August 29, 2022

Jeff Kahan
City of Ann Arbor Planning Department

Jeff,

The following narrative is a response to recent questions that have been raised by the Planning Commission and staff regarding our Village of Ann Arbor development. We have attached exhibits as noted. Please let us know if further information or clarification is required prior to the upcoming rescheduled Planning Commission meeting. Also included below is a response to the memorandum dated July 15, 2022 from the Office of Sustainability and Innovations.

1. Brownfield Clarification

Further clarification of the Brownfield conditions and our proposed mitigation plan has been requested. Attached as **Exhibit A** to this response is a Brownfield summary memo from SME for reference.

We are prepared to provide several public benefits that are above and beyond the City's rezoning requirements, including but not limited to the amenities and improvements below. Certain benefits, such as the offsite roundabout contribution, are being included in the overall plan to be approved as a non-environmental Brownfield request in lieu of including an affordable housing component.

- Full electrification of the for-sale portion of the development;
- Public access easement to Leslie Park from both Pontiac Trail and Dhu Varren, as the only access currently to the park is a single-entry point from the adjacent Dhu Varren on the Park subdivision;

- Contribution of $1.2MM in roundabout improvements for the Pontiac Trail and Dhu Varren intersection;
- Park Contribution of $302,500;
- 3,875 lineal feet of 10’ wide detached bike pathway, located along the public access road corridors to Leslie Park;
- Solar panels on the Clubhouse building;
- Solar streetlights;
- Nature trail (EGLE approval permitting);
- Covered bus stop and bicycle parking area on Pontiac Trail

2. Traffic Review

We have further worked with the traffic reviewers as to how the Pontiac Trail intersection into the development will function. The future striping in this area has now been clearly shown as referenced per the design plans from North Sky. The existing 3-lane northbound lane has been extended through the proposed access and the taper has been relocated north of the proposed access. The traffic impact study has also been amended to include a comprehensive evaluation of this specific area. The right-turn lane is no longer warranted due to site specific conditions, as stated in the amended study included in this response as **Exhibit B**.

3. AAATA Coordination

We have recently reached out to AAATA to determine their need for a bus shelter in this location and they have confirmed that their desire is for a covered shelter. In addition to providing a cover for the shelter, we are able to provide a roof extension over the bike hoops near the shelter and the site plans have been revised accordingly to call this out. The closest south bound Pontiac Trail bus shelter is about 1850’ south between Skydale and Manor Drives on the west side.

4. Pedestrian Connection to Northside Glen

There was a question from the Planning Commission in regard to connecting a pedestrian and/or bicycle path to the existing Northside Glen development at the northwest corner of the property. Although we have reached out to the Northside Glen HOA for a discussion on this topic, they have recently declined our invitation to meet. However, the terminus of the road from Northside Glen currently extends over our property line, and have adjusted our plan to connect to the existing sidewalk. The grades at this location do not allow for an ADA accessible path, however, we will also be providing an ADA path through the development to Dhu Varren that would ultimately connect to this area.

5. Crosswalks

Staff also requested clarification as to how the cross walks will function near the Pontiac Trail access point and the Dhu Varren access point. There is an existing crosswalk just south of our proposed access to Pontiac Trail that was designed and constructed with the North Sky development on the opposite side of Pontiac Trail. This included the positive contrast lights and we will be installing the requested RRFB crossing signs for the crossing with the Village of Ann Arbor development. These items as well as the future striping has now been clearly shown on the revised site plan.

6. Phasing

In regard to phasing questions, the project will be developed in 3 separate phases. A “Building Phasing Plan”, complete with development phasing lines, are now more clearly shown on sheet 10 of the revised site plan included in this response as **Exhibit C**. The individual sheets for each individual utility phase have been added to the revised site plan for extra clarity on utility phasing.

7. Solid Waste

We have worked with the solid waste reviewers and the plan has been addressed as follows:

- Townhomes: Trash, recycling and compost handling and pickup will occur using the City standard 64-gallon wheeled carts, similar to standard single-family development in the City. The residents will store the carts in their garages and wheel out to a specified location on service days, as shown on the site plan included as **Exhibit D** to this response. These locations respect the City standard 3' separation between carts. The localized compost carts will be stored in two separate centralized dumpster enclosures and will be wheeled out to a specified location on service days, as shown on the site plan. In the future event if residents do not follow their pre-determined staging locations for cart pickup, the site will be converted to standard dumpster pickup in the locations shown on the "Alternate Solid Waste Plan – Townhomes" plan as shown on **Exhibit E** to this response.

- Apartments: Trash handling and pickup will occur in a localized compactor dumpster near the community center. Recycling handling and pickup will occur using the City standard dumpsters and enclosures. Compost is not required and not being provided for the apartments, similar to standard multi-family development in the City, as significant composting volume generation is not anticipated as grounds maintenance will be contracted.

The overall solid waste plan has been worked through and accepted by public works. An alternative solid waste plan for the townhomes, showing the alternate corral locations and service routing, has been added to the revised site plan as requested.

8. Offsite Improvements

Through discussions with staff, we understand that a roundabout is preferred at Pontiac Trail and Dhu Varren. Although this is an offsite condition that we are only 3% as a contributing factor to, we have proposed to include $1,200,000 as a contribution to the ultimate cost to construct this roundabout to be included as part of a non-environmental Brownfield request. We are requesting interest for this eligible activity since we will be fronting the contribution and receiving reimbursement years down the road through the Brownfield Plan. We would also request the roundabout construction commence at the completion of our project since the traffic impact of our development will not occur until our residents are living in the community.

9. Parking Reduction

Several Planning Commissioners requested that we review the number of parking spaces provided and reduce any spaces where feasible. We have reviewed the location and number of parking spaces throughout the development, and we have removed 10 spaces from the for-sale section and another 10 spaces from the apartment section, which represents an approximately 10% reduction of open guest parking spaces from the previous plan. We feel the number of spaces that are left is adequate and necessary for guest parking throughout.

10. Sustainability Elements

We have continued to analyze the sustainability elements that will be featured at this community based on input from staff and the Planning Commission. Since the Planning Commission meeting, we have further researched the pros and cons of providing an all-electric community rather than simply an electric-ready community, as previously proposed. While

we continue to have concerns with higher utility cost expenses for our end-users, we are happy to announce that we will be converting the for-sale section to an all-electric community. We understand the importance this has for the City of Ann Arbor, and will be transparent in disclosing the inclusion of electric only appliances to our home buyers.

During the Planning Commission meeting, we had made reference to utility bills in an all-electric community being as much as 150% to 200% when compared to a traditional natural gas community. This information had been provided to us by two independent experts in the building science community. DR Nelson is an expert in residential building efficiencies and specializes in determining projected energy costs based on specified appliances using published local utility rates. Partially due to the lower cost of natural gas and higher cost of electricity for Michigan utilities compared to national rates, their analysis dated February 14, 2022, included as **Exhibit F**, showed nearly double the cost for monthly utility rates for gas vs. all-electric homes with similar appliance efficiencies in Michigan's climate. The difference in energy costs is primarily due to home heating and water heating appliances. The same study shows that carbon dioxide emissions are approximately 50% higher for all electric vs. natural gas community due to the current DTE grid being primarily powered by natural gas and the fact air source heat pumps run much more often and for longer times than natural gas furnaces (this is due to the temperature of heat supply being 120 to 140 degrees for a natural gas furnace vs. 85 to 90 degrees for an air source heat pump therefore forcing the heat pump to operate more often and for longer times to bring heat up and maintain it in colder months). A separate study performed by PE Load Calcs dated April 7, 2022 utilizing a high performance cold climate air source heat pump and high end heat pump water heater shows a closer gap of 120% to 130% between the two energy sources (**Exhibit G**). While the gap is smaller, there is still a substantial increase in cost for residents of this community when compared to neighboring communities and the upfront cost of this system is substantially more than a traditional natural gas furnace. For this reason, we are not proposing to include the apartment

portion in an all-electric program, though we will continue to include several sustainable features throughout the entire community, such as:

- Use of solar panels on the clubhouse building
- Solar powered streetlights
- All garages, including the apartments, will be pre-wired for electric vehicle charging (EV-R)
- 32 electric vehicle charging spaces (EV-I) will be provided for guest use in the open parking areas, meeting the City's new parking standards
- Energy star rated appliances throughout
- Watersense labeled plumbing fixtures throughout
- The community will provide for 3,875 lineal feet of 10' wide asphalt pathways and 1,965 lineal feet of 5' wide concrete pathways
- A covered bus shelter will be provided on Pontiac Trail for AAATA along with covered bus hoops
- Walking paths through the former landfill area open to the public
- Park contribution of $302,500
- The community recycles a large unused and contaminated property previously thought to be essentially undevelopable that has been in neglect for decades and decades into a productive community with over $3.5MM in annual tax revenue to the City upon completion
- Village that allows for diversity in lifestyles featuring both owner occupied and apartment lifestyles and multiple price points

11. Bike Share

There were comments during the Planning Commission meeting regarding the introduction of a bike share or car share program. While we believe we would have limited success with implementing a car share program, we have researched several options for providing a bike share program. Our

intent is to continue researching options and will identify a location that could serve as a bicycle corral for such an amenity during the design of the future development area.

Robertson Brothers Homes and DTN Management are pleased to present the Village of Ann Arbor for consideration by the City. We believe the development will ultimately become a point of pride for responsible development in an established area, and will provide for a housing need in the community.

Please let me know if any additional information is required at this time. Thank you.

Respectfully,

Tim Loughrin | Director of Land Acquisition and Development
Robertson Brothers Homes
6905 Telegraph Rd, Suite 200, Bloomfield Hills, MI 48301
Direct Dial: 248.282.1428 | Mobile: 248.752.7402
tloughrin@robertsonhomes.com

LIST OF EXHIBITS

EXHIBIT A – SME Summary Memo

EXHIBIT B – Updated Traffic Impact Analysis (Fleis & Vandenbrink)

EXHIBIT C – Building Phasing Plan

EXHIBIT D – Solid Waste Plan

EXHIBIT E – Alternate Solid Waste Plan - Townhomes

EXHIBIT F – DR Nelson Mechanical Equipment Review

EXHIBIT G – PE Load Calcs Mechanical Equipment Review

Recommendation: include on-site solar readiness.
Rooftop solar is an attractive and effective way to reduce carbon emissions related to EV chargers and building operations. While it is acknowledged that the petitioner intends to power some clubhouse operations with solar, we recommend considering solar readiness for the broader development, too.
Recommendation: include on-site energy storage (or readiness).
Consider pairing on-site solar with on-site batter storage systems.
To build energy resiliency, we recommend providing a dedicated location for the installation of [future, if not present] on-site energy storage as well as reserved space in the main electrical service panel and pathways for routing cable connections to support the storage system.

Strategy 1: Power Electrical Grid with 100% Renewable Energy;
Support Onsite Renewable Energy Generation with Battery Storage

Village of Ann Arbor Response: Our development proposes not only the inclusion of solar panels on the clubhouse building, but the use of solar streetlights through the community. Our team will investigate the use of battery storage systems as we move closer to the final design stage.

Achieve full building electrification.
It appears the site plans submitted do not include gas lines throughout the development. The use of fossil fuels in any capacity go against the goals of A2ZERO. We encourage the petitioner to cap any existing gas lines.

Strategy 2: Switch our Appliances and Vehicles from Gasoline, Diesel, Propane, Coal, and Natural Gas to All Electric;

Village of Ann Arbor Response: Our energy plan has been updated to convert the for-sale portion of the development to an all-electric community.

Recommendation: Expand EV charging infrastructure.
To support the EV transition, reserve space in the main electrical service panel and include pathways for routing cable connections to support EV charging in each residence.

Promote Home Electrification
Strategy 2 (continued)
Expand EV Charging Infrastructure

Village of Ann Arbor Response: Each unit, including the apartments, will include a dedicated EV ready electrical system within the garage. Additionally, there will be 32 EV charging stations throughout the community for guest use.

Recommendation: Energy Star rated appliances & LED fixtures.
The OSI encourages all LED lighting and Energy Star rated electric appliances to be used throughout the project with no gas hookups on site. Consider also choosing high-efficiency electric heating sources with a coefficient of performance (COP) greater than 1, like air source heat pumps or ground source geothermal. COP >1 options also exist for water heating.

Strategy 3: Significantly Improve the Energy Efficiency in our Homes and Buildings
Transition to More Energy Efficient Homes

Village of Ann Arbor Response: As mentioned above, the for-sale portion will be converted to an all-electric community, and we will source high-efficiency heating sources as recommended. Further, the development will provide energy star rated appliances wherever possible and LED fixtures in the homes.

Recommendation: Maximize air sealing and insulation R-values.
The buildings in Ann Arbor account for 67% of our city's total greenhouse gas emissions. A vast majority of a building's energy use is attributed to space heating. Proper air sealing and insulation can help reduce this energy demand. It does not appear that R-values were specified in the site plan. We recommend the DOE's upper end for all Climate Zone 5a insulation uses (including, for example, the use of R-60 in the attic). Aim for a blower door test ACH50 of 3 or less with appropriate mechanical ventilation.

Strategy 3: Significantly Improve the Energy Efficiency in our Homes and Buildings;
Transition to More Energy Efficient Homes and Businesses

Village of Ann Arbor Response: We will provide R values of R13/R19 for walls, R38 for ceilings, and R30 in the garage. We will achieve a blower door test ACH of 3 or less with appropriate mechanical ventilation.

Recommendation: Consult an Aging in Place (AIP) specialist.
Aging in Place paves the way for seniors to age in a place of their choosing for longer by including physical and energy efficiency components in their homes.

Strategy 3: Significantly Improve the Energy Efficiency in our Homes and Buildings; Support Aging in Place Efficiently

Village of Ann Arbor Response: Many of the apartment homes are first floor units, ideal for seniors looking for attainable housing in the area. Further, we are looking at several options for designing the future development area that will include further opportunities for single-level living.

Recommendation: Include compost waste bin designations.
It appears the Solid Waste Notes on the submitted plans does not account for composting services. We recommend accounting for this waste stream by providing designated compost bin locations so that all residents have access to resources that divert compostables from landfills.

Strategy 5: Change the Way We Use, Reuse, and Dispose of Materials
Expand Composting Program

Village of Ann Arbor Response: The for-sale portion of the development provides for compost waste pickup as per noted on the plans.

Recommendation: Consider materials use throughout structure.
Building materials can be responsible for many adverse environmental issues. To support a healthy built environment, we encourage the use of responsibly sourced materials with low embodied carbon and end-of-life options.
For a list of materials to avoid, consider the Living Building Challenge's Red List.

Strategy 5: Change the Way We Use, Reuse, and Dispose of Materials
Require Sustainable Materials in New and Existing Developments

Village of Ann Arbor Response: Low and No VOC Paints will be used in the community, and we will utilize Energy Star Rated Appliances and light fixtures wherever possible. We will use 96% and above energy efficient furnaces and A/C units. Further, we will participate in the Living Building Challenge's Red List for avoidable materials.

EXHIBIT A

SME MEMORANDUM

DATE: August 9, 2022

TO: Mr. Jeff Kahan
City Planner
City of Ann Arbor
301 E. Huron St.
Ann Arbor, MI 48104

Via email: jkahan@a2gov.org

FROM: Bret Stuntz – SME

SUBJECT: Village of Ann Arbor
Brownfield Conditions and Due Care Planning
Dhu Varren and Pontiac Trail Roads
Ann Arbor, Michigan
SME Project No.: 084695.00

The Village of Ann Arbor project consists of redevelopment of an approximately 77-acre, largely vacant tract of land (the Property), portions of which were historically used by the City of Ann Arbor for a municipal landfill, and for gravel mining. The project will be called the Village of Ann Arbor, and it will include 244 for-sale attached single family homes and townhomes and 320 high quality rental apartment homes. The purpose of this memorandum is to summarize the Property's brownfield and environmental conditions and to outline the due care planning for the Project, the process which provides for safe reuse of the site by residents and the general public.

BACKGROUND

SITE HISTORY

Based on our historical research, the majority of the Property was developed for agricultural use with a wooded area located in the central-eastern portion and a residence or farmstead located on the western portion of the Property off of Pontiac Trail, by 1937. The western portions of the Property were developed with two residential buildings under address 2670 and 2672 Pontiac Trail by at least 1948. The 2672 Pontiac Trail residence was demolished by 2014. The northeast portion of the main parcel was utilized as a City of Ann Arbor residential landfill between 1945 and 1958. Gravel mining operations occurred on the northwest, southeast, and southern portions of the Property between at least 1962 through at least 1973. Additional areas of landfilling or dumping were observed in the 1978 aerial photograph between the former landfill area and a central access drive. Areas of disturbed earth were observed in the 1980s on the central portions of the Property. A vehicle maintenance building was constructed on the northern portion of the Property by 1962. The building was damaged by a tornado in the 1980s. The remaining portions of the building were demolished, and two unregistered diesel and kerosene USTs were removed from the area of the maintenance building in 2016. The main parcel of the Property has grown wooded over time and is currently vacant.

ASSESSMENTS

Phase II Environmental Site Assessments (ESAs) were conducted in August 2020 and April 2021. We advanced 11 soil borings across the Property and installed 54 methane monitoring wells. We collected soil and soil gas samples and submitted them to an analytical laboratory for analysis of volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and/or the 10 Michigan metals. We also conducted methane screening. VOCs (methyl-tert-butyl ether (MTBE), naphthalene, tetrachloroethylene, 1,2,3-trimethylbenzene, and 1,2,4-trimethylbenzene), PAHs (benzo(a)pyrene, fluoranthene, and phenanthrene), and metals (arsenic, and mercury) were measured in soil at concentrations exceeding Part 201 criteria. We measured methane concentrations up to 16.5%, exceeding the Michigan Department of Environment, Great Lakes, and Energy (EGLE) Part 201 Residential Soil Volatilization to Indoor Air Inhalation Criteria (SVIIC) and the Residential Volatilization to Indoor Air Pathway (VIAP) screening level of 1.25% by volume. In general, significant contaminant concentrations were limited to the northern half of the Property and appear to be associated with the former municipal landfill and/or dumping of organic material in the former gravel mining pits. The exceedances of Part 201 criteria create due care obligations for a property owner.

The soil conditions encountered at the geotechnical borings generally consist of surface topsoil overlying undocumented fill from three to 32 feet below ground surface (bgs) underlain by natural clay and sand extending to the explored depths of the borings. The fill contained excessive debris. The fill in the areas outside the landfill had relatively smaller amounts of debris and was likely placed during the backfilling of the gravel pit or for general grading of the site. The on-site undocumented fill is not suitable for foundation support of the planned structures and is estimated to contain in excess of 1,280,000 cubic yards in place and in excess of 1,900,000 cubic yards once removed and transported; the cost to remove this fill and replace in engineered lifts is estimated to be approximately $96,000,000.

DUE CARE

Due care provides a mechanism for property owners to limit unacceptable exposures to hazardous substances, prevent fire and explosion hazards due to hazardous substances, and allow the Property to be used in a way that protects the public health and safety. Due care also provides a mechanism to prevent worsening or spreading of the known impact (i.e. exacerbation). Due care will be implemented during construction through an Environmental Coordination Plan for Construction (ECPC), and after construction through a Plan to Comply with Due Care (PCDC).

Due care evaluates relevant exposure pathways, determines whether they are significant, and – if so – provides for mitigation. Based on the contaminants and concentrations identified on the Property, the relevant exposure pathways are dermal contact and inhalation. For methane, explosivity is the relevant consideration.

DIRECT CONTACT

Direct contact exceedances were identified in two locations associated with impact from the former city landfill, on the northeastern portion of the Property, where roadways are planned. The PCDC will specify mitigation strategies for these areas. In general, these will consist of maintenance of pavement or adequate clean cover.

INHALATION

The vapor inhalation pathway is relevant because soil samples collected in two locations adjacent to the former landfill had VOC concentrations exceeding EGLE screening levels. However, soil gas samples (which provide a more accurate assessment of risk from inhalation) subsequently collected in the area of highest VOC impact in soils did not encounter soil gas concentrations exceeding applicable criteria or screening levels. Therefore, based on current site conditions, the impact from the landfill does not present an unacceptable risk for the vapor inhalation pathway. Moreover, road and infrastructure improvements are planned for this area.

METHANE

The most significant brownfield issue at the Property is methane. Methane levels at the site were compared to EGLE Part 201 Residential Soil Volatilization to Indoor Air Inhalation Criteria (SVIIC) and Residential VIAP screening levels, which are both equal to 1.25% by volume, which is 25% of the lower explosive limit (LEL) of methane of 5% by volume. During the six screening events at the 54 monitoring points, we encountered exceedances of the methane LEL on five occasions. All other measurements were below the methane LEL. The maximum measured methane concentration was 16.5%.

Since it is cost-prohibitive to remove all of the methane-generating fill/debris/rubble from the site, methane mitigation will consist of three principal elements: (1) specialized foundations that allow structures to be placed atop of methane-impacted fill; (2) subslab depressurization systems (SSDSs) and a methane interceptor trench, which will prevent potential methane migration onto the southern portion of the Property that is free of methane; and (3) targeted excavation and relocation of methane-generating material, when encountered and where economically feasible. The methane interceptor trench will run east-west across the center portion of the Property.

SPECIALIZED FOUNDATIONS

With specialized foundations, structures will be constructed over a grid of ground improvement technologies such as rammed aggregate piers (RAPs) with lateral support. RAPs consist of compacted aggregate piers installed on a grid that provide vertical load bearing capacity while also improving the surrounding soils during installation. The method generates significantly less spoils when the holes for the piers are installed using a reverse auger method as compared to deep foundation options such as drilled piers or removal and replacement. Therefore, this methodology also alleviates the need to excavate and dispose of most of the contaminated fill during the foundation construction process. RAPs are bridged with a layer of compacted aggregate fill, and traditional shallow spread and continuous strip foundations and slabs-on-grade are constructed above the engineered RAP system. This creates suitable platforms upon which to construct buildings.

The additional geotechnical and structural engineering costs to design the specialized foundation systems, the increased costs to install them, and the construction materials testing services (i.e., construction oversight and density testing of backfill and observation during installation) above those required for an undeveloped greenfield site are eligible brownfield costs. Since the buildings will still use traditional shallow foundations above the specialized foundation systems, the incremental cost to address the unsuitable methane-impacted fill is the entire cost of the specialized rammed aggregate pier system itself.

SUBSLAB DEPRESSURIZATION SYSTEMS AND INTERCEPTOR TRENCH

The proposed SSDSs will be designed to mitigate potential methane accumulation under buildings. The system will consist of four elements: 1) passive sub-slab venting with vent risers, 2) a vapor-barrier system, 3) sub-barrier pressure ports to document post-installation connectivity of the venting systems, and 4) methane alarms installed within the buildings.

The purpose of the methane mitigation trench is to provide a preferential pathway for methane gas such that it migrates upward, is dispersed and mixed with ambient air, and is vented passively to the atmosphere. The trench will be constructed with large volumes of highly permeable material (e.g., sand and gravel), that will provide a preferential pathway to vent riser pipes in lieu of accumulating in the subsurface and migrating horizontally to other areas of the development.

SOIL REMOVAL

Where the risk from methane accumulation is present, the risk is adequately mitigated where buildings are constructed with specialized foundations and SSDSs. In addition, where feasible and when

encountered, targeted excavations will be conducted and backfilled with clean soil, reducing the risk for future methane generation. Other impacted soil will be excavated and removed during building construction and utility installation.

EXACERBATION

If utilities extend through contaminated groundwater, we typically recommend sealing sewer systems to prevent exacerbation. That is not the case here. The utilities on the eastern side of the Property (nearest the former landfill) will be placed at maximum depths of 10 to 17 feet below ground surface. Groundwater was encountered in this area at approximately 37 feet below ground surface during the previous Phase II ESA. Therefore, based on the planned utility locations and depths – and measured groundwater depths - the utilities will not extend through groundwater, eliminating the risk for dissolved methane or other contaminants to infiltrate stormwater sewer piping. Bentonite trench plugs would prevent methane from exiting the Property within sand backfill along utility corridors.

NON-ENVIRONMENTAL BROWNFIELD CONDITIONS

Non-environmental brownfield eligible activities include demolition, hazardous materials assessment and abatement, site preparation, and infrastructure improvements. The brownfield plan for the project includes public infrastructure improvements such as paving and utilities in the public right-of-way, bus stop construction, and solar streetlights. Site preparation includes cut and fill activities and associated earthwork. Reimbursement of these costs is necessary for financial feasibility of the Project.

SUMMARY

Due care is a mechanism for property owners to limit unacceptable exposures to hazardous substances and explosion hazards. The Project, as presented, provides for appropriate due care and will allow the Property to be used in a way that protects the residents, public health, and public safety.

Please let us know if you have any questions or require additional information.

Sincerely,

Prepared By:
Bret B. Stuntz
Senior Consultant

Exhibit B

VILLAGE OF ANN ARBOR TRAFFIC IMPACT ANALYSIS

Ann Arbor, Michigan

REVISED AUGUST 23, 2022

PREPARED BY:

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

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FV JN 849220
© August 2022

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I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Michigan.

