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Traffic Impact Study
For
Proposed Harmony Development
Westfield, Indiana

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DRAFT

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For
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I certify that this Traffic Impact Study has been prepared by me or under my immediate supervision and that I have experience and training in the field of traffic and transportation engineering.

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Executive Summary

Study Purpose and Scope

The purpose of this traffic impact study (TIS) is to evaluate the operational impacts of the proposed development on the surrounding road network in Westfield, Indiana. The proposed development is bounded by 156th Street to the north, 146th Street to the south, Ditch Road to the east and Towne Road to the west. The study provides a summary of the traffic forecast and identifies the operational impacts.

The scenarios examined in this study are as follows:

- Scenario 1 – Year 2012 AM and PM peak hour traffic, with existing lane configurations.
- Scenario 2 – Year 2022 AM and PM peak hour traffic, with future lane configurations. This scenario includes scheduled improvements to the study area roadways and intersections.
- Scenario 3 – Year 2022 AM and PM peak hour traffic, with the addition of the proposed development traffic and proposed roadway lane configurations. This includes two right-in/right-out drives along 146th Street.
- Scenario 4 – Same as Scenario 3 but with no right-in/right-out drives along 146th Street.

The year 2022 was assumed to be the year at which the development will be fully developed.

The study intersections are as follows:

- 156th Street & Towne Road
- 156th Street & Ditch Road
- 151st Street & Towne Road
- 151st Street & Ditch Road
- 146th Street & Towne Road
- 146th Street & Ditch Road
- All development drives

Background and Proposed Development Information

The *Westfield Thoroughfare Plan* was used to determine the classifications of the study area roadways. The existing roadway conditions and land uses within the study area were also reviewed and considered.

The proposed development is comprised of 274 acres in southwest Westfield, Indiana. It will consist of a single family residential portion to the north and a multi-use portion to the south. The multi-use portion will include multi-family residential, grocery store, pharmacy, restaurant, gas station, and medical office land uses. The multi-use nature of this site plan necessitates internal and pass-by trip reductions to be applied. In addition, internal trips between the north portion and the south portion were considered during the assignment and distribution process.

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Traffic Forecast

Traffic volumes have been forecasted by determining the base year (2012) traffic volumes using existing traffic data provided by the City of Westfield supplemented by traffic counts performed by American Structurepoint, Inc. A background traffic growth rate was then applied to obtain the 2022 traffic volumes, followed by adding in any new trips generated by the development to the 2022 background traffic.

Capacity Analysis

A capacity analysis has been performed at each of the study intersections for the above-mentioned scenarios. To facilitate the analysis, Synchro (Version 8) was used to perform the capacity analysis at signalized and stop-controlled intersections. ARCADY 8.0 was used to perform the capacity analysis at roundabout intersections. An acceptable level of service (LOS) for this study was considered to be LOS “D” or better at each of the study intersections.

Findings

This study has shown that all study intersections can operate at acceptable levels of service. The following table summarizes what improvements, if any, are necessary.

Intersection	Improvements Needed?	Description
156 th & Towne	No	
156 th & Ditch	No	
151 st & Towne	No	
151 st & Ditch	Yes	Westbound exclusive right-turn lane or single lane roundabout.
146 th & Towne	Yes	Double lane roundabout.
146 th & Ditch	Yes	Double lane roundabout as shown in design plans.
146 th & Drive A	N/A	Right-in/Right-out Drive. Single lane approaches.
146 th & Drive B	N/A	Right-in/Right-out Drive. Single lane approaches.
Ditch & Drive C/I & Somerville	N/A	Double lane roundabout. Single lane entries except northbound. Northbound Ditch Road will have two lane entry.
151 st & Drive D	N/A	Stop-controlled drive. Single lane approaches.
151 st & Drive E	N/A	Stop-controlled drive. Single lane approaches.
151 st & Drive F	N/A	Stop-controlled drive. Single lane approaches.
151 st & Drive G	N/A	Stop-controlled drive. Single lane roundabout with two entry lanes along Drive approaches.
156 th & Drive H	N/A	Stop-controlled drive. Single lane approaches.

Study Purpose and Scope

Study Purpose

The purpose of this traffic impact study (TIS) is to evaluate the operational impacts of a proposed multi-use development to be located on a 274 acre site within the area bounded by 156th Street, Ditch Road, 146th Street, and Towne Road in the City of Westfield, Indiana. This study will determine the effects of the proposed development on the adjacent roadway system and will provide necessary recommendations.

Study Scope

To solidify the scope of this study, a traffic impact study scoping meeting was held between American Structurepoint and the City of Westfield on February 7, 2012.

The study estimates the number of new trips that will be generated by the proposed Harmony development and shows how these new trips are distributed to the surrounding public roadway system. New trips are determined based on procedures set forth in the *ITE Trip Generation Report*¹. The proposed development is to consist of multi-family residential, single family residential, grocery, general retail, bank, restaurant, medical office, and pharmacy land uses.

The year 2022 was assumed to be the horizon year at which the development will be fully developed. Year 2022 background traffic volumes were obtained by applying a growth rate of 2% per year to the existing traffic volumes.

The study area is bounded by 146th Street to the south, 156th Street to the north, Towne Road to the west and Ditch Road to the east. **Figure 1** shows the overall study area. The study intersections include the following:

- 156th Street & Towne Road
- 156th Street & Ditch Road
- 151st Street & Towne Road
- 151st Street & Ditch Road
- 146th Street & Towne Road
- 146th Street & Ditch Road
- One full access drive along 156th Street
- Four full access drives along 151st Street
- One full access drive on Ditch Road at Somerville Drive
- Two ~~full-access-right-in/right-out~~ drives along 146th Street*

*Two access options were studied along 146th Street: Two right-in/right-out drives and no right-in/right-out drives.

¹ ITE, *Trip Generation Report*, 8th Edition. 2008.

Turning movement traffic counts at existing intersections and ADT counts along 151st Street were either provided by the City of Westfield or obtained by American Structurepoint, Inc.

A traffic capacity analysis was performed using Synchro, Version 8 software and ARCADY 8.0 software for each of the study scenarios. The scenarios examined in this study are as follows.

- Scenario 1 – Year 2012 AM and PM peak hour traffic, with existing lane configurations.
- Scenario 2 – Year 2022 AM and PM peak hour traffic, with future lane configurations.
- Scenario 3 – Year 2022 AM and PM peak hour traffic, with the addition of the proposed Harmony development traffic and proposed intersection conditions. This includes two right-in/right-out drives along 146th Street.
- Scenario 4 – Same as Scenario 3, but with no right-in/right-out drives along 146th Street.

The study procedures follow the *Applicant's Guide to Traffic Impact Study* (from INDOT).

