Appendix G

Storm Water Facilities - Conveyance Restoration Plan

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INTRODUCTION

Selfridge Air National Guard Base (SANGB) is proposing maintenance of drains to restore the functions and capacity of the storm water ditch system on the base. The existing ditches require maintenance to remove built-up sediment, as they have not been regularly maintained. The lack of maintenance has resulted in inefficient storm water conveyance and areas of ponded water. Ponded water subsequently has become an attractant to wildlife, representing an aircraft strike hazard and significant safety concern. Additionally, there is concern that if maintenance is not accomplished, damage from flooding to surrounding facilities and infrastructure could occur in the future.

The existence of state regulated, often ponded wetland adjacent to a number of drain maintenance areas has resulted in the need to analyze current wetland regulations and exemptions while comparing to historic drain construction activities and general historic development of SANGB. The purpose of this document is to provide a context for the proposed ditch maintenance program and to demonstrate that the ditch maintenance program on SANGB should be considered an exempt activity. However, should SANGB not prevail on the exemption demonstration, options for meeting the program goals outside of determined regulated areas are provided.

PROJECT BACKGROUND AND NEED

The proposed ditch maintenance program is based on well-documented requirements and directives developed for government air base installations including SANGB. These directives are aimed at maintaining air safety while acknowledging the need to coordinate with federal, state, and local natural resource regulations. A summary of relevant Air Force, Department of Defense installation instructions and plans as they pertain and provide context to the proposed ditch maintenance program is provided in the following.

Memorandum of Agreement (MOA)

According to the *Memorandum of Agreement between the Federal Aviation Administration, the U.S. Air Force, the U.S. Army, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, and the U.S. Department of Agriculture to Address Aircraft-Wildlife Strikes* (signed in 2002/2003), aircraft-wildlife strikes are the second leading cause of aviation-related fatalities. In recognition of this safety concern, the MOA signatory agencies (identified in the above document title) established procedures necessary to coordinate individual agency missions and regulatory interests while addressing aircraft-wildlife strikes at airbase installations throughout the country. The MOA demonstrates that the regulatory agencies recognize the airstrike danger, the concern for maintaining safety at airbase installations, and the need to coordinate regulatory oversight.

Air Force Instruction 32-7064 Integrated Natural Resources

This publication identifies requirements to manage natural resources on Air Force (AF) installations in accordance with federal, state, and local regulations. The document states “Wetland areas near an airfield may create potential hazards to aircraft operations. Innovative techniques to manage wildlife in wetlands should be explored and implemented. Legally defensible actions to reduce the amount of wetlands on the airfield to the maximum extent possible must be explored and pursued when their presence conflicts with the flight mission. While “no net loss” of wetlands is an important AF goal, priority must be given to flight safety.”

Air Force Pamphlet 91-212, Bird/Wildlife Aircraft Strike Hazard (BASH) Management Techniques

This document provides guidance for implementing an effective BASH program. Section 2.3.5., Controlling Drainage, includes the following statements: Fresh water is one of the most important airfield wildlife attractants, especially in arid regions and near the seacoast. Standing water creates a source of drinking water and a breeding place for insects, amphibians and other food sources for birds. Mark areas of the airfield with chronic standing water after heavy rains. Coordinate with CE (civil engineering) or EM (environmental management) to fill, level, and re-seed these areas with grass to match the rest of the airfield. Since federal and state laws strictly control wetlands, coordination with CE or EM is a must before making any modifications to airfield drainage. **However, non-tidal drainage and irrigation ditches excavated on dry land are not generally considered to be “waters of the United States”** (51 FR 41206, *Final Rule for Regulatory Programs of the Corps of Engineers*) and **therefore are not considered wetlands** (emphasis added). Make airfield drainage ditches as deep as possible to limit the surface area of the water and still allow proper drainage according to civil engineering requirements. Wading birds, such as herons, egrets, and shorebirds, are less likely to use deep drainage ditches. Grade the banks of the drainage ditches to allow mowing up to the edge of the ditch. Keep drainpipes, culverts, and screens clear of debris so drainage is not impeded.

2014 SANGB BASH Plan

The 2014 SANGB BASH Plan is specific to SANGB and was developed based on a bird/wildlife hazard assessment completed in spring of 2013. According to the BASH Plan, there were over 270 bird/wildlife strikes recorded for SANGB between 1992 and 2013. A stated primary goal of the plan is to establish guidelines to decrease airfield attractiveness to birds and wildlife. Recommendations/observations documented in the BASH relevant to the proposed ditch maintenance program are summarized in the following sections.

Appendix 1, Section 2. Regional Bird/Wildlife Hazards - “Trees, brush, and weeds have been almost completely removed from “These areas,” [Priority area 1, 2 and parts of 5 in the airfield] as previously recommended, but state and federal jurisdiction over the water in these areas is the most significant remaining concern on the airfield. These areas are highly attractive to a variety of bird and other wildlife species and are largely responsible for attracting the birds noted in the base’s bird strike records. Any regenerating trees and brush in these areas must be routinely removed and the wetlands should also be drained and filled as well.”

Appendix 1, Section 3d. Drainage - "Much of the airfield is very well drained with a system of drainage ditches and underground culverts. Some of the underground systems and less of the above ground structures had become clogged (possibly collapsed) and caused water to back up on several areas of the field, especially following heavy rains as occurred preceding and during the 2013 visit by National Guard Bureau (NGB). These areas are identified and targeted for repair as necessary. Most ditches were excellently maintained however with steep sides and trimmed vegetation. Some of the ditches had aquatic vegetation such as cattails, rushes, and other brushy vegetation established in the bottoms and banks of the structures. Wetland vegetation should be routinely removed from these areas and flow of drainage water maintained to prevent recurrence of aquatic vegetation."

Annex C, i (10) Maintaining Drainage Ditches – "Regularly inspect ditches and keep them clear and obstacle free. Maintain ditch sides as steeply as possible – minimum slope ratio of 5:1 – to discourage wading birds and emergent vegetation. Remove vegetation as often as necessary to maintain flow and discourage use by birds. Reference the Land Management Plan for procedures."

Annex C, i (11) Eliminating Standing Water - "Eliminating standing water immediately is essential to avoid development of wetlands. Coordination with the Army Corps of Engineers and the appropriate state environmental permitting office is required prior to altering wetlands. Eliminate small ponds or puddles and some large bodies of standing water to reduce attractiveness to birds. Low spot and ditch maintenance is essential."

Additionally, the BASH clearly states that wetland mitigation "should never occur" in the airport operating area as it could result in increased wildlife hazards with respect to BASH. Also see the 2003 MOA between the Corps of Engineers, FAA, USAF, and other federal agencies regarding waivers or exemption for on-site wetland mitigation procedures. The memo may be found at http://wildlife-mitigation.tc.faa.gov/public_html/moa.pdf.

ANALYSIS OF EXISTING REGULATED NATURAL RESOURCES

As indicated in the applicable directives, coordination with federal and state regulatory agencies is required prior to initiating a program dealing with BASH. Because there are numerous ditches requiring maintenance traversing or located in wetland at SANGB, a current delineation was required and necessary for identifying potential permitting requirements. As such, the identification of regulated wetland was the first step in developing a drain maintenance program in compliance with the SANGB BASH Plan.

Two wetland delineations were accomplished at the installation resulting in two separate regulatory determinations. The most current wetland delineation activities were completed in 2011 by HDR, Inc. At that time, approximately 387 acres of wetland, represented by 28 different areas, were identified, flagged, and GPS surveyed. Additionally, numerous drainage ditches were identified. This information was subsequently submitted to appropriate federal and state-regulatory agencies in order to verify wetland boundaries and the regulatory status of those wetlands identified.

Wetland regulatory authority determinations were received from both the US Army Corps of Engineers (USACE) and the Michigan Department of Environmental Quality (DEQ). Federal regulatory determinations are granted by the USACE through the Jurisdictional Determination (JD) process. According to the JD dated November 27, 2013, the USACE determined that Wetlands J, R, and U are jurisdictional due to their adjacency to Lake St. Clair, a Section 10 Navigable Water (per Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act). The USACE JD is valid for five years after issuance, which results in the SANGB JD being valid until November 2018 (see Appendix A, *Regulatory Findings)*.

The DEQ determines State regulatory authority of wetlands through the Wetland Identification Program (WIP). According to the WIP for SANGB dated February 4, 2014, approximately 385 of the 385.7 acres of wetland was determined to be regulated by the DEQ pursuant to Part 303, Wetland Protection of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Part 303). Additionally, linear features on the base were inspected to confirm their status as regulated wetlands, regulated streams (pursuant to Part 301, Inland Lakes and Streams), or exempt roadside and/or storm water conveyances (see Appendix A and Appendix B, *FY2014 Comprehensive Plan Map*). WIP determinations are valid for three years after issuance. The SANGB WIP is valid until February 2017.

Results of the delineation and final regulatory determinations were documented in a report dated April 2013 and entitled *Final Wetland Delineation Report and Associated Mapping, Selfridge Air National Guard Base*, *Michigan*. As indicated in the final report, DEQ viewed a number of the ditches requiring maintenance as having a direct hydrologic connection to surrounding regulated wetland and therefore, would not remove them from within regulated wetland boundaries. It was mistakenly assumed from preliminary discussions with the DEQ that while these ditches transverse and are located in wetland, under revised permit categories being developed at the time, the ditches could be maintained under general or minor permit categories without mitigation, as the ditches were established prior to wetland regulations to drain the airfield and areas of the installation and have been in operation since that time.

In summary, review of results from the SANGB wetland delineation activities and regulatory determinations, indicates the following with regard to the ditch maintenance plan:

- The existing JD will remain in effect until November 2018; the existing WIP will remain in effect until February 2017. Changes to these determinations cannot be made until after they have expired.
- USACE jurisdiction is limited to wetlands located immediately adjacent to Lake St. Clair; these wetlands are also located well outside of the ditch maintenance areas.
- Roadside ditches and storm water facilities (i.e. storm water ditches) constructed in upland are exempt from Part 303 and Part 301 and thus, are not considered to

be a wetland or a stream. Therefore, it is critical that any and all roadside and storm water ditches are correctly designated by the DEQ in the WIP.

- Ditches that are "surrounded" by regulated wetland are considered part of that wetland and therefore are regulated according to the current WIP.
- Cleaning of ditches where they are considered wetland (and thus, regulated) would be considered a permanent wetland impact and therefore, would require wetland mitigation**.** Additionally, if regulated ditches in wetland are proposed for clean out, it would need to be demonstrated that surrounding wetland would not be permanently impacted. Otherwise, permitted permanent wetland impacts require mitigation.
- Due to BASH concerns, wetland mitigation can ONLY be accomplished at off-site locations per directives. Both the potential acreage of wetland mitigation required and the need to move off-site make wetland mitigation cost prohibitive.

PROJECT GOALS

There are four primary goals of the proposed ditch restoration project at SANGB based on the findings from the analyses previously described:

- To maintain or improve existing storm water drainage;
- To manage wildlife in areas adjacent to taxiways and/or runways; and
- To minimize impacts to regulated wetland; and
- To avoid wetland mitigation where possible under existing regulations and permit categories, specifically through the use of applicable exemptions.

With these goals in mind, the following ditch restoration plan was developed. The methods and strategies or options for achieving the restoration plan are detailed in the following sections. In addition, regulatory requirements associated with each option are provided.

DITCH RESTORATION PLAN

Recommendations for addressing the storm water ditch restoration program for ditches located within wetland were developed based on review of historic aerials, published site data, regulations, field reconnaissance, and survey of the drain infrastructure. GPS surveyed wetland boundaries and ditch regulatory designations as verified and presented in the DEQ WIP are indicated on the site plan included in Appendix B. As review of the site plan indicates, the ditch restoration program is divided into five priority areas (designated as Priority 1 through Priority 5), which focused on ditches immediately adjacent to the airfield and of primary concern. Additionally, the gun range and the coast guard areas, where ditches are also located, were subsequently included in the program.

Potential regulatory exemptions related to the ditches and existing conditions in each of the designated priority areas were analyzed. Improvement strategies were then developed based on an understanding of the regulated resources and the project goals. Historic aerials used as part of the regulatory exemption analysis are included as

Appendix C, *Historic SANGB Aerials*. Analyses findings, recommendations, and alternatives are summarized in the following sections.

Applicability of State Exemptions
As review of the comprehensive plan map indicates, the majority of the ditches on SANGB were determined to be unregulated features. However, in general, where the linear features were surrounded by wetland, they were considered wetland (regulated pursuant to Part 303). Where these ditches existed outside of wetland, they were determined to be storm water features (exempt pursuant to Part 303 and Part 301, Inland Lakes and Streams).

There are three potential state regulatory (Part 301 and/or 303) exemptions that are related to ditches and were analyzed for applicability to SANGB: agricultural drains; county drains; and roadside ditches. In addition, the applicability of the storm water treatment facility exemption was also examined.

Agricultural Drains – A wetland that is incidentally created as a result of the construction of drains in upland for the sole purpose of removing excess soil moisture from upland areas that are primarily in agricultural use is exempt [MCL 324.30305 R4(d)]. Agricultural drain, as defined in Parts 301 and 303, "means a human-made conveyance of water that meets all of the following requirements:

(a) Does not have continuous flow.
(b) Flows primarily as a result of precipitation-induced surface runoff or groundwater drained through subsurface drainage systems.
(c) Serves agricultural production.
(d) Was constructed before January 1, 1973, or was constructed in compliance with this part or former 1979 PA 203."

Although historically Selfridge was farmland, the site has been used as an air base since the early 1940s. The property was taken under eminent domain as part of the war effort with the plan of converting it into a runway with associated infrastructure, as subsequently occurred. A property map, which graphically depicts the property acquisition over the history of the installation, is included in Appendix D, *Property Acquisition*. The majority of areas with drainage ditch maintenance concerns are associated with property acquisition in 1943 and further evolved in the 1950s when the airfield and associated drainage was constructed.

Because the property is now being used as an airbase and because these ditches were constructed as part of the airbase storm water management system, these ditches are not being used, and in the majority of cases have never been used, for agricultural purposes and therefore, do not meet the agricultural drain exemption. Furthermore, the ditch segments deemed regulated by DEQ currently flow through wetland, not upland.

However, all wetland areas receive some runoff from upland areas that must be drained for flight safety. Additionally, based on historic aerial review it is believed that these wetlands developed over time as a result of the land use conversion from drained agricultural fields to constructed air field and the subsequent lack of drain maintenance. Although the ditches in question do not meet the agricultural drain exemption due to the change in land use and the original purpose of their construction, it is believed that other regulatory exemptions may apply.

County Drains – Parts 301 and 303 exempt maintenance of a drain that was legally established and constructed pursuant to the drain code of 1956, 1956, PA 40 (drain code), if the drain was constructed before January 1, 1973, or under a permit issued under Parts 301 or 303. Further, maintenance exemptions only apply if the drain commissioner performs the work or the work is under an agreement with the drain commissioner's office.

There are two county drains in the vicinity: the Tucker Jones, which is located off-site to the north and the Irwin Drain, which is located off-site to the west. Although historic aerial photograph review indicates that these ditches were constructed prior to 1973, none of the ditches on SANGB currently represent county drains or even portions thereof. The reason none of the SANGB drains are part of the county drain system is because maintenance of drains for the installation is outside the jurisdiction and management of the Macomb County Office of Public Works (county drain commissioner) and must be handled by SANGB. As such, none of the ditches at SANGB ***currently*** meets the definition of a county drain. However, based on review of historic USGS topographic maps, it appears that many of the drains in question were at least in part, constructed as county drains. These drainage assets were likely established county drains circa 1900, and were later transferred to SANGB sometime between 1940 and 1960. Excerpts from the 1936, 1952, and 1984 USGS topographic maps for SANGB are included as Figures 1 through 3.

It is important to note that these ditches were established to provide mission critical drainage for operational areas including the airfield and to provide conveyance of established drainage that comes onto the installation. SANGB does not rely on the county to maintain ditches on the installation as the property is federally owned and outside the jurisdiction of the county. While the county does have several easements for the county drains listed above that come onto the installation, the Base Civil Engineer, the Assistant United States Property and Fiscal Officer (USPFO), serves as the drain commissioner for all existing drainage on the installation in accordance with Unified Facilities Criteria for Federal Installations and Air Force Instructions, which are very similar to those requirements imposed under drain codes. SANGB requested an exception for similar use of permits available to the county drain commissioner, but was denied such an exception by the DEQ in October of 2014 (see Appendix E, *DEQ Drain Exemption Response*).

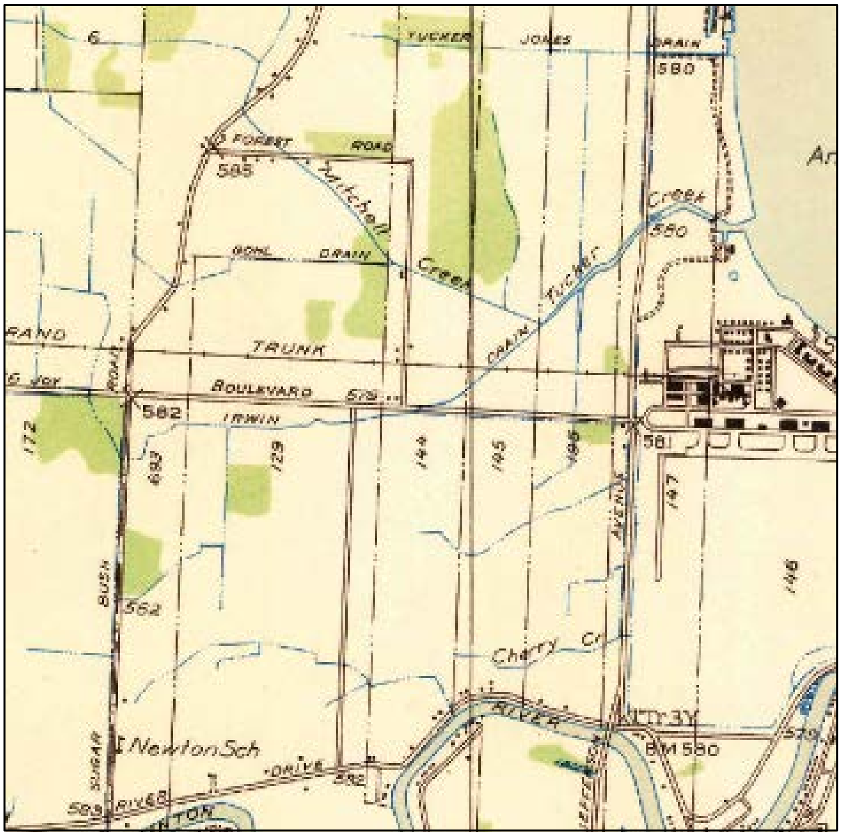


Figure 1: Selfridge Airfield 1936

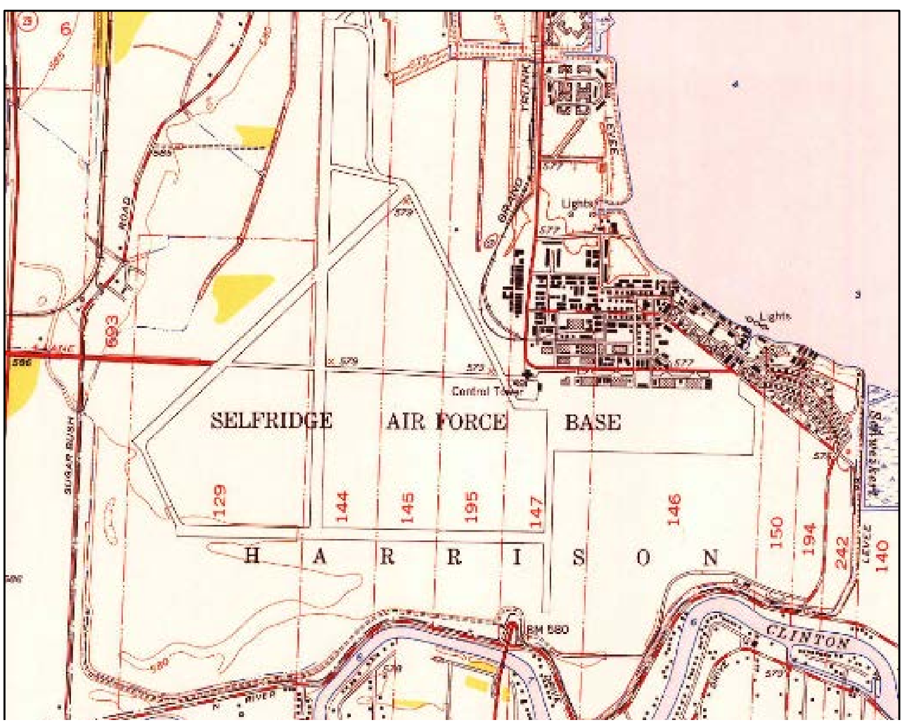


Figure 2: Selfridge Airfield 1952

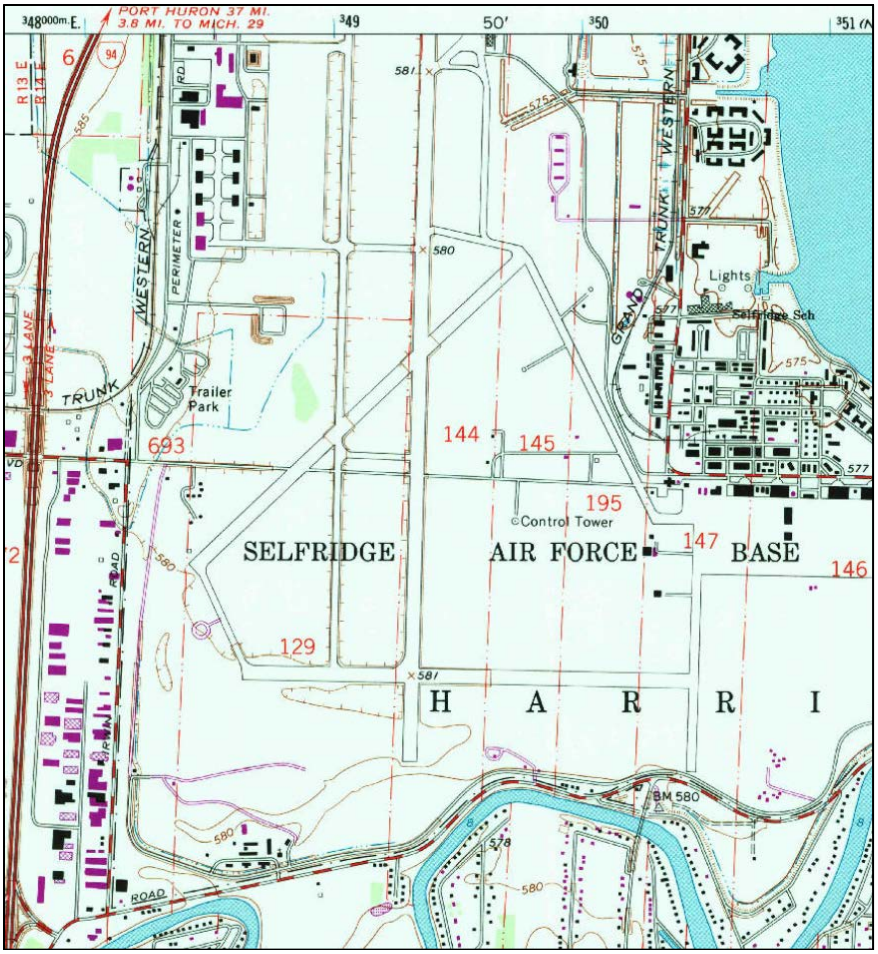


Figure 3: Selfridge Airfield 1984

Roadside Ditches – Roadside ditches are designated as "minor drainage structures and facilities" in Part 301 Rules (R 281.817). Roadside ditches are exempt from regulation and are defined as "…ditches which serve to convey storm water runoff from the highway right-of-way and which do not serve as a stream." In Part 303, wetlands incidentally created as a result of "construction of roadside ditches in upland for the sole purpose of removing excess soil moisture from upland" are exempt.

The majority of the ditches on Selfridge meet the criteria of a roadside ditch. This is verified in the DEQ WIP. With the exception of an apparent roadside ditch in upland in Priority 3, only those ditch segments surrounded by wetland, are regulated according to the WIP. It is critical to recognize that to be exempt; a ditch must be constructed in upland, for draining excess soil moisture from upland and by definition, are located along or formerly were located along a road. As a result, we do not believe that those portions of the ditches surrounded by wetland currently appear to meet the roadside ditch exemption with the exception of the southern-most ditch in Priority 3.

However, these drainage ditches are man-made and all part of a large storm water conveyance system constructed to address the drainage of storm water at the installation when the runway was constructed. The ditches were constructed to drain the airfield and installation following re-routing of Tucker Creek and re-routing of natural drainage patterns beginning prior to 1949 (see *Historic Aerials – 1940* and *Historic Aerials - 1949* in Appendix C) and continuing on into the 1950s and 1960s following property acquisition. The intended purpose for this ditch construction was to establish positive drainage to support installation operations. With this in mind, the final potential regulatory exemption reviewed is related to storm water treatment facilities.

Storm Water Facilities - A wetland that is incidentally created as a result of the construction and operation of a water treatment pond, lagoon or storm water facility in compliance with the requirements of state or federal water pollution control laws are exempt [MCL 324.30305 R4(b)]. In fact, the draft Clean Water Rules specifically state that non-jurisdictional waters include "stormwater control features constructed to convey, treat, or store water that are created in dry land." Review of historic aerials dated from the late 1930s to the present provides insight into the construction of the drains in question, as well as the condition of the land surrounding these drains through time. Appendix C includes the following aerial photograph years: 1940, 1949, 1952, 1957, 1962, 1997, and 2004. A summary of the photograph interpretation presented by priority area is provided in Table 1 included in Appendix C.

In general, the following was interpreted from review of the aforementioned aerial photographs. It is our opinion that all of the historic photograph interpretation supports the suitability of the storm water facility exemption, or in the case of Priority 3, the roadside ditch exemption, for the SANGB ditch maintenance program.

- With the exception of the ditch located in the Coast Guard Area, none of the ditches existed prior to SANGB expansion west of Jefferson Avenue between 1940 and 1949.
- All of the ditches were constructed in UPLAND previously used for agriculture.
- The ditch in the Coast Guard Area originally was used to drain agricultural fields based on review of the 1940 photograph, but was later "converted" to storm water treatment as development occurred starting between 1957 and 1962.
- The "southern" ditch located within Priority 3 clearly was constructed as a roadside ditch between 1940 and 1949 when S. Perimeter Road was constructed. This ditch continues to function as a roadside ditch. Further, this ditch is surrounded by upland. Therefore, we believe this feature was incorrectly designated as a regulated wetland by the DEQ.
- These ditches were clearly constructed for draining upland. Potential wetlands are not generally evident until the 1997 photograph. This indicates that the inefficient storm water infrastructure and lack of maintenance of both the infrastructure and surrounding undeveloped land supported the development of wetlands between 1962 and 1997.
- The ditches in question all include man-made, storm water structures such as man holes, culverts, engineered geometry and ditch slopes, drainage inlets and outlet structures, etc. lending insight with regard to their origin and intended use.

Maintenance Recommendations
Historically, the majority of SANGB was used for agriculture prior to the airbase expansion between 1940 and 1949. While in agricultural use, a large system of drainage ditches existed that was subsequently eliminated and rerouted. Overtime, the constructed storm water infrastructure has become clogged, broken, and inefficient due to the lack of maintenance. While we maintain that the proposed ditch maintenance program meets DEQ Part 303 and Part 301 exemptions, DEQ has determined that the ditches in question are regulated as wetland under Part 303. The following maintenance recommendations provide for both the exemption and regulated wetland scenarios.

Gun Range - The Gun Range area includes Wetland F400, a forested wetland. Drainage improvements are needed to prevent and/or reduce flooding on the adjacent gun range and mowed upland. A north/south drain runs through Wetland F400, which is considered part of the wetland and therefore, is currently designated as regulated. Additionally, there are several unregulated drains that run north/south surrounding the wetland.

The ditch considered regulated wetland appears for the first time in the 1952 USGS topographic map and the 1957 aerial photograph and it clearly is surrounded by upland. When originally constructed, it appears that the drain continued further south beyond the Gun Range Area. This ditch is still present in the 1984 USGS topographic map. Sometime between 1984 and 1997, this southern segment of the ditch was filled for the gun range. Coincidentally, Wetland F400 appears in the 2004 photograph after a portion of the ditch was filled. We believe, based on this evidence, it can be demonstrated that the currently regulated ditch was constructed for storm water conveyance, and therefore proposed maintenance should be considered an exempt activity.

However, should the DEQ disagree with the storm water facility exemption, or if SANGB prefers, the project team is recommending creating an east/west channel (or drain enclosure) in upland, south of Wetland F400, approximately 600 feet long. This alternative will:

- Eliminate potential wetland impacts;
- Eliminate the need for DEQ permitting;
- Eliminate wetland mitigation required for permanent wetland impacts; and
- Result in creation of a new ditch in mowed upland half the length of the existing wetland channel, without a vegetated over story, that will remove storm water runoff for this area and alleviate flooding.

These conditions will result in a cost reduction for both construction and long term maintenance. The lack of a vegetated overstory in the upland drain location will allow for less maintenance and easier access when maintenance is needed.

Should SANGB not prevail on the exemption determination and decide to dredge the existing channel, the project will require the following:

- DEQ permitting;
- Dredging approximately 1,000 feet of regulated wetland channel;
- Continued maintenance of approximately 1,000 feet of channel;
- Demonstration that the surrounding wetland will not be permanently impacted; and
- Wetland mitigation for all permanent wetland impacts.

Coast Guard Area - The Coast Guard area includes Wetland C. Drainage improvements are needed to reduce or eliminate flooding to surrounding development. Additionally, this area must be maintained as an herbaceous community due to visibility needs. Currently, a drain parallels the eastern boundary, determined to be within Wetland C, and therefore, is regulated. Reportedly, the drain channel originally was located adjacent to the wetland. However, the lack of maintenance has resulted in the wetland expanding to now include the channel. Flow is to the north, eventually discharging to an unregulated roadside ditch along N. Perimeter Road.

Originally, the ditch in question functioned as an agricultural drain within upland farm fields, and is visible on the 1940 aerial photograph. Over time and continued surrounding development, this ditch was converted to storm water conveyance. Additionally, also due to surrounding development, segments of the ditch that existed beyond the Coast Guard Area, were eliminated, filled in, and rerouted. The majority of these activities occurred between 1957 and 1962. Evidence of potential wetland appears in the 1997 aerial photograph. We believe based on this evidence, it can be demonstrated that the currently regulated ditch was constructed for storm water conveyance, and therefore proposed maintenance should be considered an exempt activity.

However, should the DEQ disagree with the storm water facility exemption, based on ditch and culvert elevations located outside of regulated wetland, it is recommended that the culvert just south of N. Perimeter Road be repaired and regular mowing of vegetation in the drain be performed so that the area may be re-evaluated in 2017, after the current WIP expires. Additionally, there may be an opportunity to direct drainage to the unregulated roadside ditch and bypass Wetland C entirely. This alternative will:

- Eliminate potential wetland impacts;
- Eliminate the need for DEQ permitting; and
- Eliminate wetland mitigation required for permanent wetland impacts;

With regard to vegetation, trees may be cut down without a permit. However, stumps must remain and soil undisturbed by machinery.

Alternatively, should SANGB not prevail on the exemption determination and decide to: cleanout the drain within Wetland C, the project would require the following:

- DEQ permitting;
- Dredging approximately 900 feet of regulated wetland channel;
- Continued maintenance of approximately 900 feet of channel;
- Demonstration that the surrounding wetland will not be permanently impacted; and
- Wetland mitigation for all permanent wetland impacts.

Priorities 1 and 2 - Priorities 1 and 2 are located adjacent to Taxiway A and include Wetland B. Due to the adjacency to the taxiway, the purpose for improving drainage to Priorities 1 and 2 is related to the management of wildlife. Trees have recently been cleared from Priorities 1 and 2 due to safety concerns and applicable airfield regulations concerning management of transition zones in proximity to the airfield. In addition to obtaining compliance with airfield regulations, the tree removal has significantly decreased potential wildlife hazards by decreasing or eliminating standing water. It has also removed vegetation obstruction within ditches. However, these two priority areas drain large portions of the airfield. As such, although standing water has been addressed, continued conveyance of storm water (or the lack thereof) is a major concern.

The ditches in question associated with Priorities 1 and 2 originally were constructed as the airfield expanded, primarily between 1952 and 1957. Although there appears to be possible wetland developing in Priority 2 in the 1952 photograph, the most significant evidence of wetland occurs between the 1962 and 1997 photographs for both priority areas. The drainage systems also appear on the 1984 USGS topographic map. As such, the ditches in question clearly were originally constructed in upland for the purpose of draining the surrounding airfield and development along Doolittle Drive. We believe based on this evidence, it can be demonstrated that the currently regulated ditches in Priorities 1 and 2 were constructed for storm water conveyance, and therefore proposed maintenance should be considered an exempt activity.

However, should the DEQ disagree with the storm water facility exemption, or if SANGB prefers, an alternative would be to directly connect the open ditches in Priority 1 to the storm sewer as it passes under the drains near Doolittle Drive in order to improve the drainage slope and decrease the travel length in the open drain. In Priority 2, improvements can be made to the drain downstream of the regulated area to increase the drain slope and improve drainage. As the drain exists, sediment and debris are building up and obstructing the flow of water.

Priority 3 - This priority area includes Wetland D (D600 and D800, primarily). The WIP designates an apparent roadside ditch surrounded by upland as part of the regulated wetland complex. In addition, a small segment of ditch located to the north was designated as regulated wetland.

Historically, Priority 3 consisted entirely of upland agricultural land including a farmstead. Between 1940 and 1949, S. Perimeter Road was constructed along with the roadside ditch, the southern ditch in question, to service storm water runoff associated with the road. From 1949 through at least 1957, extensive development occurred within Priority 3. The northern ditch first appears in the 1957 photograph, constructed parallel to paved and developed surfaces. The 1984 USGS topographic map clearly shows this as a roadside ditch and part of the storm water system.

It is believed that the DEQ regulated designation for the roadside ditch is due to the fact that the original delineation included the ditch as part of the wetland because vegetation obscured the upland separation. Since the delineation, the vegetation has been mowed and it is clear that the ditch should be exempt. The DEQ should be approached to determine if the roadside ditch can be removed as a regulated feature. If there is success with getting the roadside ditch removed as a regulated feature, maintenance is an exempt activity. Based on historic aerials, the north ditch meets the storm water facility exemption in our opinion.

However, should the DEQ disagree with the roadside ditch and storm water facility exemptions, dredging the ditches would then require the following:

- DEQ permitting;
- Dredging approximately 1,200 feet of regulated south wetland channel and 1,300 feet of north regulated wetland channel;
- Demonstration that the surrounding wetland will not be permanently impacted; and
- Wetland mitigation for all permanent wetland impacts.

A second alternative for the south ditch, if the DEQ cannot revise the existing WIP findings for this area, would be to wait until the WIP expires in 2017 and demonstrate that conditions have changed.

Other alternatives may be available; however, additional information is needed in order to determine their feasibility. A clear understanding of the drainage goals will allow a further exploration of appropriate alternatives within this area, such as improvements to the inlet capacity and/or pumping operations of the West Pumphouse or re-opening the outlet to the Clinton River. It is our understanding that SANGB is evaluating the reopening of a culvert from Priority 3 to the Clinton River. However, there are contamination concerns related to a former leaking underground storage tank and associated remedial action at 1533-AOC within Priority 3 that may prevent culvert reopening from occurring until remediation at the site is completed.

Priority 4 - This area includes a very small portion of Wetland D200 and Wetland G. The WIP clearly shows all the drains outside of Wetlands D200 and G as unregulated. It appears that drainage improvements can be made outside of regulated resources and therefore, will not require a DEQ permit or wetland mitigation. Regardless of the wetland determination, it is recommended that the pumping operations, inlet configuration, and existing conditions of the West Pump House be evaluated and altered in order to increase the drainage slope and minimize sediment and debris accumulation within the drainage system. This will improve drainage within the roadside ditch for both Priorities Areas 3 and 4.

Priority 5 - Priority 5 might be the most difficult area to address since it includes the most wetland, (forested Wetland A) and the longest reach of unmaintained ditch (approximately 3,100 feet). Much of this area was recently cleared in order to address transition zone requirements on the airfield and airfield movement visibility concerns with respect to the air traffic control tower. Per the SANGB Integrated National Resource Management Plan (INRMP), the areas that have been cleared, need to remain as such for mission requirements due to transition zone requirements and visual site concerns with respect to aircraft movement area. Per the INRMP, this area will be maintained as an herbaceous habitat. Specifically, this pertains to everything east of the visual site line between the control tower to the aircraft movement area between the hangers on the west ramp.

This priority area contains several drainage systems: the primary drain (labeled as the Irwin Drain on the 1936 USGS topographic map) is wholly located in a regulated wetland, and the tributary drains (labeled the Mitchell Creek and the Gohl Drain on the 1936 USGS topographic map) are partially located in regulated wetland. The Gohl Drain is tributary to the Mitchell Creek, which is tributary to the Irwin Drain (see figure 1). This system originally outlet to Lake St. Clair through the Tucker Creek. Priority 5 historically consisted entirely of upland agricultural land. Even with the development of SANGB, Priority 5 appears to be in agricultural use until at least 1962.