Agency Review	Date	Comments
City of Ann Arbor	7-15-21	Comments letter provided
City of Ann Arbor	11-10-21	Comments letter provided
City of Ann Arbor	6-27-22	Comments letter provided

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References

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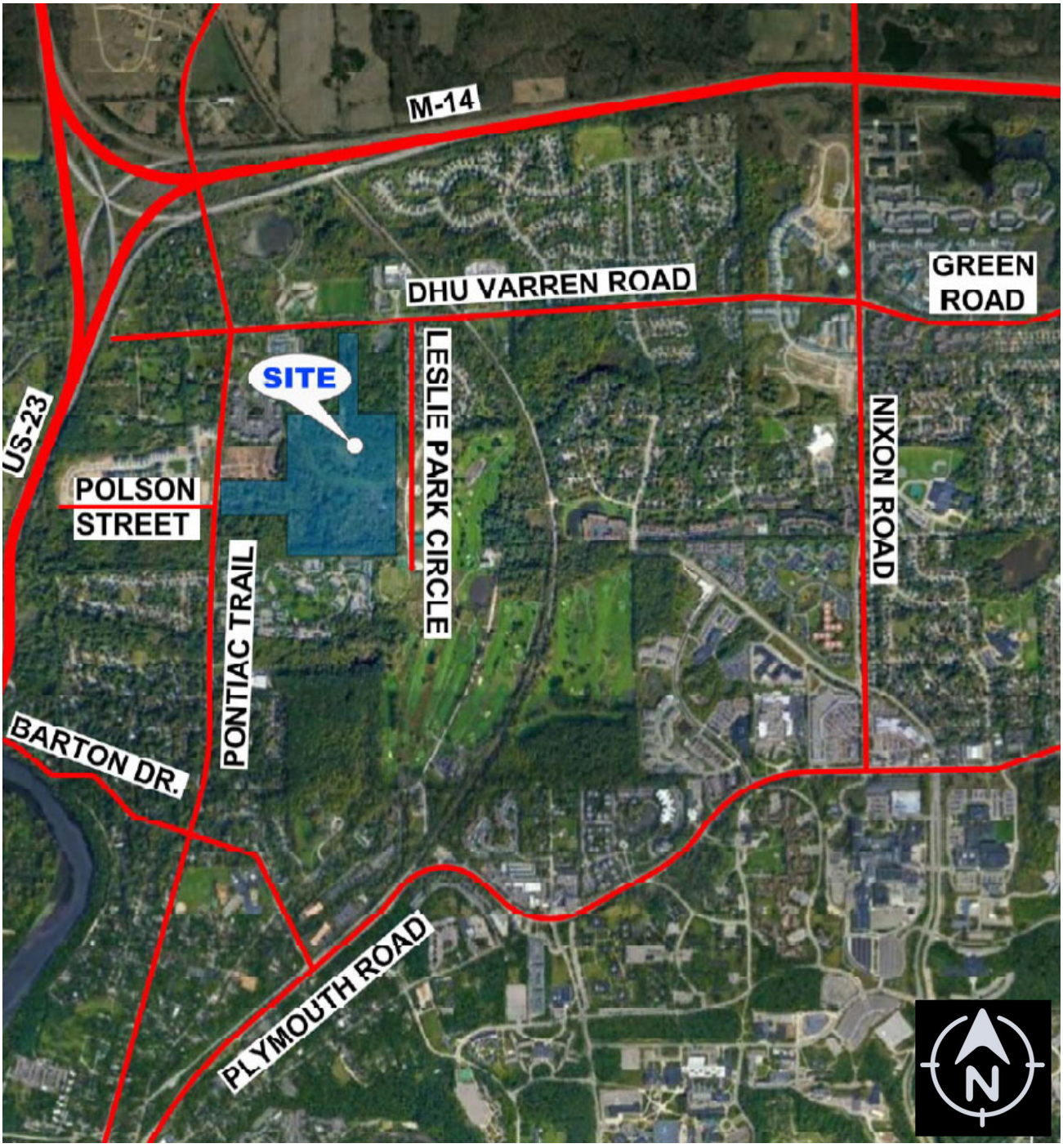
EXECUTIVE SUMMARY

This report presents the results of a Transportation Impact Analysis (TIA) for the proposed Village of Ann Arbor development in Ann Arbor, Michigan. The project site is located generally in the southeast quadrant of the Pontiac Trail & Dhu Varren Road intersection, as shown on **Figure E1**. The proposed development includes the construction of multi-family residential units on approximately 64 acres. Site access is proposed via one (1) proposed driveway on Pontiac Trail, one (1) proposed driveway on Dhu Varren Road, and one (1) internal connection to Leslie Park Circle.

FIGURE E1: SITE LOCATION



The scope of this study was developed based on Fleis & VandenBrink's (F&V) knowledge of the study area, understanding of the development program, accepted traffic engineering practice and information published by the Institute of Transportation Engineers (ITE), and pursuant to the requirements of the City of Ann Arbor.

Background Data

Due to the impact of COVID-19 and the subsequent closures of businesses and schools, current traffic volume data is not representative of "typical" operations. Therefore, existing 2016 and 2019 peak hour traffic volume data was used where available and additional data collection was performed where necessary.

The existing 2021 data was compared with the historical data and determined to be significantly less; therefore, the growth rate provided by the Washtenaw Area Transportation Study (WATS) was applied to the 2016 and 2019 volumes for use in the study. Additionally, the North Sky, Cottages at Barton Green, Nixon Farms, and Bristol Ridge residential developments were currently under development during the collection of the 2016/2019 traffic volumes or will be under development within the buildout year of 2025; therefore, the site trip generations for each were included for the background traffic operations analysis.

Trip Generation

The number of peak hour (AM and PM) and daily vehicle trips that would be generated by the proposed development was forecast based on data published by ITE in the *Trip Generation Manual, 10th Edition* and ITE *Trip Generation Handbook, 3rd Edition*. Multi-modal trips were calculated for this site based upon the modal split data provided by the City of Ann Arbor to determine the number of vehicular, pedestrian, transit, and bicyclist trips generated by the proposed development, as summarized in **Table E1**.

Table E1: Site Trip Generation

Modal Site Trip Generation	Average Daily Traffic (trips/day)	AM Peak Hour (trips/hour)			PM Peak Hour (trips/hour)		
		In	Out	Total	In	Out	Total
Vehicular Trips	3,340	57	163	220	167	107	274
Pedestrian Trips	47	1	2	3	3	1	4
Cyclist Trips	93	2	4	6	5	2	7
Transit Trips	325	5	14	19	15	9	24

Site Trip Distribution

The vehicular trips that would be generated by the proposed development were assigned to the study roads based on the proposed access plan, existing traffic patterns, and ITE methodologies. To determine residential trips distribution, it was assumed that the majority of the trips in the AM are home-to-work based trips, and in the PM are work-to-home based trips. Therefore, the global trip generation is based on trips leaving the study network in the AM and entering the study network in the PM. The trip distribution utilized for this analysis is summarized in **Table E2**.

Table E2: Trip Distribution

To/From	Via	AM	PM
North	Nixon Road	1%	2%
	Pontiac Trail	2%	2%
South	Nixon Road	16%	13%
	Pontiac Trail	49%	43%
East	Green Road	16%	17%
	Barton Drive	7%	11%
West	Barton Drive	9%	12%
Total		**100%**	**100%**

OPERATIONAL ANALYSIS SUMMARY

The existing peak hour vehicle delays and Levels of Service (LOS) were calculated at the study intersections using Synchro (Version 11) traffic analysis software. Additionally, Rodel roundabout analysis software was used to evaluate the roundabout intersections. The results of the analysis are summarized below.

1. **Existing Conditions:** All study intersection approaches and movements currently operate acceptably at LOS D or better during both peak periods, with the exception of the following:
    - Pontiac Trail & Dhu Varren Road: The WB approach is currently operating at LOS F during the AM peak hour.
2. **Existing Conditions with Improvements:** The results of the existing conditions with improvements analysis indicates the following:
    - Pontiac Trail & Dhu Varren Road: The traffic signal and all-way stop-control warrants are not met, based on existing volumes; therefore, the construction of a roundabout is recommended.
3. **Background (2025) Conditions:** A conservative annual growth rate of **2.00%** per year was provided by WATS for use in this analysis to project traffic volumes to the buildout year of 2025. Additionally, the trip generation associated with several background developments were included in the background analysis. All study intersection approaches and movements are expected to operate in a manner similar to existing conditions, with the following additional delays:
    - Pontiac Trail & Dhu Varren Road: The WB approach is expected to experience an approximately 161-second increase in delay during the AM peak hour and is expected to operate at LOS F during the PM peak hour, with an approximately 69-second increase in delay.
    - Pontiac Trail & Barton Drive: The EB approach, the NB left-turn movement, and the southbound shared through/right movement are expected to operate at LOS F during the AM peak hour. Additionally, the EB approach is expected to operate at LOS F during the PM peak hour and the NB left-turn movement and SB left-turn movement are expected to operate at LOS E.
4. **Background (2025) Conditions with Improvements:** The results of the background (2025) conditions analysis with improvements indicates the following
    - Pontiac Trail & Dhu Varren Road: The traffic signal and all-way stop-control warrants are met, based on background volumes; however, they are expected to increase the overall delay at this intersection. Therefore, the construction of a roundabout is recommended.
    - Pontiac Trail & Barton Drive: Mitigation measures were evaluated in order to improve failing LOS; however, the improvements necessary to mitigate the failing LOS are not likely feasible due to ROW constraints; in addition, these mitigation measures would result in a negative impact on non-motorized operations and safety. Therefore, **no mitigation measures are recommended**; however, the improvements that were identified are documented in the body of the report for **informational purposes only**.
5. **Future Conditions:** The results of the future conditions analysis indicates that all study intersection approaches and movements are expected to continue operating in a manner similar to background conditions, with the exception of the following:
    - Pontiac Trail & Dhu Varren Road: The WB approach is expected to experience increased delays of approximately 49-seconds and 26-seconds during the AM and PM peak hours, respectively.
    - Pontiac Trail & Barton Drive: The SB shared through/right movement is expected to experience an approximately 58-second increase in delay during the AM peak hour. The NB and SB left-turn movements are expected to operate at LOS F during the PM peak hour. Additionally, the NB shared through/right movement is expected to operate at LOS E and the EB approach is expected to experience an approximately 106-second increase in delay during the PM peak hour.
    - An auxiliary turn lane analysis was performed for the proposed site driveways along Pontiac Trail and along Dhu Varren Road. The results indicate that auxiliary turn lane treatments are not warranted or recommended on Dhu Varren Road. A northbound right-turn lane is warranted on northbound Pontiac Trail at the S. Site Drive; however, review of all nearby developments, roadway

characteristics, available ROW, sidewalk easements, and environmental impacts was taken into consideration when evaluating the feasibility of a right-turn lane at this intersection. The review indicates that the construction of a right-turn lane into the site would produce more negative impacts (wetland disturbance, greater pedestrian risk, etc.), than the potential vehicular safety benefit gained for slowing vehicles entering the site from northbound Pontiac Trail.

- Therefore, auxiliary turn lane treatments are **not recommended** at either of either of the proposed site driveway locations.

6. **Future Conditions with Improvements:** The results of the future conditions analysis with improvements indicates the following

- Pontiac Trail & Dhu Varren Road: The traffic signal and all-way stop-control warrants are met, based on future volumes; however, they are expected to increase the overall delay at this intersection. Therefore, the construction of a roundabout is recommended.
- Pontiac Trail & Barton Drive: Mitigation measures to improve failing LOS were evaluated and are documented in the body of the report for **informational purposed only**; however, these improvements necessary to mitigate the failing LOS are not likely feasible due to ROW constraints. In addition, these mitigation measures would result in a negative impact on non-motorized operations and safety; therefore, it is recommended to encourage non-motorized trips by constructing a sheltered bus stop and bike parking area(s) adjacent to the site.

7. **Crash Analysis:** The study intersections were below or similar to the average crash rate (crashes per million entering vehicles) for intersections in the SEMCOG region with similar characteristics.

- There was only one (1) pedestrian crash that occurred along Pontiac Trail (A-injury); however, the crash occurred at a marked pedestrian crossing location with existing signage. The crash was the result of an inattentive driver; therefore, indicating there is no correctable pattern.

8. **Access Management:**

- The results of the intersection sight distance analysis indicates that all of the proposed driveways have adequate lines of sight, assuming the vision triangles remain free of vegetation. Therefore, it is recommended for the developer/contractor to ensure the sight triangles are clear during the construction of the proposed site driveway.
- Review of the driveway spacing indicates that the proposed Bristol Ridge driveway is located approximately 250-ft to the north; however, the driveway is located on the same side (east) of Pontiac Trail, which creates less potential turning conflict points. Additionally, Polson Street is also located close (~180-ft south) to the proposed site driveway and is on the opposite (west) side of Pontiac Trail. Review of the project parcel survey information indicates that the proposed site driveway is located on the northern side of the property frontage along Pontiac Trail; additionally, the area to the south of the proposed location is existing wetlands.
  - Therefore, it is recommended to locate the proposed site driveway as far north along the Pontiac Trail property frontage away from Polson Street as possible. This configuration will provide a positive driveway offset from Polson Street and reduce the number of potential turning conflict points, while also minimizing the environmental impact from disturbing the existing wetland area

9. **Multi-Modal Transportation Evaluation:**

- The proposed development will provide sidewalk along Dhu Varren Road, adjacent to the site property.
- Existing mid-block pedestrian crossing treatments including, continental pavement markings and street lighting, are provided at the crosswalk locations along Pontiac Trail and along Dhu Varren Road which meet the City of Ann Arbor requirements.
  - Dhu Varren: Additional crosswalk safety enhancements including, advanced warning signs and stop/yield to pedestrian signage at the crosswalk may be added for additional safety emphasis.

  - Pontiac Trail: The existing pedestrian crossing located on Pontiac Trail, between Polson Street was reviewed and additional mitigation measures including the installation of a Rectangular Rapid Flashing Beacon (RRFB), in conjunction with positive contrast lighting and high visibility pavement markings is recommended at this location due to the potential increase in pedestrian volumes at this location.

- Additionally, the existing transit routes that currently pass by the proposed development can sufficiently accommodate the additional transit riders.

RECOMMENDATIONS

The recommendations of this TIA are as follows:

Recommended Improvements and Timing	Existing (2021) *Baseline*	Background (2025) *No Build*	Future (2025) *With Development*
Pontiac Trail & Dhu Varren Road			
• Construct a roundabout with enhanced pedestrian crossings and markings	✓		
Dhu Varren Road & N. Site Drive			
• Provide sheltered bus stop and bike racks			✓
Pontiac Trail & S. Site Drive			
• Provide sheltered bus stop and bike racks			✓
Existing Mid-Block Crossings			
• **<u>Dhu Varren Road (3 Locations) & Pontiac Trail (north crossing only)</u>** ▪ Install "Stop Here to Pedestrians" sign (R1-6) and/or "Yield Here to Pedestrians" sign (R1-5a) • Add advance "Pedestrian Warning Series with Ahead" signs (W11-2)	✓		
• **<u>Pontiac Trail (south crossing only)</u>** ▪ Install "Stop Here to Pedestrians" sign (R1-6) and/or "Yield Here to Pedestrians" sign (R1-5a) ▪ Add advance "Pedestrian Warning Series with Ahead" signs (W11-2) ▪ Provide a Rectangular Rapid Flashing Beacon (RRFB) ▪ Update crossing with high visibility pavement markings ▪ Install positive contrast lighting			✓

1 INTRODUCTION

This report presents the results of a Transportation Impact Analysis (TIA) for the proposed Robertson Brothers' Village of Ann Arbor development in the City of Ann Arbor, Michigan. The project site is located generally in the southeast quadrant of the Pontiac Trail & Dhu Varren Road intersection, as shown on **Figure 1**. The proposed project includes a multi-family residential development on approximately 64 acres. Site access is proposed via one (1) driveway on Pontiac Trail, one (1) driveway on Dhu Varren Road, and one (1) internal connection to Leslie Park Circle. In accordance with Section 2.29.6 of the City of Ann Arbor Zoning Ordinance a Transportation Impact Analysis (TIA) is required for permitting of site access.

The purpose of this study is to identify the traffic related impacts, if any, of the proposed development project on the adjacent road network. Specific tasks undertaken for this study include the following:

1. **Study Area**
    a. Provide a description of the study area including surrounding land uses, intersection and roadway geometries, speed limits, functional classifications, and traffic volume data (where available). In addition, a study area map showing the site location and study intersections will also be provided.
2. **Proposed Land Use**:
    a. Obtain and review the proposed site plan which includes the proposed land uses, densities, and desired site access locations. A description of the current and proposed land use, including characteristics such as the number and type of dwelling units, will be accompanied with a complete project site plan (with buildings identified as to proposed use).
3. **Existing Conditions**:
    a. Provide an analysis of the traffic-related impacts of the proposed development at the following study intersections:
        - Pontiac Tr. & Dhu Varren Rd.
        - Pontiac Tr. & Polson St.
        - Pontiac Trail & Barton Rd.
        - Dhu Varren Rd. & Leslie Park Circle
        - Dhu Varren Rd. & Site Access Dr. (proposed)
        - Pontiac Tr. & Site Access Dr. (proposed)
    b. Due to the impact of COVID-19 and the subsequent closures of business and schools, current traffic volume data is not representative of "typical" operations. Therefore, the data collection necessary for this study is proposed as follows:
        - Obtain existing available traffic count data from the Southeast Michigan Council of Governments (SEMCOG), WATS, Michigan Department of Transportation (MDOT) Traffic Data Management System (TDMS), and the City of Ann Arbor.
        - Review available historical traffic count data at the study intersections and adjacent roadways previously performed by MDOT, SEMCOG, WATS, and the City of Ann Arbor.
        - Collect existing weekday AM (7:00 AM to 9:00 AM) and PM (4:00 PM to 6:00 PM) peak period traffic volume data at the study intersections where pre-COVID traffic volumes are not available.
        - Compare the existing turning movement count data to historical traffic volumes collected in the area to determine adjusted 2021 turning movement counts at the study intersections.
        - Existing traffic volumes at the proposed site driveways will be determined through balancing the traffic volumes through the study network.
    c. Calculate the Existing vehicle delays, LOS, and vehicle queues at the study intersections during the AM and PM. The analysis will be performed at each of the study intersections. Intersection analysis shall include LOS determination for all approaches and movements. The LOS will be based on the procedures outlined in the HCM 6th Edition, the latest edition of Transportation Research Board's Highway Capacity Manual. Rodel roundabout analysis software will be used to evaluate the roundabout intersections.
    d. Identify improvements (if any) for the study road network that would be required to accommodate the existing traffic volumes.

FIGURE 1

SITE LOCATION MAP

VILLAGE ON ANN ARBOR TIS - ANN ARBOR, MI

LEGEND

SITE — SITE LOCATION

NORTH

SCALE: NOT TO SCALE

4. **Background Conditions (No Build)**:
    a. Calculate the future background traffic volumes based on an appropriate traffic growth determined from local or statewide traffic volume data or it will be obtained from WATS. In addition, any applicable background developments in the vicinity, as identified by the City of Ann Arbor.
    b. Calculate the **Background *(without the proposed development)*** vehicle delays, LOS, and vehicle queues at the study intersections during the AM and PM peak periods. Intersection analysis shall include LOS determination for all approaches and movements. The LOS will be based on the procedures outlined in the HCM 6th Edition, the latest edition of Transportation Research Board's Highway Capacity Manual. Rodel roundabout analysis software will be used to evaluate the roundabout intersections.
    c. Identify improvements (if any) for the study road network that would be required to accommodate the background traffic volumes.
5. **Trip Generation**:
    a. Forecast the number of AM and PM peak hour trips that would be generated by the proposed development based on data published by the Institute of Transportation Engineers (ITE) in *Trip Generation, 10th Edition*.
    b. A table will be provided in the report outlining the categories and quantities of land uses, with the corresponding trip generation rates or equations, and the resulting number of trips.
6. **Trip Distribution and Traffic Assignment:**
    a. Assign the trips that would be generated by the proposed development to the adjacent road network based on existing traffic patterns. The distribution of the estimated trip generation to the adjacent street network and nearby intersections shall be included in the report and the basis will be explained. The corresponding volumes will be provided in a graphical format.
    b. Combine the site-generated traffic assignments with the background traffic forecasts to establish the Future weekday AM and PM peak hour traffic volumes.
    c. Provide the trip distribution to the City of Ann Arbor for review prior to use in the analysis.
7. **Future Conditions**:
    a. Calculate the **Future (with the proposed development)** vehicle delays, LOS, and vehicle queues at the study intersections and proposed driveways during the AM and PM peak periods. Intersection analysis shall include LOS determination for all approaches and movements. The LOS will be based on the procedures outlined in the HCM 6th Edition, the latest edition of Transportation Research Board's Highway Capacity Manual. Rodel roundabout analysis software will be used to evaluate the roundabout intersections.
    b. Identify improvements (if any) for the study road network that would be required to accommodate the site-generated traffic volumes.
8. **Access Management**
    a. Provide an exhibit that shows the proposed site driveway locations and all of the existing adjacent roadways within 200-ft of the proposed development, including all on-street parking/loading areas.
    b. Evaluate sight distance at the proposed site driveway locations.
9. **Multi-Modal Analysis**
    a. Provide a diagram that shows the existing and proposed non-motorized facilities, and interconnectivity to the proposed site plan. The pedestrian circulation plan will show all possible points of conflict between motorized traffic and pedestrian/bicycle traffic on public streets and sidewalks within 200 feet of the proposed development.
    b. Review the City of Ann Arbor Crosswalk Design Guidelines to determine improvements, if any, for the existing and proposed uncontrolled crossings on Pontiac Trail between Dhu Varren and Polson Street, and on Dhu Varren between Pontiac Trail and Leslie Park Circle.
10. **Crash Analysis**
    a. Perform a crash analysis for the most recent three years of available data at the study intersections.
    b. Perform a crash analysis in accordance with the SEMCOG Crash Analysis Process 2016.
    c. Provide recommendations for crash mitigation measures, as necessary.

The scope of this study was developed based on Fleis & VandenBrink's (F&V) knowledge of the study area, understanding of the development program, accepted traffic engineering practice, and information published by the Institute of Transportation Engineers (ITE). In addition, the City of Ann Arbor also provided input regarding the scope of work for this study and provided comments regarding previous iterations of this TIA. The study analyses were completed using Synchro/SimTraffic (Version 11). Sources of data for this study include information provided by the City of Ann Arbor, the Washtenaw Area Transportation Study (WATS), and ITE. All background information is provided in **Appendix A**.

2 BACKGROUND DATA

2.1 EXISTING ROAD NETWORK

Vehicle transportation for the proposed development is provided via Pontiac Trail and Dhu Varren Road; with regional transportation provided via M-14 and US-23. The lane use and traffic control at the study intersections are shown on **Figure 2** and the study roadways are further described below. For the purposes of this study, all minor streets, ramps, and driveways are assumed to have an operating speed of 25 miles per hour (mph), unless otherwise noted.

Pontiac Trail generally runs in the north and south directions, adjacent to the west side of the site. The roadway is under the jurisdiction of the City of Ann Arbor, has a posted speed limit of 35 mph adjacent to the proposed site, and reduces to 25 mph south of the site near Skydale Drive. The study section of roadway has a typical two (2) lane cross-section, with one (1) lane in each direction, is classified as a *Minor Arterial*, and has an AADT volume of approximately 4,500 vehicles per day (MDOT 2019) south of Dhu Varren Road. At the signalized intersection with Barton Drive, Pontiac Trail widens to provide exclusive left-turn lanes for both the northbound and the southbound approaches. Additionally, directional bike lanes are provided throughout the study corridor.

Dhu Varren Road generally runs in the east and west directions, adjacent to the north side of the site, with a posted speed limit of 35 mph. Dhu Varren Road is under the jurisdiction of the City of Ann Arbor and is classified as a *Major Collector* with an AADT volume of approximately 5,200 vehicles per day (MDOT 2019) west of Nixon Road. The study roadway provides a typical two-lane cross-section, with one lane in each direction. West of Pontiac Trail, Dhu Varren Road is un-paved and dead ends after approximately a ¼ mile to the west. East of the roundabout with Nixon Road, Dhu Varren Road becomes Green Road. Additionally, directional bike lanes are provided throughout the study corridor.

Nixon Road runs in the north and south directions and intersects with Dhu Varren Road approximately 1 mile east of the site. The study roadway is classified as a *Major Collector*, is under the jurisdiction of the City of Ann Arbor, and has an AADT volume of approximately 7,600 vehicles per day (MDOT 2019) south of Dhu Varren Road / Green Road. Nixon Road has a typical two-lane cross-section, with one lane in each direction. Nixon Road has a speed limit of 35mph to the north of Dhu Varren Road / Green Road and a speed limit of 30mph to the south of Dhu Varren Road / Green Road. Additionally, directional bike lanes are provided throughout the study corridor.

Barton Drive generally runs in the northwest and southeast directions and intersects with Pontiac Trail approximately ¾ mile south of the site. The roadway has a posted speed limit of 25 mph, is classified as a *Minor Arterial*, and is under the jurisdiction of the City of Ann Arbor. Barton Drive has a typical two-lane cross-section, with one lane in each direction and has an AADT volume of approximately 6,500 vehicles per day (MDOT 2019) east of Pontiac Trail. Additionally, directional bike lanes are provided on the study section of Barton Drive, located east of Pontiac Trail.

Polson Street generally runs in the east and west directions on the west side of Pontiac Trial. Polson Street is a *Local Road* that serves as an access point to the North Sky Pulte residential development, which was partially constructed at the time of this study. This development was assumed as a background development for this study.

Leslie Park Circle generally runs in the north and south directions east of the site. Leslie Park Circle is a *Local Road* that serves as an access point to Leslie Park and to the "Dhu Varren on the Park" residential neighborhood. The proposed development will include internal access to Leslie Park Circle.