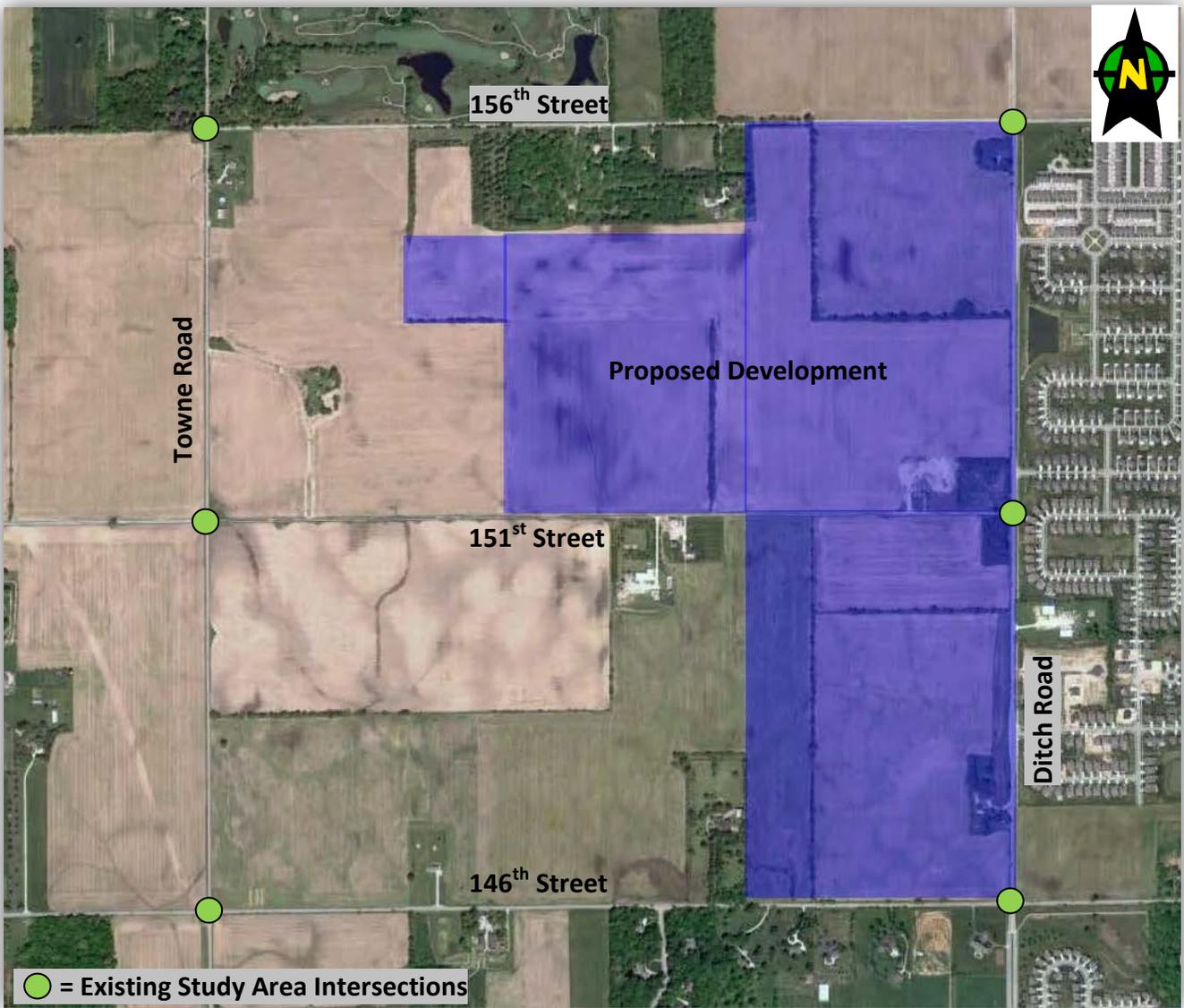


Figure 1 – Study Area

Background Information

Existing Roadway Conditions within Study Area

- 146th Street: 146th Street is a 2-lane east-west facility. The speed limit within the vicinity of the study area is posted at 50 mph. It is classified in the Westfield Thoroughfare Plan as a primary arterial 2. 146th Street is planned to be a 4-lane roadway before the year 2022. Therefore, scenarios 2 and 3 will include 146th Street as a 4-lane roadway.
- 151st Street: 151st Street is a 2-lane east-west facility. The speed limit within the vicinity of the study area is not posted. It is classified in the Westfield Thoroughfare Plan as a collector street.
- 156th Street: 156th Street is a 2-lane east-west facility. The speed limit within the vicinity of the study area is posted at 50 mph. It is classified in the Westfield Thoroughfare Plan as a collector street.
- Towne Road: Towne Road is a 2-lane north-south facility. The speed limit within the vicinity of the study area is posted at 45 mph. It is classified in the Westfield Thoroughfare Plan as a primary arterial 2.
- Ditch Road: Ditch Road is a 2-lane north-south facility. The speed limit within the vicinity of the study area is posted at 40 mph south of 151st Street and 50 mph north of 151st Street. It is classified in the Westfield Thoroughfare Plan as a primary arterial 2.

Existing Intersection Conditions within Study Area

- 146th Street & Towne Road: This intersection is currently an all-way stop controlled intersection with one lane in each direction on all approaches. When 146th Street is widened to four-lanes, this intersection will become a roundabout. Therefore, scenario 2 and 3 will analyze this intersection as a roundabout.
- 146th Street & Ditch Road: This intersection is currently an all-way stop controlled intersection with one lane in each direction along all approaches. When 146th Street is widened to four-lanes, this intersection will become a roundabout. Therefore, scenario 2 and 3 will analyze this intersection as a roundabout.
- 151st Street & Towne Road: This intersection is currently a two-way stop controlled intersection with 151st Street stopping for Towne Road. Each approach has one lane in each direction.
- 151st Street & Ditch Road: This intersection is currently a one-way stop controlled intersection with 151st Street stopping for Ditch Road. Each approach has one lane in each direction.
- 156th Street & Towne Road: This intersection is currently a one-way stop controlled intersection with 156th Street stopping for Ditch Road. Each approach has one lane in each direction.

- 156th Street & Ditch Road: This intersection is currently an all-way stop controlled intersection with one lane in each direction on all approaches.

Existing Land Use within Study Area

The areas near the proposed Harmony development consist primarily of single family homes or agricultural land.

Future Roadway Improvements

Hamilton County is planning to upgrade 146th Street to a limited access 4-lane divided roadway within the vicinity of the site. This improvement will include roundabout intersections at 146th Street & Towne Road and 146th Street & Ditch Road. In addition, two frontage roads will be constructed on either side of proposed 146th Street. Since 146th Street is to be a limited access roadway, these frontage roads will provide access to drives along 146th Street. However, it should be noted that the frontage road north of 146th Street will only be constructed to the existing residences and will not connect to the next major roadway.

This improvement is expected to be completed before the year 2022. Therefore, this improvement was considered in Scenario 2, Scenario 3, and Scenario 34 of this analysis. New traffic volumes from the proposed development were distributed based on the new 146th Street configuration and intersection capacity analysis was based on the proposed intersection conditions. Specific geometry for 146th Street & Ditch Road was provided by RW Armstrong United.

In addition, US 31 is currently being upgraded to freeway standards through Hamilton County. With this project, some roads that currently have direct access to US 31 will no longer have access. For instance, 156th Street currently has direct access to US 31 but will not have an interchange when US 31 is upgraded to freeway standards. Therefore, future interchange locations were taken into consideration when determining trip distribution.

Proposed Development

The proposed development is to be located on a 274-acre site which is bounded by 146th Street, 156th Street, Towne Road, and Ditch Road. The proposed development will consist of atwo multi-use sectionsections and a single family residential section, as shown in **Figure 2**. In this figure, the yellow and light pink isare the single family residential areaareas, and the red is the multi-use section. The single family residential section will consist of 708 lots and the multi-use section will consist of a grocery store, inline retail, two banks, three sit down restaurants, a pharmacy, a medical office building, and 250 multi-use family dwelling units. A further breakdown of land uses is shown in the Trip Generation section of this report.

Multiple access points have been identified for the proposed Harmony development. All proposed access drives will be full access drives with the exception of the drives along 146th Street which will be right-in/right-out only drives. The access drives are shown and labeled on **Figure 2**.



Figure 2 – Site Layout

Traffic Forecast

Traffic has been forecasted by determining the base year (2012) traffic volumes using existing traffic data provided by the City of Westfield or collected by American Structurepoint, Inc., then applying a background traffic growth rate to obtain the 2022 traffic volumes, and finally adding in any new trips generated by the development to the 2022 background traffic. The following sections of the report provide greater detail of these steps.

