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November 30, 2022

Mr. Bradley Kosco, PE, PS
City Engineer
City of Hudson Engineering Department
1140 Terex Road
Hudson, Ohio 44236

Re: City of Hudson, Reserve at River Oaks Intersection Analysis
Preliminary Draft of Findings

Dear Mr. Kosco:

As a follow-up to our project coordination, American Structurepoint is pleased to submit our technical memorandum for the subject project.

Project Background

The Reserve at River Oaks is a community in Hudson, Ohio, located south of Boston Mills Road. The community is made up of approximately 194 single-family homes run by a Homeowner's Association. This memo will focus on two intersections within the community, Timberline Trail/Kingswood Drive and Regal Woods Drive/Rosewood Trail. Timberline Trail and Regal Woods Drive are both stop-controlled, and Kingswood Drive and Rosewood Trail are the through movements at each intersection, respectively. Both locations have received inquiries as to the location of the stop signs at the intersections as well as speed concerns at each intersection. This memo will focus on each intersection and potential countermeasures to alleviate concerns from the community.

Previous studies

The City of Hudson previously conducted four-way stop sign warrant analysis at both intersections. The studies are summarized below.

- Timberline Trail & Kingswood Drive Four-Way Stop Sign Warrant (2021): This memo provided a four-way stop warrant analysis at the intersection and determined it does not meet minimum criteria for additional stop signs.

- Regal Woods Drive & Rosewood Trail Four-Way Stop Sign Warrant (2021): This memo provided a four-way stop warrant analysis at the intersection and determined it does not meet minimum criteria for additional stop signs.
- Reserve at River Oaks Subdivision – Rosewood Trail & Regal Woods Drive Stop Sign Follow Up Evaluation (2022): The City of Hudson performed a follow-up four-way stop warrant analysis at the intersection and determined it did not meet minimum criteria for additional stop signs. The study also noted that there were significant sight distance issues at the intersection that were being addressed by the City Arborist. Speed did not appear to be an issue leading up to this intersection per counts collected by the City's JAMAR traffic counting unit.

Peer Review of Previous Studies

American Structurepoint reviewed the three previous studies listed above. Each study references portions of the Ohio Manual of Uniform Traffic Control Devices (OMUTCD) regarding the use of stop signs and the process for warranting a four-way stop at an intersection.

- The first two studies reported that neither intersection warranted an all-way stop condition. The results were based on the following criteria from the OMUTCD:
    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 multiway 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 volume warrants are 70 percent of the values provided in Items 1 and 2.*
    d. *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 criteria were not met for any of the OMUTCD conditions, therefore American Structurepoint concurs that a four-way stop should not be used at this time at either intersection.

- The follow up study performed in 2022 by the City of Hudson provided an additional four-way stop warrant analysis of Regal Woods Drive and Rosewood Trail. The study concluded that the OMUTCD Multi-Way Stop Sign conditions were not met, therefore the 4-way stop was not warranted. In addition to the stop sign warrant analysis, speed conditions of the road were collected and sight conditions at the intersection were analyzed. The report concluded that the average vehicular speeds did not exceed 25 mph, therefore excessive speed was not an issue. Sight conditions at the intersection are impacted from residential landscaping and trees planted between the curb and sidewalk. Given the data in the report, American Structurepoint concurs with the final conclusion to not warrant the all-way stop condition and to provide tree pruning to improve sight distance and sign visibility.

StreetLight Data

As a follow-up to the previous studies, we collected data from StreetLight, a web-based platform that collects GPS signals and location-based service signals from cell phones, and provides real-time vehicular, bicycle and pedestrian movements across the United States. For this report, turning movement counts were collected from StreetLight for both intersections to confirm results of the previous analysis and to identify any variation in existing traffic conditions since the previous four-way stop warrant analysis was conducted.

