.0	3.0			3.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95			0.95	
Frt		1.00	0.85		0.99		1.00	1.00			0.99	
Flt Protected		0.95	1.00		0.98		0.95	1.00			1.00	
Satd. Flow (prot)		1915	1812		1682		1728	3500			3876	
Flt Permitted		0.72	1.00		0.87		0.95	1.00			0.94	
Satd. Flow (perm)		1445	1812		1504		1728	3500			3626	
Volume (vph)	125	5	675	5	5	1	535	1200	10	10	850	65
Peak-hour factor, PHF	0.86	0.86	0.86	0.55	0.55	0.55	0.98	0.98	0.98	0.95	0.95	0.95
Adj. Flow (vph)	145	6	785	9	9	2	546	1224	10	11	895	68
RTOR Reduction (vph)	0	0	3	0	2	0	0	1	0	0	6	0
Lane Group Flow (vph)	0	151	782	0	18	0	546	1233	0	0	968	0
Heavy Vehicles (%)	1%	1%	1%	9%	9%	9%	1%	1%	1%	1%	1%	1%
Turn Type	Perm		pm+ov	Perm			Prot			Perm		
Protected Phases		8	5		4		5	2			6	
Permitted Phases	8	8	8	4	4			2		6	6	
Actuated Green, G (s)		11.7	53.1		11.7		41.4	70.3			24.9	
Effective Green, g (s)		12.7	55.1		12.7		42.4	71.3			25.9	
Actuated g/C Ratio		0.14	0.61		0.14		0.47	0.79			0.29	
Clearance Time (s)		4.0	4.0		4.0		4.0	4.0			4.0	
Vehicle Extension (s)		2.0	2.0		2.0		2.0	2.0			2.0	
Lane Grp Cap (vph)		204	1170		212		814	2773			1043	
v/s Ratio Prot			c0.32				0.32	0.35				
v/s Ratio Perm		c0.10	0.12		0.01						c0.27	
v/c Ratio		0.74	0.67		0.09		0.67	0.44			0.93	
Uniform Delay, d1		37.1	11.5		33.6		18.4	3.0			31.1	
Progression Factor		1.00	1.00		1.00		0.55	0.24			1.00	
Incremental Delay, d2		11.9	1.1		0.1		1.0	0.3			13.5	
Delay (s)		48.9	12.6		33.7		11.0	1.0			44.6	
Level of Service		D	B		C		B	A			D	
Approach Delay (s)		18.5			33.7			4.1			44.6	
Approach LOS		B			C			A			D	

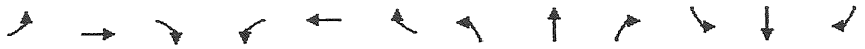
Intersection Summary			
HCM Average Control Delay	18.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	79.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	2181	2169	2339	1900	2147	1900	1900	1900	1900
Lane Width	11	11	11	11	11	11	11	11	11	11	11	12
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Flt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1745	1837	1561	1884	1883	1884	1745	3943	1546	1728	3445	
Flt Permitted	0.95	1.00	1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1745	1837	1561	1884	1883	1884	1745	3943	1546	1728	3445	
Volume (vph)	15	15	40	595	15	525	25	1205	810	540	970	20
Peak-hour factor, PHF	0.83	0.83	0.83	0.95	0.95	0.95	0.97	0.97	0.97	0.95	0.95	0.95
Adj. Flow (vph)	18	18	48	626	16	553	26	1242	835	568	1021	21
RTOR Reduction (vph)	0	0	35	0	0	9	0	0	57	0	2	0
Lane Group Flow (vph)	18	18	13	313	329	544	26	1242	778	568	1040	0
Heavy Vehicles (%)	0%	0%	0%	1%	0%	2%	0%	0%	1%	1%	1%	0%
Turn Type	Split		pt+ov	Split		pt+ov	Prot		pt+ov	Prot		
Protected Phases	3	3	3 5	4	4	4 1	5	2	2 4	1	6	
Permitted Phases		3						2			6	
Actuated Green, G (s)	0.8	0.8	23.0	16.5	16.5	49.0	18.2	28.2	44.7	28.5	38.5	
Effective Green, g (s)	1.8	1.8	24.0	17.5	17.5	50.0	19.2	29.2	46.7	29.5	39.5	
Actuated g/C Ratio	0.02	0.02	0.27	0.19	0.19	0.56	0.21	0.32	0.52	0.33	0.44	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lane Grp Cap (vph)	35	37	416	366	366	1047	372	1279	802	566	1512	
v/s Ratio Prot	c0.01	0.01	0.01	0.17	0.17	0.29	0.01	c0.31	c0.50	c0.33	0.30	
v/s Ratio Perm												
v/c Ratio	0.51	0.49	0.03	0.86	0.90	0.52	0.07	0.97	0.97	1.00	0.69	
Uniform Delay, d1	43.7	43.6	24.4	35.0	35.4	12.5	28.3	30.0	21.0	30.3	20.3	
Progression Factor	1.00	1.00	1.00	1.01	1.01	0.95	0.98	0.97	1.48	0.73	0.71	
Incremental Delay, d2	5.2	3.6	0.0	11.2	16.1	0.1	0.0	13.6	17.3	29.4	0.6	
Delay (s)	48.9	47.3	24.4	46.5	51.7	12.0	27.6	42.6	48.3	51.5	15.0	
Level of Service	D	D	C	D	D	B	C	D	D	D	B	
Approach Delay (s)		34.6			31.9			44.7			27.9	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM Average Control Delay	36.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	93.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR	SBR2	NEL	NER
Lane Configurations									
Ideal Flow (vphpl)	1900	1900	1900	1917	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	11	12	12	12	12
Total Lost time (s)	3.0			3.0	3.0			3.0	
Lane Util. Factor	1.00			0.95	0.95			0.97	
Flt	0.98			1.00	0.95			1.00	
Flt Protected	0.96			1.00	1.00			0.95	
Satd. Flow (prot)	1751			3486	3282			3502	
Flt Permitted	0.96			1.00	1.00			0.95	
Satd. Flow (perm)	1751			3486	3282			3502	
Volume (vph)	85	15	0	1450	1070	525	10	580	0
Peak-hour factor, PHF	0.75	0.75	0.95	0.95	0.95	0.95	0.95	0.89	0.89
Adj. Flow (vph)	113	20	0	1526	1126	553	11	652	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	133	0	0	1526	1690	0	0	652	0
Heavy Vehicles (%)	2%	2%	1%	1%	1%	1%	1%	0%	0%
Turn Type									
Protected Phases	4			2	6			3	
Permitted Phases					6				
Actuated Green, G (s)	8.6			51.7	51.7			17.7	
Effective Green, g (s)	9.6			52.7	52.7			18.7	
Actuated g/C Ratio	0.11			0.59	0.59			0.21	
Clearance Time (s)	4.0			4.0	4.0			4.0	
Vehicle Extension (s)	2.0			2.0	2.0			2.0	
Lane Grp Cap (vph)	187			2041	1922			728	
v/s Ratio Prot	c0.08			0.44	c0.51			c0.19	
v/s Ratio Perm									
v/c Ratio	0.71			0.75	0.88			0.90	
Uniform Delay, d1	38.9			13.7	15.9			34.7	
Progression Factor	1.00			1.00	0.31			1.00	
Incremental Delay, d2	10.1			2.6	3.3			13.3	
Delay (s)	49.0			16.3	8.2			48.0	
Level of Service	D			B	A			D	
Approach Delay (s)	49.0			16.3	8.2			48.0	
Approach LOS	D			B	A			D	

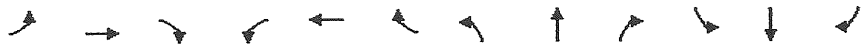
Intersection Summary				
HCM Average Control Delay	19.1	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.86			
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	9.0	
Intersection Capacity Utilization	78.9%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.91			0.91			1.00			1.00	
Flt Protected		0.98			0.98			1.00			1.00	
Satd. Flow (prot)		1700			1703			1893			1874	
Flt Permitted		0.89			0.94			0.94			0.98	
Satd. Flow (perm)		1541			1627			1782			1837	
Volume (vph)	10	0	20	5	0	10	40	1000	15	15	925	20
Peak-hour factor, PHF	0.61	0.61	0.61	0.75	0.75	0.75	0.93	0.93	0.93	0.95	0.95	0.95
Adj. Flow (vph)	16	0	33	7	0	13	43	1075	16	16	974	21
RTOR Reduction (vph)	0	31	0	0	12	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	18	0	0	8	0	0	1134	0	0	1010	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			2			1			1	
Permitted Phases	2			2			1			1		
Actuated Green, G (s)		5.7			5.7			76.0			76.0	
Effective Green, g (s)		6.7			6.7			77.0			77.0	
Actuated g/C Ratio		0.07			0.07			0.86			0.86	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		115			122			1530			1577	
v/s Ratio Prot												
v/s Ratio Perm		c0.01			0.00			c0.64			0.55	
v/c Ratio		0.16			0.07			0.74			0.64	
Uniform Delay, d1		38.9			38.6			2.5			2.0	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.7			0.2			3.3			2.0	
Delay (s)		39.5			38.8			5.7			4.0	
Level of Service		D			D			A			A	
Approach Delay (s)		39.5			38.8			5.7			4.0	
Approach LOS		D			D			A			A	

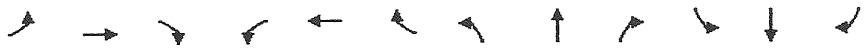
Intersection Summary				
HCM Average Control Delay	6.0	HCM Level of Service	A	
HCM Volume to Capacity ratio	0.69			
Actuated Cycle Length (s)	89.7	Sum of lost time (s)	6.0	
Intersection Capacity Utilization	87.6%	ICU Level of Service	E	
Analysis Period (min)	15			

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	11	10	10	10	12
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Util. Factor	0.97	1.00		1.00	1.00		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.95		1.00	0.97		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3351	1790		1711	1812		1728	3407		1668	3336	1599
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3351	1790		1711	1812		1728	3407		1668	3336	1599
Volume (vph)	475	355	170	125	315	70	235	785	80	95	605	360
Peak-hour factor, PHF	0.93	0.93	0.93	0.89	0.89	0.89	0.92	0.92	0.92	0.95	0.95	0.95
Adj. Flow (vph)	511	382	183	140	354	79	255	853	87	100	637	379
RTOR Reduction (vph)	0	22	0	0	10	0	0	9	0	0	0	104
Lane Group Flow (vph)	511	543	0	140	423	0	255	931	0	100	637	275
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	1%	1%	1%	1%	1%	1%
Turn Type	Prot			Prot			Prot			Prot		pm+ov
Protected Phases	7	4		3	8		5	2		1	6	7
Permitted Phases												6
Actuated Green, G (s)	12.0	23.9		7.0	18.9		12.0	24.9		4.8	17.7	29.7
Effective Green, g (s)	14.0	25.9		9.0	20.9		14.0	26.9		6.8	19.7	33.7
Actuated g/C Ratio	0.17	0.32		0.11	0.26		0.17	0.33		0.08	0.24	0.42
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	582	575		191	470		300	1137		141	815	728
v/s Ratio Prot	c0.15	c0.30		0.08	0.23		c0.15	c0.27		0.06	0.19	0.07
v/s Ratio Perm												0.11
v/c Ratio	0.88	0.94		0.73	0.90		0.85	0.82		0.71	0.78	0.38
Uniform Delay, d1	32.5	26.7		34.6	28.8		32.3	24.6		35.9	28.4	16.2
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	14.0	24.4		13.5	19.6		19.9	4.7		15.1	4.9	0.3
Delay (s)	46.5	51.1		48.2	48.5		52.2	29.3		51.0	33.3	16.5
Level of Service	D	D		D	D		D	C		D	C	B
Approach Delay (s)		48.9			48.4			34.2			29.2	
Approach LOS		D			D			C			C	

Intersection Summary				
HCM Average Control Delay	38.8	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.86			
Actuated Cycle Length (s)	80.6	Sum of lost time (s)	6.0	
Intersection Capacity Utilization	79.0%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	14	12	11	12	11	11	12
Total Lost time (s)		3.0			3.0	3.0		3.0		3.0	3.0	
Lane Util. Factor		1.00			1.00	1.00		0.95		1.00	1.00	
Frt		0.93			1.00	0.85		0.96		1.00	1.00	
Flt Protected		0.98			0.95	1.00		1.00		0.95	1.00	
Satd. Flow (prot)		1729			1805	1723		3332		1745	1836	
Flt Permitted		0.91			0.76	1.00		0.95		0.09	1.00	
Satd. Flow (perm)		1610			1435	1723		3181		165	1836	
Volume (vph)	2	0	2	393	0	190	2	955	410	215	745	2
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.97	0.97	0.97	0.95	0.95	0.95
Adj. Flow (vph)	2	0	2	414	0	200	2	985	423	226	784	2
RTOR Reduction (vph)	0	1	0	0	0	29	0	51	0	0	0	0
Lane Group Flow (vph)	0	3	0	0	414	171	0	1359	0	226	786	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm			Perm		pm+ov	Perm			pm+pt		
Protected Phases		4			4	1		2		1	6	
Permitted Phases	4			4		4	2			6		
Actuated Green, G (s)		28.2			28.2	37.5		40.5		53.8	53.8	
Effective Green, g (s)		29.2			29.2	39.5		41.5		54.8	54.8	
Actuated g/C Ratio		0.32			0.32	0.44		0.46		0.61	0.61	
Clearance Time (s)		4.0			4.0	4.0		4.0		4.0	4.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)		522			466	814		1467		281	1118	
v/s Ratio Prot						0.02				c0.09	0.43	
v/s Ratio Perm		0.00			c0.29	0.08		c0.43		0.40		
v/c Ratio		0.01			0.89	0.21		0.93		0.80	0.70	
Uniform Delay, d1		20.6			28.9	15.6		22.8		22.5	12.0	
Progression Factor		1.00			1.00	1.00		0.91		1.00	1.00	
Incremental Delay, d2		0.0			18.2	0.1		4.1		15.3	2.0	
Delay (s)		20.6			47.1	15.7		24.9		37.8	14.1	
Level of Service		C			D	B		C		D	B	
Approach Delay (s)		20.6			36.9			24.9			19.4	
Approach LOS		C			D			C			B	

Intersection Summary			
HCM Average Control Delay	25.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	117.3%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	5	35	1315	10	15	1030
Peak Hour Factor	0.68	0.68	0.92	0.92	0.93	0.93
Hourly flow rate (vph)	7	51	1429	11	16	1108
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						516
pX, platoon unblocked	0.42					
vC, conflicting volume	2575	720			1440	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	4731	720			1440	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	86			97	
cM capacity (veh/h)	0	375			467	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1
Volume Total	59	953	487	1124
Volume Left	7	0	0	16
Volume Right	51	0	11	0
cSH	2	1700	1700	467
Volume to Capacity	28.87	0.56	0.29	0.03
Queue Length 95th (ft)	Err	0	0	3
Control Delay (s)	Err	0.0	0.0	1.5
Lane LOS	F			A
Approach Delay (s)	Err	0.0		1.5
Approach LOS	F			

Intersection Summary			
Average Delay	224.9		
Intersection Capacity Utilization	76.2%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	35	45	850	35	20	725
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	36	47	885	36	21	755
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1701	904			922	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1701	904			922	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	63	86			97	
cM capacity (veh/h)	98	336			741	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	83	922	21	755
Volume Left	36	0	21	0
Volume Right	47	36	0	0
cSH	163	1700	741	1700
Volume to Capacity	0.51	0.54	0.03	0.44
Queue Length 95th (ft)	63	0	2	0
Control Delay (s)	48.1	0.0	10.0	0.0
Lane LOS	E		B	
Approach Delay (s)	48.1	0.0	0.3	
Approach LOS	E			

Intersection Summary			
Average Delay	2.4		
Intersection Capacity Utilization	58.2%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	55	760	0	1	570	5	5	0	1	5	1	40
Peak Hour Factor	0.93	0.93	0.93	0.91	0.91	0.91	0.88	0.88	0.88	0.75	0.75	0.75
Hourly flow rate (vph)	59	817	0	1	626	5	6	0	1	7	1	53
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)					869							
pX, platoon unblocked												
vC, conflicting volume	632			817			1621	1570	817	1568	1567	629
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	632			817			1621	1570	817	1568	1567	629
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	94			100			92	100	100	92	99	89
cM capacity (veh/h)	951			802			70	105	379	86	105	486

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	876	633	7	61
Volume Left	59	1	6	7
Volume Right	0	5	1	53
cSH	951	802	81	307
Volume to Capacity	0.06	0.00	0.08	0.20
Queue Length 95th (ft)	5	0	7	18
Control Delay (s)	1.6	0.0	53.4	19.6
Lane LOS	A	A	F	C
Approach Delay (s)	1.6	0.0	53.4	19.6
Approach LOS			F	C

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	86.7%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	10	1	45	10	0	15	50	1060	25	15	735	45
Peak Hour Factor	0.67	0.67	0.67	0.63	0.63	0.63	0.95	0.95	0.95	0.81	0.81	0.81
Hourly flow rate (vph)	15	1	67	16	0	24	53	1116	26	19	907	56
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2230	2220	935	2274	2234	1129	963			1142		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2230	2220	935	2274	2234	1129	963			1142		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	42	96	79	22	100	90	93			97		
cM capacity (veh/h)	26	40	325	20	39	251	719			615		

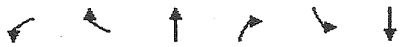
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	84	40	1195	981
Volume Left	15	16	53	19
Volume Right	67	24	26	56
cSH	102	46	719	615
Volume to Capacity	0.82	0.87	0.07	0.03
Queue Length 95th (ft)	115	88	6	2
Control Delay (s)	121.6	233.1	2.7	1.0
Lane LOS	F	F	A	A
Approach Delay (s)	121.6	233.1	2.7	1.0
Approach LOS	F	F		

Intersection Summary			
Average Delay	10.2		
Intersection Capacity Utilization	94.1%	ICU Level of Service	F
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕		↰	↕	
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	1	5	20	10	0	285	10	910	10	150	745	5
Peak Hour Factor	0.69	0.69	0.69	0.75	0.75	0.75	0.80	0.80	0.80	0.95	0.95	0.95
Hourly flow rate (vph)	1	7	29	13	0	380	12	1138	12	158	784	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)											1018	
pX, platoon unblocked	0.51	0.51	0.51	0.51	0.51		0.51					
vC, conflicting volume	2651	2278	787	2301	2274	1144	789			1150		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	4214	3486	585	3532	3479	1144	590			1150		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	89	0	100	0	98			74		
cM capacity (veh/h)	0	2	264	0	2	246	509			611		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1	SB 2
Volume Total	38	393	1162	158	789
Volume Left	1	13	12	158	0
Volume Right	29	380	12	0	5
cSH	0	0	509	611	1700
Volume to Capacity	Err	Err	0.02	0.26	0.46
Queue Length 95th (ft)	Err	Err	2	26	0
Control Delay (s)	Err	Err	1.1	12.9	0.0
Lane LOS	F	F	A	B	
Approach Delay (s)	Err	Err	1.1	2.2	
Approach LOS	F	F			

Intersection Summary			
Average Delay	Err		
Intersection Capacity Utilization	120.6%	ICU Level of Service	H
Analysis Period (min)	15		



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	15	15	1020	25	15	845
Peak Hour Factor	0.84	0.84	0.93	0.93	0.95	0.95
Hourly flow rate (vph)	18	18	1097	27	16	889
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			771			1063
pX, platoon unblocked	0.83					
vC, conflicting volume	2031	1110			1124	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2242	1110			1124	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	53	93			97	
cM capacity (veh/h)	38	257			625	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	36	1124	905
Volume Left	18	0	16
Volume Right	18	27	0
cSH	66	1700	625
Volume to Capacity	0.54	0.66	0.03
Queue Length 95th (ft)	55	0	2
Control Delay (s)	110.3	0.0	0.8
Lane LOS	F		A
Approach Delay (s)	110.3	0.0	0.8
Approach LOS	F		

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	66.5%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	10	10	1035	45	20	840
Peak Hour Factor	0.61	0.61	0.97	0.97	0.93	0.93
Hourly flow rate (vph)	16	16	1067	46	22	903
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			407			
pX, platoon unblocked						
vC, conflicting volume	1585	1090			1113	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1585	1090			1113	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	83	92			97	
cM capacity (veh/h)	98	213			635	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	33	1113	323	602
Volume Left	16	0	22	0
Volume Right	16	46	0	0
cSH	134	1700	635	1700
Volume to Capacity	0.24	0.65	0.03	0.35
Queue Length 95th (ft)	23	0	3	0
Control Delay (s)	40.4	0.0	1.1	0.0
Lane LOS	E		A	
Approach Delay (s)	40.4	0.0	0.4	
Approach LOS	E			

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	67.2%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	5	35	1415	10	15	1115
Peak Hour Factor	0.68	0.68	0.92	0.92	0.93	0.93
Hourly flow rate (vph)	7	51	1538	11	16	1199
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						516
pX, platoon unblocked	0.42					
vC, conflicting volume	2775	774			1549	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	5200	774			1549	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	85			96	
cM capacity (veh/h)	0	345			424	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1
Volume Total	59	1025	524	1215
Volume Left	7	0	0	16
Volume Right	51	0	11	0
cSH	1	1700	1700	424
Volume to Capacity	63.91	0.60	0.31	0.04
Queue Length 95th (ft)	Err	0	0	3
Control Delay (s)	Err	0.0	0.0	1.9
Lane LOS	F			A
Approach Delay (s)	Err	0.0		1.9
Approach LOS	F			

Intersection Summary			
Average Delay	209.2		
Intersection Capacity Utilization	80.7%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	35	45	915	35	20	785
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	36	47	953	36	21	818
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1831	971			990	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1831	971			990	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	55	85			97	
cM capacity (veh/h)	81	307			699	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	83	990	21	818
Volume Left	36	0	21	0
Volume Right	47	36	0	0
cSH	139	1700	699	1700
Volume to Capacity	0.60	0.58	0.03	0.48
Queue Length 95th (ft)	78	0	2	0
Control Delay (s)	63.9	0.0	10.3	0.0
Lane LOS	F		B	
Approach Delay (s)	63.9	0.0	0.3	
Approach LOS	F			

Intersection Summary			
Average Delay	2.9		
Intersection Capacity Utilization	61.6%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	55	800	0	1	600	5	5	0	1	5	1	40
Peak Hour Factor	0.93	0.93	0.93	0.91	0.91	0.91	0.88	0.88	0.88	0.75	0.75	0.75
Hourly flow rate (vph)	59	860	0	1	659	5	6	0	1	7	1	53
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)					869							
pX, platoon unblocked												
vC, conflicting volume	665			860			1697	1646	860	1644	1643	662
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	665			860			1697	1646	860	1644	1643	662
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	94			100			91	100	100	91	99	89
cM capacity (veh/h)	924			773			62	94	358	76	94	465

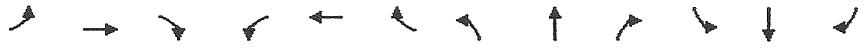
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	919	666	7	61
Volume Left	59	1	6	7
Volume Right	0	5	1	53
cSH	924	773	71	284
Volume to Capacity	0.06	0.00	0.10	0.22
Queue Length 95th (ft)	5	0	8	20
Control Delay (s)	1.7	0.0	60.7	21.2
Lane LOS	A	A	F	C
Approach Delay (s)	1.7	0.0	60.7	21.2
Approach LOS			F	C

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	90.4%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	10	1	45	15	0	15	50	1090	30	15	765	45
Peak Hour Factor	0.67	0.67	0.67	0.63	0.63	0.63	0.95	0.95	0.95	0.81	0.81	0.81
Hourly flow rate (vph)	15	1	67	24	0	24	53	1147	32	19	944	56
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2301	2293	972	2346	2305	1163	1000			1179		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2301	2293	972	2346	2305	1163	1000			1179		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	35	96	78	0	100	90	92			97		
cM capacity (veh/h)	23	35	309	18	35	239	696			596		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	84	48	1232	1019
Volume Left	15	24	53	19
Volume Right	67	24	32	56
cSH	91	33	696	596
Volume to Capacity	0.91	1.43	0.08	0.03
Queue Length 95th (ft)	128	131	6	2
Control Delay (s)	153.7	492.9	3.0	1.0
Lane LOS	F	F	A	A
Approach Delay (s)	153.7	492.9	3.0	1.0
Approach LOS	F	F		

Intersection Summary				
Average Delay	17.2			
Intersection Capacity Utilization	96.7%	ICU Level of Service	F	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	1	5	20	0	0	0	10	1245	10	170	775	5
Peak Hour Factor	0.69	0.69	0.69	0.75	0.75	0.75	0.80	0.80	0.80	0.95	0.95	0.95
Hourly flow rate (vph)	1	7	29	0	0	0	12	1556	12	179	816	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)											1018	
pX, platoon unblocked	0.57	0.57	0.57	0.57	0.57		0.57					
vC, conflicting volume	2764	2770	818	2794	2766	1562	821			1569		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	4120	4131	679	4173	4125	1562	683			1569		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	89	0	100	100	98			58		
cM capacity (veh/h)	0	1	257	0	1	139	517			423		

Direction, Lane #	EB 1	NB 1	SB 1	SB 2
Volume Total	38	1581	179	821
Volume Left	1	12	179	0
Volume Right	29	12	0	5
cSH	3	517	423	1700
Volume to Capacity	12.72	0.02	0.42	0.48
Queue Length 95th (ft)	Err	2	51	0
Control Delay (s)	Err	3.9	19.6	0.0
Lane LOS	F	A	C	
Approach Delay (s)	Err	3.9	3.5	
Approach LOS	F			

Intersection Summary			
Average Delay	147.5		
Intersection Capacity Utilization	121.1%	ICU Level of Service	H
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	15	15	1120	25	15	945
Peak Hour Factor	0.84	0.84	0.93	0.93	0.95	0.95
Hourly flow rate (vph)	18	18	1204	27	16	995
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			364			1075
pX, platoon unblocked	0.80	0.67			0.67	
vC, conflicting volume	2244	616			1231	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1507	0			844	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	80	98			97	
cM capacity (veh/h)	89	726			528	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1
Volume Total	36	803	428	1011
Volume Left	18	0	0	16
Volume Right	18	0	27	0
cSH	158	1700	1700	528
Volume to Capacity	0.23	0.47	0.25	0.03
Queue Length 95th (ft)	21	0	0	2
Control Delay (s)	34.3	0.0	0.0	1.0
Lane LOS	D			A
Approach Delay (s)	34.3	0.0		1.0
Approach LOS	D			

Intersection Summary				
Average Delay	1.0			
Intersection Capacity Utilization	71.7%	ICU Level of Service	C	
Analysis Period (min)	15			

Lane Group	EBT	EBR	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	70	602	49	542	742	870
v/c Ratio	0.36	0.63	0.21	0.72	0.23	0.68
Control Delay	47.5	14.4	35.6	26.8	1.6	25.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.5	14.4	35.6	26.9	1.6	25.3
Queue Length 50th (ft)	33	159	17	235	37	196
Queue Length 95th (ft)	102	342	51	447	51	359
Internal Link Dist (ft)	445		188		584	705
Turn Bay Length (ft)		200		250		
Base Capacity (vph)	237	1207	293	1046	3249	1737
Starvation Cap Reductn	0	0	0	26	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.30	0.50	0.17	0.53	0.23	0.50

Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	40	48	48	250	213	411	33	879	489	440	1030
v/c Ratio	0.29	0.33	0.28	0.72	0.76	0.46	0.24	0.77	0.57	0.85	0.57
Control Delay	58.2	59.0	20.0	55.1	60.6	13.8	57.1	37.6	14.7	50.5	15.0
Queue Delay	0.0	0.0	0.1	0.2	0.3	0.0	0.0	1.3	0.3	0.0	0.1
Total Delay	58.2	59.0	20.1	55.3	60.9	13.8	57.1	38.9	15.0	50.5	15.2
Queue Length 50th (ft)	29	34	0	181	192	136	23	304	173	295	284
Queue Length 95th (ft)	47	53	16	#323	#370	226	59	395	272	396	318
Internal Link Dist (ft)		152			327			304			584
Turn Bay Length (ft)	75		75			150	75		185	250	
Base Capacity (vph)	139	147	169	418	342	912	147	1393	898	658	1945
Starvation Cap Reductn	0	0	0	0	0	0	0	299	94	0	0
Spillback Cap Reductn	0	0	7	14	11	0	0	0	0	0	210
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.33	0.30	0.62	0.64	0.45	0.22	0.80	0.61	0.67	0.59

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	NBT	SBT	SBR	NEL
Lane Group Flow (vph)	72	933	931	409	432
v/c Ratio	0.35	0.48	0.85	0.44	0.62
Control Delay	51.3	10.4	22.9	10.9	41.1
Queue Delay	0.1	0.1	6.1	0.7	0.1
Total Delay	51.4	10.4	29.0	11.5	41.1
Queue Length 50th (ft)	41	152	420	121	124
Queue Length 95th (ft)	104	204	636	189	216
Internal Link Dist (ft)	1038	436	304		1207
Turn Bay Length (ft)					
Base Capacity (vph)	229	2302	1300	1106	897
Starvation Cap Reductn	0	0	313	377	0
Spillback Cap Reductn	7	249	0	0	29
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.32	0.45	0.94	0.56	0.50

Intersection Summary

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	15	44	982	862
v/c Ratio	0.10	0.26	0.59	0.54
Control Delay	16.6	14.8	4.2	3.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	16.6	14.8	4.2	3.6
Queue Length 50th (ft)	4	8	100	79
Queue Length 95th (ft)	12	19	206	180
Internal Link Dist (ft)	938	531	983	384
Turn Bay Length (ft)				
Base Capacity (vph)	237	253	1652	1611
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.06	0.17	0.59	0.54

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	347	468	167	371	189	634	67	517	361
v/c Ratio	0.56	0.68	0.60	0.65	0.64	0.63	0.37	0.65	0.40
Control Delay	43.5	35.1	51.9	35.6	52.5	32.2	53.9	40.2	5.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	43.5	35.1	51.9	35.6	52.5	32.2	53.9	40.2	5.9
Queue Length 50th (ft)	108	269	102	207	116	180	42	165	21
Queue Length 95th (ft)	180	435	197	336	197	239	98	253	91
Internal Link Dist (ft)		854		619		1014		262	
Turn Bay Length (ft)	200		100		100		100		100
Base Capacity (vph)	769	798	353	747	370	1295	206	1009	932
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.45	0.59	0.47	0.50	0.51	0.49	0.33	0.51	0.39

Intersection Summary

Lane Group	EBT	EBR	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	70	629	49	563	784	921
v/c Ratio	0.39	0.66	0.22	0.73	0.24	0.71
Control Delay	50.6	16.0	37.3	28.1	1.6	27.3
Queue Delay	0.0	0.0	0.0	0.1	0.0	0.0
Total Delay	50.6	16.0	37.3	28.2	1.6	27.3
Queue Length 50th (ft)	37	195	19	270	41	233
Queue Length 95th (ft)	102	374	51	471	54	386
Internal Link Dist (ft)	445		188		584	705
Turn Bay Length (ft)		200		250		
Base Capacity (vph)	220	1174	273	1017	3247	1672
Starvation Cap Reductn	0	0	0	25	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.32	0.54	0.18	0.57	0.24	0.55

Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	40	48	48	235	249	438	33	918	516	470	1078
v/c Ratio	0.30	0.34	0.29	0.70	0.74	0.48	0.25	0.80	0.60	0.87	0.51
Control Delay	59.7	60.6	20.3	55.1	57.1	14.9	58.4	39.5	15.9	53.5	13.7
Queue Delay	0.0	0.0	0.2	0.4	0.4	0.0	0.0	2.9	0.5	0.0	0.1
Total Delay	59.7	60.6	20.4	55.5	57.6	14.9	58.4	42.3	16.4	53.5	13.8
Queue Length 50th (ft)	30	36	0	181	192	162	25	337	206	335	248
Queue Length 95th (ft)	47	53	16	#293	#318	250	59	418	294	431	274
Internal Link Dist (ft)		152			327			304			584
Turn Bay Length (ft)	75		75			150	75		185	250	
Base Capacity (vph)	134	141	164	403	406	921	142	1363	889	648	2222
Starvation Cap Reductn	0	0	0	0	0	0	0	324	105	0	0
Spillback Cap Reductn	0	0	7	20	20	7	0	0	0	0	256
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.30	0.34	0.31	0.61	0.65	0.48	0.23	0.88	0.66	0.73	0.55

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	NBT	SBT	SBR	NEL
Lane Group Flow (vph)	72	974	973	431	455
v/c Ratio	0.37	0.48	0.87	0.45	0.66
Control Delay	54.2	10.3	24.6	11.0	44.0
Queue Delay	0.4	0.1	13.8	0.9	0.2
Total Delay	54.6	10.5	38.4	11.9	44.2
Queue Length 50th (ft)	46	170	489	138	144
Queue Length 95th (ft)	104	214	705	203	227
Internal Link Dist (ft)	1038	436	304		1207
Turn Bay Length (ft)					
Base Capacity (vph)	217	2327	1291	1099	861
Starvation Cap Reductn	0	0	315	398	0
Spillback Cap Reductn	21	439	0	0	54
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.37	0.52	1.00	0.61	0.56

Intersection Summary

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	44	44	1035	899
v/c Ratio	0.24	0.24	0.66	0.57
Control Delay	14.4	14.5	5.9	4.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.4	14.5	5.9	4.3
Queue Length 50th (ft)	6	6	117	86
Queue Length 95th (ft)	19	18	258	207
Internal Link Dist (ft)	938	531	983	384
Turn Bay Length (ft)				
Base Capacity (vph)	273	271	1575	1581
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.16	0.16	0.66	0.57

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	358	489	172	392	195	652	67	533	378
v/c Ratio	0.61	0.75	0.64	0.70	0.66	0.58	0.40	0.71	0.44
Control Delay	45.9	38.4	55.1	38.4	54.3	31.6	56.0	43.0	7.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.9	38.4	55.1	38.4	54.3	31.6	56.0	43.0	7.8
Queue Length 50th (ft)	120	303	114	236	129	197	45	183	40
Queue Length 95th (ft)	186	460	203	358	202	246	98	262	120
Internal Link Dist (ft)		854		619		1014		262	
Turn Bay Length (ft)	200		100		100		100		100
Base Capacity (vph)	704	747	329	707	361	1273	190	935	883
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.51	0.65	0.52	0.55	0.54	0.51	0.35	0.57	0.43

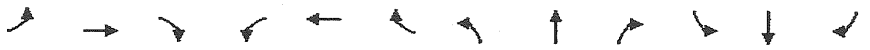
Intersection Summary

Lane Group	EBT	EBR	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	70	651	49	579	848	956
v/c Ratio	0.55	0.71	0.30	0.82	0.27	0.63
Control Delay	68.1	24.3	44.6	41.2	1.7	29.1
Queue Delay	0.0	0.0	0.0	0.6	0.0	0.0
Total Delay	68.1	24.3	44.6	41.8	1.7	29.1
Queue Length 50th (ft)	52	323	26	387	48	308
Queue Length 95th (ft)	102	400	51	490	60	421
Internal Link Dist (ft)	445		188		584	705
Turn Bay Length (ft)		200		250		
Base Capacity (vph)	140	966	178	786	3143	1523
Starvation Cap Reductn	0	0	0	42	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.50	0.67	0.28	0.78	0.27	0.63

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	14	16	12	12	12	12	12	12	12	12	12
Total Lost time (s)		3.0	3.0		3.0		3.0	3.0			3.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95			0.95	
Flt		1.00	0.85		0.96		1.00	1.00			0.98	
Flt Protected		0.96	1.00		0.99		0.95	1.00			1.00	
Satd. Flow (prot)		1918	1812		1801		1787	3564			3512	
Flt Permitted		0.69	1.00		0.90		0.95	1.00			0.95	
Satd. Flow (perm)		1384	1812		1640		1787	3564			3341	
Volume (vph)	60	5	605	10	15	10	550	790	15	5	775	100
Peak-hour factor, PHF	0.93	0.93	0.93	0.73	0.73	0.73	0.95	0.95	0.95	0.92	0.92	0.92
Adj. Flow (vph)	65	5	651	14	21	14	579	832	16	5	842	109
RTOR Reduction (vph)	0	0	26	0	12	0	0	1	0	0	7	0
Lane Group Flow (vph)	0	70	625	0	37	0	579	847	0	0	949	0
Heavy Vehicles (%)	1%	1%	1%	0%	0%	0%	1%	1%	1%	1%	1%	1%
Turn Type	Perm		pm+ov	Perm			Prot			Perm		
Protected Phases		8	5		4		5	2			6	
Permitted Phases	8	8	8	4	4			2		6	6	
Actuated Green, G (s)		7.6	51.9		7.6		44.3	100.3			51.0	
Effective Green, g (s)		9.6	55.9		9.6		46.3	102.3			53.0	
Actuated g/C Ratio		0.08	0.47		0.08		0.39	0.87			0.45	
Clearance Time (s)		5.0	5.0		5.0		5.0	5.0			5.0	
Vehicle Extension (s)		2.5	2.5		2.5		2.5	3.0			3.0	
Lane Grp Cap (vph)		113	905		134		702	3092			1502	
v/s Ratio Prot			c0.27				c0.32	0.24				
v/s Ratio Perm		0.05	0.07		0.02						c0.28	
v/c Ratio		0.62	0.69		0.28		0.82	0.27			0.63	
Uniform Delay, d1		52.4	24.2		50.9		32.2	1.4			24.9	
Progression Factor		1.00	1.00		1.00		1.00	1.00			1.00	
Incremental Delay, d2		8.4	2.1		0.8		7.7	0.2			0.9	
Delay (s)		60.7	26.3		51.7		39.8	1.6			25.8	
Level of Service		E	C		D		D	A			C	
Approach Delay (s)		29.7			51.7			17.1			25.8	
Approach LOS		C			D			B			C	

Intersection Summary			
HCM Average Control Delay	23.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	117.9	Sum of lost time (s)	9.0
Intersection Capacity Utilization	76.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

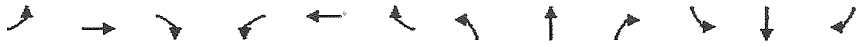


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	12	12	12	11	11	11
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1900	1615	1698	1710	1599	1805	3610	1615	1728	3424	
Flt Permitted	0.95	1.00	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1805	1900	1615	1698	1710	1599	1805	3610	1615	1728	3424	
Volume (vph)	25	30	30	600	30	580	30	750	665	550	790	50
Peak-hour factor, PHF	0.92	0.92	0.92	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	27	33	33	612	31	592	31	765	679	561	806	51
RTOR Reduction (vph)	0	0	31	0	0	53	0	0	0	0	4	0
Lane Group Flow (vph)	27	33	2	313	330	539	31	765	679	561	853	0
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Turn Type	Split		Prot	Split		pm+ov	Prot		pm+ov	Prot		
Protected Phases	3	3	3	4	4	1	5	2	4	1	6	
Permitted Phases		3				4		2	2		6	
Actuated Green, G (s)	4.2	4.2	4.2	21.8	21.8	58.9	3.4	30.5	52.3	37.1	64.2	
Effective Green, g (s)	5.7	5.7	5.7	23.3	23.3	61.9	4.9	32.5	55.8	38.6	66.2	
Actuated g/C Ratio	0.05	0.05	0.05	0.21	0.21	0.55	0.04	0.29	0.50	0.34	0.59	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5.0	4.5	4.5	5.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	2.0	2.0	3.0	3.0	2.0	3.0	
Lane Grp Cap (vph)	92	97	82	353	355	926	79	1047	804	595	2022	
v/s Ratio Prot	0.01	c0.02	0.00	0.18	c0.19	0.20	0.02	0.21	c0.18	c0.32	0.25	
v/s Ratio Perm						0.14			0.24			
v/c Ratio	0.29	0.34	0.02	0.89	0.93	0.58	0.39	0.73	0.84	0.94	0.42	
Uniform Delay, d1	51.3	51.4	50.5	43.1	43.6	16.6	52.2	35.9	24.4	35.7	12.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.8	2.1	0.1	22.4	30.0	0.6	1.2	2.7	8.1	23.3	0.1	
Delay (s)	53.0	53.5	50.6	65.5	73.6	17.2	53.3	38.5	32.5	59.0	12.7	
Level of Service	D	D	D	E	E	B	D	D	C	E	B	
Approach Delay (s)		52.3			44.5			36.1			31.0	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM Average Control Delay	37.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	112.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	85.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR	SBR2	NEL	NER
Lane Configurations									
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	11	11	11	11	11	11	11
Total Lost time (s)	3.0			3.0	3.0	3.0		3.0	
Lane Util. Factor	1.00			0.95	1.00	1.00		0.97	
Frt	0.98			1.00	1.00	0.85		1.00	
Flt Protected	0.96			1.00	1.00	1.00		0.95	
Satd. Flow (prot)	1787			3452	1818	1546		3385	
Flt Permitted	0.96			0.85	1.00	1.00		0.95	
Satd. Flow (perm)	1787			2934	1818	1546		3385	
Volume (vph)	60	10	15	980	970	430	20	450	0
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.94	0.94	0.94	0.88	0.88
Adj. Flow (vph)	62	10	16	1021	1032	457	21	511	0
RTOR Reduction (vph)	0	0	0	0	0	1	0	0	0
Lane Group Flow (vph)	72	0	0	1037	1032	477	0	511	0
Heavy Vehicles (%)	0%	0%	1%	1%	1%	1%	1%	0%	0%
Turn Type			Perm			Perm			
Protected Phases	3			2	6			4	
Permitted Phases			2		6	6			
Actuated Green, G (s)	5.5			59.5	59.5	59.5		17.3	
Effective Green, g (s)	7.5			61.5	61.5	61.5		19.3	
Actuated g/C Ratio	0.08			0.63	0.63	0.63		0.20	
Clearance Time (s)	5.0			5.0	5.0	5.0		5.0	
Vehicle Extension (s)	2.5			3.0	3.0	3.0		2.5	
Lane Grp Cap (vph)	138			1854	1149	977		671	
v/s Ratio Prot	c0.04				c0.57			c0.15	
v/s Ratio Perm				0.35		0.31			
v/c Ratio	0.52			0.56	0.90	0.49		0.76	
Uniform Delay, d1	43.2			10.2	15.2	9.5		36.8	
Progression Factor	1.00			1.00	1.00	1.00		1.00	
Incremental Delay, d2	2.7			0.4	9.4	0.4		4.9	
Delay (s)	45.9			10.6	24.7	9.9		41.7	
Level of Service	D			B	C	A		D	
Approach Delay (s)	45.9			10.6	20.0			41.7	
Approach LOS	D			B	C			D	

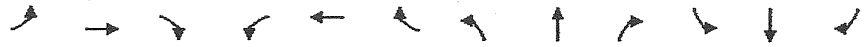
Intersection Summary			
HCM Average Control Delay	21.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	97.3	Sum of lost time (s)	9.0
Intersection Capacity Utilization	78.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.91			0.91			1.00			1.00	
Flt Protected		0.98			0.98			1.00			1.00	
Satd. Flow (prot)		1704			1702			1893			1877	
Flt Permitted		0.93			0.93			0.95			0.97	
Satd. Flow (perm)		1614			1607			1810			1821	
Volume (vph)	10	1	20	10	0	20	30	955	15	20	935	10
Peak-hour factor, PHF	0.69	0.69	0.69	0.68	0.68	0.68	0.86	0.86	0.86	0.94	0.94	0.94
Adj. Flow (vph)	14	1	29	15	0	29	35	1110	17	21	995	11
RTOR Reduction (vph)	0	27	0	0	27	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	17	0	0	17	0	0	1162	0	0	1027	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			2			1			1	
Permitted Phases	2			2			1			1		
Actuated Green, G (s)		5.7			5.7			71.2			71.2	
Effective Green, g (s)		6.7			6.7			72.2			72.2	
Actuated g/C Ratio		0.08			0.08			0.85			0.85	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		127			127			1539			1549	
v/s Ratio Prot												
v/s Ratio Perm		0.01			c0.01			c0.64			0.56	
v/c Ratio		0.14			0.14			0.75			0.66	
Uniform Delay, d1		36.4			36.4			2.7			2.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.5			0.5			3.5			2.3	
Delay (s)		36.9			36.9			6.1			4.4	
Level of Service		D			D			A			A	
Approach Delay (s)		36.9			36.9			6.1			4.4	
Approach LOS		D			D			A			A	

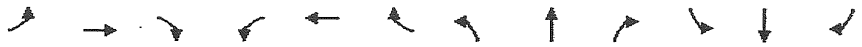
Intersection Summary			
HCM Average Control Delay	6.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	84.9	Sum of lost time (s)	6.0
Intersection Capacity Utilization	78.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	11	10	10	10	12
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Util. Factor	0.97	1.00		1.00	1.00		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.95		1.00	0.98		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3385	1804		1745	1861		1745	3370		1668	3336	1599
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3385	1804		1745	1861		1745	3370		1668	3336	1599
Volume (vph)	380	355	180	160	345	55	210	405	120	60	475	375
Peak-hour factor, PHF	0.95	0.95	0.95	0.93	0.93	0.93	0.82	0.82	0.82	0.90	0.90	0.90
Adj. Flow (vph)	400	374	189	172	371	59	256	494	146	67	528	417
RTOR Reduction (vph)	0	15	0	0	5	0	0	22	0	0	0	137
Lane Group Flow (vph)	400	548	0	172	425	0	256	618	0	67	528	280
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Turn Type	Prot			Prot			Prot			Prot		pm+ov
Protected Phases	7	4		3	8		5	2		1	6	7
Permitted Phases												6
Actuated Green, G (s)	16.1	34.1		14.1	32.1		16.9	33.1		6.5	22.7	38.8
Effective Green, g (s)	18.1	36.1		16.1	34.1		18.9	35.1		8.5	24.7	42.8
Actuated g/C Ratio	0.17	0.33		0.15	0.32		0.18	0.33		0.08	0.23	0.40
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	568	604		261	589		306	1097		132	764	679
v/s Ratio Prot	c0.12	c0.30		0.10	0.23		c0.15	0.18		0.04	c0.16	0.07
v/s Ratio Perm												0.11
v/c Ratio	0.70	0.91		0.66	0.72		0.84	0.56		0.51	0.69	0.41
Uniform Delay, d1	42.3	34.2		43.3	32.6		43.0	30.0		47.6	38.1	23.4
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	4.0	17.3		5.9	4.4		17.7	0.7		3.1	2.7	0.4
Delay (s)	46.3	51.5		49.2	37.0		60.6	30.7		50.7	40.8	23.8
Level of Service	D	D		D	D		E	C		D	D	C
Approach Delay (s)		49.3			40.5			39.2			34.4	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM Average Control Delay	40.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	107.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	76.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	14	16	12	12	12	11	11	12	12	11	12
Total Lost time (s)		3.0	3.0		3.0		3.0	3.0			3.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95			0.95	
Frt		1.00	0.85		0.96		1.00	1.00			0.98	
Flt Protected		0.96	1.00		0.99		0.95	1.00			1.00	
Satd. Flow (prot)		1918	1812		1801		1728	3445			3395	
Flt Permitted		0.76	1.00		0.91		0.95	1.00			0.95	
Satd. Flow (perm)		1531	1812		1656		1728	3445			3230	
Volume (vph)	60	5	605	10	15	10	550	790	15	5	775	100
Peak-hour factor, PHF	0.93	0.93	0.93	0.73	0.73	0.73	0.95	0.95	0.95	0.92	0.92	0.92
Adj. Flow (vph)	65	5	651	14	21	14	579	832	16	5	842	109
RTOR Reduction (vph)	0	0	3	0	13	0	0	1	0	0	9	0
Lane Group Flow (vph)	0	70	648	0	36	0	579	847	0	0	947	0
Heavy Vehicles (%)	1%	1%	1%	0%	0%	0%	1%	1%	1%	1%	1%	1%
Turn Type	Perm		pm+ov	Perm			Prot			Perm		
Protected Phases		8	5		4		5	2			6	
Permitted Phases	8	8	8	4	4			2		6	6	
Actuated Green, G (s)		7.8	48.7		7.8		40.9	74.2			29.3	
Effective Green, g (s)		8.8	50.7		8.8		41.9	75.2			30.3	
Actuated g/C Ratio		0.10	0.56		0.10		0.47	0.84			0.34	
Clearance Time (s)		4.0	4.0		4.0		4.0	4.0			4.0	
Vehicle Extension (s)		3.0	3.0		3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)		150	1081		162		804	2878			1087	
v/s Ratio Prot			c0.28				c0.34	0.25				
v/s Ratio Perm		0.05	0.08		0.02						c0.29	
v/c Ratio		0.47	0.60		0.22		0.72	0.29			0.87	
Uniform Delay, d1		38.4	13.0		37.5		19.3	1.6			28.0	
Progression Factor		1.00	1.00		1.00		0.92	0.70			1.00	
Incremental Delay, d2		2.3	0.9		0.7		2.0	0.2			7.8	
Delay (s)		40.7	13.9		38.2		19.8	1.3			35.8	
Level of Service		D	B		D		B	A			D	
Approach Delay (s)		16.5			38.2			8.8			35.8	
Approach LOS		B			D			A			D	

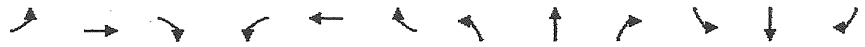
Intersection Summary			
HCM Average Control Delay	19.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	77.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	11	11	11	11	11	11	11	11	12
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1745	1837	1561	1641	1653	1546	1745	3490	1561	1728	3424	
Flt Permitted	0.95	1.00	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1745	1837	1561	1641	1653	1546	1745	3490	1561	1728	3424	
Volume (vph)	25	30	30	600	30	580	30	750	665	550	790	50
Peak-hour factor, PHF	0.92	0.92	0.92	0.96	0.96	0.96	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	27	33	33	625	31	604	32	789	700	579	832	53
RTOR Reduction (vph)	0	0	24	0	0	32	0	0	80	0	7	0
Lane Group Flow (vph)	27	33	9	320	336	572	32	789	620	579	878	0
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Turn Type	Split		pt+ov	Split		pt+ov	Prot		pt+ov	Prot		
Protected Phases	3	3	3 5	4	4	4 1	5	2	2 4	1	6	
Permitted Phases		3						2			6	
Actuated Green, G (s)	2.4	2.4	22.8	20.4	20.4	55.0	16.4	20.6	41.0	30.6	34.8	
Effective Green, g (s)	3.4	3.4	23.8	21.4	21.4	56.0	17.4	21.6	43.0	31.6	35.8	
Actuated g/C Ratio	0.04	0.04	0.26	0.24	0.24	0.62	0.19	0.24	0.48	0.35	0.40	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	66	69	413	390	393	962	337	838	746	607	1362	
v/s Ratio Prot	0.02	c0.02	0.01	0.19	c0.20	0.37	0.02	c0.23	0.40	c0.34	c0.26	
v/s Ratio Perm												
v/c Ratio	0.41	0.48	0.02	0.82	0.85	0.59	0.09	0.94	0.83	0.95	0.64	
Uniform Delay, d1	42.3	42.4	24.5	32.5	32.8	10.2	29.8	33.6	20.4	28.5	21.9	
Progression Factor	1.00	1.00	1.00	0.98	0.98	0.88	0.91	0.88	1.05	0.75	0.80	
Incremental Delay, d2	4.1	5.1	0.0	7.4	9.7	0.5	0.1	17.1	6.5	18.8	0.7	
Delay (s)	46.4	47.6	24.5	39.2	41.7	9.5	27.2	46.5	27.8	40.0	18.3	
Level of Service	D	D	C	D	D	A	C	D	C	D	B	
Approach Delay (s)		39.1			25.6			37.5			26.9	
Approach LOS		D			C			D			C	

Intersection Summary			
HCM Average Control Delay	30.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	85.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR	SBR2	NEL	NER
Lane Configurations									
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	11	12	12	12	12
Total Lost time (s)	3.0			3.0	3.0			3.0	
Lane Util. Factor	1.00			0.95	0.95			0.97	
Frt	0.98			1.00	0.95			1.00	
Flt Protected	0.96			1.00	1.00			0.95	
Satd. Flow (prot)	1787			3452	3291			3502	
Flt Permitted	0.96			0.92	1.00			0.95	
Satd. Flow (perm)	1787			3175	3291			3502	
Volume (vph)	60	10	15	980	970	430	20	450	0
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.95	0.95	0.95	0.88	0.88
Adj. Flow (vph)	62	10	16	1021	1021	453	21	511	0
RTOR Reduction (vph)	0	0	0	0	1	0	0	0	0
Lane Group Flow (vph)	72	0	0	1037	1494	0	0	511	0
Heavy Vehicles (%)	0%	0%	1%	1%	1%	1%	1%	0%	0%
Turn Type			Perm						
Protected Phases	4			2	6			3	
Permitted Phases			2		6				
Actuated Green, G (s)	6.1			55.4	55.4			16.5	
Effective Green, g (s)	7.1			56.4	56.4			17.5	
Actuated g/C Ratio	0.08			0.63	0.63			0.19	
Clearance Time (s)	4.0			4.0	4.0			4.0	
Vehicle Extension (s)	2.0			2.0	2.0			2.0	
Lane Grp Cap (vph)	141			1990	2062			681	
v/s Ratio Prot	c0.04				c0.45			c0.15	
v/s Ratio Perm				0.33					
v/c Ratio	0.51			0.52	0.72			0.75	
Uniform Delay, d1	39.8			9.3	11.5			34.2	
Progression Factor	1.00			1.00	0.19			1.00	
Incremental Delay, d2	1.3			1.0	0.8			4.1	
Delay (s)	41.1			10.3	3.0			38.3	
Level of Service	D			B	A			D	
Approach Delay (s)	41.1			10.3	3.0			38.3	
Approach LOS	D			B	A			D	

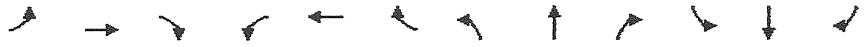
Intersection Summary			
HCM Average Control Delay	12.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	69.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.91			0.91			1.00			1.00	
Flt Protected		0.98			0.98			1.00			1.00	
Satd. Flow (prot)		1704			1702			1893			1877	
Flt Permitted		0.93			0.93			0.95			0.97	
Satd. Flow (perm)		1614			1607			1810			1821	
Volume (vph)	10	1	20	10	0	20	30	955	15	20	935	10
Peak-hour factor, PHF	0.69	0.69	0.69	0.68	0.68	0.68	0.86	0.86	0.86	0.94	0.94	0.94
Adj. Flow (vph)	14	1	29	15	0	29	35	1110	17	21	995	11
RTOR Reduction (vph)	0	27	0	0	27	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	17	0	0	17	0	0	1162	0	0	1027	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			2			1			1	
Permitted Phases	2			2			1			1		
Actuated Green, G (s)		5.7			5.7			71.2			71.2	
Effective Green, g (s)		6.7			6.7			72.2			72.2	
Actuated g/C Ratio		0.08			0.08			0.85			0.85	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		127			127			1539			1549	
v/s Ratio Prot												
v/s Ratio Perm		0.01			c0.01			c0.64			0.56	
v/c Ratio		0.14			0.14			0.75			0.66	
Uniform Delay, d1		36.4			36.4			2.7			2.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.5			0.5			3.5			2.3	
Delay (s)		36.9			36.9			6.1			4.4	
Level of Service		D			D			A			A	
Approach Delay (s)		36.9			36.9			6.1			4.4	
Approach LOS		D			D			A			A	

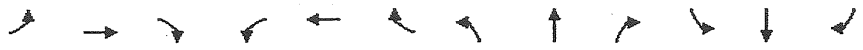
Intersection Summary			
HCM Average Control Delay	6.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	84.9	Sum of lost time (s)	6.0
Intersection Capacity Utilization	78.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	11	10	10	10	12
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Util. Factor	0.97	1.00		1.00	1.00		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.95		1.00	0.98		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3385	1804		1745	1861		1745	3370		1668	3336	1599
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3385	1804		1745	1861		1745	3370		1668	3336	1599
Volume (vph)	380	355	180	160	345	55	210	405	120	60	475	375
Peak-hour factor, PHF	0.95	0.95	0.95	0.93	0.93	0.93	0.82	0.82	0.82	0.90	0.90	0.90
Adj. Flow (vph)	400	374	189	172	371	59	256	494	146	67	528	417
RTOR Reduction (vph)	0	23	0	0	8	0	0	33	0	0	0	145
Lane Group Flow (vph)	400	540	0	172	422	0	256	607	0	67	528	272
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Turn Type	Prot			Prot			Prot			Prot		pm+ov
Protected Phases	7	4		3	8		5	2		1	6	7
Permitted Phases												6
Actuated Green, G (s)	10.0	24.5		8.0	22.5		11.9	21.9		4.7	14.7	24.7
Effective Green, g (s)	12.0	26.5		10.0	24.5		13.9	23.9		6.7	16.7	28.7
Actuated g/C Ratio	0.15	0.34		0.13	0.31		0.18	0.30		0.08	0.21	0.36
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	514	604		221	576		307	1018		141	704	641
v/s Ratio Prot	c0.12	c0.30		0.10	0.23		c0.15	0.18		0.04	c0.16	0.06
v/s Ratio Perm												0.11
v/c Ratio	0.78	0.89		0.78	0.73		0.83	0.60		0.48	0.75	0.42
Uniform Delay, d1	32.3	25.0		33.5	24.4		31.5	23.5		34.5	29.2	19.0
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	7.3	15.6		15.8	4.8		17.4	0.9		2.5	4.5	0.5
Delay (s)	39.6	40.5		49.2	29.2		48.9	24.4		37.0	33.7	19.4
Level of Service	D	D		D	C		D	C		D	C	B
Approach Delay (s)		40.1			34.9			31.4			28.1	
Approach LOS		D			C			C			C	

Intersection Summary			
HCM Average Control Delay	33.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	79.1	Sum of lost time (s)	9.0
Intersection Capacity Utilization	76.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	14	12	11	12	11	11	12
Total Lost time (s)		3.0			3.0	3.0		3.0		3.0	3.0	
Lane Util. Factor		1.00			1.00	1.00		0.95		1.00	1.00	
Frt		0.93			1.00	0.85		0.95		1.00	1.00	
Flt Protected		0.98			0.95	1.00		1.00		0.95	1.00	
Satd. Flow (prot)		1729			1805	1723		3300		1728	1818	
Flt Permitted		0.91			0.76	1.00		0.95		0.10	1.00	
Satd. Flow (perm)		1607			1435	1723		3150		173	1818	
Volume (vph)	2	0	2	446	0	205	2	795	450	235	770	2
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.96	0.96	0.96
Adj. Flow (vph)	2	0	2	469	0	216	2	837	474	245	802	2
RTOR Reduction (vph)	0	1	0	0	0	42	0	86	0	0	0	0
Lane Group Flow (vph)	0	3	0	0	469	174	0	1227	0	245	804	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Turn Type	Perm			Perm		pm+ov	Perm			pm+pt		
Protected Phases		4			4	1		2		1	6	
Permitted Phases	4			4		4	2			6		
Actuated Green, G (s)		30.7			30.7	40.0		38.0		51.3	51.3	
Effective Green, g (s)		31.7			31.7	42.0		39.0		52.3	52.3	
Actuated g/C Ratio		0.35			0.35	0.47		0.43		0.58	0.58	
Clearance Time (s)		4.0			4.0	4.0		4.0		4.0	4.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)		566			505	862		1365		278	1056	
v/s Ratio Prot						0.02				c0.10	0.44	
v/s Ratio Perm		0.00			c0.33	0.08		0.39		c0.41		
v/c Ratio		0.00			0.93	0.20		0.90		0.88	0.76	
Uniform Delay, d1		18.9			28.1	14.1		23.7		23.5	14.2	
Progression Factor		1.00			1.00	1.00		1.03		1.00	1.00	
Incremental Delay, d2		0.0			23.4	0.1		4.9		26.1	3.3	
Delay (s)		18.9			51.5	14.3		29.3		49.6	17.5	
Level of Service		B			D	B		C		D	B	
Approach Delay (s)		18.9			39.7			29.3			25.0	
Approach LOS		B			D			C			C	

Intersection Summary				
HCM Average Control Delay	30.1	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.89			
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	6.0	
Intersection Capacity Utilization	118.5%	ICU Level of Service	H	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	5	5	890	10	10	910
Peak Hour Factor	0.83	0.83	0.95	0.95	0.99	0.99
Hourly flow rate (vph)	6	6	937	11	10	919
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						516
pX, platoon unblocked	0.50					
vC, conflicting volume	1881	474			947	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2754	474			947	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	25	99			99	
cM capacity (veh/h)	8	542			726	

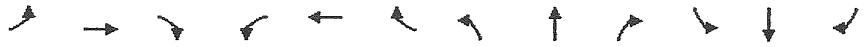
Direction, Lane #	WB 1	NB 1	NB 2	SB 1
Volume Total	12	625	323	929
Volume Left	6	0	0	10
Volume Right	6	0	11	0
cSH	16	1700	1700	726
Volume to Capacity	0.76	0.37	0.19	0.01
Queue Length 95th (ft)	47	0	0	1
Control Delay (s)	460.0	0.0	0.0	0.4
Lane LOS	F			A
Approach Delay (s)	460.0	0.0		0.4
Approach LOS	F			

Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	65.9%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	30	15	795	20	5	795
Peak Hour Factor	0.56	0.56	0.92	0.92	0.95	0.95
Hourly flow rate (vph)	54	27	864	22	5	837
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1722	875			886	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1722	875			886	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	46	92			99	
cM capacity (veh/h)	99	351			768	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	80	886	5	837
Volume Left	54	0	5	0
Volume Right	27	22	0	0
cSH	130	1700	768	1700
Volume to Capacity	0.62	0.52	0.01	0.49
Queue Length 95th (ft)	80	0	1	0
Control Delay (s)	70.0	0.0	9.7	0.0
Lane LOS	F		A	
Approach Delay (s)	70.0	0.0	0.1	
Approach LOS	F			

Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	53.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	30	625	0	0	620	5	0	0	0	0	0	45
Peak Hour Factor	0.82	0.82	0.82	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	37	762	0	0	674	5	0	0	0	0	0	49
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)					869							
pX, platoon unblocked												
vC, conflicting volume	679			762			1561	1515	762	1512	1512	677
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	679			762			1561	1515	762	1512	1512	677
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	96			100			100	100	100	100	100	89
cM capacity (veh/h)	918			850			80	116	408	95	115	453

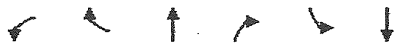
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	799	679	0	49
Volume Left	37	0	0	0
Volume Right	0	5	0	49
cSH	918	850	1700	453
Volume to Capacity	0.04	0.00	0.00	0.11
Queue Length 95th (ft)	3	0	0	9
Control Delay (s)	1.0	0.0	0.0	13.9
Lane LOS	A		A	B
Approach Delay (s)	1.0	0.0	0.0	13.9
Approach LOS			A	B

Intersection Summary					
Average Delay	1.0				
Intersection Capacity Utilization	67.3%	ICU Level of Service		C	
Analysis Period (min)	15				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	10	1	30	20	0	20	45	610	20	10	650	15
Peak Hour Factor	0.64	0.64	0.64	0.58	0.58	0.58	0.98	0.98	0.98	0.85	0.85	0.85
Hourly flow rate (vph)	16	2	47	34	0	34	46	622	20	12	765	18
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1556	1532	774	1569	1530	633	782			643		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1556	1532	774	1569	1530	633	782			643		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	81	99	88	54	100	93	95			99		
cM capacity (veh/h)	82	110	402	74	109	480	836			942		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	64	69	689	794
Volume Left	16	34	46	12
Volume Right	47	34	20	18
cSH	199	129	836	942
Volume to Capacity	0.32	0.53	0.05	0.01
Queue Length 95th (ft)	33	64	4	1
Control Delay (s)	31.5	61.2	1.4	0.3
Lane LOS	D	F	A	A
Approach Delay (s)	31.5	61.2	1.4	0.3
Approach LOS	D	F		

Intersection Summary			
Average Delay	4.6		
Intersection Capacity Utilization	70.7%	ICU Level of Service	C
Analysis Period (min)	15		



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	5	5	930	10	10	950
Peak Hour Factor	0.83	0.83	0.95	0.95	0.99	0.99
Hourly flow rate (vph)	6	6	979	11	10	960
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						516
pX, platoon unblocked	0.45					
vC, conflicting volume	1964	495			989	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	3149	495			989	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	99			99	
cM capacity (veh/h)	4	526			700	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1
Volume Total	12	653	337	970
Volume Left	6	0	0	10
Volume Right	6	0	11	0
cSH	8	1700	1700	700
Volume to Capacity	1.59	0.38	0.20	0.01
Queue Length 95th (ft)	61	0	0	1
Control Delay (s)	1212.6	0.0	0.0	0.4
Lane LOS	F			A
Approach Delay (s)	1212.6	0.0		0.4
Approach LOS	F			

Intersection Summary			
Average Delay	7.6		
Intersection Capacity Utilization	68.0%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	20	10	875	15	15	865
Peak Hour Factor	0.84	0.84	0.93	0.93	0.95	0.95
Hourly flow rate (vph)	24	12	941	16	16	911
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			771			1063
pX, platoon unblocked	0.82					
vC, conflicting volume	1891	949			957	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2087	949			957	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	50	96			98	
cM capacity (veh/h)	47	319			723	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	36	957	926
Volume Left	24	0	16
Volume Right	12	16	0
cSH	66	1700	723
Volume to Capacity	0.54	0.56	0.02
Queue Length 95th (ft)	56	0	2
Control Delay (s)	111.4	0.0	0.6
Lane LOS	F		A
Approach Delay (s)	111.4	0.0	0.6
Approach LOS	F		

Intersection Summary			
Average Delay	2.4		
Intersection Capacity Utilization	67.5%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	1	0	890	5	1	885
Peak Hour Factor	0.25	0.25	0.85	0.85	0.96	0.96
Hourly flow rate (vph)	4	0	1047	6	1	922
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			407			
pX, platoon unblocked						
vC, conflicting volume	1513	1050			1053	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1513	1050			1053	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	96	100			100	
cM capacity (veh/h)	113	227			663	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	4	1053	308	615
Volume Left	4	0	1	0
Volume Right	0	6	0	0
cSH	113	1700	663	1700
Volume to Capacity	0.04	0.62	0.00	0.36
Queue Length 95th (ft)	3	0	0	0
Control Delay (s)	38.2	0.0	0.1	0.0
Lane LOS	E		A	
Approach Delay (s)	38.2	0.0	0.0	
Approach LOS	E			

Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	57.1%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	5	5	990	10	10	1005
Peak Hour Factor	0.83	0.83	0.95	0.95	0.99	0.99
Hourly flow rate (vph)	6	6	1042	11	10	1015
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						516
pX, platoon unblocked	0.40					
vC, conflicting volume	2083	526			1053	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	3687	526			1053	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	99			98	
cM capacity (veh/h)	1	501			663	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1
Volume Total	12	695	358	1025
Volume Left	6	0	0	10
Volume Right	6	0	11	0
cSH	3	1700	1700	663
Volume to Capacity	4.25	0.41	0.21	0.02
Queue Length 95th (ft)	Err	0	0	1
Control Delay (s)	Err	0.0	0.0	0.5
Lane LOS	F			A
Approach Delay (s)	Err	0.0		0.5
Approach LOS	F			

Intersection Summary			
Average Delay	57.9		
Intersection Capacity Utilization	70.9%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	30	15	865	20	5	860
Peak Hour Factor	0.56	0.56	0.92	0.92	0.95	0.95
Hourly flow rate (vph)	54	27	940	22	5	905
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1867	951			962	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1867	951			962	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	33	92			99	
cM capacity (veh/h)	80	318			720	

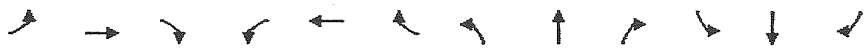
Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	80	962	5	905
Volume Left	54	0	5	0
Volume Right	27	22	0	0
cSH	107	1700	720	1700
Volume to Capacity	0.75	0.57	0.01	0.53
Queue Length 95th (ft)	102	0	1	0
Control Delay (s)	103.6	0.0	10.0	0.0
Lane LOS	F		B	
Approach Delay (s)	103.6	0.0	0.1	
Approach LOS	F			

Intersection Summary			
Average Delay	4.3		
Intersection Capacity Utilization	56.7%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	30	670	0	0	660	5	0	0	0	0	0	45
Peak Hour Factor	0.82	0.82	0.82	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	37	817	0	0	717	5	0	0	0	0	0	49
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)					869							
pX, platoon unblocked												
vC, conflicting volume	723			817			1659	1613	817	1610	1610	720
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	723			817			1659	1613	817	1610	1610	720
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	96			100			100	100	100	100	100	89
cM capacity (veh/h)	884			811			67	101	379	81	100	428

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	854	723	0	49
Volume Left	37	0	0	0
Volume Right	0	5	0	49
cSH	884	811	1700	428
Volume to Capacity	0.04	0.00	0.00	0.11
Queue Length 95th (ft)	3	0	0	10
Control Delay (s)	1.1	0.0	0.0	14.5
Lane LOS	A		A	B
Approach Delay (s)	1.1	0.0	0.0	14.5
Approach LOS			A	B

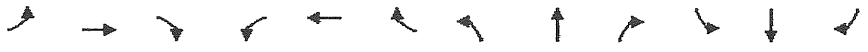
Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	69.6%	ICU Level of Service	C
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	10	1	30	30	0	20	45	645	30	10	690	15
Peak Hour Factor	0.64	0.64	0.64	0.58	0.58	0.58	0.98	0.98	0.98	0.85	0.85	0.85
Hourly flow rate (vph)	16	2	47	52	0	34	46	658	31	12	812	18
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1644	1625	821	1657	1618	673	829			689		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1644	1625	821	1657	1618	673	829			689		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	78	98	88	19	100	92	94			99		
cM capacity (veh/h)	70	96	378	64	96	455	802			906		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	64	86	735	841
Volume Left	16	52	46	12
Volume Right	47	34	31	18
cSH	177	97	802	906
Volume to Capacity	0.36	0.89	0.06	0.01
Queue Length 95th (ft)	38	126	5	1
Control Delay (s)	36.5	140.4	1.5	0.4
Lane LOS	E	F	A	A
Approach Delay (s)	36.5	140.4	1.5	0.4
Approach LOS	E	F		

Intersection Summary				
Average Delay	9.2			
Intersection Capacity Utilization	75.3%	ICU Level of Service	D	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	2	1	5	0	0	0	11	1030	10	167	845	5
Peak Hour Factor	0.50	0.50	0.50	0.80	0.80	0.80	0.96	0.96	0.96	0.92	0.92	0.92
Hourly flow rate (vph)	4	2	10	0	0	0	11	1073	10	182	918	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)											1027	
pX, platoon unblocked	0.59	0.59	0.59	0.59	0.59		0.59					
vC, conflicting volume	2385	2390	921	2394	2388	1078	924			1083		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	3334	3343	867	3348	3339	1078	872			1083		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	41	95	100	100	100	98			72		
cM capacity (veh/h)	2	3	211	1	3	268	462			648		

Direction, Lane #	EB 1	NB 1	SB 1	SB 2
Volume Total	16	1095	182	924
Volume Left	4	11	182	0
Volume Right	10	10	0	5
cSH	7	462	648	1700
Volume to Capacity	2.45	0.02	0.28	0.54
Queue Length 95th (ft)	78	2	29	0
Control Delay (s)	1723.7	1.0	12.7	0.0
Lane LOS	F	A	B	
Approach Delay (s)	1723.7	1.0	2.1	
Approach LOS	F			

Intersection Summary			
Average Delay	14.0		
Intersection Capacity Utilization	113.5%	ICU Level of Service	H
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	20	10	985	15	15	985
Peak Hour Factor	0.73	0.73	0.85	0.85	0.97	0.97
Hourly flow rate (vph)	27	14	1159	18	15	1015
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			364			1048
pX, platoon unblocked	0.67	0.73			0.73	
vC, conflicting volume	2214	588			1176	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1807	68			873	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	42	98			97	
cM capacity (veh/h)	47	722			566	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1
Volume Total	41	773	404	1031
Volume Left	27	0	0	15
Volume Right	14	0	18	0
cSH	68	1700	1700	566
Volume to Capacity	0.60	0.45	0.24	0.03
Queue Length 95th (ft)	65	0	0	2
Control Delay (s)	117.8	0.0	0.0	0.9
Lane LOS	F			A
Approach Delay (s)	117.8	0.0		0.9
Approach LOS	F			

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	73.8%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	30	670	0	0	660	5	0	0	0	0	0	45
Peak Hour Factor	0.82	0.82	0.82	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	37	817	0	0	717	5	0	0	0	0	0	49
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)					862							
pX, platoon unblocked												
vC, conflicting volume	723			817			1659	1613	817	1610	1610	720
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	723			817			1659	1613	817	1610	1610	720
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	96			100			100	100	100	100	100	89
cM capacity (veh/h)	884			811			67	101	379	81	100	428

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	854	723	0	49
Volume Left	37	0	0	0
Volume Right	0	5	0	49
cSH	884	811	1700	428
Volume to Capacity	0.04	0.00	0.00	0.11
Queue Length 95th (ft)	3	0	0	10
Control Delay (s)	1.1	0.0	0.0	14.5
Lane LOS	A		A	B
Approach Delay (s)	1.1	0.0	0.0	14.5
Approach LOS			A	B

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	69.6%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	52	186	865	20	5	860
Peak Hour Factor	0.56	0.56	0.92	0.92	0.95	0.95
Hourly flow rate (vph)	93	332	940	22	5	905
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		8				
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1867	951			962	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1867	951			962	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	0			99	
cM capacity (veh/h)	80	318			720	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	425	962	5	905
Volume Left	93	0	5	0
Volume Right	332	22	0	0
cSH	367	1700	720	1700
Volume to Capacity	1.16	0.57	0.01	0.53
Queue Length 95th (ft)	420	0	1	0
Control Delay (s)	131.4	0.0	10.0	0.0
Lane LOS	F		B	
Approach Delay (s)	131.4	0.0	0.1	
Approach LOS	F			

Intersection Summary			
Average Delay	24.3		
Intersection Capacity Utilization	64.9%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	5	990	10	10	1005
Peak Hour Factor	0.83	0.83	0.95	0.95	0.99	0.99
Hourly flow rate (vph)	0	6	1042	11	10	1015
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						516
pX, platoon unblocked	0.79					
vC, conflicting volume	1575	526			1053	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1461	526			1053	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	99			98	
cM capacity (veh/h)	95	501			663	

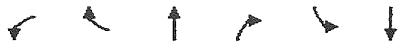
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	6	695	358	348	677
Volume Left	0	0	0	10	0
Volume Right	6	0	11	0	0
cSH	501	1700	1700	663	1700
Volume to Capacity	0.01	0.41	0.21	0.02	0.40
Queue Length 95th (ft)	1	0	0	1	0
Control Delay (s)	12.3	0.0	0.0	0.5	0.0
Lane LOS	B			A	
Approach Delay (s)	12.3	0.0		0.2	
Approach LOS	B				

Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	44.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	446	205	795	450	235	770
Peak Hour Factor	0.95	0.95	0.95	0.95	0.96	0.96
Hourly flow rate (vph)	469	216	837	474	245	802
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			407			
pX, platoon unblocked						
vC, conflicting volume	1964	1074			1311	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1964	1074			1311	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	1			54	
cM capacity (veh/h)	30	219			529	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	685	1311	512	535
Volume Left	469	0	245	0
Volume Right	216	474	0	0
cSH	42	1700	529	1700
Volume to Capacity	16.47	0.77	0.46	0.31
Queue Length 95th (ft)	Err	0	60	0
Control Delay (s)	Err	0.0	13.4	0.0
Lane LOS	F		B	
Approach Delay (s)	Err	0.0	6.6	
Approach LOS	F			