Existing Traffic Data

Manual turning movement counts were provided by the City of Westfield for the intersections of 146th Street & Towne Road and 146th Street & Ditch Road. The remaining turning movement counts were obtained by American Structurepoint, Inc. in January 2012. In addition, the City of Westfield provided 24-hour average daily traffic (ADT) counts for 151st Street between Towne Road and Ditch Road. The ADT counts were ~~obtained~~collected in September 2011. Counts ~~obtained~~collected in 2011 were assumed to be existing traffic volumes.

Figure 3 shows the 2012 existing traffic volumes. The raw data for the traffic counts are provided in **Appendix A** of this report.

Figure 3 – Existing Traffic Volumes

Background Traffic Growth

It has been assumed the site will be fully developed by the year 2022; therefore, the year 2022 was chosen as the horizon year. In order to estimate the existing traffic volumes that will be present on the study area roadways for the year 2022, the background traffic growth must be determined.

Background traffic growth refers to the growth of traffic volumes that occur over time due to influences outside of the study area. These influences can range from transportation improvements to the status of the economy. Typically, the background traffic growth rate is determined by comparing historic traffic counts with current traffic counts.

In order to determine the background traffic growth rate, various sources of data were consulted. INDOT historic traffic data, Hamilton County historic traffic data, the projected volumes from a current impact fee study (provided by HNTB), and a previous INDOT study performed in the area were all used to help determine the background growth rate. A background growth rate of 2% per year was chosen. This growth rate is consistent with the projections from HNTB, which accounts for growth within the study area. This growth rate is also consistent with the previous INDOT report². This study analyzed SR 32 through the City of Westfield which is directly to the north of the proposed site. The INDOT study used growth rates ranging from 1.4% per year to 2.7% per year.

It should also be noted that this growth rate was applied in a linear manner, as opposed to compounded. Linear growth is growth that occurs at a constant amount per year, as opposed to an exponentially growing amount added each year (compound growth).

Trip Generation

The Institute of Transportation Engineers (ITE) *Trip Generation Report, 8th Edition* was used to calculate the generated trips for the proposed development. **Table 1** contains the number of AM peak and PM peak trips that would be generated by each specific land use within the proposed Harmony development.

Internal Trips

Internal trips are trips which have origins and destinations within a development, but never actually travel on the public roadway system. For instance, a trip may begin at a pharmacy and end at a bank, both of which are located within the same development, and would not travel on external roads. For this proposed development, internal trips will occur between the land uses within the multi-use portion of the proposed development since they are all connected via internal roads. Procedures outlined in the ITE *Trip Generation Handbook* were used to estimate the number of internal trips that will occur within the proposed multi-use development. The internal trips are shown in **Table 2**.

Pass-By Trips

Pass-by trips consist of those that are an intermediate stop en route from a trip origin to a trip destination. For example, on the way home (destination) from work (origin), many people stop along

² *Project Summary for SR 32 from US 31 to SR 38 in Hamilton County*, INDOT. April 2008

their route to get fuel (intermediate stop). This is not a new trip for the overall area but does change the travel pattern of the individual vehicles that were already present.

The *ITE Trip Generation Handbook* provides estimated pass-by trip percentages for each retail land use and was used to determine the appropriate pass-by percentages for the proposed development. These percentages were applied to the generated traffic volumes and the non pass-by trips represent the new trips added to the roadway system by the proposed development. The pass-by trip reductions are shown in **Table 1**.

Table 1 – Trip Generation for Proposed Land Uses

Land Use	ITE Code	Size	AM Enter	AM Exit	PM Enter	PM Exit
Multi-Family	220	250 DU	25	101	101	54
		Internal	1617	13	54	40
		External	98	88	47	14
Grocery	850	68,000 SF	149	95	364	350
		Internal	3746	37	5670	6376
		External	112103	58	308294	287274
		Pass-By (36%)	4037	21	111106	10399
		Non Pass-By	7266	37	197188	184175
Retail	820	22,000 SF	38	25	113	118
		Internal	1012	10	1822	2125
		External	2826	15	9591	9793
		Pass-By (61%)	1716	9	5856	5957
		Non Pass-By	1110	6	3735	3836
Bank	912	8,400 SF	958	746	21108	18108
		Internal	416	317	733	638
		External	542	429	1475	1270
		Pass-By (47%)	220	214	735	633
		Non Pass-By	322	215	740	637
Restaurant	932	16,600 SF	99	92	109	76
		Internal	3526	3635	34	2726
		External	6473	5657	75	4950
		Pass-By (43%)	2831	2425	32	2122
		Non Pass-By	3642	32	43	28
Pharmacy	881	15,500 SF	23	18	80	80
		Internal	86	7	25	28
		External	1517	11	55	52
		Pass-By (49%)	78	5	27	25
		Non Pass-By	89	6	28	27

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Land Use	ITE Code	Size	AM Enter	AM Exit	PM Enter	PM Exit
Medical Office	720	40,000 SF	73	19	37	101
		Internal	89	8	1619	1618
		External	6564	11	2418	8583
Single Family	210	708 DU	126	379	386385	226
Fast Food Restaurant	934	4,500 SF	113	109	79	73
		Internal	16	15	19	20
		External	97	94	60	53
		Pass-By (AM: 49%, PM: 50%)	48	46	30	27
		Non Pass-By	49	48	30	26
Gas Station w/Convenience Store	853	3,000 SF	66	66	90	8990
		Internal	15	16	20	19
		External	51	50	70	7071
		Pass-By (AM: 63%, PM: 66%)	32	32	46	4647
		Non Pass-By	19	18	24	24
Total New Trips			398415	627640	820838	658676
Total Pass-By Trips			174192	139152	311332	287310

Trip Distribution and Traffic Assignment

The existing land uses and transportation system were taken into account when determining where to distribute the newly generated trips. In addition to the land uses and transportation system, the existing traffic volumes were used to determine the percentage of traffic that would use each route. The computer software program TRAFFIX was used to help facilitate the assignment and distribution. **Figure 4** shows the overall trip distribution amounts. It should be noted that **Figure 4** represents a combination of assignment and distribution percentages. Different distribution percentages were assumed for each type of land use. For example, distribution percentages for retail land uses differed from distribution percentages for residential land uses. Additional figures in **Appendix C** show the distribution percentages for each land use type.



Figure 4 – Trip Distribution

Resulting 2022 Traffic Volumes

After applying the background growth rate of 2.0 percent per year to the 2012 traffic volumes and adding in trips generated by the proposed development, the total 2022 traffic volumes were obtained for each of the study intersections. **Figure 5** shows the background 2022 traffic volumes at the study intersections for study scenario 2. **Figure 6 illustrates Figures 6 through 7 illustrate** the generated traffic volumes added to the 2022 background traffic volumes at the study intersections and access drives for study scenario 3.

Figure 5 – Scenario 2: Year 2022 Traffic Volumes

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Figure 6 – Scenario 3: Year 2022 Traffic Volumes with Proposed Development: Two Right-In Right-Outs

Figure 7 – Scenario 4: Year 2022 Traffic Volumes with Proposed Development: No Right-in/Right-out

Capacity Analysis

A capacity analysis has been performed for each study intersection and each study scenario based on the methodology outlined in the *Highway Capacity Manual* (TRB 2010). The standard parameter used to evaluate traffic operating conditions is referred to as the level-of-service (LOS). There are six LOS (A through F), which relate to driving conditions from best to worst, respectively. LOS for both signalized and unsignalized intersections are defined in terms of control delay per vehicle, which is a direct correlation to driver discomfort, frustration, fuel consumption, and lost travel time. **Table 2** provides the LOS criteria as defined in the *Highway Capacity Manual*. To facilitate the analysis, Synchro and SimTraffic (Version 8) were used to perform the capacity analysis at signalized and stop-controlled intersections and driveways. ARCADY 8.0 was used to perform the capacity analysis at roundabout intersections. The output from Synchro and ARCADY includes the average vehicle control delay, LOS, average queue length, and 95th percentile (or maximum) queue length.