The drains were relocated between 1940 and 1949 as part of an extensive airfield expansion that spanned the airbase from Joy Boulevard at the southwest terminus to N. Jefferson Avenue at the northeast terminus. The Irwin Drain was disconnected from the Tucker Creek and relocated to the north (intercepting the Mitchell Creek earlier) and was tied into the Tucker-Jones Drain along N. Perimeter Road as shown on the 1952 USGS topographic map. , Eventually, with the development of the Coast Guard Area, the Irwin drain was redirected into an enclosed storm sewer which outlets to the Clinton River through the West Pump House. The northern portion of the drain was filled as evident on the 1962 photograph. The downstream portion of the Mitchell Creek/Gohl Drain was also redirected into the enclosed storm sewer in the early 1960s.. It appears that Wetland A developed between 1962 and 1997.

We believe based on this evidence, it can be demonstrated that the currently regulated ditches were constructed for storm water conveyance, and therefore proposed maintenance should be considered an exempt activity. However, should the DEQ disagree with the storm water facility exemptions, dredging the ditches would then require the following:

- DEQ permitting;
- Dredging approximately 3,100 feet of regulated wetland channel;
- Continued maintenance of approximately 3,100 feet of channel;
- Demonstration that the surrounding wetland will not be permanently impacted; and
- Wetland mitigation for all permanent wetland impacts.

Alternatively, maintenance can be done to the existing inlets from the northern portion of Priority 5 into the storm drain that services the area. Field reconnaissance indicated that this underground storm drainage system was in need of further investigation and probable maintenance specifically related to sinkholes, damage to pipes, and missing manhole covers.

In the southern portion of Priority 5, it may be feasible to bisect the drain by constructing a new enclosed storm sewer on the south side of E. Joy Boulevard to connect into the existing storm sewer system. This benefits Selfridge by the following:

- Eliminates potential wetland impacts;
- Eliminates the need for DEQ permitting;
- Eliminates wetland mitigation required for permanent wetland impacts; and

This alternative may result in a cost reduction for long term maintenance.

CONCLUSIONS

National directives clearly document the importance of balancing air safety and potential wildlife hazards with natural resource regulations. These directives further stipulate the requirements and methods for maintaining safe government installations. SANGB is proposing a ditch maintenance program designed to restore storm water conveyance throughout the base to: decrease flooding concerns for surrounding development, including a military airfield; reduce or eliminate open water and the associated BASH concerns; and to meet the requirements of the site-specific, SANGB BASH plan.

The USACE JD is valid until November 2018, while the DEQ WIP is valid until February 2017. The DEQ WIP confirmed wetland boundaries and regulatory status of existing natural features, including the ditches located throughout the property. The WIP confirmed that the majority of the linear features on Selfridge are unregulated storm water ditches. However, where a ditch is surrounded by wetland, it was determined that the ditch is regulated as part of that wetland. As such, any work proposed in the regulated segments of the ditches would require a DEQ permit and subsequent wetland mitigation. Additionally, we believe the southern drain segment in Priority 3 was incorrectly designated as regulated wetland. Clearly, it was created and functions as a roadside ditch, surrounded by upland and servicing S. Perimeter Road.

Historic aerial photograph review demonstrates that the ditches in question were constructed in upland, for the purposes of storm water conveyance or, as is the case in

Priority 3, as a roadside ditch. As such, we believe there is a valid argument regarding exemption of the maintenance activities. However, we also believe, should SANGB not prevail on exemption of the maintenance activities, that there are viable, cost effective alternatives for achieving SANGB's stated goals of restoring proper site drainage, eliminating or greatly reducing wildlife air hazards due to ponded water, and avoiding regulated wetland and wetland mitigation.

We have identified alternatives for each priority area whereby DEQ permitting would be avoided and construction and maintenance costs would likely be lower than if the existing regulated portions of the drains were dredged. Our recommendations are to proceed with presenting the exemption analysis to DEQ. However, if a favorable determination is not successful, we recommend managing vegetation to a herbaceous condition in areas where visibility is currently hindered; to proceed with storm water ditch improvement activities outside of the regulated areas; and to request a new WIP after the current WIP expires in 2017 in case some wetland boundaries are changed by the storm water improvements. It is also imperative that DEQ re-evaluate the regulatory finding for the road side ditch in Priority 3. That can be done now or can be done as part of a new WIP after 2017.

APPENDIX A
Regulatory Findings

USACE Jurisdictional Determination

DEPARTMENT OF THE ARMY
DETROIT DISTRICT, CORPS OF ENGINEERS
REGULATORY OFFICE
477 MICHIGAN AVENUE
DETROIT MI 48226-2550

REPLY TO
ATTENTION OF:

November 27, 2013

Engineering & Technical Services
Regulatory Office
File No. LRE-2006-01185-250-J13

Kenneth Baker
Selfridge Air National guard Base
28900 Selfridge Avenue
Harrison Township, Michigan 48045

Dear Mr. Baker:

This is in response to your recent request regarding the Corps of Engineers' jurisdiction on property adjacent to Lake St. Clair at 28900 Selfridge Avenue (otherwise known as Selfridge Air National Guard Base) in Harrison Twp., Michigan (Sections 5-18, Township 2N, Range 14E and Sections 31-32, Township 3N, Range 14E). Specifically, your request included approximately 387 acres of wetlands on approximately 3075 acres of property, which were designated by your consultant as Areas A, B, C, D, E, F, G, H, J, K, L, M, N, P, Q, R, T, and U.

We recently inspected the property and determined that Areas J, R, and U contain wetlands adjacent to Lake St. Clair, which is a navigable water of the United States. Lake St. Clair and its adjacent wetlands are under the regulatory jurisdiction of the Corps of Engineers. The wetlands in Areas J, R, and U are under the Corps' jurisdiction are depicted on the enclosed drawings. We also concur with the delineations of the wetlands within Areas J, R, and U that you submitted contained in the document "Final Wetland Delineation Report and Associated Mapping, Selfridge Air National Guard Base, Michigan," prepared by your consultant, HDR, Inc.

The Corps of Engineers' authority to regulate certain activities on and adjacent to the property in question is found in Section 10 of the Rivers and Harbors Act (Section 10), and Section 404 of the Clean Water Act (Section 404).

Under Section 10, a Corps permit is required for any structures or work in navigable waters of the United States, such as Lake St. Clair, to what is called the Ordinary High Water Mark (OHWM). In Lake St. Clair, the OHWM extends to the elevation contour of 576.3 International Great Lakes Datum 1985. Additionally, a Section 10 permit is required for structures or work outside this limit if they affect the course, location, or condition of the waterbody as to its navigable capacity. Some typical examples of structures or work requiring Section 10 permits within this jurisdictional area include beach nourishment, boat ramps, breakwaters, bulkheads, dredging, filling or discharging material such as sand, gravel or stones, groins and jetties, mooring buoys, piers (seasonal or permanent), placement of riprap for wave protection or streambank stabilization, boat hoists, pilings and construction of marina facilities.

Section 404 requires a Corps permit for the discharge of dredged or fill material into navigable waters of the United States and in wetlands adjacent to those waters. The area of Corps jurisdiction under Section 404 extends to the OHWM, and to the upland boundary of any adjacent wetlands. Projects involving discharges typically include placement of fill material for homes and landscaping, impoundments, causeways, road fills, dams and dikes, riprap, groins, breakwaters, revetments, and beach nourishment. Section 404 also regulates discharges of dredged material incidental to certain activities such as grading, mechanized landclearing, ditching or other excavation activity, and the installation of certain pile-supported structures.

If you anticipate discharging any dredged or fill material in Lake St. Clair or in wetlands adjacent to Lake St. Clair, you will need to apply for and receive authorization from the Corps prior to starting such work. Likewise, any construction or other work waterward of the OHWM will require prior Corps authorization. The necessary permit application can be found on our website at http://www.lre.usace.army.mil/Missions/RegulatoryProgramandPermits.aspx. Please complete and return the application following the procedures set forth in the application. Plan view and cross-sectional view drawings, in 8½" x 11" format, should accompany the application. Drawings and a narrative on the form should specifically identify and describe all of the structures, work, and discharges which we regulate as described above, including temporary or construction measures.

Our assertion of jurisdiction is based on the following criteria: (1) our documentation that the wetlands within areas identified as Areas J, R, and U meet our technical definition of a wetland per the criteria in the *1987 Corps of Engineers Wetlands Delineation Manual* and the appropriate Regional Supplement.

Furthermore, in 1984 a portion of the Corps' regulatory responsibilities was assumed by the Michigan Department of Environmental Quality (MDEQ). Areas A-H, K-Q, and T are within the assumed area. Unless otherwise notified, a separate authorization from the Corps is not required; however, a permit must be obtained from the MDEQ. Therefore, we recommend that you contact Mr. Luke Golden of the Michigan Department of Environmental Quality, Land and Water Management Division, 27700 Donald Court, Warren, Michigan, 48092, (586) 753-3761 for a determination of State permit requirements

This letter contains an approved jurisdictional determination for the property in question. If you object to this determination, you may request an administrative appeal under Corps regulations at 33 Code of Federal Regulations (CFR) Part 331. We have enclosed a Notification of Appeal Process (NAP) fact sheet and a Request for Appeal (RFA) form. If you request to appeal this determination you must submit a completed RFA form to the Corps' Great Lakes and Ohio River Division office at following address:

Appeals Review Officer
U.S. Army Corps of Engineers
Great Lakes and Ohio River Division
550 Main Street
Rm 10-524
Cincinnati, Ohio 45202-3222

In order for an RFA to be accepted by the Corps, the Corps must determine that the RFA is complete, that it meets the criteria for appeal under 33 CFR Part 331.5, and that it has been received by the Division office within 60 days of the date of the NAP sheet. If you decide to submit an RFA form, it must be received at the above address by January 27, 2013. It is not necessary to submit an RFA form to the Division office if you do not object to the determination in this letter. You may contact the Appeals Review Officer at (513) 684-6212 and send a facsimile at (513) 684-2460.

This jurisdiction determination is valid for a period of five years from the date of this letter unless new information warrants revision of the delineation before the expiration date. Should you have any questions, please contact me at the above address, by E-Mail at Eric.J.Warda@usace.army.mil, or by telephone at 313-226-5382. In all communications, please refer to File Number LRE-2006-01185-250-J13.

We are interested in your thoughts and opinions concerning your experience with the Detroit District, Corps of Engineers Regulatory Program. If you are interested in letting us know how we are doing, you can complete an electronic Customer Service Survey from our web site at: http://per2.nwp.usace.army.mil/survey.html. Alternatively, you may contact us and request a paper copy of the survey that you may complete and return to us by mail or fax. Thank you for taking the time to complete the survey, we appreciate your feedback.

Sincerely,

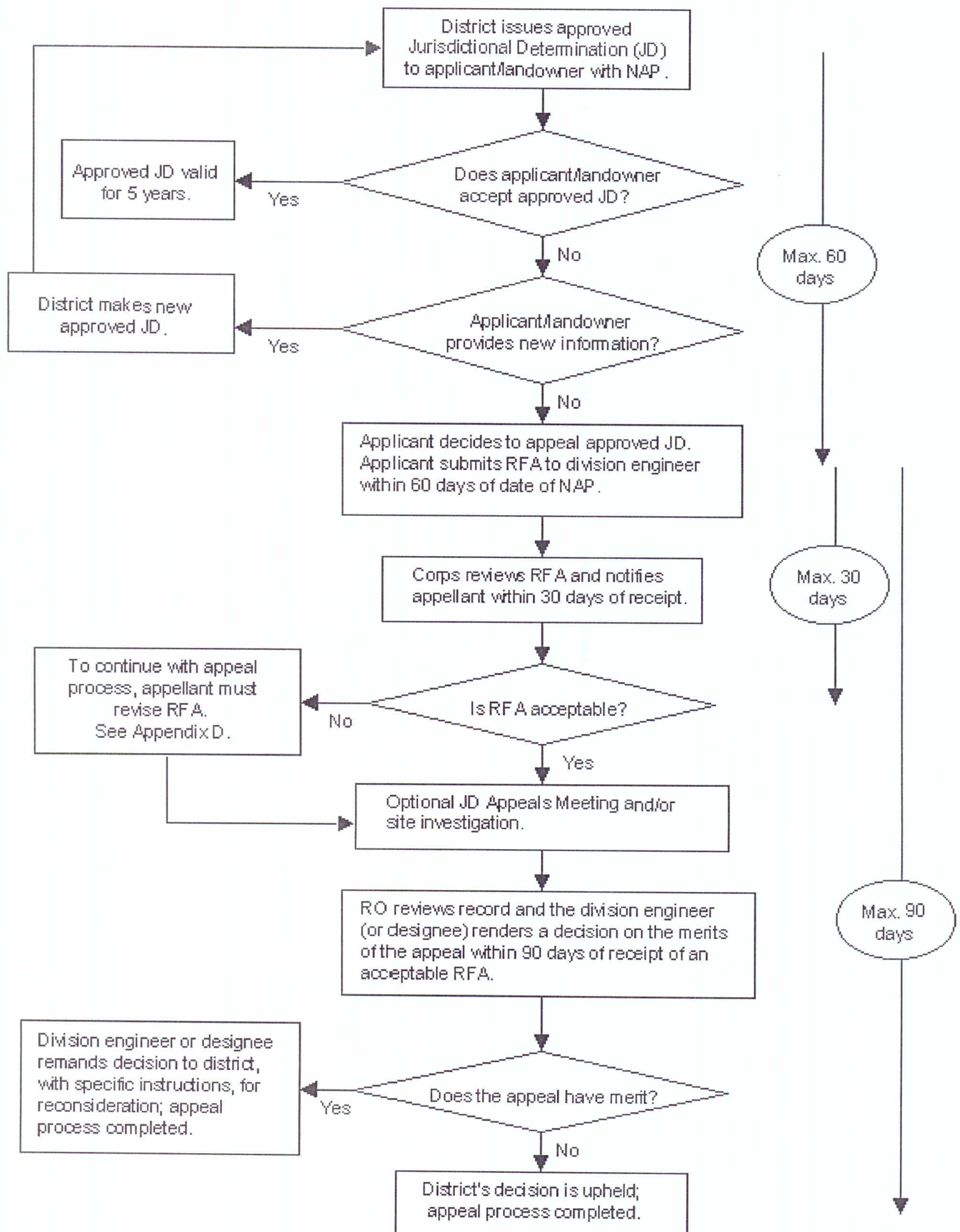
Eric J. Warda

Eric J. Warda
Regulatory Project Manager
Compliance & Enforcement Branch
Regulatory Office

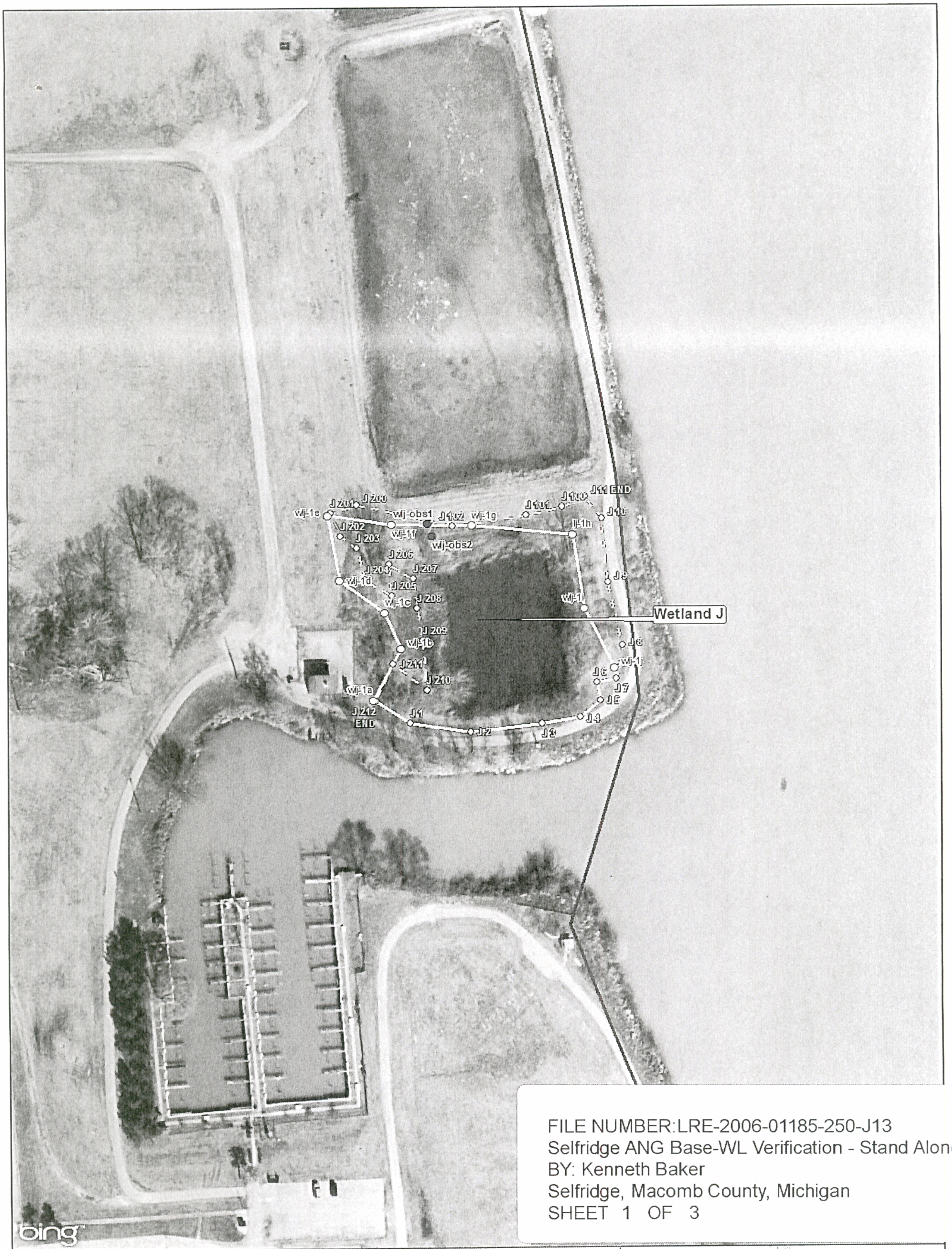
Enclosure

Copy Furnished
MDEQ, Southeast Michigan Office

Administrative Appeal Process for Approved Jurisdictional Determinations



Appendix C



FILE NUMBER:LRE-2006-01185-250-J13
Selfridge ANG Base-WL Verification - Stand Alone JD
BY: Kenneth Baker
Selfridge, Macomb County, Michigan
SHEET 1 OF 3

Wetlands and Waters of the U.S. Delineation Map Selfridge ANGB, Michigan

Prepared By: HDR, Inc.

Drawn By: SG Checked By: MG	Scale: 1 " = 100 '

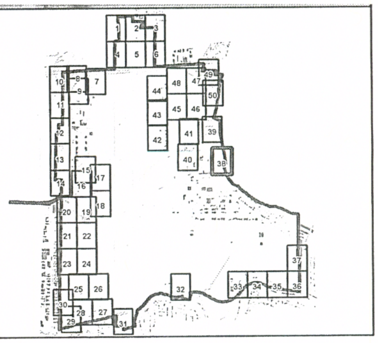
Date: December 2012

Selfridge ANGB Boundary
Observation Points
Field Delineated GPS Point
Wetland
Drainage
2006 Wetland Flags
2006 Wetlands

0 25 50 100 Feet
0 10 20 40 Meters

N

Map Projection: Lambert Conformal Conic
State Plane, Michigan South, FIPS 2113, Feet Intl
North American Datum of 1983



FILE NUMBER:LRE-2006-01185-250-J13
Selfridge ANG Base-WL Verification - Stand Alone JD
BY: Kenneth Baker
Selfridge, Macomb County, Michigan
SHEET 2 OF 3

Wetlands and Waters of the U.S. Delineation Map Selfridge ANGB, Michigan

Prepared By: HDR, Inc.

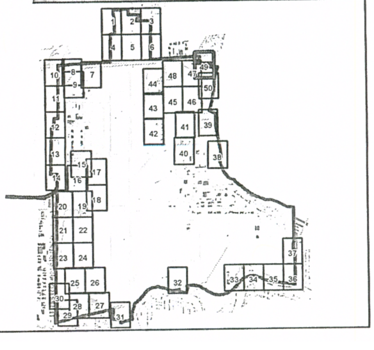
Drawn By: SG Checked By: MG	Scale: 1 " = 100 '

Date: December 2012

Selfridge ANGB Boundary
Observation Points
Field Delineated GPS Point
Wetland
Drainage
2006 Wetland Flags
2006 Wetlands

0 25 50 100 Feet
0 10 20 40 Meters
N

Map Projection: Lambert Conformal Conic
State Plane, Michigan South, FIPS 2113, Feet Int'l
North American Datum of 1983



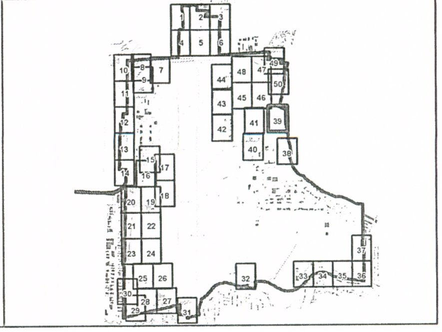
FILE NUMBER:LRE-2006-01185-250-J13
Selfridge ANG Base-WL Verification - Stand Alone JD
BY: Kenneth Baker
Selfridge, Macomb County, Michigan
SHEET 3 OF 3

Wetlands and Waters of the U.S. Delineation Map Selfridge ANGB, Michigan

Prepared By: HDR, Inc.

Selfridge ANGB Boundary
Observation Points
Field Delineated GPS Point
Wetland
Drainage
2006 Wetland Flags
2006 Wetlands

Map Projection: Lambert Conformal Conic State Plane, Michigan South, FIPS 2113, Feet Intl North American Datum of 1983



Drawn By: SG
Checked By: MG

Scale: 1 " = 100 '

Date: December 2012

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: Kenneth Baker	File Number: LRE-2006-01185-250-J13	Date: November 27, 2013

Attached is:		See Section below
	INITIAL PROFFERED PERMIT (Standard Permit or Letter of permission)	A
	PROFFERED PERMIT (Standard Permit or Letter of permission)	B
	PERMIT DENIAL	C
XX	APPROVED JURISDICTIONAL DETERMINATION	D
	PRELIMINARY JURISDICTIONAL DETERMINATION	E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at `http://www.usace.army.mil/cecw/pages/reg_materials.aspx` or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact:	If you only have questions regarding the appeal process you may also contact:
Eric Warda U.S. Army Corps of Engineers Regulatory Office REGULATORY OFFICE 477 MICHIGAN AVENUE DETROIT MI 48226-2550 313-226-5382	Appeal Review Officer U.S. Army Corps of Engineers Great Lakes and Ohio River Division 550 Main Street, Room 10-524 Cincinnati, Ohio 45202-3222 Tel. (513) 684-6212 Fax (513) 684-2460

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.

_______________________ Signature of appellant or agent.	Date:	Telephone number:

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD): 25 November 2013

B. DISTRICT OFFICE, FILE NAME, AND NUMBER:Selfridge ANG Base, LRE-2006-01185-250-J13

C. PROJECT LOCATION AND BACKGROUND INFORMATION:

State: MICH County/parish/borough: Macomb City: Harrison Twp
Center coordinates of site (lat/long in degree decimal format): Lat. 42.61654° N, Long. -82.83319° W.
Universal Transverse Mercator:
Name of nearest waterbody: Lake St. Clair
Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows:
Name of watershed or Hydrologic Unit Code (HUC):

☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☒ Office (Desk) Determination. Date: 25 November 2013
☒ Field Determination. Date(s): 6 August 2013

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** "*navigable waters of the U.S.*" within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]

☐ Waters subject to the ebb and flow of the tide.
☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** "*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. **Waters of the U.S.**
   a. **Indicate presence of waters of U.S. in review area (check all that apply):** [1]
      ☐ TNWs, including territorial seas
      ☒ Wetlands adjacent to TNWs
      ☐ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
      ☐ Non-RPWs that flow directly or indirectly into TNWs
      ☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
      ☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
      ☐ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
      ☐ Impoundments of jurisdictional waters
      ☐ Isolated (interstate or intrastate) waters, including isolated wetlands

   b. **Identify (estimate) size of waters of the U.S. in the review area:**
      Non-wetland waters: linear feet: width (ft) and/or acres.
      Wetlands: 3 wetlands for a total of 3.4 acres.

   c. **Limits (boundaries) of jurisdiction** based on: **1987 Delineation Manual**
      Elevation of established OHWM (if known):576.3 IGLD 1985.

2. **Non-regulated waters/wetlands (check if applicable):**[3]
   ☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain: .

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[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).
[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. **TNW**
   Identify TNW: **Lake St. Clair**.

   Summarize rationale supporting determination: .

2. **Wetland adjacent to TNW**
   Summarize rationale supporting conclusion that wetland is "adjacent": Each of the wetlands ("J." "R," and "U" are adjacent to Lake St. Clair as they are only separated by berms, thuly making them Waters of the US (33CFR 328.3(c)).

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. **Characteristics of non-TNWs that flow directly or indirectly into TNW**

   (i) General Area Conditions:
   Watershed size: **Pick List**
   Drainage area: **Pick List**
   Average annual rainfall: inches
   Average annual snowfall: inches

   (ii) Physical Characteristics:
   (a) Relationship with TNW:
   ☐ Tributary flows directly into TNW.
   ☐ Tributary flows through **Pick List** tributaries before entering TNW.

   Project waters are **Pick List** river miles from TNW.
   Project waters are **Pick List** river miles from RPW.
   Project waters are **Pick List** aerial (straight) miles from TNW.
   Project waters are **Pick List** aerial (straight) miles from RPW.
   Project waters cross or serve as state boundaries. Explain: .

   Identify flow route to TNW[5]: .

---

[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.
[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

Tributary stream order, if known: .

(b) General Tributary Characteristics (check all that apply):

Tributary is:
- ☐ Natural
- ☐ Artificial (man-made). Explain: .
- ☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):
Average width: feet
Average depth: feet
Average side slopes: **Pick List.**

Primary tributary substrate composition (check all that apply):
- ☐ Silts
- ☐ Sands
- ☐ Concrete
- ☐ Cobbles
- ☐ Gravel
- ☐ Muck
- ☐ Bedrock
- ☐ Vegetation. Type/% cover:
- ☐ Other. Explain: .

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: .
Presence of run/riffle/pool complexes. Explain: .
Tributary geometry: **Pick List**
Tributary gradient (approximate average slope): %

(c) Flow:
Tributary provides for: **Pick List**
Estimate average number of flow events in review area/year: **Pick List**
Describe flow regime: .
Other information on duration and volume: .

Surface flow is: **Pick List.** Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .
- ☐ Dye (or other) test performed: .

Tributary has (check all that apply):
- ☐ Bed and banks
- ☐ OHWM[6] (check all indicators that apply):
  - ☐ clear, natural line impressed on the bank
  - ☐ the presence of litter and debris
  - ☐ changes in the character of soil
  - ☐ destruction of terrestrial vegetation
  - ☐ shelving
  - ☐ the presence of wrack line
  - ☐ vegetation matted down, bent, or absent
  - ☐ sediment sorting
  - ☐ leaf litter disturbed or washed away
  - ☐ scour
  - ☐ sediment deposition
  - ☐ multiple observed or predicted flow events
  - ☐ water staining
  - ☐ abrupt change in plant community
  - ☐ other (list):
- ☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):
- ☐ High Tide Line indicated by:
  - ☐ oil or scum line along shore objects
  - ☐ fine shell or debris deposits (foreshore)
  - ☐ physical markings/characteristics
  - ☐ tidal gauges
  - ☐ other (list):
- ☐ Mean High Water Mark indicated by:
  - ☐ survey to available datum;
  - ☐ physical markings;
  - ☐ vegetation lines/changes in vegetation types.

(iii) Chemical Characteristics:
Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: .
Identify specific pollutants, if known: .

---

[6]A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7]Ibid.

(iv) **Biological Characteristics. Channel supports (check all that apply):**

☐ Riparian corridor. Characteristics (type, average width): .
☐ Wetland fringe. Characteristics: .
☐ Habitat for:
  ☐ Federally Listed species. Explain findings: .
  ☐ Fish/spawn areas. Explain findings: .
  ☐ Other environmentally-sensitive species. Explain findings: .
  ☐ Aquatic/wildlife diversity. Explain findings: .

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) **Physical Characteristics:**

(a) General Wetland Characteristics:

Properties:
Wetland size: acres
Wetland type. Explain: .
Wetland quality. Explain: .
Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:

Flow is: **Pick List**. Explain: .

Surface flow is**: Pick List**
Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .
☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:

☐ Directly abutting
☐ Not directly abutting
  ☐ Discrete wetland hydrologic connection. Explain: .
  ☐ Ecological connection. Explain: .
  ☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW

Project wetlands are **Pick List** river miles from TNW.
Project waters are **Pick List** aerial (straight) miles from TNW.
Flow is from: **Pick List.**
Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) **Chemical Characteristics:**

Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: .
Identify specific pollutants, if known: .

(iii) **Biological Characteristics. Wetland supports (check all that apply):**

☐ Riparian buffer. Characteristics (type, average width): .
☐ Vegetation type/percent cover. Explain: .
☐ Habitat for:
  ☐ Federally Listed species. Explain findings: .
  ☐ Fish/spawn areas. Explain findings: .
  ☐ Other environmentally-sensitive species. Explain findings: .
  ☐ Aquatic/wildlife diversity. Explain findings: .

3. Characteristics of all wetlands adjacent to the tributary (if any)

All wetland(s) being considered in the cumulative analysis: **Pick List**
Approximately ( ) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N)	Size (in acres)	Directly abuts? (Y/N)	Size (in acres)

Summarize overall biological, chemical and physical functions being performed: .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: .

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   - ☐ TNWs: linear feet width (ft), Or, acres.
   - ☒ Wetlands adjacent to TNWs: 3 wetlands ("J," "R," and "U") comprising of a total of 3.4 acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   - ☐ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: .
   - ☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

Provide estimates for jurisdictional waters in the review area (check all that apply):

☐ Tributary waters: linear feet width (ft).

☐ Other non-wetland waters: acres.

Identify type(s) of waters: .

3. **Non-RPWs[8] that flow directly or indirectly into TNWs.**

☐ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional waters within the review area (check all that apply):

☐ Tributary waters: linear feet width (ft).

☐ Other non-wetland waters: acres.

Identify type(s) of waters: .

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**

☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.

☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. **Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.**

☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. **Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.**

☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional wetlands in the review area: acres.

7. **Impoundments of jurisdictional waters.[9]**

As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.

☐ Demonstrate that impoundment was created from "waters of the U.S.," or

☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or

☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]

☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.

☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.

☐ which are or could be used for industrial purposes by industries in interstate commerce.

☐ Interstate isolated waters. Explain: .

☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

---

[8]See Footnote # 3.

[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.

[10] Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.*

Provide estimates for jurisdictional waters in the review area (check all that apply):

☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
  Identify type(s) of waters: .
☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):

☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
  ☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):

☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):

☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):

☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: Dated April 2013.
☒ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
  ☒ Office concurs with data sheets/delineation report.
  ☐ Office does not concur with data sheets/delineation report.
☐ Data sheets prepared by the Corps: .
☐ Corps navigable waters' study: .
☐ U.S. Geological Survey Hydrologic Atlas: .
  ☐ USGS NHD data.
  ☐ USGS 8 and 12 digit HUC maps.
☒ U.S. Geological Survey map(s). Cite scale & quad name:1:24K MI-New Haven.
☐ USDA Natural Resources Conservation Service Soil Survey. Citation: .
☒ National wetlands inventory map(s). Cite name:ORM2.
☐ State/Local wetland inventory map(s): .
☐ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
☒ Photographs: ☒ Aerial (Name & Date):ORM2 Maps.
  or ☐ Other (Name & Date): .
☐ Previous determination(s). File no. and date of response letter: .
☐ Applicable/supporting case law: .
☐ Applicable/supporting scientific literature: .
☐ Other information (please specify): .

B. ADDITIONAL COMMENTS TO SUPPORT JD: Each of the wetlands ("J." "R," and "U" are adjacent to Lake St. Clair as they are only separated by berms, thuly making them Waters of the US (33CFR 328.3(c)).

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING

RICK SNYDER
GOVERNOR

DAN WYANT
DIRECTOR

February 4, 2014

Selfridge Air National Guard Base
127 CES/CEV
28900 Selfridge Avenue
Harrison Township, Michigan 48035

ATTENTION: Mr. Kenneth Baker

Dear Mr. Baker:

SUBJECT: Wetland Identification Report
Wetland Identification File Number: 13-50-0003-WA

The Department of Environmental Quality (DEQ) conducted a Level 3 Wetland Identification field review of approximately 554 acres on property located in T03N, R14E, Sections 31, 32; and T02N, R14E, Sections 5-9, and 16-18, Harrison Township, Macomb County on August 7, 2013. The wetland review was conducted in accordance with Part 303, Wetland Protection of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA); and Rule 4 (1), Wetland Identification and Assessment (R 281.924) of the Administrative Rules for Part 303. This is a report of our findings in response to your Wetland Identification Program application.

The DEQ staff reviewed the GPS-mapped wetland boundaries on-site as requested in your Wetland Identification Application. Based on a review of plant communities, hydrologic indicators, soils, and an in-office review of other pertinent information, the DEQ confirmed, in part, the GPS-mapped wetland boundaries observed during the 2013 site inspection. During the field review, mapped wetland boundary lines were altered by the DEQ in several locations. GPS points associated with the DEQ wetland boundary line alterations were updated by the consultant as requested by the DEQ. Final wetland boundaries were determined and confirmed by the DEQ during the site visit. A final wetland map set was submitted by the consultant to the DEQ in December, 2013. Final wetland boundaries confirmed by the DEQ are documented on the enclosed site maps (Wetland Assessment Overview and Wetland Assessment Detail map pages 1 through 50). The site maps of the review area were created by combining information from your consultant and the DEQ. The new maps identify the areas containing wetland. A new delineation is not necessary.

While on-site, the DEQ modified the GPS-mapped wetland boundary lines associated with several wetlands throughout the site. These were as follows:

Wetland H (map page 4 of 50); several wetland boundary GPS points located at the southwest tip of this wetland were moved eastward approximately 15 feet. GPS points H411 and H413 were moved westward approximately 15 feet. A narrow upland "peninsula" was demarcated, extending for several hundred feet northward along the stream/drain's west bank.

Wetland C (map page 9 of 50); the wetland boundary line was expanded outward approximately 20 feet on the west side of the southeast corner (GPS points c46 and c45).

Wetland P (map page 13 of 50); the wetland boundary line near the corner of the security fence was expanded outward approximately 20 feet (between GPS points p428 and p426).

Wetland A (map page 15 of 50); the wetland boundary line associated with GPS points a721 through a727 was reverted approximately to the 06-50-0010-WA delineation line.

Wetland G (map page 21 of 50); over 1.5 acres of wetland area were added near the middle portion of this wetland. This ended up being somewhat consistent with the 06-50-0010-WA wetland delineation boundary line within that area.

Wetland D200 and D800 (map pages 25 and 26 of 50); much of the southern boundary line of Wetland D200 and the northern boundary line of Wetland D800 was modified somewhat by the DEQ during the field inspection; in some areas, the wetland line was expanded outward and in some areas it was contracted.

Staff from the DEQ adjusted the wetland boundary line along the southwestern edge of Wetland D800; a long upland berm associated with a linear wetland drainageway was designated as non-wetland (map pages 28-30 of 50).

Wetland J and F400; staff from the DEQ adjusted the northwest boundary of Wetland J (map page 38 of 50) eastward approximately 20 feet. A portion of the corner of Wetland F400 (map page 41 of 50) was expanded outward approximately 60 feet (between GPS points f442 and f443).

Of the approximately 385.7 acres of wetland within the review area, approximately 385 acres of wetland are regulated by the DEQ pursuant to Part 303. Wetlands onsite are regulated due to one or more of the following:

a) greater than five acres.
b) located within 1000 feet of Lake St. Clair.
c) located within 500 feet of a river or stream/drain.
d) have surface water connection(s) to a lake, pond, stream, or Lake St. Clair.

Please be advised that any of the following activities within a regulated wetland require a permit under Part 303:

a) Deposit or permit the placing of fill material in a regulated wetland.
b) Dredge, remove, or permit the removal of soil or minerals from regulated wetland.
c) Construct, operate, or maintain any use or development in a regulated wetland.
d) Drain surface water from a regulated wetland.

For upland (non-wetland) areas and the 0.7-acre non-regulated wetland indicated on the site map (see map page 25), the DEQ lacks jurisdiction under Part 303 for activities occurring in those areas. The non-regulated wetland is not regulated because it is not contiguous to Lake St. Clair, an inland water body or stream/drain, nor is it at least five acres in size.

During the August site visit, the applicant asked DEQ staff to specifically review several linear features to determine if any might be classified as something other than wetland. Staff from the DEQ inspected those features in question. The DEQ concurred with the consultant's wetland determinations in each case. If you have additional questions regarding other hydrologic features on-site, please contact the DEQ, Water Resources Division, Southeast Michigan District office at 586-753-3700; or, 27700 Donald Court, Warren, Michigan 48092-2793. For specific permit-related questions regarding hydrologic features on-site, a pre-application meeting with DEQ permit staff may be beneficial.

