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Aerial Infrared Deer Survey Report

Mill Creek MetroParks Mahoning County, OH

Dates of aerial scans:

January 21/22 and February 18/19, 2024

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Introduction and Background:

Aerial infrared wildlife scans are widely regarded as the most accurate way to determine animal populations and distribution.

Infrared sensors are used to detect the body heat produced by large animals, such as deer, which is greater than the surface temperatures of their surroundings.

To minimize the effect of solar heating on the surrounding area, it is most effective to conduct an infrared survey after sunset.

In order to be able to see as much as possible, infrared wildlife scans must be done after the leaves have fallen from the trees in autumn and before the trees bud out again in the spring.

Furthermore, the winter months are preferable for conducting infrared scans as there will be a bigger temperature difference between the animals and their surroundings. Snow cover is also beneficial.

Methods:

Our infrared scan was done utilizing one of FLIR's highest resolution infrared cameras

The infrared scan was done via airplane flying at a constant altitude. Due to the varying topography of the area, the altitude above the ground varied between approximately 1,200 feet and 1,400 feet.

Fifteen (15) parks were scanned per outlines provided by the client. The total area of the parks surveyed was approximately 4,859 acres, or 7.6 square miles. The total area surveyed, including perimeter buffers (approximately 300'–400' beyond the parks' boundaries) and internal areas that were not actually part of the parks was over 8,700 acres, or 13.6 square miles.

Methods (cont'd):

The sites were irregularly shaped and individual flight plans were created to ensure complete coverage of every park, including the approximately 300'–400' buffer zone around each park.

The “central area” of the park system, consisting of Mill Creek Park, Hitchcock Woods, Huntington Woods, Mill Creek Wildlife Preserve, and Collier Preserve, were all flown together as one big area on the first night of the survey (January 21/22, 2024). Also flown on the first night were four (4) of the smaller sites in areas east and west of the central areas. These sites were Cranberry Run, Springfield Forest, Egypt Swamp, and Sebring Woods.

The six (6) remaining outlying parks – McGuffey Wildlife Preserve, Yellow Creek, Vickers Nature Preserve, Sawmill Creek, Metro Parks Farm, and Hawkins Marsh – were flown individually on the second night of the survey (February 18/19, 2024).

Flight line headings (directions) for each work area were chosen based on the highest efficiency for each site. Flight lines were spaced approximately 400 feet apart. This allowed for approximately 30% overlap in the coverage from one line to the next to ensure that there were no gaps in the coverage due to wind, turbulence, or human error.

Radiometric sequences (thermal infrared "videos") were recorded continuously for each flight line at a frame rate of at least 15 frames per second. The camera was pointed straight down through an opening in the floor of the airplane. This permitted the entire survey area to be seen, unobstructed, at slightly forward and slightly backward angles (as the lens field of view is approximately 25°) in addition to being seen straight down. Analyzing the thermal signatures in multiple frames covering the entire field of view of the lens helps to differentiate deer from other objects and allows for a higher likelihood of identifying thermal signatures consistent with the presence of deer in and around large trees and in densely wooded areas.

Methods (cont'd):

Each recorded sequence was analyzed frame-by-frame. Individual frames were thermally tuned and analyzed by a certified thermographer to identify thermal signatures consistent with the presence of deer. Ninety-six (96) sequences were recorded and approximately 84,300 individual frames were analyzed in order to prepare this report.

Many different frames are analyzed when determining whether or not a particular thermal signature is caused by a deer. Furthermore, each frame was thermally tuned in many different ways to help differentiate a deer's signature from that of another object.

Adjacent sequences were analyzed to avoid duplicating deer counts in areas of overlap. Although deer could possibly move far enough in the time between flight lines to be mistaken for unique signatures and therefore double counted, the likelihood of that happening is very low. Furthermore, there is an equal probability that the deer could move far enough between flight lines to be missed altogether and not be counted at all. Deer are most active at dusk and dawn, and the scans were done well after sunset to decrease the chances for that type of error.

During the analysis, the infrared images were also compared side-by-side to "Google® Earth" imagery in order to identify natural and man-made features that may produce infrared readings that could be confused with wildlife. Items that could produce strong thermal signatures include natural items such as standing water, ice, rocks, tree trunks, and even certain types of vegetation. Man-made objects that can appear as thermal anomalies include sewer drains, electrical transformers, manhole covers, lights, and structures.

General Notes and Disclaimers:

As stated earlier, infrared scans are widely considered to be the most accurate method for counting deer. The accuracy of infrared surveys is most often quoted to be “85% or better” when done in ideal conditions.

This accuracy is accepted even though most infrared surveys only scan part of a site and then extrapolate the data to come up with the count. Although that method may yield results that are “close enough” for some purposes, Above All – Ohio does not extrapolate data from partial scans. We scan the entire site and count every thermal signature that we see that is consistent with the presence of deer. We also plot the locations as accurately as possible on Google Earth so as to get an idea of the distribution of the herds in addition to the population count.

In ideal or nearly ideal conditions, our method could potentially provide greater accuracy than the accepted norm, but we can never claim 100% accuracy in “real world” conditions. Some reasons for this are:

(1) The biggest source of error is that the infrared scans do not actually show “deer” – they show thermal patterns and any anomaly in the pattern must be analyzed to determine whether it is likely caused by the presence of a deer or something else. Whether or not a particular thermal anomaly is a deer or something else is always a judgement call. The survey and analysis are performed utilizing high quality equipment and powerful analytical software. However, due to the limits of technology and the conditions unique to any given location within the site, the thermographer must rely on his or her background, knowledge of wildlife, knowledge of infrared science, and past experience to make the call as to whether or not a particular thermal signature resulted from the presence of a deer or not.

(2) Some thermal anomalies may be due to the presence of other warm-blooded animals – horses, livestock, humans, and even smaller animals such as coyote and bear. For purposes of this survey, it was assumed that all signatures consistent with the presence of deer were, in fact, deer. If it

General Notes and Disclaimers (cont'd):

is known that a particular part of the surveyed area is regularly used for livestock grazing (for example), please let me know so I can reevaluate the area(s).

(3) Although not a large source of error, wildlife does move. As stated previously, deer are crepuscular animals and are most active around dusk and dawn. We generally start our surveys at least two hours after sunset to allow the deer time to become less active. Still, deer may be on the move at any time of the night and could conceivably cover enough ground to either be counted twice or missed altogether.

(4) Our infrared scan was planned and performed to the best of our ability and knowledge with consideration to infrared science, thermography, wildlife biology, weather conditions, site geography and topography, and other conditions *at the time the work was completed*. However, this report can only be considered accurate for the dates and times of the scan. The results presented herein will be different from those of any other survey (infrared or otherwise) that may have been done in the past or may be done in the future.

Survey Details and Condition Analysis:

Geographic Data:

The areas surveyed were in Mahoning County, Ohio. The areas surveyed were irregularly shaped but consisted of approximately 4,859 total acres within fifteen (15) distinct parks. The total area surveyed of approximately 8,717 acres includes a buffer zone around each park, roughly 300'–400' wide.

Site Conditions:

Several areas of the parks were very densely wooded. Even without leaves on the trees, thermal signatures of the deer can be masked by tree branches in densely wooded areas and very difficult to pick out. However, it is worth noting that in such heavily wooded areas, ground vegetation (food) is scarce, so deer are less likely to be present there anyway.

It was estimated that there was about 2" of snow cover in all scanned areas on both nights of the scan. It was also below freezing on both nights – temperatures were approximately 15°F and below on the night of January 21/22 and approximately 29°F and below on the night of February 18/19 – for the duration of the scans both nights. Winds were less than 10mph and humidity levels both nights were slightly high for winter (~70% Jan 21/22, ~60% Feb 18/19).

My overall assessment is that the site physical conditions were very good and that the overall weather conditions were very good both nights. Data quality was excellent both nights. My overall assessment of the survey conditions was very good.

Due to the previously mentioned factors, we can never guarantee total accuracy in any survey. However, I feel that these results are comfortably within the generally accepted “normal” accuracy range of 85%.

Celestial Data:

Dates and times of survey:

- (1) Approximately 9:05 PM EST January 21
to approximately 1:35 AM EST January 22
- (2) Approximately 10:15 PM EST February 18
to approximately 12:45 AM EST February 19

Sunset times:

- (1) Approximately 5:25 PM EST, January 21, 2024
- (2) Approximately 5:59 PM EST, February 18, 2024

Weather Data:

Sky condition during survey:

Clear skies on Jan 21 /22; partly cloudy on Feb 18/19.

Temperature:

At or below freezing for the entire duration of the survey, both nights. (15°F and below Jan 21 /22; 29°F and below Feb 18/19)

Winds at time of scan:

Less than 10 mph for the entire duration of the survey, both nights.

Snow cover:

Approximately 2" at all locations, both nights.

My overall assessment of the suitability of the environmental conditions for an infrared wildlife survey is that the conditions were very good, both nights.

Review of Acquired Data:

Flight conditions were excellent during the scan with some wind (approximately 5 to 10 mph) but minimal turbulence, both nights.

All equipment functioned as expected.

Due to variations in elevation across the site, lack of thermal contrast in some areas, and the very narrow depth of field of the infrared camera, some portions of the data were not optimally focused. However, data from all flight lines was usable.

Overlap of flight lines was good and consistent and there were no gaps in coverage noted.

Resolution of the imagery was calculated to be between 10" and 12" per pixel in most areas. This resolution is more than adequate to detect thermal anomalies caused by the presence of deer.

My overall assessment of the data quality is that it was very good.

Infrared Scan Results and Discussion:

A total of 1,864 thermal infrared signatures with properties consistent with the presence of deer were identified within the fifteen (15) parks' survey areas.

Of those signatures, 1,417 were within the various park boundaries as we were provided. The remaining 447 signatures were outside, but within 400' of a park boundary. Animals observed within the buffer zone likely reside mainly within the parks.

Pins for thermal signatures observed in the buffer zone were placed in Google Earth and were labeled "x" (as opposed to pins within the park boundaries that have no label). Note that although some pins were placed in Google Earth to identify signatures that were more than 400' from the closest park boundary (labeled "xx"), the signatures were NOT included in the counts.