The current dataset available in StreetLight only includes volumes through April 2022. Therefore, turning movement counts were filtered from 1/1/2022 to 4/30/2022. Traffic counts from the follow up study completed by the City of Hudson were conducted in June 2022 and are more recent than what is available from StreetLight for Regal Woods Drive and Rosewood Trail, therefore the City's data was used in the analysis rather than Streetlight. The following table presents volumes collected from StreetLight for the Timberline Trail/Kingswood Drive intersection. The data confirms the previous studies' conclusion that a four-way stop is not warranted.

	North			East			South			West			
	Timberline N (Southbound)			Kingswood E (Westbound)			Timberline S (Northbound)			Kingswood W (Eastbound)			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
5:00am	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15am	0	0	0	0	0	0	0	0	0	0	0	0	0
5:30am	0	0	0	0	0	0	0	0	0	0	0	0	0
5:45am	0	0	0	0	0	0	0	0	0	0	0	0	0
6:00am	0	0	0	0	0	0	0	0	0	0	0	0	0
6:15am	0	0	0	0	0	0	0	0	0	0	0	0	0
6:30am	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45am	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00am	0	0	0	0	0	3	0	0	0	0	0	0	3
7:15am	0	0	0	0	0	6	0	0	0	0	0	0	6
7:30am	1	0	0	0	0	3	0	0	0	0	0	0	4
7:45am	0	0	0	0	0	2	0	0	0	0	0	0	2
8:00am	1	0	0	0	0	2	0	0	0	0	0	0	3
8:15am	1	0	0	0	0	2	0	0	0	0	0	0	3
8:30am	1	0	0	0	0	2	0	0	0	0	0	0	3
8:45am	1	0	0	0	0	1	0	0	0	0	0	0	2
9:00am	1	0	0	0	0	1	0	0	0	0	0	0	2
9:15am	1	0	0	0	0	1	0	0	0	0	0	0	2
9:30am	1	0	0	0	0	1	0	1	0	0	0	0	3
9:45am	1	0	0	0	0	0	0	1	0	0	0	0	2
10:00am	1	0	0	0	0	0	0	1	0	0	0	0	2
10:15am	1	1	0	0	0	1	0	0	0	0	0	0	3
10:30am	0	0	0	0	0	1	0	0	0	0	0	0	1
10:45am	1	0	0	0	0	0	0	0	0	0	0	0	1
11:00am	2	1	0	0	0	1	0	0	0	0	0	0	4
11:15am	2	1	0	0	0	1	0	0	0	0	0	0	4
11:30am	1	0	0	0	0	2	0	0	0	0	0	0	3
11:45am	1	0	0	0	0	2	0	0	0	0	0	0	3
12:00pm	1	1	0	0	0	1	0	0	0	0	0	0	3
12:15pm	1	1	0	0	0	1	0	0	0	0	0	0	3
12:30pm	2	1	0	0	0	1	0	0	0	0	0	0	4
12:45pm	2	0	0	0	0	0	0	0	0	0	0	0	2
1:00pm	2	0	0	0	0	1	0	0	0	0	0	0	3
1:15pm	2	1	0	0	0	1	0	1	0	0	0	0	5
1:30pm	2	1	0	0	0	1	0	0	0	0	0	0	4
1:45pm	1	0	0	0	0	1	0	0	0	0	0	0	2
2:00pm	3	1	0	0	0	1	0	1	0	0	0	0	6
2:15pm	2	0	0	0	0	1	0	1	0	0	0	0	4
2:30pm	1	0	0	0	0	1	0	0	0	0	0	0	2
2:45pm	1	1	0	0	0	1	0	0	0	0	0	0	3
3:00pm	2	3	0	0	0	1	0	0	0	0	0	0	6
3:15pm	5	6	0	0	0	1	0	0	0	0	0	0	12
3:30pm	3	3	0	0	0	1	0	0	0	0	0	0	7
3:45pm	2	2	0	0	0	2	0	1	0	0	0	0	7
4:00pm	2	1	0	0	0	1	0	1	0	0	0	0	5
4:15pm	2	1	0	0	0	0	0	0	0	0	0	0	3
4:30pm	2	0	0	0	0	1	0	0	0	0	0	0	3
4:45pm	2	1	0	0	0	1	0	0	0	0	0	0	4
5:00pm	2	1	0	0	0	1	0	0	0	0	0	0	4
5:15pm	3	1	0	0	0	1	0	0	0	0	0	0	5
5:30pm	3	1	0	0	0	0	0	0	0	0	0	0	4
5:45pm	2	1	0	0	0	1	0	0	0	0	0	0	4
6:00pm	2	1	0	0	0	2	0	1	0	0	0	0	6
6:15pm	2	1	0	0	0	2	0	0	0	0	0	0	5
6:30pm	3	2	0	0	0	2	0	0	0	0	0	0	7
6:45pm	2	2	0	0	0	2	0	0	0	0	0	0	6
7:00pm	1	1	0	0	0	0	0	0	0	0	0	0	2
7:15pm	1	1	0	0	0	0	0	0	0	0	0	0	2
7:30pm	1	1	0	0	0	1	0	0	0	0	0	0	3
7:45pm	2	1	0	0	0	0	0	0	0	0	0	0	3
8:00pm	2	1	0	0	0	1	0	0	0	0	0	0	4
8:15pm	2	1	0	0	0	1	0	0	0	0	0	0	4
8:30pm	2	1	0	0	0	0	0	0	0	0	0	0	3
8:45pm	3	0	0	0	0	1	0	0	0	0	0	0	4
9:00pm	2	0	0	0	0	0	0	0	0	0	0	0	2
9:15pm	1	1	0	0	0	0	0	0	0	0	0	0	2
9:30pm	0	1	0	0	0	0	0	0	0	0	0	0	1
9:45pm	0	0	0	0	0	1	0	0	0	0	0	0	1
Grand Total	94	46	0	0	0	67	0	9	0	0	0	0	216

