Nicholson Drive Traffic Study

City of Hudson

August 27, 2014

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INTRODUCTION

A study of Nicholson Drive has been performed in response to resident concerns about traffic and safety. This study analyzes roadway geometry, traffic volumes, traffic speeds, and cut-through traffic.

The study area consists of Nicholson Drive between Streetsboro Street (SR 303) and Barlow Drive in the City of Hudson. This street was constructed in 1989-1991 prior to the merger of Hudson Township and the City of Hudson. Nicholson Drive is a 25 mph street that serves single-family residences. The street contains one travel lane in each direction with no turn lanes. Nicholson Drive is uncurbed and has no sidewalks or dedicated bicycle facilities.

Several subdivision streets intersect Nicholson Drive. Two of these intersections – Heritage Court and Williamsburg Circle – operate under all-way stop control. The remaining intersections are under stop control with Nicholson Drive as the free-flow street. **Figure 1** shows the project study area.

Nicholson Drive serves as the primary means of access into the subdivision from Barlow Drive and Streetsboro Street (SR 303). An access point to Streetsboro Street (SR 303) is also provided via Independence Drive. An access point to Barlow Drive is provided via Williamsburg Circle.

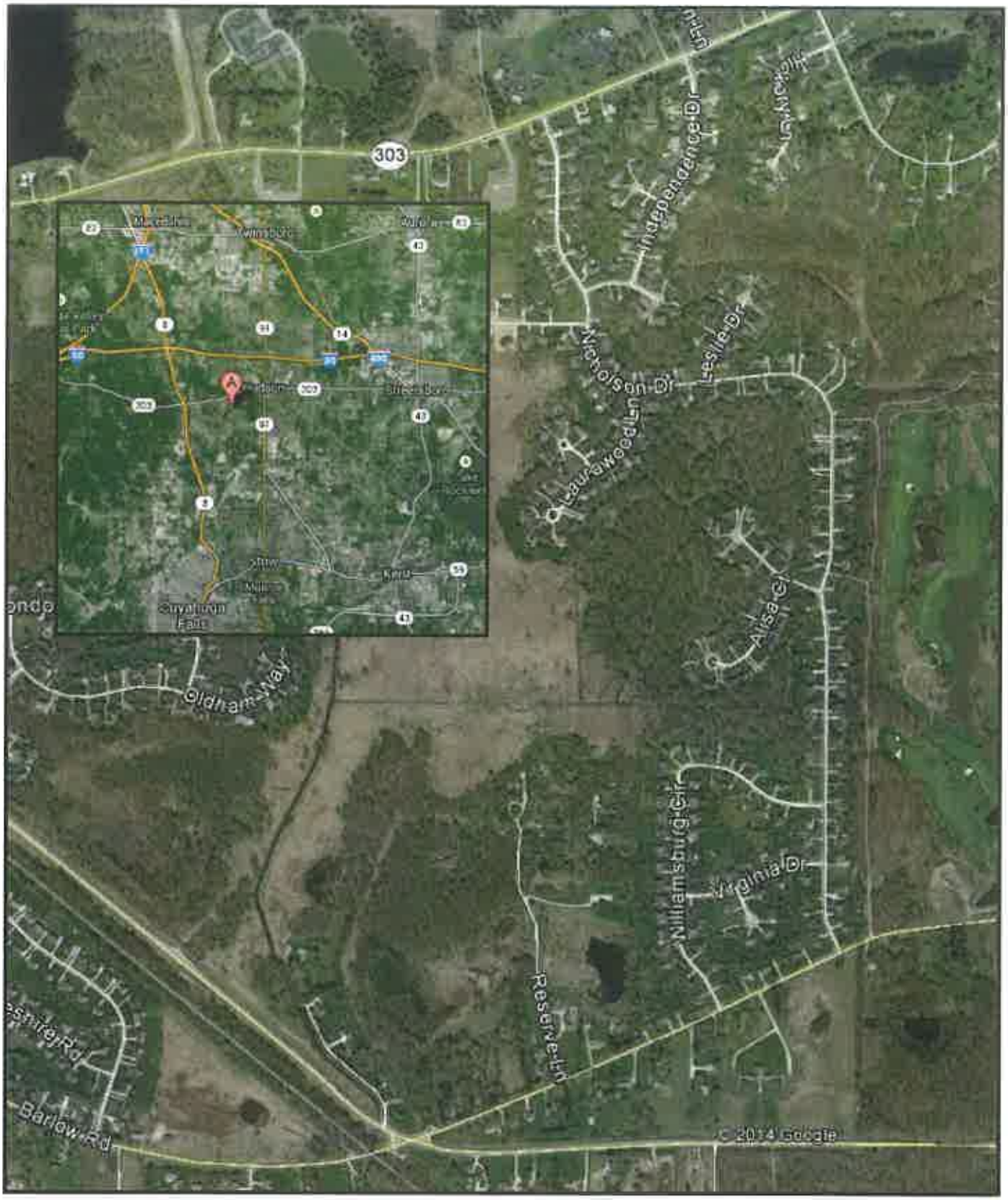
EXISTING ROADWAY CONDITIONS

Horizontal Alignment

The existing horizontal alignment of Nicholson Drive was studied to determine if the roadway curves meet the ODOT Location and Design (L&D) Manual requirements. This study focused on determining if the existing geometry is adequate for the 25-mph posted speed and used a 30-mph speed as a design speed check. For the 25-mph posted speed limit, 37 degree curves are permitted with no superelevation required until 29 degree curves and sharper are present. Assuming a design speed equal to 30 mph, 22 degree-45 minute curves are permitted with no superelevation required until 17 degree-30 minute curves are exceeded. Since survey information was only collected along the centerline of Nicholson Drive and not along the edges of pavement, no superelevation checks were included in this study.

As a result of the field survey, the existing alignment of Nicholson Drive and each intersecting side road was recreated. The analysis shows that the sharpest curve along Nicholson drive is 22 degrees-30 minutes, indicating that the horizontal geometry meets 30 mph design speed criteria. The approaching curvature of each side road to Nicholson Drive was also checked. The most limiting curve is at Heritage Court, which has a 27 degree-45 minute curve at the Nicholson Drive. The data shows that each side road is adequate for a 30-mph design speed except Heritage Court, which only meets the 25 mph posted speed. Each side road is controlled by stop signs approaching Nicholson drive.

A copy of the horizontal alignment of Nicholson Drive can be found in **Appendix A.** A copy of the survey data in AutoCAD format is provided as **Appendix B** on disc.



Imagery courtesy of Google Maps.

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FIGURE 1: Study Area Map
Nicholson Drive Traffic Study
Hudson, Ohio

Vertical Alignment

The existing vertical alignment of Nicholson Drive was studied to determine if the roadway grades and vertical curves meet the ODOT Location and Design Manual requirements. The centerline of Nicholson Drive survey data was transferred to the recreated horizontal alignment of Nicholson Drive. This enabled the existing centerline of Nicholson Drive to be plotted at approximately 50 feet intervals along the length of Nicholson drive. The resulting existing centerline profile grade was then compared to the ODOT Location and Design Manual requirements for vertical geometry. A computable, geometric profile was then developed that closely follows the existing conditions to determine the suitable design speed for the existing conditions.