You may request the DEQ reassess the subject review area, or any portion of the review area, should you disagree with the findings, within 60 days of the date of this report. A written request to reassess the Wetland Identification Review area must be accompanied by supporting evidence with regard to wetland vegetation, soils, or hydrology different from, or in addition to, the information relied upon by DEQ staff in preparing this report. The request should be submitted to:

Wetland Identification Program
Department of Environmental Quality
Water Resources Division
P.O. Box 30458
Lansing, Michigan 48909-7958

Please be aware that this identification report does not constitute a determination of the presence of wetland that may be regulated under local ordinances or federal law. The U.S. Army Corps of Engineers (USACE) retains regulatory authority over certain wetlands pursuant to Section 404 of the Clean Water Act (CWA), and specifically those wetlands associated with traditionally navigable waters of the state. Navigable waters are generally the Great Lakes, their connecting waters, and river systems and lakes connected to these waters. In other areas of the state, the DEQ is responsible for identification of wetland boundaries for purposes of compliance with the CWA under an agreement with the U.S. Environmental Protection Agency. Our review indicates a portion of the wetland identification review area may be within those areas regulated by the USACE. Many activities within these areas may also require a federal review and/or a permit. Additional information may be obtained by contacting the USACE at 313-226-2218.

This Wetland Identification Report is limited to findings pursuant to Part 303 and does not constitute a determination of jurisdiction under other DEQ administered programs. Any land use activities undertaken on the assessed parcel may be subject to regulation pursuant to the NREPA under the following programs:

Floodplain Regulatory Authority found in Part 31, Water Resources Protection
Part 91, Soil Erosion and Sedimentation Control
Part 301, Inland Lakes and Streams
Part 323, Shorelands Protection and Management
Part 325, Great Lakes Submerged Lands

The enclosed map depicts an approximation of the location of the regulated wetland areas within the review area. If a more precise map(s) of the regulated wetland areas GPS-mapped on-site is needed or required for site development or planning purposes, we recommend you obtain this from your consultant.

The findings contained in this report do not convey, provide, or otherwise imply approval of any governing act, ordinance, or regulation, nor does it waive the obligation to acquire any applicable federal, state, county, or local approvals. This Wetland Identification Report is not a permit for any activity that requires a permit from the DEQ.

The findings contained in this report are binding on the DEQ until February 4, 2017, a period of three years from the date of this Wetland Identification Report unless a reassessment is conducted. Please contact me if you have any questions regarding this report.

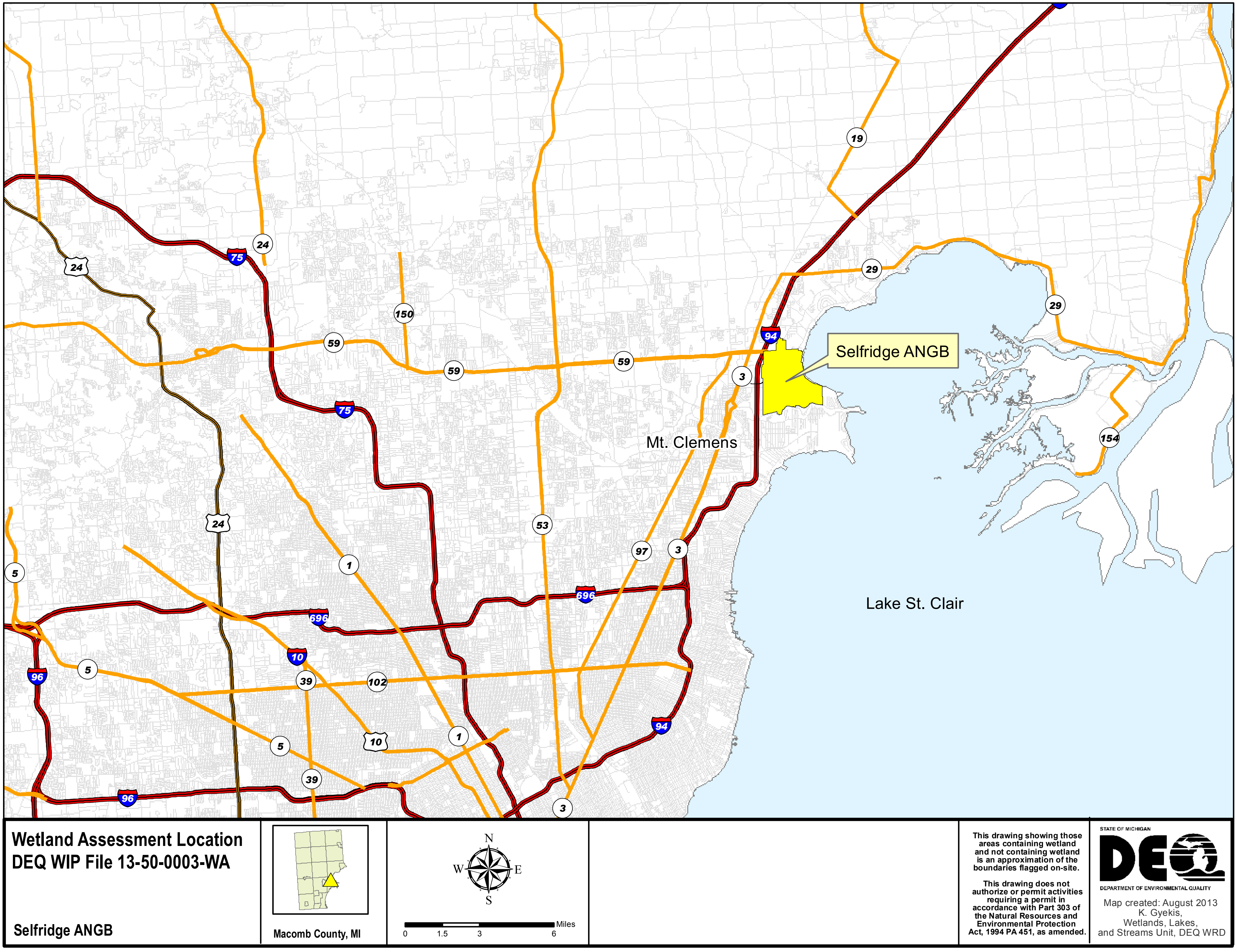
Sincerely,

Keto Gyekis

Keto Gyekis
Wetland Identification Program Coordinator
Water Resources Division
517-284-5534

Enclosure

cc: USACE, Detroit District
Macomb County Soil Enforcement Agent (CEA)
Macomb County Health Department
Harrison Township Clerk
Mr. Barry Lenz, HDR, Inc.
Ms. Bridget Kelly-Butcher, HDR, Inc.
Mr. Andrew Hartz, DEQ
Mr. Luke Golden, DEQ



Wetland Assessment Location
DEQ WIP File 13-50-0003-WA

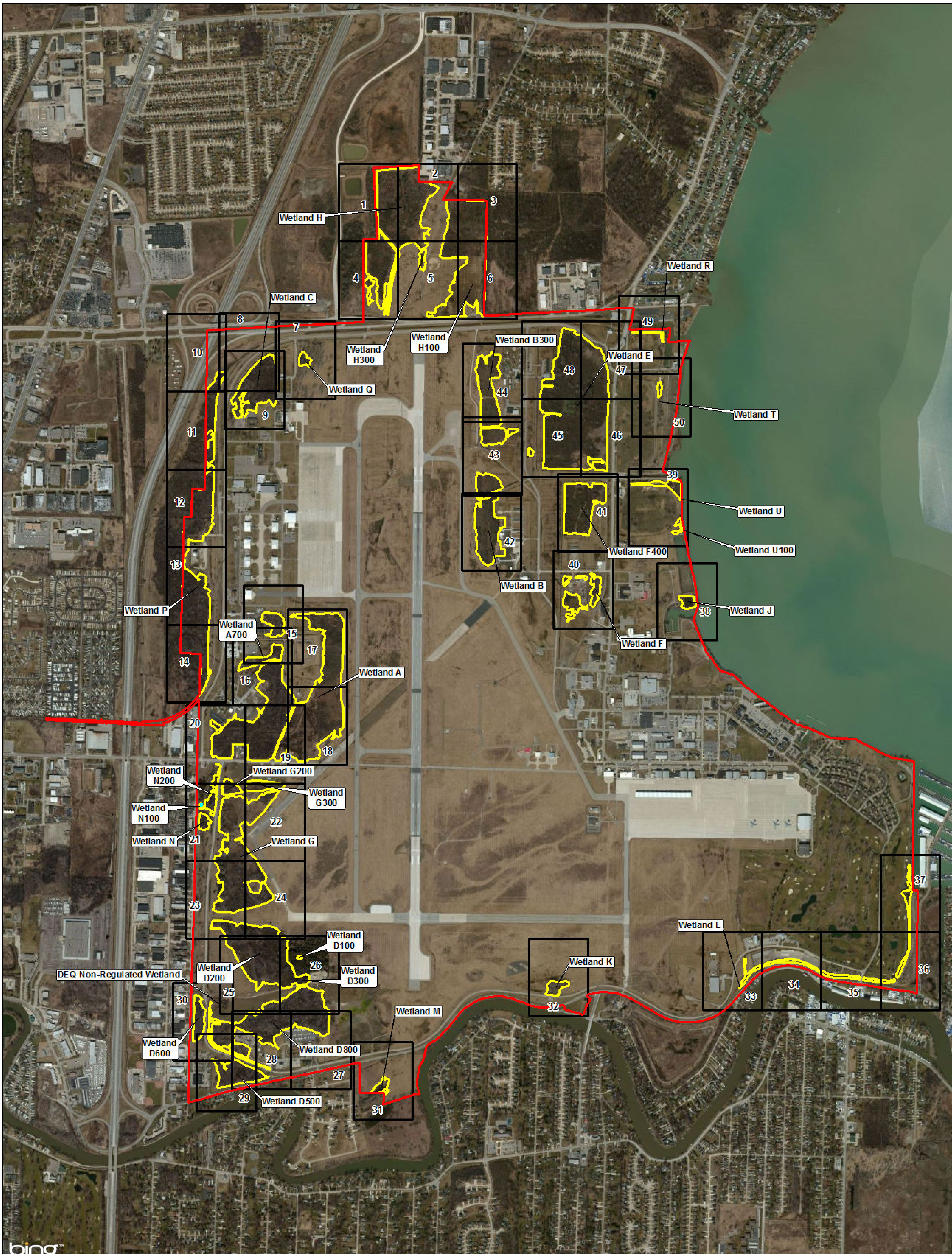
Selfridge ANGB

This drawing showing those areas containing wetland and not containing wetland is an approximation of the boundaries flagged on-site.

This drawing does not authorize or permit activities requiring a permit in accordance with Part 303 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

STATE OF MICHIGAN
DEQ
DEPARTMENT OF ENVIRONMENTAL QUALITY

Map created: August 2013
K. Gyekis,
Wetlands, Lakes,
and Streams Unit, DEQ WRD



Overview

Wetland Assessment Overview
DEQ WIP File 13-50-0003-WA
Selfridge ANGB, MI

STATE OF MICHIGAN
DEQ
DEPARTMENT OF ENVIRONMENTAL QUALITY

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Map created: January 2014

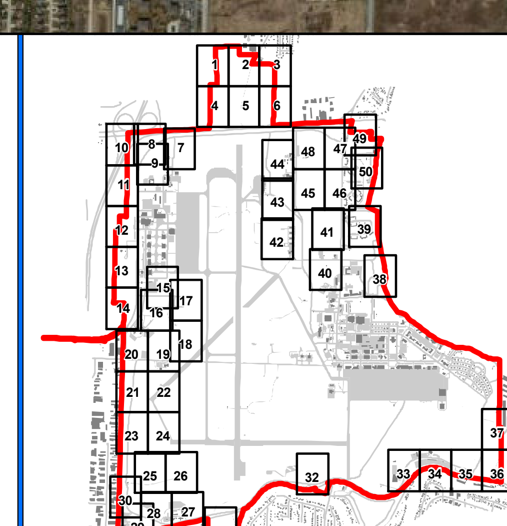
Selfridge ANGB Boundary
2013 Regulated Wetlands

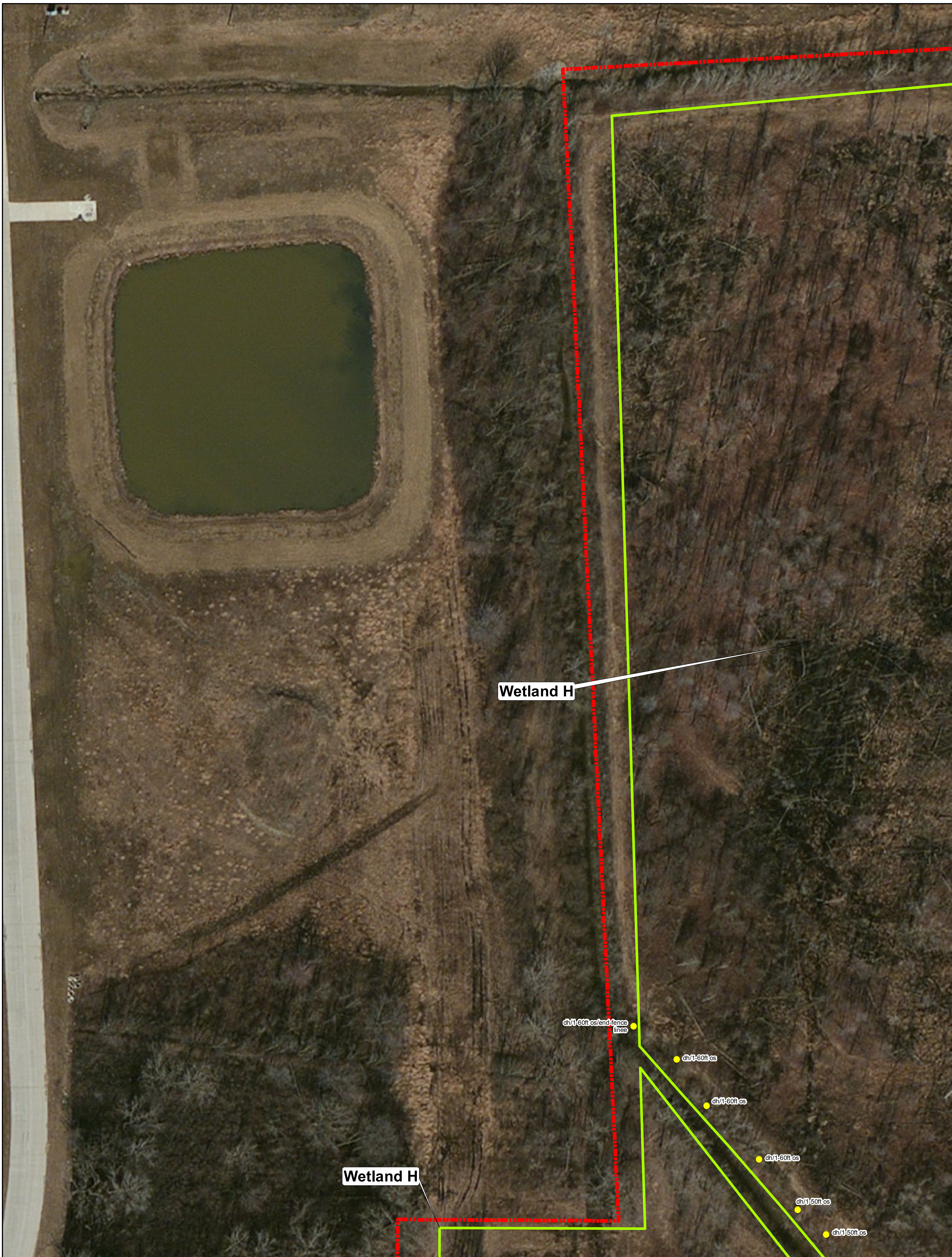
N

0 500 1,000 2,000 Feet

0 100 200 400 Meters

Map Projection: Lambert Conformal Conic
State Plane, Michigan South, FIPS 2113, Feet Int'l
North American Datum of 1983





Wetland Assessment Detail
DEQ WIP File 13-50-0003-WA
Selfridge ANGB

STATE OF MICHIGAN
DEQ
DEPARTMENT OF ENVIRONMENTAL QUALITY

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Map created: January 2014

Selfridge ANGB Boundary
GPS Point
Regulated Wetland
Non-Regulated Wetland

0 25 50 100 Feet
0 10 20 40 Meters

N

Map Projection: Lambert Conformal Conic
State Plane, Michigan South, FIPS 2113, Feet Int'l
North American Datum of 1983

Wetland Assessment Detail
DEQ WIP File 13-50-0003-WA
Selfridge ANGB

STATE OF MICHIGAN
DEQ
DEPARTMENT OF ENVIRONMENTAL QUALITY

Map created: January 2014

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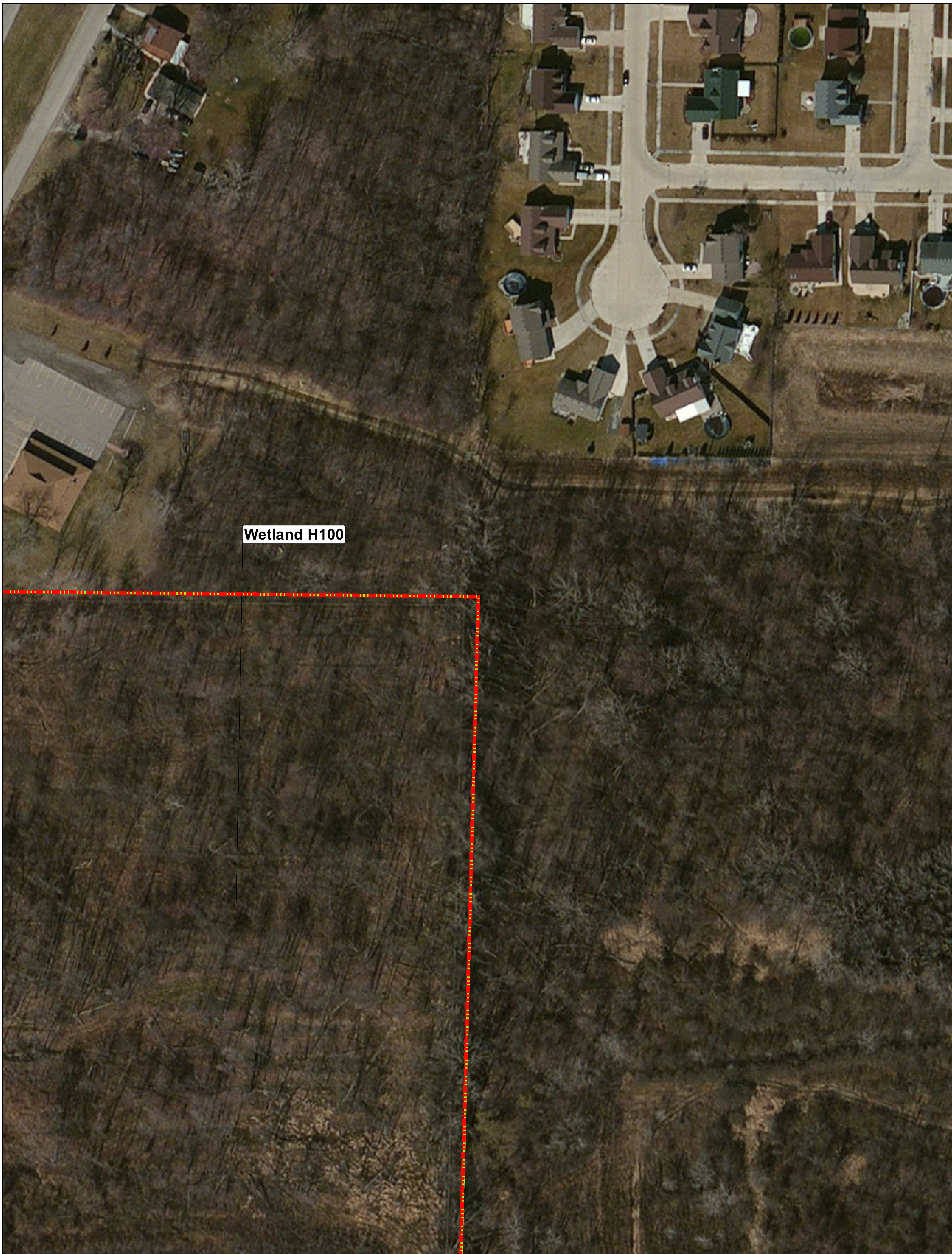
Selfridge ANGB Boundary
Regulated Wetland
GPS Point
Non-Regulated Wetland

0 25 50 100 Feet
0 10 20 40 Meters
N

Map Projection: Lambert Conformal Conic
State Plane, Michigan South, FIPS 2113, Feet Int'l
North American Datum of 1983



Wetland Assessment Detail
DEQ WIP File 13-50-0003-WA
Selfridge ANGB

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY

This drawing showing those areas containing wetland and not containing wetland is an approximation of the boundaries flagged on-site.

This drawing does not authorize or permit activities requiring a permit in accordance with Part 303 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

Map created: January 2014

Selfridge ANGB Boundary

GPS Point

Regulated Wetland

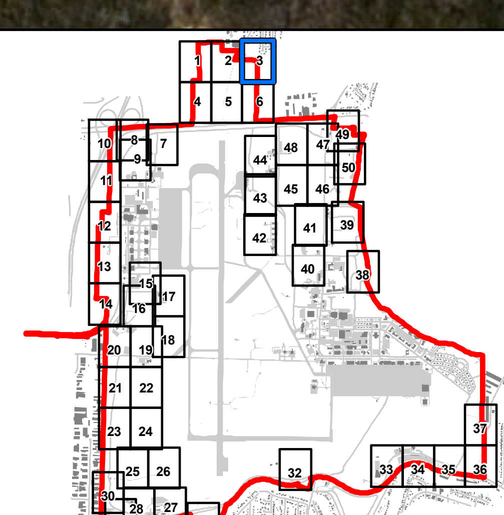
Non-Regulated Wetland

0 25 50 100 Feet

0 10 20 40 Meters

N

Map Projection: Lambert Conformal Conic
State Plane, Michigan South, FIPS 2113, Feet Int'l
North American Datum of 1983



Wetland Assessment Detail
DEQ WIP File 13-50-0003-WA
Selfridge ANGB

STATE OF MICHIGAN
DEQ
DEPARTMENT OF ENVIRONMENTAL QUALITY

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GPS Point
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0 10 20 40 Meters
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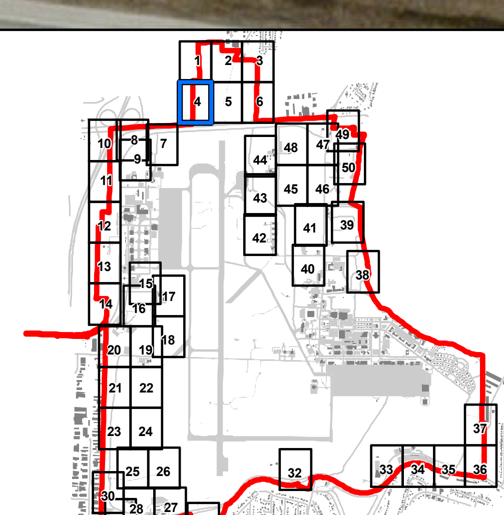

Wetland Assessment Detail
DEQ WIP File 13-50-0003-WA
Selfridge ANGB

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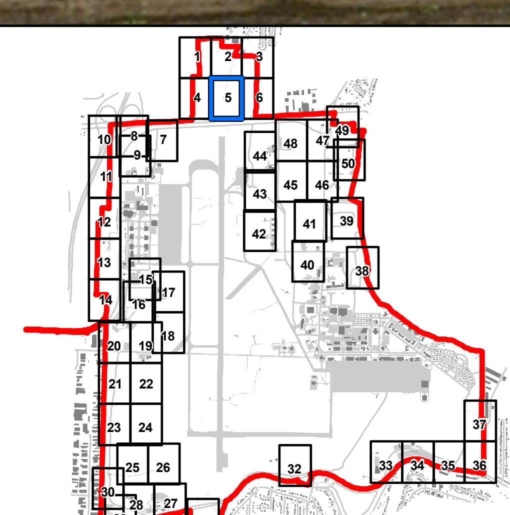

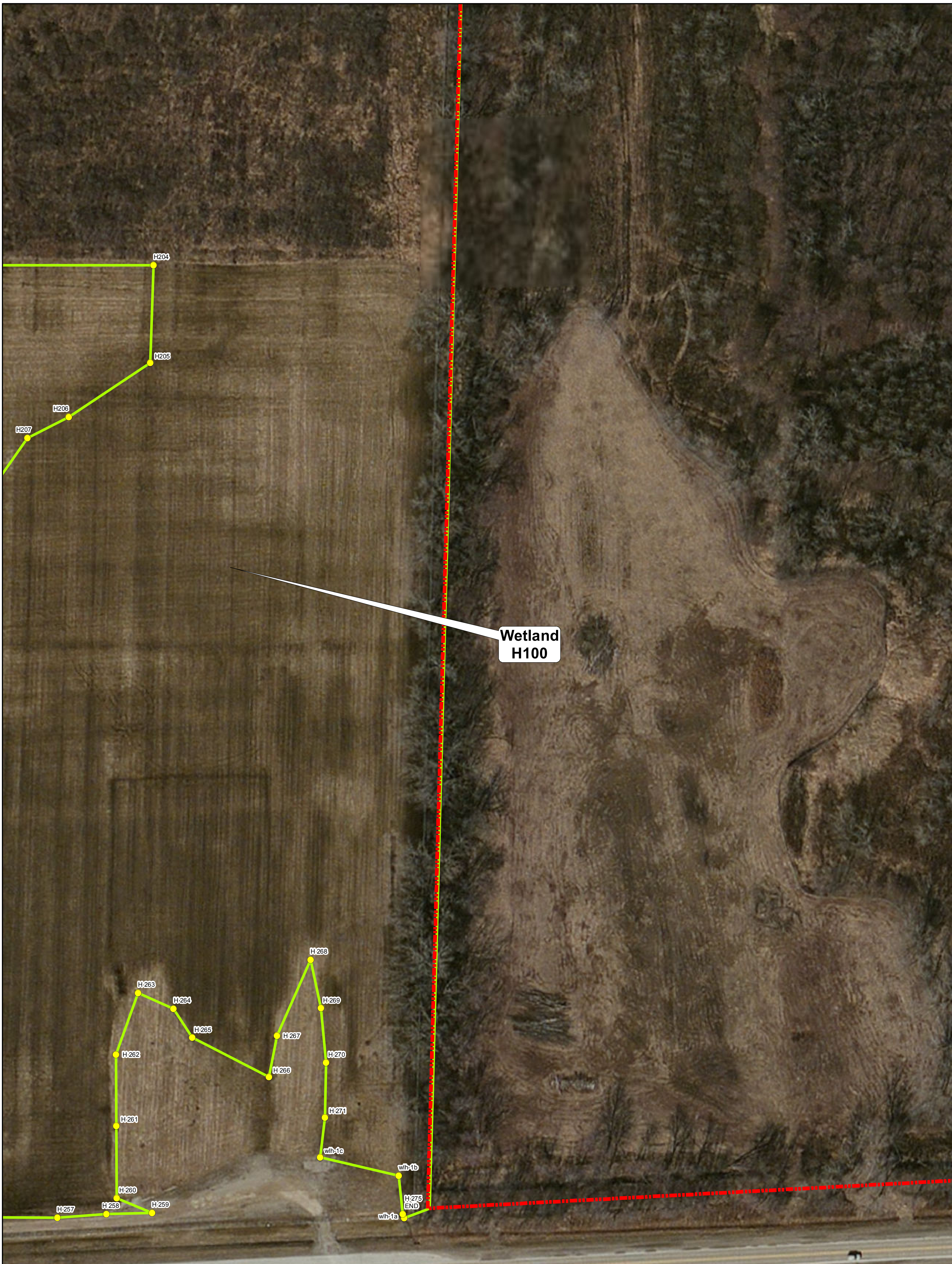

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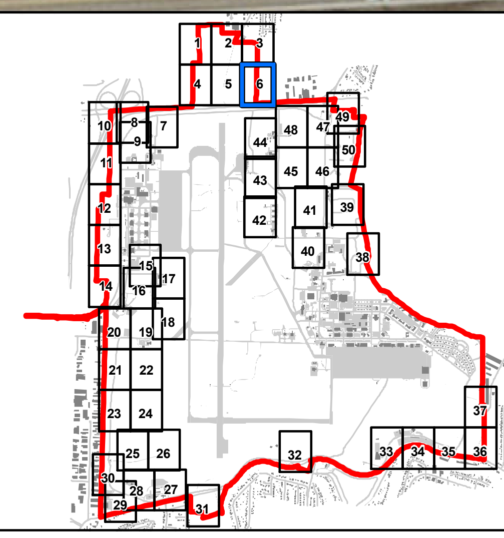

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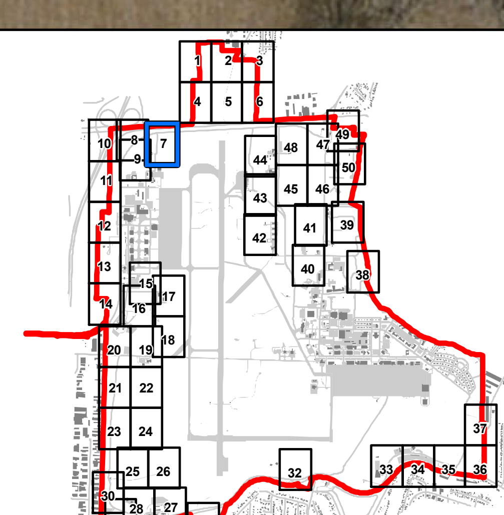

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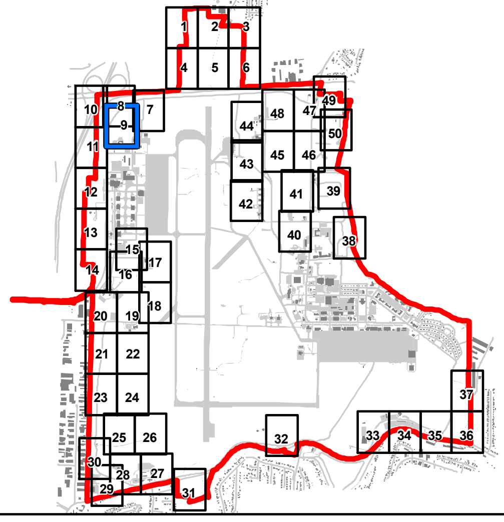

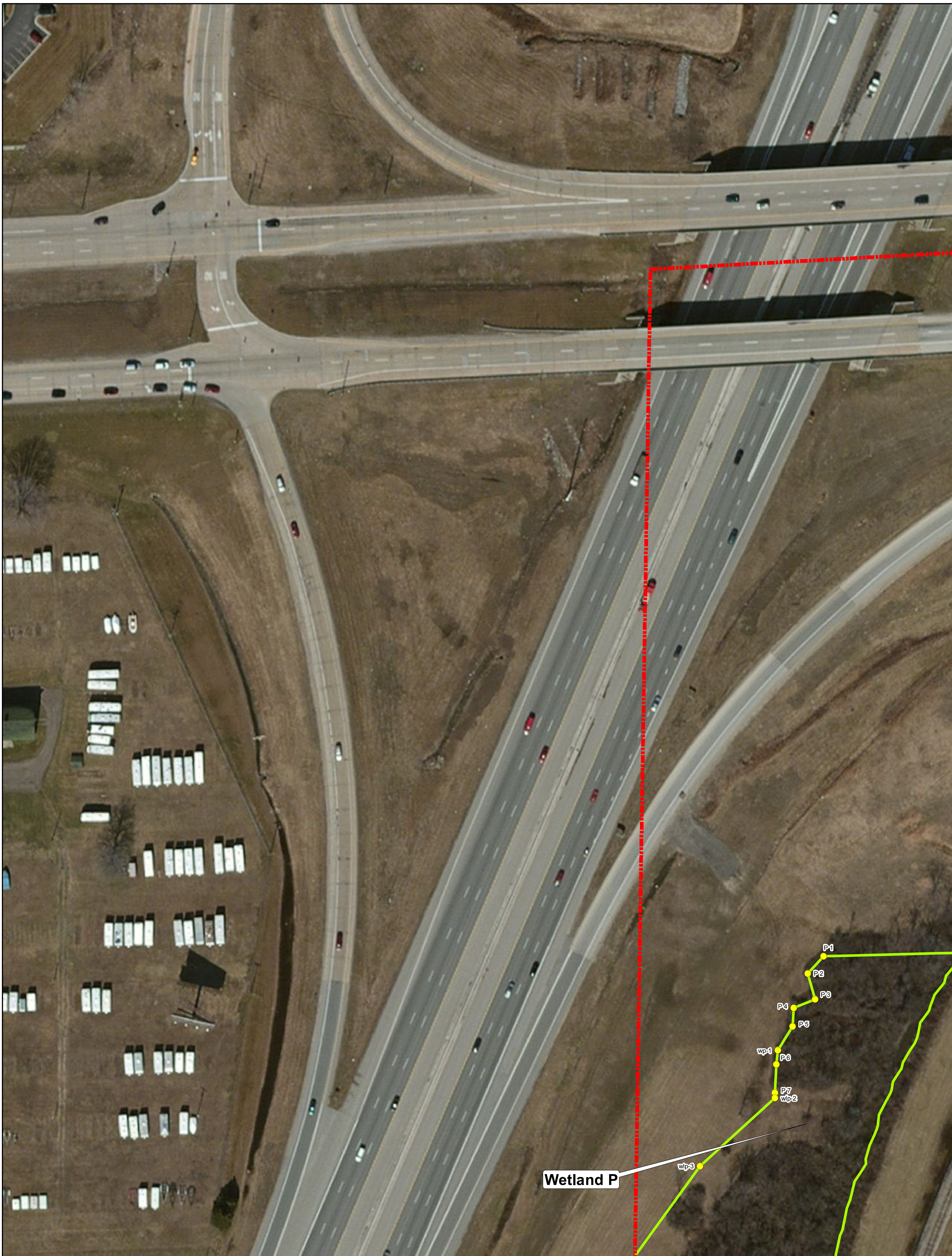

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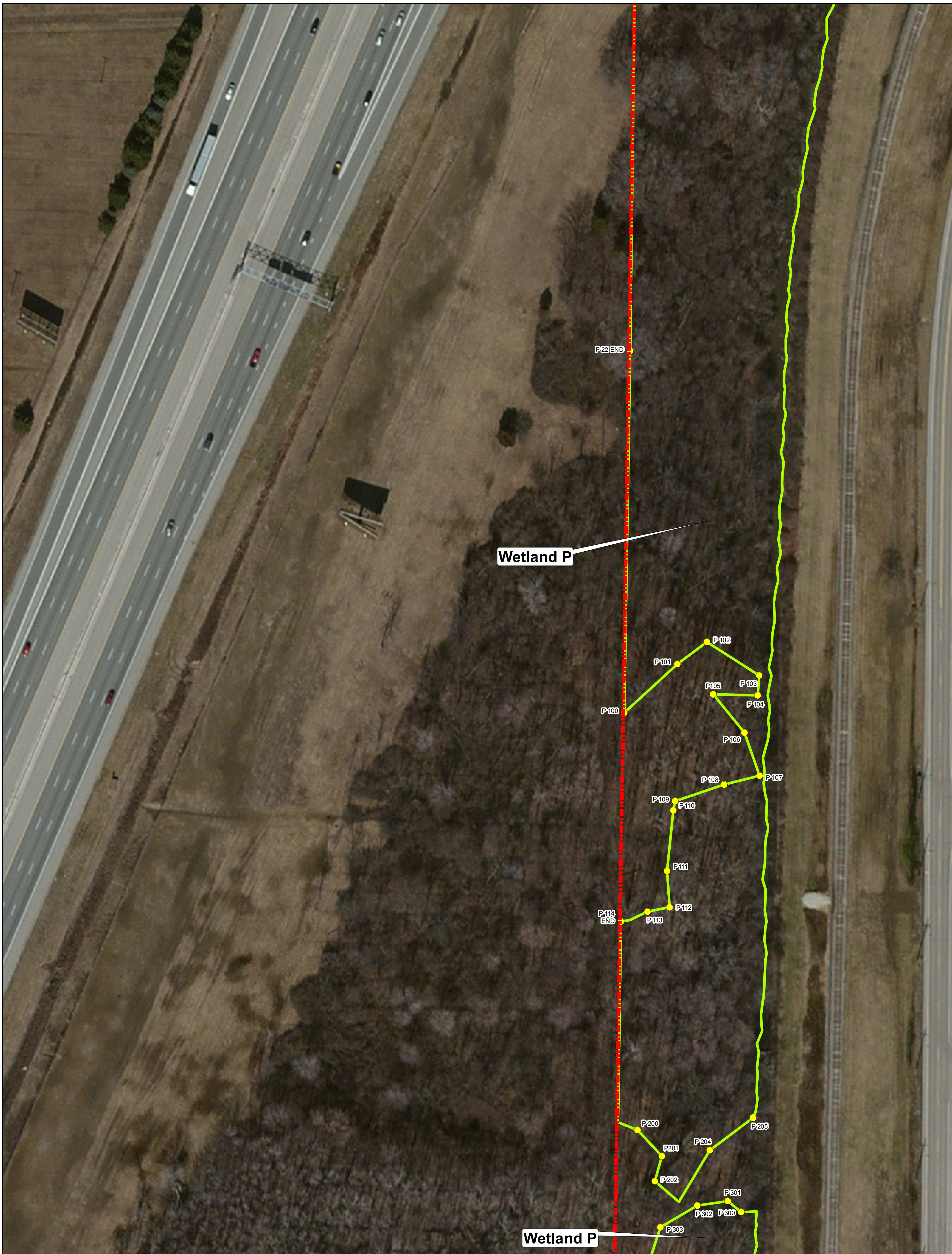