Crash Analysis

Crash data was obtained from ODOT's GIS Crash Analysis Tool (GCAT) for the previous five years (2017-2021) for both intersections. There have not been any recorded crashes at either of the intersections, therefore 4-way stops are not warranted by crash history.

Speed Analysis

The City of Hudson provided speed data extracted from a JAMAR traffic recorder. Data on Kingswood Drive was taken from 6/27/2022 to 7/5/2022. The posted speed limit on Kingswood Drive is 25 mph. The average speed during collection was 22 mph and the 85th percentile speed was 25 mph. Data on Rosewood Trail was collected from 6/21/2022 to 6/27/2022. The posted speed limit on Rosewood Trail is 25 mph. The average speed during collection was 22 mph and the 85th percentile speed was 26 mph. The data indicates that operating speeds for both streets are not a concern through the intersections.

Field Observations

American Structurepoint conducted a field visit on Saturday, September 24, 2022, at 11:00 am. A weekend day was selected with the intent to capture peak pedestrian movements when families and children would be at home. During the visit, several observations were made at the intersections.

Timberline Trail and Kingswood Drive

This intersection is controlled by a 2-way stop located along Timberline Trail. Approaching views of the stop signs are obstructed by trees located within the existing tree lawn. As these trees continue to grow, sign visibility will continue to be a problem. Figures 1 and 2 were taken on Timberline Trail in both directions during the field visit.

In Figure 1, the stop sign is completely hidden from view while approaching the intersection. The branches of the trees have completely covered the face of the sign making it difficult to see. Also, this sign was placed with an 8-foot lateral offset. ODOT standards allow a 2-foot lateral offset from the curb (SCD TC-42.20) which will improve visibility of the sign. Figure 2 shows another sign that can be seen approaching the intersection. This sign is currently visible; however, future growth of the existing tree may obstruct views of the sign. Record plans indicate both signs meet current OMUTCD standard sizes for a residential street.