The ODOT requirements for vertical design call for limiting the sharpness of grade breaks and vertical curves so that driver comfort and proper sight distance is attained for the design speed. Vertical curves are either crest type or sag type and their sharpness is measured by a factor "K". For crest type curves, "K" must be above 12 for 25 mph and above 19 for 30 mph. For sag type curves, "K" must be above 26 for 25 mph and above 37 for 30 mph. Grade breaks should not exceed 1.85% for 25 mph and should not exceed 1.30% for 30 mph. Given the limited survey data set, analyzing the existence of grade breaks can only be approximated. For this study, grade breaks are presented as the best way to approximate the existing profile grade line when not in a clearly defined vertical curve area.

The analysis shows that the overall vertical conditions are limited by two features south of Heritage Court - one grade break (PVI Sta. 118+22) and one sag curve (PVI Sta. 119+46). This grade break is suitable for 25 mph, but the sag curve is suitable for 23.5 mph. The remainder of the vertical alignment meets criteria for 30 mph or higher.

Copies of the vertical profiles for Nicholson Drive can be found in Appendix A.

Intersection Sight Distance

Each intersecting side road was investigated for proper sight distance for vehicles making right or left turns. The vehicle setback distance was set at the preferred distance of 17.8 feet from the edge of Nicholson Drive to check clear sight triangles. For the purposes of this study, the 3-way stop conditions at Williamsburg Circle and Heritage Court were ignored. No sight distance deficiencies were found for the 25 mph posted speed. However, a number a small trees (between Leslie Drive and north of Jamestown Court) located just beyond the ditch lines may become problematic as they age and grow larger. Additionally, landscaping and vegetation on the southwest corner of the Nicholson Drive/Williamsburg Circle intersection is close to interfering with sight distance. Some of this vegetation appears to be within the existing right-of-way and should be monitored to maintain adequate sight distance.

Intersection Angles

Each intersecting side road was investigated for the angle it intersects Nicholson Drive. ODOT Location and Design requirements call for the intersection angles to be between 70 degrees and 90 degrees. No intersection angles deficiencies were found along Nicholson Drive.

TRAFFIC COUNTS

Daily Volumes

Automatic tube count machines were placed on Nicholson Drive and other locations within the subdivision. The tube counters were placed between Thursday, May 1 and Thursday May 8, 2014. A summary of the count data is shown in **Table 1**. Copies of the count data are located in **Appendix C**. Table 1 indicates that Nicholson Drive serves 700-800 vehicles per day. Traffic volumes are generally higher in the northern end of the street, as more residents access the subdivision from Streetsboro Street (SR 303) than from Barlow Road. As indicated later in the Origin-Destination analysis section, the daily volume near Streetsboro Street (SR 303) increases to approximately 1,000 vehicles per day. Heritage Court serves approximately 300 vehicles per day, while Williamsburg Circle serves approximately 150 vehicles per day. These volumes are all well within the capacity of the street and are reasonable levels for residential environment.

Table 1: Daily Volume Summary
(Data only shown for full days of counting)

	Fri 5/2	Sat 5/3	Sun 5/4	Mon 5/5	Tues 5/6	Wed 5/7	Average	Weekday Average
Nicholson Drive north of Heritage Ct.	796	825	656	754	790	773	759	778
Nicholson Drive south of Heritage Ct.	684	670	552	682	755	701	674	706
Nicholson Dr. south of Williamsburg Circle	725	683	563	758	--	--	682	741
Heritage Court west of Nicholson Drive	-	-	-	-	-	329	329	329
Williamsburg Circle west of Nicholson Dr.	-	-	-	-	-	136	136	136
Barlow Road west of Williamsburg Circle	2,199	1,787	1,739	2,175	2,247	2,297	2,074	2,230
Barlow Road east of Nicholson Drive	2,602	2,218	2,117	2,592	2,701	2,718	2,491	2,653
Streetsboro Street (SR 303) west of Nicholson Drive	15,915	14,292	11,896	14,422	15,668	14,222	14,402	15,057
Streetsboro Street (SR 303) east of Nicholson Drive	16,050	14,663	12,270	14,676	15,841	16,028	14,921	15,649

Vehicle Classification

The tube counters were used to collect vehicle classification data for the weeklong period. As shown in **Table 2**, the vast majority of vehicles on Nicholson Drive are passenger cars. Trucks represent less than

2% of the overall traffic volume. Approximately 10 trucks per day travel on Nicholson Drive. This volume is a normal amount of truck traffic that could be expected for this size subdivision, as delivery trucks, landscaping vehicles, and utility maintenance trucks could all contribute to this total. No trucks with 5 or more axles were counted. An average of 8 buses per weekday (4 AM, 4 PM) were counted. The Hudson City Schools bus garage was contacted to obtain an updated count for the 2014-15 school year. According to the bus garage, a total of 10 buses per weekday (5 AM, 5 PM) typically use Nicholson Drive.

Table 2: Vehicle Classification Percentages
(average of Nicholson Drive count locations)

	Bicycles	Passenger Cars	Buses	Trucks
Nicholson Drive	1.0%	97.0%*	0.6%	1.4%*

*Two-axle, 6-tire vehicles (approximately 1.5% of overall volume) could be either dual-wheeled pickup trucks, or single unit panel trucks (e.g. a furniture delivery truck). For the purposes of this table, half of these vehicle types were assumed to be passenger cars and half were assumed to be trucks.

Copies of the raw vehicle classification count data can be found in **Appendix D.**

A small number (approximately 3%) of vehicles were unable to be classified by the tube counters. It is likely that many of these unclassified data points were vehicles pulling into or out of driveways in close proximity to the recording station - perhaps even backing over the counters. The percentages shown in Table 2 exclude these unclassified vehicles.

Signs prohibiting trucks are currently located on Nicholson Drive entering the subdivision from both Streetsboro Street (SR 303) and Barlow Drive. Based on Section 440.01 (d) of the Hudson City Code, trucks are not allowed off of the State Route system or County roads unless the road is signed as a truck route (on-street deliveries excepted). Therefore, these signs are enforceable and are recommended to remain.

CRASH ANALYSIS

Crash data for the most recent three-year period (2011-2013) was analyzed to identify potential safety issues on Nicholson Drive. Crash data was obtained through the Ohio Department of Public Safety crash records. During the three-year period one crash occurred on Nicholson Drive within the subdivision. (This total does not include intersection-related crashes at either Streetsboro Street [SR 303] or Barlow Street.) This crash involved a vehicle running off the road and striking a mailbox between Virginia Drive and Barlow Street. No intersection-related crashes occurred in the subdivision.