Intersection Summary			
Average Delay	2254.2		
Intersection Capacity Utilization	144.6%	ICU Level of Service	H
Analysis Period (min)	15		



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	20	10	985	15	15	985
Peak Hour Factor	0.84	0.84	0.93	0.93	0.95	0.95
Hourly flow rate (vph)	24	12	1059	16	16	1037
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			771			1063
pX, platoon unblocked	0.42					
vC, conflicting volume	2136	1067			1075	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	3735	1067			1075	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	96			98	
cM capacity (veh/h)	2	272			652	

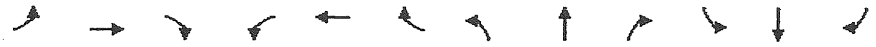
Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	36	1075	1053
Volume Left	24	0	16
Volume Right	12	16	0
cSH	3	1700	652
Volume to Capacity	11.76	0.63	0.02
Queue Length 95th (ft)	Err	0	2
Control Delay (s)	Err	0.0	0.8
Lane LOS	F		A
Approach Delay (s)	Err	0.0	0.8
Approach LOS	F		

Intersection Summary			
Average Delay	165.4		
Intersection Capacity Utilization	73.8%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕		↰	↕	
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	2	1	5	17	1	170	10	860	10	167	845	5
Peak Hour Factor	0.50	0.50	0.50	0.80	0.80	0.80	0.96	0.96	0.96	0.92	0.92	0.92
Hourly flow rate (vph)	4	2	10	21	1	212	10	896	10	182	918	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)											1027	
pX, platoon unblocked	0.49	0.49	0.49	0.49	0.49		0.49					
vC, conflicting volume	2419	2211	921	2214	2209	901	924			906		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	3869	3448	841	3455	3443	901	846			906		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	22	95	0	51	37	97			76		
cM capacity (veh/h)	0	3	182	1	3	340	393			755		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1	SB 2
Volume Total	16	235	917	182	924
Volume Left	4	21	10	182	0
Volume Right	10	212	10	0	5
cSH	1	6	393	755	1700
Volume to Capacity	23.11	40.59	0.03	0.24	0.54
Queue Length 95th (ft)	Err	Err	2	23	0
Control Delay (s)	Err	Err	1.0	11.3	0.0
Lane LOS	F	F	A	B	
Approach Delay (s)	Err	Err	1.0	1.9	
Approach LOS	F	F			

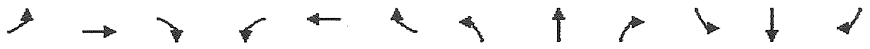
Intersection Summary				
Average Delay	1105.4			
Intersection Capacity Utilization	113.7%	ICU Level of Service	H	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	10	1	30	30	0	20	45	645	30	10	690	15
Peak Hour Factor	0.64	0.64	0.64	0.58	0.58	0.58	0.98	0.98	0.98	0.85	0.85	0.85
Hourly flow rate (vph)	16	2	47	52	0	34	46	658	31	12	812	18
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1644	1625	821	1657	1618	673	829			689		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1644	1625	821	1657	1618	673	829			689		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	78	98	88	19	100	92	94			99		
cM capacity (veh/h)	70	96	378	64	96	455	802			906		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	64	86	735	841
Volume Left	16	52	46	12
Volume Right	47	34	31	18
cSH	177	97	802	906
Volume to Capacity	0.36	0.89	0.06	0.01
Queue Length 95th (ft)	38	126	5	1
Control Delay (s)	36.5	140.4	1.5	0.4
Lane LOS	E	F	A	A
Approach Delay (s)	36.5	140.4	1.5	0.4
Approach LOS	E	F		

Intersection Summary			
Average Delay	9.2		
Intersection Capacity Utilization	75.3%	ICU Level of Service	D
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	30	650	0	0	645	5	0	0	0	0	0	45
Peak Hour Factor	0.82	0.82	0.82	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	37	793	0	0	701	5	0	0	0	0	0	49
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)					869							
pX, platoon unblocked												
vC, conflicting volume	707			793			1619	1572	793	1570	1570	704
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	707			793			1619	1572	793	1570	1570	704
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	96			100			100	100	100	100	100	89
cM capacity (veh/h)	896			828			72	107	392	87	106	437

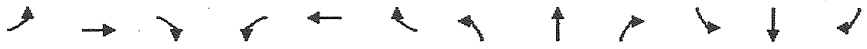
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	829	707	0	49
Volume Left	37	0	0	0
Volume Right	0	5	0	49
cSH	896	828	1700	437
Volume to Capacity	0.04	0.00	0.00	0.11
Queue Length 95th (ft)	3	0	0	9
Control Delay (s)	1.1	0.0	0.0	14.3
Lane LOS	A		A	B
Approach Delay (s)	1.1	0.0	0.0	14.3
Approach LOS			A	B

Intersection Summary				
Average Delay	1.0			
Intersection Capacity Utilization	68.6%	ICU Level of Service	C	
Analysis Period (min)	15			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	30	15	830	20	5	830
Peak Hour Factor	0.56	0.56	0.92	0.92	0.95	0.95
Hourly flow rate (vph)	54	27	902	22	5	874
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1797	913			924	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1797	913			924	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	39	92			99	
cM capacity (veh/h)	89	334			744	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	80	924	5	874
Volume Left	54	0	5	0
Volume Right	27	22	0	0
cSH	117	1700	744	1700
Volume to Capacity	0.69	0.54	0.01	0.51
Queue Length 95th (ft)	91	0	1	0
Control Delay (s)	85.2	0.0	9.9	0.0
Lane LOS	F		A	
Approach Delay (s)	85.2	0.0	0.1	
Approach LOS	F			

Intersection Summary			
Average Delay	3.7		
Intersection Capacity Utilization	54.9%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	2	1	5	17	1	145	10	825	10	147	815	5
Peak Hour Factor	0.50	0.50	0.50	0.80	0.80	0.80	0.96	0.96	0.96	0.92	0.92	0.92
Hourly flow rate (vph)	4	2	10	21	1	181	10	859	10	160	886	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)											1027	
pX, platoon unblocked	0.54	0.54	0.54	0.54	0.54		0.54					
vC, conflicting volume	2275	2099	889	2102	2096	865	891			870		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	3356	3030	794	3036	3025	865	799			870		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	64	95	0	78	49	98			79		
cM capacity (veh/h)	1	6	212	3	6	356	448			779		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1	SB 2
Volume Total	16	204	880	160	891
Volume Left	4	21	10	160	0
Volume Right	10	181	10	0	5
cSH	3	22	448	779	1700
Volume to Capacity	5.09	9.22	0.02	0.21	0.52
Queue Length 95th (ft)	Err	Err	2	19	0
Control Delay (s)	Err	Err	0.8	10.8	0.0
Lane LOS	F	F	A	B	
Approach Delay (s)	Err	Err	0.8	1.6	
Approach LOS	F	F			

Intersection Summary				
Average Delay	1022.6			
Intersection Capacity Utilization	108.8%	ICU Level of Service	G	
Analysis Period (min)	15			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	1	0	840	5	1	840
Peak Hour Factor	0.25	0.25	0.85	0.85	0.96	0.96
Hourly flow rate (vph)	4	0	988	6	1	875
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			407			
pX, platoon unblocked						
vC, conflicting volume	1431	991			994	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1431	991			994	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	97	100			100	
cM capacity (veh/h)	127	248			698	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	4	994	293	583
Volume Left	4	0	1	0
Volume Right	0	6	0	0
cSH	127	1700	698	1700
Volume to Capacity	0.03	0.58	0.00	0.34
Queue Length 95th (ft)	2	0	0	0
Control Delay (s)	34.2	0.0	0.1	0.0
Lane LOS	D		A	
Approach Delay (s)	34.2	0.0	0.0	
Approach LOS	D			

Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	54.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	20	10	825	15	15	820
Peak Hour Factor	0.84	0.84	0.93	0.93	0.95	0.95
Hourly flow rate (vph)	24	12	887	16	16	863
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			771			1063
pX, platoon unblocked	0.87					
vC, conflicting volume	1790	895			903	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1911	895			903	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	63	97			98	
cM capacity (veh/h)	64	342			757	

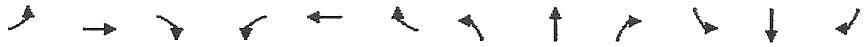
Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	36	903	879
Volume Left	24	0	16
Volume Right	12	16	0
cSH	88	1700	757
Volume to Capacity	0.41	0.53	0.02
Queue Length 95th (ft)	41	0	2
Control Delay (s)	71.2	0.0	0.6
Lane LOS	F		A
Approach Delay (s)	71.2	0.0	0.6
Approach LOS	F		

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	65.2%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕		↰	↕	
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	2	1	5	17	1	140	10	790	10	142	780	5
Peak Hour Factor	0.50	0.50	0.50	0.80	0.80	0.80	0.96	0.96	0.96	0.92	0.92	0.92
Hourly flow rate (vph)	4	2	10	21	1	175	10	823	10	154	848	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)											1027	
pX, platoon unblocked	0.58	0.58	0.58	0.58	0.58		0.58					
vC, conflicting volume	2184	2013	851	2016	2011	828	853			833		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	3039	2746	743	2751	2741	828	747			833		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	79	96	0	87	53	98			81		
cM capacity (veh/h)	2	9	243	5	9	374	503			804		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1	SB 2
Volume Total	16	198	844	154	853
Volume Left	4	21	10	154	0
Volume Right	10	175	10	0	5
cSH	7	41	503	804	1700
Volume to Capacity	2.40	4.76	0.02	0.19	0.50
Queue Length 95th (ft)	78	Err	2	18	0
Control Delay (s)	1684.2	Err	0.6	10.5	0.0
Lane LOS	F	F	A	B	
Approach Delay (s)	1684.2	Err	0.6	1.6	
Approach LOS	F	F			

Intersection Summary			
Average Delay	970.5		
Intersection Capacity Utilization	104.8%	ICU Level of Service	G
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	10	1	30	20	0	20	45	590	20	10	625	15
Peak Hour Factor	0.64	0.64	0.64	0.58	0.58	0.58	0.98	0.98	0.98	0.85	0.85	0.85
Hourly flow rate (vph)	16	2	47	34	0	34	46	602	20	12	735	18
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1506	1482	744	1519	1481	612	753			622		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1506	1482	744	1519	1481	612	753			622		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	82	99	89	58	100	93	95			99		
cM capacity (veh/h)	89	118	418	81	117	493	857			958		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	64	69	668	765
Volume Left	16	34	46	12
Volume Right	47	34	20	18
cSH	213	140	857	958
Volume to Capacity	0.30	0.49	0.05	0.01
Queue Length 95th (ft)	30	58	4	1
Control Delay (s)	29.1	53.7	1.4	0.3
Lane LOS	D	F	A	A
Approach Delay (s)	29.1	53.7	1.4	0.3
Approach LOS	D	F		

Intersection Summary				
Average Delay	4.3			
Intersection Capacity Utilization	69.4%	ICU Level of Service	C	
Analysis Period (min)	15			

Lane Group	EBT	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	4	469	216	1313	245	804
v/c Ratio	0.01	0.93	0.24	0.91	0.87	0.76
Control Delay	15.0	55.0	8.4	27.7	50.5	20.7
Queue Delay	0.0	0.0	0.0	7.8	0.0	0.0
Total Delay	15.0	55.0	8.4	35.5	50.5	20.7
Queue Length 50th (ft)	1	247	40	301	88	331
Queue Length 95th (ft)	8	#433	79	m#327	#227	498
Internal Link Dist (ft)	264	285		327		284
Turn Bay Length (ft)			200		250	
Base Capacity (vph)	592	526	901	1450	281	1056
Starvation Cap Reductn	0	0	0	122	0	0
Spillback Cap Reductn	0	0	0	0	0	1
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.89	0.24	0.99	0.87	0.76

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	400	563	172	430	256	640	67	528	417
v/c Ratio	0.77	0.89	0.77	0.73	0.83	0.60	0.41	0.79	0.54
Control Delay	43.6	40.7	57.9	31.4	55.5	25.4	41.8	40.0	11.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	43.6	40.7	57.9	31.4	55.5	25.4	41.8	40.0	11.3
Queue Length 50th (ft)	100	243	85	181	125	137	32	133	64
Queue Length 95th (ft)	#165	#429	#186	284	#214	171	71	#205	149
Internal Link Dist (ft)		854		619		1014		262	
Turn Bay Length (ft)	200		100		100		100		100
Base Capacity (vph)	522	659	224	616	313	1066	166	681	767
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.77	0.85	0.77	0.70	0.82	0.60	0.40	0.78	0.54

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	44	44	1162	1027
v/c Ratio	0.24	0.24	0.74	0.65
Control Delay	14.4	14.5	8.4	5.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.4	14.5	8.4	5.6
Queue Length 50th (ft)	6	6	157	114
Queue Length 95th (ft)	19	18	#531	294
Internal Link Dist (ft)	938	531	468	395
Turn Bay Length (ft)				
Base Capacity (vph)	273	271	1572	1581
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.16	0.16	0.74	0.65

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	NBT	SBT	NEL
Lane Group Flow (vph)	72	1037	1495	511
v/c Ratio	0.44	0.51	0.72	0.75
Control Delay	47.0	11.2	3.9	41.4
Queue Delay	0.0	0.0	0.2	0.5
Total Delay	47.0	11.2	4.1	41.9
Queue Length 50th (ft)	39	168	23	141
Queue Length 95th (ft)	82	236	64	185
Internal Link Dist (ft)	1038	436	304	1207
Turn Bay Length (ft)				
Base Capacity (vph)	179	2015	2090	778
Starvation Cap Reductn	0	0	120	0
Spillback Cap Reductn	0	0	0	58
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.40	0.51	0.76	0.71

Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	27	33	33	320	336	604	32	789	700	579	885
v/c Ratio	0.35	0.40	0.07	0.82	0.85	0.61	0.09	0.91	0.83	0.95	0.62
Control Delay	54.0	56.5	9.7	44.4	47.1	9.7	26.8	43.0	21.5	43.4	19.1
Queue Delay	0.0	0.0	0.0	0.2	0.3	1.1	0.0	0.0	1.6	12.8	0.0
Total Delay	54.0	56.5	9.7	44.6	47.3	10.8	26.8	43.0	23.1	56.3	19.1
Queue Length 50th (ft)	15	19	0	171	183	133	12	181	151	241	143
Queue Length 95th (ft)	42	#52	23	m#264	m#287	m193	m27	#336	#474	m#480	m126
Internal Link Dist (ft)		152			327			304			584
Turn Bay Length (ft)	75		75			150	75			350	
Base Capacity (vph)	78	82	457	390	393	1001	360	868	847	614	1991
Starvation Cap Reductn	0	0	0	0	0	188	0	0	4	0	0
Spillback Cap Reductn	0	0	0	2	2	0	0	0	51	41	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.35	0.40	0.07	0.82	0.86	0.74	0.09	0.91	0.88	1.01	0.44

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBT	EBR	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	70	651	49	579	848	956
v/c Ratio	0.40	0.61	0.25	0.72	0.29	0.85
Control Delay	43.7	13.6	30.8	20.6	1.5	40.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	43.7	13.6	30.8	20.6	1.5	40.8
Queue Length 50th (ft)	38	146	18	136	29	360
Queue Length 95th (ft)	77	217	39	m153	m44	#485
Internal Link Dist (ft)	435		188		584	705
Turn Bay Length (ft)		200		150		
Base Capacity (vph)	210	1198	236	929	2934	1125
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.33	0.54	0.21	0.62	0.29	0.85

Intersection Summary

Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	400	563	172	430	256	640	67	528	417
v/c Ratio	0.70	0.90	0.65	0.72	0.83	0.57	0.44	0.73	0.52
Control Delay	51.0	52.4	58.0	40.3	67.8	32.8	59.9	46.7	13.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.0	52.4	58.0	40.3	67.8	32.8	59.9	46.7	13.1
Queue Length 50th (ft)	148	382	123	273	190	208	49	196	98
Queue Length 95th (ft)	207	#607	203	401	#294	241	98	259	193
Internal Link Dist (ft)		854		619		1014		262	
Turn Bay Length (ft)	200		100		100		100		100
Base Capacity (vph)	636	685	309	673	331	1190	169	851	817
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.63	0.82	0.56	0.64	0.77	0.54	0.40	0.62	0.51

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	44	44	1162	1027
v/c Ratio	0.24	0.24	0.74	0.65
Control Delay	14.4	14.5	8.4	5.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.4	14.5	8.4	5.6
Queue Length 50th (ft)	6	6	157	114
Queue Length 95th (ft)	19	18	#531	294
Internal Link Dist (ft)	938	531	983	384
Turn Bay Length (ft)				
Base Capacity (vph)	273	271	1572	1581
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.16	0.16	0.74	0.65

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	NBT	SBT	SBR	NEL
Lane Group Flow (vph)	72	1037	1032	478	511
v/c Ratio	0.41	0.54	0.90	0.49	0.75
Control Delay	58.0	11.2	27.3	11.6	49.8
Queue Delay	0.1	0.1	39.6	1.6	0.0
Total Delay	58.1	11.2	66.9	13.2	49.9
Queue Length 50th (ft)	51	195	564	162	186
Queue Length 95th (ft)	104	245	813	235	#276
Internal Link Dist (ft)	1038	436	304		1207
Turn Bay Length (ft)					
Base Capacity (vph)	197	2130	1275	1085	796
Starvation Cap Reductn	0	0	317	418	0
Spillback Cap Reductn	3	143	0	0	7
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.37	0.52	1.08	0.72	0.65

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

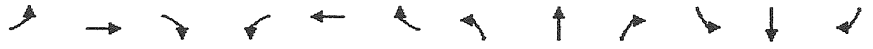
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	27	33	33	313	330	592	31	765	679	561	857
v/c Ratio	0.24	0.28	0.25	0.86	0.90	0.59	0.27	0.76	0.84	0.92	0.41
Control Delay	57.8	58.6	22.2	67.4	72.9	15.4	58.8	41.4	28.3	57.4	12.8
Queue Delay	0.0	0.0	0.2	8.0	12.5	0.0	0.0	1.3	2.3	0.0	0.1
Total Delay	57.8	58.6	22.4	75.4	85.4	15.4	58.8	42.7	30.6	57.4	12.9
Queue Length 50th (ft)	19	23	0	233	249	209	22	266	318	389	180
Queue Length 95th (ft)	52	60	34	#445	#476	374	56	335	455	#671	225
Internal Link Dist (ft)		152			327			304			584
Turn Bay Length (ft)	75		75			150	75		185	250	
Base Capacity (vph)	114	120	133	362	365	992	122	1203	808	619	2134
Starvation Cap Reductn	0	0	0	0	0	0	0	237	52	0	0
Spillback Cap Reductn	0	0	6	30	30	5	0	5	0	0	247
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.24	0.28	0.26	0.94	0.99	0.60	0.25	0.79	0.90	0.91	0.45

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	11	10	10	10	12
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Util. Factor	0.97	1.00		1.00	1.00		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.95		1.00	0.98		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3385	1814		1745	1857		1745	3372		1668	3336	1599
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3385	1814		1745	1857		1745	3372		1668	3336	1599
Volume (vph)	340	325	140	160	310	55	160	415	120	60	480	340
Peak-hour factor, PHF	0.95	0.95	0.95	0.93	0.93	0.93	0.82	0.82	0.82	0.90	0.90	0.90
Adj. Flow (vph)	358	342	147	172	333	59	195	506	146	67	533	378
RTOR Reduction (vph)	0	13	0	0	6	0	0	22	0	0	0	168
Lane Group Flow (vph)	358	476	0	172	386	0	195	630	0	67	533	210
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Turn Type	Prot			Prot			Prot			Prot		pm+ov
Protected Phases	7	4		3	8		5	2		1	6	7
Permitted Phases												6
Actuated Green, G (s)	14.8	32.6		11.1	28.9		14.4	29.8		6.3	21.7	36.5
Effective Green, g (s)	16.8	34.6		13.1	30.9		16.4	31.8		8.3	23.7	40.5
Actuated g/C Ratio	0.17	0.35		0.13	0.31		0.16	0.32		0.08	0.24	0.41
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	570	629		229	575		287	1074		139	792	697
v/s Ratio Prot	c0.11	c0.26		c0.10	0.21		c0.11	0.19		0.04	c0.16	0.05
v/s Ratio Perm												0.08
v/c Ratio	0.63	0.76		0.75	0.67		0.68	0.59		0.48	0.67	0.30
Uniform Delay, d1	38.6	28.9		41.8	30.0		39.2	28.5		43.7	34.5	20.1
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.2	5.2		13.0	3.1		6.3	0.8		2.6	2.3	0.2
Delay (s)	40.8	34.1		54.7	33.1		45.5	29.3		46.3	36.8	20.3
Level of Service	D	C		D	C		D	C		D	D	C
Approach Delay (s)		36.9			39.7			33.0			31.1	
Approach LOS		D			D			C			C	

Intersection Summary				
HCM Average Control Delay	34.6	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.71			
Actuated Cycle Length (s)	99.8	Sum of lost time (s)	9.0	
Intersection Capacity Utilization	70.0%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.91			0.91			1.00			1.00	
Flt Protected		0.98			0.98			1.00			1.00	
Satd. Flow (prot)		1704			1702			1893			1876	
Flt Permitted		0.93			0.93			0.96			0.97	
Satd. Flow (perm)		1614			1607			1813			1822	
Volume (vph)	10	1	20	10	0	20	30	845	15	20	815	10
Peak-hour factor, PHF	0.69	0.69	0.69	0.68	0.68	0.68	0.86	0.86	0.86	0.94	0.94	0.94
Adj. Flow (vph)	14	1	29	15	0	29	35	983	17	21	867	11
RTOR Reduction (vph)	0	27	0	0	27	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	17	0	0	17	0	0	1035	0	0	899	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			2			1			1	
Permitted Phases	2			2			1			1		
Actuated Green, G (s)		5.7			5.7			71.2			71.2	
Effective Green, g (s)		6.7			6.7			72.2			72.2	
Actuated g/C Ratio		0.08			0.08			0.85			0.85	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		127			127			1542			1549	
v/s Ratio Prot												
v/s Ratio Perm		0.01			c0.01			c0.57			0.49	
v/c Ratio		0.14			0.14			0.67			0.58	
Uniform Delay, d1		36.4			36.4			2.2			1.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.5			0.5			2.3			1.6	
Delay (s)		36.9			36.9			4.6			3.5	
Level of Service		D			D			A			A	
Approach Delay (s)		36.9			36.9			4.6			3.5	
Approach LOS		D			D			A			A	

Intersection Summary				
HCM Average Control Delay	5.5	HCM Level of Service	A	
HCM Volume to Capacity ratio	0.63			
Actuated Cycle Length (s)	84.9	Sum of lost time (s)	6.0	
Intersection Capacity Utilization	71.5%	ICU Level of Service	C	
Analysis Period (min)	15			

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR	SBR2	NEL	NER
Lane Configurations									
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	11	11	11	11
Total Lost time (s)	3.0			3.0	3.0	3.0		3.0	
Lane Util. Factor	1.00			0.95	1.00	1.00		0.97	
Frt	0.98			1.00	1.00	0.85		1.00	
Flt Protected	0.96			1.00	1.00	1.00		0.95	
Satd. Flow (prot)	1787			3571	1818	1546		3385	
Flt Permitted	0.96			0.88	1.00	1.00		0.95	
Satd. Flow (perm)	1787			3139	1818	1546		3385	
Volume (vph)	60	10	15	920	915	385	20	400	0
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.94	0.94	0.94	0.88	0.88
Adj. Flow (vph)	62	10	16	958	973	410	21	455	0
RTOR Reduction (vph)	0	0	0	0	0	2	0	0	0
Lane Group Flow (vph)	72	0	0	974	973	429	0	455	0
Heavy Vehicles (%)	0%	0%	1%	1%	1%	1%	1%	0%	0%
Turn Type			Perm			Perm			
Protected Phases	3			2	6			4	
Permitted Phases			2			6			
Actuated Green, G (s)	5.4			53.1	53.1	53.1		16.0	
Effective Green, g (s)	7.4			55.1	55.1	55.1		18.0	
Actuated g/C Ratio	0.08			0.62	0.62	0.62		0.20	
Clearance Time (s)	5.0			5.0	5.0	5.0		5.0	
Vehicle Extension (s)	2.5			3.0	3.0	3.0		2.5	
Lane Grp Cap (vph)	148			1933	1119	952		681	
v/s Ratio Prot	c0.04				c0.54			c0.13	
v/s Ratio Perm				0.31		0.28			
v/c Ratio	0.49			0.50	0.87	0.45		0.67	
Uniform Delay, d1	39.2			9.6	14.2	9.1		33.0	
Progression Factor	1.00			1.00	1.00	1.00		1.00	
Incremental Delay, d2	1.8			0.2	7.4	0.3		2.2	
Delay (s)	41.1			9.8	21.6	9.5		35.2	
Level of Service	D			A	C	A		D	
Approach Delay (s)	41.1			9.8	17.9			35.2	
Approach LOS	D			A	B			D	

Intersection Summary			
HCM Average Control Delay	18.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	89.5	Sum of lost time (s)	9.0
Intersection Capacity Utilization	73.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	12	12	12	11	11	11
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1900	1615	1698	1712	1599	1805	3610	1615	1728	3426	
Flt Permitted	0.95	1.00	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1805	1900	1615	1698	1712	1599	1805	3610	1615	1728	3426	
Volume (vph)	25	30	30	435	30	420	30	835	470	395	855	50
Peak-hour factor, PHF	0.63	0.63	0.63	0.96	0.96	0.96	0.91	0.91	0.91	0.84	0.84	0.84
Adj. Flow (vph)	40	48	48	453	31	438	33	918	516	470	1018	60
RTOR Reduction (vph)	0	0	45	0	0	40	0	0	0	0	4	0
Lane Group Flow (vph)	40	48	3	235	249	398	33	918	516	470	1074	0
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Turn Type	Split		Prot	Split		pm+ov	Prot		pm+ov	Prot		
Protected Phases	3	3	3	4	4	1	5	2	4	1	6	
Permitted Phases		3				4		2	2		6	
Actuated Green, G (s)	3.9	3.9	3.9	18.2	18.2	48.0	3.1	32.9	51.1	29.8	59.6	
Effective Green, g (s)	5.4	5.4	5.4	19.7	19.7	51.0	4.6	34.9	54.6	31.3	61.6	
Actuated g/C Ratio	0.05	0.05	0.05	0.19	0.19	0.49	0.04	0.34	0.53	0.30	0.60	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5.0	4.5	4.5	5.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	2.0	2.0	3.0	3.0	2.0	3.0	
Lane Grp Cap (vph)	94	99	84	324	326	836	80	1220	854	524	2043	
v/s Ratio Prot	0.02	c0.03	0.00	0.14	c0.15	0.14	0.02	c0.25	0.12	c0.27	0.31	
v/s Ratio Perm						0.10			0.20			
v/c Ratio	0.43	0.48	0.03	0.73	0.76	0.48	0.41	0.75	0.60	0.90	0.53	
Uniform Delay, d1	47.4	47.6	46.5	39.3	39.6	17.3	48.0	30.4	16.9	34.5	12.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	3.1	3.7	0.1	7.8	10.2	0.2	1.3	2.7	1.2	17.4	0.2	
Delay (s)	50.5	51.3	46.6	47.1	49.8	17.5	49.3	33.0	18.1	51.9	12.5	
Level of Service	D	D	D	D	D	B	D	C	B	D	B	
Approach Delay (s)		49.4			33.7			28.1			24.5	
Approach LOS		D			C			C			C	

Intersection Summary				
HCM Average Control Delay	28.7	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.79			
Actuated Cycle Length (s)	103.3	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	74.5%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	14	16	12	12	12	12	12	12	12	12	12
Total Lost time (s)		3.0	3.0		3.0		3.0	3.0			3.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95			0.95	
Frt		1.00	0.85		0.96		1.00	1.00			0.98	
Flt Protected		0.96	1.00		0.99		0.95	1.00			1.00	
Satd. Flow (prot)		1918	1812		1801		1787	3563			3507	
Flt Permitted		0.80	1.00		0.87		0.95	1.00			0.95	
Satd. Flow (perm)		1613	1812		1597		1787	3563			3333	
Volume (vph)	60	5	585	10	15	10	535	730	15	5	705	100
Peak-hour factor, PHF	0.93	0.93	0.93	0.73	0.73	0.73	0.95	0.95	0.95	0.88	0.88	0.88
Adj. Flow (vph)	65	5	629	14	21	14	563	768	16	6	801	114
RTOR Reduction (vph)	0	0	30	0	12	0	0	1	0	0	9	0
Lane Group Flow (vph)	0	70	599	0	37	0	563	783	0	0	912	0
Heavy Vehicles (%)	1%	1%	1%	0%	0%	0%	1%	1%	1%	1%	1%	1%
Turn Type	Perm		pm+ov	Perm			Prot			Perm		
Protected Phases		8	5		4		5	2			6	
Permitted Phases	8	8	8	4	4			2		6	6	
Actuated Green, G (s)		4.5	36.4		4.5		31.9	67.0			30.1	
Effective Green, g (s)		6.5	40.4		6.5		33.9	69.0			32.1	
Actuated g/C Ratio		0.08	0.50		0.08		0.42	0.85			0.39	
Clearance Time (s)		5.0	5.0		5.0		5.0	5.0			5.0	
Vehicle Extension (s)		2.5	2.5		2.5		2.5	3.0			3.0	
Lane Grp Cap (vph)		129	965		127		743	3017			1313	
v/s Ratio Prot			c0.26				c0.32	0.22				
v/s Ratio Perm		0.04	0.07		0.02						c0.27	
v/c Ratio		0.54	0.62		0.29		0.76	0.26			0.69	
Uniform Delay, d1		36.1	15.0		35.3		20.3	1.2			20.6	
Progression Factor		1.00	1.00		1.00		1.00	1.00			1.00	
Incremental Delay, d2		3.6	1.1		0.9		4.2	0.0			1.6	
Delay (s)		39.7	16.1		36.3		24.5	1.3			22.2	
Level of Service		D	B		D		C	A			C	
Approach Delay (s)		18.4			36.3			11.0			22.2	
Approach LOS		B			D			B			C	

Intersection Summary				
HCM Average Control Delay	16.6	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.72			
Actuated Cycle Length (s)	81.5	Sum of lost time (s)	9.0	
Intersection Capacity Utilization	73.2%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	11	10	10	10	12
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Util. Factor	0.97	1.00		1.00	1.00		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.95		1.00	0.98		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3385	1814		1745	1855		1745	3374		1668	3336	1599
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3385	1814		1745	1855		1745	3374		1668	3336	1599
Volume (vph)	330	310	135	155	290	55	155	405	115	60	465	325
Peak hour factor, PHF	0.95	0.95	0.95	0.93	0.93	0.93	0.82	0.82	0.82	0.90	0.90	0.90
Adj. Flow (vph)	347	326	142	167	312	59	189	494	140	67	517	361
RTOR Reduction (vph)	0	13	0	0	6	0	0	22	0	0	0	180
Lane Group Flow (vph)	347	455	0	167	365	0	189	612	0	67	517	181
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Turn Type	Prot			Prot			Prot			Prot		pm+ov
Protected Phases	7	4		3	8		5	2		1	6	7
Permitted Phases												6
Actuated Green, G (s)	14.8	32.6		10.6	28.4		11.3	25.0		6.1	19.8	34.6
Effective Green, g (s)	16.8	34.6		12.6	30.4		13.3	27.0		8.1	21.8	38.6
Actuated g/C Ratio	0.18	0.37		0.13	0.32		0.14	0.29		0.09	0.23	0.41
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	603	666		233	598		246	966		143	771	705
v/s Ratio Prot	c0.10	c0.25		c0.10	0.20		c0.11	c0.18		0.04	0.15	0.05
v/s Ratio Perm												0.07
v/c Ratio	0.58	0.68		0.72	0.61		0.77	0.63		0.47	0.67	0.26
Uniform Delay, d1	35.5	25.2		39.1	27.0		39.0	29.3		41.0	33.0	18.4
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.3	2.9		10.0	1.8		13.4	1.4		2.4	2.3	0.2
Delay (s)	36.8	28.1		49.2	28.8		52.4	30.7		43.5	35.3	18.6
Level of Service	D	C		D	C		D	C		D	D	B
Approach Delay (s)		31.8			35.1			35.7			29.5	
Approach LOS		C			D			D			C	

Intersection Summary				
HCM Average Control Delay	32.7	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.67			
Actuated Cycle Length (s)	94.3	Sum of lost time (s)	6.0	
Intersection Capacity Utilization	67.9%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

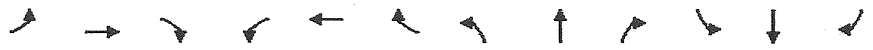
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.94			0.91			1.00			1.00	
Flt Protected		0.98			0.98			1.00			1.00	
Satd. Flow (prot)		1740			1702			1894			1879	
Flt Permitted		0.92			0.89			0.99			0.97	
Satd. Flow (perm)		1644			1538			1876			1825	
Volume (vph)	5	1	5	10	0	20	10	820	15	20	790	1
Peak-hour factor, PHF	0.69	0.69	0.69	0.68	0.68	0.68	0.86	0.86	0.86	0.94	0.94	0.94
Adj. Flow (vph)	7	1	7	15	0	29	12	953	17	21	840	1
RTOR Reduction (vph)	0	7	0	0	27	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	8	0	0	17	0	0	982	0	0	862	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			2			1			1	
Permitted Phases	2			2			1			1		
Actuated Green, G (s)		5.5			5.5			78.3			78.3	
Effective Green, g (s)		6.5			6.5			79.3			79.3	
Actuated g/C Ratio		0.07			0.07			0.86			0.86	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		116			109			1621			1576	
v/s Ratio Prot												
v/s Ratio Perm		0.01			c0.01			c0.52			0.47	
v/c Ratio		0.07			0.16			0.61			0.55	
Uniform Delay, d1		39.8			40.1			1.8			1.6	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.3			0.7			1.7			1.4	
Delay (s)		40.1			40.7			3.5			3.0	
Level of Service		D			D			A			A	
Approach Delay (s)		40.1			40.7			3.5			3.0	
Approach LOS		D			D			A			A	

Intersection Summary				
HCM Average Control Delay	4.4	HCM Level of Service	A	
HCM Volume to Capacity ratio	0.57			
Actuated Cycle Length (s)	91.8	Sum of lost time (s)	6.0	
Intersection Capacity Utilization	65.3%	ICU Level of Service	C	
Analysis Period (min)	15			

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR	SBR2	NEL	NER
Lane Configurations									
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	11	11	11	11	11	11	11
Total Lost time (s)	3.0			3.0	3.0	3.0		3.0	
Lane Util. Factor	1.00			0.95	1.00	1.00		0.97	
Frt	0.98			1.00	1.00	0.85		1.00	
Flt Protected	0.96			1.00	1.00	1.00		0.95	
Satd. Flow (prot)	1787			3452	1818	1546		3385	
Flt Permitted	0.96			0.90	1.00	1.00		0.95	
Satd. Flow (perm)	1787			3098	1818	1546		3385	
Volume (vph)	60	10	15	880	875	365	20	380	0
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.94	0.94	0.94	0.88	0.88
Adj. Flow (vph)	62	10	16	917	931	388	21	432	0
RTOR Reduction (vph)	0	0	0	0	0	2	0	0	0
Lane Group Flow (vph)	72	0	0	933	931	407	0	432	0
Heavy Vehicles (%)	0%	0%	1%	1%	1%	1%	1%	0%	0%
Turn Type			Perm			Perm			
Protected Phases	3			2	6			4	
Permitted Phases			2		6	6			
Actuated Green, G (s)	5.4			49.1	49.1	49.1		15.2	
Effective Green, g (s)	7.4			51.1	51.1	51.1		17.2	
Actuated g/C Ratio	0.09			0.60	0.60	0.60		0.20	
Clearance Time (s)	5.0			5.0	5.0	5.0		5.0	
Vehicle Extension (s)	2.5			3.0	3.0	3.0		2.5	
Lane Grp Cap (vph)	156			1869	1097	933		687	
v/s Ratio Prot	c0.04				c0.51			c0.13	
v/s Ratio Perm				0.30		0.26			
v/c Ratio	0.46			0.50	0.85	0.44		0.63	
Uniform Delay, d1	36.8			9.5	13.7	9.0		30.8	
Progression Factor	1.00			1.00	1.00	1.00		1.00	
Incremental Delay, d2	1.6			0.2	6.3	0.3		1.6	
Delay (s)	38.3			9.7	19.9	9.4		32.4	
Level of Service	D			A	B	A		C	
Approach Delay (s)	38.3			9.7	16.7			32.4	
Approach LOS	D			A	B			C	

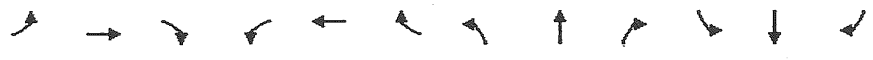
Intersection Summary				
HCM Average Control Delay	17.4	HCM Level of Service		B
HCM Volume to Capacity ratio	0.76			
Actuated Cycle Length (s)	84.7	Sum of lost time (s)		9.0
Intersection Capacity Utilization	71.1%	ICU Level of Service		C
Analysis Period (min)	15			
c Critical Lane Group				



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	12	12	12	11	11	11
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	*0.77	1.00	1.00	0.95	1.00	1.00	*0.83	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1900	1615	1698	1389	1599	1805	3610	1615	1728	2992	
Flt Permitted	0.95	1.00	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1805	1900	1615	1698	1389	1599	1805	3610	1615	1728	2992	
Volume (vph)	25	30	30	415	30	395	30	800	445	370	815	50
Peak-hour factor, PHF	0.63	0.63	0.63	0.96	0.96	0.96	0.91	0.91	0.91	0.84	0.84	0.84
Adj. Flow (vph)	40	48	48	432	31	411	33	879	489	440	970	60
RTOR Reduction (vph)	0	0	45	0	0	42	0	0	0	0	3	0
Lane Group Flow (vph)	40	48	3	250	213	369	33	879	489	440	1027	0
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Turn Type	Split		Prot	Split		pm+ov	Prot		pm+ov	Prot		
Protected Phases	3	3	3	4	4	1	5	2	4	1	6	
Permitted Phases		3				4		2	2		6	
Actuated Green, G (s)	3.9	3.9	3.9	18.1	18.1	45.8	3.0	31.6	49.7	27.7	56.3	
Effective Green, g (s)	5.4	5.4	5.4	19.6	19.6	48.8	4.5	33.6	53.2	29.2	58.3	
Actuated g/C Ratio	0.05	0.05	0.05	0.20	0.20	0.49	0.05	0.34	0.53	0.29	0.58	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5.0	4.5	4.5	5.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	2.0	2.0	3.0	3.0	2.0	3.0	
Lane Grp Cap (vph)	98	103	87	333	273	830	81	1215	861	506	1748	
v/s Ratio Prot	0.02	c0.03	0.00	0.15	c0.15	0.13	0.02	c0.24	0.11	c0.25	0.34	
v/s Ratio Perm						0.10			0.19			
v/c Ratio	0.41	0.47	0.03	0.75	0.78	0.44	0.41	0.72	0.57	0.87	0.59	
Uniform Delay, d1	45.7	45.8	44.7	37.8	38.1	16.6	46.4	29.0	15.6	33.5	13.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.8	3.3	0.1	9.2	13.4	0.1	1.2	2.2	0.9	14.3	0.5	
Delay (s)	48.4	49.1	44.9	47.0	51.5	16.8	47.6	31.2	16.5	47.8	13.6	
Level of Service	D	D	D	D	D	B	D	C	B	D	B	
Approach Delay (s)		47.4			33.9			26.4			23.9	
Approach LOS		D			C			C			C	

Intersection Summary				
HCM Average Control Delay	27.9	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.77			
Actuated Cycle Length (s)	99.8	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	71.6%	ICU Level of Service	C	
Analysis Period (min)	15			

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	14	16	12	12	12	12	12	12	12	12	12
Total Lost time (s)		3.0	3.0		3.0		3.0	3.0			3.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95			0.95	
Frt		1.00	0.85		0.96		1.00	1.00			0.98	
Flt Protected		0.96	1.00		0.99		0.95	1.00			1.00	
Satd. Flow (prot)		1918	1812		1801		1787	3563			3506	
Flt Permitted		0.83	1.00		0.88		0.95	1.00			0.95	
Satd. Flow (perm)		1659	1812		1606		1787	3563			3333	
Volume (vph)	60	5	560	10	15	10	515	690	15	5	665	95
Peak-hour factor, PHF	0.93	0.93	0.93	0.73	0.73	0.73	0.95	0.95	0.95	0.88	0.88	0.88
Adj. Flow (vph)	65	5	602	14	21	14	542	726	16	6	756	108
RTOR Reduction (vph)	0	0	36	0	12	0	0	1	0	0	9	0
Lane Group Flow (vph)	0	70	566	0	37	0	542	741	0	0	861	0
Heavy Vehicles (%)	1%	1%	1%	0%	0%	0%	1%	1%	1%	1%	1%	1%
Turn Type	Perm		pm+ov	Perm			Prot			Perm		
Protected Phases		8	5		4		5	2			6	
Permitted Phases	8	8	8	4	4			2		6	6	
Actuated Green, G (s)		4.4	33.1		4.4		28.7	61.4			27.7	
Effective Green, g (s)		6.4	37.1		6.4		30.7	63.4			29.7	
Actuated g/C Ratio		0.08	0.49		0.08		0.41	0.84			0.39	
Clearance Time (s)		5.0	5.0		5.0		5.0	5.0			5.0	
Vehicle Extension (s)		2.5	2.5		2.5		2.5	3.0			3.0	
Lane Grp Cap (vph)		140	959		136		724	2980			1306	
v/s Ratio Prot			c0.24				c0.30	0.21				
v/s Ratio Perm		0.04	0.07		0.02						c0.26	
v/c Ratio		0.50	0.59		0.27		0.75	0.25			0.66	
Uniform Delay, d1		33.2	13.9		32.5		19.3	1.3			18.9	
Progression Factor		1.00	1.00		1.00		1.00	1.00			1.00	
Incremental Delay, d2		2.0	0.8		0.8		4.0	0.0			1.2	
Delay (s)		35.2	14.7		33.3		23.3	1.3			20.1	
Level of Service		D	B		C		C	A			C	
Approach Delay (s)		16.8			33.3			10.6			20.1	
Approach LOS		B			C			B			C	

Intersection Summary				
HCM Average Control Delay	15.3	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.70			
Actuated Cycle Length (s)	75.8	Sum of lost time (s)	9.0	
Intersection Capacity Utilization	70.4%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	55	800	0	1	600	5	5	0	1	5	1	40
Peak Hour Factor	0.93	0.93	0.93	0.91	0.91	0.91	0.88	0.88	0.88	0.75	0.75	0.75
Hourly flow rate (vph)	59	860	0	1	659	5	6	0	1	7	1	53
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)					869							
pX, platoon unblocked												
vC, conflicting volume	665			860			1697	1646	860	1644	1643	662
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	665			860			1697	1646	860	1644	1643	662
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	94			100			91	100	100	91	99	89
cM capacity (veh/h)	924			773			62	94	358	76	94	465

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	919	666	7	61
Volume Left	59	1	6	7
Volume Right	0	5	1	53
cSH	924	773	71	284
Volume to Capacity	0.06	0.00	0.10	0.22
Queue Length 95th (ft)	5	0	8	20
Control Delay (s)	1.7	0.0	60.7	21.2
Lane LOS	A	A	F	C
Approach Delay (s)	1.7	0.0	60.7	21.2
Approach LOS			F	C

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	90.4%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	50	350	915	35	20	785
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	52	365	953	36	21	818
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		8				
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1831	971			990	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1831	971			990	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	36	0			97	
cM capacity (veh/h)	81	307			699	

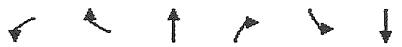
Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	417	990	21	818
Volume Left	52	0	21	0
Volume Right	365	36	0	0
cSH	350	1700	699	1700
Volume to Capacity	1.19	0.58	0.03	0.48
Queue Length 95th (ft)	433	0	2	0
Control Delay (s)	144.0	0.0	10.3	0.0
Lane LOS	F		B	
Approach Delay (s)	144.0	0.0	0.3	
Approach LOS	F			

Intersection Summary			
Average Delay	26.8		
Intersection Capacity Utilization	78.6%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	35	1415	10	15	1115
Peak Hour Factor	0.68	0.68	0.92	0.92	0.93	0.93
Hourly flow rate (vph)	0	51	1538	11	16	1199
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						516
pX, platoon unblocked	0.67					
vC, conflicting volume	2175	774			1549	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2261	774			1549	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	85			96	
cM capacity (veh/h)	23	345			424	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	51	1025	524	416	799
Volume Left	0	0	0	16	0
Volume Right	51	0	11	0	0
cSH	345	1700	1700	424	1700
Volume to Capacity	0.15	0.60	0.31	0.04	0.47
Queue Length 95th (ft)	13	0	0	3	0
Control Delay (s)	17.2	0.0	0.0	1.2	0.0
Lane LOS	C			A	
Approach Delay (s)	17.2	0.0		0.4	
Approach LOS	C				

Intersection Summary				
Average Delay	0.5			
Intersection Capacity Utilization	51.4%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	393	190	955	410	215	745
Peak Hour Factor	0.92	0.92	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	427	207	974	418	219	760
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			407			
pX, platoon unblocked						
vC, conflicting volume	2003	1184			1393	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2003	1184			1393	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	0			56	
cM capacity (veh/h)	30	185			497	

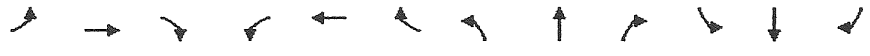
Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	634	1393	473	507
Volume Left	427	0	219	0
Volume Right	207	418	0	0
cSH	41	1700	497	1700
Volume to Capacity	15.49	0.82	0.44	0.30
Queue Length 95th (ft)	Err	0	56	0
Control Delay (s)	Err	0.0	13.2	0.0
Lane LOS	F		B	
Approach Delay (s)	Err	0.0	6.4	
Approach LOS	F			

Intersection Summary				
Average Delay	2109.9			
Intersection Capacity Utilization	145.5%	ICU Level of Service	H	
Analysis Period (min)	15			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	15	15	1120	25	15	945
Peak Hour Factor	0.84	0.84	0.93	0.93	0.95	0.95
Hourly flow rate (vph)	18	18	1204	27	16	995
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			771			1063
pX, platoon unblocked	0.63					
vC, conflicting volume	2244	1218			1231	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2969	1218			1231	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	92			97	
cM capacity (veh/h)	10	222			569	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	36	1231	1011
Volume Left	18	0	16
Volume Right	18	27	0
cSH	19	1700	569
Volume to Capacity	1.89	0.72	0.03
Queue Length 95th (ft)	122	0	2
Control Delay (s)	847.7	0.0	0.9
Lane LOS	F		A
Approach Delay (s)	847.7	0.0	0.9
Approach LOS	F		

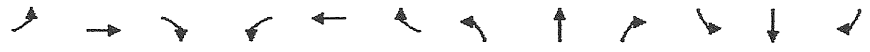
Intersection Summary			
Average Delay	13.7		
Intersection Capacity Utilization	71.7%	ICU Level of Service	C
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	1	5	20	10	0	305	10	940	10	170	775	5
Peak Hour Factor	0.69	0.69	0.69	0.75	0.75	0.75	0.80	0.80	0.80	0.95	0.95	0.95
Hourly flow rate (vph)	1	7	29	13	0	407	12	1175	12	179	816	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)											1018	
pX, platoon unblocked	0.50	0.50	0.50	0.50	0.50		0.50					
vC, conflicting volume	2789	2389	818	2413	2385	1181	821			1188		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	4591	3787	636	3835	3780	1181	641			1188		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	88	0	100	0	97			70		
cM capacity (veh/h)	0	1	240	0	1	234	473			592		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1	SB 2
Volume Total	38	420	1200	179	821
Volume Left	1	13	12	179	0
Volume Right	29	407	12	0	5
cSH	0	0	473	592	1700
Volume to Capacity	Err	Err	0.03	0.30	0.48
Queue Length 95th (ft)	Err	Err	2	32	0
Control Delay (s)	Err	Err	1.2	13.7	0.0
Lane LOS	F	F	A	B	
Approach Delay (s)	Err	Err	1.2	2.5	
Approach LOS	F	F			

Intersection Summary			
Average Delay	Err		
Intersection Capacity Utilization	125.0%	ICU Level of Service	H
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	10	1	45	15	0	15	50	1090	30	15	765	45
Peak Hour Factor	0.67	0.67	0.67	0.63	0.63	0.63	0.95	0.95	0.95	0.81	0.81	0.81
Hourly flow rate (vph)	15	1	67	24	0	24	53	1147	32	19	944	56
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2301	2293	972	2346	2305	1163	1000			1179		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2301	2293	972	2346	2305	1163	1000			1179		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	35	96	78	0	100	90	92			97		
cM capacity (veh/h)	23	35	309	18	35	239	696			596		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	84	48	1232	1019
Volume Left	15	24	53	19
Volume Right	67	24	32	56
cSH	91	33	696	596
Volume to Capacity	0.91	1.43	0.08	0.03
Queue Length 95th (ft)	128	131	6	2
Control Delay (s)	153.7	492.9	3.0	1.0
Lane LOS	F	F	A	A
Approach Delay (s)	153.7	492.9	3.0	1.0
Approach LOS	F	F		

Intersection Summary			
Average Delay	17.2		
Intersection Capacity Utilization	96.7%	ICU Level of Service	F
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	55	785	0	1	585	5	5	0	1	5	1	40
Peak Hour Factor	0.93	0.93	0.93	0.91	0.91	0.91	0.88	0.88	0.88	0.75	0.75	0.75
Hourly flow rate (vph)	59	844	0	1	643	5	6	0	1	7	1	53
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)					869							
pX, platoon unblocked												
vC, conflicting volume	648			844			1664	1613	844	1611	1610	646
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	648			844			1664	1613	844	1611	1610	646
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	94			100			91	100	100	92	99	89
cM capacity (veh/h)	937			784			65	98	366	80	99	475

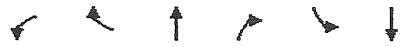
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	903	649	7	61
Volume Left	59	1	6	7
Volume Right	0	5	1	53
cSH	937	784	75	294
Volume to Capacity	0.06	0.00	0.09	0.21
Queue Length 95th (ft)	5	0	7	19
Control Delay (s)	1.7	0.0	57.4	20.4
Lane LOS	A	A	F	C
Approach Delay (s)	1.7	0.0	57.4	20.4
Approach LOS			F	C

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	88.8%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	35	45	885	35	20	755
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	36	47	922	36	21	786
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1768	940			958	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1768	940			958	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	59	85			97	
cM capacity (veh/h)	89	320			718	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	83	958	21	786
Volume Left	36	0	21	0
Volume Right	47	36	0	0
cSH	150	1700	718	1700
Volume to Capacity	0.56	0.56	0.03	0.46
Queue Length 95th (ft)	70	0	2	0
Control Delay (s)	55.5	0.0	10.2	0.0
Lane LOS	F		B	
Approach Delay (s)	55.5	0.0	0.3	
Approach LOS	F			

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	60.1%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	5	35	1365	10	15	1065
Peak Hour Factor	0.68	0.68	0.92	0.92	0.93	0.93
Hourly flow rate (vph)	7	51	1484	11	16	1145
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						516
pX, platoon unblocked	0.42					
vC, conflicting volume	2667	747			1495	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	4944	747			1495	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	86			96	
cM capacity (veh/h)	0	360			445	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1
Volume Total	59	989	505	1161
Volume Left	7	0	0	16
Volume Right	51	0	11	0
cSH	1	1700	1700	445
Volume to Capacity	41.35	0.58	0.30	0.04
Queue Length 95th (ft)	Err	0	0	3
Control Delay (s)	Err	0.0	0.0	1.7
Lane LOS	F			A
Approach Delay (s)	Err	0.0		1.7
Approach LOS	F			

Intersection Summary			
Average Delay	217.4		
Intersection Capacity Utilization	78.0%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	10	10	985	45	20	800
Peak Hour Factor	0.61	0.61	0.97	0.97	0.93	0.93
Hourly flow rate (vph)	16	16	1015	46	22	860
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			407			
pX, platoon unblocked						
vC, conflicting volume	1512	1039			1062	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1512	1039			1062	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	85	93			97	
cM capacity (veh/h)	109	231			664	

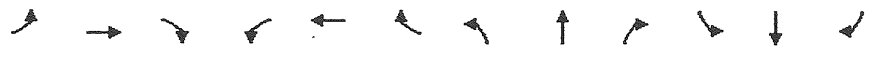
Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	33	1062	308	573
Volume Left	16	0	22	0
Volume Right	16	46	0	0
cSH	148	1700	664	1700
Volume to Capacity	0.22	0.62	0.03	0.34
Queue Length 95th (ft)	20	0	3	0
Control Delay (s)	36.0	0.0	1.1	0.0
Lane LOS	E		A	
Approach Delay (s)	36.0	0.0	0.4	
Approach LOS	E			

Intersection Summary				
Average Delay	0.8			
Intersection Capacity Utilization	64.6%	ICU Level of Service	C	
Analysis Period (min)	15			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	15	15	970	25	15	805
Peak Hour Factor	0.84	0.84	0.93	0.93	0.95	0.95
Hourly flow rate (vph)	18	18	1043	27	16	847
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			771			1063
pX, platoon unblocked	0.91					
vC, conflicting volume	1935	1056			1070	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2026	1056			1070	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	69	94			98	
cM capacity (veh/h)	57	276			655	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	36	1070	863
Volume Left	18	0	16
Volume Right	18	27	0
cSH	95	1700	655
Volume to Capacity	0.38	0.63	0.02
Queue Length 95th (ft)	38	0	2
Control Delay (s)	64.4	0.0	0.7
Lane LOS	F		A
Approach Delay (s)	64.4	0.0	0.7
Approach LOS	F		

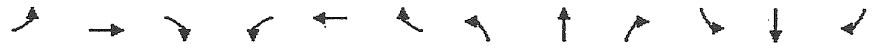
Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	64.4%	ICU Level of Service	C
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	1	5	20	10	0	275	10	875	10	145	715	5
Peak Hour Factor	0.69	0.69	0.69	0.75	0.75	0.75	0.80	0.80	0.80	0.95	0.95	0.95
Hourly flow rate (vph)	1	7	29	13	0	367	12	1094	12	153	753	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)											1018	
pX, platoon unblocked	0.53	0.53	0.53	0.53	0.53		0.53					
vC, conflicting volume	2552	2192	755	2216	2188	1100	758			1106		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	3914	3238	541	3282	3231	1100	545			1106		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	90	0	100	0	98			76		
cM capacity (veh/h)	0	4	290	0	4	260	548			635		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1	SB 2
Volume Total	38	380	1119	153	758
Volume Left	1	13	12	153	0
Volume Right	29	367	12	0	5
cSH	0	0	548	635	1700
Volume to Capacity	Err	Err	0.02	0.24	0.45
Queue Length 95th (ft)	Err	Err	2	23	0
Control Delay (s)	Err	Err	0.9	12.5	0.0
Lane LOS	F	F	A	B	
Approach Delay (s)	Err	Err	0.9	2.1	
Approach LOS	F	F			

Intersection Summary			
Average Delay	Err		
Intersection Capacity Utilization	116.6%	ICU Level of Service	H
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	10	1	45	10	0	15	50	1025	25	15	710	45
Peak Hour Factor	0.67	0.67	0.67	0.63	0.63	0.63	0.95	0.95	0.95	0.81	0.81	0.81
Hourly flow rate (vph)	15	1	67	16	0	24	53	1079	26	19	877	56
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2163	2152	904	2207	2167	1092	932			1105		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2163	2152	904	2207	2167	1092	932			1105		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	49	97	80	32	100	91	93			97		
cM capacity (veh/h)	29	44	338	23	43	263	738			635		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	84	40	1158	951
Volume Left	15	16	53	19
Volume Right	67	24	26	56
cSH	112	51	738	635
Volume to Capacity	0.75	0.77	0.07	0.03
Queue Length 95th (ft)	102	80	6	2
Control Delay (s)	98.3	188.5	2.5	0.9
Lane LOS	F	F	A	A
Approach Delay (s)	98.3	188.5	2.5	0.9
Approach LOS	F	F		

Intersection Summary				
Average Delay	8.7			
Intersection Capacity Utilization	92.0%	ICU Level of Service	F	
Analysis Period (min)	15			

Lane Group	EBT	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	4	414	200	1410	226	786
v/c Ratio	0.01	0.89	0.24	0.93	0.79	0.70
Control Delay	15.8	51.0	10.4	25.6	38.8	17.3
Queue Delay	0.0	0.0	0.0	25.7	0.0	0.0
Total Delay	15.8	51.0	10.4	51.4	38.8	17.3
Queue Length 50th (ft)	1	210	44	251	75	305
Queue Length 95th (ft)	8	#368	83	m#353	#198	458
Internal Link Dist (ft)	278	285		327		284
Turn Bay Length (ft)			200		250	
Base Capacity (vph)	576	510	843	1517	287	1118
Starvation Cap Reductn	0	0	0	177	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.81	0.24	1.05	0.79	0.70

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	511	565	140	433	255	940	100	637	379
v/c Ratio	0.87	0.94	0.73	0.89	0.84	0.81	0.61	0.81	0.46
Control Delay	49.0	50.6	57.3	50.6	57.4	31.6	51.9	38.7	9.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.0	50.6	57.3	50.6	57.4	31.6	51.9	38.7	9.8
Queue Length 50th (ft)	129	258	69	202	125	228	49	158	60
Queue Length 95th (ft)	#212	#459	#153	#364	#250	#338	#112	#237	130
Internal Link Dist (ft)		854		619		2871		262	
Turn Bay Length (ft)	200		100		100		100		100
Base Capacity (vph)	590	606	193	488	304	1161	164	793	816
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.87	0.93	0.73	0.89	0.84	0.81	0.61	0.80	0.46

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	49	20	1134	1011
v/c Ratio	0.27	0.12	0.72	0.63
Control Delay	14.5	14.4	7.8	5.0
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.5	14.4	7.8	5.0
Queue Length 50th (ft)	8	3	151	110
Queue Length 95th (ft)	16	14	#578	272
Internal Link Dist (ft)	938	531	495	388
Turn Bay Length (ft)				
Base Capacity (vph)	262	247	1565	1607
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.19	0.08	0.72	0.63

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	NBT	SBT	NEL
Lane Group Flow (vph)	133	1526	1690	652
v/c Ratio	0.72	0.75	0.88	0.90
Control Delay	60.8	16.8	10.0	51.5
Queue Delay	0.0	0.9	0.1	11.9
Total Delay	60.8	17.7	10.1	63.3
Queue Length 50th (ft)	74	317	7	186
Queue Length 95th (ft)	110	406	m#276	#275
Internal Link Dist (ft)	1038	436	304	1207
Turn Bay Length (ft)				
Base Capacity (vph)	195	2043	1924	739
Starvation Cap Reductn	0	0	8	0
Spillback Cap Reductn	0	242	0	80
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.68	0.85	0.88	0.99

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	18	18	48	313	329	553	26	1242	835	568	1042
v/c Ratio	0.46	0.44	0.10	0.86	0.90	0.52	0.07	0.95	0.95	1.00	0.66
Control Delay	80.4	76.1	8.4	52.5	57.6	13.2	26.6	39.2	35.2	54.1	16.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	1.5	0.0	44.9	0.9	0.9	0.0
Total Delay	80.4	76.1	8.4	52.5	57.6	14.7	26.6	84.0	36.1	55.0	16.2
Queue Length 50th (ft)	10	10	0	180	191	126	12	349	431	186	155
Queue Length 95th (ft)	#38	#37	23	m#305	m#330	m216	m16	m#480	m#460	m#443	m146
Internal Link Dist (ft)		152			327			304			584
Turn Bay Length (ft)	75		75			150	75			350	
Base Capacity (vph)	39	41	460	365	365	1056	390	1314	881	567	2151
Starvation Cap Reductn	0	0	0	0	0	315	0	187	7	0	0
Spillback Cap Reductn	0	0	1	0	0	0	0	0	0	2	79
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.46	0.44	0.10	0.86	0.90	0.75	0.07	1.10	0.96	1.01	0.50

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBT	EBR	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	151	785	20	546	1234	974
v/c Ratio	0.74	0.67	0.09	0.67	0.44	0.93
Control Delay	59.3	12.8	31.5	12.5	1.0	49.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	59.3	12.8	31.5	12.5	1.0	49.2
Queue Length 50th (ft)	82	209	9	91	4	331
Queue Length 95th (ft)	#153	289	17	m110	m23	#454
Internal Link Dist (ft)	445		188		584	705
Turn Bay Length (ft)		200		150		
Base Capacity (vph)	225	1230	237	870	2776	1050
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.67	0.64	0.08	0.63	0.44	0.93

Intersection Summary

Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	511	565	140	433	255	940	100	637	379
v/c Ratio	0.85	0.90	0.58	0.77	0.82	0.87	0.63	0.82	0.45
Control Delay	62.9	56.1	58.7	47.9	69.9	48.0	72.2	53.9	10.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	62.9	56.1	58.7	47.9	69.9	48.0	72.2	53.9	10.6
Queue Length 50th (ft)	204	421	105	313	195	354	77	249	66
Queue Length 95th (ft)	#318	#696	171	432	#352	#482	#159	#344	162
Internal Link Dist (ft)		854		619		2871		262	
Turn Bay Length (ft)	200		100		100		100		100
Base Capacity (vph)	620	630	338	628	331	1152	168	828	839
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.82	0.90	0.41	0.69	0.77	0.82	0.60	0.77	0.45

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	49	20	1134	1011
v/c Ratio	0.27	0.12	0.72	0.63
Control Delay	14.5	14.4	7.8	5.0
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.5	14.4	7.8	5.0
Queue Length 50th (ft)	8	3	151	110
Queue Length 95th (ft)	16	14	#578	272
Internal Link Dist (ft)	938	531	983	388
Turn Bay Length (ft)				
Base Capacity (vph)	262	247	1565	1607
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.19	0.08	0.72	0.63

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	NBT	SBT	SBR	NEL
Lane Group Flow (vph)	133	1526	1163	582	652
v/c Ratio	0.58	0.73	1.20	0.63	1.00
Control Delay	53.9	18.5	124.3	18.2	79.1
Queue Delay	1.7	11.8	81.5	8.4	48.8
Total Delay	55.5	30.3	205.7	26.6	127.9
Queue Length 50th (ft)	87	377	~987	245	~237
Queue Length 95th (ft)	123	488	#1274	381	#361
Internal Link Dist (ft)	1038	436	304		1207
Turn Bay Length (ft)					
Base Capacity (vph)	271	2082	968	924	654
Starvation Cap Reductn	0	0	128	301	0
Spillback Cap Reductn	49	555	0	0	79
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.60	1.00	1.38	0.93	1.13

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	18	18	48	304	318	536	26	1230	827	551	1010
v/c Ratio	0.14	0.13	0.30	0.82	0.85	0.55	0.21	0.82	0.89	1.24	0.71
Control Delay	49.8	49.5	18.7	61.2	65.3	17.4	51.6	36.0	25.9	162.4	20.8
Queue Delay	0.0	0.0	0.5	16.3	25.2	0.0	0.0	91.0	9.8	0.0	1.2
Total Delay	49.8	49.5	19.2	77.5	90.4	17.4	51.6	126.9	35.8	162.4	22.0
Queue Length 50th (ft)	12	12	0	209	220	195	18	487	309	#511	410
Queue Length 95th (ft)	33	33	31	#358	#382	306	46	593	#546	#723	574
Internal Link Dist (ft)		152			327			304			584
Turn Bay Length (ft)	75		75			150	75		185	250	
Base Capacity (vph)	148	155	176	372	372	981	164	1506	934	444	1423
Starvation Cap Reductn	0	0	0	0	0	0	0	480	95	0	0
Spillback Cap Reductn	0	0	24	60	60	0	0	0	0	0	211
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.12	0.32	0.97	1.02	0.55	0.16	1.20	0.99	1.24	0.83

Intersection Summary

Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	11	10	10	10	12
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Util. Factor	0.97	1.00		1.00	1.00		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.96		1.00	0.97		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3351	1798		1711	1807		1728	3408		1668	3336	1599
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3351	1798		1711	1807		1728	3408		1668	3336	1599
Volume (vph)	440	325	135	125	285	70	195	795	80	95	610	330
Peak-hour factor, PHF	0.93	0.93	0.93	0.89	0.89	0.89	0.92	0.92	0.92	0.95	0.95	0.95
Adj. Flow (vph)	473	349	145	140	320	79	212	864	87	100	642	347
RTOR Reduction (vph)	0	11	0	0	7	0	0	6	0	0	0	138
Lane Group Flow (vph)	473	483	0	140	392	0	212	945	0	100	642	209
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	1%	1%	1%	1%	1%	1%
Turn Type	Prot			Prot			Prot			Prot		pm+ov
Protected Phases	7	4		3	8		5	2		1	6	7
Permitted Phases												6
Actuated Green, G (s)	18.3	36.7		12.0	30.4		16.9	36.6		7.3	27.0	45.3
Effective Green, g (s)	20.3	38.7		14.0	32.4		18.9	38.6		9.3	29.0	49.3
Actuated g/C Ratio	0.18	0.34		0.12	0.29		0.17	0.34		0.08	0.26	0.44
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	604	618		213	520		290	1168		138	859	743
v/s Ratio Prot	c0.14	c0.27		0.08	0.22		c0.12	c0.28		0.06	0.19	0.05
v/s Ratio Perm												0.08
v/c Ratio	0.78	0.78		0.66	0.75		0.73	0.81		0.72	0.75	0.28
Uniform Delay, d1	44.0	33.2		47.0	36.5		44.4	33.7		50.4	38.4	20.3
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	6.6	6.4		7.1	6.1		9.1	4.2		17.1	3.6	0.2
Delay (s)	50.6	39.5		54.1	42.6		53.6	37.9		67.5	42.0	20.5
Level of Service	D	D		D	D		D	D		E	D	C
Approach Delay (s)		45.0			45.6			40.7			37.5	
Approach LOS		D			D			D			D	

Intersection Summary					
HCM Average Control Delay	41.6	HCM Level of Service		D	
HCM Volume to Capacity ratio	0.77				
Actuated Cycle Length (s)	112.6	Sum of lost time (s)		6.0	
Intersection Capacity Utilization	75.4%	ICU Level of Service		D	
Analysis Period (min)	15				
c Critical Lane Group					

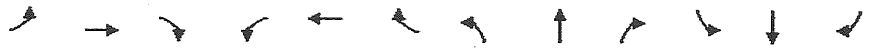
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.91			0.91			1.00			1.00	
Flt Protected		0.98			0.98			1.00			1.00	
Satd. Flow (prot)		1700			1703			1892			1874	
Flt Permitted		0.89			0.94			0.94			0.98	
Satd. Flow (perm)		1541			1627			1785			1837	
Volume (vph)	10	0	20	5	0	10	40	900	15	15	825	20
Peak-hour factor, PHF	0.61	0.61	0.61	0.75	0.75	0.75	0.93	0.93	0.93	0.95	0.95	0.95
Adj. Flow (vph)	16	0	33	7	0	13	43	968	16	16	868	21
RTOR Reduction (vph)	0	31	0	0	12	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	18	0	0	8	0	0	1027	0	0	904	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			2			1			1	
Permitted Phases	2			2			1			1		
Actuated Green, G (s)		5.7			5.7			76.0			76.0	
Effective Green, g (s)		6.7			6.7			77.0			77.0	
Actuated g/C Ratio		0.07			0.07			0.86			0.86	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		115			122			1532			1577	
v/s Ratio Prot												
v/s Ratio Perm		c0.01			0.00			c0.57			0.49	
v/c Ratio		0.16			0.07			0.67			0.57	
Uniform Delay, d1		38.9			38.6			2.1			1.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.7			0.2			2.3			1.5	
Delay (s)		39.5			38.8			4.5			3.3	
Level of Service		D			D			A			A	
Approach Delay (s)		39.5			38.8			4.5			3.3	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM Average Control Delay	5.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	89.7	Sum of lost time (s)	6.0
Intersection Capacity Utilization	81.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR	SBR2	NEL	NER
Lane Configurations									
Ideal Flow (vphpl)	1900	1900	1900	1853	1693	1900	1900	1900	1900
Lane Width	12	12	12	12	11	11	11	12	12
Total Lost time (s)	3.0			3.0	3.0	3.0		3.0	
Lane Util. Factor	1.00			0.95	1.00	1.00		0.97	
Frt	0.98			1.00	1.00	0.85		1.00	
Flt Protected	0.96			1.00	1.00	1.00		0.95	
Satd. Flow (prot)	1751			3486	1620	1546		3502	
Flt Permitted	0.96			1.00	1.00	1.00		0.95	
Satd. Flow (perm)	1751			3486	1620	1546		3502	
Volume (vph)	85	15	0	1400	1020	485	10	540	0
Peak-hour factor, PHF	0.75	0.75	0.95	0.95	0.92	0.92	0.92	0.89	0.89
Adj. Flow (vph)	113	20	0	1474	1109	527	11	607	0
RTOR Reduction (vph)	0	0	0	0	0	1	0	0	0
Lane Group Flow (vph)	133	0	0	1474	1109	537	0	607	0
Heavy Vehicles (%)	2%	2%	1%	1%	1%	1%	1%	0%	0%
Turn Type						Perm			
Protected Phases	3			2	6			4	
Permitted Phases					6	6			
Actuated Green, G (s)	12.2			62.0	62.0	62.0		18.0	
Effective Green, g (s)	14.2			64.0	64.0	64.0		20.0	
Actuated g/C Ratio	0.13			0.60	0.60	0.60		0.19	
Clearance Time (s)	5.0			5.0	5.0	5.0		5.0	
Vehicle Extension (s)	2.5			3.0	3.0	3.0		2.5	
Lane Grp Cap (vph)	232			2081	967	923		653	
v/s Ratio Prot	c0.08			0.42	c0.68			c0.17	
v/s Ratio Perm						0.35			
v/c Ratio	0.57			0.71	1.15	0.58		0.93	
Uniform Delay, d1	43.7			15.1	21.6	13.3		42.9	
Progression Factor	1.00			1.00	1.00	1.00		1.00	
Incremental Delay, d2	2.8			1.1	78.3	0.9		19.6	
Delay (s)	46.5			16.2	99.9	14.3		62.5	
Level of Service	D			B	F	B		E	
Approach Delay (s)	46.5			16.2	72.0			62.5	
Approach LOS	D			B	E			E	

Intersection Summary			
HCM Average Control Delay	48.3	HCM Level of Service	D
HCM Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	107.2	Sum of lost time (s)	9.0
Intersection Capacity Utilization	91.3%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

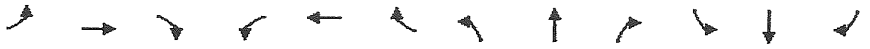


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	2023	2011	2261	1900	2496	1900	1897	1900	1900
Lane Width	12	12	12	12	12	12	12	12	12	11	11	11
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Util. Factor	1.00	1.00	1.00	*0.99	*0.99	1.00	1.00	*0.79	1.00	1.00	*0.65	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1900	1615	1884	1884	1884	1805	3944	1599	1725	2358	
Flt Permitted	0.95	1.00	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1805	1900	1615	1884	1884	1884	1805	3944	1599	1725	2358	
Volume (vph)	15	15	40	450	15	385	25	1275	650	415	1025	20
Peak-hour factor, PHF	0.83	0.83	0.83	0.92	0.92	0.92	0.97	0.97	0.97	0.86	0.86	0.86
Adj. Flow (vph)	18	18	48	489	16	418	26	1314	670	483	1192	23
RTOR Reduction (vph)	0	0	45	0	0	75	0	0	0	0	1	0
Lane Group Flow (vph)	18	18	3	246	259	343	26	1314	670	483	1214	0
Heavy Vehicles (%)	0%	0%	0%	1%	0%	2%	0%	0%	1%	1%	1%	0%
Turn Type	Split		Prot	Split		pm+ov	Prot		pm+ov	Prot		
Protected Phases	3	3	3	4	4	1	5	2	4	1	6	
Permitted Phases		3				4		2	2		6	
Actuated Green, G (s)	5.4	5.4	5.4	18.7	18.7	47.0	4.2	39.1	57.8	28.3	63.2	
Effective Green, g (s)	6.9	6.9	6.9	20.2	20.2	50.0	5.7	41.1	61.3	29.8	65.2	
Actuated g/C Ratio	0.06	0.06	0.06	0.18	0.18	0.45	0.05	0.37	0.56	0.27	0.59	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5.0	4.5	4.5	5.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	2.0	2.0	3.0	3.0	2.0	3.0	
Lane Grp Cap (vph)	113	119	101	346	346	908	94	1474	891	467	1398	
v/s Ratio Prot	c0.01	0.01	0.00	0.13	0.14	0.10	0.01	0.33	c0.14	c0.28	c0.51	
v/s Ratio Perm						0.08			0.28			
v/c Ratio	0.16	0.15	0.03	0.71	0.75	0.38	0.28	0.89	0.75	1.03	0.87	
Uniform Delay, d1	48.8	48.8	48.4	42.2	42.5	19.8	50.2	32.4	18.6	40.1	18.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.7	0.6	0.1	6.7	8.6	0.1	0.6	8.5	3.6	50.8	6.0	
Delay (s)	49.5	49.4	48.5	48.9	51.1	19.8	50.8	40.9	22.2	90.9	24.8	
Level of Service	D	D	D	D	D	B	D	D	C	F	C	
Approach Delay (s)		48.9			36.4			34.8			43.6	
Approach LOS		D			D			C			D	

Intersection Summary				
HCM Average Control Delay	38.5	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.84			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	9.0	
Intersection Capacity Utilization	78.7%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				

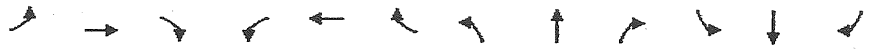
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1863	1900	1900	2083	1900
Lane Width	12	14	16	12	12	12	12	12	12	12	12	12
Total Lost time (s)		3.0	3.0		3.0		3.0	3.0			3.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95			0.95	
Frt		1.00	0.85		0.99		1.00	1.00			0.99	
Flt Protected		0.95	1.00		0.98		0.95	1.00			1.00	
Satd. Flow (prot)		1915	1812		1682		1787	3500			3872	
Flt Permitted		0.72	1.00		0.87		0.95	1.00			0.94	
Satd. Flow (perm)		1445	1812		1491		1787	3500			3623	
Volume (vph)	125	5	660	5	5	1	520	1145	10	10	795	65
Peak-hour factor, PHF	0.86	0.86	0.86	0.55	0.55	0.55	0.98	0.98	0.98	0.86	0.86	0.86
Adj. Flow (vph)	145	6	767	9	9	2	531	1168	10	12	924	76
RTOR Reduction (vph)	0	0	20	0	2	0	0	1	0	0	6	0
Lane Group Flow (vph)	0	151	747	0	18	0	531	1177	0	0	1006	0
Heavy Vehicles (%)	1%	1%	1%	9%	9%	9%	1%	1%	1%	1%	1%	1%
Turn Type	Perm		pm+ov	Perm			Prot			Perm		
Protected Phases		8	5		4		5	2			6	
Permitted Phases	8	8	8	4	4			2		6	6	
Actuated Green, G (s)		11.4	42.2		11.4		30.8	66.2			30.4	
Effective Green, g (s)		13.4	46.2		13.4		32.8	68.2			32.4	
Actuated g/C Ratio		0.15	0.53		0.15		0.37	0.78			0.37	
Clearance Time (s)		5.0	5.0		5.0		5.0	5.0			5.0	
Vehicle Extension (s)		2.5	2.5		2.5		2.5	3.0			3.0	
Lane Grp Cap (vph)		221	1018		228		669	2725			1340	
v/s Ratio Prot			c0.27				c0.30	0.34				
v/s Ratio Perm		0.10	0.14		0.01						c0.28	
v/c Ratio		0.68	0.73		0.08		0.79	0.43			0.75	
Uniform Delay, d1		35.1	16.0		31.8		24.4	3.2			24.1	
Progression Factor		1.00	1.00		1.00		1.00	1.00			1.00	
Incremental Delay, d2		7.7	2.6		0.1		6.2	0.1			2.4	
Delay (s)		42.8	18.6		31.9		30.6	3.3			26.5	
Level of Service		D	B		C		C	A			C	
Approach Delay (s)		22.6			31.9			11.8			26.5	
Approach LOS		C			C			B			C	

