

AGENDA CITY OF KENTWOOD PLANNING COMMISSION TUESDAY, DECEMBER 12, 2023 KENTWOOD COMMISSION CHAMBERS 4900 BRETON AVENUE, SE 7:00 P.M.

- A. Call to Order
- B. Pledge of Allegiance (Dan Holtrop)
- C. Roll Call
- D. Declaration of Conflict of Interest
- E. Approval of the Minutes of November 28, 2023.
- F. Approval of the Agenda for December 12, 2023
- G. Acknowledge visitors and those wishing to speak to non- agenda items.
- H. Old Business

There is no Old Business

I. Public Hearing

 $\underline{\text{Case#29-23}} - \text{GRR Ancillary} - \text{Rezoning of 10.57 acres of land from I-1 Industrial to C-PUD Commercial Planned Unit Development and Preliminary Site Plan Review located at the NW corner of 36th Street and Patterson Avenue$

J. Work Session

There are no work sessions

K. New Business

Set public hearing date of January 23, 2024, for: <u>Case#1-24</u> – Storage Five Kentwood LLC – Rezoning of 5.87 acres of land from C-2 Commercial to Conditional I-1 located at 1800-1900 44th Street SE

- L. Other Business
 - 1. Commissioners' Comments

4900 BRETON AVENUE SE, PO BOX 8848, KENTWOOD, MICHIGAN 49518-8848 • PHONE (616) 698-9610 Equal Opportunity Employer, Drug-Free Workplace www.ci.kentwood.mi.us Agenda - Planning Commission December 12, 2023 Page 2

- 2. Staff's Comments
- M. Adjournment

*Public Hearing Format:

- 1. Staff Presentation Introduction of project, Staff Report and Recommendation Introduction of project representative
- 2. Project Presentation By project representative
- 3. Open Public Hearing (please state name, address and speak at podium. Comments are limited to five minutes per speaker; exceptions may be granted by the chair for representative speakers and applicants.)
- 4. Close Public Hearing
- 5. Commission Discussion Requests for clarification to project representative, public or staff
- 6. Commission decision Options
- a. postpone decision table to date certain
- b. reject proposal
- c. accept proposal
- d. accept proposal with conditions.

PROPOSED MINUTES OF THE REGULAR MEETING OF THE KENTWOOD PLANNING COMMISSION NOVEMBER 28, 2023, 7:00 P.M. COMMISSION CHAMBERS

- A. Chair Jones called the meeting to order at 7:00 p.m.
- B. The Pledge of Allegiance was led by Commissioner Jones.
- C. Roll Call:

Members Present: Bill Benoit, Dan Holtrop, Sandra Jones, Ed Kape, Alex Porter, Ray Poyner, Darius Quinn, Doug VanderMeer, Sarah Weir Members Absent: Ray Poyner (with notification) Others Present Economic Development Planner Lisa Golder, Planning Assistant Monique Collier and one citizen.

Motion by Kape, supported by Quinn, to excuse Poyner from the meeting.

- Motion Carried (8-0) -
- Poyner absent -
- D. Declaration of Conflict of Interest

There was no conflict of interest statement expressed.

E. Approval of the Minutes and Findings of Fact

Motion by Commissioner Holtrop, supported by Commissioner Benoit, to approve the Minutes of November 14, 2023 and the Findings of Fact for: <u>Case#7-22</u> – Revised GRR Ancillary Requested Master Plan Amendment from Industrial to Commercial - Located at the NW Corner of Patterson Avenue and 36th Street SE; <u>Case# 28-23</u> - DAMA Ventures LLC – Special Land Use Indoor Vehicle Sales and Site Plan Review – Located within Phase A of 3350 Broadmoor Avenue, zoned I-1 Light Industrial

- Motion Carried (8-0) -
- Poyner absent -
- F. Approval of the Agenda

Motion by Commissioner Quinn, supported by Commissioner Weir, to approve the agenda for the November 28, 2023 meeting.

- Motion Carried (8-0) –
- Poyner absent -
- G. Acknowledge visitors wishing to speak to non-agenda items.

Proposed Minutes Planning Commission November 28, 2023 Page 2 H. There was no public comment.

I. Old Business

There was no Old Business

J. Public Hearing

<u>Case#29-23</u> – GRR Ancillary – Rezoning of 10.57 acres of land from I-1 Industrial to C-PUD Commercial Planned Unit Development and Preliminary Site Plan Review located at the NW corner of 36th Street and Patterson Avenue (**The applicant has requested tabling to the December 12, 2023 meeting**)

Motion by Holtrop, supported by Benoit, to table <u>Case#29-23</u>- GRR Ancillary to December 12, 2023.

- Motion Carried (8-0) -
- Poyner absent -

K. Work Session

There were no work sessions

L. New Business

There is no business

- M. Other Business
 - 1. Commissioners' Comments

The Commissioners wished Jones a Happy Birthday!

Kape stated December 7, 2023 the Tree Lighting Ceremony will be held at 6pm at City Hall.

2. Staff's Comments

Golder stated December 11 will be the joint meeting with the City Commission at 5:30pm.

Golder stated we will have a work session on Storage 5 they have come back with another plan.

N. Adjournment

Proposed Minutes Planning Commission November 28, 2023 Page 3

Motion by Commissioner Benoit, supported by Commissioner Quinn, to adjourn the meeting.

- Motion Carried (9-0) -
- Poyner absent -

Meeting adjourned at 8:15pm

Respectfully submitted,

Ed Kape, Secretary

December 7, 2023

MEMO TO:	Kentwood Planning Commission
FROM:	Lisa Golder, Planner
RE:	Application for GRR Ancillary CPUD

The applicant for the GRR Ancillary PUD project has provided additional information regarding the proposed CPUD for GRR Ancillary development. The following is a discussion of the information provided and the issues that will be raised when the recommendation is provided.

1. Access:

Applicant is proposing two driveways on Patterson Avenue. During the Master Plan amendment discussion, the City left open the possibility of having two driveways on Patterson Avenue. However, this issue was also dependent on the review of the traffic study and the review of the Kent County Road Commission (KCRC). KCRC has jurisdiction over this major arterial street.

The Michigan Access Management Guidebook sets access management principles and standards. The goal of the access management guidelines is to achieve a safe and efficient flow of traffic along a road while providing reasonable access to abutting properties. The MDOT guidelines set standards for reasonable driveway clearance from signalized and unsignalized intersections. When the posted speed is 40-55 mph, the desirable corner clearance is 460 feet. The Michigan Access Guidelines also offer standards for unsignalized driveway spacing. For speed on the roadway of 55 mph, driveways are recommended to be 455+ feet from one another. In the case of the GRR Ancillary CPUD, the southern driveway does not quite meet the driveway clearance for distance from the signalized intersection, and in fact, the applicant's traffic analysis shows that, at times, the queue for the through movement could back up over 500 feet. In addition, the southern driveway is too close to the northern driveway, as it is spaced just 240' away (455+ feet recommended). Therefore, it is recommended that only one full-service driveway is provided for the development—the northern driveway. The southern driveway, if permitted at all, must be right-in, right-out only.

2. The applicant has provided some additional some information regarding how the development meets the standards of Section 12.05 Site Design Standards, as follows:

12.05 5 Site Design Guidelines:

- a. An extensively landscaped greenbelt, with an average width of 30 feet and minimum of 20 feet shall be provided along all public streets. Plantings within the greenbelt shall exceed the requirements of Section 19.03A. Low, undulating (horizontal and vertical) berms or an architectural feature (decorative stone or brick wall, wrought iron fencing or combination) may be permitted as an alternative to the trees.
- b. Site design and landscaping shall diminish the prominence of parking lots as viewed from public streets. Parking lot landscaping shall exceed the amount otherwise required.

Applicant has provided the same general information to generally describe the landscaping but left the detail for the final plan. The applicant provided a cross section of the greenbelt between the parking area and the public street to portray the screening of the parking lot from the street. Additional information to be provided should include the height of the berm.

c. City entranceway landmark or entrance sign may be required near the intersection of two arterial streets or at an entrance point to the city. The type and conceptual design of said landmark shall be determined as part of the Preliminary PUD Plan approval, and the timing of installation described in the PUD Agreement.

Applicant is proposing entryway signage; however, there is no conceptual design for the signage, nor is timing of installation described.

- d. Extensive pedestrian gathering and seating plazas, greenways and tree lined drives shall be within parking lots and throughout the site to provide an inviting pedestrian environment, protection of the pedestrian from vehicular circulation for improved traffic operations and views.
- e. Other site amenities to create a pedestrian scale environment shall be provided such as bike racks, benches, information kiosks, art, planters or streetscape elements to separate mainline buildings from the parking lots.

The only shown seating area is near the diesel fueling location. The pedestrian circulation could be improved across the site.

No additional information has been provided regarding pedestrian circulation and amenities.

The applicant has detailed the amount of new sidewalk proposed. No sidewalk has been provided along the north-south driveway for the development and no future connection is proposed to the Consumers Energy easement to the north or along the future driveway that is intended to serve the industrial use to the west.

The Kentwood Non-Motorized Trail plan shows a 10' wide path along Patterson Avenue. The applicant has shown the path, but it is described as an easement only. In other areas of the community, the city has required property owners to install the nonmotorized path as part of the development.

g. Sign types and materials shall be consistent with the overall architectural design of the PUD. Signs for uses or buildings located in the PUD shall be subject to the sign limitations allowed for uses or buildings of a similar type built in the respective zoning districts, as determined by the Zoning Administrator.

The applicant has indicated that signage will be uniform, attractive and consistent with the architectural design theme and building material. The ordinance requires that the allowance for signage in PUDs is subject to the sign limitations allowed by uses and buildings of a similar type. This requirement is waivable with Planning and City Commission approval. The waiver would allow, for example, for a freestanding sign for the hotel, even though the hotel has no direct street frontage. However, the waiver that the developer is requesting is for an off-premise sign (for signage outside of the PUD for the industrial property to the west).

h. The site shall have a minimum open space of thirty (30) percent exclusive of areas of deferred parking.

The applicant has the needed open space for the uses proposed on the site but also has 50 extra parking spaces. These spaces could be deferred parking, allowing more open space until the additional parking is found to be necessary.

- 7. <u>Building Height and Architectural Guidelines</u>: Information on architecture and building design (elevations or perspectives, materials and description of design standards) shall be submitted and comply with the following:
- a. Architecture throughout the development shall be compatible based on a design theme established with the Preliminary PUD Plan and described in the PUD Agreement.
- c. Buildings shall utilize high quality architecture with variable building lines, peaked roofs or parapet walls, architectural accents, and brick facades.
- d. Building heights will be as required by the Commercial Districts (Chapter 8).
- e. The depth of the front building line shall be varied to break up the building massing.
- f. The predominant material utilized on facades which are visible from a public right-of-way or parking lots shall be brick. Other materials may be used for architectural accents, provided such materials shall have the appearance of wood or cut or cast stone.
- g. A building or buildings shall face (front facade or side elevation with appearance of a front facade) the intersection of existing arterial streets. The building(s) shall have distinct architecture that creates a prominent landmark at the intersection, with no loading or utility areas that face the intersection. There shall be a landscaped plaza in front of the building or between buildings. Parking is encouraged behind buildings.

The applicant has provided a little more detail regarding the architecture guidelines. Three types of materials are specified: an appropriate percentages of glass, and a mix of high-quality materials including metal/composite panels, decorative masonry/brick and or stone. One picture has been provided.

The ordinance requires that the building shall face (front façade or side façade with appearance of façade) the intersection of two arterial streets. Instead, the gas station pumps face the public street.

3. Waivers

The applicant has listed the PUD waivers that are being requested. These include:

- Building height for hotel
- Front yard building setback for Parcel 3
- Parking allowed in front of buildings rather than behind (for arterial street)

The application also requests a waiver for the Special Land Use for a drive through restaurant, coffee shop, bank and gas station. Special Land Uses approvals are not waivable.

4. Development Agreement

The applicant has provided a proposed development Agreement for the PUD.

5. Other issues

The applicant shall provide traffic and stacking information on the freestanding truck diesel fuel station, west of the gas station.

The applicant must justify the width of the proposed curb cuts.

A lighting plan for the overall PUD shall be required for final approval of any phase.

The Kent County Road Commission has not reviewed the revised traffic memo yet.

In light of the issues yet to be resolved, staff recommends discussion of the issues on December 12th and tabling of the recommendation on this project until January 9, 2024.



GRR ANCILLARY QUALIFYING STATEMENTS AND CONDITIONS FOR PUD ZONING

The following statements are hereby submitted as additional information to our existing application and associated documents. They are intended to supplement our application and to clarify how our proposal meets the intent and purpose of the C-PUD Zoning and achieve benefits not otherwise possible under Conventional Commercial Zoning.

1. Architectural Design

The buildings included in the PUD proposal include a 1-story retail establishment with a drive-thru, a 1-story bank with a drive-thru, a 1-story restaurant with a drive-thru, a gas station/convenience store, a future 1-story commercial/retail building, a 1-story childcare center with an outdoor play area, and a 4-story hotel.

The architectural style of the buildings will reinforce the overall aesthetics of the site, bringing continuity architecturally to the mixed-use development. The materials utilized in the building design will include appropriate percentages of glass, with a mix of high-quality materials that include metal/composite panel, decorative masonry/brick, and/or stone per the zoning ordinance. The intent of the PUD Ordinance will be fully satisfied through thoughtful building design, with great care given to an architectural language that is consistent with the overall site concept for this development. The theme for this architectural design includes: a gateway signage feature, unifying architecture in building and landscape design, creative use of materials (within the restrictions outlined by the current zoning ordinance and regulations), as well as forms, features, and finishes. The design team's goal is to tie together this important City of Kentwood site from the experience upon entering, to the landscape, and finally the buildings' exteriors and interiors. This unifying and cohesive design will make the project attractive, interesting and sustainable, while also fulfilling the City's Objectives for Planned Unit Development projects.





Sample of Architectural Style

- 2. <u>Site Design</u>
 - a. Curb-Cuts

The GRR Ancillary project will have two full access curb-cuts on Patterson Avenue located in approximately the same location as the existing curb-cuts that serve the current industrial uses and directly across the street from the two curb-cuts the serve Cascade Township industrial uses. The northern drive will serve the new hotel, the two proposed commercial uses and the future 20-acre industrial development to the west. The southern drive will serve the restaurant and the gas station, including diesel fuel customers. Design of both curb-cuts will follow Road Commission standards including lane tapers, drive widths, turning radii and all improvements in the public right-of-way.

An Amended Traffic Impact Study and Memo from Progressive AE dated December 1, 2023 has been submitted, justifying the need for two Patterson Avenue curb-cuts. The amended study also addresses the diesel fueling station. We anticipate a letter from the Kent County Road Commission supporting our proposal for two Patterson curb-cuts.

The GRR Ancillary C-PUD also proposes one full access curb-cut on 36th Street. This drive is located directly opposite an existing drive to the south and will primarily serve the adjacent retail use, the gas station and the child



care center. Design of this drive will satisfy the Kentwood City Engineer including lane tapers, drive width, turning radii and all improvements in the public right-of-way.

All three curb-cuts are optimally located to best serve the overall layout of the PUD providing safe, convenient access to and from each use. These coordinated/shared locations would be difficult to achieve with conventional commercial zoning.

b. Vehicular Drives

Internal drives will provide convenient and safe access to all parts of the PUD. Vehicular movement within the PUD will flow intuitively with obvious routes and patterns. Appropriate drive widths and turning radii will allow visitors a comfortable and safe experience to reach each use and parking area and will accommodate emergency vehicles if/when needed. Uniform wayfinding signs will provide additional clarity and convenience to visitors. Many of these details would be difficult to achieve with conventional zoning but are possible through PUD Zoning.

c. Parking Facilities

Parking facilities are designed to comply with Chapter 17 of the Ordinance. Parking spaces are located adjacent to the various uses with convenient, direct access from the internal drives. Parking space and aisle dimensions comply with Section 17.04 and the number of spaces slightly exceeds the requirements of Section 8.03.C.1, however barrier free spaces have not been included yet so the surplus will be reduced during Final Site Plan Review. Parking lots are interconnected with pedestrian walks providing safe pedestrian access from one use to another; a benefit that is achievable through PUD Zoning. No deferred parking is proposed at this time.

d. Pedestrian Walkways

The Preliminary Site Plan (C-103) includes 3,909 linear feet of new sidewalk (0.74 miles) with three connections to the existing public sidewalks along Patterson and 36th Street. These sidewalks will provide safe, convenient connections to and from the various uses. Sidewalks are separated from vehicular drives and bordered with landscaping and site lighting to create a pleasant, pedestrian scale environment. Painted cross-walks (12) are provided at driveway crossings to provide further safety measures for pedestrians. In addition, 5-foot wide easement for a possible future public bike path along Patterson Avenue will be provided if needed. The extent



and interconnectivity of the sidewalks is a requirement of the PUD Zoning and not a requirement of conventional zoning.

e. Site lighting

Safe, sufficient site lighting will comply with Chapter 20 of the Ordinance. Light fixtures and poles styles will follow the architectural design theme and be consistent throughout the PUD. Pole heights will not exceed 25 feet and fixtures will have energy-efficient LED lamps and cut-off/non-glare optics. A photometric grid plan with foot-candle levels will be provided during Final Site Plan Review. Unified site lighting will provide a cohesive element to the overall commercial development.

f. Signage

Signs throughout the PUD will be uniform, attractive and consistent with the architectural design theme and building material. Sign areas, heights and setbacks will comply with Chapters 8 and 16 of the Ordinance. Proposed signs include three ground signs and two pole signs, each with multi-tenants displayed on them. Building wall signs will be proposed during Final Site Plan Review as permitted by the ordinance and wayfinding signs will be provided as needed to provide clear directions within the development. A welcoming gateway feature/sign will be provided near the intersection of Patterson Avenue and 36th Street as requested. Uniform, shared signage is advantage of the PUD and not achievable under conventional zoning.

g. Landscape Design

Selection and placement of plant material is another method of creating an attractive, unified overall development not workable under conventional zoning. Extensive landscaping will be provided including tree-lined drives and greenbelt buffer plantings (see cross-section on next page) as required by Chapters 12 and 19 of the Ordinance. Detailed Planting Plans will be submitted during Final Site Plan Review with specific plant types, sizes and quantities. Plants will be hardy, native varieties that provide seasonal interest and low maintenance.





Proposed Greenbelt Cross-Section

h. Site Grading, Drainage & Infrastructure

Grading – Rather than attempt to grade the sites to fit an unknown user and create a potential soil erosion concern, the proposed grading will be limited to what is necessary to construct the private drives, utilities and detention pond enlargement.

Drainage – A master drainage plan has been prepared and approved by Kentwood Engineering Department. Previous development of this property included the construction of a detention basin, which outlets to the existing creek flowing East to West through the site. The detention basin is planned to be enlarged to accommodate the developed drainage from the entire 10acre commercial site and the southeast corner of the 20-acre industrial parcel. A new, unified storm sewer system will be installed throughout the development, providing a storm sewer stub to each parcel. The detention basin and storm sewer system will be a private system with future maintenance provided by a 433 agreement with the Kent County Drain Commission.

Sanitary Sewer – The sewer in this part of the City of Kentwood is part of the City of Grand Rapids system. The existing system has adequate depth and capacity to service the proposed development. We propose to serve this project by installing a public main from an existing manhole in 36th Street extending North approximately 515 feet within a public easement with individual laterals to each parcel.



Watermain – The watermain in this part of the City of Kentwood is part of the City of Grand Rapids system. The existing system has adequate flow and pressure to service the proposed development. We propose to loop an 8" public water main through the project connecting to two existing stubs off Patterson Avenue. Provisions will also be made to extend a 12" main along the North project boundary to service the future industrial development to the West. The watermain will be within a public easement and provide fire and domestic services as required to each parcel.

Site grading, drainage and infrastructure will be designed and constructed in an efficient and coordinated manner as part of the proposed PUD, which would be challanging under conventional zoning.

i. Land Division

Currently the total 30-acre land is under one ownership, GRR Ancillary MU LLC and it exists as four parcels as shown on Sheet C-101. Under the Land Division Act, there are at least 16 splits available. It is the developer's intent to divide the property as metes and bounds parcels, with the 10.57-acre C-PUD subdivided into six parcels as shown on sheet C-103 and further described in the PUD Agreement.

j. Project Phasing

It is the developer's intent to construct the two private drives extending West from the existing Patterson Avenue curb cuts along with the North / South private drive from 36th Street to the North property line. The sanitary sewer, watermain and storm sewer systems within these private drives will also be constructed. This will provide utility service and access to all six parcels, which then can be sold as demand dictates. The gas station and hotel parcels are anticipated to be developed first.

k. Proposed Waivers

• The building height needed for the hotel is 54 feet. Technically the Ordinance requires a 30' maximum height because the parcel is adjacent to a residential zone, even though the land is a Consumers Energy Easement. Otherwise, 40' is the maximum height adjacent to non-residential property. So logically, we need a 14' waiver from code for the hotel. By comparison, the adjacent Grand Rapids Water Tower and Consumers Energy transmission towers are both approximately 100 feet in height.



- Front yard building setback for Parcel 3. Code requires 30', we are requesting 25'.
- Special Land Use for drive-through restaurant, coffee shop and bank.
- Special Land Use Approval for Gas Station
- Parking in front of buildings instead of behind buildings
- Signage on Patterson Avenue for 20-acre Industrial property.

PLANNED UNIT DEVELOPMENT AGREEMENT

This Planned Unit Development Agreement (the "Agreement") is executed this _____ day of _____, 20____, between the City of Kentwood, a Michigan municipal corporation, the address of which is 4900 Breton Avenue, S.E., P.O. Box 8848, Kentwood, Michigan 49518- 8848 (the "City") and GRR Ancillary MU, LLC, located at 1971 E Beltline Ave NE, Suite 240, Grand Rapids, MI 49525 (the "Developer").

RECITALS

A. The Developer owns approximately 10.57 acres of real property located at the NW corner of 36th Street and Patterson Avenue in the City of Kentwood, Kent County, Michigan (the "Property"), more specifically described on attached **Schedule A**.

B. The Master Planned zoning of the Property is CPUD Commercial Planned Unit Development. On ______, the City Commission of the City of Kentwood approved the Preliminary PUD Plan for the development (the "Project"). A copy of the approved Preliminary PUD Plan of the Project is attached as **Schedule B.** (the "Site Plan").

C. In its approval of the Preliminary PUD Site Plan, the Kentwood City Commission (the "Commission") adopted certain conditions of approval which were relied upon by the Commission in granting its approval. This Agreement incorporates those conditions.

AGREEMENT

Section 1. <u>Compliance with Laws, Ordinances, Permits.</u> If the Project is developed, Developer shall construct, install, and operate the Project in accordance with approvals received from governmental entities with applicable jurisdiction. In constructing the Project, Developer agrees to comply with all state and local laws, ordinances, and regulations as well as the terms of this Agreement. Without limiting the preceding sentence, it is understood and agreed that except as expressly provided for herein, development of the Project must comply with the City of Kentwood Zoning Ordinance in effect as of the date of this Agreement (the "Zoning Ordinance").

Section 2. <u>Compliance with City Approvals.</u> Without limiting the provisions of Section 1, and notwithstanding any provision in this Agreement to the contrary, if the Project is developed, Developer shall design, develop, construct, and operate the Project in accordance with the conditions of approval outlined in the City Commission Findings of Fact. Developer acknowledges and agrees that neither Developer, nor a successor in title, may seek variances from the City's Zoning Board of Appeals in connection with the

conditions identified in Section 4 of this Agreement (the "Conditions"). However, Developer is not prohibited from applying for other variances.

Section 3. <u>Amendment to Site Plan</u>

A. The Developer acknowledges that the City, in approving the Project, relied on the Developer's representations that the Project will be constructed as depicted on the approved site plan dated ______ and as described in City staff's report dated ______ for Case No. ______ and further acknowledges that Amendments and Deviations to the Approved Plan may be considered, including other permitted C-2 and C-4 uses, in accordance with Section 12.13 of the Zoning Ordinance.

B. Any requested changes to the Site Plan shall be applied for by the Developer to the City in accordance with Section 12.13 of the Zoning Ordinance (or any applicable successor section). Any major changes approved shall be (a) identified as a separate addendum to this Agreement which shall be signed by the City and the party requesting the change and recorded with the Kent County Register of Deeds, and (b) noted on the Site Plan, which notation shall be signed by the Mayor of the City with the date of the approval of the amendment. Any change not considered a minor change shall be considered a major change. The City's Director of Community Development (the "Zoning Administrator"), in accordance with Section 12.13 of the Zoning Ordinance (or any applicable successor officer), shall determine whether the change is major or minor, which determination shall be final. Any approved minor change shall be noted on the Site Plan, which notation shall be final. Any approved minor change shall be noted on the Site Plan, which notation shall be final. Any approved minor change shall be noted on the Site Plan, which notation shall be determined in accordance with the date of approval of the amendment. Minor changes shall be determined in accordance with the standards contained in Section 13.05 (I)2 of the Zoning Ordinance.

Section 4. <u>Conditions.</u> The Project shall be developed in accordance with the conditions outlined in the City Commission Findings of Fact dated ______, and attached Qualifying Statement dated December 5, 2023.

Section 5. <u>Phases.</u> As described in the Qualifying Statement dated December 5, 2023.

Section 6. <u>Public Utilities.</u> Developer agrees that, if the Project is developed, Developer shall provide public electricity, telephone, gas, water, and sanitary sewer service ("Public Utilities") as shown on the Site Plan. In such event, Developer agrees that Public Utilities (except streetlights) shall be installed and maintained underground if required by the City. Prior to the issuance of any building permits for the Project, Developer shall provide all easements reasonably necessary for Public Utilities shown on the Site Plan, in such locations approved in advance by the relevant utility service provider. Easements for water and sanitary sewer service shall, at the City's request, name the City of Grand Rapids as a grantee or additional grantee. Prior to issuing any foundation or buildings permits for the Project, the Developer shall submit to the City Engineer and the City of Grand Rapids, for their review and approval, line drawings. Thereafter, and before issuing any foundation or building permits for any phase of the Project, final construction drawings for that phase of the Project shall be submitted for the review and approval of the City Engineer and the City of Grand Rapids.

Section 7. <u>Violation of Agreement.</u> The parties acknowledge that monetary damages for a breach of this Agreement would be inadequate to compensate the parties for the benefit of their bargain. Accordingly, the parties expressly agree that in the event of a violation of this Agreement, the non-breaching party shall be entitled to receive specific performance. Nothing herein shall be deemed a waiver of the City's rights to seek enforcement of this Agreement or zoning approvals previously granted, to the extent otherwise authorized by law. Notwithstanding the foregoing, in the event there is a violation(s) or alleged violation(s) of the terms or conditions of this Agreement by the Developer, then the City shall serve written

notice upon the Developer setting forth the manner in which Developer has violated the Agreement, and such notice shall include a demand that the violation(s) be cured within a stated reasonable time period. Violations or alleged violations of the terms and conditions of this Agreement shall entitle the prevailing party, in the event of litigation to enforce this Agreement, to receive its reasonable attorney and consulting fees incurred.

Section 8. <u>Amendment.</u> This Agreement may only be amended in writing, signed by the City and the Developer.

Section 9. <u>Recording and Binding Effect.</u> The rights and obligations under this Agreement are covenants and restrictions intended to run with the land, and this Agreement shall be binding upon and inure to the benefit of the parties, as well as their subrogees, successors and assigns. It is the parties' intent that this Agreement shall be recorded with the Kent County Register of Deeds. The City shall be responsible for all costs associated with recording the Agreement.

Section 10. <u>Entire Agreement.</u> This is the entire agreement between the parties with respect to its subject matter. The captions are for convenience only, however, the recitals are deemed an integral part of the agreement for purposes of interpretation.

Section 11. <u>Miscellaneous.</u>

(a) <u>Severability</u>. The invalidity or unenforceability of any provision of this Agreement shall not affect the enforceability or validity of the remaining provisions and this Agreement shall be construed in all respects as if any invalid or unenforceable provision were omitted.

(b) <u>Notices.</u> Any and all notices permitted or required to be given shall be in writing and sent either by mail or personal delivery to the address first above given. Either party may modify its notice address by providing the other party written notice of such modification.

(c) <u>Waiver</u>. No failure or delay on the part of any party in exercising any right, power, or privilege under this Agreement shall operate as a waiver thereof, nor shall any single or partial exercise of any right, power, or privilege under this Agreement preclude further exercise thereof or the exercise of any other right; power, or privilege. The rights and remedies provided in this Agreement are cumulative and not exclusive of any rights and remedies provided by law.

(d) <u>Governing Law.</u> This Agreement is being executed and delivered and is intended to be performed in the State of Michigan and shall be construed and enforced in accordance with, and the rights of the parties shall be governed by, the laws thereof.

(e) <u>Authorization</u>. The parties affirm that their representatives executing this Agreement on their behalf are authorized to do so and that all resolutions or similar actions necessary to approve this Agreement have been adopted and approved. The Developer further affirms that it is not in default under the terms of the purchase agreement for the Property.

(f) <u>Liability of Developer</u>. The term "Developer" as used in this Agreement is limited to mean and include only the owner of the Property or a portion of the Property affected at the time in question. In the event of any sale, transfer or conveyance of any portion of the Property, the Developer will automatically be freed and relieved from all personal liability for the performance of any covenants or obligations on the part of the Developer contained in this Agreement after the date of such sale, transfer or conveyance, and the Developer's successor(s) shall assume all commitments with respect to the covenants, agreements, stipulations and obligations as to that portion of the Property sold, transferred or conveyed.