SPEED ANALYSIS

Speed Studies

Vehicle speeds on Nicholson Drive was evaluated via two methodologies – using data collected by the tube counts and using data collected from manual spot speed studies.

The tube counters that were placed for the purposes of collecting traffic volumes also are capable of recording speed data. A summary of the data from these tube counters is shown on **Table 3.** This

represents a week of speed data (May 1-8, 2014). The tube counters on Nicholson Drive were placed in "free-flow" conditions - far enough away from the stop signs so that speeds were not influenced by vehicles slowing down for the stop signs. Copies of the speed data collected are located in **Appendix E**.

Table 3: Speed Data from Tube Counters

	Average (50th Percentile) Speed	85th Percentile Speed
Nicholson Drive north of Heritage Court	25 mph	30 mph
Nicholson Drive south of Heritage Court	26 mph	33 mph
Nicholson Drive south of Williamsburg Circle	22 mph	26 mph

Through use of a radar gun, one hour of spot speed data was manually collected for at three locations on Nicholson Drive. These locations were also chosen in "free-flow" conditions – places where speed were not influenced by stop signs. Care was also taken to make the recorder inconspicuous, so that normal driver behavior would occur. The radar gun readings were taken from an unmarked parked car on side streets. A summary of the spot speed data in shown in **Table 4**. Copies of the spot speed data collected are located in Appendix E.

Table 4: Spot Speed Data

	Average (50th Percentile) Speed	85th Percentile Speed
Nicholson Drive at Union Drive	26 mph	29 mph
Nicholson Drive at Leslie Drive	28 mph	32 mph
Nicholson Drive at Virginia Drive	27 mph	30 mph

Based on the results in Table 3 and Table 4, the average speeds on Nicholson Drive are generally near the posted 25-mph speed limit. All locations had average speeds within 3 miles per hour of the speed limit. The 85th-percentile speed, which is often used in the determination of speed limits, was generally near 30 miles per hour throughout the corridor.

The speeds on Nicholson Drive are generally close to the speed limit. Based on the crash data (one crash in three years), excessive speeds do not appear to be causing a safety issue on Nicholson Drive. Speeds are typically considered acceptable when the 85th-percentile speed is within 10mph of the posted speed limit, which is the case on Nicholson Drive. Therefore, no action is recommended at this time.

Potential Traffic Calming Solutions (if needed in future)

It is important to keep speeds at reasonable levels, especially on a street like Nicholson Drive that does not have a sidewalk and frequently has pedestrians walking in or near the roadway. If speeds were to noticeably increase in the future, traffic calming measures could be considered at that time. For informational purposes only, the following paragraph describes potential traffic calming solutions suitable

for Nicholson Drive if speeds increased in the future. These future solutions would range from low-cost, short-term strategies to higher-cost, long-term projects.

If needed due to future increases in speeds, a short-term solution would be to implement mobile speed trailers on Nicholson Drive. Additional permanent signage would not be recommended. Multiple speed limit signs are already posted in each direction of the street, and additional signs would be generally ignored by drivers and lead to clutter. If needed, potential long-term solutions could include installation of numerous speed tables or chicanes along Nicholson Drive. However, the speed reduction benefits of these long-term solutions would have to be weighed against some potential concerns, such as effects to emergency response vehicles, inconvenience for residents who would have to traverse them several times daily, increased noise, and nighttime visibility of the devices.

Barlow Road and Streetsboro Street (SR 303)

While not directly relevant to Nicholson Drive operations, the tube counters placed on SR 303 and Barlow Road for the origin-destination study recorded speed data in addition to volume data. The speed data on these roadways are shown in **Table 5** for informational purposes.

Table 5: Speed Data on Barlow Drive and Streetsboro Street (SR 303)

	Average (50th Percentile) Speed	85th Percentile Speed
Barlow Road west of Williamsburg Circle	33 mph	41 mph
Barlow Road east of Nicholson Drive	35 mph	40 mph
Streetsboro Street (SR 303) west of Nicholson Dr.	44 mph	50 mph
Streetsboro Street (SR 303) east of Nicholson Dr.	33 mph	41 mph

MULTI-WAY STOP WARRANTS

The Nicholson Drive/Williamsburg Circle and the Nicholson Drive/Heritage Court intersections are the only multi-way stop control locations in the study area. These multi-way stop conditions were implemented prior to the merger of the City of Hudson and Hudson Township. These locations were analyzed to determine if these locations meet criteria for multi-way stop control. The Ohio Manual of Uniform Traffic Control Devices (OMUTCD) provides guidance on the use of multi-way stop control at intersections. **Appendix F** contains detailed charts that evaluate each of the two intersections according to the OMUTCD criteria. **Table 6** shows a summary of the warrant results.

Table 6: Multi-Way Stop Warrant Summary

	Nicholson Drive/ Heritage Court	Nicholson Drive/ Williamsburg Circle
Criteria A Met?	No	No
Criteria B Met?	No	No
Criteria C Met?	No	No
Optional Criteria Met?	No	No
Warrant Met?	No	No

Based on Table 6, neither the Nicholson Drive/Heritage Court intersection nor the Nicholson Drive/Williamsburg Circle meet OMUTCD criteria for a multi-way stop warrant. As shown in Appendix F, both intersections have volumes that are significantly below the warrant guidelines.

It is recommended that both the Nicholson Drive/Heritage Court and Nicholson Drive/Williamsburg Circle intersections be converted to minor street stop control operation. As shown in the previous section, vehicle speeds in the vicinity of these stop signs are not lower than speeds in other parts of Nicholson Drive. Some studies have shown that speeds are actually higher on streets with all-way stops, as drivers try to "make up lost time". Another benefit of removing of these stop signs would be a reduction is noise from vehicles braking and accelerating.

ORIGIN-DESTINATION STUDY

Two methodologies were employed to help determine the number of cut-through trips in the subdivision. Data was collected via a manual origin-destination (O-D) license plate survey and via Bluetooth receptors.

Manual O-D Survey

On Wednesday May 6, 2014, a manual license plate survey was conducted for 8 hours. (8:15-10:00 AM, 10:30-12:30 PM, 1:30-3:30 PM, and 4:00-6:15 PM) This survey was conducted on a weekday while school was in session. The weather was warm and dry, so traffic patterns – particularly to/from Ellsworth golf course - should represent normal spring/summer conditions. This survey was performed by stationing people at the entrance points to the subdivision, recording the license plates of all vehicles entering and exiting the subdivision. These records were logged and the compared to identify the number of vehicles that through the subdivision in a 5-minute time period or less.

Table 7 shows the results of the manual survey. A total of 33 cut-through vehicles were counted during the 8-hour survey period. This represents an average of 4 cut-through vehicles per hour. Four of the 33 vehicles used Independence Drive while cutting through the neighborhood. The remaining 29 vehicles drove the entire length of Nicholson Drive to cut through the subdivision. None of the observed cut-through vehicles were heavy trucks or buses.