Intersection Summary			
HCM Average Control Delay	18.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	87.6	Sum of lost time (s)	9.0
Intersection Capacity Utilization	78.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	11	10	10	10	12
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Util. Factor	0.97	1.00		1.00	1.00		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.96		1.00	0.97		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3351	1798		1711	1805		1728	3406		1668	3336	1599
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3351	1798		1711	1805		1728	3406		1668	3336	1599
Volume (vph)	425	310	130	120	270	70	190	770	80	90	590	315
Peak-hour factor, PHF	0.93	0.93	0.93	0.89	0.89	0.89	0.92	0.92	0.92	0.95	0.95	0.95
Adj. Flow (vph)	457	333	140	135	303	79	207	837	87	95	621	332
RTOR Reduction (vph)	0	11	0	0	8	0	0	6	0	0	0	137
Lane Group Flow (vph)	457	462	0	135	374	0	207	918	0	95	621	195
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	1%	1%	1%	1%	1%	1%
Turn Type	Prot			Prot			Prot			Prot		pm+ov
Protected Phases	7	4		3	8		5	2		1	6	7
Permitted Phases												6
Actuated Green, G (s)	17.8	35.3		11.5	29.0		16.5	35.4		7.2	26.1	43.9
Effective Green, g (s)	19.8	37.3		13.5	31.0		18.5	37.4		9.2	28.1	47.9
Actuated g/C Ratio	0.18	0.34		0.12	0.28		0.17	0.34		0.08	0.26	0.44
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	606	613		211	511		292	1164		140	857	744
v/s Ratio Prot	c0.14	c0.26		0.08	0.21		c0.12	c0.27		0.06	0.19	0.05
v/s Ratio Perm												0.07
v/c Ratio	0.75	0.75		0.64	0.73		0.71	0.79		0.68	0.72	0.26
Uniform Delay, d1	42.5	32.0		45.6	35.4		42.9	32.4		48.7	37.1	19.5
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	5.3	5.2		6.2	5.4		7.7	3.6		12.3	3.1	0.2
Delay (s)	47.8	37.2		51.9	40.8		50.6	36.1		61.0	40.2	19.7
Level of Service	D	D		D	D		D	D		E	D	B
Approach Delay (s)		42.4			43.7			38.7			35.6	
Approach LOS		D			D			D			D	

Intersection Summary				
HCM Average Control Delay	39.5	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.75			
Actuated Cycle Length (s)	109.4	Sum of lost time (s)	6.0	
Intersection Capacity Utilization	73.0%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				



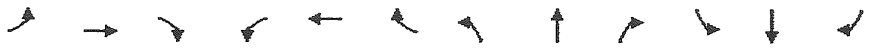
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.91			0.91			1.00			1.00	
Flt Protected		0.98			0.98			1.00			1.00	
Satd. Flow (prot)		1701			1703			1893			1876	
Flt Permitted		0.88			0.91			0.97			0.98	
Satd. Flow (perm)		1523			1577			1835			1839	
Volume (vph)	5	0	10	5	0	10	25	875	15	15	800	10
Peak-hour factor, PHF	0.61	0.61	0.61	0.75	0.75	0.75	0.93	0.93	0.93	0.95	0.95	0.95
Adj. Flow (vph)	8	0	16	7	0	13	27	941	16	16	842	11
RTOR Reduction (vph)	0	15	0	0	12	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	9	0	0	8	0	0	984	0	0	869	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			2			1			1	
Permitted Phases	2			2			1			1		
Actuated Green, G (s)		3.8			3.8			84.1			84.1	
Effective Green, g (s)		4.8			4.8			85.1			85.1	
Actuated g/C Ratio		0.05			0.05			0.89			0.89	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		76			79			1628			1632	
v/s Ratio Prot												
v/s Ratio Perm		c0.01			0.00			c0.54			0.47	
v/c Ratio		0.12			0.10			0.60			0.53	
Uniform Delay, d1		43.5			43.5			1.3			1.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.7			0.5			1.7			1.2	
Delay (s)		44.2			44.0			3.0			2.4	
Level of Service		D			D			A			A	
Approach Delay (s)		44.2			44.0			3.0			2.4	
Approach LOS		D			D			A			A	

Intersection Summary				
HCM Average Control Delay	3.7	HCM Level of Service	A	
HCM Volume to Capacity ratio	0.58			
Actuated Cycle Length (s)	95.9	Sum of lost time (s)	6.0	
Intersection Capacity Utilization	71.8%	ICU Level of Service	C	
Analysis Period (min)	15			

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR	SBR2	NEL	NER
Lane Configurations									
Ideal Flow (vphpl)	1900	1900	1900	1917	1693	1900	1900	1900	1900
Lane Width	12	12	11	11	11	11	11	12	12
Total Lost time (s)	3.0			3.0	3.0	3.0		3.0	
Lane Util. Factor	1.00			0.95	1.00	1.00		0.97	
Frt	0.98			1.00	1.00	0.85		1.00	
Flt Protected	0.96			1.00	1.00	1.00		0.95	
Satd. Flow (prot)	1751			3486	1620	1546		3502	
Flt Permitted	0.96			1.00	1.00	1.00		0.95	
Satd. Flow (perm)	1751			3486	1620	1546		3502	
Volume (vph)	85	15	0	1350	985	465	10	515	0
Peak-hour factor, PHF	0.75	0.75	0.95	0.95	0.92	0.92	0.92	0.89	0.89
Adj. Flow (vph)	113	20	0	1421	1071	505	11	579	0
RTOR Reduction (vph)	0	0	0	0	0	1	0	0	0
Lane Group Flow (vph)	133	0	0	1421	1071	515	0	579	0
Heavy Vehicles (%)	2%	2%	1%	1%	1%	1%	1%	0%	0%
Turn Type						Perm			
Protected Phases	3			2	6			4	
Permitted Phases					6	6			
Actuated Green, G (s)	12.2			62.0	62.0	62.0		17.9	
Effective Green, g (s)	14.2			64.0	64.0	64.0		19.9	
Actuated g/C Ratio	0.13			0.60	0.60	0.60		0.19	
Clearance Time (s)	5.0			5.0	5.0	5.0		5.0	
Vehicle Extension (s)	2.5			3.0	3.0	3.0		2.5	
Lane Grp Cap (vph)	232			2083	968	924		651	
v/s Ratio Prot	c0.08			0.41	c0.66			c0.17	
v/s Ratio Perm						0.33			
v/c Ratio	0.57			0.68	1.11	0.56		0.89	
Uniform Delay, d1	43.6			14.6	21.6	13.0		42.5	
Progression Factor	1.00			1.00	1.00	1.00		1.00	
Incremental Delay, d2	2.8			0.9	62.7	0.7		14.0	
Delay (s)	46.4			15.6	84.2	13.7		56.5	
Level of Service	D			B	F	B		E	
Approach Delay (s)	46.4			15.6	61.3			56.5	
Approach LOS	D			B	E			E	

Intersection Summary				
HCM Average Control Delay	42.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	107.1	Sum of lost time (s)	9.0
Intersection Capacity Utilization	88.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	2023	2011	2261	1900	2496	1900	1897	1900	1900
Lane Width	12	12	12	12	12	12	12	12	12	11	11	11
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Util. Factor	1.00	1.00	1.00	*0.99	*0.99	1.00	1.00	*0.79	1.00	1.00	*0.65	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1900	1615	1884	1884	1884	1805	3944	1599	1725	2358	
Flt Permitted	0.95	1.00	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1805	1900	1615	1884	1884	1884	1805	3944	1599	1725	2358	
Volume (vph)	15	15	40	430	15	365	25	1225	625	390	990	20
Peak-hour factor, PHF	0.83	0.83	0.83	0.92	0.92	0.92	0.97	0.97	0.97	0.86	0.86	0.86
Adj. Flow (vph)	18	18	48	467	16	397	26	1263	644	453	1151	23
RTOR Reduction (vph)	0	0	45	0	0	81	0	0	0	0	1	0
Lane Group Flow (vph)	18	18	3	235	248	316	26	1263	644	453	1173	0
Heavy Vehicles (%)	0%	0%	0%	1%	0%	2%	0%	0%	1%	1%	1%	0%
Turn Type	Split		Prot	Split		pm+ov	Prot		pm+ov	Prot		
Protected Phases	3	3	3	4	4	1	5	2	4	1	6	
Permitted Phases		3				4		2	2		6	
Actuated Green, G (s)	5.2	5.2	5.2	17.7	17.7	42.3	4.1	42.2	59.9	24.6	62.7	
Effective Green, g (s)	6.7	6.7	6.7	19.2	19.2	45.3	5.6	44.2	63.4	26.1	64.7	
Actuated g/C Ratio	0.06	0.06	0.06	0.18	0.18	0.42	0.05	0.41	0.59	0.24	0.60	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5.0	4.5	4.5	5.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	2.0	2.0	3.0	3.0	2.0	3.0	
Lane Grp Cap (vph)	112	118	100	334	334	841	93	1611	937	416	1410	
v/s Ratio Prot	c0.01	0.01	0.00	0.12	c0.13	0.09	0.01	0.32	0.12	c0.26	c0.50	
v/s Ratio Perm						0.08			0.28			
v/c Ratio	0.16	0.15	0.03	0.70	0.74	0.38	0.28	0.78	0.69	1.09	0.83	
Uniform Delay, d1	48.1	48.1	47.7	41.8	42.2	21.7	49.4	27.8	15.5	41.0	17.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.7	0.6	0.1	6.6	8.6	0.1	0.6	3.9	2.1	70.2	4.4	
Delay (s)	48.8	48.7	47.8	48.4	50.8	21.8	50.0	31.7	17.6	111.3	21.8	
Level of Service	D	D	D	D	D	C	D	C	B	F	C	
Approach Delay (s)		48.2			37.1			27.3			46.7	
Approach LOS		D			D			C			D	

Intersection Summary				
HCM Average Control Delay	36.6	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.83			
Actuated Cycle Length (s)	108.2	Sum of lost time (s)	9.0	
Intersection Capacity Utilization	75.7%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1863	1900	1900	2083	1900
Lane Width	12	14	16	12	12	12	12	12	12	12	12	12
Total Lost time (s)		3.0	3.0		3.0		3.0	3.0			3.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95			0.95	
Frt		1.00	0.85		0.99		1.00	1.00			0.99	
Flt Protected		0.95	1.00		0.98		0.95	1.00			1.00	
Satd. Flow (prot)		1915	1812		1682		1787	3500			3870	
Flt Permitted		0.72	1.00		0.85		0.95	1.00			0.94	
Satd. Flow (perm)		1445	1812		1458		1787	3500			3624	
Volume (vph)	120	5	640	5	5	1	505	1090	10	10	755	65
Peak-hour factor, PHF	0.86	0.86	0.86	0.55	0.55	0.55	0.98	0.98	0.98	0.86	0.86	0.86
Adj. Flow (vph)	140	6	744	9	9	2	515	1112	10	12	878	76
RTOR Reduction (vph)	0	0	22	0	2	0	0	1	0	0	6	0
Lane Group Flow (vph)	0	146	722	0	18	0	515	1121	0	0	960	0
Heavy Vehicles (%)	1%	1%	1%	9%	9%	9%	1%	1%	1%	1%	1%	1%
Turn Type	Perm		pm+ov	Perm			Prot			Perm		
Protected Phases		8	5		4		5	2			6	
Permitted Phases	8	8	8	4	4			2		6	6	
Actuated Green, G (s)		8.7	38.8		8.7		30.1	64.3			29.2	
Effective Green, g (s)		10.7	42.8		10.7		32.1	66.3			31.2	
Actuated g/C Ratio		0.13	0.52		0.13		0.39	0.80			0.38	
Clearance Time (s)		5.0	5.0		5.0		5.0	5.0			5.0	
Vehicle Extension (s)		2.5	2.5		2.5		2.5	3.0			3.0	
Lane Grp Cap (vph)		186	1000		188		691	2796			1362	
v/s Ratio Prot			c0.28				0.29	0.32				
v/s Ratio Perm		c0.10	0.12		0.01						c0.27	
v/c Ratio		0.78	0.72		0.10		0.75	0.40			0.71	
Uniform Delay, d1		35.0	15.5		31.9		21.9	2.5			22.0	
Progression Factor		1.00	1.00		1.00		1.00	1.00			1.00	
Incremental Delay, d2		18.6	2.4		0.2		4.1	0.1			1.7	
Delay (s)		53.6	17.9		32.1		26.1	2.6			23.7	
Level of Service		D	B		C		C	A			C	
Approach Delay (s)		23.8			32.1			10.0			23.7	
Approach LOS		C			C			A			C	

Intersection Summary			
HCM Average Control Delay	17.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	83.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	75.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Evening Peak Hour Queue Results – Existing vs. Build Comparison

Location	Movement	2004 Existing Condition			2007 Build Condition with Mitigation		
		Storage [a]	Average	95th Percentile	Storage	Average	95th Percentile
Forest Avenue at Warren Avenue	EB L/T	500	79	185	500	82	153
	EB R	250	263	439	250	209	289
	WB L/T/R	250	9	20	250	9	17
	NB L	250	253	425	150	91	110
	NB T/R	650	90	112	650	4	23
	SB L/T/R	500	251	352	500	331	454
Forest Avenue at Allen Avenue	EB L	75	12	33	75	10	38
	EB T	75	12	33	75	10	37
	EB R	75	0	31	75	0	23
	WB L	400	154	242	400	180	305
	WB L/T	400	164	255	400	191	330
	WB R	150	112	194	150	126	216
	NB L	75	18	46	75	12	16
	NB T	375	498	616	375	349	480
	NB R	185	195	286	375	431	460
	SB L	250	361	528	350	186	443
	SB T/R	650	530	750	650	155	146
Forest Avenue at Stevens Avenue / Bishop Street	EB L/R	500	87	123	500	74	110
	NB L/T	325	333	432	325	317	406
	SB T	375	854	1134	n/a		
	SB R	375	204	316			
	SB T/R	n/a			375	276	276
	NEB L/R	500	203	302	500	275	275
Allen Avenue at Plymouth Street/ Northfield Green Drive	EB L/T/R	300	5	13	300	8	16
	WB L/T/R	300	4	15	300	3	14
	NB L/T/R	500	0	216	500	151	578
	SB L/T/R	500	0	162	500	110	272
Allen Avenue at Washington Avenue	EB L	200	174	265	200	129	212
	EB T/R	500	325	495	500	258	459
	WB L	100	99	168	100	69	153
	WB T/R	500	264	369	500	202	364
	NB L	100	151	254	100	125	250
	NB T/R	500	335	467	500	228	338
	SB L	100	72	147	100	49	112
	SB T	500	230	334	500	158	237
	SB R	100	37	117	100	60	130
Allen Avenue at proposed site drive	EB L/T/R	n/a			50	1	8
	WB L/T				500	210	368
	WB R				200	44	83
	NB L/T/R				400	251	353
	SB L				250	75	198
	SB T/R				350	305	458

a lane or lane group storage capacity length, measured in feet
EB = Eastbound; WB = Westbound; NB = Northbound; SB = Southbound; NEB = Northeastbound; L = Left; T = Through; R = Right
n/a not applicable; movement does not exist under current condition

Comment 2

See attached summaries of historical traffic information at all study intersections for which VHB has collected such data.

Historical Traffic Comparision- Forest Avenue at Warren Avenue

Date	Day	Forest Avenue (West of Warren Avenue)	Forest Avenue (East of Warren Avenue)	Warren Avenue (South of Forest Avenue)
September 29, 2005	Thursday	1,751	2,533	1,092
October 5, 2004	Tuesday	1,924	2,850	1,271
May 18, 2004	Tuesday	1,956	2,851	1,264

Historical Traffic Comparision- Allen Avenue at Woodlawn Avenue

Date	Day	Woodlawn Avenue (East of Allen Avenue)	Allen Avenue (North of Woodlawn Avenue)	Allen Avenue (South of Woodlawn Avenue)
October 5, 2004	Tuesday	77	1,626	1,643
May 18, 2004	Tuesday	76	1,250	1,280

Historical Traffic Comparision- Forest Avenue at Bishop Street/ Stevens Avenue

Date	Day	Forest Avenue (West of Bishop Street)	Forest Avenue (East of Bishop Street)	Stevens Avenue (SE of Forest Avenue)	Bishop Street (South of Forest Avenue)
August 18, 2005	Thursday	2,724	1,939	855	113
October 5, 2004	Tuesday	3,037	2,201	906	120
May 18, 2004	Tuesday	2,861	2,174	770	147

Historical Traffic Comparision- Allen Avenue at Washington Avenue

Date	Day	Allen Avenue (North of Washington Street)	Allen Avenue (South of Washington Street)	Washington Street (West of Allen Avenue)	Washington Street (East of Allen Avenue)
October 5, 2004	Tuesday	877	1,525	2,107	1,757
August 10, 2004	Tuesday	806	1,401	1,914	1,705
May 18, 2004	Tuesday	618	830	1,201	1,201

Planning and Development Department
Lee D. Urban, Director

Planning Division
Alexander Jaegerman, Director

December 29, 2005

John M. Hession, P.E.
Senior Project Manager
Vanasse Hangen Brustlin, Inc
101 Walnut Street
Post Office Box 9151
Watertown, MA 02471-9151

Dear John,

In preparation for the upcoming workshop meetings with the Planning Board, I wanted to outline a structure for reviewing the Morrill's Crossing proposal in order to address each standard for review and highlight any outstanding issues. Attached for your review is a spreadsheet of the topics and standards for review, a well as a list of issues/concerns. My hope is that we will be able to add and clarify aspects of this chart to keep ahead of the review.

City staff will be meeting over the next two weeks to identify any concerns and request any additional information.

Today, I met with Captain Cass of the Fire Department and the Parking Manager, John Peverada. Their comments are listed below and also appear on the chart.

1. Fire
   A. improved access will be required to the apartments and recreation field to the rear of the site. Details of gates, roadway improvements, fire lanes/access will be needed.
   B. A formalized emergency access point along Allen Avenue is needed to provide emergency access. (One had been shown earlier, but is not evident now.)
   C. If access is shown on Guilford land, we will need to see permission.
   D. An evacuation plan should be submitted for worst-case-scenarios, including an accident at the signalized entrance, and/or a train blocking the roadway.
   E. Sprinklers will be required in all retail and residential spaces.
   F. Hydrant locations appear sufficient.

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2. Parking
   A. Is Bruno's parking demand/supply indicated anywhere?
   B. Please create a chart indicating on one column, the breakdown of square footages for each use; and a second column showing the parking spaces provided for each use.
   C. There may be a need for an off-site shuttle parking service during the Christmas season for employees of the center.
   D. Please give more information on the responsibilities of the "Rideshare Coordinator".
   E. There may be conflicts between the residents of the rear apartments and the boxing club attendees.
   F. Is there the possibility of moving the recreation field and detention area to the east, so that additional parking can be created?
   G. Can there be an illustration, similar to the plan for boxing event parking, showing which parking spaces will be used during a Saturday in December?

I have also received a letter from METRO expressing their support of the cul de sac design and their plan to be present at the January 17 workshop. The letter is attached.

I'll forward additional comments as I receive them.

Would you like to set up a time to meet before the Planning Board workshop?

Sincerely,

Sarah Hopkins
Development Review Manager

cc.: Alexander Jaegerman, Planning Division Director
Capt. Cass, Fire Prevention
John Peverada, Parking Manager

Transportation
Land Development
Environmental
Services

VHB imagination | innovation | energy Creating results for our clients and benefits for our communities

February 24, 2006

Vanasse Hangen Brustlin, Inc.

Ref: 07334.00

Sarah Hopkins
Development Review Services Manager
Department of Planning & Development
City of Portland
389 Congress Street
Portland, Maine 04101

Re: Morrill's Crossing - Response to Fire and Parking Comments

Dear Sarah:

The following are VHB's responses to the comments provided by Captain Cass of the Fire Department and the Parking Manager, John Peverada as presented in your letter dated, December 29, 2005. Since your meeting with Captain Cass and Mr. Peverada, we have had several meetings where these comments have been discussed and where input has been provided from several City departments and peer review consultants. These meetings have in included you, Captain Cass, Mr. Peverada, Alex Jaegerman, Kathi Earley, Eric Labelle, Penny Littell, and Tom Errico. It is our understanding that these comments have been adequately addressed and this letter provides a summary of the agreed upon actions.

FIRE

A. *improved access will be required to the apartments and recreation field to the rear of the site. Details of gates, roadway improvements, fire lanes/access will be needed.*

An Overall Emergency Access Plan has been prepared which illustrates the access locations to the site (main entrance, one-way access from Morrill Street to the townhome drive, and apartment access from Morrill Street) and the emergency vehicle access locations (Allen Avenue and Morrill Street). The internal circulation is also shown for emergency vehicles within the site, including access to the apartments and recreational field. The Overall Emergency Access Plan, the Morrill Street emergency access exhibit, and the Emergency Access Details are included as Attachment A. The Allen Avenue emergency access exhibit is included as Attachment B.

B. *A formalized emergency access point along Allen Avenue is needed to provide emergency access. (One had been shown earlier, but is not evident now.)*

An emergency vehicle access is provided from Allen Avenue to the main parking field in the vicinity of Bruno's. The location and detail of the access is included as Attachment B.

101 Walnut Street
Post Office Box 9151
Watertown, Massachusetts 02471-9151
617.924.1770 ▪ FAX 617.924.2286
email: info@vhb.com
www.vhb.com

C. *If access is shown on Guilford land, we will need to see permission.*

An emergency access across the Guilford right-of-way (off Allen Avenue adjacent to Bruno's restaurant) was considered by the applicant. We were informed by the Fire Department that this is a location that they use to access the portions of the site that abut the railroad today. Packard contacted Guilford in an attempt to acquire a portion of Guilford's right-of-way or to obtain easement rights for emergency vehicle access. Packard was not able to acquire either the right-of-way or easement from Guilford.

An alternative location for emergency vehicle access has been provided from Allen Avenue as has been identified in the response to Comment B above.

D. *An evacuation plan should be submitted for worst-case-scenarios, including an accident at the signalized entrance, and/or a train blocking the roadway.*

There are now five points of access to the proposed Morrill's Crossing development; the main access drive, the one-way access from Morrill Street to the townhome driveway, the access to the apartments from Morrill Street, the emergency vehicle access from Allen Avenue in the vicinity of Bruno's, and the emergency vehicle access from Morrill Street/apartment drive to the loading area of the supermarket. As discussed with Captain Cass, in the event that an incident occurs that blocks the signalized entrance and/or a train blocks the roadway, all of these locations can be used as emergency points of egress for customers and residents of the development. Please refer to the Overall Emergency Access Plan provided as Attachment A.

E. *Sprinklers will be required in all retail and residential spaces.*

Sprinklers will be provided for all buildings, whether retail, residential or other, as required by local and state building codes.

F. *Hydrant locations appear sufficient.*

No further response required.

PARKING

G. *Is Bruno's parking demand/supply indicated anywhere?*

The Bruno's parking demand, based on the ITE Parking Generation was presented in the Traffic Impact and Access Study and Technical Appendix dated November 2005. However, a more detailed analysis of the Bruno's parking demand and supply, based on ULI Shared Parking, has been provided in the Parking Demand memorandum addressed to Sarah Hopkins and dated, February 7, 2006.

H. *Please create a chart indicating on one column, the breakdown of square footages for each use; and a second column showing the parking spaces provided for each use.*

The hourly parking demand, by use, has been provided for both the weekday and weekend "Non-Peak" and "Peak" seasons in the Parking Demand memorandum addressed to Sarah Hopkins and dated, February 7, 2006.

I. *There may be a need for an off-site shuttle parking service during the Christmas season for employees of the center.*

The Parking Demand memorandum addressed to Sarah Hopkins and dated, February 7, 2006 shows that there is adequate parking provided on-site even during the Christmas season. An off-site shuttle parking service for employees is not needed.

J. *Please give more information on the responsibilities of the "Rideshare Coordinator".*

The "Rideshare Coordinator" is essentially a part-time position (most times filled by an employee of the site and in this case will likely to be an employee of the property management company or Stop & Shop as the largest tenant) whose job it will be to coordinate and promote the various rideshare and TDM programs in place. They will serve as the point person for the site employees (and residents) who are seeking to form carpooling arrangements. Generally, employees will make known to the coordinator that they are looking for opportunities to carpool. It will then be the Rideshare Coordinator's job to match this person with another person, if available, so that they can carpool together. Alternatively, the rideshare coordinator could also provide that individual with information on METRO and other transportation opportunities that might be available.

Another responsibility for this specific site might also be to coordinate (and enforce) the peak season employee parking plan; reminding/providing employees information on when and where they should be parking during those busy times of the year.

K. *There may be conflicts between the residents of the rear apartments and the boxing club attendees.*

With the new access alternative for the apartments (Attachment C), there is no direct vehicular connection from the boxing club to the apartments. We feel that this addresses the potential for conflicts between the two uses.

L. *Is there the possibility of moving the recreation field and detention area to the east, so that additional parking can be created?*

The recreation field and detention area are located on the "Burt Property" at the easterly end of the site. This portion of the site is constrained by Milliken Brook and wetland resource areas associated with the brook. The design, as presented, maximizes the parking provided adjacent to the recreation field and no additional parking can be created in this area. It is important to note that there is a surplus of parking provided adjacent to the boxing club that can be used as overflow parking for the recreation field if needed.

M. *Can there be an illustration, similar to the plan for boxing event parking, showing which parking spaces will be used during a Saturday in December?*

An exhibit was prepared and attached to the Parking Demand memorandum addressed to Sarah Hopkins and dated, February 7, 2006 that shows parking space supply, by use, for the "Peak Season" weekend condition.

Also included are two additional attachments. The first (Attachment D) shows our proposed Night (off-hour) Lighting Exhibit and Photometric Plan for your review and comment. The second (Attachment E) shows the originally proposed Boxing Club and our revised proposal for the Boxing Club. The new Boxing Club is a single-story, 14,000 square foot building.

We are looking forward to our next workshop scheduled for the 7th of March. Please give me a call if you have any questions or need additional information.

Very truly yours,

VANASSE HANGEN BRUSTLIN, INC.

John Hession
Senior Project Manager

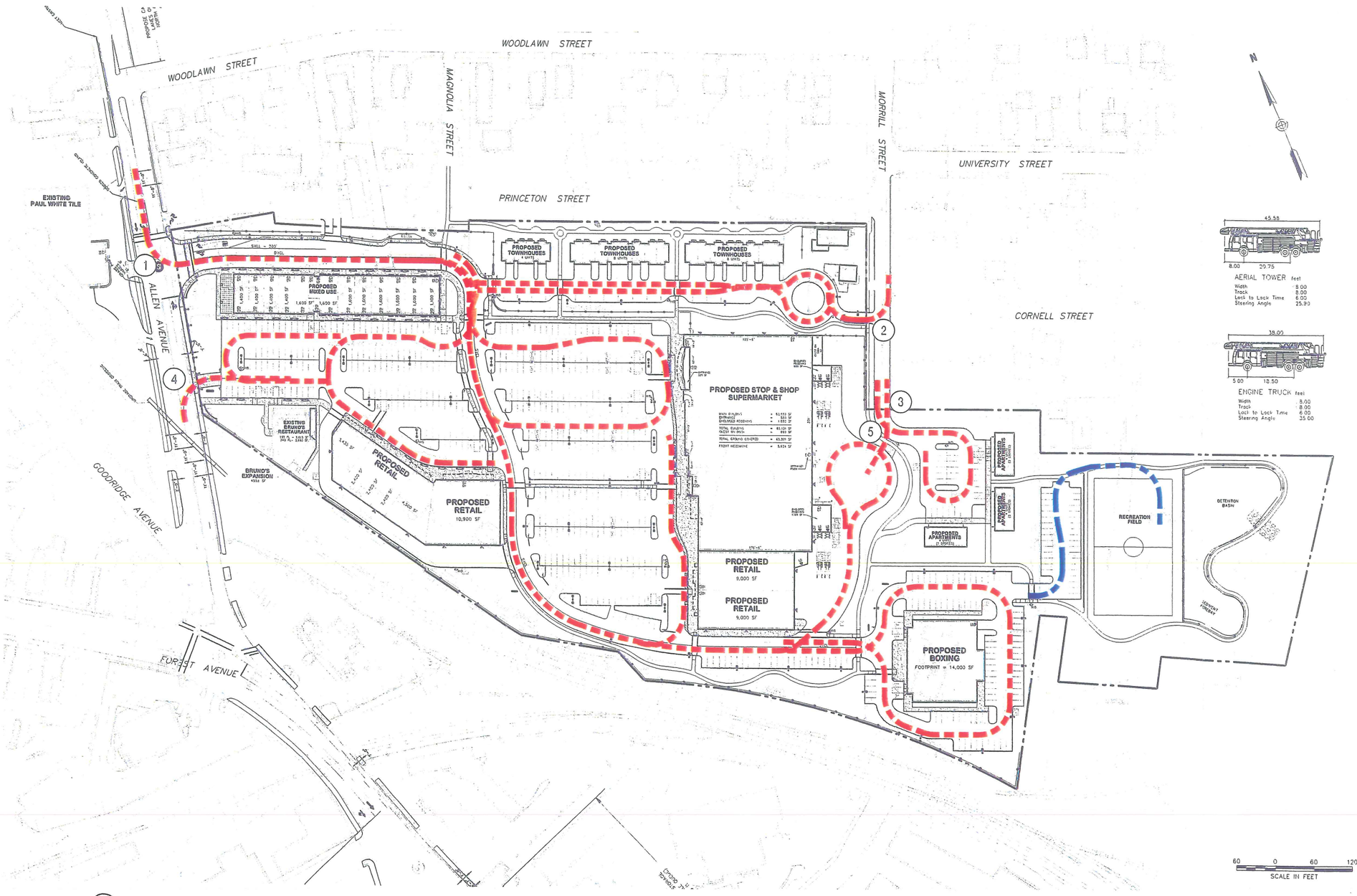
cc: Capt. Greg Cass, Portland Fire Department
John Peveroda, Parking Manager

Attachment A

VHB
Vanasse Hangen Brustlin, Inc.

Transportation
Land Development
Environmental Services

101 Walnut Street, P.O. Box 9151
Watertown, Massachusetts 02471
617 924 1770 • FAX 617 924 2286



60 0 60 120
SCALE IN FEET

1	RESPONSE TO COMMENTS	2/19/06

Designed: DHF | Drawn: BKF | Checked: KSS
2nd Checked: BKF | Approved:
Scale: 1" = 60' | Date: June 30, 2005

Morrill's Crossing

Allen Avenue
Portland, Maine

Site Plan Approval

Not Approved for Construction

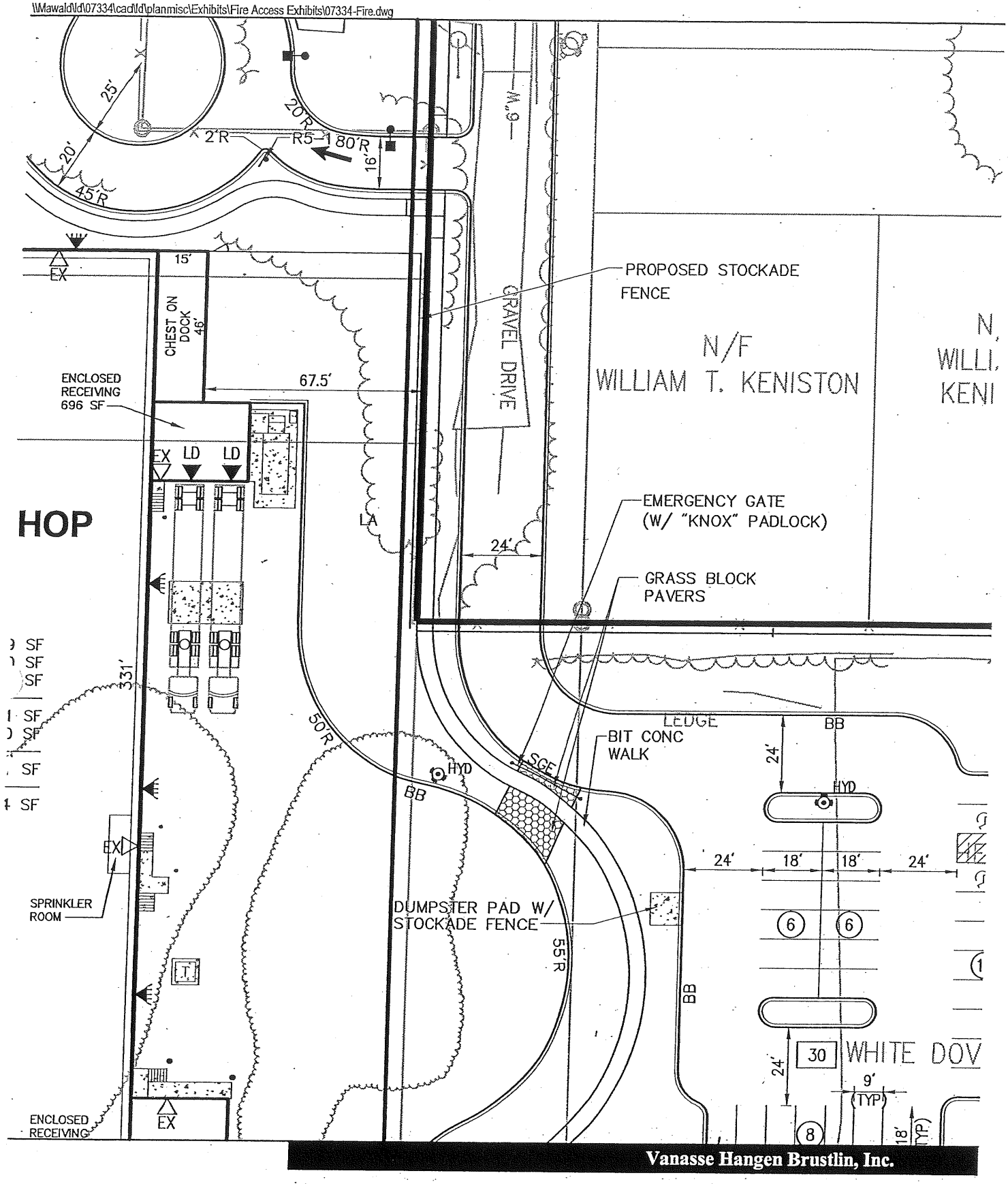
Overall Emergency Access Plan

C-2

Sheet 2 of 16

Project Number
07334.00

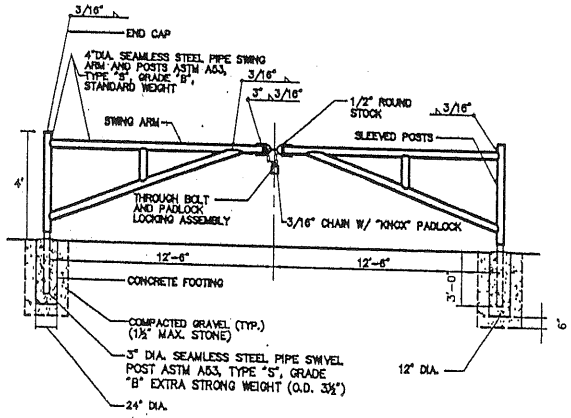
07334-Overall Emergency Access



Proposed Emergency Access
Morrill Street
Morrill's Crossing
Portland, Maine

Attachment A

0 20 40 Feet

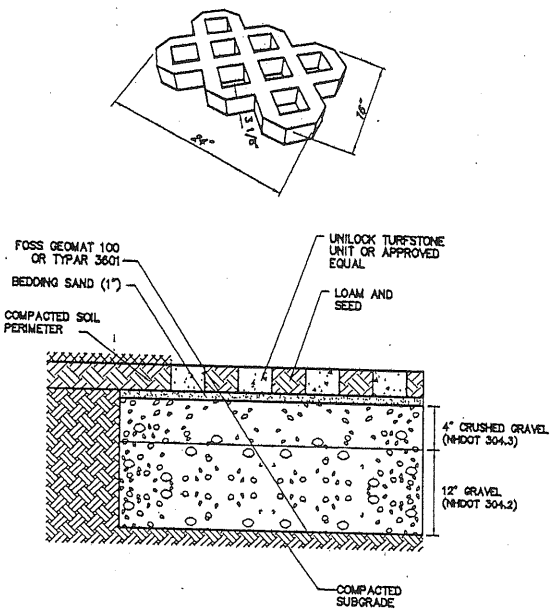


Notes:

1. SHOP PRIME PAINT EXPOSED SURFACES FIELD PAINT EPOXY ENAMEL--YELLOW.
2. PROVIDE "MASTER" PADLOCK WITH 6 WORKING KEYS.
3. 3,000 PSI CONCRETE FOOTING

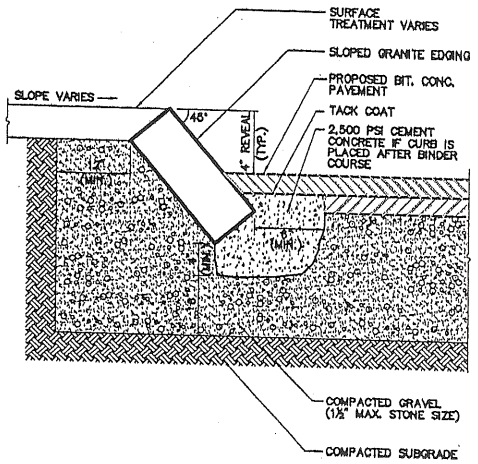
Emergency Gate (Double)

N.T.S. Source: VHB 6/03 REV LD_488



Grass Block Paver

N.T.S. Source: VHB 6/02 LD_



Sloped Granite Edging (SGE)

N.T.S. Source: VHB 6/03 LD_401

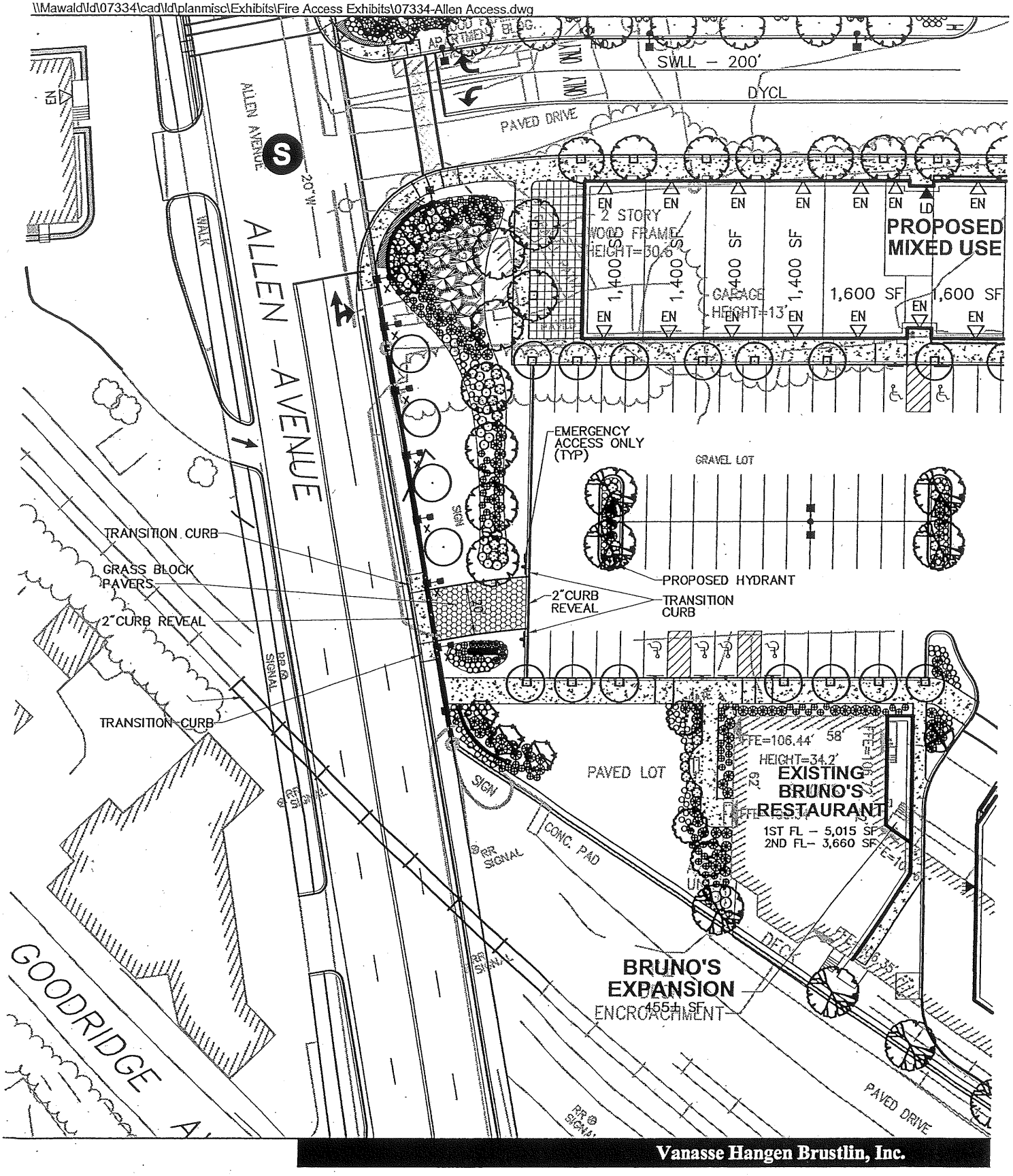
Vanasse Hangen Brustlin, Inc.

Attachment A

Emergency Access
Details
Morrill's Crossing
Portland, ME

Attachment B

\\Mawald\ld\07334\cad\ld\planmisc\Exhibits\Fire Access Exhibits\07334-Allen Access.dwg

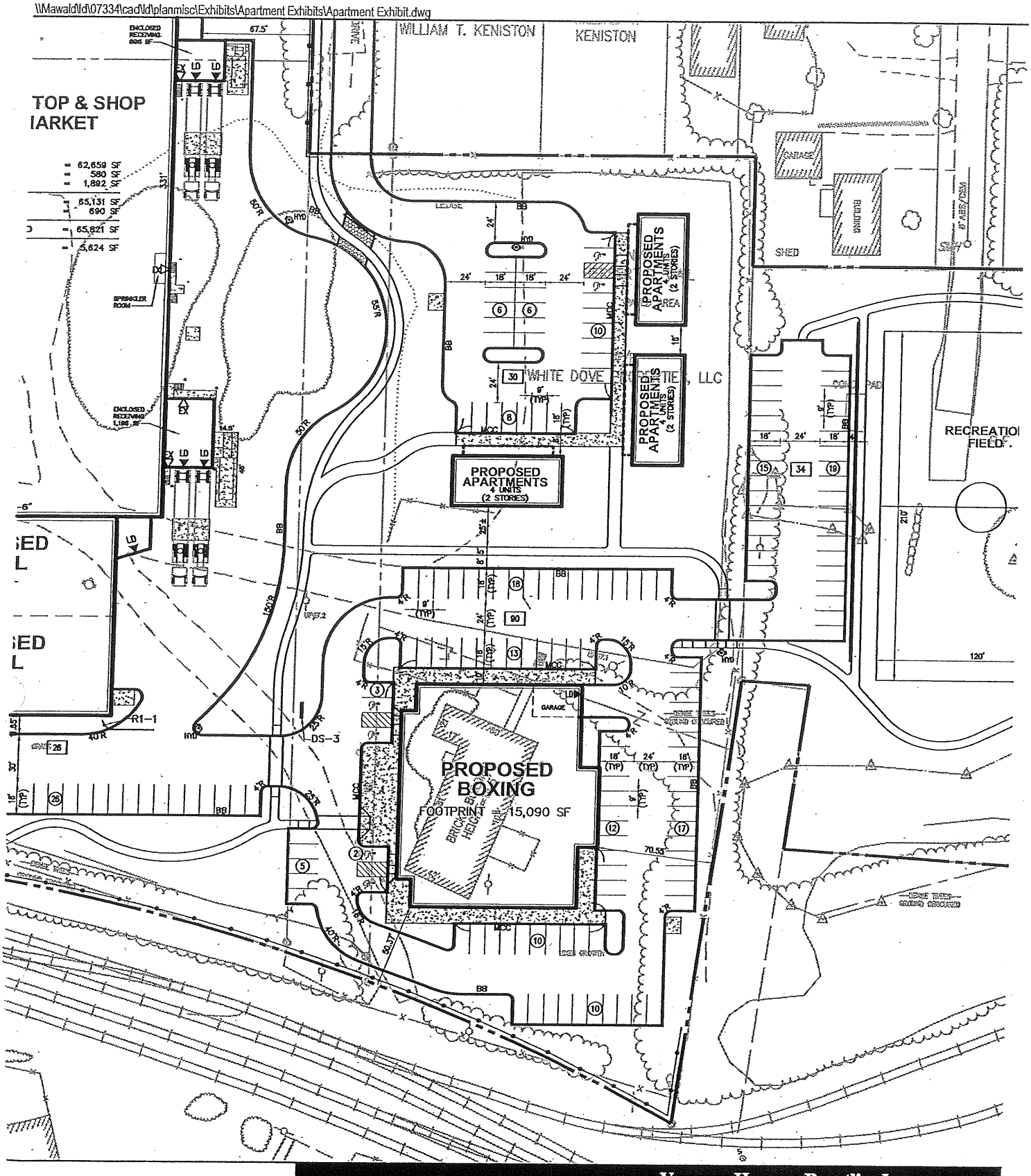


Vanasse Hangen Brustlin, Inc.

Proposed Emergency Access — Attachment B

Morrill's Crossing
Portland, Maine

0 25 50 Feet



Proposed Emergency Access

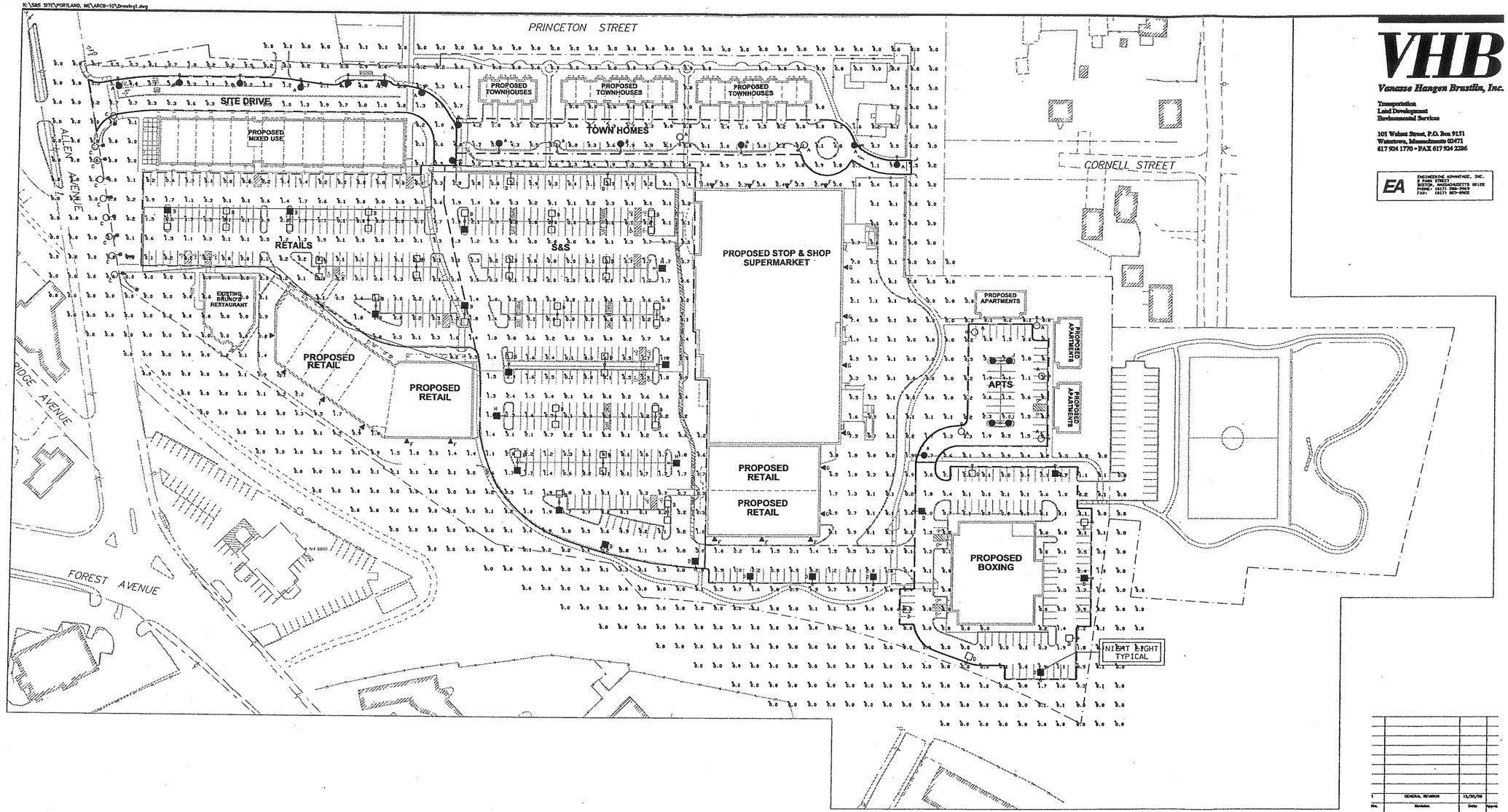
Attachment C

Morrill's Crossing
Portland, Maine

0 40 80 Feet

Attachment D

K:\SAS SITE\PORTLAND, ME\ARCD-10\Drawings1.dwg



VHB
Vanasse Hangen Brustlin, Inc.
Transportation
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Environmental Services
101 Walnut Street, P.O. Box 9151
Watertown, Massachusetts 02471
617 924 1770 • FAX 617 924 2286

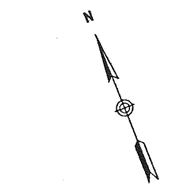
EA ENGINEERING ADVANTAGE, INC.
1 BOND STREET
BOSTON, MASSACHUSETTS 02114
PHONE: (617) 338-3969
FAX: (617) 523-0402

GREENBRIAR FLAT LENS

Luminaire Schedule							
Projects: All Projects							
Symbol	Qty	Label	Arrangement	Lumens	LLF	Description
	2	J	D180	23000	0.750	LWH-S-250-MH-F 12' POLE
	4	N	SINGLE	22000	0.750	GFM-S-250-MH-F 15' POLE 3' BASE
	6	G	SINGLE	22000	0.750	CWM-FT-250-MH-F
	13	F	SINGLE	12000	0.750	CWS-S-175-MH-F
	12	B	SINGLE	22000	0.750	GFM-S-250-MH-F 15' POLE 3' BASE
	15	A	SINGLE	22000	0.750	LWH-S-250-MH-F 12' POLE
	8	B	SINGLE	22000	0.750	GFM-S-250-MH-F 15' POLE 3' BASE

Statistical Area Summary						
Projects: All Projects						
Label	Avg	Max	Min	Avg/Min	Max/Min	
BANK AREA SUMMARY	0.56	4.7	0.0	0.00	0.00	
STOP N SHOP SUMMARY	0.59	3.1	0.0	0.00	0.00	
RETAIL SUMMARY	0.54	2.9	0.0	0.00	0.00	
APTS. SUMMARY	1.59	9.8	0.0	0.00	0.00	
TOWN HOUSE SUMMARY	1.34	8.8	0.0	0.00	0.00	
SITE DRIVE SUMMARY	2.02	9.2	0.2	10.10	41.00	

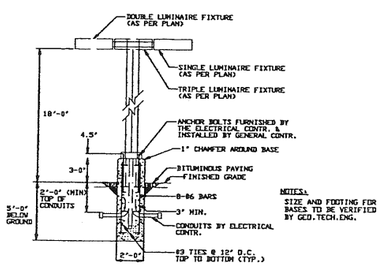
LSI INDUSTRIES INC. CINCINNATI, OHIO
LOCATION: PROPOSED RETAIL FOR STOP_N_SHOP PORTLAND,ME.
SCALE: 1"=60' | JOB NO: LO-63704A-6
DRAWING NO: | DATE: 04/27/05
SHEET 1 OF 1



50 0 50 100
SCALE IN FEET

NOTES:

1. SITE LIGHTING FIXTURES SHALL BE PROVIDED AS SPECIFIED OR APPROVED EQUAL.
2. ALL FIXTURES SHALL BE SUPPLIED WITH 12 INCH ARMS FOR ROUND POLES.
3. ALL POLES SHALL BE #RTPN-SG11-15-M-BRZ. 15 FOOT ROUND TAPERED STEEL WITH TENON.
4. ALL LAMPS SHALL BE PHILIPS.
5. ALL WORK SHALL BE INSTALLED IN A NEAT WORKMANLIKE MANNER AND SHALL COMPLY WITH STATE AND LOCAL CODES.
6. NOT USED.
7. AT EACH PYLON SIGN FURNISH VP JUNCTION BOX AND CONNECT SIGN.
8. ALL SITE LIGHTING FIXTURES TO BE WIRED FOR 277 VOLTS.



NOTES:
SIZE AND FOOTING FOR BASES TO BE VERIFIED BY GEO.TECH.ENG.

LIGHTING POLE BASE DETAIL
NOT TO SCALE

SITE LIGHTING SCHEDULE
ALL EQUIPMENT TO BE LSI INDUSTRIES.

	TYPE A	TYPE B	TYPE C	TYPE D	TYPE E	TYPE F	TYPE G	TYPE H	TYPE J
ADAPTER	LSI-GREENLEE	BKA-RNM-090-CLR	LSI-ARCLITE	BKA-RNM-090-CLR	LSI-GREENLEE			BKA-RNM-090-CLR	LSI-GREENLEE
NO. FIXTURES PER POLE	1 @ 90°	2 @ 180°	WALL MOUNT	1 @ 90°	BOLLARD	WALL MOUNT	WALL MOUNT	1 @ 90°	2 @ 90°
FIXTURE CAT. NUMBER	LWH-250HPS MT-S-F-BLK-X-CHS-4-SIGC-12-CRC-4	2-GFM-S-250-PSMV F-MT-BRZ-MD	HBR-35/45-PL-MT-GRN-4.5-PSM-WA/40/MT/BLK-GRN-X-BLK	1-GFM-S-250 PSMV-F-MT-BRZ	ABR-50MH-MT-EL-BLK-DT	CWS-S-175MH-F-MT-BRZ	CWM-FT-250MH-F-MT-BRZ	1-GFM-S-250 PSMV-F-MT-BRZ	LWH-250HPS MT-S-F-BLK-X-CH-D180-4-SIGC-12-CRC-4
FIXTURE DIST. TYPE	TYPE 4 WITH HOUSE SIDE SHIELD	TYPE 5		GFM-2-HSS TYPE 3		TYPE 3	FORWARD THROW	GFM-S TYPE 3	TYPE 3
LAMP	1-HS 250/C/U	2-HS 250/BU/PS		1-HS 250/BU/PS	1-HS 50 HED	1-HS 175/C/U	1-HS 250/C/U	1-HS 250/BU/PS	2-HS 250/C/U
NOTES	12' POLE AND BRACKET		MOUNT ON BRICK PIER 9'-6" AFG TO BOTTOM	HOUSE SIDE SHIELD	41' HIGH	18' AFG	18' AFG		12' POLE AND BRACKET

No.	Revision	Date	App'd.
1	GENERAL REVISION	11/30/05	

Designed by LAF | Drawn by CJC | Checked by LAF
CAD checked by | Approved by
Scale 1"= 50' | Date 06/16/05
Project Title

Proposed Mixed Use Development
Morrill's Crossing
Portland, Maine

Issued for
Review

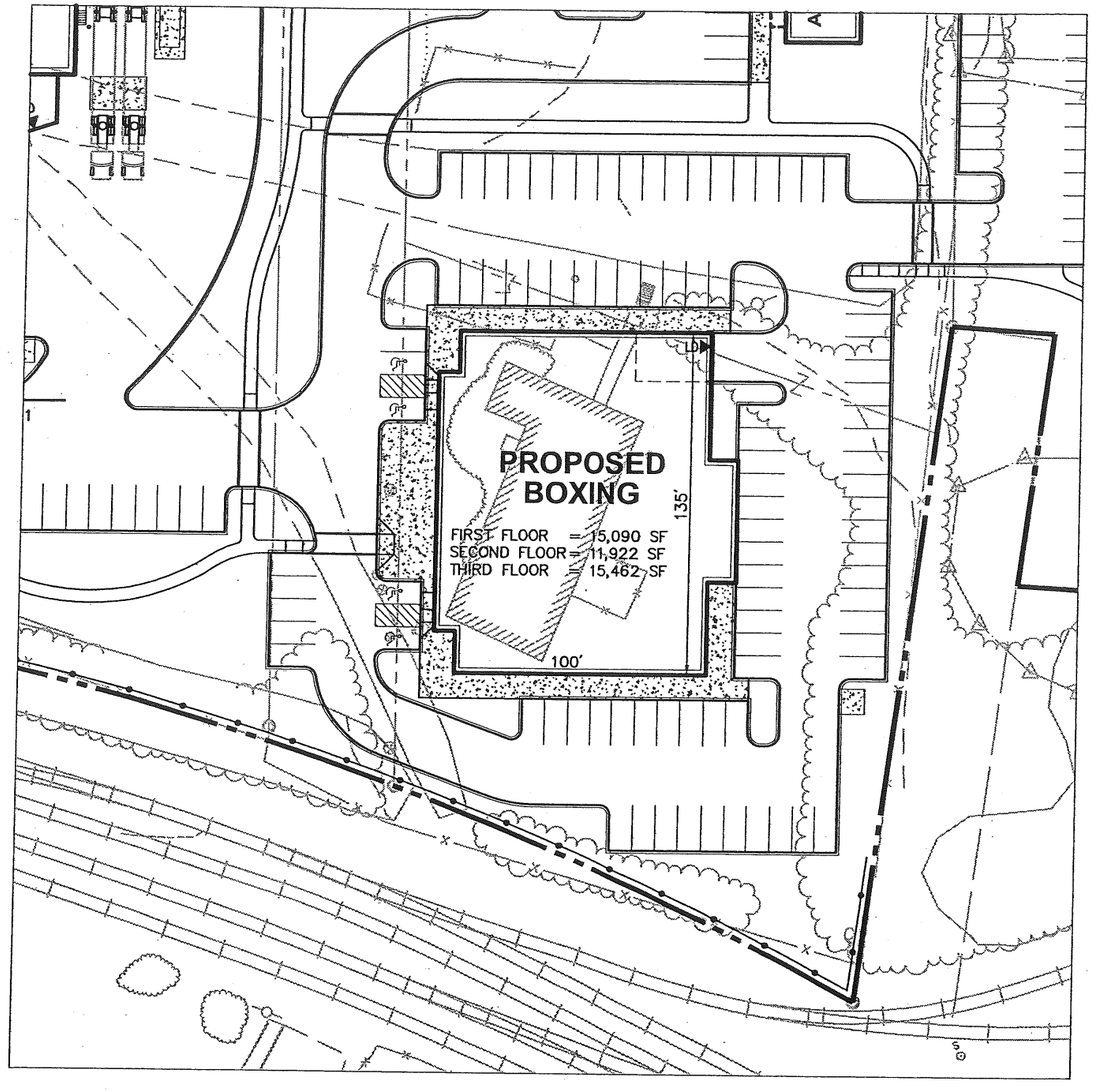
Not Approved for Construction
Drawing Title

SITE NIGHT LIGHTING & PHOTOMETRICS PLAN

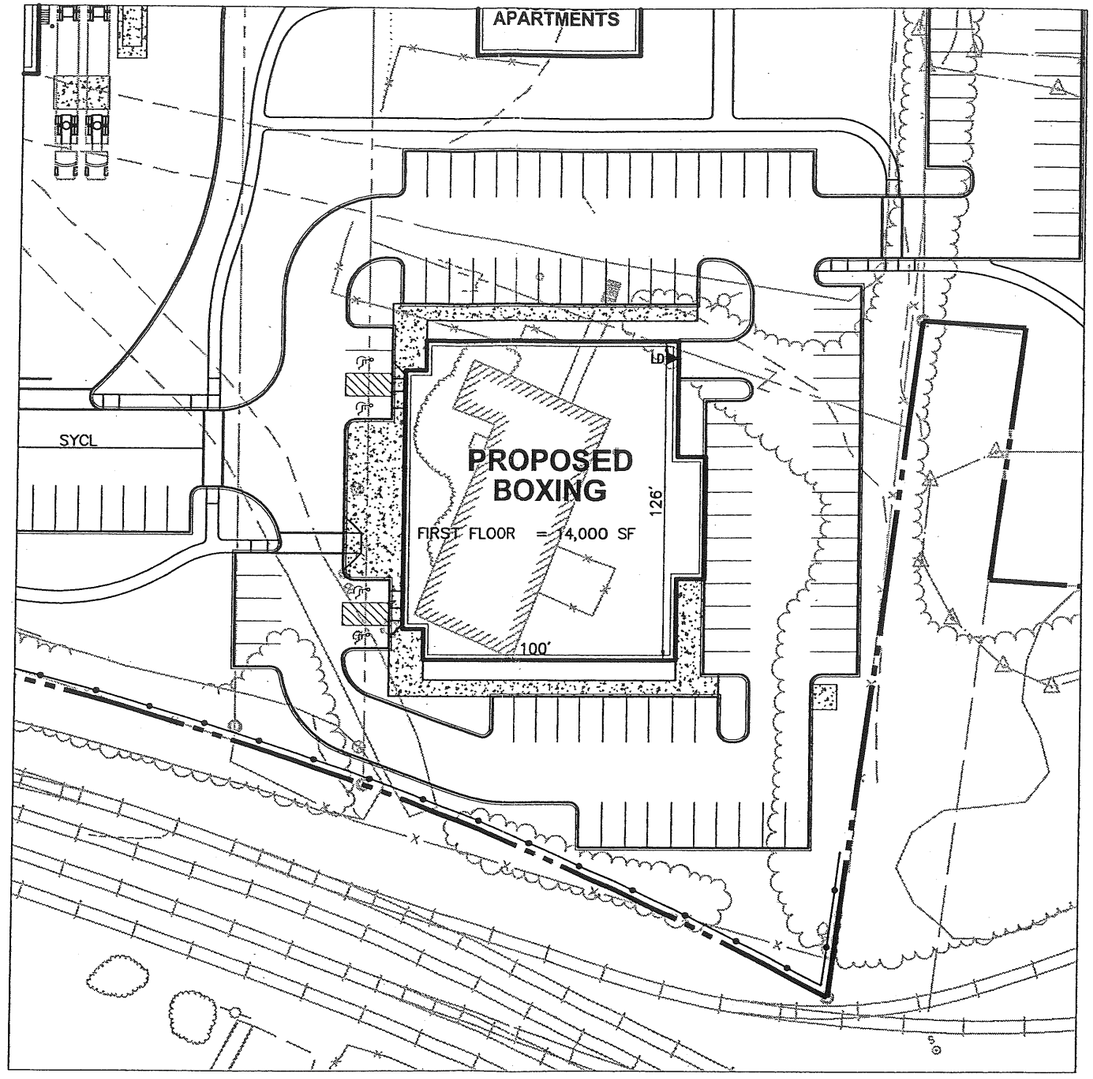
Drawing Number
SL-1NL

Sheet of
3 1

Project Number
07334



PROPOSED BOXING CLUB – SITE PLANS 7/1/05



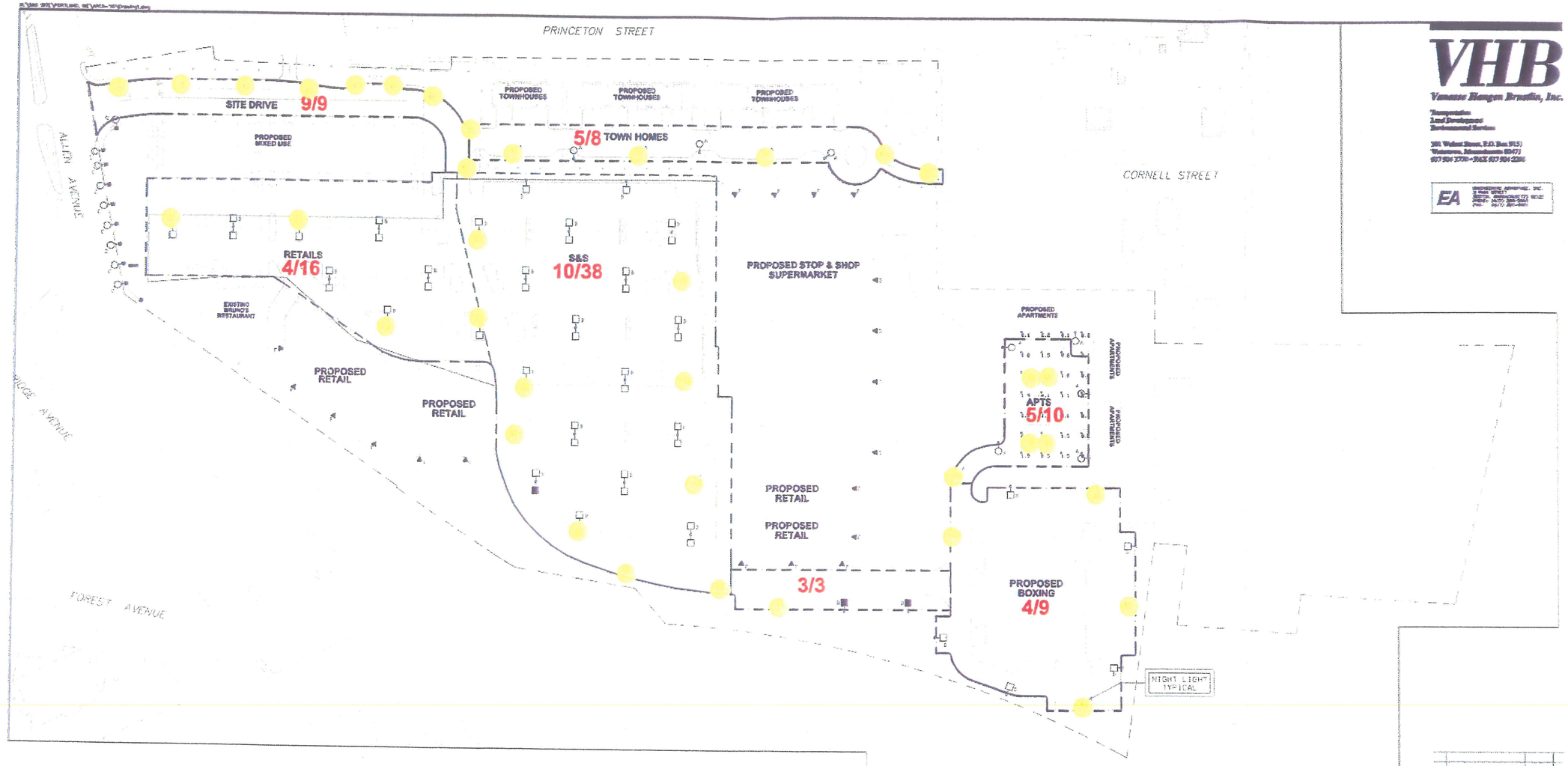
REVISED BOXING CLUB – 2/24/06

0 25 50 Feet

Vanasse Hangen Brustlin, Inc.

2/24/06

Boxing Club
Building Areas Comparison
Morrill's Crossing
Portland, Maine



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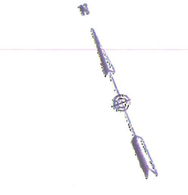
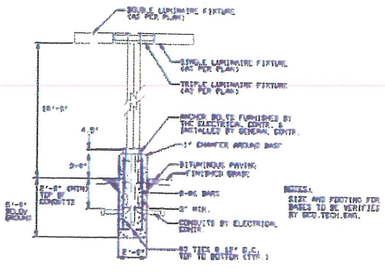
101 Walnut Street, P.O. Box 9151
Watertown, Massachusetts 02471
617 924 1770 • FAX 617 924 2286
EA ENGINEERING ASSOCIATES, INC.
5 MAIN STREET
SUITE 1 • (802) 254-5172 VOICE
FAX: (802) 257-2691



NOTES:

1. SITE LIGHTING FIXTURES SHALL BE PROVIDED AS SPECIFIED OR APPROVED EQUAL.
2. ALL FIXTURES SHALL BE SUPPLIED WITH 18 INCH ARMS FOR ROUND POLES.
3. ALL POLES SHALL BE SWTPH-SG15-18-R-BK7, 18 FOOT ROUND TAPERED STEEL WITH TENON.
4. ALL LAMPS SHALL BE PHILIPS.
5. ALL WORK SHALL BE INSTALLED IN A NEAT WORKMANLIKE MANNER AND SHALL COMPLY WITH STATE AND LOCAL CODES.
6. NOT USED.
7. AT EACH POLE# SIGN FURNISH 4# JUNCTION BOX AND CONNECT SIGN.
8. ALL 277V LIGHTING FIXTURES TO BE WIRED FOR 277 VOLTS.



LIGHTING POLE BASE DETAIL
NOT TO SCALE

NOTES:
SIZE AND FOOTING FOR BASES TO BE VERIFIED BY MFG. TECHNICIANS.

GREENBRIAR FLAT LENS

Luminaire Schedule
Project: All Projects

Symbol	Qty	Label	Arrangement	Lamp(s)	LLF	Description
	10	A	SINGLE	ED28S	0.750	LWFH-S-250-MH-F 18' POLE
	4	H	SINGLE	ED28S	0.750	SFM-S-250-MH-F 25' POLE 3' BASE
	6	G	SINGLE	ED28S	0.750	CWMH-F -250-MH-F
	33	F	SINGLE	ED28S	0.750	CWH2-S-175-MH-F
	10	B	SINGLE	ED28S	0.750	SFM-S-250-MH-F 25' POLE 3' BASE
	15	A	SINGLE	ED28S	0.750	LWFH-S-250-MH-F 18' POLE
	18	B	SINGLE	ED28S	0.750	SFM-S-250-MH-F 25' POLE 3' BASE

Statistical Area Summary
Project: All Projects

Label	Avg	Max	Min	Avg/Min	Max/Min
BANK AREA SUMMARY	3.06	4.7	1.6	6.88	8.88
STOP N SHOP SUMMARY	3.55	3.1	1.0	5.66	8.00
RETAIL SUMMARY	2.54	12.9	1.0	5.88	8.60
APTS. SUMMARY	1.55	5.0	0.6	6.85	8.60
TOWN HOUSE SUMMARY	1.34	6.8	1.0	6.88	8.88
SITE DRIVE SUMMARY	2.80	10.0	1.0	10.56	41.66

SITE LIGHTING SCHEDULE
ALL EQUIPMENT TO BE LSI INDUSTRIES.

	TYPE A	TYPE B	TYPE C	TYPE D	TYPE E	TYPE F	TYPE G	TYPE H	TYPE J
ADAPTER	LSI-GREENLEE	BKA-BWH-SPK-CLR	LSI-ARCLITE	BKA-BWH-SPK-CLR	LSI-GREENLEE			BKA-BWH-SPK-CLR	LSI-GREENLEE
NO. FIXTURES PER POLE	1 @ 94°	2 @ 180°	WALL MOUNT	1 @ 90°	BOLLARD	WALL MOUNT	WALL MOUNT	1 @ 90°	2 @ 90°
FIXTURE CAT. NUMBER	SFM-S-250HS MT-S-F-BLK-R-CYC-A-21MC-18-CBC-A	R-SFM-S-250-PSMV T-MT-BRZ-HD	SWMH-F-MT-BRZ-HD-SPK-A-R-A	I-SFM-S-250 PSMH-F-MT-BRZ	ARC-SWH-MT-EL-BLK-R1	CWH2-S-175MH-F-MT-BRZ	SWMH-FT-SQSMH-T-R1-BRZ	I-SFM-S-250 PSMH-T-MT-BRZ	SFM-S-250HS MT-S-F-BLK-R-CYC-A-21MC-18-CBC-A
FIXTURE ASSY. TYPE	TYPE A WITH HOUSE SIDE SHIELD	TYPE B		SFM-S-250 TYPE B		TYPE B	FURNACE TYPEN	SFM-S TYPE B	TYPE B
LAMP	1-#6 250/E/U	2-#6 250/BU/PS		1-#6 250/BU/PS	1-#6 50 HPS	1-#6 175/E/U	1-#6 250/E/U	1-#6 250/BU/PS	2-#6 250/E/U
NOTES	18' POLE AND BRACKET		MOUNT ON BRICK PIER 8'-0" AFG TO BOTTOM	HOUSE SIDE SHIELD	41' HIGH	18' AFG	18' AFG		82' POLE AND BRACKET

No.	Revision	Date	Drawn By

Designed by LAF Drawn by CPC Checked by LAF
QAC Checked by
Approved by
Date 7-4-07 Proj. No. 06168
Project No.

Proposed Mixed Use Development
Morrill's Crossing
Portland, Maine
Owner for
Review

Not Approved for Construction
Issued for

SITE NIGHT LIGHTING & PHOTOMETRICS PLAN

Drawing Number
SL-1NL

Sheet # 3 of 3
Project Number 06168

DeLUCA-HOFFMAN ASSOCIATES, INC.
CONSULTING ENGINEERS

778 MAIN STREET
SUITE 8
SOUTH PORTLAND, MAINE 04106
TEL. 207 775 1121
FAX 207 879 0896

- ROADWAY DESIGN
- ENVIRONMENTAL ENGINEERING
- TRAFFIC STUDIES AND MANAGEMENT
- PERMITTING
- AIRPORT ENGINEERING
- SITE PLANNING
- CONSTRUCTION ADMINISTRATION

MEMORANDUM

DATE: **November 15, 2005**

TO: **Sarah Hopkins, City of Portland**

C: **John Hession, PE VHB**

FROM: Stephen R. Bushey, P.E.

SUBJECT: **Morrill's Crossing**
Site Plan Review

DeLuca-Hoffman Associates, Inc. has reviewed the application materials prepared by VHB and submitted 7/1/05. This includes the full size drawing set with drawing sheets C-1 through C-14, the Stormwater Management Report and the application with supporting materials. The project involves a complex development activity over a previously developed area and we understand that multiple City staff across several departments will be providing reviews in addition to our own. For that reason we have generally kept our review oriented to the primary issues of stormwater management, erosion control and technical plan design relating to the Site layout, grading plans, utility layout and details.

We offer the following comments for consideration at this time.

Layout and Materials Plans

1. We trust that Staff and the City Traffic Engineer will provide feedback as necessary regarding the circulation and layout of the project. The layout appears to be generally considerate of typical shopping center style layouts and allows for customer access as well as truck deliveries. Signage, however, directing the various users of the site seems critical given the multiple development functions occurring on the property. We assume the traffic engineer will consider the need for the Shopping Center entrance configuration developed in accordance with DOT standards.

2. The applicant is proposing parking space sizes of 9' x 18' which is below the City standard of 9' x 19'. We generally support this request as it allows for the placement of a longitudinal island in the parking lot as well as greater buffering to the Townhouses.