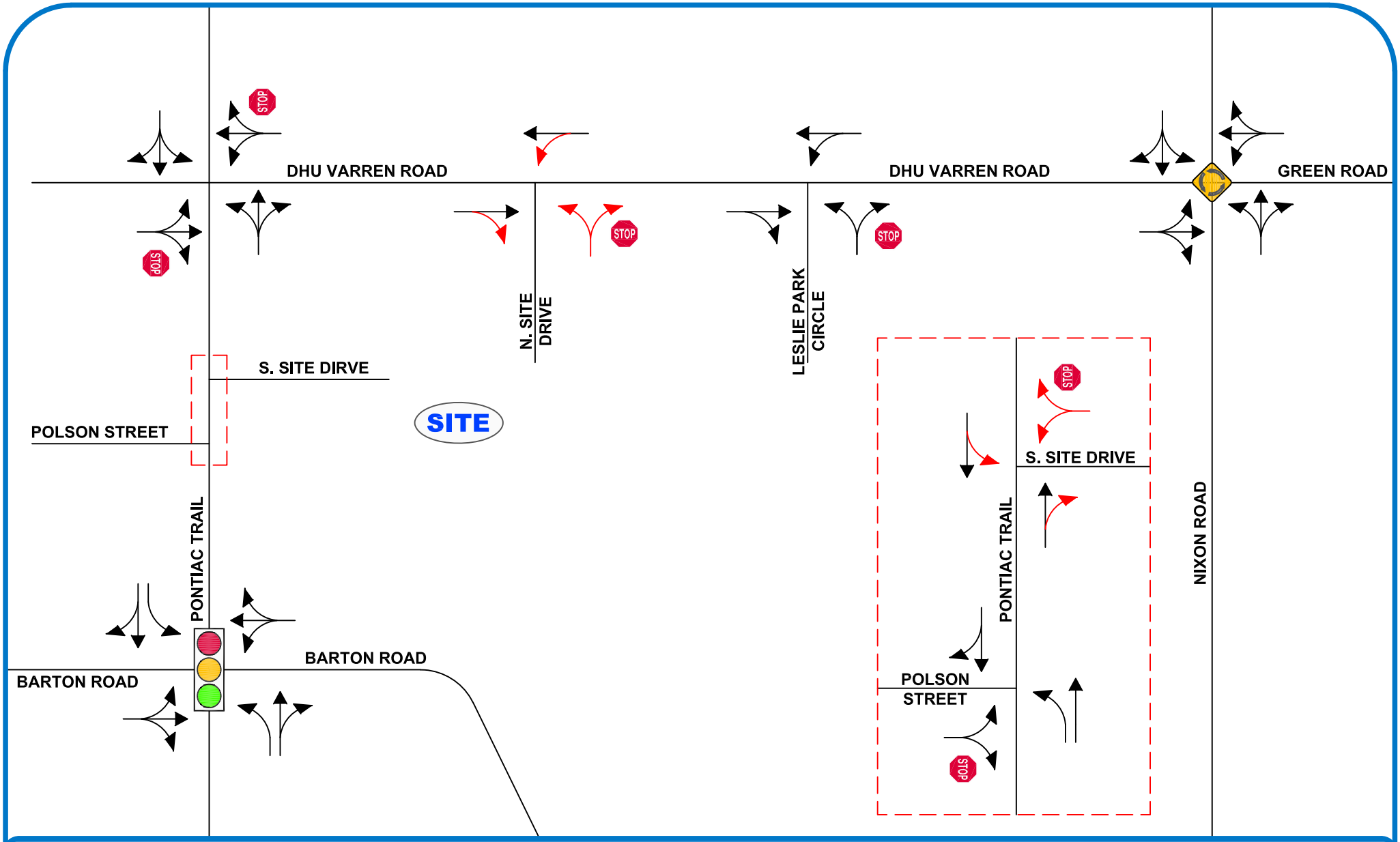


FIGURE 2

LANE USE AND TRAFFIC CONTROL

VILLAGE ON ANN ARBOR TIS - ANN ARBOR, MI

LEGEND

- ROADS
- PROPOSED ROADS
- LANE USE
- PROPOSED LANE USE
- SIGNALIZED INTERSECTION
- UNSIGNALIZED INTERSECTION
- ROUNDABOUT INTERSECTION

NORTH

SCALE: NOT TO SCALE

2.2 EXISTING TRAFFIC VOLUMES

Due to the impact of COVID-19 and the subsequent closures of businesses and schools, current traffic volume data is not representative of "typical" operations. Therefore, existing peak hour traffic volume data at the study intersections were obtained from previous traffic studies completed within the City of Ann Arbor.

F&V subconsultant Traffic Data Collection, Inc (TDC) collected current 2021 TMC data at the following study intersections.

- Pontiac Tr. & Dhu Varren Rd.
- Pontiac Tr. & Polson St.
- Pontiac Trail & Barton Rd.
- Dhu Varren Rd. & Leslie Park Circle

Historical traffic volume data was obtained by F&V at the following intersections: Nixon Road & Dhu Varren Road / Green Road (2016), Pontiac Trail & Dhu Varren Road (2019), Pontiac Trail & Barton Drive (2019). An annual growth rate of 2.0% was provided by WATS and was applied to historic traffic volumes to calculate the expected 2021 traffic volumes. When expected 2021 traffic volumes were compared to the collected 2021 traffic volumes, the collected volumes were significantly less than pre-COVID volume expectations. Therefore, the expected 2021 traffic volumes calculated from 2016 and 2019 volumes were utilized in the study. Minor street movements to/from Leslie Park Circle were utilized, and the intersection of Polson Street utilized site generated traffic volumes from the North Sky neighborhood based on the projected trip generation volumes identified in the associated traffic study.

During collection of the turning movement counts, Peak Hour Factors (PHFs), pedestrian and bike volumes, and commercial truck percentages were recorded and used in the traffic analysis. At locations where access is provided between study intersections, "dummy" intersections were used to account for sink and source volumes, and through volumes were carried along the main study roadways. The AM and PM peak hours of existing network traffic were identified to generally occur between 7:30 AM to 8:30 AM and 4:30 PM to 5:30 PM for a typical weekday. The traffic volume data are included in **Appendix A** and the existing peak hour traffic volumes are summarized on **Figure 3**.

3 ANALYSIS

4 EXISTING CONDITIONS

4.1 EXISTING OPERATIONS

The existing AM and PM peak hour vehicle delays and Levels of Service (LOS) were calculated at the study intersection using Synchro (Version 11) traffic analysis software. The results of the analysis of existing conditions were based on the existing lane use and traffic control shown on **Figure 2**, the existing traffic volumes shown on **Figure 3**, and the methodologies presented in the Highway Capacity Manual 6th Edition (HCM6). Additionally, the roundabout intersection of Nixon Road & Dhu Varren Road / Green Road was evaluated using the Rodel roundabout analysis software.

Descriptions of LOS "A" through "F" as defined in the HCM6, are provided in **Appendix B** for signalized and unsignalized intersections. Typically, LOS D is considered acceptable, with LOS A representing minimal delay, and LOS F indicating failing conditions. Microsimulations were also conducted at the study intersections using SimTraffic to further evaluate the network performance. The results of the existing vehicle and pedestrian / cyclist operational analyses are summarized in **Tables 1 and 2** and results are provided in **Appendix B**.

The results of the existing conditions analysis show that all study intersection approaches and movements are currently operating acceptably at a LOS D or better during both peak periods, with the exception of the following:

PONTIAC TRAIL & DHU VARREN ROAD

- During the AM peak hour: the westbound approach currently operates at LOS F.

A review of SimTraffic network simulations indicates acceptable operations during the AM peak hour. The 95th percentile vehicle queue length for the westbound approach was approximately 134 feet (5-6 vehicles) during the AM peak hour. However, the large volume (~180 vehicles) of vehicles making the westbound left-turn movement and microsimulation observations indicate that the vehicles on the westbound approach are able to find adequate gaps within the through traffic along Pontiac Trail, without experiencing significant delays and/or excessive vehicle queueing. Review of SimTraffic microsimulations at all of the other study intersections indicate acceptable operations during both peak periods.

The results of the non-motorized existing conditions analysis indicate that all study intersection approaches will operate at a LOS D or better for pedestrians and cyclists during both the AM and PM peak hours.

Table 1: Existing Intersection Operations

Intersection		Control	Approach	Existing Conditions			
				AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	Pontiac Trail & Dhu Varren Road	Stop (Minor)	EB	15.2	C	12.1	B
			WB	55.2	F	27.1	D
			NBL	8.1	A	7.4	A
			SBL	8.1	A	8.7	A
2	Pontiac Trail & Polson Street	Stop (Minor)	EB	0.0*	A	0.0*	A
			NBL	0.0*	A	0.0*	A
			SB	Free		Free	
3	Pontiac Trail & Barton Drive	Signalized	EB	45.9	D	27.5	C
			WB	21.1	C	23.7	C
			NBL	51.1	D	28.8	C
			NBTR	20.0	C	21.8	C
			SBL	23.8	C	29.8	C
			SBTR	36.4	D	18.3	B
			Overall	**36.5**	**D**	**23.9**	**C**
4	Dhu Varren Road & Leslie Park	Stop (Minor)	EB	Free		Free	
			WBL	7.9	A	7.7	A
			NB	11.3	B	10.5	B

** Indicates no vehicle volume present*

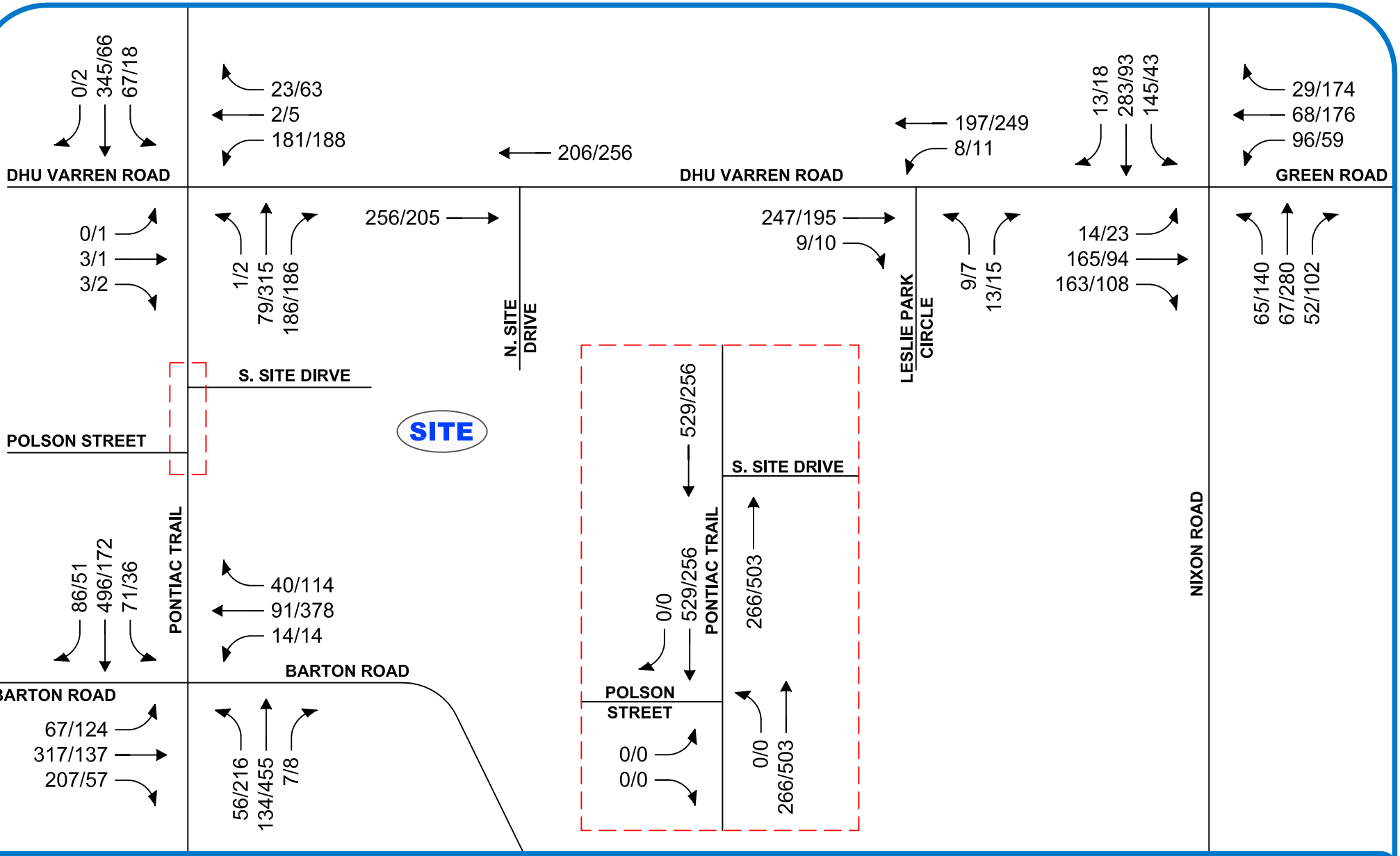


FIGURE 3

EXISTING TRAFFIC VOLUMES

VILLAGE ON ANN ARBOR TIS - ANN ARBOR, MI

LEGEND

ROADS

PROPOSED ROADS

TRAFFIC VOLUMES (AM/PM)

NORTH

SCALE: NOT TO SCALE

Table 1 Continued: Existing Intersection Operations

Intersection		Control	Approach	Existing Conditions			
				AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS
5	Nixon Road & Dhu Varren Road / Green Road	Roundabout	EB	6.3	A	4.0	A
			WB	4.3	A	7.3	A
			NB	4.7	A	6.5	A
			SB	5.6	A	4.2	A
			Overall	**5.5**	**A**	**6.0**	**A**

Table 2: Existing Non-motorized Operations

Intersection		Control	Approach	Existing Conditions			
				AM Peak		PM Peak	
				Pedestrian LOS	Cyclist LOS	Pedestrian LOS	Cyclist LOS
1	Pontiac Trail & Dhu Varren Road	Stop (Minor)	NB	B	*n/a*[1]	A	*n/a*[1]
			SB	B	*n/a*[1]	A	*n/a*[1]
2	Pontiac Trail & Polson Street	Stop (Minor)	NB	C	*n/a*[1]	C	*n/a*[1]
			SB	C	*n/a*[1]	C	*n/a*[1]
3	Pontiac Trail & Barton Drive	Signalized	EB	B	C	B	C
			WB	B	B	B	B
			NB	B	C	C	C
			SB	B	C	B	C
4	Leslie Park & Dhu Varren Road	Stop (Minor)	NB	B	*n/a*[1]	B	*n/a*[1]
			SB	B	*n/a*[1]	B	*n/a*[1]

4.2 EXISTING IMPROVEMENTS

PONTIAC TRAIL & DHU VARREN ROAD

In order to improve the existing traffic operations to a LOS D or better for all intersection approaches and movements the following mitigation measures were evaluated:

A. Traffic Signal

B. All-Way Stop Control

C. Roundabout

A. Traffic Signal Warrant Analysis

A signal warrant analysis was conducted at the study intersection of Pontiac Trail & Dhu Varren Road. The *2011 Michigan Manual on Uniform Traffic Control Devices* (MMUTCD) documents the guidelines by which traffic signal control may or should be considered. The City of Ann Arbor provided 13-hour turning movement traffic volume data for use in the study. F&V evaluated Warrant 1 (8-Hour Vehicular Volume), Warrant 2 (4-Hour Vehicular Volume), Warrant 3 (Peak-Hour), and Warrant 7 (Crash Experience) for this study.

[1] Cyclist LOS calculations are only available for signalized intersections. Additionally, neither pedestrian nor cyclist LOS calculations are available for roundabout intersections; therefore, Nixon Road & Dhu Varren Road was excluded.

Warrant 1

According to the MMUTCD, Warrant 1, Condition A is intended for application at locations where a large volume of intersecting traffic is the principal reason to consider installing a traffic control signal. Condition B is intended for application where Condition A is not satisfied and where the traffic volume on the major street is so heavy that traffic on a minor intersecting street suffers excessive delay or conflict in entering or crossing the major street. It is intended that Warrant 1 be treated as a single warrant, where Warrant 1 is satisfied if either Conditions A or B are met. Analysis of the standards of this warrant indicates that Condition A and Condition B are met for 4 hours and 0 hours, respectively. Therefore, ***Warrant 1 is not met.***

Warrant 2

The Four-Hour signal warrant conditions are intended to be applied where the volume of intersecting traffic is the principal reason to consider installing a traffic control signal. The need for a signal shall be considered if for each of any four hours of an average day, the approach volumes fall above the applicable curve on Figure 4C-1. Analysis of the standards for this warrant indicates that the intersection approach volumes fall above the applicable curve for 2 hours. Therefore, ***Warrant 2 is not met.***

Warrant 3

The Peak Hour signal warrant conditions is intended for use at a location where traffic conditions are such that for a minimum of 1 hour of an average day, the minor-street traffic suffers undue delay when entering or crossing the major street. The need for a signal shall be considered if on any hour of an average day, the approach volumes fall above the applicable curve on Figure 4C-3. Analysis of the standards for this warrant indicates that the intersection approach volumes fall above the applicable curve for 0 hours. Therefore, ***Warrant 3 is not met.***

Warrant 7

The Crash Experience warrant conditions are intended to be applied where the severity and frequency of crashes are the principal reasons to consider a traffic control signal. For the study intersections analyzed, the 56% volume factor criteria may be considered in place of the 80% volume factor. F&V completed a crash review for the study intersection based on historical crash data for the most recent available three years (2017-2019) obtained from the Michigan Traffic Crash Facts (MTCF) website.

The results of the crash analysis indicate the intersection of Pontiac Trail & Dhu Varren Road experienced a total of six (6) crashes, averaging 2 crashes per year over the three years analyzed. The crash type with the greatest frequency at the intersection was head-on crashes accounting for 33% of reported crashes. The remaining crashes were a sideswipe, a rear-end, a single motor vehicle, and an angle crash. Of the four crashes reported, four were property damage only (PDO), one included a C-injury, and one included a A-injury, with zero fatal crashes. This crash data indicates that the frequency and severity at this location is not significant, and a correctable crash pattern does not exist. Therefore, ***Warrant 7 is not met.***

Table 3: Existing Signal Warrant Analysis Summary

Pontiac Trail & Dhu Varren Road		
Warrant 1: Eight Hour		**NO**
Condition A	*Hours Met*	**4**
	Warrant Met	**NO**
Condition B	*Hours Met*	**0**
	Warrant Met	**NO**
Warrant 2: Four-Hour	*Hours Met*	**2**
	Warrant Met	**NO**
Warrant 3: Peak-Hour	*Hours Met*	**0**
	Warrant Met	**NO**
Warrant 7: Crash Experience	*Warrant Met*	**NO**

The results of the signal warrant analysis indicates that a traffic signal is currently **NOT** warranted at the intersection based on existing traffic volumes. Additionally, review of network simulations for this intersection does not indicate that minor-street traffic suffers undue delay and vehicle queues are observed to be acceptably processed during the peak hours. The existing signal warrant charts are provided in **Appendix E**.

B. All-Way Stop Control Analysis

Section 2B.07 of the *MMUTCD* provides the following criterion to evaluate for the consideration of multi-way stop control at an intersection.

A. Where traffic control signals are justified, the multi-way stop is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.

B. Five or more reported crashes in a 12-month period that are susceptible to correction by a multi-way stop installation. Such crashes include right-turn and left-turn collisions as well as right-angle collisions.

C. Minimum volumes:

1 The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day; and

2 The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour; but

3 If the 85th-percentile approach speed of the major-street traffic exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the values provided in Items 1 and 2.

Where no single criterion is satisfied, but where Criteria B, C.1, and C.2 are all satisfied to 80 percent of the minimum values. Criterion C.3 is excluded from this condition.

The results of the all-way stop-control analysis indicates that 5 of the 8 hours of criteria are met. Therefore, all-way stop is currently **NOT** warranted at the intersection of Pontiac Trail & Dhu Varren Road based on existing traffic volumes. The existing all-way stop control warrant chart is provided in **Appendix E**.

C. Roundabout

In a further effort to mitigate the existing failing LOS and vehicle delay at the intersection of Pontiac Trail & Dhu Varren Road during the AM peak hour, a preliminary analysis of a roundabout was investigated using Rodel (Roundabout Analysis Software). Further analysis using a fully designed roundabout would be necessary; however, the results of the preliminary analysis indicate that, all approaches will operate at a LOS A during both peak periods, as shown in **Table 4**. The construction of a roundabout at this location would also improve pedestrian safety across Pontiac Trail, by slowing vehicles entering the intersection and by providing a median refuge for pedestrian to make a two-stage crossing. Additionally, a review of the SimTraffic network simulations indicates acceptable operations during both peak periods and improved vehicle queue lengths for westbound traffic.

RECOMMENDED IMPROVEMENTS SUMMARY

Intersections and Recommended Mitigation Measures
Pontiac Trail & Dhu Varren Road
• Construct a roundabout with enhanced pedestrian crossings and markings

Table 4: Existing Intersection Operations with Improvements

Intersection		Control	Approach	Existing w/ Improvements			
				AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	Pontiac Trail & Dhu Varren Road	Roundabout	EB	2.1	A	1.0	A
			WB	4.2	A	5.1	A
			NB	4.4	A	5.6	A
			SB	5.1	A	3.5	A
			Overall	**4.7**	**A**	**5.2**	**A**

5 BACKGROUND CONDITIONS

5.1 BACKGROUND GROWTH

Washtenaw Area Transportation Study (WATS) is the multi-jurisdictional agency responsible for the transportation planning in Washtenaw County. WATS maintains the area transportation planning models and provides information regarding projected growth rates along roadways throughout their jurisdiction. F&V contacted WATS to obtain a background growth rate for use in this study. The WATS travel demand forecast model indicated the following growth rates compounded annually from 2015 to 2040. The growth rates for study corridors provided by WATS are summarized in **Table 5**.

Table 5: WATS Growth Rates

Road	Limits	Growth Rate
Dhu Varren Road	Pontiac Trail to Nixon Road	1.90%
Pontiac Trail	Barton Drive to Dhu Varren Road	1.47%
Nixon Road	Plymouth Road to Dhu Varren Road	1.40%

The annual growth rates were rounded up to a conservative average annual growth rate of **2.00%**, which was applied to the 2016 and 2019 traffic volumes to forecast the existing 2021 traffic volumes and background 2025 traffic volumes ***without the proposed development.***

In addition to the background traffic growth, it is important to account for traffic that will be generated by developments within the vicinity of the study area that are currently under construction or will be within the buildout year. The City of Ann Arbor provided the following developments were currently under development during the 2016/2019 data collection or will be under development within the buildout year of 2025.

- North Sky
- The Cottages at Barton Green
- Nixon Farms
- Bristol Ridge

Therefore, the site trip generations for each of the residential developments were included for the background traffic operations analysis, based on their respective traffic studies. The trip generation information from the traffic studies completed for these background developments are provided in **Appendix A**. Additionally, there were mitigation measures identified within these traffic studies including a left-turn lane on Pontiac Trail, which was included within the Synchro model as baseline background condition.

5.2 BACKGROUND OPERATIONS (2025 NO BUILD)

Background peak hour vehicle delays and LOS ***without the proposed development*** were calculated based on the existing lane use and traffic control shown on **Figure 2**, the background traffic volumes shown on **Figure 4**, and the methodologies presented in the HCM6. The results of the analysis of background conditions are presented in **Appendix C** and are summarized in **Table 6** and **Table 7**.

Table 6: Background Intersection Operations

	Intersection	Control	Approach	Existing Conditions				Background Conditions				Difference			
				AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	Pontiac Trail & Dhu Varren Road	Stop (Minor)	EB	15.2	C	12.1	B	17.4	C	13.6	B	2.2	-	1.5	-
			WB	55.2	F	27.1	D	216.2	F	95.7	F	161.0	-	68.6	D→F
			NBL	8.1	A	7.4	A	8.2	A	7.4	A	0.1	-	0.0	-
			SBL	8.1	A	8.7	A	8.4	A	9.1	A	0.3	-	0.4	-
2	Pontiac Trail & Polson Street	Stop (Minor)	EB	0.0*	A	0.0*	A	16.7	C	13.3	B	16.7	C	13.3	B
			NBL	0.0*	A	0.0*	A	9.2	A	8.4	A	9.2	A	8.4	A
			SB	Free		Free		Free		Free		Free		Free	

** Indicates no vehicle volume present*

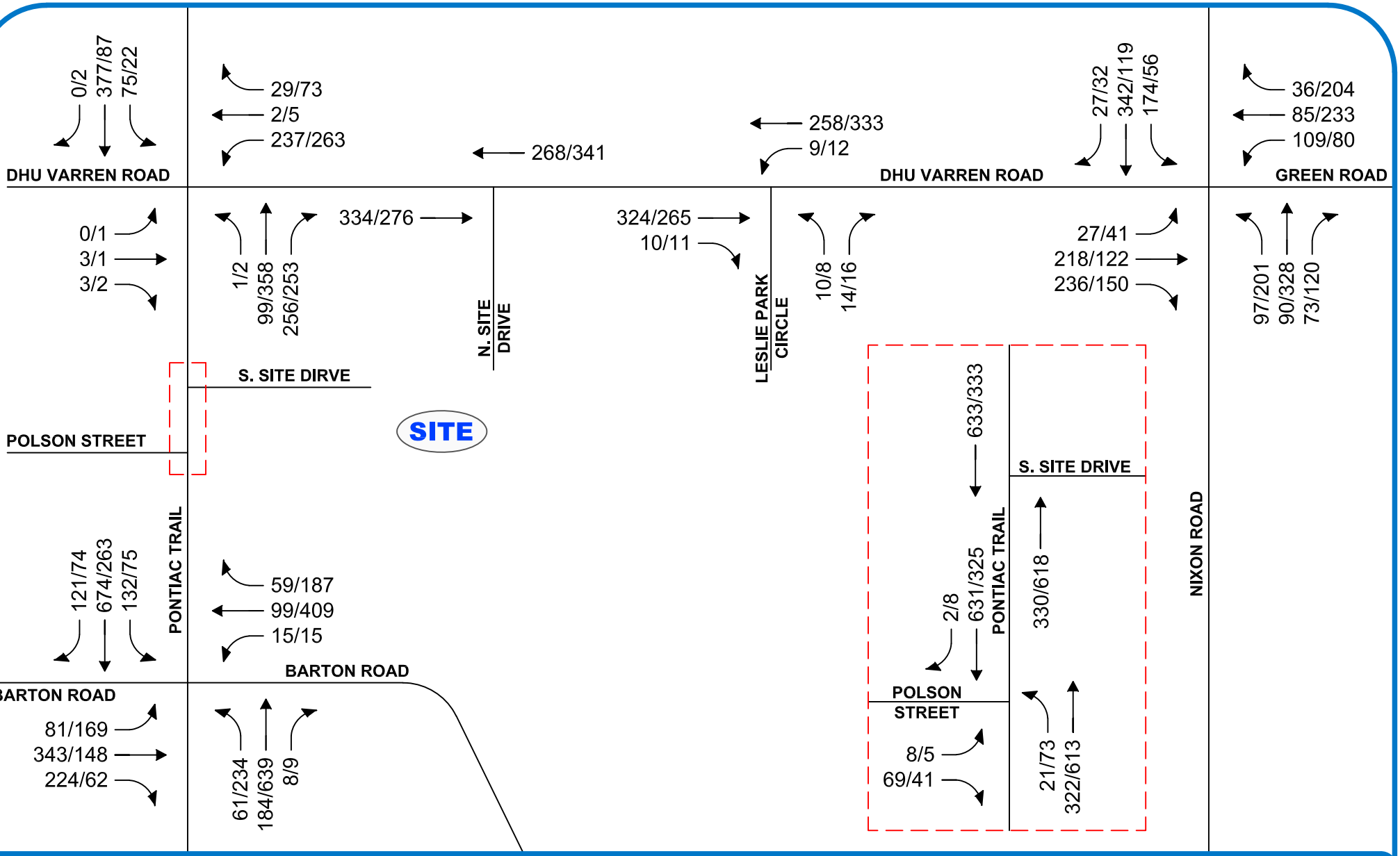


FIGURE 4

BACKGROUND TRAFFIC VOLUMES

VILLAGE ON ANN ARBOR TIS - ANN ARBOR, MI

LEGEND

ROADS

PROPOSED ROADS

TRAFFIC VOLUMES (AM/PM)

NORTH

SCALE: NOT TO SCALE

Table 6 Continued: Background Intersection Operations

	Intersection	Control	Approach	Existing Conditions				Background Conditions				Difference			
				AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
3	Pontiac Trail & Barton Drive	Signalized	EB	45.9	D	27.5	C	66.2	F	208.4	F	20.3	D→F	180.9	C→F
			WB	21.1	C	23.7	C	21.7	C	35.5	D	0.6	-	11.8	C→D
			NBL	51.1	D	28.8	C	213.7	F	63.9	E	162.6	D→F	35.1	C→E
			NBTR	20.0	C	21.8	C	21.3	C	40.5	D	1.3	-	18.7	C→D
			SBL	23.8	C	29.8	C	28.5	C	75.8	E	4.7	-	46.0	C→E
			SBTR	36.4	D	18.3	B	116.5	F	25.0	C	80.1	D→F	6.7	B→C
			Overall	36.5	D	23.9	C	78.0	E	68.1	E	41.5	D→E	44.2	C→E
4	Dhu Varren Road & Leslie Park	Stop (Minor)	EB	Free		Free		Free		Free		Free		Free	
			WBL	7.9	A	7.7	A	8.2	A	7.9	A	0.3	-	0.2	-
			NB	11.3	B	10.5	B	12.8	B	11.7	B	1.5	-	1.2	-
5	Nixon Road & Dhu Varren Road / Green Road	Roundabout	EB	6.3	A	4.0	A	10.4	B	4.7	A	4.1	A→B	0.7	-
			WB	4.3	A	7.3	A	4.7	A	11.6	B	0.4	-	4.3	A→B
			NB	4.7	A	6.5	A	5.7	A	9.1	A	1.0	-	2.6	-
			SB	5.6	A	4.2	A	7.4	A	4.9	A	1.8	-	0.7	-
			Overall	5.5	A	6.0	A	7.6	A	8.6	A	2.1	-	2.6	-

The results of the background conditions analysis indicates that all of the study intersection approaches and movements will continue to operate in a manner similar to existing conditions, with the following additional delays with the increase in background traffic volumes:

PONTIAC TRAIL & DHU VARREN ROAD

- During the AM peak hour: the westbound approach is expected to experience a 161-second increase in delay. Review of SimTraffic network simulations indicates similar operations to existing conditions.
- During the PM peak hour: the westbound approach is expected to operate at LOS F with an approximately 69-second increase in delay. Further review of SimTraffic network simulations indicates the 95th percentile vehicle queue length for the westbound approach was approximately 176 feet (7-8 vehicles) during the PM peak hour.