Table 7: Origin-Destination Survey Results

	Total Inbound Vehicles	Total Outbound Vehicles	Total Vehicles Surveyed	Cut-through Vehicles (North to South)	Cut-through Vehicles (South to North)
Location 1: Nicholson Drive @ Streetsboro Street (SR 303)	263	238	501	13	16
Location 2: Independence Drive @ Streetsboro Street (SR 303)	80	75	155	3	1
Location 3: Nicholson Drive @ Barlow Road	131	166	297	16	17

Based on the hourly volume patterns in the tube count data, the 8-hour survey period represents 50% of the daily volume, therefore it is estimated that a total of 66 cut-through trips per day pass through the subdivision.

Bluetooth

Four Bluetooth receptor (Traffax) devices were placed for a one-week period from May 1-7, 2014. Because the devices could record data for multiple days, the Bluetooth study was performed as a "check" on the manual O-D survey to make sure that the Bluetooth devices were placed at the following locations:

- Location A: Streetsboro Street (SR 303) west of Nicholson Drive
- Location B: Streetsboro Street (SR 303) east of Independence Drive
- Location C: Barlow Road west of Williamsburg Circle
- Location D: Barlow Road east of Nicholson Drive

The Traffax units recorded vehicles passing by that have an active Bluetooth device (phone, stereo, GPS unit, etc.). Any device/vehicle that passed by a Traffax unit on both Streetsboro Street (SR 303) and Barlow Road (either A to C, A to D, B to C, B to D, C to A, C to B, D to A, or D to B) within a 5-minute timeframe was assumed to be a cut-through trip. For example, if a device/vehicle passed by Location A at 1:43pm and then Location D at 1:48pm, that was counted as a cut-through trip. However, if a vehicle passed by Location A at 1:43 and Location D at 2:00pm, it was not counted as a cut-through trip and was assumed that the vehicle had a stop within the subdivision.

A total of 10,500 Bluetooth data points were collected during the week. Tube counters were placed adjacent to the Bluetooth data collection units in order to determine the percentage of vehicles with active Bluetooth devices. Based on the tube count data, it was calculated that 5% of vehicles had an active Bluetooth device.

During the five full days that the Traffax units were deployed (May 2-6, 2014), a total of 23 cut-through trips were recorded, which translates to 460 total cut-through trips during the period. This corresponds to an average of 92 cut-through trips per day, which is consistent with the findings of the manual O-D survey, as both methodologies show fewer than 100 cut-through trips per day.

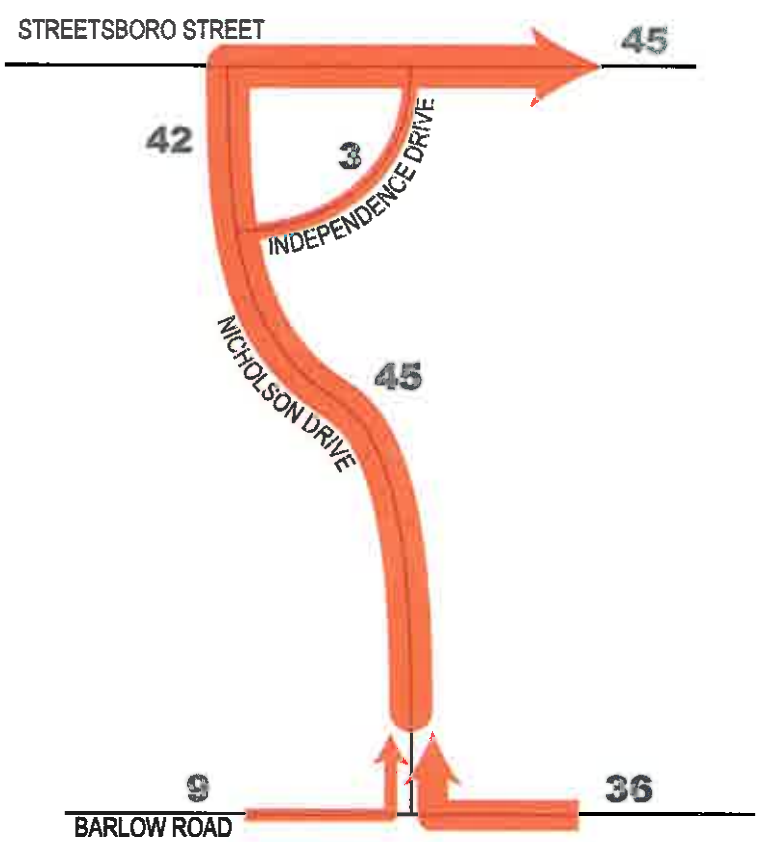
Summary

Based on the Bluetooth and manual origin-destination survey, an average of 79 cut-through vehicles on Nicholson Drive. The cut-through traffic represents 8% of the overall traffic on Nicholson Drive at Streetsboro Street (SR 303), and represents 13% of the overall traffic on Nicholson Drive at Barlow Road. **Figure 2** contains graphics illustrating the cut-through volumes.

As shown in Figure 2, the majority of the cut-through trips were to/from the east on Barlow Drive and to/from the east Streetsboro Street (SR 303). This is expected, as Terex Road provides a faster means of making trips to/from the west. The cut-through trips are not clustered in the peak hours, so it does not appear that drivers are using Nicholson Drive to avoid congested peak hour conditions on Darrow Road. The cut-through trips are most likely residents along Barlow Road, Weeping Willow Drive, and traffic to/from Ellsworth Meadows Golf Course.

Appendix G contains a brief summary of the Bluetooth and manual origin-destination survey data. **Appendix H** contains all of the data points collected by the manual origin-destination surveys.

Daily Cut-Through Trips Northbound
Average of Bluetooth & Manual Origin-Destination Survey



Daily Cut-Through Trips Southbound
Average of Bluetooth & Manual Origin-Destination Survey