The parties have executed this Agreement or	on the day and year first above written
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WITNESSES:		CITY OF KI	ENTWOOD	
Print Name		Print Name		
Print Name		Print Name		
STATE OF MICHIGAN COUNTY OF KENT	} } ss. }			
Acknowledged before and	me in Kent Count	y, Michigan on the Mayor and	, t Clerk, respectively	by y, of the City of
centwood, a Michigan municip	al corporation, fo	r the City.		
		r Z N	Notary Public, Acting in My Commission E:	County, MI County, MI xpires:

WITNESSES:

GRR ANCILLARY MU, LLC

Ву:
Name: M. Elliot Muller
Its: Manager

Print Name

STATE OF MICHIGAN

} } ss.

}

COUNTY OF KENT

Acknowledged before me in Kent County, Michigan on ______, by M. Elliot Muller, the Manager of GRR Ancillary MU, LLC, a Michigan limited liability company.

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				No	tary Public,	County, MI
				AC	ung in	County, MI
				My	/ Commission Ex	xpires:
Drafted By a	and When Re	ecorded R	eturn To:			

SCHEDULE A

Legal Descriptions to be furnished at Final Site Plan Approval



SCHEDULE B

PUD Site Plan

Approved PUD Site Plan to be furnished



SCHEDULE C

City Commission Findings of Fact to be furnished





Traffic Impact Study 36th Street at Patterson Avenue Commercial Development Kentwood, Michigan

Prepared for:

Ben M. Muller Realty 1971 E. Beltline Ave, Suite 240 Grand Rapids, MI 49525

Prepared by:

Progressive AE 1811 4 Mile Road NE Grand Rapids, MI 49525

December 2023 Project No. 60116009

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EXECUTIVE SUMMARY

Introduction

Ben Muller Reality is proposing a commercial development on a roughly 10-acre parcel situated on the northwest corner of the Patterson Avenue and 36th Street intersection. The proposed project includes the construction of seven commercial buildings, including a hotel, bank, day care center, fast-food restaurant, convenience store/gas station, and general retail space. Construction of the project is anticipated to be completed within five years.

Access to the site will be via three site access driveways: two existing full access driveways to Patterson Avenue, and one proposed full access driveway to 36th Street opposing the existing Eaton Corporation Driveway. The driveways to Patterson Avenue oppose the existing driveways of Comcast and the United States Postal Service.

As part of the project approval process, the Kent County Road Commission (KCRC) and the City of Kentwood have requested a traffic impact study be prepared to quantify the impacts the project may have on the surrounding roadway network.

The purpose of this traffic impact study is to analyze the potential impacts of the planned development and to identify what physical and/or operational roadway system improvements may be necessary to mitigate existing or anticipated background issues, and/or impacts created by this development's traffic.

Pre-study coordination was completed with the City of Kentwood and KCRC to help identify the required study area, study parameters, and any specific areas of concern.

Study Area

The study area includes one existing signalized intersection and three existing stop-controlled intersections as listed below.

- Patterson Avenue at 36th Street
- Patterson Avenue at Comcast Driveway (proposed north driveway)
- Patterson Avenue at USPS Driveway (proposed south driveway)
- 36th Street at Eaton Driveway (proposed driveway)

Data Collection

Morning (7:00 – 9:00 a.m.) and afternoon (4:00 – 6:00 p.m.) peak hour turning-movement counts at the study area intersections were collected in August 2023 on a typical weekday.

Analysis

Three analysis scenarios were completed for the weekday morning and afternoon peak hours as part of the study as follows:

- Existing Conditions
- Background (2028) Conditions
- Future (2028) Conditions

An annual background traffic growth rate of 2.50 percent was applied to the existing volumes to help reflect anticipated non-development traffic increases by the 2028 horizon year. This background growth rate is higher than typical and was utilized based on information provided by the Kent County Road Commission.

Trip generation for the site was calculated for the typical weekday morning and afternoon peak hours based on the methods of the ITE Trip Generation Manual, 11th Edition, published by the Institute of Transportation Engineers (ITE). After reductions for pass-by and internal trips, the site is expected to generate approximately 300 new weekday morning peak hour vehicle trips (161 inbound, 139 outbound),

60116009 Progressive AE and approximately 344 new weekday afternoon peak hour trips (172 inbound, 172 outbound) onto the street system.

For the existing, background (2028), and future (2028) conditions, a capacity and gueuing analyses were performed to determine the impacts the site would have on the roadways and intersections within the study area.

Conclusions

Based on the analyses performed as part of this study, the proposed development will have minor impacts on the surrounding roadway network. The findings of this study are as follows:

Existing Conditions

The existing conditions analyses show the Patterson Avenue/36th Street intersection is currently operating at an overall level of service (LoS) "C" during the morning peak hour, and LoS "D" during the afternoon peak hour. All individual movements at the intersection are currently operating at LoS "D" or better during the morning and afternoon peak hours, except for the movements listed below.

- The westbound left-turn movement is currently operating at LoS "E" during the morning peak hour.
- . The northbound right-turn movement is currently operating at LoS "E" during the afternoon peak hour.

The controlled movements at the unsignalized study area intersections are currently operating at LoS "C" or better during the morning and afternoon peak hours. intersection

Background (2028) Conditions

The background (2028) conditions show the Patterson Avenue/36th Street intersection is anticipated to 2028 operate at an overall LoS "D" during the morning peak hour and deteriorate to an overall LoS "E" during the afternoon peak hour. Optimizing the signal timings at the intersection resulted in marginal improvement; however, the intersection is anticipated to continue operating at an overall LoS "E" during the afternoon peak hour. Additional capacity improvements such as dual northbound right-turns lanes -turns lanes may be necessary in the future based on the anticipated background traffic growth.

All individual movements at the Patterson Avenue/36th Street intersection are anticipated to operate at LoS "D" or better during the morning and afternoon peak hours, except for the movements listed below.

- The westbound left-turn movement is anticipated to operate at LoS "F" during the morning peak hour and LoS "E" during the afternoon peak hour.
- The delay for the northbound right-turn movement is anticipated to increase significantly due to . background traffic growth. This movement is anticipated to operate at LoS "F" with long queues during the afternoon peak hour. A detailed queuing analysis is provided in the next chapter. yuerry PM PEONE Dight fit normbound richts

The controlled movements at the unsignalized study area intersections are anticipated to continue

operating at LoS "C" or better during the morning and afternoon peak hours.

Westbour VEAT = F PM = E

AN P

PM

Future (2028) Conditions

Compared to background (2028) conditions, the Patterson Avenue/36th Street intersection is anticipated to continue operating at an overall LoS "D" during the morning peak hour and an overall LoS "E" during the afternoon peak hour. As with background (2028) conditions, optimizing the signal timings at the intersection resulted in marginal improvement; however, the intersection is anticipated to continue operating at an overall LoS "E" during the afternoon peak hour.

All individual movements at the Patterson Avenue/36th Street intersection are anticipated to operate at LoS "D" or better during the morning and afternoon peak hours, except for the movements listed below.

As with background (2028) conditions, the westbound left-turn movement is anticipated to operate at • LoS "F" during the morning peak hour and LoS "E" during the afternoon peak hour. Traffic generated by the proposed development has little to no impact on this movement.

- As with background (2028) conditions, the northbound right-turn movement is anticipated to operate at LoS "F" with long queues during the afternoon peak hour. Traffic generated by the proposed development has little to no impact on this movement.
- Compared to background (2028) conditions, the southbound left-turn movement is anticipated to deteriorate from LoS "D" to LoS "E" during the afternoon peak hour. This would likely be considered acceptable, as the 95th percentile queue for this movement is anticipated to be contained within the existing southbound left-turn lane.

The controlled movements at the proposed site driveways are anticipated to operate at LoS "C" or better during the morning and afternoon peak hours.

The results of the queuing analysis show all queues for the controlled movements at the proposed site driveways are anticipated to be one vehicle or less during the morning and afternoon peak hours. The longest queue is anticipated to be for the eastbound left-turn movement at approximately one vehicle. Vehicles turning left into the site from the two-way left-turn lanes along Patterson Avenue and 36th Street are not anticipated to conflict with left-turn vehicle queues from adjacent intersections.

The most significant impacts related to vehicular queuing within the study area occur at the signalized Patterson Avenue/36th Street intersection as follows:

- The queue within the dual westbound left-turn lanes is anticipated to slightly surpass the available storage within the dual left-turn lanes due to the increase in background traffic volumes; however, additional storage capacity is available within the existing two-way left-turn lane.
- The northbound right-turn movement queue is anticipated to significantly increase due to the increase in background traffic volumes.
- The southbound left-turn movement queue is anticipated to increase to approximately 170 feet under future (2028) conditions; however, the available storage within the left-turn lane is not exceeded. As the proposed south driveway is located approximately 400 feet north of the Patterson Avenue/36th Street intersection, this queue is not anticipated to conflict with northbound vehicles turning left into the site.

The right-turn lane warrant analyses indicated right-turn lanes and/or tapers would be warranted at the proposed site driveways as follows:

- A southbound right-turn lane would be warranted at the proposed north driveway to Patterson Avenue during the morning peak hour while a right-turn taper would be warranted during the afternoon peak hour.
- A southbound right-turn lane would be warranted at the proposed south driveway to Patterson Avenue during the morning and afternoon peak hours.
- A westbound right-turn taper would be warranted at the proposed driveway to 36th Street during the morning and afternoon peak hours.

Recommendations

The following is a list of recommendations to mitigate the impact of the proposed development and improve operations within the study area:

- The proposed site driveways should operate as full access driveways to the proposed development. Restricting movements at the driveways would funnel more traffic to other driveways, potentially creating longer delays and queuing on those approaches.
- As shown on the proposed site plan, all exiting approaches at the site driveways should include a separate left-turn lane and right-turn lane.
- A southbound right-turn lane should be constructed at both the proposed north and south site driveways to Patterson Avenue. The right-turn lane should be designed and constructed to current Kent County Road Commission standards.

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- A westbound right-turn taper should be constructed at the proposed site driveway to 36th Street. The right-turn taper should be designed and constructed to current Kent County Road Commission standards.
- Signal timings at the Patterson Avenue/36th Street intersections should be monitored and optimized as construction of the proposed development is completed.
- The Kent County Road Commission and/or the City of Kentwood should monitor the Patterson Avenue/36th Street intersection for potential capacity improvements, such as dual northbound right-turn lanes, should background traffic volumes increase as anticipated within this report.

progressive ae

То:	Ben M. Muller Reality Co., Inc. – Elliot Muller RJM Design – Jim Morgan, PLA
From:	Progressive AE, Inc. – Nick LaCroix, PE, PTOE; Christopher Zull, PE
Date:	December 1, 2023
Re:	36th Street at Patterson Avenue Traffic Impact Study

INTRODUCTION

This memorandum follows the traffic impact study previously prepared, dated October 2023, for the proposed development site located on the northwest corner of the 36th Street/Patterson Avenue intersection. As part of the Kent County Road Commission and City of Kentwood (City) review process, additional analyses were requested. These included the potential elimination of the proposed south driveway due to the anticipated southbound queuing along Patterson Avenue and the proposed south driveway location being 430 feet north of the 36th Street/Patterson Avenue intersection.

ANALYSIS

Queuing (HCM Methodology)

The traffic study shows the southbound queuing along Patterson Avenue at 36th Street may extend past the proposed south driveway by approximately three vehicles during the morning peak hour. Queuing during the afternoon peak hour is not anticipated to extend to the proposed south driveway. These queues were based on the Highway Capacity Manual (HCM) methodology and represent the 95th percentile queue and will likely occur less than five percent of the time.

Table 1 shows the hourly traffic volumes along Patterson Avenue north of 36th Street based on data from the Grand Valley Metro Council (GVMC). The morning peak hour experiences the heaviest southbound traffic volumes throughout a typical day resulting in the longest queues. Therefore, the morning peak hour is the only time period throughout a typical day where the southbound gueue may extend to the proposed south driveway.

The southbound queuing along Patterson Avenue is anticipated to have minimal impact on traffic operations at the proposed south driveway as these queues will likely only occur during the morning peak hour. During the time periods where the driveway may be blocked during the morning peak hour, there is adequate vehicular storage within exit driveway and within the northbound left-turn lane to accommodate a short queue of entering and/or exiting vehicles. It is also anticipated these queues will dissipate quickly on the next signal cycle at the 36th Street/Patterson Avenue intersection.

Table 1. Patterson Ave. Traffic Volumes Time NR

12:00 A.M.	42	37	79
1:00	44	28	72
2:00	31	49	80
3:00	56	61	117
4:00	80	152	232
5:00	131	367	498
6:00	255	435	690
7:00	331	591	922
8:00	304	481	785
9:00	358	351	709
10:00	335	366	701
11:00	424	451	875
12:00 P.M.	448	518	966
1:00	381	483	864
2:00	459	551	1010
3:00	539	518	1057
4:00	517	463	980
5:00	546	447	993
6:00	366	379	745
7:00	267	315	582
8:00	163	204	367
9:00	128	150	278
10:00	107	118	225
11:00	80	76	156

SB

Total

Source: GVMC, June 2020

Progressive AE, Inc.

Memo

Queuing (Microsimulation Methodology)

An additional queuing analysis was performed utilizing the *SimTraffic*[®] microsimulation software to supplement the HCM queuing analysis completed as part of the original study. Five simulations were run during the morning and afternoon peak hours, with the average of the results being reported. Table 2 shows the shows the anticipated 95th percentile queues along the Patterson Avenue southbound approach to 36th Street. Copies of the *SimTraffic*[®] analyses are attached to this memo.

Table 2. Future (2028) Southbound Patterson Avenue95th Percentile Queues

	HCM Met	hodology	Microsimulation		
Intersection/ Movement	AM Queue (ft)	PM Queue (ft)	AM Queue (ft)	PM Queue (ft)	
SBT	505	260	417	294	
SBT/R	505	300	417	300	

¹Queue shown per lane for Microsimulation analysis.

Source: Progressive AE, October 2023

As shown in Table 2, the southbound queue along Patterson Avenue is not anticipated to extend past the proposed south driveway during either the morning or afternoon peak hours.

Capacity Analysis

Based on the comments received on the traffic impact study, two alternatives were considered for driveway access to Patterson Avenue. Alternative 1 includes two full access driveways as proposed in the traffic study. Alternative 2 eliminates the proposed south driveway, resulting in only one full access driveway along Patterson Avenue. Copies of the Synchro analysis for Alternative 2 are attached to this memo.

Figure 1 shows the anticipated peak hour traffic volume and levels of service at the proposed north driveway for Alternative 2.

Table 3 shows a comparison of the anticipated future traffic operations at the proposed Patterson Avenue driveway(s) under Alternative 1 and Alternative 2. All controlled movements at the proposed site driveway(s) are anticipated to operate at LoS "C" or better during the morning and afternoon peak hours for Alternative 1.

For Alternative 2, all controlled movements at the proposed site driveway(s) are anticipated to operate at LoS "D" or better during the morning and afternoon peak hours. It should



Figure 1. Future (2028) Peak Hour Volumes and LoS (Alternative 2)

be noted that the eastbound left-turn movement exiting the north driveway is anticipated to operate at LoS "D" with 33.2 seconds to delay during the morning peak hour. As this movement is nearing capacity, additional traffic exiting the site will result in significantly increasing delay. Future development planned on adjacent properties that will utilize this driveway will likely result in unacceptable delay and queuing.

Intersection/	Future (2028) Conditions North and South Driveways (Alt 1)			Future (2028) Conditions North Driveway Only (Alt 2)					
Movement	A	M .	P.M.		A	A.M.		P.M.	
	LoS	Delay(s)	LoS	Delay(s)	LoS	Delay(s)	LoS	Delay(s)	
Patterson Ave	enue / Com	cast Driveway	(Proposed	North Drive	way) ¹				
EBL	С	22.3	С	15.9	D	33.2	С	21.1	
EBT/R	В	11.0	В	10.4	В	11.8	В	11.0	
WB	В	13.5	С	16.2	С	16.2	С	21.3	
NBL	В	10.3	А	8.5	В	11.1	А	8.9	
SBL	А	8.2	А	8.7	Α	8.2	А	8.6	
Patterson Ave	enue / USPS	6 Driveway (P	roposed So	outh Drivewa	y)1				
EBL	С	22.8	В	14.1	-	-	-	-	
EBT/R	В	11.4	В	10.7	-	-	-	-	
WB	В	12.7	В	13.8	-	-	-	-	
NBL	В	10.4	A	8.6	-	-	-	-	
SBL	А	8.2	А	0	-	-	-	-	

Table 3. Future (2028) Levels of Service and Delay

¹Unsignalized intersection, controlled movements shown.

Source: Progressive AE, November 2023

CONCLUSIONS AND RECOMMENDATIONS

Based on the analyses performed as part of the initial traffic impact study and the additional analyses completed as part of this memorandum, two full access driveway approaches to Patterson Avenue would be recommended based on the following:

- The anticipated southbound queue along Patterson Avenue is anticipated to extend approximately three vehicles past the proposed south driveway less than five percent of the time during the morning peak hour based on HCM methodology calculations. The queue is not anticipated to extend to the driveway during all other time periods throughout a typical day as the southbound traffic volumes are heaviest during the morning peak hour.
- The microsimulation analysis of southbound Patterson Avenue queuing shows the 95th percentile queue is not anticipated to extend past the proposed south driveway during either the morning or afternoon peak hours.
- Southbound queueing along Patterson Avenue is anticipated to dissipate quickly during the next signal cycle resulting in minimal impact at the site driveway. Adequate vehicular storage is planned for the exit approach and northbound left-turn movement to accommodate a short-lived queue.
- The proposed site driveway will provide a net benefit to traffic operations within the study area as additional development is constructed on adjacent properties.

NDL/ecy

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Progressive AE, Inc.

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Intersection

Int Delay, s/veh

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	- ሽ	- 1 +			- 44		<u>۲</u>	∱ î≽		<u>۲</u>	_ ≜ ‡}	
Traffic Vol, veh/h	87	0	143	12	0	17	102	586	24	12	996	110
Future Vol, veh/h	87	0	143	12	0	17	102	586	24	12	996	110
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	-	-	-	75	-	-	100	-	-
Veh in Median Storage,	,# -	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	60	60	60	85	85	85	80	80	80
Heavy Vehicles, %	0	0	0	15	15	15	2	2	2	1	1	1
M∨mt Flow	95	0	155	20	0	28	120	689	28	15	1245	138

Major/Minor	Minor2		ſ	Minor1 Majo			Major1	Major2						
Conflicting Flow All	1929	2301	692	1596	2356	359	1383	0	0	717	0	0		
Stage 1	1344	1344	-	943	943	-	-	-	-	-	-	-		
Stage 2	585	957	-	653	1413	-	-	-	-	-	-	-		
Critical Hdwy	7.5	6.5	6.9	7.8	6.8	7.2	4.14	-	-	4.12	-	-		
Critical Hdwy Stg 1	6.5	5.5	-	6.8	5.8	-	-	-	-	-	-	-		
Critical Hdwy Stg 2	6.5	5.5	-	6.8	5.8	-	-	-	-	-	-	-		
Follow-up Hdwy	3.5	4	3.3	3.65	4.15	3.45	2.22	-	-	2.21	-	-		
Pot Cap-1 Maneuver	*~ 69	43	*687	*146	33	*833	706	-	-	1153	-	-		
Stage 1	*393	391	-	*434	441	-	-	-	-	-	-	-		
Stage 2	*821	462	-	*622	327	-	-	-	-	-	-	-		
Platoon blocked, %	1	1	1	1	1	1	1	-	-	1	-	-		
Mov Cap-1 Maneuver	*~ 57	35	*687	*97	27	*833	706	-	-	1153	-	-		
Mov Cap-2 Maneuver	*220	188	-	*207	130	-	-	-	-	-	-	-		
Stage 1	*326	386	-	*360	366	-	-	-	-	-	-	-		
Stage 2	*658	383	-	*475	323	-	-	-	-	-	-	-		
Approach	EB			WB			NB			SB				
HCM Control Delay, s	19.9			16.2			1.6			0.1				
HCM LOS	С			С										
Minor Lane/Maior Myr	nt	NRI	NRT	NBR I	EBI n1 l	EBI n2V	VRI n1	SBI	SBT	SBR				
Canacity (veh/h)		706	-		220	687	370	1153						_
HCM Lane V/C Ratio		0 17		_	0/3	0.226	0 131	0.013		_				
HCM Control Delay (s	•)	11 1			22.2	11.8	16.2	8.2						
HCM Lane LOS	<i>י</i> ן	R 11.1		_	00.2 D	R	10.2 C	0.2		_				
HCM 95th %tile O(vet	n)	0.6	_	_	2	0 9	04	0	_	_				
	9	0.0	-	-	2	0.9	0.4	0	_					
Notes														
~: Volume exceeds capacity		\$: Delay exceeds 300s +: Computation Not Defined								*: All major volume in platoon				

2.4

Intersection

Int Delay, s/veh

Movement	EDI	EDT	EDD	\//D1			NDI	NDT	NDD	CDI	CDT	CDD
Movement	EDL	EDI	EDN	VVDL	VVDI	WDN	INDL	INDI	NDN	JDL	SDI	SDR
Lane Configurations	<u>۲</u>	- î>			- 4 >		ግ	- † Þ		ገ	- † Þ	
Traffic Vol, veh/h	105	0	143	11	0	5	114	891	6	2	834	101
Future Vol, veh/h	105	0	143	11	0	5	114	891	6	2	834	101
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	-	-	-	75	-	-	100	-	-
Veh in Median Storage,	# -	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	70	70	70	85	85	85	95	95	95
Heavy Vehicles, %	0	0	0	21	21	21	1	1	1	1	1	1
Mvmt Flow	114	0	155	16	0	7	134	1048	7	2	878	106

Minor2		ľ	Minor1			Major1		Ν	/lajor2				
1727	2258	492	1763	2308	528	984	0	0	1055	0	0		
935	935	-	1320	1320	-	-	-	-	-	-	-		
792	1323	-	443	988	-	-	-	-	-	-	-		
7.5	6.5	6.9	7.92	6.92	7.32	4.12	-	-	4.12	-	-		
6.5	5.5	-	6.92	5.92	-	-	-	-	-	-	-		
6.5	5.5	-	6.92	5.92	-	-	-	-	-	-	-		
3.5	4	3.3	3.71	4.21	3.51	2.21	-	-	2.21	-	-		
*154	52	*754	*121	37	*685	1047	-	-	1007	-	-		
*695	612	-	*323	336	-	-	-	-	-	-	-		
*687	368	-	*671	535	-	-	-	-	-	-	-		
1	1	1	1	1	1	1	-	-	1	-	-		
*137	45	*754	*86	32	*685	1047	-	-	1007	-	-		
*336	209	-	*188	169	-	-	-	-	-	-	-		
*606	610	-	*281	293	-	-	-	-	-	-	-		
*593	320	-	*532	534	-	-	-	-	-	-	-		
EB			WB			NB			SB				
15.3			21.3			1			0				
С			С										
nt	NBL	NBT	NBR I	EBLn1 I	EBLn2V	VBLn1	SBL	SBT	SBR				
	1047	-	-	336	754	243	1007	-	-				
	0.128	-	-	0.34	0.206	0.094	0.002	-	-				
)	8.9	-	-	21.1	11	21.3	8.6	-	-				
,	А	-	-	С	В	С	А	-	-				
ו)	0.4	-	-	1.5	0.8	0.3	0	-	-				
pacity	\$: De	lay exc	eeds 30)0s -	+: Com	outation	Not De	fined	*: All m	najor volur	ne in platoon		
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Summary of All Intervals

Run Number	1	2	3	4	5	Avg	
Start Time	6:45	6:45	6:45	6:45	6:45	6:45	
End Time	8:00	8:00	8:00	8:00	8:00	8:00	
Total Time (min)	75	75	75	75	75	75	
Time Recorded (min)	60	60	60	60	60	60	
# of Intervals	4	4	4	4	4	4	
# of Recorded Intervals	3	3	3	3	3	3	
Vehs Entered	4245	4043	4167	4125	4192	4153	
Vehs Exited	4255	4065	4128	4112	4197	4152	
Starting Vehs	104	111	99	99	111	100	
Ending Vehs	94	89	138	112	106	105	
Travel Distance (mi)	2397	2258	2320	2302	2366	2329	
Travel Time (hr)	124.1	93.6	128.9	144.0	119.8	122.1	
Total Delay (hr)	69.3	42.1	76.2	91.5	65.9	69.0	
Total Stops	4276	3445	4676	5325	4485	4443	
Fuel Used (gal)	116.6	104.0	116.3	122.0	114.8	114.8	

Interval #0 Information Seeding

Start Time	6:45
End Time	7:00
Total Time (min)	15
Volumes adjusted by Grow	vth Factors.
No data recorded this inter	rval.

Interval #1 Information Pre

Start Time	7:00	
End Time	7:15	
Total Time (min)	15	

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	1	2	3	4	5	Avg	
Vehs Entered	942	960	973	945	1009	965	
Vehs Exited	962	991	993	905	1001	973	
Starting Vehs	104	111	99	99	111	100	
Ending Vehs	84	80	79	139	119	98	
Travel Distance (mi)	535	539	554	518	564	542	
Travel Time (hr)	21.7	21.9	23.4	26.9	27.1	24.2	
Total Delay (hr)	9.4	9.5	10.8	15.2	14.3	11.8	
Total Stops	788	771	872	903	1022	873	
Fuel Used (gal)	24.7	24.7	25.7	25.2	27.2	25.5	

Interval #2 Information Peak

Start Time	7:15	
End Time	7:30	
Total Time (min)	15	
Volumes adjusted by PHF, Gr	owth Factors.	

Run Number	1	2	3	4	5	Avg	
Vehs Entered	1265	1173	1201	1186	1234	1210	
Vehs Exited	1163	1142	1113	1147	1160	1144	
Starting Vehs	84	80	79	139	119	98	
Ending Vehs	186	111	167	178	193	165	
Travel Distance (mi)	684	643	651	651	675	661	
Travel Time (hr)	41.8	28.3	36.4	44.9	37.1	37.7	
Total Delay (hr)	26.3	13.7	21.7	30.1	21.8	22.7	
Total Stops	1394	1034	1348	1658	1431	1375	
Fuel Used (gal)	34.2	29.7	32.0	35.3	32.8	32.8	

Interval #3 Information Post

Start Time	7:30
End Time	8:00
Total Time (min)	30
Valueses adjusted by Crewith Festers	

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	1	2	3	4	5	Avg	
Vehs Entered	2038	1910	1993	1994	1949	1977	
Vehs Exited	2130	1932	2022	2060	2036	2036	
Starting Vehs	186	111	167	178	193	165	
Ending Vehs	94	89	138	112	106	105	
Travel Distance (mi)	1178	1077	1114	1133	1126	1126	
Travel Time (hr)	60.6	43.5	69.1	72.2	55.6	60.2	
Total Delay (hr)	33.7	18.8	43.8	46.2	29.8	34.5	
Total Stops	2094	1640	2456	2764	2032	2193	
Fuel Used (gal)	57.7	49.6	58.6	61.6	54.8	56.5	

Intersection: 1: Patterson Ave & 36th St

Movement	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	NB	SB
Directions Served	L	Т	TR	L	L	Т	TR	L	Т	Т	R	L
Maximum Queue (ft)	112	178	182	262	274	1001	872	143	221	204	151	243
Average Queue (ft)	40	88	82	243	260	553	438	61	133	104	58	78
95th Queue (ft)	88	153	149	299	297	1311	1139	117	212	182	109	208
Link Distance (ft)		294	294			1362	1362		1054	1054		
Upstream Blk Time (%)						5	1					
Queuing Penalty (veh)						0	0					
Storage Bay Dist (ft)	200			250	250			500			250	250
Storage Blk Time (%)		0		12	41	1						
Queuing Penalty (veh)		0		19	67	7						

Intersection: 1: Patterson Ave & 36th St

Movement	SB	SB
Directions Served	Т	TR
Maximum Queue (ft)	446	445
Average Queue (ft)	239	243
95th Queue (ft)	417	417
Link Distance (ft)	398	398
Upstream Blk Time (%)	4	4
Queuing Penalty (veh)	23	26
Storage Bay Dist (ft)		
Storage Blk Time (%)	11	
Queuing Penalty (veh)	10	

Summary of All Intervals

Run Number	1	2	3	4	5	Avg	
Start Time	3:45	3:45	3:45	3:45	3:45	3:45	
End Time	5:00	5:00	5:00	5:00	5:00	5:00	
Total Time (min)	75	75	75	75	75	75	
Time Recorded (min)	60	60	60	60	60	60	
# of Intervals	4	4	4	4	4	4	
# of Recorded Intervals	3	3	3	3	3	3	
Vehs Entered	4917	4745	4768	4785	4784	4803	
Vehs Exited	4912	4757	4760	4808	4789	4806	
Starting Vehs	126	131	102	119	123	119	
Ending Vehs	131	119	110	96	118	115	
Travel Distance (mi)	2752	2653	2660	2707	2700	2694	
Travel Time (hr)	132.4	123.7	123.3	129.9	137.5	129.4	
Total Delay (hr)	67.8	61.5	60.6	66.4	74.4	66.1	
Total Stops	5496	5137	5175	5616	6098	5506	
Fuel Used (gal)	133.4	127.5	127.8	130.8	133.7	130.6	

Interval #0 Information Seeding

Start Time	3:45
End Time	4:00
Total Time (min)	15
Volumes adjusted by Gr	rowth Factors.
No data recorded this in	terval.