Table 2 – Level of Service Criteria for Signalized and Unsignalized Intersections

LOS	Control Delay Per Vehicle (second)	
	Signalized Intersection	Unsignalized and Roundabout Intersection
A	≤ 10	≤ 10
B	> 10 and ≤ 20	> 10 and ≤ 15
C	> 20 and ≤ 35	> 15 and ≤ 25
D	> 35 and ≤ 55	> 25 and ≤ 35
E	> 55 and ≤ 80	> 35 and ≤ 50
F	> 80	> 50

The capacity analysis has been performed at the study intersections for each of the study scenarios summarized in **Table 3**. **Appendix B** provides the software output from the capacity analysis.

Table 3 – Study Scenarios

Scenario	Year	Analysis Hours	Harmony Volumes	Right-in/Right Out On 146 th Street
1	2012	AM & PM Peak	Not Included	Not Included
2	2022	AM & PM Peak	Not Included	Not Included
3	2022	AM & PM Peak	Included	Two Included
<u>4</u>	<u>2022</u>	<u>AM & PM Peak</u>	<u>Included</u>	<u>Not Included</u>

Lane Configurations

During the capacity analysis, the proposed year 2022 intersection lane configurations were developed based upon the Harmony development and the intersection improvements required to achieve an acceptable LOS (LOS “D” or better) for each of the study intersections.

The existing traffic data, the traffic forecast for the year 2022, and the existing intersection lane configurations were used as the input for the capacity analysis. During the capacity analysis, the proposed year 2022 intersection lane configurations were developed based upon current plans for 146th Street and the intersection improvements required to achieve an acceptable LOS (LOS “D” or better) for each of the study intersections.

Level of Service and Delay Results

Table 4 shows the intersection of 156th Street & Towne Road will continue to operate at an acceptable LOS in the year 2022 with the existing intersection lane configurations and control. The City of Westfield also requested a roundabout analysis at this location. **Table 4** shows that a one-lane roundabout would also operate above an acceptable level of service in the year 2022.

Table 4 – Summary of Capacity Analysis for 156th Street & Towne Road

Scenarios	Analysis Year	AM Peak		PM Peak	
		LOS** <u>LOS¹</u>	Avg. Delay (sec/veh)** <u>1</u>	LOS** <u>LOS¹</u>	Avg. Delay (sec/veh)** <u>1</u>
1	2012	B	10.3	A	9.7
2	2022	B	10.8	B	10.1
3A <u>3A²</u>	2022	B	11.3	B	10.4
3B <u>3B³</u>	2022	A	4.1	A	4.1
<u>4A²</u>	<u>2022</u>	<u>B</u>	<u>11.2</u>	<u>B</u>	<u>10.4</u>
<u>4B³</u>	<u>2022</u>	<u>A</u>	<u>4.1</u>	<u>A</u>	<u>4.1</u>

~~3A~~¹ Represents the westbound approach at the intersection.

² Refers to the existing intersection conditions ~~and 3B~~ refers.

³ Refers to ~~roundabout~~ the proposed intersection conditions: single lane roundabout.

*~~**~~ Represents the worst approach at the intersection.*

Table 5 shows the intersection of 156th Street & Ditch Road will continue to operate at an acceptable LOS in the year 2022 with the existing intersection lane configurations and control. The City of Westfield also requested a roundabout analysis at this location. **Table 5** shows that a one-lane roundabout would also operate above an acceptable level of service in the year 2022.

Table 5 – Summary of Capacity Analysis for ~~151st~~156th Street & Ditch Road

Scenarios	Analysis Year	AM Peak		PM Peak	
		LOS	Avg. Delay (sec/veh)	LOS	Avg. Delay (sec/veh)
1	2012	A	8.6	A	8.3
2	2022	A	9.2	A	8.7
3A *3A ¹	2022	B	10.56	B	10.78
3B *3B ²	2022	A	4.5	A	4.67
<u>4A¹</u>	<u>2022</u>	<u>B</u>	<u>10.6</u>	<u>B</u>	<u>10.8</u>
<u>4B²</u>	<u>2022</u>	<u>A</u>	<u>4.5</u>	<u>A</u>	<u>4.7</u>

*3A refers¹ Refers to the existing intersection conditions and 3B refers₂ Refers to ~~roundabout~~the proposed intersection conditions:-: single lane roundabout.

Table 6 shows the intersection of 151st Street & Towne Road will continue to operate at an acceptable LOS in the year 2022 with the existing intersection lane configurations and control.

Table 6 – Summary of Capacity Analysis for 151st Street & Towne Road

Scenarios	Analysis Year	AM Peak		PM Peak	
		LOS *LOS ¹	Avg. Delay (sec/veh)* ¹	LOS *LOS ¹	Avg. Delay (sec/veh)* ¹
1	2012	B	10.0	B	10.1
2	2022	B	10.5	B	10.5
3	2022	B	11.89	B	11.8
<u>4</u>	<u>2022</u>	<u>B</u>	<u>11.9</u>	<u>B</u>	<u>11.8</u>

*Represents¹ Represents the ~~worst~~westbound approach at the intersection.

Table 7 shows the intersection of 151st Street & Ditch Road will continue to operate at an acceptable LOS for scenario 2 with the existing intersection lane configurations and control. Scenarios 1 and 2 represent existing intersection conditions. For ~~scenarios~~scenarios 3 and 4, 151st Street will be realigned just north of the existing intersection to align with the existing drive on the east side of Ditch Road, Bridgeport Drive. In ~~scenarios~~scenarios 3 and 4, the eastbound approach will operate ~~below~~above acceptable levels of service with the proposed intersection conditions. The proposed intersection conditions include existing lane configurations along Ditch Road and ~~the westbound approach~~Bridgeport Drive. The eastbound approach of 151st Street should consist of two exit lanes and one entry lane. Scenario 3B shows that if a roundabout is installed at this intersection, a level of service “A” can be achieved during both the AM and PM peak hours.

Table 7 – Summary of Capacity Analysis for 151st Street & Ditch Road

Scenarios	Analysis Year	AM Peak		PM Peak	
		LOS* <u>LOS¹</u>	Avg. Delay (sec/veh)* <u>1</u>	LOS* <u>LOS¹</u>	Avg. Delay (sec/veh)* <u>1</u>
1	2012	B	10.6	A	9.4
2	2022	B	11.2	A	9.6
<u>3A¹</u>	<u>2022</u>	<u>B</u>	<u>13.9</u>	<u>B</u>	<u>12.5</u>
3A <u>**3B²</u>	2022	EA	<u>435.5</u>	EA	<u>25.07.5</u>
<u>4A¹</u>	<u>2022</u>	<u>B</u>	<u>13.9</u>	<u>B</u>	<u>12.5</u>
3B <u>**4B²</u>	2022	A	5.5	A	7.4

¹Represents ~~the worst~~eastbound approach at the intersection.

~~**3A refers~~²Refers to the existing intersection conditions ~~and 3B refers~~.

³Refers to ~~roundabout~~the proposed intersection conditions: single lane roundabout.

Table 8 shows the intersection of 151st Street & Bridgeport Drive currently operates at acceptable levels of service and will continue to operate at an acceptable LOS for scenario 2 with the existing intersection lane configurations and control. Scenarios 1 and 2 represent existing intersection conditions. For scenarios 3 through 4, 151st Street will be with Bridgeport Drive. In scenarios 3 and 4, Bridgeport Drive will operate below acceptable levels of service with the existing intersection conditions. However, acceptable levels of service can be achieved if a roundabout is constructed at this location.