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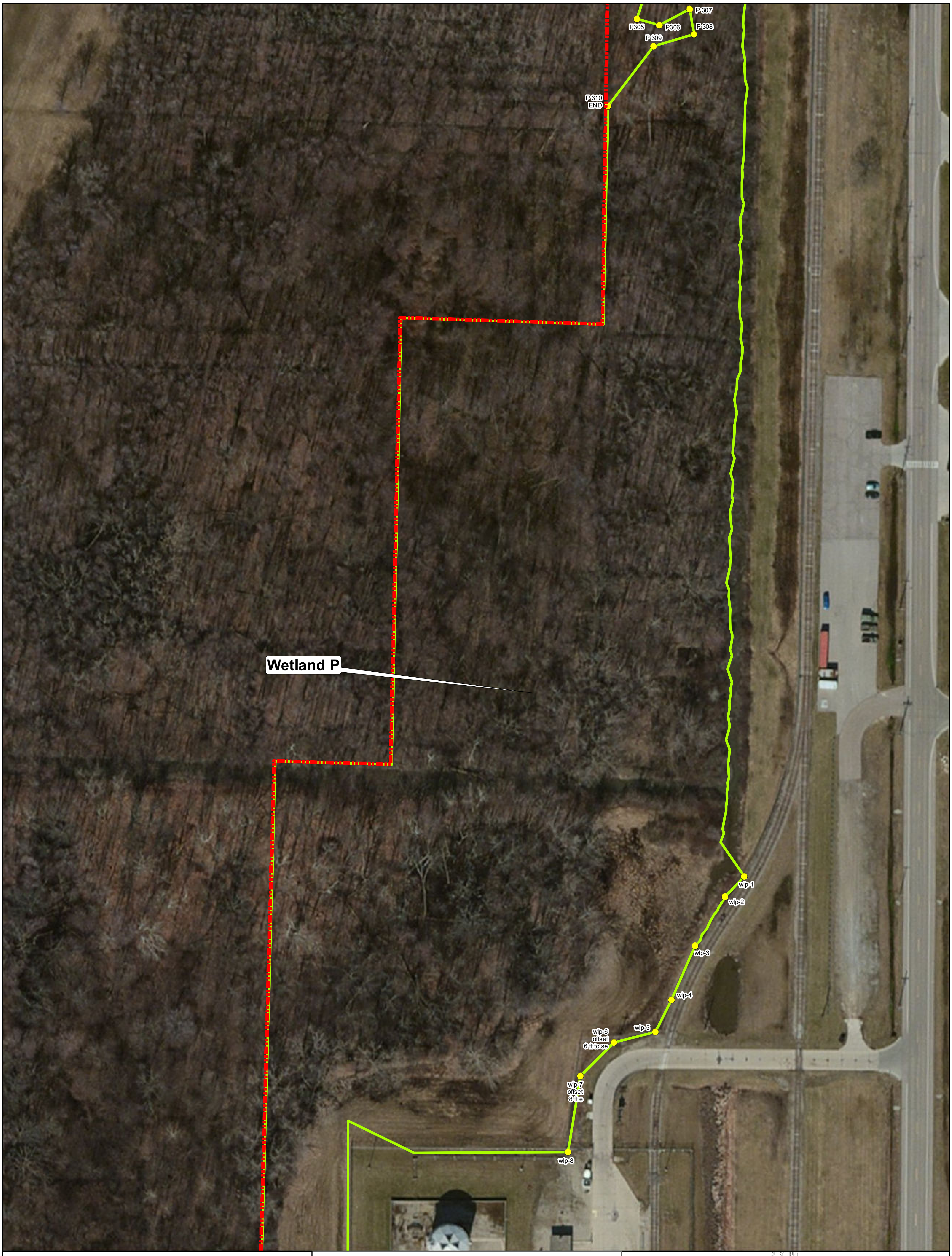

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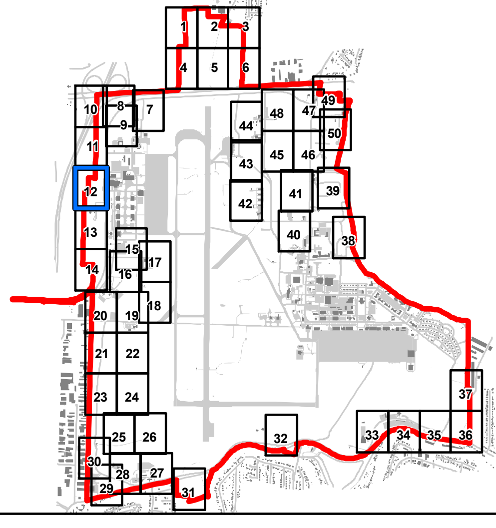

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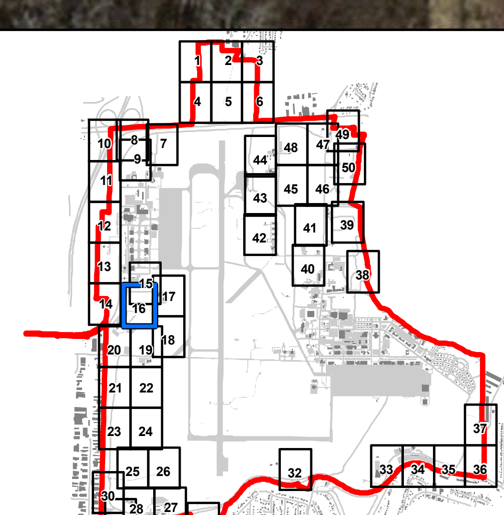

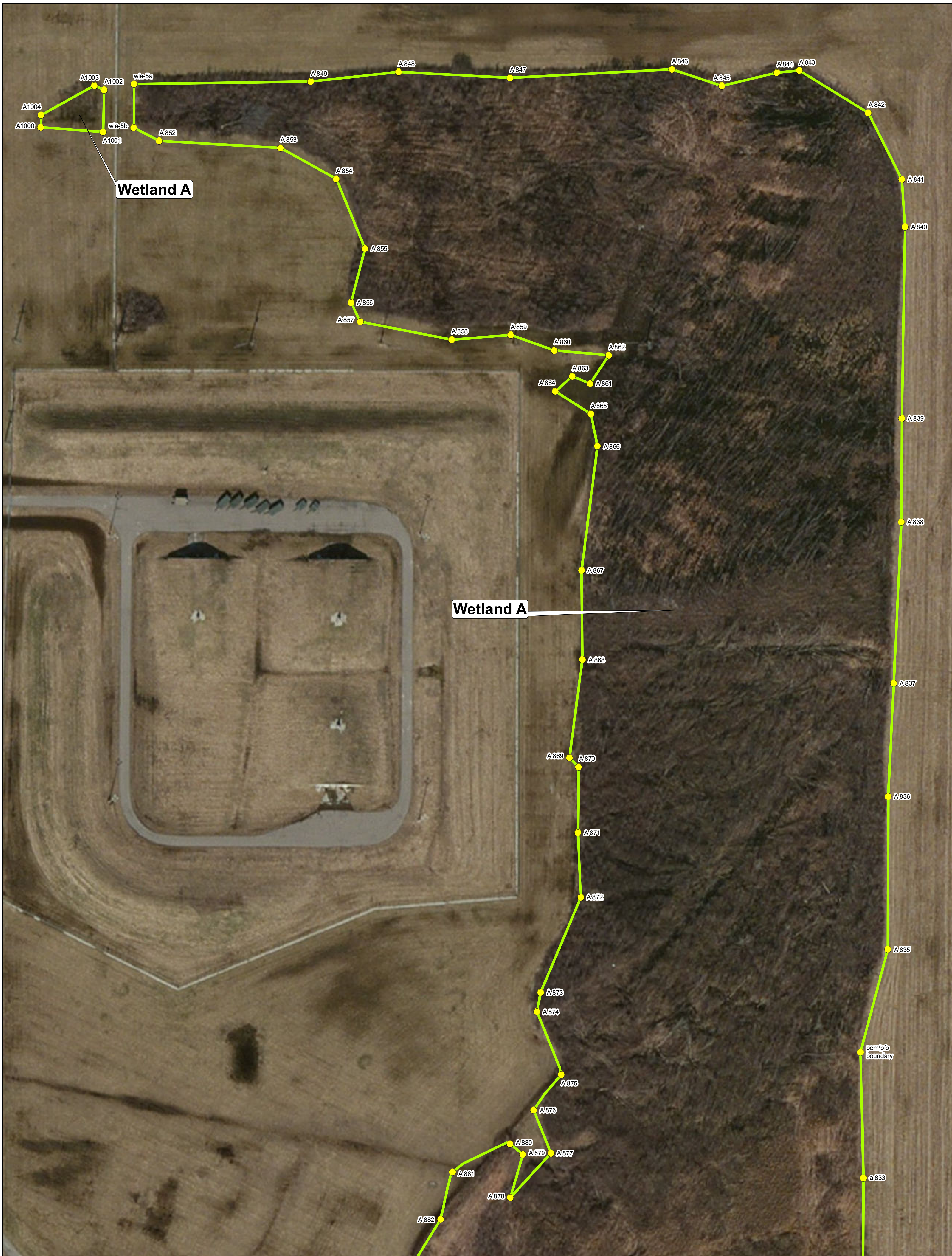

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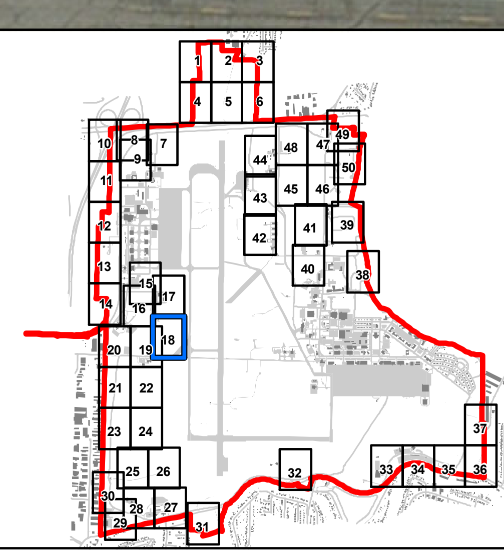

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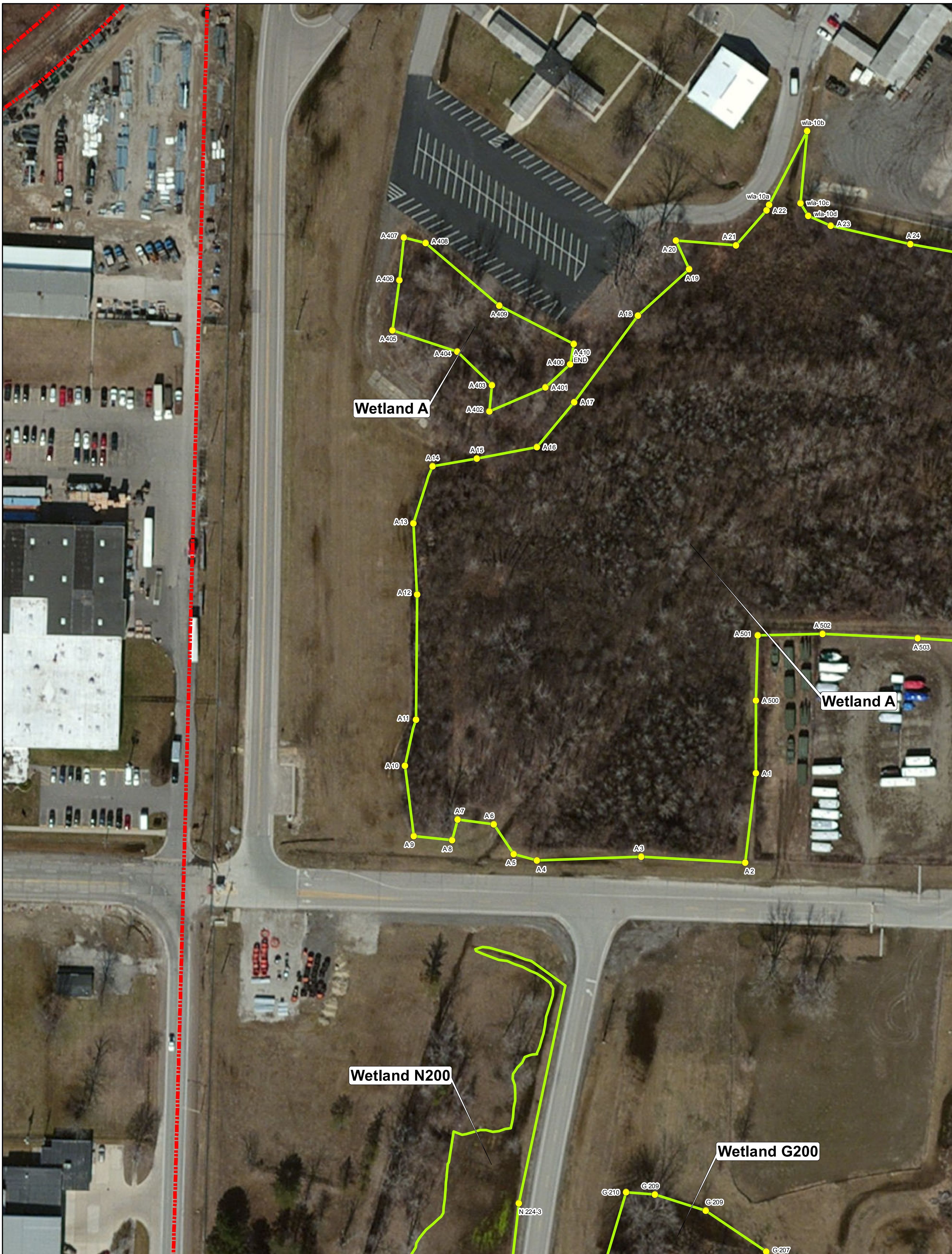

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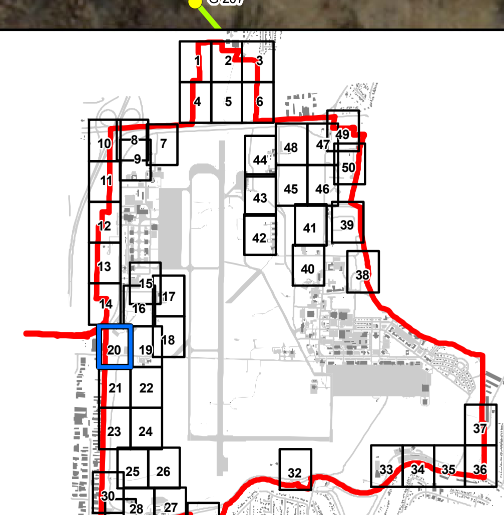

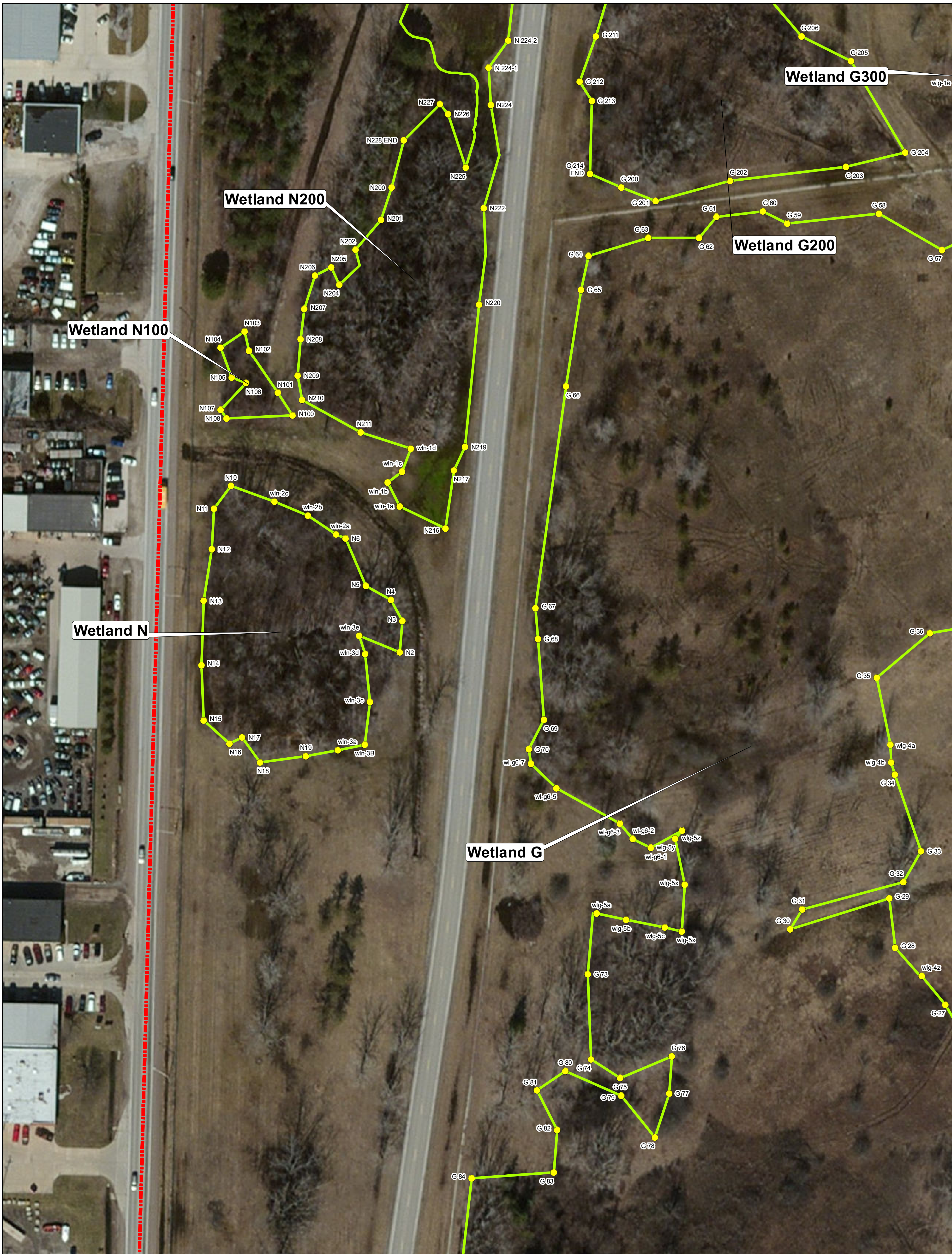

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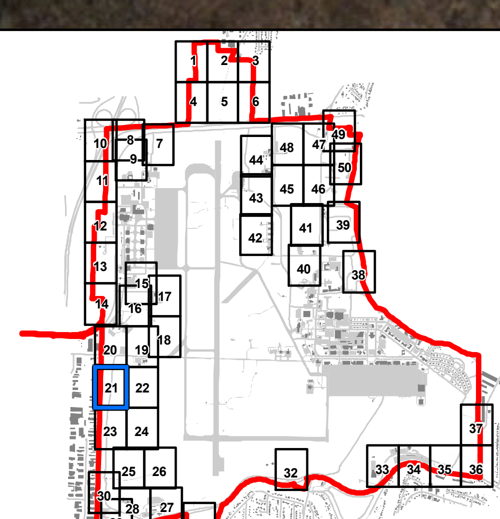

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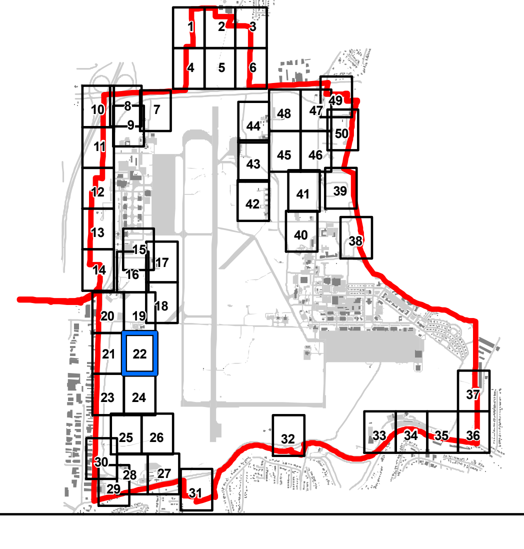

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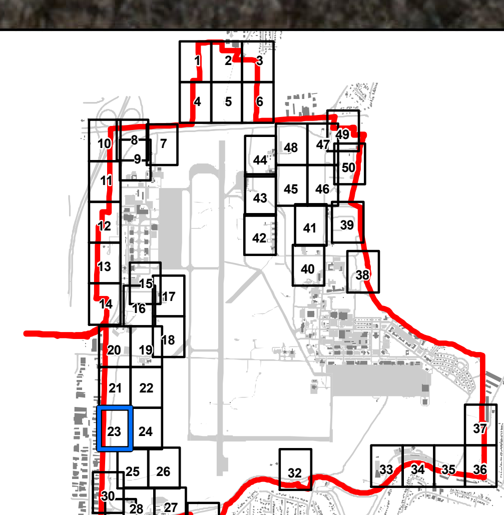

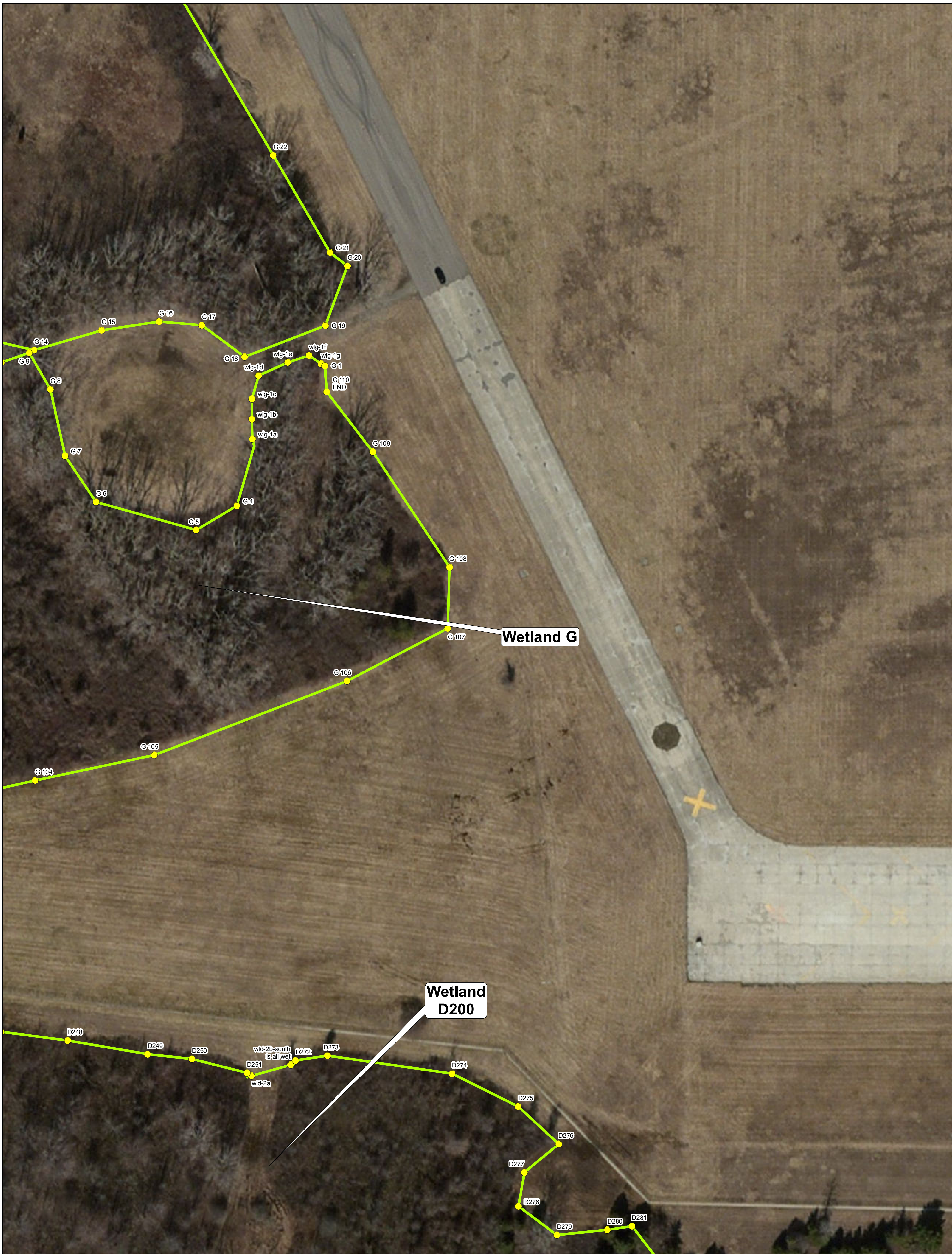

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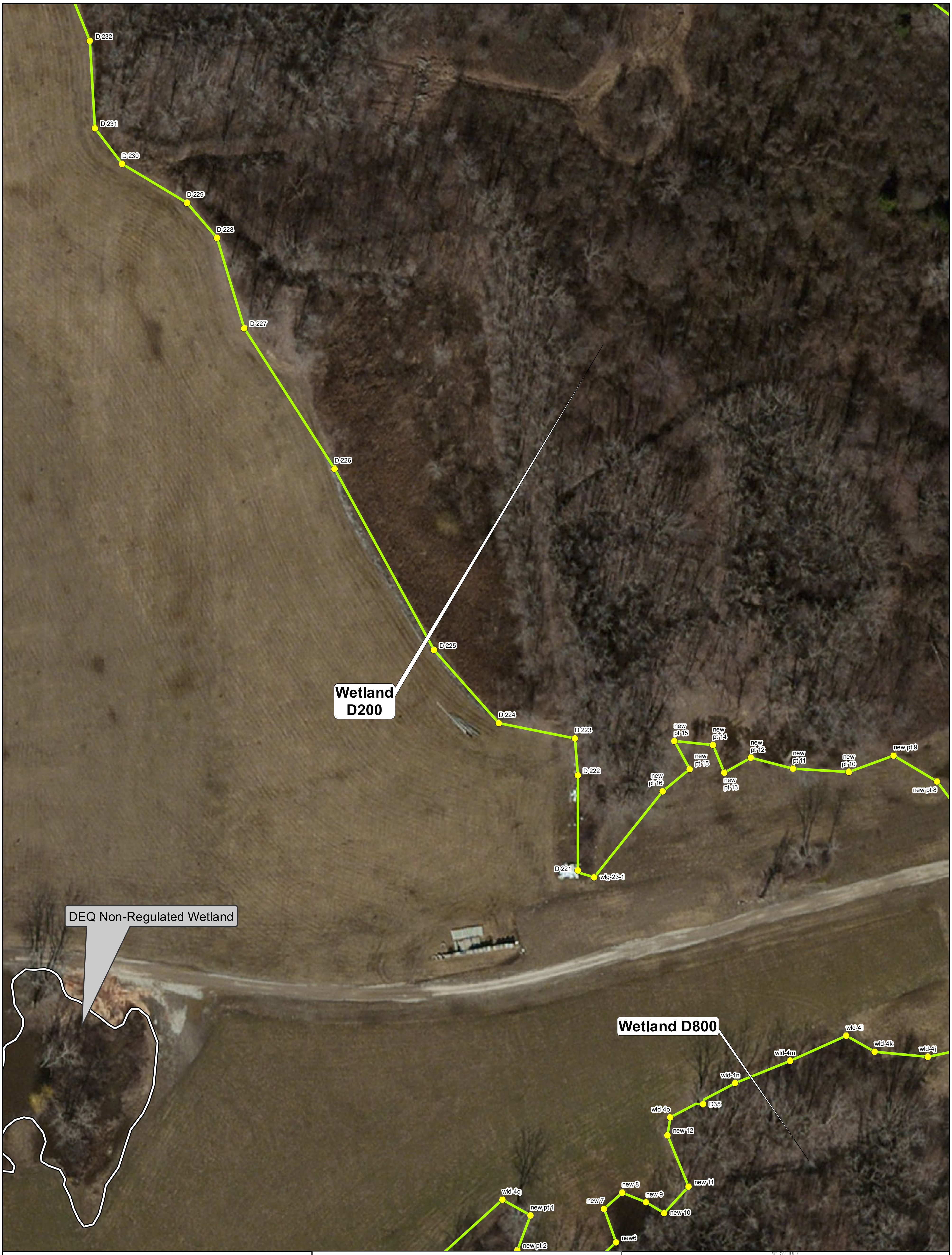

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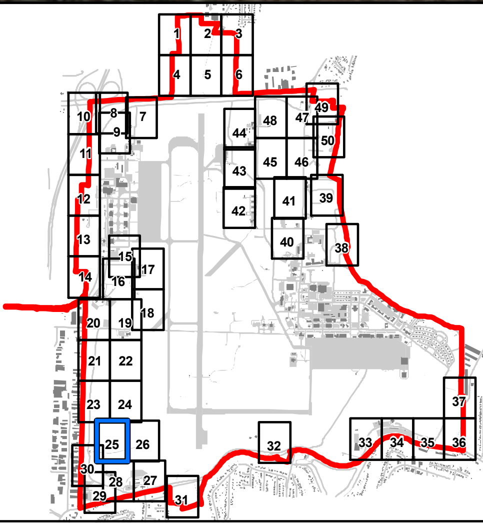

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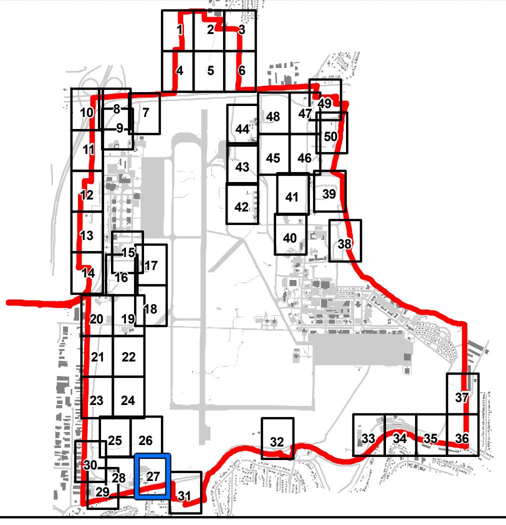

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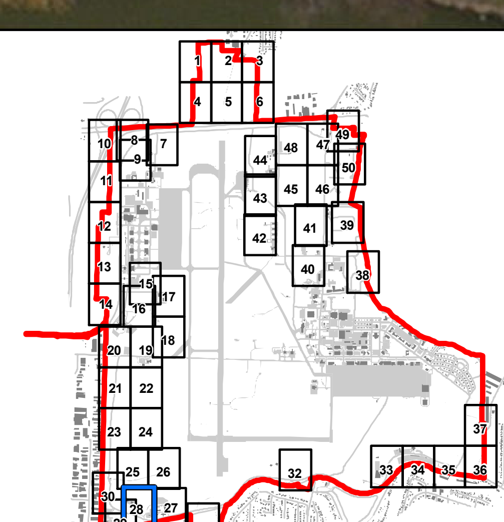

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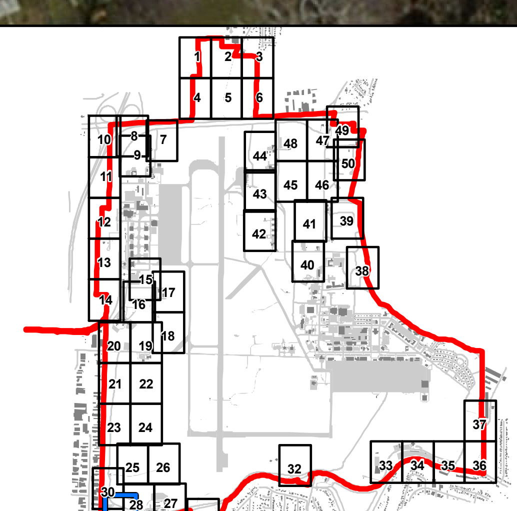

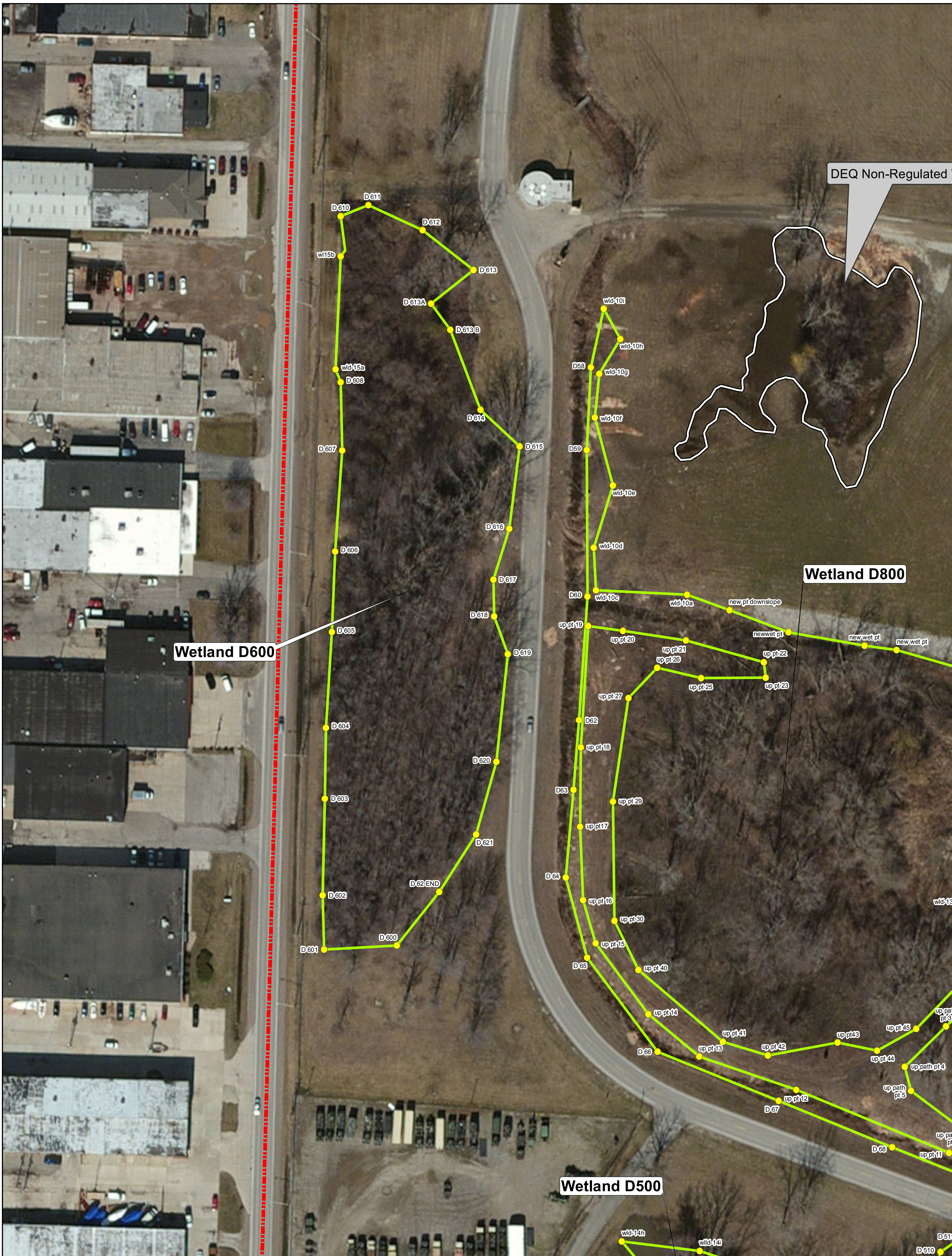

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0 10 20 40 Meters
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Page 31 of 50

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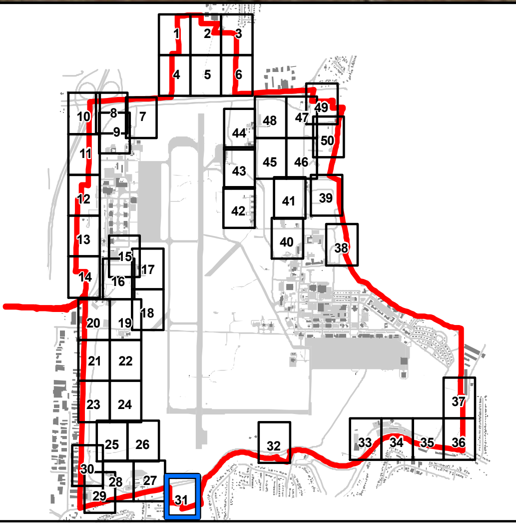