It should be noted that if a thermal signature was within one park's surveyed area as well as within the buffer zone of an adjacent park, the signature was only counted once (for the park it was within).

Two sets of calculations are included with the report. The first set's calculations are based strictly on the number of signatures observed within the park boundaries. The second set includes the buffer zone in the area calculations and the additional signatures observed within the buffer zone.

The second set of calculations which includes signatures in the buffer zone is likely to be the more accurate representation of the "true" density of the population.

Infrared Scan Results and Discussion (cont'd):

It should be noted that the higher the ratio of surveyed area to park size, the more skewed the “acres per deer,” “deer per acre,” and “deer per square mile” calculations will be. When the ratio of surveyed area to park size is greater than ~2.0, a small difference in the count can result in a large difference in animal density. Specifically:

- Very small parks such as Cranberry Run and Sebring Woods (and really, any park less than 0.5 square miles / 320 acres) are so small, that the deer per square mile calculations are extremely unreliable.
- Calculations for parks that have very irregular boundaries (such as Mill Creek) can also be skewed higher due to extrapolation.
- Calculations can be drastically skewed when a park is both small and has irregular boundaries (such as Yellow Creek).

In all of these situations, a small difference in the number of deer observed can result in large variations in the calculations.

Overall, the density of deer in all of the parks was very high, even when taking these things into consideration. It is not uncommon to see densities in the 100–150 deer per square mile range in this area of the country, but most of the parks here were even higher.

Conclusions:

Results of this survey must be reviewed with wildlife management experts and personnel that are familiar with the specific parks and the deer population therein to determine any specific reasons for, or problems due to, deer overpopulation; to determine the overall health of the herd; to determine the health of the ecosystem of the parks; or to make any decisions regarding further action.

If there are any questions regarding the data, this report, or the survey in general, please do not hesitate to contact me.

List of files and images included in report:

- (1) Count Summary showing number of thermal signatures identified on a per-park basis as well as some calculations on density and habitat.
- (2) Count Ranges (based on estimated accuracy) and additional density/habitat calculations.
- (3) Aerial photo maps showing the location of observed thermal signatures consistent with the presence of deer (aerial images used are Copyright Google® Earth) in each park.

Additional file delivered:

Mill Creek MetroParks 2024 Deer Survey – Final.kmz: This file is a "Google® Earth" KMZ file showing the park boundaries as provided, the approximate survey area for each park (purple outlines), and the approximate observed locations of infrared signatures consistent with the presence of deer. This file can be opened and viewed within Google® Earth.

Each marker on the result maps and included in the KMZ file indicates the number of signatures detected at each location. The observed location of the signatures is at the pointed end of the marker. For groups of deer, the pointed end of the marker was placed approximately in the middle of the group.

In some areas, the markers could be placed very accurately. However, in heavily wooded areas or areas that have little or no distinguishing land features, the placement accuracy may be lower.

A marker with "no name" indicates that the signature was observed inside the park boundary. A marker named "x" means that it was observed outside the park, but within the buffer zone. A marker named "xx" means it was outside the park and more than 400' away from a boundary. Markers named "xx" were NOT included in any park or buffer zone count.

Side note: The marker description (such as "151-617-325-240") is only used internally during the analysis of the data. It is in, in effect, a serial number for that particular signature which allows us to quickly find it in the infrared data sequences if needed for further review. If there are two serial numbers in the description, the signature was observed in the overlap area of adjacent flight lines and deemed to be the same thermal signature or set of signatures.

2024 Deer Count Summary - All Parks

				Thermal Signatures Observed within Park Boundaries								Thermal Signatures Observed within Park Boundaries plus Signatures within ~300-400' buffer				Ratio of Surveyed Area to Park Size
Park		Park Size (acres)	Park size (sq miles)	Count	Acres per Deer	Deer per Acre	Deer per Sq Mile	Acres Surveyed	Sq Miles Surveyed	Count	Acres per Deer	Deer per Acre	Deer per Sq Mile			
Central	Mill Creek Park	1,626	2.54	565	2.88	0.35	222	3,170	4.95	781	4.06	0.25	158	1.95		
	Hitchcock Woods	689	1.08	255	2.70	0.37	237	1,010	1.58	325	3.11	0.32	206	1.47		
	Huntington Woods	383	0.60	118	3.25	0.31	197	568	0.89	124	4.58	0.22	140	1.48		
	Mill Creek Wildlife Sanctuary	482	0.75	181	2.66	0.38	240	708	1.11	213	3.32	0.30	193	1.47		
	Collier Preserve	303	0.47	72	4.21	0.24	152	459	0.72	83	5.53	0.18	116	1.51		
East	McGuffey Wildlife Preserve	78	0.12	11	7.09	0.14	90	159	0.25	15	10.60	0.09	60	2.04		
	Yellow Creek	76	0.12	22	3.45	0.29	185	281	0.44	24	11.71	0.09	55	3.70		
	Springfield Forest	89	0.14	21	4.24	0.24	151	209	0.33	44	4.75	0.21	135	2.35		
	Cranberry Run Headwaters	27	0.04	7	3.86	0.26	166	76	0.12	19	4.00	0.25	160	2.81		
West	Vickers Nature Preserve	262	0.41	30	8.73	0.11	73	404	0.63	48	8.42	0.12	76	1.54		
	Sebring Woods	39	0.06	20	1.95	0.51	328	102	0.16	23	4.43	0.23	144	2.62		
	Egypt Swamp Preserve	75	0.12	14	5.36	0.19	119	256	0.40	28	9.14	0.11	70	3.41		
	Sawmill Creek	167	0.26	22	7.59	0.13	84	276	0.43	34	8.12	0.12	79	1.65		
	MetroParks Farm	402	0.63	53	7.58	0.13	84	637	1.00	64	9.95	0.10	64	1.58		
	Hawkins Marsh	161	0.25	26	6.19	0.16	103	402	0.63	39	10.31	0.10	62	2.50		
Totals and Averages:		4,859	7.59	1,417	3.43	0.29	187	8,717	13.62	1,864	4.68	0.21	137	1.79		

Overall for all parks

Estimated survey accuracy: **85%**

Count: **1417** thermal signatures within parks
Site size: **4,859** park acres
Site size: **7.59** park sq miles

Count: **1864** total thermal signatures
Site size: **8,717** acres surveyed
Site size: **13.62** sq miles surveyed

Estimated ranges:

	Low	Count	High
Total:	1204	1417	1630
Park acres per deer:	4.0	3.4	3.0
Deer per park square mile:	158.6	186.6	214.7

Estimated ranges:

	Low	Count	High
Total:	1584	1864	2144
Surveyed acres per deer:	5.5	4.7	4.1
Deer per surveyed square mile:	116.3	136.9	157.4

2024 Deer Count Ranges by Park - CENTRAL

(estimated accuracy of survey: 85%)

Mill Creek Park

Park Area (1,626 acres)			
	Low	Count	High
Count:	480	565	650
Acres per deer:	3.39	2.88	2.50
Deer per square mile:	189	222	256

Surveyed Area (3,170 acres)			
	Low	Count	High
Count:	664	781	898
Acres per deer:	4.78	4.06	3.53
Deer per square mile:	134	158	181

Hitchcock Woods

Park Area (689 acres)			
	Low	Count	High
Count:	217	255	293
Acres per deer:	3.18	2.70	2.35
Deer per square mile:	201	237	272

Surveyed Area (1,010 acres)			
	Low	Count	High
Count:	276	325	374
Acres per deer:	3.66	3.11	2.70
Deer per square mile:	175	206	237

Huntington Woods

Park Area (383 acres)			
	Low	Count	High
Count:	100	118	136
Acres per deer:	3.82	3.25	2.82
Deer per square mile:	168	197	227

Surveyed Area (568 acres)			
	Low	Count	High
Count:	105	124	143
Acres per deer:	5.39	4.58	3.98
Deer per square mile:	119	140	161

Mill Creek Wildlife Sanctuary

Park Area (482 acres)			
	Low	Count	High
Count:	154	181	208
Acres per deer:	3.13	2.66	2.32
Deer per square mile:	204	240	276

Surveyed Area (708 acres)			
	Low	Count	High
Count:	181	213	245
Acres per deer:	3.91	3.32	2.89
Deer per square mile:	164	193	221

Collier Preserve

Park Area (303 acres)			
	Low	Count	High
Count:	61	72	83
Acres per deer:	4.95	4.21	3.66
Deer per square mile:	129	152	175

Surveyed Area (459 acres)			
	Low	Count	High
Count:	71	83	95
Acres per deer:	6.51	5.53	4.81
Deer per square mile:	98	116	133

2024 Deer Count Ranges by Park - EAST

(estimated accuracy of survey: 85%)

McGuffey Wildlife Preserve

Park Area (78 acres)			
	Low	Count	High
Count:	9	11	13
Acres per deer:	8.34	7.09	6.17
Deer per square mile:	77	90	104

Surveyed Area (159 acres)			
	Low	Count	High
Count:	13	15	17
Acres per deer:	12.47	10.60	9.22
Deer per square mile:	51	60	69

Yellow Creek

Park Area (76 acres)			
	Low	Count	High
Count:	19	22	25
Acres per deer:	4.06	3.45	3.00
Deer per square mile:	157	185	213

Surveyed Area (281 acres)			
	Low	Count	High
Count:	20	24	28
Acres per deer:	13.77	11.71	10.18
Deer per square mile:	46	55	63

Springfield Forest

Park Area (89 acres)			
	Low	Count	High
Count:	18	21	24
Acres per deer:	4.99	4.24	3.69
Deer per square mile:	128	151	174

Surveyed Area (209 acres)			
	Low	Count	High
Count:	37	44	51
Acres per deer:	5.59	4.75	4.13
Deer per square mile:	115	135	155

Cranberry Run Headwaters

Park Area (27 acres)			
	Low	Count	High
Count:	6	7	8
Acres per deer:	4.54	3.86	3.35
Deer per square mile:	141	166	191

Surveyed Area (76 acres)			
	Low	Count	High
Count:	16	19	22
Acres per deer:	4.71	4.00	3.48
Deer per square mile:	136	160	184

2024 Deer Count Ranges by Park - WEST

(estimated accuracy of survey: 85%)

Vickers Nature Preserve

Park Area (262 acres)			
	Low	Count	High
Count:	26	30	35
Acres per deer:	10.27	8.73	7.59
Deer per square mile:	62	73	84