According to the volumes obtained from StreetLight Data, Timberline Trail constitutes the major movement, with traffic volumes that slightly exceed the volumes on Kingswood. The OMUTCD indicates that stop signs at a 2-way stop should be placed on the minor street (OMUTCD Section 2B.06). At this time, American Structurepoint does not recommend switching the stop signs due to the relatively small difference in volumes.

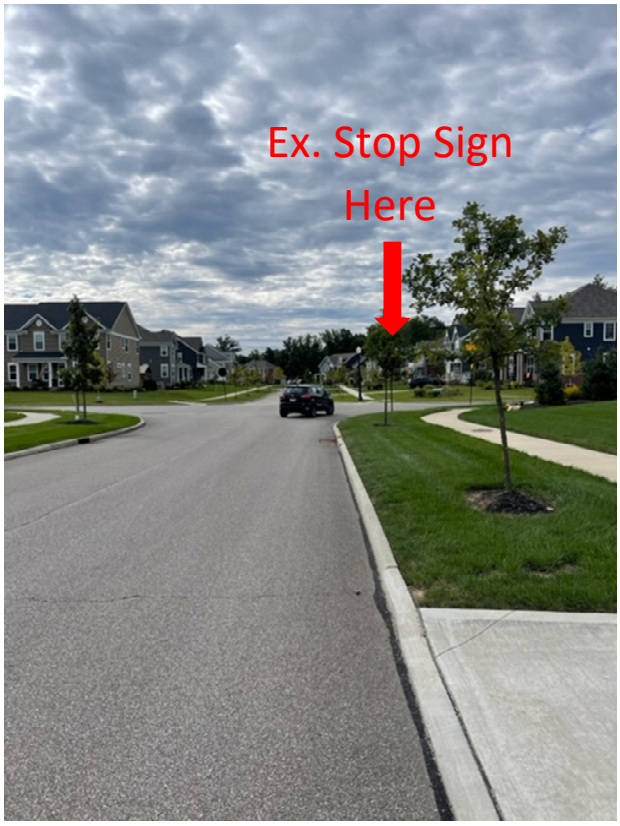


Figure 1: Timberline Trail Looking South

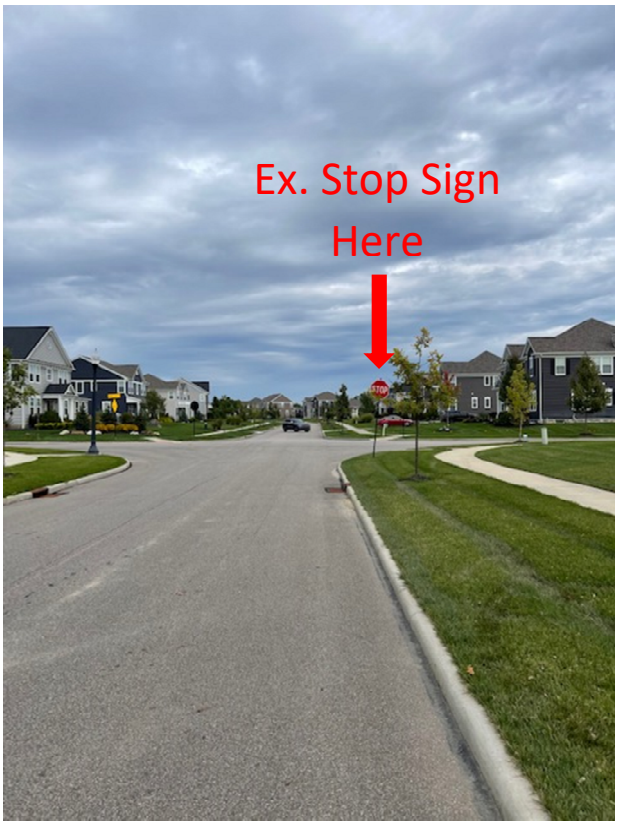


Figure 2: Timberline Trail Looking North

Rosewood Trail and Regal Woods Drive

This intersection is controlled by a 2-way stop located along Regal Woods Drive. Regal Woods Drive bisects the curve of Rosewood Trail which restricts sight distance at the intersection. The stop signs at this intersection appear to be visible along both approaches. Record plans indicate both stop signs meet current OMUTCD standard sizes for a residential street.