PONTIAC TRAIL & BARTON DRIVE

- During the AM peak hour: the eastbound approach, the northbound left-turn movement, and the southbound shared through/right movement are expected to operate at LOS F. Additionally, the overall intersection is expected to operate at LOS E. Review of SimTraffic network simulations indicates long vehicles queues for the southbound shared through/right movement; these queues were present throughout the peak hour. Network simulations also indicate long vehicle queues for the eastbound approach; these queues were observed to be present throughout the majority of the peak hour.
- During the PM peak hour: the eastbound approach is expected to operate at LOS F. Additionally, the northbound left-turn movement, the southbound left-turn movement, and the overall intersection are expected to operate at LOS E. Review of SimTraffic network simulations indicates long vehicles queues for the eastbound approach; these queues observed to persist throughout the peak hour. The long queues for the eastbound approach are the result of a high volume of eastbound left-turn traffic (~170 vehicles) attempting to find gaps within the westbound traffic flow. Additionally, microsimulations indicates long vehicle queues on the northbound approach, which were typically observed to be present throughout the peak hour. The northbound approach vehicle queues are the result of the high volume of left-turn (~230 vehicles) and through (~640 vehicles) traffic and the long queues are often extended by vehicles in the northbound left-turn lane exceeding the available storage area and blocking the shared through/right lane. Review of microsimulations for the southbound left-turn lane indicate generally acceptable operations; however, this is in part due to the northbound left-turn vehicles occasionally blocking the northbound through lane and providing additional gaps for permissive southbound left-turn traffic within the northbound traffic flow.

The results of the non-motorized background conditions analysis indicate that all study intersection approaches will operate at a LOS D or better for pedestrians and cyclists during both the AM and PM peak hours.

Table 7: Background Non-motorized Operations

Intersection		Control	Approach	Existing Conditions				Background Conditions			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Pedestrian LOS	Cyclist LOS	Pedestrian LOS	Cyclist LOS	Pedestrian LOS	Cyclist LOS	Pedestrian LOS	Cyclist LOS
1	Pontiac Trail & Dhu Varren Road	Stop (Minor)	NB	B	*n/a*[1]	A	*n/a*[1]	B	*n/a*[1]	B	*n/a*[1]
			SB	B	*n/a*[1]	A	*n/a*[1]	B	*n/a*[1]	B	*n/a*[1]
2	Pontiac Trail & Polson Street	Stop (Minor)	NB	C	*n/a*[1]	C	*n/a*[1]	C	*n/a*[1]	C	*n/a*[1]
			SB	C	*n/a*[1]	C	*n/a*[1]	C	*n/a*[1]	C	*n/a*[1]
3	Pontiac Trail & Barton Drive	Signalized	EB	B	C	B	C	B	C	B	C
			WB	B	B	B	B	B	B	B	B
			NB	B	C	C	C	B	C	C	D
			SB	B	C	B	C	C	D	C	C
4	Leslie Park & Dhu Varren Road	Stop (Minor)	NB	B	*n/a*[1]	B	*n/a*[1]	B	*n/a*[1]	B	*n/a*[1]
			SB	B	*n/a*[1]	B	*n/a*[1]	B	*n/a*[1]	B	*n/a*[1]

5.3 Background Improvements

Pontiac Trail & Dhu Varren Road

In order to improve the existing traffic operations to a LOS D or better for all intersection approaches and movements the following mitigation measures were evaluated:

A. Traffic Signal with addition of Left-turn Lanes

B. All-Way Stop Control

C. Roundabout

A. Traffic Signal Warrant Analysis

The results of the signal warrant analysis indicates that a traffic signal is expected to meet Warrant 2 and Warrant 3 based on the projected background traffic volumes. The addition of a traffic signal at this intersection was evaluated and it was determined that the delay would *increase* on the Pontiac Trail approaches with the addition of signalization while providing only minor improvements on the Dhu Varren Road approaches. The background conditions signal warrant charts are provided in **Appendix E**.

Table 8: Background Signal Warrant Analysis Summary

Pontiac Trail & Dhu Varren Road		
Warrant 1: Eight Hour		NO
Condition A	*Hours Met*	6
	Warrant Met	NO
Condition B	*Hours Met*	3
	Warrant Met	NO
Warrant 2: Four-Hour	*Hours Met*	4
	Warrant Met	YES
Warrant 3: Peak-Hour	*Hours Met*	1
	Warrant Met	YES

[1] Cyclist LOS calculations are only available for signalized intersections. Additionally, neither pedestrian nor cyclist LOS calculations are available for roundabout intersections; therefore, Nixon Road & Dhu Varren Road was excluded.

B. All-Way Stop Control Analysis

The results of the all-way stop-control analysis indicates that 9 of the 8 hours of criteria are met and therefore this intersection is expected to meet all way stop warrant with the addition of background traffic volumes. The addition of an all-way stop at this intersection was evaluated and it was determined that the delay would *increase* on the Pontiac Trail approaches while providing only minor improvements on the Dhu Varren Road approaches. The background all-way stop control warrant chart is provided in **Appendix E**.

C. Roundabout

In a further effort to mitigate the failing LOS and vehicle delay at the intersection of Pontiac Trail & Dhu Varren Road during the peak periods, a preliminary analysis of a roundabout was investigated using Rodel (Roundabout Analysis Software). Further analysis using a fully designed roundabout would be necessary; however, the results of the preliminary analysis indicate that, all approaches will operate at a LOS B or better during both peak periods.

In addition to improving the failing LOS at this intersection during both peak periods, the construction of a roundabout is expected to improve operations during all other times of the day, as a roundabout provides yield control on all approaches, which does not require vehicles to stop unless conflicting traffic is present. Similarly, a roundabout will also minimize the adverse impact to Pontiac Trail and provide the lowest delay for the intersection overall. Additionally, the construction of a roundabout at this location would also improve pedestrian safety across Pontiac Trail, by slowing vehicles entering the intersection and by providing a median refuge for pedestrian to make a two-stage crossing. A review of the SimTraffic network simulations indicates acceptable operations during both peak periods and improved vehicle queue lengths for westbound traffic.

PONTIAC TRAIL & BARTON DRIVE

In order to improve traffic operations at the signalized intersection of Pontiac Trail & Barton Drive, to a LOS D or better during both peak periods, mitigation measures were investigated, including signal timing adjustments and geometric improvements. Signal timing optimizations were evaluated to mitigate the background delays but were found to be insufficient. The results of the analysis indicate that additional capacity is needed to accommodate the background volumes at this intersection. Therefore, geometric improvements were investigated; the results indicate that an additional through lane is needed for northbound and southbound Pontiac Trail. Additionally, an exclusive left-turn lane for eastbound Barton Drive and an exclusive right-turn lane for westbound Barton Drive would be needed to provide sufficient intersection capacity to improve all approaches and movements to LOS D or better.

The identified mitigation measures as summarized below:

- Construct a second northbound through lane and a second southbound through lane on Pontiac Trail at Barton Drive.
- Construct an exclusive eastbound left-turn lane and an exclusive westbound right-turn on Barton Drive at Pontiac Trail.

Upon review of the available ROW and the City's infrastructure planning in this area the constructability of these improvements is not likely to be feasible. Therefore, these improvements are **not recommended** at this intersection and were **identified purely for informational purposes** to demonstrate what would be necessary to reduce intersection delays for vehicles. Furthermore, additional capacity at this intersection has the potential to impact the safety and operations for non-motorized and pedestrian users, these improvements were identified to describe the necessary changes required to mitigate the failing LOS experienced at this intersection under background conditions.

The results of the background conditions with improvements analysis are summarized in **Table 9** and indicate that, with the implementation of the geometric mitigation measures identified above, all approaches and movements will operate acceptably at LOS D or better during both peak periods. Review of SimTraffic network simulations indicates acceptable operations during both peak periods. In addition, microsimulation observations during both the AM and PM peak hours indicate significantly improved vehicle queueing at the signalized intersection of Pontiac Trail and Barton Drive. Review of SimTraffic network simulations at all of the other study intersections indicates acceptable operations during both peak periods.

Table 9: Background Intersection Operations with Improvements

Intersection		Control	Approach	Background w/ IMP			
				AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	Pontiac Trail & Dhu Varren Road	Roundabout	EB	2.3	A	1.0	A
			WB	4.6	A	6.0	A
			NB	5.0	A	6.8	A
			SB	5.7	A	3.7	A
			Overall	**5.2**	**A**	**6.2**	**A**
3	** Pontiac Trail & Barton Drive	Signalized	EBL	46.2	D	35.8	D
			EBTR	34.0	C	14.0	B
			WBTL	17.2	B	16.9	B
			WBR	14.3	B	14.0	B
			NBL	35.0	D	30.1	C
			NBTR	17.5	B	17.6	B
			SBL	22.1	C	24.1	C
			SBTR	24.8	C	15.5	B
			Overall	**26.6**	**C**	**19.3**	**B**

*** Indicates that the mitigation measures identified for the study intersection of Pontiac Trail & Barton Drive are **NOT RECOMMENDED** and are provided for **INFORMATIONAL PURPOSES ONLY***

RECOMMENDED IMPROVEMENTS SUMMARY

Intersections and Recommended Mitigation Measures
Pontiac Trail & Dhu Varren Road
• Construct a roundabout with enhanced pedestrian crossings and markings

6 SITE TRIP GENERATION

The trip generation for the proposed development used the recommended engineering practice and methodologies, as published in the Institute of Transportation Engineers (ITE) *Trip Generation Manual 10th Edition* and the ITE *Trip Generation Handbook, 3rd Edition*. Additional data provided by the City of Ann Arbor was also used in the analysis, in conjunction with the ITE methodology. The trip generation analysis summarized below provides the information necessary to provide a comprehensive traffic impact study considering all multi-modal impacts (vehicles, pedestrians, transit, and bikes). By using the ITE data for the proposed development and then adjusting based on local data, we have presented a conservative approach tailored to the specific needs of the City of Ann Arbor.

6.1 VEHICULAR TRIP GENERATION ANALYSIS

The first step in evaluating the trip generation for the proposed development was to calculate the trip generation using the ITE *Trip Generation Manual (10th Edition)*. **Table 10** shows the ITE trip generation for the Village of Ann Arbor development. The applicable land use code used in the trip generation analysis were reviewed and approved by the City of Ann Arbor. The proposed development includes the construction of 562 multi-family residential units.

Table 10: Vehicular Trip Generation per *ITE Trip Generation Manual, 10th Edition*

Land Use	ITE Code	Amount	Units	Average Daily Traffic (vpd)	AM Peak Hour (vph)			PM Peak Hour (vph)		
					In	Out	Total	In	Out	Total
Multi-Family Home (Low-Rise)	220	378	D.U.	2,817	39	130	169	122	71	193
Multi-Family Housing (Mid-Rise)	221	184	DU	1,001	16	46	62	49	31	80
Total Trips		**562**	**D.U.**	**3,818**	**55**	**176**	**231**	**171**	**102**	**273**

6.2 ITE Modal Split

The vehicle trips in **Table 10** were then converted to person trips by using the baseline vehicle mode split and baseline vehicle occupancy rates published by ITE in Appendix B, Table B.1, of the ITE *Trip Generation Handbook, 3rd Edition.* The vehicle mode splits and vehicle occupancy rates for the studies contained within the *Trip Generation Manual* are provided in **Table 11** below.

Table 11: Baseline Vehicle Occupancy Rates per *ITE Trip Generation Handbook, 3rd Edition*

AM PEAK HOUR					
Inbound			Outbound		
Personal Vehicle	Truck	Vehicle Occupancy	Personal Vehicle	Truck	Vehicle Occupancy
0.892	0.070	1.13	0.968	0.010	1.09
PM PEAK HOUR					
Inbound			Outbound		
Personal Vehicle	Truck	Vehicle Occupancy	Personal Vehicle	Truck	Vehicle Occupancy
0.963	0.010	1.15	0.947	0.015	1.21
WEEKDAY					
Personal Vehicle		Truck		Vehicle Occupancy	
0.943		0.026		1.145	

The above factors were applied to the total vehicle trips generated in **Table 10** to provide the total number of person-trips generated by the proposed development. This was accomplished by dividing the number of total site-generated vehicle trips by the personal vehicle mode split (i.e., "personal vehicle" in the tables above) and multiplying by the vehicle occupancy to obtain the total number of site-generated person-trips. The total person trips are summarized in **Table 12**.

Table 12: Person-Trip Generation per ITE Trip Generation Handbook, 3rd Edition

	Average Daily Traffic (vpd)	AM Peak Hour (vph)			PM Peak Hour (vph)		
		In	Out	Total	In	Out	Total
Total Person Trips	4,639	70	198	268	205	130	335

6.3 City of Ann Arbor Modal Split

A modal split was the applied to the Person-Trips to determine the number of site-generated trips using a variety of mode choices. This was calculated by applying the modal splits provided by the City of Ann Arbor. The factors are summarized in **Table 13** below and the relevant excerpts are included in **Appendix A**.

Table 13: City of Ann Arbor Commuting Modal Splits

Vehicle	0.900
Walk	0.010
Bike	0.020
Transit	0.070

These factors were applied to the Person-Trips in **Table 12** to calculate the modal split trip generation for the proposed development. For walking, cycling, and transit mode choices, one person-trip corresponds to one pedestrian, bike, or transit trip and no further adjustments were required. However, site-generated vehicle trips must be adjusted to reflect appropriate vehicle occupancy in accounting for multiple-occupant vehicles. Therefore, the SEMCOG *Transportation Demand Management (TDM) in Southeast Michigan* document was referenced to obtain vehicle occupancy rates relevant to Michigan communities. The document specified an

average vehicle occupancy of 1.1 persons/vehicle for work-related trips and 1.4 persons/vehicle for non-work-related trips. Therefore, it was assumed that residential site-generated vehicle trips would have a vehicle occupancy of 1.1 persons/vehicle for AM and PM peak hour trips and an average of 1.25 persons/vehicle for daily trips. The modal split trip generation for the proposed development is summarized in **Table 14** and was used in the traffic impact study to evaluate the study intersections. *Note: The values have been rounded up to the nearest whole number.*

Table 14: Modal Split Trip Generation

Modal Site Trip Generation	Average Daily Traffic (trips/day)	AM Peak Hour (trips/hour)			PM Peak Hour (trips/hour)		
		In	Out	Total	In	Out	Total
Vehicular Trips	3,340	57	163	220	167	107	274
Pedestrian Trips	47	1	2	3	3	1	4
Cyclist Trips	93	2	4	6	5	2	7
Transit Trips	325	5	14	19	15	9	24

7 SITE TRAFFIC ASSIGNMENT

The vehicular trips that would be generated by the proposed development were assigned to the study road network based on existing peak hour traffic patterns, the proposed site access plan, and the methodologies published by ITE. To determine residential trips distribution, it was assumed that the majority of the trips in the AM are home-to-work based trips, and in the PM are work-to-home based trips. Therefore, the global trip generation is based on trips exiting the study network in the AM and entering the study network in the PM. This methodology also indicates that new vehicle trips will return to their direction of origin. The resulting distribution of site-generated vehicle traffic is summarized in **Table 15**.

Table 15: Site Trip Distribution

To/From	Via	AM	PM
North	Nixon Road	1%	2%
	Pontiac Trail	2%	2%
South	Nixon Road	16%	13%
	Pontiac Trail	49%	43%
East	Green Road	16%	17%
	Barton Drive	7%	11%
West	Barton Drive	9%	12%
Total		**100%**	**100%**

The site-generated vehicles were assigned to the study road network based on this trip distribution model as shown on **Figure 5**. The site-generated trips shown on **Figure 5** were added to the background traffic volumes shown on **Figure 4** to calculate the future peak hour traffic volumes shown on **Figure 6**.

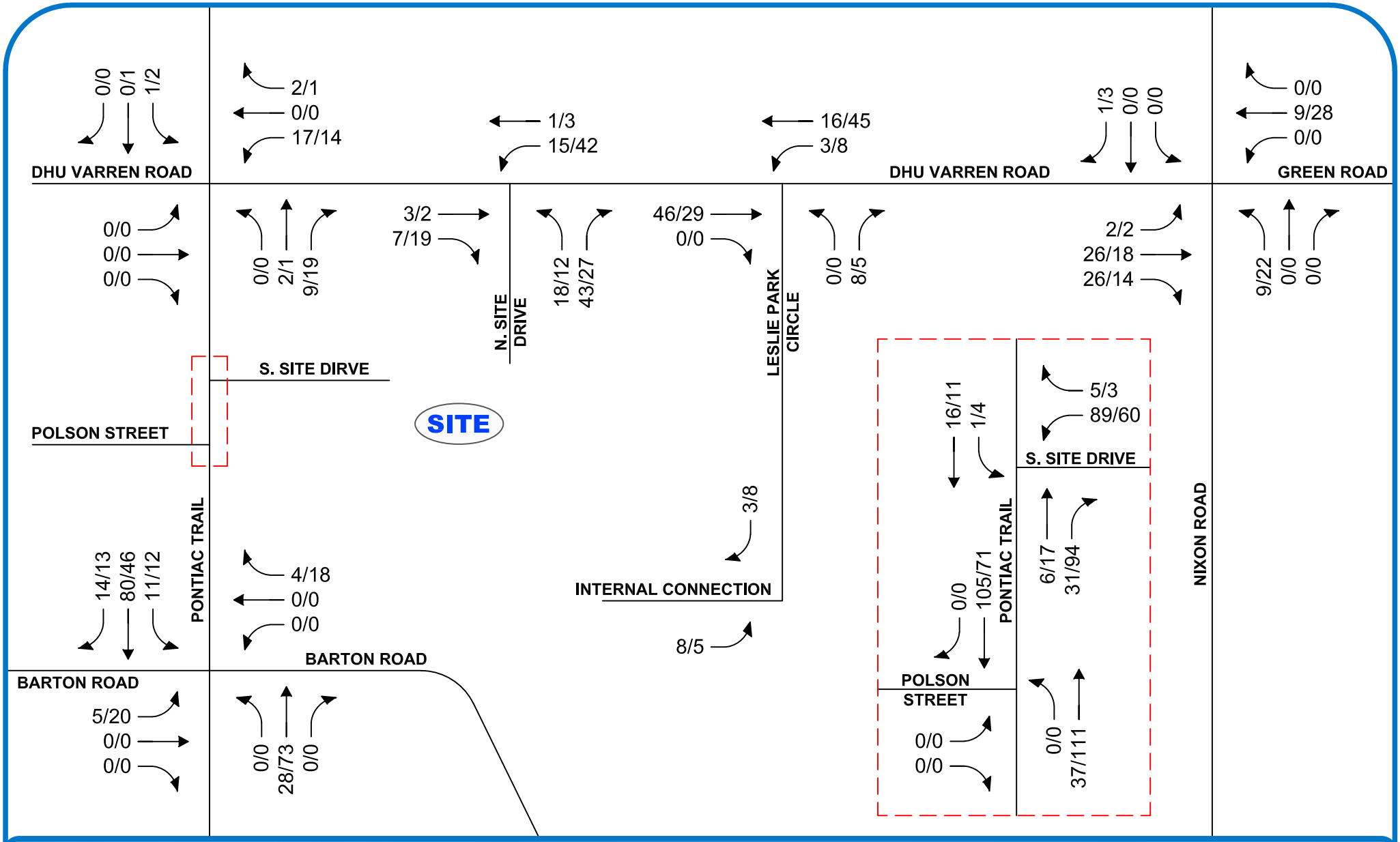


FIGURE 5

SITE-GENERATED TRAFFIC VOLUMES

VILLAGE ON ANN ARBOR TIS - ANN ARBOR, MI

LEGEND

ROADS

PROPOSED ROADS

TRAFFIC VOLUMES (AM/PM)

NORTH

SCALE: NOT TO SCALE

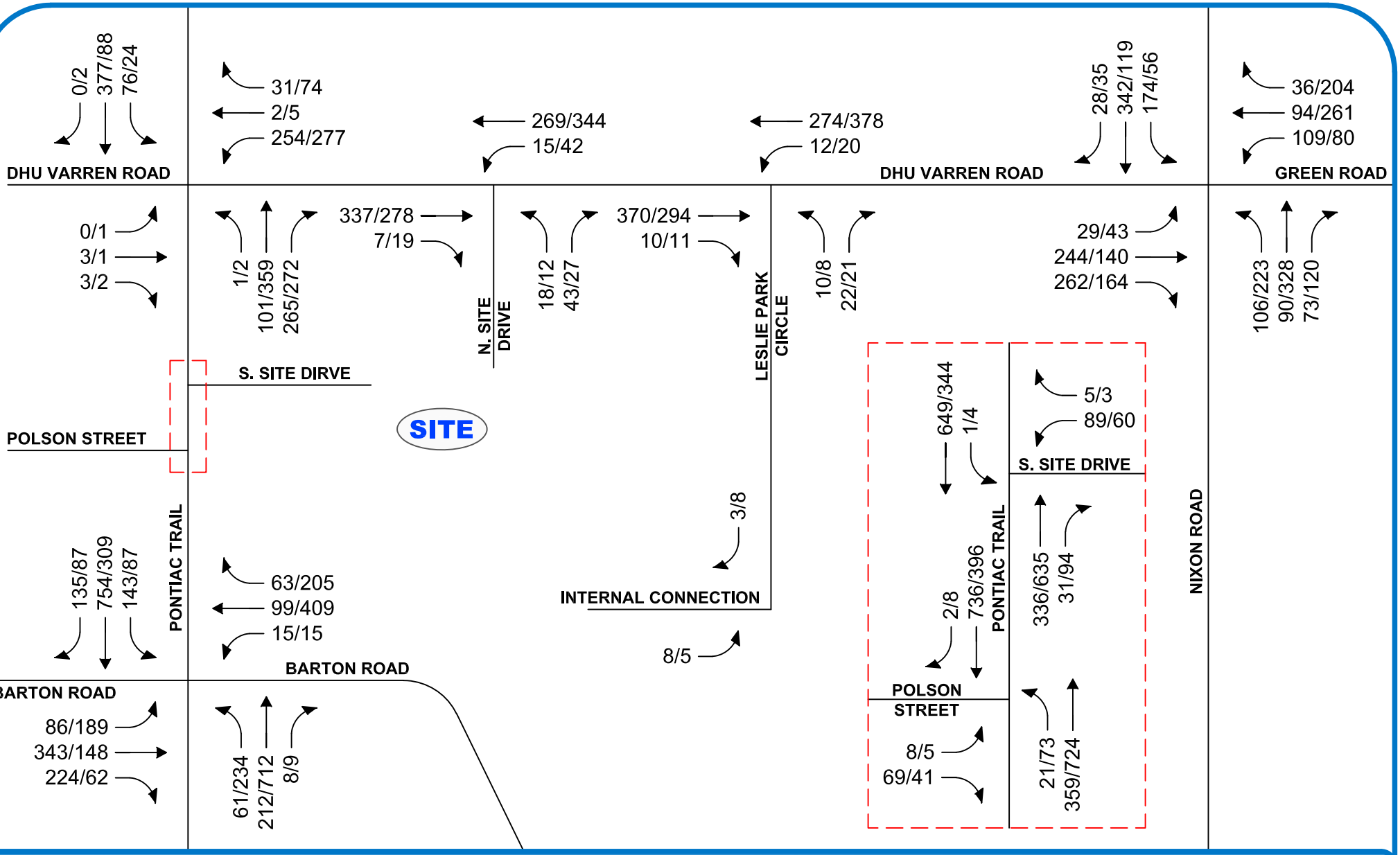


FIGURE 6

FUTURE TRAFFIC VOLUMES

VILLAGE ON ANN ARBOR TIS - ANN ARBOR, MI

LEGEND

ROADS

PROPOSED ROADS

TRAFFIC VOLUMES (AM/PM)