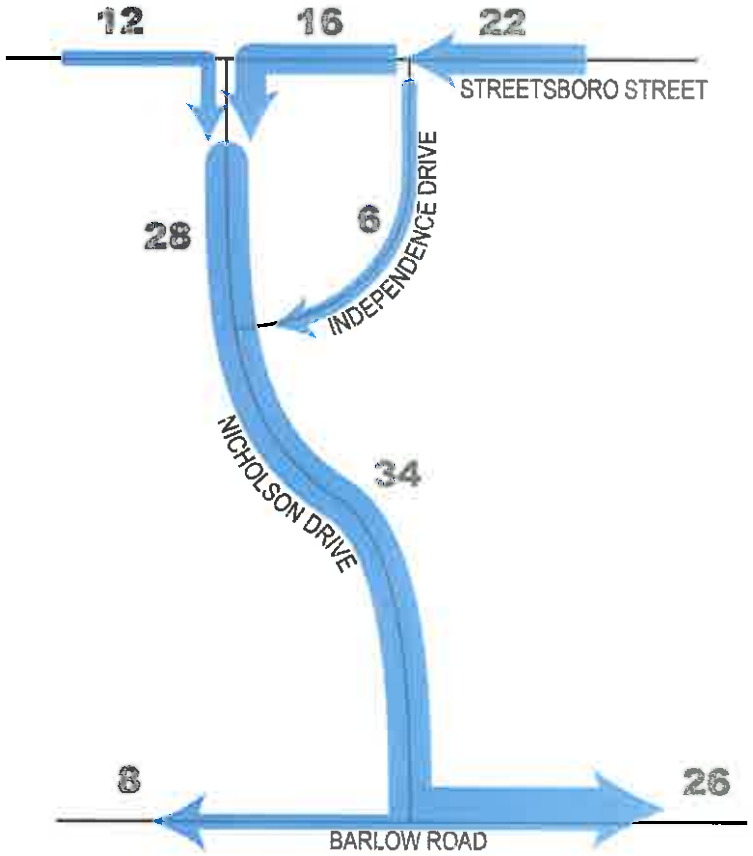


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FIGURE 2: Daily Cut-Through Trips
Nicholson Drive Traffic Study
Hudson, Ohio

CONCLUSION & RECOMMENDATIONS

The following is a summary of findings for Nicholson Drive:

- With one exception, Nicholson Drive meets ODOT Location & Design (L&D) Manual 25-mph design criteria for horizontal curvature, vertical curvature, intersection sight distance, and intersection alignment.
    - One sag curve south of Heritage Court only meets L&D criteria for 23.5 mph
- Traffic volumes on Nicholson Drive average between 700-1,000 vehicles per day, with higher volumes at the northern portion of the street
- Approximately 10 trucks per day use Nicholson Drive, representing less than 2% of traffic volumes
- Approximately 10 school buses per day use Nicholson Drive
- One crash (vehicle struck mailbox) has occurred on Nicholson Drive in the past 3 years
- Average speeds on Nicholson Drive very nearly match the posted 25-mph speed limit. 85th-percentile speeds are generally near 30 miles per hour.
- The existing multi-way stop control intersections of Nicholson Drive/Heritage Court and Nicholson Drive/Williamsburg Circle do not meet Ohio Manual of Traffic Control Devices (OMUTCD) criteria for multi-way stops.
    - Removal of these multi-way stop signs is unlikely to increase vehicle speeds
- Origin-destination studies indicate approximately 80 daily "cut-through" trips use Nicholson Drive.
    - This represents about 10% of overall traffic volume
    - No "cut-through" heavy trucks were counted

Based on the above findings, no major safety or operational issues are occurring on Nicholson Drive. The street experiences traffic volumes and speeds that are typical for a 25-mph residential subdivision street. Therefore, no actions to slow speeds are recommended at this time. However, with no sidewalks and pedestrians frequently walking in or near the pavement edge, it is important to keep the speeds at their current reasonable levels. If speeds were to noticeably increase in the future, a variety of short-term and long-term solutions could be pursued. Further evaluation of these solutions could be analyzed if the 85th-percentile speeds increased to 35 miles per hour along Nicholson Drive.

Existing signs prohibiting trucks at both ends of Nicholson Drive should remain. A review of Hudson City Code indicates that through trucks are prohibited from Nicholson Drive, thus the signs are enforceable.

The unwarranted multi-way stop signs on Nicholson Drive at Heritage Court and at Williamsburg Circle are recommended for removal. These two intersections are recommended to operate so that only the minor street is under stop control. Vegetation on the southeast corner of the Nicholson Drive/Williamsburg Circle intersection should be monitored to ensure adequate sight distance is maintained.

Appendix A

Roadway Alignment & Profiles

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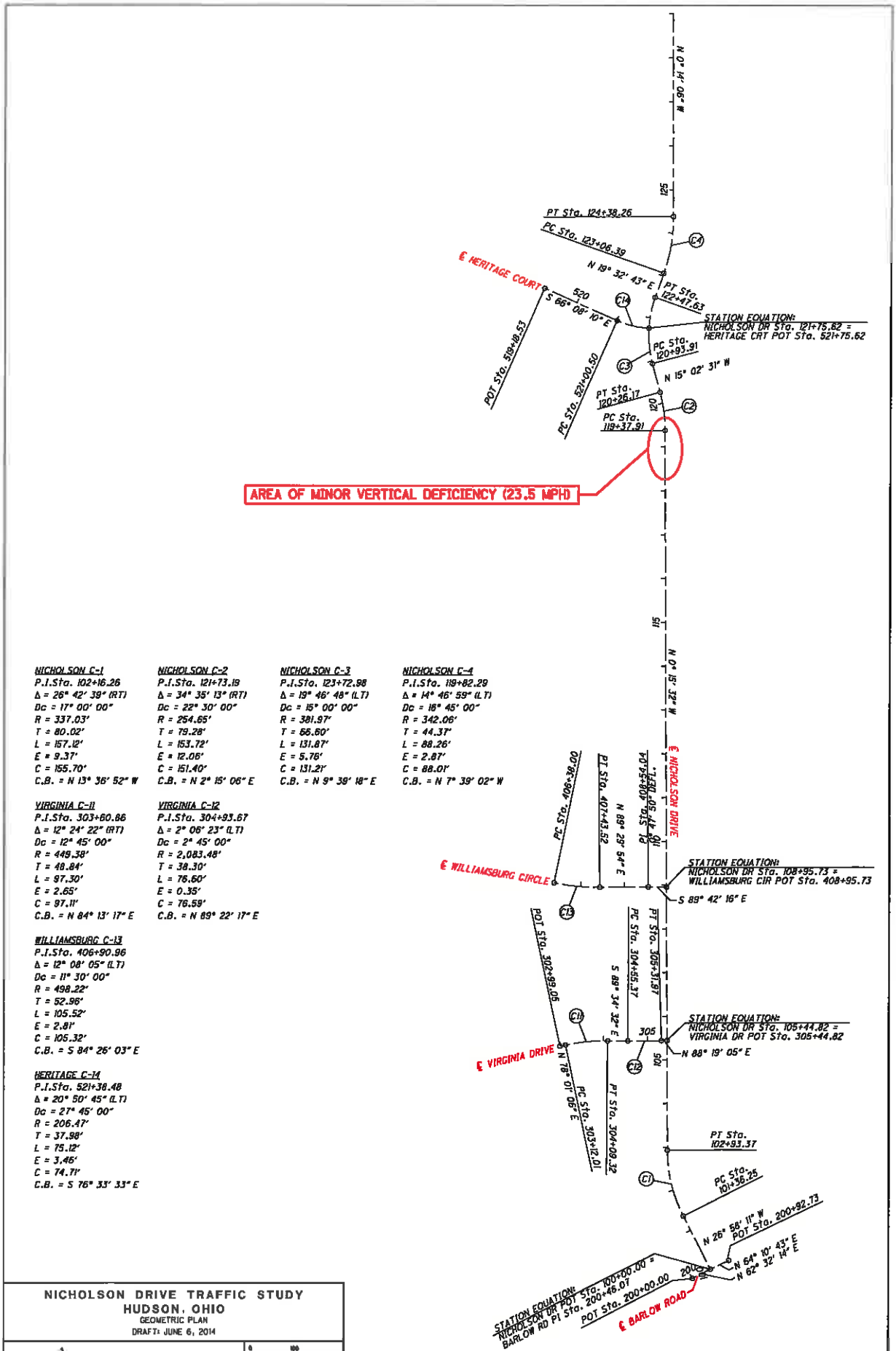