Table 8 – Summary of Capacity Analysis for Bridgeport Drive & Ditch Road

<u>Scenarios</u>	<u>Analysis Year</u>	<u>AM Peak</u>		<u>PM Peak</u>	
		<u>LOS¹</u>	<u>Avg. Delay (sec/veh)¹</u>	<u>LOS¹</u>	<u>Avg. Delay (sec/veh)¹</u>
<u>1</u>	<u>2012</u>	<u>B</u>	<u>11.5</u>	<u>B</u>	<u>10.4</u>
<u>2</u>	<u>2022</u>	<u>B</u>	<u>12.5</u>	<u>B</u>	<u>11.0</u>
<u>3A¹</u>	<u>2022</u>	<u>E</u>	<u>45.1</u>	<u>D</u>	<u>25.3</u>
<u>3B²</u>	<u>2022</u>	<u>A</u>	<u>5.5</u>	<u>A</u>	<u>7.5</u>
<u>4A¹</u>	<u>2022</u>	<u>E</u>	<u>45.8</u>	<u>D</u>	<u>25.3</u>
<u>4B²</u>	<u>2022</u>	<u>A</u>	<u>5.5</u>	<u>A</u>	<u>7.4</u>

¹Represents the westbound approach at the intersection.

²Refers to the existing intersection conditions.

³Refers to the proposed intersection conditions: single lane roundabout.

Table 9 shows the intersection of 146th Street & Towne Road will continue to operate at an acceptable LOS in the year 2022 with the proposed intersection lane configurations and control. Scenario 1 represents existing intersection conditions. Scenarios 2 ~~and 3~~ through 4 represent the proposed intersection conditions. These intersection conditions include a two-lane roundabout with two-lane entries on each approach. The northbound and southbound approaches will flare from a single lane to a double lane entry.

Table 9 – Summary of Capacity Analysis for 146th Street & Towne Road

<u>Scenarios</u>	<u>Analysis Year</u>	<u>AM Peak</u>		<u>PM Peak</u>	
		<u>LOS</u>	<u>Avg. Delay (sec/veh)</u>	<u>LOS</u>	<u>Avg. Delay (sec/veh)</u>
<u>1</u>	<u>2012</u>	<u>B</u>	<u>11.1</u>	<u>C</u>	<u>15.3</u>
<u>2</u>	<u>2022</u>	<u>A</u>	<u>2.43</u>	<u>A</u>	<u>2.3</u>
<u>3</u>	<u>2022</u>	<u>A</u>	<u>2.3</u>	<u>A</u>	<u>2.6</u>
<u>4</u>	<u>2022</u>	<u>A</u>	<u>2.3</u>	<u>A</u>	<u>2.6</u>

Table 910 shows the intersection of 146th Street & Ditch Road will continue to operate at an acceptable LOS in the year 2022 with the proposed intersection conditions. Scenario 1 represents existing intersection conditions. Scenarios 2 ~~and 3~~ through 4 represent the proposed intersection conditions as provided by ~~RW-ArmstrongUnited~~. These intersection conditions include a two-lane roundabout with two-lane entries on each approach. The northbound and southbound approaches will flare from a single lane to a double lane entry.

Table 10 – Summary of Capacity Analysis for 146th Street & Ditch Road

Scenarios	Analysis Year	AM Peak		PM Peak	
		LOS	Avg. Delay (sec/veh)	LOS	Avg. Delay (sec/veh)
1	2012	C	17.2	D	34.4
2	2022	A	2.54	A	2.65
3	2022	A	3.64	A	3.98
<u>4</u>	<u>2022</u>	<u>A</u>	<u>3.4</u>	<u>A</u>	<u>3.8</u>

Table 1011 shows the intersection of 146th Street & Drive A will operate at an acceptable LOS in the year 2022 with the proposed intersection conditions. The proposed intersection conditions consist of a right-in/right-out stop-sign controlled intersection with the southbound approach stopping for the westbound approach. The drive will consist of one entry lane and one right-turn only exit lane. 146th Street will consist of two through lanes in the eastbound direction, and ~~one~~two through ~~lane~~lanes and one ~~through/right-shared-turn~~ lane in the westbound direction.

Table 11 – Summary of Capacity Analysis for 146th Street & Drive A

Scenarios	Analysis Year	AM Peak		PM Peak	
		LOS*LOS ¹	Avg. Delay (sec/veh) * ¹	LOS*LOS ¹	Avg. Delay (sec/veh) * ¹
3	2022	A	9.56	B	10.8
<u>4</u>	<u>2022</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>

~~*Represents~~ Represents the ~~worst~~southbound approach at the intersection.

Table 11 shows the intersection of 146th Street & Drive B will operate at an acceptable LOS in the year 2022 with the proposed intersection conditions. The proposed intersection conditions consist of a right-in/right-out stop-sign controlled intersection with the northbound approach stopping for the eastbound approach. The drive will consist of one entry lane and one right-turn only exit lane. 146th Street will consist of ~~one~~two through ~~lane~~lanes and one ~~through~~/right-shared-turn lane in the eastbound direction, and two through lanes in the westbound direction.

Table 12 – Summary of Capacity Analysis for 146th Street & Drive B

Scenarios	Analysis Year	AM Peak		PM Peak	
		LOS*	Avg. Delay (sec/veh)*	LOS*	Avg. Delay (sec/veh)*
3	2022	A	9.35	B	10.24
<u>4</u>	<u>2022</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>

*Represents the ~~worst~~northbound approach at the intersection.

Table 12 shows the intersection of 146th Street & Drive C/I & Somerville Drive will operate at an acceptable LOS in the year 2022 with the proposed intersection conditions. The proposed intersection conditions consist of a 5-legged roundabout intersection. The southbound, westbound, north-eastbound, and south-eastbound approaches will consist of a single entry lane and a single exit lane. Due to the high number of northbound left-turning vehicles during the PM peak hour, the northbound approach should consist of a two-lane entry and a single lane exit. This entry should consist of an exclusive left-turn lane and a shared through/right-turn lane.

Table 13 – Summary of Capacity Analysis for Ditch Road & Drive C/I & Somerville Drive

Scenarios	Analysis Year	AM Peak		PM Peak	
		LOS	Avg. Delay (sec/veh)	LOS	Avg. Delay (sec/veh)
<u>3</u>	<u>2022</u>	<u>A</u>	<u>9.1</u>	<u>A</u>	<u>6.7</u>
<u>34</u>	2022	A	9.375	A	5.439.0

Table 1314 shows the intersection of 151st Street & Drive D will operate at an acceptable LOS in the year 2022 with the proposed intersection conditions. The proposed intersection conditions include a stop controlled intersection with the northbound approach (Drive D) stopping for the eastbound and westbound approaches (151st Street). Each approach will consist of one lane in each direction.

Table 14 – Summary of Capacity Analysis for 151st Street & Drive D

Scenarios	Analysis Year	AM Peak		PM Peak	
		LOS * <u>LOS</u> ¹	Avg. Delay (sec/veh)* <u>1</u>	LOS * <u>LOS</u> ¹	Avg. Delay (sec/veh)* <u>1</u>
3	2022	A	9.3	A	9.1
<u>4</u>	<u>2022</u>	<u>A</u>	<u>9.3</u>	<u>A</u>	<u>9.1</u>

~~*Represents~~ Represents the ~~worst~~northbound approach at the intersection.

Table 1415 shows the intersection of 151st Street & Drive E will operate at an acceptable LOS in the year 2022 with the proposed intersection conditions. The proposed intersection conditions include a stop controlled intersection with the northbound and southbound approaches (Drive E) stopping for the eastbound and westbound approaches (151st Street). Each approach will consist of one lane in each direction.