NORTH

SCALE: NOT TO SCALE

8 FUTURE CONDITIONS

8.1 FUTURE OPERATIONS

The future peak hour vehicle delays and LOS ***with the proposed development*** were calculated based on the future lane use and traffic control shown on **Figure 2**, the proposed site access plan, the future traffic volumes shown on **Figure 6**, and the methodologies presented in the HCM6. Additionally, regardless of any informational and/or recommended improvements identified under the background improvements analysis, the future conditions analysis assumes baseline conditions and the existing lane use and traffic control. The results of the future conditions analysis are presented in **Appendix D** and are summarized in **Table 16** and **Table 17.**

Table 16: Future Intersection Operations

	Intersection	Control	Approach	Background Conditions				Future Conditions				Difference			
				AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	Pontiac Trail & Dhu Varren Road	Stop (Minor)	EB	17.4	C	13.6	B	17.6	C	13.8	B	0.2	-	0.2	-
			WB	216.2	F	95.7	F	264.7	F	121.4	F	48.5	-	25.7	-
			NBL	8.2	A	7.4	A	8.2	A	7.4	A	0.0	-	0.0	-
			SBL	8.4	A	9.1	A	8.4	A	9.2	A	0.0	-	0.1	-
2	Pontiac Trail & Polson Street	Stop (Minor)	EB	16.7	C	13.3	B	19.5	C	15.1	C	2.8	-	1.8	B→C
			NBL	9.2	A	8.4	A	9.7	A	8.7	A	0.5	-	0.3	-
			SB	Free		Free		Free		Free		Free		Free	
3	Pontiac Trail & Barton Drive	Signalized	EB	66.2	F	208.4	F	69.5	F	314.3	F	3.3	-	105.9	-
			WB	21.7	C	35.5	D	21.9	C	37.5	D	0.2	-	2.0	-
			NBL	213.7	F	63.9	E	213.7	F	118.1	F	0.0	-	54.2	E→F
			NBTR	21.3	C	40.5	D	21.8	C	58.7	E	0.5	-	18.2	D→E
			SBL	28.5	C	75.8	E	30.6	C	319.6	F	2.1	-	243.8	E→F
			SBTR	116.5	F	25.0	C	174.2	F	27.8	C	57.7	-	2.8	-
			Overall	**78.0**	**E**	**68.1**	**E**	**102.2**	**F**	**104.9**	**F**	**24.2**	**E→F**	**36.8**	**E→F**
4	Dhu Varren Road & Leslie Park	Stop (Minor)	EB	Free		Free		Free		Free		Free		Free	
			WBL	8.2	A	7.9	A	8.3	A	8.0	A	0.1	-	0.1	-
			NB	12.8	B	11.7	B	13.3	B	12.1	B	0.5	-	0.4	-
5	Nixon Road & Dhu Varren Road / Green Road	Roundabout	EB	10.4	B	4.7	A	12.8	B	4.9	A	2.4	-	0.2	-
			WB	4.7	A	11.6	B	4.8	A	13.6	B	0.1	-	2.0	-
			NB	5.7	A	9.1	A	5.9	A	10.0	A	0.2	-	0.9	-
			SB	7.4	A	4.9	A	7.6	A	5.1	A	0.2	-	0.2	-
			Overall	7.6	A	8.6	A	**8.6**	**A**	**9.5**	**A**	**1.0**	**-**	**0.9**	**-**
6	Dhu Varren Road & N. Site Drive	Stop (Minor)	EB	N/A				Free		Free		N/A			
			WBL					8.3	A	8.1	A				
			NB					13.0	B	12.5	B				
7	Pontiac Trail & S. Site Drive	Stop (Minor)	WB	N/A				33.9	D	33.1	D	N/A			
			NBL					Free		Free					
			SB					8.3	A	9.6	A				

The results of the future conditions analysis show that all study intersection approaches and movements will continue to operate in a manner similar to background conditions, with the exception of the following:

PONTIAC TRAIL & DHU VARREN ROAD

- During the AM peak hour: the westbound approach is expected to experience an increased delay of approximately 49-seconds. Review of SimTraffic indicates similar operations to existing conditions.
- During the PM peak hour: the westbound approach is expected to experience an increased delay of approximately 26-seconds. Review of SimTraffic indicates similar operations to existing conditions.

PONTIAC TRAIL & BARTON DRIVE

- During the AM peak hour: the southbound shared through/right movement is expected to experience an approximately 58-second increase in delay. A review of SimTraffic network simulations indicates similar operations to those observed under the background conditions, with long vehicles queues for the southbound shared through/right movement and the eastbound approach; these queues were generally observed to be present throughout the peak hour. Additionally, microsimulations indicates periods of vehicle queues on the northbound approach, as a result of the constant flow of southbound traffic limiting the permissive northbound left-turn gaps and causing vehicles in the northbound left-turn lane to exceed the available storage area.
- During the PM peak hour: the northbound left-turn movement, the southbound left-turn movement, and the overall intersection are expected to operate at a LOS F. The northbound shared through/right movement is expected to operate at LOS E. Additionally, the eastbound approach is expected to experience an approximately 106-second increase in delay. Review of SimTraffic microsimulations during the PM peak hour indicates similar operations to those observed under the background conditions, with periods of long vehicle queues for the eastbound and northbound approaches. These vehicles queues were observed to persist throughout the PM peak hour and are the result of a high volume of left-turn traffic on both approaches and a high volume of northbound through traffic. Additionally, occasional periods of vehicle queues were observed for the southbound left-turn movement; however, these queues were typically observed to dissipate within the peak hour.

The results of the non-motorized future conditions analysis indicate that all study intersection approaches will operate at a LOS D or better for pedestrians and cyclists during both the AM and PM peak hours.

Table 17: Future Non-motorized Operations

Intersection		Control	Approach	Background Conditions				Future Conditions			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Pedestrian LOS	Cyclist LOS	Pedestrian LOS	Cyclist LOS	Pedestrian LOS	Cyclist LOS	Pedestrian LOS	Cyclist LOS
1	Pontiac Trail & Dhu Varren Road	Stop (Minor)	NB	B	*n/a*[1]	B	*n/a*[1]	B	*n/a*[1]	B	*n/a*[1]
			SB	B	*n/a*[1]	B	*n/a*[1]	B	*n/a*[1]	B	*n/a*[1]
2	Pontiac Trail & Polson Street	Stop (Minor)	NB	C	*n/a*[1]	C	*n/a*[1]	D	*n/a*[1]	D	*n/a*[1]
			SB	C	*n/a*[1]	C	*n/a*[1]	D	*n/a*[1]	D	*n/a*[1]
3	Pontiac Trail & Barton Drive	Signalized	EB	B	C	B	C	B	D	C	C
			WB	B	B	B	B	B	B	B	B
			NB	B	C	C	D	B	C	C	D
			SB	C	D	C	C	C	D	C	C
4	Leslie Park & Dhu Varren Road	Stop (Minor)	NB	B	*n/a*[1]	B	*n/a*[1]	C	*n/a*[1]	C	*n/a*[1]
			SB	B	*n/a*[1]	B	*n/a*[1]	C	*n/a*[1]	C	*n/a*[1]

[1] Cyclist LOS calculations are only available for signalized intersections. Additionally, neither pedestrian nor cyclist LOS calculations are available for roundabout intersections; therefore, Nixon Road & Dhu Varren Road was excluded.

8.2 AUXILIARY TURN LANE ANALYSIS

In order to determine the configuration of the proposed site driveways on Pontiac Trail and Dhu Varren Road, the City of Ann Arbor warrants for right- and left-turn lanes were evaluated and are included in **Appendix E**. The City of Ann Arbor does not maintain community specific auxiliary turn lane warrants; therefore, MDOT Geometric Design Guidance Section 1.1.4 was utilized in order to determine where turn lanes or passing flares meet the criteria for consideration. The results of the analysis of these standards indicate the following based on future traffic operations and available capacity:

Intersection	Movement	2025 Build-out		
		AM Peak	PM Peak	MDOT Criteria
Dhu Varren Road & N. Site Drive	WB LT	No Treatment	No Treatment	**No Treatment**
	EB RT	No Treatment	No Treatment	**No Treatment**
Pontiac Trail & S. Site Drive	SB LT	No Treatment	No Treatment	**No Treatment**
	NB RT	No Treatment	Right-turn Lane	**Right-Turn Lane**

The results of auxiliary turn lane analysis indicates that a northbound right-turn lane is warranted at the S. Site Drive on Pontiac Trail, based solely on the projected future peak hour traffic volumes. However, a review of all nearby developments, roadway characteristics, available ROW, sidewalk easements, and environmental impacts was taken into consideration when evaluating the feasibility of a right-turn lane at this intersection. The area east of Pontiac Trail, south of the proposed driveway, is comprised of wetlands that are not suitable for development; therefore, the construction of a right-turn lane would necessitate that the wetlands are infilled and mitigated, resulting in undesirable environmental impacts.

Furthermore, the additional pavement associated with the construction of a right-turn lane would substantially increase the length of the existing pedestrian crossing, located approximately 150-ft to the south of the proposed driveway; this expanded length would increase the exposure time and potential risk associated with crossing for the most vulnerable road users (pedestrians and bicyclists). The results of the review indicates that the construction of a right-turn lane into the site would produce more negative impacts (wetland disturbance, greater pedestrian risk, etc.), than the potential vehicular safety benefit gained for slowing vehicles entering the site from northbound Pontiac Trail; therefore, a right turn lane is **not recommended** at either of the proposed site driveways.

8.3 FUTURE IMPROVEMENTS

In order to improve traffic operations to a LOS D or better for all intersection approaches and movements in the future condition, mitigation measures were investigated, including signal-timing adjustments, traffic control modification, and geometric improvements. The proposed improvements and their impact to intersection operations are discussed below.

PONTIAC TRAIL & DHU VARREN ROAD

In order to improve the existing traffic operations to a LOS D or better for all intersection approaches and movements the following mitigation measures were evaluated:

A. Traffic Signal with addition of Left-turn Lanes

B. All-Way Stop Control

C. Roundabout

A. Traffic Signal Warrant Analysis

The results of the signal warrant analysis indicates that a traffic signal is expected to meet Warrant 2 and Warrant 3 based on the projected future traffic volumes. The addition of a traffic signal at this intersection was evaluated and it was determined that the delay would *increase* on the Pontiac Trail approaches with the addition of signalization while providing only minor improvements on the Dhu Varren Road approaches. The future conditions signal warrant charts are provided in **Appendix E**.

Table 18: Future Signal Warrant Analysis Summary

Pontiac Trail & Dhu Varren Road		
Warrant 1: Eight Hour		**NO**
Condition A	*Hours Met*	**6**
	Warrant Met	**NO**
Condition B	*Hours Met*	**4**
	Warrant Met	**NO**
Warrant 2: Four-Hour	*Hours Met*	**4**
	Warrant Met	**YES**
Warrant 3: Peak-Hour	*Hours Met*	**2**
	Warrant Met	**YES**

B. All-Way Stop Control Analysis

The results of the all-way stop-control analysis indicates that 10 of the 8 hours of criteria are met and therefore this intersection is expected to meet all way stop warrant with the future traffic volumes. The addition of an all-way stop at this intersection was evaluated and it was determined that the delay would *increase* on the Pontiac Trail approaches while providing only minor improvements on the Dhu Varren Road approaches. The background all-way stop control warrant chart is provided in **Appendix E**.

C. Roundabout

In a further effort to mitigate the failing LOS and vehicle delay at the intersection of Pontiac Trail & Dhu Varren Road during the peak periods, a preliminary analysis of a roundabout was investigated using Rodel (Roundabout Analysis Software). Further analysis using a fully designed roundabout would be necessary; however, the results of the preliminary analysis indicate that, all approaches will operate at a LOS A or better during both peak periods.

In addition to improving the failing LOS at this intersection during both peak periods, the construction of a roundabout is expected to improve operations during all other times of the day, as a roundabout provides yield control on all approaches, which does not require vehicles to stop unless conflicting traffic is present. Similarly, a roundabout will also minimize the adverse impact to Pontiac Trail and provide the lowest delay for the intersection overall. Additionally, the construction of a roundabout at this location would also improve pedestrian safety across Pontiac Trail, by slowing vehicles entering the intersection and by providing a median refuge for pedestrian to make a two-stage crossing. A review of the SimTraffic network simulations indicates acceptable operations during both peak periods and improved vehicle queue lengths for westbound traffic. Therefore, the following mitigation measure is recommended to mitigate background conditions:

PONTIAC TRAIL & BARTON DRIVE

In order to improve traffic operations at the signalized intersection of Pontiac Trail & Barton Drive, to a LOS D or better during both peak periods, mitigation measures were investigated, including signal timing adjustments and geometric improvements. Signal timing optimizations were evaluated to mitigate the background delays but were found to be insufficient. The results of the analysis indicate that additional capacity is needed to accommodate the background volumes at this intersection. Therefore, geometric improvements were investigated; the results indicate that an additional through lane is needed for northbound and southbound Pontiac Trail. Additionally, an exclusive left-turn lane for eastbound Barton Drive and an exclusive right-turn lane for westbound Barton Drive would be needed to provide sufficient intersection capacity to improve all approaches and movements to LOS D or better.

The identified mitigation measures as summarized below:

- Construct a second northbound through lane and a second southbound through lane on Pontiac Trail at Barton Drive.
- Construct an exclusive eastbound left-turn lane and an exclusive westbound right-turn on Barton Drive at Pontiac Trail.

Upon review of the available ROW and the City's infrastructure planning in this area the constructability of these improvements is not likely to be feasible. Therefore, these improvements are **not recommended** at this intersection and were **identified purely for informational purposes** to demonstrate what would be necessary to reduce intersection delays for vehicles. Furthermore, additional capacity at this intersection has the potential to impact the safety and operations for non-motorized and pedestrian users, these improvements were identified to describe the necessary changes required to mitigate the failing LOS experienced at this intersection under background conditions.

The results of the future conditions analysis with improvements analysis are summarized in **Table 19** and indicates that all study intersection approaches and movements will operate at LOS D or better during both peak periods, with the implementation of the theoretical improvements identified above.

Review of SimTraffic microsimulations at the signalized study intersection of Pontiac Trail & Barton Drive indicates acceptable operations with minimal vehicle queueing. Network simulation observations at the other study intersections indicates acceptable operations.

Table 19: Future Intersection Operations with Improvements

Intersection		Control	Approach	Future w/ Improvements			
				AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	Pontiac Trail & Dhu Varren Road	Roundabout	EB	2.3	A	1.0	A
			WB	4.8	A	6.1	A
			NB	5.1	A	7.1	A
			SB	5.8	A	3.8	A
			Overall	**5.3**	**A**	**6.4**	**A**
3	** Pontiac Trail & Barton Drive	Signalized	EBL	51.1	D	44.4	F
			EBTR	34.8	C	14.0	B
			WBTL	17.4	B	16.9	B
			WBR	14.6	B	14.2	B
			NBL	39.2	D	36.7	D
			NBTR	17.6	B	18.9	B
			SBL	23.0	C	27.1	C
			SBTR	27.9	C	16.0	B
			Overall	**28.2**	**C**	**21.1**	**C**

*** Indicates that the mitigation measures identified for the study intersection of Pontiac Trail & Barton Drive are **NOT RECOMMENDED** and are provided for **INFORMATIONAL PURPOSES ONLY***

RECOMMENDED IMPROVEMENTS SUMMARY

Pontiac Trail & Dhu Varren Road
• Construct a roundabout with enhanced pedestrian crossings and markings

9 CRASH ANALYSIS

A crash analysis was conducted at all of the study intersections and roadway segments; intersection crash data was initially collected for an influence area of 150-ft, then the detailed crash data (UD-10s) were further evaluated to include only the intersection related crashes. F&V obtained historical crash data for the most recent available three years (January 1, 2017, to December 31, 2019) from Michigan Traffic Crash Facts (MTCF). It should be noted that animal crashes were excluded from this analysis. The crashes at each of the intersections are summarized by type in **Table 20** and the crashes with injuries are summarized in **Table 21**.

Table 20: Study Intersections & Segments Crash Summary

Location	Crash Type								Total
	Single Motor Vehicle Crash	Head-On	Head-On Left-Turn	Angle	Rear End	Sideswipe-Same	Sideswipe-Opposite	Other / Unknown	
Nixon Road & Dhu Varren Road / Green Road	3	0	0	3	3	0	0	0	**9**
Nixon Road to Leslie Park Circle (Dhu Varren Segment)	2	0	0	2	5	0	0	1	**10**
Pontiac Trail & Barton Drive	1	0	6	6	3	2	1	0	**19**
Leslie Park Circle to Pontiac Trail (Dhu Varren Segment)	1	0	0	0	1	0	0	0	**2**
Pontiac Trail & Dhu Varren Road	1	2	0	1	1	0	1	0	**6**
Dhu Varren Road to Polson Street (Pontiac Trail Segment)	0	0	1	0	1	0	0	0	**2**
Dhu Varren Road & Leslie Park Circle	0	0	1	0	0	0	0	0	**1**
Polson Street to Barton Drive (Pontiac Trail Segment)	1	0	0	1	2	0	0	0	**4**
Pontiac Trail & Polson Street	0	0	0	0	0	0	0	0	**0**

Table 21: Study Intersections & Segments Crash Injury Summary

Location	Fatality	Type "A" Injury	Type "B" Injury	Type "C" Injury	Total
Nixon Road & Dhu Varren Road / Green Road	0	0	0	0	**0**
Nixon Road to Leslie Park Circle (Dhu Varren Segment)	0	0	0	0	**0**
Pontiac Trail & Barton Drive	0	0	1	1	**2**
Leslie Park Circle to Pontiac Trail (Dhu Varren Segment)	0	0	0	0	**0**
Pontiac Trail & Dhu Varren Road	0	1	1	1	**3**
Dhu Varren Road to Polson Street (Pontiac Trail Segment)	0	0	0	0	**0**
Dhu Varren Road & Leslie Park Circle	0	0	1	0	**1**
Polson Street to Barton Drive (Pontiac Trail Segment)	0	1	0	0	**1**
Pontiac Trail & Polson Street	0	0	0	0	**0**

The SEMCOG Crash Analysis Process 2016 *Regional Critical Intersection Crash Rates, Frequencies and Casualty Ratios: By Presence or Absence of Signalization* and *Regional Critical Segment Crash Rates, Frequencies and Casualty Ratios: By Higher Functional Class of Roadway* was used to compare the actual crash rates and crash frequencies to the regional crash rates and crash frequencies for similar intersection and segment operations. However, the SEMCOG Crash Analysis Process does not provide any crash rate or

frequency data for regional roundabouts. Therefore, the Federal Highway Administration's Roundabouts: An Informational Guide was utilized to provide a comparison between national level crash frequency and the crash frequency at the Nixon Road & Dhu Varren Road / Green Road roundabout. The results of the analysis are summarized for intersections and segments in **Table 22** and **Table 23**, respectively.

Table 22: Study Network Intersection Crash Analysis Summary

Intersection	Average ADT (Entering Volume vpd)	Crash Frequency (crashes/year)			Crash Rate (crashes per MV)		
		Intersection Annual Crash Frequency	SEMCOG Average Annual Crash Frequency	Difference	Intersection Crash Rate	SEMCOG Average Crash Rate	Difference
Nixon Road & Dhu Varren Road / Green Road	12,350	3.00	2.40	0.60	0.67	0.46	0.21
Pontiac Trail & Barton Drive	16,740	6.33	4.69	1.64	1.04	0.87	0.17
Pontiac Trail & Dhu Varren Road	8,695	2.00	1.33	0.68	0.63	1.05	-0.42
Dhu Varren Road & Leslie Park Circle	4,850	0.33	1.33	-1.00	0.19	1.05	-0.86
Pontiac Trail & Polson Street	7,770	0.00	1.33	-1.33	0.0	1.05	-1.05

Table 23: Study Network Segment Crash Analysis Summary

Segment	Length (Miles)	Average ADT (Entering Volume vpd)	Crash Frequency (crashes/year/mile)			Crash Rate (crashes per MV/mile)		
			Intersection Annual Crash Frequency	SEMCOG Average Annual Crash Frequency	Difference	Intersection Crash Rate	SEMCOG Average Crash Rate	Difference
Dhu Varren Rd. (Leslie Park to Nixon Rd)	0.97	5,530	3.78	3.55	0.23	1.82	15.49	-13.67
Dhu Varren Rd. (Pontiac Trail to Leslie Park)	0.39	4,615	1.71	3.55	-1.84	0.40	15.49	-15.09
Pontiac Trail (Dhu Varren Rd to Polson St)	0.37	7,770	1.80	2.58	-0.78	0.24	16.42	-16.18
Pontiac Trail (Polson St and Barton Dr)	0.73	9,355	1.83	2.58	-0.75	0.39	16.42	-16.03

The results of the analysis shows that three (3) of the five (5) study intersections have crash frequencies (crashes per year) above the SEMCOG average; however, based on the volume of daily traffic entering these intersections, the crash rates are below average for three (3) of the intersections and are similar to the SEMCOG regional rates for the other two (2) intersections. The results also indicate that one (1) of the four (4) roadway segments has a crash frequency (crashes per year per mile) above the SEMCOG average; however, based on the daily volume of traffic along the roadway, the crashes rate is below the average for similar segments within the SEMCOG region. The study intersections and roadway segments were further analyzed and in-depth analysis for each of the study intersections and roadway segments is provided and summarized below.

NIXON ROAD & DHU VARREN ROAD / GREEN ROAD

There were nine (9) crashes reported at or associated with the intersection of Nixon Road & Dhu Varren Road / Green Road from 2017 through 2019. The three crash types that occurred at this intersection were equally distributed between single motor vehicle crashes, angle crashes, and rear-end straight crashes. In the summer of 2017, the intersection of Nixon Road & Dhu Varren Road / Green Road was reconstructed into a roundabout. Out of the nine (9) crashes that occurred, two (2) of the crashes happened before the roundabout was constructed. There were 0 crashes that resulted in injuries at this intersection between 2017 and 2019. Detailed review of the crash reports (UD-10) indicates there is no correctable crash pattern at this location.

PONTIAC TRAIL & BARTON DRIVE

There were nineteen (19) crashes reported at or associated with the intersection of Pontiac Trail & Barton Drive from 2017 through 2019. The majority of crashes at this intersection were angle (32%) and head on left turns (32%). The majority of the angle type crashes were the result of vehicles running a red light. The red light running may be a result of vehicles speeding, as the yellow and all-red timing at the signal was designed for a 25-mph speed limit. Therefore, the City of Ann Arbor may want to consider increasing the yellow and all-red timing to accommodate vehicle speeds. Additionally, the head-on left-turn crashes at this intersection occurred on several different approaches, indicating that there is not a correctable pattern. There were two (2) injuries, one (1) Type-B injury and one (1) Type-C injury; however, there were no Fatalities or Type-A injuries.

DHU VARREN ROAD & PONTIAC TRAIL

There were six (6) crashes reported at or associated with the intersection of Dhu Varren Road & Pontiac Trail from 2017 through 2019. The majority of crashes were head on (32%). The remaining crash types occurred once for each crash type and accounts for the remaining 68% of crashes. The majority of crashes at this intersection were the result of drivers losing control due to weather conditions. Therefore, the results of the crash analysis indicates that there is no correctable crash pattern at this location. There were three (3) injury crashes at this intersection: one (1) Type-A injury, one (1) Type-B injury, and one (1) Type-C injury; however, there were no Fatalities. Review of the Type-A injury crash indicates that this crash was weather related, as a vehicle crossed the roadway center line going around a curve and collided with another vehicle; therefore, this crash does not represent a correctable pattern.

DHU VARREN ROAD & LESLIE PARK CIRCLE

There was one (1) crash reported at or associated with the intersection of Dhu Varren Road & Leslie Park Circle from 2017 through 2019. The one (1) crash that occurred was a head-on left-turn crash, which resulted in a Type-B injury.

PONTIAC TRAIL & POLSON STREET

There were 0 crashes reported at or associated with the intersection of Pontiac Trail & Polson Street in 2017 through 2019.

DHU VARREN ROAD (NIXON ROAD TO LESLIE PARK CIRCLE)

There were ten (10) crashes reported along the Dhu Varren Road segment between Nixon Road and Leslie Park Circle in 2017 through 2019. The majority of crashes along this segment were rear-end (50%). All of the rear-end crashes were the result of vehicles slowing and being struck by another vehicle not paying attention. The remaining five (5) crashes were all weather related and/or the result of inattentive drivers. There were 0 crashes that resulted in injuries at this intersection between 2017 and 2019. Detailed review of the crash reports (UD-10) indicates there is no correctable crash pattern at this location.

DHU VARREN ROAD (LESLIE PARK CIRCLE TO PONTIAC TRAIL)

There were two (2) crashes reported along the Dhu Varren Road segment between Leslie Park Circle and Pontiac Trail in 2017 through 2019. The crashes included one (1) single motor vehicle crash and one (1) rear-end crash. The single motor vehicle crash was the result of a construction equipment vehicle forgetting to lower their box and striking utility wires. The rear-end crash was the result of a vehicle hitting another vehicle which had slowed for a school bus. There were 0 crashes that resulted in injuries at this intersection between 2017 and 2019. Detailed review of the crash reports indicates there is no correctable crash pattern at this location.

PONTIAC TRAIL (DHU VARREN ROAD TO POLSON STREET)

There were two (2) crashes reported along the Pontiac Trail segment between Dhu Varren Road and Polson Street in 2017 through 2019. The crashes included one (1) rear-end vehicle crash and one (1) head-on left-turn crash. The rear-end crash was the result of a vehicle hitting another vehicle that had slowed for stopped traffic. The head-on left-turn crash was the result of a vehicle turning onto a side street in front of another vehicle and being struck. There were 0 crashes that resulted in injuries at this intersection between 2017 and 2019. Detailed review of the crash reports indicates there is no correctable crash pattern at this location.

PONTIAC TRAIL (POLSON STREET TO BARTON DRIVE)

There were four (4) crashes reported along the Pontiac Trail segment between Polson Street and Barton Drive in 2017 through 2019. The majority of crashes along this segment were rear-end (50%), with one (1) pedestrian crash (25%) and one (1) angle crash (25%). The rear-end crashes were the result of vehicles slowing and being struck by another vehicle not paying attention. The angle crash was the result of a vehicle turning from a stop-control and not yielding to a vehicle on Pontiac Trail. The pedestrian crash was the result of a vehicle failing to yield to a pedestrian within a marked crosswalk. The pedestrian crash resulted in an A-injury. There were no other crashes that resulted in injuries at this intersection between 2017 and 2019. The pedestrian crash occurred at a marked pedestrian crossing; therefore, indicating there is no correctable crash pattern at this location.