Page 32 of 50

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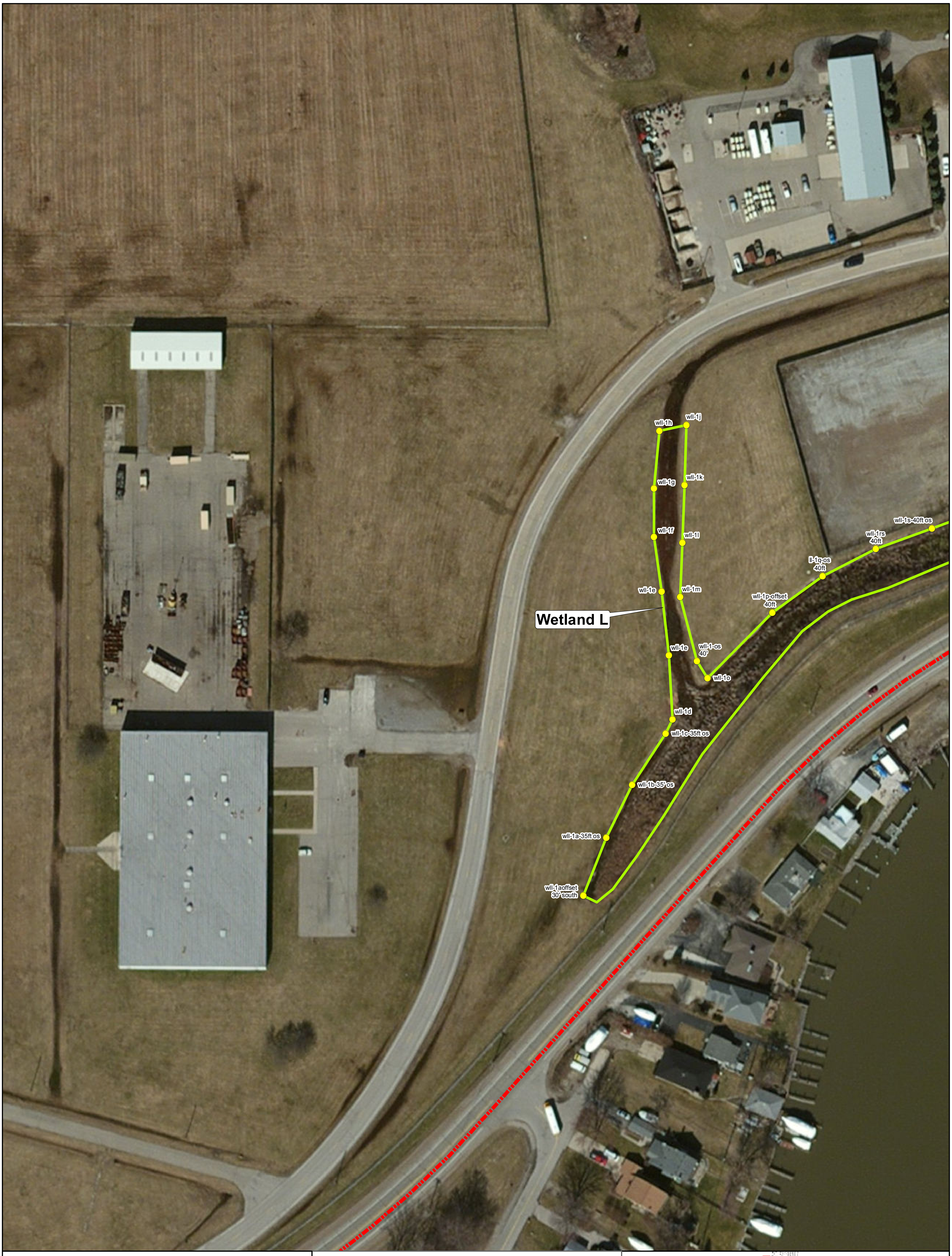

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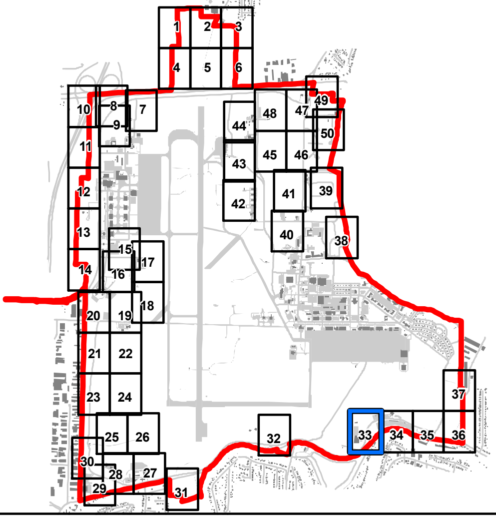

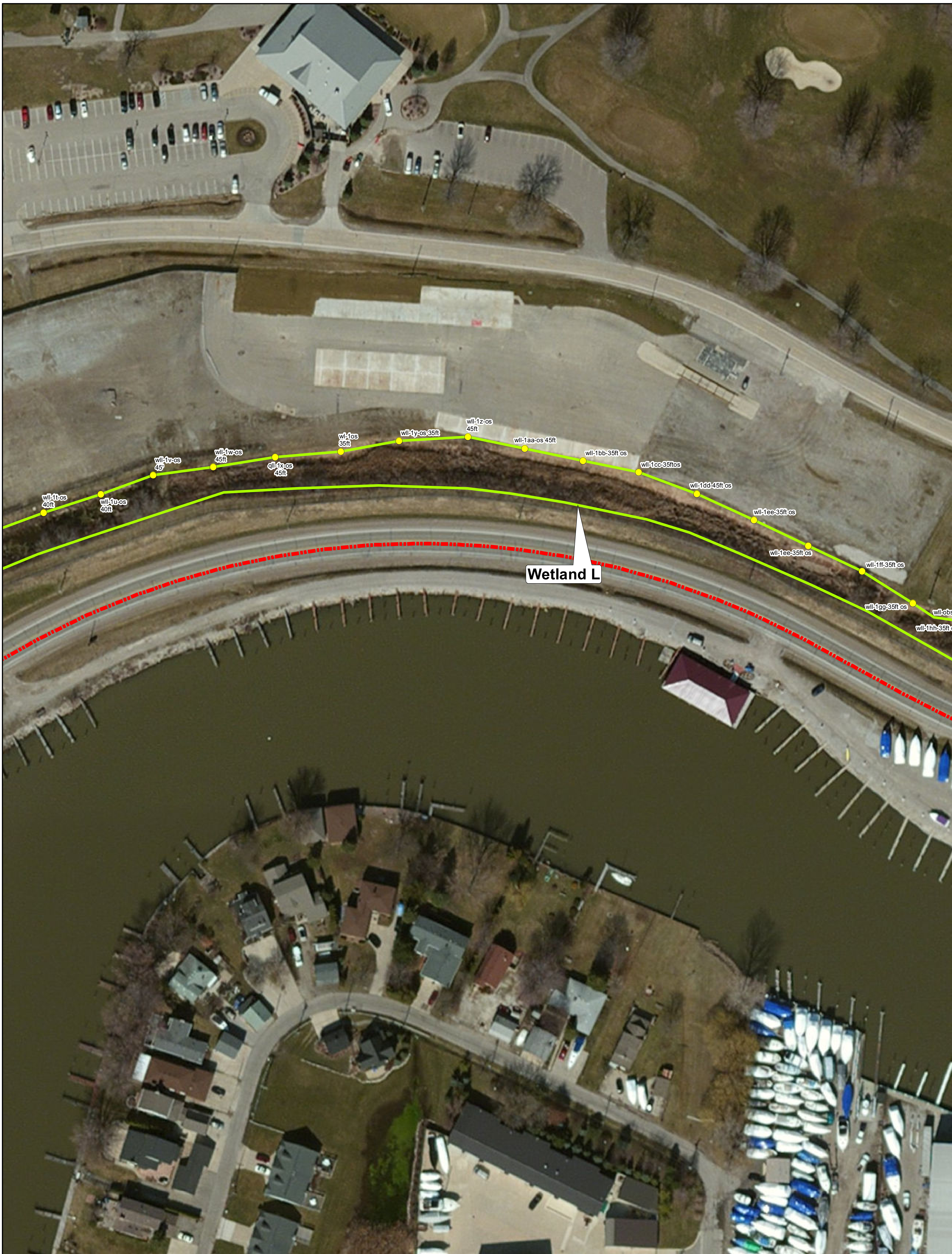

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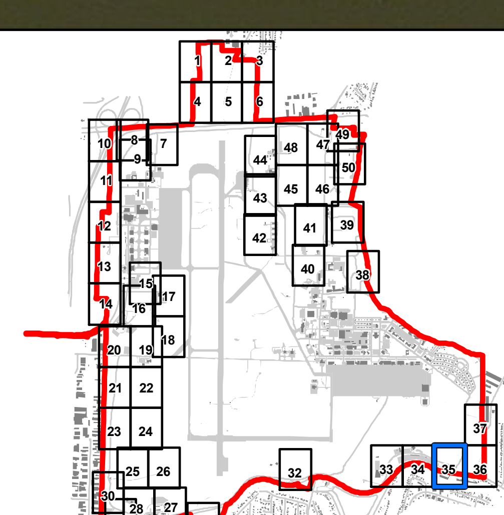

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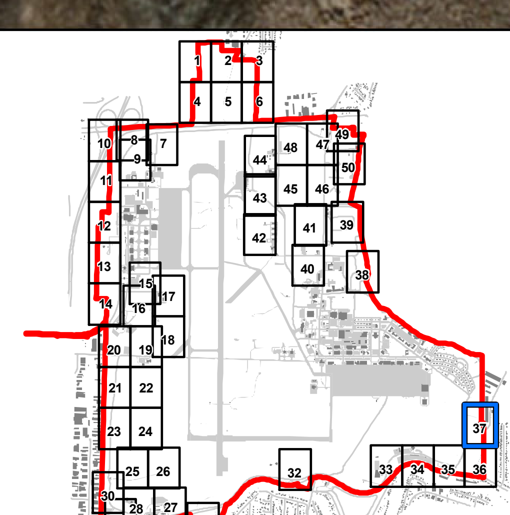

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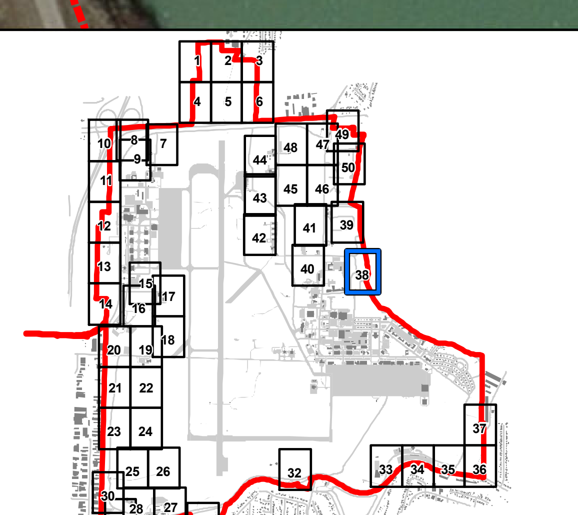

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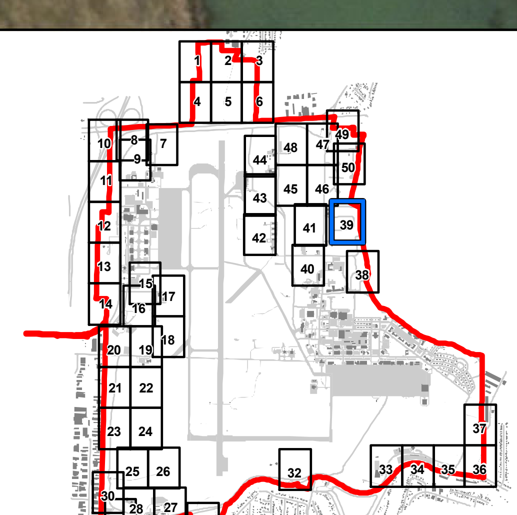

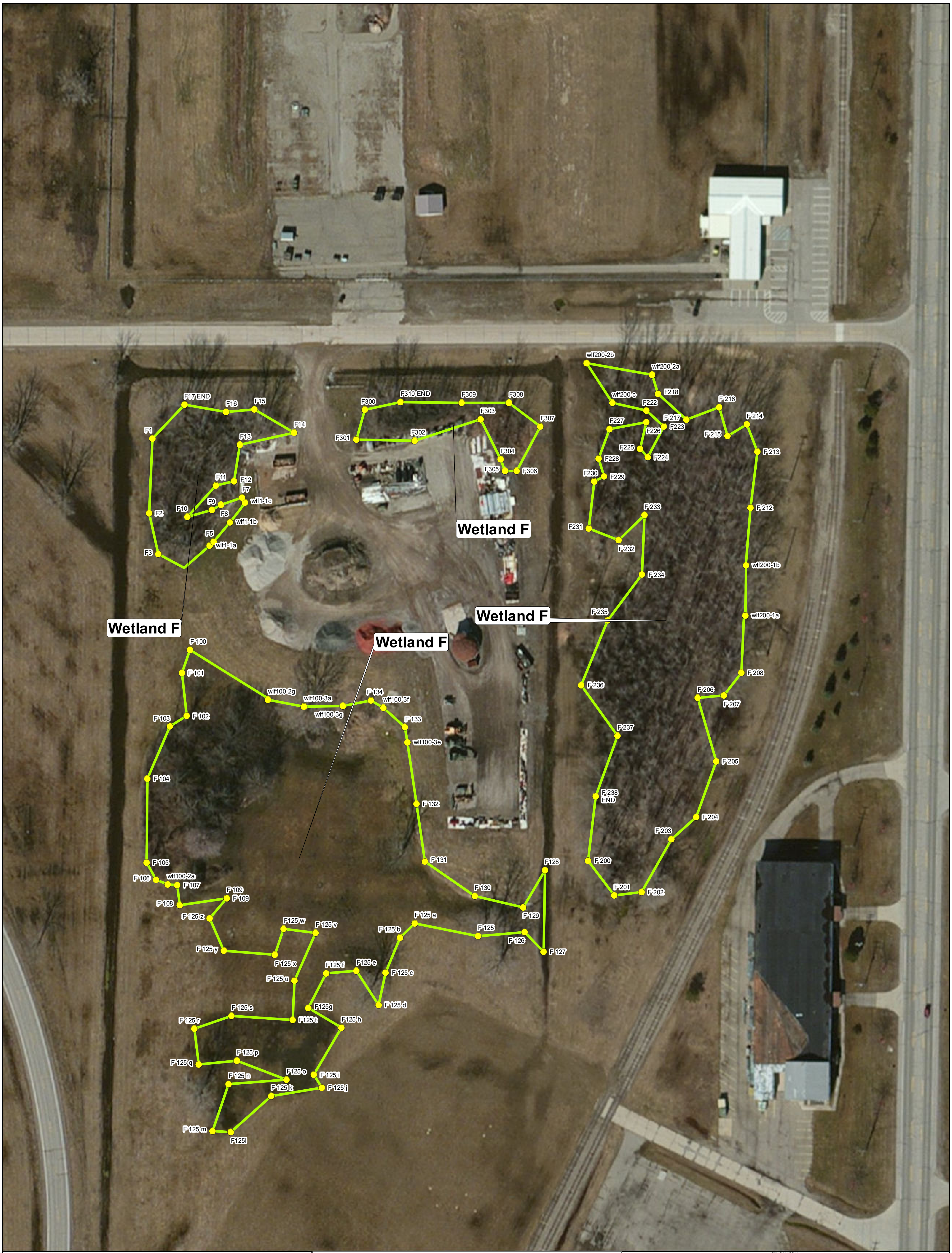

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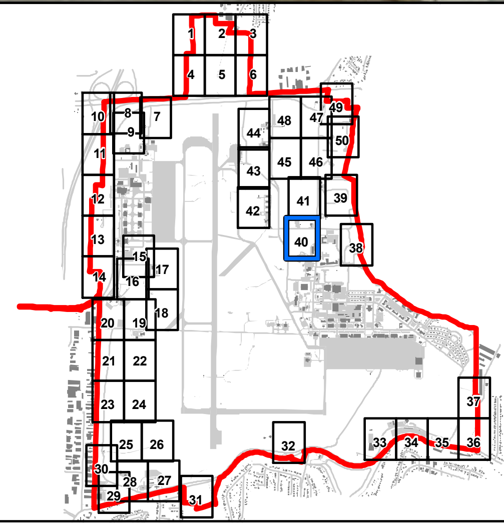

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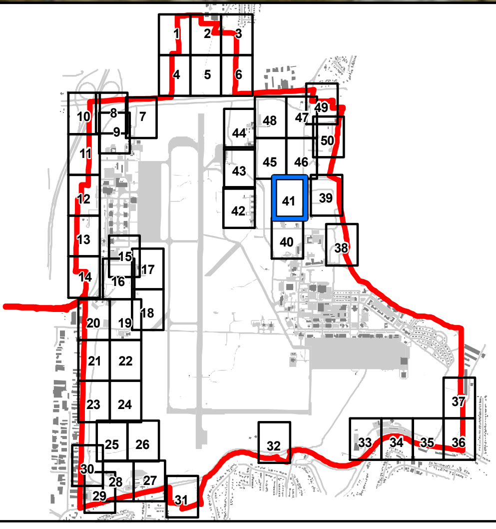

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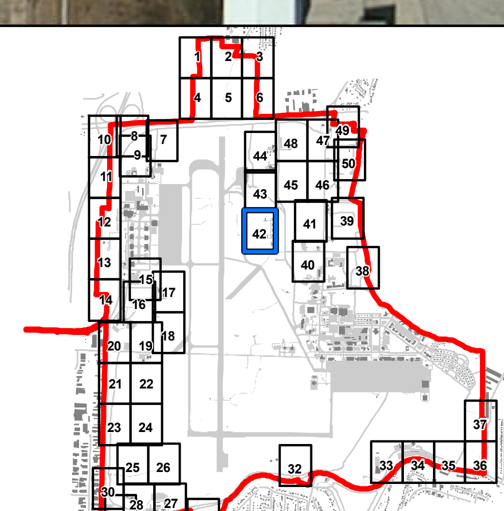

Page 43 of 50

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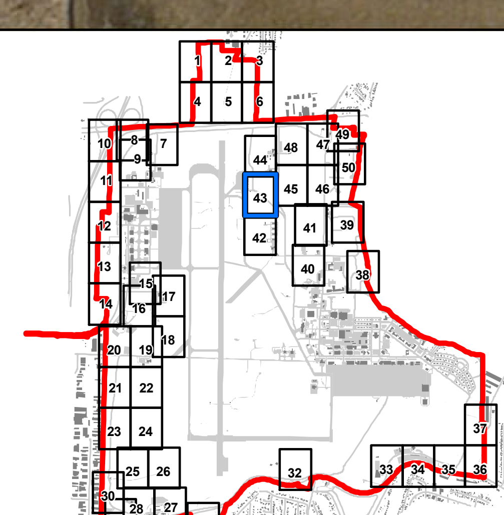

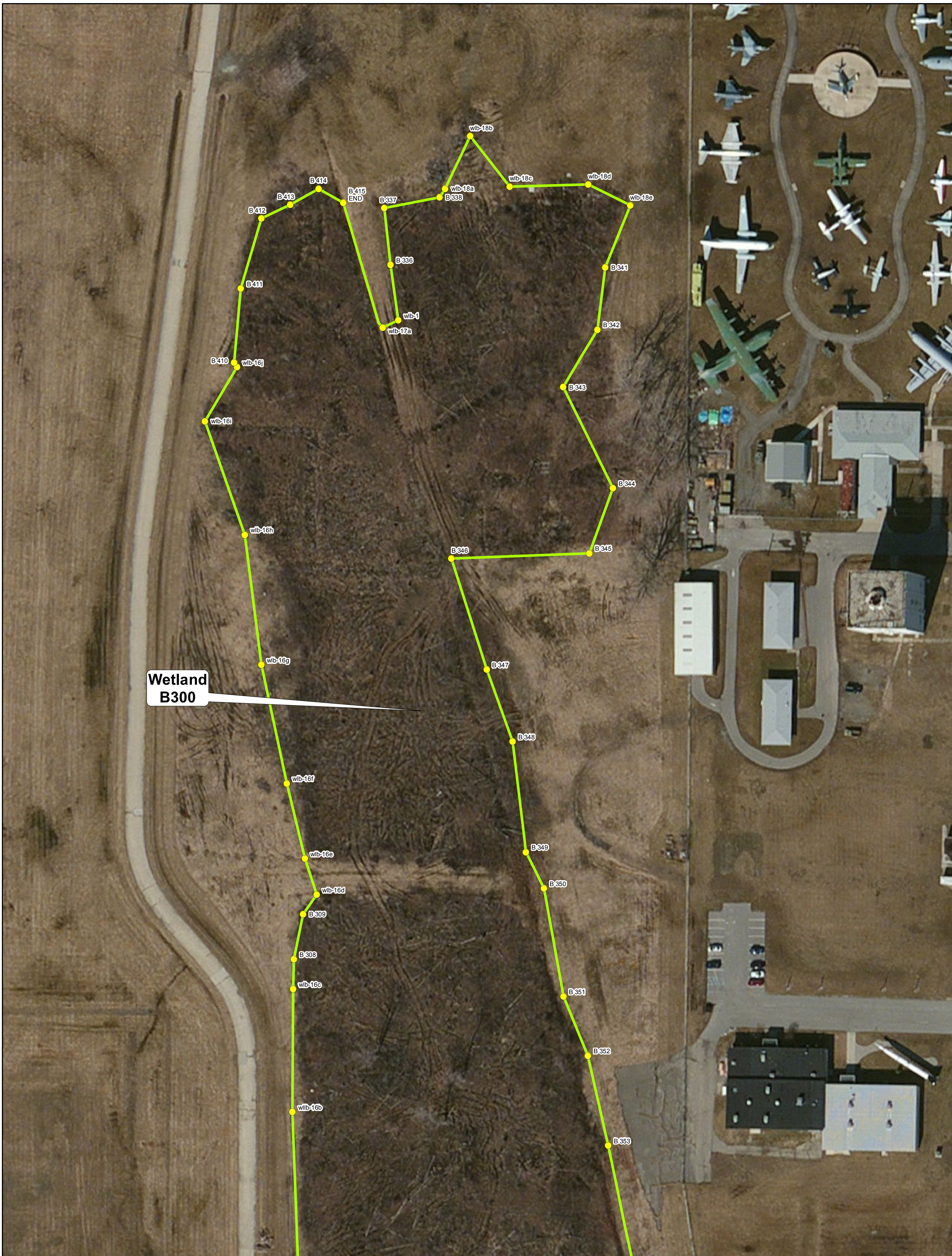

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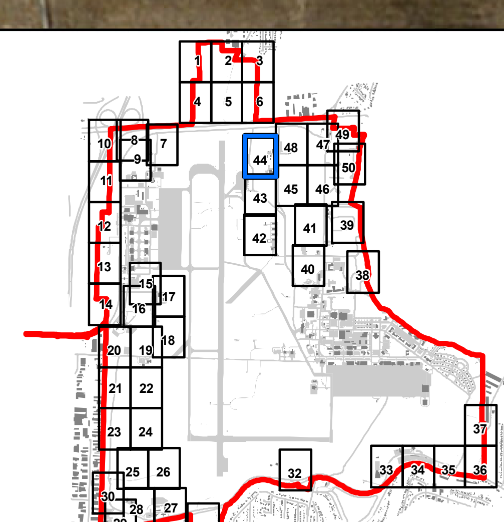

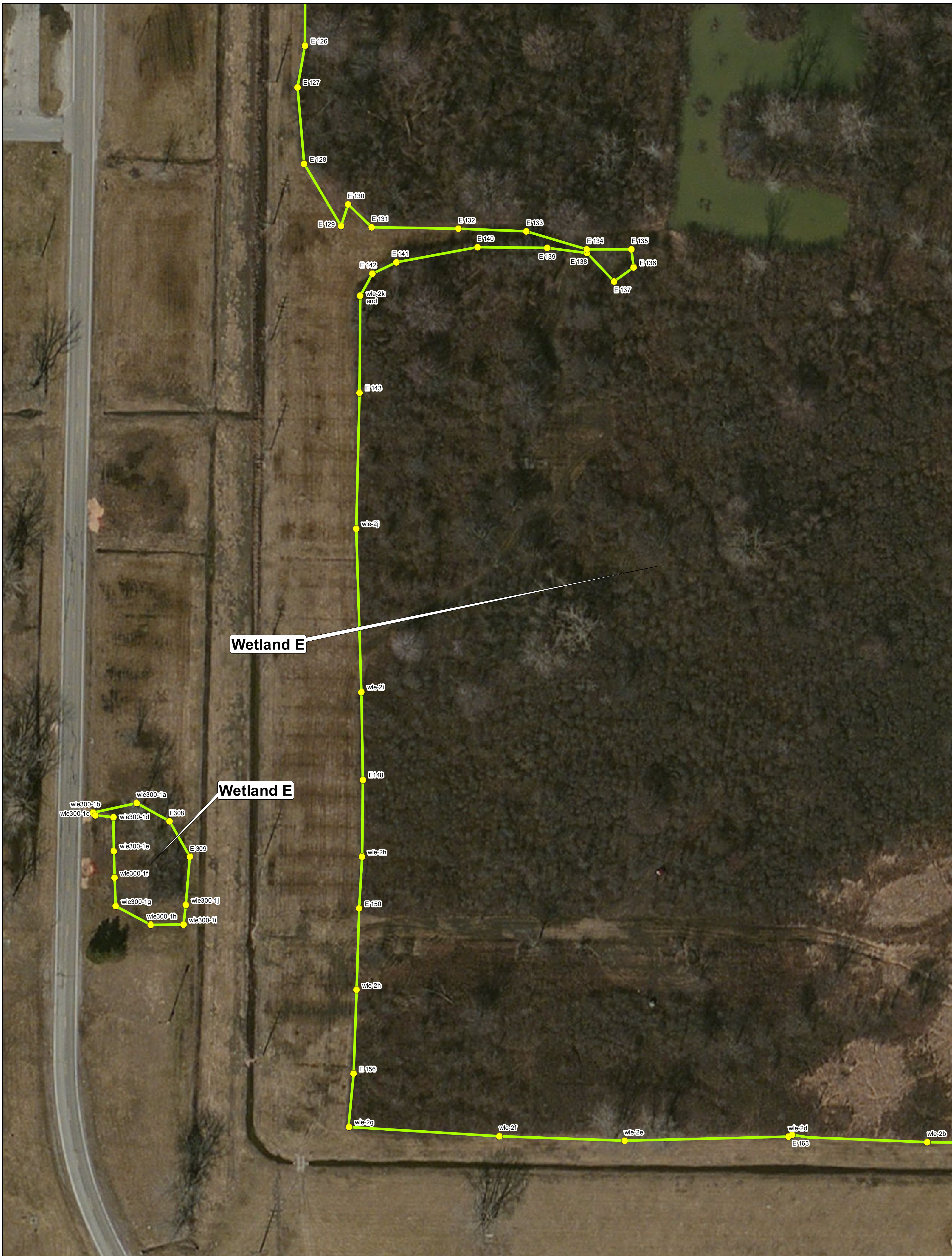

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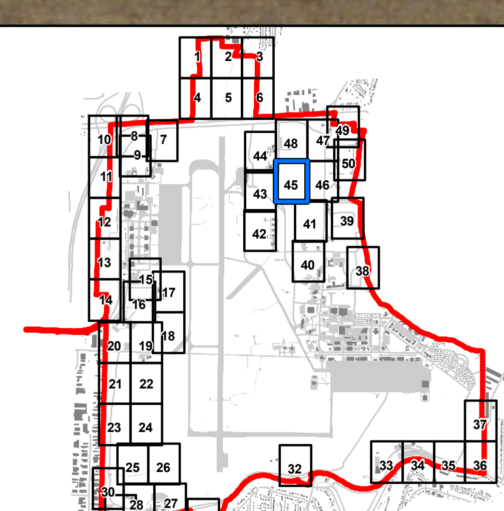

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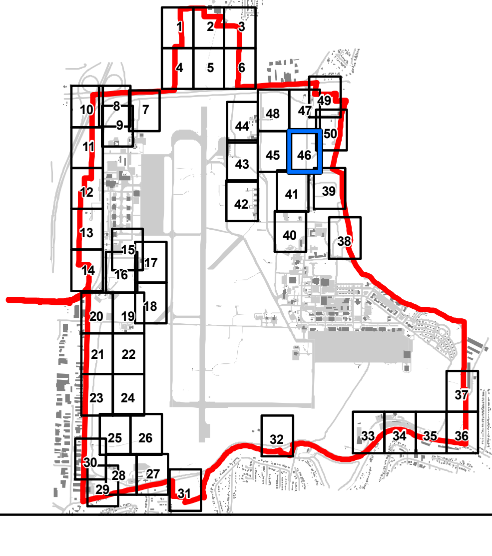

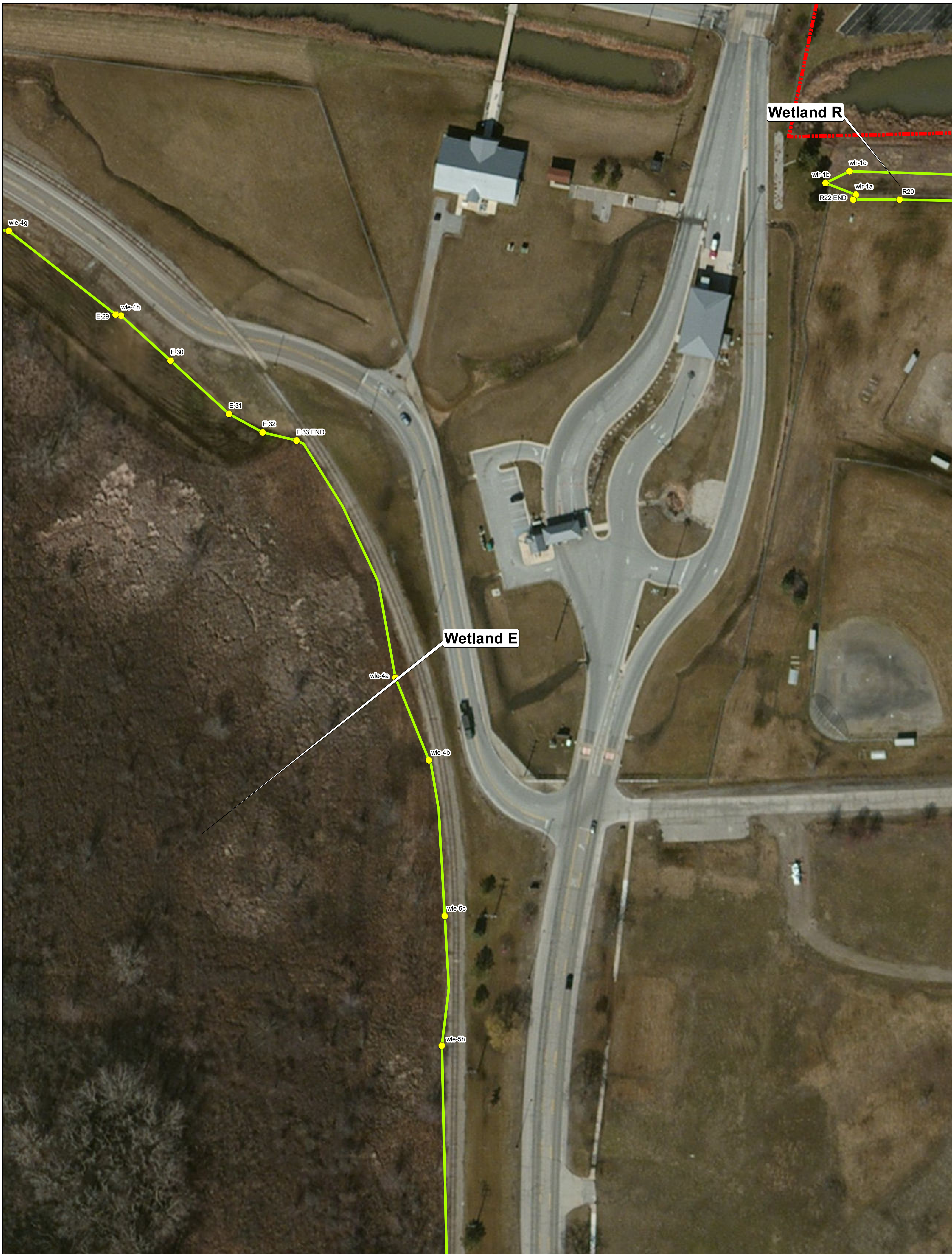

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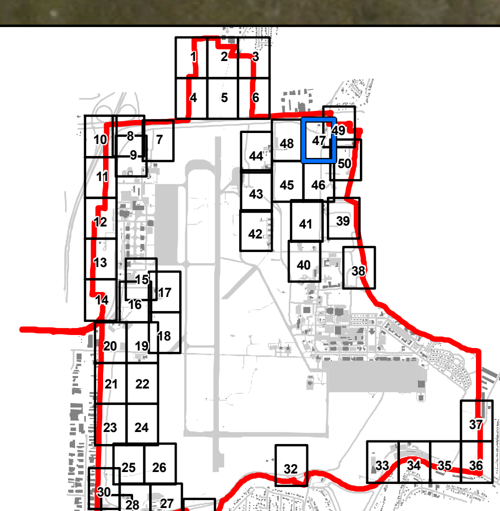

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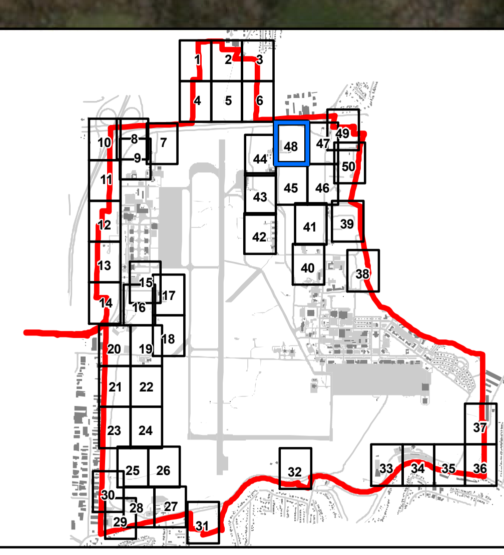

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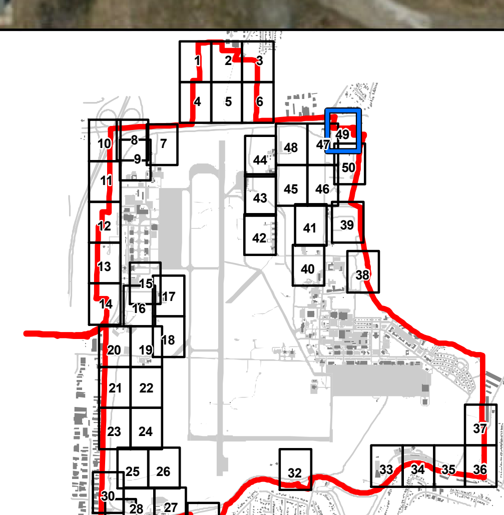