3. The circulation of the bus route should be presented to the City and the route pattern confirmed for adequate radii and maneuvering.

Grading, Drainage and Erosion Control Plans

Comment 1:

The project design includes a closed storm drainage system consisting of catch basins, manholes and pipes. The system also includes as a major component, several underground storage systems and water quality treatment devices. We applaud the engineer's use of the TSS removal devises and simply request that the sizing criteria and manufacturer's information be provided prior to final review of the project.

Response:

The proposed water quality structures have been sized according to the manufacturer's guidelines. The sizing criteria and typical structure details are included in Attachment G.

Comment 2:

The proposed drainage system includes several flared inlets on the north side of the property. These flared inlets appear to collect runoff from the offsite contributing watershed area to the north. We have not specifically walked the adjacent properties to ascertain exact drainage patterns, however, we recommend that the engineer verify the existing drainage conditions and locations for their new inlets to assure that the development activity will not result in drainage issues within these offsite residential properties. The planned locations appear reasonable, however, as is often the case, additional inlets may be necessary. The currently planned inlets also leave little area for ponding at the inlet point onsite and may result in new ponding conditions on the adjacent properties, thus creating potential problems with abutters. We also recommend that these inlets be stabilized with riprap or other measures as necessary.

Response:

VHB has walked the adjacent properties where these inlets are proposed and believes that they are sized and located properly to not create drainage problems on adjacent properties.

However, VHB will field verify during construction the location of the inlets to ensure that they are located properly to avoid drainage issues within the off-site residential properties. The plans have been modified to include specific stabilization methods at the appropriate inlets and are shown on Attachment H.

Comment 3:

The engineer should review the offsite drainage systems in Princeton Street with the Public Works Department and discuss the disposition of any storm drainage within the street. There may be little to no drainage infrastructure of concern, however, it is currently unclear as to the existence of combined or separated drainage measures within the street and what, if any, impact may result from the project.

Response:

VHB met with the DPW to review the existing utilities within Princeton Street. Based on the existing conditions survey, Princeton Street is an unaccepted and unimproved roadway. To the best of VHB's and the City's knowledge the only utility within the street is an 8-inch sewer running west to east. VHB does not anticipate that construction activities associated with this project will impact the utility infrastructure within Princeton Street. A copy of the existing utility plan received from the City is included as Attachment I.

Comment 5:

We recommend that the written Erosion Control requirements be provided on a plan sheet(s), as is customary with larger projects reviewed by the DEP.

Response:

VHB has added Erosion Control Plans to the set of Site Plans. The new plans are included in Attachment J.

Comment 6:

The applicant should provide a Drainage Maintenance program that outlines the specific measures, maintenance requirements and record keeping measures for the project. This is especially important given the complexity of the infrastructure proposed for the project that includes underground stormwater storage systems and Water quality treatment devices.

Response:
VHB has prepared an Operation and Maintenance Plan for the stormwater management system. The plan is included as Attachment K.

7. We recommend that additional spot grades be provided around the parking lot islands to the extend practicable since the number of catch basins is being minimized by the use of double grated structures.

8. We recommend that the access drives be crowned to the extent possible, particularly at the entrance. This would require additional catch basin inlets along the entry drive.

9. We note that several light poles appear to be located within the underground storage systems. This may be possible; we simply suggest this be confirmed with the product vendor.

10. The plans should clarify the size of all drainage structures since some of the manholes may need to be larger than 4' dia. to allow for multiple pipes and sizes.

11. Within the erosion control program for the site we suggest the use of organic filter (mulch) berms as often as possible in place of silt fence.

12. The erosion control requirements must be revised to include the DEP's standard procedures for Wintertime activities. A copy of these requirements can be provided to the engineer if necessary.

13. We recommend that engineer confirm the jurisdictional status of the brook as it crosses the far eastern side of the site and any regulatory (NRPA) restrictions including setbacks that the DEP may require. The City has more recently encouraged a setback of up to 100' for the urban streams in the City. Given the applicant's intentions to install a detention basin near the stream in an area that is now an unsightly open area, it seems that this development activity seems reasonable and well within consideration for relaxation of the setback requirements. The engineer should confirm that the stream is not considered wetlands of special significance. Are there any Shoreland zoning issues pertaining to the stream?

14. We understand that the Public Works Department is considering their position regarding the need for quantity control measures on the site. This is due to the site's proximity to Milliken Brook and the downstream infrastructure that is in place to handle flows from this area. We note that the stormwater analysis suggests only a modest increase in the imperviousness level of the developed site, however, to further support the potential for the design approach of minimizing the quantity control measures we recommend the design engineer provide an analysis that provides the predicted increases to peak discharges and volumes that would result form the site without the benefits of the quantity control measures now incorporated into the design and analysis. This will allow the City a better understanding of the potential for downstream impacts if quantity control measures are not fully implemented as part of the project. Our current perspective is that the project should provide quantity and quality control, however, the level of quantity control may be able to be adjusted depending upon the findings of the additional analysis suggested above.

15. Assuming the construction of a basin will remain part of the project, we recommend that a basin detail sheet that includes a larger scale plan, cross sections and details be provided for the Final plans. Additional information including underlying soils conditions, embankment design and surface stabilization measures should be provided.

Utility Plans

1. The Portland Water District may require the installation of a Fire Line Supply meter and meter pit into the development since there will be multiple services for both domestic and Fire supply. Will a meter be required for the Morrill Street connection? The Final Plans should include these measures as required by the District.

2. The layout includes multiple hydrant locations that should be reviewed and approved by the Fire Department.

3. The applicant should confirm the need for utility easements for power and telephone.

Details

1. The geotechnical engineer should review the Pavement Section detail on Sheet C-11 and a pavement section derived from the onsite soils conditions provided. The section appears to be a bit thin.

2. The outlet control structure on Sheet C-13 must be modified to allow for the 48" outlet pipe size.

3. We are uncertain as to where the sediment forebay berm and the low flow sediment forebay berms are to be located. This should be clarified.

We trust these comments are helpful and we look forward to continued discussions and plan revisions from the Applicant.

If you have any questions please call.

Steve Bushey, PE
Senior Engineer
DeLuca-Hoffman Associates, Inc.

Transportation
Land Development
Environmental
Services

VHB imagination | innovation | energy Creating results for our clients and benefits for our communities

February 17, 2006

Vanasse Hangen Brustlin, Inc.

Ref: 07334.00

Sarah Hopkins
City Planner
City of Portland
55 Main Street
Portland, Maine

Re: Morrill's Crossing– Response to Site Plan Peer Review

The following are VHB's responses to the site plan peer review recommendations offered by Mr. Stephen Bushey of Deluca Hoffman Associates in his memo addressed to you dated, November 15, 2005 regarding Morrill's Crossing. In his review, Mr. Bushey has offered recommendations that we discussed in a meeting with him where you were present. A majority of Mr. Bushey's recommendations have been considered and are addressed below. Draft copies of the site plan drawings reflecting the changes discussed below are included as an attachment to this letter.

Additional input from the Maine Department of Environmental Protection (ME DEP) will be required to address Comments 4, 14, and 15 within the Grading, Drainage and Erosion Control section. VHB has contacted Linda Kokemuller with the DEP to schedule a meeting discuss these items. The responses to the above reference comments will be submitted under a separate cover once all the necessary information has been compiled.

Layout and Materials Plans

Comment 1:

We trust that Staff and the City Traffic Engineer will provide feedback as necessary regarding the circulation and layout of the project. The layout appears to be generally considerate of typical shopping center style layouts and allows for customer access as well as truck deliveries. Signage, however, directing the various users of the site seems critical given the multiple development functions occurring on the property. We assume the traffic engineer will consider the need for the Shopping Center entrance configuration developed in accordance with DOT standards.

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Response:

The City Traffic Engineer, Mr. Thomas Errico of Wilbur Smith Associates, has reviewed the site plans for circulation and layout. He provided his comments to the city via email on January 23, 2006. A copy of the comments, as well as VHB's responses, is included as Attachment A.

VHB has added internal directional signage in four locations that we believe to be appropriate. The directional signage has been added to the plans and is highlighted in Attachment B.

VHB references Appendix D of the Maine DOT Driveway and Entrance Rules, which states that the Shopping Center Entrance configuration does not apply within Urban Compact Areas of Urban Compact Communities. A copy of Appendix D is attached for reference as Attachment C. The driveway has been designed to function adequately for vehicular movements entering and exiting the site.

Comment 2:

The applicant is proposing parking space sizes of 9' x 18' which is below the City standard of 9' x 19'. We generally support this request as it allows for the placement of a longitudinal island in the parking lot as well as greater buffering to the Townhouses.

Response:

VHB concurs with this comment.

Comment 3:

The circulation of the bus route should be presented to the City and the route pattern confirmed for adequate radii and maneuvering.

Response:

VHB met with the Peter Cavanaugh, GM/Director of Operations of the Greater Portland Transit District (The Metro), on November 21, 2005 to discuss bus route circulation within the site. At this meeting, the Metro proposed that the bus route be located such that the bus travels on the road adjacent to the town houses and reverses direction by use of the turning circle at the end of the road.

VHB has revised the turning circle to ensure that it is adequately sized to accommodate the Metro buses. The revised layout with the Autoturn turning movement simulation can be found in Attachment D.

A letter has been submitted by Metro to the City regarding their approval of the route.

Comment 4:

We trust the Traffic Engineer will comment on the alignment and geometry of the turning circle adjacent the Townhouses.

Response:

Per Attachment A, Mr. Errico has reviewed the layout and circulation of the site.

Comment 5:

We suggest that stop bars and stop signs be placed on the plans at strategic locations. For example it is unclear if they are proposed at the end of each drive aisle, as is common in shopping center parking areas. Given the through movement nature of some of the traffic, additional control measures may be warranted.

Response:

The drawings have been modified to include stop bars and signage along the main drive aisle in locations we feel appropriate and highlighted in Attachment E.

Comment 6:

We suggest that the Final drawings contain a baseline layout, coordinate system or centerline layout of the drive aisle.

Response:

The drawings have been modified to include a centerline layout of the drive aisle, which is highlighted in Attachment F.

Comment 7:

We recommend that additional spot grades be provided around the parking lot islands to the extend practicable since the number of catch basins is being minimized by the use of double grated structures.

Response:

VHB has updated the plans to provide additional spot grades to ensure positive drainage flows to all structures. The revised plans are highlighted in Attachment L.

Comment 8:

We recommend that the access drives be crowned to the extent possible, particularly at the entrance. This would require additional catch basin inlets along the entry drive.

Response:

The entrance has been crowned from Allen Avenue to the Allen Avenue Apartments connection. A new catch basin has been added to the south side of the entrance. The remaining portion flows south to north across the roadway due to the restrictions resulting from the architectural design of the mixed use building, which maintains a constant finished floor elevation for a distance of approximately 185 feet. The changes are highlighted in Attachment L.

Comment 9:

We note that several light poles appear to be located within the underground storage systems. This may be possible; we simply suggest this be confirmed with the product vendor.

Response:

The detention structure layouts have been modified to avoid any conflicts with the subsurface drainage structures. The changes are highlighted in Attachment M.

Comment 10:

The plans should clarify the size of all drainage structures since some of the manholes may need to be larger than 4' dia. to allow for multiple pipes and sizes.

Response:

The plans have been modified to clarify the sizes of drainage structures larger than 4' diameter. The highlighted plans can be found in Attachment L.

Comment 11:

Within the erosion control program for the site we suggest the use of organic filter (mulch) berms as often as possible in place of silt fence.

Response:

VHB has updated the Erosion Control Plan to include the use of organic filter berms in appropriate areas, specifically in the areas of the proposed town houses, the wetlands south of the recreational field, and the residences at the eastern part of the site. The changes are highlighted in Attachment N.

Comment 12:

The erosion control requirements must be revised to include the DEP's standard procedures for Wintertime activities. A copy of these requirements can be provided to the engineer if necessary.

Response:

The erosion control requirements have been revised to include the DEP's standard procedures for Wintertime activities, they can be found on the Erosion Control Plan (Attachment J).

Comment 13:

We recommend that engineer confirm the jurisdictional status of the brook as it crosses the far eastern side of the site and any regulatory (NRPA) restrictions including setbacks that the DEP may require. The City has more recently encouraged a setback of up to 100' for the urban streams in the City. Given the applicant's intentions to install a detention basin near the stream in an area that is now an unsightly open area, it seems that this development activity seems reasonable and well within consideration for relaxation of the setback requirements. The engineer should confirm that the stream is not considered wetlands of special significance. Are there any Shoreland zoning issues pertaining to the stream?

Response:

VHB met with Linda Kokemueller with the Maine DEP to review the jurisdictional status of the stream. The stream is within the jurisdiction of the Maine DEP. Given that much of this area has been previously disturbed the DEP has requested a 25-foot wooded buffer and bank restoration for Milliken Brook. The plans have been modified accordingly and are shown in Attachment O. We will be meeting with the DEP to present our modified buffer/bank landscape design.

Utility Plans

Comment 1:

The Portland Water District may require the installation of a Fire Line Supply meter and meter pit into the development since there will be multiple services for both domestic and Fire supply. Will a meter be required for the Morrill Street connection? The Final Plans should include these measures as required by the District.

Response:

VHB contacted Portland Water District (PWD) to confirm their requirements for the installation of a Fire Line Supply meter. Since then we've been coordinating the layout of the system. A meter has been installed on the Allen Avenue connection. In addition, PWD requested that we eliminate the connection at Morrill Street. A fire flow analysis has been preformed to confirm adequate flow for the site. A copy of the correspondence, plans, and fire flow report are included in Attachment P.

Comment 2:

The layout includes multiple hydrant locations that should be reviewed and approved by the Fire Department.

Response:

The Fire Department has reviewed the hydrant locations. At a meeting in September '05, a fire department representative requested a hydrant be placed near the emergency access off of Allen Avenue. This has been updated on the plans and is highlight in Attachment Q. A December 29, 2005 letter received from the City summarizes a meeting with Captain Cass which confirms the approved locations.

Comment 3:

The applicant should confirm the need for utility easements for power and telephone.

Response:

The applicant will coordinate all required easements with the utility providers.

Details

Comment 1:

The geotechnical engineer should review the Pavement Section detail on Sheet C-11 and a pavement section derived from the onsite soils conditions provided. The section appears to be a bit thin.

Response:

The pavement section detail has been adjusted based on the recommendation of the preliminary geotechnical evaluation prepared by R.W. Gillespie & Associates, Inc. The detail is highlighted in Attachment R. Upon final geotechnical evaluation the pavement detail with be adjusted if necessary based on further recommendations.

Comment 2:

The outlet control structure on Sheet C-13 must be modified to allow for the 48" outlet pipe size.

Response:

The detail has been updated accordingly and is highlighted in Attachment S.

Comment 3:

We are uncertain as to where the sediment forebay berm and the low flow sediment forebay berms are to be located. This should be clarified.

Response:

Sheet C-6 has been updated to show the location of the sediment forebay berm and Sheet C-13 has been updated to eliminate the Low Flow Sediment Forebay Berm. The modification is highlight in Attachment T.

Please give me a call if you have any questions or need additional information.

Very truly yours,

VANASSE HANGEN BRUSTLIN, INC.

John Hession/HH

John Hession
Project Manager

David Fenstermacher
Project Engineer

Attachment A

Transportation
Land Development
Environmental
Services

VHB imagination | innovation | energy Creating results for our clients and benefits for our communities

February 17, 2006

Vanasse Hangen Brustlin, Inc.

Ref: 07334.00

Sarah Hopkins
Development Review Services Manager
Department of Planning & Development
City of Portland
389 Congress Street
Portland, Maine 04101

Re: Morrill's Crossing - Response to Tom Errico Site Plan Comments

Dear Sarah:

The following are VHB's responses to the site plan comments raised by Mr. Thomas Errico of Wilbur Smith Associates in his e-mail addressed to you dated, January 23, 2006 regarding Morrill's Crossing. Mr. Errico has raised several constructive comments that we believe improve the overall site design. Where these comments result in changes to the site plan, our proposed revisions are shown on attachments to this letter.

Comment 1:

It seems that two different crosswalk treatments are being proposed for the project. An explanation on the selection of treatment should be provided. I would also ask that the City Engineer review and approve the specification for the "stamped" pavement proposal. I would also note that the city should provide guidance on whether the stamped treatment should be applied to the crossings on Allen Avenue.

Response:

The proposed plan does specify two different crosswalk treatments for the project. The "stamped" pavement crosswalks serve as an urban streetscape treatment along the main entrance and along the primary pedestrian routes. They are intended to provide a visual interest and to clearly delineate the pedestrian corridors through the commercial and townhome portions of the development. Standard striped crosswalks are proposed in all other locations.

VHB discussed the use of the "stamped: pavement treatment with Mr. Errico and Mr. Eric Labelle from the Public Works Department. It is our understanding that Mr. Labelle approves of its use given that it is part of a private development.

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Comment 2:

I would suggest that the applicant provide a sidewalk on the easterly side of the main entrance roadway from the bus pullout to Allen Avenue.

Response:

As discussed with Mr. Errico, Mr. Patrick Carroll of Carroll Associates, and Planning staff, a sidewalk from Allen Avenue to the bus stop on the easterly side of the main entrance has been added to the plan. The change is highlighted on Attachment A.

Comment 3:

The location of the crosswalk on the main entrance roadway at Allen Avenue seems to be set back to far.

Response:

The crosswalk has been modified to be set closer to Allen Avenue. The new location is based on the turning movements requirements of entering vehicles. The new layout is highlighted on Attachment B.

Comment 4:

I would suggest that the applicant provide crosswalks on all approaches at the Allen Avenue/Main entrance roadway intersection.

Response:

VHB believes that the crosswalk, as originally proposed (crossing the northerly leg of Allen Avenue) provides adequate crossing opportunities, especially in light of the additional sidewalk provided along the site drive (see response to Comment 2). The addition of a crosswalk, crossing the southerly leg of Allen Avenue, would result in a reduction of the available queue storage between the railroad crossing and the site drive. VHB recommends that a single crossing of Allen Avenue remain in the location originally proposed.

Comment 5:

The Main entrance roadway has a cross section dimension of 12' exit lanes and one 20' entry lane I would suggest that the dimensions be adjusted to allow for some shoulder area exiting the site for bicyclists.

Response:

The main entrance drive has been modified to allow for shoulder area exiting the site. The new lane configuration consists of one 18 foot wide entry lane, one 12 foot wide exit lane, and one 14 foot wide exit lane. The new configuration is highlighted in Attachment C.

Comment 6:

The main circulatory roadway through the site is proposed to be 30' wide. The applicant should document how this roadway shall be marked. It is my opinion that the roadway be designed with such treatment that it appears to be the primary or highest classification roadway.

Response:

VHB has added a single yellow centerline along the main site roadway. The change is highlighted in Attachment D.

Comment 7:

Two crosswalks are illustrated from the parking aisle to the Stop and Shop store frontage. I would rather not have a crosswalk terminate in a travel lane. Elimination or alternatives are recommended.

Response:

The crosswalks as shown are a Stop & Shop design requirement to delineate the accessible route from the store entrance/exit to the accessible parking spaces. According to Chapter 5: General Site and Building Elements of the Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines: "Accessible routes must connect parking spaces to accessible entrances. In parking facilities where the accessible route must cross vehicular traffic lanes, marked crossings enhance pedestrian safety, particularly for people using wheelchairs and other mobility aids."

Comment 8:

The applicant should document the winter maintenance program, particularly for all sidewalks and trails on their site.

Response:

As part of the general maintenance program, all sidewalks and trails will be cleared during snow storm events.

Comment 9:

All regulatory signage and pavement markings should be illustrated on a plan.

Response:

A regulatory signage chart, as well as the pavement markings, was illustrated on the Layout and Material Plans originally submitted. Those plans have been updated to reflect revision requested. Please refer to Attachment E.

Comment 10:

A waiver for the parking stall dimension standard will be required. The parking stalls are proposed to be 18' long. The standard is 19'.

Response:

The applicant has submitted a waiver request for the parking stall dimension to under a separate cover. Please note that the parking stall dimension was supported by Mr. Steve Bushey of Deluca-Hoffman in his review of the Site Plans.

Comment 11:

Traffic control at key on site intersections needs to be illustrated. An example of this is at the intersection in front of the Boxing Facility.

Response:

Stop signs have been added to the parking aisle approaches to the main drive aisle in appropriate locations as per Mr. Bushey's comments. Additional signage has been provided in the area of the Boxing Club intersection. The changes are highlighted in Attachment F.

Comment 12:

Based upon the different land uses and size of the site, I would suggest that the applicant implement a wayfinding signage program that provides destination information.

Response:

Directional signage has been added to the plans. The changes are highlighted in Attachment G.

Comment 13:

The pavement arrows exiting the site should be revised to account for movements to Paul White Tile.

Response:

The pavement arrow in the left exiting lane has been modified to show a through-left movement to account for movements to Paul White Tile. The change is highlighted in Attachment H.

Comment 14:

The applicant should confirm that the bus stop pullout dimensions have been approved by METRO.

Response:

The townhome drive cul-de-sac radii have been revised to provide for adequate turning movements for both busses and Fire Department vehicles. Updated plans have been sent to Metro for review. The revised cul-de-sac design is provided in Attachment I.

Comment 15:

I would suggest providing a crosswalk on the truck delivery driveway entrance and appropriate sidewalk connections to the store front. A good pedestrian connection should be provided between the proposed apartments and the retail portion of the site.

Response:

A sidewalk has been added to the side of the retail and a crosswalk connection has been provided on the truck delivery driveway connecting the store to the apartment walkway. The changes are highlighted in Attachment J.

Please give me a call if you have any questions or need additional information.

Very truly yours,

VANASSE HANGEN BRUSTLIN, INC.

John Hession
Project Manager

David Fenstermacher
Project Engineer

With attachments
cc: Thomas Errico – Wilbur Smith Associates

Attachment B

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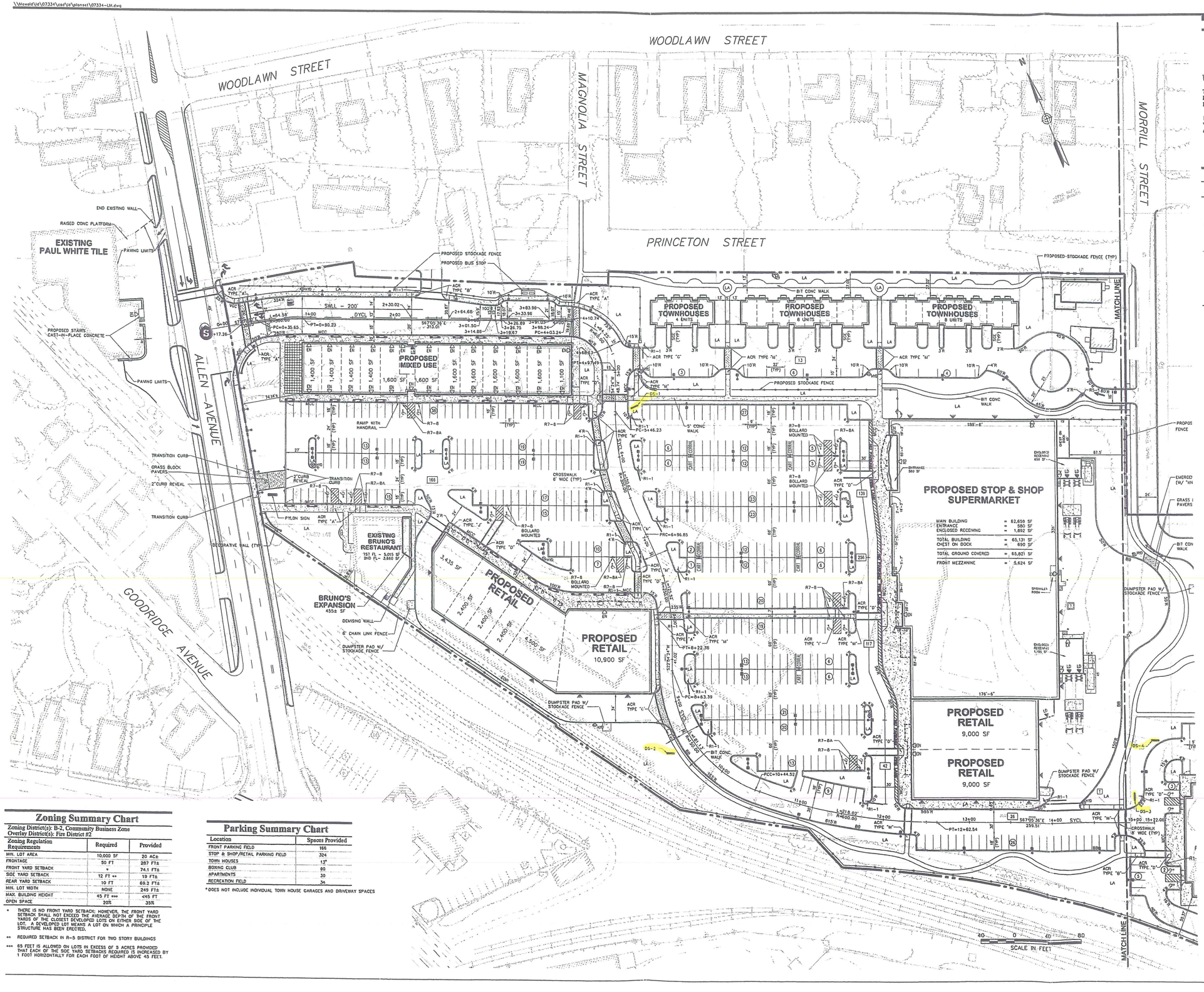

Zoning Summary Chart

Zoning District(s): B-2, Community Business Zone
Overlay District(s): Fire District #2

Zoning Regulation Requirements	Required	Provided
MIN. LOT AREA	10,000 SF	20 AC±
FRONTAGE	50 FT	287 FT±
FRONT YARD SETBACK	*	74.1 FT±
SIDE YARD SETBACK	12 FT **	19 FT±
REAR YARD SETBACK	10 FT	69.2 FT±
MIN. LOT WIDTH	NONE	249 FT±
MAX. BUILDING HEIGHT	45 FT ***	<45 FT
OPEN SPACE	20%	35%

* THERE IS NO FRONT YARD SETBACK; HOWEVER, THE FRONT YARD SETBACK SHALL NOT EXCEED THE AVERAGE DEPTH OF THE FRONT YARDS OF THE CLOSEST DEVELOPED LOTS ON EITHER SIDE OF THE LOT. A DEVELOPED LOT MEANS A LOT ON WHICH A PRINCIPLE STRUCTURE HAS BEEN ERECTED.

** REQUIRED SETBACK IN R-5 DISTRICT FOR TWO STORY BUILDINGS

*** 65 FEET IS ALLOWED ON LOTS IN EXCESS OF 5 ACRES PROVIDED THAT EACH OF THE SIDE YARD SETBACKS REQUIRED IS INCREASED BY 1 FOOT HORIZONTALLY FOR EACH FOOT OF HEIGHT ABOVE 45 FEET.

Parking Summary Chart

Location	Spaces Provided
FRONT PARKING FIELD	166
STOP & SHOP/RETAIL PARKING FIELD	324
TOWN HOUSES	13*
BOXING CLUB	80
APARTMENTS	30
RECREATION FIELD	34

*DOES NOT INCLUDE INDIVIDUAL TOWN HOUSE GARAGES AND DRIVEWAY SPACES

Sign Summary

M.U.T.C.D. Number	Specification Width	Specification Height	Desc.
R1-1	30"	30"	STOP
R5-1	30"	30"	DO NOT ENTER
R7-8	12"	18"	RESERVED PARKING
R7-8A	12"	6"	VAN ACCESS

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No.	Revision	Date	Appvd.
1	RESPONSE TO COMMENTS	2/17/06	

Designed by DHF | Drawn by DHF | Checked by KSS
CAD checked by BKF | Approved by
Scale 1" = 40' | Date June 30, 2005

Project Title
Morrill's Crossing

Allen Avenue
Portland, Maine

Issued for
Site Plan Approval

Not Approved for Construction

Drawing Title
Layout and Materials Plan 1

Drawing Number
C-3

Sheet of
3 16

Project Number
07334.00

07334-LM.dwg

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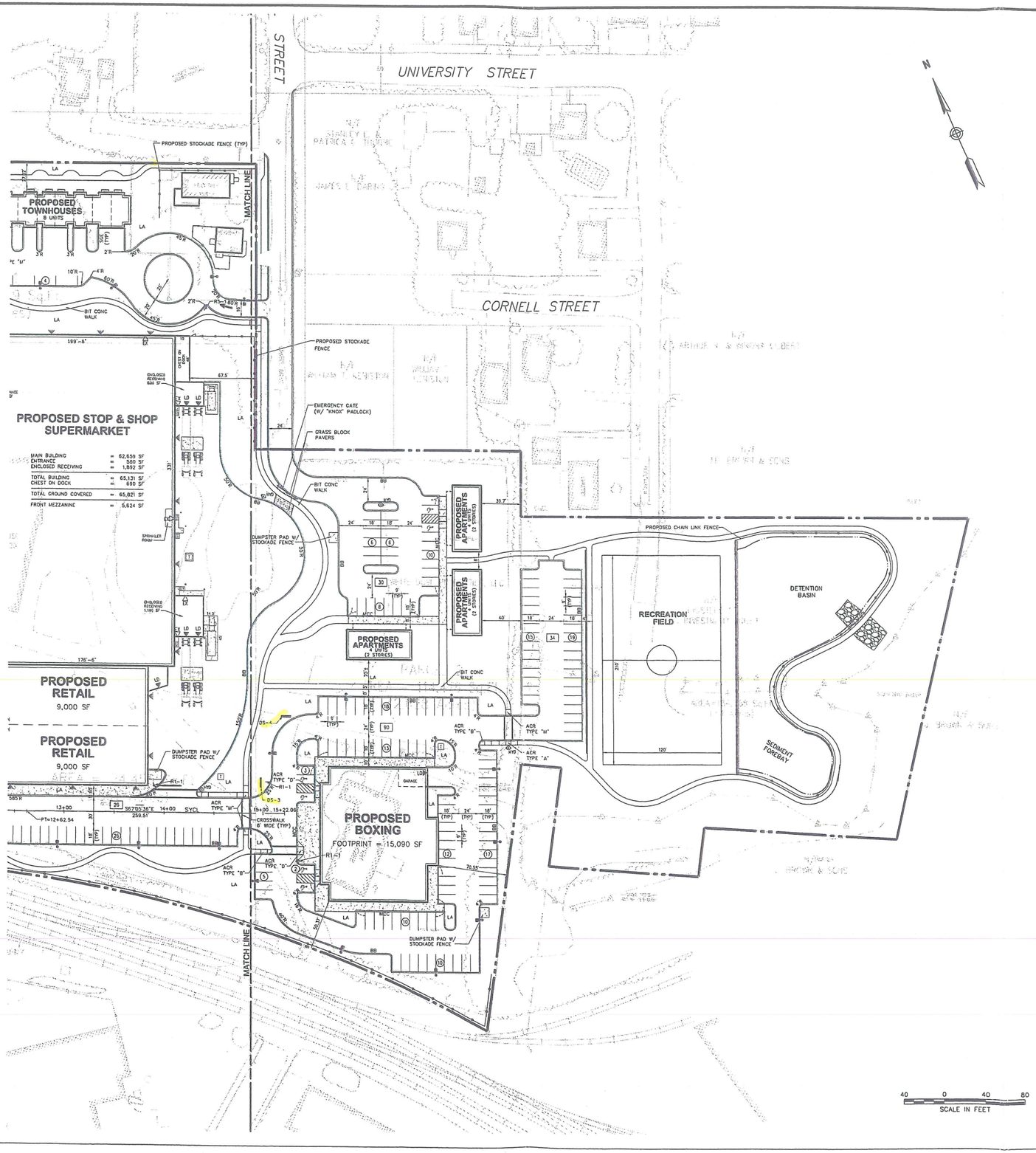

VHB
Vanasse Hangen Brustlin, Inc.
Transportation
Land Development
Environmental Services

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Watertown, Massachusetts 02471
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Directional Sign Summary

Number	Description
DS-1	STOP & SHOP ← SUNOCO → PORTLAND BOXING CLUB ↑ RECREATION FIELD ↑
DS-2	PORTLAND BOXING CLUB ↑ RECREATION FIELD ↑
DS-3	PORTLAND BOXING CLUB ↑ RECREATION FIELD ←
DS-4	RECREATION FIELD →

No.	Revision	Date	Appvd
1	RESPONSE TO COMMENTS	2/17/06	

Designed by DHF	Drawn by DHF	Checked by KSS	
CAD checked by BKF		Approved by	
Scale 1" = 40'		Date June 30, 2005	

Project Title
Morrill's Crossing

Allen Avenue
Portland, Maine

Issued for
Site Plan Approval

Not Approved for Construction

Drawing Title
Layout and Materials Plan 2

Drawing Number
C-4

Sheet 4 of 16

Project Number
07334.00

07334-LM.dwg

APPENDIX D - URBAN COMPACT AND SERVICE CENTER COMMUNITIES

MDOT Driveway and Entrance rules **do not apply within** Urban Compact Areas of Urban Compact Communities. They **do apply** to State and State Aid Highways **outside** Urban Compact Areas of the Urban Compact Communities listed below.

Municipalities with Urban Compact Areas are those in which the population according to the last United States census;

1. Exceed 7,500 inhabitants.

2. Is less than 7,500 inhabitants but more than 2,499 inhabitants, and in which the ratio of people whose place of employment is in a given municipality to employed people residing in that same municipality is 1.0 or greater, ***and when the municipality has not exercised the opt-out provision of this section.***

"Compact" or "Built-up sections" means a section of the highway where structures are nearer than 200 feet apart for a distance of ¼ of a mile, unless otherwise defined; reference M.R.S.A. 23 §754, revised July 1, 1999.

Presently there are 43 Urban Compact Municipalities.

Auburn	Augusta	Bangor	Bath
Belfast	Biddeford	Brewer	Brunswick
Cape Elizabeth	Caribou	Fairfield	Falmouth
Farmington	Freeport	Gardiner	Gorham
Houlton	Kennebunk	Kittery	Lewiston
Lisbon	Millinocket	Old Orchard Beach	Old Town
Orono	Portland	Presque Isle	Rockland
Rumford	Saco	Sanford	Scarborough
Skowhegan	South Portland	Standish	Topsham
Waterville	Wells	Westbrook	Windham
Winslow	Yarmouth	York	

NOTE: Some communities may have "built up sections" as defined above but are not considered Urban Compact Communities. Chapter 299 Parts A & B, Driveway and Entrance Rules will apply in these communities.

SERVICE CENTER COMMUNITIES

The MDOT Driveway and Entrance Rules include a reference to Service Center Communities when defining "Mobility Arterial Corridors".

The communities where we work, shop, get medical care or a cultural experience are an important subset of Maine's nearly 500 cities and towns. We call them many things: cities, hubs, shire towns, county seats and market towns. Whether living within them or outside them, we all depend upon them in some way.

The State Planning Office has defined 69 such communities statewide and termed them "service centers." These communities vary tremendously in size and appearance, but share three attributes:

a) they are job centers -- importing workers,

b) they are retail centers -- with sales exceeding the needs of the local population, and/or

Attachment D

flawald\ld\07334\cad\ld\planmisc\Truck Movements\07334_ATURN_BUS-2-16-06.dwg

PROPOSED STOCKADE FENCE (TYP)

N/F
STANLEY E. &
PATRICA G. THORNE

N/F
JAMES E. DARING JR.

LA

27.02'

LA

25

PROPOSED TOWNHOUSES
8 UNITS

N/F
INE F. & JACK ADAMS

LA

LA

LA

3'R

3'R

SGE (TYP)

2'R

20'R

45'R

HEIGHT=17'

24.5'

48.6'

MATCH LINE

HEIGHT=7.5'

24'

27'

ACR TYPE "M"

10'R

10'R

4'R

60'R

HYD

4

PARCEL 1

A = 333,719 Sq.Ft.

(7.661 Acres)

25'

20'

45'R

2'R

20'R

R5-180'R

16'

M.9

BIT CONC WALK

LA

199'-6"

EX

15'

CHEST ON DOCK 46'

EN

19'-3"

MCC

GRAVEL

PROPOSED STOCKADE FENCE

N/F

0 15 30 Feet

Vanasse Hangen Brustlin, Inc.

Bus Route Exhibit

Morrill Street Access
Townhouse Cul-de-Sac
Morrill's Crossing
Portland, Maine

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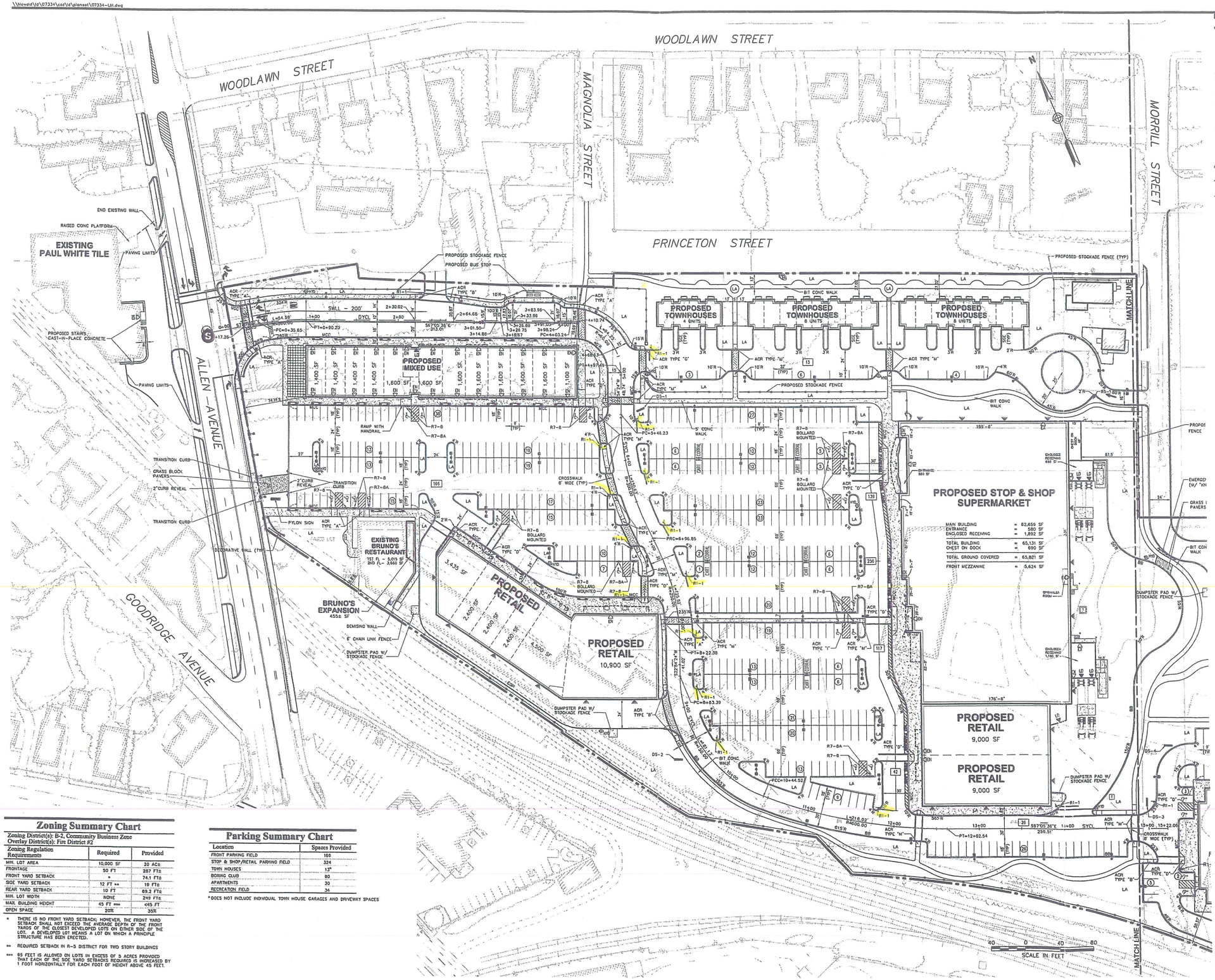

Zoning Summary Chart

Zoning District(s): B-2, Community Business Zone
Overlay District(s): Fire District #2

Zoning Regulation Requirements	Required	Provided
MIN. LOT AREA	10,000 SF	20 ACS
FRONTAGE	50 FT	287 FTS
FRONT YARD SETBACK	*	74.1 FTS
SIDE YARD SETBACK	12 FT **	19 FTS
REAR YARD SETBACK	10 FT	69.2 FTS
MIN. LOT WIDTH	NONE	249 FTS
MAX. BUILDING HEIGHT	45 FT ***	45 FT
OPEN SPACE	20%	35%

* THERE IS NO FRONT YARD SETBACK; HOWEVER, THE FRONT YARD SETBACK SHALL NOT EXCEED THE AVERAGE DEPTH OF THE FRONT YARDS OF THE CLOSEST DEVELOPED LOTS ON EITHER SIDE OF THE LOT. A DEVELOPED LOT MEANS A LOT ON WHICH A PRINCIPLE STRUCTURE HAS BEEN ERECTED.

** REQUIRED SETBACK IN R-5 DISTRICT FOR TWO STORY BUILDINGS

*** 95 FEET IS ALLOWED ON LOTS IN EXCESS OF 5 ACRES PROVIDED THAT EACH OF THE SIDE YARD SETBACKS REQUIRED IS INCREASED BY 1 FOOT HORIZONTALLY FOR EACH FOOT OF HEIGHT ABOVE 45 FEET.

Parking Summary Chart

Location	Spaces Provided
FRONT PARKING FIELD	166
STOP & SHOP/RETAIL PARKING FIELD	324
TOWN HOUSES	12*
BOWING CLUB	80
APARTMENTS	30
RECREATION FIELD	34

*DOES NOT INCLUDE INDIVIDUAL TOWN HOUSE GARAGES AND DRIVEWAY SPACES

Sign Summary

M.U.T.C.D. Number	Specification Width	Specification Height	Desc.
R1-1	30"	30"	STOP
R5-1	30"	30"	DO NOT ENTER
R7-8	12"	18"	RESERVED PARKING
R7-8A	12"	6"	VAN ACCESSIBLE

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Environmental Services
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No.	Revision	Date	Appvd.
1	RESPONSE TO COMMENTS	2/17/06	

Designed by DHF | Drawn by DHF | Checked by KSS
CAD checked by BKF | Approved by
Scale 1" = 40' | Date June 30, 2005

Project Title
Morrill's Crossing
Allen Avenue
Portland, Maine

Issued for
Site Plan Approval
Not Approved for Construction

Drawing Title
Layout and Materials Plan 1

Drawing Number
C-3

Sheet 3 of 16

Project Number
07334.00

07334-LM.dwg

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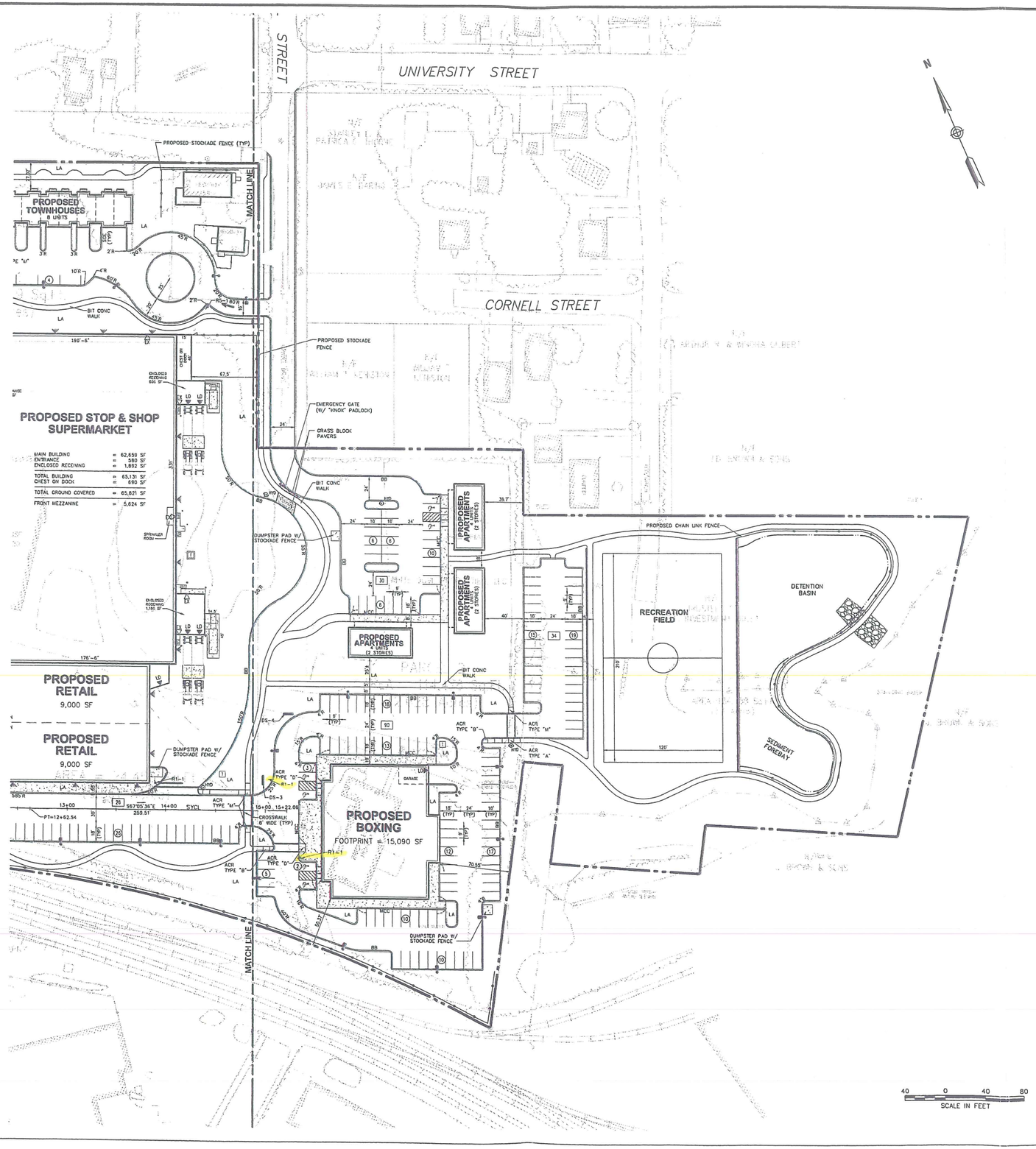

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Directional Sign Summary

Number	Description
DS-1	STOP & SHOP ← BRUNO'S → PORTLAND BOXING CLUB ↑ RECREATION FIELD ↑
DS-2	PORTLAND BOXING CLUB ↑ RECREATION FIELD ↑
DS-3	PORTLAND BOXING CLUB ↑ RECREATION FIELD ←
DS-4	RECREATION FIELD →

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Layout and Materials Plan 2

Drawing Number
C-4

Sheet 4 of 16

Project Number
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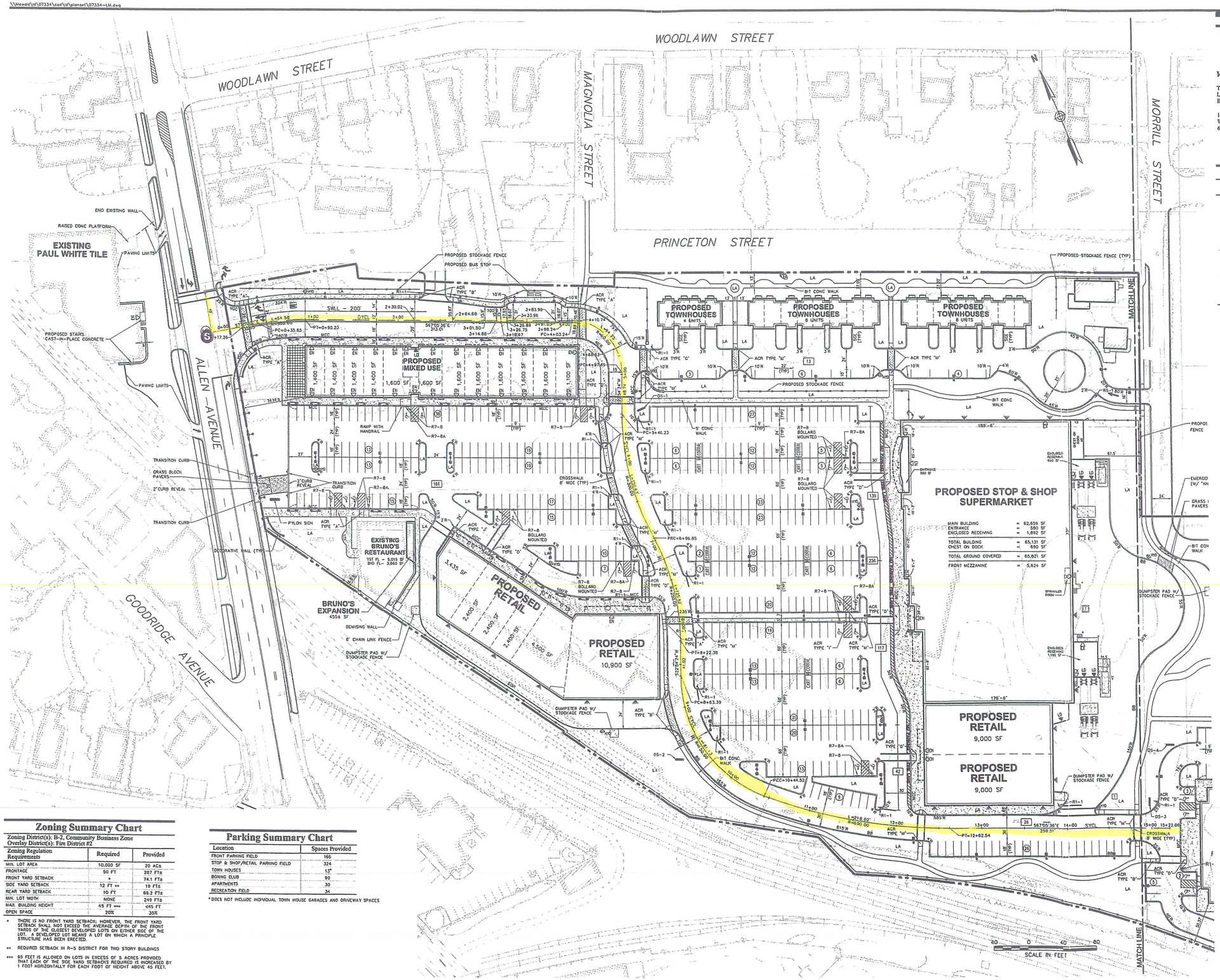

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Overlay District(s): Fire District #2

Zoning Regulation Requirements	Required	Provided
MIN. LOT AREA	10,000 SF	20 AC±
FRONTAGE	50 FT	267 FT±
FRONT YARD SETBACK	*	74.1 FT±
SIDE YARD SETBACK	12 FT **	19 FT±
REAR YARD SETBACK	10 FT	69.2 FT±
MIN. LOT WIDTH	NONE	249 FT±
MAX. BUILDING HEIGHT	45 FT ***	<45 FT
OPEN SPACE	20%	35%

* THERE IS NO FRONT YARD SETBACK; HOWEVER, THE FRONT YARD SETBACK SHALL NOT EXCEED THE AVERAGE DEPTH OF THE FRONT YARDS OF THE CLOSEST DEVELOPED LOTS ON EITHER SIDE OF THE LOT. A DEVELOPED LOT MEANS A LOT ON WHICH A PRINCIPLE STRUCTURE HAS BEEN ERECTED.

** REQUIRED SETBACK IN R-5 DISTRICT FOR TWO STORY BUILDINGS

*** 65 FEET IS ALLOWED ON LOTS IN EXCESS OF 5 ACRES PROVIDED THAT EACH OF THE SIDE YARD SETBACKS REQUIRED IS INCREASED BY 1 FOOT HORIZONTALLY FOR EACH FOOT OF HEIGHT ABOVE 45 FEET.

Parking Summary Chart

Location	Spaces Provided
FRONT PARKING FIELD	166
STOP & SHOP/RETAIL PARKING FIELD	324
TOWN HOUSES	13*
BOWLING CLUB	90
APARTMENTS	30
RECREATION FIELD	34

*DOES NOT INCLUDE INDIVIDUAL TOWN HOUSE GARAGES AND DRIVEWAY SPACES

Sign Summary

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R1-1	30"	30"	STOP
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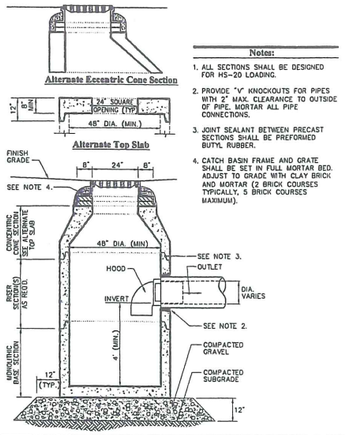
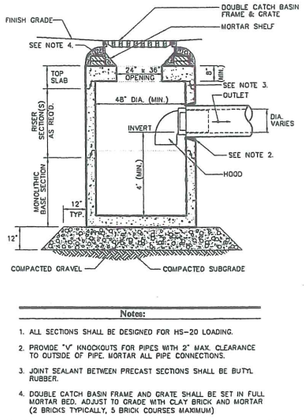


Notes:

1. ALL SECTIONS SHALL BE DESIGNED FOR HS-20 LOADING.
2. PROVIDE "V" KNOCKOUTS FOR PIPES WITH 2" MAX. CLEARANCE TO OUTSIDE OF PIPE. MORTAR ALL PIPE CONNECTIONS.
3. JOINT SEALANT BETWEEN PRECAST SECTIONS SHALL BE PREFORMED BUTYL RUBBER.
4. CATCH BASIN FRAME AND GRATE SHALL BE SET IN FULL MORTAR BED. ADJUST TO GRADE WITH CLAY BRICK AND MORTAR (2 BRICK COURSES TYPICALLY, 5 BRICK COURSES MAXIMUM).

Catch Basin (CB) With Hood

N.T.S. Source: VHB 6/03 LD_101

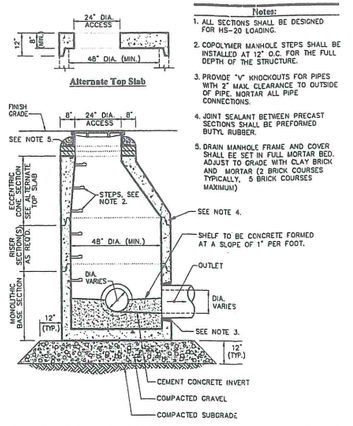


Notes:

1. ALL SECTIONS SHALL BE DESIGNED FOR HS-20 LOADING.
2. PROVIDE "V" KNOCKOUTS FOR PIPES WITH 2" MAX. CLEARANCE TO OUTSIDE OF PIPE. MORTAR ALL PIPE CONNECTIONS.
3. JOINT SEALANT BETWEEN PRECAST SECTIONS SHALL BE BUTYL RUBBER.
4. DOUBLE CATCH BASIN FRAME AND GRATE SHALL BE SET IN FULL MORTAR BED. ADJUST TO GRADE WITH CLAY BRICK AND MORTAR (2 BRICKS TYPICALLY, 5 BRICK COURSES MAXIMUM)

Double Grate Catch Basin (DCB) with Hood

N.T.S. Source: VHB 6/03 LD_103

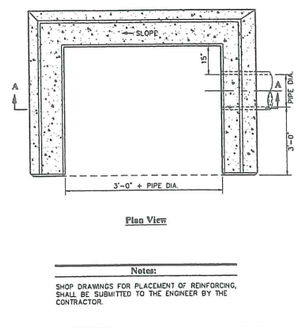


Notes:

1. ALL SECTIONS SHALL BE DESIGNED FOR HS-20 LOADING.
2. COPOLYMER MANHOLE STEPS SHALL BE INSTALLED AT 12" O.C. FOR THE FULL DEPTH OF THE STRUCTURE.
3. PROVIDE "V" KNOCKOUTS FOR PIPES WITH 2" MAX. CLEARANCE TO OUTSIDE OF PIPE. MORTAR ALL PIPE CONNECTIONS.
4. JOINT SEALANT BETWEEN PRECAST SECTIONS SHALL BE PREFORMED BUTYL RUBBER.
5. DRAIN MANHOLE FRAME AND COVER SHALL BE SET IN FULL MORTAR BED. ADJUST TO GRADE WITH CLAY BRICK AND MORTAR (2 BRICK COURSES TYPICALLY, 5 BRICK COURSES MAXIMUM)

Drain Manhole (DMH)

N.T.S. Source: VHB 6/03 LD_115



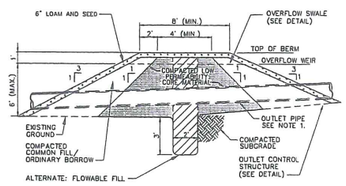
Notes:

SHOP DRAWINGS FOR PLACEMENT OF REINFORCING, SHALL BE SUBMITTED TO THE ENGINEER BY THE CONTRACTOR.

Directional Headwall

N.T.S. Source: VHB 6/03 LD_135

DETENTION BASIN NO.	DIAMETER ORIFICE A	INVERT ORIFICE A	DIMENSION ORIFICE B	INVERT ORIFICE B	DIMENSION ORIFICE C	INVERT ORIFICE C	DIAMETER OUTLET PIPE	INVERT OUTLET PIPE	OVERFLOW RIPRAP SWALE DIMENSIONS	SWALE ELEV.	TOP OF BERM
1	8"	81.0	1'x3'	82.0	1'x2'	84.5	48"	80.5	W=15 D=1'	87.5	88.5

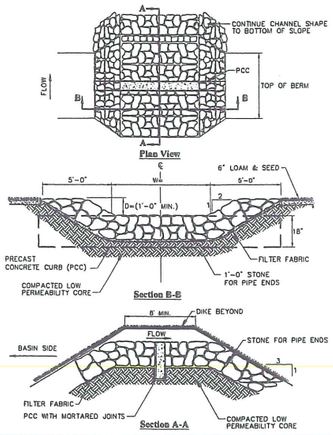


Notes:

1. WHERE PIPES PENETRATE THE LOW PERMEABILITY CORE, PIPE SHALL BE BEDDED IN THE LOW PERMEABILITY CORE MATERIAL.
2. THE BERM SECTION IS SUBJECT TO CHANGE AND WILL BE BASED ON THE RESULTS OF FURTHER GEOTECHNICAL INVESTIGATIONS.

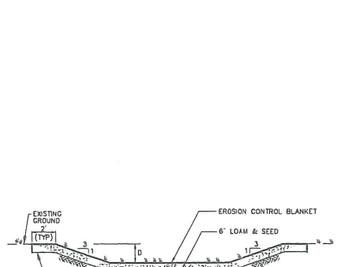
Detention Basin Berm Section

N.T.S. Source: VHB 6/03 LD_160



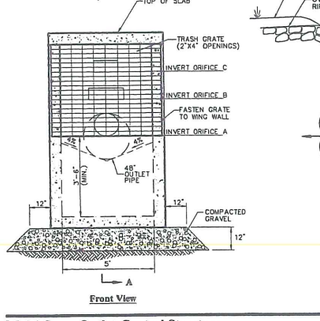
Overflow Stone Swale

N.T.S. Source: 6/03 LD_161



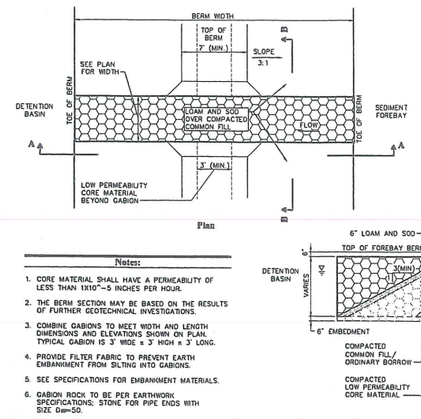
Grassed Swale

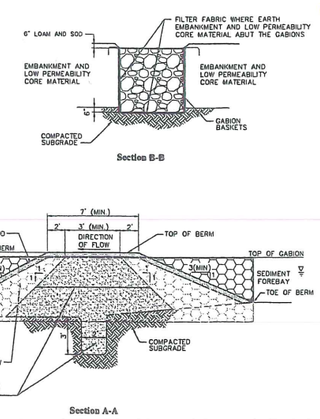
N.T.S. Source: VHB 6/03 REV LD_171



Multi-Stage Outlet Control Structure

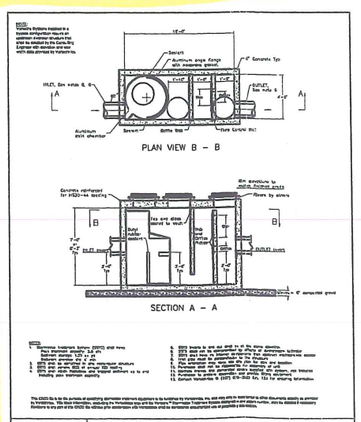
N.T.S. Source: VHB 6/03 REV LD_162

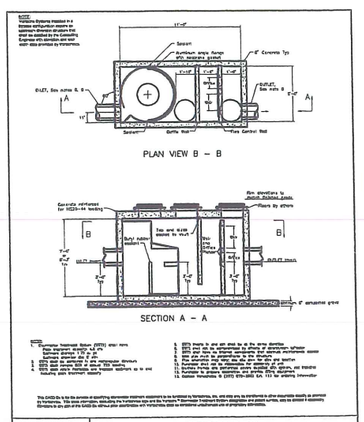




Sediment Forebay Berm

N.T.S. Source: VHB 6/02 LD_164





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Designed by | Drawn by | Checked by
CAD checked by | Approved by
Scale: As Noted | Date: June 30, 2005

Project Title
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Allen Avenue
Portland, Maine

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Drawing Title

Site Details 3

Drawing Number
C-15
Sheet 15 of 16
Project Number 07334.00

07334-D1.DWG

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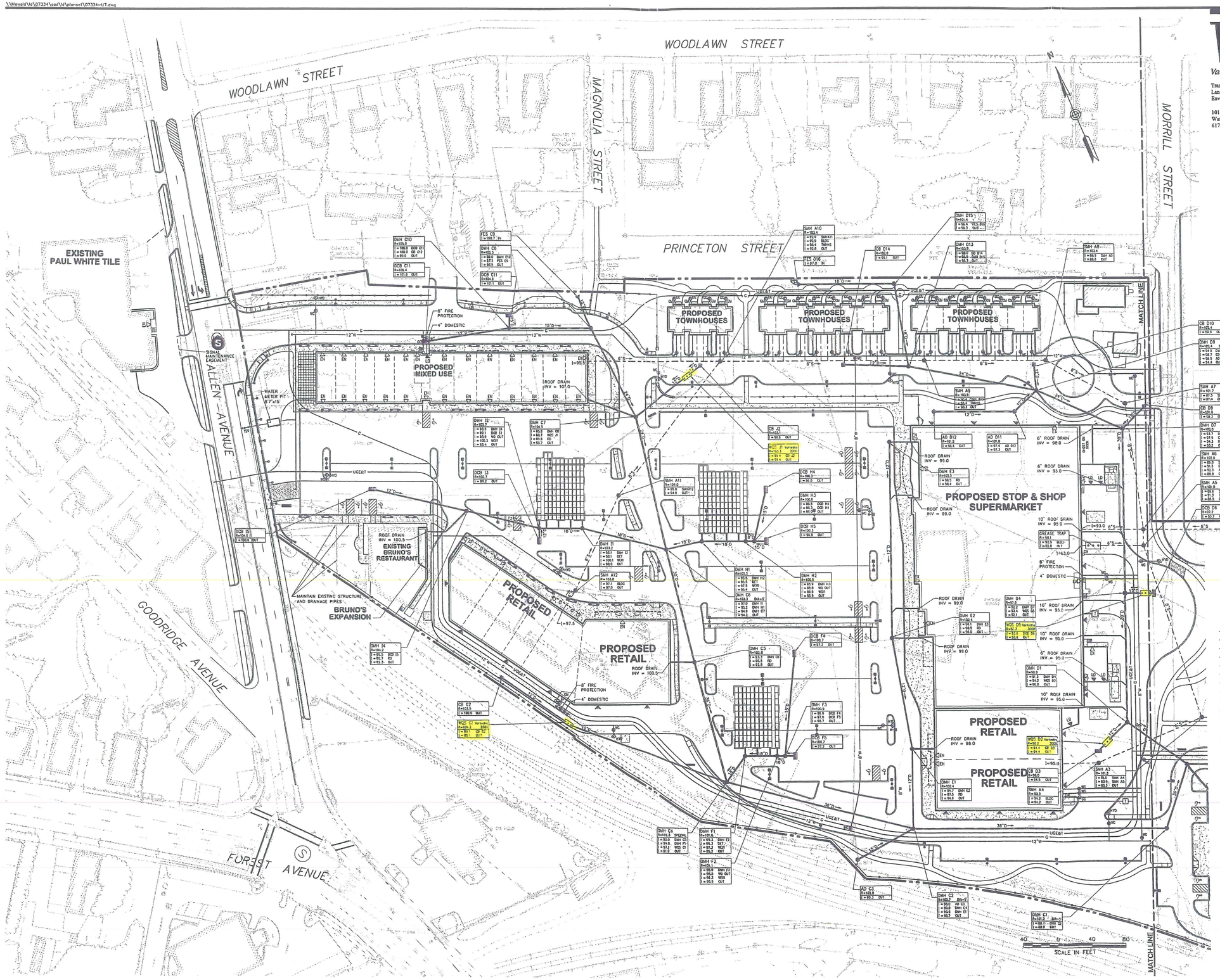

VHB
Vanasse Hangen Brustlin, Inc.

Transportation
Land Development
Environmental Services

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Watertown, Massachusetts 02471
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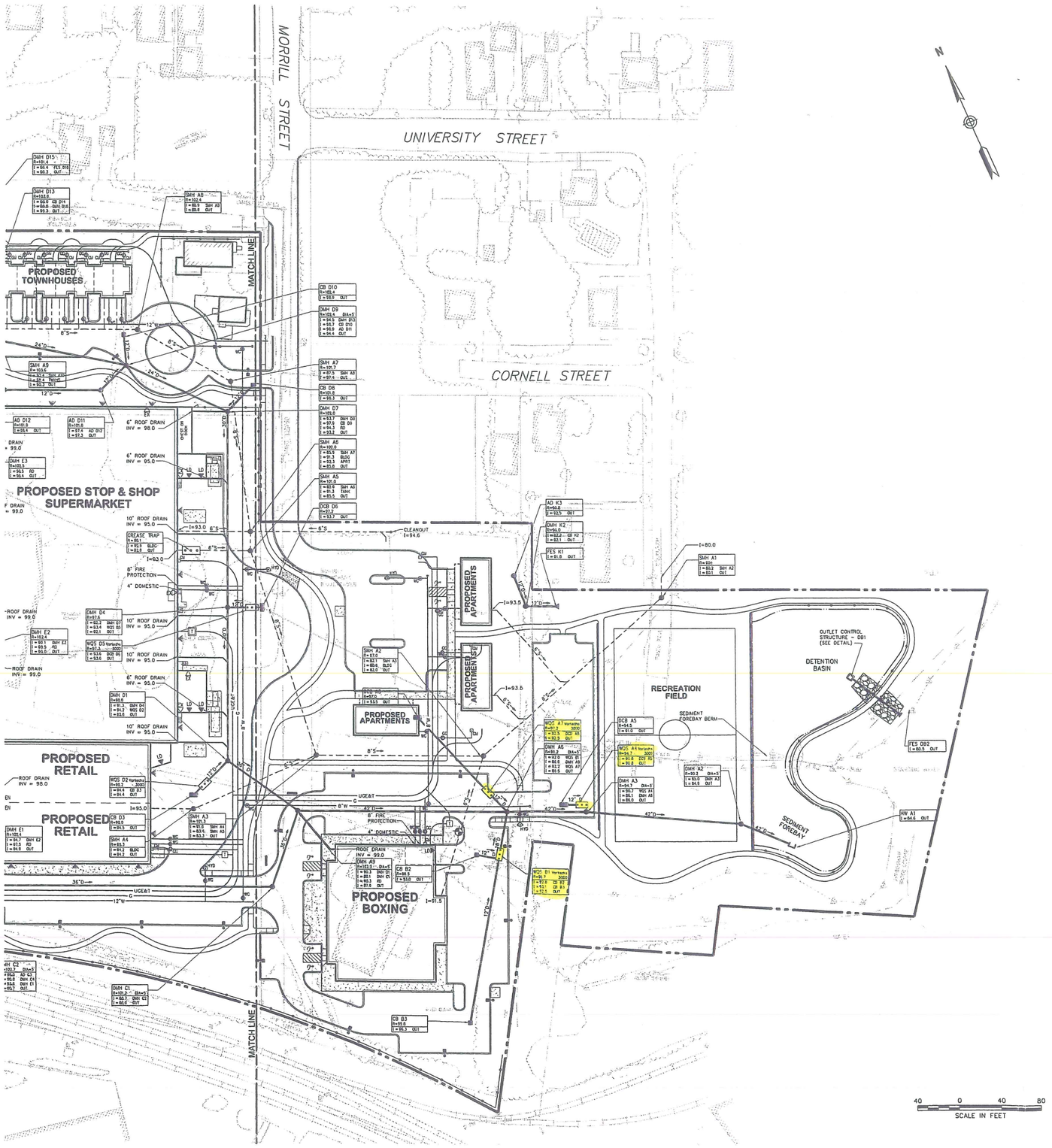
Drawing Title
Utility Plan 1

Drawing Number
C-9

Sheet 9 of 16

Project Number
07334.00

07334-UT.DWG



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SCALE IN FEET

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Drawing Title

Utility Plan 2

Drawing Number
C-10

Sheet 10 of 16

Project Number
07334.00

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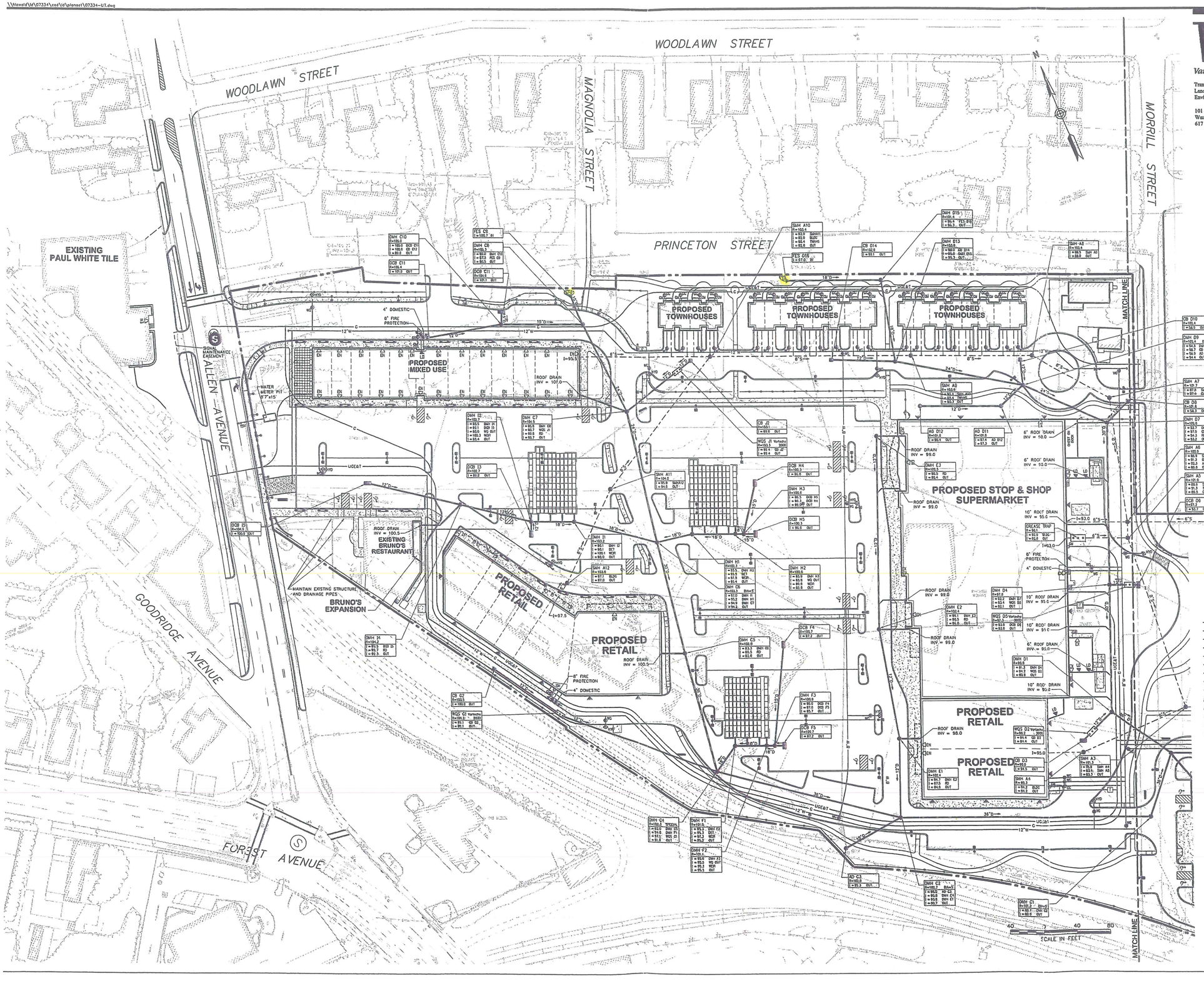

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Sheet 9 of 16

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07334-UT.DWG

499/12

HO.

8" SANITARY SEWER

EDGE OF ROAD

GRAVEL ROAD

2"x4" FENCE

STREET

POLE # 12

90°-00'-00"

89°-58'-16"

GRAVEL ROAD

T.P. P.K. IN POLE # 12
CORNER MORRILL ST. & PRINCETON ST. EL. = 102.87

LOAM & SEED
SEE SECTION 615

LAWN

POLE # 12.1

STA. 2+23
. TYPE "A" M.H.

MIXED WOODS
MEDIUM GROWTH

STA. 4+41.12
... TYPE "A" M.H.

MAGNOLIA STREET

STA. 6+66.87
. TYPE "A" M.H.

MATCH LINE

90°-00'-00"

90°-00'-00"

. 8" SANITARY SEWER

1+0 . 8" SANITARY SEWER 2+0 3+0 . 8" SANITARY SEWER 4+0 5+0 . 8" SANITARY SEWER

60.0'

25.0'

PRINCETON STREET

W.G.

1" W 1" GRAVEL ROAD W 1"

W.G.

FLOWER BED 6'x6'

DRAINAGE

DITCH

GRAVEL ROAD

RIP-RAP EXISTING DRAINAGE DITCH INCIDENTAL TO 603.

STA. 0+00
. TYPE "A" M.H.

MORRILL

EDGE OF ROAD

APPROX. 19°

HO. # 56

LAWN

MIXED WOODS
MEDIUM GROWTH

As Built Nov. 1978

HO. # 46

DEDICATED PRINCETON STREET

INTERSECTION OF MAGNOLIA ST. & PRINCETON ST. (END M.H.)
RIM ELEV = 103.50

STA. 6+66.87
. TYPE "A" M.H.

6'-0" MATCH LINE (THIS SHT.)

L = 29.72'

S = 0.006 ft/ft

8" SANITARY SEWER

INVERT 99.05

INVERT 98.86

EXIST'G. SURFACE ELEV.

HO.

56

EL. 101.0

INVERT 90.75

8" ASB./CEM. CL. 3300 SANITARY SEWER

L = 223'

S = 0.0067

8" CRUSHED STONE GRAVEL

INVERT 90.01

INVERT 92.30

19" ASB./CEM. CL. 3300 SANITARY SEWER

L = 218.12'

S = 0.00826

6" CRUSHED STONE BASE

8" ASB./CEM. CL. 3300 SANITARY SEWER

L = 225.3'

S = 0.006.75

6" CRUSHED STONE BASE

INVERT 93.64

STA. 0+00 TYPE "A" M.H.