Intersection site distance is limited along the westbound approach to the intersection along Regal Woods Drive. When sitting at the stop sign on Regal Woods Drive, it is impossible to see traffic approaching from the right, due to the trees planted between the curb and sidewalk as well as private trees and bushes planted on the property on the northern corner of the intersection. See Figures 3 and 4 for views of each stop-controlled approach. Appendix A shows the plan view of how the sight distance is impacted by the trees sitting at the stop sign westbound on Regal Woods and looking southbound from Rosewood Trail.

Views of the intersection along the other approaches are partially blocked by the trees planted between the curb and walk. These trees should be continuously pruned to maximize sight distance at the intersection.

Record traffic counts indicate Rosewood Trail is the major movement at this intersection, therefore the stop signs should remain in their existing location.

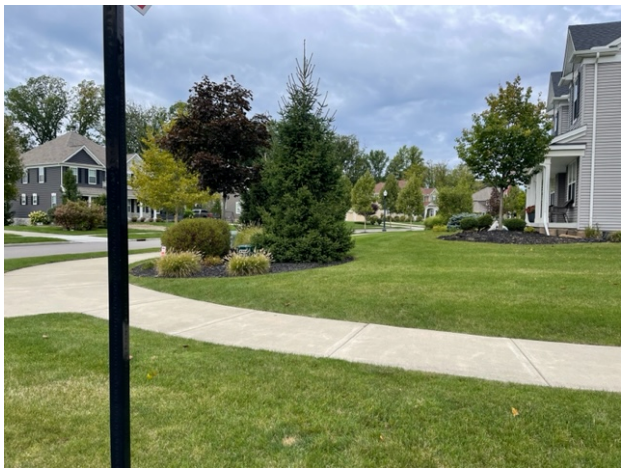


Figure 3: Regal Woods Looking North

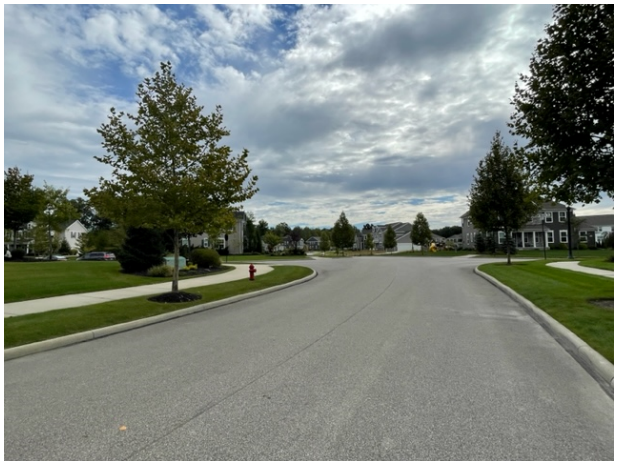


Figure 4: Rosewood Looking South

Additional Observations

During our field visit, we noted that existing curb return radii at both intersections are larger than required by ODOT design guidance shown below. According to record plans, the turning radius on each corner of the intersections is 46.5 feet. The ODOT *Location and Design Manual Volume 1,* section 401.5.2 suggests the following corner radii for an urban street:

1. *15 to 25 ft. radii are adequate for passenger vehicles and may be provided at minor cross streets where there are few trucks or at major intersections where there are parking lanes.*
2. *25 ft. or more radii should be provided at minor intersections on new or reconstruction projects where space permits.*
3. *30 ft. radii or more should be used where feasible at major cross street intersections.*
4. *Radii of 40 ft. or more, three-centered compound curves or simple curves with tapers to fit truck paths should be provided at intersections used frequently by buses or large trucks.*

Using the guidelines from the L&D, the turning radii on the corners should be limited to 25 feet maximum, which would minimize crossing distances. The large radii at the intersections also places the radius point on the approach curb return farther from the through edge of pavement. This makes stop sign placement difficult, either being placed closer to the intersection at a larger lateral offset, or farther from the intersection at the radius point. The larger radii also encourage higher operating speeds.