Interval #1 Information Pre

Start Time	4:00	
End Time	4:15	
Total Time (min)	15	

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	1	2	3	4	5	Avg	
Vehs Entered	1162	1153	1131	1114	1097	1131	
Vehs Exited	1171	1180	1111	1129	1098	1140	
Starting Vehs	126	131	102	119	123	119	
Ending Vehs	117	104	122	104	122	109	
Travel Distance (mi)	661	662	629	643	620	643	
Travel Time (hr)	29.3	29.2	27.9	28.6	26.9	28.4	
Total Delay (hr)	13.9	13.7	13.1	13.6	12.4	13.4	
Total Stops	1052	1117	1025	1018	978	1036	
Fuel Used (gal)	31.1	31.3	29.4	30.1	29.1	30.2	

Interval #2 Information Peak

Start Time	4:15	
End Time	4:30	
Total Time (min)	15	
Volumes adjusted by PHF, G	rowth Factors.	

Run Number	1	2	3	4	5	Avg	
Vehs Entered	1384	1331	1360	1345	1415	1365	
Vehs Exited	1323	1291	1320	1293	1353	1317	
Starting Vehs	117	104	122	104	122	109	
Ending Vehs	178	144	162	156	184	163	
Travel Distance (mi)	738	710	731	734	764	736	
Travel Time (hr)	39.0	36.0	35.6	39.1	45.5	39.0	
Total Delay (hr)	21.7	19.3	18.4	22.0	27.5	21.8	
Total Stops	1783	1583	1581	1969	2180	1822	
Fuel Used (gal)	36.8	35.1	35.7	37.0	39.7	36.8	

Interval #3 Information Post

Start Time	4:30
End Time	5:00
Total Time (min)	30
Volumes adjusted by Crowth Fasters	

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	1	2	3	4	5	Avg	
Vehs Entered	2371	2261	2277	2326	2272	2301	
Vehs Exited	2418	2286	2329	2386	2338	2350	
Starting Vehs	178	144	162	156	184	163	
Ending Vehs	131	119	110	96	118	115	
Travel Distance (mi)	1354	1281	1299	1330	1315	1316	
Travel Time (hr)	64.1	58.5	59.8	62.2	65.2	62.0	
Total Delay (hr)	32.2	28.4	29.1	30.8	34.4	31.0	
Total Stops	2661	2437	2569	2629	2940	2649	
Fuel Used (gal)	65.5	61.1	62.7	63.7	64.9	63.6	

Intersection: 1: Patterson Ave & 36th St

Movement	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	NB	SB
Directions Served	L	Т	TR	L	L	Т	TR	L	Т	Т	R	L
Maximum Queue (ft)	159	256	237	251	259	271	244	234	884	1025	275	264
Average Queue (ft)	48	157	141	154	187	95	122	65	355	416	229	106
95th Queue (ft)	111	234	213	239	254	183	204	156	729	917	325	194
Link Distance (ft)		294	294			1362	1362		1054	1054		
Upstream Blk Time (%)										3		
Queuing Penalty (veh)										0		
Storage Bay Dist (ft)	200			250	250			500			250	250
Storage Blk Time (%)	0	3		0	1	0			1	2	20	
Queuing Penalty (veh)	0	2		0	1	0			1	18	92	

Intersection: 1: Patterson Ave & 36th St

Movement	SB	SB
Directions Served	Т	TR
Maximum Queue (ft)	333	339
Average Queue (ft)	205	209
95th Queue (ft)	294	300
Link Distance (ft)	398	398
Upstream Blk Time (%)	0	0
Queuing Penalty (veh)	0	0
Storage Bay Dist (ft)		
Storage Blk Time (%)	3	
Queuing Penalty (veh)	4	



Traffic Impact Study 36th Street at Patterson Avenue Commercial Development Kentwood, Michigan

Prepared for:

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December 2023 Project No. 60116009

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EXECUTIVE SUMMARY

Introduction

Ben Muller Reality is proposing a commercial development on a roughly 10-acre parcel situated on the northwest corner of the Patterson Avenue and 36th Street intersection. The proposed project includes the construction of seven commercial buildings, including a hotel, bank, day care center, fast-food restaurant, convenience store/gas station, and general retail space. Construction of the project is anticipated to be completed within five years.

Access to the site will be via three site access driveways: two existing full access driveways to Patterson Avenue, and one proposed full access driveway to 36th Street opposing the existing Eaton Corporation Driveway. The driveways to Patterson Avenue oppose the existing driveways of Comcast and the United States Postal Service.

As part of the project approval process, the Kent County Road Commission (KCRC) and the City of Kentwood have requested a traffic impact study be prepared to quantify the impacts the project may have on the surrounding roadway network.

The purpose of this traffic impact study is to analyze the potential impacts of the planned development and to identify what physical and/or operational roadway system improvements may be necessary to mitigate existing or anticipated background issues, and/or impacts created by this development's traffic.

Pre-study coordination was completed with the City of Kentwood and KCRC to help identify the required study area, study parameters, and any specific areas of concern.

Study Area

The study area includes one existing signalized intersection and three existing stop-controlled intersections as listed below.

- Patterson Avenue at 36th Street
- Patterson Avenue at Comcast Driveway (proposed north driveway)
- Patterson Avenue at USPS Driveway (proposed south driveway)
- 36th Street at Eaton Driveway (proposed driveway)

Data Collection

Morning (7:00 - 9:00 a.m.) and afternoon (4:00 - 6:00 p.m.) peak hour turning-movement counts at the study area intersections were collected in August 2023 on a typical weekday.

Analysis

Three analysis scenarios were completed for the weekday morning and afternoon peak hours as part of the study as follows:

- Existing Conditions
- Background (2028) Conditions
- Future (2028) Conditions

An annual background traffic growth rate of 2.50 percent was applied to the existing volumes to help reflect anticipated non-development traffic increases by the 2028 horizon year. This background growth rate is higher than typical and was utilized based on information provided by the Kent County Road Commission.

Trip generation for the site was calculated for the typical weekday morning and afternoon peak hours based on the methods of the ITE Trip Generation Manual, 11th Edition, published by the Institute of Transportation Engineers (ITE). After reductions for pass-by and internal trips, the site is expected to generate approximately 300 new weekday morning peak hour vehicle trips (161 inbound, 139 outbound),

1

and approximately 344 new weekday afternoon peak hour trips (172 inbound, 172 outbound) onto the street system.

For the existing, background (2028), and future (2028) conditions, a capacity and queuing analyses were performed to determine the impacts the site would have on the roadways and intersections within the study area.

Conclusions

Based on the analyses performed as part of this study, the proposed development will have minor impacts on the surrounding roadway network. The findings of this study are as follows:

Existing Conditions

The existing conditions analyses show the Patterson Avenue/36th Street intersection is currently operating at an overall level of service (LoS) "C" during the morning peak hour, and LoS "D" during the afternoon peak hour. All individual movements at the intersection are currently operating at LoS "D" or better during the morning and afternoon peak hours, except for the movements listed below.

- The westbound left-turn movement is currently operating at LoS "E" during the morning peak hour.
- The northbound right-turn movement is currently operating at LoS "E" during the afternoon peak hour.

The controlled movements at the unsignalized study area intersections are currently operating at LoS "C" or better during the morning and afternoon peak hours.

Background (2028) Conditions

The background (2028) conditions show the Patterson Avenue/36th Street intersection is anticipated to operate at an overall LoS "D" during the morning peak hour and deteriorate to an overall LoS "E" during the afternoon peak hour. Optimizing the signal timings at the intersection resulted in marginal improvement; however, the intersection is anticipated to continue operating at an overall LoS "E" during the afternoon peak hour. Additional capacity improvements such as dual northbound right-turns lanes may be necessary in the future based on the anticipated background traffic growth.

All individual movements at the Patterson Avenue/36th Street intersection are anticipated to operate at LoS "D" or better during the morning and afternoon peak hours, except for the movements listed below.

- The westbound left-turn movement is anticipated to operate at LoS "F" during the morning peak hour and LoS "E" during the afternoon peak hour.
- The delay for the northbound right-turn movement is anticipated to increase significantly due to background traffic growth. This movement is anticipated to operate at LoS "F" with long queues during the afternoon peak hour. A detailed queuing analysis is provided in the next chapter.

The controlled movements at the unsignalized study area intersections are anticipated to continue operating at LoS "C" or better during the morning and afternoon peak hours.

Future (2028) Conditions

Compared to background (2028) conditions, the Patterson Avenue/36th Street intersection is anticipated to continue operating at an overall LoS "D" during the morning peak hour and an overall LoS "E" during the afternoon peak hour. As with background (2028) conditions, optimizing the signal timings at the intersection resulted in marginal improvement; however, the intersection is anticipated to continue operating at an overall LoS "E" during the afternoon peak hour.

All individual movements at the Patterson Avenue/36th Street intersection are anticipated to operate at LoS "D" or better during the morning and afternoon peak hours, except for the movements listed below.

• As with background (2028) conditions, the westbound left-turn movement is anticipated to operate at LoS "F" during the morning peak hour and LoS "E" during the afternoon peak hour. Traffic generated by the proposed development has little to no impact on this movement.

- As with background (2028) conditions, the northbound right-turn movement is anticipated to operate at LoS "F" with long queues during the afternoon peak hour. Traffic generated by the proposed development has little to no impact on this movement.
- Compared to background (2028) conditions, the southbound left-turn movement is anticipated to
 deteriorate from LoS "D" to LoS "E" during the afternoon peak hour. This would likely be considered
 acceptable, as the 95th percentile queue for this movement is anticipated to be contained within the
 existing southbound left-turn lane.

The controlled movements at the proposed site driveways are anticipated to operate at LoS "C" or better during the morning and afternoon peak hours.

The results of the queuing analysis show all queues for the controlled movements at the proposed site driveways are anticipated to be one vehicle or less during the morning and afternoon peak hours. The longest queue is anticipated to be for the eastbound left-turn movement at approximately one vehicle. Vehicles turning left into the site from the two-way left-turn lanes along Patterson Avenue and 36th Street are not anticipated to conflict with left-turn vehicle queues from adjacent intersections.

The most significant impacts related to vehicular queuing within the study area occur at the signalized Patterson Avenue/36th Street intersection as follows:

- The queue within the dual westbound left-turn lanes is anticipated to slightly surpass the available storage within the dual left-turn lanes due to the increase in background traffic volumes; however, additional storage capacity is available within the existing two-way left-turn lane.
- The northbound right-turn movement queue is anticipated to significantly increase due to the increase in background traffic volumes.
- The southbound left-turn movement queue is anticipated to increase to approximately 170 feet under future (2028) conditions; however, the available storage within the left-turn lane is not exceeded. As the proposed south driveway is located approximately 400 feet north of the Patterson Avenue/36th Street intersection, this queue is not anticipated to conflict with northbound vehicles turning left into the site.

The right-turn lane warrant analyses indicated right-turn lanes and/or tapers would be warranted at the proposed site driveways as follows:

- A southbound right-turn lane would be warranted at the proposed north driveway to Patterson Avenue during the morning peak hour while a right-turn taper would be warranted during the afternoon peak hour.
- A southbound right-turn lane would be warranted at the proposed south driveway to Patterson Avenue during the morning and afternoon peak hours.
- A westbound right-turn taper would be warranted at the proposed driveway to 36th Street during the morning and afternoon peak hours.

Recommendations

The following is a list of recommendations to mitigate the impact of the proposed development and improve operations within the study area:

- The proposed site driveways should operate as full access driveways to the proposed development. Restricting movements at the driveways would funnel more traffic to other driveways, potentially creating longer delays and queuing on those approaches.
- As shown on the proposed site plan, all exiting approaches at the site driveways should include a separate left-turn lane and right-turn lane.
- A southbound right-turn lane should be constructed at both the proposed north and south site driveways to Patterson Avenue. The right-turn lane should be designed and constructed to current Kent County Road Commission standards.

- A westbound right-turn taper should be constructed at the proposed site driveway to 36th Street. The right-turn taper should be designed and constructed to current Kent County Road Commission standards.
- Signal timings at the Patterson Avenue/36th Street intersections should be monitored and optimized as construction of the proposed development is completed.
- The Kent County Road Commission and/or the City of Kentwood should monitor the Patterson Avenue/36th Street intersection for potential capacity improvements, such as dual northbound right-turn lanes, should background traffic volumes increase as anticipated within this report.

CHAPTER 1

INTRODUCTION

Ben Muller Reality is proposing a commercial development on a roughly 10-acre parcel situated on the northwest corner of the Patterson Avenue and 36th Street intersection. The proposed project includes the construction of seven commercial buildings, including a hotel, bank, day care center, fast-food restaurant, convenience store/gas station, and general retail space. Construction of the project is anticipated to be completed within five years.

Access to the site will be via three site access driveways: two existing full access driveways to Patterson Avenue, and one proposed full access driveway to 36th Street opposing the existing Eaton Corporation Driveway. The driveways to Patterson Avenue oppose the existing driveways of Comcast and the United States Postal Service. Figure 1 shows the location of the site and access driveways.

As part of the project approval process, the Kent County Road Commission and the City of Kentwood have requested a traffic impact study be prepared to quantify the impacts the project may have on the surrounding roadway network.

The purpose of this traffic impact study was to analyze the potential impacts of the planned development and to identify what physical and/or operational roadway system improvements may be necessary to mitigate existing or anticipated background issues, and/or impacts created by this development's traffic. Tasks undertaken to complete the analyses include:

1. **Data Collection.** Morning and afternoon peak hour turning-movement counts were completed at the study area intersections in August 2023. Information regarding lane configurations, speed limits, traffic controls and other related data for the study area roadways was also collected.



Figure 1. Location Map and Study Area

- 2. **Background Growth.** An annual background traffic growth rate of 2.50 percent was applied to the existing volumes to help reflect anticipated non-development traffic increases by the 2028 horizon year. This background growth rate is higher than typical and was utilized based on information provided by the Kent County Road Commission.
- 3. *Trip Generation/Distribution.* The number of trips the proposed development is expected to generate during peak hours was identified. These trips were then assigned to the adjacent street system based upon the patterns followed by existing traffic and engineering judgment.
- 4. *Levels of Service.* Capacity calculations were completed at the study area intersections and the proposed site driveways to identify existing and anticipated future peak hour operational characteristics.
- 5. *Mitigation.* Roadway/intersection improvements were identified, when applicable, that will enable the adjacent roadways and study area intersections to maintain equal and/or acceptable levels of operation under future conditions upon the addition of background traffic growth and/or due to development traffic.

Pre-study coordination was completed with the Kent County Road Commission and the City of Kentwood to help identify the required study area, study parameters, and any specific areas of concern. The following chapters outline the results of analyses completed during the study process.

CHAPTER 2

EXISTING CONDITIONS

The first step in the identification of potential traffic impacts is to determine how well the adjacent streets are operating under current conditions. This chapter summarizes the data collection and existing operating conditions analysis procedures.

Key Study Area Roadways

36th Street

36th Street is a primary east-west arterial roadway within the study area under Kent County Road Commission jurisdiction. Within the study area, it generally has a five-lane cross-section with two travel lanes in each direction and a two-way left-turn lane. The existing speed limit is 50 miles per hour west of Patterson Avenue and 45 miles per hour east of Patterson Avenue. Weekday 24-hour traffic volumes along 36th Street average approximately 7,000 vehicles per day west of Patterson Avenue increasing to 15,500 vehicles per day east of Patterson Avenue.

Patterson Avenue

Patterson Avenue is a primary north-south arterial roadway within the study area under Kent County Road Commission jurisdiction. Within the study area, it generally has a fivelane cross-section with two travel lanes in each direction and a two-way left-turn lane. The existing speed limit is 55 miles per hour within the study area. Weekday 24-hour traffic volumes along Patterson Avenue average approximately 14,000 vehicles per day north of 36th Street increasing to 32,000 vehicles per day south of 36th Street.

Existing Intersections

The study area includes one existing signalized intersection and three existing stop-controlled intersections as listed in Table 1.



Eastbound 36th Street at Eaton Driveway



Southbound Patterson Avenue at USPS Driveway

Intersection	Troffic Control	Cycle Length		
Intersection		AM	PM	
36th Street / Patterson Avenue	Signal	100	120	
Patterson Avenue / Comcast Driveway	Two-Way Stop	-	-	
Patterson Avenue / USPS Driveway	Two-Way Stop	-	-	
36th Street / Eaton Driveway	Two-Way Stop	-	-	

Table 1. Existing Intersections

Source: Progressive AE, October 2023

Data Collection

Morning (7:00 - 9:00 a.m.) and afternoon (4:00 - 6:00 p.m.) peak hour turning-movement counts at the study area intersections were collected in August 2022 on a typical weekday. Figure 2 shows the existing morning and afternoon peak hour volumes at the study area intersections. Detailed printouts of the count reports are included in the appendix.

These counts indicated that the typical weekday morning peak hour generally occurs between 7:15 to 8:15 a.m. and the typical afternoon peak hour occurs between 4:15 to 5:15 p.m.

Existing Conditions Capacity Analysis

Intersection "level-of-service" (LoS) calculations were completed to evaluate the current operational efficiency of the study area intersections. These calculations were completed using techniques outlined in the <u>Highway Capacity Manual</u>, published by the Transportation Research Board. Per MDOT requirements, *Synchro*® traffic analysis software, version 11, based on the Highway Capacity Manual methodologies, was used in the analysis.

Levels-of-service at signalized and unsignalized intersections relates to the delay, traffic volumes, and intersection geometry. Levels of service are expressed in a range from "A" to "F", with "A" denoting the highest, or best, operating conditions. Generally, a LoS "D" rating is considered the minimum acceptable service level for signalized and unsignalized intersections in most areas, although a LoS "E" or LoS "F" can be deemed as acceptable during the peak hours. The criteria for determining the LoS at signalized and unsignalized intersections are outlined in the appendix of this report.

The existing morning and afternoon peak hours were analyzed at the study area intersections. Table 2 and Figure 2 show the levels-of-service at the study area intersections. Copies of the *Synchro*[®] analyses are included in the appendix.

As shown in Table 2, the Patterson Avenue/36th Street intersection is currently operating at an overall LoS "C" during the morning peak hour and LoS "D" during the afternoon peak hour. All individual movements at the intersection are currently operating at LoS "D" or better during the morning and afternoon peak hours, except for the movements listed below.

- The westbound left-turn movement is currently operating at LoS "E" during the morning peak hour.
- The northbound right-turn movement is currently operating at LoS "E" during the afternoon peak hour.

Table 2. Existing Levels-of-Service and Delay

	Existing Conditions						
Intersection/		AM		PM			
Wovement	LoS	Delay (s)	LoS Delay (s)				
36 th Street / Patterson Avenue							
Overall	С	33.8	D	43.8			
EBL	D	39.7	D	40.9			
EBT/R	D	45.8	D	50.8			
WBL	Е	58.9	D	53.0			
WBT/R	D	36.3	D	45.0			
NBL	D	38.4	С	33.3			
NBT	С	23.9	С	31.9			
NBR	В	10.9	Е	64.4			
SBL	В	18.0	С	29.0			
SBT/R	С	30.4	С	24.7			
Patterson Avenue / Comcast Driveway ¹							
EB	С	15.8	В	12.0			
WB	В	11.3	В	12.8			
NB	А	0	А	0			
SBL	А	8.1	А	8.5			
Patterson Ave	nue / US	SPS Drivewa	ay ¹				
EB	В	12.5	В	10.1			
WB	В	11.2	В	11.1			
NBL	А	9.2	А	8.1			
SBL	А	8.0	А	0			
36 th Street / Ea	ton Driv	veway ¹					
WBL	А	8.0	А	8.5			
NB	А	9.2	В	10.4			

¹Unsignalized intersection, controlled movement(s) shown. Source: Progressive AE, October 2023

The controlled movements at the unsignalized study area intersections are currently operating at LoS "C" or better during the morning and afternoon peak hours.



CHAPTER 3

BACKGROUND (2028) CONDITIONS

The purpose of this chapter is to summarize the anticipated background (2028) traffic conditions within the study area with background traffic growth in place. These analyses provide a basis for comparing anticipated future conditions without the proposed development in place.

Background Traffic Volumes

An annual traffic growth rate was used to estimate growth on study area roadways. An annual growth rate of 2.50 percent was applied to the existing peak hour volumes to help determine background (2028) peak hour volumes. This background growth rate is higher than typical and was utilized based on information provided by the Kent County Road Commission.

Figure 3 shows the anticipated background (2028) traffic volumes for the weekday morning and afternoon peak hours with the addition of background growth.

Background (2028) Capacity Analysis

A capacity analysis was completed to evaluate the background (2028) morning and afternoon peak hours at the study area intersections with background traffic in place. Table 3 and Figure 3 show the levels-of-service at the study area intersections. Copies of the *Synchro*[®] analyses are included in the appendix.

As shown in Table 3, the Patterson Avenue/36th Street intersection is anticipated to operate at an overall LoS "D" during the morning peak hour and deteriorate to an overall LoS "E" during the afternoon peak hour. Optimizing the signal timings at the intersection resulted in marginal improvement; however, the intersection is anticipated to continue operating at an overall LoS "E" during the afternoon peak hour. Additional capacity improvements such as dual northbound right-turns lanes may be necessary in the future based on the anticipated background traffic growth. For the purposes of this study, no capacity improvements or modifications to the existing signal timing were considered to have been implemented.

All individual movements at the Patterson Avenue/36th Street intersection are anticipated to operate at LoS "D" or better during the morning and afternoon peak hours, except for the movements listed below.

- The westbound left-turn movement is anticipated to operate at LoS "F" during the morning peak hour and LoS "E" during the afternoon peak hour.
- The delay for the northbound right-turn movement is anticipated to increase significantly due to background traffic growth. This movement is anticipated to operate at LoS "F" with long queues during the afternoon peak hour. A detailed queuing analysis is provided in the next chapter.

The controlled movements at the unsignalized study area intersections are anticipated to continue operating at LoS "C" or better during the morning and afternoon peak hours.

		Existing C	onditions		Background (2028) Conditions				
Intersection/	A	М	F	M	1	AM	PM		
liteventent	LoS	Delay (s)	LoS	Delay (s)	LoS	Delay (s)	LoS	Delay (s)	
36th Street / Patterson Avenue									
Overall	С	33.8	D	43.8	D	42.9	Е	65.0	
EBL	D	39.7	D	40.9	D	40.0	D	40.7	
EBT/R	D	45.8	D	50.8	D	48.9	D	52.7	
WBL	Е	58.9	D	53.0	F	89.2	E	55.5	
WBT/R	D	36.3	D	45.0	D	35.7	D	43.9	
NBL	D	38.4	С	33.3	D	42.7	D	40.8	
NBT	С	23.9	С	31.9	С	25.2	D	37.5	
NBR	В	10.9	E	64.4	В	12.0	F	139.6	
SBL	В	18.0	С	29.0	В	19.3	D	38.6	
SBT/R	С	30.4	С	24.7	D	40.7	С	30.6	
Patterson Ave	enue / Comc	ast Driveway	/ ¹						
EB	С	15.8	В	12.0	С	17.6	В	12.9	
WB	В	11.3	В	12.8	В	12.0	В	13.7	
NBL	A	0	А	0	Α	0	А	0	
SBL	A	8.1	A	8.5	A	8.2	А	8.7	
Patterson Ave	enue / USPS	Driveway ¹							
EB	В	12.5	В	10.1	В	13.1	В	10.5	
WB	В	11.2	В	11.1	В	11.4	В	11.6	
NBL	A	9.2	А	8.1	A	9.6	А	8.3	
SBL	A	8.0	А	0	A	8.2	А	0	
36 th Street / E	aton Drivewa	ay ¹							
WBL	А	8.0	А	8.5	Α	8.1	A	8.7	
NB	A	9.2	В	10.4	A	9.4	В	10.7	

Table 3. Background (2028) Levels-of-Service and Delay

¹Unsignalized intersection, controlled movements shown. Source: Progressive AE, October 2023



CHAPTER 4

FUTURE (2028) CONDITIONS

The purpose of this chapter is to summarize the anticipated future (2028) traffic conditions within the study area with background traffic growth and the proposed development traffic in place. These analyses provide the before/after comparison of future conditions and help define the timing and applicability of any potential roadway improvements necessary to mitigate the impact of the proposed development.

Proposed Development & Site Access

Ben Muller Reality is proposing a commercial development on an approximate 10-acre site located on the northwest corner of the Patterson Avenue & 36th Street intersection. The proposed project includes the construction of seven commercial buildings, including a hotel, bank, day care center, fastfood restaurant, convenience store/gas station, and general retail space. A copy of the preliminary site plan is included in the appendix.

Access to the site will be via three site access driveways: two existing full access driveways to Patterson Avenue and one proposed full access driveway to 36th Street opposing the existing Eaton Corporation Driveway. The driveways to Patterson Avenue oppose the existing Comcast Driveway and USPS driveway.

Construction of the project is anticipated to be completed within the next five years.

Trip Generation

The Trip Generation Manual, Eleventh Edition, by the Institute of Transportation Engineers (ITE) was used to calculate the anticipated traffic that may be generated by the proposed site. Trips are measured individually for inbound and outbound movements; therefore, a visit to the site by an employee or visitor, for instance, generates two trips—one inbound and one outbound. Based on the land use descriptions provided within the ITE Trip Generation Manual, the most applicable land uses for the proposed site are shown in Table 4.

The proposed site will capitalize on the high traffic volumes along Patterson Avenue and 36th Street by "capturing" customers passing by the location to/from work or other destinations. These trips are classified as "pass-by" trips since they are already on the roadway network and enter the site as they drive past. While pass-by trips do not add new trips to the roadway network, they add turning movements at the site driveways.



In addition to pass-by traffic reductions for the applicable land uses, the trip generation projections take into account internally captured or "shared" trips that are common to this type of development. A shared trip is one that visits more than one use on the site (i.e. a hotel guest that dines at the on-site restaurant and/or visits the convenience store). This lessens the overall impact of a multiple-use site on the adjacent street system. The National Cooperative Highway Research Program (NCHRP) has published Report 684 – *Enhancing Internal Trip Capture Estimation for Mixed-Use Developments*. The current edition of the ITE Trip Generation handbook includes six types of applicable uses for trip sharing; office, retail, residential, restaurant, cinema, and hotel. The methodology has been incorporated into a spreadsheet model which estimates the morning and afternoon internal peak hour trips by arrival and departure. The internal capture estimation tool worksheets are included in the appendix. Based on the results of this analysis, it is anticipated approximately 12% of the morning peak hour trips and 13% of the afternoon peak hour trips would be considered internal trips.

Trips for the site were calculated for the typical weekday morning and afternoon peak hours. Table 4 shows the peak hour trips anticipated to be generated by the proposed development after full completion of the site. The site is expected to generate approximately 300 new weekday morning peak hour vehicle trips (161 inbound, 139 outbound), and approximately 344 new weekday afternoon peak hour trips (172 inbound, 172 outbound) onto the street system.

	ITE	Ci=o	AM			PM		
	Code	Size	Total	Enter	Exit	Total	Enter	Exit
Hotel	310	310 136 Rooms		34	27	73	37	36
Day Care Center	565	11,000 SF	121	64	57	122	57	65
Strip Potoil Plaza (<10K)	000	8,400 SF	20	12	8	69	34	35
Strip Retail Plaza (<40K)	022	7,200 SF	17	10	7	62	31	31
Drive-in Bank	912	3,000 SF	30	17	13	63	32	31
Fast-Food Restaurant with Drive-through	934	3,000 SF	134	68	66	99	52	47
Convenience Store/Gas Station	945	12 Fueling Positions ³	324	162	162	273	137	136
	Subtotal:	707	367	340	761	380	381	
	81	40	41	99	49	50		
Subtota	626	327	299	662	331	331		
	326	166	160	318	159	159		
	300	161	139	344	172	172		

Table 4. Weekday Morning and Afternoon Peak-Hour Trip Generation Summary

¹Per ITE and NCHRP capture form, overall capture rates are 12% during the AM peak-hour and 13% during the PM peak-hour. ²ITE pass-by reduction percentages applied to commercial uses:

Daycare: 40% AM and PM peak hour

Strip Retail: 25% PM peak hour

Bank: 29% AM peak hour, 35% PM peak hour

Fast Food Restaurant: 50% AM peak hour, 55% PM peak hour

Convenience Store/Gas Station: 75% AM peak hour, 76% PM peak hour

³12 fueling positions utilized as the truck diesel fueling position is anticipated to generate minimal traffic, particularly during the peak hours.

Source: ITE Trip Generation Manual, 11th Edition

Trip Distribution

The directional distribution of the site generated new trips was based upon existing travel patterns and engineering judgment. Based on these assumptions, the directional distribution to/from the proposed development for site generated new trips is expected to be approximately as follows:

To/from Patterson Avenue north	30%	To/from 36 th Street east	25%
To/from Patterson Avenue south	30%	To/from 36 th Street west	15%

In addition to the overall distribution shown above, site trips were distributed to the three site driveways based on the location and trip generation characteristics of each individual land use. This was accomplished by dividing the overall site into zones and assigning generated trips for each zone separately. For example, trips to/from the convenience store/gas station were primarily assigned to the proposed south driveway along Patterson Avenue and the proposed driveway along 36th Street.

Based upon the above distribution patterns for new trips, existing directional patterns along Patterson Avenue and 36th Street for pass-by trips, and the existing access driveway locations, the anticipated peak hour site-generated traffic was assigned to the study area intersections. Figure 4 shows the total anticipated morning and afternoon peak hour trips for site generated traffic upon full completion and occupancy of the proposed site.

The anticipated site trips were added to the background (2028) peak hour volumes to depict the estimated total future (2028) volumes during the morning and afternoon peak hours. Figure 5 shows the total anticipated future (2028) volumes.

Future (2028) Capacity Analysis

Intersection level-of-service calculations were completed to evaluate the future (2028) morning and afternoon peak hour conditions at the site access driveways and study area intersections assuming the completion of the proposed development. Table 5 and Figure 5 show the levels-of-service at the study area intersections. Copies of the *Synchro*[®] analyses are included in the appendix.