Table 15 – Summary of Capacity Analysis for 151st Street & Drive E

Scenarios	Analysis Year	AM Peak		PM Peak	
		LOS * <u>LOS</u> ¹	Avg. Delay (sec/veh)* <u>1</u>	LOS * <u>LOS</u> ¹	Avg. Delay (sec/veh)* <u>1</u>
3	2022	B	10.8	B	11.9
<u>4</u>	<u>2022</u>	<u>B</u>	<u>10.8</u>	<u>B</u>	<u>11.9</u>

~~*Represents~~ Represents the ~~worst~~southbound approach at the intersection.

Table 1516 shows the intersection of 151st Street & Drive F will operate at an acceptable LOS in the year 2022 with the proposed intersection conditions. The proposed intersection conditions include a stop controlled intersection with the southbound approach (Drive F) stopping for the eastbound and westbound approaches (151st Street). Each approach will consist of one lane in each direction.

Table 16 – Summary of Capacity Analysis for 151st Street & Drive F

Scenarios	Analysis Year	AM Peak		PM Peak	
		LOS * <u>LOS</u> ¹	Avg. Delay (sec/veh)* <u>1</u>	LOS * <u>LOS</u> ¹	Avg. Delay (sec/veh)* <u>1</u>
3	2022	A	9.4	A	9.9
<u>4</u>	<u>2022</u>	<u>A</u>	<u>9.4</u>	<u>A</u>	<u>9.9</u>

~~*Represents~~¹Represents the ~~worst~~worst southbound approach at the intersection.

Table 1617 shows the intersection of 151st Street & Drive G will operate at an acceptable LOS in the year 2022 with the proposed intersection conditions. The proposed intersection conditions include a stop controlled intersection with the southbound approach (Drive G) stopping for the eastbound and westbound approaches (151st Street). Each approach will consist of one lane in each direction.

Table 17 – Summary of Capacity Analysis for 151st Street & Drive G

Scenarios	Analysis Year	AM Peak		PM Peak	
		LOS * <u>LOS</u> ¹	Avg. Delay (sec/veh)* <u>1</u>	LOS * <u>LOS</u> ¹	Avg. Delay (sec/veh)* <u>1</u>
3	2022	A	9.6	B	10.0
<u>4</u>	<u>2022</u>	<u>A</u>	<u>9.6</u>	<u>A</u>	<u>9.9</u>

~~*Represents~~¹Represents the ~~worst~~worst southbound approach at the intersection.

Table 1718 shows the intersection of 151st Street & Drive H will operate at an acceptable LOS in the year 2022 with the proposed intersection conditions. The proposed intersection conditions include a stop controlled intersection with the northbound approach (Drive H) stopping for the eastbound and westbound approaches (156th Street). Each approach will consist of one lane in each direction.

Table 18 – Summary of Capacity Analysis for 151st Street & Drive H

Scenarios	Analysis Year	AM Peak		PM Peak	
		LOS * <u>LOS</u> ¹	Avg. Delay (sec/veh)* <u>1</u>	LOS * <u>LOS</u> ¹	Avg. Delay (sec/veh)* <u>1</u>
3	2022	A	9.0	A	9.4

<u>4</u>	<u>2022</u>	<u>A</u>	<u>9.0</u>	<u>A</u>	<u>9.4</u>
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*~~Represents~~ Represents the ~~worst~~northbound approach at the intersection.

Findings

The capacity analysis has shown that all study intersections can achieve acceptable levels of service for all ~~three~~five study scenarios with the proposed intersection conditions. The proposed intersection conditions are described below. These intersection conditions are representative of the scenario in which there are two right-in/right-out only drives along 146th Street.

156th Street & Towne Road – This intersection will operate above acceptable levels of service during the AM and PM peak hours for all scenarios with either existing intersection conditions or with a single lane roundabout.

156th Street & Ditch Road – This intersection will operate above acceptable levels of service during the AM and PM peak hours for all scenarios with either existing intersection conditions or with a single lane roundabout.

151st Street & Towne Road – This intersection will operate above acceptable levels of service during the AM and PM peak hours for all scenarios with existing intersection conditions.

151st Street & Ditch Road – This intersection will operate above acceptable levels of service during the PM peak hour for all scenarios with proposed intersection conditions; however, the ~~eastbound~~westbound approach (Bridgeport Drive) will operate below acceptable levels of service for Scenario 3 during the AM peak hour. The proposed intersection conditions should include one of the following two options:

- Two-way stop controlled with 151st and Bridgeport stopping for Ditch: 151st Street should be realigned with the drive to the east and eastbound 151st Street approach should consist of two eastbound lanes and one westbound lane. The westbound approach of Bridgeport Drive should include existing lane configurations. For this intersection condition, the ~~eastbound~~westbound approach will experience delays amounting to a LOS E during the AM peak hour.
- Roundabout: This intersection should be a single-lane roundabout and all approaches should consist of a single entry and exit lane.

146th Street & Towne Road – This intersection will operate above acceptable levels of service during the AM and PM peak hours for all scenarios with proposed intersection conditions:

- Double lane roundabout.
- Two-lane entries on all approaches.

146th Street & Ditch Road – This intersection will operate above acceptable levels of service during the AM and PM peak hours for all scenarios with proposed intersection conditions:

- Double lane roundabout.
- Two-lane entries on all approaches.

146th Street & Drive A – This intersection will operate above acceptable levels of service during the AM and PM peak hours for Scenario 3 with proposed intersection conditions:

- Right-in/Right-out intersection.
- Drive A to consist of one entry lane and one exit lane.
- 146th Street to be constructed as planned but with an additional westbound right-turn lane.

146th Street & Drive B – This intersection will operate above acceptable levels of service during the AM and PM peak hours for Scenario 3 and Scenario 5 with proposed intersection conditions:

- Right-in/Right-out intersection.
- Drive B to consist of one entry lane and one exit lane.
- 146th Street to be constructed as planned but with an additional eastbound right-turn lane.

Ditch Road & Drive C/I & Somerville Road – This intersection will operate above acceptable levels of service during the AM and PM peak hours for ~~Scenario 3~~ Scenarios 3 through 4 with proposed intersection conditions:

- Double lane roundabout.
- Northbound Ditch Road to consist of one two entry lanes and one exit lane.
- All remaining approaches to consist of one entry lane and one exit lane.

151st Street & Drive D – This intersection will operate above acceptable levels of service during the AM and PM peak hours for ~~Scenario 3~~ Scenarios 3 through 4 with proposed intersection conditions:

- Stop controlled T-intersection with Drive D stopping for 151st Street.
- All approaches consisting of one lane in each direction.

151st Street & Drive E – This intersection will operate above acceptable levels of service during the AM and PM peak hours for ~~Scenario 3~~ Scenarios 3 through 4 with proposed intersection conditions:

- Stop controlled intersection with Drive E stopping for 151st Street.
- All approaches consisting of one lane in each direction.

151st Street & Drive F – This intersection will operate above acceptable levels of service during the AM and PM peak hours for ~~Scenario 3~~ Scenarios 3 through 4 with proposed intersection conditions:

- Stop controlled T-intersection with Drive F stopping for 151st Street.
- All approaches consisting of one lane in each direction.

151st Street & Drive G – This intersection will operate above acceptable levels of service during the AM and PM peak hours for ~~Scenario 3~~ Scenarios 3 through 4 with proposed intersection conditions:

- Stop controlled T-intersection with Drive G stopping for 151st Street.
- All approaches consisting of one lane in each direction.