After reviewing the detailed crash reports (UD-10) for each of the study intersections, there were no crash patterns identified for any of the intersections. Therefore, no mitigations are recommended for any of the study intersections to mitigate current crash patterns; however, the recommended mitigation measure of the construction of a roundabout at the Dhu Varren Road & Pontiac Trail intersection should improve crash severity.

In addition, The City of Ann Arbor's plan for Moving Together Towards Vision Zero was reviewed. The plan commits to provide safe road conditions for all travels including pedestrians, bicyclist, and other motorized and non-motorized road users. Therefore, this study reviewed the non-motorized crashes in addition to motorized crashes. There were no bicycle or pedestrian involved crashes at any of the study intersections in the past three (3) years (2017 – 2019) of available data. There was a single pedestrian crash along the study roadway segment of Pontiac Trail between Polson Street and Barton Drive; however, this crash occurred at a marked and signed pedestrian location as the result of an inattentive driver. Therefore, no correctable crash pattern is present.

10 ACCESS MANAGEMENT ANALYSIS

10.1 HORIZONTAL SIGHT DISTANCE EVALUATION

The horizontal sight distance was reviewed at the proposed site driveways to Pontiac Trail (S. Site Drive) and to Dhu Varren Road (N. Site Drive). According to *Section 9.5 – Intersection Sight Distance* of the AASHTO design manual *A Policy on Geometric Design of Highways and Streets, 7th Edition (2018),* an intersection sight distance of 390 feet is required for a left turn from a complete stop and a sight distance of 335 feet is required for a right turn from a stopped position at the study intersections based on the existing 35 mph speed limit along Pontiac Trail and along Dhu Varren Road.

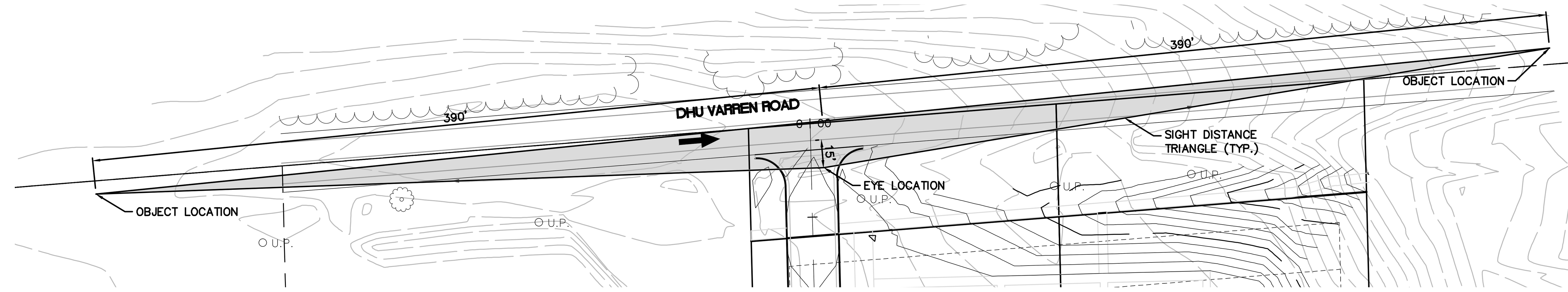
The AASHTO manual states that the "vertex (decision point) of the departure sight triangle on the minor road should be 14.5 ft from the edge of the major-road traveled way". This gives an accurate depiction of driver behavior when making a turn from a minor roadway. The results of the sight distance analysis show that there is adequate sight distance for both proposed site driveway locations. The horizontal intersection sight distance measurements are shown for the site driveways on **Figure 7**. Therefore, it is recommended for the developer/ contractor to ensure the sight triangles are clear during the construction of the proposed site driveway.

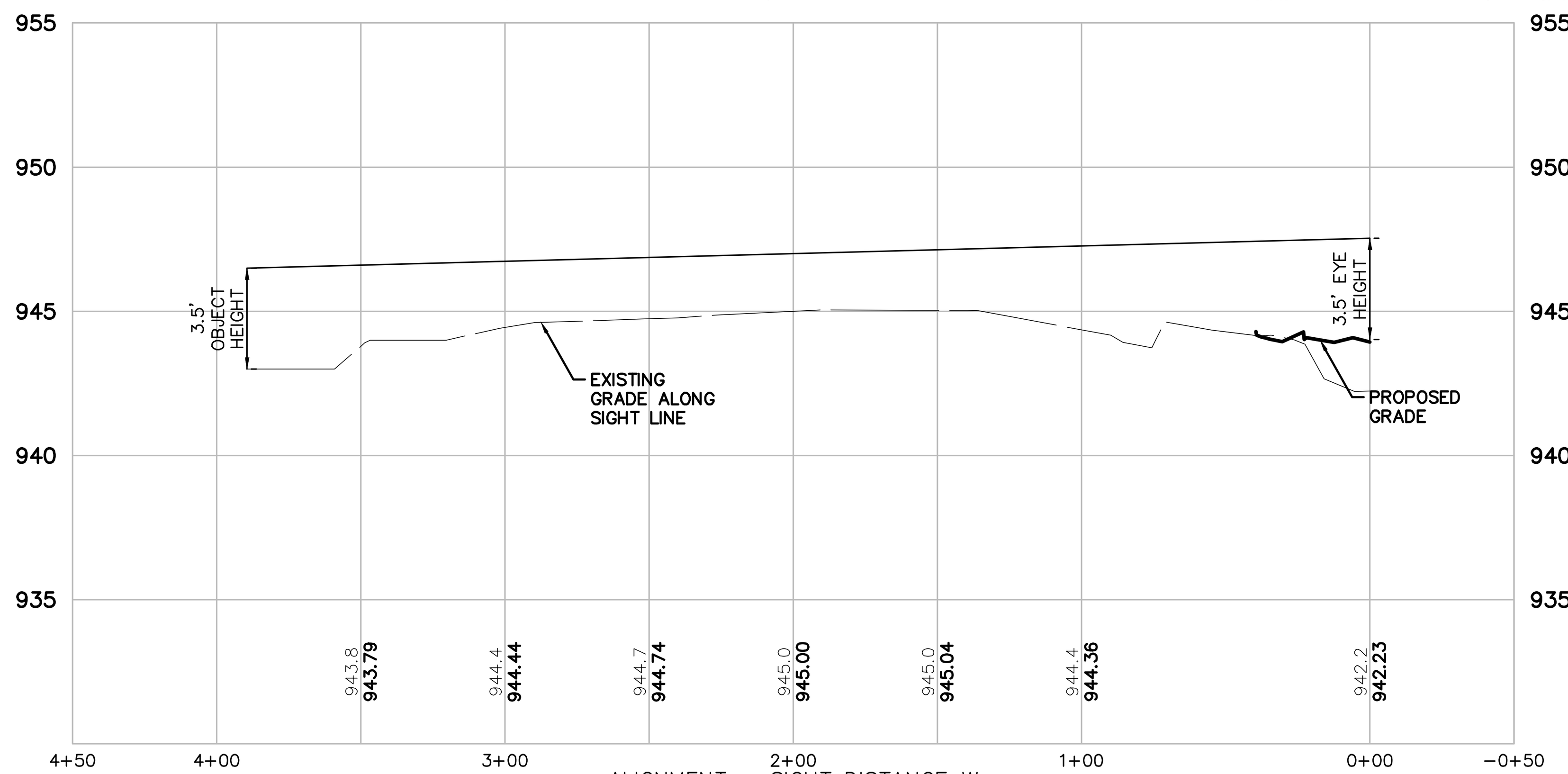
10.2 VERTICAL INTERSECTION SIGHT DISTANCE EVALUATION

A vertical sight distance analysis was performed to determine if the grade changes on Dhu Varren Road would create sight distance limitations at the proposed N. Site Drive location. The results of the analysis show that the proposed N. Site Drive is located near the top of a crest vertical curve. However, based on an assumed drivers eye height identified of 3.5 feet, per AASHTO recommendations, there will be adequate sight distance to the west and east of the proposed site driveway for drivers to see incoming vehicles. The vertical intersection sight distance measurements are shown on **Figure 7**.

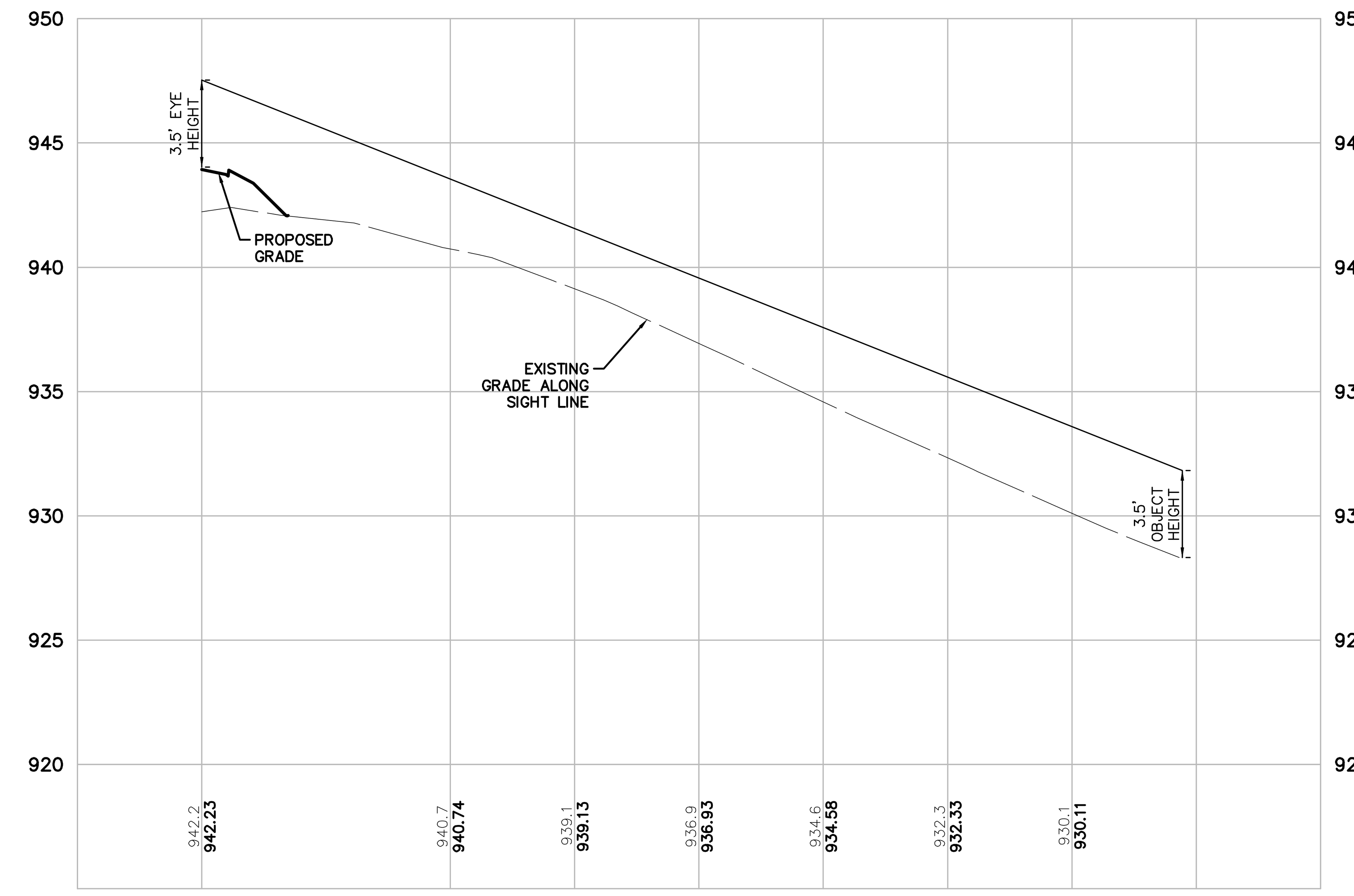
A vertical sight distance analysis was performed to determine if the grade changes on Pontiac Trail would create sight distance limitations at the proposed S. Site Drive location. The results of the analysis show that the proposed S. Site Drive is located in the vertex point of a sag vertical curve. However, based on the length of the sag vertical curve and the speed limit along Pontiac Trail, there is no sight loss. Drivers will be able to see vehicles on the edges of the vertical curve to the north and south. The vertical intersection sight distance measurements are shown on **Figure 7**.

Figure 7

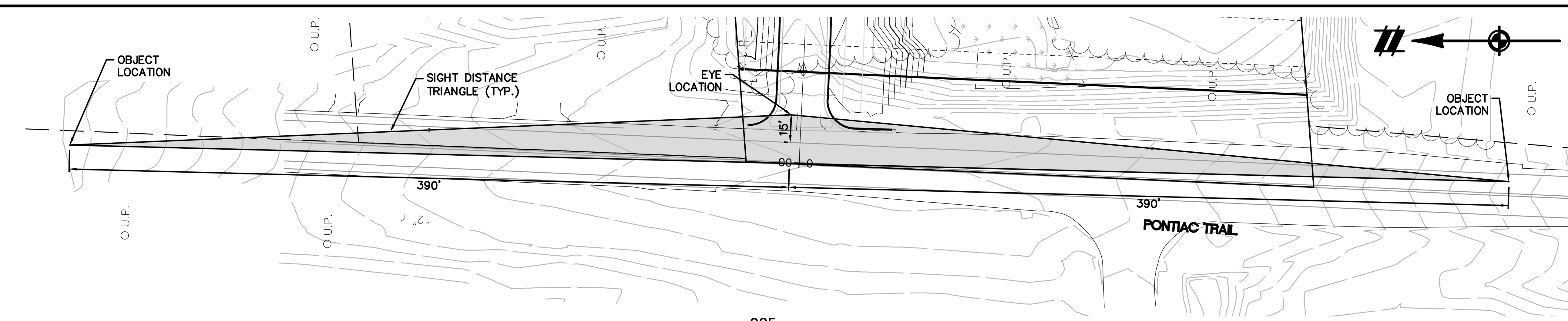




ALIGNMENT – SIGHT DISTANCE W
VERT: 1"=5'
HORZ: 1"=50'

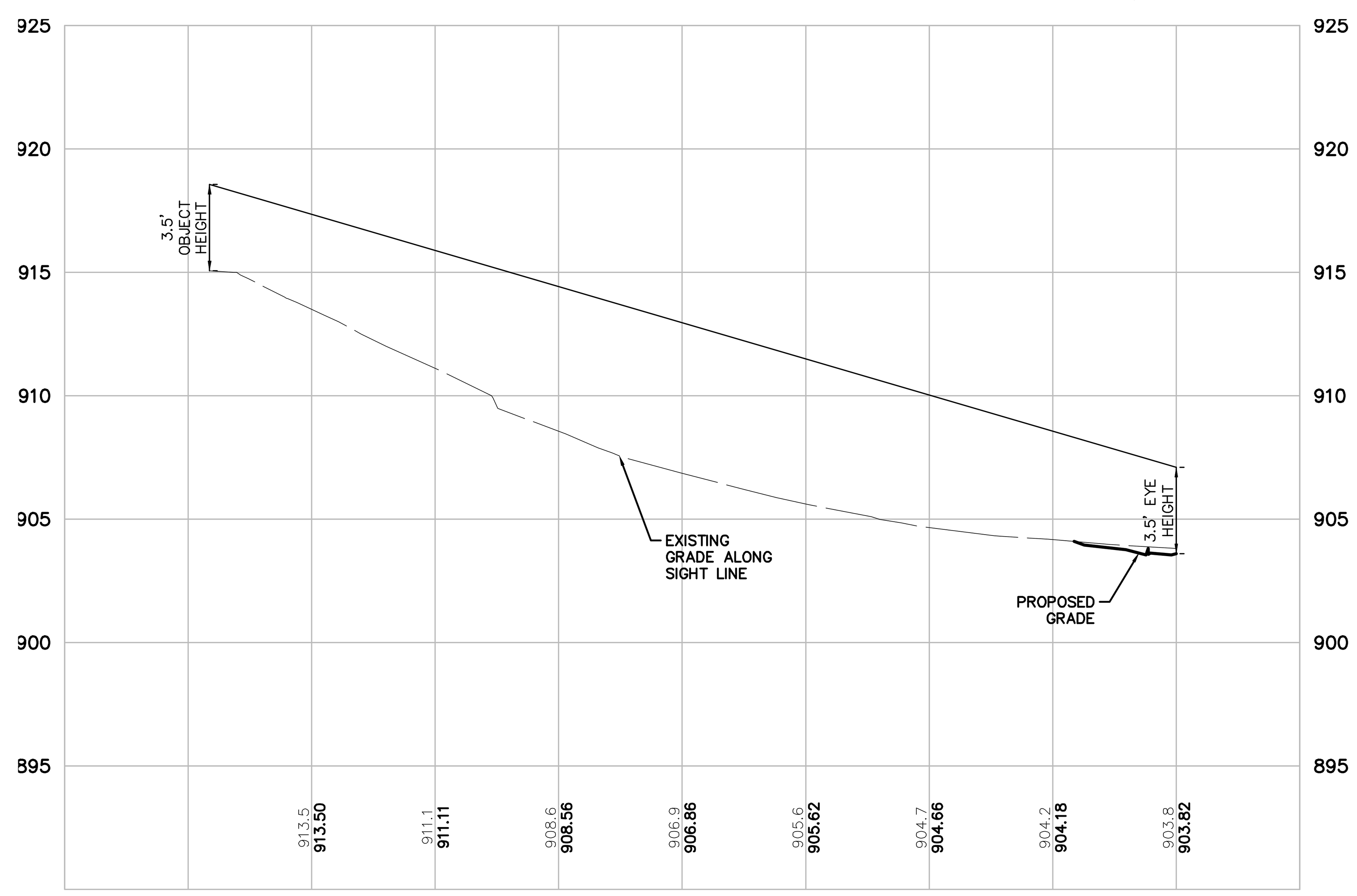


ALIGNMENT – SIGHT DISTANCE E
VERT: 1"=5'
HORZ: 1"=50'

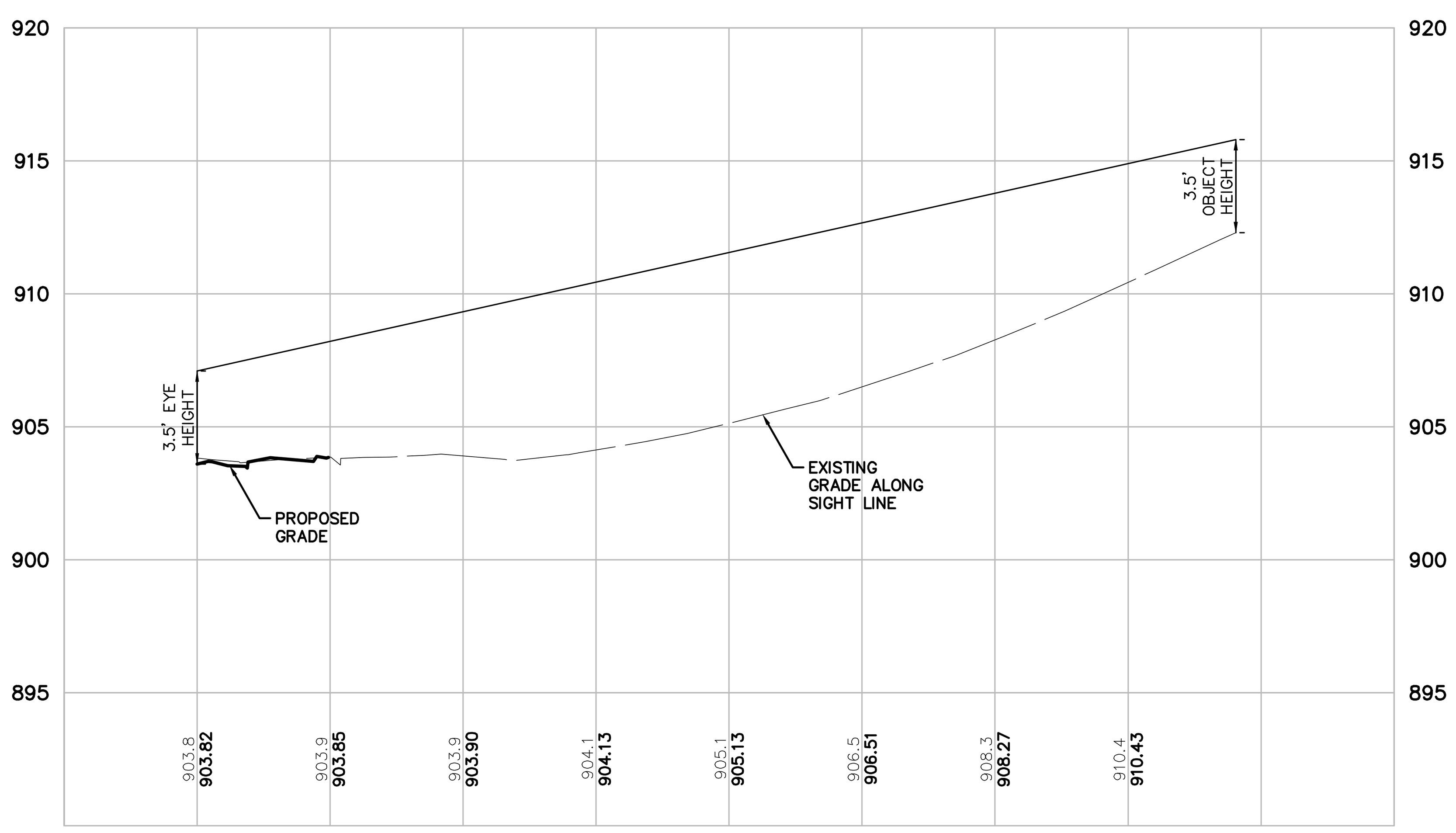


INTERSECTION SIGHT DISTATANCE

SIGHT DISTANCE SHOWN IN ACCORDANCE WITH SECTION 9.5 – INTERSECTION SIGHT DISTANCE OF THE AASHTO DESIGN MANUAL A POLICY OF GEOMETRIC DESIGN OF HIGHWAYS AND STREETS, 7TH EDITION (2018)



ALIGNMENT – SIGHT DISTANCE N
VERT: 1"=5'
HORZ: 1"=50'



ALIGNMENT – SIGHT DISTANCE S
VERT: 1"=5'
HORZ: 1"=50'

811 Know what's below. Call before you dig.

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NOTICE:
CONSTRUCTION SITE SAFETY IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR; NEITHER THE OWNER NOR THE ENGINEER SHALL BE EXPECTED TO ASSUME ANY RESPONSIBILITY FOR SAFETY OF THE WORK, OF PERSONS ENGAGED IN THE WORK, OF ANY NEARBY STRUCTURES, OR OF ANY OTHER PERSONS.

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SOUTHFIELD, MI 48076
248.447.2000

SECTION 16
TOWN 2 SOUTH, RANGE 6 EAST
ANN ARBOR TOWNSHIP
WASHTENAW COUNTY, MICHIGAN

CLIENT
ROBERTSON BROTHERS CO.
VILLAGE OF ANN ARBOR
SITE PLAN
INTERSECTION SIGHT DISTANCE EXHIBIT

DATE
JUNE 7, 2021

2021–10–11 PER CITY AND WCWRC

REVISIONS

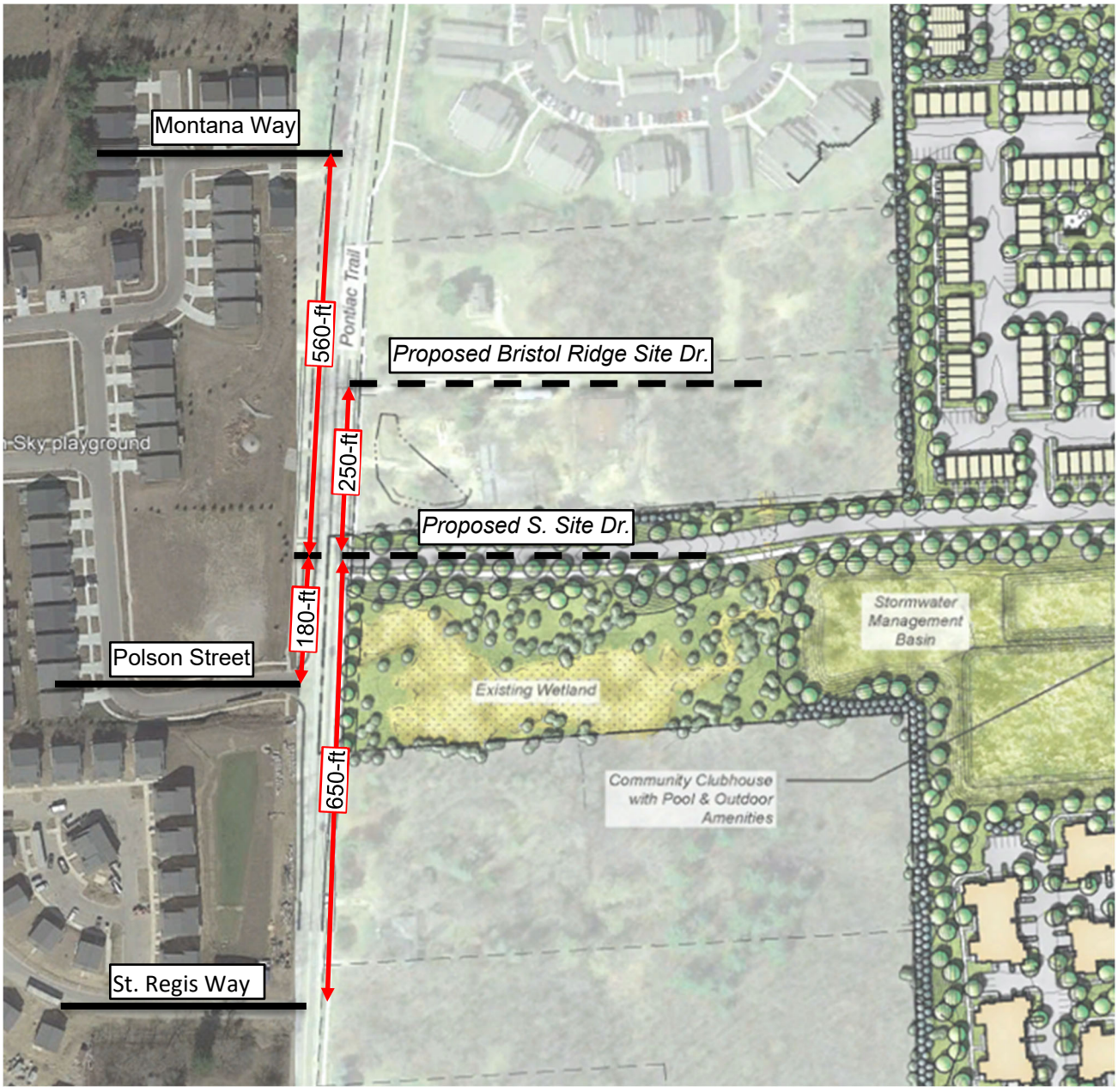
SCALE 0
NO SCALE

DR.	SK	CH.	SS
P.M.	MB		
BOOK	NA		
JOB	18002264		
SHEET NO.	59		

10.3 Proposed Site Driveway Location and Driveway Spacing

The driveway spacing on Pontiac Trail in the vicinity of the proposed S. Site Drive was reviewed to identify any potential impacts and conflicts associated with the proposed site driveway location. The access management shown in **Exhibit 1** below depicts the location of the proposed site driveway and the approximate spacing from nearby existing and proposed driveways.