Countermeasures

While the data collected from the various studies suggest operating speeds and crash history are not a problem, the sight distance issues, pedestrian crossing distances, and wide turning radii create a sense of perceived danger at both intersections. Fears from the community that there could be accidents in the future stem from the perceived dangers experienced while they are personally navigating the intersection. There are additional features that can be changed or upgraded at the intersection that create a sense of safety while navigating the community.

Short-Term Countermeasures

Short term countermeasures are low-cost features that can be added to the intersections that increase driver awareness and recognition of the possible conflicts at the intersection.

- Increase the size of all stop signs from 30 inches to 36 inches to increase visibility
- Place red post reflectors on all stop signs to increase visibility
- Paint stop bars on the stop approaches and high visibility crosswalks at each intersection to increase pedestrian awareness per ODOT SDC TC-74.10
- Move the location of the stop sign on Timberline Trail on the north side of the intersection closer to the curb to increase visibility
- Continuously trim and prune trees at both intersections to provide positive sight distance and visibility of all signs.
- Consider installing STOP AHEAD (W3-1) signs ahead of the stop signs if sign visibility is limited after intermittent obstructions, such as trees, are addressed and the lateral offsets of signs are adjusted.

Long Term Countermeasures

Long term countermeasures are higher cost countermeasures that can be implemented within 5 years.

Reconstruct the curb returns at both intersections to match urban radius guidelines of the *ODOT Location and Design Manual Volume 1.* By reconstructing the curb returns with 25 foot radii, pedestrian crossings become shorter and stopped vehicles are moved closer to the intersection and sight distance improves. Turning movements around the radii will naturally be slower as well.

Consider installing a mini roundabout at both intersections. Instead of decreasing the turning radii and reconstructing the intersections, a mini roundabout can fit in the existing pavement. See example below in figure 5. Mini roundabouts can be constructed with just pavement markings or raised islands on the approaches and in the center of the intersection. The purpose of the mini roundabout would be to lower vehicular speeds and the associated traffic islands can provide a refuge for pedestrians crossing the street. Plowing and ice removal during the winter months is a potential maintenance issue that will need discussed with city crews prior to installation.