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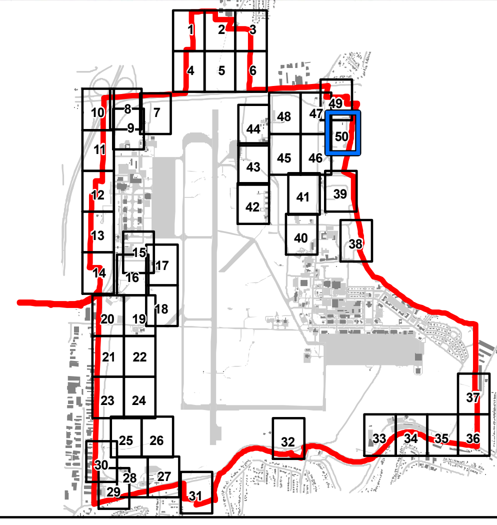
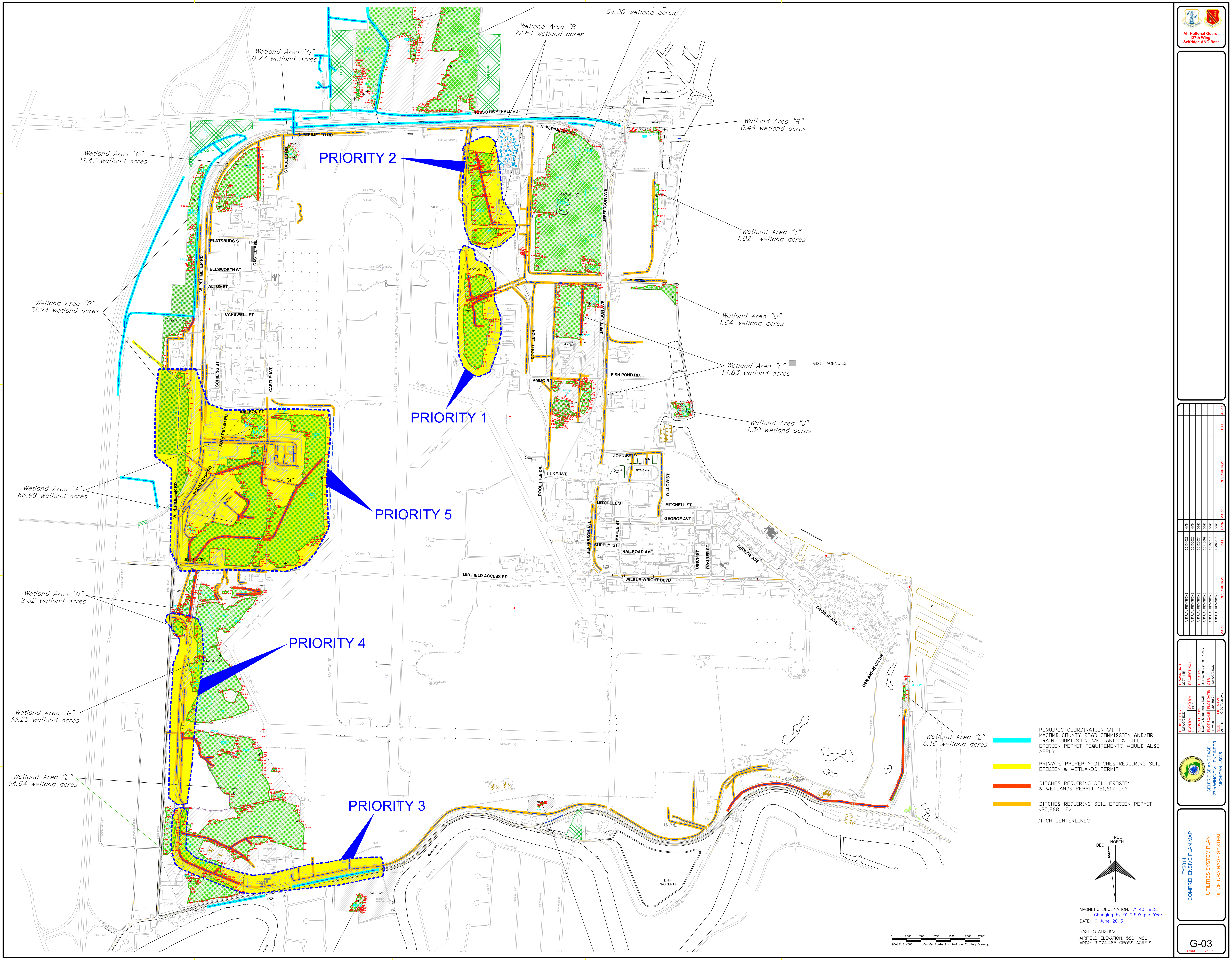


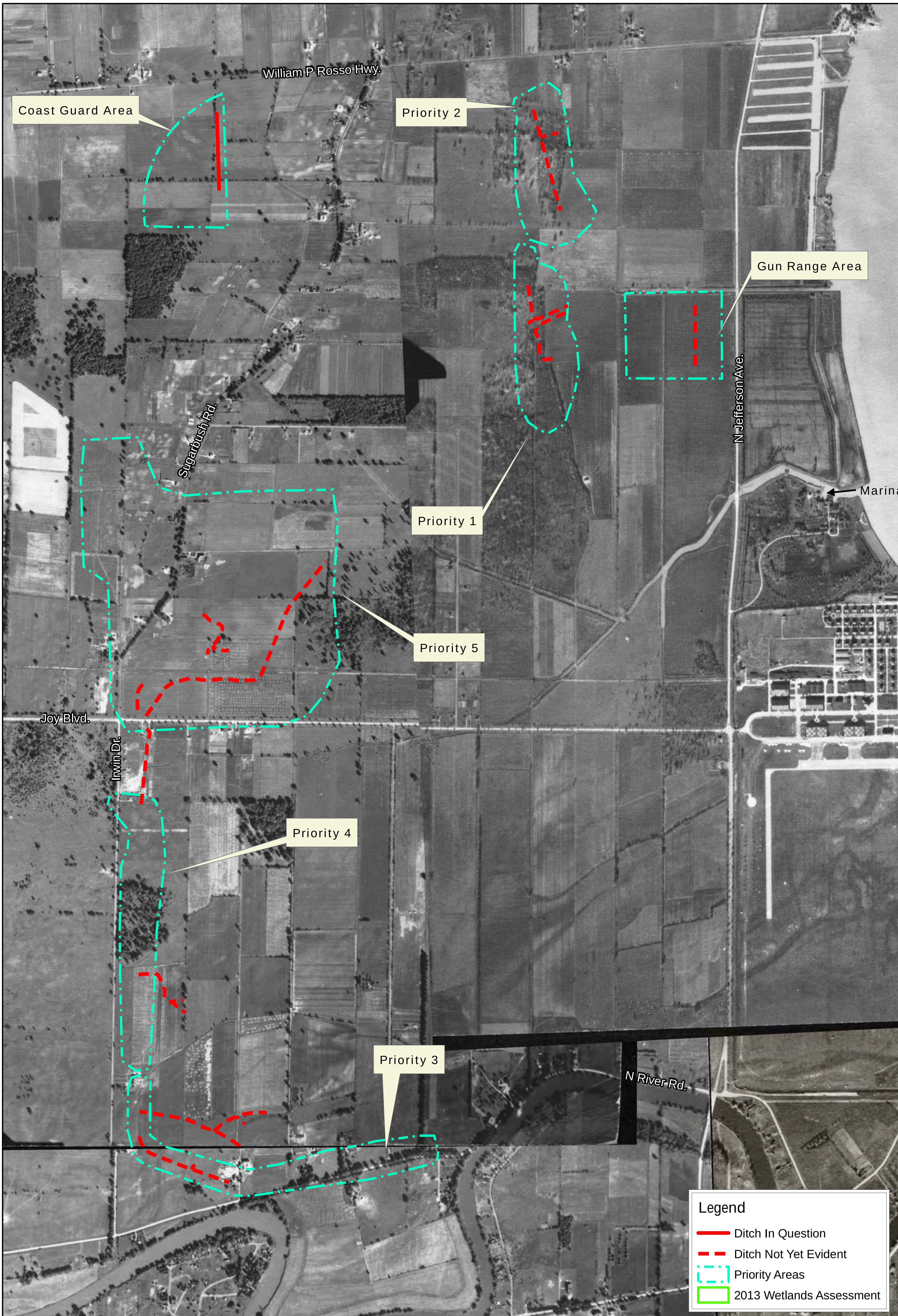


SUBMITTED ON 6 Jun 2013
SELFRIDGE ANG BASE, MICHIGAN, 127WG/CE

APPENDIX C
Historic SANGB Aerials

Table 1: Aerial Photograph Review

Priority Area Designation								
Photograph Year	**Overall SANGB Development**	**Gun Range Area**	**Coast Guard Area**	**Priority 1**	**Priority 2**	**Priority 3**	**Priority 4**	**Priority 5**
1940	Base development is limited to east side of N. Jefferson Ave.; large agricultural drains within center of property discharging to Lake St. Clair at current marina location.	Area consists entirely of agricultural field; apparent ditch located along western boundary of current Wetland F; ditch in question non-existent.	Area consists entirely of agricultural field; the ditch in question appears to be an agricultural drain that extends south beyond the Coast Guard Area.	Area consists entirely of agricultural field; the ditch in question is non-existent.	Area appears to be a combination of both agricultural field and scattered trees/scrub. An east/west oriented ditch runs through Priority 2; however, the north/south ditch that exists today is not evident.	Area generally parallels N. River Rd. and consists entirely of land in agricultural use including a farmstead; ditches in question do not exist.	Area consists entirely of land in agricultural use; ditches in question do not exist.	Area consists entirely of land in agricultural use; northern-most ditche in question apparent as an agricultural ditch; remaining ditches in question do not exist.
1949	Base development expanded to west of N. Jefferson Ave.; perimeter roads evident; majority ofexisting runways/taxiways constructed; large agricultural drain system evident in 1940 eliminated by airfield construction; agricultural drains replaced by storm water drains west of the runways.	Conditions unchanged from 1940.	Conditions unchanged from 1940.	A single, large ditch is evident and is part of the larger airfield storm water system created when the base runways/taxiways were constructed; the ditch in this Priorty represents the northern extent of the ditch system in Priority 5. Land surrounding the ditch appears to be in agricultural use.	Conditions unchanged from 1940.	One of the two drains in question apparent (the southern segment); appears to have been constructed for storm water, created as a roadside ditch along newly constructed S. Perimeter Rd.	Conditions unchanged from 1940; adjacent land converted to airbase runways/taxiways.	Several of the ditches are evident, constructed as part of a large storm water management system servicing the airbase expansion; primary ditch in Priority 5 continues to the northeast into Priority 1; surrounding land remains in agricultural use.
1952	Runways/taxiways extended to the north; housing apparent on the east side of N. Jefferson Ave.; more storm water drainage construction/relocation evident on the west side of airfield due to the northern expansion; structures evident along Sugarbush Road.	Conditions unchanged from 1940.	Conditions unchanged from 1940.	The northern extension of the airfield under construction; single ditch in Priority 1 is seperataed from the remainder of the system in Priority 5; instead, new ditch segment created to flow north to Perimeter Road and on the west side of the north airfield extension. Land surrounding the ditch appears to be in agricultural use.	Area is no longer entirely in agricultural use due to the airbase expansion. Existing ditches are not evident.	Conditions unchanged from 1949.	Conditions unchanged from 1949; surrounding land disturbed likely from construction and development.	Development along Sugarbush Rd. evident; land surrounding drains in question remain in agricultural use.
1957	Structures evident in southwest corner of base; last segment of the major drain on the property is filled in for development leaving the marina as it exists today.	Ditch requiring maintenance is evident extending south beyond the Gun Range Area; area surrounding the ditch is open field or in agricultural use.	Conditions unchanged from 1940.	Ditches as they exist today are beginning to become evident; the single ditch is now divided into two separate ditch lines. Surrounding land becoming vegetated.	Existing ditches becoming evident; appear to be conveying storm water from surrounding development and discharging to the north near N. Permimeter Rd.; portions of the land surrounding the ditches consist of field and scrub.	Major development apparent on north side of southern ditch segment; second (northern) ditch segment apparent constructed as part of the development; surrounding land is cleared.	Conditions unchanged from 1952; development evident along Joy Blvd.	Conditions unchanged from 1952 with the exception of the southeast corner of Priority 5 which appears to be no longer used in agriculture.
1962	Extensive development evident in northwest corner of base bound by Sugarbush Rd. and Plattsburg St.; entire drainage system in this area elminated; Falcon/Doolittle Drive with additional development evident in northeast corner of base; drainage in this area also significantly altered.	Conditions unchanged from 1962.	Significant development is evident just south of the Coast Guard Area; the southern extent of the ditch in question is apparently filled for this development. The area no longer appears to be actively used for agriculture.	Falcon Drive to the north and Doolittle Drive to the east now exist. Development is evident betweend Priority 1 and Doolittle Drive. Land surrounding ditches are beginning to vegetate.	Land appears cleared; ditches in question apparent; appear to be servicing surrounding development to the east.	Conditions unchanged from 1957.	All land in Priority 4 surrounding the drians in question is cleared; development along Joy Blvd. increasing.	All drians in question are apparent; surrounding land cleared with development increasing.
1997	With the exception of Ammo Rd. near the northeast corner of the base and some additional development north of Plattsburg St. in the northwest corner, base development is relatively unchanged.	Gun range is apparent between ditch in question and Ammo Road and the outlet to this ditch no longer appears to exist (southern portion of ditch appears filled in). Area surrounding ditch in question appears to be reverting to scrub vegetation.	Additional develop evident surrounding the Coast Guard Area. Area appears to be forested.	Area appears vegetated but unclear with regard to wetland.	Unchanged from 1962 with the exception of denser vegetation.	Conditions unchanged from 1962; however, land surrounding development is more densely vegetated where it is not developed.	Conditions unchanged from 1962.	Conditions unchanged from 1962.
2004	With the exception of the housing that no longer exists east of N. Jefferson Ave. in the northeast corner of the base, the site appears as it exists today.	Conditions unchanged from 1997; however, area surrounding the ditch in question appears to exist as designated Wetland F.	Wetland C as it currently exists is evident.	Unchanged from 1997. Forested vegetation approximates the boundaries of Wetland B.	Unchanged from 1997. Forested vegetation approximates the boundaries of Wetland B.	Southern ditch is a roadside ditch separated by upland from Wetland D; areas left unmaintained outside of development consist of forest largely part of Wetland D.	Conditions unchanged from 1997; areas of Wetland G are unmaintained forest and scrub land.	Conditions unchanged from 1997; areas of Wetland A are unmaintained forest.



Selfridge ANGB Ditch Maintenance

Harrison Charter Township, MI

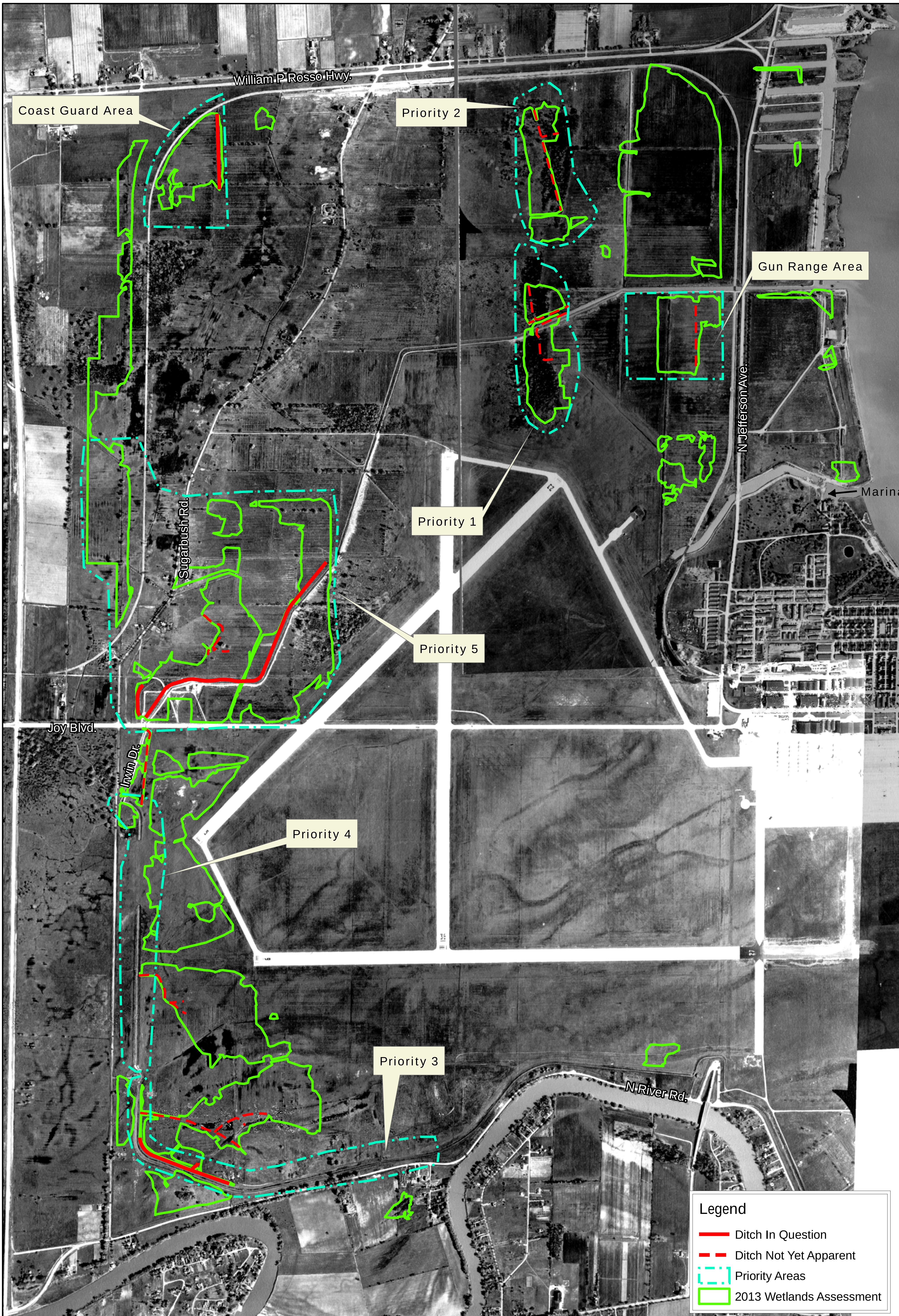
0 500 1,000 2,000 Feet

©

Client: Anderson, Eckstein & Westrick

Created by: WAD, March 23, 2016, ASTI Project 9374

Historic Aerials - 1940



Selfridge ANGB Ditch Maintenance

Harrison Charter Township, MI

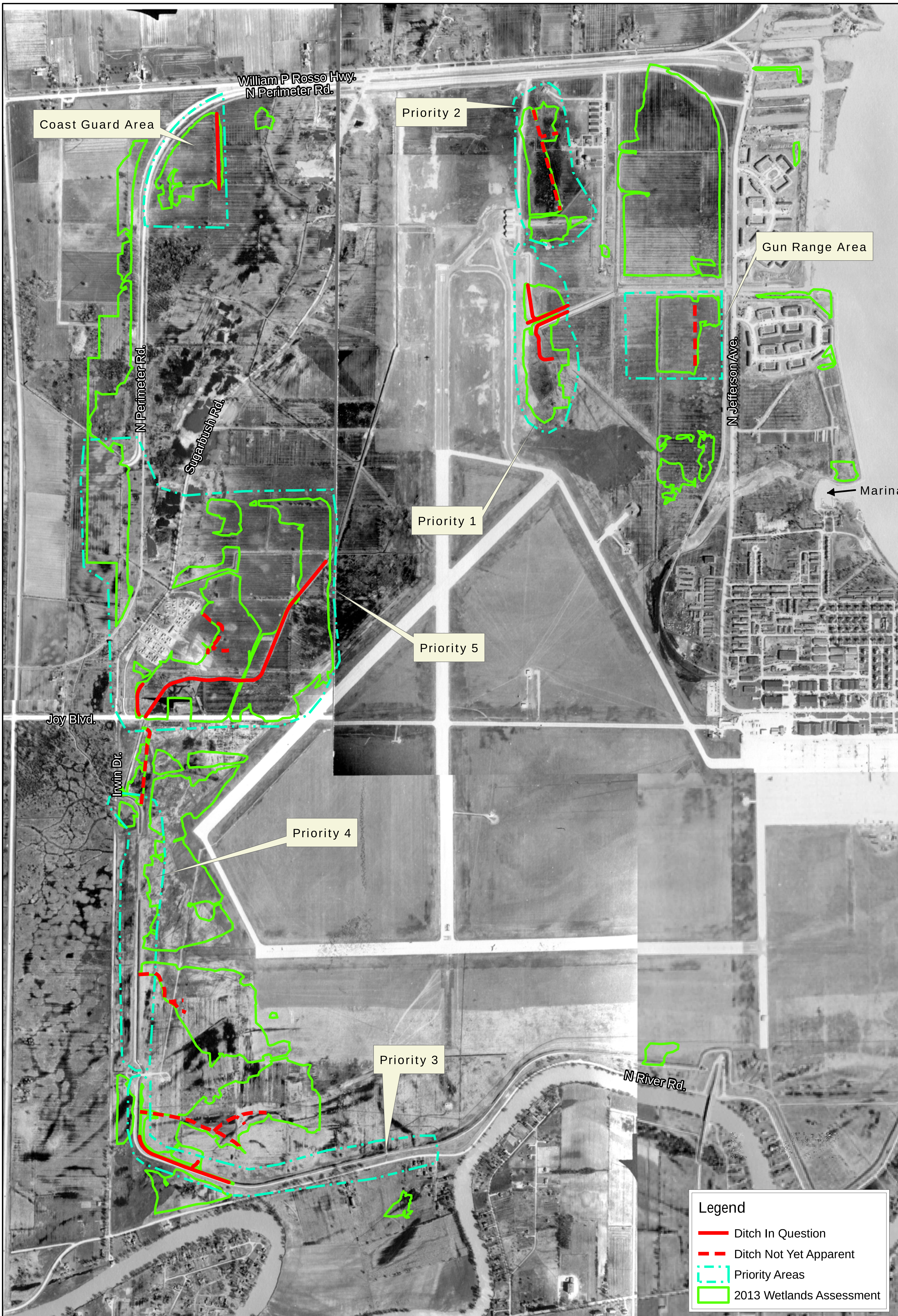
0 500 1,000 2,000 Feet

© ASTI Environmental

Client: Anderson, Eckstein & Westrick

Created by: WAD, March 23, 2016, ASTI Project 9374

Historic Aerials - 1949



Selfridge ANGB Ditch Maintenance

Harrison Charter Township, MI

Client: Anderson, Eckstein & Westrick

Created by: WAD, March 23, 2016, ASTI Project 9374

Historic Aerials - 1952

Selfridge ANGB Ditch Maintenance

Harrison Charter Township, MI

0 500 1,000 2,000 Feet

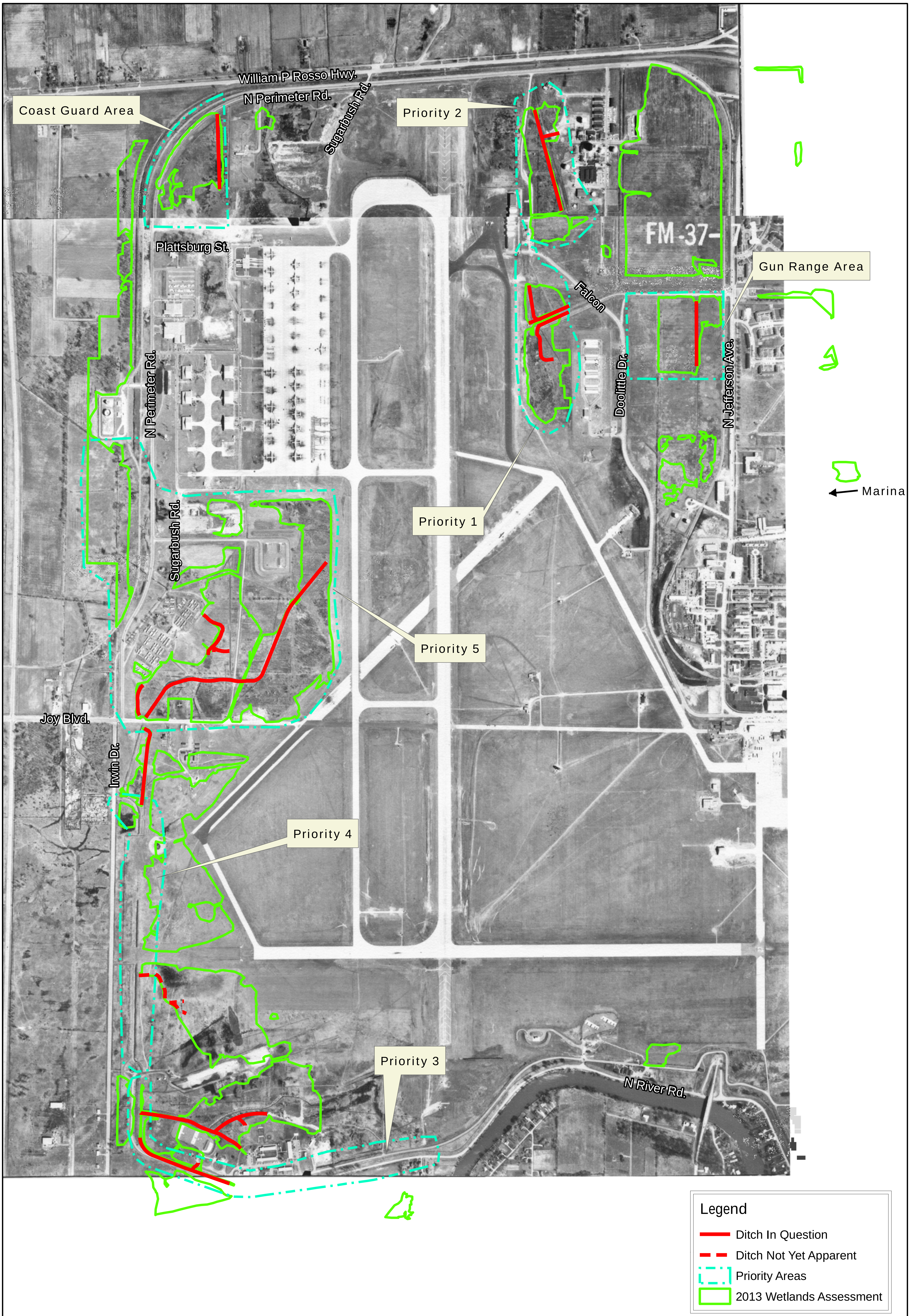
©

ASTI Environmental

Client: Anderson, Eckstein & Westrick

Created by: WAD, March 23, 2016, ASTI Project 9374

Historic Aerials - 1957



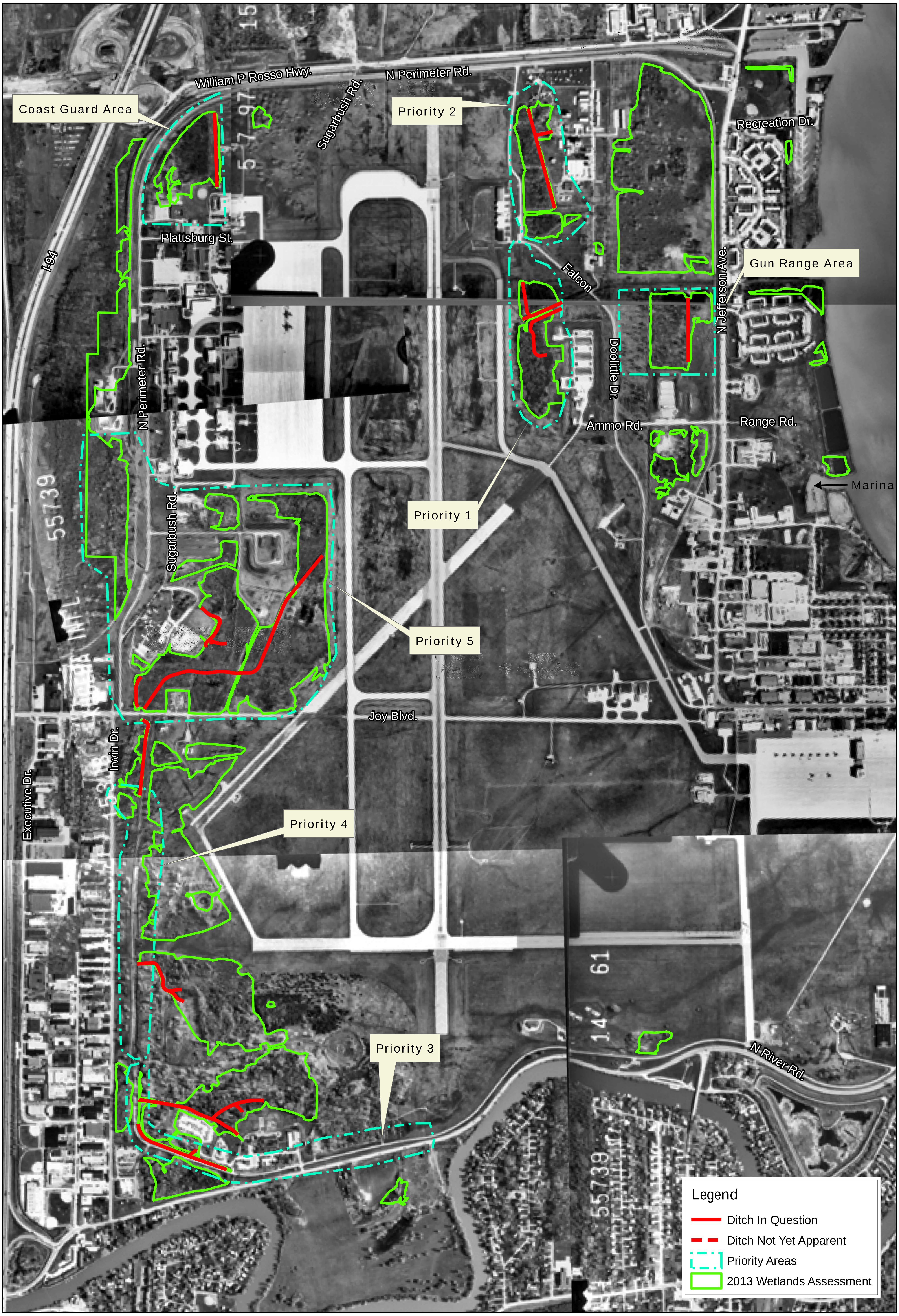
Selfridge ANGB Ditch Maintenance

Harrison Charter Township, MI

Client: Anderson, Eckstein & Westrick

Created by: WAD, March 23, 2016, ASTI Project 9374

Historic Aerials - 1962



Selfridge ANGB Ditch Maintenance

Harrison Charter Township, MI

Client: Anderson, Eckstein & Westrick

Created by: WAD, March 23, 2016, ASTI Project 9374

Historic Aerials - 1997

Selfridge ANGB Ditch Maintenance

Harrison Charter Township, MI

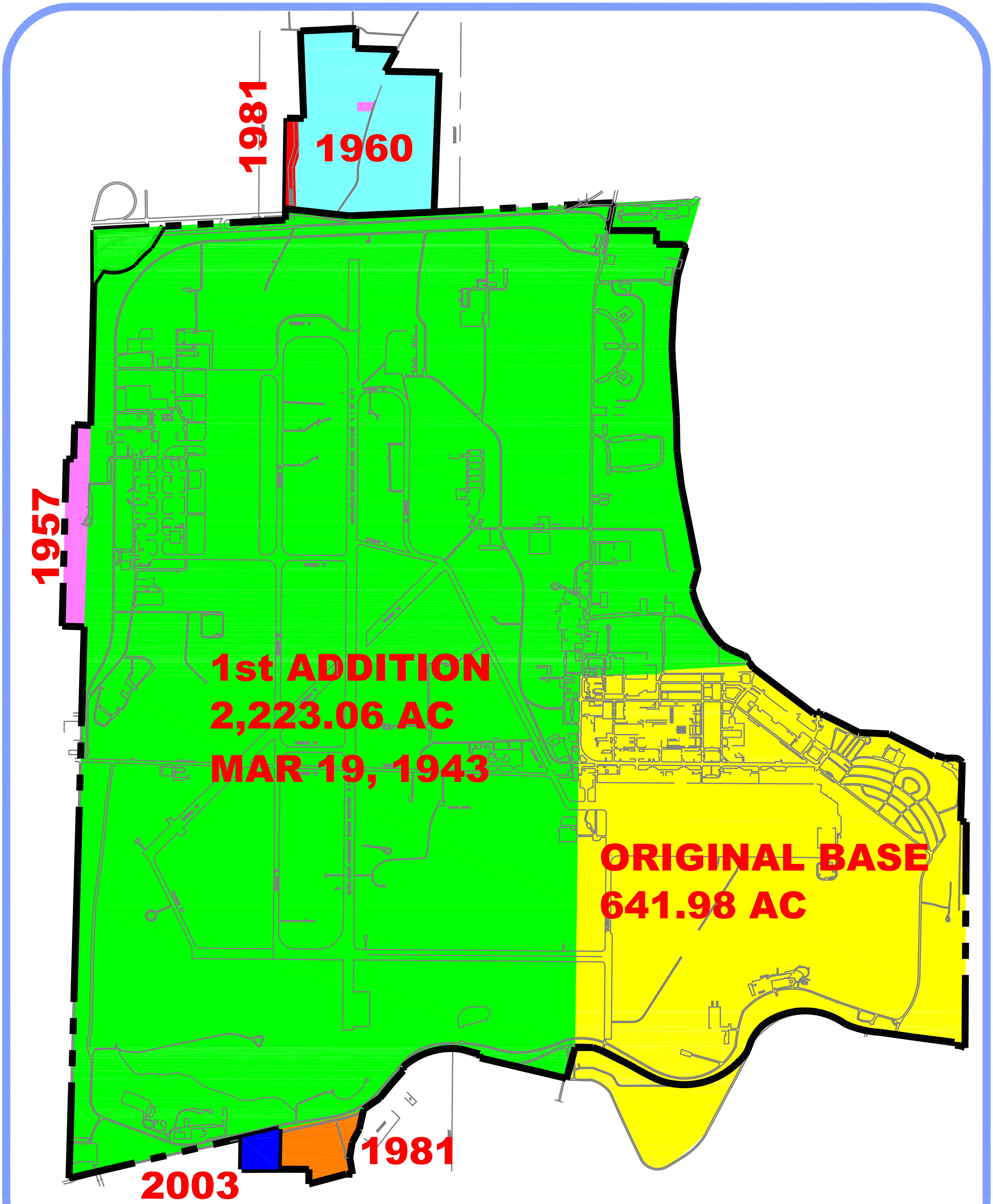
0 500 1,000 2,000 Feet

Client: Anderson, Eckstein & Westrick

Created by: WAD, March 23, 2016, ASTI Project 9374

Historic Aerials - 2004

APPENDIX D
Property Acquisition Map



SELFRIDGE ANG BASE | PROPERTY ACQUISITION | Date 11 DEC 03

O:\Plans, Documents & Photos\Archive Files\Maps\Real Property\Property History.dwg, 8x11 portrait,
12/11/2003 10:14:50 AM

APPENDIX E

DEQ Drain Exemption Response

Baker, Kenneth F NFG USAF 127 MSG (US)

From: Boldys, Karyn (DEQ) <BoldysK@michigan.gov>
Sent: Wednesday, November 05, 2014 8:47 AM
To: Baker, Kenneth F Civ USAF ANG 127 CES/CEV
Subject: RE: Scheduling Next Selfridge INRMP Working Group Meeting

Hi Ken,

I had a phone conference on Monday with Lansing to determine if we would allow an exemption to the permit. We cannot authorize an exemption to the permit. We tossed around a few ideas at the meeting to try and get your project into the minor permit category. Andy and I agreed that we should meet with you face to face to discuss options for your project. Are you available sometime over the next two weeks to have a meeting to discuss the project? Would it be easier for you to come here or meet you at the base?

Sincerely,
Karyn Boldys
Water Resources Division
Southeast Michigan District
Michigan Department of Environmental Quality (DEQ)
27700 Donald Court, Warren, MI 48092
586.753.3862 (office)

-----Original Message-----
From: Baker, Kenneth F Civ USAF ANG 127 CES/CEV [mailto:Kenneth.Baker.2@ang.af.mil]
Sent: Thursday, October 09, 2014 4:41 PM
To: Rundell, William E Maj USAF ANG 127 WG/SEF; Chris_Mensing@fws.gov; Sargent, Lori (DNR); Timothy.S.Wilson@aphis.usda.gov; Sierakowski, Thomas G LtCol USAF ANG 127 CES/CC; Forys, Timothy J Civ USAF ANG 127 CES/CEO; Martin, Kelli A SMSgt USAF ANG 127 OSS/OSA
Cc: Arif, Mohammad (DMVA); Hartz, Andrew (DEQ); Boldys, Karyn (DEQ)
Subject: Scheduling Next Selfridge INRMP Working Group Meeting

ALCON,

I am looking to schedule the next Integrated Natural Resources Management Plan (INRMP) working group meeting for Selfridge. At this time the next available date looks to be 3 December 2014. I am planning to have the meeting in the AM. Please let me know if you have any issues with the proposed date.

Also I am currently working on the agenda, if you have any items you would like me to add please let me know.

Very Respectfully,

Kenneth Baker
127 CES/CEV
Selfridge ANGB, MI
(586) 239-5741 COM
(586) 239-5900 FAX
DSN 273-5741

Baker, Kenneth F NFG USAF 127 MSG (US)

From:	Baker, Kenneth F Civ USAF ANG 127 CES/CEV
Sent:	Tuesday, October 07, 2014 7:55 AM
To:	'Boldys, Karyn (DEQ)'
Subject:	RE: Ditch Maintenance Follow-Up Selfridge

Karyn,

Thank you for the update regarding the status of this inquiry.

Respectfully,

Kenneth Baker
127 CES/CEV
Selfridge ANGB, MI
(586) 239-5741 COM
(586) 239-5900 FAX
DSN 273-5741

-----Original Message-----
From: Boldys, Karyn (DEQ) [mailto:BoldysK@michigan.gov]
Sent: Tuesday, October 07, 2014 7:52 AM
To: Baker, Kenneth F Civ USAF ANG 127 CES/CEV
Subject: RE: Ditch Maintenance Follow-Up Selfridge

Hi Ken,

I just wanted to give up an update. I spoke with Andy yesterday and we agreed that Lansing will have to make the call as to whether or not we can grant an exemption to the MP requirements. I sent all the information to Lansing yesterday and requested a phone conference with them to discuss the request. For now, we are in a holding pattern. I will get back to you as soon we have our conference call with Lansing.

Sincerely,
Karyn Boldys
Water Resources Division
Southeast Michigan District
Michigan Department of Environmental Quality (DEQ)
27700 Donald Court, Warren, MI 48092
586.753.3862 (office)

-----Original Message-----
From: Baker, Kenneth F Civ USAF ANG 127 CES/CEV [mailto:Kenneth.Baker.2@ang.af.mil]
Sent: Thursday, October 02, 2014 4:04 PM
To: Boldys, Karyn (DEQ)
Cc: Hartz, Andrew (DEQ); Arif, Mohammad (DMVA); Sierakowski, Thomas G LtCol USAF ANG 127 CES/CC; Klawinski, Kevin J Civ USAF ANG 127 CES/CECE; Plegue, Dennis (DMVA); Marek, Kevin P CIV (US) (kevin.marek@us.af.mil)
Subject: Ditch Maintenance Follow-Up Selfridge

Ms. Boldys,

This e-mail is a follow-up to our phone discussion a little over a month ago concerning ditch maintenance at Selfridge Air National Guard (ANG) Base. We have reviewed the revised permit categories and would like to request for an exception to minor permit category 20, Maintenance of Drains. We strongly feel that our maintenance projects will meet all of the criteria for this category. Please consider this request with the understanding that it is imperative for us to maintain these ditches to continue our mission at Selfridge.