STA. 2+23 TYPE "A" M.H.

STA. 4+41.12 TYPE "A" M.H.

5+50

6+00

DATE	REVISIONS

CITY OF PORTLAND, MAINE
DEPARTMENT OF PUBLIC WORKS
PRINCETON ST. SANITARY SEWER
FROM MORRILL ST. TO:
MAGNOLIA STREET

DRAWN W. F.	REFERENCES	SCALE
TRACED	BB. 212 / 40-48	HOR. 1 IN. = 20 FT.
CHECKED W. E. W.		VER. 1 IN. = 4 FT.
DIRECTED W. F. M.		
APPROVED Dec 22 '78	E. M. Goodwin City Engineer	499/12

NOTE BOOK
SEWER
No.

ALIGNMENT CHECKED
ST. OF WAY CHECKED

P.V.B.

4-12-78

199/12

PLATE 5, PLAN-PROFILE
KEUFFEL & ESSER CO

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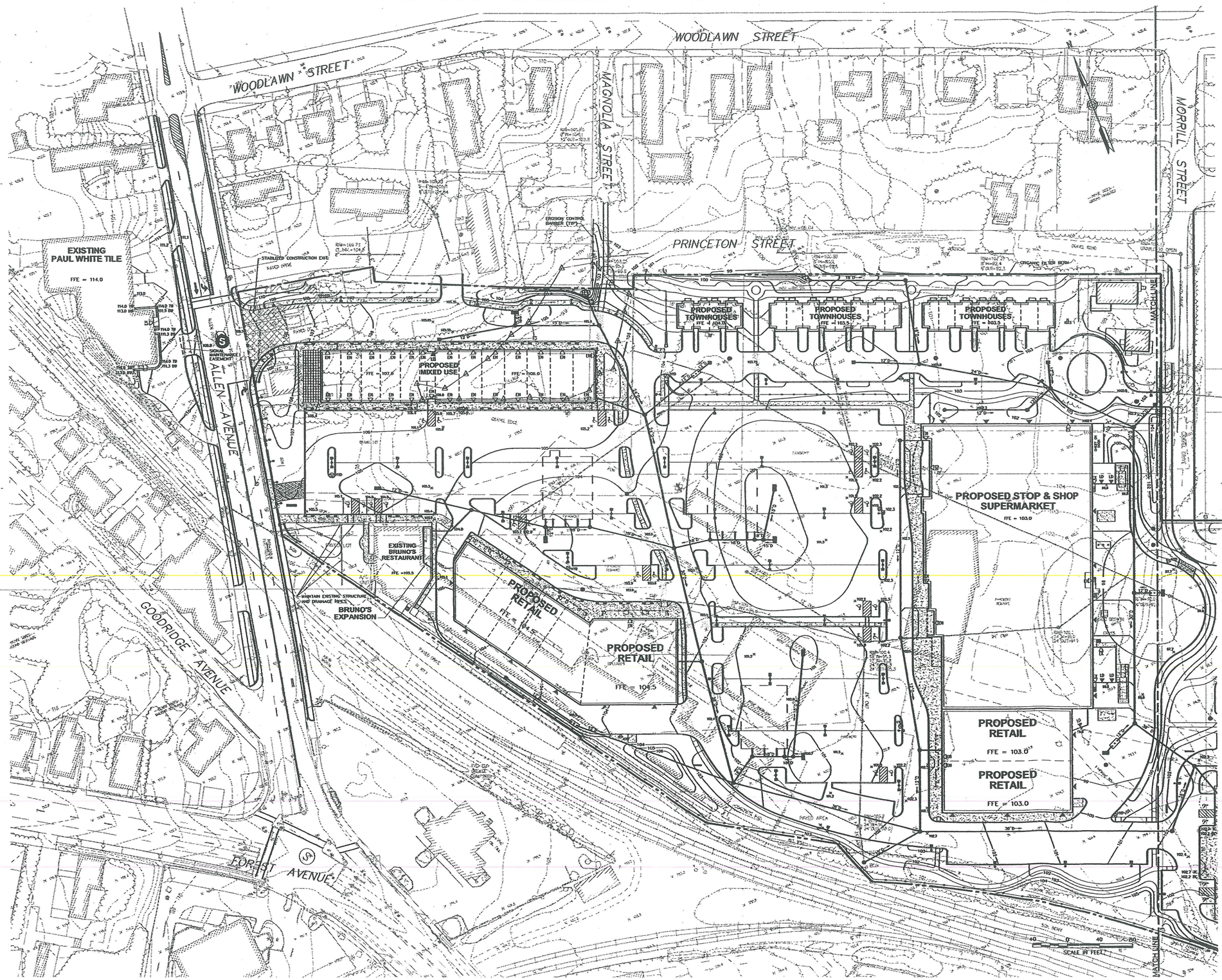

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Transportation
Land Development
Environmental Services
101 Walnut Street, P.O. Box 9151
Watertown, Massachusetts 02471
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No.	Revision	Date	Appvd.

Designed by DHF	Drawn by DHF	Checked by KSS	
CAD checked by BKF	Approved by		
Scale 1" = 40'	Date June 30, 2005		

Project Title
Morrill's Crossing

Allen Avenue
Portland, Maine

Issued for
Site Plan Approval

Not Approved for Construction

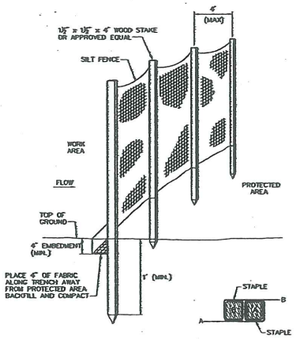
Drawing Title
Erosion Control Plan 1

Drawing Number
C-7

Sheet 7 of 16

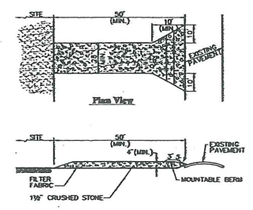
Project Number
07334.00

07334-DI.DWG



Silt Fence Barrier — 6/03

N.T.S. Source: VHB LD_ESP



Notes:

1. ENTRANCE WIDTH SHALL BE A TWENTY-FIVE (25) FOOT MINIMUM, BUT NOT LESS THAN THE FULL WIDTH AT POINTS WHERE INGRESS OR EGRESS OCCURS.
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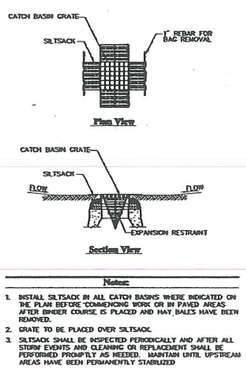
3. STABILIZED CONSTRUCTION EXIT SHALL BE REMOVED PRIOR TO FINAL FINISH MATERIALS BEING INSTALLED.

Stabilized Construction Exit — 6/03

N.T.S. Source: VHB LD_642



Notes:

1. INSTALL SILTSACK IN ALL CATCH BASINS WHERE INDICATED ON THE PLAN BEFORE COMMENCING WORK OR IN PAVED AREAS AFTER BINDER COURSE IS PLACED AND HAY BALES HAVE BEEN REMOVED.
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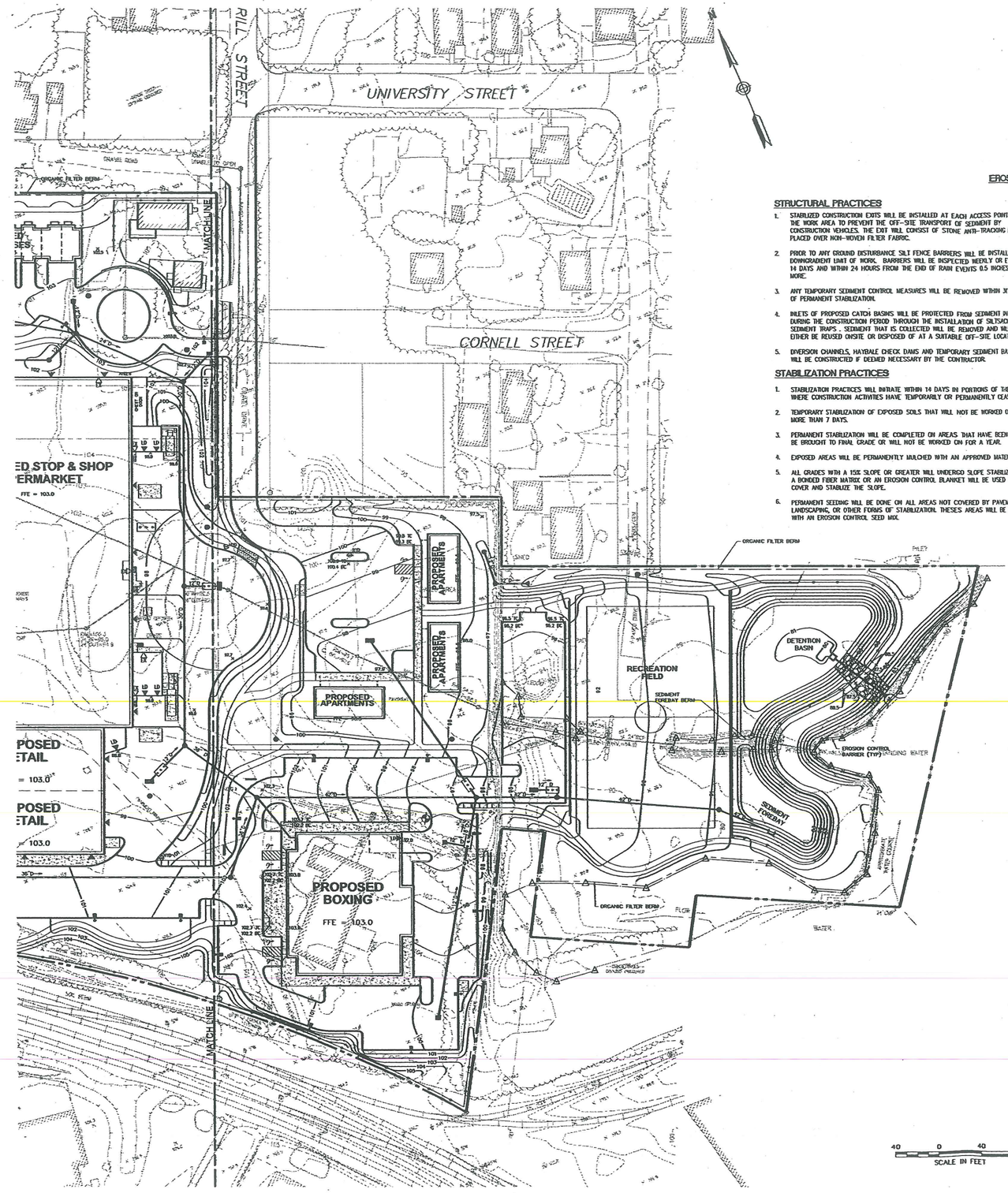
Siltsack Sediment Trap — 6/03

N.T.S. Source: VHB LD_674



40 0 40 80
SCALE IN FEET

EROSION CONTROL NOTES

STRUCTURAL PRACTICES

1. STABILIZED CONSTRUCTION EXITS WILL BE INSTALLED AT EACH ACCESS POINT TO THE WORK AREA TO PREVENT THE OFF-SITE TRANSPORT OF SEDIMENT BY CONSTRUCTION VEHICLES. THE EXIT WILL CONSIST OF STONE ANTI-TRACKING PADS PLACED OVER NON-WOVEN FILTER FABRIC.
2. PRIOR TO ANY GROUND DISTURBANCE SILT FENCE BARRIERS WILL BE INSTALLED DOWNGRADIENT LIMIT OF WORK. BARRIERS WILL BE INSPECTED WEEKLY OR EVERY 14 DAYS AND WITHIN 24 HOURS FROM THE END OF RAIN EVENTS 0.5 INCHES OR MORE.
3. ANY TEMPORARY SEDIMENT CONTROL MEASURES WILL BE REMOVED WITHIN 30 DAYS OF PERMANENT STABILIZATION.
4. INLETS OF PROPOSED CATCH BASINS WILL BE PROTECTED FROM SEDIMENT INFLOW DURING THE CONSTRUCTION PERIOD THROUGH THE INSTALLATION OF SILTSACK SEDIMENT TRAPS . SEDIMENT THAT IS COLLECTED WILL BE REMOVED AND WILL EITHER BE REUSED ONSITE OR DISPOSED OF AT A SUITABLE OFF-SITE LOCATION.
5. DIVERSION CHANNELS, HAYBALE CHECK DAMS AND TEMPORARY SEDIMENT BASINS WILL BE CONSTRUCTED IF DEEMED NECESSARY BY THE CONTRACTOR

STABILIZATION PRACTICES

1. STABILIZATION PRACTICES WILL INITIATE WITHIN 14 DAYS IN PORTIONS OF THE SITE WHERE CONSTRUCTION ACTIVITIES HAVE TEMPORARILY OR PERMANENTLY CEASED.
2. TEMPORARY STABILIZATION OF EXPOSED SOILS THAT WILL NOT BE WORKED ON FOR MORE THAN 7 DAYS.
3. PERMANENT STABILIZATION WILL BE COMPLETED ON AREAS THAT HAVE BEEN EITHER BE BROUGHT TO FINAL GRADE OR WILL NOT BE WORKED ON FOR A YEAR.
4. EXPOSED AREAS WILL BE PERMANENTLY MULCHED WITH AN APPROVED MATERIAL.
5. ALL GRADES WITH A 15% SLOPE OR GREATER WILL UNDERGO SLOPE STABILIZATION. A BONDED FIBER MATRIX OR AN EROSION CONTROL BLANKET WILL BE USED TO COVER AND STABILIZE THE SLOPE.
6. PERMANENT SEEDING WILL BE DONE ON ALL AREAS NOT COVERED BY PAVEMENT, LANDSCAPING, OR OTHER FORMS OF STABILIZATION. THESES AREAS WILL BE SEEDED WITH AN EROSION CONTROL SEED MIX.

WINTER CONSTRUCTION

1. BY NOVEMBER 15 ALL AREAS OF THE SITE NOT STABILIZED WITH PAVEMENT, ROAD GRAVEL BASE, 75% VEGETATION OR RIPRAP SHALL UNDERGO WINTER STABILIZATION PRACTICES.
2. DURING WINTER CONSTRUCTION NO MORE THAN 1 ACRE OF THE SITE WILL BE WITHOUT STABILIZATION AT ANY GIVEN TIME.
3. MULCHING WILL CONSIST OF A COMBINATION OF HAY AND STRAW APPLIED AT A MINIMUM 4 INCH THICKNESS AT A RATE OF 150 LB. PER 1,000 SF. IT WILL BE PLACED ON TOP OF THE SNOW AT THE END OF EACH DAY ALL AREAS OF BROUGHT TO FINAL GRADE WILL BE STABILIZED WITH HAY, STRAW OR EROSION CONTROL MATTING AND WILL BE PROPERLY ANCHORED.
4. ALL AREAS WITHIN 100 FT. OF NATURAL RESOURCES WILL BE STABILIZED BY 75% MATURE VEGETATION OR BE MULCH WITH PROTECTION BY AN EROSION CONTROL COVER. IN ADDITION A DOUBLE ROW OF SEDIMENT BARRIERS WILL BE PLACED BETWEEN THE NATURAL RESOURCE AND DISTURBED AREA.
5. STOCKPILES OF SOIL WILL BE MULCHED WITH HAY OR STRAW AT TWO TIMES THE NORMAL RATE OR WITH A FOUR-INCH LAYER OF EROSION CONTROL MIX. MULCHING WILL OCCUR WITHIN 24 HOURS OF STOCKPILING OR BEFORE A MAJOR RAINFALL/SNOWFALL EVENT. ALL STOCKPILES WILL BE PLACE AT LEAST 100 FT. FROM ANY NATURAL RESOURCES.
6. ANY AREA HAVING A GRADE GREATER THAN 15% IS CONSIDERED A SLOPE. IF NOT STABILIZED BY SEPTEMBER 1ST THEN THE SOIL WITH BE STABILIZED BY TEMPORARY VEGETATION AND EROSION CONTROL MATS OR SOD OR AN EROSION CONTROL MIX OR WITH STONE RIPRAP.
7. MAINTENANCE ON EROSION CONTROL MEASURES WILL BE PREFORMED THROUGHOUT CONSTRUCTION. THE CONTRACTOR WILL BE RESPONSIBLE FOR A VISUAL INSPECTION OF ALL MEASURES AFTER EACH RAINFALL, SNOWFALL OR PERIOD OF THAWING AND RUNOFF TO ENSURE FUCTIONALITY.

OTHER CONTROLS

1. ON DRY AND WINDY DAYS WHEN DUST GENERATION IS A CONCERN, A WATER TRUCK WILL TRAVERSE THE SITE AND SPRAY WATER AS NECESSARY TO PREVENT DUST FROM FORMING.

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No.	Revision	Date	Appvd.

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CAD checked by BKF	Approved by		
Scale 1" = 40'	Date June 30, 2005		

Project Title
Morrill's Crossing

Allen Avenue
Portland, Maine

Issued for
Site Plan Approval

Not Approved for Construction

Drawing Title
Erosion Control Plan 2

Drawing Number
C-8

Sheet 8 of 16

Project Number
07334.00

Operation and Maintenance Plan

Site

Morrill's Crossing
Portland, Maine

Site Developer

Morrills Corner, LLC
c/o Packard Development, LLC
One Wells Avenue
Newton, Massachusetts 02459

Maintenance Supervisor

To be determined upon completion of project.

Operation and Maintenance Plan

This Operation and Maintenance Plan includes details on pavement maintenance, stormwater system maintenance, snow management plan and trash removal. Each of these items is described below.

The site manager shall keep detailed records/documentation of all inspection and maintenance activities performed on the site.

Pavement Maintenance

Sweeping is an effective initial treatment for reducing pollutant loading into stormwater. The parking lots and driveways will be vacuum swept at least once per week. In addition, the parking lot will be inspected on a weekly. Trash and debris will be removed as needed.

Snow Management Plan

Improper snow management can cause erosion in buffer zone or wetland resources, can be a source of contamination, and can impede the performance of the stormwater management system. Snow plowed from paved surfaces at the site will not be stockpiled within the wetlands or the buffer zones. Snow storage shall be on paved areas to allow melt water to be routed through and treated by the stormwater management system. If necessary, excess snow will be removed from the parking lot and disposed of off-site. Deicing compounds will only be used when conditions could result in pedestrian injuries or vehicle damage. Non-toxic substances will be used whenever practicable.

Stormwater Management System

All components of the stormwater management system for the proposed project will be inspected and maintained on a regular basis as described below.

Catch Basins

All catch basins will be inspected at least four times throughout the year. Inspection will focus on excessive sand, sediment and debris buildup. In addition indications of malfunction or structural damage will be checked Maintenance on the catch basins will conducted in the Spring and Fall of every year. Sand, sediment, or debris (when it reaches a depth of more than 6 inches) will be removed. Floating debris and oil will also be removed and disposed of properly.

Water Quality Structures- Vortechs

The water quality structures will be inspected quarterly. The removal of sediments, oil, and debris will be conducted yearly and as outlined by the manufactures guidelines.

Subsurface Detention Facilities- StormTech

The subsurface detention facilities will be inspected quarterly. The removal of sediments, oil, and debris will be conducted yearly and as outlined by the manufactures guidelines.

Stormwater Detention Facilities

A broad inspection of the on site detention facility will be conducted during the fall of every year. The embankment to the detention pond will be inspected for settlement and slope erosion. Internal piping and

downstream swamping also will be inspected. The outlet control structure will be inspected for sediment and debris buildup. The sediment forebay, which is included in the detention facility, will be inspected for excessive sediment and debris buildup. Maintenance on the detention facility will be conducted every Fall. Woody vegetation will be controlled where necessary. Repair on debris guards will be conducted to ensure they are in proper working order. Debris and sediment buildup at the outlet control structure will be removed. Every two to five years or when deemed necessary, excessive sediment and debris will be removed from the sediment forebay.

Culverts

All culverts will be inspected every spring for sediment and debris buildup. Sediment and debris will be removed every Spring and Fall from inside the conduit, the inlet and outlet. Erosion at the inlets and outlets will also be repair.

Stormwater Channels

All open stormwater channels, swales and ditches will be inspected every Spring and Fall. Removal of all obstruction to flow in the channels will be conducted every fall and spring. Repair on ditch lining erosion, slumping slopes and rip rap will be made every Fall if necessary. Mowing and control of vegetated and woody growth will also be conducted.

Vegetated Areas

To prevent increased runoff and erosion vegetated areas on site will be inspected in the spring of every year. Vegetated areas with sparse growth or bare spots will be replanted.

Trash Removal

The on-site buffer zone and resource areas will be inspected for litter and trash on a monthly basis. Any accumulated trash, litter, and discarded materials in this area will be removed and will be disposed of at a suitable location.

No disposal of materials will be permitted within the wetlands or buffer zone on the project site. This prohibition applies to trash, fill material, construction debris, grass clippings, collected leaves and cut branches.

Other Practices and Measures

Other long term inspection and maintenance practices and measures that are deemed necessary by the site engineer and City of Portland can be included in the operation and maintenance plan at a later date.

Reporting and Documentation

The Site Manager will be responsible for maintaining a proper inspection and maintenance log. This log will be available to the City of Portland, upon request.

Morrill's Crossing, Portland, ME
Long-Term Inspection & Maintenance

Driveways and Parking Surfaces

Inspection	Frequency	Date Inspected	Inspector	Comments
Inspect parking lot/ driveway for sediment and debris build up	Weekly			

Maintenance	Frequency	Date of Maintenance	Performed by	Comments
Sweep Pavement to remove sediment	Weekly			
Clear accumulated "winter" sand in parking lots and along driveways	Early Spring of every year or as needed			

Catch Basin Systems

Maintenance	Frequency	Date Inspected	Inspector	Comments
Inspect all catch basins for excessive sand, sediment and debris buildup. Also, inspect for structural damage or indications of malfunction	Quarterly			

Maintenance	Frequency	Date of Maintenance	Performed by	Comments
Remove and legally dispose of accumulated sediments and debris from bottom of the basin, inlet grates, inflow channels to the basin and pipes between basin	Spring and Fall of every year			
Remove floating debris and oils	Spring and Fall of every year			

Stormwater Detention Facilities

Inspection	Frequency	Date Inspected	Inspector	Comments
Inspect the embankment for settlement, slope erosion, internal piping, and downstream swamping	Fall of every year			
Inspect Outlet Control Structure for sediment and debris buildup	Fall of Every Year			
Inspect sediment forebay for excessive sediment and debris buildup	Fall of Every Year			

Maintenance	Frequency	Date of Maintenance	Performed by	Comments
Mow the embankment to control woody vegetation	Fall of Every Year			
Remove and dispose of sediments and debris within the control structure	Fall of Every Year			
Repair any damage to trash racks or debris guards	Fall of Every Year			
Control woody vegetation and replace any dislodged stone in riprap spillway	Fall of Every Year			
Remove and Dispose of accumulated sediments within the impoundment and forebay.	Every 2 -5 Years			

Inspection	Frequency	Date Inspected	Inspector	Comments
Inspect culverts for sediment and debris buildup	Spring every year			

Maintenance	Frequency	Date of Maintenance	Performed by	Comments
Remove accumulated sediment and debris at the outlet, and within the conduit	Spring, Fall of every year			
Repair any erosion damage at the culvert's inlet and outlet	Spring, Fall of every year			

Stormwater Channels

Inspection	Frequency	Date Inspected	Inspector	Comments
Inspect ditches, swales and other open stormwater channels	Spring and Fall of every Year			

Maintenance	Frequency	Date of Maintenance	Performed by	Comments
Remove any obstructions and accumulated sediments or debris	Spring and Fall of every Year			
Control vegetated growth and woody vegetation	Fall of every year			
Repair any erosion of the ditch lining	Fall of every year			
Mow vegetated ditches	Fall of every year			
Repair any slumping side slopes	Fall of every year			
Replace riprap where underlying filter fabric, gravel, or stone is dislodged	Fall of every year			

Vegetated Areas

Inspection	Frequency	Date Inspected	Inspector	Comments
Inspect all Slopes and Embankments	Spring of every Year			

Maintenance	Frequency	Date of Maintenance	Performed by	Comments
Replant Bare Areas or Areas with Sparse Growth	Spring of every Year			

Other Practices and Measures

Maintenance	Frequency	Date	Performed by	Comments

Water Quality Structures*

Inspection	Frequency	Date Inspected	Inspector	Comments
Inspect all water quality structures (StormTech and Vortechs) for excessive sediment/debris buildup. Also, inspect for structural damage or indication of malfunction	Quarterly			

Maintenance	Frequency	Date of Maintenance	Performed by	Comments
Removal of sediments, oil and debris from water quality structures	Yearly and as outlined by manufacturing guidelines			

*refer to insert of manufacturing guidelines

Subsurface Detention Facilities*

Inspection	Frequency	Date Inspected	Inspector	Comments
Inspection of subsurface detention (Isolator Row)	Quarterly			

Maintenance	Frequency	Date of Maintenance	Performed by	Comments
Removal and disposal of accumulated sediments and debris (Isolator Row)	Yearly			

*refer to insert of manufacturing guidelines

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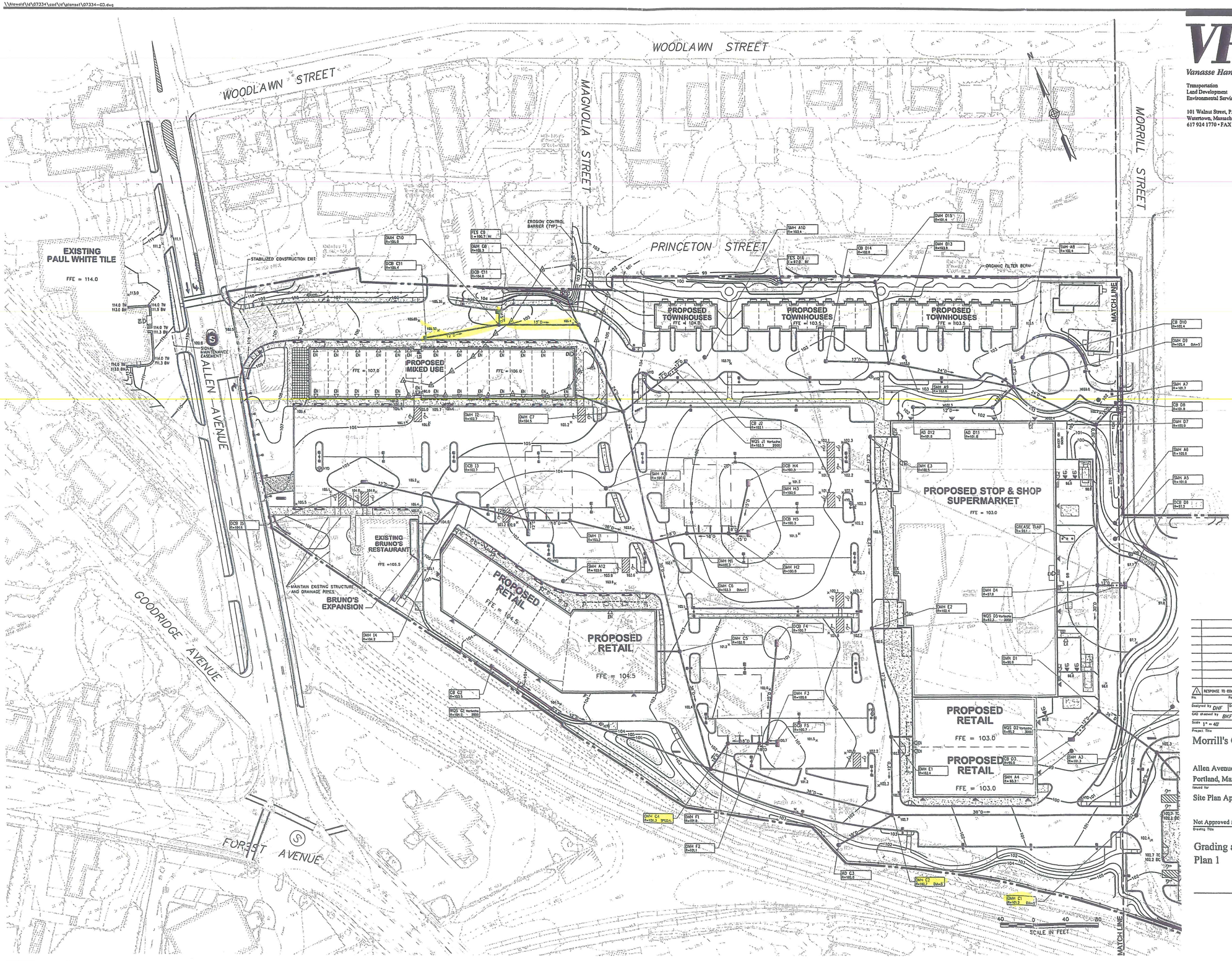

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No.	Revision	Date	Appvd.
1	RESPONSE TO COMMENTS	2/17/06	

Designed by DHF | Drawn by DHF | Checked by KSS
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Scale 1" = 40' | Date June 30, 2005

Project Title
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Allen Avenue
Portland, Maine

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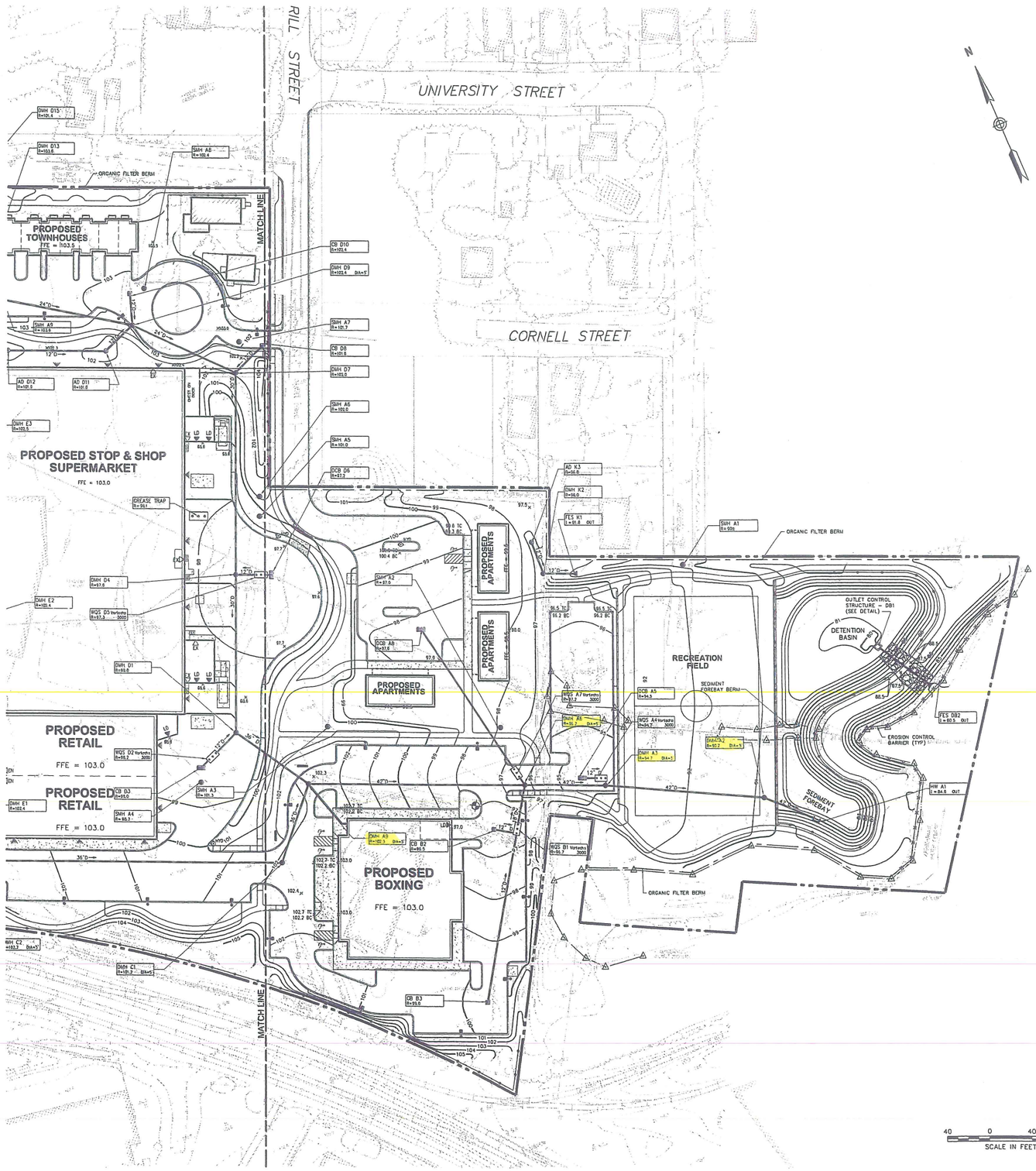
Drawing Title
Grading and Drainage Plan 1

Drawing Number
C-5

Sheet 5 of 16

Project Number
07334.00

07334-C3.DWG



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Project Title
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Allen Avenue
Portland, Maine

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Drawing Title
Grading and Drainage Plan 2

Drawing Number
C-6

Sheet 6 of 16

Project Number
07334.00

07334-GD.DWG

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WOODLAWN STREET
MAGNOLIA STREET
PRINCETON STREET
MORRILL STREET
ALLEN AVENUE
GOODRIDGE AVENUE
FOREST AVENUE
EXISTING PAUL WHITE TILE
SIGNAL MAINTENANCE EASEMENT
PROPOSED TOWNHOUSES
PROPOSED MIXED USE
PROPOSED STOP & SHOP SUPERMARKET
PROPOSED RETAIL
EXISTING BRUNO'S RESTAURANT
BRUNO'S EXPANSION
MAINTAIN EXISTING STRUCTURE AND DRAINAGE PIPES
WATER METER PIT 6'3"x15'
4" DOMESTIC
8" FIRE PROTECTION
ROOF DRAIN INV = 107.0
ROOF DRAIN INV = 100.5
ROOF DRAIN INV = 99.0
ROOF DRAIN INV = 98.0
6" ROOF DRAIN INV = 38.0
6" ROOF DRAIN INV = 33.0
10" ROOF DRAIN INV = 35.0
10" ROOF DRAIN INV = 95.0
GREASE TRAP
MATCH LINE
SCALE IN FEET
0 40 80

1	RESPONSE TO COMMENTS	2/17/06
No.	Revision	Date Appvd

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Project Title
Morrill's Crossing

Allen Avenue
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Drawing Title
Utility Plan 1

Drawing Number
C-9

Sheet 9 of 16

Project Number
07334.00

07334-UT.DWG

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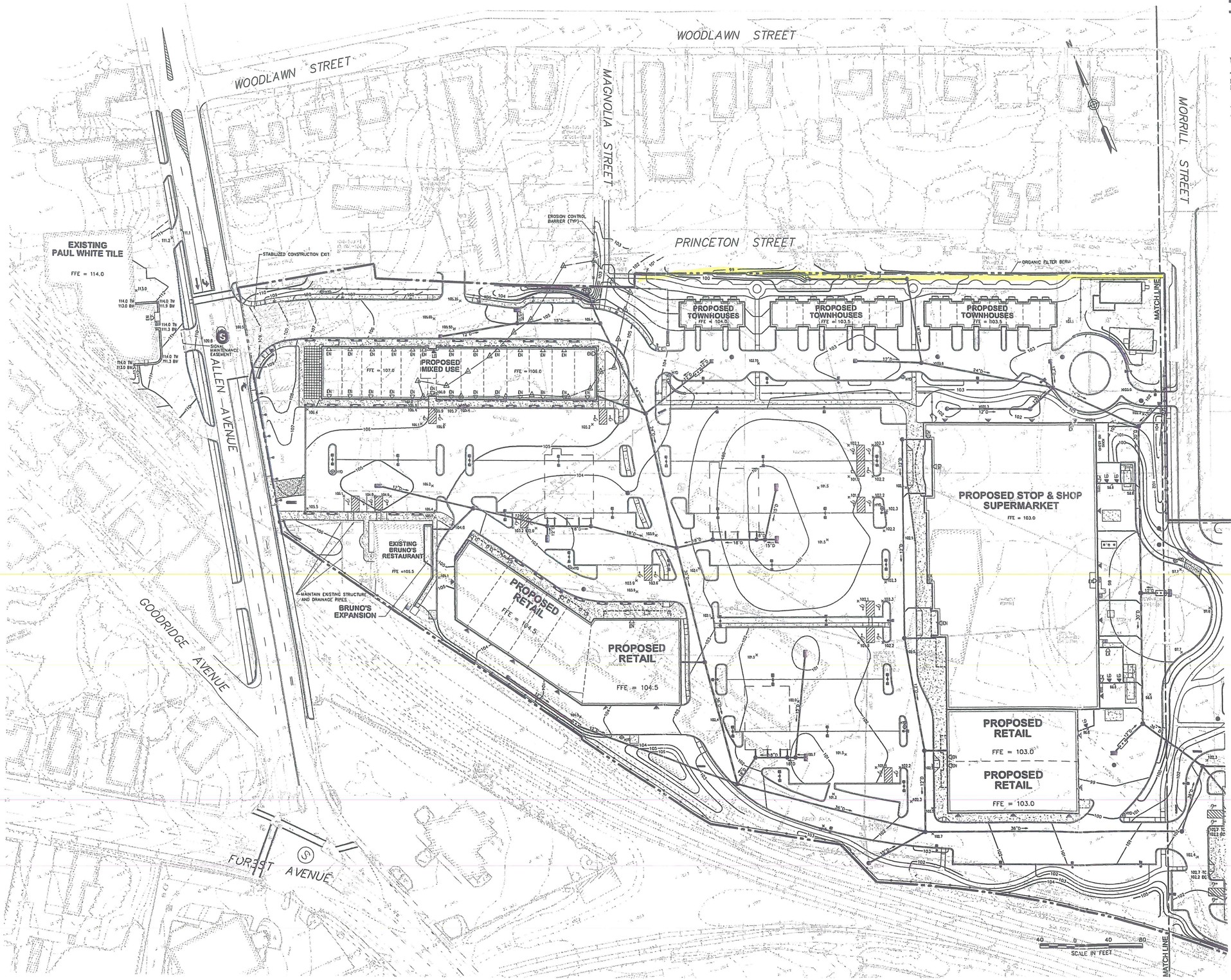

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Erosion Control Plan 1

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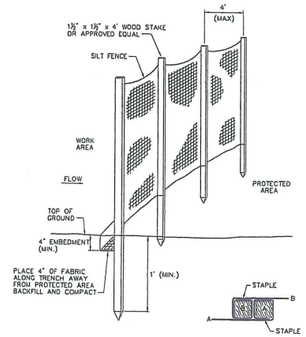
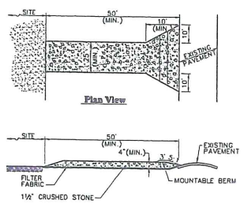


Wood Stake Joint Detail

Silt Fence Barrier

N.T.S. Source: VHB 6/03 LD_650



Plan View

Cross-section

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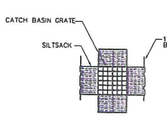
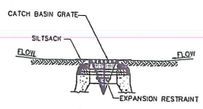
3. STABILIZED CONSTRUCTION EXIT SHALL BE REMOVED PRIOR TO FINAL FINISH MATERIALS BEING INSTALLED.

Stabilized Construction Exit

N.T.S. Source: VHB 6/03 LD_682



Plan View



Section View

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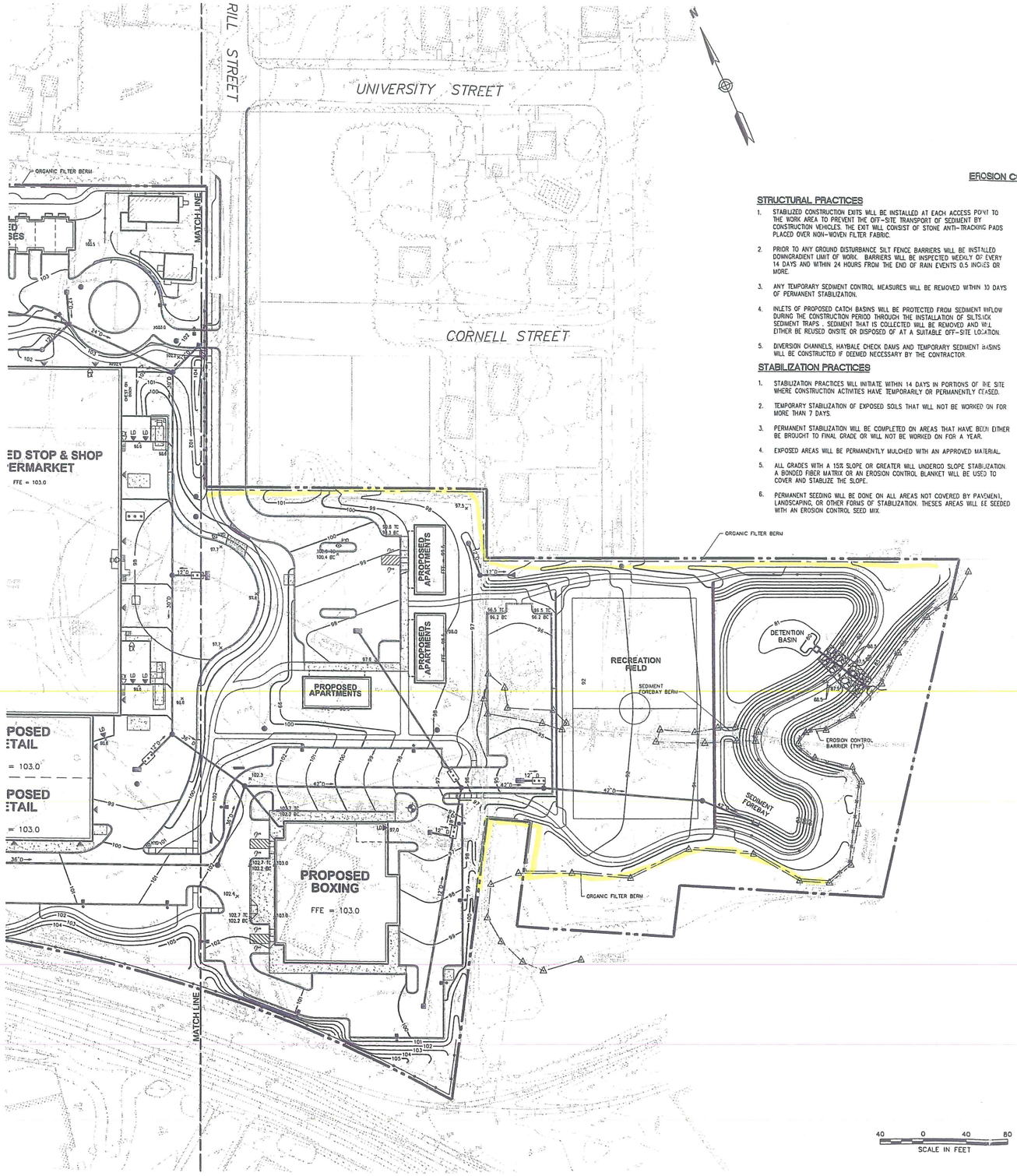
Siltsack Sediment Trap

N.T.S. Source: VHB 6/03 LD_674



EROSION CONTROL NOTES

STRUCTURAL PRACTICES

1. STABILIZED CONSTRUCTION EXITS WILL BE INSTALLED AT EACH ACCESS POINT TO THE WORK AREA TO PREVENT THE OFF-SITE TRANSPORT OF SEDIMENT BY CONSTRUCTION VEHICLES. THE EXIT WILL CONSIST OF STONE ANTI-TRACKING PADS PLACED OVER NON-WOVEN FILTER FABRIC.
2. PRIOR TO ANY GROUND DISTURBANCE SILT FENCE BARRIERS WILL BE INSTALLED DOWNGRADIENT LIMIT OF WORK. BARRIERS WILL BE INSPECTED WEEKLY OR EVERY 14 DAYS AND WITHIN 24 HOURS FROM THE END OF RAIN EVENTS 0.5 INCHES OR MORE.
3. ANY TEMPORARY SEDIMENT CONTROL MEASURES WILL BE REMOVED WITHIN 30 DAYS OF PERMANENT STABILIZATION.
4. INLETS OF PROPOSED CATCH BASINS WILL BE PROTECTED FROM SEDIMENT INFLOW DURING THE CONSTRUCTION PERIOD THROUGH THE INSTALLATION OF SILTSACK SEDIMENT TRAPS. SEDIMENT THAT IS COLLECTED WILL BE REMOVED AND WILL EITHER BE REUSED ONSITE OR DISPOSED OF AT A SUITABLE OFF-SITE LOCATION.
5. DIVERSION CHANNELS, HAYBALE CHECK DAMS AND TEMPORARY SEDIMENT BASINS WILL BE CONSTRUCTED IF DEEMED NECESSARY BY THE CONTRACTOR.

STABILIZATION PRACTICES

1. STABILIZATION PRACTICES WILL INITIATE WITHIN 14 DAYS IN PORTIONS OF THE SITE WHERE CONSTRUCTION ACTIVITIES HAVE TEMPORARILY OR PERMANENTLY CEASED.
2. TEMPORARY STABILIZATION OF EXPOSED SOILS THAT WILL NOT BE WORKED ON FOR MORE THAN 7 DAYS.
3. PERMANENT STABILIZATION WILL BE COMPLETED ON AREAS THAT HAVE BEEN EITHER BE BROUGHT TO FINAL GRADE OR WILL NOT BE WORKED ON FOR A YEAR.
4. EXPOSED AREAS WILL BE PERMANENTLY MULCHED WITH AN APPROVED MATERIAL.
5. ALL GRADES WITH A 15% SLOPE OR GREATER WILL UNDERGO SLOPE STABILIZATION. A BONDED FIBER MATRIX OR AN EROSION CONTROL BLANKET WILL BE USED TO COVER AND STABILIZE THE SLOPE.
6. PERMANENT SEEDING WILL BE DONE ON ALL AREAS NOT COVERED BY PAVEMENT, LANDSCAPING, OR OTHER FORMS OF STABILIZATION. THESES AREAS WILL BE SEEDED WITH AN EROSION CONTROL SEED MIX.

WINTER CONSTRUCTION

1. BY NOVEMBER 15 ALL AREAS OF THE SITE NOT STABILIZED WITH PAVEMENT, ROAD GRAVEL BASE, 75% VEGETATION OR RIPRAP SHALL UNDERGO WINTER STABILIZATION PRACTICES.
2. DURING WINTER CONSTRUCTION NO MORE THAN 1 ACRE OF THE SITE WILL BE WITHOUT STABILIZATION AT ANY GIVEN TIME.
3. MULCHING WILL CONSIST OF A COMBINATION OF HAY AND STRAW APPLIED AT A MINIMUM 4 INCH THICKNESS AT A RATE OF 150 LB. PER 1,000 SF. IT WILL BE PLACED ON TOP OF THE SNOW. AT THE END OF EACH DAY ALL AREAS OF BROUGHT TO FINAL GRADE WILL BE STABILIZED WITH HAY, STRAW OR EROSION CONTROL MATTING AND WILL BE PROPERLY ANCHORED.
4. ALL AREAS WITHIN 100 FT. OF NATURAL RESOURCES WILL BE STABILIZED BY 75% NATURE VEGETATION OR BE MULCH WITH PROTECTION BY AN EROSION CONTROL COVER. IN ADDITION A DOUBLE ROW OF SEDIMENT BARRIERS WILL BE PLACED BETWEEN THE NATURAL RESOURCE AND DISTURBED AREA.
5. STOCKPILES OF SOIL WILL BE MULCHED WITH HAY OR STRAW AT TWO TIMES THE NORMAL RATE OR WITH A FOUR-INCH LAYER OF EROSION CONTROL MIX. MULCHING WILL OCCUR WITHIN 24 HOURS OF STOCKPILING OR BEFORE A MAJOR RAINFALL/SNOWFALL EVENT. ALL STOCKPILES WILL BE PLACE AT LEAST 100 FT. FROM ANY NATURAL RESOURCES.
6. ANY AREA HAVING A GRADE GREATER THAN 15% IS CONSIDERED A SLOPE. IF NOT STABILIZED BY SEPTEMBER 1ST THEN THE SOIL WITH BE STABILIZED BY TEMPORARY VEGETATION AND EROSION CONTROL MATS OR SOD OR AN EROSION CONTROL MIX OR WITH STONE RIPRAP.
7. MAINTENANCE ON EROSION CONTROL MEASURES WILL BE PREFORMED THROUGHOUT CONSTRUCTION. THE CONTRACTOR WILL BE RESPONSIBLE FOR A VISUAL INSPECTION OF ALL MEASURES AFTER EACH RAINFALL, SNOWFALL OR PERIOD OF THAWING AND RUNOFF TO ENSURE FUCTIONALITY.

OTHER CONTROLS

1. ON DRY AND WINDY DAYS WHEN DUST GENERATION IS A CONCERN, A WATER TRUCK WILL TRAVERSE THE SITE AND SPRAY WATER AS NECESSARY TO PREVENT DUST FROM FORMING.

VHB
Vanasse Hangen Brustlin, Inc.
Transportation
Land Development
Environmental Services
101 Walnut Street, P.O. Box 9151
Watertown, Massachusetts 02471
617 924 1770 • FAX 617 924 2286

No.	Revision	Date	Appvd

Designed by KSS | Drawn by BKF | Checked by KSS
CAD checked by BKF | Approved by
Scale 1" = 40' | Date June 30, 2005

Project Title
Morrill's Crossing

Allen Avenue
Portland, Maine

Issued for
Site Plan Approval

Not Approved for Construction

Drawing Title
Erosion Control Plan 2

Drawing Number
C-8

Sheet 8 of 16

Project Number
07334.00

07334-ER.DWG

Attachment O

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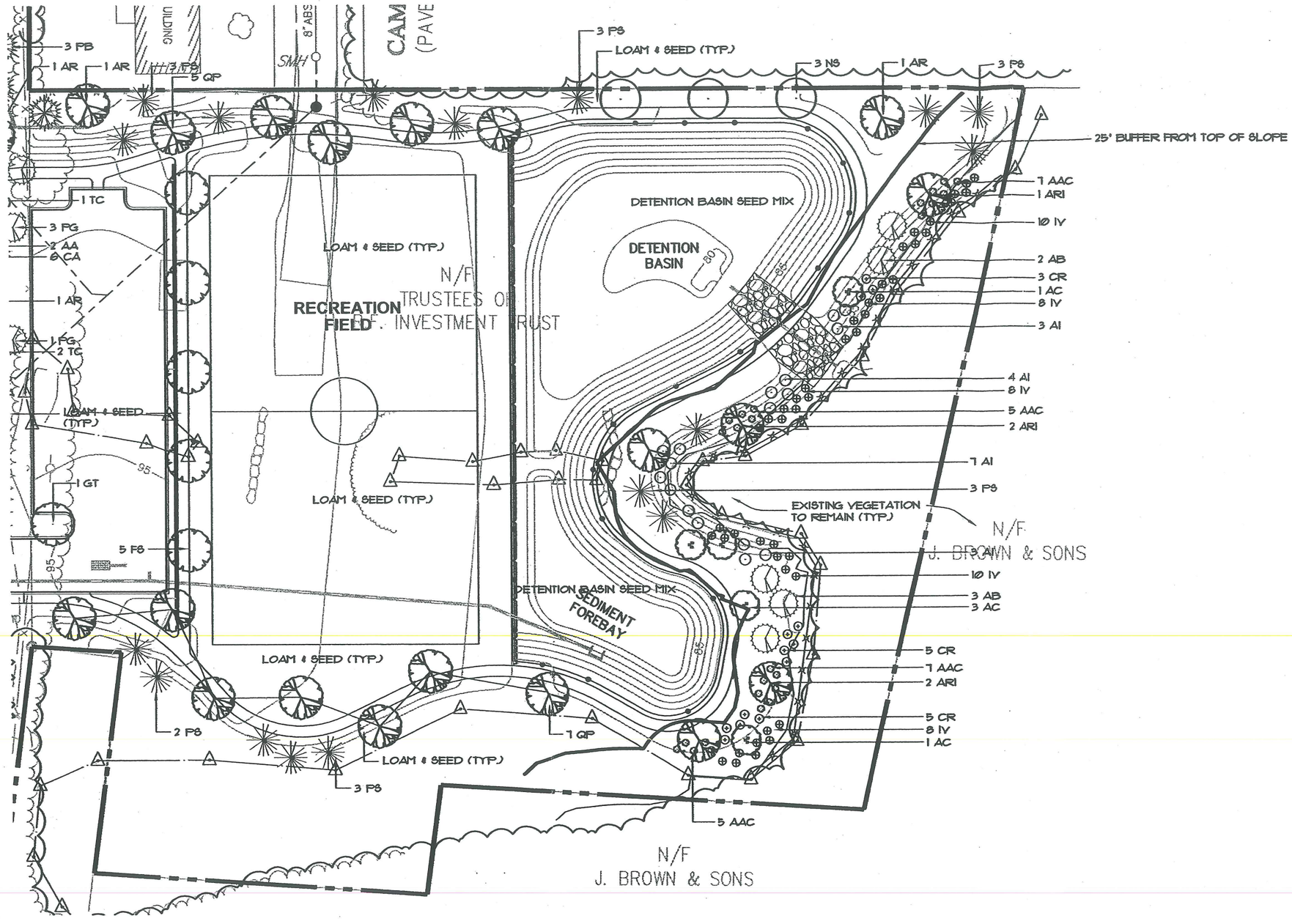

0 25 50 Feet

Vanasse Hangen Brustlin, Inc.

MILLIKEN BROOK
LANDSCAPED BUFFER PLAN
MORRILL'S CROSSING
PORTLAND, ME

Fenstermacher, Dave

From: Rico Spugnardi [RSpugnardi@pwd.org]
Sent: Monday, December 12, 2005 11:44 AM
To: Fenstermacher, Dave
Subject: RE: Portland, ME - Morrill's Crossing

Hi Dave,
We just looked at your proposed water main design and have the following comments:

1. A Fireline Meter with a meter pit located on private property will be required for this project at the connection to Allen Avenue. This will allow for metering of domestic water use for the site while still being able to handle the flows needed for fire protection for the site. There is a substantial cost increase for these meters from 12" to 8", so perhaps it makes sense for your mechanical engineer to investigate whether an 8" water main is sufficient for this site.

2. Because there will be a meter, the connection to the main in Morrill Street isn't desirable. With pressure/elevation not being an issue and adequate volume of water from the 20" main in Allen Avenue, we don't believe that looping into the 6" main in Morrill Street will add any significant benefit to the water main design. You should have your mechanical engineer confirm this as well.

3. All water mains, services, and hydrants located beyond the meter pit will be private and will be the responsibility of the owner of the project after construction.

Once you have incorporated these changes into your design, please submit a hard copy of the plans to us so that we can review the final design. If you have any questions or comments, please feel free to give me a call. We are also available to meet with you at any time to discuss the project at your convenience.

Thanks,
Rico Spugnardi
Design Engineer

Portland Water District
225 Douglass Street
P.O. Box 3553
Portland, Maine 04104-3553
(207) 774-5961 x3199 (v)
(207) 761-8307 (f)
rspugnardi@pwd.org
www.pwd.org

-----Original Message-----
From: Fenstermacher, Dave [mailto:DHFenstermacher@VHB.com]
Sent: Monday, December 12, 2005 10:35 AM
To: Rico Spugnardi
Subject: Portland, ME - Morrill's Crossing

Rico,
Attached is a PDF of our proposed water line layout for the Morrill's Crossing project. I've highlighted the water line in blue. Below is the comment from our peer reviewer. Could you take a look at the layout to respond to the peer reviewer comment below, and also review the plan yourself and see if there are any additional comments that you would like to make?

1. The Portland Water District may require the installation of a Fire Line Supply meter and meter pit into the development since there will be multiple services for both domestic and Fire supply. Will a meter be required for the Morrill Street connection? The Final Plans should include these measures as required by the District.

Thanks,
Dave

David Fenstermacher, PE
VHB
Vanasse Hangen Brustlin, Inc.
101 Walnut Street
Post Office Box 9151
Watertown, MA 02472
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WOODLAWN STREET
MAGNOLIA STREET
PRINCETON STREET
MORRILL STREET
ALLEN AVENUE
GOODRIDGE AVENUE
FOREST AVENUE
MATCH LINE
EXISTING PAUL WHITE TILE
SIGNAL MAINTENANCE EASEMENT
PROPOSED MIXED USE
PROPOSED TOWNHOUSES
PROPOSED STOP & SHOP SUPERMARKET
PROPOSED RETAIL
EXISTING BRUNO'S RESTAURANT
BRUNO'S EXPANSION
MAINTAIN EXISTING STRUCTURE AND DRAINAGE PIPES
WATER METER PIT 5'7"x15'
4" DOMESTIC
8" FIRE PROTECTION
ROOF DRAIN INV = 100.0
ROOF DRAIN INV = 100.5
ROOF DRAIN INV = 99.0
ROOF DRAIN INV = 98.0
6" ROOF DRAIN INV = 98.0
6" ROOF DRAIN INV = 95.0
10" ROOF DRAIN INV = 95.0
10" ROOF DRAIN INV = 93.0
GREASE TRAP
SCALE IN FEET

No.	Revision	Date
1	RESPONSE TO COMMENTS	2/17/06

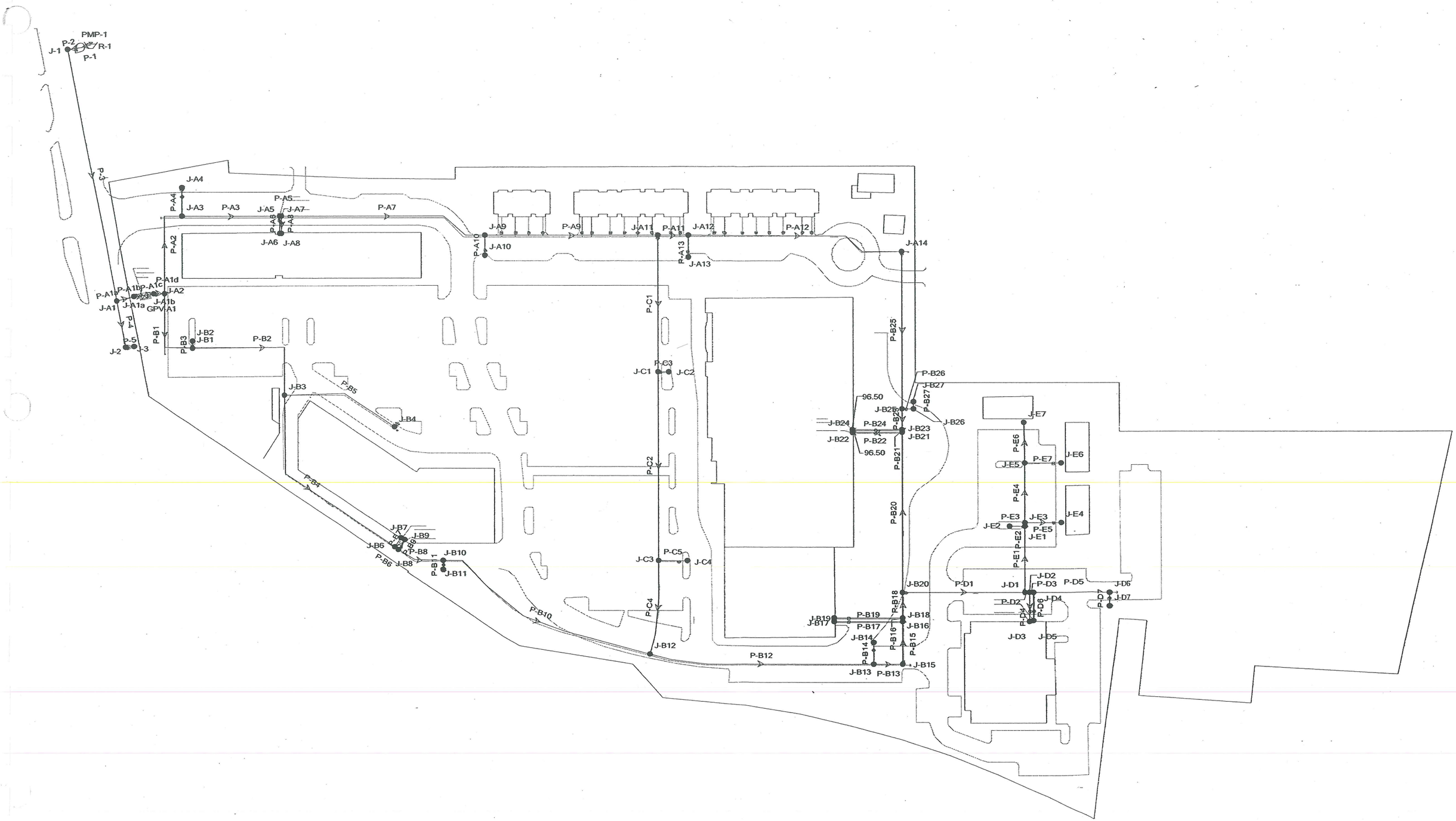
Designed by DHF | Drawn by DHF | Checked by KSS
CAD checked by BKF | Approved by
Scale 1" = 40' | Date June 30, 2005

Project Title
Morrill's Crossing
Allen Avenue
Portland, Maine
Issued for
Site Plan Approval
Not Approved for Construction
Drawing Title
Utility Plan 1

Drawing Number
C-9
Sheet 9 of 16
Project Number
07334.00

07334-UT.DWG

Scenario: Base



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Fire Flow Analysis
Fire Flow Report

Label	Zone	Fire Flow Iterations	Fire Flow Balanced?	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Needed (gpm)	Total Flow Available (gpm)	Residual Pressure (psi)	Calculated Residual Pressure (psi)	Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction	Minimum System Pressure (psi)	Calculated Minimum System Pressure (psi)	Minimum System Junction
J-A2	Zone	3	true	true	1,500.00	3,000.00	1,500.00	3,000.00	60.00	61.36	20.00	57.99	J-A4	N/A	-0.22	PMP-1
J-A3	Zone	3	true	true	1,500.00	3,000.00	1,500.00	3,000.00	60.00	61.12	20.00	57.27	J-A4	N/A	-0.22	PMP-1
J-A4	Zone	3	true	true	500.00	1,500.00	500.00	1,500.00	60.00	64.29	20.00	66.29	J-1	N/A	-0.22	PMP-1
J-B1	Zone	3	true	true	1,500.00	3,000.00	1,500.00	3,000.00	60.00	61.59	20.00	57.95	J-A4	N/A	-0.22	PMP-1
J-B2	Zone	2	true	true	500.00	1,500.00	500.00	1,500.00	60.00	66.70	20.00	66.29	J-1	N/A	-0.22	PMP-1
J-B3	Zone	3	true	true	1,500.00	3,000.00	1,500.00	3,000.00	60.00	60.88	20.00	57.91	J-A4	N/A	-0.22	PMP-1
J-B4	Zone	4	true	true	500.00	1,411.37	500.00	1,411.37	60.00	60.00	20.00	66.50	J-1	N/A	-0.22	PMP-1
J-B6	Zone	3	true	true	1,500.00	3,000.00	1,500.00	3,000.00	60.00	60.64	20.00	57.23	J-B11	N/A	-0.22	PMP-1
J-B7	Zone	16	true	true	1,500.00	2,640.48	1,500.00	2,640.48	60.00	60.00	20.00	60.23	J-B11	N/A	-0.22	PMP-1
J-B8	Zone	3	true	true	1,500.00	3,000.00	1,500.00	3,000.00	60.00	60.58	20.00	57.21	J-B11	N/A	-0.22	PMP-1
J-B9	Zone	3	true	true	500.00	1,500.00	520.00	1,520.00	60.00	61.40	20.00	66.29	J-1	N/A	-0.22	PMP-1
J-B10	Zone	3	true	true	1,500.00	3,000.00	1,500.00	3,000.00	60.00	60.74	20.00	57.01	J-B11	N/A	-0.22	PMP-1
J-B11	Zone	2	true	true	500.00	1,500.00	500.00	1,500.00	60.00	66.72	20.00	66.29	J-1	N/A	-0.22	PMP-1
J-B12	Zone	3	true	true	1,500.00	3,000.00	1,500.00	3,000.00	60.00	60.95	20.00	57.42	J-B11	N/A	-0.22	PMP-1
J-C3	Zone	16	true	true	1,500.00	2,860.08	1,500.00	2,860.08	60.00	60.01	20.00	56.37	J-C4	N/A	-0.22	PMP-1
J-C1	Zone	16	true	true	1,500.00	2,819.15	1,500.00	2,819.15	60.00	60.00	20.00	56.33	J-C2	N/A	-0.22	PMP-1
J-A11	Zone	2	true	true	1,500.00	3,000.00	1,500.00	3,000.00	60.00	102.45	20.00	57.07	J-A13	N/A	-0.22	PMP-1
J-A9	Zone	3	true	true	1,500.00	3,000.00	1,500.00	3,000.00	60.00	60.94	20.00	57.09	J-A10	N/A	-0.22	PMP-1
J-A10	Zone	2	true	true	500.00	1,500.00	500.00	1,500.00	60.00	65.83	20.00	66.29	J-1	N/A	-0.22	PMP-1
J-A5	Zone	5	true	true	1,500.00	2,765.29	1,500.00	2,765.29	60.00	60.00	20.00	59.13	J-A4	N/A	-0.22	PMP-1
J-A7	Zone	5	true	true	1,500.00	2,752.86	1,500.00	2,752.86	60.00	60.00	20.00	59.22	J-A4	N/A	-0.22	PMP-1
J-A12	Zone	3	true	true	1,500.00	3,000.00	1,500.00	3,000.00	60.00	60.64	20.00	56.88	J-A13	N/A	-0.22	PMP-1
J-A13	Zone	2	true	true	500.00	1,500.00	500.00	1,500.00	60.00	65.93	20.00	66.29	J-1	N/A	-0.22	PMP-1
J-B25	Zone	16	true	true	1,500.00	2,760.20	1,500.00	2,760.20	60.00	60.01	20.00	55.25	J-B22	N/A	-0.22	PMP-1
J-B26	Zone	4	true	true	1,500.00	2,389.66	1,500.00	2,389.66	60.00	60.00	20.00	59.33	J-B22	N/A	-0.22	PMP-1
J-C2	Zone	2	true	true	500.00	1,500.00	500.00	1,500.00	60.00	66.29	20.00	66.29	J-1	N/A	-0.22	PMP-1
J-C4	Zone	3	true	true	500.00	1,500.00	500.00	1,500.00	60.00	65.13	20.00	66.29	J-1	N/A	-0.22	PMP-1
J-B13	Zone	3	true	true	1,500.00	3,000.00	1,500.00	3,000.00	60.00	60.19	20.00	56.73	J-B14	N/A	-0.22	PMP-1
J-B14	Zone	2	true	true	500.00	1,500.00	500.00	1,500.00	60.00	66.75	20.00	66.29	J-1	N/A	-0.22	PMP-1
J-B16	Zone	16	true	true	1,500.00	2,867.24	1,500.00	2,867.24	60.00	60.01	20.00	57.10	J-B22	N/A	-0.22	PMP-1
J-B18	Zone	16	true	true	1,500.00	2,858.32	1,500.00	2,858.32	60.00	60.01	20.00	57.10	J-B22	N/A	-0.22	PMP-1
J-B20	Zone	4	true	true	1,500.00	2,981.24	1,500.00	2,981.24	60.00	60.00	20.00	55.80	J-B22	N/A	-0.22	PMP-1
J-B21	Zone	16	true	true	1,500.00	2,768.48	1,500.00	2,768.48	60.00	60.01	20.00	54.81	J-B22	N/A	-0.22	PMP-1
J-B23	Zone	16	true	true	1,500.00	2,767.24	1,500.00	2,767.24	60.00	60.01	20.00	54.87	J-B22	N/A	-0.22	PMP-1
J-B22	Zone	3	true	true	500.00	820.62	584.00	904.62	60.00	60.01	20.00	67.79	J-1	N/A	-0.22	PMP-1
J-B24	Zone	4	true	true	1,500.00	2,125.38	1,500.00	2,125.38	60.00	60.00	20.00	61.74	J-B22	N/A	-0.22	PMP-1
J-B17	Zone	4	true	true	500.00	858.79	500.00	858.79	60.00	60.00	20.00	67.71	J-1	N/A	-0.22	PMP-1
J-B19	Zone	15	true	true	1,500.00	2,434.59	1,500.00	2,434.59	60.00	60.01	20.00	61.08	J-B22	N/A	-0.22	PMP-1
J-D1	Zone	4	true	true	1,500.00	2,347.88	1,500.00	2,347.88	60.00	60.00	20.00	57.14	J-E2	N/A	-0.22	PMP-1
J-E1	Zone	4	true	true	1,500.00	2,180.60	1,500.00	2,180.60	60.00	60.00	20.00	56.32	J-E2	N/A	-0.22	PMP-1
J-E2	Zone	3	true	true	500.00	1,500.00	500.00	1,500.00	60.00	63.88	20.00	66.29	J-1	N/A	-0.22	PMP-1
J-E5	Zone	4	true	true	1,500.00	1,983.99	1,500.00	1,983.99	60.00	60.00	20.00	58.65	J-E7	N/A	-0.22	PMP-1
J-E7	Zone	4	true	true	500.00	1,292.51	520.00	1,312.51	50.00	50.00	20.00	66.78	J-1	N/A	-0.22	PMP-1
J-E6	Zone	2	true	true	500.00	1,000.00	500.00	1,000.00	50.00	62.53	20.00	67.43	J-1	N/A	-0.22	PMP-1
J-E4	Zone	4	true	true	500.00	1,427.00	520.00	1,447.00	50.00	50.00	20.00	65.87	J-E2	N/A	-0.22	PMP-1
J-E3	Zone	4	true	true	1,500.00	2,170.21	1,500.00	2,170.21	60.00	60.00	20.00	56.47	J-E2	N/A	-0.22	PMP-1
J-D2	Zone	4	true	true	1,500.00	2,339.44	1,500.00	2,339.44	60.00	60.00	20.00	57.26	J-E2	N/A	-0.22	PMP-1
J-D4	Zone	4	true	true	1,500.00	2,333.79	1,500.00	2,333.79	60.00	60.00	20.00	57.28	J-D7	N/A	-0.22	PMP-1
J-D3	Zone	3	true	true	500.00	1,500.00	520.00	1,520.00	50.00	50.92	20.00	66.29	J-1	N/A	-0.22	PMP-1
J-D5	Zone	4	true	true	1,500.00	2,111.54	1,500.00	2,111.54	60.00	60.00	20.00	60.18	J-D7	N/A	-0.22	PMP-1
J-D6	Zone	4	true	true	1,500.00	2,215.47	1,500.00	2,215.47	60.00	60.00	20.00	55.98	J-D7	N/A	-0.22	PMP-1
J-D7	Zone	3	true	true	500.00	1,500.00	500.00	1,500.00	60.00	64.25	20.00	66.29	J-1	N/A	-0.22	PMP-1
J-A6	Zone	16	true	true	1,500.00	2,906.57	1,500.00	2,906.57	60.00	60.00	20.00	58.07	J-A4	N/A	-0.22	PMP-1
J-A8	Zone	3	true	true	500.00	1,500.00	520.00	1,520.00	60.00	60.81	20.00	66.29	J-1	N/A	-0.22	PMP-1
J-1	Zone	3	true	true	1,500.00	3,000.00	1,500.00	3,000.00	60.00	61.78	20.00	64.12	J-3	N/A	-0.22	PMP-1
J-2	Zone	2	true	true	1,500.00	3,000.00	1,500.00	3,000.00	60.00	67.82	20.00	61.79	J-1	N/A	-0.22	PMP-1
J-3	Zone	4	true	true	1,500.00	3,046.38	2,421.18	3,967.56	60.00	60.00	20.00	61.43	J-1	N/A	-0.22	PMP-1
J-A1	Zone	2	true	true	1,500.00	3,000.00	1,500.00	3,000.00	60.00	66.84	20.00	61.79	J-1	N/A	-0.22	PMP-1
J-A14	Zone	16	true	true	1,500.00	2,614.11	1,500.00	2,614.11	60.00	60.00	20.00	58.71	J-B22	N/A	-0.22	PMP-1
J-B15	Zone	4	true	true	1,500.00	2,965.55	1,500.00	2,965.55	60.00	60.00	20.00	57.11	J-B14	N/A	-0.22	PMP-1
J-B27	Zone	2	true	true	500.00	1,500.00	500.00	1,500.00	60.00	70.50	20.00	66.29	J-1	N/A	-0.22	PMP-1
J-A1a	Zone	2	true	true	1,500.00	3,000.00	1,500.00	3,000.00	60.00	66.64	20.00	61.79	J-1	N/A	-0.22	PMP-1
J-A1b	Zone	3	true	true	1,500.00	3,000.00	1,500.00	3,000.00	60.00	61.10	20.00	58.11	J-A4	N/A	-0.22	PMP-1

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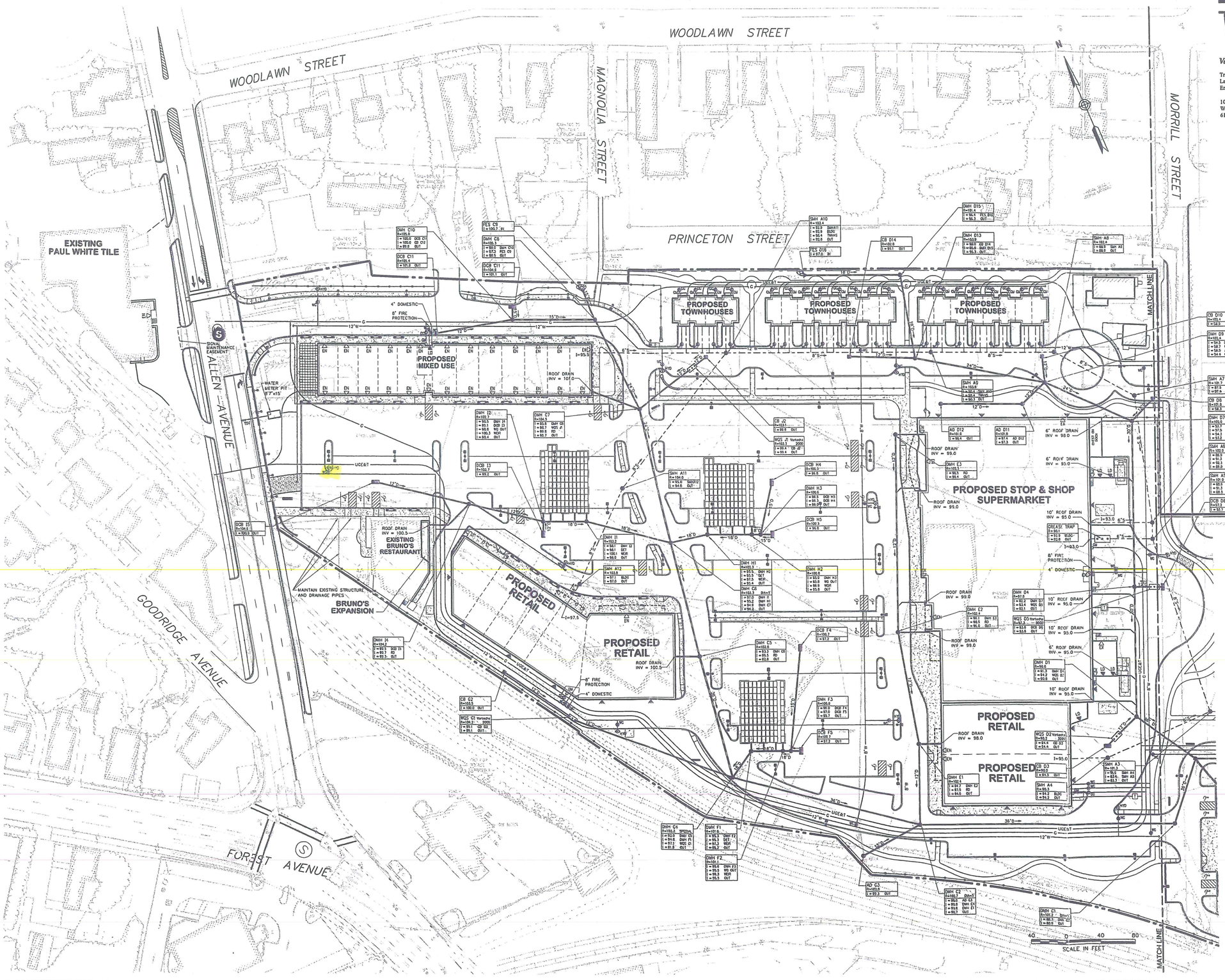
\\Mawald\d\07334\cad\d\planset\07334-UT.dwg



VHB

Vanasse Hangen Brustlin, Inc.