Surveyed Area (404 acres)			
	Low	Count	High
Count:	41	48	55
Acres per deer:	9.90	8.42	7.32
Deer per square mile:	65	76	87

Sebring Woods

Park Area (39 acres)			
	Low	Count	High
Count:	17	20	23
Acres per deer:	2.29	1.95	1.70
Deer per square mile:	279	328	377

Surveyed Area (102 acres)			
	Low	Count	High
Count:	20	23	26
Acres per deer:	5.22	4.43	3.86
Deer per square mile:	123	144	166

Egypt Swamp Preserve

Park Area (75 acres)			
	Low	Count	High
Count:	12	14	16
Acres per deer:	6.30	5.36	4.66
Deer per square mile:	102	119	137

Surveyed Area (256 acres)			
	Low	Count	High
Count:	24	28	32
Acres per deer:	10.76	9.14	7.95
Deer per square mile:	60	70	81

Sawmill Creek

Park Area (167 acres)			
	Low	Count	High
Count:	19	22	25
Acres per deer:	8.93	7.59	6.60
Deer per square mile:	72	84	97

Surveyed Area (276 acres)			
	Low	Count	High
Count:	29	34	39
Acres per deer:	9.55	8.12	7.06
Deer per square mile:	67	79	91

Metro Parks Farm

Park Area (402 acres)			
	Low	Count	High
Count:	45	53	61
Acres per deer:	8.92	7.58	6.60
Deer per square mile:	72	84	97

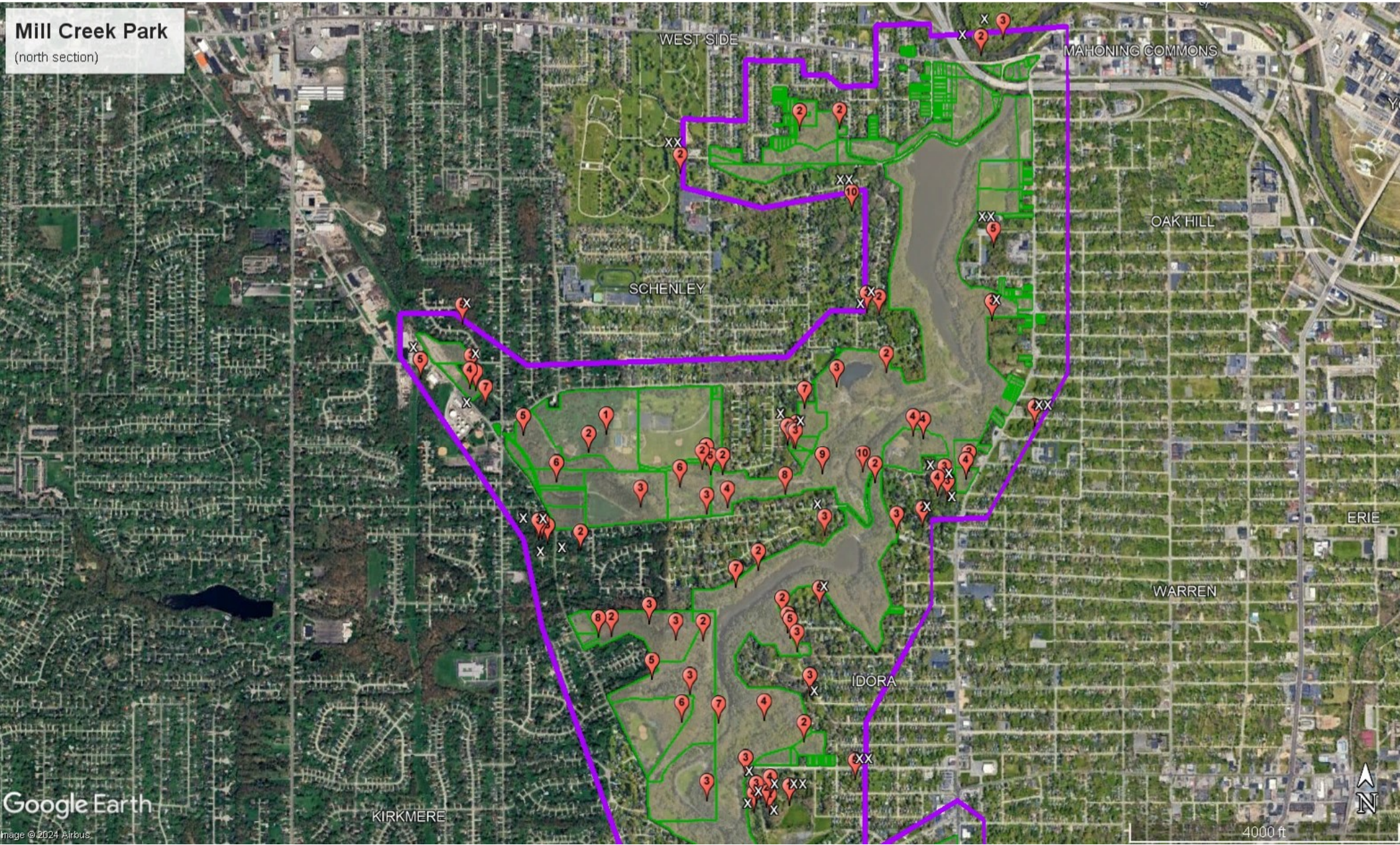
Surveyed Area (637 acres)			
	Low	Count	High
Count:	54	64	74
Acres per deer:	11.71	9.95	8.65
Deer per square mile:	55	64	74

Hawkins Marsh

Park Area (161 acres)			
	Low	Count	High
Count:	22	26	30
Acres per deer:	7.29	6.19	5.38
Deer per square mile:	88	103	119

Surveyed Area (402 acres)			
	Low	Count	High
Count:	33	39	45
Acres per deer:	12.13	10.31	8.96
Deer per square mile:	53	62	71

Mill Creek Park
(north section)



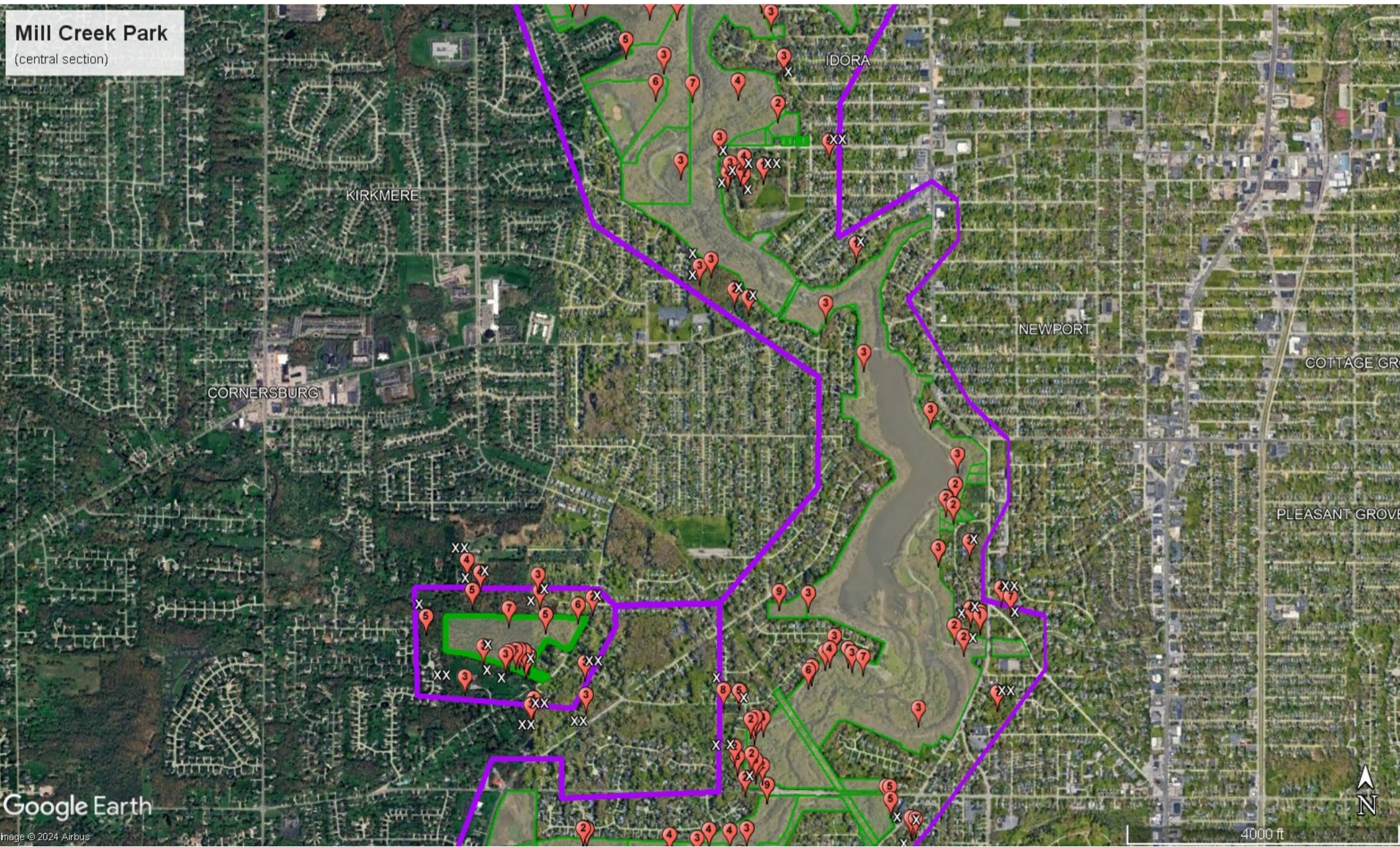
Google Earth

Image © 2024 Airbus



Mill Creek Park

(central section)