Exhibit 1: Proposed Driveway Spacing



The "Bristol Ridge Townhomes" is an approved development that has begun construction with expected occupancy by 2023; therefore, the proposed Bristol Ridge Site Drive location was positioned based on the site plan and was included in this evaluation.

Review of the driveway configuration and spacing illustrated on **Exhibit 1** indicates that the proposed Bristol Ridge driveway is located approximately 250-ft north of the proposed S. Site Drive and is located on the same side (east) of Pontiac Trail. However, the Bristol Ridge Drive being located on the same side of the road will therefore provide less potential turning conflicts with the proposed site driveway; additionally, the Bristol Ridge

Drive is adequately spaced from the proposed site driveway to provide sufficient stopping sight distance between the driveways.

Further evaluation of the driveway configuration and spacing exhibit indicates that Polson Street is located approximately 180-ft south of the proposed site drive and is located on the opposite side (west) of Pontiac Trail. Review of the project parcel indicates that the proposed project site has approximately 300-ft of frontage along Pontiac Trail, including the area directly opposite of Polson Street. However, review of the site survey information indicates that area south of the proposed site driveway location is comprised of wetlands that are not suitable for development. As a result, in order to align the proposed site driveway with Polson Street, the majority of the existing wetlands would need to be infilled and mitigated, which is not desirable and would have much larger environmental impacts.

Therefore, it is recommended to locate the proposed site driveway as far north along the property frontage away from Polson Street as possible, creating a positive driveway offset for ingress left-turn traffic along Pontiac Trail. This driveway configuration will provide the safest operations and minimal conflict points, while also minimizing the environmental impact to the existing wetlands.

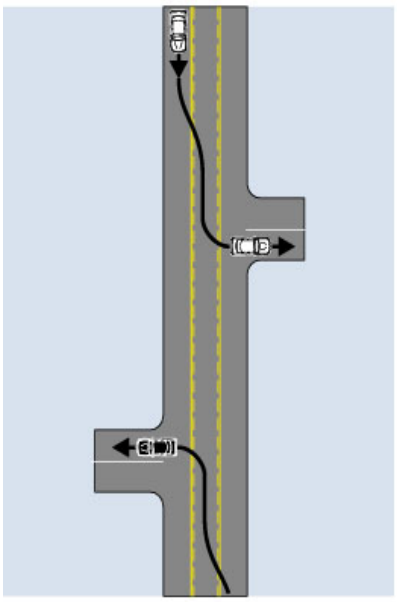


Figure 9: Locate Driveways on Opposite Sides of a Roadway to Achieve a Positive Offset

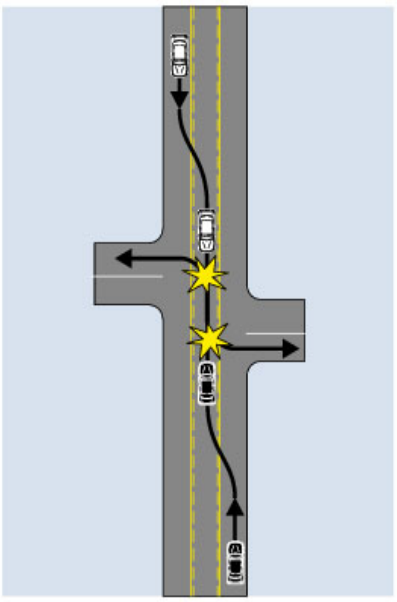


Figure 10: Avoid Locating Driveways on Opposite Sides of the Roadway that Create an Overlap for Left Turns Exiting the Major Roadway

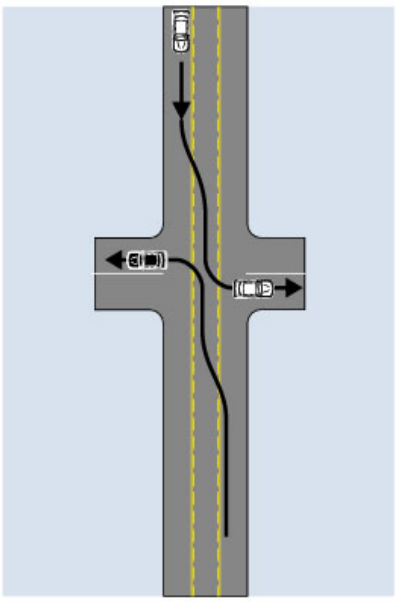


Figure 11: Align Driveways on Opposite Sides of the Roadway

DHU VARREN ROAD

N. SITE DRIVE

LESLIE PARK CIRCLE

RECCOMMENDED

RECCOMMENDED

RECCOMMENDED

RECCOMMENDED

SITE

PONTIAC TRAIL

S. SITE DRIVE

LESLIE PARK CONNECTION

POLSON STREET

RECCOMMENDED

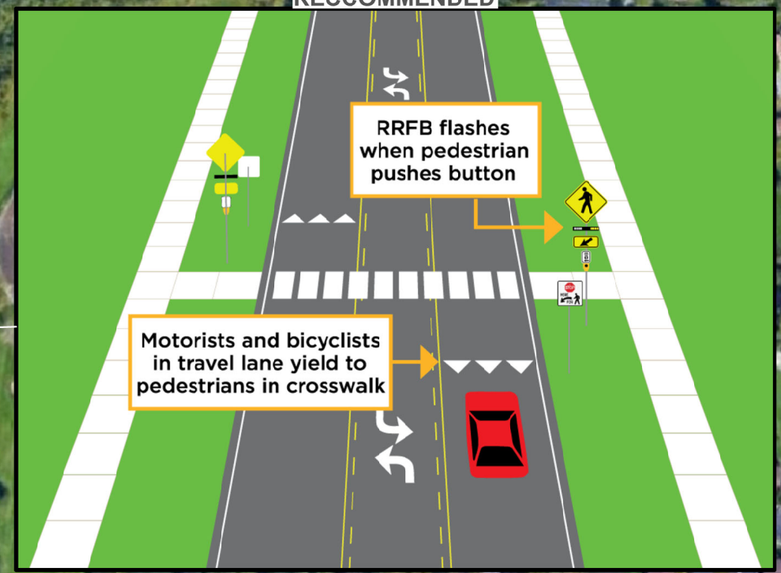


FIGURE 8

MULTI-MODAL CIRCULATION PLAN

VILLAGE ON ANN ARBOR TIS - ANN ARBOR, MI

LEGEND

- SITE — SITE LOCATION
- EXISTING BIKE LANE
- BUS STOP
- SIDEWALK
- PROPOSED SIDEWALK
- EXISTING CROSSWALK / CONFLICT POINT

NORTH

SCALE: NOT TO SCALE

F&V

11 MULTI-MODAL TRANSPORTATION EVALUATION

The existing and proposed non-motorized facilities, and interconnectivity to the proposed site are shown on **Figure 8** and indicates all possible points of conflict between motorized traffic and pedestrian/bicycle traffic on Pontiac Trail and Dhu Varren Road, adjacent to the project site. The proposed development plan includes the construction of internal sidewalks throughout the site, in addition to the sidewalk along the site frontage on Dhu Varren Road. The details are shown on the attached site plan.

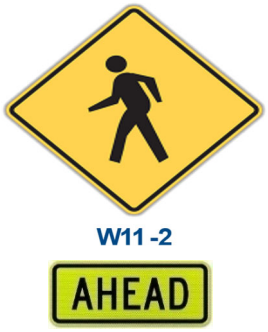
11.1 UNCONTROLLED CROSSING EVALUATION

Ann Arbor's *Crosswalk Design Guidelines* were evaluated in order to determine what improvements, if any, are recommended for the existing uncontrolled crossings along Dhu Varren Road and along Pontiac Trail. Currently, there appears to be only "continental pavement marking" and "street lighting" crosswalk treatments in use at all of the existing mid-block and intersection crossings, within close proximity to the development site.

Pontiac Trail is classified as a *Minor Arterial* and Dhu Varren Road is classified as a *Major Collector*, both with an Annual Average Daily Traffic (AADT) volume greater than 1,500 vehicles per day; therefore, the *NCHRP-562 Report* was evaluated to determine what improvements, if any, are recommended for the existing uncontrolled crossings. Based on the area, available pedestrian data, and trip generation assumptions, the pedestrian volume was projected to not exceed the 20 pedestrians/hour thresholds within the worksheet; therefore, the crossings are not expected to meet the minimum pedestrian volumes to be considered for a TCD type of treatment. However, through discussions with the City staff, the NCHRP spreadsheet was evaluated on a safety basis, assuming a pedestrian volume of 40 pedestrian/hour (double the pedestrian volume threshold); the NCHRP-562 Report worksheets are included in **Appendix E**.

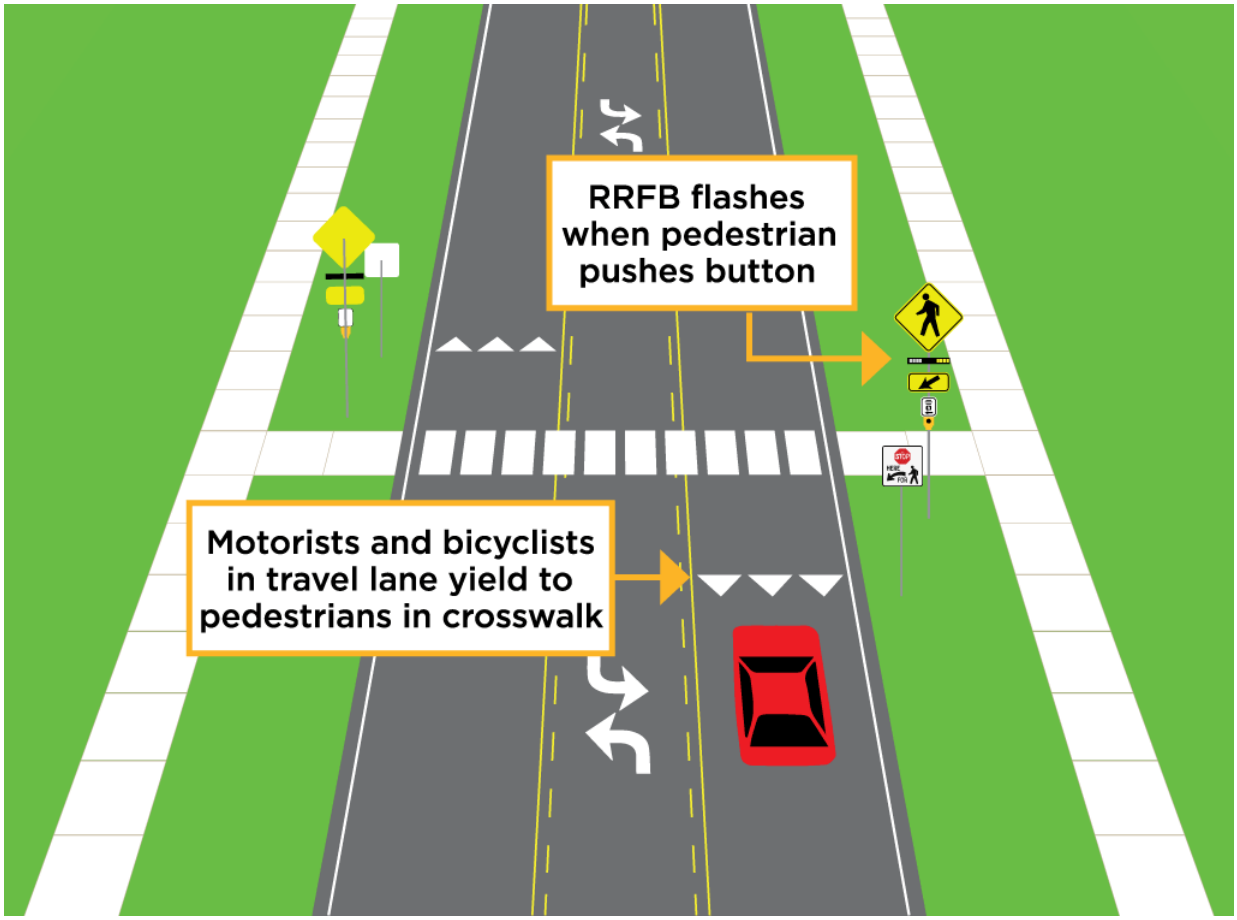
Evaluating the worksheet provided within the NCHRP report indicates that "Crosswalk" Treatment ONLY is recommended for all crossings along Pontiac Trail and along Dhu Varren Road. Therefore, the City of Ann Arbor's Crosswalk Design Guidelines were evaluated and indicated that only high visibility markings are recommended at the existing crosswalk locations. However, the following additional treatments were identified and may also be provided at the existing crosswalks along Pontiac Trail and along Dhu Varren Road to enhance safety at the crossing locations:

- Pedestrian Warning Series (W11-2) with "Ahead"
- Stop Here to Pedestrians sign (R1-6)
- Yield Here to Pedestrians sign (R1-5a)



Additionally, a review of the existing crosswalk showed that potential increase in pedestrian traffic at the Pontiac Trail crossing would warrant the addition of a Rectangular Rapid Flashing Beacon (RRFB) at this intersection. This recommended safety measure, when used in combination with positive contrast lighting and high visibility pavement markings, will significantly improve the safety efficacy at this crossing location. Therefore, the following pedestrian crossing treatments are recommended for the existing crossing located on Pontiac Trail, between Polson Street and the proposed site driveway:

- Provide high visibility pavement markings
- Provide positive contrast lighting
- Install a Rectangular Rapid Flashing Beacon (RRFB)



11.2 Proximity to Transit

The existing transit facilities adjacent to the proposed site development were reviewed. There are two (2) bus stops located on Dhu Varren Road, to the east and west of the proposed N. site Drive. Additionally, there is one (1) bus stop located on Pontiac Trail, to the north of S. Site Drive. Within the immediate study area, several transit routes operated by *The Ride* transit service are present.

- **Route 22: Pontiac – Dhu Varren** – Travels from the Blake Road Transit Center to the Pierpont Commons with scheduled stops at Pontiac & Moore, Arrowwood Hills, Dhu Varren & Omlesaad, and the Plymouth Mall. There are stop on this route along Pontiac Trail and along Dhu Varren Road.
- **Route 63: U-M - Pontiac** – Travels form the U-M Central Campus Transit Center to the Food Gatherers with scheduled stops at U-M Cancer Center and Arrowwood Hills. There are stop on this route along Pontiac Trail and along Dhu Varren Road.

There is an opportunity with the proposed development and proximity to transit and bike lanes to reduce the vehicular impact of the proposed development on the study intersections and adjacent roadway network. Multi modal considerations for this development on Dhu Varren and Pontiac trail include:

- Sheltered bus stops
- Bike racks

12 Conclusions

The conclusions of this TIA are as follows:

1. **Existing Conditions:** All study intersection approaches and movements currently operate acceptably at LOS D or better during both peak periods, with the exception of the following:

- Pontiac Trail & Dhu Varren Road: The WB approach is currently operating at LOS F during the AM peak hour.

2. **Existing Conditions with Improvements:** The results of the existing conditions with improvements analysis indicates the following:
    - Pontiac Trail & Dhu Varren Road: The traffic signal and all-way stop-control warrants are not met, based on existing volumes; therefore, the construction of a roundabout is recommended.
3. **Background (2025) Conditions:** A conservative annual growth rate of **2.00%** per year was provided by WATS for use in this analysis to project traffic volumes to the buildout year of 2025. Additionally, the trip generation associated with several background developments were included in the background analysis. All study intersection approaches and movements are expected to operate in a manner similar to existing conditions, with the following additional delays:
    - Pontiac Trail & Dhu Varren Road: The WB approach is expected to experience an approximately 161-second increase in delay during the AM peak hour and is expected to operate at LOS F during the PM peak hour, with an approximately 69-second increase in delay.
    - Pontiac Trail & Barton Drive: The EB approach, the NB left-turn movement, and the southbound shared through/right movement are expected to operate at LOS F during the AM peak hour. Additionally, the EB approach is expected to operate at LOS F during the PM peak hour and the NB left-turn movement and SB left-turn movement are expected to operate at LOS E.
4. **Background (2025) Conditions with Improvements:** The results of the background (2025) conditions analysis with improvements indicates the following
    - Pontiac Trail & Dhu Varren Road: The traffic signal and all-way stop-control warrants are met, based on background volumes; however, they are expected to increase the overall delay at this intersection. Therefore, the construction of a roundabout is recommended.
    - Pontiac Trail & Barton Drive: Mitigation measures were evaluated in order to improve failing LOS; however, the improvements necessary to mitigate the failing LOS are not likely feasible due to ROW constraints; in addition, these mitigation measures would result in a negative impact on non-motorized operations and safety. Therefore, **no mitigation measures are recommended**; however, the improvements that were identified are documented in the body of the report for **informational purposes only**.
5. **Future Conditions:** The results of the future conditions analysis indicates that all study intersection approaches and movements are expected to continue operating in a manner similar to background conditions, with the exception of the following:
    - Pontiac Trail & Dhu Varren Road: The WB approach is expected to experience increased delays of approximately 49-seconds and 26-seconds during the AM and PM peak hours, respectively.
    - Pontiac Trail & Barton Drive: The SB shared through/right movement is expected to experience an approximately 58-second increase in delay during the AM peak hour. The NB and SB left-turn movements are expected to operate at LOS F during the PM peak hour. Additionally, the NB shared through/right movement is expected to operate at LOS E and the EB approach is expected to experience an approximately 106-second increase in delay during the PM peak hour.
    - An auxiliary turn lane analysis was performed for the proposed site driveways along Pontiac Trail and along Dhu Varren Road. The results indicate that auxiliary turn lane treatments are not warranted or recommended on Dhu Varren Road. A northbound right-turn lane is warranted on northbound Pontiac Trail at the S. Site Drive; however, review of all nearby developments, roadway characteristics, available ROW, sidewalk easements, and environmental impacts was taken into consideration when evaluating the feasibility of a right-turn lane at this intersection. The review indicates that the construction of a right-turn lane into the site would produce more negative impacts (wetland disturbance, greater pedestrian risk, etc.), than the potential vehicular safety benefit gained for slowing vehicles entering the site from northbound Pontiac Trail.
        - Therefore, auxiliary turn lane treatments are **not recommended** at either of either of the proposed site driveway locations.

6. **Future Conditions with Improvements:** The results of the future conditions analysis with improvements indicates the following

    - Pontiac Trail & Dhu Varren Road: The traffic signal and all-way stop-control warrants are met, based on future volumes; however, they are expected to increase the overall delay at this intersection. Therefore, the construction of a roundabout is recommended.

    - Pontiac Trail & Barton Drive: Mitigation measures to improve failing LOS were evaluated and are documented in the body of the report for **informational purposed only**; however, these improvements necessary to mitigate the failing LOS are not likely feasible due to ROW constraints. In addition, these mitigation measures would result in a negative impact on non-motorized operations and safety; therefore, it is recommended to encourage non-motorized trips by constructing a sheltered bus stop and bike parking area(s) adjacent to the site.

7. **Crash Analysis:** The study intersections were below or similar to the average crash rate (crashes per million entering vehicles) for intersections in the SEMCOG region with similar characteristics.

    - There was only one (1) pedestrian crash that occurred along Pontiac Trail (A-injury); however, the crash occurred at a marked pedestrian crossing location with existing signage. The crash was the result of an inattentive driver; therefore, indicating there is no correctable pattern.

8. **Access Management:**

    - The results of the intersection sight distance analysis indicates that all of the proposed driveways have adequate lines of sight, assuming the vision triangles remain free of vegetation. Therefore, it is recommended for the developer/contractor to ensure the sight triangles are clear during the construction of the proposed site driveway.

    - Review of the driveway spacing indicates that the proposed Bristol Ridge driveway is located approximately 250-ft to the north; however, the driveway is located on the same side (east) of Pontiac Trail, which creates less potential turning conflict points. Additionally, Polson Street is also located close (~180-ft south) to the proposed site driveway and is on the opposite (west) side of Pontiac Trail. Review of the project parcel survey information indicates that the proposed site driveway is located on the northern side of the property frontage along Pontiac Trail; additionally, the area to the south of the proposed location is existing wetlands.

        - Therefore, it is recommended to locate the proposed site driveway as far north along the Pontiac Trail property frontage away from Polson Street as possible. This configuration will provide a positive driveway offset from Polson Street and reduce the number of potential turning conflict points, while also minimizing the environmental impact from disturbing the existing wetland area

9. **Multi-Modal Transportation Evaluation:**

    - The proposed development will provide sidewalk along Dhu Varren Road, adjacent to the site property.

    - Existing mid-block pedestrian crossing treatments including, continental pavement markings and street lighting, are provided at the crosswalk locations along Pontiac Trail and along Dhu Varren Road which meet the City of Ann Arbor requirements.

        - Dhu Varren: Additional crosswalk safety enhancements including, advanced warning signs and stop/yield to pedestrian signage at the crosswalk may be added for additional safety emphasis.

        - Pontiac Trail: The existing pedestrian crossing located on Pontiac Trail, between Polson Street was reviewed and additional mitigation measures including the installation of a Rectangular Rapid Flashing Beacon (RRFB), in conjunction with positive contrast lighting and high visibility pavement markings is recommended at this location due to the potential increase in pedestrian volumes at this location.

    - Additionally, the existing transit routes that currently pass by the proposed development can sufficiently accommodate the additional transit riders.

13 RECOMMENDATIONS

The recommendations of this TIA are as follows:

Recommended Improvements and Timing	Existing (2021) *Baseline*	Background (2025) *No Build*	Future (2025) *With Development*
Pontiac Trail & Dhu Varren Road			
• Construct a roundabout with enhanced pedestrian crossings and markings	✓		
Dhu Varren Road & N. Site Drive			
• Provide sheltered bus stop and bike racks			✓
Pontiac Trail & S. Site Drive			
• Provide sheltered bus stop and bike racks			✓
Existing Mid-Block Crossings			
• **<u>Dhu Varren Road (3 Locations) & Pontiac Trail (north crossing only)</u>** ▪ Install "Stop Here to Pedestrians" sign (R1-6) and/or "Yield Here to Pedestrians" sign (R1-5a) • Add advance "Pedestrian Warning Series with Ahead" signs (W11-2)	✓		
• **<u>Pontiac Trail (south crossing only)</u>** ▪ Install "Stop Here to Pedestrians" sign (R1-6) and/or "Yield Here to Pedestrians" sign (R1-5a) ▪ Add advance "Pedestrian Warning Series with Ahead" signs (W11-2) ▪ Provide a Rectangular Rapid Flashing Beacon (RRFB) ▪ Update crossing with high visibility pavement markings ▪ Install positive contrast lighting			✓

K:\18002264\DWG\PLAN SETS\SITE PRELIMINARY\18002264SP-03-OL-PHASE.DWG 8/8/2022 2:49 PM STEVE SILLS

Exhibit C

UTILITY PHASING DESCRIPTION:

PHASE 1 WILL INCLUDE THE WATERMAIN CONNECTIONS TO THE STUB PROVIDED IN THE BRISTOL RIDGE DEVELOPMENT AND THE CONNECTION IN HUNLEY DRIVE TO PROVDE TWO CONNECTIONS FOR A LOOPED SYSTEM. THE WATER MAIN WILL ALSO BE LOOPED ANYWHERE PHASE 1 SERVICE LEADS ARE PROPOSED AND WILL BE STUBBED INTO FUTURE PHASES ALONG THE NORTHERN TOWNHOME ROAD (ROAD G) AND ON THE MAIN NORTH/SOUTH ACCESS ROAD (ROAD S).

THE SANITARY TRUNK LINE RELOCATION WILL OCCUR DURING PHASE 1. CONSTRUCTION OF THE SANITARY SEWER TO AT LEAST THE NEXT UPSTREAM MANHOLE BEYOND ANY LEADS SERVICING BUILDINGS PROPOSED IN PHASE 1 IS PROPOSED.

THE COMPLETE WATER AND SANITARY SYSTEMS ARE WILL BE CONSTRUCTED DURING PHASE 1 FOR THE APARTMENT AND CLUBHOUSE AREA. APPROXIMATELY ¾ OF THE WATERMAIN AND ½ OF THE SANITARY SEWER WITHIN THE TOWNHOME AREAS ARE TO BE CONSTRUCTED DURING PHASE 1.

PHASE 2 UTILITY CONSTRUCTION WILL INCLUDE CLOSING THE WATERMAIN LOOP ALONG THE NORTHERN TOWNHOME AREA ROAD (ROAD G), EXTENDING SANITARY SEWER FROM THE STUB CONSTRUCTED DURING PHASE 1 THROUGH THE TOWNHOME AREAS AND PROVIDING A STUB TO THE NORTH ON THE MAIN NORTH/SOUTH ACCESS ROAD (ROAD S).

PHASE 3 UTILITY CONSTRUCTION WILL INCLUDE THE WATERMAIN CONNECTION TO DHU VARREN ROAD AND CONNECTION TO THE STUB AT THE SITE'S EASTERN BOUNDARY LINE ON THE CHURCH PROPERTY. THE SANITARY SEWER ALONG THE MAIN NORTH/SOUTH ACCESS ROAD (ROAD S) WILL ALSO BE INSTALLED DURING PHASE 3.