Compared to background (2028) conditions, the Patterson Avenue/36th Street intersection is anticipated to continue operating at an overall LoS "D" during the morning peak hour and an overall LoS "E" during the afternoon peak hour. As with background (2028) conditions, optimizing the signal timings at the intersection resulted in marginal improvement; however, the intersection is anticipated to continue operating at an overall LoS "E" during the afternoon peak hour. For the purposes of this study, no capacity improvements or modifications to the existing signal timing were considered to have been implemented.

All individual movements at the Patterson Avenue/36th Street intersection are anticipated to operate at LoS "D" or better during the morning and afternoon peak hours, except for the movements listed below.

- As with background (2028) conditions, the westbound left-turn movement is anticipated to operate at LoS "F" during the morning peak hour and LoS "E" during the afternoon peak hour. Traffic generated by the proposed development has little to no impact on this movement.
- As with background (2028) conditions, the northbound right-turn movement is anticipated to operate at LoS "F" with long queues during the afternoon peak hour. Traffic generated by the proposed development has little to no impact on this movement.
- Compared to background (2028) conditions, the southbound left-turn movement is anticipated to
 deteriorate from LoS "D" to LoS "E" during the afternoon peak hour. This would likely be considered
 acceptable as the 95th percentile queue for this movement is anticipated to be contained within the
 existing southbound left-turn lane.

The controlled movements at the proposed site driveways are anticipated to operate at LoS "C" or better during the morning and afternoon peak hours.

	Existing (2023)			Background (2028)				Future (2028)												
Intersection/	1	۹M	F	PM	A	۸M	Р	М	АМ		F	PM								
Movement	LoS	Delay	LoS	Delay	LoS	Delay	LoS	Delay	LoS	Delay	LoS	Delay								
36th Street / F	atters	on Aven	ue																	
Overall	С	33.8	D	43.8	D	42.9	Е	65.0	D	46.3	Е	67.9								
EBL	D	39.7	D	40.9	D	40.0	D	40.7	D	40.4	D	41.3								
EBT/R	D	45.8	D	50.8	D	48.9	D	52.7	D	50.0	D	53.2								
WBL	Е	58.9	D	53.0	F	89.2	Е	55.5	F	89.2	E	55.5								
WBT/R	D	36.3	D	45.0	D	35.7	D	43.9	D	35.7	D	43.6								
NBL	D	38.4	С	33.3	D	42.7	D	40.8	D	46.1	D	46.5								
NBT	С	23.9	С	31.9	С	25.2	D	37.5	С	26.1	D	39.9								
NBR	В	10.9	E	64.4	В	12.0	F	139.6	В	12.7	F	147.5								
SBL	В	18.0	С	29.0	В	19.3	D	38.6	С	21.1	E	67.5								
SBT/R	С	30.4	С	24.7	D	40.7	С	30.6	D	51.7	С	34.2								
Patterson Ave	Patterson Avenue / Comcast Driveway (Proposed North Driveway) ¹																			
EBL	<u> </u>	15.0	Б	12.0	0	17.6	р	12.0	С	22.3	С	15.9								
EBT/R		15.6	Б	12.0		0.11	D	12.9	В	11.0	В	10.4								
WB	В	11.3	В	12.8	В	12.0	В	13.7	В	13.5	С	16.2								
NBL	Α	0	Α	0	Α	0	А	0	В	10.3	А	8.5								
SBL	Α	8.1	Α	8.5	А	8.2	А	8.7	А	8.2	А	8.7								
Patterson Ave	enue / I	USPS Dr	iveway	(Propose	ed Sou	th Drive	way) ¹													
EBL	Б	10 E	Б	10.1	Р	10 1	р	10 F	С	22.8	В	14.1								
EBT/R		12.5	Б	10.1	D	13.1	D	10.5	В	11.4	В	10.7								
WB	В	11.2	В	11.1	В	11.4	В	11.6	В	12.7	В	13.8								
NBL	А	9.2	Α	8.1	А	9.6	А	8.3	В	10.4	Α	8.6								
SBL	Α	8.0	Α	0	А	8.2	А	0	А	8.2	А	0								
36 th Street / E	aton D	riveway	(Propos	sed Drive	way) ¹															
EBL	-	-	-	-	-	-	-	-	Α	8.0	А	8.1								
WBL	Α	8.0	Α	8.5	А	8.1	А	8.7	А	8.1	А	8.6								
NB	Α	9.2	В	10.4	А	9.4	В	10.7	А	9.3	В	11.0								
SBL									В	14.5	С	17.7								
SBT/R	-	-	-	-	-						-	-	-	-	-	-	Α	9.1	Α	9.1

Table 5. Future (2028) Levels-of-Service and Delay

¹Unsignalized intersection, controlled movements shown.

Source: Progressive AE, October 2023

Queuing Analysis

A queuing analysis was performed at the study area intersections to compare the existing, background (2028) and future (2028) vehicular queues at the study area intersections. Table 6 shows the shows the anticipated 95th percentile queues at the study area intersections for all three scenarios. Copies of the *Synchro*[®] analyses are included in the appendix.

The results of the queuing analysis show all queues for the controlled movements at the proposed site driveways are anticipated to be one vehicle or less during the morning and afternoon peak hours. The longest queue is anticipated to be for the eastbound left-turn movement at approximately one vehicle. Vehicles turning left into the site from the two-way left-turn lanes along Patterson Avenue and 36th Street are not anticipated to conflict with left-turn vehicle queues from adjacent intersections.

The most significant impacts related to vehicular queuing within the study area occur at the signalized Patterson Avenue/36th Street intersection as follows:

- The queue within the dual westbound left-turn lanes is anticipated to slightly surpass the available storage within the dual left-turn lanes due to the increase in background traffic volumes; however, additional storage capacity is available within the existing two-way left-turn lane.
- The northbound right-turn movement queue is anticipated to significantly increase due to the increase in background traffic volumes.
- The southbound left-turn movement queue is anticipated to increase to approximately 170 feet under future (2028) conditions; however, the available storage within the left-turn lane is not exceeded. As the proposed south driveway is located approximately 400 feet north of the Patterson Avenue/36th Street intersection, this queue is not anticipated to conflict with northbound vehicles turning left into the site.

		Exis	ting	Backgrou	ind (2028)	Future (2028)		
Intersection/	Storage	Cond	itions	Cond	itions	Conditions		
Movement	Length	AM	PM	AM	PM	AM	PM	
lilovonion	(ft)	Queue	Queue	Queue	Queue	Queue	Queue	
		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
36th Street / Patte	rson Avenu	le						
EBL	250 ¹	62	76	69	85	69	85	
EBT/R	-	92	230	106	262	108	268	
WBL	300 ²	305	216	365	245	365	245	
WBT/R	-	148	172	166	190	178	206	
NBL	500 ¹	41	48	44	53	57	71	
NBT	-	184 356		212	415	221	432	
NBR	200	16 707		32	1230	46	1230	
SBL	300 ¹	26	50	29	58	42	170	
SBT/R	-	338	274	476	344	505	368	
Patterson Avenue / Proposed North Driveway & Comcast Driveway								
EBL	-	0	0	0	0	15	13	
EBT/R	-	0			0	8	8	
WB	-	5	3	8	5	8	5	
NBL	100 ¹	0	0	0	0	5	5	
SBL	100 ¹	0 0		0	0	0	0	
Patterson Avenue / Proposed South Driveway & USPS Driveway								
EBL	-	2	0	2	0	18	10	
EBT/R	-	3	0	3	0	13	13	
WB	-	3	3	3	3	3	3	
NBL	100 ¹	0	0	0	0	8	5	
SBL	100 ¹	0	0	0	0	0	0	
36 th Street / Propo	sed Drivew	ay & Eaton	Driveway					
EBL	250 ¹	-	-	-	-	3	5	
WBL	50 ¹	0	0	0	0	0	0	
NB	-	0	3	0	3	0	3	
SBL	-	_				8	13	
SBT/R	-	-	-	-	-	3	5	

Table 6. Existing, Background (2028) & Future (2028) 95th Percentile Queues

¹Additional storage within existing two-way left-turn lane

²Storage length for dual left-turn lanes, additional storage available within existing two-way left-turn lane. Source: Progressive AE, October 2023

Turn Lane Warrant Analysis

Based on the volume of traffic anticipated to be generated by the proposed development and the volume of traffic along Patterson Avenue and 36th Street, right-turn lane warrants were applied at the proposed site driveways. Left-turn lane warrants were not performed as the existing two-way left-turn lane will serve as a left-turn lane into the site. Turn lane warrant graphs for the site driveways are included in the Appendix.

Future turning movement volumes at the proposed site driveways to Paterson Avenue and 36th Street were utilized to apply Michigan Department of Transportation (MDOT) guidelines for right-turn lanes and tapers contained within the "*Geometric Design Guidance*" manual. These guidelines were utilized as the Kent County Road Commission uses them as a guideline for establishing the need for turning lanes on county roadways. The warrant analyses indicated right-turn lanes and/or tapers would be warranted at the proposed site driveways as follows:

- A southbound right-turn lane would be warranted at the proposed north driveway to Patterson Avenue during the morning peak hour while a right-turn taper would be warranted during the afternoon peak hour.
- A southbound right-turn lane would be warranted at the proposed south driveway to Patterson Avenue during the morning and afternoon peak hours.
- A westbound right-turn taper would be warranted at the proposed driveway to 36th Street during the morning and afternoon peak hours.





CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

This chapter summarizes the results of the analyses performed as part of the study. Recommendations to improve the surrounding roadway network are also presented.

Conclusions

Based on the analyses performed as part of this study, the proposed development will have minor impacts on the surrounding roadway network. The findings of this study are as follows:

Existing Conditions

The existing conditions analyses show the Patterson Avenue/36th Street intersection is currently operating at an overall LoS "C" during the morning peak hour and LoS "D" during the afternoon peak hour. All individual movements at the intersection are currently operating at LoS "D" or better during the morning and afternoon peak hours, except for the movements listed below.

- The westbound left-turn movement is currently operating at LoS "E" during the morning peak hour.
- The northbound right-turn movement is currently operating at LoS "E" during the afternoon peak hour.

The controlled movements at the unsignalized study area intersections are currently operating at LoS "C" or better during the morning and afternoon peak hours.

Background (2028) Conditions

The background (2028) conditions show the Patterson Avenue/36th Street intersection is anticipated to operate at an overall LoS "D" during the morning peak hour and deteriorate to an overall LoS "E" during the afternoon peak hour. Optimizing the signal timings at the intersection resulted in marginal improvement; however, the intersection is anticipated to continue operating at an overall LoS "E" during the afternoon peak hour. Additional capacity improvements, such as dual northbound right-turns lanes, may be necessary in the future based on the anticipated background traffic growth.

All individual movements at the Patterson Avenue/36th Street intersection are anticipated to operate at LoS "D" or better during the morning and afternoon peak hours, except for the movements listed below.

- The westbound left-turn movement is anticipated to operate at LoS "F" during the morning peak hour and LoS "E" during the afternoon peak hour.
- The delay for the northbound right-turn movement is anticipated to increase significantly due to background traffic growth. This movement is anticipated to operate at LoS "F" with long queues during the afternoon peak hour. A detailed queuing analysis is provided in the next chapter.

The controlled movements at the unsignalized study area intersections are anticipated to continue operating at LoS "C" or better during the morning and afternoon peak hours.

Future (2028) Conditions

Compared to background (2028) conditions, the Patterson Avenue/36th Street intersection is anticipated to continue operating at an overall LoS "D" during the morning peak hour and an overall LoS "E" during the afternoon peak hour. As with background (2028) conditions, optimizing the signal timings at the intersection resulted in marginal improvement; however, the intersection is anticipated to continue operating at an overall LoS "E" during the afternoon peak hour.

All individual movements at the Patterson Avenue/36th Street intersection are anticipated to operate at LoS "D" or better during the morning and afternoon peak hours, except for the movements listed below.

• As with background (2028) conditions, the westbound left-turn movement is anticipated to operate at LoS "F" during the morning peak hour and LoS "E" during the afternoon peak hour. Traffic generated by the proposed development has little to no impact on this movement.

- As with background (2028) conditions, the northbound right-turn movement is anticipated to operate at LoS "F" with long queues during the afternoon peak hour. Traffic generated by the proposed development has little to no impact on this movement.
- Compared to background (2028) conditions, the southbound left-turn movement is anticipated to deteriorate from LoS "D" to LoS "E" during the afternoon peak hour. This would likely be considered acceptable as the 95th percentile queue for this movement is anticipated to be contained within the existing southbound left-turn lane.

The controlled movements at the proposed site driveways are anticipated to operate at LoS "C" or better during the morning and afternoon peak hours.

The results of the queuing analysis show all queues for the controlled movements at the proposed site driveways are anticipated to be one vehicle or less during the morning and afternoon peak hours. The longest queue is anticipated to be for the eastbound left-turn movement at approximately one vehicle. Vehicles turning left into the site from the two-way left-turn lanes along Patterson Avenue and 36th Street are not anticipated to conflict with left-turn vehicle queues from adjacent intersections.

The most significant impacts related to vehicular queuing within the study area occur at the signalized Patterson Avenue/36th Street intersection as follows:

- The queue within the dual westbound left-turn lanes is anticipated to slightly surpass the available storage within the dual left-turn lanes due to the increase in background traffic volumes; however, additional storage capacity is available within the existing two-way left-turn lane.
- The northbound right-turn movement queue is anticipated to significantly increase due to the increase in background traffic volumes.
- The southbound left-turn movement queue is anticipated to increase to approximately 170 feet under future (2028) conditions; however, the available storage within the left-turn lane is not exceeded. As the proposed south driveway is located approximately 400 feet north of the Patterson Avenue/36th Street intersection, this queue is not anticipated to conflict with northbound vehicles turning left into the site.

The right-turn lane warrant analyses indicated right-turn lanes and/or tapers would be warranted at the proposed site driveways as follows:

- A southbound right-turn lane would be warranted at the proposed north driveway to Patterson Avenue during the morning peak hour while a right-turn taper would be warranted during the afternoon peak hour.
- A southbound right-turn lane would be warranted at the proposed south driveway to Patterson Avenue during the morning and afternoon peak hours.
- A westbound right-turn taper would be warranted at the proposed driveway to 36th Street during the morning and afternoon peak hours.

Recommendations

The following is a list of recommendations to mitigate the impact of the proposed development and improve operations within the study area:

- The proposed site driveways should operate as full access driveways to the proposed development. Restricting movements at the driveways would funnel more traffic to other driveways, potentially creating longer delays and queuing on those approaches.
- As shown on the proposed site plan, all exiting approaches at the site driveways should include a separate left-turn lane and right-turn lane.
- A southbound right-turn lane should be constructed at both the proposed north and south site driveways to Patterson Avenue. The right-turn lane should be designed and constructed to current Kent County Road Commission standards.

- A westbound right-turn taper should be constructed at the proposed site driveway to 36th Street. The right-turn taper should be designed and constructed to current Kent County Road Commission standards.
- Signal timings at the Patterson Avenue/36th Street intersections should be monitored and optimized as construction of the proposed development is completed.
- The Kent County Road Commission and/or the City of Kentwood should monitor the Patterson Avenue/36th Street intersection for potential capacity improvements, such as dual northbound right-turn lanes, should background traffic volumes increase as anticipated within this report.

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Technical Appendix

36th Street at Patterson Avenue Commercial Development TIS

- Level of Service Definitions
- Glossary
- Site Plan
- NCHRP Captured Trips Results
- Turn Lane Warrant Data
- Traffic Count Data
- Synchro Analyses Results

Level of Service Definitions Signalized Intersections

- Level of Service A: Describes operations with very low average stopped delay, i.e., less than 10.0 seconds per vehicle. This occurs when progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.
- Level of Service B: Describes operations with an average stopped delay in the range of 10.0 to 20.0 seconds per vehicle. This generally occurs with good progression and/or short cycle lengths. More vehicles stop than for LOS A, causing higher levels of average delay.
- Level of Service C: Describes operations with an average stopped delay in the range of 20.1 to 35.0 seconds per vehicle. These higher delays may result from fair progression and/or longer cycle lengths. Individual cycle failures may begin to appear in this level. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.
- Level of Service D: Describes operations with an average stopped delay in the range of 35.1 to 55.0 seconds per vehicle. At Level of Service D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high v/c (volume/capacity) ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.
- Level of Service E: Describes operations with an average stopped delay in the range of 55.1 to 80.0 seconds per vehicle. This is considered to be the limit of acceptable delay in many cases. These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are a frequent occurrence.
- Level of Service F: Describes operations with an average stopped delay in excess of 80.0 seconds per vehicle. This is considered to be unacceptable to most drivers. This condition often occurs with over-saturation, i.e., when arrival flow rates exceed the capacity of the intersection. It may also occur at high v/c ratios with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

Level of Service Definitions <u>Unsignalized</u> Intersections

Level of Service A:	Average delay per vehicles for impeded movements is less than 10 seconds. There is little or no delay with typically low side street and/or main street traffic.
Level of Service B:	Average stopped delays from 10.1 seconds to 15.0 seconds. Short delays, many acceptable gaps in main street traffic stream.
Level of Service C:	Average delay per vehicle ranges from 15.1 to 25.0 seconds. Average traffic delays with frequent gaps in main street traffic.
Level of Service D:	Average delays from 25.1 to 35.0 seconds for impeded movements. Long traffic delays for impeded movements due in part to a limited number of acceptable gaps.
Level of Service E:	Average delays in the 35.1 to 50.0 second range. May experience very long delays for impeded movements with a very small number of acceptable gaps in the traffic stream.
Level of Service F:	Average vehicle delays of over 50.0 seconds. Extreme traffic delays with virtually no acceptable gaps in main street traffic.

Glossary

Approach: A set of lanes accommodating all left-turn, through, and right-turn movements arriving at an intersection from a given direction.

Arterial: Signalized streets that serve primarily through traffic and provide access to abutting properties as a secondary function.

Average Stopped Delay: The total time vehicles are stopped in an intersection approach or lane group during a specified time interval divided by the volume departing from the approach or lane group during the same time period, in seconds per vehicle.

Background Traffic: Traffic volumes that will be on the roadway network without the presence of the proposed development.

Bypass Lane: A one-lane widening on a two-lane roadway that allows through traffic to pass by waiting left-turn traffic.

Capacity: The maximum rate of flow at which persons or vehicles can be reasonably expected to traverse a point or uniform segment of a lane or roadway during a specified time period under prevailing roadway, traffic, and control conditions; usually expressed as vehicles per hour or persons per hour.

Conflicting Traffic Volume: The volume of traffic which conflicts with a specific movement at an intersection.

Corridor: A lineal study area aligned with a roadway facility in which traffic, land use, right-ofway, environmental, and other factors are evaluated to determine future transportation facility needs.

Cycle: Any complete sequence of traffic signal indications.

Cycle Length: The total time for a traffic signal to complete one cycle.

Design Hour Volume: The traffic volume for the design hour, usually a forecast of the relevant peak hour volume, in vehicles per hour.

Diverted Linked Trips: Trips from the traffic volume on roadways within the vicinity of the generator but which requires a diversion from that roadway to another roadway to gain access to the site.

Driveway Offset: Distance between driveways on opposite sides of a roadway, measured parallel to roadway.

Freeway: A multi-lane divided highway having a minimum of two lanes for exclusive use of traffic in each direction and full control of access and egress.

Gaps (Critical Gap): The median time headway between vehicles in a major traffic stream which will permit side-street vehicles to cross through or merge with the major traffic stream.

Green Time: The actual length of the "green" indication for a given movement at a signalized intersection.
Level of Service: A qualitative measure describing operational conditions within a traffic stream; generally described in terms of such factors as speed and travel time, delay, freedom to maneuver, traffic interruptions, comfort and convenience, and safety.

Operational Analysis: A use of capacity analysis to determine the prevailing level of service on an existing or projected facility, with known or projected traffic, roadway, and control conditions. This analysis can involve a particular location, such as an intersection or a corridor.

Pass-by Trips: Trips made as intermediate stops on the way from an origin to a primary trip destination.

Peak Hour (AM): The one hour period in the morning representing the highest hourly volume of traffic flow on the adjacent public street system.

Peak Hour (PM): The one hour period in the afternoon or evening representing the highest hourly volume of traffic flow on the adjacent public street system.

Peak Hour Factor: The hourly volume during the maximum volume hour of the day divided by four times the peak 15-minute flow within the peak hour; a measure of traffic demand fluctuation within the peak hour.

Phase: The part of the signal cycle allocated to any combination of traffic movements receiving the right-of-way simultaneously during one or more intervals.

Roadway Conditions: Geometric characteristics of a street or highway, including the type of facility, number and width of lanes (by direction), shoulder widths and lateral clearances, design speed, etc.

Service Drive: A roadway (usually private) that provides internal access to two or more uses.

Site Traffic: Existing or projected vehicular traffic generated by the development.

Study Area: The geographic area containing site access points and critical intersections (and connecting highway segments) which are impacted by the site-traffic generated by the development, and should be evaluated.

System Improvements: Added lanes, signal improvements, and other roadway improvements not considered site-related improvements.

Traffic Impact: The adverse impact on intersection Level of Service and/or street and highway safety and operations as determined by the criteria and procedures set forth in this handbook.

Trip (Directional Trip): A single or one-direction vehicle movement with either the origin or the destination (exiting or entering) inside a study site.

Trip Distribution: The distribution or assignment of site traffic into site driveways and study area roadways/intersections based upon expected direction of approach and departure.

Unsignalized Intersection: Any intersection not controlled by traffic signals.

Volume: The number of persons or vehicles passing a point on a lane or roadway during some time interval, such as one hour or during an average day.

Volume-to-Capacity Ratio (V/C): The ratio of demand flow rate to capacity for a traffic facility.

Site Plan





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				Engineering Janners • engineers • 252 Clyde Park, S.W. • Grand Rapi Phone: (616) 531-3660 www.exxele	G, INC. surveyors ds, MI 49509 engineering.com
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NCHRP Captured Trip Results

NCHRP 684 Internal Trip Capture Estimation Tool											
Project Name:	36th at Patterson TIS	Organization:									
Project Location:	Kentwood, MI		Performed By:	PAE							
Scenario Description:	Future (2028) Conditions		Date:	9/20/2023							
Analysis Year:	2028		Checked By:								
Analysis Period:	AM Street Peak Hour		Date:								

Table 1-A: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate) Development Data (For Information Only) Estimated Vehicle-Trips³ Land Use ITE LUCs¹ Quantity Units Total Entering Exiting Office 0 Retail 822,912,945 201 190 Varies Varies 391 Restaurant 934 3,000 sft 134 68 66 Cinema/Entertainment 0 Residential 0 Hotel 310 136 Rooms 61 34 27 All Other Land Uses² 11,000 64 565 sft 121 57 707 367 340

Table 2-A: Mode Split and Vehicle Occupancy Estimates										
		Entering Tri	os		Exiting Trips					
Land Ose	Veh. Occ.4	% Transit	% Non-Motorized	i I	Veh. Occ. ⁴	% Transit	% Non-Motorized			
Office	1.00	0%	0%		1.00	0%	0%			
Retail	1.00	0%	0%		1.00	0%	0%			
Restaurant	1.00	0%	0%		1.00	0%	0%			
Cinema/Entertainment	1.00	0%	0%		1.00	0%	0%			
Residential	1.00	0%	0%		1.00	0%	0%			
Hotel	1.00	0%	0%		1.00	0%	0%			
All Other Land Uses ²	1.00	0%	0%		1.00	0%	0%			

Table 3-A: Average Land Use Interchange Distances (Feet Walking Distance)										
Origin (From)		Destination (To)								
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel				
Office										
Retail										
Restaurant										
Cinema/Entertainment										
Residential										
Hotel										

Table 4-A: Internal Person-Trip Origin-Destination Matrix*											
		Destination (To)									
Oligin (Floin)	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel					
Office		0	0	0	0	0					
Retail	0		25	0	0	0					
Restaurant	0	9		0	0	1					
Cinema/Entertainment	0	0	0		0	0					
Residential	0	0	0	0		0					
Hotel	0	4	2	0	0						

Table 5-A: Computations Summary				Table 6-A: Internal Trip Capture Percentages by Land Use			
	Total	Entering	Exiting	Land Use	Entering Trips	Exiting Trips	
All Person-Trips	707	367	340	Office	N/A	N/A	
Internal Capture Percentage	12%	11%	12%	Retail	6%	13%	
				Restaurant	40%	15%	
External Vehicle-Trips ⁵	625	326	299	Cinema/Entertainment	N/A	N/A	
External Transit-Trips ⁶	0	0	0	Residential	N/A	N/A	
External Non-Motorized Trips ⁶	0	0	0	Hotel	3%	22%	

¹ Land Use Codes (LUCs) from <i>Trip Generation Manual</i> , published by the Institute of Transportation Engineers.
² Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator.
³ Enter trips assuming no transit or non-motorized trips (as assumed in ITE <i>Trip Generation Manual</i>).
⁴ Enter vehicle occupancy assumed in Table 1-A vehicle trips. If vehicle occupancy changes for proposed mixed-use project, manual adjustments must be made to Tables 5-A, 9-A (O and D). Enter transit, non-motorized percentages that will result with proposed mixed-use project complete.
⁵ Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-A.
⁶ Person-Trips
*Indicates computation that has been rounded to the nearest whole number.

Estimation Tool Developed by the Texas A&M Transportation Institute - Version 2013.1

Project Name:	36th at Patterson TIS
Analysis Period:	AM Street Peak Hour

Table 7-A: Conversion of Vehicle-Trip Ends to Person-Trip Ends											
L and Llas	Tab	le 7-A (D): Enter	ing Trips		Table 7-A (O): Exiting Trips						
Land Ose	Veh. Occ.	Vehicle-Trips	Person-Trips*		Veh. Occ.	Vehicle-Trips	Person-Trips*				
Office	1.00	0	0		1.00	0	0				
Retail	1.00	201	201		1.00	190	190				
Restaurant	1.00	68	68		1.00	66	66				
Cinema/Entertainment	1.00	0	0		1.00	0	0				
Residential	1.00	0	0		1.00	0	0				
Hotel	1.00	34	34	1	1.00	27	27				

Table 8-A (O): Internal Person-Trip Origin-Destination Matrix (Computed at Origin)											
	Destination (To)										
Oligili (FIOIII)	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel					
Office		0	0	0	0	0					
Retail	55		25	0	27	0					
Restaurant	20	9		0	3	2					
Cinema/Entertainment	0	0	0		0	0					
Residential	0	0	0	0		0					
Hotel	20	4	2	0	0						

Table 8-A (D): Internal Person-Trip Origin-Destination Matrix (Computed at Destination)											
	Destination (To)										
Origin (From)	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel					
Office		64	16	0	0	0					
Retail	0		34	0	0	0					
Restaurant	0	16		0	0	1					
Cinema/Entertainment	0	0	0		0	0					
Residential	0	34	14	0		0					
Hotel	0	8	4	0	0						

Table 9-A (D): Internal and External Trips Summary (Entering Trips)											
		Person-Trip Esti	mates		External Trips by Mode*						
Destination Land Use	Internal	External	Total		Vehicles ¹	Transit ²	Non-Motorized ²				
Office	0	0	0		0	0	0				
Retail	13	188	201		188	0	0				
Restaurant	27	41	68		41	0	0				
Cinema/Entertainment	0	0	0		0	0	0				
Residential	0	0	0		0	0	0				
Hotel	1	33	34		33	0	0				
All Other Land Uses ³	0	64	64		64	0	0				

Table 9-A (O): Internal and External Trips Summary (Exiting Trips)										
Origin Land Llas	I	Person-Trip Esti	mates			External Trips by Mode*				
Origin Land Ose	Internal	External	Total		Vehicles ¹	Transit ²	Non-Motorized ²			
Office	0	0	0		0	0	0			
Retail	25	165	190		165	0	0			
Restaurant	10	56	66		56	0	0			
Cinema/Entertainment	0	0	0		0	0	0			
Residential	0	0	0		0	0	0			
Hotel	6	21	27		21	0	0			
All Other Land Uses ³	0	57	57		57	0	0			

¹Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-A

²Person-Trips

³Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator *Indicates computation that has been rounded to the nearest whole number.

NCHRP 684 Internal Trip Capture Estimation Tool									
Project Name:	36th at Patterson TIS		Organization:						
Project Location:	Kentwood, MI		Performed By:	PAE					
Scenario Description:	Future (2028) Conditions		Date:	45189					
Analysis Year:	2028		Checked By:						
Analysis Period:	PM Street Peak Hour		Date:						

	Table 1	-P: Base Vehic	le-Trip Generatio	n Es	timates (Single-Use S	ite Estimate)			
Land Line	Developme	ent Data (<i>For Int</i>	formation Only)			Estimated Vehicle-Trips ³			
Land Ose	ITE LUCs ¹	Quantity	Units		Total	Entering	Exiting		
Office					0				
Retail	822,912,945	Varies	Varies		467	234	233		
Restaurant	934	3,000	sft		99	52	47		
Cinema/Entertainment					0				
Residential					0				
Hotel	310	136	Rooms		73	37	36		
All Other Land Uses ²	565	11,000	sft		122	57	65		
					761	380	381		

Table 2-P: Mode Split and Vehicle Occupancy Estimates										
		Entering Tri	ps			Exiting Trips				
Land Use	Veh. Occ.4	% Transit	% Non-Motorized		Veh. Occ. ⁴	% Transit	% Non-Motorized			
Office	1.00	0%	0%		1.00	0%	0%			
Retail	1.00	0%	0%		1.00	0%	0%			
Restaurant	1.00	0%	0%		1.00	0%	0%			
Cinema/Entertainment	1.00	0%	0%		1.00	0%	0%			
Residential	1.00	0%	0%		1.00	0%	0%			
Hotel	1.00	0%	0%		1.00	0%	0%			
All Other Land Uses ²	1.00	0%	0%		1.00	0%	0%			

Table 3-P: Average Land Use Interchange Distances (Feet Walking Distance)									
Origin (From)				Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel			
Office									
Retail									
Restaurant									
Cinema/Entertainment									
Residential									
Hotel									

Table 4-P: Internal Person-Trip Origin-Destination Matrix*										
Origin (From)	Destination (To)									
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel				
Office		0	0	0	0	0				
Retail	0		15	0	0	6				
Restaurant	0	19		0	0	3				
Cinema/Entertainment	0	0	0		0	0				
Residential	0	0	0	0		0				
Hotel	0	5	3	0	0					

Table 5-P	Table 5-P: Computations Summary				Table 6-P: Internal Trip Capture Percentages by Land Use			
	Total Entering Exiting		Land Use	Entering Trips	Exiting Trips			
All Person-Trips	761	380	381	Office	N/A	N/A		
Internal Capture Percentage	13%	13%	13%	Retail	10%	9%		
				Restaurant	35%	47%		
External Vehicle-Trips ⁵	659	329	330	Cinema/Entertainment	N/A	N/A		
External Transit-Trips ⁶	0	0	0	Residential	N/A	N/A		
External Non-Motorized Trips ⁶	0	0	0	Hotel	24%	22%		

¹Land Use Codes (LUCs) from *Trip Generation Manual*, published by the Institute of Transportation Engineers.

²Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator.

³Enter trips assuming no transit or non-motorized trips (as assumed in ITE *Trip Generation Manual*).

⁴Enter vehicle occupancy assumed in Table 1-P vehicle trips. If vehicle occupancy changes for proposed mixed-use project, manual adjustments must be ⁵Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P.

⁶Person-Trips

*Indicates computation that has been rounded to the nearest whole number.

Estimation Tool Developed by the Texas A&M Transportation Institute - Version 2013.1

Project Name:	36th at Patterson TIS
Analysis Period:	PM Street Peak Hour

Table 7-P: Conversion of Vehicle-Trip Ends to Person-Trip Ends									
Land Use	Table 7-P (D): Entering Trips				Т	able 7-P (O): Exiting Trips			
	Veh. Occ.	Vehicle-Trips	Person-Trips*	Ī	Veh. Occ.	Vehicle-Trips	Person-Trips*		
Office	1.00	0	0	Ī	1.00	0	0		
Retail	1.00	234	234	Ī	1.00	233	233		
Restaurant	1.00	52	52	I	1.00	47	47		
Cinema/Entertainment	1.00	0	0	I	1.00	0	0		
Residential	1.00	0	0	Ī	1.00	0	0		
Hotel	1.00	37	37	Ī	1.00	36	36		

Table 8-P (O): Internal Person-Trip Origin-Destination Matrix (Computed at Origin)									
Origin (From)	Destination (To)								
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel			
Office		0	0	0	0	0			
Retail	5		68	9	61	12			
Restaurant	1	19		4	8	3			
Cinema/Entertainment	0	0	0		0	0			
Residential	0	0	0	0		0			
Hotel	0	6	24	0	1				

Table 8-P (D): Internal Person-Trip Origin-Destination Matrix (Computed at Destination)										
Origin (From)		Destination (To)								
	Office	Office Retail Restaurant Cinema/Entertainment		Residential	Hotel					
Office		19	1	0	0	0				
Retail	0		15	0	0	6				
Restaurant	0	117		0	0	26				
Cinema/Entertainment	0	9	2		0	0				
Residential	0	23	7	0		4				
Hotel	0	5	3	0	0					

	Table 9-P (D): Internal and External Trips Summary (Entering Trips)									
Destination Land Use	P	erson-Trip Estima	ates		External Trips by Mode*					
	Internal	External	Total	1	Vehicles ¹	Transit ²	Non-Motorized ²			
Office	0	0	0	T	0	0	0			
Retail	24	210	234	T	210	0	0			
Restaurant	18	34	52	1	34	0	0			
Cinema/Entertainment	0	0	0	1	0	0	0			
Residential	0	0	0	1	0	0	0			
Hotel	9	28	37	1	28	0	0			
All Other Land Uses ³	0	57	57	T	57	0	0			

	Та	ble 9-P (O): Inter	nal and External	Trip	s Summary (Exiting Tr	ips)	
	P	erson-Trip Estima	tes			External Trips by Mode*	
Origin Land Use	Internal	External	Total		Vehicles ¹	Transit ²	Non-Motorized ²
Office	0	0	0		0	0	0
Retail	21	212	233		212	0	0
Restaurant	22	25	47		25	0	0
Cinema/Entertainment	0	0	0	T I	0	0	0
Residential	0	0	0		0	0	0
Hotel	8	28	36		28	0	0
All Other Land Uses ³	0	65	65	1	65	0	0

¹Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P

²Person-Trips ³Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator *Indicates computation that has been rounded to the nearest whole number.



Turn Lane Warrant Data

Right-Turn Lane on 4-lane Highway

Project:36th St at Patterson Commercial Development TISScenario:Future (2028) Conditions

Major Road:Patterson AvenueMinor Road:Proposed North DrivewayDirection:SB

	AM	PM
Right-Turn Volume During DHV (Vehicles per Hour)	53	44
Total DHV (Vehicles per Hour)	1116	935



Right-Turn Lane on 4-lane Highway

 Project:
 36th St at Patterson Commercial Development TIS

 Scenario:
 Future (2028) Conditions

Major Road:Patterson AvenueMinor Road:Proposed South DrivewayDirection:SB

	AM	PM
Right-Turn Volume During DHV (Vehicles per Hour)	67	57
Total DHV (Vehicles per Hour)	1124	956



Right-Turn Lane on 4-lane Highway

Project:36th St at Patterson Commercial Development TISScenario:Future (2028) Conditions

Major Road:36th StreetMinor Road:Proposed DrivewayDirection:WB

	AM	PM
Right-Turn Volume During DHV (Vehicles per Hour)	62	63
Total DHV (Vehicles per Hour)	463	483





Traffic Count Data

Progressive AE 1811 4 Mile Rd NE

Grand Rapids, Michigan, United States 49525 (616) 361-2664 Count Name: 36th St & Patterson Ave Site Code: Start Date: 08/24/2023 Page No: 1

Turning Movement Data

			36th St				•	36th St	ig iv	0,00		Pa	tterson A	Ave			Pa	atterson A	ve		
		E	astboun	d			V	/estboun	d			N	orthbour	nd			S	outhbour	nd		
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
7:00 AM	11	25	16	1	52	106	40	8	0	154	11	68	72	0	151	8	159	9	0	176	533
7:15 AM	8	31	10	0	49	142	78	15	0	235	14	101	75	1	190	9	197	11	0	217	691
7:30 AM	7	23	22	0	52	162	68	12	0	242	16	126	107	0	249	16	222	9	0	247	790
7:45 AM	19	44	20	0	83	147	71	11	0	229	18	135	114	0	267	11	261	17	0	289	868
Hourly Total	45	123	68	1	236	557	257	46	0	860	59	430	368	1	857	44	839	46	0	929	2882
8:00 AM	9	40	13	0	62	124	59	15	0	198	8	119	82	0	209	11	171	12	0	194	663
8:15 AM	13	39	15	0	67	78	58	12	0	148	9	89	90	0	188	10	160	14	0	184	587
8:30 AM	5	29	8	0	42	75	52	11	0	138	3	96	109	0	208	8	139	9	0	156	544
8:45 AM	9	32	9	0	50	94	53	11	0	158	6	90	87	0	183	7	148	8	0	163	554
Hourly Total	36	140	45	0	221	371	222	49	0	642	26	394	368	0	788	36	618	43	0	697	2348
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4:00 PM	21	70	14	1	105	99	65	12	0	176	36	204	224	0	464	15	158	27	0	200	945
4:15 PM	11	84	19	0	114	85	69	12	0	166	8	170	189	0	367	24	147	16	0	187	834
4:30 PM	14	76	14	0	104	86	58	10	0	154	16	208	248	0	472	17	161	24	0	202	932
4:45 PM	10	81	13	0	104	110	61	8	0	179	13	141	184	0	338	19	148	13	0	180	801
Hourly Total	56	311	60	1	427	380	253	42	0	675	73	723	845	0	1641	75	614	80	0	769	3512
5:00 PM	17	99	7	0	123	105	80	10	0	195	14	184	239	0	437	17	200	14	0	231	986
5:15 PM	16	70	7	0	93	99	70	8	0	177	9	111	119	0	239	10	138	11	0	159	668
5:30 PM	16	37	12	0	65	83	61	5	0	149	11	149	156	1	316	19	198	20	0	237	767
5:45 PM	17	71	12	0	100	78	63	4	0	145	11	132	102	0	245	9	137	11	0	157	647
Hourly Total	66	277	38	0	381	365	274	27	0	666	45	576	616	1	1237	55	673	56	0	784	3068
Grand Total	203	851	211	2	1265	1673	1006	164	0	2843	203	2123	2197	2	4523	210	2744	225	0	3179	11810
Approach %	16.0	67.3	16.7	-	-	58.8	35.4	5.8	-	-	4.5	46.9	48.6	-	-	6.6	86.3	7.1	-	-	-
Total %	1.7	7.2	1.8	-	10.7	14.2	8.5	1.4	-	24.1	1.7	18.0	18.6	-	38.3	1.8	23.2	1.9	-	26.9	-
Lights	190	806	177	-	1173	1572	950	158	-	2680	183	2034	2086	-	4303	200	2632	214	-	3046	11202
% Lights	93.6	94.7	83.9	-	92.7	94.0	94.4	96.3	-	94.3	90.1	95.8	94.9	-	95.1	95.2	95.9	95.1	-	95.8	94.9
Mediums	8	20	22	-	50	52	30	4	-	86	13	52	62	-	127	3	57	7	-	67	330
% Mediums	3.9	2.4	10.4	-	4.0	3.1	3.0	2.4	-	3.0	6.4	2.4	2.8	-	2.8	1.4	2.1	3.1	-	2.1	2.8
Articulated Trucks	5	25	12	-	42	49	26	2	-	77	7	37	49	-	93	7	55	4	-	66	278
% Articulated Trucks	2.5	2.9	5.7	-	3.3	2.9	2.6	1.2	-	2.7	3.4	1.7	2.2	-	2.1	3.3	2.0	1.8	-	2.1	2.4
Pedestrians	-	-	-	2	-	-	-	-	0	-	-	-	-	2	-	-	-	-	0	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-

Progressive AE 1811 4 Mile Rd NE

Grand Rapids, Michigan, United States 49525 (616) 361-2664 Count Name: 36th St & Patterson Ave Site Code: Start Date: 08/24/2023 Page No: 2

Turning Movement Peak Hour Data (7:15 AM)

												. 00									
			36th St					36th St				Pa	tterson A	ve			Pa	tterson A	Ave		
		E	Eastboun	d			v	Vestbour	nd			Ν	lorthbour	nd			S	outhbour	nd		
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
7:15 AM	8	31	10	0	49	142	78	15	0	235	14	101	75	1	190	9	197	11	0	217	691
7:30 AM	7	23	22	0	52	162	68	12	0	242	16	126	107	0	249	16	222	9	0	247	790
7:45 AM	19	44	20	0	83	147	71	11	0	229	18	135	114	0	267	11	261	17	0	289	868
8:00 AM	9	40	13	0	62	124	59	15	0	198	8	119	82	0	209	11	171	12	0	194	663
Total	43	138	65	0	246	575	276	53	0	904	56	481	378	1	915	47	851	49	0	947	3012
Approach %	17.5	56.1	26.4	-	-	63.6	30.5	5.9	-	-	6.1	52.6	41.3	-	-	5.0	89.9	5.2	-	-	-
Total %	1.4	4.6	2.2	-	8.2	19.1	9.2	1.8	-	30.0	1.9	16.0	12.5	-	30.4	1.6	28.3	1.6	-	31.4	-
PHF	0.566	0.784	0.739	-	0.741	0.887	0.885	0.883	-	0.934	0.778	0.891	0.829	-	0.857	0.734	0.815	0.721	-	0.819	0.868
Lights	39	123	55	-	217	547	256	51	-	854	48	451	345	-	844	44	820	46	-	910	2825
% Lights	90.7	89.1	84.6	-	88.2	95.1	92.8	96.2	-	94.5	85.7	93.8	91.3	-	92.2	93.6	96.4	93.9	-	96.1	93.8
Mediums	3	6	7	-	16	13	13	1	-	27	5	22	22	-	49	2	18	2	-	22	114
% Mediums	7.0	4.3	10.8	-	6.5	2.3	4.7	1.9	-	3.0	8.9	4.6	5.8	-	5.4	4.3	2.1	4.1	-	2.3	3.8
Articulated Trucks	1	9	3	-	13	15	7	1	-	23	3	8	11	-	22	1	13	1	-	15	73
% Articulated Trucks	2.3	6.5	4.6	-	5.3	2.6	2.5	1.9	-	2.5	5.4	1.7	2.9	-	2.4	2.1	1.5	2.0	-	1.6	2.4
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	1	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-

Turning Movement Peak Hour Data (4:15 PM)

			36th St			-		36th St				Pa	tterson A	ve			Pa	tterson A	ve		
		E	Eastboun	d			٧	Vestboun	d			N	lorthbour	d			S	outhbour	nd		
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
4:15 PM	11	84	19	0	114	85	69	12	0	166	8	170	189	0	367	24	147	16	0	187	834
4:30 PM	14	76	14	0	104	86	58	10	0	154	16	208	248	0	472	17	161	24	0	202	932
4:45 PM	10	81	13	0	104	110	61	8	0	179	13	141	184	0	338	19	148	13	0	180	801
5:00 PM	17	99	7	0	123	105	80	10	0	195	14	184	239	0	437	17	200	14	0	231	986
Total	52	340	53	0	445	386	268	40	0	694	51	703	860	0	1614	77	656	67	0	800	3553
Approach %	11.7	76.4	11.9	-	-	55.6	38.6	5.8	-	-	3.2	43.6	53.3	-	-	9.6	82.0	8.4	-	-	-
Total %	1.5	9.6	1.5	-	12.5	10.9	7.5	1.1	-	19.5	1.4	19.8	24.2	-	45.4	2.2	18.5	1.9	-	22.5	-
PHF	0.765	0.859	0.697	-	0.904	0.877	0.838	0.833	-	0.890	0.797	0.845	0.867	-	0.855	0.802	0.820	0.698	-	0.866	0.901
Lights	50	324	46	-	420	359	256	39	-	654	49	694	842	-	1585	72	636	64	-	772	3431
% Lights	96.2	95.3	86.8	-	94.4	93.0	95.5	97.5	-	94.2	96.1	98.7	97.9	-	98.2	93.5	97.0	95.5	-	96.5	96.6
Mediums	1	8	6	-	15	17	6	1	-	24	1	5	10	-	16	0	12	2	-	14	69
% Mediums	1.9	2.4	11.3	-	3.4	4.4	2.2	2.5	-	3.5	2.0	0.7	1.2	-	1.0	0.0	1.8	3.0	-	1.8	1.9
Articulated Trucks	1	8	1	-	10	10	6	0	-	16	1	4	8	-	13	5	8	1	-	14	53
% Articulated Trucks	1.9	2.4	1.9	-	2.2	2.6	2.2	0.0	-	2.3	2.0	0.6	0.9	-	0.8	6.5	1.2	1.5	-	1.8	1.5
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Progressive AE 1811 4 Mile Rd NE

Grand Rapids, Michigan, United States 49525 (616) 361-2664 Count Name: Patterson Ave & Comcast Drwy Site Code: Start Date: 08/24/2023 Page No: 1

Turning Movement Data

		:	Site Drwy	/			Co	mcast D	rwy	0.00		Pa	tterson A	ve			Pa	itterson A	ve	ľ	
		E	astboun	d			V	Vestbour	nd			N	orthbour	nd			S	outhbour	nd	I	
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
7:00 AM	0	0	0	0	0	4	0	3	0	7	0	79	7	0	86	5	175	0	0	180	273
7:15 AM	0	0	0	0	0	3	0	5	0	8	0	115	8	0	123	7	237	0	0	244	375
7:30 AM	0	0	0	0	0	7	0	7	0	14	0	140	3	0	143	2	232	1	0	235	392
7:45 AM	1	0	0	0	1	0	0	0	0	0	0	166	4	0	170	1	300	0	0	301	472
Hourly Total	1	0	0	0	1	14	0	15	0	29	0	500	22	0	522	15	944	1	0	960	1512
8:00 AM	0	0	0	0	0	1	0	3	0	4	0	134	6	0	140	1	183	0	0	184	328
8:15 AM	0	0	2	0	2	5	0	4	0	9	0	115	0	0	115	1	176	1	0	178	304
8:30 AM	0	0	0	0	0	0	0	2	0	2	1	111	0	0	112	1	159	0	0	160	274
8:45 AM	0	0	0	0	0	0	0	2	1	2	0	106	5	0	111	0	158	0	0	158	271
Hourly Total	0	0	2	0	2	6	0	11	1	17	1	466	11	0	478	3	676	1	0	680	1177
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4:00 PM	1	0	0	0	1	4	0	1	0	5	0	245	2	0	247	2	186	0	0	188	441
4:15 PM	0	0	0	0	0	2	0	0	0	2	0	197	1	0	198	0	197	0	0	197	397
4:30 PM	0	0	0	0	0	1	0	1	0	2	0	227	1	0	228	0	187	0	0	187	417
4:45 PM	0	0	0	0	0	3	0	2	0	5	0	167	1	0	168	0	193	0	0	193	366
Hourly Total	1	0	0	0	1	10	0	4	0	14	0	836	5	0	841	2	763	0	0	765	1621
5:00 PM	0	0	1	0	1	2	0	2	0	4	0	214	4	0	218	2	210	0	0	212	435
5:15 PM	0	0	0	0	0	2	0	0	0	2	0	168	2	0	170	0	203	0	0	203	375
5:30 PM	0	0	0	0	0	2	0	2	0	4	0	185	1	0	186	0	221	0	0	221	411
5:45 PM	0	0	0	0	0	3	0	1	0	4	0	143	4	0	147	0	166	0	0	166	317
Hourly Total	0	0	1	0	1	9	0	5	0	14	0	710	11	0	721	2	800	0	0	802	1538
Grand Total	2	0	3	0	5	39	0	35	1	74	1	2512	49	0	2562	22	3183	2	0	3207	5848
Approach %	40.0	0.0	60.0	-	-	52.7	0.0	47.3	-	-	0.0	98.0	1.9	-	-	0.7	99.3	0.1	-	-	-
Total %	0.0	0.0	0.1	-	0.1	0.7	0.0	0.6	-	1.3	0.0	43.0	0.8	-	43.8	0.4	54.4	0.0	-	54.8	-
Lights	2	0	3	-	5	25	0	26	-	51	1	2413	35	-	2449	17	3066	2	-	3085	5590
% Lights	100.0	-	100.0	-	100.0	64.1	-	74.3	-	68.9	100.0	96.1	71.4	-	95.6	77.3	96.3	100.0	-	96.2	95.6
Mediums	0	0	0	-	0	4	0	2	-	6	0	62	5	-	67	3	67	0	-	70	143
% Mediums	0.0	-	0.0	-	0.0	10.3	-	5.7	-	8.1	0.0	2.5	10.2	-	2.6	13.6	2.1	0.0	-	2.2	2.4
Articulated Trucks	0	0	0	-	0	10	0	7	-	17	0	37	9	-	46	2	50	0	-	52	115
% Articulated Trucks	0.0	-	0.0	-	0.0	25.6	-	20.0	-	23.0	0.0	1.5	18.4	-	1.8	9.1	1.6	0.0	-	1.6	2.0
Pedestrians	-	-	-	0	-	-	-	-	1	-	-	-	-	0	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-	-

Progressive AE 1811 4 Mile Rd NE

Grand Rapids, Michigan, United States 49525 (616) 361-2664 Count Name: Patterson Ave & Comcast Drwy Site Code: Start Date: 08/24/2023 Page No: 2

Turning Movement Peak Hour Data (7:15 AM)

					Turi	i i i g	1010 0	CITIC		can	1100	Du	ia (1	.10	,						
			Site Drwy	/			Co	mcast D	rwy			Pa	tterson A	ve			Pa	tterson A	ve		
		E	Eastboun	d			V	Vestbour	d			Ν	lorthbour	nd			S	outhbour	nd		
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
7:15 AM	0	0	0	0	0	3	0	5	0	8	0	115	8	0	123	7	237	0	0	244	375
7:30 AM	0	0	0	0	0	7	0	7	0	14	0	140	3	0	143	2	232	1	0	235	392
7:45 AM	1	0	0	0	1	0	0	0	0	0	0	166	4	0	170	1	300	0	0	301	472
8:00 AM	0	0	0	0	0	1	0	3	0	4	0	134	6	0	140	1	183	0	0	184	328
Total	1	0	0	0	1	11	0	15	0	26	0	555	21	0	576	11	952	1	0	964	1567
Approach %	100.0	0.0	0.0	-	-	42.3	0.0	57.7	-	-	0.0	96.4	3.6	-	-	1.1	98.8	0.1	-	-	-
Total %	0.1	0.0	0.0	-	0.1	0.7	0.0	1.0	-	1.7	0.0	35.4	1.3	-	36.8	0.7	60.8	0.1	-	61.5	-
PHF	0.250	0.000	0.000	-	0.250	0.393	0.000	0.536	-	0.464	0.000	0.836	0.656	-	0.847	0.393	0.793	0.250	-	0.801	0.830
Lights	1	0	0	-	1	9	0	13	-	22	0	521	20	-	541	10	916	1	-	927	1491
% Lights	100.0	-	-	-	100.0	81.8	-	86.7	-	84.6	-	93.9	95.2	-	93.9	90.9	96.2	100.0	-	96.2	95.1
Mediums	0	0	0	-	0	0	0	0	-	0	0	23	1	-	24	1	25	0	-	26	50
% Mediums	0.0	-	-	-	0.0	0.0	-	0.0	-	0.0	-	4.1	4.8	-	4.2	9.1	2.6	0.0	-	2.7	3.2
Articulated Trucks	0	0	0	-	0	2	0	2	-	4	0	11	0	-	11	0	11	0	-	11	26
% Articulated Trucks	0.0	-	-	-	0.0	18.2	-	13.3	-	15.4	-	2.0	0.0	-	1.9	0.0	1.2	0.0	-	1.1	1.7
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Turning Movement Peak Hour Data (4:00 PM)

		E	Site Drwy Eastboun	/ d			Co V	mcast Di Vestbour	rwy id			Pa N	itterson A Iorthbour	ive id	,		Pa S	tterson A outhbour	Ave nd		
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
4:00 PM	1	0	0	0	1	4	0	1	0	5	0	245	2	0	247	2	186	0	0	188	441
4:15 PM	0	0	0	0	0	2	0	0	0	2	0	197	1	0	198	0	197	0	0	197	397
4:30 PM	0	0	0	0	0	1	0	1	0	2	0	227	1	0	228	0	187	0	0	187	417
4:45 PM	0	0	0	0	0	3	0	2	0	5	0	167	1	0	168	0	193	0	0	193	366
Total	1	0	0	0	1	10	0	4	0	14	0	836	5	0	841	2	763	0	0	765	1621
Approach %	100.0	0.0	0.0	-	-	71.4	0.0	28.6	-	-	0.0	99.4	0.6	-	-	0.3	99.7	0.0	-	-	-
Total %	0.1	0.0	0.0	-	0.1	0.6	0.0	0.2	-	0.9	0.0	51.6	0.3	-	51.9	0.1	47.1	0.0	-	47.2	-
PHF	0.250	0.000	0.000	-	0.250	0.625	0.000	0.500	-	0.700	0.000	0.853	0.625	-	0.851	0.250	0.968	0.000	-	0.971	0.919
Lights	1	0	0	-	1	6	0	3	-	9	0	819	3	-	822	0	745	0	-	745	1577
% Lights	100.0	-	-	-	100.0	60.0	-	75.0	-	64.3	-	98.0	60.0	-	97.7	0.0	97.6	-	-	97.4	97.3
Mediums	0	0	0	-	0	1	0	1	-	2	0	14	0	-	14	2	10	0	-	12	28
% Mediums	0.0	-	-	-	0.0	10.0	-	25.0	-	14.3	-	1.7	0.0	-	1.7	100.0	1.3	-	-	1.6	1.7
Articulated Trucks	0	0	0	-	0	3	0	0	-	3	0	3	2	-	5	0	8	0	-	8	16
% Articulated Trucks	0.0	-	-	-	0.0	30.0	-	0.0	-	21.4	-	0.4	40.0	-	0.6	0.0	1.0	-	-	1.0	1.0
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Progressive AE 1811 4 Mile Rd NE

Grand Rapids, Michigan, United States 49525 (616) 361-2664 Count Name: Patterson Ave & Dykstra Auto Drwy Site Code: Start Date: 08/24/2023 Page No: 1

Turning Movement Data

		Dyks	stra Auto	Drwy			U	ISPS Drv	vy vy	0.001		Pa	tterson A	Ave			Pa	tterson A	ve		
Start Time	Left	E Thru	Eastboun Right	Peds	App. Total	Left	V Thru	Vestbour Right	nd Peds	App. Total	Left	N Thru	orthbour Right	nd Peds	App. Total	Left	S Thru	outhbour Right	nd Peds	App. Total	Int. Total
7:00 AM	0	0	2	1	2	1	0	1	0	2	2	83	3	0	88	2	176	0	0	178	270
7:15 AM	0	0	2	0	2	2	0	2	0	4	3	121	4	. 1	128	2	234	2	0	238	372
7:30 AM	1	0	0	0	1	0	0	1	0	1	1	142	5	0	148	2	235	3	0	240	390
7:45 AM	1	0	2	0	3	0	0	1	0	1	0	171	2	0	173	1	294	3	0	298	475
Hourly Total	2	0	6	1	8	3	0	5	0	8	6	517	14	1	537	7	939	8	0	954	1507
8:00 AM	1	0	1	0	2	0	0	0	0	0	1	140	1	0	142	0	183	1	0	184	328
8:15 AM	0	0	0	0	0	1	0	0	0	1	1	116	0	0	117	1	183	0	0	184	302
8:30 AM	0	0	0	0	0	0	0	0	0	0	1	113	0	0	114	0	156	0	0	156	270
8:45 AM	1	0	3	0	4	1	0	0	1	1	2	109	2	1	113	0	156	2	0	158	276
Hourly Total	2	0	4	0	6	2	0	0	1	2	5	478	3	1	486	1	678	3	0	682	1176
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4:00 PM	1	0	0	0	1	3	0	2	0	5	0	243	0	1	243	0	190	1	0	191	440
4:15 PM	0	0	1	0	1	0	0	0	0	0	1	192	0	0	193	0	197	0	0	197	391
4:30 PM	0	0	1	0	1	0	0	0	0	0	1	231	2	0	234	0	191	0	0	191	426
4:45 PM	0	0	1	0	1	1	0	2	0	3	0	160	0	0	160	0	196	0	0	196	360
Hourly Total	1	0	3	0	4	4	0	4	0	8	2	826	2	1	830	0	774	1	0	775	1617
5:00 PM	0	0	0	0	0	1	0	1	0	2	1	217	1	0	219	0	214	0	0	214	435
5:15 PM	2	0	3	0	5	0	0	0	0	0	2	165	1	0	168	0	203	0	0	203	376
5:30 PM	1	0	2	0	3	0	0	1	0	1	0	185	0	0	185	1	222	0	0	223	412
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	151	1	0	152	1	166	0	0	167	319
Hourly Total	3	0	5	0	8	1	0	2	0	3	3	718	3	0	724	2	805	0	0	807	1542
Grand Total	8	0	18	1	26	10	0	11	1	21	16	2539	22	3	2577	10	3196	12	0	3218	5842
Approach %	30.8	0.0	69.2	-	-	47.6	0.0	52.4	-	-	0.6	98.5	0.9	-	-	0.3	99.3	0.4	-	-	-
Total %	0.1	0.0	0.3	-	0.4	0.2	0.0	0.2	-	0.4	0.3	43.5	0.4	-	44.1	0.2	54.7	0.2	-	55.1	-
Lights	8	0	18	-	26	7	0	10	-	17	16	2427	21	-	2464	7	3068	12	-	3087	5594
% Lights	100.0	-	100.0	-	100.0	70.0	-	90.9	-	81.0	100.0	95.6	95.5	-	95.6	70.0	96.0	100.0	-	95.9	95.8
Mediums	0	0	0	-	0	0	0	1	-	1	0	67	1	-	68	0	68	0	-	68	137
% Mediums	0.0	-	0.0	-	0.0	0.0	-	9.1	-	4.8	0.0	2.6	4.5	-	2.6	0.0	2.1	0.0	-	2.1	2.3
Articulated Trucks	0	0	0	-	0	3	0	0	-	3	0	45	0	-	45	3	60	0	-	63	111
% Articulated Trucks	0.0	-	0.0	-	0.0	30.0	-	0.0	-	14.3	0.0	1.8	0.0	-	1.7	30.0	1.9	0.0	-	2.0	1.9
Pedestrians	-	-	-	1	-	-	-	-	1	-	-	-	-	3	-	-	-	-	0	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	100.0	-	-	-	-	100.0	-	-	-	-	-	-	-

Progressive AE 1811 4 Mile Rd NE

Grand Rapids, Michigan, United States 49525 (616) 361-2664 Count Name: Patterson Ave & Dykstra Auto Drwy Site Code: Start Date: 08/24/2023 Page No: 2

Turning Movement Peak Hour Data (7:15 AM)