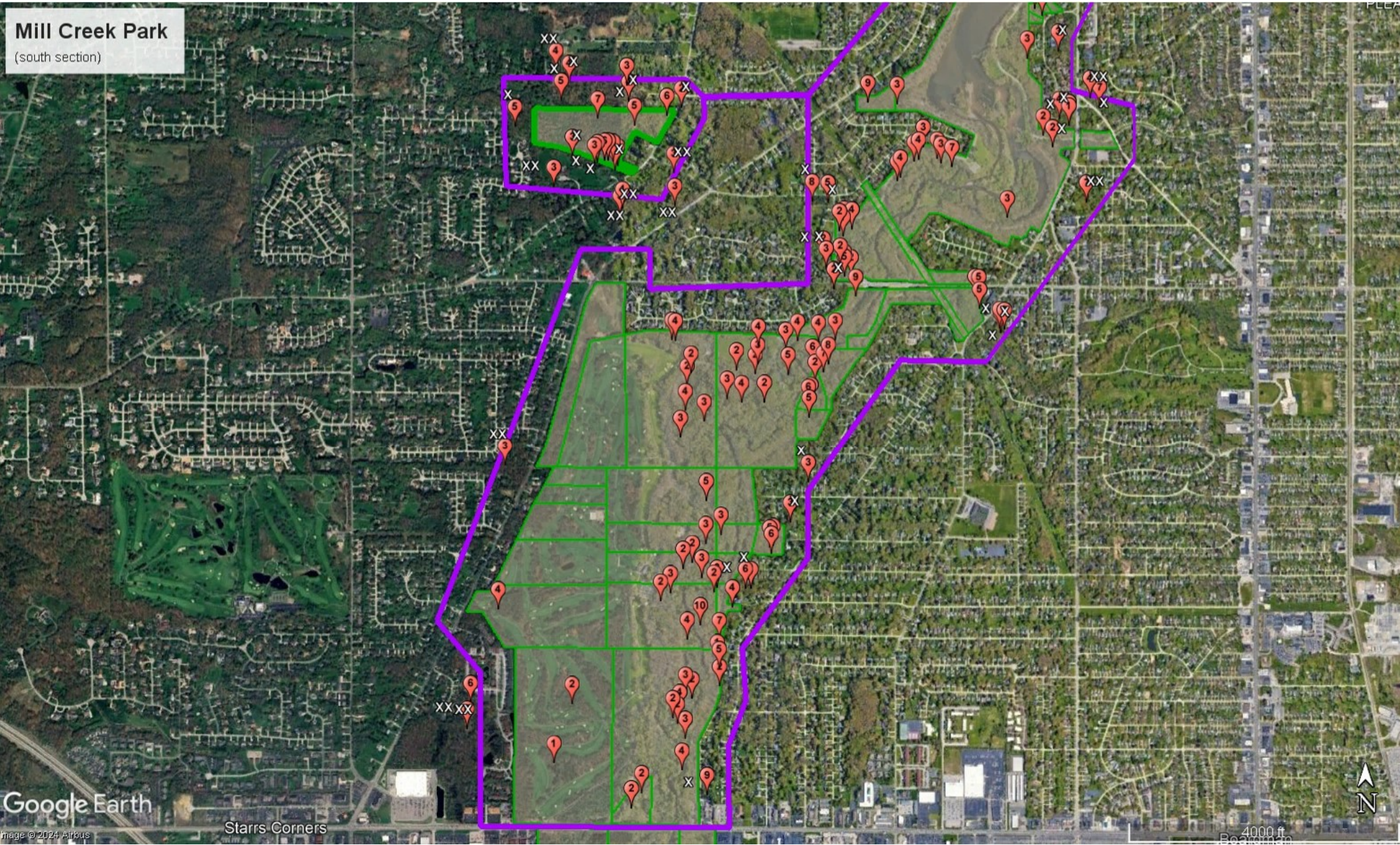
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Image © 2024 Airbus

4000 ft

Mill Creek Park

(south section)



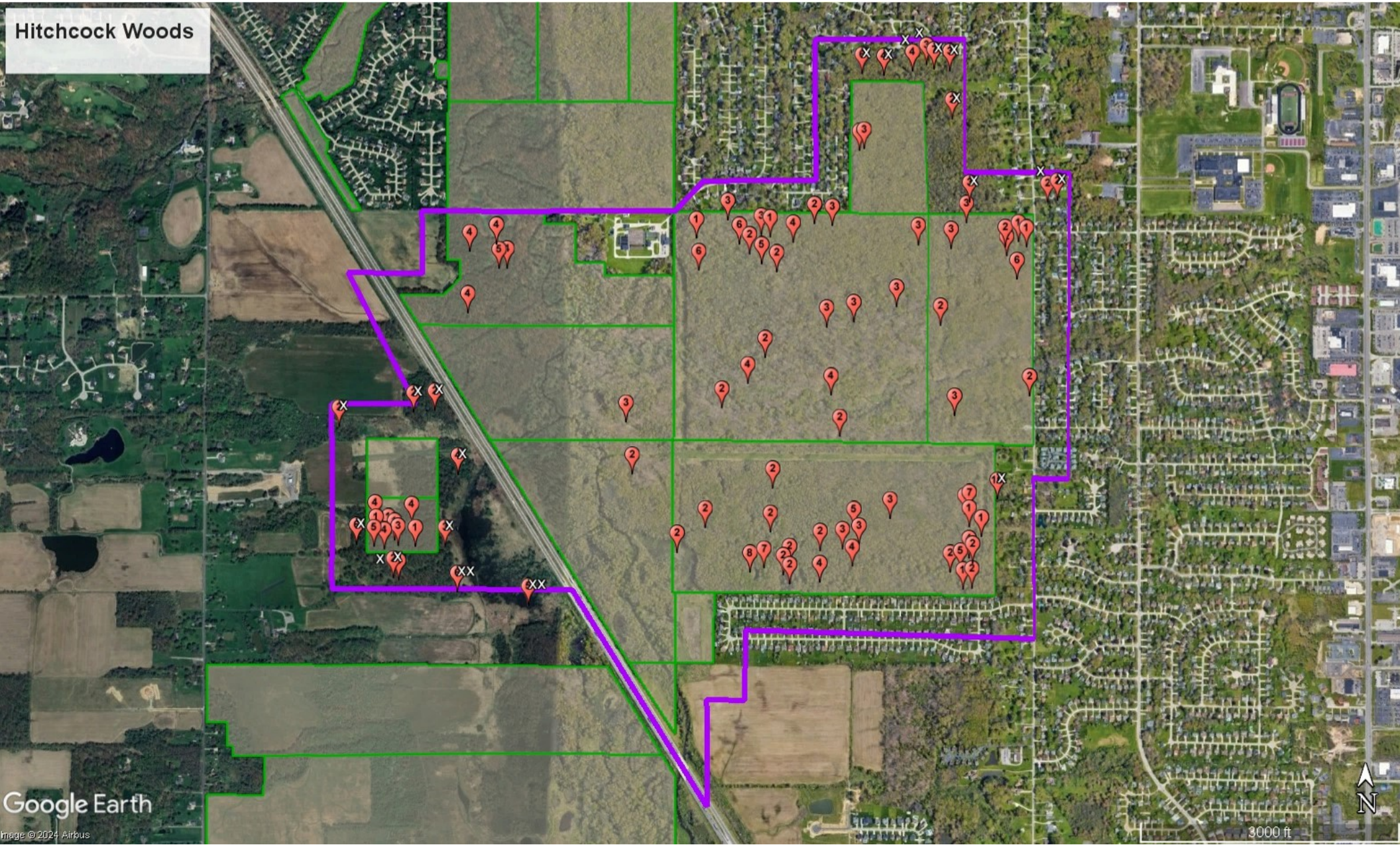
Google Earth

Starrs Corners

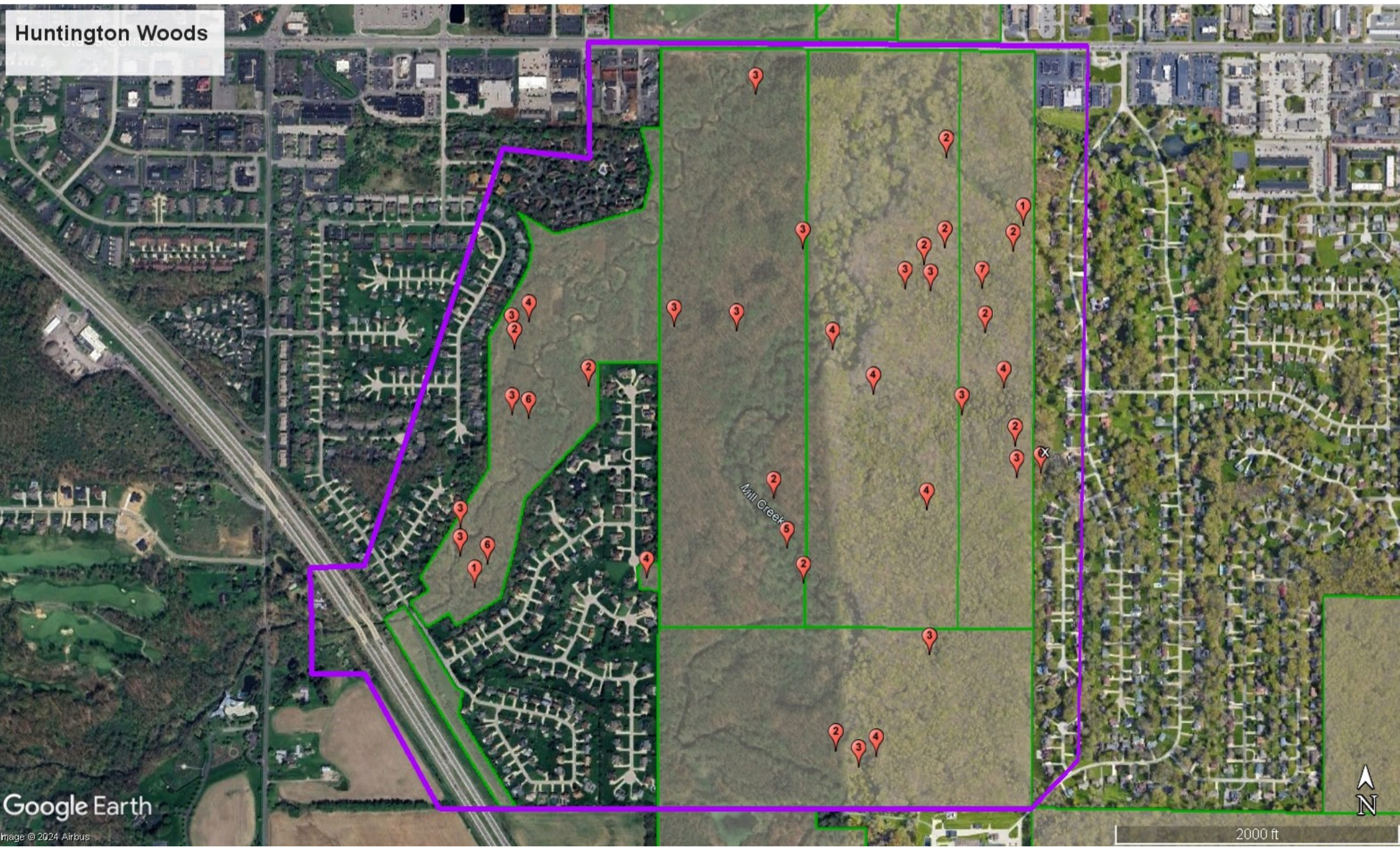
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4000 ft
Back to map