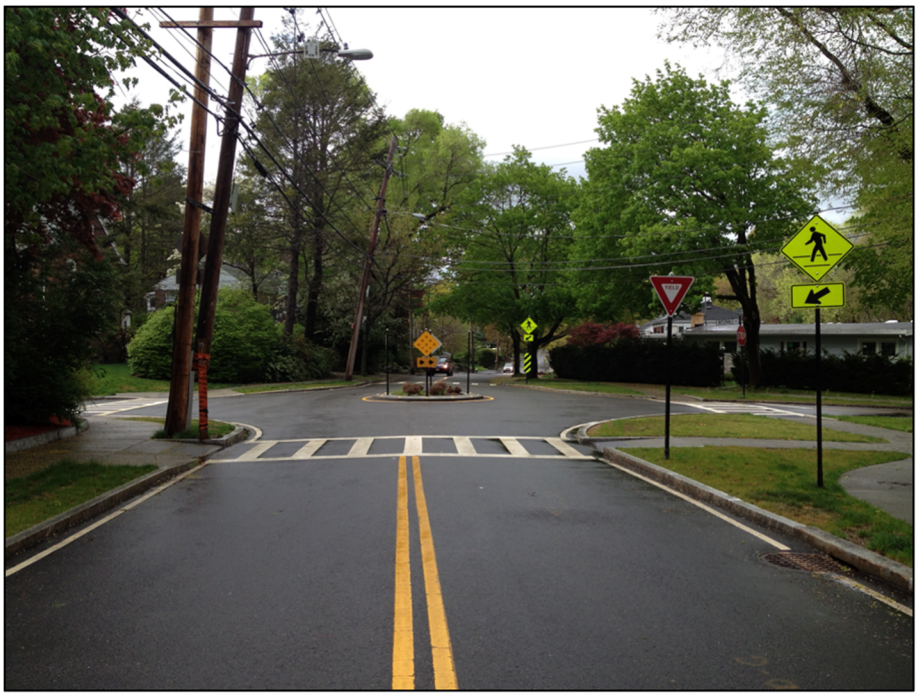


Figure 5: Example of mini roundabout within intersection

Q&A of Resident Questions

Q1. Is the MUTCD a law or more of a guideline to help municipalities make decisions? What authority does the City of Hudson have in making these types of decisions and implementation plans?

> *A1. According to section 4511.09 of the Ohio Revised Code, Ohio has adopted the use of the Ohio Manual of Uniform Traffic Control Devices (OMUTCD) which conforms to the national MUTCD published by the Federal Highway Administration. Section 4511.11 of the Ohio Revised Code requires that all local authorities in their respective jurisdictions conform with the OMUTCD. Since the OMUTCD is required by the Ohio Revised Code, it is considered part of the law to follow what is within the manual.*
>
> *The City of Hudson is required to use the OMUTCD and guidelines within.*

Q2. Can a STOP AHEAD sign be placed before the stop sign or CROSS TRAFFIC DOES NOT STOP sign placed below the stop sign be installed at both intersections?

> *A2. If sign visibility continues to be an issue, STOP AHEAD signs are suggested after trees are trimmed and the lateral offset of signs are updated per ODOT Standards. CROSS TRAFFIC DOES NOT STOP signs are not recommended at this time.*

Q3. Can the existing 30” by 30” STOP signs be replaced with 36” X 36” STOP signs?

> *A3. Yes. This has been recommended above.*

Q4. Can the STOP signs at the intersection of Rosewood Trail and Regal Woods Drive be flipped?

A4. No. Previous studies have indicated that Rosewood Trail is the major street of the intersection. The OMUTCD suggests that stop signs should be used on the minor street. At this time, stops signs should remain as they are.

Q5. Can crosswalks be painted at the intersection of Rosewood Trail and Regal Woods Drive and Timberline Trail and Kingswood Drive?

A5. Yes. Crosswalks on all crossings of the intersection are recommended.

Q6. Will pedestrian crossing warning signs be installed at the intersections?

A6. At this time, pedestrian warning signs are not recommended but should be considered after implementation of all other countermeasures.

In conclusion, both intersections within this memo should be monitored after implementation of the City's chosen countermeasures.

Sincerely,
American Structurepoint, Inc.