					1 011	onic	oun	1100		i (<i>i</i>											
		Dyks	tra Auto	Drwy			U	SPS Drv	vy			Pa	tterson A	ve			Pa	tterson A	ve		
		E	astboun	d			v	Vestbour	nd			N	orthbour	nd			S	outhbour	nd		
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
7:15 AM	0	0	2	0	2	2	0	2	0	4	3	121	4	1	128	2	234	2	0	238	372
7:30 AM	1	0	0	0	1	0	0	1	0	1	1	142	5	0	148	2	235	3	0	240	390
7:45 AM	1	0	2	0	3	0	0	1	0	1	0	171	2	0	173	1	294	3	0	298	475
8:00 AM	1	0	1	0	2	0	0	0	0	0	1	140	1	0	142	0	183	1	0	184	328
Total	3	0	5	0	8	2	0	4	0	6	5	574	12	1	591	5	946	9	0	960	1565
Approach %	37.5	0.0	62.5	-	-	33.3	0.0	66.7	-	-	0.8	97.1	2.0	-	-	0.5	98.5	0.9	-	-	-
Total %	0.2	0.0	0.3	-	0.5	0.1	0.0	0.3	-	0.4	0.3	36.7	0.8	-	37.8	0.3	60.4	0.6	-	61.3	-
PHF	0.750	0.000	0.625	-	0.667	0.250	0.000	0.500	-	0.375	0.417	0.839	0.600	-	0.854	0.625	0.804	0.750	-	0.805	0.824
Lights	3	0	5	-	8	1	0	3	-	4	5	538	11	-	554	5	911	9	-	925	1491
% Lights	100.0	-	100.0	-	100.0	50.0	-	75.0	-	66.7	100.0	93.7	91.7	-	93.7	100.0	96.3	100.0	-	96.4	95.3
Mediums	0	0	0	-	0	0	0	1	-	1	0	26	1	-	27	0	22	0	-	22	50
% Mediums	0.0	-	0.0	-	0.0	0.0	-	25.0	-	16.7	0.0	4.5	8.3	-	4.6	0.0	2.3	0.0	-	2.3	3.2
Articulated Trucks	0	0	0	-	0	1	0	0	-	1	0	10	0	-	10	0	13	0	-	13	24
% Articulated Trucks	0.0	-	0.0	-	0.0	50.0	-	0.0	-	16.7	0.0	1.7	0.0	-	1.7	0.0	1.4	0.0	-	1.4	1.5
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	1	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-

Turning Movement Peak Hour Data (4:00 PM)

		Dyks E	stra Auto Eastboun	Drwy d	-		U V	SPS Drv Vestbour	vy id			Pa N	itterson A	ve nd	,		Pa S	itterson A outhbour	ive nd		
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
4:00 PM	1	0	0	0	1	3	0	2	0	5	0	243	0	1	243	0	190	1	0	191	440
4:15 PM	0	0	1	0	1	0	0	0	0	0	1	192	0	0	193	0	197	0	0	197	391
4:30 PM	0	0	1	0	1	0	0	0	0	0	1	231	2	0	234	0	191	0	0	191	426
4:45 PM	0	0	1	0	1	1	0	2	0	3	0	160	0	0	160	0	196	0	0	196	360
Total	1	0	3	0	4	4	0	4	0	8	2	826	2	1	830	0	774	1	0	775	1617
Approach %	25.0	0.0	75.0	-	-	50.0	0.0	50.0	-	-	0.2	99.5	0.2	-	-	0.0	99.9	0.1	-	-	-
Total %	0.1	0.0	0.2	-	0.2	0.2	0.0	0.2	-	0.5	0.1	51.1	0.1	-	51.3	0.0	47.9	0.1	-	47.9	-
PHF	0.250	0.000	0.750	-	1.000	0.333	0.000	0.500	-	0.400	0.500	0.850	0.250	-	0.854	0.000	0.982	0.250	-	0.984	0.919
Lights	1	0	3	-	4	3	0	4	-	7	2	811	2	-	815	0	746	1	-	747	1573
% Lights	100.0	-	100.0	-	100.0	75.0	-	100.0	-	87.5	100.0	98.2	100.0	-	98.2	-	96.4	100.0	-	96.4	97.3
Mediums	0	0	0	-	0	0	0	0	-	0	0	9	0	-	9	0	14	0	-	14	23
% Mediums	0.0	-	0.0	-	0.0	0.0	-	0.0	-	0.0	0.0	1.1	0.0	-	1.1	-	1.8	0.0	-	1.8	1.4
Articulated Trucks	0	0	0	-	0	1	0	0	-	1	0	6	0	-	6	0	14	0	-	14	21
% Articulated Trucks	0.0	-	0.0	-	0.0	25.0	-	0.0	-	12.5	0.0	0.7	0.0	-	0.7	-	1.8	0.0	-	1.8	1.3
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	1	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-

Progressive AE 1811 4 Mile Rd NE

Grand Rapids, Michigan, United States 49525 (616) 361-2664 Count Name: 36th St & Eaton Drwy Site Code: Start Date: 08/24/2023 Page No: 1

Turning Movement Data

				10	in in ing i	NOVEII		ala					
		36tl	h St			36t	h St			Eator	n Drwy		
Chart Time		Eastb	ound			West	bound			North	bound		
Start Time	Thru	Right	Peds	App. Total	Left	Thru	Peds	App. Total	Left	Right	Peds	App. Total	Int. Total
7:00 AM	53	0	0	53	0	62	0	62	0	0	1	0	115
7:15 AM	55	0	0	55	1	108	0	109	0	0	1	0	164
7:30 AM	54	0	0	54	2	91	0	93	0	1	0	1	148
7:45 AM	83	0	0	83	7	93	0	100	0	1	0	1	184
Hourly Total	245	0	0	245	10	354	0	364	0	2	2	2	611
8:00 AM	67	1	0	68	3	78	0	81	0	0	0	0	149
8:15 AM	56	0	0	56	0	83	0	83	0	0	0	0	139
8:30 AM	46	1	0	47	0	64	0	64	0	0	0	0	111
8:45 AM	53	0	0	53	0	67	0	67	0	0	3	0	120
Hourly Total	222	2	0	224	3	292	0	295	0	0	3	0	519
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-
4:00 PM	107	0	0	107	1	127	0	128	0	1	1	1	236
4:15 PM	112	0	0	112	1	90	0	91	0	4	0	4	207
4:30 PM	111	0	0	111	0	100	0	100	0	3	0	3	214
4:45 PM	96	0	0	96	0	85	0	85	0	1	0	1	182
Hourly Total	426	0	0	426	2	402	0	404	0	9	1	9	839
5:00 PM	133	0	0	133	0	109	0	109	2	3	0	5	247
5:15 PM	97	0	0	97	0	101	0	101	0	0	0	0	198
5:30 PM	70	0	0	70	0	88	0	88	1	2	0	3	161
5:45 PM	93	0	0	93	0	88	0	88	0	1	1	1	182
Hourly Total	393	0	0	393	0	386	0	386	3	6	1	9	788
Grand Total	1286	2	0	1288	15	1434	0	1449	3	17	7	20	2757
Approach %	99.8	0.2	-	-	1.0	99.0	-	-	15.0	85.0	-	-	-
Total %	46.6	0.1	-	46.7	0.5	52.0	-	52.6	0.1	0.6	-	0.7	-
Lights	1198	2	-	1200	15	1345	-	1360	3	17	-	20	2580
% Lights	93.2	100.0	-	93.2	100.0	93.8	-	93.9	100.0	100.0	-	100.0	93.6
Mediums	44	0	-	44	0	53	-	53	0	0	-	0	97
% Mediums	3.4	0.0	-	3.4	0.0	3.7	-	3.7	0.0	0.0	-	0.0	3.5
Articulated Trucks	44	0	-	44	0	36	-	36	0	0	-	0	80
% Articulated Trucks	3.4	0.0	-	3.4	0.0	2.5	-	2.5	0.0	0.0	-	0.0	2.9
Pedestrians	-	-	0	-	-	-	0	-	-	-	7	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	100.0	-	-

Progressive AE 1811 4 Mile Rd NE

Grand Rapids, Michigan, United States 49525 (616) 361-2664 Count Name: 36th St & Eaton Drwy Site Code: Start Date: 08/24/2023 Page No: 2

Turning Movement Peak Hour Data (7:15 AM)

			i un in		mont			aia (7. j	0 / (ivi)				
		36th	n St			36th	n St			Eaton	Drwy		
Otort Time		Eastb	ound			Westb	ound			North	bound		
Start Time	Thru	Right	Peds	App. Total	Left	Thru	Peds	App. Total	Left	Right	Peds	App. Total	Int. Total
7:15 AM	55	0	0	55	1	108	0	109	0	0	1	0	164
7:30 AM	54	0	0	54	2	91	0	93	0	1	0	1	148
7:45 AM	83	0	0	83	7	93	0	100	0	1	0	1	184
8:00 AM	67	1	0	68	3	78	0	81	0	0	0	0	149
Total	259	1	0	260	13	370	0	383	0	2	1	2	645
Approach %	99.6	0.4	-	-	3.4	96.6	-	-	0.0	100.0	-	-	-
Total %	40.2	0.2	-	40.3	2.0	57.4	-	59.4	0.0	0.3	-	0.3	-
PHF	0.780	0.250	-	0.783	0.464	0.856	-	0.878	0.000	0.500	-	0.500	0.876
Lights	227	1	-	228	13	340	-	353	0	2	-	2	583
% Lights	87.6	100.0	-	87.7	100.0	91.9	-	92.2	-	100.0	-	100.0	90.4
Mediums	18	0	-	18	0	19	-	19	0	0	-	0	37
% Mediums	6.9	0.0	-	6.9	0.0	5.1	-	5.0	-	0.0	-	0.0	5.7
Articulated Trucks	14	0	-	14	0	11	-	11	0	0	-	0	25
% Articulated Trucks	5.4	0.0	-	5.4	0.0	3.0	-	2.9	-	0.0	-	0.0	3.9
Pedestrians	-	-	0	-	-	-	0	-	-	-	1	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	100.0	-	-

Turning Movement Peak Hour Data (4:15 PM)

	1							(1
		36t	n St			36t	n St			Eaton	Drwy		
Start Time		Eastb	ound			West	bound			North	bound		
Start Time	Thru	Right	Peds	App. Total	Left	Thru	Peds	App. Total	Left	Right	Peds	App. Total	Int. Total
4:15 PM	112	0	0	112	1	90	0	91	0	4	0	4	207
4:30 PM	111	0	0	111	0	100	0	100	0	3	0	3	214
4:45 PM	96	0	0	96	0	85	0	85	0	1	0	1	182
5:00 PM	133	0	0	133	0	109	0	109	2	3	0	5	247
Total	452	0	0	452	1	384	0	385	2	11	0	13	850
Approach %	100.0	0.0	-	-	0.3	99.7	-	-	15.4	84.6	-	-	-
Total %	53.2	0.0	-	53.2	0.1	45.2	-	45.3	0.2	1.3	-	1.5	-
PHF	0.850	0.000	-	0.850	0.250	0.881	-	0.883	0.250	0.688	-	0.650	0.860
Lights	430	0	-	430	1	366	-	367	2	11	-	13	810
% Lights	95.1	-	-	95.1	100.0	95.3	-	95.3	100.0	100.0	-	100.0	95.3
Mediums	12	0	-	12	0	11	-	11	0	0	-	0	23
% Mediums	2.7	-	-	2.7	0.0	2.9	-	2.9	0.0	0.0	-	0.0	2.7
Articulated Trucks	10	0	-	10	0	7	-	7	0	0	-	0	17
% Articulated Trucks	2.2	-	-	2.2	0.0	1.8	-	1.8	0.0	0.0	-	0.0	2.0
Pedestrians	-	-	0	-	-	-	0	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-



Synchro Analysis Results

Queues 1: Patterson Ave & 36th St

	۶	-	4	+	1	Ť	1	1	Ļ
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	61	292	618	356	65	573	440	57	1109
v/c Ratio	0.25	0.76	0.93	0.51	0.34	0.40	0.39	0.15	0.78
Control Delay	42.1	47.1	61.5	38.0	28.4	23.2	1.6	12.6	28.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.1	47.1	61.5	38.0	28.4	23.2	1.6	12.6	28.2
Queue Length 50th (ft)	35	74	201	107	20	139	1	15	333
Queue Length 95th (ft)	62	92	#305	148	41	184	16	26	338
Internal Link Dist (ft)		296		1342		1028			406
Turn Bay Length (ft)	200		250		500		250	250	
Base Capacity (vph)	259	399	666	842	229	1435	1141	428	1427
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	0.24	0.73	0.93	0.42	0.28	0.40	0.39	0.13	0.78
Intersection Summary									

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis 1: Patterson Ave & 36th St

	۶	-	$\mathbf{\hat{z}}$	4	+	*	1	1	۲	1	Ŧ	~
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1	≜ †Ъ		ሻሻ	41 2		۲	^	1	<u>۲</u>	A12	
Traffic Volume (vph)	45	146	70	575	278	53	56	493	378	47	860	49
Future Volume (vph)	45	146	70	575	278	53	56	493	378	47	860	49
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.4	6.4		6.4	6.4		6.5	6.5	6.4	6.5	6.5	
Lane Util. Factor	1.00	0.95		0.97	0.95		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.95		1.00	0.98		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1703	3226		3400	3421		1770	3539	1583	1770	3510	
Flt Permitted	1.00	1.00		0.95	1.00		0.11	1.00	1.00	0.37	1.00	
Satd. Flow (perm)	1792	3226		3400	3421		196	3539	1583	685	3510	
Peak-hour factor, PHF	0.74	0.74	0.74	0.93	0.93	0.93	0.86	0.86	0.86	0.82	0.82	0.82
Adj. Flow (vph)	61	197	95	618	299	57	65	573	440	57	1049	60
RTOR Reduction (vph)	0	58	0	0	16	0	0	0	185	0	4	0
Lane Group Flow (vph)	61	234	0	618	340	0	65	573	255	57	1105	0
Confl. Peds. (#/hr)			1	1								
Heavy Vehicles (%)	6%	6%	6%	3%	3%	3%	2%	2%	2%	2%	2%	2%
Turn Type	pm+pt	NA		Prot	NA		pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases	4						2		2	6		
Actuated Green, G (s)	11.5	11.5		19.6	19.8		43.1	38.0	57.6	43.1	38.0	
Effective Green, g (s)	11.5	11.5		19.6	19.8		43.1	38.0	57.6	43.1	38.0	
Actuated g/C Ratio	0.12	0.12		0.20	0.20		0.43	0.38	0.58	0.43	0.38	
Clearance Time (s)	6.4	6.4		6.4	6.4		6.5	6.5	6.4	6.5	6.5	
Vehicle Extension (s)	3.0	3.0		4.0	3.0		3.0	0.2	4.0	3.0	0.2	
Lane Grp Cap (vph)	206	370		666	677		164	1344	911	350	1333	
v/s Ratio Prot	0.03	c0.07		c0.18	0.10		c0.02	0.16	0.05	0.01	c0.31	
v/s Ratio Perm	0.00						0.15		0.11	0.06		
v/c Ratio	0.30	0.63		0.93	0.50		0.40	0.43	0.28	0.16	0.83	
Uniform Delay, d1	38.9	42.2		39.5	35.7		36.9	22.9	10.7	21.3	28.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	0.84	0.88	
Incremental Delay, d2	0.8	3.5		19.4	0.6		1.6	1.0	0.2	0.2	5.7	
Delay (s)	39.7	45.8		58.9	36.3		38.4	23.9	10.9	18.0	30.4	
Level of Service	D	D		E	D		D	С	В	В	С	
Approach Delay (s)		44.7			50.6			19.5			29.8	
Approach LOS		D			D			В			С	
Intersection Summary												
HCM 2000 Control Delay			33.8	H	CM 2000	Level of	Service		C.			
HCM 2000 Volume to Canacit	tv ratio		0 79	11	2000	2010101	0011100		0			
Actuated Cycle Length (s)	., 1010		100.0	S	um of lost	time (s)			25.8			
Intersection Canacity Utilization	on		74.2%		ULevel	of Service	<i>,</i>		_0.0 D			
Analysis Period (min)			15		2 _ 20.01 (2			

c Critical Lane Group

0.3

Intersection

Int Delay, s/veh

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4			4		٦	∱ î≽		۲.	A	
Traffic Vol, veh/h	1	0	0	11	0	15	0	560	21	11	952	1
Future Vol, veh/h	1	0	0	11	0	15	0	560	21	11	952	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	75	-	-	100	-	-
Veh in Median Storage,	# -	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	60	60	60	60	60	60	85	85	85	80	80	80
Heavy Vehicles, %	0	0	0	15	15	15	2	2	2	1	1	1
Mvmt Flow	2	0	0	18	0	25	0	659	25	14	1190	1

Major/Minor	Minor2		ſ	Minor1		l	Major1		Ν	Major2				
Conflicting Flow All	1549	1903	596	1295	1891	342	1191	0	0	684	0	0		
Stage 1	1219	1219	-	672	672	-	-	-	-	-	-	-		
Stage 2	330	684	-	623	1219	-	-	-	-	-	-	-		
Critical Hdwy	7.5	6.5	6.9	7.8	6.8	7.2	4.14	-	-	4.12	-	-		
Critical Hdwy Stg 1	6.5	5.5	-	6.8	5.8	-	-	-	-	-	-	-		
Critical Hdwy Stg 2	6.5	5.5	-	6.8	5.8	-	-	-	-	-	-	-		
Follow-up Hdwy	3.5	4	3.3	3.65	4.15	3.45	2.22	-	-	2.21	-	-		
Pot Cap-1 Maneuver	*182	101	*718	*318	92	*833	861	-	-	1194	-	-		
Stage 1	*456	442	-	*698	633	-	-	-	-	-	-	-		
Stage 2	*821	651	-	*649	418	-	-	-	-	-	-	-		
Platoon blocked, %	1	1	1	1	1	1	1	-	-	1	-	-		
Mov Cap-1 Maneuver	*175	100	*718	*315	90	*833	861	-	-	1194	-	-		
Mov Cap-2 Maneuver	*335	280	-	*449	267	-	-	-	-	-	-	-		
Stage 1	*456	436	-	*698	633	-	-	-	-	-	-	-		
Stage 2	*796	651	-	*642	413	-	-	-	-	-	-	-		
Approach	FB			WB			NB			SB				
HCM Control Delay	15.8			11.3			0			0.1				
HCM LOS	C			R			Ŭ			0.1				
	Ŭ			5										
Minor Lane/Maior My	mt	NRI	NRT	NRR I	EBI n1V	VRI n1	SBI	SBT	SBR					
Capacity (yeb/b)		861			335	612	110/		ODIX					
HCM Lane V/C Patio		001	-	-	0.005	0.071	0.012	-	-					
HCM Control Delay (s	•)	-	-	-	15.8	11 3	0.01Z	-	-					
HCM Lane LOS	<i>)</i>	0 A	-	-	13.0 C	II.J R	0.1	-	-					
HCM 95th %tile O(vel	h)	0			0	0.2	0							
	1)	0	-	-	0	0.2	U							
Notes														
~: Volume exceeds ca	apacity	\$: De	lav exc	eeds 30)0s -	+: Com	outation	Not De	fined	*: All n	najor volu	ime in plato	oon	

0.2

Intersection

Int Delay, s/veh

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4			4		ሻ	∱ β		۲.	A	
Traffic Vol, veh/h	3	0	5	2	0	4	5	574	12	5	949	9
Future Vol, veh/h	3	0	5	2	0	4	5	574	12	5	949	9
Conflicting Peds, #/hr	0	0	1	1	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	100	-	-	75	-	-
Veh in Median Storage,	# -	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	67	67	67	60	60	60	85	85	85	81	81	81
Heavy Vehicles, %	0	0	0	17	17	17	2	2	2	1	1	1
M∨mt Flow	4	0	7	3	0	7	6	675	14	6	1172	11

Major/Minor	Minor2		ſ	Ainor1		I	Major1		N	/lajor2					
Conflicting Flow All	1540	1891	593	1293	1889	345	1183	0	0	689	0	0			
Stage 1	1190	1190	-	694	694	-	-	-	-	-	-	-			
Stage 2	350	701	-	599	1195	-	-	-	-	-	-	-			
Critical Hdwy	7.5	6.5	6.9	7.84	6.84	7.24	4.14	-	-	4.12	-	-			
Critical Hdwy Stg 1	6.5	5.5	-	6.84	5.84	-	-	-	-	-	-	-			
Critical Hdwy Stg 2	6.5	5.5	-	6.84	5.84	-	-	-	-	-	-	-			
Follow-up Hdwy	3.5	4	3.3	3.67	4.17	3.47	2.22	-	-	2.21	-	-			
Pot Cap-1 Maneuver	*120	85	*718	*180	72	*828	870	-	-	1189	-	-			
Stage 1	*483	462	-	*667	612	-	-	-	-	-	-	-			
Stage 2	*821	637	-	*646	431	-	-	-	-	-	-	-			
Platoon blocked, %	1	1	1	1	1	1	1	-	-	1	-	-			
Mov Cap-1 Maneuver	*118	84	*717	*177	71	*828	870	-	-	1189	-	-			
Mov Cap-2 Maneuver	*324	279	-	*376	259	-	-	-	-	-	-	-			
Stage 1	*480	459	-	*663	607	-	-	-	-	-	-	-			
Stage 2	*809	633	-	*636	429	-	-	-	-	-	-	-			
Approach	EB			WB			NB			SB					
HCM Control Delay, s	12.5			11.2			0.1			0				 	
HCM LOS	B			B			•••								
	-			_											
Minor Long/Major My	mt.	NDI	NDT				CDI	орт	CDD						
	III		INDI			VDLIII	3DL 1100	SDI	JDK					 	
		0/0	-	-	493	0.017	1109	-	-						
HCM Cantral Dalay (a		0.007	-	-	10.024	0.017	0.005	-	-						
HCM Control Delay (s	5)	9.2	-	-	12.5	II.Z	0	-	-						
HOM Lane LUS	-)	A	-	-	D 1	B	A	-	-						
	1)	0	-	-	0.1	0.1	U	-	-						
Notes															
~: Volume exceeds ca	apacity	\$: De	lay exc	eeds 30)0s -	+: Com	outation	Not De	fined	*: All r	najor volu	ime in p	latoon		

0.2					
EBT	EBR	WBL	WBT	NBL	NBR
		5	- † †	Y	
259	1	13	370	0	2
259	1	13	370	0	2
0	1	1	0	0	0
Free	Free	Free	Free	Stop	Stop
-	None	-	None	-	None
-	-	25	-	0	-
# 0	-	-	0	1	-
0	-	-	0	0	-
78	78	88	88	60	60
5	5	3	3	0	0
332	1	15	420	0	3
	0.2 EBT 259 259 0 Free - - - - 4 0 0 78 5 332	0.2 EBT EBR ↑↓ 259 1 259 1 259 1 1 259 1 1 Free Free - None - # 0 - 78 78 5 332 1	0.2 EBT EBR WBL ↑↑ 13 259 1 13 259 1 13 259 1 13 0 1 1 Free Free Free - None - - 25 # 0 - 25 # 0 - 3 78 78 88 5 5 3 332 1 15	0.2 EBT EBR WBL WBT ↑↑ ↑↑ ↑↑ 259 1 13 370 259 1 13 370 259 1 13 370 0 1 1 0 Free Free Free Free 0 1 1 0 Free Free Free Free 0 - 255 - # 0 - 0 0 - 0 - 255 - 0 78 78 888 88 3 332 1 15 420	0.2 EBT EBR WBL WBT NBL ↑↑ ↑↑ ↑↑ ↑↑ 259 1 13 370 0 259 1 13 370 0 259 1 13 370 0 259 1 13 370 0 0 1 1 0 0 Free Free Free Stop - None - None - 25 - 0 # 0 - 25 0 1 0 - 25 0 1 0 - 25 0 1 0 - 0 0 1 0 - 0 0 0 78 78 88 88 60 5 5 3 3 0 332 1 15 420 0

Major/Minor	Major1	I	Major2	1	Minor1				
Conflicting Flow All	0	0	334	0	574	168			
Stage 1	-	-	-	-	334	-			
Stage 2	-	-	-	-	240	-			
Critical Hdwy	-	-	4.16	-	6.8	6.9			
Critical Hdwy Stg 1	-	-	-	-	5.8	-			
Critical Hdwy Stg 2	-	-	-	-	5.8	-			
Follow-up Hdwy	-	-	2.23	-	3.5	3.3			
Pot Cap-1 Maneuver	-	-	1215	-	*640	853			
Stage 1	-	-	-	-	*703	-			
Stage 2	-	-	-	-	*905	-			
Platoon blocked, %	-	-		-	1				
Mov Cap-1 Maneuver	-	-	1214	-	*631	852			
Mov Cap-2 Maneuver	-	-	-	-	*627	-			
Stage 1	-	-	-	-	*702	-			
Stage 2	-	-	-	-	*894	-			
Approach	EB		WB		NB				
HCM Control Delay, s	0		0.3		9.2				
HCM LOS					А				
Minor Lane/Maior Mvr	nt	NBLn1	EBT	EBR	WBL	WBT			
Capacity (veh/h)	-	852	-	-	1214	-			
HCM Lane V/C Ratio		0.004	-	-	0.012	-			
HCM Control Delay (s)	9.2	-	-	8	-			
HCM Lane LOS	/	A	-	-	A	-			
HCM 95th %tile Q(veh	ו)	0	-	-	0	-			
Notes									
~: Volume exceeds ca	pacity	\$: De	lav exc	eeds 30)0s	+: Comr	utation Not Defined	*: All maior volume in platoon	
	1	. .							

Queues 1: Patterson Ave & 36th St

	٦	-	•	-	1	1	1	1	Ŧ
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	58	457	434	346	59	870	1000	89	831
v/c Ratio	0.16	0.78	0.75	0.53	0.24	0.61	1.01	0.38	0.59
Control Delay	40.8	56.3	55.7	47.2	23.2	32.0	45.4	23.3	24.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	40.8	56.3	55.7	47.2	23.2	32.0	45.4	23.3	24.4
Queue Length 50th (ft)	37	174	164	130	23	282	~461	28	234
Queue Length 95th (ft)	76	230	216	172	48	356	#707	50	274
Internal Link Dist (ft)		296		1342		1028			406
Turn Bay Length (ft)	200		250		500		250	250	
Base Capacity (vph)	364	663	646	1076	272	1424	991	256	1397
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	0.16	0.69	0.67	0.32	0.22	0.61	1.01	0.35	0.59

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.