Hitchcock Woods



Huntington Woods

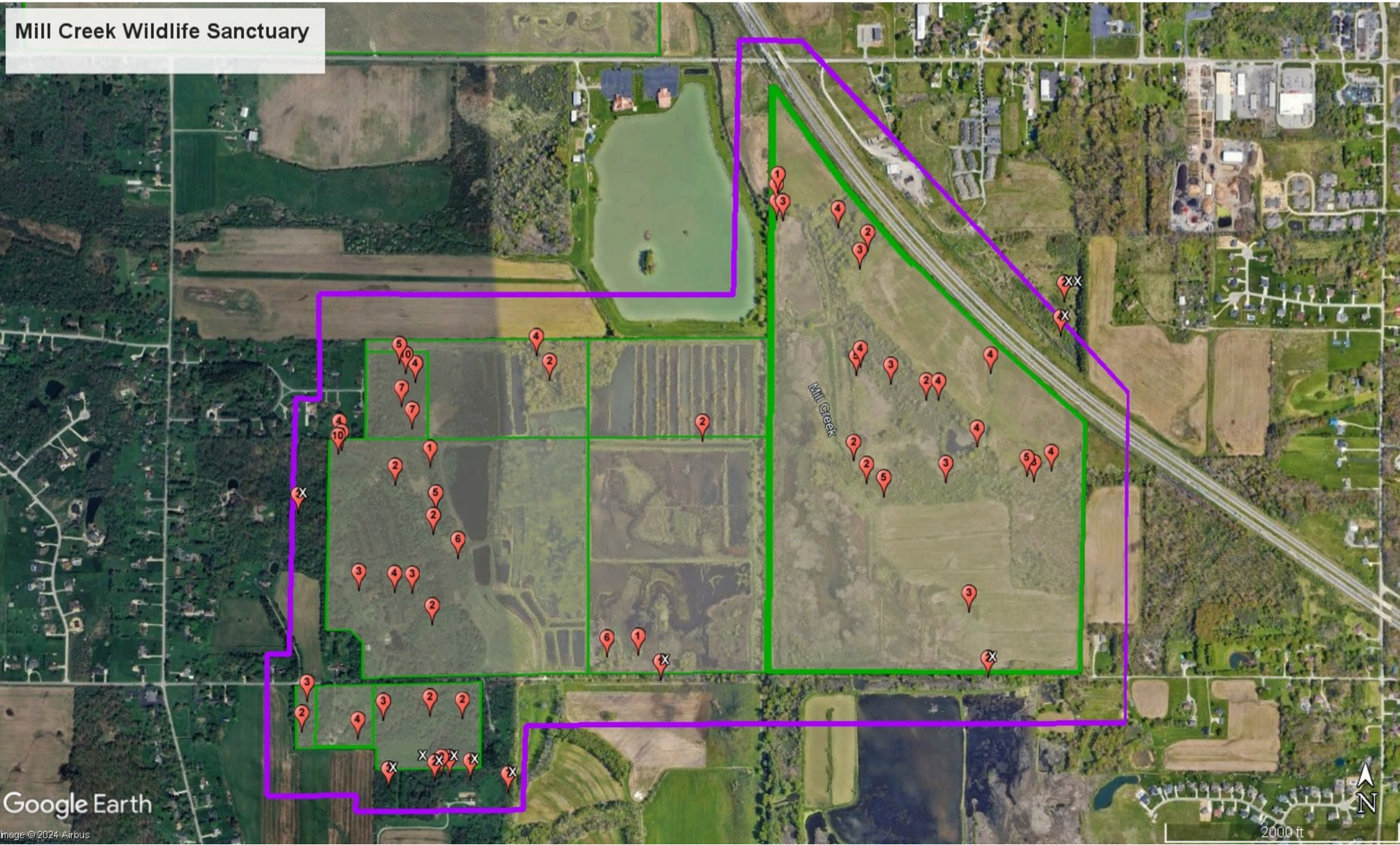


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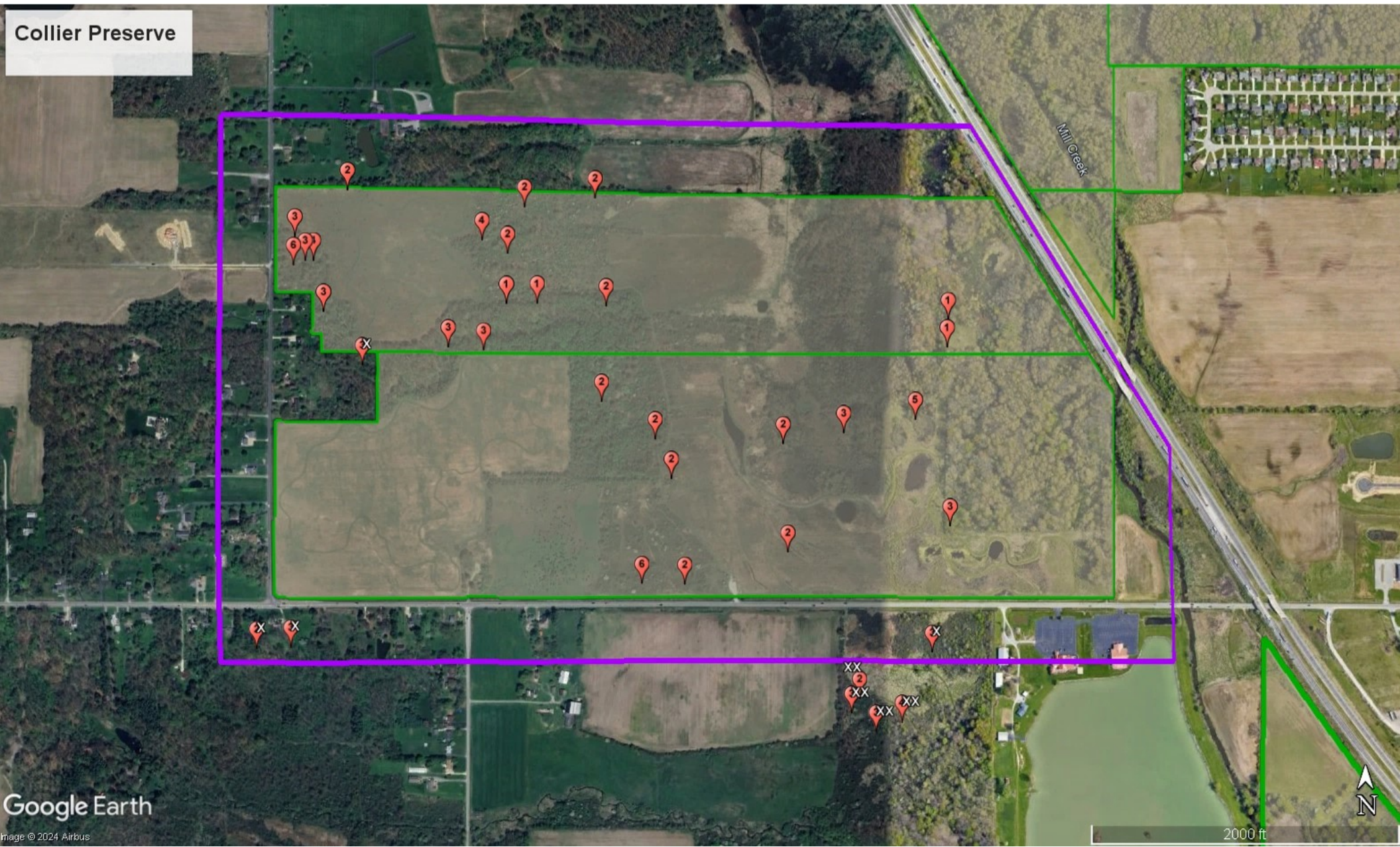
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2000 ft