Transportation
Land Development
Environmental Services

101 Walnut Street, P.O. Box 9151
Watertown, Massachusetts 02471
617 924 1770 • FAX 617 924 2286

No.	Revision	Date	Approved
1	RESPONSE TO COMMENTS	2/17/08	

Designed by DHF | Drawn by DHF | Checked by KSS
CAD checked by BKF | Approved by
Scale 1" = 40' | Date June 30, 2005

Project Title
Morrill's Crossing

Allen Avenue
Portland, Maine

Issued for
Site Plan Approval

Not Approved for Construction

Drawing Title
Utility Plan 1

Drawing Number
C-9

Sheet 9 of 16

Project Number
07334.00

07334-UT.DWG

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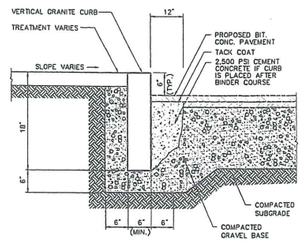
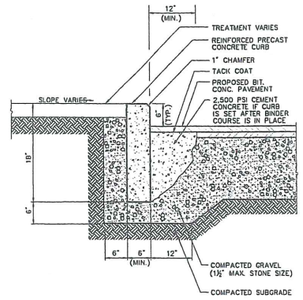


Vertical Granite Curb (VGC)

6/03

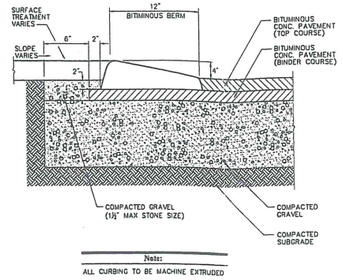
N.T.S. Source: VHB LD_402



Precast Concrete Curb (PCC)

6/03

N.T.S. Source: VHB LD_404

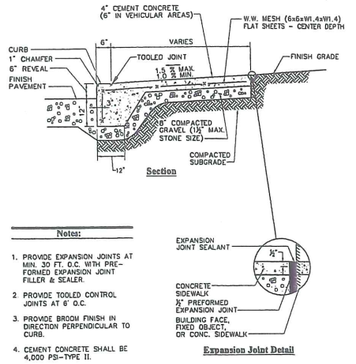


Note:
ALL CURBING TO BE MACHINE EXTRUDED

Bituminous Berm (BB)

4/04

N.T.S. Source: VHB LD_407

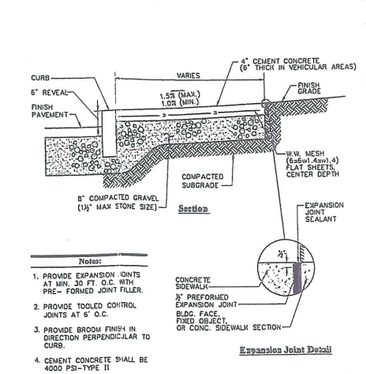


Notes:
1. PROVIDE EXPANSION JOINTS AT MIN. 30 FT. O.C. WITH PRE-FORMED EXPANSION JOINT FILLER & SEALER.
2. PROVIDE TOOLED CONTROL JOINTS AT 6' O.C.
3. PROVIDE BROOM FINISH IN DIRECTION PERPENDICULAR TO CURB.
4. CEMENT CONCRETE SHALL BE 4,000 PSI-TYPE II.

Monolithic Concrete Curb (MCC) & Sidewalk

6/03

N.T.S. Source: VHB LD_421

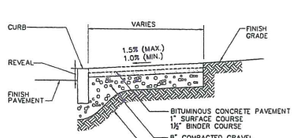


Notes:
1. PROVIDE EXPANSION JOINTS AT MIN. 30 FT. O.C. WITH PRE-FORMED JOINT FILLER.
2. PROVIDE TOOLED CONTROL JOINTS AT 6' O.C.
3. PROVIDE BROOM FINISH IN DIRECTION PERPENDICULAR TO CURB.
4. CEMENT CONCRETE SHALL BE 4000 PSI-TYPE II

Concrete Sidewalk

6/03

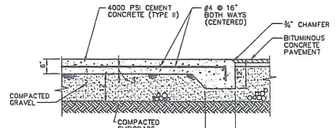
N.T.S. Source: VHB LD_420



Bituminous Concrete Sidewalk

10/04

N.T.S. Source: VHB LD_422

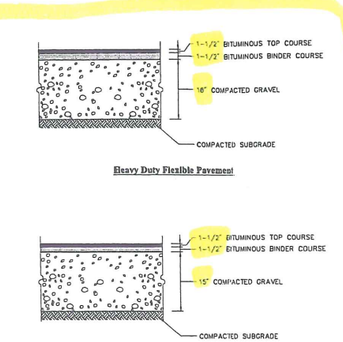


Notes:
1. SIZE OF DUMPSTER PAD TO BE AS INDICATED ON PLANS.
2. CONSTRUCTION JOINTS SHALL BE SPACED NO MORE THAN 40 FEET ON CENTER AND SHALL BE EQUALLY SPACED OVER THE LENGTH AND WIDTH OF THE PAD.

Dumpster Pad

6/03

N.T.S. Source: VHB LD_710

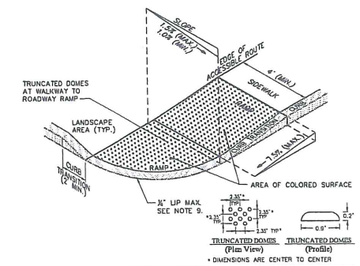


Note:
PAVEMENT SECTIONS ARE SUBJECT TO CHANGE AND WILL BE BASED ON THE RESULTS OF FURTHER GEOTECHNICAL INVESTIGATIONS.

Bituminous Concrete Pavement Sections

2/16

N.T.S. Source: VHB REV LD_430a

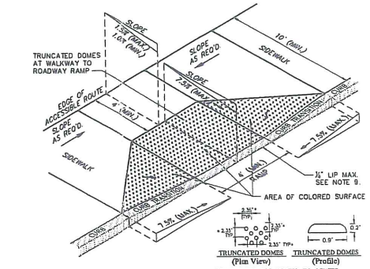


Notes:
1. THE MAXIMUM ALLOWABLE SIDEWALK AND CURB RAMP CROSS SLOPES SHALL BE 1.5 (1% MIN.).
2. THE MAXIMUM ALLOWABLE SLOPE OF ACCESSIBLE ROUTE EXCLUDING CURB RAMPS SHALL BE 5%
3. THE MAXIMUM ALLOWABLE SLOPE OF ACCESSIBLE ROUTE CURB RAMPS SHALL BE 7.5%.
4. A MINIMUM OF 3 FEET CLEAR SHALL BE MAINTAINED AT ANY PERMANENT OBSTACLE IN ACCESSIBLE ROUTE (I.E., HYDRANTS, UTILITY POLES, TREE WELLS, SIGNS, ETC.).
5. CURB TREATMENT VARIES, SEE PLANS FOR CURB TYPE.
6. RAMP, CURB, AND ADJACENT PAVEMENTS SHALL BE GRADED TO PREVENT PONDING.
7. TYPICAL SIDEWALK SECTION FOR RAMP SECTION CONSTRUCTION.
8. WHERE ACCESSIBLE ROUTES ARE LESS THAN 5' IN WIDTH (EXCLUDING CURBING) A 5' x 5' PASSING AREA SHALL BE PROVIDED AT INTERVALS NOT TO EXCEED 200 FEET.
9. ELIMINATE CURBING AT RAMP WHERE IT ABUTS ROADWAY, EXCEPT WHERE VERTICAL CURBING IS INDICATED ON THE DRAWINGS TO BE INSTALLED AND SET FLUSH.
10. DETECTABLE WARNINGS SHALL CONTRAST VISUALLY WITH ADJOINING SURFACES.

Accessible Curb Ramp (ACR) - Type 'B'

6/03

N.T.S. Source: VHB LD_501

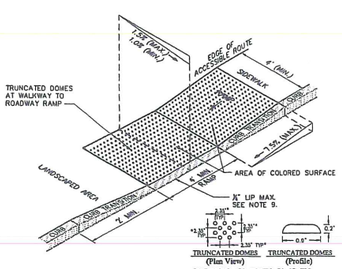


Notes:
1. THE MAXIMUM ALLOWABLE SIDEWALK AND CURB RAMP CROSS SLOPES SHALL BE 1.5 (1% MIN.).
2. THE MAXIMUM ALLOWABLE SLOPE OF ACCESSIBLE ROUTE EXCLUDING CURB RAMPS SHALL BE 5%
3. THE MAXIMUM ALLOWABLE SLOPE OF ACCESSIBLE ROUTE CURB RAMPS SHALL BE 7.5%.
4. A MINIMUM OF 3 FEET CLEAR SHALL BE MAINTAINED AT ANY PERMANENT OBSTACLE IN ACCESSIBLE ROUTE (I.E., HYDRANTS, UTILITY POLES, TREE WELLS, SIGNS, ETC.).
5. CURB TREATMENT VARIES, SEE PLANS FOR CURB TYPE
6. RAMP, CURB, AND ADJACENT PAVEMENTS SHALL BE GRADED TO PREVENT PONDING.
7. TYPICAL SIDEWALK SECTION FOR RAMP SECTION CONSTRUCTION.
8. WHERE ACCESSIBLE ROUTES ARE LESS THAN 5' IN WIDTH (EXCLUDING CURBING) A 5' x 5' PASSING AREA SHALL BE PROVIDED AT INTERVALS NOT TO EXCEED 200 FEET.
9. ELIMINATE CURBING AT RAMP WHERE IT ABUTS ROADWAY, EXCEPT WHERE VERTICAL CURBING IS INDICATED ON THE DRAWINGS TO BE INSTALLED AND SET FLUSH.
10. DETECTABLE WARNINGS SHALL CONTRAST VISUALLY WITH ADJOINING SURFACES.

Accessible Curb Ramp (ACR) Type 'D'

6/03

N.T.S. Source: VHB LD_503

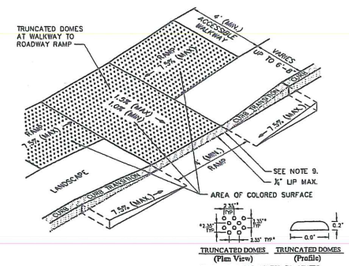


Notes:
1. THE MAXIMUM ALLOWABLE SIDEWALK AND CURB RAMP CROSS SLOPES SHALL BE 1.5 (1% MIN.).
2. THE MAXIMUM ALLOWABLE SLOPE OF ACCESSIBLE ROUTE EXCLUDING CURB RAMPS SHALL BE 5%
3. THE MAXIMUM ALLOWABLE SLOPE OF ACCESSIBLE ROUTE CURB RAMPS SHALL BE 7.5%.
4. A MINIMUM OF 3 FEET CLEAR SHALL BE MAINTAINED AT ANY PERMANENT OBSTACLE IN ACCESSIBLE ROUTE (I.E., HYDRANTS, UTILITY POLES, TREE WELLS, SIGNS, ETC.).
5. CURB TREATMENT VARIES, SEE PLANS FOR CURB TYPE.
6. RAMP, CURB, AND ADJACENT PAVEMENTS SHALL BE GRADED TO PREVENT PONDING.
7. TYPICAL SIDEWALK SECTION FOR RAMP SECTION CONSTRUCTION.
8. WHERE ACCESSIBLE ROUTES ARE LESS THAN 5' IN WIDTH (EXCLUDING CURBING) A 5' x 5' PASSING AREA SHALL BE PROVIDED AT INTERVALS NOT TO EXCEED 200 FEET.
9. ELIMINATE CURBING AT RAMP WHERE IT ABUTS ROADWAY, EXCEPT WHERE VERTICAL CURBING IS INDICATED ON THE DRAWINGS TO BE SET FLUSH.
10. DETECTABLE WARNINGS SHALL CONTRAST VISUALLY WITH ADJOINING SURFACES.

Accessible Curb Ramp (ACR) Type 'G'

6/03

N.T.S. Source: VHB LD_506

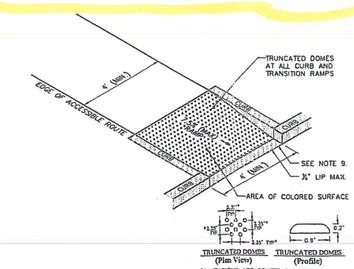


Notes:
1. THE MAXIMUM ALLOWABLE SIDEWALK AND CURB RAMP CROSS SLOPES SHALL BE 1.5 (1% MIN.).
2. THE MAXIMUM ALLOWABLE SLOPE OF ACCESSIBLE ROUTE EXCLUDING CURB RAMPS SHALL BE 5%
3. THE MAXIMUM ALLOWABLE SLOPE OF ACCESSIBLE ROUTE CURB RAMPS SHALL BE 7.5%.
4. A MINIMUM OF 3 FEET CLEAR SHALL BE MAINTAINED AT ANY PERMANENT OBSTACLE IN ACCESSIBLE ROUTE (I.E., HYDRANTS, UTILITY POLES, TREE WELLS, SIGNS, ETC.).
5. CURB TREATMENT VARIES, SEE PLANS FOR CURB TYPE.
6. RAMP, CURB, AND ADJACENT PAVEMENTS SHALL BE GRADED TO PREVENT PONDING.
7. TYPICAL SIDEWALK SECTION FOR RAMP SECTION CONSTRUCTION.
8. WHERE ACCESSIBLE ROUTES ARE LESS THAN 5' IN WIDTH (EXCLUDING CURBING) A 5' x 5' PASSING AREA SHALL BE PROVIDED AT INTERVALS NOT TO EXCEED 200 FEET.
9. ELIMINATE CURBING AT RAMP WHERE IT ABUTS ROADWAY, EXCEPT WHERE VERTICAL CURBING IS INDICATED ON THE DRAWINGS TO BE INSTALLED AND SET FLUSH.
10. DETECTABLE WARNINGS SHALL CONTRAST VISUALLY WITH ADJOINING SURFACES.

Accessible Curb Ramp (ACR) Type 'I'

6/03

N.T.S. Source: VHB LD_508

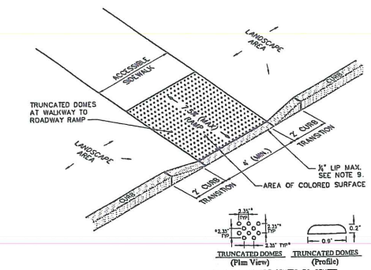


Notes:
1. THE MAXIMUM ALLOWABLE SIDEWALK AND CURB RAMP CROSS SLOPES SHALL BE 1.5 (1% MIN.).
2. THE MAXIMUM ALLOWABLE SLOPE OF ACCESSIBLE ROUTE EXCLUDING CURB RAMPS SHALL BE 5%
3. THE MAXIMUM ALLOWABLE SLOPE OF ACCESSIBLE ROUTE CURB RAMPS SHALL BE 7.5%.
4. A MINIMUM OF 3 FEET CLEAR SHALL BE MAINTAINED AT ANY PERMANENT OBSTACLE IN ACCESSIBLE ROUTE (I.E., HYDRANTS, UTILITY POLES, TREE WELLS, SIGNS, ETC.).
5. CURB TREATMENT VARIES, SEE PLANS FOR CURB TYPE.
6. RAMP, CURB, AND ADJACENT PAVEMENTS SHALL BE GRADED TO PREVENT PONDING.
7. TYPICAL SIDEWALK SECTION FOR RAMP SECTION CONSTRUCTION.
8. WHERE ACCESSIBLE ROUTES ARE LESS THAN 5' IN WIDTH (EXCLUDING CURBING) A 5' x 5' PASSING AREA SHALL BE PROVIDED AT INTERVALS NOT TO EXCEED 200 FEET.
9. ELIMINATE CURBING AT RAMP WHERE IT ABUTS ROADWAY, EXCEPT WHERE VERTICAL CURBING IS INDICATED ON THE DRAWINGS TO BE INSTALLED AND SET FLUSH.
10. DETECTABLE WARNINGS SHALL CONTRAST VISUALLY WITH ADJOINING SURFACES.

Accessible Curb Ramp (ACR) Type 'J'

6/03

N.T.S. Source: VHB LD_509

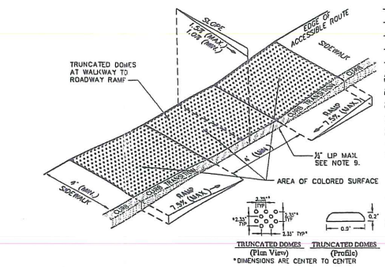


Notes:
1. THE MAXIMUM ALLOWABLE SIDEWALK AND CURB RAMP CROSS SLOPES SHALL BE 1.5 (1% MIN.).
2. THE MAXIMUM ALLOWABLE SLOPE OF ACCESSIBLE ROUTE EXCLUDING CURB RAMPS SHALL BE 5%
3. THE MAXIMUM ALLOWABLE SLOPE OF ACCESSIBLE ROUTE CURB RAMPS SHALL BE 7.5%.
4. A MINIMUM OF 3 FEET CLEAR SHALL BE MAINTAINED AT ANY PERMANENT OBSTACLE IN ACCESSIBLE ROUTE (I.E., HYDRANTS, UTILITY POLES, TREE WELLS, SIGNS, ETC.).
5. CURB TREATMENT VARIES, SEE PLANS FOR CURB TYPE.
6. RAMP, CURB AND ADJACENT PAVEMENTS SHALL BE GRADED TO PREVENT PONDING.
7. TYPICAL SIDEWALK SECTION FOR RAMP SECTION CONSTRUCTION.
8. WHERE ACCESSIBLE ROUTES ARE LESS THAN 5' IN WIDTH (EXCLUDING CURBING) A 5' x 5' PASSING AREA SHALL BE PROVIDED AT INTERVALS NOT TO EXCEED 200 FEET.
9. ELIMINATE CURBING (OTHER THAN VERTICAL CURBING, WHICH SHALL BE SET FLUSH) WHERE IT ABUTS ROADWAY.
10. DETECTABLE WARNINGS SHALL CONTRAST VISUALLY WITH ADJOINING SURFACES.

Accessible Curb Ramp (ACR) Type 'M'

6/03

N.T.S. Source: VHB LD_512



Notes:
1. THE MAXIMUM ALLOWABLE SIDEWALK AND CURB RAMP CROSS SLOPES SHALL BE 1.5 (1% MIN.).
2. THE MAXIMUM ALLOWABLE SLOPE OF ACCESSIBLE ROUTE EXCLUDING CURB RAMPS SHALL BE 5%
3. THE MAXIMUM ALLOWABLE SLOPE OF ACCESSIBLE ROUTE CURB RAMPS SHALL BE 7.5%.
4. A MINIMUM OF 3 FEET CLEAR SHALL BE MAINTAINED AT ANY PERMANENT OBSTACLE IN ACCESSIBLE ROUTE (I.E., HYDRANTS, UTILITY POLES, TREE WELLS, SIGNS, ETC.).
5. CURB TREATMENT VARIES, SEE PLANS FOR CURB TYPE.
6. RAMP, CURB, AND ADJACENT PAVEMENTS SHALL BE GRADED TO PREVENT PONDING.
7. TYPICAL SIDEWALK SECTION FOR RAMP SECTION CONSTRUCTION.
8. WHERE ACCESSIBLE ROUTES ARE LESS THAN 5' IN WIDTH (EXCLUDING CURBING) A 5' x 5' PASSING AREA SHALL BE PROVIDED AT INTERVALS NOT TO EXCEED 200 FEET.
9. ELIMINATE CURBING AT RAMP (OTHER THAN VERTICAL CURBING, WHICH SHALL BE SET FLUSH) WHERE IT ABUTS ROADWAY.
10. DETECTABLE WARNINGS SHALL CONTRAST VISUALLY WITH ADJOINING SURFACES.

Accessible Curb Ramp (ACR) Type 'A'

6/03

N.T.S. Source: VHB LD_500

No.	Revision	Date	Appvd.
1	RESPONSE TO COMMENTS	2/17/06	
Designed by	Drawn by	Checked by	
CAD checked by		Approved by	
Scale: As Noted		Date: June 30, 2005	

Project Title:
Morrill's Crossing
Allen Avenue
Portland, Maine
Issued for:
Site Plan Approval
Not Approved for Construction
Drawing Title:
Site Details 1
Drawing Number:
C-13
Sheet 13 of 16
Project Number:
07334.00

07334-DT.DWG

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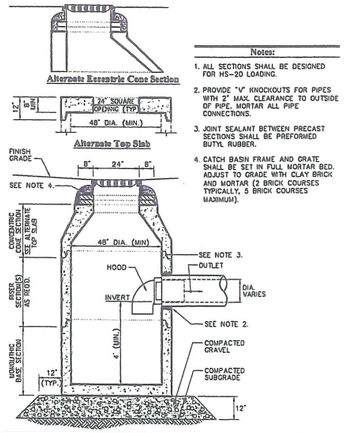
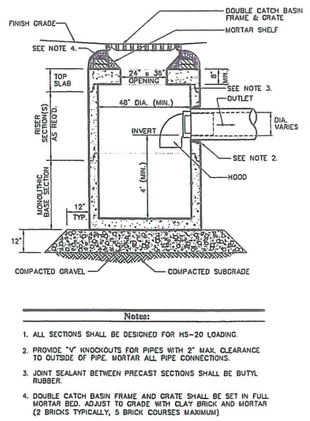


Notes:

1. ALL SECTIONS SHALL BE DESIGNED FOR HS-20 LOADING.
2. PROVIDE "V" KNOCKOUTS FOR PIPES WITH 2" MAX. CLEARANCE TO OUTSIDE OF PIPE. MORTAR ALL PIPE CONNECTIONS.
3. JOINT SEALANT BETWEEN PRECAST SECTIONS SHALL BE PREFORMED BUTYL RUBBER.
4. CATCH BASIN FRAME AND GRATE SHALL BE SET IN FULL MORTAR BED. ADJUST TO GRADE WITH CLAY BRICK AND MORTAR (2 BRICK COURSES TYPICALLY, 5 BRICK COURSES MAXIMUM).

Catch Basin (CB) With Hood

N.T.S. Source: VHB 6/03 LD_101

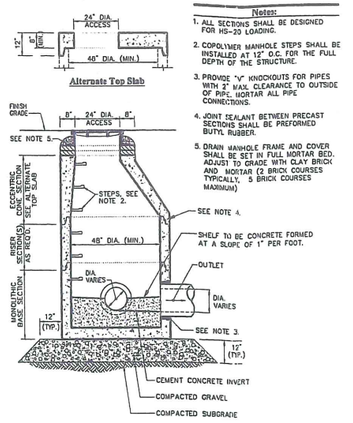


Notes:

1. ALL SECTIONS SHALL BE DESIGNED FOR HS-20 LOADING.
2. PROVIDE "V" KNOCKOUTS FOR PIPES WITH 2" MAX. CLEARANCE TO OUTSIDE OF PIPE. MORTAR ALL PIPE CONNECTIONS.
3. JOINT SEALANT BETWEEN PRECAST SECTIONS SHALL BE BUTYL RUBBER.
4. DOUBLE CATCH BASIN FRAME AND GRATE SHALL BE SET IN FULL MORTAR BED. ADJUST TO GRADE WITH CLAY BRICK AND MORTAR (2 BRICKS TYPICALLY, 5 BRICK COURSES MAXIMUM)

Double Grate Catch Basin (DCB) with Hood

N.T.S. Source: VHB 6/03 LD_103

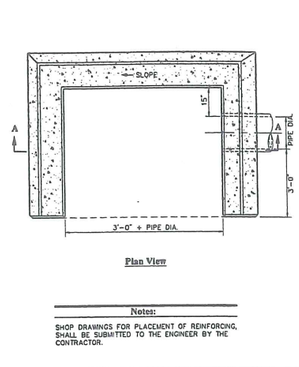


Notes:

1. ALL SECTIONS SHALL BE DESIGNED FOR HS-20 LOADING.
2. COPOLYMER MANHOLE STEPS SHALL BE INSTALLED AT 12" O.C. FOR THE FULL DEPTH OF THE STRUCTURE.
3. PROVIDE "V" KNOCKOUTS FOR PIPES WITH 2" MAX. CLEARANCE TO OUTSIDE OF PIPE. MORTAR ALL PIPE CONNECTIONS.
4. JOINT SEALANT BETWEEN PRECAST SECTIONS SHALL BE PREFORMED BUTYL RUBBER.
5. DRAIN MANHOLE FRAME AND COVER SHALL BE SET IN FULL MORTAR BED. ADJUST TO GRADE WITH CLAY BRICK AND MORTAR (2 BRICK COURSES TYPICALLY, 5 BRICK COURSES MAXIMUM)

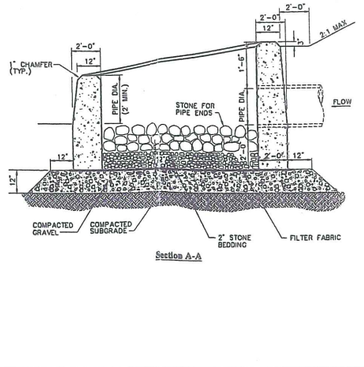
Drain Manhole (DMH)

N.T.S. Source: VHB 6/03 LD_115



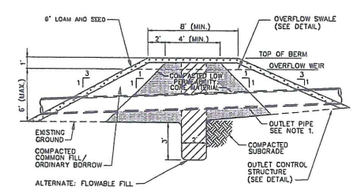
Notes:

SHOP DRAWINGS FOR PLACEMENT OF REINFORCING SHALL BE SUBMITTED TO THE ENGINEER BY THE CONTRACTOR.



Directional Headwall

N.T.S. Source: VHB 6/03 LD_135

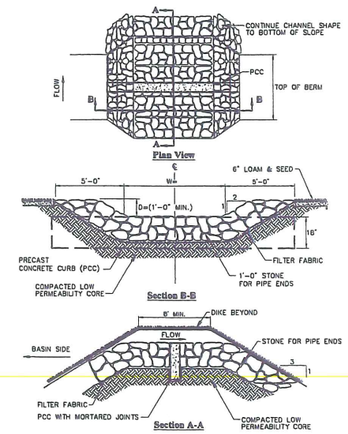


Notes:

1. WHERE PIPES PENETRATE THE LOW PERMEABILITY CORE, PIPE SHALL BE BEDDED IN THE LOW PERMEABILITY CORE MATERIAL.
2. THE BERM SECTION IS SUBJECT TO CHANGE AND WILL BE BASED ON THE RESULTS OF FURTHER GEOTECHNICAL INVESTIGATIONS.

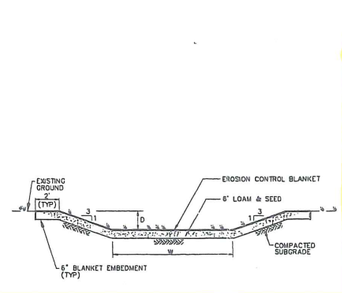
Detention Basin Berm Section

N.T.S. Source: VHB 6/03 LD_160



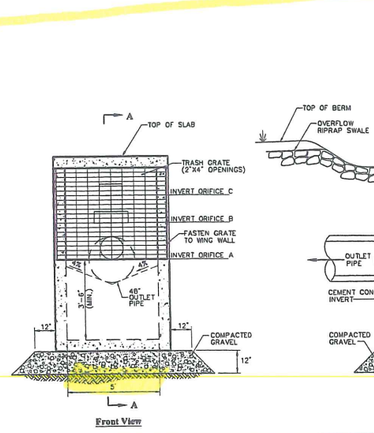
Overflow Stone Swale

N.T.S. Source: 6/03 LD_161



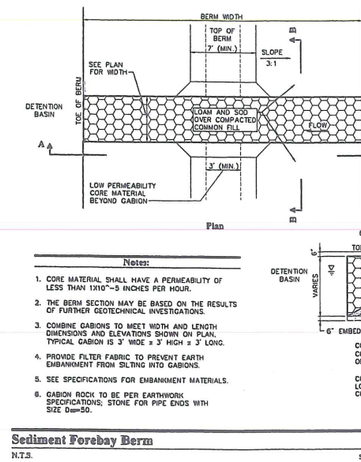
Grassed Swale

N.T.S. Source: VHB 6/03 REV LD_171



Multi-Stage Outlet Control Structure

N.T.S. Source: VHB 6/03 REV LD_162

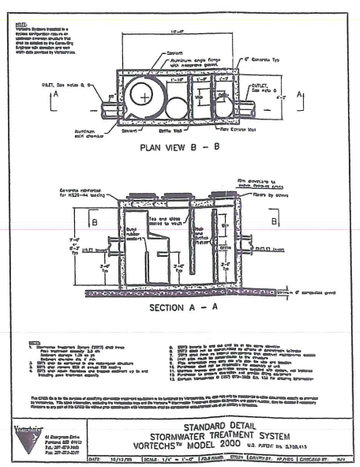


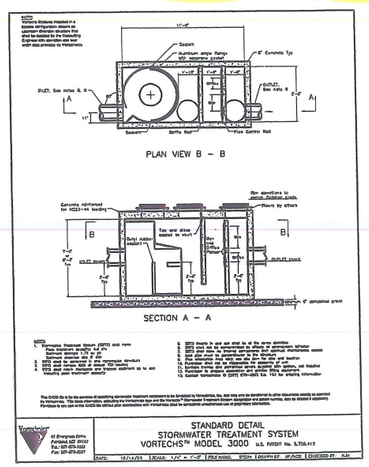
Notes:

1. CORE MATERIAL SHALL HAVE A PERMEABILITY OF LESS THAN 1×10^{-5} INCHES PER HOUR.
2. THE BERM SECTION MAY BE BASED ON THE RESULTS OF FURTHER GEOTECHNICAL INVESTIGATIONS.
3. COMBINE GABIONS TO MEET WIDTH AND LENGTH DIMENSIONS AND ELEVATIONS SHOWN ON PLAN. TYPICAL GABION IS 3' WIDE x 3' HIGH x 3' LONG.
4. PROVIDE FILTER FABRIC TO PREVENT EARTH EMBANKMENT FROM SILTING INTO GABIONS.
5. SEE SPECIFICATIONS FOR EMBANKMENT MATERIALS.
6. GABION ROCK TO BE PER EARTHWORK SPECIFICATIONS; STONE FOR PIPE ENDS WITH SIZE Dso=50.

Sediment Forebay Berm

N.T.S. Source: VHB 6/03 LD_164





No.	Revision	Date	Appvd
1	RESPONSE TO COMMENTS	2/17/06	

Designed by | Drawn by | Checked by
CAD checked by | Approved by
Scale: As Noted | Date: June 30, 2005

Project Title
Morrill's Crossing

Allen Avenue
Portland, Maine
Issued for
Site Plan Approval

Not Approved for Construction
Drawing Title
Site Details 3

Drawing Number
C-15
Sheet 15 of 16
Project Number
07334.00

07334-DT.DWG

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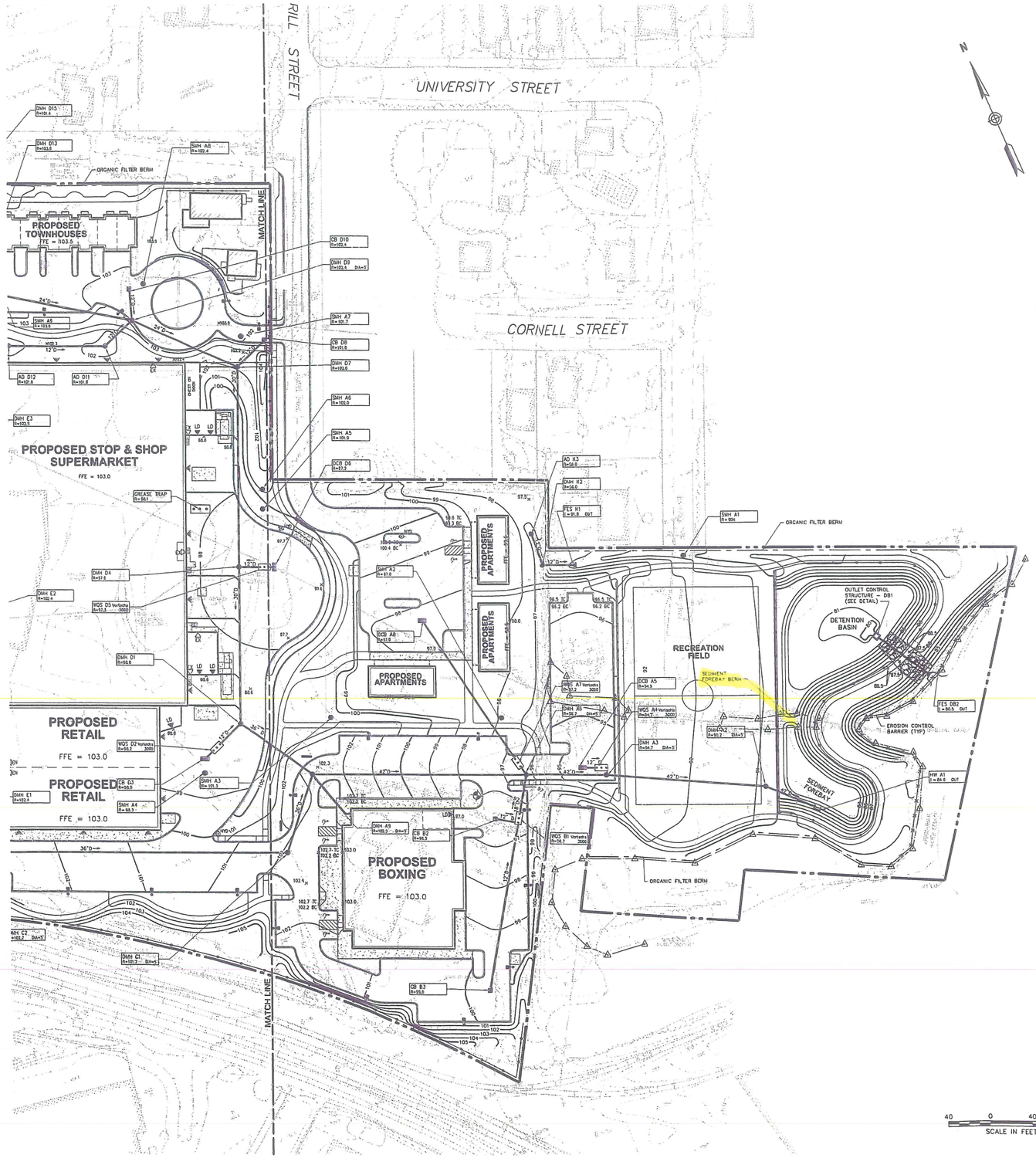

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Environmental Services

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No.	Revision	Date	Appvd.
1	RESPONSE TO COMMENTS	2/17/09	

Designed by KSS | Drawn by BKF | Checked by KSS
CAD checked by BKF | Approved by
Scale 1" = 40' | Date June 30, 2005

Project Title
Morrill's Crossing

Allen Avenue
Portland, Maine

Issued for
Site Plan Approval

Not Approved for Construction

Drawing Title
Grading and Drainage Plan 2

Drawing Number
C-6

Sheet 6 of 16

Project Number
07334.00

07334-GD.DWG

Hession, John

From: Thomas Errico [terrico@wilbursmith.com]
Sent: Monday, January 23, 2006 5:09 PM
To: SH@portlandmaine.gov
Cc: KAS@portlandmaine.gov; Nagi, Robert; Hession, John
Subject: Morrill's Crossing -- Site Plan Comments

Sarah—

The following outlines my comments on the site plan for the above referenced project.

1. It seems that two different crosswalk treatments are being proposed for the project. An explanation on the selection of treatment should be provided. I would also ask that the City Engineer review and approve the specification for th "stamped" pavement proposal. I would also note that the City should provide guidance on whether the "stamped" treatment should be applied to the crossings on Allen Avenue.
2. I would suggest that the applicant provide a sidewalk on the easterly side of the main entrance roadway from the bus pullout to Allen Avenue.
3. The location of the crosswalk on the main entrance roadway at Allen Avenue seems to be set back too far.
4. I would suggest that the applicant provide crosswalks on all approaches at the Allen Avenue/Main Entrance Roadwa intersection.
5. The Main entrance roadway has a cross-section dimension of two 12' exit lanes and one 20' entry lane. I would suggest that the dimensions be adjusted to allow for some shoulder area exiting the site for bicyclists.
6. The main circulatory roadway through the site is proposed to be 30' wide. The applicant should document how this roadway will be marked. It is my opinion that the roadway be designed with such treatment that it appears to be the primary or highest classification roadway.
7. Two crosswalks are illustrated from the parking aisle to the Stop N' Shop store frontage. I would rather not have a crosswalk terminate in a travel lane. Elimination or alternatives to this treatment are recommended.
8. The applicant should document the winter maintenance program, particularly for all sidewalks and trails on their site.
9. All regulatory signage and pavement markings should be illustrated on a plan.
10. A waiver for the parking stall dimension standard will be required. The parking stalls are proposed to be 18' long. The standard is 19'.
11. Traffic control at key on-site intersections need to be illustrated. An example of this is at the intersection in front of the Boxing Facility.
12. Based upon the different land uses and size of the site, I would suggest that the applicant implement a wayfinding signage program that provides destination information.
13. The pavement arrows exiting the site should be revised to account for movements to Paul White Tile.
14. The applicant should confirm that the bus stop pullout dimensions have been approved by METRO.
15. I would suggest providing a crosswalk on the truck delivery driveway entrance and appropriate sidewalk connections to the store front. A good pedestrian connection should be provided between the proposed apartments and the retai portion of the site.

Please contact me if you have any questions or comments.

Thomas A. Errico, P.E.
Senior Transportation Engineer
Wilbur Smith Associates
59 Middle Street

Transportation
Land Development
Environmental
Services

VHB imagination | innovation | energy Creating results for our clients and benefits for our communities

February 17, 2006

Vanasse Hangen Brustlin, Inc.

Ref: 07334.00

Sarah Hopkins
Development Review Services Manager
Department of Planning & Development
City of Portland
389 Congress Street
Portland, Maine 04101

Re: Morrill's Crossing - Response to Tom Errico Site Plan Comments

Dear Sarah:

The following are VHB's responses to the site plan comments raised by Mr. Thomas Errico of Wilbur Smith Associates in his e-mail addressed to you dated, January 23, 2006 regarding Morrill's Crossing. Mr. Errico has raised several constructive comments that we believe improve the overall site design. Where these comments result in changes to the site plan, our proposed revisions are shown on attachments to this letter.

Comment 1:

It seems that two different crosswalk treatments are being proposed for the project. An explanation on the selection of treatment should be provided. I would also ask that the City Engineer review and approve the specification for the "stamped" pavement proposal. I would also note that the city should provide guidance on whether the stamped treatment should be applied to the crossings on Allen Avenue.

Response:

The proposed plan does specify two different crosswalk treatments for the project. The "stamped" pavement crosswalks serve as an urban streetscape treatment along the main entrance and along the primary pedestrian routes. They are intended to provide a visual interest and to clearly delineate the pedestrian corridors through the commercial and townhome portions of the development. Standard striped crosswalks are proposed in all other locations.

VHB discussed the use of the "stamped: pavement treatment with Mr. Errico and Mr. Eric Labelle from the Public Works Department. It is our understanding that Mr. Labelle approves of its use given that it is part of a private development.

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email: info@vhb.com
www.vhb.com

Comment 2:

I would suggest that the applicant provide a sidewalk on the easterly side of the main entrance roadway from the bus pullout to Allen Avenue.

Response:

As discussed with Mr. Errico, Mr. Patrick Carroll of Carroll Associates, and Planning staff, a sidewalk from Allen Avenue to the bus stop on the easterly side of the main entrance has been added to the plan. The change is highlighted on Attachment A.

Comment 3:

The location of the crosswalk on the main entrance roadway at Allen Avenue seems to be set back to far.

Response:

The crosswalk has been modified to be set closer to Allen Avenue. The new location is based on the turning movements requirements of entering vehicles. The new layout is highlighted on Attachment B.

Comment 4:

I would suggest that the applicant provide crosswalks on all approaches at the Allen Avenue/Main entrance roadway intersection.

Response:

VHB believes that the crosswalk, as originally proposed (crossing the northerly leg of Allen Avenue) provides adequate crossing opportunities, especially in light of the additional sidewalk provided along the site drive (see response to Comment 2). The addition of a crosswalk, crossing the southerly leg of Allen Avenue, would result in a reduction of the available queue storage between the railroad crossing and the site drive. VHB recommends that a single crossing of Allen Avenue remain in the location originally proposed.

Comment 5:

The Main entrance roadway has a cross section dimension of 12' exit lanes and one 20' entry lane I would suggest that the dimensions be adjusted to allow for some shoulder area exiting the site for bicyclists.

Response:

The main entrance drive has been modified to allow for shoulder area exiting the site. The new lane configuration consists of one 18 foot wide entry lane, one 12 foot wide exit lane, and one 14 foot wide exit lane. The new configuration is highlighted in Attachment C.

Comment 6:

The main circulatory roadway through the site is proposed to be 30' wide. The applicant should document how this roadway shall be marked. It is my opinion that the roadway be designed with such treatment that it appears to be the primary or highest classification roadway.

Response:

VHB has added a single yellow centerline along the main site roadway. The change is highlighted in Attachment D.

Comment 7:

Two crosswalks are illustrated from the parking aisle to the Stop and Shop store frontage. I would rather not have a crosswalk terminate in a travel lane. Elimination or alternatives are recommended.

Response:

The crosswalks as shown are a Stop & Shop design requirement to delineate the accessible route from the store entrance/exit to the accessible parking spaces. According to Chapter 5: General Site and Building Elements of the Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines: "Accessible routes must connect parking spaces to accessible entrances. In parking facilities where the accessible route must cross vehicular traffic lanes, marked crossings enhance pedestrian safety, particularly for people using wheelchairs and other mobility aids."

Comment 8:

The applicant should document the winter maintenance program, particularly for all sidewalks and trails on their site.

Response:

As part of the general maintenance program, all sidewalks and trails will be cleared during snow storm events.

Comment 9:

All regulatory signage and pavement markings should be illustrated on a plan.

Response:

A regulatory signage chart, as well as the pavement markings, was illustrated on the Layout and Material Plans originally submitted. Those plans have been updated to reflect revision requested. Please refer to Attachment E.

Comment 10:

A waiver for the parking stall dimension standard will be required. The parking stalls are proposed to be 18' long. The standard is 19'.

Response:

The applicant has submitted a waiver request for the parking stall dimension to under a separate cover. Please note that the parking stall dimension was supported by Mr. Steve Bushey of Deluca-Hoffman in his review of the Site Plans.

Comment 11:

Traffic control at key on site intersections needs to be illustrated. An example of this is at the intersection in front of the Boxing Facility.

Response:

Stop signs have been added to the parking aisle approaches to the main drive aisle in appropriate locations as per Mr. Bushey's comments. Additional signage has been provided in the area of the Boxing Club intersection. The changes are highlighted in Attachment F.

Comment 12:

Based upon the different land uses and size of the site, I would suggest that the applicant implement a wayfinding signage program that provides destination information.

Response:

Directional signage has been added to the plans. The changes are highlighted in Attachment G.

Comment 13:

The pavement arrows exiting the site should be revised to account for movements to Paul White Tile.

Response:

The pavement arrow in the left exiting lane has been modified to show a through-left movement to account for movements to Paul White Tile. The change is highlighted in Attachment H.

Comment 14:

The applicant should confirm that the bus stop pullout dimensions have been approved by METRO.

Response:

The townhome drive cul-de-sac radii have been revised to provide for adequate turning movements for both busses and Fire Department vehicles. Updated plans have been sent to Metro for review. The revised cul-de-sac design is provided in Attachment I.

Comment 15:

I would suggest providing a crosswalk on the truck delivery driveway entrance and appropriate sidewalk connections to the store front. A good pedestrian connection should be provided between the proposed apartments and the retail portion of the site.

Response:

A sidewalk has been added to the side of the retail and a crosswalk connection has been provided on the truck delivery driveway connecting the store to the apartment walkway. The changes are highlighted in Attachment J.

Please give me a call if you have any questions or need additional information.

Very truly yours,

VANASSE HANGEN BRUSTLIN, INC.

John Hession
Project Manager

David Fenstermacher
Project Engineer

With attachments
cc: Thomas Errico – Wilbur Smith Associates

VHB

Attachment A

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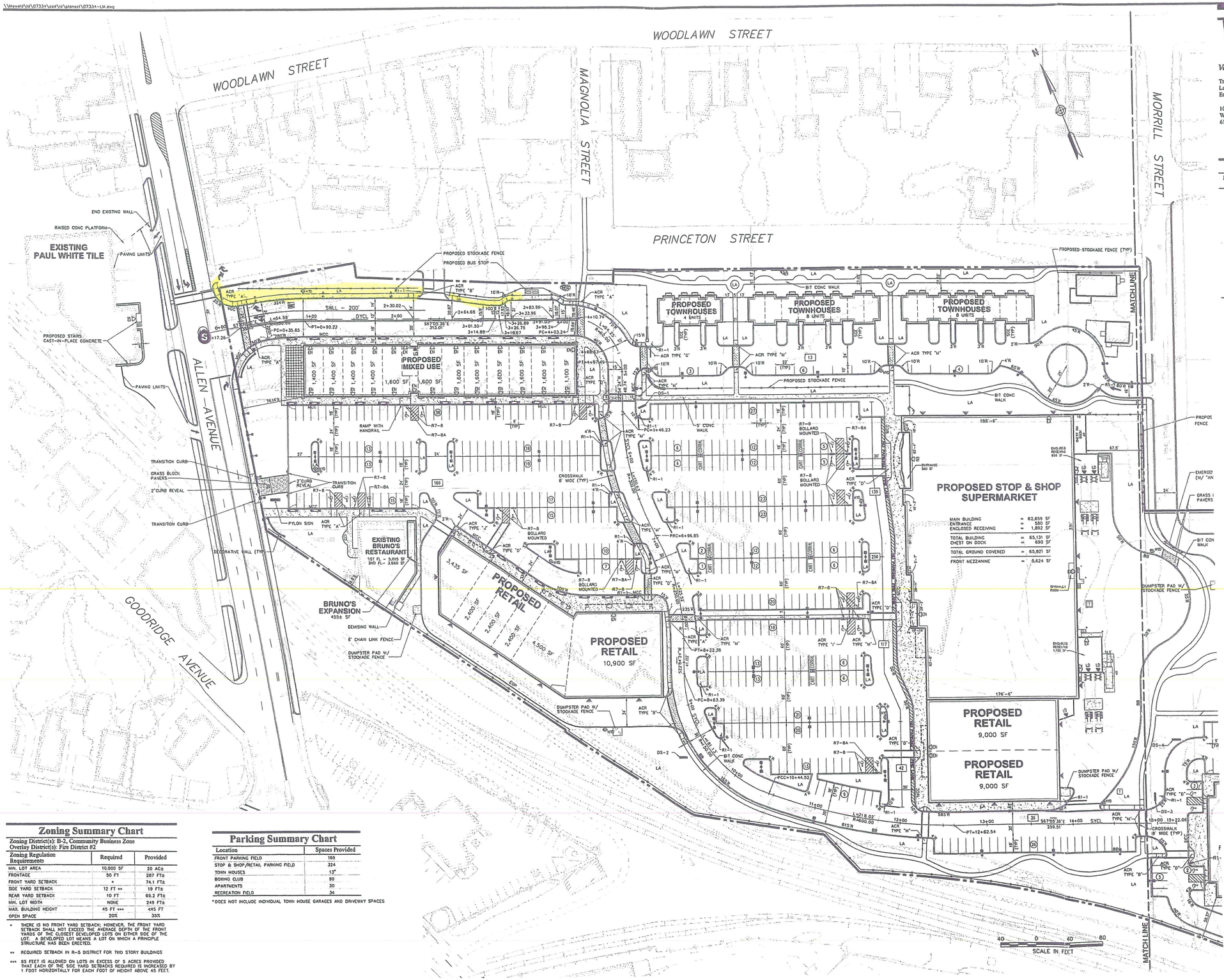

Zoning Summary Chart

Zoning District(s): B-2, Community Business Zone
Overlay District(s): Fire District #2

Zoning Regulation Requirements	Required	Provided
MIN. LOT AREA	10,000 SF	20 AC±
FRONTAGE	50 FT	287 FT±
FRONT YARD SETBACK	*	74.1 FT±
SIDE YARD SETBACK	12 FT **	19 FT±
REAR YARD SETBACK	10 FT	69.2 FT±
MIN. LOT WIDTH	NONE	249 FT±
MAX. BUILDING HEIGHT	45 FT ***	≤45 FT
OPEN SPACE	20%	35%

* THERE IS NO FRONT YARD SETBACK; HOWEVER, THE FRONT YARD SETBACK SHALL NOT EXCEED THE AVERAGE DEPTH OF THE FRONT YARDS OF THE CLOSEST DEVELOPED LOTS ON EITHER SIDE OF THE LOT. A DEVELOPED LOT MEANS A LOT ON WHICH A PRINCIPLE STRUCTURE HAS BEEN ERECTED.

** REQUIRED SETBACK IN R-5 DISTRICT FOR TWO STORY BUILDINGS

*** 65 FEET IS ALLOWED ON LOTS IN EXCESS OF 5 ACRES PROVIDED THAT EACH OF THE SIDE YARD SETBACKS REQUIRED IS INCREASED BY 1 FOOT HORIZONTALLY FOR EACH FOOT OF HEIGHT ABOVE 45 FEET.

Parking Summary Chart

Location	Spaces Provided
FRONT PARKING FIELD	155
STOP & SHOP/RETAIL PARKING FIELD	324
TOWN HOUSES	13*
BOXING CLUB	50
APARTMENTS	30
RECREATION FIELD	34

*DOES NOT INCLUDE INDIVIDUAL TOWN HOUSE GARAGES AND DRIVEWAY SPACES

Sign Summary

M.U.T.C.D. Number	Specification Width	Specification Height	Desc.
R1-1	30"	30"	STOP
R5-1	30"	30"	DO NOT ENTER
R7-8	12"	18"	RESERVED PARKING
R7-8A	12"	6"	VAN ACCESSIBLE

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No.	Revision	Date	Appvd
1	RESPONSE TO COMMENTS	2/17/06	

Designed by DHF | Drawn by DHF | Checked by KSS
CAD operated by BKF | Approved by
Scale 1" = 40' | Date June 30, 2005

Project Title
Morrill's Crossing
Allen Avenue
Portland, Maine
Issued for
Site Plan Approval
Not Approved for Construction

Drawing Title
Layout and Materials Plan 1

Drawing Number
C-3
Sheet 3 of 16
Project Number
07334.00

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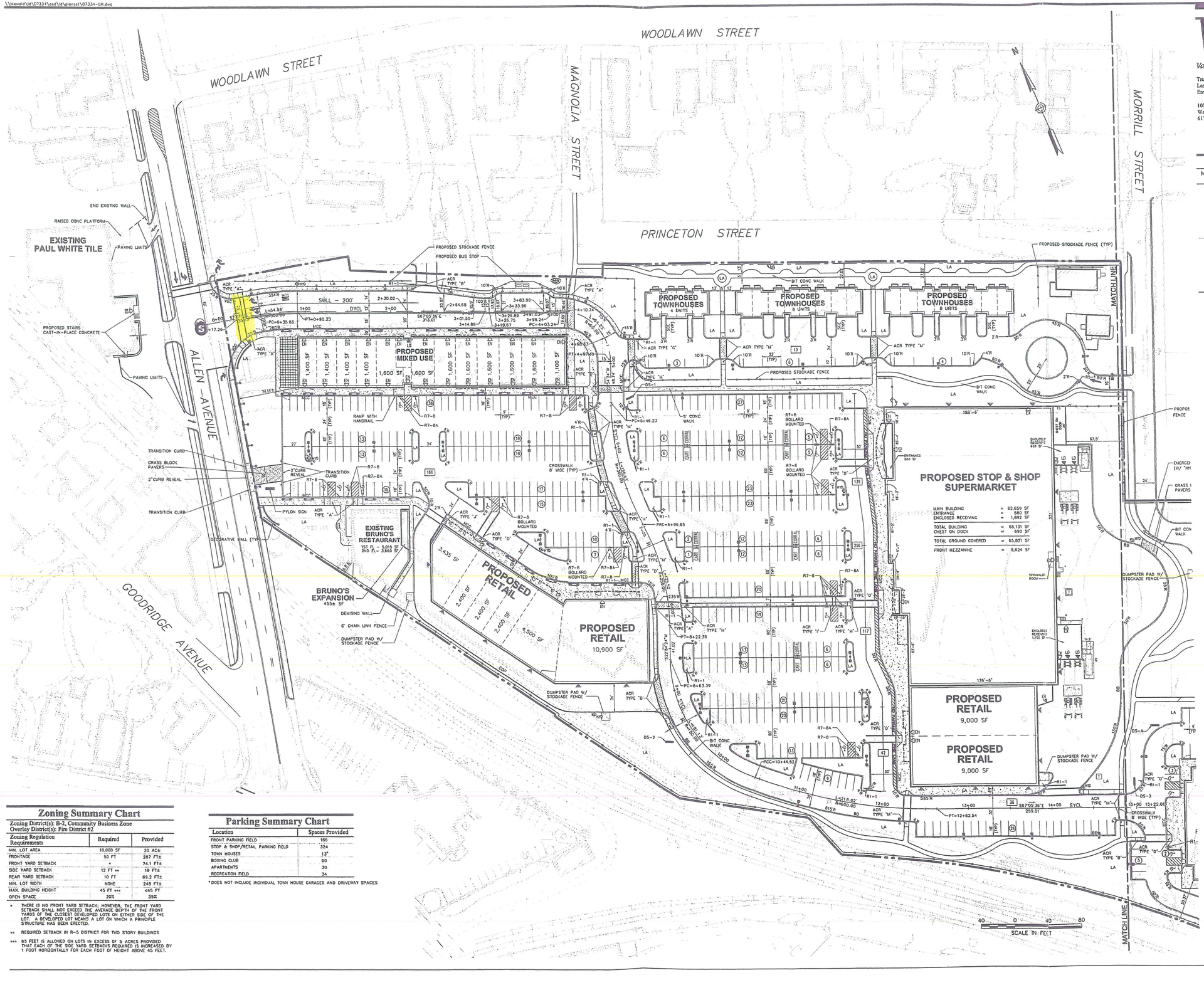

Zoning Summary Chart

Zoning District(s): B-2, Community Business Zone
Overlay District(s): Fire District #2

Zoning Regulation Requirements	Required	Provided
MIN. LOT AREA	10,000 SF	20 AC±
FRONTAGE	50 FT	287 FT±
FRONT YARD SETBACK	*	74.1 FT±
SIDE YARD SETBACK	12 FT **	19 FT±
REAR YARD SETBACK	10 FT	69.2 FT±
MIN. LOT WIDTH	NONE	249 FT±
MAX. BUILDING HEIGHT	45 FT ***	<45 FT
OPEN SPACE	20%	35%

* THERE IS NO FRONT YARD SETBACK; HOWEVER, THE FRONT YARD SETBACK SHALL NOT EXCEED THE AVERAGE DEPTH OF THE FRONT YARDS OF THE CLOSEST DEVELOPED LOTS ON EITHER SIDE OF THE LOT. A DEVELOPED LOT MEANS A LOT ON WHICH A PRINCIPLE STRUCTURE HAS BEEN ERECTED.

** REQUIRED SETBACK IN R-5 DISTRICT FOR TWO STORY BUILDINGS

*** 65 FEET IS ALLOWED ON LOTS IN EXCESS OF 5 ACRES PROVIDED THAT EACH OF THE SIDE YARD SETBACKS REQUIRED IS INCREASED BY 1 FOOT HORIZONTALLY FOR EACH FOOT OF HEIGHT ABOVE 45 FEET.

Parking Summary Chart

Location	Spaces Provided
FRONT PARKING FIELD	166
STOP & SHOP/RETAIL PARKING FIELD	324
TOWN HOUSES	13*
BOXING CLUB	90
APARTMENTS	30
RECREATION FIELD	34

* DOES NOT INCLUDE INDIVIDUAL TOWN HOUSE GARAGES AND DRIVEWAY SPACES

Sign Summary

M.U.T.C.D. Number	Specification Width	Specification Height	Desc.
R1-1	30"	30"	STOP
R5-1	30"	30"	DO NOT ENTER
R7-8	12"	18"	RESERVED PARKING
R7-8A	12"	6"	VAN ACCESSIBLE

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No.	Revision	Date	Appvd.
1	RESPONSE TO COMMENTS	2/17/06	

Designed by DHF | Drawn by DHF | Checked by KSS
CAD released by BKF | Approved by
Scale 1" = 40' | Date June 30, 2005

Project Title
Morrill's Crossing
Allen Avenue
Portland, Maine

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Site Plan Approval

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Drawing Title
Layout and Materials Plan 1

Drawing Number
C-3

Sheet 3 of 16

Project Number
07334.00

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Attachment C

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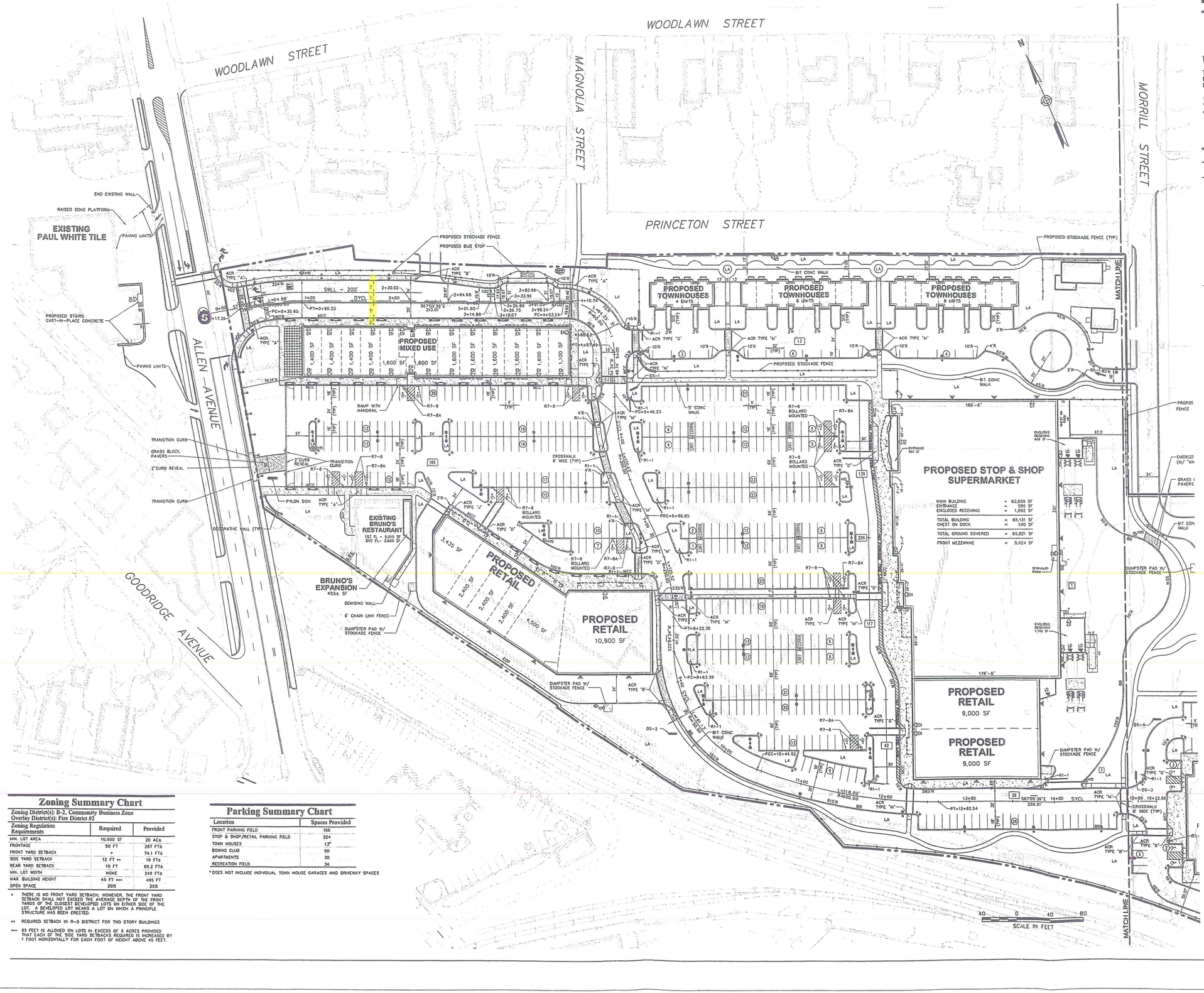

Zoning Summary Chart

Zoning District(s): B-2, Community Business Zone
Overlay District(s): Fire District #2

Zoning Regulation Requirements	Required	Provided
MIN. LOT AREA	10,000 SF	20 AC±
FRONTAGE	50 FT	287 FT±
FRONT YARD SETBACK	*	74.1 FT±
SIDE YARD SETBACK	12 FT **	19 FT±
REAR YARD SETBACK	10 FT	69.2 FT±
MIN. LOT WIDTH	NONE	249 FT±
MAX. BUILDING HEIGHT	45 FT ***	<45 FT
OPEN SPACE	20%	35%

* THERE IS NO FRONT YARD SETBACK; HOWEVER, THE FRONT YARD SETBACK SHALL NOT EXCEED THE AVERAGE DEPTH OF THE FRONT YARDS OF THE CLOSEST DEVELOPED LOTS ON EITHER SIDE OF THE LOT. A DEVELOPED LOT MEANS A LOT ON WHICH A PRINCIPLE STRUCTURE HAS BEEN ERECTED.

** REQUIRED SETBACK IN R-5 DISTRICT FOR TWO STORY BUILDINGS

*** 65 FEET IS ALLOWED ON LOTS IN EXCESS OF 5 ACRES PROVIDED THAT EACH OF THE SIDE YARD SETBACKS REQUIRED IS INCREASED BY 1 FOOT HORIZONTALLY FOR EACH FOOT OF HEIGHT ABOVE 45 FEET.

Parking Summary Chart

Location	Spaces Provided
FRONT PARKING FIELD	165
STOP & SHOP/RETAIL PARKING FIELD	324
TOWN HOUSES	13*
BOXING CLUB	90
APARTMENTS	30
RECREATION FIELD	34

*DOES NOT INCLUDE INDIVIDUAL TOWN HOUSE GARAGES AND DRIVEWAY SPACES

Sign Summary

M.U.T.C.D. Number	Specification Width	Specification Height	Desc.
R1-1	30"	30"	STOP
R5-1	30"	30"	DO NOT ENTER
R7-8	12"	18"	RESERVED PARKING
R7-8A	12"	6"	VAN ACCESS

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No.	Revision	Date	Appvd
1	RESPONSE TO COMMENTS	2/17/08	

Designed by DHF | Drawn by DHF | Checked by KSS
CAD checked by BKF | Approved by
Scale 1" = 40' | Date June 30, 2005

Project Title
Morrill's Crossing

Allen Avenue
Portland, Maine

Issued for
Site Plan Approval

Not Approved for Construction

Drawing Title
Layout and Materials Plan 1

Drawing Number
C-3

Sheet 3 of 16

Project Number
07334.00

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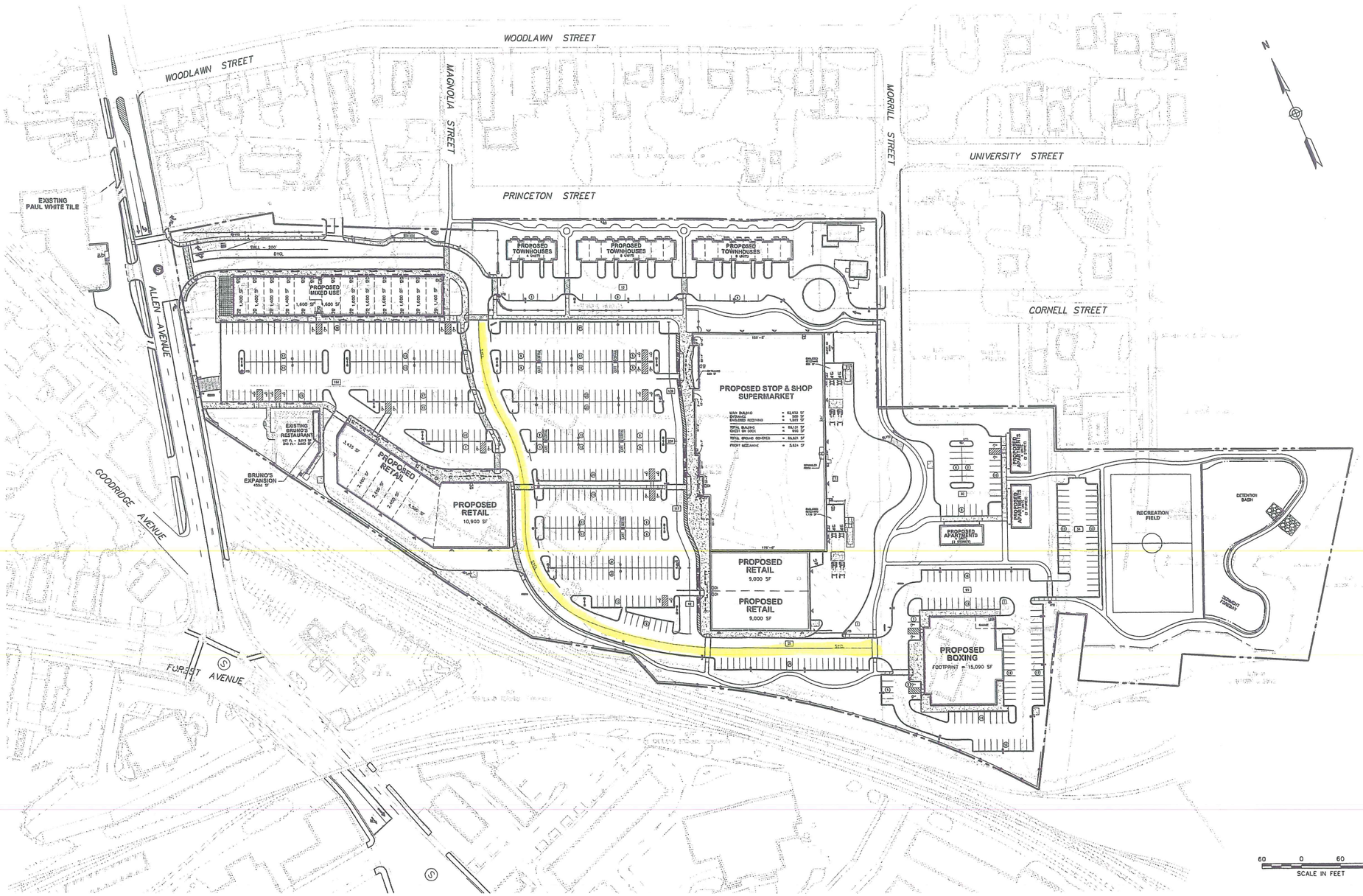

1	RESPONSE TO COMMENTS	1/16/08	
No.	Revision	Date	Appvd
Designed by DHF	Drawn by BKF	Checked by KSS	
CAD checked by BKF	Approved by		
Scale 1" = 60'	Date June 30, 2005		

Project Title
Morrill's Crossing

Allen Avenue
Portland, Maine

Issued for
Site Plan Approval

Not Approved for Construction
Drawing Title

Overall Site Plan

Drawing Number
C-2

Sheet 2 of 16

Project Number
07334.00

07334-OSP.dwg

Attachment E

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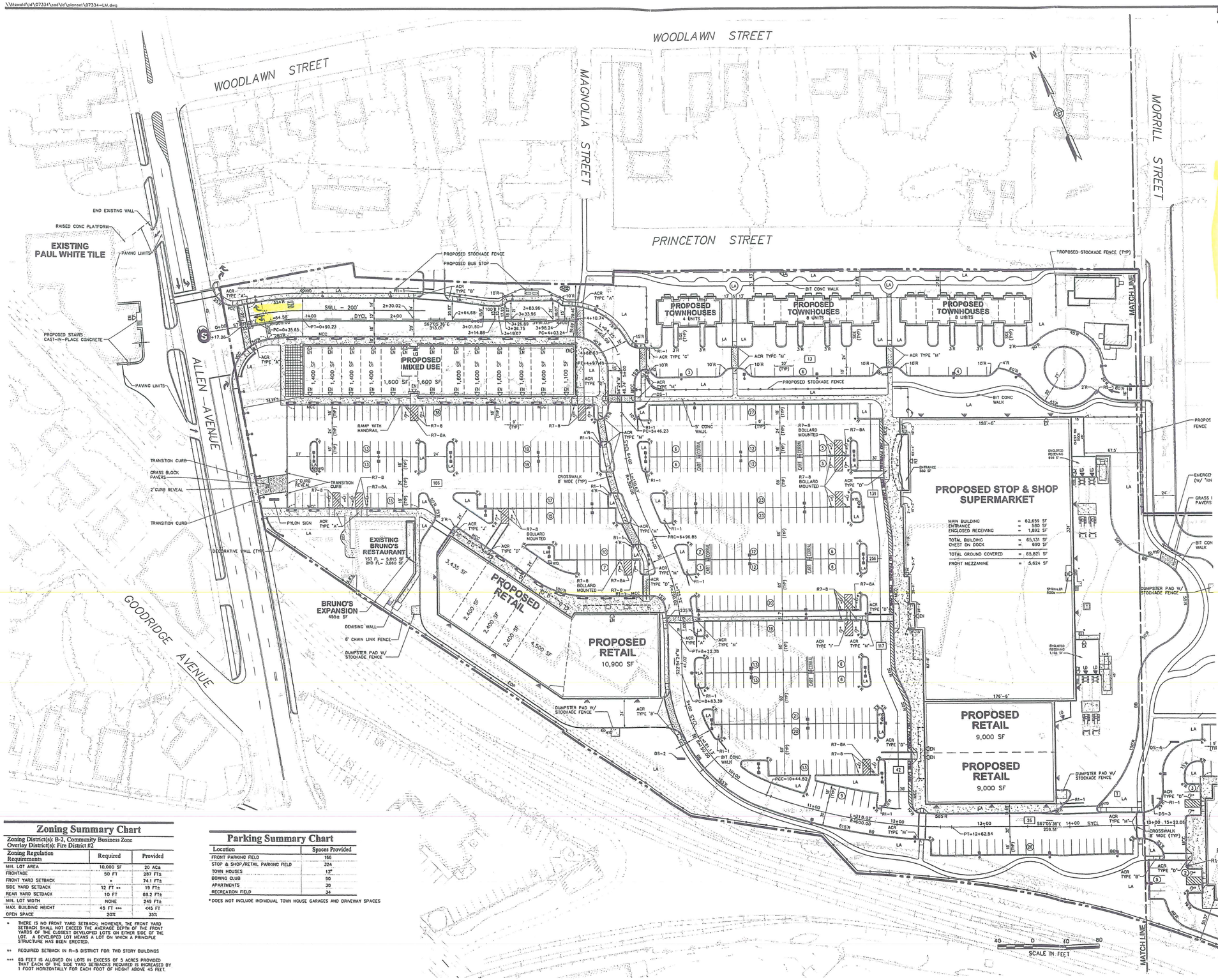

Zoning Summary Chart

Zoning District(s): B-2, Community Business Zone
Overlay District(s): Fire District #2

Zoning Regulation Requirements	Required	Provided
MIN. LOT AREA	10,000 SF	20 AC±
FRONTAGE	50 FT	287 FT±
FRONT YARD SETBACK	*	74.1 FT±
SIDE YARD SETBACK	12 FT **	19 FT±
REAR YARD SETBACK	10 FT	69.2 FT±
MIN. LOT WIDTH	NONE	249 FT±
MAX. BUILDING HEIGHT	45 FT ***	45± FT
OPEN SPACE	20%	35%

* THERE IS NO FRONT YARD SETBACK; HOWEVER, THE FRONT YARD SETBACK SHALL NOT EXCEED THE AVERAGE DEPTH OF THE FRONT YARDS OF THE CLOSEST DEVELOPED LOTS ON EITHER SIDE OF THE LOT. A DEVELOPED LOT MEANS A LOT ON WHICH A PRINCIPLE STRUCTURE HAS BEEN ERECTED.

** REQUIRED SETBACK IN R-5 DISTRICT FOR TWO STORY BUILDINGS

*** 65 FEET IS ALLOWED ON LOTS IN EXCESS OF 5 ACRES PROVIDED THAT EACH OF THE SIDE YARD SETBACKS REQUIRED IS INCREASED BY 1 FOOT HORIZONTALLY FOR EACH FOOT OF HEIGHT ABOVE 45 FEET.