HCM Signalized Intersection Capacity Analysis 1: Patterson Ave & 36th St

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	5	≜ 1₀		ካካ	≜1 2		5	**	1	5	4 12	
Traffic Volume (vph)	52	358	53	386	268	40	51	748	860	77	656	67
Future Volume (vph)	52	358	53	386	268	40	51	748	860	77	656	67
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.4	6.4		6.4	6.4		6.5	6.5	6.4	6.5	6.5	
Lane Util. Factor	1.00	0.95		0.97	0.95		1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.98		1.00	0.98		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	3471		3433	3470		1787	3574	1599	1770	3490	
Flt Permitted	1.00	1.00		0.95	1.00		0.21	1.00	1.00	0.20	1.00	
Satd. Flow (perm)	1863	3471		3433	3470		403	3574	1599	365	3490	
Peak-hour factor, PHF	0.90	0.90	0.90	0.89	0.89	0.89	0.86	0.86	0.86	0.87	0.87	0.87
Adj. Flow (vph)	58	398	59	434	301	45	59	870	1000	89	754	77
RTOR Reduction (vph)	0	10	0	0	11	0	0	0	84	0	6	0
Lane Group Flow (vph)	58	447	0	434	335	0	59	870	916	89	825	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	1%	1%	1%	2%	2%	2%
Turn Type	pm+pt	NA		Prot	NA		pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	7	4		3	8		5	2	. 3	1	6	
Permitted Phases	4						2		2	6		
Actuated Green, G (s)	21.3	21.3		20.3	22.1		52.6	46.5	66.8	52.6	46.5	
Effective Green, g (s)	21.3	21.3		20.3	22.1		52.6	46.5	66.8	52.6	46.5	
Actuated g/C Ratio	0.18	0.18		0.17	0.18		0.44	0.39	0.56	0.44	0.39	
Clearance Time (s)	6.4	6.4		6.4	6.4		6.5	6.5	6.4	6.5	6.5	
Vehicle Extension (s)	3.0	3.0		4.0	3.0		3.0	0.2	4.0	3.0	0.2	
Lane Grp Cap (vph)	330	616		580	639		247	1384	890	231	1352	
v/s Ratio Prot	0.03	c0.13		0.13	0.10		0.01	0.24	c0.17	c0.02	0.24	
v/s Ratio Perm	0.00						0.09		0.40	0.15		
v/c Ratio	0.18	0.73		0.75	0.52		0.24	0.63	1.03	0.39	0.61	
Uniform Delay, d1	40.7	46.6		47.4	44.2		32.8	29.8	26.6	36.1	29.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	0.77	0.77	
Incremental Delay, d2	0.3	4.2		5.6	0.8		0.5	2.2	37.8	1.0	2.0	
Delay (s)	40.9	50.8		53.0	45.0		33.3	31.9	64.4	29.0	24.7	
Level of Service	D	D		D	D		С	С	E	С	С	
Approach Delay (s)		49.7			49.4			48.8			25.1	
Approach LOS		D			D			D			С	
Intersection Summary												
HCM 2000 Control Delay			43.8	H	CM 2000	Level of	Service		D			
HCM 2000 Volume to Capac	ity ratio		0.92									
Actuated Cycle Length (s)			120.0	Si	um of lost	time (s)			25.8			
Intersection Capacity Utilizati	ion		85.2%	IC	U Level o	of Service	9		E			
Analysis Period (min)			15									
c Critical Lane Group												

0.2

Intersection

Int Delay, s/veh

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4			4		۲.	∱ î≽		۲.	∱ î≽	
Traffic Vol, veh/h	1	0	0	10	0	4	0	836	5	2	784	0
Future Vol, veh/h	1	0	0	10	0	4	0	836	5	2	784	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	75	-	-	100	-	-
Veh in Median Storage,	# -	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	60	60	60	70	70	70	85	85	85	95	95	95
Heavy Vehicles, %	0	0	0	21	21	21	1	1	1	1	1	1
Mvmt Flow	2	0	0	14	0	6	0	984	6	2	825	0

Major/Minor	Minor2		N	Ainor1			Major1		Ν	/lajor2				
Conflicting Flow All	1321	1819	413	1404	1816	495	825	0	0	990	0	0		
Stage 1	829	829	-	987	987	-	-	-	-	-	-	-		
Stage 2	492	990	-	417	829	-	-	-	-	-	-	-		
Critical Hdwy	7.5	6.5	6.9	7.92	6.92	7.32	4.12	-	-	4.12	-	-		
Critical Hdwy Stg 1	6.5	5.5	-	6.92	5.92	-	-	-	-	-	-	-		
Critical Hdwy Stg 2	6.5	5.5	-	6.92	5.92	-	-	-	-	-	-	-		
Follow-up Hdwy	3.5	4	3.3	3.71	4.21	3.51	2.21	-	-	2.21	-	-		
Pot Cap-1 Maneuver	*415	*136	*780	*303	*118	*709	*1166	-	-	1039	-	-		
Stage 1	*735	*644	-	*589	*535	-	-	-	-	-	-	-		
Stage 2	*711	*566	-	*694	*612	-	-	-	-	-	-	-		
Platoon blocked, %	1	1	1	1	1	1	1	-	-	1	-	-		
Mov Cap-1 Maneuver	*411	*136	*780	*303	*117	*709	*1166	-	-	1039	-	-		
Mov Cap-2 Maneuver	*516	*336	-	*427	*313	-	-	-	-	-	-	-		
Stage 1	*735	*642	-	*589	*535	-	-	-	-	-	-	-		
Stage 2	*706	*566	-	*693	*610	-	-	-	-	-	-	-		
Approach	EB			WB			NB			SB				
HCM Control Delay, s	12			12.8			0			0				
HCM LOS	В			В										
Minor Lane/Major Mvr	nt	NBL	NBT	NBR I	EBLn1V	VBLn1	SBL	SBT	SBR					
Capacity (veh/h)		* 1166	-	-	516	482	1039	-	-					
HCM Lane V/C Ratio		-	-	-	0.003	0.041	0.002	-	-					
HCM Control Delay (s	;)	0	-	-	12	12.8	8.5	-	-					
HCM Lane LOS	/	А	-	-	В	В	А	-	-					
HCM 95th %tile Q(veh	ר)	0	-	-	0	0.1	0	-	-					
Notes														
~: Volume exceeds ca	apacity	\$: De	lay exc	eeds 30)0s -	⊦: Com	putation	Not De	fined	*: All n	najor volu	ime in plate	oon	

0.1

Intersection

Int Delay, s/veh

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		\$			\$		1	∱î ≽		1	∱î ≽	
Traffic Vol, veh/h	1	0	3	4	0	4	2	836	2	0	793	1
Future Vol, veh/h	1	0	3	4	0	4	2	836	2	0	793	1
Conflicting Peds, #/hr	0	0	1	1	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	100	-	-	75	-	-
Veh in Median Storage,	# -	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	60	60	60	85	85	85	95	95	95
Heavy Vehicles, %	0	0	0	13	13	13	1	1	1	2	2	2
Mvmt Flow	1	0	3	7	0	7	2	984	2	0	835	1

Major/Minor	Minor2		N	Ainor1			Major1		Ν	/lajor2				
Conflicting Flow All	1332	1826	419	1408	1825	493	836	0	0	986	0	0		
Stage 1	836	836	-	989	989	-	-	-	-	-	-	-		
Stage 2	496	990	-	419	836	-	-	-	-	-	-	-		
Critical Hdwy	7.5	6.5	6.9	7.76	6.76	7.16	4.12	-	-	4.14	-	-		
Critical Hdwy Stg 1	6.5	5.5	-	6.76	5.76	-	-	-	-	-	-	-		
Critical Hdwy Stg 2	6.5	5.5	-	6.76	5.76	-	-	-	-	-	-	-		
Follow-up Hdwy	3.5	4	3.3	3.63	4.13	3.43	2.21	-	-	2.22	-	-		
Pot Cap-1 Maneuver	*514	*194	*780	*496	*182	*726	*1166	-	-	1039	-	-		
Stage 1	*735	*644	-	*601	*547	-	-	-	-	-	-	-		
Stage 2	*711	*566	-	*709	*624	-	-	-	-	-	-	-		
Platoon blocked, %	1	1	1	1	1	1	1	-	-	1	-	-		
Mov Cap-1 Maneuver	*509	*194	*779	*493	*181	*726	*1166	-	-	1039	-	-		
Mov Cap-2 Maneuver	*560	*363	-	*515	*347	-	-	-	-	-	-	-		
Stage 1	*734	*644	-	*600	*545	-	-	-	-	-	-	-		
Stage 2	*704	*565	-	*705	*624	-	-	-	-	-	-	-		
Approach	EB			WB			NB			SB				
HCM Control Delay, s	10.1			11.1			0			0				
HCM LOS	В			В										
Minor Lane/Major Mvr	nt	NBL	NBT	NBR I	EBLn1V	VBLn1	SBL	SBT	SBR					
Capacity (veh/h)		* 1166	-	-	710	603	1039	-	-					
HCM Lane V/C Ratio		0.002	-	-	0.006	0.022	-	-	-					
HCM Control Delay (s)	8.1	-	-	10.1	11.1	0	-	-					
HCM Lane LOS	,	А	-	-	В	В	А	-	-					
HCM 95th %tile Q(veh	ı)	0	-	-	0	0.1	0	-	-					
Notes														
~: Volume exceeds ca	pacity	\$: De	lay exc	eeds 30)0s -	: Com	putation	Not De	fined	*: All n	najor volu	ime in p	latoon	

ntersection						
nt Delay, s/veh	0.2					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	≜ î∌		1	^	Y	
Traffic Vol, veh/h	452	0	1	385	2	11
Future Vol, veh/h	452	0	1	385	2	11
Conflicting Peds, #/hr	0	1	1	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage,	# 0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	88	88	65	65
Heavy Vehicles, %	2	2	2	2	0	0
Mvmt Flow	532	0	1	438	3	17

Major/Minor	Major1	Ν	/lajor2	ľ	Minor1				
Conflicting Flow All	0	0	533	0	754	267			
Stage 1	-	-	-	-	533	-			
Stage 2	-	-	-	-	221	-			
Critical Hdwy	-	-	4.14	-	6.8	6.9			
Critical Hdwy Stg 1	-	-	-	-	5.8	-			
Critical Hdwy Stg 2	-	-	-	-	5.8	-			
Follow-up Hdwy	-	-	2.22	-	3.5	3.3			
Pot Cap-1 Maneuver	-	-	1031	-	*483	737			
Stage 1	-	-	-	-	*558	-			
Stage 2	-	-	-	-	*901	-			
Platoon blocked, %	-	-		-	1				
Mov Cap-1 Maneuver	-	-	1030	-	*482	736			
Mov Cap-2 Maneuver	-	-	-	-	*498	-			
Stage 1	-	-	-	-	*557	-			
Stage 2	-	-	-	-	*900	-			
Approach	EB		WB		NB				
HCM Control Delay, s	0		0		10.4				
HCM LOS					В				
Minor Lane/Maior Mym	nt I	NBLn1	EBT	EBR	WBL	WBT			
Capacity (veh/h)		686	-	-	1030	-			
HCM Lane V/C Ratio		0.029	-	-	0.001	-			
HCM Control Delay (s)		10.4	-	-	8.5	-			
HCM Lane LOS		В	-	-	A	-			
HCM 95th %tile Q(veh))	0.1	-	-	0	-			
Notes									
~: Volume exceeds ca	pacity	\$: De	lay exc	eeds 30)0s ·	+: Comp	utation Not Defined	*: All major volume in platoon	

Queues 1: Patterson Ave & 36th St

	≯	-	1	-	1	1	1	1	Ŧ	
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	
Lane Group Flow (vph)	69	330	700	405	73	650	498	65	1255	
v/c Ratio	0.29	0.84	1.05	0.55	0.38	0.46	0.44	0.19	0.89	
Control Delay	43.8	54.7	88.9	37.6	30.0	24.3	2.7	13.0	34.0	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	43.8	54.7	88.9	37.6	30.0	24.3	2.7	13.0	34.0	
Queue Length 50th (ft)	40	88	~252	123	23	162	14	17	400	
Queue Length 95th (ft)	69	106	#365	166	44	212	32	29	#476	
Internal Link Dist (ft)		296		1342		1028			406	
Turn Bay Length (ft)	200		250		500		250	250		
Base Capacity (vph)	248	399	666	851	230	1420	1120	387	1412	
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	0.28	0.83	1.05	0.48	0.32	0.46	0.44	0.17	0.89	

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.

HCM Signalized Intersection Capacity Analysis 1: Patterson Ave & 36th St

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	5	≜ †Ъ		ሻሻ	A12		۲	^	1	ሻ	≜1 }	
Traffic Volume (vph)	51	165	79	651	316	60	63	559	428	53	974	55
Future Volume (vph)	51	165	79	651	316	60	63	559	428	53	974	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.4	6.4		6.4	6.4		6.5	6.5	6.4	6.5	6.5	
Lane Util. Factor	1.00	0.95		0.97	0.95		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.95		1.00	0.98		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1703	3226		3400	3420		1770	3539	1583	1770	3511	
Flt Permitted	1.00	1.00		0.95	1.00		0.11	1.00	1.00	0.32	1.00	
Satd. Flow (perm)	1792	3226		3400	3420		199	3539	1583	590	3511	
Peak-hour factor, PHF	0.74	0.74	0.74	0.93	0.93	0.93	0.86	0.86	0.86	0.82	0.82	0.82
Adj. Flow (vph)	69	223	107	700	340	65	73	650	498	65	1188	67
RTOR Reduction (vph)	0	56	0	0	16	0	0	0	169	0	4	0
Lane Group Flow (vph)	69	274	0	700	389	0	73	650	329	65	1251	0
Confl. Peds. (#/hr)			1	1								
Heavy Vehicles (%)	6%	6%	6%	3%	3%	3%	2%	2%	2%	2%	2%	2%
Turn Type	pm+pt	NA		Prot	NA		pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases	4						2		2	6		
Actuated Green, G (s)	11.8	11.8		19.6	21.3		42.8	37.5	57.1	42.8	37.5	
Effective Green, g (s)	11.8	11.8		19.6	21.3		42.8	37.5	57.1	42.8	37.5	
Actuated g/C Ratio	0.12	0.12		0.20	0.21		0.43	0.38	0.57	0.43	0.38	
Clearance Time (s)	6.4	6.4		6.4	6.4		6.5	6.5	6.4	6.5	6.5	
Vehicle Extension (s)	3.0	3.0		4.0	3.0		3.0	0.2	4.0	3.0	0.2	
Lane Grp Cap (vph)	211	380		666	728		168	1327	903	315	1316	
v/s Ratio Prot	0.03	c0.08		c0.21	0.11		c0.02	0.18	0.07	0.01	c0.36	
v/s Ratio Perm	0.01						0.16		0.14	0.08		
v/c Ratio	0.33	0.72		1.05	0.53		0.43	0.49	0.36	0.21	0.95	
Uniform Delay, d1	39.1	42.5		40.2	34.9		40.9	23.9	11.6	23.4	30.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	0.81	0.87	
Incremental Delay, d2	0.9	6.4		49.0	0.8		1.8	1.3	0.3	0.3	14.4	
Delay (s)	40.0	48.9		89.2	35.7		42.7	25.2	12.0	19.3	40.7	
Level of Service	D	D		F	D		D	С	В	В	D	
Approach Delay (s)		47.4			69.6			20.9			39.7	
Approach LOS		D			E			С			D	
Intersection Summarv												
HCM 2000 Control Delay			42.9	H	CM 2000	Level of	Service		D			
HCM 2000 Volume to Canacit	v ratio		0.90	11	2000	_0.0.01	0011100					
Actuated Cycle Length (s)	, 1010		100.0	S	im of lost	time (s)			25.8			
Intersection Canacity Utilization	n		80.5%		ULevel	of Service	ć		_0.0 D			
Analysis Period (min)			15		2 201010		-		2			

c Critical Lane Group

0.3

Intersection

Int Delay, s/veh

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4			4		۲.	∱ î≽		۲	∱ β	
Traffic Vol, veh/h	1	0	0	12	0	17	0	634	24	12	1078	1
Future Vol, veh/h	1	0	0	12	0	17	0	634	24	12	1078	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	75	-	-	100	-	-
Veh in Median Storage,	# -	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	60	60	60	60	60	60	85	85	85	80	80	80
Heavy Vehicles, %	0	0	0	15	15	15	2	2	2	1	1	1
Mvmt Flow	2	0	0	20	0	28	0	746	28	15	1348	1

Major/Minor	Minor2		N	/linor1		l	Major1		Ν	/lajor2				
Conflicting Flow All	1752	2153	675	1464	2139	387	1349	0	0	774	0	0		
Stage 1	1379	1379	-	760	760	-	-	-	-	-	-	-		
Stage 2	373	774	-	704	1379	-	-	-	-	-	-	-		
Critical Hdwy	7.5	6.5	6.9	7.8	6.8	7.2	4.14	-	-	4.12	-	-		
Critical Hdwy Stg 1	6.5	5.5	-	6.8	5.8	-	-	-	-	-	-	-		
Critical Hdwy Stg 2	6.5	5.5	-	6.8	5.8	-	-	-	-	-	-	-		
Follow-up Hdwy	3.5	4	3.3	3.65	4.15	3.45	2.22	-	-	2.21	-	-		
Pot Cap-1 Maneuver	*120	62	*657	*235	55	*804	783	-	-	1142	-	-		
Stage 1	*409	399	-	*666	606	-	-	-	-	-	-	-		
Stage 2	*792	621	-	*594	376	-	-	-	-	-	-	-		
Platoon blocked, %	1	1	1	1	1	1	1	-	-	1	-	-		
Mov Cap-1 Maneuver	*115	61	*657	*233	55	*804	783	-	-	1142	-	-		
Mov Cap-2 Maneuver	*288	244	-	*390	234	-	-	-	-	-	-	-		
Stage 1	*409	394	-	*666	606	-	-	-	-	-	-	-		
Stage 2	*764	621	-	*586	372	-	-	-	-	-	-	-		
Approach	EB			WB			NB			SB				
HCM Control Delay, s	17.6			12			0			0.1				
HCM LOS	С			В										
Minor Lane/Major Mvr	nt	NBL	NBT	NBR I	EBLn1V	VBLn1	SBL	SBT	SBR					
Capacity (veh/h)		783	-	-	288	559	1142	-	-					
HCM Lane V/C Ratio		-	-	-	0.006	0.086	0.013	-	-					
HCM Control Delay (s	;)	0	-	-	17.6	12	8.2	-	-					
HCM Lane LOS	,	А	-	-	С	В	А	-	-					
HCM 95th %tile Q(veh	ו)	0	-	-	0	0.3	0	-	-					
Notes														
~: Volume exceeds ca	apacity	\$: De	lay exc	eeds 30)0s +	: Com	outation	Not De	fined	*: All r	najor volu	ime in plat	toon	

0.2

Intersection

Int Delay, s/veh

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		\$			÷		1	∱î ∌		ľ	∱ î,	
Traffic Vol, veh/h	3	0	6	2	0	5	6	650	14	6	1074	10
Future Vol, veh/h	3	0	6	2	0	5	6	650	14	6	1074	10
Conflicting Peds, #/hr	0	0	1	1	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	100	-	-	75	-	-
Veh in Median Storage,	# -	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	67	67	67	60	60	60	85	85	85	81	81	81
Heavy Vehicles, %	0	0	0	17	17	17	2	2	2	1	1	1
Mvmt Flow	4	0	9	3	0	8	7	765	16	7	1326	12

Major/Minor	Minor2		1	Minor1		I	Major1		ſ	Major2			
Conflicting Flow All	1743	2141	670	1465	2139	391	1338	0	0	781	0	0	
Stage 1	1346	1346	-	787	787	-	-	-	-	-	-	-	
Stage 2	397	795	-	678	1352	-	-	-	-	-	-	-	
Critical Hdwy	7.5	6.5	6.9	7.84	6.84	7.24	4.14	-	-	4.12	-	-	
Critical Hdwy Stg 1	6.5	5.5	-	6.84	5.84	-	-	-	-	-	-	-	
Critical Hdwy Stg 2	6.5	5.5	-	6.84	5.84	-	-	-	-	-	-	-	
Follow-up Hdwy	3.5	4	3.3	3.67	4.17	3.47	2.22	-	-	2.21	-	-	
Pot Cap-1 Maneuver	*83	55	*657	*135	45	*799	795	-	-	1133	-	-	
Stage 1	*440	421	-	*630	580	-	-	-	-	-	-	-	
Stage 2	*792	605	-	*591	392	-	-	-	-	-	-	-	
Platoon blocked, %	1	1	1	1	1	1	1	-	-	1	-	-	
Mov Cap-1 Maneuver	*81	55	*656	*131	45	*799	795	-	-	1133	-	-	
Mov Cap-2 Maneuver	*288	248	-	*332	229	-	-	-	-	-	-	-	
Stage 1	*436	419	-	*625	575	-	-	-	-	-	-	-	
Stage 2	*777	599	-	*579	390	-	-	-	-	-	-	-	
Approach	EB			WB			NB			SB			
HCM Control Delay, s	13.1			11.4			0.1			0			
HCM LOS	В			В									
Minor Lane/Major Mvr	mt	NBL	NBT	NBR	EBLn1V	VBLn1	SBL	SBT	SBR				
Capacity (veh/h)		795	-	-	460	570	1133	-	-				
HCM Lane V/C Ratio		0.009	-	-	0.029	0.02	0.007	-	-				
HCM Control Delay (s	3)	9.6	-	-	13.1	11.4	8.2	-	-				
HCM Lane LOS	<i>.</i>	А	-	-	В	В	А	-	-				
HCM 95th %tile Q(veh	h)	0	-	-	0.1	0.1	0	-	-				
Notes													
		* D	1		10	<u>^</u>		NULD.	C	¥ A II .			1.1

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon
Intersection						
Int Delay, s/veh	0.2					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	4 1.		5	**	M	
Traffic Vol, veh/h	293	1	15	419	0	2
Future Vol, veh/h	293	1	15	419	0	2
Conflicting Peds, #/hr	0	1	1	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage	,#0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	78	78	88	88	60	60
Heavy Vehicles, %	5	5	3	3	0	0
Mymt Flow	376	1	17	476	0	3

Major/Minor	Major1	Ν	/lajor2	ľ	Minor1				
Conflicting Flow All	0	0	378	0	650	190			
Stage 1	-	-	-	-	378	-			
Stage 2	-	-	-	-	272	-			
Critical Hdwy	-	-	4.16	-	6.8	6.9			
Critical Hdwy Stg 1	-	-	-	-	5.8	-			
Critical Hdwy Stg 2	-	-	-	-	5.8	-			
Follow-up Hdwy	-	-	2.23	-	3.5	3.3			
Pot Cap-1 Maneuver	-	-	1170	-	*622	826			
Stage 1	-	-	-	-	*669	-			
Stage 2	-	-	-	-	*876	-			
Platoon blocked, %	-	-		-	1				
Mov Cap-1 Maneuver	-	-	1169	-	*612	825			
Mov Cap-2 Maneuver	-	-	-	-	*600	-			
Stage 1	-	-	-	-	*668	-			
Stage 2	-	-	-	-	*863	-			
Approach	EB		WB		NB				
HCM Control Delay, s	0		0.3		9.4				
HCM LOS					А				
Minor Lane/Major Mvn	nt	NBLn1	EBT	EBR	WBL	WBT			
Capacity (veh/h)		825	-	-	1169	-			
HCM Lane V/C Ratio		0.004	-	-	0.015	-			
HCM Control Delay (s))	9.4	-	-	8.1	-			
HCM Lane LOS		А	-	-	А	-			
HCM 95th %tile Q(veh	I)	0	-	-	0	-			
Notes									
~: Volume exceeds ca	pacity	\$: De	lay exc	eeds 30)0s	+: Comp	utation Not Defined	*: All major volume in platoon	

Queues 1: Patterson Ave & 36th St

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Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	
Lane Group Flow (vph)	66	517	491	391	67	984	1131	100	940	
v/c Ratio	0.18	0.83	0.81	0.55	0.33	0.73	1.19	0.53	0.71	
Control Delay	41.1	59.0	58.3	46.3	30.3	37.1	112.9	36.3	30.0	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	41.1	59.0	58.3	46.3	30.3	37.1	112.9	36.3	30.0	
Queue Length 50th (ft)	42	197	187	147	28	357	~881	32	274	
Queue Length 95th (ft)	85	262	245	190	53	415	#1230	58	344	
Internal Link Dist (ft)		296		1342		1028			406	
Turn Bay Length (ft)	200		250		500		250	250		
Base Capacity (vph)	377	663	646	1095	216	1343	952	201	1317	
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	0.18	0.78	0.76	0.36	0.31	0.73	1.19	0.50	0.71	

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.

HCM Signalized Intersection Capacity Analysis 1: Patterson Ave & 36th St

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	5	≜t ≽		ሻሻ	4 16		5	^	1	5	≜t ≽	
Traffic Volume (vph)	59	405	60	437	303	45	58	846	973	87	742	76
Future Volume (vph)	59	405	60	437	303	45	58	846	973	87	742	76
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.4	6.4		6.4	6.4		6.5	6.5	6.4	6.5	6.5	
Lane Util. Factor	1.00	0.95		0.97	0.95		1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.98		1.00	0.98		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	3470		3433	3470		1787	3574	1599	1770	3490	
Flt Permitted	1.00	1.00		0.95	1.00		0.15	1.00	1.00	0.13	1.00	
Satd. Flow (perm)	1863	3470		3433	3470		280	3574	1599	242	3490	
Peak-hour factor, PHF	0.90	0.90	0.90	0.89	0.89	0.89	0.86	0.86	0.86	0.87	0.87	0.87
Adj. Flow (vph)	66	450	67	491	340	51	67	984	1131	100	853	87
RTOR Reduction (vph)	0	10	0	0	11	0	0	0	68	0	6	0
Lane Group Flow (vph)	66	507	0	491	380	0	67	984	1063	100	934	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	1%	1%	1%	2%	2%	2%
Turn Type	pm+pt	NA		Prot	NA		pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases	4						2		2	6		
Actuated Green, G (s)	22.4	22.4		21.3	24.1		50.5	43.8	65.1	50.5	43.8	
Effective Green, g (s)	22.4	22.4		21.3	24.1		50.5	43.8	65.1	50.5	43.8	
Actuated g/C Ratio	0.19	0.19		0.18	0.20		0.42	0.36	0.54	0.42	0.36	
Clearance Time (s)	6.4	6.4		6.4	6.4		6.5	6.5	6.4	6.5	6.5	
Vehicle Extension (s)	3.0	3.0		4.0	3.0		3.0	0.2	4.0	3.0	0.2	
Lane Grp Cap (vph)	347	647		609	696		201	1304	867	187	1273	
v/s Ratio Prot	0.03	c0.15		0.14	0.11		0.02	0.28	c0.22	c0.03	0.27	
v/s Ratio Perm	0.01						0.12		0.45	0.20		
v/c Ratio	0.19	0.78		0.81	0.55		0.33	0.75	1.23	0.53	0.73	
Uniform Delay, d1	40.4	46.5		47.4	43.0		39.8	33.4	27.5	44.4	33.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	0.81	0.82	
Incremental Delay, d2	0.3	6.2		8.1	0.9		1.0	4.1	112.1	2.8	3.6	
Delay (s)	40.7	52.7		55.5	43.9		40.8	37.5	139.6	38.6	30.6	
Level of Service	D	D		E	D		D	D	F	D	С	
Approach Delay (s)		51.3			50.3			90.5			31.4	
Approach LOS		D			D			F			С	
Intersection Summary												
HCM 2000 Control Delay			65.0	H	CM 2000	Level of	Service		E			
HCM 2000 Volume to Capac	city ratio		1.07									
Actuated Cycle Length (s)			120.0	Si	um of lost	time (s)			25.8			
Intersection Capacity Utilization	tion		94.3%	IC	U Level o	of Service)		F			
Analysis Period (min)			15									
c Critical Lane Group												

Intersection

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4			4		۲.	A		۲.	A	
Traffic Vol, veh/h	1	0	0	11	0	5	0	946	6	2	887	0
Future Vol, veh/h	1	0	0	11	0	5	0	946	6	2	887	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	75	-	-	100	-	-
Veh in Median Storage,	,# -	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	60	60	60	70	70	70	85	85	85	95	95	95
Heavy Vehicles, %	0	0	0	21	21	21	1	1	1	1	1	1
Mvmt Flow	2	0	0	16	0	7	0	1113	7	2	934	0

Major/Minor	Minor2		N	Minor1			Major1		Ν	/lajor2				
Conflicting Flow All	1495	2058	467	1588	2055	560	934	0	0	1120	0	0		
Stage 1	938	938	-	1117	1117	-	-	-	-	-	-	-		
Stage 2	557	1120	-	471	938	-	-	-	-	-	-	-		
Critical Hdwy	7.5	6.5	6.9	7.92	6.92	7.32	4.12	-	-	4.12	-	-		
Critical Hdwy Stg 1	6.5	5.5	-	6.92	5.92	-	-	-	-	-	-	-		
Critical Hdwy Stg 2	6.5	5.5	-	6.92	5.92	-	-	-	-	-	-	-		
Follow-up Hdwy	3.5	4	3.3	3.71	4.21	3.51	2.21	-	-	2.21	-	-		
Pot Cap-1 Maneuver	*336	*88	*729	*232	*74	*662	*1090	-	-	976	-	-		
Stage 1	*687	*602	-	*556	*505	-	-	-	-	-	-	-		
Stage 2	*664	*532	-	*649	*572	-	-	-	-	-	-	-		
Platoon blocked, %	1	1	1	1	1	1	1	-	-	1	-	-		
Mov Cap-1 Maneuver	*332	*88	*729	*231	*74	*662	*1090	-	-	976	-	-		
Mov Cap-2 Maneuver	*457	*297	-	*377	*278	-	-	-	-	-	-	-		
Stage 1	*687	*601	-	*556	*505	-	-	-	-	-	-	-		
Stage 2	*656	*532	-	*647	*571	-	-	-	-	-	-	-		
Approach	EB			WB			NB			SB				
HCM Control Delay, s	12.9			13.7			0			0				
HCM LOS	В			В										
Minor Lane/Major Mvr	mt	NBL	NBT	NBR I	EBLn1V	VBLn1	SBL	SBT	SBR					
Capacity (veh/h)		* 1090	-	-	457	436	976	-	-					
HCM Lane V/C Ratio		-	-	-	0.004	0.052	0.002	-	-					
HCM Control Delay (s	5)	0	-	-	12.9	13.7	8.7	-	-					
HCM Lane LOS	,	А	-	-	В	В	А	-	-					
HCM 95th %tile Q(veh	h)	0	-	-	0	0.2	0	-	-					
Notes														
~: Volume exceeds ca	apacity	\$: De	lay exc	eeds 30)0s -	+: Com	outation	Not De	fined	*: All n	najor volu	me in p	latoon	

Intersection

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4			4		۲.	A		٦	Ŷ≽	
Traffic Vol, veh/h	1	0	3	5	0	5	2	946	2	0	897	1
Future Vol, veh/h	1	0	3	5	0	5	2	946	2	0	897	1
Conflicting Peds, #/hr	0	0	1	1	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	100	-	-	75	-	-
Veh in Median Storage,	# -	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	60	60	60	85	85	85	95	95	95
Heavy Vehicles, %	0	0	0	13	13	13	1	1	1	2	2	2
M∨mt Flow	1	0	3	8	0	8	2	1113	2	0	944	1

Major/Minor	Minor2		N	/linor1			Major1		Ν	/lajor2				
Conflicting Flow All	1506	2064	474	1591	2063	558	945	0	0	1115	0	0		
Stage 1	945	945	-	1118	1118	-	-	-	-	-	-	-		
Stage 2	561	1119	-	473	945	-	-	-	-	-	-	-		
Critical Hdwy	7.5	6.5	6.9	7.76	6.76	7.16	4.12	-	-	4.14	-	-		
Critical Hdwy Stg 1	6.5	5.5	-	6.76	5.76	-	-	-	-	-	-	-		
Critical Hdwy Stg 2	6.5	5.5	-	6.76	5.76	-	-	-	-	-	-	-		
Follow-up Hdwy	3.5	4	3.3	3.63	4.13	3.43	2.21	-	-	2.22	-	-		
Pot Cap-1 Maneuver	*466	*121	*729	*449	*111	*677	*1090	-	-	977	-	-		
Stage 1	*687	*602	-	*569	*515	-	-	-	-	-	-	-		
Stage 2	*664	*533	-	*663	*583	-	-	-	-	-	-	-		
Platoon blocked, %	1	1	1	1	1	1	1	-	-	1	-	-		
Mov Cap-1 Maneuver	*460	*121	*728	*446	*111	*677	*1090	-	-	977	-	-		
Mov Cap-2 Maneuver	*515	*313	-	*477	*299	-	-	-	-	-	-	-		
Stage 1	*686	*602	-	*567	*514	-	-	-	-	-	-	-		
Stage 2	*654	*532	-	*659	*583	-	-	-	-	-	-	-		
Approach	EB			WB			NB			SB				
HCM Control Delay, s	10.5			11.6			0			0				
HCM LOS	В			В										
Minor Lane/Major Mvr	nt	NBL	NBT	NBR I	EBLn1V	/BLn1	SBL	SBT	SBR					
Capacity (veh/h)		* 1090	-	-	660	560	977	-	-					
HCM Lane V/C Ratio		0.002	-	-	0.007	0.03	-	-	-					
HCM Control Delay (s)	8.3	-	-	10.5	11.6	0	-	-					
HCM Lane LOS	/	A	-	-	В	В	A	-	-					
HCM 95th %tile Q(veh	ו)	0	-	-	0	0.1	0	-	-					
Notes														
~: Volume exceeds ca	pacity	\$: De	lay exc	eeds 30)0s +	: Com	outation	Not De	fined	*: All n	najor volu	me in platoo	n	

Intersection		
Int Delay, s/veh	0.2	

· · · , , · · · ·						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	_ ≜ î≽		- ሽ	- 11	۰¥	
Traffic Vol, veh/h	512	0	1	436	2	12
Future Vol, veh/h	512	0	1	436	2	12
Conflicting Peds, #/hr	0	1	1	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage	,# 0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	88	88	65	65
Heavy Vehicles, %	2	2	2	2	0	0
Mvmt Flow	602	0	1	495	3	18

Major/Minor	Major1	I	Major2		Minor1				
Conflicting Flow All	0	0	603	0	853	302			
Stage 1	-	· -	-	-	603	-			
Stage 2	-		-	-	250	-			
Critical Hdwy	-	· -	4.14	-	6.8	6.9			
Critical Hdwy Stg 1	-		-	-	5.8	-			
Critical Hdwy Stg 2	-	· -	-	-	5.8	-			
Follow-up Hdwy	-	· -	2.22	-	3.5	3.3			
Pot Cap-1 Maneuver	-	· -	971	-	*441	700			
Stage 1	-		-	-	*515	-			
Stage 2	-	· -	-	-	*877	-			
Platoon blocked, %	-	· -		-	1				
Mov Cap-1 Maneuver	-	· -	970	-	*440	699			
Mov Cap-2 Maneuver	-	· -	-	-	*459	-			
Stage 1	-	· -	-	-	*514	-			
Stage 2	-		-	-	*876	-			
Approach	EB		WB		NB				
HCM Control Delay, s	0)	0		10.7				
HCM LOS					В				
Minor Lane/Major Mvn	nt	NBLn1	EBT	EBR	WBL	WBT			
Capacity (veh/h)		650	-	-	970	-			
HCM Lane V/C Ratio		0.033	-	-	0.001	-			
HCM Control Delay (s)	10.7	-	-	8.7	-			
HCM Lane LOS	,	В	-	-	А	-			
HCM 95th %tile Q(veh	ו)	0.1	-	-	0	-			
Notes									
~: Volume exceeds ca	pacity	\$: De	lav exc	eeds 30)0s	+: Comp	utation Not Defined	*: All major volume in platoon	
		. . .						in an age i to an a platoon	

Queues 1: Patterson Ave & 36th St

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Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	
Lane Group Flow (vph)	69	348	700	449	100	674	498	102	1296	
v/c Ratio	0.30	0.86	1.05	0.58	0.50	0.48	0.46	0.30	0.93	
Control Delay	44.7	54.8	88.9	36.8	35.9	25.1	3.8	15.0	39.9	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	44.7	54.8	88.9	36.8	35.9	25.1	3.8	15.0	39.9	
Queue Length 50th (ft)	41	90	~252	133	32	172	26	27	427	
Queue Length 95th (ft)	69	108	#365	178	57	221	46	42	#505	
Internal Link Dist (ft)		296		1342		1028			406	
Turn Bay Length (ft)	200		250		500		250	250		
Base Capacity (vph)	239	409	666	856	229	1397	1079	370	1389	
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	0.29	0.85	1.05	0.52	0.44	0.48	0.46	0.28	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.