Selfridge has approximately 85,260 linear feet of ditches, of those ditches 21,600 linear feet of ditches transverse wetlands, which must be maintained for us to continue our flying operations. These ditch lines were established to provide mission critical drainage for operational areas to include our airfield. Selfridge ANG Base does not rely on the County to maintain ditches on the installation as the property is federally owned and outside the jurisdiction of the County.

The Base Civil Engineer and the Assistant United States Property and Fiscal Officer (USPFO) serves as the drain commissioner for all of our existing drainage in accordance with Unified Facilities Criteria for Federal Installations and Air Force Instructions, which are very similar to those imposed under drain codes.

The current ditch maintenance project under design is for approximately 1500' of ditch lines requiring maintenance that transvers jurisdictional wetland. I expect we will have the design completed for this project sometime this fall, which we will submit along with a permit application.

Respectfully,

Kenneth Baker
127 CES/CEV
Selfridge ANGB, MI
(586) 239-5741 COM
(586) 239-5900 FAX
DSN 273-5741

Appendix H

Urban Tree Survey and Action Plan

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FINAL

URBAN TREE SURVEY
AND ACTION PLAN
SELFRIDGE AIR NATIONAL GUARD BASE
MACOMB COUNTY, MI

Prepared for:

National Guard Bureau
NGB/A7AN
Conaway Hall – 3500 Fetchet Avenue
Andrews ANGB, MD 20762

Prepared by:

Steve Harriott, PWS
Martin Berlett
Versar ESA
9200 Rumsey Road
Columbia, MD 21045

Prepared Under NGB Contract W9133L-05-D-0010

December 2009

TABLE OF CONTENTS

Page

PART 1
SELFRIDGE ANGB URBAN TREE SURVEY

PART 2
SELFRIDGE ANGB URBAN TREE ACTION PLAN

TABLE OF CONTENTS (Cont'd)

PART 1

SELFRIDGE ANGB URBAN TREE SURVEY

1.0 INTRODUCTION

The Selfridge Air National Guard Base (ANGB) consists of approximately 3,091 acres (nearly 5 square miles of land; Figure 1-1). Over 1,337 acres of Selfridge ANGB are covered with pavement, buildings, or other unusable land. Selfridge ANGB includes over 138 acres of improved or landscaped grounds, and over 1,488 acres of the land is semi-improved. This semi-improved area includes the grounds on which grass is maintained for erosion resistance, weed and brush control, and fire hazard reduction. Semi-improved areas also include road shoulders, ditch slopes, and drainage canals, ditches, swales, and other open space at Selfridge ANGB. Certain areas of Selfridge ANGB include unimproved forest. It must be noted that trees within the Selfridge airfield Air Installations Compatible Use Zone (AICUZ) "clear zone" were excluded from this project, because they are scheduled for removal.

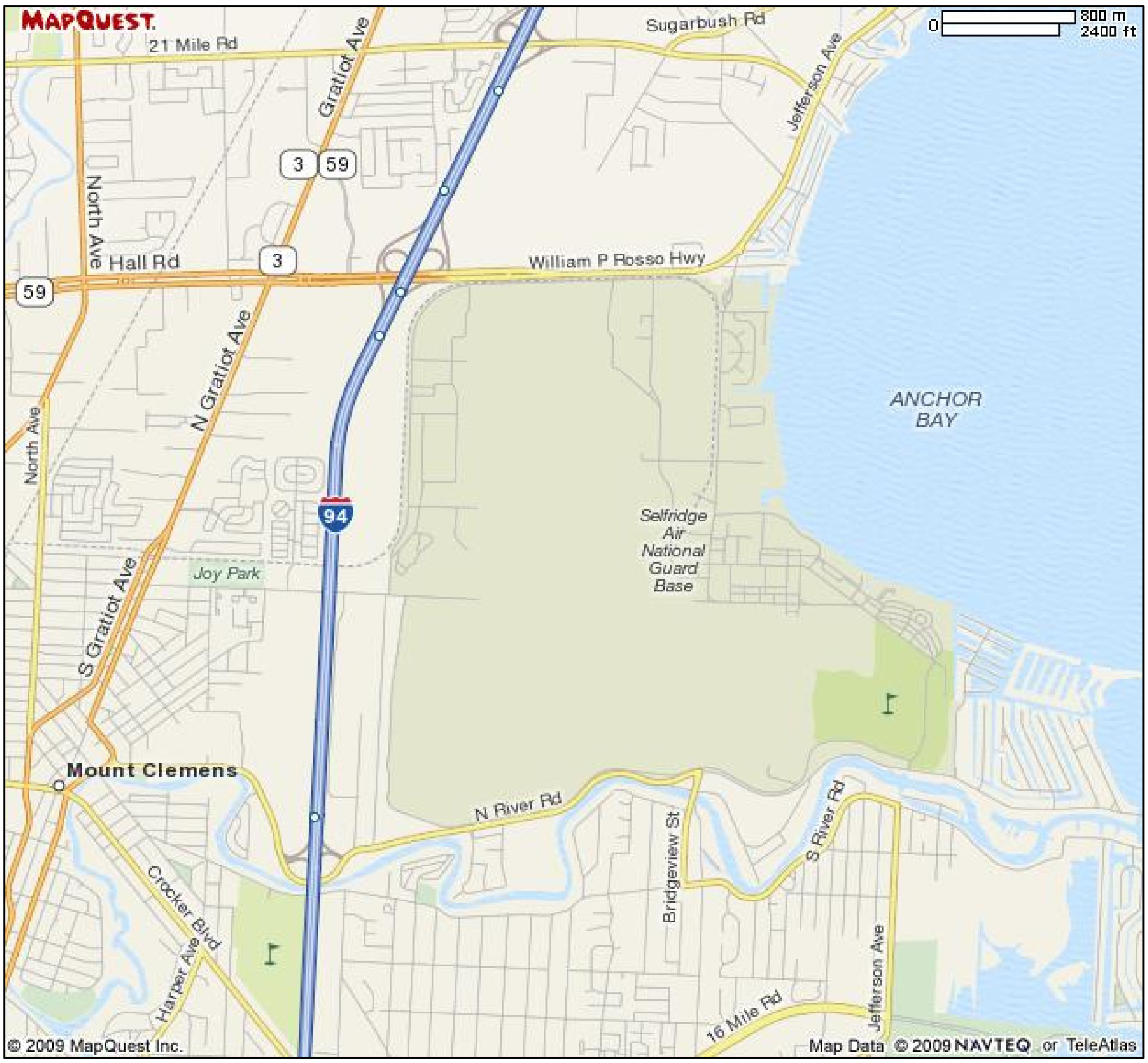

Figure 1-1. Location of the Selfridge ANGB, in Macomb County, Michigan.

The preparation of a base-wide Urban Tree Survey, Database, and Action Plan, consistent with the Selfridge ANGB Integrated Natural Resources Management Plan (INRMP) and the DoD Urban Forestry Manual (August 1996), was needed to collect, analyze, and synthesize biological information on tree, and associated landscaping, species present at Selfridge ANGB. Past studies to document these biological resources on this installation were out of date, or not existent. New surveys were deemed necessary, using state-of-the-art approaches that capture the management philosophies of the INRMP.

The current Selfridge ANGB INRMP was completed in November 2001 and it is currently under revision. This INRMP identified a need for enhanced management of urban tree resources at Selfridge ANGB. This Urban Tree Survey, Database, and Action Plan includes geospatial maps and mapping data of native and non-native trees and associated vegetative communities, quantitative and qualitative information on these communities and specified individual trees, and recommendations to discourage non-native and invasive species.

Because the trees in certain developed areas of military facilities (as well as other urban environments) are generally subject to greater stress (e.g., soil compaction, air and water pollution, heat accumulation, vandalism, etc.) than trees in more natural conditions, a rigorous program must be implemented to monitor, select, and maintain these trees. These difficulties may cause the health of individual trees to decline and possibly become safety hazards requiring immediate action; therefore, routine pruning, tree removal, and replacement of problem individuals or species must be part of an installation's urban forestry management action plan.

The many benefits trees provide to the communities in which they are located justify the allocation of resources necessary for the implementation of urban forestry programs on DoD installations. Wildlife habitat, microclimate modification (i.e., wind breaks, shade, dissipation of "city heat island" effects, water quality enhancement, soil conservation, and aesthetic improvement are just a few of the positive attributes provided by properly selected and maintained trees in the urban landscape.

Some goals of the Selfridge ANGB Urban Tree Survey, Database, and Action Plan task were to collect field data on tree species present, and their condition. The data were then organized in a format that will assist management of the overall ecosystem and facility operations, and to ensure compliance with environmental legislation, regulations, and guidelines.

2.0 MATERIALS AND METHODS

2.1 BACKGROUND RESEARCH

Prior to initiation of the urban tree field surveys for Selfridge ANGB, Versar conducted a thorough search for data, reports, and other information pertinent to urban tree resources at the facility and the region. In coordination with ANG personnel at Selfridge ANGB, Versar collected regional information on native and non-native tree species, diseases, and pests that affect them. Important primary sources reviewed included the 2001 Selfridge ANGB Integrated Natural Resources Management Plan (INRMP), and the 2004 Final Comprehensive Biological Survey Report (e2M 2004). Other background research also included consultation with State and local natural resource management agencies. Much of the background research materials consist of locally and regionally relevant scientific studies concerning tree management and conservation, and are included in Appendices A, B, and C.

2.2 SURVEY EQUIPMENT

All Selfridge Urban Tree Survey data were collected via a survey-grade differential global positioning system (DGPS). The DGPS unit used for the surveying was a Trimble GeoXT system that collected real-time, differentially-corrected satellite data. All survey points were collected in the field at Selfridge ANGB via a differential global positioning system (DGPS). The DGPS unit Versar used for the surveying was a Trimble GeoXT system that collected real-time, differentially-corrected satellite data. Based on extensive field testing of this unit by Versar personnel, the accuracy of horizontal fixes from the GeoXT is plus/minus approximately 24 inches with no data post-processing; these results were achieved for the UTS survey at Selfridge ANGB (refer to accompanying CD for original DGPS survey data). All survey points were downloaded into Trimble's Microsoft Windows-based processing software for data export and then into a Geographic Information System for map plotting.

2.3 SURVEY METHODS AND TECHNIQUES

2.3.1 URBAN TREE SURVEY

The scope of work (SOW) for the Selfridge ANGB Urban Tree Survey task indicated that a GIS must be used in conjunction with a DGPS to identify and survey the precise locations of all trees greater than six (6.0) inches diameter at breast height (dbh) that meet any of the following criteria:

- Tree trunk within fifty (50) feet of the edge of any graveled or paved surface (ex. paved road, graveled footpath, paved or graveled parking lot); or

- Tree trunk or attached branch within fifty (50) feet of any building or above-ground structure, including utility lines or pipes (but for base perimeter fence, only those trees with trunks closer than ten (10) feet, or with branches overhanging the fence, need be mapped); or

- Tree trunk within twenty (20) feet of an imaginary, ground level, line following directly above any underground utility line or pipe (ex. gas lines, telecommunications lines, stormwater or sewer pipes).

Additionally, the SOW directed Versar to identify trees immediately adjacent to installation that present, by location or condition, a potential hazard to the installation (e.g. storm toppling of tree across entrance road or across perimeter fence). Versar was also directed only to survey locations of off-installation trees with the consent of neighboring property owners.

Ortho-rectified, natural color low-altitude aerial photography of the installation (dated 2006) was used in the GIS to produce a map indicating all potential survey areas at Selfridge ANGB that met the above criteria specified in the SOW. This was accomplished by creating new GIS layers to overlay the aerial photography that depicted buffers 50 feet from all paved or graveled surfaces, buildings, and above-ground utility lines; buffers 20 feet from underground utilities; and buffers 10 feet from the installation perimeter fence.

The resulting GIS buffers map was then loaded into the DGPS and used as a visual tool during the survey. All trees (6 inches or greater dbh, per the SOW) within the buffer target areas were then logged in the field using the DGPS at the Selfridge ANGB. Data sheets, specifically designed for the Selfridge ANGB task were used to record data on every tree surveyed. Data fields collected included a unique identification number; the tree genus and species; common name; dbh; canopy height and radius; condition (excellent, good, fair, poor, removal); interference potential (high, medium, low); urgency level (immediate, this year, 2, 5, or 10 years, long-term); and general comments about each surveyed tree (Figure 2-1). More information about each of these data fields is included below.

- **Identification Number**
  Each surveyed tree was assigned a unique ID number in the DGPS that allows it to be accessed in the resulting GIS database and maps.

- **Genus/Species**
  Each tree was identified to genus and species in the field by Versar's expert botanist. The most recent synonymy by Kartesz (1994) was used for the most correct and up-to-date synonymy. In addition, the recent Michigan State University publication *Natural Communities of Michigan: Classification and Description* (Kost et al. 2007) was used for community-level vegetation descriptions at Selfridge ANGB.

- **Common Name**
  Each tree was identified to common name in the field by Versar's expert botanist and recorded. The most recent common names indicated in Kartesz (1994) were used.

- **Diameter at Breast Height (dbh)**
  A tree diameter tape was used in the field to directly measure dbh of each tree.

SELFRIDGE URBAN TREE SURVEY **DATE:** 25 JULY 2008 **INVESTIGATORS:** SPH/MB

TREE ID	GENUS/SPECIES	COMMON NAME	DBH (in.)	CANOPY HEIGHT/ RADIUS (ft./ft.)	CONDITION (excellent; good; fair; poor; removal)	INTERFERENCE POTENTIAL (high, medium, low)	URGENCY LEVEL (immediate; this year; 2, 5, or 10 years; long-term)	COMMENTS
899		SILVER MAPLE	26	41/26	E	L	L	
900		WHITE SPRUCE	9	21/15	E	L	L	
901		" "	9	21/15	E	L	L	
902		" "	10	23/17	E	L	L	
903		" "	8	20/15	E	L	L	
904		" "	8	19/11	E	L	L	
905		SILVER MAPLE	22	37/21	G	L	L	
906		WHITE SPRUCE	9	22/16	E	L	L	
907		BLUE SPRUCE	10	20/14	E	L	L	
908		WHITE SPRUCE	8	22/15	E	L	L	
909		" "	9	22/15	E	L	L	
910		WHITE SPRUCE	9	22/15	E	L	L	
911		BLUE SPRUCE	9	20/12	E	L	L	
912		SILVER MAPLE	7	15/8	P	L	L	
913		" "	18	37/21	E	L	L	
914		" "	15	35/21	F	M	2	ROTTEN CORE - HANGS OVER ROAD
915		" "	16	40/21	F	M	5	" "
916		" "	14	35/20	E	L	L	
917		" "	18	35/20	E	L	L	
918		CRABAPPLE	7(AVE)	15/17	F	L	L	
919	JUGLANS NIGRA	BLACK WALNUT	14	26/25	E	L	L	
920		" "	21	31/22	E	M	2	OVER PL
921		" "	10	31/25	E	M	2	" "
922		" "	10	22/17	G	M	2	" "
923		" "	14	28/22	E	M	2	" "
924		" "	15	35/22	E	M	2	" "
925		" "	15	31/21	F	M	2	" "
926		AM. ELM	9(AVG)	26/21	F	L	L	
927		BOXELDER	8(AVE)	23/17	E	L	L	
928		AM. ELM	7(AVE)	27/8	F	L	L	

Figure 2-1. Example data sheet used for collecting information during Versar's July 2008 urban tree survey at Selfridge ANGB.

- **Canopy Height and Radius**
  Canopy height and radius was visually estimated in the field by Versar's expert botanist.

- **Condition**
  Categories were assigned in the field to each surveyed tree by Versar's expert botanist, based on the following criteria:

  Excellent: No potential problems noted. The tree is apparently in excellent health. Only long-term monitoring and care is required.

  Good: Only a few minor problems were noted (e.g., a few small dead limbs, very small wounds to bark and trunk, minor insect problems, etc.). The tree does not usually require any immediate care.

  Fair: More major problems were noted (e.g., major parts of bark, trunk, or limbs damaged, missing or damaged foliage, moderate insect infestations, etc.). The tree is still likely to recover with proper care.

  Poor: Moderate to severe problems were noted (e.g., much of bark, limbs, or trunk damaged or missing, foliage more than 50% dead or missing, major insect infestations, etc.). It is uncertain if the tree will survive, even with immediate care.

  Removal: The tree is either already dead or death is imminent, due to major damage from insects, disease, severe physical damage to bark, major limbs and trunk, or other terminal conditions. The tree should be removed as soon as possible.

- **Interference Potential**
  Categories were assigned in the field by Versar's expert botanist, based on the following criteria:

  High: All or part of the tree has near-term potential to cause damage to existing structures, utility lines, roadways, parking lots, or other man-made features. Action should be taken, based on the prescribed Urgency Level and Comments (see below) to prevent injuries and/or significant damage to property.

  Medium: All or part of the tree has near-term to long-term potential to cause damage to existing structures, utility lines, roadways, parking lots, or other man-made features. Action should be taken, based on the prescribed Urgency Level and Comments (see below) to prevent injuries and/or significant damage to property.

Low: Because of its specific location, the tree (whether healthy or not) is not likely to cause damage to existing structures, utility lines, roadways, parking lots, or other man-made features. Note that some trees assigned to this category can still be assigned one of the more immediate urgency level categories; see below.

- **Urgency Level**
  Categories were assigned in the field by Versar's expert botanist, based on the following criteria:

  Immediate: The tree should be cared for or removed immediately. This category was assigned to trees that posed imminent significant safety hazards (such as closely overhanging electric transmission lines or roofs of buildings, etc.) or to ash trees with infestations of the emerald ash borer.

  This Year: The tree should be cared for this year. This category was assigned to trees that posed safety hazards (such as overhanging electric transmission lines or roofs of buildings, etc.), but with less threatening conditions than the Immediate category.

  Two, Five, or 10 Years: The tree should be cared for within the specified number of years. It was Versar's best professional judgment that this tree will need the maintenance specified under the Comments section (primarily trimming; see below) within the indicated time period.

  Long-term: Based on a combination of Condition and Interference Potential, the tree likely will only require occasional monitoring to confirm that it remains healthy and that its status has not changed.

- **Comments**
  Where appropriate, comments on each surveyed tree were recorded in the field by Versar's expert botanist. Comments were intended to clarify the diagnosis of each tree, and were intended to specifically guide care where it is most needed.

2.3.2 WOODY VEGETATION CLUSTERS MAPPING

Also per the SOW, Versar used geo-referencing techniques to identify and map landscape-scale boundaries of all parcels of woody vegetation (including saplings) at the Selfridge ANGB. All discrete previously mapped wetland woody vegetation clusters were also indicated as separate parcels. GIS layers containing previously mapped wetlands at the Selfridge ANGB were provided to Versar by the National Guard Bureau and the Selfridge ANGB GIS department. Wetlands boundaries were not delineated in the field by Versar as part of this task. Woody vegetation clusters were primarily mapped by digitizing parcels directly in a GIS directly on recent, geo-referenced low-altitude natural color aerial photography. Other woody vegetation clusters were mapped in the field using a DGPS at Selfridge ANGB during the July 2008 Versar urban tree surveys. All mapped woody vegetation cluster boundaries were checked for accuracy during the July 2008 Versar urban tree surveys.

3.0 RESULTS

3.1 SPECIES DISTRIBUTION

A total of 1,822 trees, including 49 species were surveyed throughout the Selfridge ANGB via DGPS, using the specified criteria (refer to Section 2.3 for criteria) (Table 3-1 and Table 3-2). Refer to Appendix D for the original field data sheets, and to Appendix E for a large panel-format graphic depiction of the final urban tree survey, overlaid on a recent, low-altitude aerial photograph. Appendix F is a large panel-format map depicting other woody vegetation clusters at the Selfridge ANGB. The most common tree species meeting the specified criteria were Norway maple (*Acer platanoides*; 425); silver maple (*Acer saccharinum*; 303); eastern cottonwood (*Populus deltiodes*; 201); green ash (*Fraxinus pennsylvanica*; 163); red pine (*Pinus resinosa;* 114); blue spruce (*Picea pungens*; 100); and white spruce (*Picea glauca*; 44). Some species, such as cottonwood, were most numerous in peripheral mesic areas, particularly along the shores of Lake St. Clair and minor drainages. There were far fewer cottonwood trees around clusters of buildings and residential areas. Other trees, such as Norway maple, silver maple, and green ash were found throughout the installation. Based on average diameters, the largest commonly-found trees (greater than 5 individuals observed) on the installation were London plane (*Platanus hybrida*; 37.4 inches); eastern cottonwood (35.9 inches); weeping willow (*Salix babylonica*; 33.0 inches), basswood (*Tilia americana*; 30.1 inches); and honey locust (*Gleditsia triacanthos*; 29.5 inches). The tallest commonly-found trees (greater than 5 individuals observed) on the installation were eastern cottonwoods, with average canopies of about 46 feet; London plane, with average canopies of about 45 feet; basswood, with average canopies of about 41 feet; and white pine, with average canopies of about 41 feet.

The historic "300 Housing Area" possessed the greatest concentration of trees meeting the survey criteria, at approximately 346 total. The Selfridge Golf Course also possessed a large number of sizeable old trees, at approximately 334 total. There are other areas of forest with greater numbers of trees, such as the northwestern forested parcel, and the parcel of forest immediately north of the Border Patrol's facilities in the southwestern part of the ANGB, but only small parts of some of these parcels met the survey criteria.

3.2 TREE PROBLEMS ENCOUNTERED

Tree problems encountered ranged from branches over, under, and in electric lines (the most commonly noted problem throughout) to ash trees infested with emerald ash borer (herein, EAB), to trees with large dead branches over roads and parking lots, to smaller dead branches and cracks in the trunks. To show the severity of the EAB problem, only one out of the total 163 ash trees (primarily green ash) surveyed did not possess obvious signs of EAB infestation. Because of the current quarantine situation with infested ash trees, all ash trees in this survey have been recommended for immediate removal. All current Michigan quarantine requirements, such as movement of cut trees, storage, and chipping (refer to Appendix B for a copy of the Michigan quarantine notice) must be strictly followed in the removal and disposal of trees from Selfridge ANGB.

Table 3-1. Partial summary of data from the Selfridge ANGB Urban Tree Survey by Versar, Inc., July 2008.

Common Name	Count	Average Height (ft.)	Average Diameter (in.)
American Elm	70	33.0286	27.2714
Apple	3	15.0000	12.0000
Arborvitae	6	16.1667	9.1667
Basswood	7	41.4286	30.1429
Black Locust	2	16.0000	15.0000
Black Spruce	2	17.0000	14.0000
Black Walnut	11	30.4545	23.4545
Blue Spruce	100	18.7900	12.3800
Box Elder	19	23.7368	19.4211
Bradford Pear	26	18.0000	15.8846
Cherry (unidentified)	7	15.1429	13.1429
Chestnut Oak	1	50.0000	50.0000
Crabapple	34	13.6471	15.5588
Crack Willow	5	35.0000	25.0000
Eastern Cottonwood	201	46.0945	35.8856
Green Ash	163	28.5767	20.5890
Hackberry	6	30.0000	26.1667
Hawthorn	24	16.4583	15.7083
Honey Locust	59	32.8814	29.4746
Jack Pine	13	20.0000	17.0000
Kentucky Coffeetree	1	35.0000	25.0000
Little Leaf Linden	14	20.0714	15.2143
Loblolly Pine	3	14.3333	11.3333
London Plane	20	45.3000	37.3500
Norway Maple	425	29.9059	23.3341
Norway Spruce	20	26.6500	15.9000
Paper Birch	1	23.0000	19.0000
Pin Oak	6	26.3333	21.6667
Red Cedar	1	18.0000	9.0000
Red Maple	10	22.1000	18.3000
Red Mulberry	4	24.5000	24.7500
Red Pine	114	15.1842	12.3772
River Birch	1	10.0000	8.0000
Rock Elm	4	28.2500	19.5000
Sand Cherry	2	8.5000	9.0000
Silver Maple	303	40.0924	27.8449
Slippery Elm	22	28.4091	17.7727
Sugar Maple	4	35.5000	30.7500
Swamp White Oak	1	55.0000	45.0000
Sweet Cherry	1	10.0000	8.0000
Tree of Heaven	1	15.0000	11.0000
Tulip Poplar	4	26.0000	17.7500
Weeping Cherry	3	11.0000	8.0000
Weeping Willow	21	38.1429	33.0000
White Ash	1	25.0000	18.0000
White Oak	4	37.5000	28.7500
White Pine	27	41.2222	20.0370
White Spruce	44	19.7727	13.6364
White Willow	1	18.0000	20.0000

Table 3-2. Summary of tree condition data from the Selfridge ANGB Urban Tree Survey by Versar, Inc., July 2008.

Condition	Total Count
Excellent	789
Good	517
Fair	282
Poor	54
Remove	180

One of the most commonly noted problems encountered at Selfridge ANGB were trees planted too close to buildings and residences. This situation often posed an unsafe condition where the main stem of the tree or its large main (often heavy) branches were over roofs and other parts of buildings and residences. This appears to be a fairly ubiquitous problem, not only in urban settings, but also in suburban and rural situations. People often miscalculate exactly how large the sapling they plant (next to their house or building) will get upon maturity.

Another fairly common problem encountered throughout the Selfridge ANGB urban tree survey was the use of steel wire around the trunks and branches for bracing guys when the trees were planted as saplings. Numerous cases were observed during this survey where the tree trunks and branches were attempting to grow over the wire (the wire used is very tough and seems not to break despite the pressure from the tree expanding), and were being cut off. Not only does this situation compromise the structural integrity of the tree as it matures, but also opens it up to various diseases and afflictions. These bracing guys are almost never necessary when planting new tree saplings, and should never be used. In the odd case where bracing guys are required, other degradable materials should be used (e.g., cloth or degradable rope, etc.); these trees should be inspected annually so that the guy materials can be removed as soon as they are no longer needed.

4.0 CONCLUSIONS

This urban tree survey will be an important update to add to the revised Selfridge ANGB Integrated Natural Resources Management Plan. It will serve as a useful baseline tool of urban tree resources at Selfridge ANGB, and will help guide grounds and natural resources managers in the allocation of resources for their management. As it is part of an Access database, and as a database is only useful when it is current and accurate, a schedule should be devised for regular updates. It is suggested that updates to this urban tree survey be made approximately every three to five years.

We used our best professional judgment to make accurate predictions about the Selfridge ANGB urban tree resources at the time these surveys were conducted. Trees, however, are a living resource exposed to somewhat unpredictable natural and man-made stressors, and as such are essentially a “moving target” in terms of management. Nonetheless, adherence to the management schedule set out in this initial urban tree survey will result in a safer and healthier resource for all Selfridge ANGB personnel to enjoy.

PART 2

SELFRIDGE ANGB URBAN TREE ACTION PLAN

5.0 URBAN TREE MAINTENANCE TECHNIQUES

5.1 MOVING THE TARGET

A "hazard tree" is structurally defective and has a target (e.g., house, shed, patio, picnic table, parking lot, etc.) within range. If the target is moved out of range of the defective tree, it is no longer a hazard, but is still a defective tree. Because it is often difficult to predict the direction of fall of a defective tree or tree part, and because most people are poor judges of the actual heights of trees, it is recommended that a "target" be defined as any object within a specified distance (1.5 times the estimated tree height) of the defective tree (Pokorny 2003).

If feasible, moving a target away from the defective tree can also be an important way of "buying time." If a hazardous tree is identified but corrective action cannot be taken immediately, consider moving the target first. For example, if a picnic table or bench is the target beneath a highly defective tree, but corrective actions cannot be taken in the desired amount of time, move the table or bench away from the tree. Moving the target in most urban situations is likely a temporary measure; in most cases it reduces risk, but does not eliminate it entirely.

Wherever people congregate or spend significant amounts of time in one place, the potential for a hazardous situation exists. For example, users of urban parks seek solitude, and go to great lengths to get away from their fellow visitors. For this reason, it should be assumed that if a tree within an urban park is surrounded by mowed grass it should be considered as having potential targets. An area of mowed grass without nearby picnic tables, benches, or paved paths (i.e., "targets") can probably be considered a low-risk area, but the trees in such an area should still receive periodic inspections, even if the intensity and frequency is less rigorous than that afforded other, more intensively used areas. However, if it is known that people regularly congregate under a tree or group of trees in a park, even if such use is technically illegal, increased vigilance is required.

5.2 CORRECTING THE TREE

5.2.1 Pruning

Pruning off the defective parts of a tree is by far the most common means of correcting defects and minimizing the chance of tree failure. Industry standards for pruning (ANSI 300 – 1995 and ANSI Z1331.1 – 2000) should always be followed. Examples of tree defects that often can be corrected using proper pruning techniques are described below.

- **Cracks:** For large branches with major cracks, removal of entire branches back to their junction with the main stem is usually the most effective remedy. Cabling and bracing, however, is an option that should be considered in some circumstances (refer to Cabling section below).

- **Dead Branches:** Remove large branches (greater than 4 inches diameter) that are broken or lodged in the crown. At the same time, remove the remaining stub, using good pruning techniques.

- **Weak Branch Unions with Included Bark:** Where a tree has a weak branch union with included bark, remove the affected branch. As with most corrective actions, this is most effective if implemented while the tree is young. See the cabling and bracing section below for other options.

- **Decayed Branches:** Remove all large branches (greater than 4 inches diameter) with evidence of decay, and all large dead branches. The pruning procedure must remove the branch back to live, sound wood, but should not necessarily cut into live wood. Proper pruning cuts, even for large branches, are made just outside the branch-bark ridge, without injuring the branch collar.

- **Unsound Architecture:** Prune branches that have a sharp angle, bend, or twist (unless such growth is characteristic of the tree species). These are “architecturally unsound trees.” As with weak unions, early intervention is always better than removing large branches later in the tree’s life.

- **Visual Obstructions:** Remove branches that obstruct street signs, signals, street or security lighting, or branches that limit visibility of approaching traffic.

- **Physical Obstructions:** Remove branches that impair pedestrian or vehicular traffic.

- **Interference with Utility Lines:** Prune trees that interfere with overhead utility lines to eliminate the interference. Topping trees for utility clearance is no longer considered an acceptable pruning practice. Maintenance of such trees is usually the responsibility of the utility company that owns the lines. Special training and certification for maintenance workers who do this work is mandated by the federal Occupational Safety and Health Act (OSHA), and should be required by all communities.

5.2.2 Cabling and Bracing

Cabling and bracing should not be recommended as a treatment for hazardous trees unless the tree has significant historic or landscape value (Pokorny 2003). The decision to apply cabling and bracing procedures to trees should not be made lightly. Because it is critically important that such procedures be done correctly, the following subsections provide information to make informed decisions regarding when and how to use these tools in their tree risk management programs.

5.2.2.1 Industry Standards

Industry standards for installing support systems in trees are published by the National Standards Institute in The American National Standard for Tree Care Operations- Tree, Shrub, and Other Woody Plant Maintenance-Standard Practices - Part 3 - Tree Support Systems (ANSI 2001). This publication includes sections on hardware selection and requirements, installation practices, cabling and bracing requirements, and guying techniques. The ISA has published a companion publication, Best Management Practices: Tree Support Systems," to serve as a "how to" guide for defining cabling, bracing, and guying procedures and methods (Smiley and Lilly 2001). Tree care managers who write contracts and bidding specifications for tree maintenance work projects should be familiar with these standards and best management practices. Arborists should be hired who are experienced and will agree in writing to perform all cabling and bracing operations in accordance the ANSI A300 - Part 3 - Standards.

5.2.2.2 History of Cabling and Bracing

Cabling and bracing of trees has been practiced for many years. There are obscure references to bracing done in the early 1800s, but bracing trees, as we know the practice today, can be traced back to the early twentieth century. Some of the first bracing systems used chains and other rigid materials such as rods, flat straps, and tubing. Cable and eyebolts came into use after 1910 and have been widely accepted, with some modifications, as new materials were developed. During the 1930's the National Park Service published guidelines for material sizes and strengths that have been followed since that time. Modern materials used in cabling and bracing systems include rigid material such as threaded rod or bolts or flexible material such as metal or synthetic fiber cable (Pokorny 2003).

Cabling and bracing systems are very similar to the standing rigging on sailing ships. The use of flexible and rigid braces between masts and spars onboard sailing ships to support huge loads is very similar to the goals of bracing trees to themselves. Proper selection, sizing, and placing of support materials can be expected to add to the life expectancy of trees. Cabling and bracing has extended the life of many trees and reduced the risk from failure to an acceptable level. The design and installation of a proper system of cabling and bracing, however, requires professional judgment and experience. When hiring an arborist to install a cabling and bracing system, look for an experienced arborist who has observed tree failures and worked with trees that have been saved by proper cabling and bracing systems.

5.2.2.3 Cabling and Bracing Defined

Cabling and bracing is the practice of adding a support system to a tree to reduce the stress on weak branch unions. Many trees have acute, V-shaped branch unions that form included bark. Included bark acts as a wedge that weakens and separates branch unions that join at too sharp an angle. A similar situation occurs when two equal-sized stems form off the main trunk of a tree after the loss of the main leader. The bark of the two stems push against each other and the two leaders do not have a strong connection to the main trunk. As the tree grows, these structural defects can lead to failure of one of the two stems. Adding properly installed cabling and bracing will reduce the strain on the branch union, and extend the life of the tree.

Cabling and bracing can also be used to correct trees with poor architecture. Typically, as trees grow, the trunks and limbs taper toward the ends. This tapering reduces the strain on the higher and outer limbs in the tree. If limbs and trunks do not taper, a large amount of leverage acts on the point of attachment where the branch meets the stem, which can lead to failure. Improper pruning can also place strain on branch unions. The inner branches of some trees have been removed because of the mistaken belief that such hyper-thinning eliminates the possibility of wind failure. Actually, by removing these inner branches, the tree will put on more length and less bulk in its limbs. This leads to the condition referred to as "lion's tailing." Because the limbs are long and thin, but still maintain a full complement of foliage, the limbs will whip severely and possibly fail, instead of swaying naturally.

5.2.2.4 Analysis of Tree Condition

There are many considerations that must be addressed before a cabling and bracing system is installed in a tree. The tree may have a high value in a particular landscape, or it might be a historic or unique specimen. Before investing in a cabling and bracing system, the cost of installation and future maintenance must be balanced against the risk of failure and possible loss of aesthetic value during the tree's extended life.

Carefully assess the tree to determine if it is a reasonable candidate for the investment in cabling and bracing. Consider the whole tree during this assessment. The roots must be strong enough to support the tree. If there is decay in the main trunk or branches, factor that information into the decision to remove or save the tree. If the tree has cracked already, the arborist must know how well the tree species in question is able to compartmentalize decay. Some trees can isolate decay better than others. The outcome of a decision to apply a cabling and bracing procedure to a white oak (*Quercus alba*) is likely completely different than a basswood. Cabling and bracing does not repair a tree. Cabling will add a level of security and risk reduction, and can help to affect the direction of failure if a branch should fail. When designed properly and installed by a trained arborist, proper use of cabling and bracing will extend the life of a tree and reduce the risk to an acceptable level.

If the decision is made to use cabling and bracing to extend the life of a tree, it must be understood that such treatments are temporary. Consideration must be given to planting a younger tree or trees to be used as replacements if the cabled and braced tree is removed.

Some trees will benefit from having weight removed from the branches before the installation of cabling and bracing hardware. All necessary pruning should be done, therefore, before the tree is cabled. Removing major lateral limbs creates large wounds that can lead to extensive decay on the main trunk of the tree. If weight reduction is determined to be necessary, a slight crown reduction by using proper thinning cuts in the crown is the safest course of action.

The possible harm from over-pruning a tree to remove a significant amount of weight must also be recognized. Most trees will need only routine pruning to remove dead limbs and other material in accordance with accepted pruning standards.

5.2.2.5 Inspection Schedule

Once a tree has been cabled and braced it is necessary to inspect the tree on a routine schedule. The size, age, site, and risk potential of the tree will determine the inspection schedule. No cabling or bracing installation, however, should ever go more than two years without inspection, and annual inspections are a good idea. Some inspections can be done from the ground. Binoculars can be used to make a more thorough inspection of the tree without having to climb it, or use an aerial lift to inspect the crown. As time passes, it will be necessary to have an arborist inspect the anchor points and any changes in the tree's growth from within the tree. There may come a time when a new cabling and bracing system will be necessary. Again, this assessment will need to be done by an experienced arborist following the same procedures as in the first installation.

As the tree grows taller, a new system may be added, higher in the tree (the old system must, however, be left in place).

5.2.2.6 Liabilities

Cabling and bracing is a practice that, when properly applied, can extend the life of a tree. In addition, cabling and bracing can reduce the potential for failure to an acceptable level. Once a tree comes under an arborist's care, they are obligated to follow accepted trade practices. During the inspection, the arborist may determine that the removal of part of the tree is a better option than cabling and bracing. Care must be exercised in this case since the removal of large portions of the tree can lead to conditions that could lead to tree failure. If the risk of failure is too high, then removal of the tree may be the best option.