LEGEND

- BOUNDARY LINE
- EXIST. EASEMENT
- SECTION LINE
- BOUNDARY/PROPERTY LINE
- EXIST. SETBACK
- EXIST. TREE LINE
- EXIST. CURB AND GUTTER
- EXIST. FENCE
- EXIST. RAILROAD
- EXIST. GRAVEL
- EXIST. BUILDING
- EXIST. WATER EDGE
- EXIST. WETLAND BUFFER
- EXIST. WETLAND
- PROP. BUILDING
- PROP. SETBACK
- PROP. BACK/EDGE CURB
- PROP. ROAD CENTERLINE
- PROP. PARKING STRIPE
- PROP. R.O.W. LINE
- PROP. LOT LINE
- PROP. ROAD CENTERLINE
- PROP. WALK
- PROP. ASPH.

REVISIONS
2021-10-11 PER CITY AND WCWRC
2022-01-19 PER CITY AND WCWRC
2022-03-31 PER CITY AND WCWRC
2022-06-06 PER CITY
2022-06-16 PER CITY
2022-06-17 REV. PHOTOMETRICS.
2022-07-12 PER CITY
2022-08-05 PER CITY

SCALE 0 50 100
1" = 100 FEET
DR. SK CH. SS
P.M. MB
BOOK NA
JOB 18002264
SHEET NO. 10

DATE JUNE 7, 2021

CLIENT
ROBERTSON BROTHERS CO.

VILLAGE OF ANN ARBOR
SITE PLAN

BUILDING PHASING PLAN

SECTION 16
TOWN 2 SOUTH, RANGE 6 EAST
ANN ARBOR TOWNSHIP
WASHTENAW COUNTY, MICHIGAN

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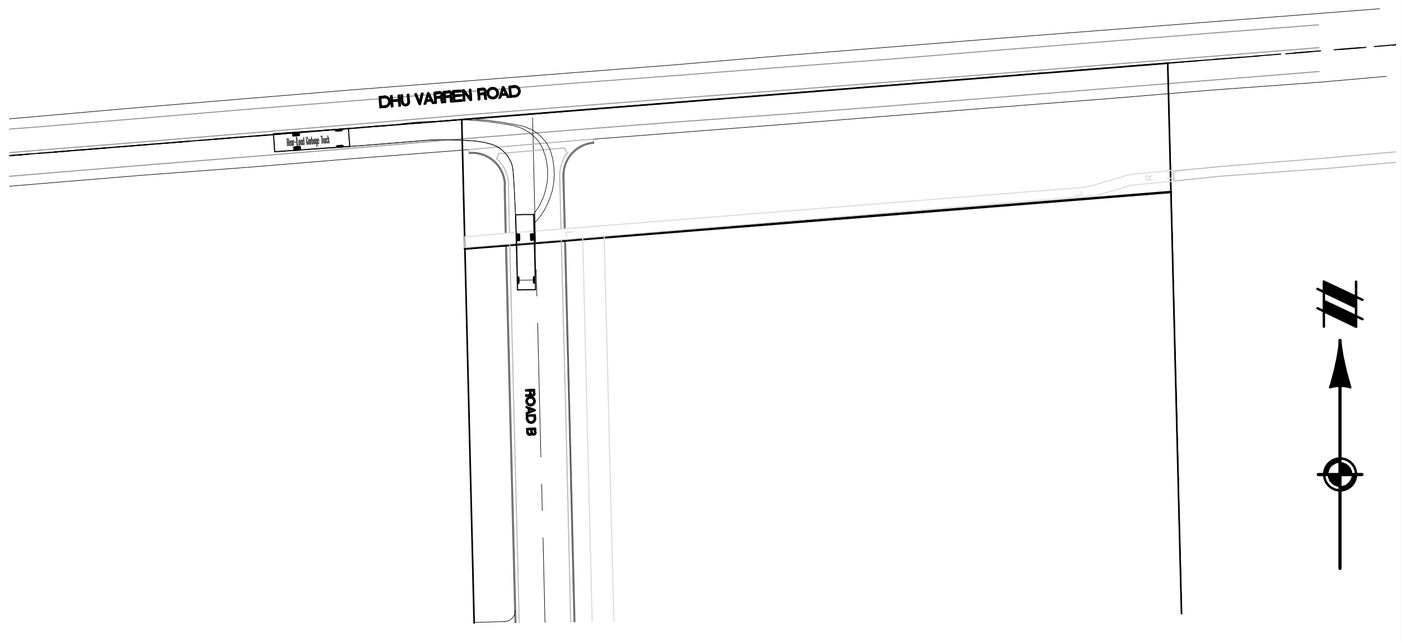
THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ENGINEER. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK. THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

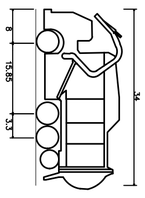
Know what's below.
Call before you dig.
811

EXHIBIT D

DHU VARREN ROAD ENTRANCE



TRASH TRUCK TEMPLATE DETAIL



Front Load Garbage	
Overall Length	34.000ft
Overall Width	8.500ft
Overall Body Height	1.132ft
Min. Body Ground Clearance	1.132ft
Track Width	7.132ft
Lock-to-lock time	6.000s
Max Steering Angle (Virtual)	40.00°

SOLID WASTE NOTES (TOWNHOMES):

1. TRASH HANDLING AND PICKUP TO OCCUR IN CITY STANDARD 64 GALLON CARTS.
2. RECYCLING HANDLING AND PICKUP TO OCCUR IN CITY STANDARD 64 GALLON CARTS.
3. COMPOSTING HANDLING AND PICKUP TO OCCUR IN CITY STANDARD 64 GALLON CARTS, STORED IN A LOCALIZED ENCLOSURE, TO BE WHEELED OUT ON SERVICE DAY. SIGNIFICANT COMPOSTING VOLUME GENERATION BY RESIDENTS IS NOT ANTICIPATED AS OUTSIDE MAINTENANCE WILL BE CONTRACTED. THE DEVELOPMENT IS RESPONSIBLE FOR WHEELING COMPOST CARTS FROM THE ENCLOSURE ON COLLECTION DATE. ALL CARTS SHALL BE PLACED A MINIMUM OF THREE FEET APART.
4. REFER TO THIS PLAN FOR GENERAL PLACEMENTS DURING PICKUP WITHIN THE TOWNHOUSE AREAS. BINS ARE SHOWN WITH A STANDARD 3' SEPARATION. DURING SERVICE DAYS, BINS ALSO BE PLACED WITHIN THE PAVEMENT ALONG PRIVATE ROADS THAT ARE AT 25' BC/BC OR GREATER. THE CARTS PLACED IN THE PAVEMENT FOR PICKUP ARE TO BE ADJACENT TO THE BACK OF CURB AND PLACED IN THE AREA IMMEDIATELY IN FRONT OF THE CART LOCATION SHOWN ON THIS PLAN.
5. SOLID WASTE AND RECYCLING BINS ARE TO BE STORED IN GARAGES WHEN NOT IN SERVICE.

TRASH TRUCK (TYP.)

INDIVIDUAL RUBBISH CART, (TYP.)

INDIVIDUAL RECYCLING CART, (TYP.)

3' TYP.

COMPOST CART STORAGE ENCLOSURE. CARTS TO BE WHEELED OUT ON SERVICE DAY IN LOCATION SHOWN.

CLUBHOUSE

DATE	JUNE 7, 2021
REVISIONS	2021-10-11 PER CITY AND WCWRC
	2022-01-19 PER CITY AND WCWRC
	2022-03-31 PER CITY AND WCWRC
	2022-06-06 PER CITY
	2022-06-16 PER CITY
	2022-06-17 REV. PHOTOMETRICS
	2022-07-12 PER CITY
	2022-08-05 PER CITY
SCALE	0 25 50
	1" = 50 FEET
DR. SK CH. SS	
P.M. MB	
BOOK NA	
JOB 18002264	
SHEET NO. 66	

CLIENT
ROBERTSON BROTHERS CO.

VILLAGE OF ANN ARBOR
SITE PLAN

SOLID WASTE PLAN – TOWNHOMES

SECTION 16

TOWN 2 SOUTH, RANGE 6 EAST

ANN ARBOR TOWNSHIP

WASHTENAW COUNTY, MICHIGAN

ATWELL
866.850.4200 www.atwell-group.com
TWO TOWNE SQUARE, SUITE 700
SOUTHFIELD, MI 48076
248.447.2000

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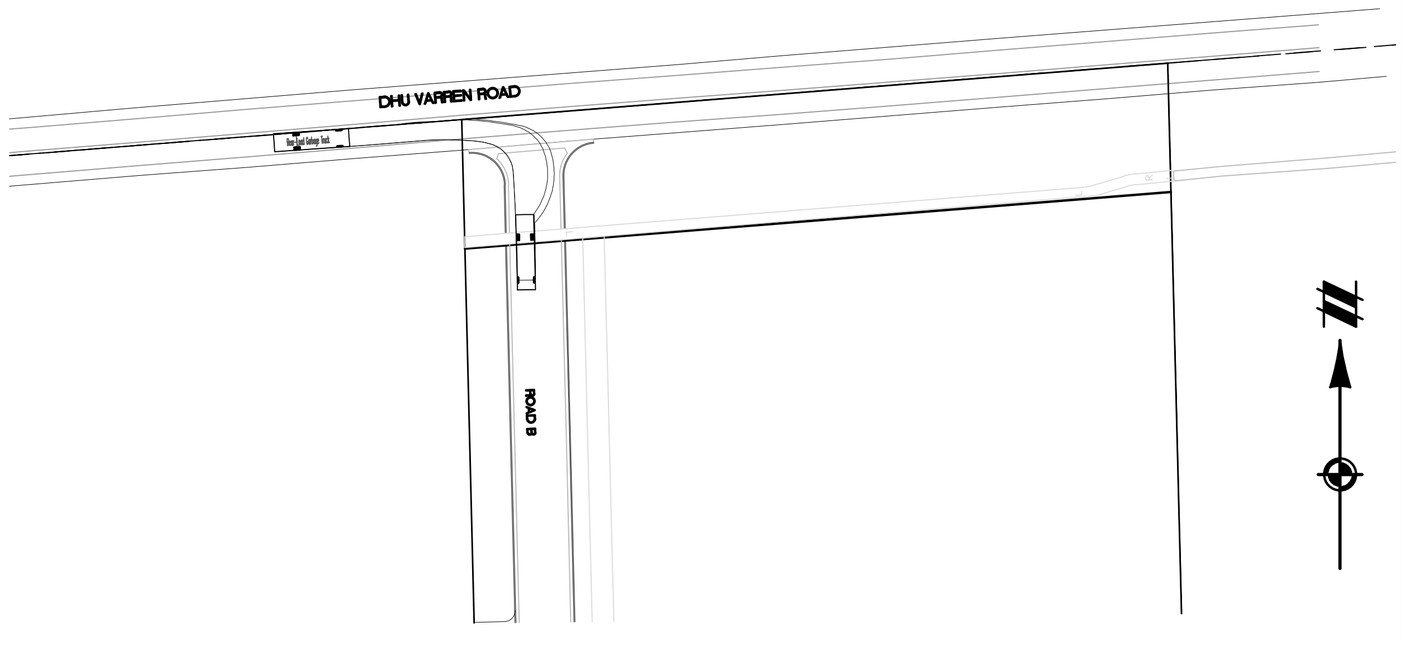
Know what's below. Call before you dig.
THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK AND SHALL BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

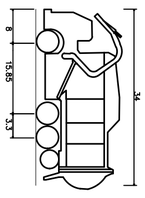
K:\18002264\DWG\PLAN SETS\SITE PRELIMINARY\18002264SP-09-DT.DWG 8/8/2022 3:08 PM STEVE SILLS

EXHIBIT E

DHU VARREN ROAD ENTRANCE



TRASH TRUCK TEMPLATE DETAIL



Front Load Garbage	
Overall Length	34.000ft
Overall Width	8.500ft
Overall Body Height	1.132ft
Min. Body Ground Clearance	1.132ft
Track Width	7.000ft
Lock-to-lock time	6.000s
Max Steering Angle (Virtual)	40.00°

SOLID WASTE NOTES (TOWNHOMES):

1. IF THE CITY FINDS THAT THE RESIDENTS OF THE VILLAGE OF ANN ARBOR ARE UNWILLING TO TRANSPORT CARTS TO THESE DESIGNATED LOCATIONS, OR PLACEMENT OF THE CARTS DO NOT ADHERE TO THE DESIGNATED LOCATIONS, INCLUDING CART SPACING, THE CITY WILL REQUIRE THAT THE CARTS BE REPLACED BY DUMPSTERS FOR SOLID WASTE AND RECYCLING SERVICES AS SHOWN. ALL COSTS ASSOCIATED WITH THESE MODIFICATIONS, INCLUDING THE CONSTRUCTION OF DUMPSTER CORRALS THAT MEET THE CITY'S THEN-CURRENT STANDARDS WILL BE AT THE EXPENSE OF THE PROPERTY OWNER.

DATE	JUNE 7, 2021
REVISIONS	2021-10-11 PER CITY AND WCWRC
	2022-01-19 PER CITY AND WCWRC
	2022-03-31 PER CITY AND WCWRC
	2022-06-06 PER CITY
	2022-06-16 PER CITY
	2022-06-17 REV. PHOTOMETRICS
	2022-07-12 PER CITY
	2022-08-05 PER CITY
SCALE	0 25 50
	1" = 50 FEET
DR. SK CH. SS	
P.M. MB	
BOOK NA	
JOB 18002264	
SHEET NO. 68	

CLIENT
ROBERTSON BROTHERS CO.

VILLAGE OF ANN ARBOR
SITE PLAN
SOLID WASTE PLAN – TOWNHOMES ALTERNATE

SECTION 16
TOWN 2 SOUTH, RANGE 6 EAST
ANN ARBOR TOWNSHIP
WASHTENAW COUNTY, MICHIGAN

ATWELL
866.850.4200 www.atwell-group.com
TWO TOWNE SQUARE, SUITE 700
SOUTHFIELD, MI 48076
248.447.2000

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811 Know what's below. Call before you dig.

EXHIBIT F

D.R. Nelson & Associates

Building Science Delivered

P.O. Box 2420
Birmingham, MI 48012

Office: 248-393-9100
Fax: 248-499-9773

Mechanical Equipment Review - Impact of natural gas to electric February 14, 2022

The analysis on the following pages uses REM/Rate v 16.06, the computer software program developed for the Energy Star® for homes program by the United States Environmental Protection Agency and the Department of Energy. The predicted costs are based on average climate data for Southeast Michigan and use the October 2021 published utility rates:

DTE Energy

ELECTRIC SERVICE

Monthly Service Charge $8.41

Rate: 0-17 kWh at 0.1620 $/kWh
17+ kWh at 0.1818 $/kWh

GAS SERVICE

Monthly Service Charge $12.88

Rate: 0.6677 $/Therm

An important element to consider when thinking about this subject is the utility rates in the State of Michigan versus the National Average. For the State of Michigan, natural gas rates are 36% below the national average and electricity rates are 27% higher than the national average.

Prices

Petroleum	Michigan	U.S. Average	Period	find more
Domestic Crude Oil First Purchase	$ 81.09 /barrel	$ 78.51 /barrel	Oct-21	
Natural Gas	**Michigan**	**U.S. Average**	**Period**	find more
City Gate	$ 4.94 /thousand cu ft	$ 6.41 /thousand cu ft	Oct-21	find more
Residential	$ 11.20 /thousand cu ft	$ 17.48 /thousand cu ft	Oct-21	find more
Coal	**Michigan**	**U.S. Average**	**Period**	find more
Average Sales Price	--	$ 31.41 /short ton	2020	
Delivered to Electric Power Sector	W	$ 2.03 /million Btu	Oct-21	
Electricity	**Michigan**	**U.S. Average**	**Period**	find more
Residential	17.96 cents/kWh	14.11 cents/kWh	Oct-21	find more
Commercial	12.30 cents/kWh	11.56 cents/kWh	Oct-21	find more
Industrial	8.19 cents/kWh	7.53 cents/kWh	Oct-21	find more

Data taken from:
https://www.eia.gov/state/print.php?sid=MI

PROJECTED YEARLY HOMEOWNER EXPENSES

HEATING SPECIFICATIONS			
GAS		**ELECTRIC**	
Efficiency:	96% AFUE	**Efficiency:**	8.5 HSPF
Rated Output Capacity:	58 kBtuh	**Compressor Capacity at 17°F:**	14.6 kBtuh
		Compressor Capacity at 47°F:	24 kBtuh
		Electric Resistance Backup Capacity:	5 kW
COOLING SPECIFICATIONS			
GAS		**ELECTRIC**	
Efficiency:	13 SEER	**Efficiency:**	14 SEER
Capacity:	24 kBtuh	**Capacity:**	24 kBtuh
Sensible Heat Fraction:	0.70	**Sensible Heat Fraction:**	0.80
WATER HEATING SPECIFICATIONS			
GAS		**ELECTRIC**	
Size:	50 gallon	**Size:**	50 gallon
Energy Factor:	0.70	**Energy Factor:**	0.91
Recovery Efficiency:	0.80	**Recovery Efficiency:**	0.98

1335 END UNIT		
UTILITY	GAS	ELECTRIC
HEATING	$315	$1,101
COOLING	$156	$137
WATER HEATING	$100	$611
LIGHTS & APPLIANCES	$763	$960
SERVICE CHARGE	$255	$101
TOTAL	$1,590	$2,911

1335 MIDDLE UNIT		
UTILITY	GAS	ELECTRIC
HEATING	$230	$805
COOLING	$147	$129
WATER HEATING	$100	$611
LIGHTS & APPLIANCES	$763	$960
SERVICE CHARGE	$255	$101
TOTAL	$1,496	$2,606

1613 END UNIT		
UTILITY	GAS	ELECTRIC
HEATING	$398	$1,395
COOLING	$185	$165
WATER HEATING	$99	$600
LIGHTS & APPLIANCES	$836	$1,033
SERVICE CHARGE	$255	$101
TOTAL	$1,773	$3,294

1613 MIDDLE UNIT		
UTILITY	GAS	ELECTRIC
HEATING	$313	$1,091
COOLING	$175	$155
WATER HEATING	$99	$600
LIGHTS & APPLIANCES	$836	$1,033
SERVICE CHARGE	$255	$101
TOTAL	$1,677	$2,980

1836 A UNIT		
UTILITY	GAS	ELECTRIC
HEATING	$383	$1,345
COOLING	$174	$154
WATER HEATING	$94	$571
LIGHTS & APPLIANCES	$863	$1,060
SERVICE CHARGE	$255	$101
TOTAL	$1,770	$3,231

1833 B UNIT		
UTILITY	GAS	ELECTRIC
HEATING	$280	$976
COOLING	$148	$130
WATER HEATING	$94	$571
LIGHTS & APPLIANCES	$863	$1,060
SERVICE CHARGE	$255	$101
TOTAL	$1,640	$2,838

1835 C UNIT		
UTILITY	GAS	ELECTRIC
HEATING	$391	$1,374
COOLING	$155	$136
WATER HEATING	$94	$571
LIGHTS & APPLIANCES	$863	$1,060
SERVICE CHARGE	$255	$101
TOTAL	$1,758	$3,242

EMISSIONS

CARBON DIOXIDE	1335 END UNIT		1335 MIDDLE UNIT	
tons / year	GAS	ELECTRIC	GAS	ELECTRIC
HEATING	2.7	4.6	1.9	3.4
COOLING	0.7	0.6	0.6	0.5
WATER HEATING	0.9	2.6	0.9	2.6
LIGHTS & APPLIANCES	3.4	4.0	3.4	4.0
TOTAL	7.6	11.8	6.9	10.5

CARBON DIOXIDE	1613 END UNIT		1613 MIDDLE UNIT	
tons / year	GAS	ELECTRIC	GAS	ELECTRIC
HEATING	3.4	5.9	2.6	4.6
COOLING	0.8	0.7	0.7	0.7
WATER HEATING	0.9	2.5	0.9	2.5
LIGHTS & APPLIANCES	3.7	4.3	3.7	4.3
TOTAL	8.8	13.4	8.0	12.1

CARBON DIOXIDE	1836 A UNIT		1833 B UNIT		1835 C UNIT	
tons / year	GAS	ELECTRIC	GAS	ELECTRIC	GAS	ELECTRIC
HEATING	3.2	5.7	2.4	4.1	3.3	5.8
COOLING	0.7	0.7	0.6	0.5	0.7	0.6
WATER HEATING	0.8	2.4	0.8	2.4	0.8	2.4
LIGHTS & APPLIANCES	3.8	4.5	3.8	4.5	3.8	4.5
TOTAL	8.7	13.2	7.7	11.5	8.7	13.2

The following pages contain the actual reports from the REM/Rate software which we summarized above. The reports are 2 pages for each of the 7 floorplans. The floorplan name is listed towards the top of each page. AB stands for As Built with gad furnace and water heater, ELEC means Electric

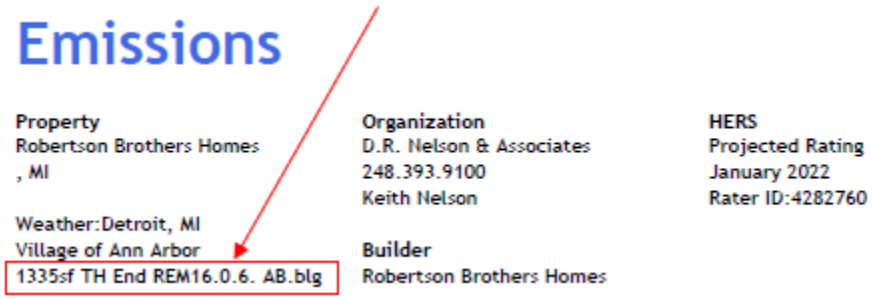

Exhibit G

Baseline Gas vs Electric Heat Pumps – Utility Cost Comparison

The tables below show only the utility cost comparisons between our baseline gas appliances, using a 14 SEER air conditioning system, versus an all-electric appliance package, using a cold-climate 18 SEER heat pump and 3.75 UEF hybrid electric water heater. Heating utility costs are estimates based on the ASHRAE Bin Method, which uses 65F Heating Degree Day values. Cooling utility costs are simplified estimates based on annual full-load cooling hours and the 65F Cooling Degree Day values. Water Heating costs are estimates based on the U.S. Government ENERGYGUIDE cost labels, and then scaled based on the DTE Energy utility rates. Lights and appliance costs were estimated from the REM/Rate v16.01 computer software program. October 2021 published utility rates from DTE Energy:

DTE Electric Service
Monthly Service Charge $8.41
Rate: 0-17 kWh at 0.1620 $/kWh
17+ kWh at 0.1818 $/kWh

DTE Gas Service:
Monthly Service Charge $12.88
Rate: 0.6677 $/Therm

HEATING SPECIFICATIONS			
GAS		**ELECTRIC - HEAT PUMP**	
Efficiency:	96% AFUE	**Efficiency:**	10 HSPF
Rated Output Capacity:	26/25 kBtuh	**Rated Output Capacity:**	1.5 T
R.O.C. (24' End Unit):	40/39 kBtuh	**Electric Resistance:**	3kw / 24' End 5kw
COOLING SPECIFICATIONS			
ELECTRIC		**ELECTRIC - HEAT PUMP**	
Efficiency:	14 SEER	**Efficiency:**	18 SEER
Capacity:	17.1 kBtuh	**Capacity:**	17.1 kBtuh
Sensible Heat Fraction:	0.70	**Sensible Heat Fraction:**	0.80
WATER HEATING			
GAS		**ELECTRIC - HEAT PUMP**	
Size:	50 gallon	**Size:**	50 gallon
Energy Factor:	0.70	**Energy Factor:**	3.75
Recovery Efficiency:	0.80	**Recovery Efficiency:**	4.30

16' - 1335 END		
UTILITY	GAS	ELEC. HP
HEATING	$350	$868
COOLING	$585	$455
WATER HEATING	$160	$139
LIGHTS & APPLIANCES	$763	$960
SERVICE CHARGE	$255	$101
TOTAL	**$2,113**	**$2,523**

16' - 1335 INT		
UTILITY	GAS	ELEC. HP
HEATING	$259	$609
COOLING	$537	$417
WATER HEATING	$160	$139
LIGHTS & APPLIANCES	$763	$960
SERVICE CHARGE	$255	$101
TOTAL	**$1,974**	**$2,226**

20' - 1613 END		
UTILITY	GAS	ELEC. HP
HEATING	$389	$961
COOLING	$669	$521
WATER HEATING	$160	$139
LIGHTS & APPLIANCES	$836	$1,033
SERVICE CHARGE	$255	$101
TOTAL	**$2,309**	**$2,755**

20' - 1613 INT		
UTILITY	GAS	ELEC. HP
HEATING	$312	$749
COOLING	$627	$448
WATER HEATING	$160	$139
LIGHTS & APPLIANCES	$836	$1,033
SERVICE CHARGE	$255	$101
TOTAL	**$2,190**	**$2,470**

24' - 1836 END		
UTILITY	GAS	ELEC. HP
HEATING	$474	$1,295
COOLING	$701	$545
WATER HEATING	$160	$139
LIGHTS & APPLIANCES	$863	$1,060
SERVICE CHARGE	$255	$101
TOTAL	**$2,453**	**$3,140**

24' - 1833 INT		
UTILITY	GAS	ELEC. HP
HEATING	$355	$881
COOLING	$644	$501
WATER HEATING	$160	$139
LIGHTS & APPLIANCES	$863	$1,060
SERVICE CHARGE	$255	$101
TOTAL	**$2,277**	**$2,682**

An important element to consider when thinking about this subject is the utility rates in the State of Michigan versus the National Average. For the State of Michigan, natural gas rates are 36% below the national average and electricity rates are 27% higher than the national average.

The cost estimates shown in this report, just to reiterate, are the utility cost estimates. These do not reflect the upfront costs of the HVAC equipment, water heater equipment, and appliances, nor do they reflect installation costs associating with gas plumbing, or any state and federal incentives for high efficiency heat pump equipment.

ANTHONY AMADIO
Mechanical Engineer, PE

PE LOAD CALCS, LLC
824 Gisele Court
Haines City, FL 33844
901.257.5910
anthony.amadio@peloadcalcs.com

Digitally signed by
Anthony R Amadio
Date: 2022.04.07
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