Parking Summary Chart

Location	Spaces Provided
FRONT PARKING FIELD	166
STOP & SHOP/RETAIL PARKING FIELD	224
TOWN HOUSES	12*
BOXING CLUB	90
APARTMENTS	30
RECREATION FIELD	34

* DOES NOT INCLUDE INDIVIDUAL TOWN HOUSE GARAGES AND DRIVEWAY SPACES

Sign Summary

M.U.T.C.D. Number	Specification Width	Specification Height	Desc.
R1-1	30"	30"	STOP
R5-1	30"	30"	DO NOT ENTER
R7-8	12"	18"	RESERVED PARKING
R7-8A	12"	6"	VAN ACCESSIBLE

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No.	Revision	Date	Appvd
1	RESPONSE TO COMMENTS	2/12/08	

Designed by DHF | Drawn by DHF | Checked by KSS
CAD checked by BKF | Approved by
Scale 1" = 40' | Date June 30, 2005

Project Title
Morrill's Crossing
Allen Avenue
Portland, Maine

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Drawing Title
Layout and Materials Plan 1

Drawing Number
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Sheet 3 of 16

Project Number
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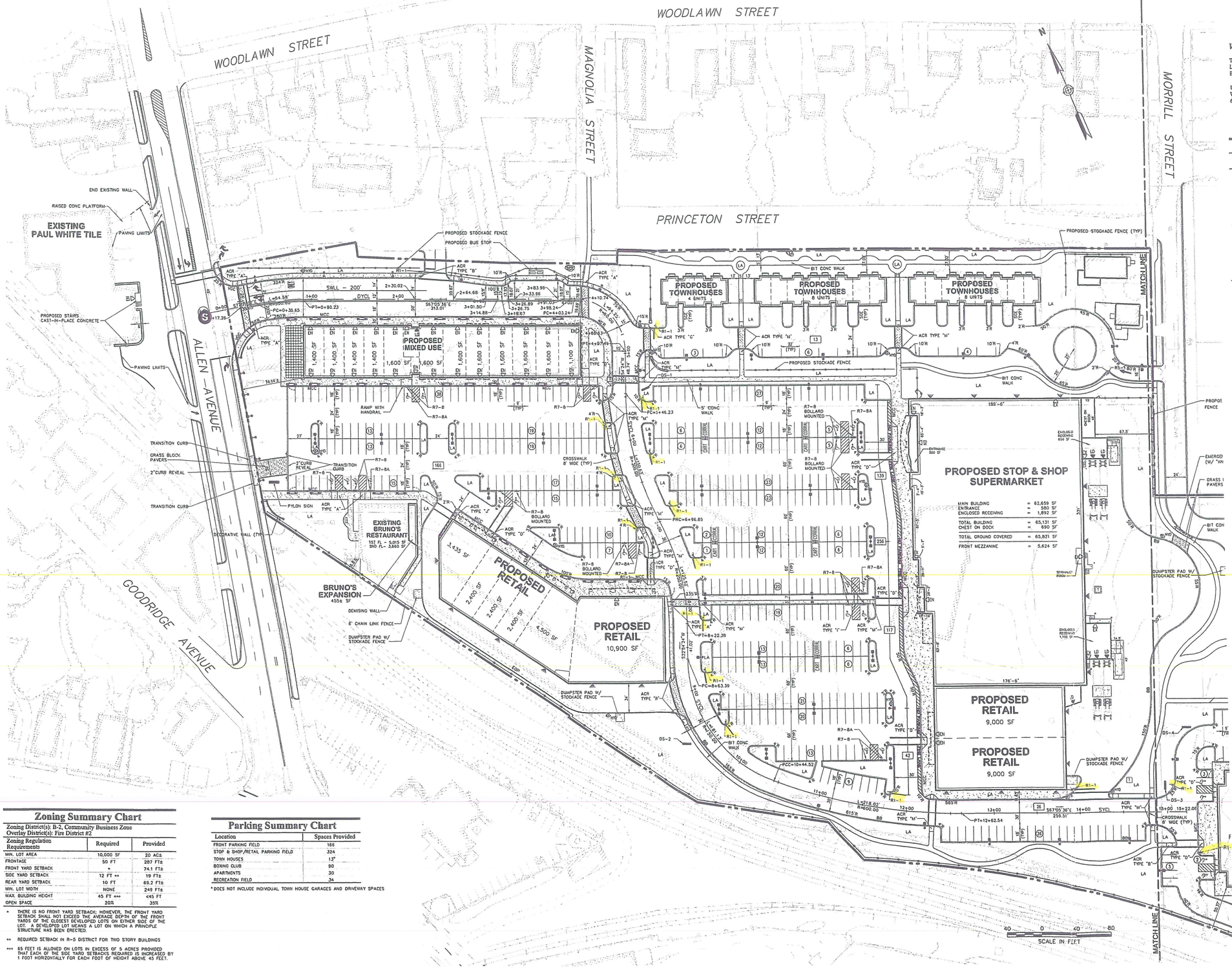


Zoning Summary Chart

Zoning District(s): B-2, Community Business Zone
Overlay District(s): Fire District #2

Zoning Regulation Requirements	Required	Provided
MIN. LOT AREA	10,000 SF	20 AC±
FRONTAGE	50 FT	287 FT±
FRONT YARD SETBACK	*	74.1 FT±
SIDE YARD SETBACK	12 FT **	19 FT±
REAR YARD SETBACK	10 FT	69.2 FT±
MIN. LOT WIDTH	NONE	249 FT±
MAX. BUILDING HEIGHT	45 FT ***	<45 FT
OPEN SPACE	20%	33%

* THERE IS NO FRONT YARD SETBACK; HOWEVER, THE FRONT YARD SETBACK SHALL NOT EXCEED THE AVERAGE DEPTH OF THE FRONT YARDS OF THE CLOSEST DEVELOPED LOTS ON EITHER SIDE OF THE LOT. A DEVELOPED LOT MEANS A LOT ON WHICH A PRINCIPLE STRUCTURE HAS BEEN ERECTED.

** REQUIRED SETBACK IN R-5 DISTRICT FOR TWO STORY BUILDINGS

*** 65 FEET IS ALLOWED ON LOTS IN EXCESS OF 5 ACRES PROVIDED THAT EACH OF THE SIDE YARD SETBACKS REQUIRED IS INCREASED BY 1 FOOT HORIZONTALLY FOR EACH FOOT OF HEIGHT ABOVE 45 FEET.

Parking Summary Chart

Location	Spaces Provided
FRONT PARKING FIELD	166
STOP & SHOP/RETAIL PARKING FIELD	324
TOWN HOUSES	13*
BOXING CLUB	90
APARTMENTS	30
RECREATION FIELD	34

* DOES NOT INCLUDE INDIVIDUAL TOWN HOUSE GARAGES AND DRIVEWAY SPACES

Sign Summary

M.U.T.C.D. Number	Specification Width	Specification Height	Desc.
R1-1	30"	30"	STOP
R5-1	30"	30"	DO NOT ENTER
R7-8	12"	18"	RESERVED PARKING
R7-8A	12"	6"	VAN ACCESSIBLE

VHB
Vanasse Hangen Brustlin, Inc.
Transportation
Land Development
Environmental Services
101 Walnut Street, P.O. Box 9151
Watertown, Massachusetts 02471
617 924 1770 • FAX 617 924 2286

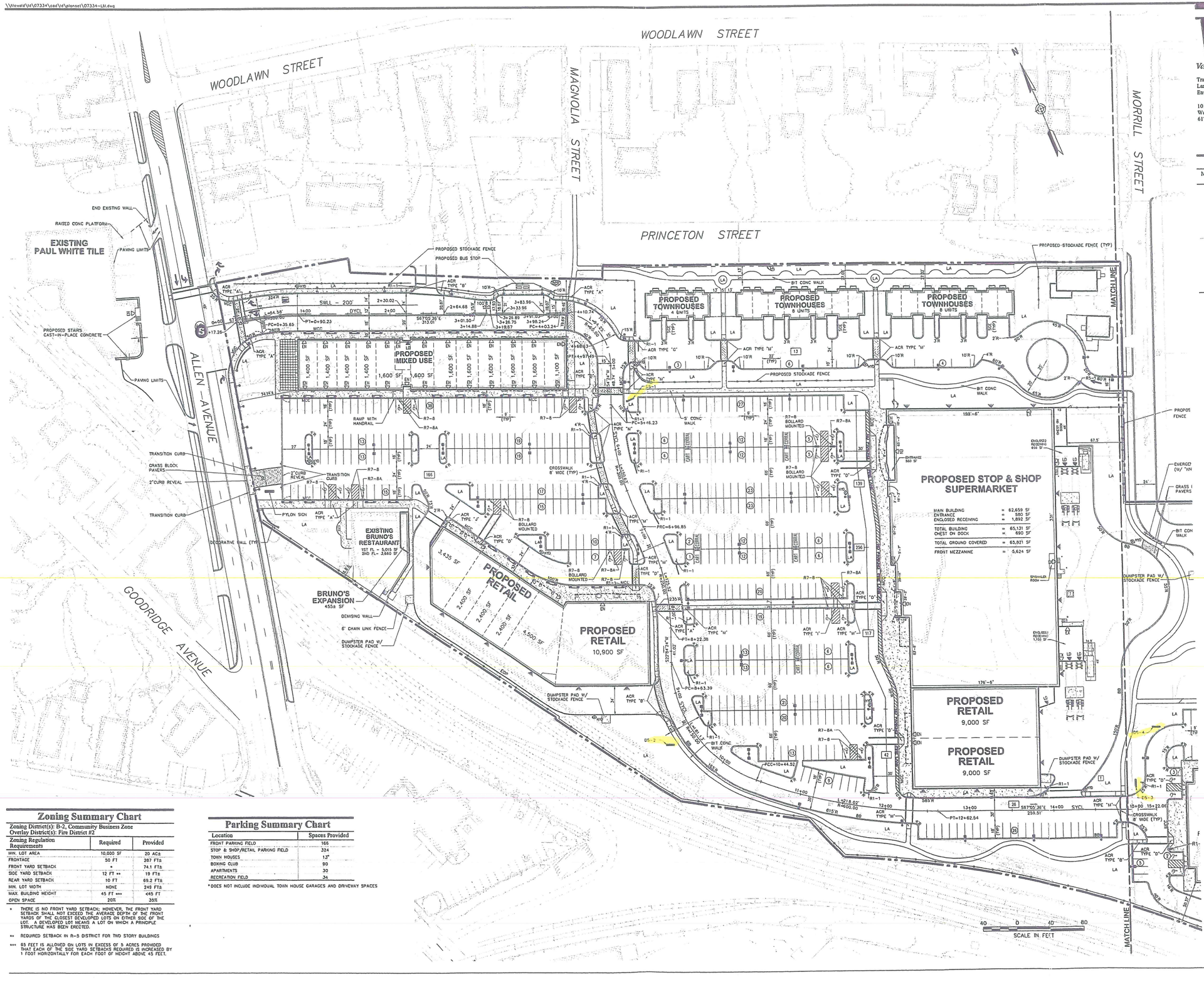
No.	Revision	Date	Appvd.
1	RESPONSE TO COMMENTS	2/17/06	

Designed by DHF | Drawn by DHF | Checked by KSS
CAD checked by BKF | Approved by
Scale 1" = 40' | Date June 30, 2005

Project Title
Morrill's Crossing
Allen Avenue
Portland, Maine
Issued for
Site Plan Approval
Not Approved for Construction
Drawing Title
Layout and Materials Plan 1

Drawing Number
C-3
Sheet 3 of 16
Project Number 07334.00

07334-LM.dwg



Zoning Summary Chart

Zoning District(s): B-2, Community Business Zone
Overlay District(s): Fire District #2

Zoning Regulation Requirements	Required	Provided
MIN. LOT AREA	10,000 SF	20 AC±
FRONTAGE	50 FT	267 FT±
FRONT YARD SETBACK	*	74.1 FT±
SIDE YARD SETBACK	12 FT **	19 FT±
REAR YARD SETBACK	10 FT	69.2 FT±
MIN. LOT WIDTH	NONE	249 FT±
MAX. BUILDING HEIGHT	45 FT ***	<45 FT
OPEN SPACE	20%	35%

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Parking Summary Chart

Location	Spaces Provided
FRONT PARKING FIELD	166
STOP & SHOP/RETAIL PARKING FIELD	324
TOWN HOUSES	13*
BOXING CLUB	80
APARTMENTS	30
RECREATION FIELD	34

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Sheet 3 of 16

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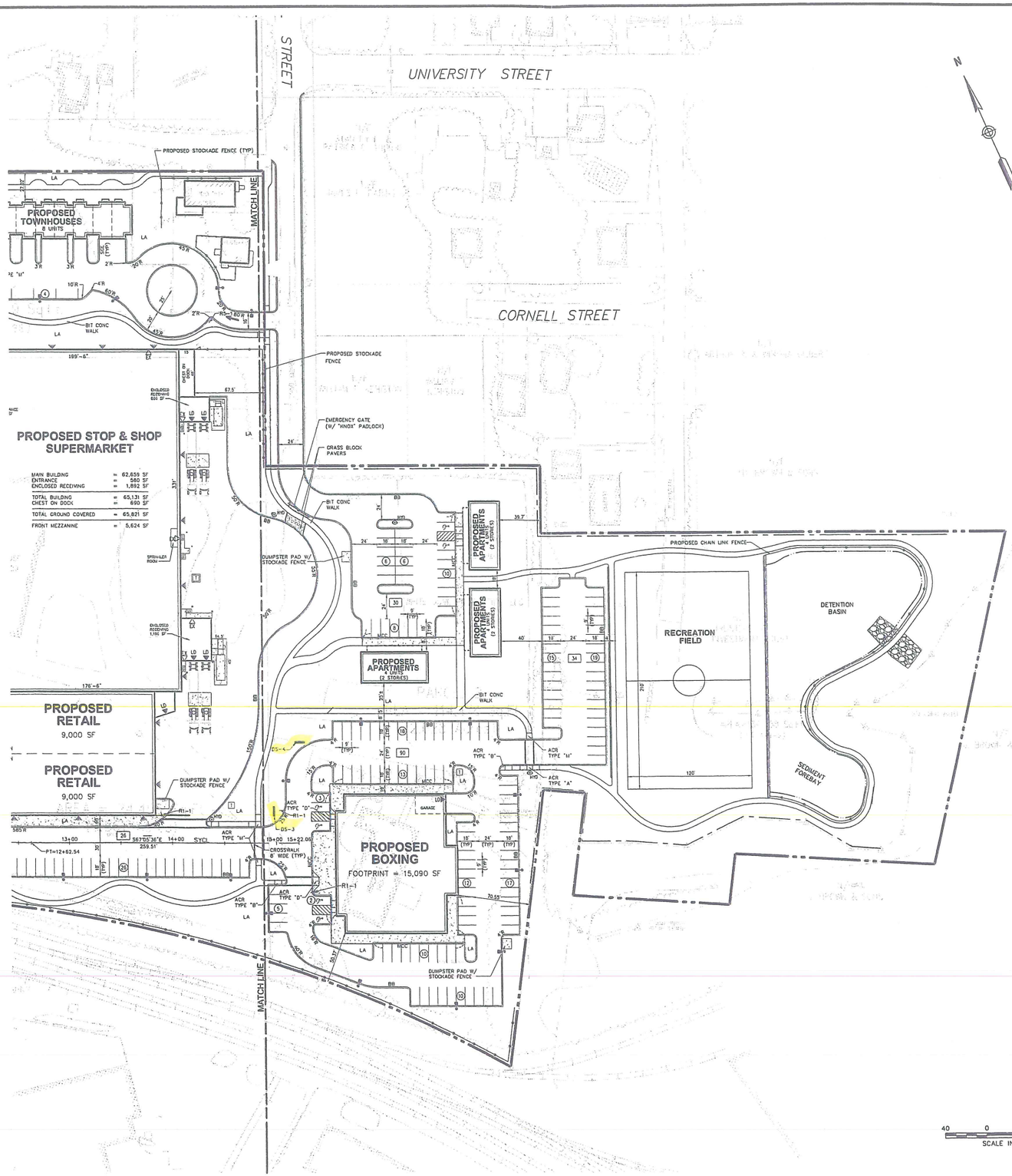

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Environmental Services

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Directional Sign Summary

Number	Description
DS-1	STOP & SHOP ← BRUNO'S → PORTLAND BOXING CLUB ↑ RECREATION FIELD ↑
DS-2	PORTLAND BOXING CLUB ↑ RECREATION FIELD ↑
DS-3	PORTLAND BOXING CLUB ↑ RECREATION FIELD ←
DS-4	RECREATION FIELD →

No.	Revision	Date	Appvd
1	RESPONSE TO COMMENTS	9/17/05	

Designed by DHF | Drawn by DHF | Checked by HSS
CAD checked by BHF | Approved by
Scale 1" = 40' | Date June 30, 2005

Project Title
Morrill's Crossing

Allen Avenue
Portland, Maine

Issued for
Site Plan Approval

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Drawing Title
Layout and Materials Plan 2

Drawing Number
C-4

Sheet 4 of 16

Project Number
07334.00

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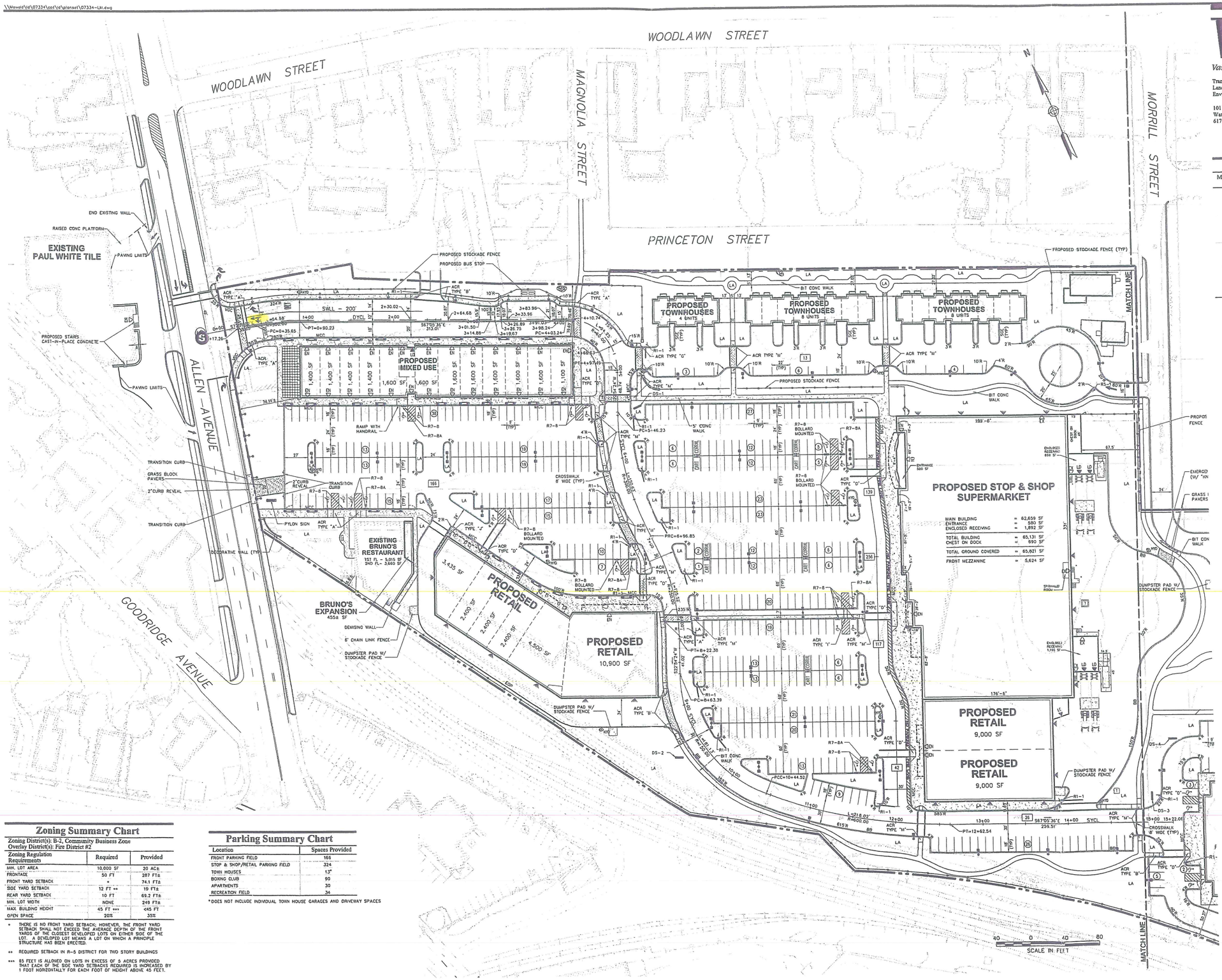

Zoning Summary Chart

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Zoning Regulation Requirements	Required	Provided
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No.	Revision	Date	Appd.
1	RESPONSE TO COMMENTS	2/17/09	

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CAD checked by BKF | Approved by
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Allen Avenue
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Layout and Materials Plan 1

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Sheet 3 of 16
Project Number
07334.00

07334-LM.dwg

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PROPOSED STOCKADE FENCE (TYP)

N/F
STANLEY E. &
PATRICA G. THORNE

N/F
JAMES E. DARING JR.

MATCH LINE

LA

27.02'

25'

PROPOSED TOWNHOUSES
8 UNITS

N/F
INE F. & JACK L. ADAMS

HEIGHT=17'
24.5'
48.6'

HEIGHT=7.5'
24'
27'

SGE (TYP)

45'R

2'R

20'R

3'R

3'R

ACR TYPE "M"

10'R

10'R

4'R

60'R

HYD

4

25'

20'

45'R

20'R

2'R

R5-180'R

16'

M.9

BIT CONC WALK

199'-6"

EX

EN

19'-3"

MCC

15'

CHEST ON DOCK 46'

GRAVEL

PROPOSED STOCKADE FENCE

N/F

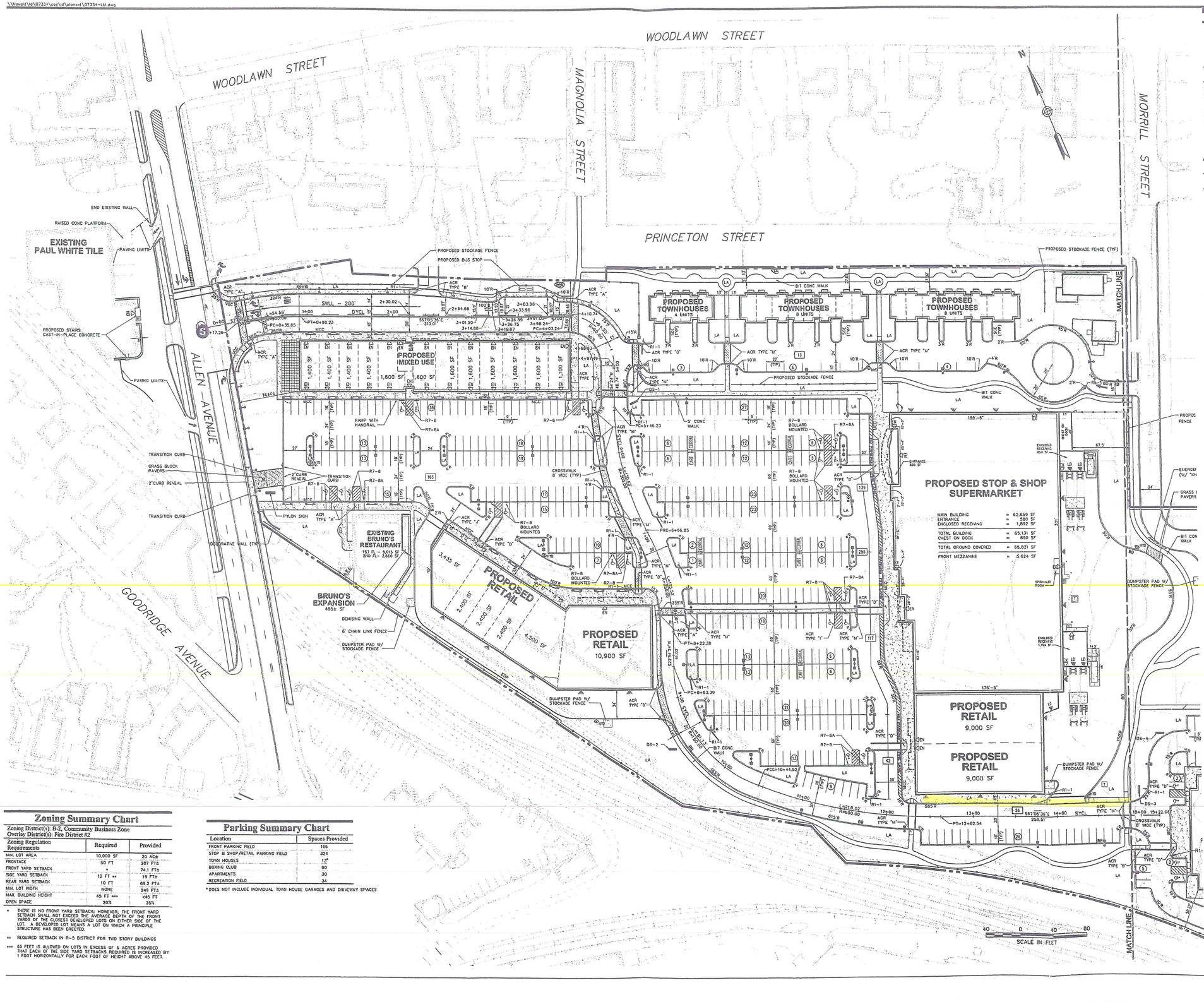
A = 333,719 Sq.Ft.
(7.661 Acres)

0 15 30 Feet

Vanasse Hangen Brustlin, Inc.

Bus Route Exhibit

Morrill Street Access
Townhouse Cul-de-Sac
Morrill's Crossing
Portland, Maine



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Sheet 3 of 16

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CARROLL ASSOCIATES
75 MARKET STREET PORTLAND, ME 04101
PHONE 207.775.1552 FAX 207.772.3713
LANDSCAPE ARCHITECTS

PROJECT MEMO: Morrill's Crossing

TO: Sarah Hopkins
FROM: Pat Carroll
DATE: January 25, 2006

RE: Landscape Peer Review

At your request, Carroll Associates has reviewed the proposed Morrill's Crossing project with respect to landscaping, buffering, screening, pedestrian circulation, and integration within the existing neighborhood. Reference materials included site visits, previous submission materials from the Applicant; discussions with the City Arborist and others in the horticultural industry, and specific review of the landscape plans for Morrill's Crossing (drawings C-9 and C-10 dated 6/30/05). The plans were reviewed for conformance with the City of Portland Land Use Standards (Chapter 14), B-2 and Contract Zone Requirements as well as Section VI- Arboricultural Specifications and Standards of Practice in the City of Portland Technical and Design Standards. Based on this analysis the following observations are made:

OVERALL SITE PLAN CONCEPT

The project consists of a mixed use development containing approximately 150,000 SF of non-residential space, 45 residential units on a parcel of land containing 20.2 acres of land. The site is located on the eastern side of Morrill's Corner in Portland abutting the Portland terminal rail lines along the south, Allen Avenue to the west, and an established residential neighborhood to the north. Primary access to the site will be from Allen Avenue across from Paul White Tile. The site is currently a mixture of vacant land and existing retail, warehouse, and office space which will for the most part be demolished for the proposed development.

An extensive landscape plan has been submitted which includes over 500 trees and 2774 shrub/ groundcover plants, as well as preservation of a small amount of existing vegetation at the rear of the property

PERIMETER BUFFER PLANTINGS

The project directly abuts an established residential neighborhood to the north and proposes to buffer the project through a combination of landscape plantings and fencing. A 6-foot stockade fence is proposed to run along the north property line from Allen Avenue approximately 240 feet to the driveway connection with the Allen Avenue Apartments. It is unclear whether the fencing extends beyond this driveway but it is recommended that it be extended to the proposed Townhouses on the east side of Magnolia Street. A mixture of deciduous and evergreen plantings has been located on both sides of the fencing adjacent to the Allen Street Apartments in conformance with the technical guidelines. Along the middle portion of the site adjacent to Princeton Street a landscaped pedestrian esplanade is proposed. This landscaping, along with the placement of the townhouse buildings, seems to provide adequate buffering between the retail/ commercial uses and the residential neighborhood between Magnolia and Morrill Streets. A second section of stockade fencing is located on the northeast corner of the project adjacent to the residences on Morrill Street, extending approximately 280 feet along the west side of the Merrill Street right-of- way. Further east along the north property line minimal fencing is proposed. Supplemental buffer plantings here are rather sparse and not adequate to properly buffer the residential uses from the service area of the grocery, especially the residences that exist at Cornell and Cambridge Streets where lights from the recreation field parking lot will shine directly into the adjacent residence.

The site is highly visible from Forest and Allen Avenues, especially where the railroad crossings occur. At these locations views are predominantly at the rear of the proposed retail buildings adjacent to Bruno's and northeastward across the parking lot towards the Stop and Shop. A 6-foot chain link fence and minimal plantings are proposed continuously along the railroad line. In several locations some earth berming is proposed to help screen the parking lots. It is recommended that additional evergreen plantings be located along the south property line in the areas between Bruno's and the supermarket to more effectively screen the rear service and parking lots from view. The addition of stockade fencing and/or berming where feasible in this area will also aid in minimizing the impact of these areas from Forest and Allen Avenues.

Entrance plantings and landscaping along Allen Avenue seems attractive and will provide a welcoming arrival for visitors. Berming this landscape area between Allen Avenue and the development is recommended to significantly screen the parking lot and vehicles from view and allow the landscaping to become the foreground element in the streetscape.

INTERIOR BUFFER PLANTINGS

Buffer plantings have been proposed within the project to buffer between the residential uses and the retail/ office uses. This planting consists primarily of evergreen trees located along the north and east sides of the supermarket, attempting to soften and screen the building mass and service areas. Landscape strips are also located between the townhouses/ retail parking lot and apartments/ Boxing Club uses on the east end of the project. This planting appears adequate as a buffer between differing uses with the exception of the supermarket service area, where additional evergreen trees, lower shrub masses, and fencing could be used to provide significantly more screening of this activity than proposed. It is also recommended that the applicant consider providing shrub understory massings where Austrian Pines are indicated, as these trees tend to lose lower branches and their effectiveness in screening will be greatly diminished as they mature.

Dumpster locations are indicated on the site plan and are proposed to be screened with a wood fence. The addition of some plant material around these structures would help soften their visual impact. More importantly, however, there is concern regarding the number and location of the dumpster pads. There are none indicated adjacent to the Mixed-Use building or for the townhouses, and the two located behind the proposed retail building seem awkward for a refuse truck to service. Trash haulers typically will place the dumpster where it can be easily lifted, and if the enclosures do not work properly the fear is that the dumpsters will be left outside the enclosure.

Parking lot islands are well landscaped with a mixture of shade trees, shrubs, and perennials/ ground covers and should provide an attractive element to the project. Technical Guidelines recommend that 10% of the parking area be landscaped and it is unclear whether this standard has been met with the proposed parking layout. Additional islands and plantings would help break up the mass of parking and provide shade, perhaps could be accommodated where light pole bases are located throughout, adding protection to the lights as well.

There is some concern regarding the extensive use of Inkberry (Ilex glabra) within the parking lot islands and throughout the site. The landscape plan specifies a total of 361 of this species to be used on the site. While the plant has a good form and is salt tolerant, it may not be suited for the harsh environment of a parking lot, where heat, dry soil, snow loading and wind burn could damage plants and lead to unsightly and dead plants. The applicant should consider using this plant where relatively protected and select anther species for the parking lot islands or where exposed to extreme growing conditions.

OTHER LANDSCAPE CONCERNS

Tree plantings indicated within cutouts in the sidewalks at the mixed-use building and other retail buildings appear to be located within very small openings (3'x3') in the pavement. Based on our experience and discussions with the City Arborist, the minimum opening size should be 24 SF, or and area approximately 6'x4'. It is also recommended that the cutouts be raised to reduce the amount of road salt and other toxins from the parking lots from being deposited in the treewell. Given the width of sidewalk indicated on the plan, there is concern whether the cutouts will allow adequate pedestrian movement along the walkway. There is also concern regarding the proximity of the trees to the buildings, but the species indicated (Armstrong Maple) is narrow and upright and should be able to survive in such a planting condition.

There is no street tree planting or other landscaping proposed in front of the supermarket and it appears that there are locations where some level of planting could be installed. This would greatly soften the front façade of the building, provide shade and interest for the pedestrian, and break up the scale of the building and pavement.

It does not appear that curbing is proposed in the island areas between driveways at the townhouses. Plantings here will not be protected from plows, vehicle wheels, etc and will have a difficult time growing. It is recommended that curbing be provided in all locations where planting or lawn areas could be subject to vehicular traffic and abuse.

Snow storage areas identified on the plan are minimal. Given the extensive landscaping proposed for the project, it appears that a plan for snow storage/ removal is critical. There is little room on islands or lawn areas to plow snow, and those plant materials adjacent to roadways, parking areas, and sidewalks need to be able to withstand plowing conditions.

Preservation of existing vegetation is not well defined on the drawings. Notes indicate that tree protection will occur at the edge of grading limits, but this does not seem to be indicated on the plan. Technical Standards as well as standard practice recommends that protection extend to the dripline of the trees to be protected. Drawings and notes should be revised to better indicate the areas and means of protection.

It appears that the detention basins will function as dry basins except for periods of inundation during storm events. It may be desirable to provide some plantings on the sideslopes to soften its appearance and blend into the natural environment which it abuts. A taller fence along the field side might also be considered to minimize balls from ending up in the pond area, and a gate somewhere would aid in retrieving those that do.

Irrigation of the landscape areas is not proposed. It is recommended that the applicant consider such a system, as there is a major investment in plant material. it is relatively inexpensive to install/ maintain, and is proven to greatly benefit landscape plants, especially in such a harsh setting.

With the extensive landscaping proposed it is critical that a maintenance program be established that protects the Owner, City, and neighbors and insures that all landscaping is properly maintained, replaced, and protected throughout the life of the project.

OTHER SITE PLAN CONCERNS

Pedestrian circulation is indicated throughout the project and in general seems to move pedestrians effectively. Several thoughts that would improve pedestrian circulation include:

1. Connect the sidewalk along the north side of the entrance roadway between Magnolia and Allen Avenue. This seems to be a natural connection and desired circulation route for pedestrians moving from the townhouses to Allen Avenue as well as neighborhood residents.
2. Connect the pedestrian sidewalk running east-west on the north side of the supermarket parking lot to Morrill's Street. This would allow neighborhood residents a more direct route to the supermarket as well as provide a connection to the apartments and recreation field in the rear.
3. Move the sidewalk along the supermarket service area to the east side of the landscape area, providing a greater buffer between the service area and pedestrian as well as making it more accessible for the apartment residents.
4. Provide additional berming and landscaping along the sidewalk between the driveway and railroad along the south side. This will be a pretty hostile environment for pedestrians and berming/ landscaping can add interest and better separation between the two.
5. Provide a sidewalk connection between the two apartment buildings in the rear and the recreation field/ parking lot. This route will definitely be used by residents and it makes sense to provide such a pathway.
6. Provide a pedestrian connection between the pathway that extends around the field/ detention pond and Cambridge Street.

Site Lighting is proposed to be a combination of 15' high pole lights in the large parking lot, 12' high pole lights adjacent to the residential and pedestrian oriented uses, and building mounted wall packs on the rear and sides of the retail and supermarket buildings. It appears that lighting fixtures will be sharp cut-off type and that minimal spill of light will be present at the property lines. Building mounted lights on the north side of the supermarket seem to provide excessive levels of light and do not seem warranted at the levels proposed. Lighting of the service area is high directly adjacent to the building but falls off quickly as one moves away from the loading area. It is unclear from the application whether lighting will remain on all night or only when operating, and the Board may wish to request clarification on this item.

It appears that the project will be constructed in phases. While the townhouses and apartments do provide buffer and screening of the retail center from the neighborhood, if their construction is delayed it will be critical that adequate buffer planting and/or screening be installed to protect the neighborhood residences. It is unclear how much of the buffer planting would be installed in the initial phase of the project.

Noise levels from vehicular traffic, service loading/ unloading, and HVAC equipment could be substantial at certain periods of the day depending on size, frequency and timing. It should be noted that plant materials by themselves are not adequate to block or suppress typical noise. To be effective, noise baffles need to be solid such that sound is reflected back or over the barrier, not dissimilar to what is found along the Interstate highways. It is unclear what methods, if any, the applicant is proposing to reduce or control noise levels on the project.

Overall the landscape plan seems appropriate and will greatly soften the impacts of such a large development, buffer the existing neighborhood, and provide an attractive retail shopping and living environment. With consideration of the recommendations in this memorandum this project we look forward to its successful completion.

Transportation
Land Development
Environmental
Services

VHB imagination | innovation | energy Creating results for our clients and benefits for our communities

February 17, 2006

Vanasse Hangen Brustlin, Inc.

Ref: 07334.00

Sarah Hopkins
Development Review Services Manager
Department of Planning & Development
City of Portland
389 Congress Street
Portland, Maine 04101

Re: Morrill's Crossing - Response to Landscape Peer Review

Dear Sarah:

The following are VHB's responses to the landscape peer review recommendations offered by Mr. Patrick Carroll of Carroll Associates in his memo addressed to you dated, January 25, 2006 regarding Morrill's Crossing. Mr. Carroll concludes that "the landscape plan seems appropriate and will greatly soften the impacts of such a large development, buffer the existing neighborhood, and provide an attractive retail shopping and living environment". In his review, Mr. Carroll has offered recommendations that we discussed in a meeting with him where you were present. Several of Mr. Carroll's recommendations have been considered and are addressed below. Draft copies of the landscape drawings reflecting the changes discussed below are included as an attachment to this letter.

PERIMETER BUFFER PLANTINGS:

Comment (page 2 of 4):

The site is highly visible from Forest and Allen Avenues, especially where the railroad crossings occur. At these locations views are predominantly at the rear of the proposed retail buildings adjacent to Bruno's.

Response:

Large evergreens have been added to infill between the proposed Maple Trees creating additional screening to the back of the buildings throughout the year.

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Watertown, Massachusetts 02471-9151
617.924.1770 ▪ FAX 617.924.2286
email: info@vhb.com
www.vhb.com

INTERIOR BUFFER PLANTINGS:

Comment (page 2 of 4):

...with the exception of the supermarket service area, where additional evergreen trees, lower shrub masses, and fencing could be used to provide significantly more screening of this activity than proposed. It is also recommended that the applicant consider providing shrub understory massings where Austrian Pines are indicated.....

Response:

Additional large evergreens and understory shrubs adjacent to the service area have been added including: Dense upright evergreen shrubs and perennials to create screening, year round interest and continuity for visual appeal from the apartments.

Comment (page 2 of 4):

There is some concern regarding the extensive use of Inkberry (Ilex glabra) within the parking lot islands and throughout the site.

Response:

The use of Inkberry has been reduced and replaced with Dwarf Mugo Pine in areas of high salt/plowing exposure, which have proven to withstand this type of abuse.

OTHER LANDSCAPE CONCERNS

Comment (page 3 of 4):

Tree plantings indicated within cutouts in the sidewalks at the mixed-use building and other retail buildings appear to be located within very small openings (3'x3') in the pavement. Based on our experience and discussions with the City Arborist, the minimum opening size should be 24 SF, or and area approximately 6' x 4'.

Response:

The 3'x3' cutouts have been increased to 3'x12' and include perennials and concrete pavers. Additionally, structural soil will be provided to sustain long term growth and greater potential for more root growth area. Concrete pavers will be dry laid providing a larger area of pervious paving for water infiltration.

Comment (page 3 of 4):

There is no street tree planting or other landscaping proposed in front of the supermarket and it appears that there are locations where some level of planting could be installed. This would greatly soften the front façade of the building…

Response:

Freestanding planters have been added to the plan in front of the two Proposed Retail buildings south of the Proposed Stop & Shop. Planters will be a minimum of 5'x5' containing one large ornamental plant encompassed by proposed annuals. Stop & Shop has found that plantings in the walkway along the front of the store actually create conflicts due to the volume of customers with shopping carriages.

Comment (page 3 of 4):

It does not appear that the curbing is proposed in the island areas between driveways at the townhouses.

Response:

Curbing has been added to these areas on the plans to protect the proposed plantings.

Comment (page 3 of 4):

Drawings and notes should be revised to better indicate the areas and means of tree protection.

Response:

Tree protection has been added to the plans in several locations the notes have been revised to reflect the suggestions. The landscape notes have also been revised and now refer to the Tree Protection Fence Detail.

Comment:

With the extensive landscaping proposed it is critical that a maintenance program be established that protects the Owner, City, and neighbors…

Response:

The Plan Maintenance Notes have been revised in order for the contractor to provide a complete maintenance program to the owner for plant and lawn care.

Other items that are identified in Mr. Carroll's memo include dumpsters (page 2 of 4), 10% interior parking lot landscaping (page 2 of 4), and pedestrian circulation (page 4 of 4). These are all items that were discussed at our meeting and the following summarizes our understanding of the discussion.

With respect to the dumpsters, it was clarified that they are located within the mixed-use building, the townhomes will have curb-side pick-up, and the dumpsters behind the proposed retail (adjacent to the railroad tracks) are roll-out units. It is our understanding that this discussion adequately addressed Mr. Carroll's comments regarding dumpsters.

Within the main parking lot (retail and supermarket parking), approximately 8% interior parking lot landscaping is provided. This is consistent with the landscaping proposed as a part of the conditional rezoning for the property. It is important to note that the overall open space/landscaping for the development exceeds 6.5 acres providing nearly 35% open space. In the design of the parking lot landscaping, a portion of the interior landscaping has been allocated to the perimeter landscape/buffer to address concerns raised during the conditional rezoning process. We believe that the landscape design is consistent with the conditional rezone and the City's Standards of Practice and Landscape Guidelines.

Mr. Carroll also provided six comments regarding pedestrian circulation. These comments were all discussed with planning staff and Mr. Errico. Sidewalks have been added in all locations where recommended by Mr. Carroll. With respect to the recommendation to provide additional berming along the railroad, we will work to incorporate additional berming as we prepare a fully revised set of permit drawings. Lastly, a pedestrian connection to Cambridge Street as not been provided due to the concern that Cambridge Street would be used for parking by the users of the recreation area. We are open to discuss this further with staff.

Please give me a call if you have any questions or need additional information.

Very truly yours,

VANASSE HANGEN BRUSTLIN, INC.

John Hession
Project Manager

David Fenstermacher
Project Engineer

Enclosure

cc: Pat Carroll – Carroll Associates

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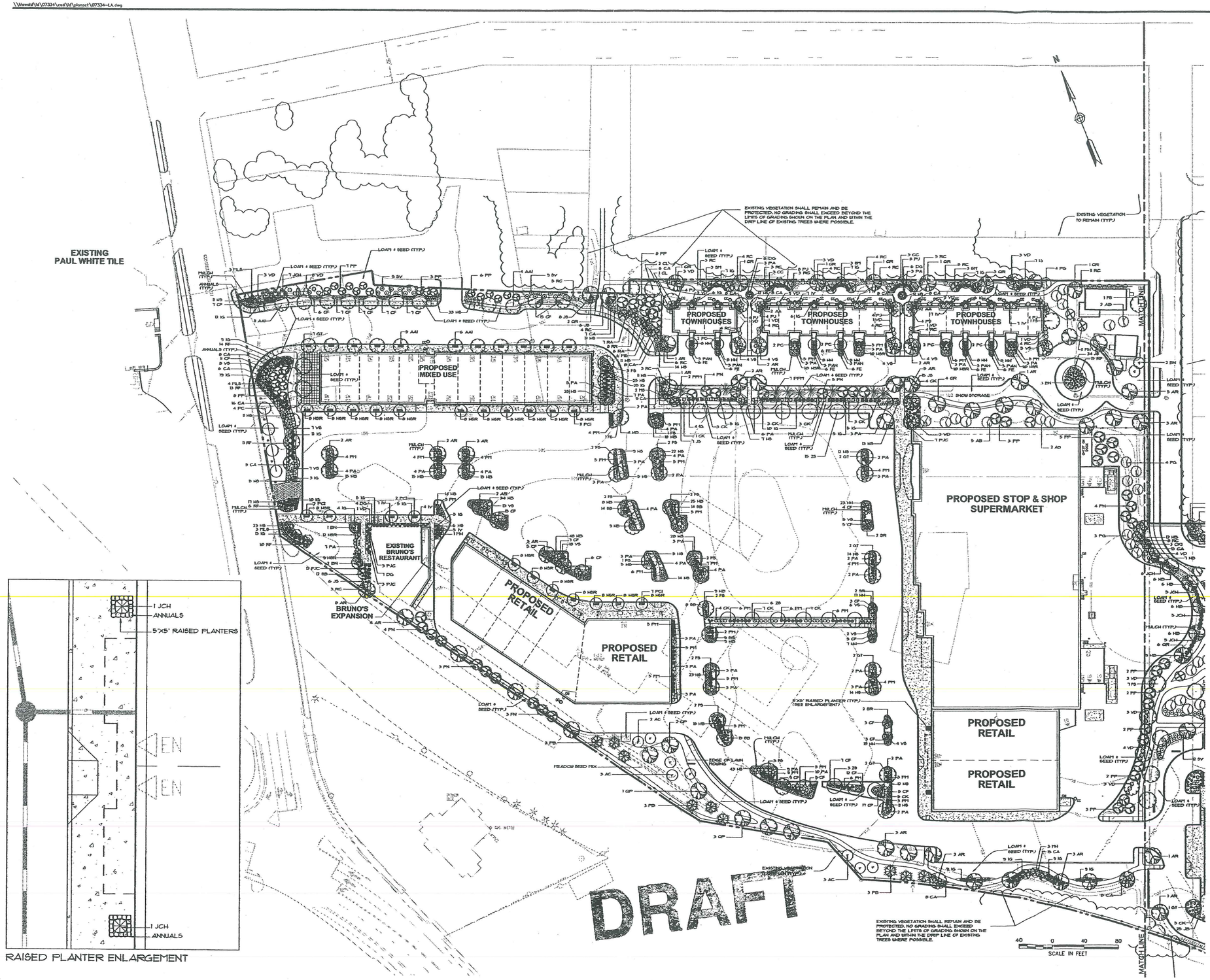

RAISED PLANTER ENLARGEMENT

VHB
Vanasse Hangen Brustlin, Inc.
Transportation
Land Development
Environmental Services
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No.	Revision	Date	Approved
1	RESPONSE TO COMMENTS	2/17/06	

Designed by EJB | Drawn by EJB | Checked by SRD
CAD checked by | Approved by
Scale 1" = 40' | Date June 30, 2005

Project Title
Morrill's Crossing

Allen Avenue
Portland, Maine

Issued for
Site Plan Approval

Not Approved for Construction

Drawing Title
Landscape Plan 1

Drawing Number
C-11

Sheet 11 of 16

Project Number
07334.00

07334-LA.DWG

1 RESPONSE TO COMMENTS 2/17/06

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QTY.	KEY	BOTANICAL NAME	COMMON NAME	SIZE
		SHADE TREES		
13	AA	ACER RUBRUM 'ARTISTRICK'	ARTISTRICK RED MAPLE	3½-3" CAL
39	AM	ACER RUBRUM 'ARTISTRICK'	ARTISTRICK RED MAPLE	3-3½" CAL
63	AR	ACER RUBRUM 'OCTOBER GLORY'	OCTOBER GLORY RED MAPLE	3½-3" CAL
3	GL	GLADRASTIS LUTEA	YELLOWWOOD	2½-3" CAL
36	FS	FRAXINUS PENNSYLVANICA 'SUMMIT'	SUMMIT GREEN ASH	2½-3" CAL
23	GT	GLEDITSIA TRIACANTHOS 'SHADE MASTER'	SHADE MASTER HONEY LOCUST	2½-3" CAL
3	NS	NYSSA SYLVATICA	TUPELO	2½-3" CAL
13	PC	PYRUS CALLERYANA 'CHANTICLEER'	CHANTICLEER PEAR (HIGH BRANCHED)	2½-3" CAL
25	PCI	PYRUS CALLERYANA 'CHANTICLEER'	CHANTICLEER PEAR (HIGH BRANCHED)	3-3½" CAL
13	QP	QUERCUS PALUSTRIS	PIN OAK	2½-3" CAL
21	QR	QUERCUS RUBRA	RED OAK	2½-3" CAL
9	TC	TILIA CORDATA 'GREENSPIRE'	GREENSPIRE LINDEN	2½-3" CAL
24	ZS	ZELKOVA SERRATA 'GREEN VASE'	GREEN VASE ZELKOVA	2½-3" CAL
		ORNAMENTAL TREES		
9	AC	AMELANCHIER CANADENSIS 'CLIFF'	CLIFF SHADBLOW SERVICEBERRY	10-12 HT.
19	BH	BETULA NIGRA 'HERITAGE'	HERITAGE RIVER BIRCH	12-14' HT.
6	CC	CERCIS CANADENSIS	EASTERN REDBUD	8-10' HT.
9	CK	CORNUS KOUSA	KOUSA DOGWOOD	2-2½" CAL
14	MH	MALUS 'HARVEST GOLD'	HARVEST GOLD CRABAPPLE	2½-3" CAL
19	MS	MALUS 'SNOWDRIFT'	SNOWDRIFT CRABAPPLE	2½-3" CAL
3	MS	MALUS 'SPRING SNOW'	SPRING SNOW CRABAPPLE	2½-3" CAL
2	MT	MAGNOLIA STELLATA	STAR MAGNOLIA	6-7' HT.
6	SR	SYRINGA RETICULATA 'IVORY SILK'	IVORY SILK TREE LILAC	2-2½" CAL
		CONIFERS		
13	AB	ABIES BALSAMEA	BALSAM FIR	6-7' HT
19	PB	PICEA ABIES	NORWAY SPRUCE	6-7' HT
31	PG	PICEA GLAUCA	WHITE SPRUCE	6-7' HT
51	PP	PICEA PUNGENS	COLORADO SPRUCE (MIXED GREEN/BLUE)	6-7' HT
9	PPM	PICEA PUNGENS 'MOORHEIM'	MOORHEIM COLORADO SPRUCE	6-7' HT
14	PS	PINUS STROBUS	WHITE PINE	6-7' HT
23	PN	PINUS NIGRA	AUSTRIAN PINE	6-7' HT.
		SHRUBS AND GROUND COVER		
115	CA	CLETHRA ALNIFOLIA	HUMMINGBIRD SUMMERSWEET	2-2½' HT.
214	GF	RUDBECKIA FULGIDA 'GOLDSTRUM'	BLACK EYED SUSAN	#1 POT
64	CK	CALAMAGROSTIS ACUTIFOLIA 'KARL FOERSTER'	FEATHER REED GRASS	#2 POT
54	DG	DEUTZIA GRACILIS 'NIKKO BLUE'	NIKKO BLENDER DEUTZIA	15-18" HT.
36	FE	FESTUCA 'ELIJA BLUE'	ELIJAH BLUE FESCUE	#1 POT
9	HA	HYDRANGEA ARBORESCENS 'ANNABELLE'	ANNABELLE HYDRANGEA	#3 POT
305	HB	HEMEROCALLIS 'BOZZ'	BOZZ DAYLILY 'RED'	#1 POT
58	HH	HEMEROCALLIS 'HAPPY RETURNS'	HAPPY RETURNS DAYLILY	#1 POT
349	HS	HEMEROCALLIS 'STELL D' ORO'	STELLA D ORO DAYLILY	#1 POT
231	HSR	HEMEROCALLIS 'SUNSET RETURNS'	SUNSET RETURNS DAYLILY	#1 POT
211	IG	ILEX GLABRA 'SHAMROCK'	SHAMROCK INKBERRY	2-2½' HT. (B&B)
56	IV	ITEA VIRGINICA 'HENRY'S GARNET'	HENRY'S GARNET VIRGINIA SWEETSPIRE	2'-2½' HT.
46	JCH	JUNIPERUS CHINENSIS 'METZI COLUMNARIS'	METZ COLUMNAR JUNIPER	4-5' HT.
72	JB	JUNIPERUS HORIZONTALIS 'BAR HARBOR'	BAR HARBOR JUNIPER	18"-24" SPD.
76	JS	JUNIPERUS CHINENSIS 'SARGENTII'	SARGENT JUNIPER	18"-24" SPD.
9	MG	MISCANTHUS SINENSIS 'TARUMPUS'	DWARF MAIDEN GRASS	#2 POT
148	PA	PENNISETUM ALOPECUROIDES 'HAMELN'	DWARF FOUNTAIN GRASS	#1 POT
19	PAN	PICEA ABIES 'NIDIFORMIS'	BIRD'S NEST SPRUCE	24-36" SPD.
48	PJ	PIERIS JAPONICA 'BROWER'S BEAUTY'	BROWER'S BEAUTY ANDROMEDA	2-2½' HT.
35	PJC	PIERIS JAPONICA 'COMPACTA'	COMPACT ANDROMEDA	2-2½' HT.
166	PM	PINUS MUGO 'PUMILIO'	DWARF MUGO PINE	18-24" SPD. (B&B)
21	RA	RHODODENDRON 'AGLO'	AGLO RHODODENDRON	2-2½' HT.
185	RC	RHODODENDRON CATAWBIENSE 'ALBUM'	WHITE CATAWBA RHODODENDRON	2-2½' HT.
69	RF	ROSA 'THE FAIRY'	THE FAIRY ROSE	18-24" SPD.
8	RR	RHODODENDRON 'PURPLE GEM'	PURPLE GEM RHODODENDRON	3 GAL.
82	SB	SPIRAEA 'BUMALDA 'GOLDFLAME'	GOLDFLAME SPIRAEA	18"-24" HT.
65	SV	SPIRAEA VANHOUTTEI	VANHOUTTE SPIRAEA	4-5' HT.
75	VD	VIBURNUM DENTATUM	ARROWWOOD VIBURNUM	3-4' HT.
9	VS	VIBURNUM P.T. 'SUMMER SNOWFLAKE'	SUMMERSNOWFLAKE VIBURNUM	2-2½' HT. (B&B)
		DEER BUFFER PLANTINGS		
9	ABI	ABIES BLABAMEA	BALSAM FIR	3-4' HT.
9	AC1	AMELANCHIAN CANADENSIS ARBOREA	SHADBLOW SERVICEBERRY	3-5' HT.
11	AI	ALNUS INCANA	SPECKLED ALDER	2-3' HT.
9	AR1	ACER RUBRUM 'OCTOBER GLORY'	OCTOBER GLORY RED MAPLE	1-1½" CAL.
13	CR	CORNUS RACEMOSA	GRAY DOGWOOD	3-4' HT.
44	IV	ILEX VERTICILLATA	WINTERBERRY HOLLY	2-3' HT.
3	PSI	PINUS STROBUS	WHITE PINE (NON-SHEERED)	4-5' HT.
22	SD	CORNUS AMOMUM	SILKY DOGWOOD	2-3' HT.

Landscape Notes

1. PROPOSED PLANTING LOCATIONS SHALL BE STAKED CAREFULLY AS SHOWN ON THE PLANS FOR FIELD REVIEW BY THE LANDSCAPE ARCHITECT PRIOR TO INSTALLATION.
2. CONTRACTOR SHALL VERIFY LOCATIONS OF ALL UTILITIES AND NOTIFY OWNERS REPRESENTATIVE OF CONFLICTS.
3. NO PLANT MATERIALS SHALL BE INSTALLED UNTIL ALL GRADING AND CONSTRUCTION HAS BEEN COMPLETED IN THE IMMEDIATE AREA.
4. A 3-INCH DEEP SHREDDED PINE BARK SHALL BE INSTALLED UNDER ALL TREES AND SHRUBS, AND IN ALL PLANTING BEDS, AS SHOWN ON THE PLANS, OR AS DIRECTED BY OWNER'S REPRESENTATIVE.
5. TREES SHALL BE BALLED AND BURLAPPED, UNLESS OTHERWISE NOTED, OR APPROVED BY THE OWNER'S REPRESENTATIVE.
6. FINAL QUANTITY FOR EACH PLANT TYPE SHALL BE AS SHOWN ON THE PLAN. THIS NUMBER SHALL TAKE PRECEDENCE IN CASE OF ANY DISCREPANCY BETWEEN QUANTITIES SHOWN ON THE PLANT LIST AND ON THE PLAN. THE CONTRACTOR SHALL REPORT ANY DISCREPANCIES BETWEEN THE NUMBER OF PLANTS SHOWN ON THE PLAN AND PLANT LABELS PRIOR TO BIDDING.
7. PROPOSED PLANT SUBSTITUTIONS MUST BE APPROVED IN WRITING BY THE OWNER'S REPRESENTATIVE.
8. PLANT MATERIALS INSTALLED SHALL MEET OR EXCEED THE SPECIFICATIONS OF THE "AMERICAN STANDARDS FOR NURSERY STOCK" BY THE AMERICAN ASSOCIATION OF NURSERYMEN.
9. PLANT MATERIALS SHALL BE GUARANTEED FOR ONE YEAR FOLLOWING DATE OF FINAL ACCEPTANCE.
10. AREAS DESIGNATED "LOAM + SEED" SHALL RECEIVE 6" OF LOAM AND SPECIFIED SEED MIX. LAWNS OVER 2:1 SLOPE SHALL BE PROTECTED WITH EROSION CONTROL FABRIC.
11. LOAM AND SEED ALL AREAS NOT OTHERWISE TREATED.
12. THIS PLAN IS INTENDED FOR LANDSCAPING PURPOSES ONLY. REFER TO SITE / CIVIL DRAWINGS FOR ALL OTHER SITE CONSTRUCTION INFORMATION.

Athletic Field Irrigation Notes

1. CONTRACTOR SHALL PROVIDE COMPLETE IRRIGATION SYSTEM DESIGN & INSTALLATION FOR THE ATHLETIC FIELD ONLY. DESIGN SHALL BE CERTIFIED BY A PROFESSIONAL LANDSCAPE ARCHITECT, ENGINEER, OR CERTIFIED IRRIGATION DESIGNER. DESIGN PLANS SHALL BE SUBMITTED TO OWNER FOR APPROVAL.
2. CONTRACTOR SHALL PROVIDE ALL MATERIALS, LABOR, AND EQUIPMENT FOR THE COMPLETE INSTALLATION OF THE IRRIGATION SYSTEM.
3. CONTRACTOR SHALL PROVIDE DRAWINGS, MATERIAL SPECIFICATIONS, SCHEMATICS, AND OTHER LITERATURE AS MAY BE REQUIRED, FOR ALL CONDUIT, CONTROLS, TIMERS, VALVES, SPRINKLER HEADS, CONNECTORS, WIRING, RAIN GUAGE, ETC. TO THE OWNER'S CONSTRUCTION MANAGER FOR APPROVAL PRIOR TO INSTALLATION.
4. CONTRACTOR SHALL COORDINATE HIS WORK WITH THE GENERAL CONTRACTOR, PLUMBING, AND ELECTRICAL CONTRACTORS.
5. BACKFLOW PREVENTER AND METER IS REQUIRED. IT SHALL BE IN CONFORMANCE WITH STATE AND MUNICIPAL REQUIREMENTS. LOCATE THIS EQUIPTIENT IN A LOCKABLE 'HOT BOX'.
6. IRRIGATION CONTROL PANEL SHALL BE LOCATED IN A LOCKABLE CABINET DESIGNED TO HOUSE THE CONTROL PANEL.
7. SITE CONTRACTOR SHALL PROVIDE 4" SCHEDULE 40 PVC SLEEVES UNDER PAVEMENT TO PROVIDE ACCESS FOR IRRIGATION LINES WHERE NECESSARY.

Tree Protection

1. EXISTING TREES TO REMAIN SHALL BE PROTECTED WITH TEMPORARY EROSION CONTROL FENCE AND HAY BALE BARRIER. ERECT BARRIER AT EDGE OF THE EARTHWORK CUT LINE PRIOR TO TREE CLEARING. LAY OUT THIS LINE BY FIELD SURVEY. WHERE POSSIBLE, THE EARTHWORK CUT LINE SHALL BE ERECTED AT THE DRIP LINE OF THE EXISTING TREES. SEE TREE PROTECTION FENCE DETAIL.
2. CONTRACTOR SHALL NOT OPERATE VEHICLES WITHIN THE TREE PROTECTION AREA. CONTRACTOR SHALL NOT STORE VEHICLES OR MATERIALS, OR DISPOSE OF ANY WASTE MATERIALS, WITHIN THE TREE PROTECTION AREA.
3. DAMAGE TO EXISTING TREES CAUSED BY THE CONTRACTOR SHALL BE REVIEWED AND REPAIRED BY A CERTIFIED ARBORIST AT THE CONTRACTOR'S EXPENSE.

Plant Maintenance Notes

1. CONTRACTOR SHALL PROVIDE COMPLETE MAINTENANCE OF THE LAWNS AND PLANTINGS. NO IRRIGATION IS PROPOSED FOR THIS SITE. THE CONTRACTOR SHALL SUPPLY SUPPLEMENTAL WATERING FOR NEW LAWNS AND PLANTINGS DURING THE ONE YEAR PLANT GUARANTEE PERIOD.
2. THE CONTRACTOR SHALL REVIEW AND SUPPLY THE OWNER WITH A COMPLETE MAINTENANCE PROGRAM OUTLINE FOR PROPER CARE OF THE PLANTS INCLUDING PROGRAMS FOR WATERING, FERTILIZATION, LAWN, (IPM) INTEGRATED PEST MANAGEMENT AND PRUNING TECHNIQUES.
3. CONTRACTOR SHALL PROVIDE ALL MATERIALS, LABOR, AND EQUIPMENT FOR THE COMPLETE LANDSCAPE MAINTENANCE WORK. WATER SHALL BE PROVIDED BY THE OWNER.
4. WATERING SHALL BE REQUIRED DURING THE GROWING SEASON, WHEN NATURAL RAINFALL IS BELOW ONE INCH PER WEEK.
5. WATER SHALL BE APPLIED IN SUFFICIENT QUANTITY TO THOROUGHLY SATURATE THE SOIL IN THE ROOT ZONE OF EACH PLANT.
6. CONTRACTOR SHALL REPLACE DEAD OR DYING PLANTS AT THE END OF THE ONE YEAR GUARANTEE PERIOD. CONTRACTOR SHALL TURN OVER MAINTENANCE TO THE FACILITY MAINTENANCE STAFF AT THAT TIME.

Dormant Cuttings:

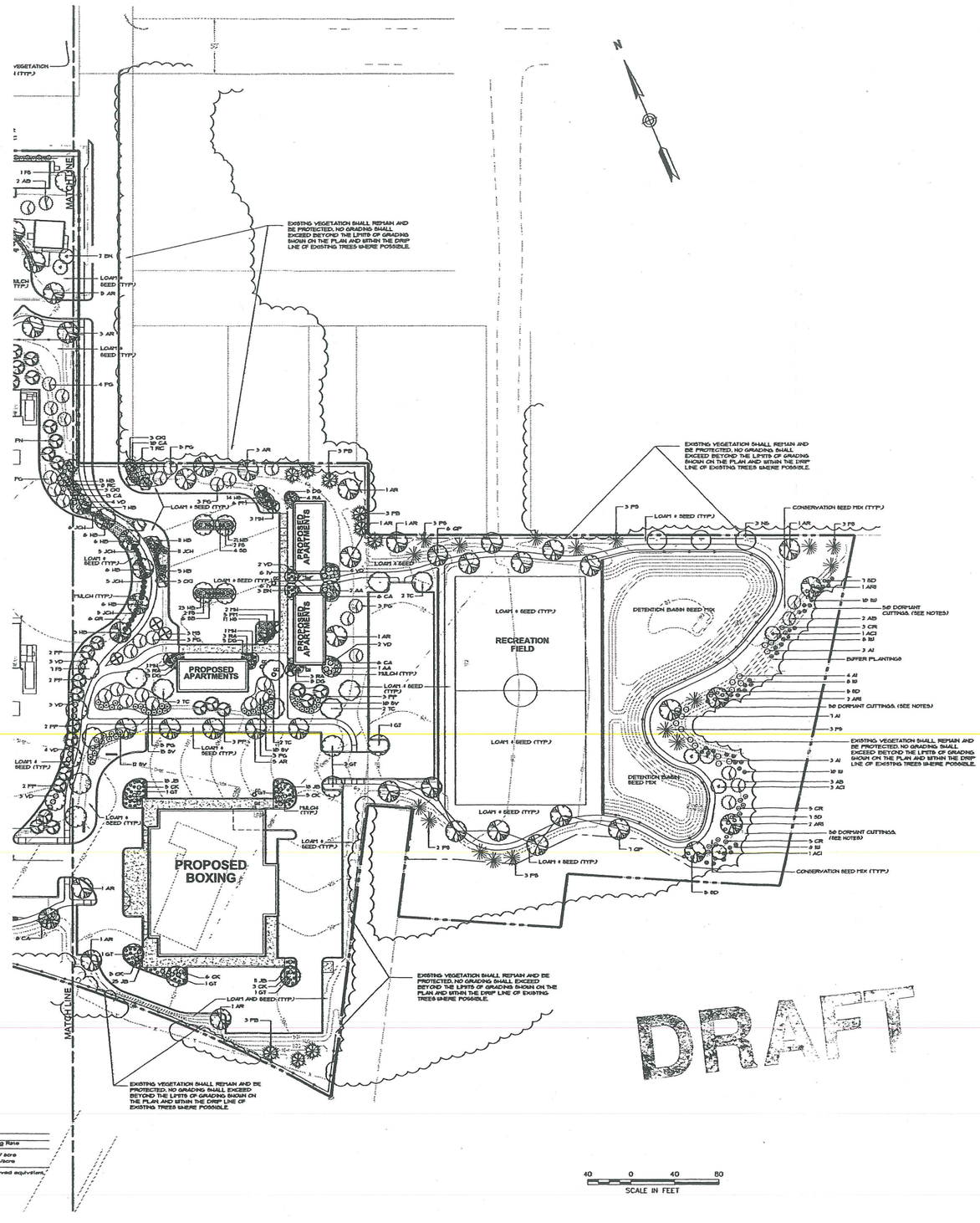
1. DORMANT CUTTINGS TO BE INSTALLED 18" ON CENTER AND DISPERSED AMONGST THE PROPOSED WETLAND BUFFER PLANTS.
2. CUTTINGS TO BE GATHERED FROM ON SITE AND INSTALLED BY A PLANT WETLAND SPECIALIST.
3. FOR SPRING PROJECTS: CUTTINGS SHALL BE GATHERED FROM ON SITE PRIOR TO MARCH 31. FOR FALL PROJECTS: CUTTINGS SHALL BE GATHERED IN THE EARLY FALL WHEN HALF DORMANT AND PLANTED THE SAME YEAR.
4. CUTTINGS SHALL BE A MINIMUM OF 1/2" THICK AND 3' FEET LONG.

Detention Basin Seed Mix

Seeding Schedule

Location	Seed Mix	Seeding Rate
Detention Basin Bottoms	New England Rivebluff Prairie Wet Meadow Mix	35 lbs/ acre
Detention Basin Side-Slopes	New England Conservation/Wildlife Mix	25 lbs/acre

Note: Seed Mix as supplied by New England Wetlands Plants, Inc. Amherst, MA (413) 256-1152, or approved equivalent.



DRAFT

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No.	RESPONSE TO COMMENTS	2/17/06
	Revision	Date

Designed by EJB | Drawn by EJB | Checked by SRD
CAD checked by | Approved by
Scale 1" = 40' | Date June 30, 2005

Project Title
Morrill's Crossing
Allen Avenue
Portland, Maine
Issued for
Site Plan Approval
Not Approved for Construction
Drawing Title
Landscape Plan 2

Drawing Number
C-12
Sheet 12 of 16
Project Number
07334.00

07334-LA.DWG

Hession, John

From: Thomas Errico [terrico@wilbursmith.com]
Sent: Monday, January 23, 2006 5:09 PM
To: SH@portlandmaine.gov
Cc: KAS@portlandmaine.gov; Nagi, Robert; Hession, John
Subject: Morrill's Crossing -- Site Plan Comments

Sarah—

The following outlines my comments on the site plan for the above referenced project.

1. It seems that two different crosswalk treatments are being proposed for the project. An explanation on the selection of treatment should be provided. I would also ask that the City Engineer review and approve the specification for the "stamped" pavement proposal. I would also note that the City should provide guidance on whether the "stamped" treatment should be applied to the crossings on Allen Avenue.
2. I would suggest that the applicant provide a sidewalk on the easterly side of the main entrance roadway from the bus pullout to Allen Avenue.
3. The location of the crosswalk on the main entrance roadway at Allen Avenue seems to be set back too far.
4. I would suggest that the applicant provide crosswalks on all approaches at the Allen Avenue/Main Entrance Roadway intersection.
5. The Main entrance roadway has a cross-section dimension of two 12' exit lanes and one 20' entry lane. I would suggest that the dimensions be adjusted to allow for some shoulder area exiting the site for bicyclists.
6. The main circulatory roadway through the site is proposed to be 30' wide. The applicant should document how this roadway will be marked. It is my opinion that the roadway be designed with such treatment that it appears to be the primary or highest classification roadway.
7. Two crosswalks are illustrated from the parking aisle to the Stop N' Shop store frontage. I would rather not have a crosswalk terminate in a travel lane. Elimination or alternatives to this treatment are recommended.
8. The applicant should document the winter maintenance program, particularly for all sidewalks and trails on their site.
9. All regulatory signage and pavement markings should be illustrated on a plan.
10. A waiver for the parking stall dimension standard will be required. The parking stalls are proposed to be 18' long. The standard is 19'.
11. Traffic control at key on-site intersections need to be illustrated. An example of this is at the intersection in front of the Boxing Facility.
12. Based upon the different land uses and size of the site, I would suggest that the applicant implement a wayfinding signage program that provides destination information.
13. The pavement arrows exiting the site should be revised to account for movements to Paul White Tile.
14. The applicant should confirm that the bus stop pullout dimensions have been approved by METRO.
15. I would suggest providing a crosswalk on the truck delivery driveway entrance and appropriate sidewalk connections to the store front. A good pedestrian connection should be provided between the proposed apartments and the retail portion of the site.

Please contact me if you have any questions or comments.

Thomas A. Errico, P.E.
Senior Transportation Engineer
Wilbur Smith Associates
[illegible] Middle Street

February 27, 2006

Vanasse Hangen Brustlin, Inc.

Ref: 07334.00

Ms. Sarah Hopkins
Development Review Services Manager
Department of Planning & Development
City of Portland
389 Congress Street
Portland, Maine 04101

Re: Response to Comments
Morrill's Crossing Traffic Study
Portland, Maine

Dear Sarah:

On Friday February 17, 2006, Vanasse Hangen Brustlin, Inc. (VHB) met with Tom Errico, acting City Traffic Engineer, and Randy Dutton from the Maine Department of Transportation (MaineDOT) to review the off site roadway plans being proposed in support of the Morrill's Crossing project. The meeting went very well and MaineDOT offered general support for the off-site roadway improvements.

During the meeting, there were several additional new comments raised by both the City and MaineDOT that required additional responses. Given that these issues were just brought to our attention, we have worked diligently to provide responses at least one week prior to the Planning Board workshop.

Generally, the comments focused on minor design elements for the project. This letter serves to summarize the general nature of the comments as we understood them to be and offers additional information in response to the new comments raised.

Bicycle and Pedestrian Committee Comments

At the meeting, Tom noted that he had recently met with representatives of the City's Bicycle and Pedestrian Committee to seek input on the proposed off-site roadway improvement plans. At that meeting, which Packard was not present at, the following comments were raised:

1. *Can the width of the travel lanes along Forest Avenue be reduced to 10 foot lanes or 10.5 foot lanes so as to increase the width of the bicycle lanes to 5 feet or 4 feet, respectively?*

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The minimum lane width that would be supported by MaineDOT on an arterial roadway such as Forest Avenue is 11 feet. Therefore, there does not appear to be any reasonable alternative to the 3 foot shoulder/bicycle lane option being proposed.

2. *Are the bicycle accommodations being extended to the Allen Avenue portion of the roadway improvements?*

   Yes, the recommended cross-section for Allen Avenue includes 14-foot outside lanes (which include 11-foot travel lanes and 3-foot shoulder/bicycle lanes) between Forest Avenue and the site driveway.

3. *Are the curb radii along the site driveway too large? Can they be reduced?*

   The curb radii at the intersection of Allen Avenue and the site driveway have been designed to accommodate the turning radius of both METRO buses and the delivery vehicles anticipated to be arriving and departing from the site. While we recognize the inherent conflict in trying to provide a minimum distance for pedestrians versus the need to provide for suitable motorized vehicle movement at the intersection, the proposed plan balances these needs to the best of our ability. In order to highlight these needs, VHB has provided truck and bus turning templates at the driveway indicating the path of the vehicles through the intersection (Attachment #1) to this letter.

4. *There is a desire to provide a more traditional pedestrian crossing at the intersection of Forest Avenue and Allen Avenue/McDonalds. Can the design at this location be modified to provide for more traditional crossings and eliminate the need for pedestrians to travel from island to island?*

   The layout of the intersection was initially designed and constructed by the Maine Department of Transportation in concert with the City of Portland. In reviewing the layout of the intersection, VHB considered several modifications to the layout of the pedestrian crossings to make it more convenient and safe. These options considered:

   - ***A direct crossing between the "Wok Inn" corner directly to the "McDonalds" side of Allen Avenue.*** While this appears to be a reasonable request, the roadway design has been a balance between the need for pedestrian amenities with the need for adequate vehicle queuing within the Morrill's Corner area. The provision of a direct crosswalk between Wok Inn and McDonalds would essentially reduce the available vehicle queuing area along outbound Forest Avenue (between Allen and Stevens) by approximately 20 feet – or one vehicle length.

Furthermore, this pedestrian connection would not be able to operate under true protected concurrent pedestrian phasing as there would be the potential for some vehicles to be crossing the pedestrian pathway when the pedestrians are provided the opportunity to cross.

Given that there is already a connection between the Wok Inn corner and the McDonalds corner via separate crossings, the limited pedestrian volume seeking to make this connection, and the potential for vehicle-pedestrian conflicts, we do not recommend any changes to the existing pedestrian facilities.

- ***Modifying the Allen Avenue crossing to provide a direct sidewalk to sidewalk connection and, therefore, avoiding the need for pedestrians to have to cross from island-to-island.*** Providing this direct connection would create potential vehicle-pedestrian conflict points as they pedestrians would not be able to cross under protected concurrent phasing operations. Again, given the limited pedestrian activity in this area and the safe pedestrian environment that currently exists at this intersection, VHB does not support any potential modification that would create new vehicle-pedestrian conflicts.

- ***Modify the existing pedestrian crossings to provide more state of the art crossing equipment.*** Recognizing that pedestrian activity may increase with the addition of new residential units as part of the proposed development, the applicant did consider the need to upgrade the pedestrian environment in some meaningful way. With this in mind, the applicant has already committed to upgrading many of the sidewalks and pedestrian ramps leading to and from existing pedestrian cross-walks throughout the Morrill's Corner area. Furthermore, the applicant has stated that all the current Morrill's Corner intersections will be upgraded to include 'countdown pedestrian timers' to provide pedestrians with a better understanding of the crossing time allocated to them.

  A recent major study of these treatments has indicted that they can reduce the number of pedestrian-related incidents at signalized intersections by up to 50 percent (see attachment #2 – ITE Journal Article).

I trust that this information is helpful and responsive to those comments and suggestions raised by the Bicycle and Pedestrian Committee. VHB and Packard are

very sensitive to the issues raised and we believe that we are providing an appropriate balance between motorized traffic along a major arterial route (Forest Avenue) and the need to provide pedestrian and bicycle amenities.

Other Maine Department of Transportation Comments

In addition to the new comments raised by the Bicycle and Pedestrian Committee, Randy Dutton offered that MDOT was generally supportive of the proposed modifications. That being said, he did have a few comments on the proposed plans which he noted would be documented in the future for the City's consideration including:

1. MDOT is concerned about the proximity of the Allen Avenue Apartment driveway with the proposed site driveway. Based on our interpretation of this concern, the applicant has been working with the owners of the Apartment complex to identify a suitable relocated driveway location which would provide greater separation between the site driveway and the apartment driveway. Furthermore, this driveway will be designated as a right-turn in/out operation only with the scored concrete median to restrict left-turns into/out of the apartment site. See Attachment # 3 for a layout of the revised Allen Avenue Apartments driveway alignment.

2. MDOT recognized the importance of evaluating vehicle queuing within the area. While they appeared to be comfortable with the general findings, they suggested that the traditional traffic analysis using the Synchro analysis software should be supplemented with a separate form of analysis using the SimTraffic software. MDOT's concern was that while Synchro does a good job estimating average vehicle queues, it tends to be overly conservative in how it calculates and presents the 95th percentile queues. VHB concurs with this view of the Synchro output and also concurs that the SimTraffic analysis provides a much more reasonable and accurate maximum queue projection as it is not a statistical calculation, but is observed based on the simulation. Attached to this letter is the requested separate analysis showing the SimTraffic output[1] which indicates that there are far fewer queuing issues than the Synchro analysis software was highlighting (Attachment #4). A separate table highlighting the specific is provided in Attachment #5.

Forest Avenue at Read Street/Adelaide Street

In a previous submission, VHB provided the City with a potential modification to the Read Street/Adelaide Street/Forest Avenue area aimed at improving both the safety and operational conditions that exist today at these locations and will exist in the future in the absence of any new traffic patterns. In essence, this modification designated Read Street as a one-way roadway away from

[1] As suggested, the SimTraffic analysis results are the average of 5 separate simulations.