Mill Creek Wildlife Sanctuary



Collier Preserve

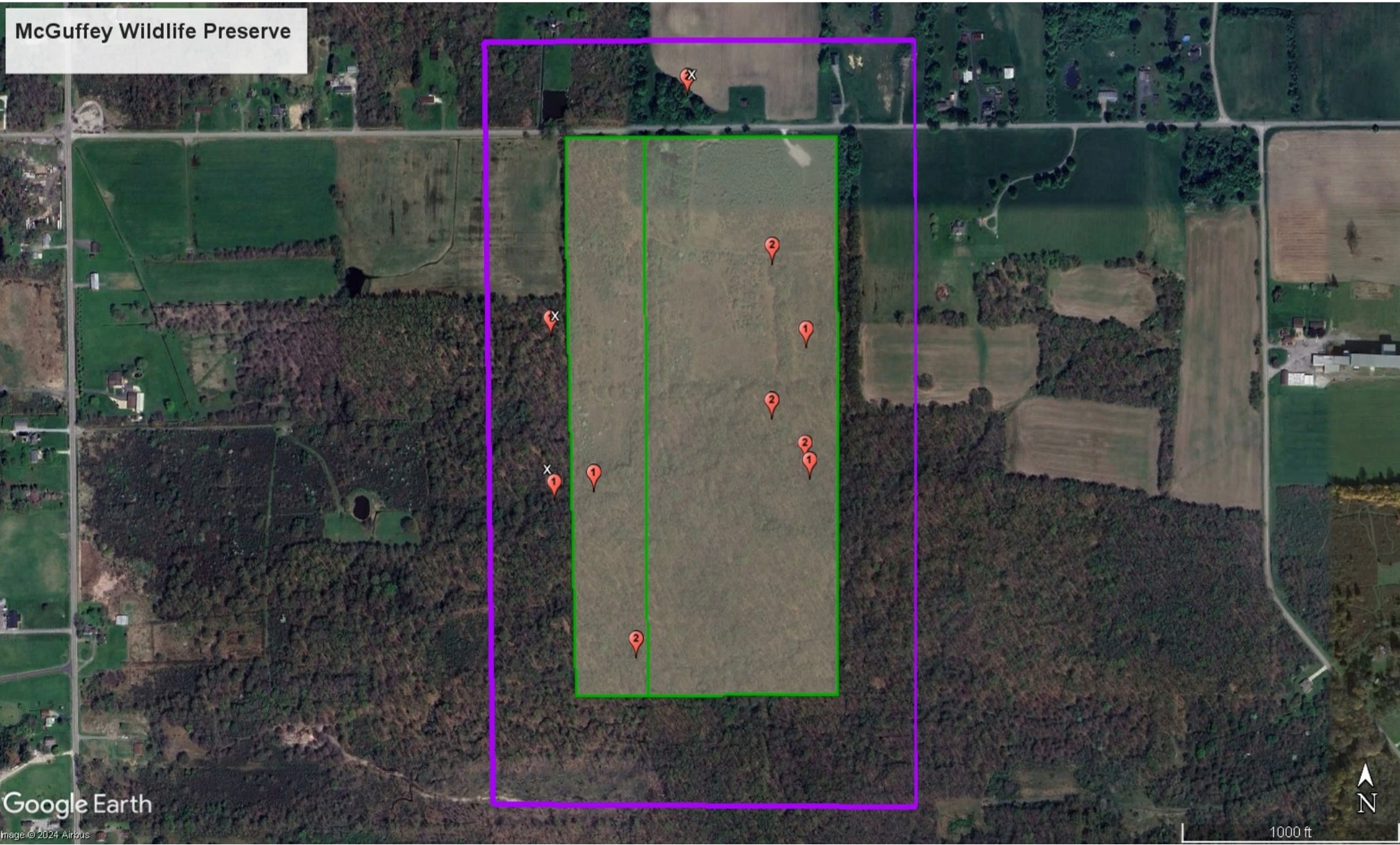


Google Earth

Image © 2024 Airbus

2000 ft

McGuffey Wildlife Preserve



Google Earth

Image © 2024 Airbus



1000 ft



Yellow Creek

Struthers

NEBO

Mahoning River

Google Earth

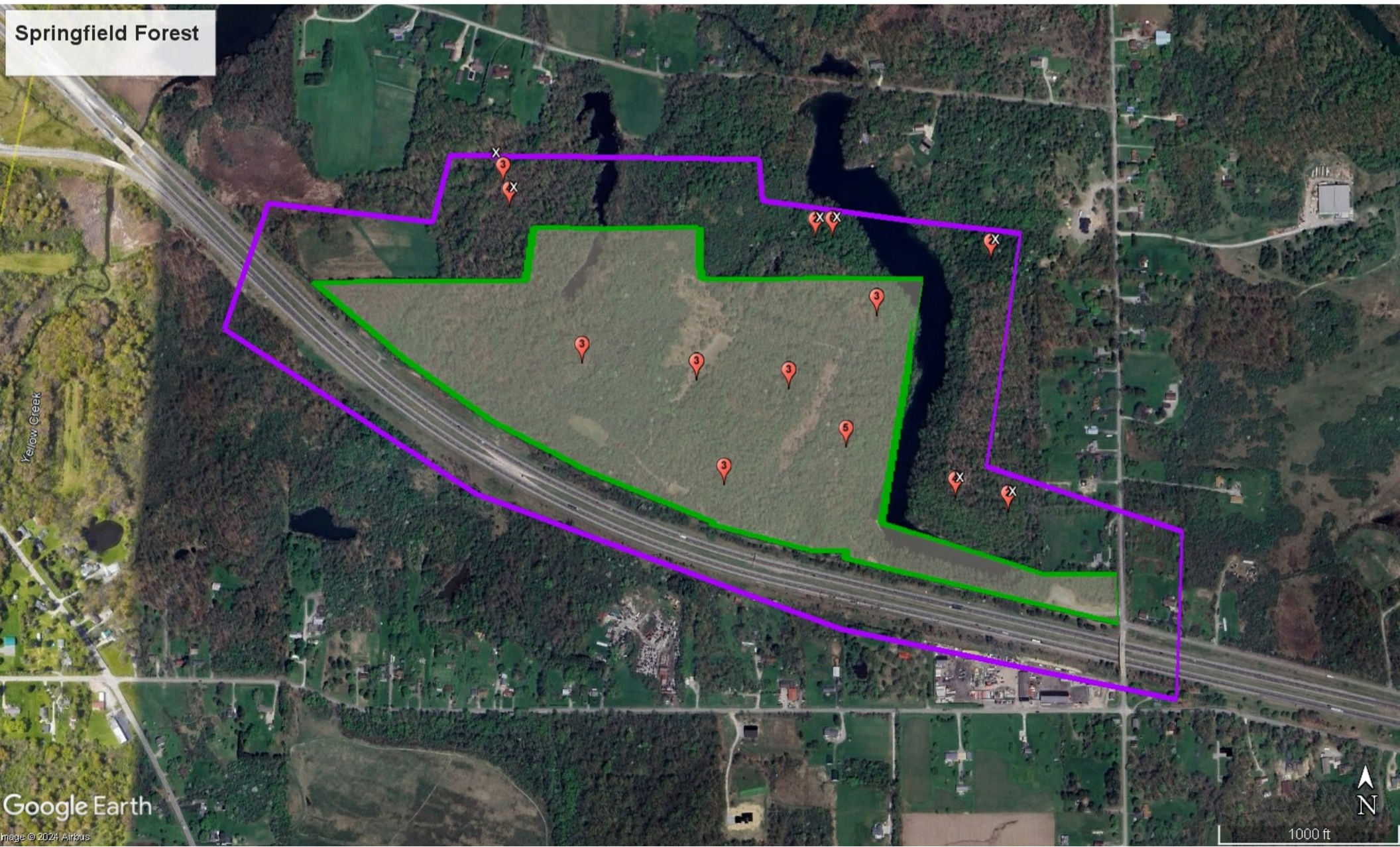
Image © 2024 Airbus

Lake Hamilton



3000 ft

Springfield Forest



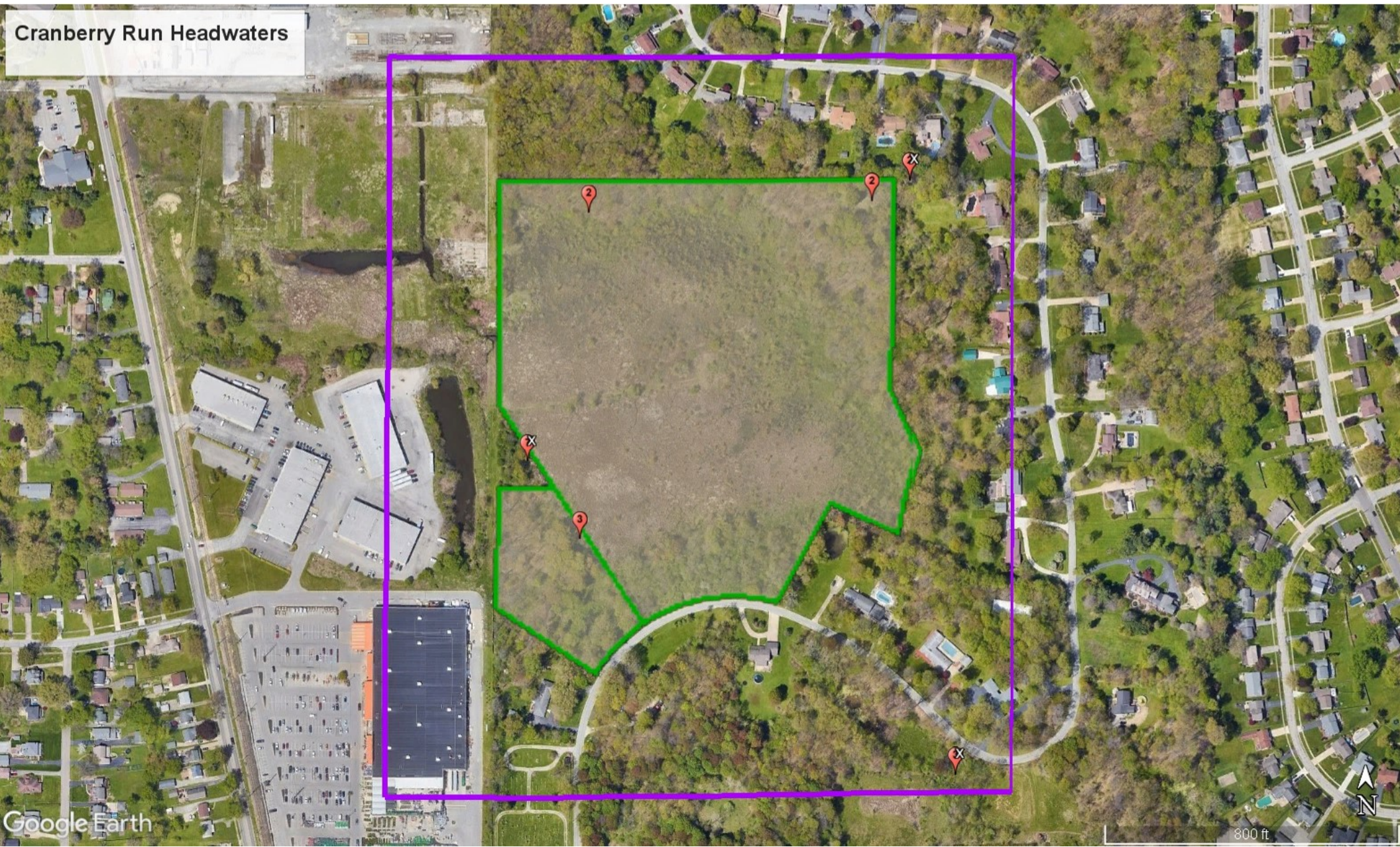
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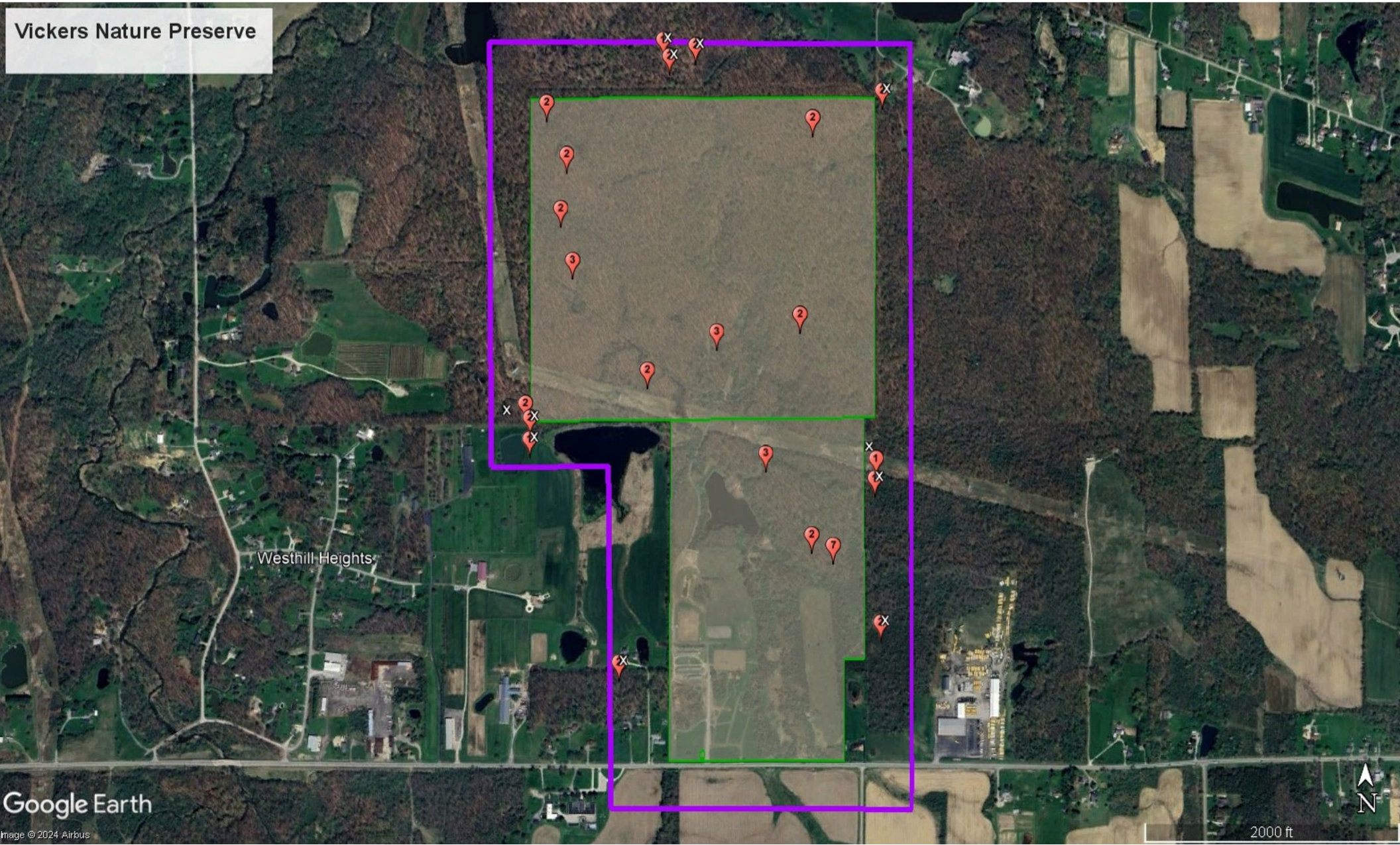