Rob Chappelle, PE
Project Manager/Team Leader

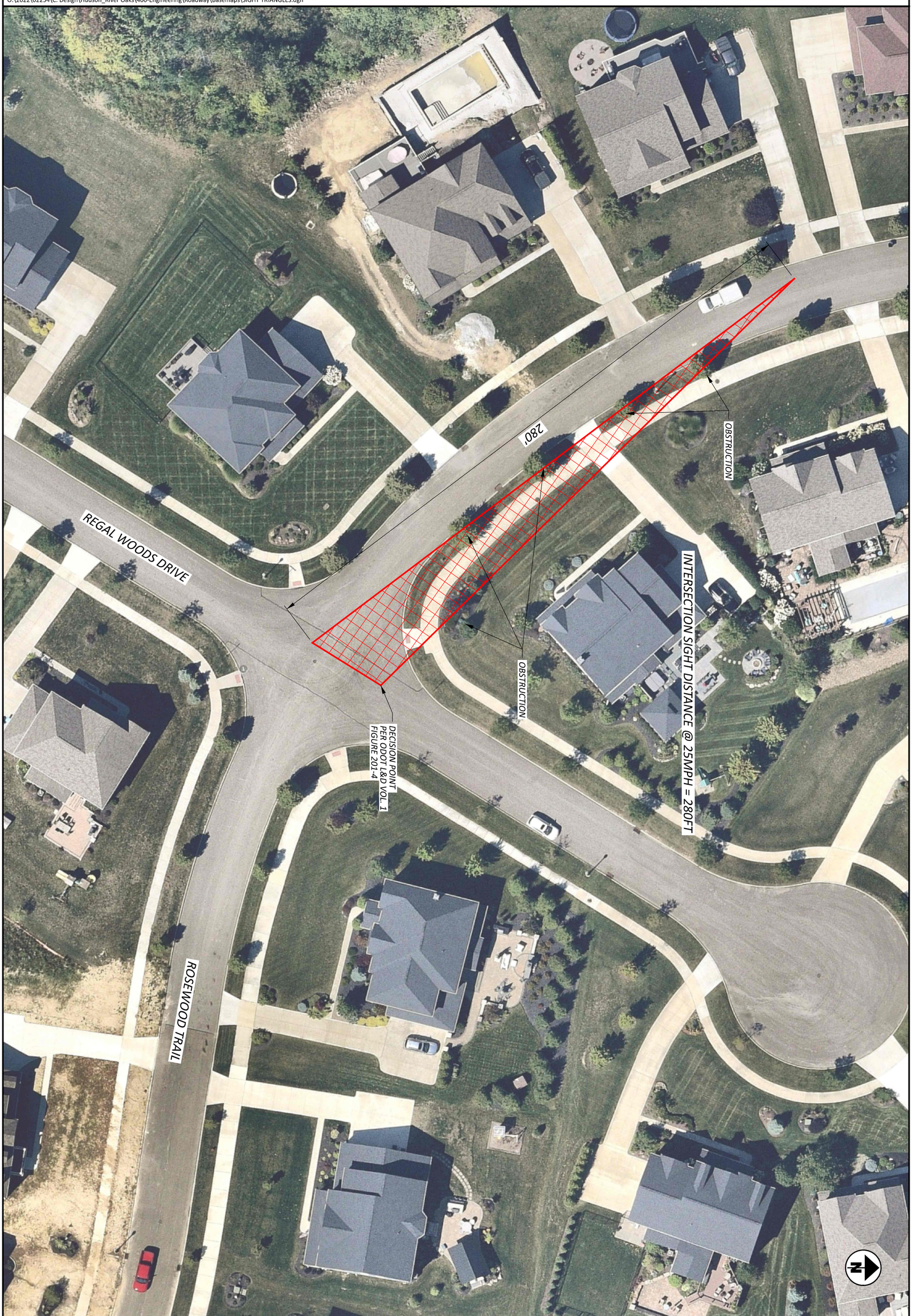
Jessica A. Chio, PE
Project Engineer

JAC:dls

Cc: file

CTY-RTE-SECTION

MODEL: Untitled Sheet PAPERSIZE: 17x11 (in.) DATE: 11/30/2022 TIME: 2:40:03 PM USER: jchio
O:\2022\02254\C. Design\Hudson_River Oaks\400-Engineering\Roadway\Basemaps\SIGHT TRIANGLES.dgn



SHEET	TOTAL	PROJECT ID	REVIEWER	DESIGNER	DESIGN AGENCY
P.0	0	0	XXX MM-DD-YY	XXX	STRUCTUREPOINT INC.

THE RESERVE AT RIVER OAKS TRAFFIC MEMO
APPENDIX A: SIGHT TRIANGLES

HORIZONTAL SCALE IN FEET
0 20
10 40