HCM Signalized Intersection Capacity Analysis 1: Patterson Ave & 36th St

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	۲	đβ		ሻሻ	A		۲	<u>†</u> †	1	۲	A	
Traffic Volume (vph)	51	169	89	651	327	90	86	580	428	84	998	65
Future Volume (vph)	51	169	89	651	327	90	86	580	428	84	998	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.4	6.4		6.4	6.4		6.5	6.5	6.4	6.5	6.5	
Lane Util. Factor	1.00	0.95		0.97	0.95		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.95		1.00	0.97		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1703	3215		3400	3391		1770	3539	1583	1770	3507	
Flt Permitted	1.00	1.00		0.95	1.00		0.11	1.00	1.00	0.30	1.00	
Satd. Flow (perm)	1792	3215		3400	3391		202	3539	1583	557	3507	
Peak-hour factor, PHF	0.74	0.74	0.74	0.93	0.93	0.93	0.86	0.86	0.86	0.82	0.82	0.82
Adj. Flow (vph)	69	228	120	700	352	97	100	674	498	102	1217	79
RTOR Reduction (vph)	0	68	0	0	25	0	0	0	134	0	4	0
Lane Group Flow (vph)	69	280	0	700	424	0	100	674	364	102	1292	0
Confl. Peds. (#/hr)			1	1								
Heavy Vehicles (%)	6%	6%	6%	3%	3%	3%	2%	2%	2%	2%	2%	2%
Turn Type	pm+pt	NA		Prot	NA		pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	 7	4		3	8		5	2	. 3		6	
Permitted Phases	4						2		2	6		
Actuated Green, G (s)	11.8	11.8		19.6	22.1		42.8	36.9	56.5	42.8	36.9	
Effective Green, g (s)	11.8	11.8		19.6	22.1		42.8	36.9	56.5	42.8	36.9	
Actuated g/C Ratio	0.12	0.12		0.20	0.22		0.43	0.37	0.56	0.43	0.37	
Clearance Time (s)	6.4	6.4		6.4	6.4		6.5	6.5	6.4	6.5	6.5	
Vehicle Extension (s)	3.0	3.0		4.0	3.0		3.0	0.2	4.0	3.0	0.2	
Lane Grp Cap (vph)	211	379		666	749		178	1305	894	309	1294	
v/s Ratio Prot	0.03	c0.09		c0.21	0.13		c0.03	0.19	0.08	0.02	c0.37	
v/s Ratio Perm	0.01						0.21		0.15	0.12		
v/c Ratio	0.33	0.74		1.05	0.57		0.56	0.52	0.41	0.33	1.00	
Uniform Delay, d1	39.5	42.6		40.2	34.7		42.1	24.6	12.3	25.4	31.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	0.81	0.89	
Incremental Delay, d2	0.9	7.4		49.0	1.0		4.0	1.5	0.4	0.6	23.7	
Delay (s)	40.4	50.0		89.2	35.7		46.1	26.1	12.7	21.1	51.7	
Level of Service	D	D		F	D		D	С	В	С	D	
Approach Delay (s)		48.4			68.3			22.4			49.5	
Approach LOS		D			Е			С			D	
Intersection Summary												
HCM 2000 Control Dolov			16.3	U.	CM 2000	Level of	Sonvico		D			
HCM 2000 Volume to Canadi	ty ratio		40.5 Λ Ω/	П		Level OI			U			
Actuated Cycle Length (c)	ly ralio		100.04	C.	um of loct	time (s)			25.8			
Intersection Canacity Litilization	מר		82.5%			of Service	2		20.0 E			
Analysis Period (min)			15	ic.			,		L			

c Critical Lane Group

Intersection

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ľ	et			÷		1	∱î ≽		5	- † 1-	
Traffic Vol, veh/h	42	0	55	12	0	17	43	631	24	12	1063	53
Future Vol, veh/h	42	0	55	12	0	17	43	631	24	12	1063	53
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	-	-	-	75	-	-	100	-	-
Veh in Median Storage,	# -	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	60	60	60	85	85	85	80	80	80
Heavy Vehicles, %	0	0	0	15	15	15	2	2	2	1	1	1
Mvmt Flow	46	0	60	20	0	28	51	742	28	15	1329	66

Major/Minor	Minor2		N	Minor1		I	Major1		Ν	/lajor2			
Conflicting Flow All	1865	2264	698	1553	2283	385	1395	0	0	770	0	0	
Stage 1	1392	1392	-	858	858	-	-	-	-	-	-	-	
Stage 2	473	872	-	695	1425	-	-	-	-	-	-	-	
Critical Hdwy	7.5	6.5	6.9	7.8	6.8	7.2	4.14	-	-	4.12	-	-	
Critical Hdwy Stg 1	6.5	5.5	-	6.8	5.8	-	-	-	-	-	-	-	
Critical Hdwy Stg 2	6.5	5.5	-	6.8	5.8	-	-	-	-	-	-	-	
Follow-up Hdwy	3.5	4	3.3	3.65	4.15	3.45	2.22	-	-	2.21	-	-	
Pot Cap-1 Maneuver	*89	48	*657	*185	39	*804	734	-	-	1147	-	-	
Stage 1	*398	390	-	*558	530	-	-	-	-	-	-	-	
Stage 2	*792	548	-	*594	347	-	-	-	-	-	-	-	
Platoon blocked, %	1	1	1	1	1	1	1	-	-	1	-	-	
Mov Cap-1 Maneuver	*80	44	*657	*158	36	*804	734	-	-	1147	-	-	
Mov Cap-2 Maneuver	*253	217	-	*300	182	-	-	-	-	-	-	-	
Stage 1	*370	385	-	*519	493	-	-	-	-	-	-	-	
Stage 2	*711	510	-	*533	342	-	-	-	-	-	-	-	
Approach	EB			WB			NB			SB			
HCM Control Delay, s	15.9			13.5			0.6			0.1			
HCM LOS	С			В									
Minor Lane/Major Mvi	mt	NBL	NBT	NBR I	EBLn1 I	EBLn2V	VBLn1	SBL	SBT	SBR			
Capacity (veh/h)		734	-	-	253	657	474	1147	-	-			
HCM Lane V/C Ratio		0.069	-	-	0.18	0.091	0.102	0.013	-	-			
HCM Control Delay (s	3)	10.3	-	-	22.3	11	13.5	8.2	-	-			
HCM Lane LOS	,	В	-	-	С	В	В	А	-	-			
HCM 95th %tile Q(vel	h)	0.2	-	-	0.6	0.3	0.3	0	-	-			
Notes													
~: Volume exceeds ca	apacity	\$: De	lay exc	eeds 30)0s -	+: Com	outation	Not De	fined	*: All m	najor volu	me in platoon	1

Intersection

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	٦	ef 👘			4		۲	∱ î≽		ኘ	Å∱	
Traffic Vol, veh/h	45	0	88	2	0	5	59	648	14	6	1057	67
Future Vol, veh/h	45	0	88	2	0	5	59	648	14	6	1057	67
Conflicting Peds, #/hr	0	0	1	1	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	-	-	-	100	-	-	75	-	-
Veh in Median Storage,	# -	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	60	60	60	85	85	85	81	81	81
Heavy Vehicles, %	0	0	0	17	17	17	2	2	2	1	1	1
Mvmt Flow	49	0	96	3	0	8	69	762	16	7	1305	83

Major/Minor	Minor2		Ν	/linor1			Major1		Ν	/lajor2			
Conflicting Flow All	1880	2277	695	1576	2310	389	1388	0	0	778	0	0	
Stage 1	1361	1361	-	908	908	-	-	-	-	-	-	-	
Stage 2	519	916	-	668	1402	-	-	-	-	-	-	-	
Critical Hdwy	7.5	6.5	6.9	7.84	6.84	7.24	4.14	-	-	4.12	-	-	
Critical Hdwy Stg 1	6.5	5.5	-	6.84	5.84	-	-	-	-	-	-	-	
Critical Hdwy Stg 2	6.5	5.5	-	6.84	5.84	-	-	-	-	-	-	-	
Follow-up Hdwy	3.5	4	3.3	3.67	4.17	3.47	2.22	-	-	2.21	-	-	
Pot Cap-1 Maneuver	*61	43	*657	*105	32	*799	741	-	-	1137	-	-	
Stage 1	*426	411	-	*505	491	-	-	-	-	-	-	-	
Stage 2	*792	517	-	*591	358	-	-	-	-	-	-	-	
Platoon blocked, %	1	1	1	1	1	1	1	-	-	1	-	-	
Mov Cap-1 Maneuver	*56	39	*656	*83	29	*799	741	-	-	1137	-	-	
Mov Cap-2 Maneuver	*251	215	-	*241	172	-	-	-	-	-	-	-	
Stage 1	*386	408	-	*458	445	-	-	-	-	-	-	-	
Stage 2	*711	469	-	*501	356	-	-	-	-	-	-	-	
Approach	EB			WB			NB			SB			
HCM Control Delay, s	15.3			12.7			0.8			0			
HCM LOS	С			В									
Minor Lane/Major Mvr	nt	NBL	NBT	NBR I	EBLn1	EBLn2V	VBLn1	SBL	SBT	SBR			
Capacity (veh/h)		741	-	-	251	656	481	1137	-	-			
HCM Lane V/C Ratio		0.094	-	-	0.195	0.146	0.024	0.007	-	-			
HCM Control Delay (s	;)	10.4	-	-	22.8	11.4	12.7	8.2	-	-			
HCM Lane LOS		В	-	-	С	В	В	А	-	-			
HCM 95th %tile Q(veh	า)	0.3	-	-	0.7	0.5	0.1	0	-	-			
Notes													
~: Volume exceeds ca	apacity	\$: De	lay exc	eeds 30)0s ·	+: Com	outation	Not De	fined	*: All n	najor volui	me in platoon	

Intersection

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	٦	∱ î≽		۲	^			4		ኘ	ef 👘	
Traffic Vol, veh/h	43	275	1	15	401	62	0	0	2	32	0	37
Future Vol, veh/h	43	275	1	15	401	62	0	0	2	32	0	37
Conflicting Peds, #/hr	0	0	1	1	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	250	-	-	25	-	-	-	-	-	0	-	-
Veh in Median Storage,	# -	0	-	-	0	-	-	1	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	78	78	78	88	88	88	60	60	60	92	92	92
Heavy Vehicles, %	2	5	5	3	3	2	0	2	0	0	0	0
Mvmt Flow	55	353	1	17	456	70	0	0	3	35	0	40

Major/Minor N	Major1		I	Major2		١	Minor1			Minor2				
Conflicting Flow All	526	0	0	355	0	0	727	1025	178	812	990	263		
Stage 1	-	-	-	-	-	-	465	465	-	525	525	-		
Stage 2	-	-	-	-	-	-	262	560	-	287	465	-		
Critical Hdwy	4.14	-	-	4.16	-	-	7.5	6.54	6.9	7.5	6.5	6.9		
Critical Hdwy Stg 1	-	-	-	-	-	-	6.5	5.54	-	6.5	5.5	-		
Critical Hdwy Stg 2	-	-	-	-	-	-	6.5	5.54	-	6.5	5.5	-		
Follow-up Hdwy	2.22	-	-	2.23	-	-	3.5	4.02	3.3	3.5	4	3.3		
Pot Cap-1 Maneuver	1272	-	-	1193	-	-	*512	315	841	436	337	*929		
Stage 1	-	-	-	-	-	-	*552	561	-	771	697	-		
Stage 2	-	-	-	-	-	-	*876	666	-	702	566	-		
Platoon blocked, %	1	-	-		-	-	1	1		1	1	1		
Mov Cap-1 Maneuver	1272	-	-	1192	-	-	*468	298	840	415	318	*929		
Mov Cap-2 Maneuver	-	-	-	-	-	-	*473	394	-	415	318	-		
Stage 1	-	-	-	-	-	-	*528	536	-	738	688	-		
Stage 2	-	-	-	-	-	-	*826	657	-	669	541	-		
Approach	EB			WB			NB			SB				
HCM Control Delay, s	1.1			0.3			9.3			11.6				
HCM LOS							А			В				
Minor Lane/Major Mvm	t	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2				
Capacity (veh/h)		840	1272	-	-	1192	-	-	415	929				
HCM Lane V/C Ratio		0.004	0.043	-	-	0.014	-	-	0.084	0.043				
HCM Control Delay (s)		9.3	8	-	-	8.1	-	-	14.5	9.1				
HCM Lane LOS		A	A	-	-	A	-	-	В	A				
HCM 95th %tile Q(veh))	0	0.1	-	-	0	-	-	0.3	0.1				
Notes														
~: Volume exceeds cap	pacity	\$: De	elay exc	eeds 30)0s -	+: Comp	outation	Not De	fined	*: All r	najor vo	olume in	platoon	

Queues 1: Patterson Ave & 36th St

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Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	
Lane Group Flow (vph)	66	531	491	440	97	1015	1131	154	988	
v/c Ratio	0.19	0.85	0.81	0.59	0.49	0.77	1.20	0.83	0.77	
Control Delay	42.0	59.7	58.3	44.9	42.1	39.1	119.8	69.0	33.1	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	42.0	59.7	58.3	44.9	42.1	39.1	119.8	69.0	33.1	
Queue Length 50th (ft)	42	202	187	162	42	375	~904	60	297	
Queue Length 95th (ft)	85	#268	245	206	71	432	#1230	#170	368	
Internal Link Dist (ft)		296		1342		1028			406	
Turn Bay Length (ft)	200		250		500		250	250		
Base Capacity (vph)	356	663	646	1096	196	1313	939	185	1287	
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	0.19	0.80	0.76	0.40	0.49	0.77	1.20	0.83	0.77	

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.

HCM Signalized Intersection Capacity Analysis 1: Patterson Ave & 36th St

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	5	≜t ≽		ካካ	≜ 15		ň	**	1	5	≜t ≽	
Traffic Volume (vph)	59	402	76	437	316	76	83	873	973	134	774	85
Future Volume (vph)	59	402	76	437	316	76	83	873	973	134	774	85
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.4	6.4		6.4	6.4		6.5	6.5	6.4	6.5	6.5	
Lane Util. Factor	1.00	0.95		0.97	0.95		1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.98		1.00	0.97		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	3455		3433	3437		1787	3574	1599	1770	3487	
Flt Permitted	0.98	1.00		0.95	1.00		0.12	1.00	1.00	0.11	1.00	
Satd. Flow (perm)	1817	3455		3433	3437		229	3574	1599	205	3487	
Peak-hour factor, PHF	0.90	0.90	0.90	0.89	0.89	0.89	0.86	0.86	0.86	0.87	0.87	0.87
Adj. Flow (vph)	66	447	84	491	355	85	97	1015	1131	154	890	98
RTOR Reduction (vph)	0	13	0	0	20	0	0	0	69	0	7	0
Lane Group Flow (vph)	66	518	0	491	420	0	97	1015	1062	154	981	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	1%	1%	1%	2%	2%	2%
Turn Type	pm+pt	NA		Prot	NA		pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases	4						2		2	6		
Actuated Green, G (s)	22.6	22.6		21.3	25.4		50.3	42.8	64.1	50.3	42.8	
Effective Green, g (s)	22.6	22.6		21.3	25.4		50.3	42.8	64.1	50.3	42.8	
Actuated g/C Ratio	0.19	0.19		0.18	0.21		0.42	0.36	0.53	0.42	0.36	
Clearance Time (s)	6.4	6.4		6.4	6.4		6.5	6.5	6.4	6.5	6.5	
Vehicle Extension (s)	3.0	3.0		4.0	3.0		3.0	0.2	4.0	3.0	0.2	
Lane Grp Cap (vph)	342	650		609	727		193	1274	854	183	1243	
v/s Ratio Prot	0.03	c0.15		0.14	0.12		0.03	0.28	c0.22	c0.05	0.28	
v/s Ratio Perm	0.01						0.18		0.44	0.30		
v/c Ratio	0.19	0.80		0.81	0.58		0.50	0.80	1.24	0.84	0.79	
Uniform Delay, d1	41.0	46.5		47.4	42.5		44.4	34.7	28.0	46.2	34.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	0.87	0.84	
Incremental Delay, d2	0.3	6.7		8.1	1.1		2.1	5.2	119.5	27.3	5.0	
Delay (s)	41.3	53.2		55.5	43.6		46.5	39.9	147.5	67.5	34.2	
Level of Service	D	D		E	D		D	D	F	E	С	
Approach Delay (s)		51.9			49.9			94.4			38.7	
Approach LOS		D			D			F			D	
Intersection Summary												
HCM 2000 Control Delay			67.9	H	CM 2000	Level of	Service		Е			
HCM 2000 Volume to Capa	city ratio		1.10									
Actuated Cycle Length (s)			120.0	Si	um of lost	time (s)			25.8			
Intersection Capacity Utiliza	ition		97.3%	IC	CU Level o	of Service)		F			
Analysis Period (min)			15									
c Critical Lane Group												

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Intersection

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ľ	et			\$		۳	∱î ≽		1	∱î ≽	
Traffic Vol, veh/h	53	0	54	11	0	5	47	943	6	2	891	44
Future Vol, veh/h	53	0	54	11	0	5	47	943	6	2	891	44
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	-	-	-	75	-	-	100	-	-
Veh in Median Storage,	# -	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	70	70	70	85	85	85	95	95	95
Heavy Vehicles, %	0	0	0	21	21	21	1	1	1	1	1	1
Mvmt Flow	58	0	59	16	0	7	55	1109	7	2	938	46

Major/Minor	Minor2		1	Minor1			Major1		Ν	/lajor2				
Conflicting Flow All	1630	2191	492	1696	2211	558	984	0	0	1116	0	0		
Stage 1	965	965	-	1223	1223	-	-	-	-	-	-	-		
Stage 2	665	1226	-	473	988	-	-	-	-	-	-	-		
Critical Hdwy	7.5	6.5	6.9	7.92	6.92	7.32	4.12	-	-	4.12	-	-		
Critical Hdwy Stg 1	6.5	5.5	-	6.92	5.92	-	-	-	-	-	-	-		
Critical Hdwy Stg 2	6.5	5.5	-	6.92	5.92	-	-	-	-	-	-	-		
Follow-up Hdwy	3.5	4	3.3	3.71	4.21	3.51	2.21	-	-	2.21	-	-		
Pot Cap-1 Maneuver	*228	*63	*729	*166	*49	*662	*1090	-	-	981	-	-		
Stage 1	*687	*602	-	*440	*423	-	-	-	-	-	-	-		
Stage 2	*664	*453	-	*649	*572	-	-	-	-	-	-	-		
Platoon blocked, %	1	1	1	1	1	1	1	-	-	1	-	-		
Mov Cap-1 Maneuver	*216	*60	*729	*147	*46	*662	*1090	-	-	981	-	-		
Mov Cap-2 Maneuver	*389	*255	-	*281	*227	-	-	-	-	-	-	-		
Stage 1	*653	*601	-	*418	*401	-	-	-	-	-	-	-		
Stage 2	*623	*430	-	*595	*571	-	-	-	-	-	-	-		
Approach	EB			WB			NB			SB				
HCM Control Delay s	13.1			16.2			0.4			0				
HCM LOS	B			C			0.1			v				
Minor Lane/Major Myr	mt	NRI	NRT	NRR	FRI n1	FRI n2\	N/RI n1	SBI	SBT	SBB				
Capacity (veh/h)		* 1000			380	720	3/13	081		JUIN	_			
HCM Lane V/C Patio		0.051	-	-	0 1/18	0.081	0.067	0.002	-	-				
HCM Control Delay (s	.)	8.5	_		15 0	10.001	16.2	8.7						
HCM Lane LOS	<i>)</i>	Δ	_		10.0 C	10. 4 R	0.2	Δ						
HCM 95th %tile O(vel	h)	0.2	_		0.5	03	0.2	0						
	1)	0.2	-	-	0.0	0.0	0.2	0						
Notes														
~: Volume exceeds ca	apacity	\$: De	lay exc	eeds 30)0s -	+: Com	putatior	Not De	fined	*: All n	najor volu	me in platoor	า	

Intersection

Movement	FRI	FRT	FRR	W/RI	WRT	W/BR	NRI	NRT	NRR	SBI	SBT	SBR
				VUDL					NDIN			ODIX
Lane Configurations	<u></u> ງ	•			- ()		า	TP			TP	
Traffic Vol, veh/h	52	0	89	5	0	5	67	939	2	0	899	57
Future Vol, veh/h	52	0	89	5	0	5	67	939	2	0	899	57
Conflicting Peds, #/hr	0	0	1	1	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	-	-	-	100	-	-	75	-	-
Veh in Median Storage,	# -	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	60	60	60	85	85	85	95	95	95
Heavy Vehicles, %	0	0	0	13	13	13	1	1	1	2	2	2
Mvmt Flow	57	0	97	8	0	8	79	1105	2	0	946	60

Major/Minor	Minor2		1	Minor1	Major1			Major2							
Conflicting Flow All	1687	2241	504	1738	2270	554	1006	0	0	1107	0	0			
Stage 1	976	976	-	1264	1264	-	-	-	-	-	-	-			
Stage 2	711	1265	-	474	1006	-	-	-	-	-	-	-			
Critical Hdwy	7.5	6.5	6.9	7.76	6.76	7.16	4.12	-	-	4.14	-	-			
Critical Hdwy Stg 1	6.5	5.5	-	6.76	5.76	-	-	-	-	-	-	-			
Critical Hdwy Stg 2	6.5	5.5	-	6.76	5.76	-	-	-	-	-	-	-			
Follow-up Hdwy	3.5	4	3.3	3.63	4.13	3.43	2.21	-	-	2.22	-	-			
Pot Cap-1 Maneuver	*393	*71	*729	*312	58	*677	1071	-	-	988	-	-			
Stage 1	*687	*602	-	*415	406	-	-	-	-	-	-	-			
Stage 2	*664	*426	-	*663	571	-	-	-	-	-	-	-			
Platoon blocked, %	1	1	1	1	1	1	1	-	-	1	-	-			
Mov Cap-1 Maneuver	*366	*66	*728	*255	54	*677	1071	-	-	988	-	-			
Mov Cap-2 Maneuver	*451	*246	-	*310	219	-	-	-	-	-	-	-			
Stage 1	*637	*602	-	*385	376	-	-	-	-	-	-	-			
Stage 2	*607	*395	-	*574	571	-	-	-	-	-	-	-			
Approach	EB			WB			NB			SB					
HCM Control Delay s	12			13.8			0.6			0					
HCM LOS	B			B			0.0			Ū					
	2														
		ND	NDT					0.01	ODT	000					
Minor Lane/Major Mvr	nt	NBL	NBT	NBR	EBLn1	EBLn2V	VBLn1	SBL	SBT	SBR					
Capacity (veh/h)		1071	-	-	451	728	425	988	-	-					
HCM Lane V/C Ratio		0.074	-	-	0.125	0.133	0.039	-	-	-					
HCM Control Delay (s	5)	8.6	-	-	14.1	10.7	13.8	0	-	-					
HCM Lane LOS		Α	-	-	В	В	В	Α	-	-					
HCM 95th %tile Q(ver	ר)	0.2	-	-	0.4	0.5	0.1	0	-	-					
Notes															
~: Volume exceeds ca	\$: De	lay exc	eeds 30)0s -	+: Com	outation	Not De	fined	*: All major volume in platoon						

Intersection

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ľ	↑ ĵ≽		ľ	- 11			¢		1	et F	
Traffic Vol, veh/h	53	483	0	1	420	63	2	0	12	42	0	41
Future Vol, veh/h	53	483	0	1	420	63	2	0	12	42	0	41
Conflicting Peds, #/hr	0	0	1	1	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	250	-	-	25	-	-	-	-	-	0	-	-
Veh in Median Storage	, # -	0	-	-	0	-	-	1	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	85	85	85	88	88	88	65	65	65	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	0	2	0	0	0	0
M∨mt Flow	62	568	0	1	477	72	3	0	18	46	0	45

Major/Minor	Major1		Ν	Major2		I	Minor1			Minor2					
Conflicting Flow All	549	0	0	569	0	0	934	1244	285	923	1208	275			
Stage 1	-	-	-	-	-	-	693	693	-	515	515	-			
Stage 2	-	-	-	-	-	-	241	551	-	408	693	-			
Critical Hdwy	4.14	-	-	4.14	-	-	7.5	6.54	6.9	7.5	6.5	6.9			
Critical Hdwy Stg 1	-	-	-	-	-	-	6.5	5.54	-	6.5	5.5	-			
Critical Hdwy Stg 2	-	-	-	-	-	-	6.5	5.54	-	6.5	5.5	-			
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.5	4.02	3.3	3.5	4	3.3			
Pot Cap-1 Maneuver	1242	-	-	999	-	-	*343	223	718	351	239	*929			
Stage 1	-	-	-	-	-	-	*405	443	-	781	705	-			
Stage 2	-	-	-	-	-	-	*877	672	-	596	448	-			
Platoon blocked, %	1	-	-		-	-	1	1		1	1	1			
Mov Cap-1 Maneuver	1242	-	-	998	-	-	*314	211	717	328	227	*929			
Mov Cap-2 Maneuver	-	-	-	-	-	-	*342	318	-	328	227	-			
Stage 1	-	-	-	-	-	-	*384	420	-	742	704	-			
Stage 2	-	-	-	-	-	-	*834	671	-	552	425	-			
Approach	EB			WB			NB			SB					
HCM Control Delay, s	0.8			0			11			13.5					
HCM LOS							В			В					
Minor Lane/Major Mvn	nt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR \$	SBLn1	SBLn2					
Capacity (veh/h)		620	1242	-	-	998	-	-	328	929					
HCM Lane V/C Ratio		0.035	0.05	-	-	0.001	-	-	0.139	0.048					
HCM Control Delay (s))	11	8.1	-	-	8.6	-	-	17.7	9.1					
HCM Lane LOS		В	А	-	-	А	-	-	С	А					
HCM 95th %tile Q(veh)	0.1	0.2	-	-	0	-	-	0.5	0.2					
Notes															
~: Volume exceeds ca	pacity	\$: De	lay exc	eeds 30)0s -	+: Comp	outation	Not De	efined	*: All r	najor v	olume in	platoon		



the existing public sidewalks.