156th Street & Drive H – This intersection will operate above acceptable levels of service during the AM and PM peak hours for ~~Scenario 3~~ Scenarios 3 through 4 with proposed intersection conditions:

- Stop controlled T-intersection with Drive H stopping for 156th Street.
- All approaches consisting of one lane in each direction.

146th Street Access

Two access options have been considered along 146th Street: One option including two right-in/right-out only drives and one option not including the drives. If right-in/right-out drives are constructed along 146th Street, they are not expected to have a negative impact on 146th Street. Right-in/right-out drives do not allow any left-turning movements; therefore, no crossing maneuvers will be created, only merging and diverging maneuvers. In addition, exclusive right-turn lanes will be constructed along 146th Street. These turn lanes would eliminate the conflict area associated with turning vehicles and through vehicles in the same lane.

If right-in/right-out drives are not constructed along 146th Street, the multi-use development north of 146th Street will be forced to use only one entrance/exit onto Ditch Road. Drive C/I and 146th Street & Ditch Road will be most affected by the traffic volume change. A higher number of vehicles would use the northbound and southbound approaches at 146th Street & Ditch Road and a higher number of vehicles would use the eastbound approach at Drive C/I & Ditch Road. Although these movements would increase, the overall intersections would still operate at acceptable levels of service.