Forest Avenue. In addition to this, several other minor modifications accompanying this altered travel patterns were also presented.

On Friday, Mr. Errico noted that the City was generally supportive of this modification but also requested that VHB investigate the possibility of making Read Street one-way towards Forest Avenue. VHB has evaluated this modification and it is presented as Attachment #6 to this letter. At this point in time, VHB is supportive of each option as they both offer upgrades to the pre-existing safety and operational issues inherent in the existing conditions. VHB continues to recommend that the first option (Read Street one-way away from Forest Avenue) be pursued as it provides much greater flexibility to the City in the long-term with respect to traffic flow and upgrades and seems to minimize the impacts to the Adelaide Street neighborhood.

Should you have any questions related to these responses, please feel free to contact me directly. We are eager to address all of your questions and concerns prior to the next scheduled Planning Board traffic workshop on March 7, 2006.

Regards,

VANASSE HANGEN BRUSTLIN, INC.

Robert L. Nagi, PE
Principal

Copies:
Tom Errico, Wilbur Smith Associates
Tom Gorrill, Gorrill-Palmer Consulting Engineers, Inc.
Randy Dutton, MaineDOT

Attachments

- #1 – Truck Turning Exhibits at Site Driveway
- #2 – ITE Journal Article
- #3 – Allen Avenue Apartments Conceptual Driveway Layout
- #4 – Revised SimTraffic Analysis
- #5 – Queue Summary of Revised SimTraffic Analysis
- #6 – Read/Adelaide/Bell Revised Circulation Concept Plan

#1 – Truck Turning Exhibits at Site Driveway

The truck turning graphics are attached to show how the design of the curb radii at the site driveway will serve the expected turning movements for the various vehicles anticipated to arrive and depart from the site. It should be noted that the turning radius of some larger trucks does encroach upon adjacent lanes and would need to travel over the scored median being proposed along Allen Avenue.

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EXISTING
AUL WHITE TILE

ALLEN AVENUE

PROPOSED
MIXED USE

1,400 SF
1,600 SF
1,100 SF

SWL 200'
DYCL
MCC
VGC
HYD
EN
LD

25'R
30'R
280'R
100'R
10'R

74.14'±

18'
24'
27'
9'
4'R
50'

40.00
25.00
7.00

CITY—BUS feet

Width	: 8.50
Track	: 8.50
Lock to Lock Time	: 6.00
Steering Angle	: 41.40

0 20 40 Feet

Vanasse Hangen Brustlin, Inc.

Bus Route

Turning Movements
Main Entrance
Morrill's Crossing
Portland, Maine

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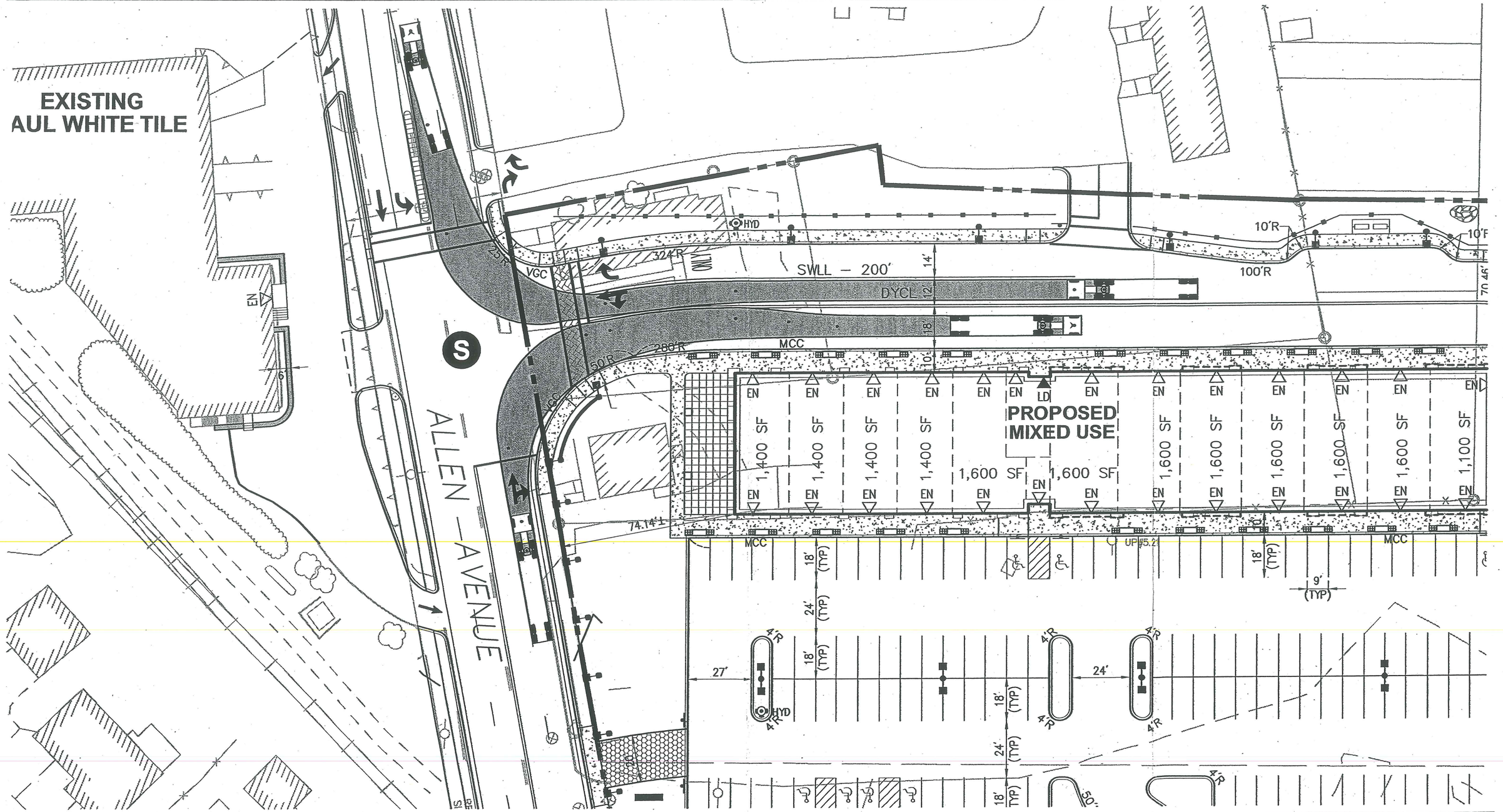

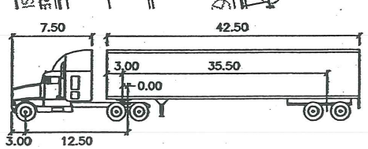

WB–50 feet

Tractor Width	: 8.00	Lock to Lock Time	: 6.00
Trailer Width	: 8.50	Steering Angle	: 17.70
Tractor Track	: 8.00	Articulating Angle	: 70.00
Trailer Track	: 8.50		

0 20 40 Feet

Vanasse Hangen Brustlin, Inc.

WB-50

Turning Movements
Main Entrance
Morrill's Crossing
Portland, Maine

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EXISTING
AUL WHITE TILE

ALLEN AVENUE

PROPOSED
MIXED USE

1,600 SF | 1,600 SF | 1,600 SF | 1,600 SF | 1,600 SF | 1,600 SF | 1,600 SF | 1,600 SF | 1,600 SF | 1,600 SF | 1,600 SF | 1,600 SF | 1,100 SF

SWLL – 200'
DYCL
MCC
VGC
HYD
EN
LD
UP 95.21
74.14'
70.46'
324'R
280'R
25'R
50'R
10'R
100'R
14'
12'
10'
18' (TYP)
24' (TYP)
9' (TYP)
27'
24'
4'R
50'

15.00 | 48.00
3.00 | 40.50
0.00
4.00 | 19.50

WB–62 feet

Tractor Width	: 8.00	Lock to Lock Time	: 6.00
Trailer Width	: 8.50	Steering Angle	: 28.40
Tractor Track	: 8.00	Articulating Angle	: 70.00
Trailer Track	: 8.50		

0 20 40 Feet

Vanasse Hangen Brustlin, Inc.

WB-62

Turning Movements
Main Entrance
Morrill's Crossing
Portland, Maine

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EXISTING
AUL WHITE TILE

ALLEN AVENUE

PROPOSED
MIXED USE

1,400 SF | 1,600 SF | 1,100 SF

SWLL – 200'

DYCL

MCC

HYD

VGC

EN

LD

UP 45.21

74.14'

WB–67	feet		
Tractor Width	: 8.00	Lock to Lock Time	: 6.00
Trailer Width	: 8.50	Steering Angle	: 28.40
Tractor Track	: 8.00	Articulating Angle	: 75.00
Trailer Track	: 8.50		

0 20 40 Feet

Vanasse Hangen Brustlin, Inc.

WB-67

Turning Movements
Main Entrance
Morrill's Crossing
Portland, Maine

#2 – ITE Journal Article on the safety benefits of the countdown pedestrian timers

The attached article provides additional information on the apparent safety benefits of the pedestrian count-down timers at signalized intersections.

Pedestrian Countdown Signals: Experience with an Extensive Pilot Installation

SAN FRANCISCO, CA, USA'S PILOT PEDESTRIAN COUNTDOWN SIGNALS WERE ASSOCIATED WITH A DECREASE IN PEDESTRIAN INJURIES AND FEWER PEDESTRIANS FINISHING CROSSING ON RED. THIS FEATURE DISCUSSES THE IMPACTS OF THE POPULAR DEVICES ON COLLISIONS, PEDESTRIAN BEHAVIOR AND ATTITUDES, MOTORIST BEHAVIOR AND SIGNAL MAINTENANCE NEEDS.

BY FRANK MARKOWITZ, STANLEY SCIORTINO, PH.D., JACK LUCERO FLECK, P.E. AND BOND M. YEE, P.E.

INTRODUCTION

At a street corner in San Francisco, CA, USA, one senior citizen said to another, "I'm a '15.' What are you?" They were discussing how long it takes them to cross the street, no longer a mystery with pedestrian countdown signals installed at about 700 of San Francisco's 1,100 signalized intersections.

More than a conversation piece, however, San Francisco's countdown signals have been associated with a 52-percent reduction in pedestrian injury collisions at pilot locations. Figure 1 shows the numeric display. Pedestrian countdown signals attempt to improve safety by displaying the time left to cross. The San Francisco Department of Parking and Traffic equipped 14 intersections in a pilot program beginning in March 2001.

Pedestrian noncompliance with signs and signals is a significant factor in pedestrian injury collisions nationally and in San Francisco, partly reflecting the frequent misunderstanding of conventional pedestrian signals. Countdown signals attempt to improve this situation by providing information on how much time is left to cross safely.

These devices have been used nationwide with generally favorable results.[1] Evaluations in Minneapolis–St. Paul, MN, USA and Montgomery County, MD, USA, each assessed five pilot locations. The Minnesota study found a reduction in pedestrians finishing crossing after conflicting traffic received the green indication and 79 percent of interviewees preferring the countdown to the conventional signal. The Montgomery County study found a reduction in pedestrian/vehicle conflicts.

In San Jose, CA, the percentage of pedestrians finishing crossing on red also was lower with countdown signals, although the study authors noted that pedestrians more often interpreted the countdown signal as allowing the start of crossing during the pedestrian clearance interval. This early experience led to the adoption of countdown signals in 2002 as a standard device in the *Manual on Uniform Traffic Control Devices* (MUTCD) *Millennium Edition*, Revision 2.

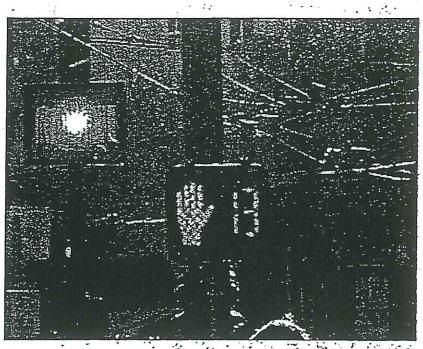

Figure 1. Pedestrian countdown signal.

Beginning in March 2001, San Francisco equipped 14 intersections in one of the early pilot testing programs in California. The period covered was sufficient that any "novelty" impacts ("the Hawthorne effect") were minimized.

(The Hawthorne effect refers to the phenomenon identified by researchers at the Western Electric Hawthorne plant, who found that virtually any reasonable change in the workplace environment had a positive impact on productivity, which they hypothesized was due to improved morale attributable to the attention paid to workers by researchers, rather than the changes themselves.)[2]

The pilot intersections were selected based on a range of factors, including pedestrian injury collision record; pedestrian volumes; crossing distance; public complaints about perceived safety; and diversity of physical and social environments. Although a press conference was held with San Francisco's mayor to introduce the new signals and the California State Automobile Association developed a flyer, the basic meaning of the countdown was intuitive to virtually all pedestrians.

- Whether respondents thought they were crossing differently due to the countdowns; and
- Whether respondents knew that to start crossing on the flashing red hand (flashing DON'T WALK) is a violation of the vehicle code.

Installation and Maintenance Experience

The Department of Parking and Traffic's Signal Shop maintains records of maintenance calls. These were available for assessing the reliability of countdown signals.

STUDY RESULTS

Crash Analysis

The number of pedestrian injury crashes declined by 52 percent after the introduction of the countdown signals (see Table 1 and Figure 2), a statistically significant reduction (confidence interval = 24.8 percent, 93.3 percent, p-value <= 0.03). There was a slight decline for the primary comparison intersection types during the time periods in question. These comparison intersection declines were not statistically significant, although the number of intersections and the injury counts were large.

The reduction in injury crashes in a higher injury non-countdown comparison sub-group was almost as great as the decline in the countdown treatment group, and the difference was not statistically significant. This suggests that regression to the mean may have played a major role in the decline.

However, the countdown injury decline was consistently greater than the non-countdown decline, in several different comparisons matching countdown and non-countdown intersections with similar pre-installation injury levels. Therefore, although the 52-percent reduction in collisions overstates the impact of the countdown, a real reduction did occur.

Pedestrian Behavior

The most important findings of the preliminary behavioral observations (as illustrated in Figure 3) were as follows:

- The percentage of pedestrians still in the crosswalk when the signal turned red showed a statistically significant decrease after the installation of countdown signals.
- The percentage of pedestrians leaving during the flashing red hand or solid red hand increased slightly (but not to a statistically significant degree).
- The percentage of pedestrians running or aborting their crossings showed a statistically significant decrease.
- The percentage of observed vehicle/pedestrian conflicts decreased (but not to a statistically significant degree).

Pedestrians who finished crossing on red dropped from 14 to 9 percent at eight intersections that were observed (during one pre-installation data collection period and two post-installation sets). This decrease is statistically significant (probability less than 1 percent of a difference due to random sample variation, pre-installation N = 591, post-installa-

Table 1. Pedestrian injury events before and after countdown signals were installed.

Treatment group	Number of intersections	Number of injury events	Percentage of injuries after/before
Group A: Countdown signals installed			
After	9	5	18.5
Before		27	
Group B: Planned countdown intersections			
After	629	740	97.0
Before		764	
Group C: No signals planned			
After	628	423	90.0
Before		469	
Group D: Countdown signals installed with 2+ crashes pre-installation			
After	3	11	42.3[a]
Before		26	
Group E: Planned countdown signals with 2+ crashes for the same period			
After	185	282	55.6[a,b]
Before		507	

Note:
[a] = Sample group crash reduction statistically significant, p-value < .05.
[b] = Difference between groups D and E not statistically significant.
Before = prior period (July 2, 1999 to April 1, 2001).
After = treatment period (April 2, 2001 to December 31, 2002).

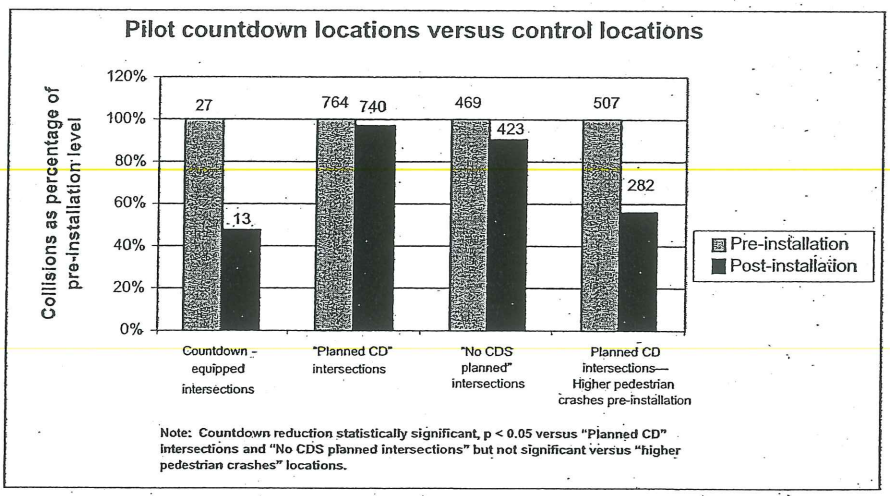

Figure 2. Pedestrian injury collision impacts of countdown signals.

from San Francisco's pilot locations provide a number of useful conclusions:

- Countdown signals appeared to reduce pedestrian injuries. Although the test group's reduction by roughly half likely was affected by regression to the mean, because the countdown reductions were consistently greater than those experienced at higher injury non-countdown locations, an improvement in safety is clearly indicated by the study. Although the trial involves a limited number of intersections, the trial period was long enough to reduce the novelty factor.
- The countdowns reduced the proportion of pedestrians finishing crossing on the red. There has not been a significant increase in the number of pedestrians starting to cross during the pedestrian clearance phase.
- The countdowns did not result in an increase in drivers running red lights.
- The devices are viewed very favorably by pedestrians for providing additional information. They are better understood than conventional pedestrian signals.
- The devices appear to imply to a substantial proportion of pedestrians that it is proper to start crossing on the flashing red hand (flashing DON'T WALK). However, the disadvantages of this effect are less important than the advantages listed above.
- The countdown signals are relatively easy to install for signal electricians. The maintenance record from two different manufacturers has been positive.
- Starting the countdown on the pedestrian clearance does not appear to reduce effectiveness substantially or trigger public complaints. Although there initially was concern among pedestrian advocates and some Department of Parking and Traffic staff that the shorter countdown would lead to complaints about allegedly insufficient time to cross and lack of usefulness, that has not been the case.
- The LED signals save energy compared to the incandescent version they replaced. The countdown uses roughly 9–10 watts and the hand/walking man uses 6–9 watts, versus about 67 watts for conventional incandescent pedestrian signals. The energy savings are a key component of San Francisco's conversion to countdown signals—the cost of installing the new countdowns was financed entirely through a loan with the state of California to be repaid out of reduced energy costs.

NEXT STEPS

Although the results are encouraging, additional analysis will be carried out when citywide results over an extended period are available. Also, within the next several years, national tests will be conducted with pedestrian countdown signals that add "animated eyes." The shifting eyes during the WALK phase remind pedestrians to check both ways. This would be funded by FHWA as part of an evaluation of several innovative technologies.

ACKNOWLEDGMENTS

The authors wish to thank the following for their support and assistance:

- California State Automobile Association, Merry Banks, traffic safety manager, as the primary funder of the pilot installations.
- DKS Associates, Shirley Chan and Deborah Dagang, for assistance with the initial tabulation and reporting of results.
- Other San Francisco Municipal Transportation Agency/Department of Parking and Traffic staff for work on the implementation and evaluation of the countdown project (including Livable Streets section manager Bridget Smith, assistant transportation engineers Maurice Growney and Philip Louie and senior engineer Harvey Quan). ■

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1. Online studies include the following:
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   - Botha, J.L. et al. "Pedestrian Countdown Signals: An Experimental Evaluation Volume 1." San Jose State University Department of Civil Engineering and City of San Jose Department of Transportation, May 2002. Accessible via www.ci.san-jose.ca.us/dot/forms/report_pedcountdown.pdf.
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   - Pulugurtha, S and S. Nambisian. *Effectiveness of Pedestrian Countdown Timers to Enhance Safety in Las Vegas.* Presented at the ITE District 6 Conference, 2004.
2. Management Guru Web site, accessible via www.mgmtguru.com/mgt301/301_Lecture1Page 9.htm.
3. SAS, Version 8.2, Cary, NC, USA, 2004.
4. Leonard, Juckes and Clement, note 1 above.
5. FHWA, Human-Centered Systems Research Program, "Pedestrian Signal Comprehension." Handout at the ITE Annual Meeting and Exhibit, Chicago, IL, USA, August 2001.

#3 – Allen Avenue Apartments Conceptual Driveway Layout

The applicant is currently working with the owner of the Allen Avenue Apartments complex to determine the optimal driveway access and egress options for their site while also integrating it within the proposed site plan. Given MaineDOTs concern about the location of the driveway in proximity to the project's main site driveway, VHB has prepared an exhibit showing the driveway relocated to the north, providing additional separation from the signalized driveway.

This proposal calls for the restriction of left-turns into and out of the Allen Avenue Apartments driveway along Allen Avenue and shifts the driveway approximately 25 feet further to the north.

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END EXISTING WALL

PLATFORM

PAVING LIMITS

TILE

REMOVE AND RESET
EXIST PLANTER AND SIGN

REMOVE AND RESET
EXIST MAILBOXES

PAVED DRIVE

RIM=106.33
2-4"IN=105.1
6"OUT=104.44

RIM=109.71
CL.INV,=104.3
8"

GAS M

PROPOSED STOCKADE

PROPOSED BUS STOP

ACR
TYPE "A"

ACR
TYPE "B"

1½ 2 STORY
WOOD FRAME
APARTMENT BLDG
HEIGHT=32.4'R

HYD

LA

R1-1

SWLL – 200'

DYCL

VGC

ALLEN AVENUE

SIGNAL
MAINTENANCE
EASEMENT

ALLEN

WALK

EN

INCRETE

PAVING LIMITS

RIM=108.8
6"IN=101.5
6"OUT=101.5

LA ELEC

331

2 STORY
WOOD FRAME
HEIGHT=30.6

GARAGE
HEIGHT=13'

LD

PROPOSED
MIXED USE

1,400 SF

1,600 SF

MCC

0 30 60 Feet

Vanasse Hangen Brustlin, Inc.

Allen Avenue Apartments
Proposed Entrance Modification
Morrill's Crossing
Portland, ME

#4 – Revised SimTraffic Analysis

Attached and provided under separate cover are updated SimTraffic analysis results as suggested by MaineDOT and the City's traffic engineer. This evaluation provides a modified evaluation of the traffic operations and vehicle queuing along area roadways and, specifically, at signalized intersections within the study area.

SimTraffic models traffic flow at a microscopic scale (as opposed to Synchro, which models traffic at a macroscopic scale). Generally, the SimTraffic model is a more accurate model for evaluating traffic operations and queuing among closely spaced traffic signals. Synchro is based on theoretical evaluations and provides a broad evaluation of various traffic operations and queuing.

Intersection: 1: School Driveway & Forest Avenue

Movement	EB	WB	NB	B55	B55	SB
Directions Served	LTR	LR	LTR	T		LTR
Maximum Queue (ft)	143	96	422	531	522	470
Average Queue (ft)	44	32	72	245	219	78
95th Queue (ft)	150	101	278	798	789	398
Link Distance (ft)	803	856	730	844	844	772
Upstream Blk Time (%)				21	21	5
Queuing Penalty (veh)				127	127	0
Storage Bay Dist (ft)						
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 2: Warren Ave & Forest Avenue

Movement	EB	EB	B38	WB	NB	NB	NB	SB	SB	B55	B27	B26
Directions Served	LT	R	T	LTR	L	T	TR	LT	TR	T	T	T
Maximum Queue (ft)	512	230	236	58	349	436	410	777	745	479	672	148
Average Queue (ft)	276	137	98	11	167	197	206	468	406	144	197	48
95th Queue (ft)	609	273	309	40	353	609	602	921	876	630	1087	343
Link Distance (ft)	445		265	217		675	675	844	844	739	1850	730
Upstream Blk Time (%)	28		22			19	19	16	13	12	7	6
Queuing Penalty (veh)	214		169			151	151	62	49	90	51	45
Storage Bay Dist (ft)		200			325							
Storage Blk Time (%)	19	14			1	20						
Queuing Penalty (veh)	120	17			7	100						

Intersection: 3: McDonald's driveway & Forest Avenue

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	R	L	LT	R	L	T	T	R	L	T	TR
Maximum Queue (ft)	47	70	45	553	583	192	82	468	512	108	351	747	726
Average Queue (ft)	17	26	16	410	442	94	9	347	379	70	282	483	394
95th Queue (ft)	61	99	40	725	733	236	47	464	529	150	416	868	865
Link Distance (ft)		138		528	528			329	329			675	675
Upstream Blk Time (%)		11		29	38			21	28			17	19
Queuing Penalty (veh)		0		119	153			202	275			116	130
Storage Bay Dist (ft)	75		75			160	75			80	325		
Storage Blk Time (%)	13	0			6	20		49	43	2	15	18	
Queuing Penalty (veh)	7	0			23	47		12	272	11	76	71	

Intersection: 4: Bishop Street & Forest Avenue

Movement	EB	NB	NB	SB	SB	NE	NE	B13
Directions Served	LR	T	T	T	R>	L	LR	T
Maximum Queue (ft)	1018	374	368	420	426	382	378	788
Average Queue (ft)	612	330	322	298	146	349	286	633
95th Queue (ft)	1144	383	389	525	331	444	394	1100
Link Distance (ft)	1067	303	303	329	329	315	315	774
Upstream Blk Time (%)	13	58	46	19	1	75	17	62
Queuing Penalty (veh)	0	389	310	139	6	0	0	0
Storage Bay Dist (ft)								
Storage Blk Time (%)								
Queuing Penalty (veh)								

Intersection: 9: Plymouth Street & Allen Avenue

Movement	EB	WB	NB	SB	B33	B32
Directions Served	LR	LR	LTR	LTR	T	T
Maximum Queue (ft)	56	68	404	429	615	431
Average Queue (ft)	24	21	77	215	238	208
95th Queue (ft)	84	88	262	542	823	799
Link Distance (ft)	986	578	844	407	740	839
Upstream Blk Time (%)				27	22	16
Queuing Penalty (veh)				206	169	127
Storage Bay Dist (ft)						
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 10: Allen Avenue & Washington Avenue

Movement	EB	EB	EB	B32	WB	WB	NB	NB	NB	SB	SB	SB	SB
Directions Served	L	L	TR	T	L	TR	L	T	TR	L	T	T	R
Maximum Queue (ft)	207	254	555	40	129	544	330	907	903	165	269	281	260
Average Queue (ft)	93	119	194	1	75	301	163	473	468	53	144	181	103
95th Queue (ft)	188	243	451	28	145	582	329	1726	1701	121	264	296	266
Link Distance (ft)			839	740		638		2887	2887		286	286	
Upstream Blk Time (%)			0			14		7	7	0	0	13	14
Queuing Penalty (veh)			2			0		0	0	0	0	0	0
Storage Bay Dist (ft)	250	250			100		340			250			250
Storage Blk Time (%)	0	0	5		7	46	11	1			1	1	14
Queuing Penalty (veh)	0	1	23		22	55	44	1			1	2	41

Intersection: 11: Warren Ave & Hicks St

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LR	LTR
Maximum Queue (ft)	292	24	36	164
Average Queue (ft)	124	1	7	75
95th Queue (ft)	325	14	28	251
Link Distance (ft)	277	265	227	342
Upstream Blk Time (%)	21			10
Queuing Penalty (veh)	0			0
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 12: Site Drive & Allen Avenue

Movement	WB	NB	SB	SB
Directions Served	LR	TR	LT	T
Maximum Queue (ft)	210	183	269	330
Average Queue (ft)	68	79	151	170
95th Queue (ft)	198	385	330	417
Link Distance (ft)	968	528	258	258
Upstream Blk Time (%)		13	7	35
Queuing Penalty (veh)		137	28	144
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Nework Summary

Network wide Queuing Penalty: 5744

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1863	1900	1900	2083	1900
Lane Width	12	14	16	12	12	12	12	12	12	12	12	12
Total Lost time (s)		3.0	3.0		3.0		3.0	3.0			3.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95			0.95	
Frt		1.00	0.85		0.99		1.00	1.00			0.99	
Flt Protected		0.95	1.00		0.98		0.95	1.00			1.00	
Satd. Flow (prot)		1915	1812		1682		1787	3500			3870	
Flt Permitted		0.72	1.00		0.86		0.95	1.00			0.94	
Satd. Flow (perm)		1445	1812		1482		1787	3500			3623	
Volume (vph)	120	5	640	5	5	1	505	1090	10	10	755	65
Peak-hour factor, PHF	0.86	0.86	0.86	0.55	0.55	0.55	0.98	0.98	0.98	0.86	0.86	0.86
Adj. Flow (vph)	140	6	744	9	9	2	515	1112	10	12	878	76
RTOR Reduction (vph)	0	0	17	0	2	0	0	0	0	0	6	0
Lane Group Flow (vph)	0	146	727	0	18	0	515	1122	0	0	960	0
Heavy Vehicles (%)	1%	1%	1%	9%	9%	9%	1%	1%	1%	1%	1%	1%
Turn Type	Perm		pm+ov	Perm			Prot			Perm		
Protected Phases		8	5		4		5	2			6	
Permitted Phases	8	8	8	4	4			2		6	6	
Actuated Green, G (s)		10.0	40.0		10.0		30.0	63.5			28.5	
Effective Green, g (s)		12.0	44.0		12.0		32.0	65.5			30.5	
Actuated g/C Ratio		0.14	0.53		0.14		0.38	0.78			0.37	
Clearance Time (s)		5.0	5.0		5.0		5.0	5.0			5.0	
Vehicle Extension (s)		2.5	2.5		2.5		2.5	3.0			3.0	
Lane Grp Cap (vph)		208	1020		213		685	2746			1323	
v/s Ratio Prot			c0.27				0.29	0.32				
v/s Ratio Perm		0.10	0.13		0.01						c0.27	
v/c Ratio		0.70	0.71		0.09		0.75	0.41			0.73	
Uniform Delay, d1		34.0	15.0		31.0		22.3	2.9			22.9	
Progression Factor		1.00	1.00		1.00		1.00	1.00			1.00	
Incremental Delay, d2		9.5	2.2		0.1		4.4	0.1			2.0	
Delay (s)		43.6	17.2		31.1		26.8	3.0			24.9	
Level of Service		D	B		C		C	A			C	
Approach Delay (s)		21.5			31.1			10.4			24.9	
Approach LOS		C			C			B			C	

Intersection Summary				
HCM Average Control Delay	17.3	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.72			
Actuated Cycle Length (s)	83.5	Sum of lost time (s)	6.0	
Intersection Capacity Utilization	75.2%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	2023	2011	2261	1900	2496	1900	1897	1900	1900
Lane Width	12	12	12	12	12	12	12	12	12	11	11	11
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Util. Factor	1.00	1.00	1.00	*0.99	*0.99	1.00	1.00	*0.79	1.00	1.00	*0.65	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1900	1615	1884	1884	1884	1805	3944	1599	1725	2358	
Flt Permitted	0.95	1.00	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1805	1900	1615	1884	1884	1884	1805	3944	1599	1725	2358	
Volume (vph)	15	15	40	430	15	365	25	1225	625	390	990	20
Peak-hour factor, PHF	0.83	0.83	0.83	0.92	0.92	0.92	0.97	0.97	0.97	0.86	0.86	0.86
Adj. Flow (vph)	18	18	48	467	16	397	26	1263	644	453	1151	23
RTOR Reduction (vph)	0	0	46	0	0	30	0	0	0	0	1	0
Lane Group Flow (vph)	18	18	2	235	248	367	26	1263	644	453	1173	0
Heavy Vehicles (%)	0%	0%	0%	1%	0%	2%	0%	0%	1%	1%	1%	0%
Turn Type	Split		Prot	Split		pm+ov	Prot		pm+ov	Prot		
Protected Phases	3	3	3	4	4	1	5	2	4	1	6	
Permitted Phases		3				4		2	2		6	
Actuated Green, G (s)	2.3	2.3	2.3	15.6	15.6	44.5	1.7	41.9	57.5	28.9	69.1	
Effective Green, g (s)	3.8	3.8	3.8	17.1	17.1	47.5	3.2	43.9	61.0	30.4	71.1	
Actuated g/C Ratio	0.04	0.04	0.04	0.16	0.16	0.44	0.03	0.41	0.57	0.28	0.66	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5.0	4.5	4.5	5.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	2.0	2.0	3.0	3.0	2.0	3.0	
Lane Grp Cap (vph)	64	67	57	301	301	888	54	1615	910	489	1564	
v/s Ratio Prot	c0.01	0.01	0.00	0.12	c0.13	0.12	0.01	0.32	0.11	c0.26	c0.50	
v/s Ratio Perm						0.08			0.29			
v/c Ratio	0.28	0.27	0.03	0.78	0.82	0.41	0.48	0.78	0.71	0.93	0.75	
Uniform Delay, d1	50.4	50.3	49.9	43.3	43.6	20.3	51.2	27.5	16.7	37.3	12.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.4	2.2	0.2	12.3	16.5	0.1	2.5	3.8	2.5	23.3	2.1	
Delay (s)	52.8	52.5	50.1	55.6	60.1	20.5	53.6	31.3	19.2	60.6	14.2	
Level of Service	D	D	D	E	E	C	D	C	B	E	B	
Approach Delay (s)		51.2			41.0			27.6			27.1	
Approach LOS		D			D			C			C	

Intersection Summary				
HCM Average Control Delay	30.5	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.80			
Actuated Cycle Length (s)	107.2	Sum of lost time (s)	9.0	
Intersection Capacity Utilization	75.7%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBR	NBL	NBT	SBT	SBR	SBR2	NEL	NER
Lane Configurations									
Ideal Flow (vphpl)	1900	1900	1900	1917	1693	1900	1900	1900	1900
Lane Width	12	12	11	11	11	11	11	12	12
Total Lost time (s)	3.0			3.0	3.0	3.0		3.0	
Lane Util. Factor	1.00			0.95	1.00	1.00		0.97	
Frt	0.98			1.00	1.00	0.85		1.00	
Flt Protected	0.96			1.00	1.00	1.00		0.95	
Satd. Flow (prot)	1751			3486	1620	1546		3502	
Flt Permitted	0.96			1.00	1.00	1.00		0.95	
Satd. Flow (perm)	1751			3486	1620	1546		3502	
Volume (vph)	85	15	0	1350	985	465	10	515	0
Peak-hour factor, PHF	0.75	0.75	0.95	0.95	0.92	0.92	0.92	0.89	0.89
Adj. Flow (vph)	113	20	0	1421	1071	505	11	579	0
RTOR Reduction (vph)	0	0	0	0	0	1	0	0	0
Lane Group Flow (vph)	133	0	0	1421	1071	515	0	579	0
Heavy Vehicles (%)	2%	2%	1%	1%	1%	1%	1%	0%	0%
Turn Type						Perm			
Protected Phases	3			2	6			4	
Permitted Phases					6	6			
Actuated Green, G (s)	7.0			71.0	71.0	71.0		17.0	
Effective Green, g (s)	9.0			73.0	73.0	73.0		19.0	
Actuated g/C Ratio	0.08			0.66	0.66	0.66		0.17	
Clearance Time (s)	5.0			5.0	5.0	5.0		5.0	
Vehicle Extension (s)	2.5			3.0	3.0	3.0		2.5	
Lane Grp Cap (vph)	143			2313	1075	1026		605	
v/s Ratio Prot	c0.08			0.41	c0.66			c0.17	
v/s Ratio Perm						0.33			
v/c Ratio	0.93			0.61	1.00	0.50		0.96	
Uniform Delay, d1	50.2			10.5	18.4	9.3		45.1	
Progression Factor	1.00			1.00	1.00	1.00		1.00	
Incremental Delay, d2	54.4			0.5	26.4	0.4		26.0	
Delay (s)	104.6			11.0	44.7	9.7		71.1	
Level of Service	F			B	D	A		E	
Approach Delay (s)	104.6			11.0	33.3			71.1	
Approach LOS	F			B	C			E	

Intersection Summary			
HCM Average Control Delay	33.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	88.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.91			0.91			1.00			1.00	
Flt Protected		0.98			0.98			1.00			1.00	
Satd. Flow (prot)		1701			1703			1893			1876	
Flt Permitted		0.88			0.91			0.97			0.98	
Satd. Flow (perm)		1523			1577			1835			1839	
Volume (vph)	5	0	10	5	0	10	25	875	15	15	800	10
Peak-hour factor, PHF	0.61	0.61	0.61	0.75	0.75	0.75	0.93	0.93	0.93	0.95	0.95	0.95
Adj. Flow (vph)	8	0	16	7	0	13	27	941	16	16	842	11
RTOR Reduction (vph)	0	15	0	0	12	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	9	0	0	8	0	0	984	0	0	869	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			2			1			1	
Permitted Phases	2			2			1			1		
Actuated Green, G (s)		3.8			3.8			84.1			84.1	
Effective Green, g (s)		4.8			4.8			85.1			85.1	
Actuated g/C Ratio		0.05			0.05			0.89			0.89	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		76			79			1628			1632	
v/s Ratio Prot												
v/s Ratio Perm		c0.01			0.00			c0.54			0.47	
v/c Ratio		0.12			0.10			0.60			0.53	
Uniform Delay, d1		43.5			43.5			1.3			1.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.7			0.5			1.7			1.2	
Delay (s)		44.2			44.0			3.0			2.4	
Level of Service		D			D			A			A	
Approach Delay (s)		44.2			44.0			3.0			2.4	
Approach LOS		D			D			A			A	

Intersection Summary					
HCM Average Control Delay	3.7	HCM Level of Service		A	
HCM Volume to Capacity ratio	0.58				
Actuated Cycle Length (s)	95.9	Sum of lost time (s)		6.0	
Intersection Capacity Utilization	71.8%	ICU Level of Service		C	
Analysis Period (min)	15				

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	11	12	12	11	11	10	10	10	12
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Util. Factor	0.97	1.00		1.00	1.00		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.96		1.00	0.97		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3351	1798		1711	1805		1728	3406		1668	3336	1599
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3351	1798		1711	1805		1728	3406		1668	3336	1599
Volume (vph)	425	310	130	120	270	70	190	770	80	90	590	315
Peak-hour factor, PHF	0.93	0.93	0.93	0.89	0.89	0.89	0.92	0.92	0.92	0.95	0.95	0.95
Adj. Flow (vph)	457	333	140	135	303	79	207	837	87	95	621	332
RTOR Reduction (vph)	0	12	0	0	7	0	0	6	0	0	0	143
Lane Group Flow (vph)	457	461	0	135	375	0	207	918	0	95	621	189
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	1%	1%	1%	1%	1%	1%
Turn Type	Prot			Prot			Prot			Prot		pm+ov
Protected Phases	7	4		3	8		5	2		1	6	7
Permitted Phases												6
Actuated Green, G (s)	18.1	36.1		9.6	27.6		16.4	36.8		7.2	27.6	45.7
Effective Green, g (s)	20.1	38.1		11.6	29.6		18.4	38.8		9.2	29.6	49.7
Actuated g/C Ratio	0.18	0.35		0.11	0.27		0.17	0.35		0.08	0.27	0.45
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	614	624		181	487		290	1205		140	900	768
v/s Ratio Prot	c0.14	c0.26		0.08	0.21		c0.12	c0.27		0.06	0.19	0.05
v/s Ratio Perm												0.07
v/c Ratio	0.74	0.74		0.75	0.77		0.71	0.76		0.68	0.69	0.25
Uniform Delay, d1	42.4	31.4		47.6	36.9		43.2	31.4		48.8	35.9	18.5
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	4.9	4.6		15.3	7.2		8.1	2.9		12.3	2.2	0.2
Delay (s)	47.2	36.0		63.0	44.1		51.2	34.3		61.1	38.2	18.6
Level of Service	D	D		E	D		D	C		E	D	B
Approach Delay (s)		41.5			49.0			37.4			34.1	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM Average Control Delay	39.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	109.7	Sum of lost time (s)	6.0
Intersection Capacity Utilization	73.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Intersection: 5: Morrill Street & Forest Avenue

Movement	WB	NB	NB	SB	SB
Directions Served	LR	T	TR	LT	T
Maximum Queue (ft)	190	545	608	227	225
Average Queue (ft)	67	496	515	59	38
95th Queue (ft)	165	680	736	185	158
Link Distance (ft)	656	538	538	285	285
Upstream Blk Time (%)		13	18	0	0
Queuing Penalty (veh)		83	113	0	0
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 6: Good Will driveway & Forest Avenue

Movement	EB	NB	SB	SB
Directions Served	LTR	LTR	L	TR
Maximum Queue (ft)	141	505	467	437
Average Queue (ft)	35	331	128	33
95th Queue (ft)	107	651	325	242
Link Distance (ft)	326	459	538	538
Upstream Blk Time (%)		10	0	0
Queuing Penalty (veh)		132	2	3
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 7: Bell Street & Forest Avenue

Movement	WB	WB	B35	NB	B15	SB	SB
Directions Served	L	R	T	TR	T	L	T
Maximum Queue (ft)	218	430	1017	444	142	58	41
Average Queue (ft)	36	369	594	132	14	13	2
95th Queue (ft)	136	541	1327	402	115	44	38
Link Distance (ft)	357	357	987	428	784		459
Upstream Blk Time (%)		71	44	1			
Queuing Penalty (veh)		0	0	0			
Storage Bay Dist (ft)						75	
Storage Blk Time (%)						0	
Queuing Penalty (veh)						3	

Intersection: 8: Woodlawn Avenue & Allen Avenue

Movement	WB	NB	NB	SB	B13
Directions Served	LR	T	TR	LT	T
Maximum Queue (ft)	231	208	82	473	351
Average Queue (ft)	85	15	4	272	103
95th Queue (ft)	217	92	35	586	363
Link Distance (ft)	972	236	236	402	374
Upstream Blk Time (%)		0		14	6
Queuing Penalty (veh)		0		130	60
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Lane Group	EBT	EBR	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	151	785	20	546	1234	974
v/c Ratio	0.74	0.67	0.09	0.67	0.44	0.93
Control Delay	59.3	12.7	31.5	12.6	1.0	49.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	59.3	12.7	31.5	12.6	1.0	49.9
Queue Length 50th (ft)	82	209	9	93	8	331
Queue Length 95th (ft)	#153	289	17	m112	m32	#454
Internal Link Dist (ft)	440		188		683	822
Turn Bay Length (ft)		200		200		
Base Capacity (vph)	225	1230	237	870	2776	1045
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.67	0.64	0.08	0.63	0.44	0.93

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	18	18	48	313	329	553	26	1242	835	568	1042
v/c Ratio	0.46	0.44	0.12	0.86	0.90	0.52	0.08	0.96	0.95	0.99	0.61
Control Delay	80.4	76.1	11.4	50.1	55.1	13.7	35.2	45.0	32.7	54.6	14.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5	0.0	0.0	0.1
Total Delay	80.4	76.1	11.4	50.1	55.1	13.7	35.2	51.5	32.7	54.6	14.5
Queue Length 50th (ft)	10	10	0	187	200	231	12	378	323	221	184
Queue Length 95th (ft)	#38	#37	28	m#298	m#326	m104	m19	m#496	m#473	m#435	m108
Internal Link Dist (ft)		152			537			395			683
Turn Bay Length (ft)	75		75			160	75		85	450	
Base Capacity (vph)	39	41	399	366	366	1067	320	1292	876	576	2149
Starvation Cap Reductn	0	0	0	0	0	0	0	49	0	0	0
Spillback Cap Reductn	0	0	2	0	0	0	0	0	0	0	180
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.46	0.44	0.12	0.86	0.90	0.52	0.08	1.00	0.95	0.99	0.53

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	NBT	SBT	NEL
Lane Group Flow (vph)	133	1526	1690	652
v/c Ratio	0.72	0.75	0.88	0.90
Control Delay	60.8	16.8	11.8	51.5
Queue Delay	0.0	0.1	0.7	12.5
Total Delay	60.8	17.0	12.4	64.0
Queue Length 50th (ft)	74	317	6	186
Queue Length 95th (ft)	110	406	m#435	#275
Internal Link Dist (ft)	1038	371	395	420
Turn Bay Length (ft)				
Base Capacity (vph)	195	2043	1924	739
Starvation Cap Reductn	0	0	60	0
Spillback Cap Reductn	0	59	0	82
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.68	0.77	0.91	0.99

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	49	20	1134	1011
v/c Ratio	0.27	0.12	0.72	0.63
Control Delay	14.5	14.4	7.8	5.0
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.5	14.4	7.8	5.0
Queue Length 50th (ft)	8	3	151	110
Queue Length 95th (ft)	16	14	#578	272
Internal Link Dist (ft)	938	531	355	388
Turn Bay Length (ft)				
Base Capacity (vph)	262	247	1565	1607
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.19	0.08	0.72	0.63

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	511	565	140	433	255	940	100	637	379
v/c Ratio	0.87	0.94	0.73	0.89	0.84	0.81	0.61	0.81	0.46
Control Delay	49.0	50.6	57.3	50.6	57.4	31.6	51.9	38.7	9.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.0	50.6	57.3	50.6	57.4	31.6	51.9	38.7	9.8
Queue Length 50th (ft)	129	258	69	202	125	228	49	158	60
Queue Length 95th (ft)	#212	#459	#153	#364	#250	#338	#112	#237	130
Internal Link Dist (ft)		854		1670		2871		1549	
Turn Bay Length (ft)	250		100		340		250		250
Base Capacity (vph)	590	606	193	488	304	1161	164	793	816
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.87	0.93	0.73	0.89	0.84	0.81	0.61	0.80	0.46

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	4	414	200	1410	226	786
v/c Ratio	0.01	0.86	0.23	1.00	0.68	0.72
Control Delay	12.8	44.2	10.4	41.6	26.8	20.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.8	44.2	10.4	41.6	26.8	20.1
Queue Length 50th (ft)	1	216	50	~450	58	292
Queue Length 95th (ft)	7	284	75	m#544	#197	#623
Internal Link Dist (ft)	278	1920		537		238
Turn Bay Length (ft)			200		250	
Base Capacity (vph)	727	637	881	1413	334	1094
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.65	0.23	1.00	0.68	0.72

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

#5 – Queue Summary of Revised SimTraffic Analysis

The attached table provides an easy-to-read summary of the queuing results provided by the SimTraffic model. This assessment is based on a 60 minute evaluation period, using the average of 5 runs (using random seeds 1-5).

The following provides brief commentary on each signalized intersection:

Forest Avenue at Warren Avenue
There are two (2) movements whose maximum queue exceeds the provided storage lengths under both the existing and build with mitigation conditions. In each case, these queues are significantly reduced under the build with mitigation scenario.

Forest Avenue at Allen Avenue/McDonalds Driveway
Under the existing conditions, there are 2 movements whose average queue exceeds the available storage length. In each of these cases, the queue exceeds the available storage because of a 'rolling' queue spillback – this is where the outbound Forest Street traffic that is released from the downstream signal (Stevens Avenue) reaches the back of the vehicle queue waiting at the Forest Street signal. Because of the way the model measures the queue, it is shown as 'exceeding' the available queue storage area. This is incorrect as it is a 'designed' queue spillback.

Furthermore, under the existing conditions, there are 10 movements whose maximum queue exceeds the available storage length. Of note is that the SimTraffic model does not take into account the lane utilization factor as it is a microscopic model of traffic flow. The inherent imbalance between inbound traffic flow along Forest Avenue approaching Allen Avenue (as discussed in prior submissions) is not considered in the SimTraffic results. It is entirely logical to assume that while both of the southbound through lanes shows maximum queue lengths relatively equal to each other that, in fact, one lane is significantly longer and one significantly shorter that the results shown.

Under the Build with Mitigation conditions, there are 4 movements whose average queue exceeds the available storage length. As noted under the existing conditions, 2 of these movements are "designed" queue spillbacks which do not actually create gridlock at the downstream signal. In the case of the other two locations, these average queues exceed the available storage by only a fraction of

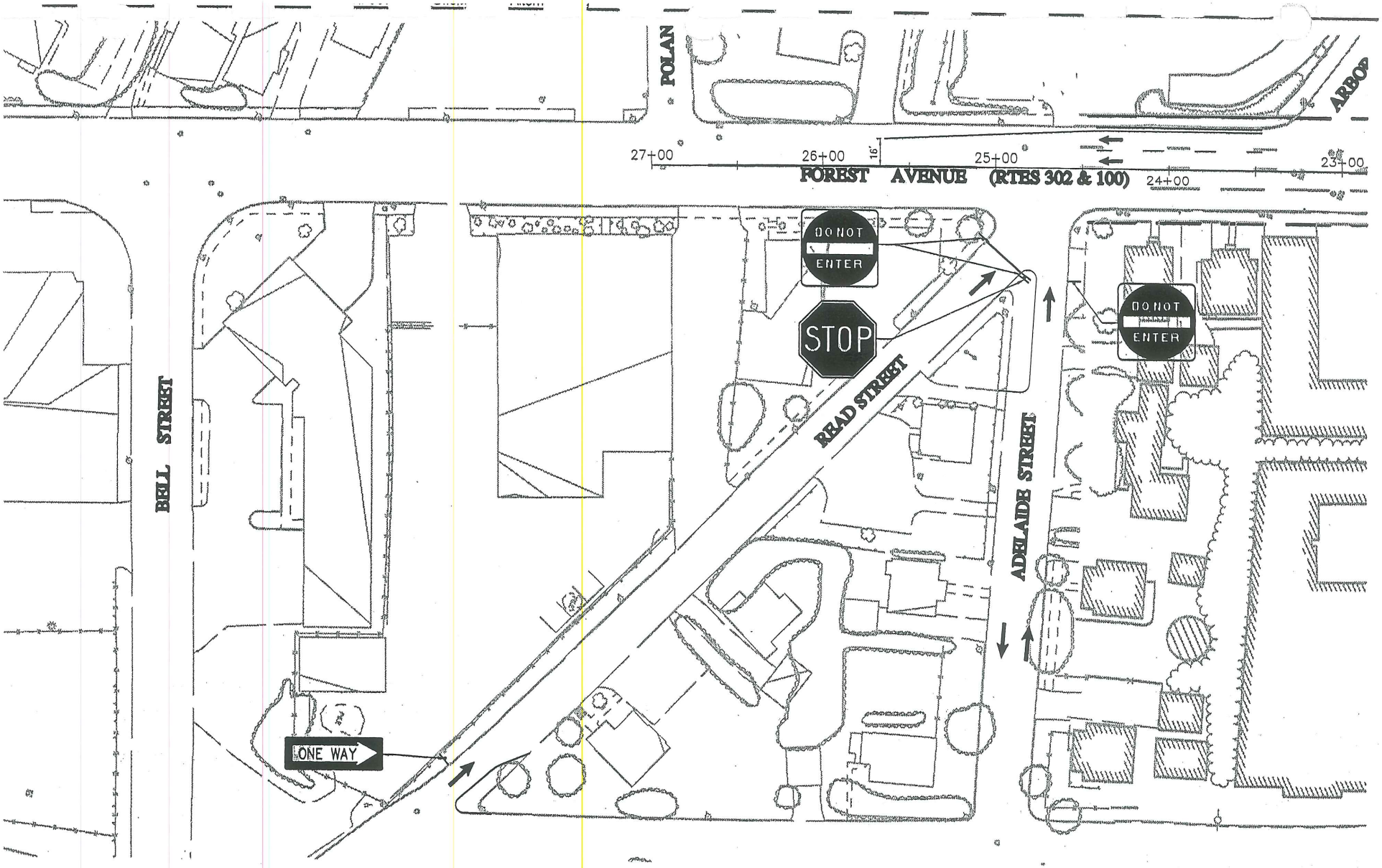
Evening Peak Hour Queue Results – Existing vs. Build Comparison

Location	Movement	2004 Existing Condition			2007 Build Condition with Mitigation		
		Storage [a]	Average	Maximum	Storage	Average	Maximum
Forest Avenue at Warren Avenue	EB L/T	-	276	512	-	224	497
	EB R	200	137	230	200	181	229
	WB L/T/R	-	11	58	-	11	51
	NB L	325	167	349	200	143	226
	NB T	675	197	436	675	84	368
	NB T/R	675	206	410	675	54	248
	SB L/T	-	468	777	-	433	781
	SB T/R	-	406	745	-	400	779
Forest Avenue at Allen Avenue	EB L	-	17	47	-	5	28
	EB T	-	26	70	-	12	59
	EB R	-	16	45	-	22	65
	WB L	535	410	553	535	332	552
	WB L/T	535	442	583	535	373	554
	WB R	160	94	192	160	168	205
	NB L	75	9	82	75	7	79
	NB T	340	347	468	340	355	476
	NB T	340	379	512	340	372	566
	NB R	80	70	108	85	104	124
	SB L	325	282	351	450	426	483
	SB T	675	483	747	675	496	746
	SB T/R	675	394	726	675	452	736
Forest Avenue at Stevens Avenue / Bishop Street	EB L/R	-	612	1,018	-	265	472
	NB T	-	330	374	-	323	357
	NB T	-	322	368	-	310	357
	SB T	340	298	420	340	234	460
	SB R	340	146	426	n/a		
	SB T/R	n/a			340	265	393
	NEB L	-	349	382	-	332	358
	NEB L/R	-	286	378	-	262	358
Allen Avenue at Plymouth Street/ Northfield Green Drive	EB L/T/R	-	24	56	-	16	44
	WB L/T/R	-	21	68	-	10	27
	NB L/T/R	-	77	404	-	186	446
	SB L/T/R	-	215	429	-	170	467
Allen Avenue at Washington Avenue	EB L	250	93	207	250	99	177
	EB L	250	119	254	250	146	285
	EB T/R	-	194	555	-	261	601
	WB L	100	75	129	100	91	138
	WB T/R	-	301	544	-	304	619
	NB L	340	163	330	340	179	352
	NB T	-	473	907	-	199	457
	NB T/R	-	468	903	-	195	453
	SB L	250	53	165	250	58	149
	SB T	-	144	269	-	138	278
	SB T	-	181	281	-	136	291
	SB R	250	103	260	250	83	232
Allen Avenue at proposed site drive	EB L/T/R	n/a			50	2	29
	WB L/T				-	244	478
	WB R				200	85	226
	NB L/T				535	280	447
	NB T/R				535	227	399
	SB L				250	121	228
	SB T/R				-	220	286

a lane or lane group storage capacity length, measured in feet

EB = Eastbound; WB = Westbound; NB = Northbound; SB = Southbound; NEB = Northeastbound; L = Left; T = Through; R = Right

n/a not applicable; movement does not exist under current condition



Vanasse Hangen Brustlin, Inc.

Proposed Traffic Improvements
Forest Avenue @ Read St. and Adelaide St.
Morrill's Crossing
Portland, Maine

Transportation
Land Development
Environmental
Services

VHB imagination | innovation | energy Creating results for our clients and benefits for our communities

February 27, 2006

Vanasse Hangen Brustlin, Inc.

Ref: 07334.00

Mr. Randy Dutton, PE
Southern Region Traffic Engineer
Maine Department of Transportation
51 Pleasant Hill Street
Scarborough, ME 04070

Re: Morrill's Crossing Development
Portland, Maine

Dear Randy:

Thank you for taking the time to meet with Mike Servetas and me last Friday February 17, 2006. As we discussed, I am forwarding you the following information and would request that you provide some written feedback to us on these outstanding issues to assist us in the permitting process and to better guide us in the development of the off-site roadway plans that your office will ultimately review and approve.

Forest Avenue Cross-Section

The basic cross-section being proposed for the Forest Avenue corridor is shown on the enclosed attachment. The available right-of-way is 62 feet along the majority of Forest Avenue. With building fronts located on the right-of-way, it is impossible to widen beyond the 62-foot layout without taking building structures. With this in mind, the proposed roadway cross-section calls for four (4) 11-foot travel lanes, a 3 foot outside shoulder on each side of the corridor, and 6-foot sidewalks for a total of 62 feet.

The City has asked that we consider the possibility of reducing the lane widths from 11 feet to either 10 or 10.5 feet to better accommodate bicycle traffic within the shoulder (any reduction in lane width would be added to the shoulder bicycle lane). Based on our conversations, it appears that 11-foot travel lanes is the minimum that MDOT would accept on an arterial roadway such as Forest Avenue. Can you please confirm this design assumption, as it is critical in how we advance this process.

Allen Avenue Apartment Driveway

During the meeting, it was also noted that the driveway location for the Morril's Crossing project was in close proximity to the driveway for the Allen Avenue Apartments. The applicant has been working closely with the owner of the Allen Avenue Apartments and has suggested the attached modification to their driveway. The driveway will be limited to right-turn in / out only and will provide an internal connection to the main development driveway which will provide access for left-turns exiting the site and entering the site.

101 Walnut Street
Post Office Box 9151
Watertown, Massachusetts 02471-9151
617.924.1770 ▪ FAX 617.924.2286
email: info@vhb.com
www.vhb.com

Site Driveway Turning Radius

In addition to the proximity to the Allen Avenue Apartment driveway, you also noted that it would be helpful to see the truck turning radii entering and exiting the site driveway. The attached plans show the truck turning radii entering and exiting the driveways for a range of vehicles including; a Bus and WB-50, WB-62, and WB-67 trucks. While the graphics show that the turns can occur in a reasonable fashion, we recognize that there is some lane encroachment associated with the larger truck sizes. With this in mind, it is our expectation that the larger WB-67 trucks will be limited in their delivery times as part of the site plan approval process.

All your other suggestions were considered and incorporated into the concept plan being presented to the City. I look forward to working with you on the design of these improvements when the project is approved by the City.

Should you have any questions related to these responses, please feel free to contact me directly.

Regards,

VANASSE HANGEN BRUSTLIN, INC.

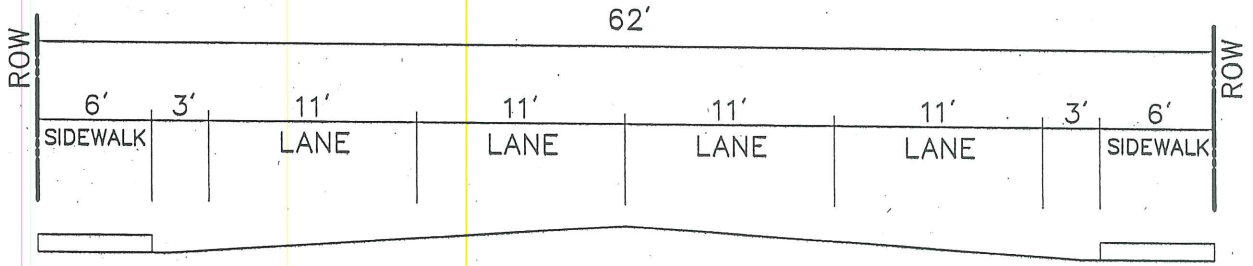
Robert L. Nagi, PE
Principal

Copies: Sarah Hopkins, City of Portland
Tom Errico, Wilbur Smith Associates
Tom Gorrill, Gorrill-Palmer Consulting Engineers, Inc.
Mike Servetas, Vanasse Hangen Brustlin, Inc.

Attachments

- Forest Avenue Recommended Cross-Section
- Allen Avenue Apartment Driveway Placement
- Truck Turning Summary at Site Driveway

Forest Avenue Recommended Cross-Section



0 5 10 Feet

Vanasse Hangen Brustlin, Inc.

2/27/06

Forest Avenue Cross Section
Morrill's Crossing
Portland, Maine

Allen Avenue Apartments Driveway Placement

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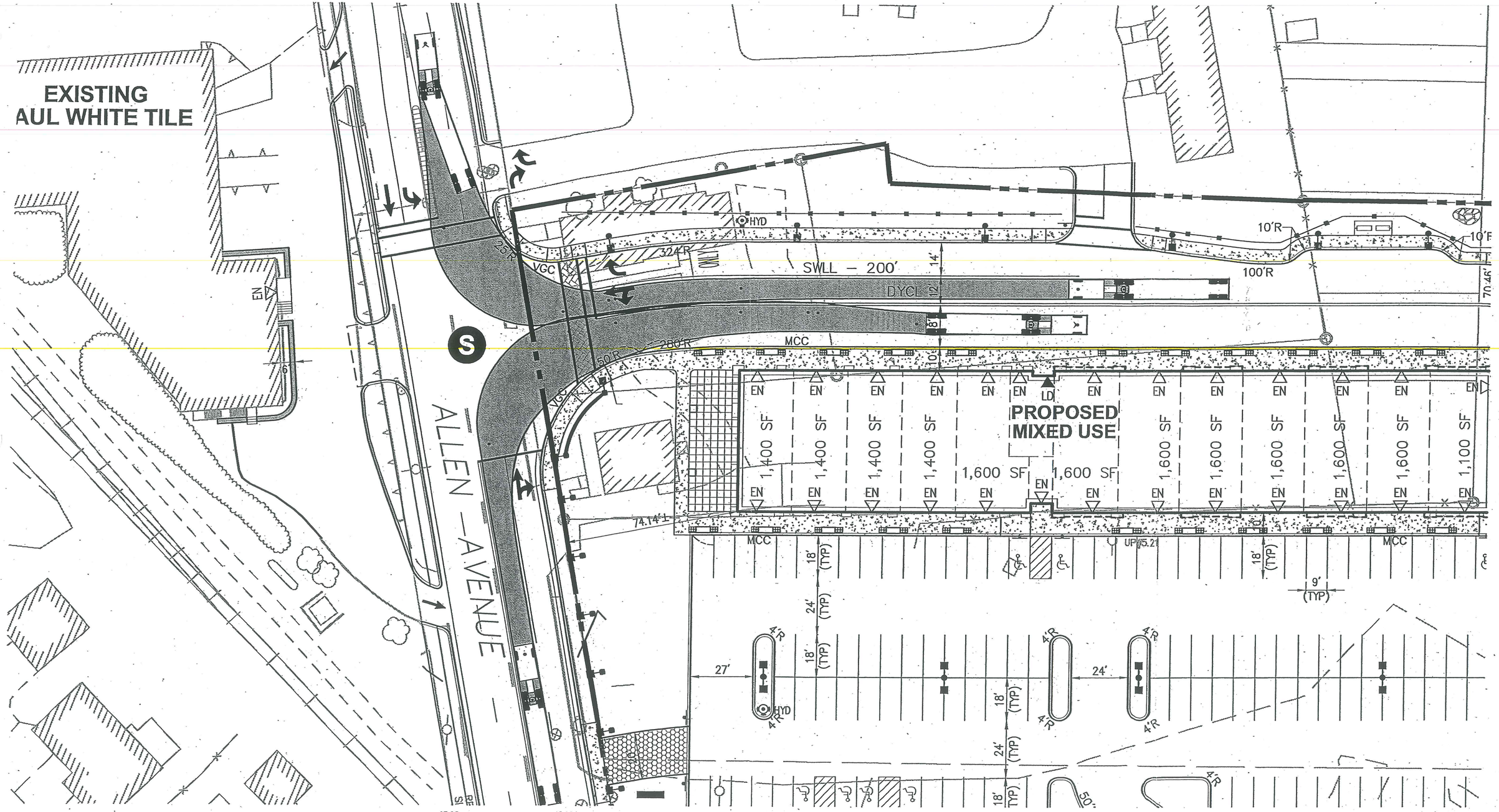

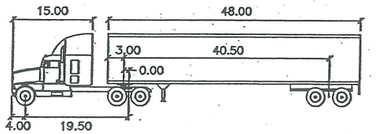

WB–62 feet

Tractor Width	: 8.00	Lock to Lock Time	: 6.00
Trailer Width	: 8.50	Steering Angle	: 28.40
Tractor Track	: 8.00	Articulating Angle	: 70.00
Trailer Track	: 8.50		

0 20 40 Feet

Vanasse Hangen Brustlin, Inc.

WB-62

Turning Movements
Main Entrance
Morrill's Crossing
Portland, Maine

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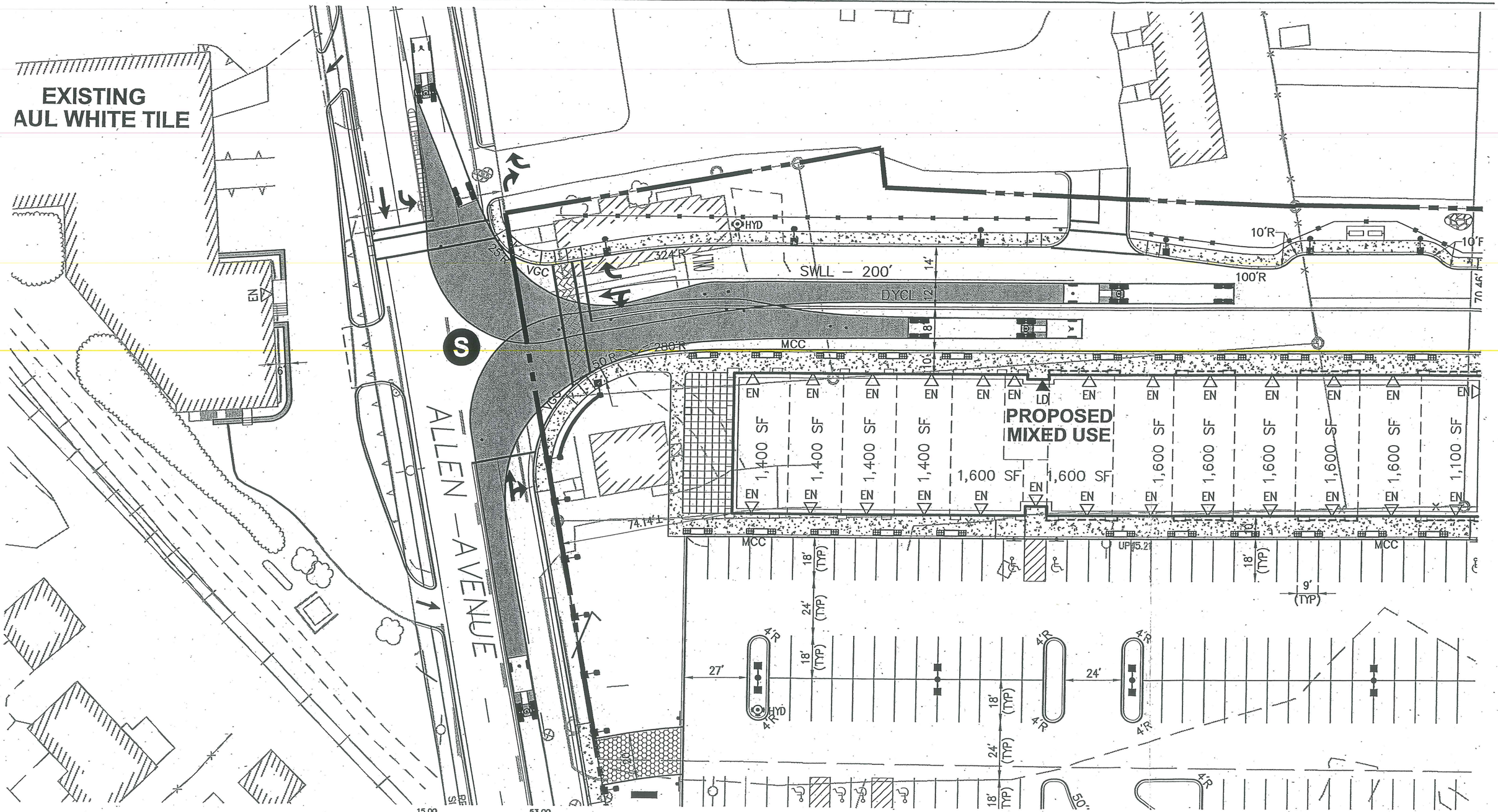

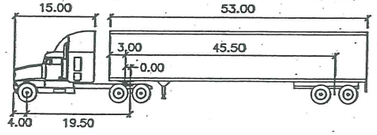

WB–67 feet

Tractor Width	: 8.00	Lock to Lock Time	: 6.00
Trailer Width	: 8.50	Steering Angle	: 28.40
Tractor Track	: 8.00	Articulating Angle	: 75.00
Trailer Track	: 8.50		

0 20 40 Feet

Vanasse Hangen Brustlin, Inc.

WB-67

Turning Movements
Main Entrance
Morrill's Crossing
Portland, Maine

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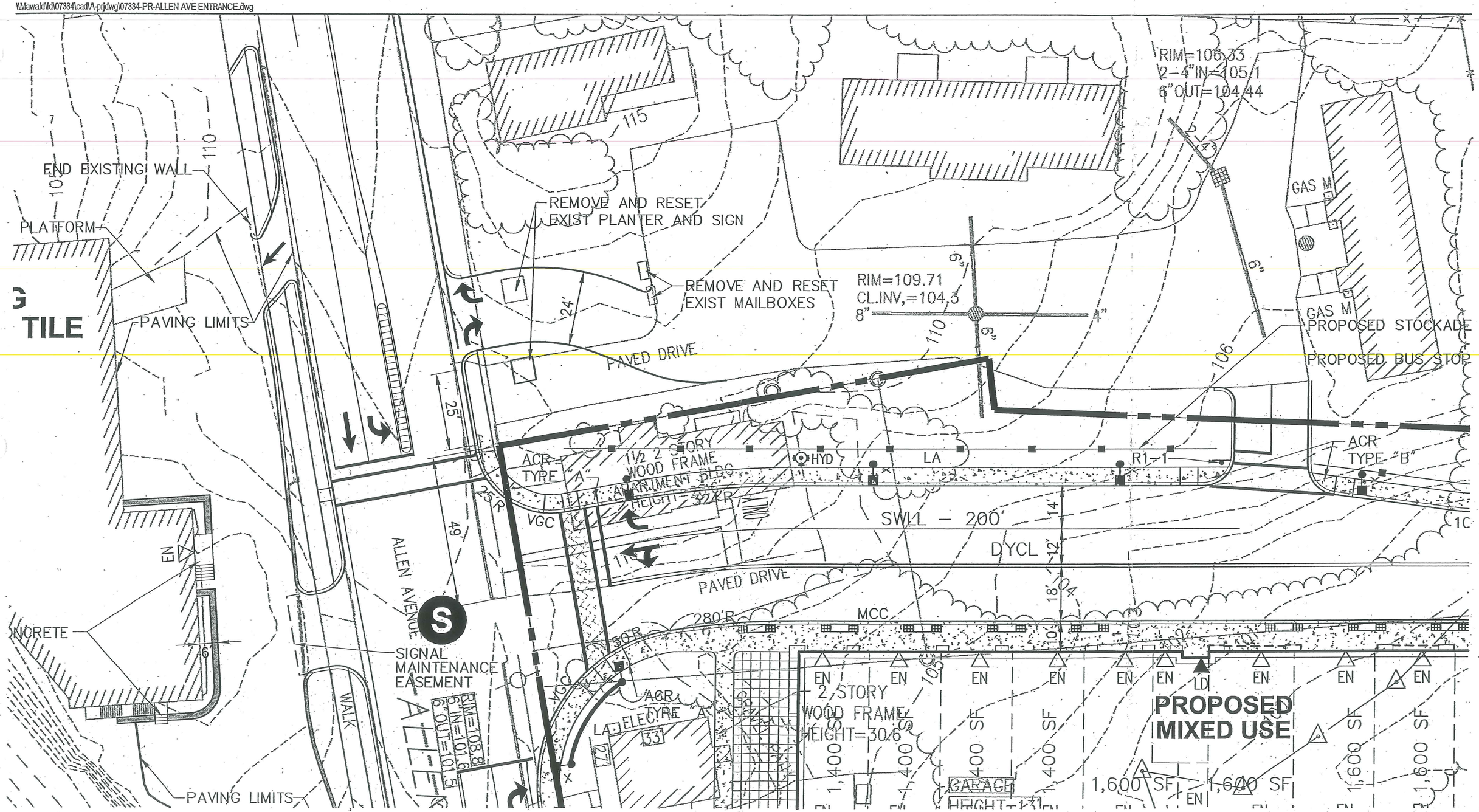

0 30 60 Feet

Vanasse Hangen Brustlin, Inc.

Allen Avenue Apartments
Proposed Entrance Modification
Morrill's Crossing
Portland, ME

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
SOUTHERN REGION
P.O. BOX 358
SCARBOROUGH, MAINE
04070-0358

JOHN ELIAS BALDACCI
GOVERNOR

DAVID A. COLE
COMMISSIONER

March 2, 2006

Mr. Robert Nagi, PE
101 Walnut Street
PO Box 9151
Watertown, MA 02471-9151

RE: Morrill's Crossing Development
Portland, Maine

Dear Robert:

Thank you for your letter to me dated February 27, 2006 regarding the above referenced project. Per the request in the letter, I am providing this response to several questions raised in your letter.

Forest Avenue Cross-Section

My understanding from the letter is that because of the proximity of buildings/structures along the corridor, the availability to widen beyond the 62 foot right of way is not feasible. The question was asked if the travel lanes on Forest Avenue or the project in general could be reduced in width from 11 feet to something narrower so that additional width could be given to the proposed 3 foot shoulder. My understanding from the letter is that the additional shoulder width would better accommodate bicycles.

Both Forest Avenue and Allen Avenue in the area of the proposed project are designated as principal arterials and considered by the Federal Government as being on the National Highway System. The primary purpose of the principal arterial is to provide vehicular mobility within and between major service centers. As such, travel lanes less than 11 feet would significantly affect both mobility and safety of the corridor and therefore will not be permitted.

In reviewing the proposed cross-section, it appears the sidewalks are proposed to be 6 feet in width on each side. Since 5 foot sidewalks are common and meet all typical standards, the applicant, with approval from the City, may want to reduce the 6 foot wide sidewalks by 6 inches to 1 foot each side and give the additional width to the shoulders.

Allen Avenue Apartment Driveway

As noted in your letter, the Department had significant concerns over the proximity of the proposed signalized entrance and the adjacent unsignalized Allen Avenue Apartment Complex entrance. In reviewing the sketch provided, it appears the apartment entrance has been shifted further north. The new location is not ideal, but is considerably better than the previous location and acceptable to the Department. The relocated entrance is proposed to be restricted to right-in / right-out turning movements only. It has been found that the only way to truly enforce the right-in / right-out only restriction is by a physical barrier and that reliance on signage only has been found to be ineffective. The Department

recommends either a raised center median be constructed on Allen Avenue past the apartment entrance or a channelized island be constructed on the apartment entrance.

Site Driveway Turning Radius

As discussed at our meeting, the applicant has presented that they will incorporate Traffic Demand Management (TDM) techniques to help reduce vehicular traffic on the adjacent roadway network. One TDM suggested by the applicant that would be incorporated into the site would be an internal Bus Stop. Therefore, a City Bus should be able to comfortably maneuver in and out of the proposed site without encroachment into opposing lanes. Based on a review of the sketches provided, it does appear that the proposed entrance can accommodate a bus without encroachment into opposing lanes. The Department concurs with the statements in the letter that larger vehicles be restricted to specific low volume times of day. Based on reviewing the sketches we recommend any vehicles larger than a WB-50 would require this restriction. This restriction is slightly smaller than the WB-67 restriction stated in the letter. We recommend the size of vehicle restriction be incorporated into permits / approvals issued by the City to avoid any future misunderstandings or miscommunication. In addition to the time of day restriction for larger vehicles, it is also recommended that any and all TDM techniques be identified / documented and incorporated into any permits / approvals given by the City.

As stated in the letter, there were other items raised at our meeting that have not been reviewed herein and the Department looks forward to offering input on any future designs.

If you have any questions or wish to discuss this in more detail please do not hesitate to contact me at 885-7000.

Sincerely,

Randall Dunton, PE, PTOE
MDOT Southern Region Sr. Traffic Engineer

C: Steve Landry, Assistant State Traffic Engineer (with copy of letter)
Bruce Munger, Southern Region Traffic Engineer
Tom Errico, Wilbur Smith Associates
File

STATE OF MAINE
RANDALL
E.
DUNTON
#8686
REGISTERED
PROFESSIONAL ENGINEER

March 2, 2006