1000 ft

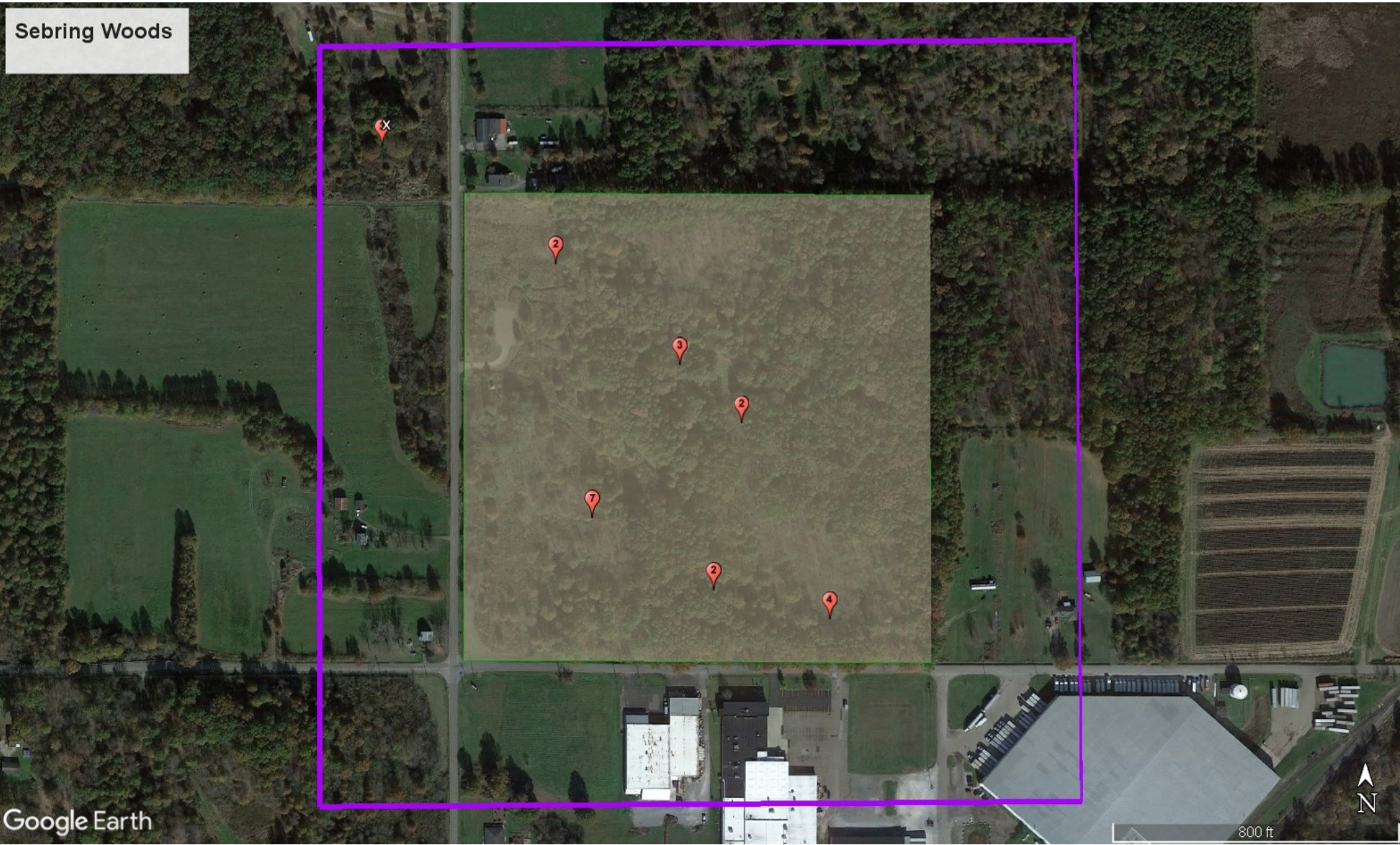
Cranberry Run Headwaters



Vickers Nature Preserve



Sebring Woods

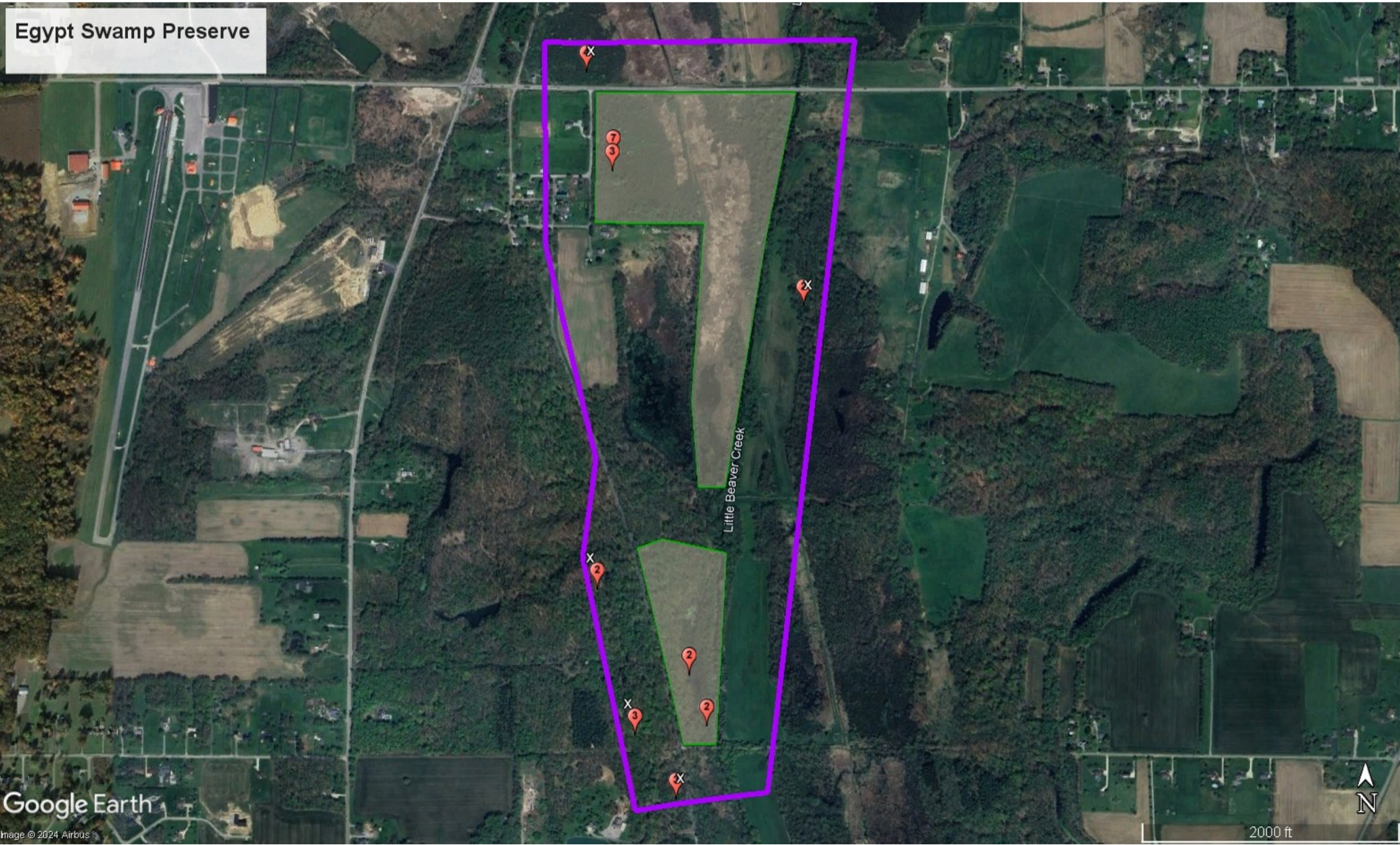


Google Earth



800 ft

Egypt Swamp Preserve



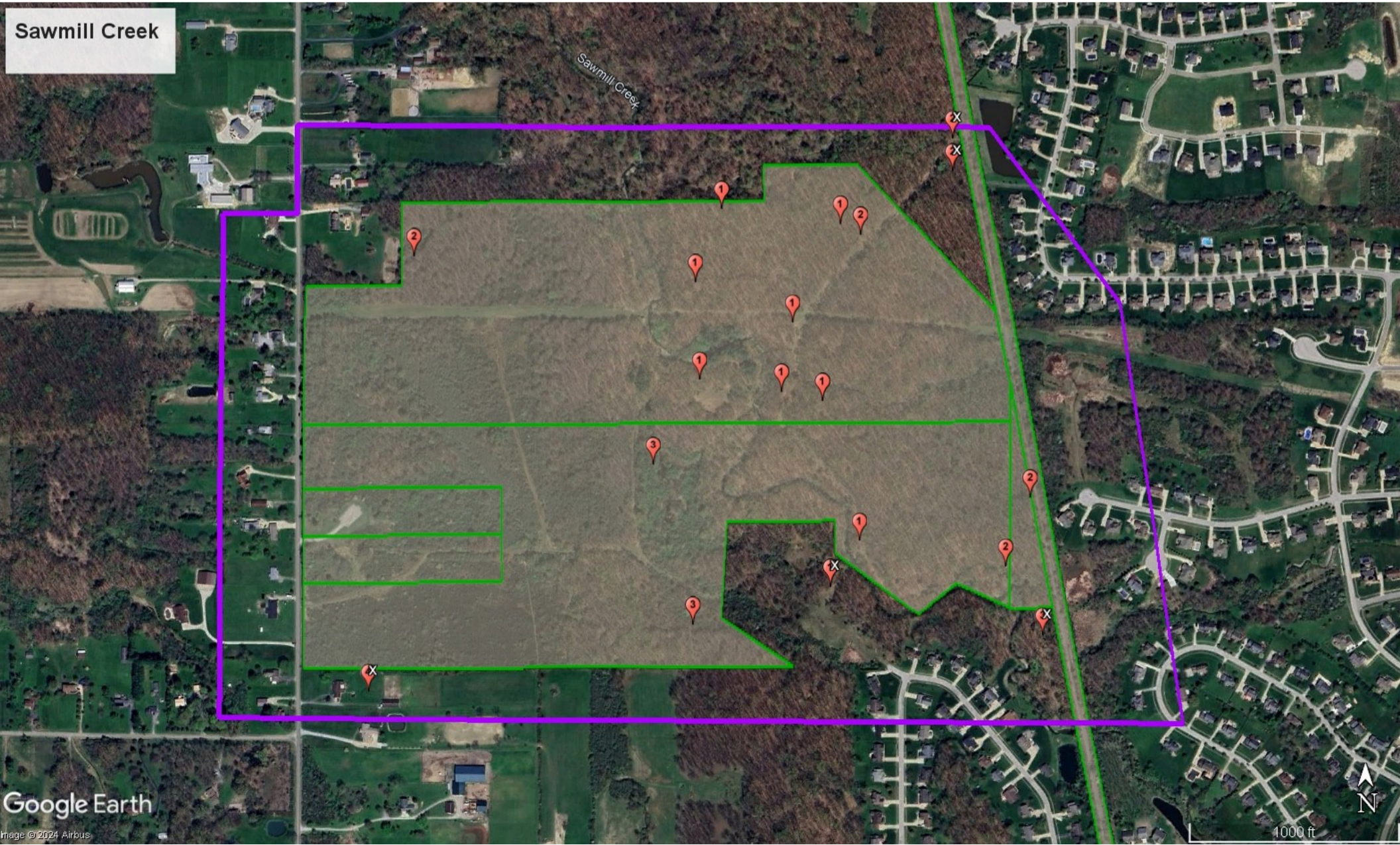
Google Earth

Image © 2024 Airbus



2000 ft

Sawmill Creek

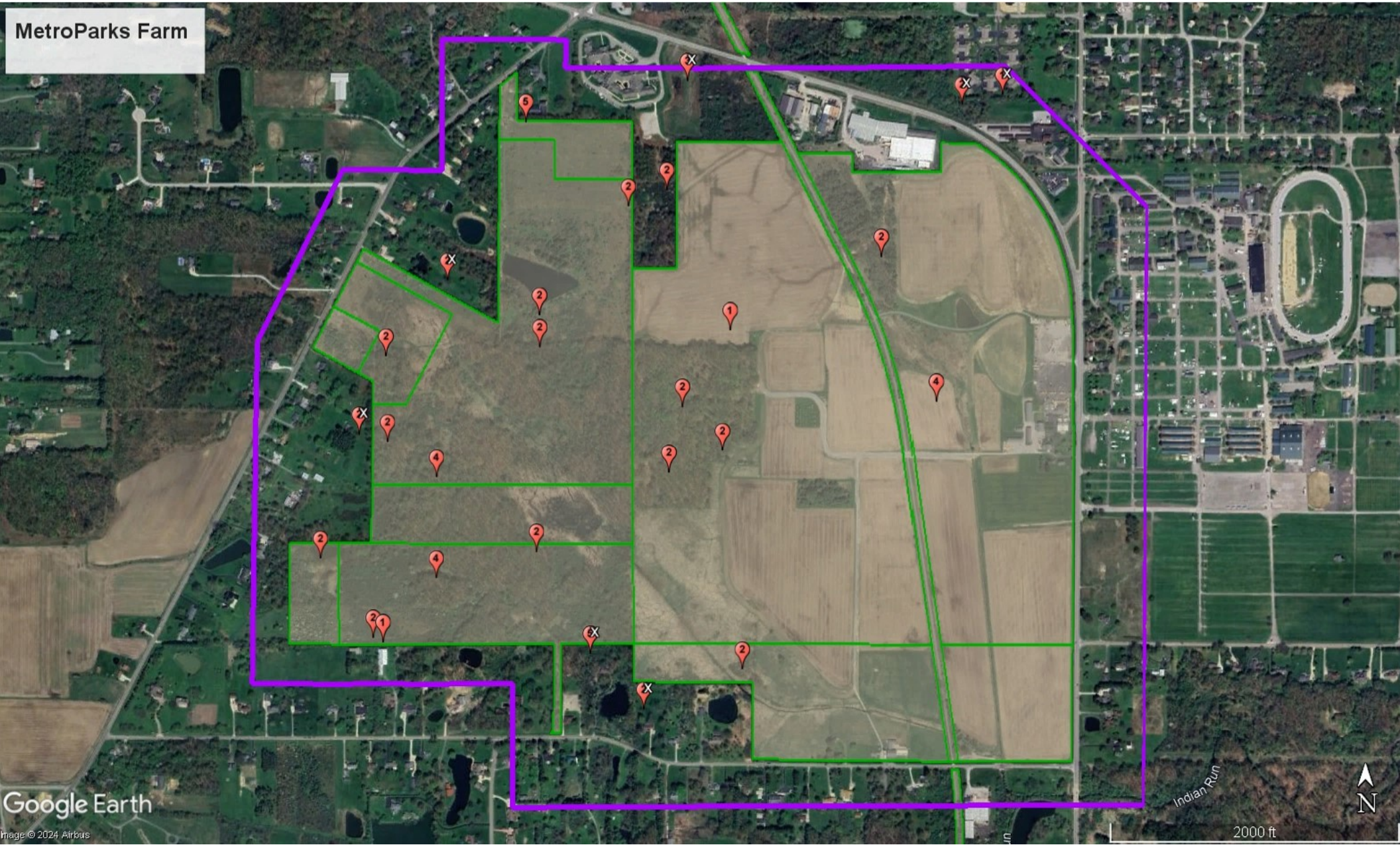


Google Earth

Image © 2024 Airbus



MetroParks Farm



Google Earth

Image © 2024 Airbus

Indian Run

2000 ft



Hawkins Marsh



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Certification:

The infrared survey was completed to the best of my ability utilizing one of the latest FLIR infrared cameras under conditions that were acceptable for this application. Acquired images were analyzed using the latest version of the “FLIR Tools+” and FLIR’s ExaminIR software.

I, a Certified Level II Thermographer, attest that I performed the scan, analyzed the acquired images, and prepared the reports. When and if necessary, I consulted with a Certified Level III Thermographer regarding any anomalies that I was not comfortable with diagnosing myself.

Please feel free to contact me with any questions you may have regarding this report or any of the conclusions found in it.

This report was prepared by:

A handwritten signature in black ink, appearing to read "Mike Holthouse", with a long horizontal flourish extending to the right.

Mike Holthouse, Certified Level II Thermographer
Above All Aerial & Specialty Photography – Ohio