NICHOLSON C-1
P.I.Sta. 102+16.26
Δ = 26° 42' 39" (RT)
Dc = 17° 00' 00"
R = 337.03'
T = 80.02'
L = 157.12'
E = 9.37'
C = 155.70'
C.B. = N 13° 36' 52" W

NICHOLSON C-2
P.I.Sta. 121+73.19
Δ = 34° 35' 13" (RT)
Dc = 22° 30' 00"
R = 254.65'
T = 79.28'
L = 153.72'
E = 12.06'
C = 151.40'
C.B. = N 2° 15' 06" E

NICHOLSON C-3
P.I.Sta. 123+72.98
Δ = 19° 46' 48" (LT)
Dc = 15° 00' 00"
R = 381.97'
T = 66.60'
L = 131.87'
E = 5.76'
C = 131.21'
C.B. = N 9° 39' 18" E

NICHOLSON C-4
P.I.Sta. 119+82.29
Δ = 14° 46' 59" (LT)
Dc = 16° 45' 00"
R = 342.06'
T = 44.37'
L = 88.26'
E = 2.87'
C = 88.01'
C.B. = N 7° 39' 02" W

VIRGINIA C-11
P.I.Sta. 303+60.86
Δ = 12° 24' 22" (RT)
Dc = 12° 45' 00"
R = 449.38'
T = 48.84'
L = 97.30'
E = 2.65'
C = 97.11'
C.B. = N 84° 13' 17" E

VIRGINIA C-12
P.I.Sta. 304+93.67
Δ = 2° 06' 23" (LT)
Dc = 2° 45' 00"
R = 2,083.48'
T = 38.30'
L = 76.60'
E = 0.35'
C = 76.59'
C.B. = N 89° 22' 17" E

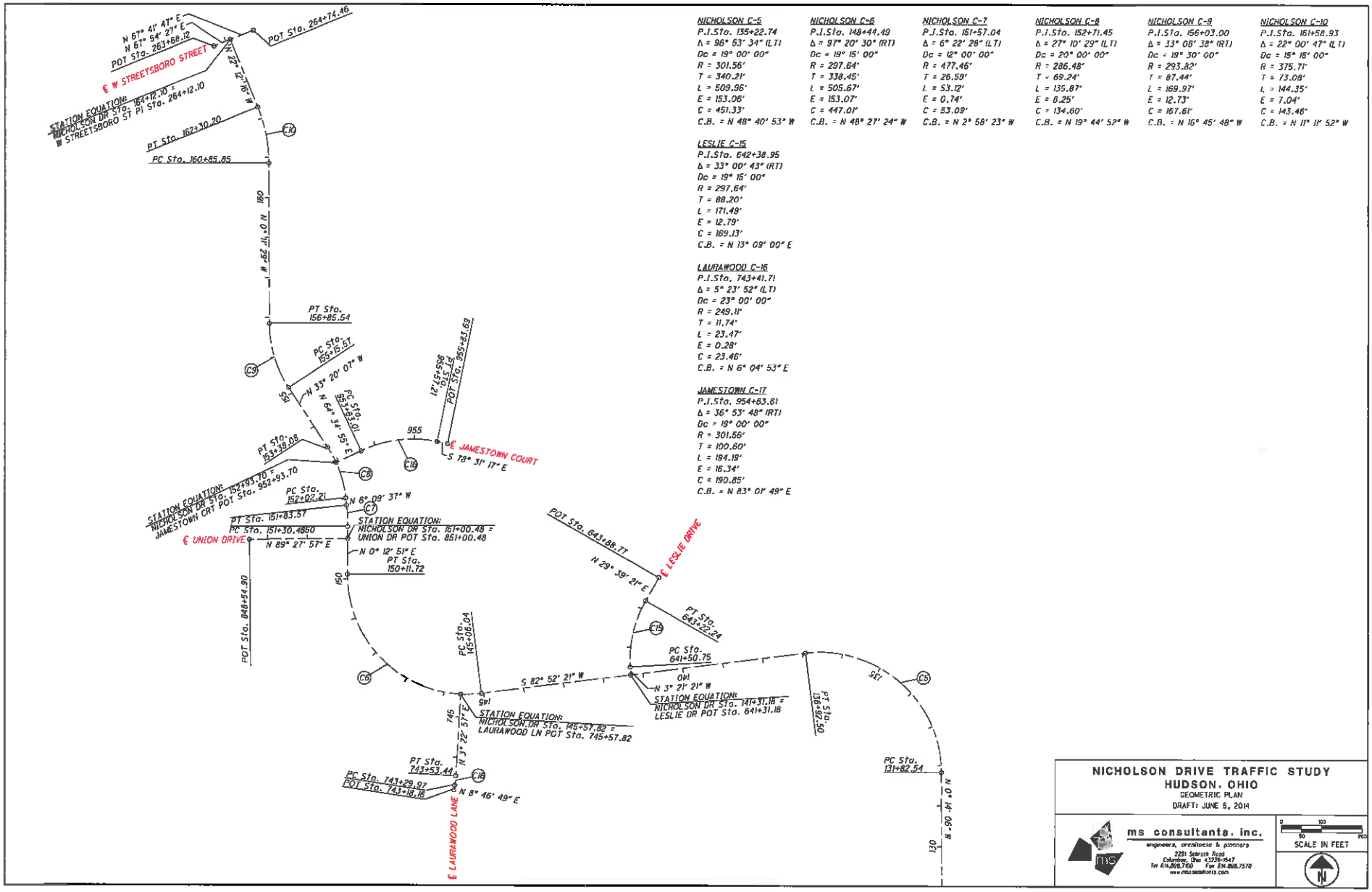
WILLIAMSBURG C-13
P.I.Sta. 406+90.96
Δ = 12° 08' 05" (LT)
Dc = 11° 30' 00"
R = 498.22'
T = 52.96'
L = 105.52'
E = 2.81'
C = 105.32'
C.B. = S 84° 26' 03" E

HERITAGE C-14
P.I.Sta. 521+38.48
Δ = 20° 50' 45" (LT)
Dc = 27° 45' 00"
R = 206.47'
T = 37.98'
L = 75.12'
E = 3.46'
C = 74.71'
C.B. = S 76° 33' 33" E