Appendices

Appendix A – Existing Study Intersection Turning Movement Counts

Appendix B – Output for Capacity Analysis

Appendix C – Trip Distribution Figures

Appendix D – Meeting Minutes

Appendix A
Existing Study Intersection Turning Movement Counts

Appendix B
Synchro Output for Capacity Analysis



Appendix C
Trip Distribution Figures

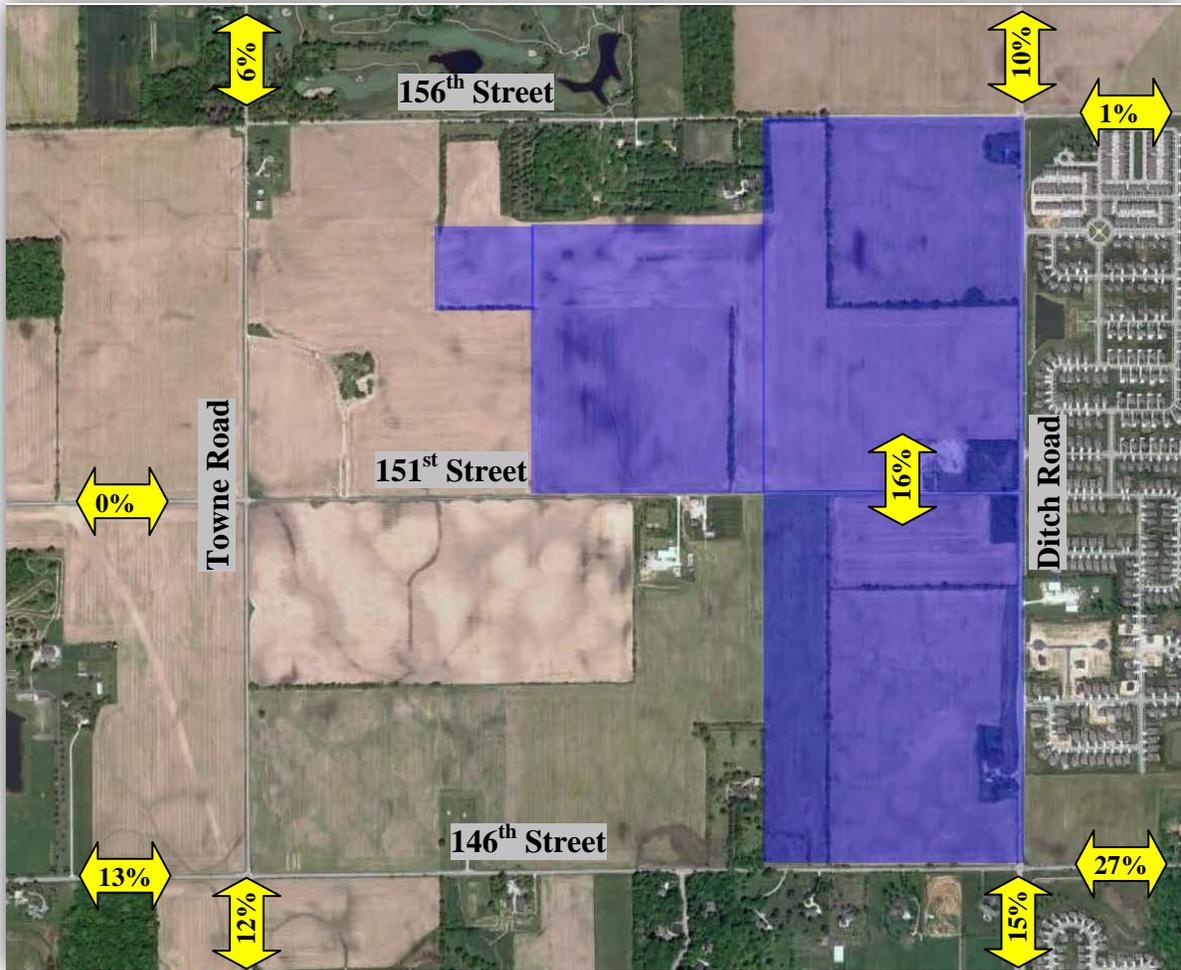


Figure A – Trip Distribution for Residential Land Uses

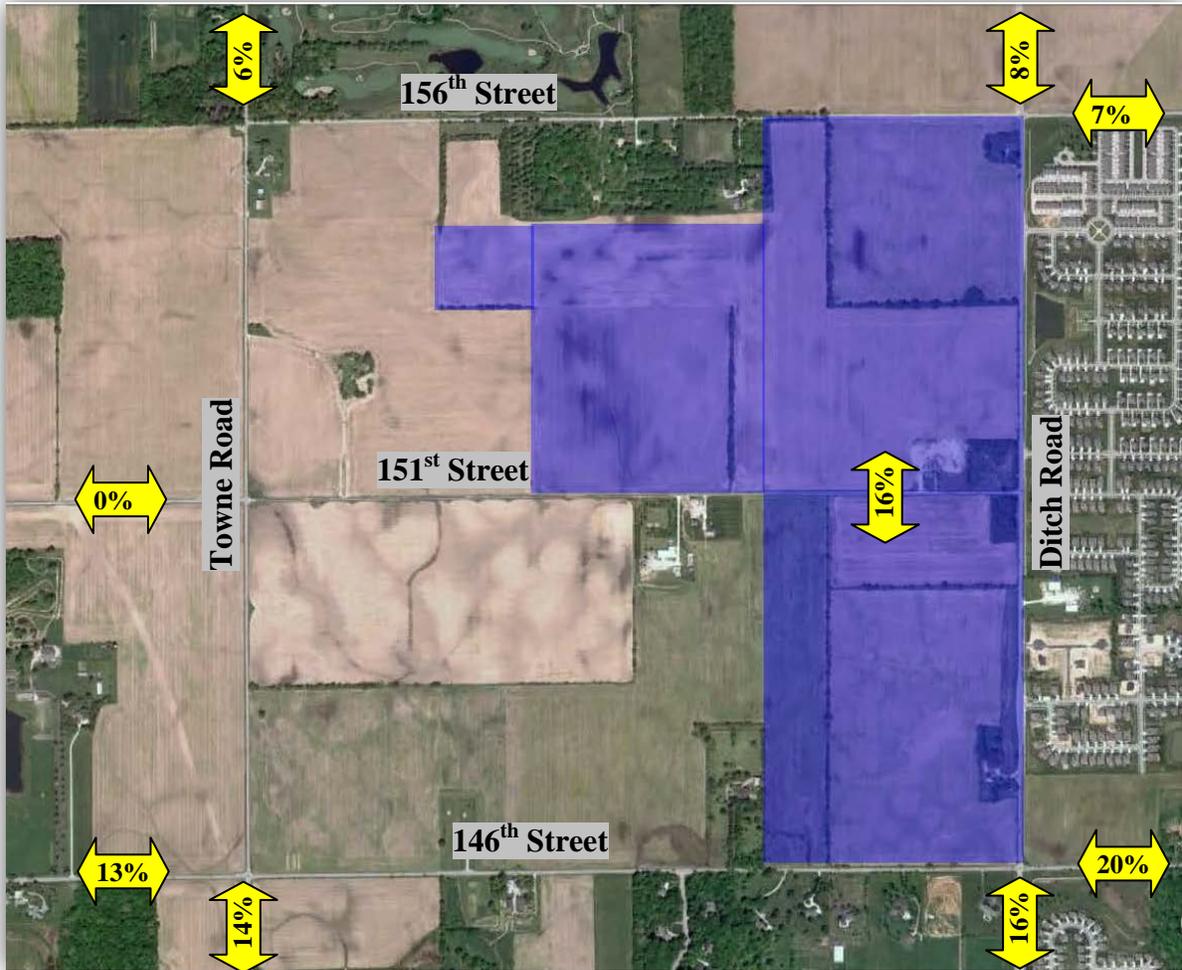


Figure B – Trip Distribution for Multi-Use Land Uses

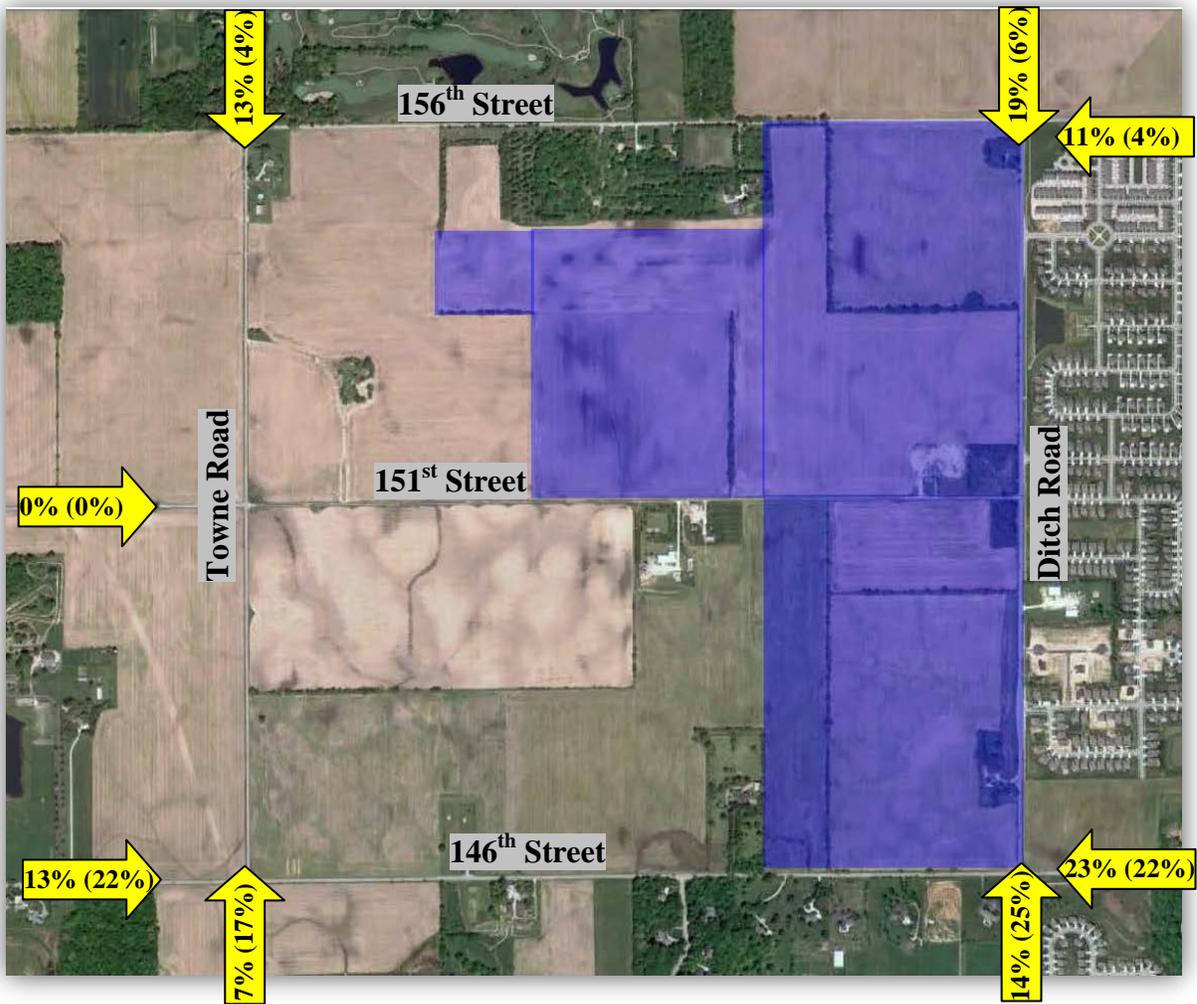


Figure C – Pass-By Trip Distribution: AM (PM)



Appendix D
Meeting Minutes



MEETING NOTES

Location: City of Westfield Public
Works Building
Date: February 7, 2012
Project: Harmony TIS

Attendees:	<u>Name</u>	<u>Representing</u>
	Neil VanTrees, P.E.	City of Westfield
	Kevin Todd, AICP	City of Westfield
	Jeromy Grenard, PE, PTOE	American Structurepoint, Inc.
	Amanda Johnson, EI	American Structurepoint, Inc.

ITEMS DISCUSSED:

1. Site Plan

- a. Neil and Kevin stated that it was their understanding that not even right-in/right-out drives were likely to be granted on 146th Street when it is widened to four lanes.

Amanda followed up with Bryan Stumpf (Director of Planning, American Structurepoint, Inc.). He has been meeting with Hamilton County for some time regarding right-in/right-out access along 146th Street and was somewhat confident access would be provided. He advised to continue study with right-in/right-out access as shown on the current site plan. Therefore, the two right-in/right-out drives were included in the analysis.

- b. Proposed distribution percentages were examined and agreed to be acceptable.

2. Road Network

- a. Per Neil, both Ditch Road and Towne Road between 146th Street and 156th Street are likely to remain the same as existing: two-lane undivided roads, not upgraded to four-lane roads.
- b. Neil requested that at the intersections of 156th & Ditch and 156th & Towne be analyzed as roundabouts in addition to existing stop-controlled intersection configurations.

- c. Neil requested that American Structurepoint check with UNITED Consulting to see the latest 146th Street plans.

Jeromy followed up with Chris Hammond (UNITED). 146th Street is currently split into two phases through the study area. Phase I is from Springmill Road to Ditch Road (including the intersection), and is currently funded. Phase II is from Ditch Road to Towne Road (including the intersection), and is currently not funded. It is definite that Phase I will be complete by 2022, and likely that Phase II will be funded and built by 2022. For this project it was assumed that the proposed 146th conditions would be extended to Towne Road, including the frontage roads.

3. Traffic Volumes

- a. Neil requested that American Structurepoint check with HNTB for future traffic projections along 146th Street that were used in the Impact Fee Study. The purpose of this would be primarily to verify the growth rate used.

Jeromy followed up with Matt Miller (HNTB), who subsequently provided all information from the Impact Fee Study pertaining to the study area.

- b. The year 2022 was determined to be the horizon year to coincide with the impact fee study and to provide a 10 year horizon year.