NICHOLSON DRIVE TRAFFIC STUDY
HUDSON, OHIO
GEOMETRIC PLAN
DRAFT: JUNE 6, 2014

ms consultants, inc.
engineers, architects & planners
2221 Schrock Road
Columbus, Ohio 43229-1547
Tel 614.898.7100 Fax 614.898.7470
www.msconsultants.com

SCALE IN FEET



NICHOLSON C-5
P.I.Sta. 135+22.74
Δ = 96° 53' 34" (LT)
Dc = 19° 00' 00"
R = 301.56'
T = 340.21'
L = 509.96'
E = 153.06'
C = 451.33'
C.B. = N 48° 40' 53" W

NICHOLSON C-6
P.I.Sta. 148+44.49
Δ = 97° 20' 30" (RT)
Dc = 19° 15' 00"
R = 297.64'
T = 338.45'
L = 505.67'
E = 153.07'
C = 447.01'
C.B. = N 48° 27' 24" W

NICHOLSON C-7
P.I.Sta. 151+57.04
Δ = 6° 22' 28" (LT)
Dc = 12° 00' 00"
R = 477.46'
T = 26.59'
L = 53.12'
E = 0.74'
C = 53.09'
C.B. = N 2° 58' 23" W

NICHOLSON C-8
P.I.Sta. 152+71.45
Δ = 27° 10' 29" (LT)
Dc = 20° 00' 00"
R = 286.48'
T = 69.24'
L = 135.87'
E = 8.25'
C = 134.60'
C.B. = N 19° 44' 52" W

NICHOLSON C-9
P.I.Sta. 156+03.00
Δ = 33° 08' 38" (RT)
Dc = 19° 30' 00"
R = 293.82'
T = 87.44'
L = 169.97'
E = 12.73'
C = 167.61'
C.B. = N 16° 45' 48" W

NICHOLSON C-10
P.I.Sta. 161+58.93
Δ = 22° 00' 47" (LT)
Dc = 15° 15' 00"
R = 375.71'
T = 73.08'
L = 144.35'
E = 7.04'
C = 143.46'
C.B. = N 11° 11' 52" W

LESLIE C-15
P.I.Sta. 642+38.95
Δ = 33° 00' 43" (RT)
Dc = 19° 15' 00"
R = 297.64'
T = 88.20'
L = 171.49'
E = 12.79'
C = 169.13'
C.B. = N 13° 09' 00" E

LAURAWOOD C-16
P.I.Sta. 743+41.71
Δ = 5° 23' 52" (LT)
Dc = 23° 00' 00"
R = 249.11'
T = 11.74'
L = 23.47'
E = 0.28'
C = 23.46'
C.B. = N 6° 04' 53" E

JAMESTOWN C-17
P.I.Sta. 954+63.61
Δ = 36° 53' 48" (RT)
Dc = 19° 00' 00"
R = 301.56'
T = 100.60'
L = 194.19'
E = 16.34'
C = 190.85'
C.B. = N 83° 01' 49" E

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HUDSON, OHIO
GEOMETRIC PLAN
DRAFT: JUNE 5, 2014

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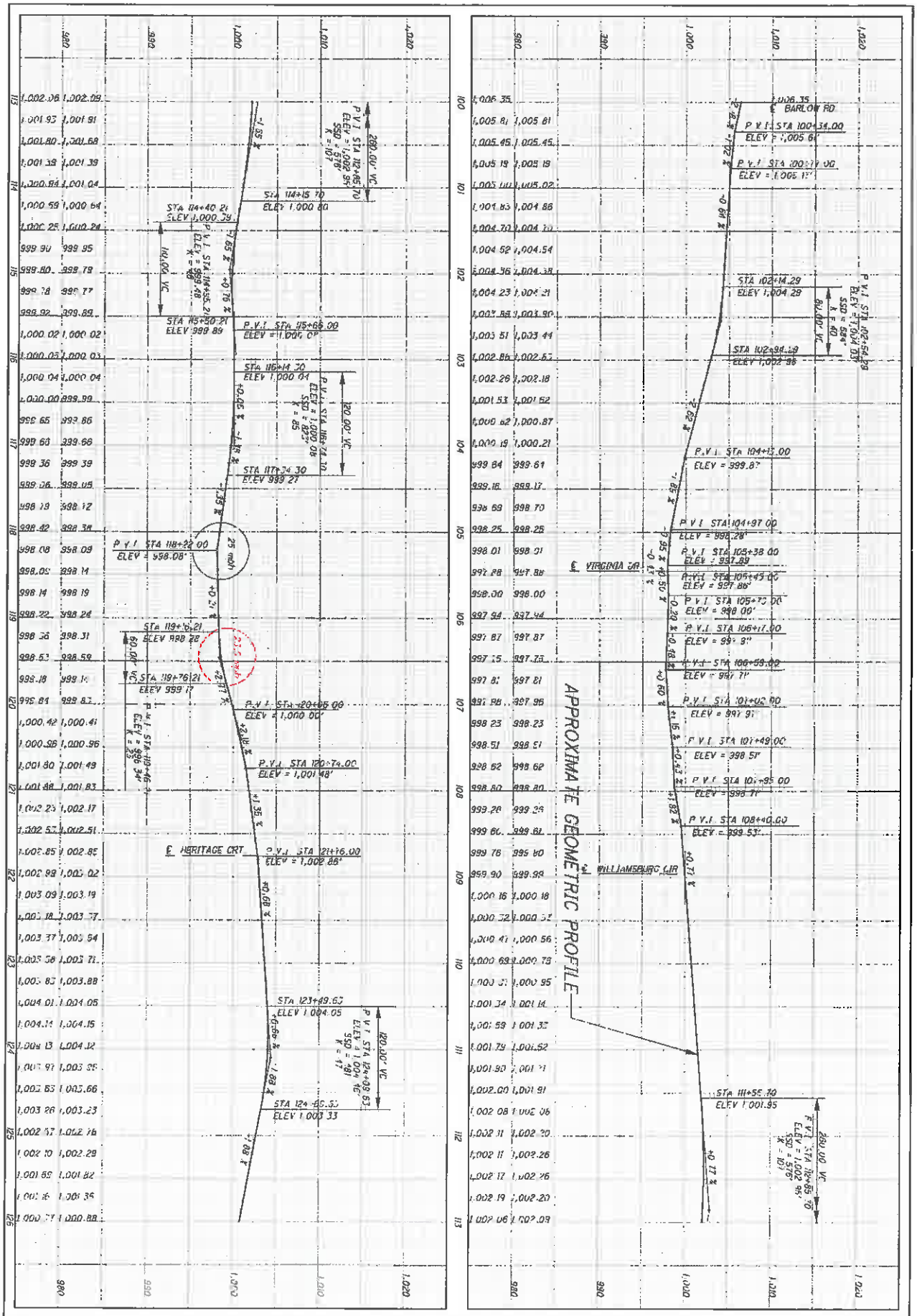

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PROFILE - STA. 100+00 TO STA. 126+00
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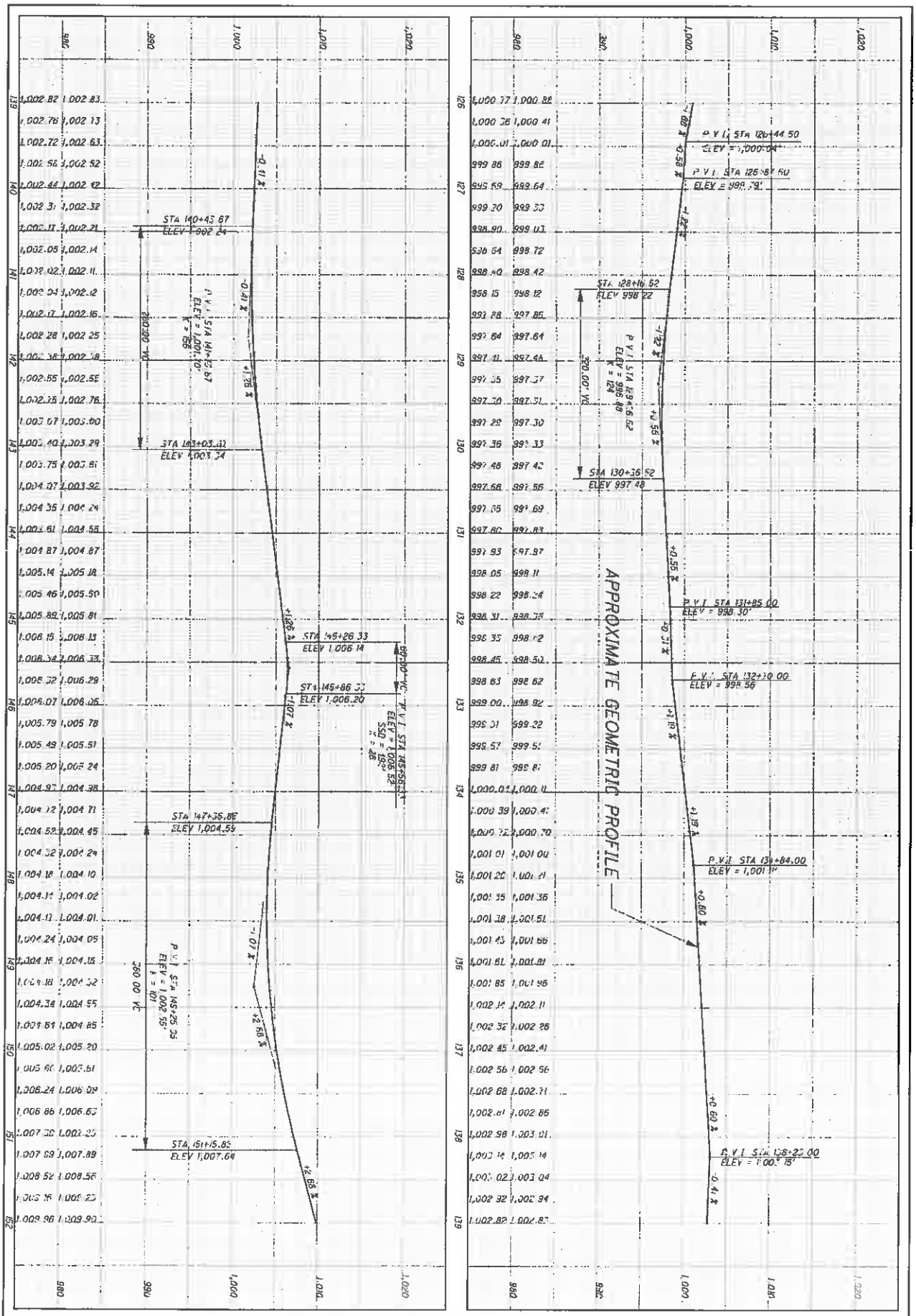

PROFILE - STA. 126+00 TO STA. 152+00
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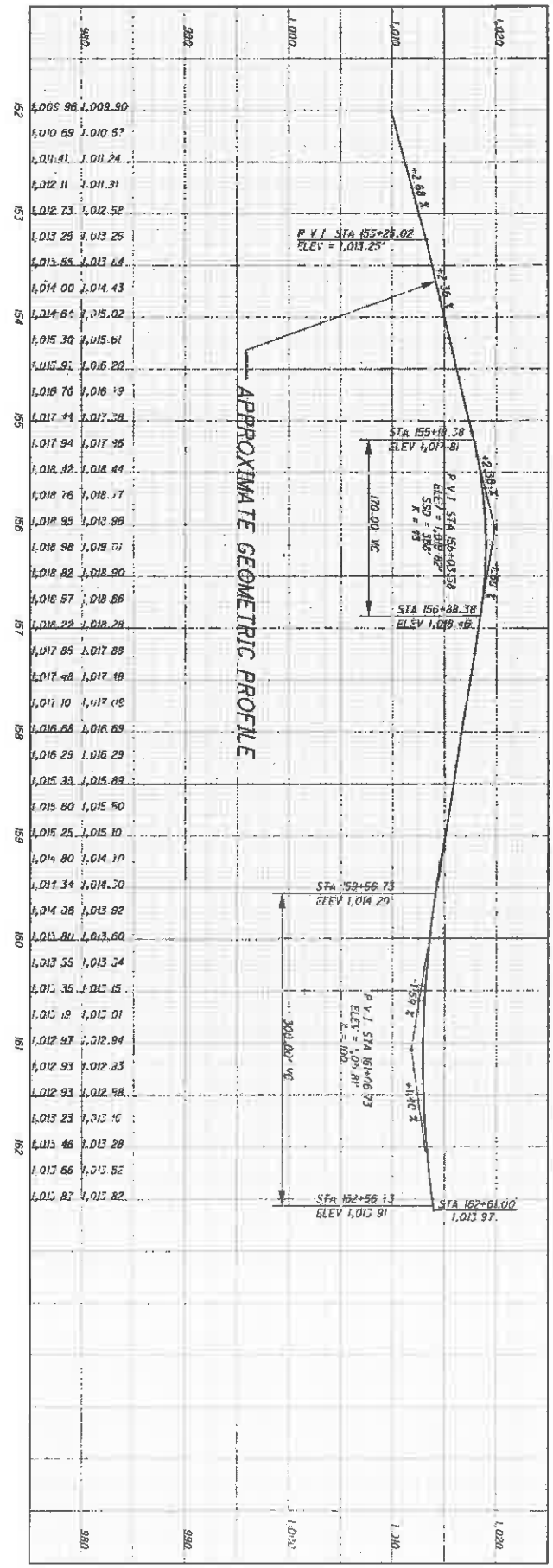

PROFILE - STA. 152+00 TO STA. 162+61
NICHOLSON DRIVE TRAFFIC STUDY, HUDSON, OHIO