Since cabling and bracing has a long history of use and is an accepted, standard practice, the concern for additional liability should be little different than if the tree were being pruned. Correction of defects by cabling and bracing, however, requires additional inspection and maintenance that must be performed regularly to ensure the integrity of the procedure. Failure to perform regular inspections, and to correct any problems that may arise, may indicate negligence. Choosing not to install a cabling and bracing system because of a fear of liability is not a good decision. The best procedure is to follow a plan that reduces the risk of failure to an acceptable level.

5.3 OTHER MANAGEMENT OPTIONS

5.3.1 Closing the Area

Closing an area and denying the public access to a portion of the urban forest is an extreme action that should be considered only in the direst situations. There are times, however, when closing an area, either temporarily or permanently, is the only option available. One example of the effective use of temporary closures is a situation where an adverse weather event such as an ice storm or tornado has left so many hazardous trees in an area that it is impossible to guarantee public safety. Closing a public area temporarily until the needed tree maintenance is done should be an option that is available to tree maintenance workers in communities.

In more permanent or sensitive situations, judicious use of a “close the area” approach can also be an effective tool for managing risk. As an example, placing a fence around a large tree to keep the public from compacting the soil over tree roots, or from being at risk from falling branches is in many ways equivalent to closing the area. For large trees of significant cultural heritage, placing a fence around them is often the only acceptable way to mitigate a hazard. Alternatively, planting wide, fenced, or densely continuous beds of flowers around an architecturally unsound tree may be an acceptable way of retaining an otherwise hazardous tree in the urban landscape. This will keep the public at a safe distance, and will also prevent the trampling of roots and soil compaction around the hallowed monarchs of the urban forest. But at the same time the hazardous situation is being resolved, consider eventual replacement of the defective tree. Proper management can extend the lifetime of a tree by only so long. Long-term strategies are needed for tree removal and replacement to achieve sustained development of an urban forest.

5.3.2 Removing the Tree

Removing a hazardous tree should be the option of last resort. This remedy should be implemented only when other corrective actions cannot reduce the level of risk to an acceptable level. Before removing the tree, consider and balance all options, including the possibility of cabling and bracing, against the benefits that a tree provides. The effects of removing a tree, including visual impact on the site, and emotional impacts to people who value a particular tree, can be substantial. While removing a tree is not an option to be considered lightly, it is sometimes an unavoidable cost to abate a hazard. Always couple the removal of a tree with a tree planting program that includes strategies to reestablish trees that are best suited for the urban landscape and the site on which they will grow. For example, plant small-stature trees under utility lines, and consider trees with smaller crowns and root systems for narrow lawn extensions and other places with restricted root space. Following are examples of high-risk tree defects that warrant tree removal.

- **Trunk Decay:** Trees that do not meet the minimum sound shell thickness guidelines must be removed. There is no other remedy for a tree that lacks the necessary amount of sound wood. Filling cavities or other methods for bracing or cabling such trees are not effective.

- **Leaning Trees:** Trees with an excessive lean must be removed. Trees that have evidence of soil mounding on the side away from the lean are particularly dangerous. Such mounding indicates that the roots on that side of the tree are failing, and usually mean that the tree has recently begun to lean. A tree that has grown for a long time with a lean less than 45 degrees may not be a significant hazard, but should be monitored closely for evidence of an increase in the lean angle.

- **Dead Trees:** Dead trees are at great risk of failure, and should be considered highly hazardous in all situations. These trees should receive priority attention by the maintenance crew, and should be removed as soon as they are found.

- **Cankers on the Main Stem:** Trees with cankers that affect 40 percent or more of the tree's circumference or are associated with decay or other defects should be considered hazardous and removed.

- **Unsound Architecture:** Some trees with a tendency to form multiple upright branches can become dangerously defective if timely pruning is not provided over the life of the tree. Other trees, particularly conifers, can develop "twin stems" if the leader is killed and two branches assume dominance. The branch unions of these trees tend to form "included bark," which acts as a wedge to force such branches apart.

- **Severe Root Injury:** Trees where root damage such as root decay or root severing affect more than 40 percent of its critical rooting area.

5.4 IMPLEMENTING CORRECTIVE ACTIONS

Just as it may take several decades for trees in an urban setting to accumulate the injuries and structural defects that make them hazardous, it could take decades of careful maintenance and planning to develop an urban tree population into the ultimately desired condition (Pokorny 2003). Individual corrective actions, however, should be completed in a timely manner. Aside from the removal or corrective treatment of the highest risk trees, there are many options available to deal with correctible trees that pose a low or moderate hazard.

6.0 PEST AND INVASIVE SPECIES

Brief descriptions of the principal pest and invasive species observed during the Selfridge ANGB urban tree survey by Versar in July 2008 are provided below. More detailed information on these and other regional pest and invasive species are included in Appendix B.

6.1 EMERALD ASH BORER

This exotic beetle from Asia was discovered in July 2002 feeding on ash trees (*Fraxinus* spp.) in southeastern Michigan, in the region of Selfridge ANGB. It was identified as *Agrilus planipennis*. Larvae feed in the cambium between the bark and wood, producing galleries that eventually girdle and kill branches and entire trees. Evidence suggests that *A. planipennis* has been established in Michigan for at least six to ten years. More than 3000 square miles in southeast Michigan are infested and more than 5 million ash trees are dead or dying from this pest. This exotic pest is also established in Windsor, Ontario, Canada. In 2003, newly established populations were detected in other areas of southern Michigan and several locations in Ohio. Infested ash nursery trees were also found in Maryland and Virginia.

6.2 WOOLY ADELGID

The balsam woolly adelgid was introduced from Europe around 1900, and is considered a serious pest of forest, seed production, landscape, and Christmas trees. The balsam woolly adelgid attacks all true firs, Abies spp., including balsam and Fraser fir. However, while some species are very tolerant (Noble fir), other species are devastated by the pest (balsam, Fraser, and sub-alpine firs). The adelgid feeds either on the outer portions of tree crowns or on the main stem and large branches. Main stem infestations are usually more serious, causing greater levels of damage and mortality. Billions of feet of fir timber have been killed by balsam woolly adelgids in North America (MDNR 2008).

The adelgid is now distributed throughout eastern and western North America. It is apparently limited in its northern distribution in Canada by cold weather. Balsam woolly adelgids infest firs in southern Canada, the Pacific Northwest, and the northeastern United States. They also occur in the Appalachian Mountains as far south as North Carolina.

6.3 SPRUCE SPIDER MITES

The spruce spider mite, *Oligonychus ununguis* (Jacobi) is a common pest of landscape conifers in Michigan and the region. This tiny eight-legged animal does best in the cool spring and fall weather with severe infestations causing discolored foliage, unthrifty looking plants and premature leaf drop. While feeding occurs in the fall and spring, often the damage does not become apparent until the heat of the summer. Spruce spider mites have been found on 43 different conifer species in the region but are most commonly found on *Abies* (fir), *Juniperus* (juniper), *Thuja* (arborvitae), *Tsuga* (hemlock), *Picea* (spruce) and *Psuedotsuga* (Douglas-fir).

Spruce spider mite eggs hatch as early as mid-March, but most eggs hatch by mid-April. Young mites feed on the previous year's foliage and do not attack the current season's growth until it hardens off in summer. Spider mites thrive when daytime temperatures are in the 60's and 70's. Adults feed by inserting their mouthparts into the foliage and withdrawing plant fluids, which results in a speckled appearance to the foliage. This 'stippling' increases in intensity until the foliage can appear bronze or bleached depending upon the host plant. Severe infestations result in needle drop. Webbing of fine silk surrounding the needles and twigs often accompanies high populations, protecting the mites from natural enemies.

6.4 ANTHRACNOSE FUNGUS

Anthracnose refers to a symptom rather than a specific fungus. Different fungi produce anthracnose on specific host plants; many plant diseases and weather stress cause similar symptoms. In general, anthracnose symptoms are worse after cool, wet springs. Spores have an extended opportunity to wash from branch and twig cankers to new leaves and shoots.

Sycamore leaves with anthracnose develop brown lesions that begin along the leaf veins. Lesions enlarge and coalesce as infection progresses. Witches' brooms develop after repeated infection and dieback of twigs. Cankers may develop on twigs. The amount of defoliation depends on the severity of the infection. Anthracnose on oak usually occurs in the lower crown. The early symptoms of oak wilt may appear similar, but appear in July and begin in the upper part of the tree. Other common Michigan trees susceptible to anthracnose are ashes (*Fraxinus* spp.), maples (*Acer* spp.), and walnuts (*Juglans* spp.).

Sanitation is important in managing anthracnose. Rake up and destroy fallen leaves to reduce source of inoculum. Remove diseased and dead wood and prune trees to improve air drainage. Fungicides are usually not needed, but fertilization may help trees that are heavily defoliated.

6.5 LEAF RUSTS

Many tree species are hosts to leaf rust; some of these in the vicinity of Selfridge ANGB include ashes, aspens, cottonwoods, larches, poplars, apples, hawthorns, and juneberry. Two different host species are required to complete this fungal pathogen's life cycle. A fungus (often species-specific) over-winters on fallen leaves and produce spores the following spring. The spores then infect a conifer host and possibly other spore types that infect the broadleaf host, thus completing the pathogen's life cycle. Yellow to orange bumps appear on the leaves of the host tree. Later in the season they are typically orange to brown with a waxy layer that contains the over wintering stage of the fungus.

Rusts usually do not seriously damage trees. Cultural practices such as watering when dry, fertilizing and mulching may increase the vigor of stressed trees. Pruning infections will remove spores and will lessen the number of spores available the next year but will not eliminate the problem.

7.0 MAINTENANCE FOR WILDLIFE ENHANCEMENTS

7.1 CONVERTING HAZARDOUS TREES INTO WILDLIFE TREES

Some defective trees can be treated to reduce the threat to human life and property to an acceptable level, while leaving a portion of the tree intact to provide wildlife habitat. This approach has been coined converting board feet into bird feet (Ostry and Nicholls 1998). Several techniques exist for converting hazardous trees into good wildlife habitat in a safe and environmentally responsible fashion. These techniques ensure that if a tree falls there are no targets within striking range.

Not all defective trees are good candidates for providing wildlife habitat, nor can all good candidates be safely converted to wildlife trees. Converting hazardous trees into wildlife trees, for example, is not recommended for street trees and should be reserved for use in parks and natural areas (Pokorny 2003). The environmental benefits that a tree risk management program can provide are often overlooked, especially as it relates to creating wildlife habitat. A tree risk management program that helps to create wildlife habitat will nurture public interest in the program. People value a variety of wildlife in and around the places where they live and work, from inner city to rural communities. The 1996 National Survey of Fishing, Hunting and Wildlife-Associated Recreation reports that 62.9 million people intentionally fed, observed, or photographed wildlife around their homes and on trips away from home (USDI 1996).

Other studies have shown that in urban areas 93 percent of residents want to know how to attract wildlife and support habitat components. Wildlife in cities and rural communities may offer greater opportunities for environmental education and non-consumptive recreation than remote locations because of the proximity to large numbers of people (Shaw et al. 1985). Demonstration sites, located in parks, nature areas and on school properties, can be very effective teaching tools and serve as living laboratories to display and interpret the wonders of nature.

7.2 HOW TREES BENEFIT WILDLIFE

Standing dead trees and dead or dying parts of live trees are beneficial to wildlife for foraging and food storage, nesting and den sites, shelter and cover, bridges, perches, and roost sites. Over 120 species of birds, 140 species of mammals, and 270 species of reptiles and amphibians depend on standing dead and dying trees of all sizes (Ackerman 1993). Further, many species of insects, spiders, mites, millipedes, centipedes, slugs, and fungi use trees for the completion of their life cycle and in turn provide a food source for many other species. Common in urban forests, the white-breasted nuthatch is a cavity nester that prefers mature stands with large decaying trees, and feeds its young an animal-based diet consisting of many of these arthropod species.

7.3 WILDLIFE CYCLE OF A TREE

It has been demonstrated that the capacity for a tree to provide wildlife habitat changes over time. As a tree matures and begins to decline (due to insects, diseases, injury or old age), it begins to play a more vital role in providing habitat and promoting ecosystem biodiversity. Even after a tree dies, its usefulness does not end; it continues to provide valuable habitat for many species of wildlife. A tree's values for wildlife are based on certain characteristics make them suitable as different types of habitat; these essentially occur in three separate phases, and are described below.

1) **Phase 1**: The first phase in the "wildlife cycle" of a tree includes standing dead or dying trees that initially attract non-cavity nesting species and primary cavity excavators (e.g., woodpeckers). These trees contain sound wood and the branches are intact. Trees in this initial phase provide foraging sites and perches for insect-feeding birds and raptors, singing perches for many songbirds, nest sites for species such as great blue herons, osprey, hawks and eagles, and nesting sites for primary cavity excavators such as woodpeckers, nuthatches, chickadees, and others.

2) **Phase 2**: The second phase in the "wildlife cycle" of a tree is a result of increased decay. The tree is still standing, but the wood is no longer sound. The branches and bark are shed and the top and larger portions of the stem break off. During this phase, the tree becomes attractive to secondary cavity users that colonize existing cavities, excavated and abandoned by primary cavity nesting species or formed when branches are shed or when tops are broken off. Secondary cavity users include most owls, some species of ducks, birds (e.g., bluebirds, swallows, wrens and flycatchers), raccoons, flying squirrels, bats, and some amphibians. These species use the tree for nesting, foraging, roosting, and perching.

3) **Phase 3**: In the third and final phase of a tree's "wildlife cycle," decay has reduced the tree to a stump and debris pile. Woody debris is important habitat for many wildlife species such as salamanders, toads, mice, grouse, and woodpeckers. It is used for nesting and shelter, as a source of and place to store food, as a lookout site, for drumming, sunning, and preening sites, and as a natural bridge or highway across streams. Decaying logs also serve as nurse-trees for seedlings and contribute to nutrient cycling.

7.4 CRITERIA FOR SELECTING WILDLIFE TREES

Within parks and other natural areas, a variety of wildlife trees should be selected for use, ranging from trees suited for long-term management to trees suited for short-term management. Phase 1 trees will be the most valuable for providing long-term wildlife habitat since they typically remain standing for an extended period and will likely develop a large number of cavities over time. Trees greater than 15 inches in diameter, and more than 50 feet tall, are generally considered the most valuable to wildlife. These trees should be slow decaying tree species such as oak and pine. Phase 2 trees provide immediate habitat for secondary cavity users and serve as foraging, roosting, and perching sites. To identify Phase 2 trees, look for existing cavities, dens or foraging holes; existing nesting or roosting sites; and/or the presence of fresh scats or bird droppings. Phase 3 trees provide immediate habitat for wildlife and contribute to nutrient recycling. Selecting trees that are currently inhabited or used by wildlife has the obvious advantage for educational purposes and demonstration projects.

7.5 WHEN TO CONSIDER CONVERTING A DEFECTIVE TREE INTO A WILDLIFE RESOURCE

Wildlife trees should only be established and maintained when human safety will not be compromised or damage to property is not imminent, and when the defective tree is a good candidate for wildlife habitation. For these reasons, it is not usually a recommended corrective action for street trees; establishment of wildlife trees should be reserved for parks and natural areas.

Reduction of risk may be as simple as moving targets like picnic tables, benches, or shelters out of striking distance from the defective tree. If the target can be moved, risk to public safety is mitigated, and the tree can be preserved for wildlife habitat. If it is not feasible to move the target, other corrective actions such as pruning to remove defective branches or to reduce tree height should be considered. For example, wildlife trees that are located along high-use urban trails and in parks will often require corrective pruning to reduce tree height to a level where the tree will no longer strike a target, should it fail. Placing a nesting box near the location where a cavity has been lost through tree or limb removal may be a successful habitat replacement. If it is not feasible to perform corrective actions that will reduce risks to public safety with minimal impact to wildlife, closing the area to pedestrian traffic is a final option. Closing the site temporarily (such as during the breeding season) is often a possibility. With proper fencing and interpretive signing, a site closed to pedestrian traffic may still be valuable as an educational/demonstration area.

8.0 MANAGEMENT RECOMMENDATIONS

8.1 PRUNING

Pruning should be implemented based on the urgency level and comments for each tree in the Selfridge ANGB database. As indicated in Section 1 above, pruning is typically required for major cracks, dead branches, weak branch unions, decayed branches, unsound architecture, visual obstructions, physical obstructions, and interference with utilities. Of these reasons for pruning, interference with electric utilities was the biggest reason for requiring pruning at Selfridge ANGB; there were a total of 129 such records. There were also a total of 8 surveyed trees with the potential to interfere with existing natural gas lines at Selfridge ANGB.

8.2 REMOVAL

Many removals have been prescribed under the individual tree Conditions category in the database (180 total records). Virtually all of the trees in this category are the ashes (primarily green ash) with documented emerald ash borer infestations; only one ash tree out of 163 total ashes did not exhibit clear signs of infestation. Because of the current quarantine of these trees, and the fact that they will all die (i.e., many will pose safety hazards) it is recommended that they be removed and stored per current State regulations as soon as practicable. Occasionally, individual trees of other species were recommended for removal when it was our best judgment that the amount of trimming required to correct the problem would likely kill the tree (e.g., when major parts of a large tree's crown were growing into overhead electrical transmission lines, or trees were growing directly over other utilities that require cleared rights-of-way). All removed trees should be replaced by appropriate native species (from local stock, if possible) in safe, reasonable nearby locations to replace the ecological and aesthetic values that will be lost.

8.3 GUY WIRES AND BRACING

As indicated in the previous sections, guy wires and bracing are rarely ever really needed. We found numerous instances at Selfridge ANGB of tree trunks and limbs growing into the steel guy wires that they were planted with (a lot of the wires were grown into the trees and were no longer removable). Many of these individual trees were disfigured and rendered architecturally unsound and less aesthetically appealing because of the scars and odd shapes created when they have grown over these wires. This practice is rarely (if ever) needed when new tree saplings are planted. In unusual instances where some guys are temporarily needed, biodegradable materials (e.g., canvas or light ropes) could be used instead of wire. In no instance, however, should guys be considered permanent; they should be monitored and removed as soon as possible.

8.4 PESTS AND OTHER RECOMMENDATIONS

In cases where we identified specific pests and invasive species at a particular tree (e.g., pinebark beetle, wooly adelgid, spruce spider mites, leaf rusts, etc.), Michigan-licensed pesticide or herbicide applicators should be contacted for treatment based on the Urgency Level indicated in the database. Where leaf fungus problems (i.e., anthracnose) have been specified in the database, the leaves from these particular trees should be isolated, collected, and taken off site for burning or other disposal wherever possible and practicable. This practice will help to keep these funguses from spreading to adjacent trees.

8.5 NON-NATIVE AND INVASIVE SPECIES REPLACEMENT

Twelve species of non-native trees were surveyed at the Selfridge ANGB as part of the 2008 UTS survey (Table 8-1). Collectively, this group of species comprises a large number of urban trees at Selfridge. These species all differ considerably in the degree of their invasiveness and their general pros and cons as urban trees. For example, neither little leaf linden nor Norway spruce appear to be invasive beyond their landscaping setting, but other species such as Norway maple and Bradford pear escape readily and are known problem invasive trees.

To maximize value to wildlife, longevity, aesthetic values, and other criteria, individual trees of each of these non-native species, as they die or become a public hazard, should be replaced with native ones where practicable. Table 8-1 presents a list of the 12 non-native trees surveyed at the Selfridge ANGB, and a variety of suggested native replacements. Replacement trees have been proposed here based on comparative size; growth habit; similar native habitats; flowering and fruiting characteristics; and aesthetics. These native species are readily available many from local tree nurseries in the region of the Selfridge ANGB. All new trees should be planted and maintained per recommendations cited in Appendix A of this report.

Table 8-1. Existing non-native trees at the Selfridge ANGB, and potential native replacements, based on relative size; growth habit; habitat requirements; flowering and fruiting characteristics; and aesthetics.

Existing Non-native Tree Species	Potential Native Tree Replacements
Bradford Pear (*Pyrus calleryana*)	Crabapple (*Malus coronaria*) Hawthorns (*Crataegus* spp.) Mountain Ash (*Sorbus decora*)
Crack Willow (*Salix fragilis*)	Black Willow (*Salix nigra*) Eastern Cottonwood (*Populus deltoides*) Kentucky Coffee Tree (*Gymnocladus dioicus*) Black Walnut (*Juglans nigra*)
Little Leaf Linden (*Tilia cordata*)	Persimmon (*Diospyros virginiana*) Basswood (*Tilia Americana*) Honey Locust (*Gleditsia triacanthos*) Hackberry (*Celtis occidentalis*)
London Plane (*Platanus hybrida*)	Sycamore (*Platanus occidentalis*) American Beech (*Fagus grandifolia*) American Elm (*Ulmus americana*) Bur Oak (*Quercus macrocarpa*)

Table 8-1. (Continued)

Existing Non-native Tree Species	Potential Native Tree Replacements
Norway Maple (*Acer platanoides*)	Black Gum (*Nyssa sylvatica*) Red Maple (*Acer rubrum*) Sugar Maple (*Acer saccharum*) Honey Locust (*Gleditsia triacanthos*)
Norway Spruce (*Picea abies*)	White Spruce (*Picea glauca*) Black Spruce (*Picea mariana*) Blue Spruce (*Picea pungens*)
Sand Cherry (*Prunus* x *cistena*)	Sand Cherry (*Prunus pumila*) Paper Birch (*Betula papyrifera*) Gray Birch (*Betula populifolia*)
Sweet Cherry (*Prunus avium*)	Black Cherry (*Prunus serotina*) Persimmon (*Diospyros virginiana*) Hackberry (*Celtis occidentalis*)
Tree of Heaven (*Ailanthus altissima*)	Quaking Aspen (*Populus tremuloides*) Big Toothed Aspen (*Populus grandidentata*) Black Walnut (*Juglans nigra*)
Weeping Cherry (*Prunus subhirtella*)	Crabapple (*Malus coronaria*) Black Cherry (*Prunus serotina*) Mountain Ash (*Sorbus decora*)
Weeping Willow (*Salix babylonica*)	Black Willow (*Salix nigra*) Bur Oak (*Quercus macrocarpa*) Eastern Cottonwood (*Populus deltoides*) Sycamore (*Platanus occidentalis*)
White Willow (*Salix alba)*	Black Willow (*Salix nigra*) Eastern Cottonwood (*Populus deltoides*) Quaking Aspen (*Populus tremuloides*) Big Toothed Aspen (*Populus grandidentata*)

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APPENDIX A

ADDITIONAL INFORMATION

ON URBAN TREE MAINTENANCE

CERTIFIED ARBORISTS IN THE VICINITY OF SELFRIDGE ANGB, MI

Contact Information	Credentials	Services	Memberships
Ray Owen Owen Tree Service ATTICA MI Phone: 800-724-6680 Fax: 810-724-6651 Email http://www.owentree.com	Certified Arborist Utility Specialist	Diagnosis of Sick Tree Fertilization Cable/Brace Consulting Tree Value Estimates Tree Risk Assessment Pest Management Pruning Removal Stump Grinding/Removal Tree Preservation Planning	ISA TCIA[3]
Randy Owen Owen Tree Service ATTICA MI Phone: 800-724-6680 Fax: 810-724-2684 Email http://www.owentree.com	Certified Arborist	Diagnosis of Sick Tree Fertilization Cable/Brace Consulting Public Education Tree Value Estimates Tree Risk Assessment Pest Management Pruning Removal Stump Grinding/Removal Tree Preservation Planning	ASCA[2] ISA TCIA[3]
Robert Stempnik J. H. Hart Urban Forestry WARREN MI Phone: 586-795-5581 Fax: 586-795-0930 Email https://www.jhhart.com	Certified Arborist	Fertilization Diagnosis of Sick Tree Cable/Brace Consulting Tree Value Estimates Stump Grinding/Removal Pruning Removal Tree Risk Assessment Pest Management	TCIA[3]
Kevin Lary J.H. Hart Urban Forestry SAINT CLAIR SHORES MI Phone: 586-795-5581 Fax: 586-795-0930 Email https://www.jhhart.com	Certified Arborist	Diagnosis of Sick Tree Fertilization Cable/Brace Consulting Tree Value Estimates Tree Risk Assessment Pruning Stump Grinding/Removal Removal Pest Management	TCIA[3]

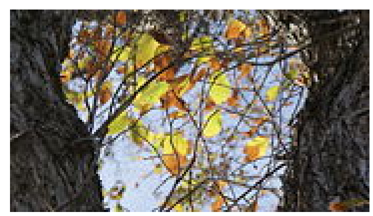
Aaron Keyworth J.H. Hart Urban Forestry WARREN MI Phone: 586-795-5581 Fax: 586-795-0930 Email https://www.jhhart.com	Certified Arborist	Diagnosis of Sick Tree Stump Grinding/Removal Cable/Brace Fertilization Tree Value Estimates Consulting Pruning Removal Pest Management Tree Risk Assessment	TCIA[3]
Brian Grass J.H. Hart Urban Forestry SAINT CLAIR SHORES MI Phone: 586-795-5581 Fax: 586-795-0930 Email https://www.jhhart.com	Certified Arborist	Diagnosis of Sick Tree Fertilization Cable/Brace Consulting Tree Value Estimates Tree Risk Assessment Stump Grinding/Removal Removal Pest Management Pruning	TCIA[3]
Steve Turner ArboriculturServices FERNDALE MI Phone: 248-259-8420 Fax: Email	Certified Arborist	Diagnosis of Sick Tree Fertilization Cable/Brace Consulting Public Education Tree Value Estimates Tree Risk Assessment Pest Management Pruning Tree Preservation Planning Tree Relocation	
Scott Ouellette Owen Tree Service LAKE ORION MI Phone: 800-724-6680 Fax: 810-724-2684 Email http://www.owentree.com	Certified Arborist	Diagnosis of Sick Tree Fertilization Consulting Tree Value Estimates Tree Risk Assessment Pest Management Pruning Removal Stump Grinding/Removal Tree Preservation Planning	ISA TCIA[3]
Shane Tucker Takeer Arbor Company WIXOM MI Phone: 248-672-2316 Fax: Email	Certified Arborist	Diagnosis of Sick Tree Fertilization Cable/Brace Consulting Public Education Tree Risk Assessment Landscape Services Pruning Removal Stump Grinding/Removal Tree Planting Tree Relocation Tree Preservation Planning	

LIFE HISTORY INFORMATION FOR PRINCIPAL TREE SPECIES AT THE SELFRIDGE ANGB

AMERICAN ELM (*Ulmus americana*).


Bark

The American Elm is a deciduous tree, which, before the advent of Dutch elm disease, commonly grew to > 30 m (100 ft) tall with a trunk > 1.2 m (4 ft) dbh. The crown forms a high, spreading canopy with open air space beneath. The leaves are alternate, 7–20 cm long, with double-serrate margins and an oblique base. The tree is hermaphroditic, having perfect flowers, i.e. with both male and female parts, and is therefore capable of self-pollination. The flowers are small, purple-brown, and, being wind-pollinated, are apetalous; they emerge in early spring before the leaves. The fruit is a flat samara 2 cm long and 1.5 cm broad, with a circular wing surrounding the single 4–5 mm seed.


Leaves

As in the closely related European White Elm, U. laevis, the flowers and seeds are borne on 1–3 cm long stems. American Elm is wholly insensitive to daylight length (photoperiod), and will continue to grow well into autumn until injured by frost [2]. The tree reaches sexual maturity at around 15 years of age and is unique within the genus in being tetraploid, i.e. having double the usual number of chromosomes. However, nowadays it is uncommon for the tree to reach over 10 years of age, such is its susceptibility to Dutch elm disease. The American Elm is the state tree of both Massachusetts and North Dakota.

Cultivation and Uses

In years past, the American Elm was used widely as a shade tree and as a street tree, because of its graceful, arching, vase-like growth form and its tolerance of most stress factors [3] Furthermore, the cross-grained wood imbues the branches with great strength, and breakages were rare. The species has been planted beyond its natural range as far north as central Alberta, and south to Lake Worth, Florida. It also survives low desert heat at Phoenix, Arizona.

Introductions across the Atlantic rarely prospered, even before the outbreak of Dutch elm disease. Introduced to the UK in 1752, it was noted that the foliage of the American Elm was far more susceptible to insect damage than native elms [4]. A few, mostly young, specimens survive in British arboreta. Introduced to Australasia, the tree was listed by nurseries in Australia in the early 20th century, and is known to have been planted along the Avenue of Honour at Ballarat and the Bacchus Marsh Avenue of Honour. It is only rarely found in New Zealand [5].

Ecology

The American Elm occurs naturally in an assortment of conditions, most notably on bottomlands and floodplains, although it also can thrive in well-drained soils. On more elevated terrain, as in the Appalachian Mountains, it often prefers to grow along streams. In the United States, it is a major member of four cover types: Black Ash-American Elm-Red Maple; Silver Maple-American Elm; Sugarberry-American Elm-Green Ash; and Sycamore-Sweetgum-American Elm. The first two of these types also occur in Canada.[4] Some hilltops near Témiscaming, Quebec, have a Sugar Maple-Ironwood-American Elm cover type [6] The leaves of the American Elm serve as food for the larvae of various Lepidoptera. See List of Lepidoptera that feed on elms.

Pests and Diseases

The American Elm is highly susceptible to Dutch elm disease (DED) and Elm Yellows; it is also moderately preferred for feeding and reproduction by the adult Elm Leaf Beetle *Xanthogaleruca luteola* [7] [5], and highly preferred for feeding by the Japanese Beetle *Popillia japonica* [8] [6] [7] in the USA. Trees grown in Europe have proven very susceptible to damage by leaf-feeding insects in general, far more so than native or Asiatic elms [4].

U. americana is also the most susceptible of all the elms to verticillium wilt [9].

Dutch Elm Disease

DED is an introduced fungal disease which has ravaged the American Elm, causing catastrophic die-offs in cities across the range. It has been estimated that only approximately 1 in 100,000 American elm trees is DED-tolerant, most known survivors simply having escaped exposure to the disease [8]. However, in some areas still not populated by the Dutch Elm disease-carrying Elm bark beetle, the American Elm continues to thrive, notably in Florida, most of Alberta and British Columbia.
The American Elm is particularly susceptible to disease because the period of infection often coincides with the period, approximately 30 days, of rapid terminal growth when new springwood vessels are fully functional. Spores introduced outside of this period remain largely static within the xylem and are thus relatively ineffective [10].

A fair number of mostly small to medium-sized American Elms survive nowadays in woodlands, suburban areas, and occasionally cities, where most often the survivors had been relatively isolated from other elms and thus spared a severe exposure to the fungus. For example, in Central Park and Tompkins Square Park in New York City [11], stands of several large elms originally planted by Frederick Law Olmsted survive because of their isolation from neighboring areas in New York where there had been heavy mortality. In Akron Ohio there is a very old elm tree that has not been infected. In historical areas of Philadelphia, Pennsylvania, there are also a few mature American Elms still standing — notably in Independence Square and the Quadrangle at the University of Pennsylvania, and also at the nearby campuses of Haverford College, Swarthmore College, and The Pennsylvania State University. The large Massachusetts Champion Elm stands on Summer Street in the Berkshire County town of Lanesborough, Massachusetts, kept alive by antifungal treatments. Rutgers University has preserved 55 mature elms on and in the vicinity of Voorhees Mall on the College Avenue Campus in New Brunswick, New Jersey in addition to seven disease-resistant trees that have been planted in this area of the campus in recent years. [12]

The American Elm's biology in some ways has helped to spare it from obliteration by the Dutch elm disease, in contrast to what happened to the American Chestnut with the chestnut blight. The elm's seeds are largely wind-dispersed, and the tree grows quickly and begins bearing seeds at a young age. It grows well along roads or railroad tracks, and in abandoned lots and other disturbed areas, where it is highly tolerant of most stress factors. Elms have been able to survive and to reproduce in areas where the disease had eliminated old trees, although most of these young elms eventually succumb to the disease at a relatively young age. There is some reason to hope that these elms will preserve the genetic diversity of the original population, and that they eventually will hybridize with DED-resistant varieties that are being developed or that occur naturally.

Two species of elm bark beetle, one of them native, are known to carry the disease in North America. Although the European elm bark beetle is known to have occurred across southern and central Alberta, it does not appear to be carrying the disease in these areas. Some cities such as Kansas City, Missouri, had used mostly American elms in planting its city streets and had had some of the finest shaded residential streets in the nation, until the disease almost obliterated these plantings in the late 1960s and early 1970s. Many cities in the United States still have some surviving American elms, but generally this species requires frequent attention to check for elm bark beetles and DED infection. (The National Park Service often checks on the hundreds of elm trees under its care in the Washington, D.C., area for signs of illness.)

Fungicidal injections can be administered by a qualified arborist to valuable American elms, to prevent the trees' becoming infected. Such injections generally are effective as a preventive measure for up to three years when performed before any symptoms have appeared, but they may not be so effective as a treatment once the disease is visibly present.

Cultivars

Numerous cultivars have been raised, originally for their aesthetic merit but more recently for their resistance to Dutch elm disease [13] The total number of named cultivars is circa 45, at least 18 of which have probably been lost to cultivation as a consequence of Dutch elm disease or other factors:

- American Liberty, Ascendens, Augustine, Aurea, Beaverlodge, Beebe's Weeping, Brandon, Burgoyne, College, Columnaris, Deadfree, Delaware, Exhibition, Fiorei, Flick's Spreader, Folia Aurea Variegata, Hines, Incisa, Independence, Iowa State, Jackson, Jefferson, Kimley, Klehmii, Lake City, L'Assomption, Lewis & Clark (`Prairie Expedition`), Littleford, Maine, Markham, Minneapolis Park, Moline, Morden, New Harmony, Nigricans, Patmore, Pendula, Penn Treaty, Princeton, Pyramidata, Queen City, Sheyenne, Skinner Upright, Star, Valley Forge, Variegata, Vase, Washington

The National Elm Trial, begun in 2005, is currently evaluating 19 cultivars in scientific plantings across the United States to better assess the strengths and weaknesses of leading cultivars.

The few disease-resistant selections that have been made available to the public as yet include 'Valley Forge', 'New Harmony', 'Princeton', 'Jefferson', and a set of six different clones collectively known as 'American Liberty' [14]. The United States National Arboretum released 'Valley Forge' and 'New Harmony' in late 1995, after screening tests performed in 1992–1993 showed both had unusually high levels of resistance to DED. 'Valley Forge' performed especially well in these tests. 'Princeton' has been in occasional cultivation since the 1920s, and gained renewed attention after its performance in the same screening tests showed it also to have a high degree of DED resistance. A later test performed in 2002–2003 confirmed the DED resistance of these same three varieties, and that of 'Jefferson'. 'Jefferson' was released to wholesale nurseries in 2004 and is becoming increasingly available for planting. Thus far, plantings of these four varieties generally appear to be successful.

In 2005, 90 'Princeton' elms were planted along Pennsylvania Avenue near the White House and to date are healthy and thriving. Introduced to the UK in 2001, 'Princeton' was selected by HRH The Prince of Wales to form the Anniversary Avenue from the Orchard Room reception centre to the Golden Bird statue at his Highgrove residence. In 2007, the Elm Recovery Projectfrom the University of Guelph in Ontario, Canada, reported that cuttings from healthy surviving old elms surveyed across Ontario had been grown to produce a bank of resistant trees, isolated for selective breeding of highly resistant cultivars [9] .

Hybrid Cultivars

Thousands of attempts to cross the American with the Siberian Elm have failed [10]. Reports of successful artificial hybridization and verification of hybridizing American elm with other elms are rare, and are regarded with taxonomic suspicion. Two allegedly successful hybridizations were: 'Hamburg', and 'Kansas Hybrid', both with the Siberian Elm *Ulmus pumila*, but it has since been suggested that the American elm in question was more likely to have been the Red Elm *Ulmus rubra*.

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BLUE SPRUCE (*Picea pungens*).

Colorado Blue Spruce or **Blue Spruce** is a species of spruce native to western North America, from southeast Idaho and southwest Wyoming, south through Utah and Colorado to Arizona and New Mexico. It grows at high altitudes from 1,750-3,000 m altitude, though unlike Engelmann Spruce in the same area, it does not reach the alpine tree-line. It is most commonly found growing along streamsides in mountain valleys, where moisture levels in the soil are greater than the often low rainfall in the area would suggest. [1][2][3]


Mature cone

It is a medium-sized evergreen tree growing to 25-30 m tall, exceptionally to 46 m tall, and with a trunk diameter of up to 1.5 m. The bark is thin and scaly, flaking off in small circular plates 5-10 cm across. The crown is conic in young trees, becoming cylindric in older trees. The shoots are stout, orange-brown, usually glabrous, and with prominent pulvini. The leaves are needle-like, 15-30 mm long, stout, rhombic in cross-section, dull gray-green to bright glaucous blue (very variable from tree to tree in wild populations), with several lines of stomata; the tip is viciously sharp.


Immature cone

The cones are pendulous, slender cylindrical, 6-11 cm long and 2 cm broad when closed, opening to 4 cm broad. They have thin, flexible scales 20-24 mm long, with a wavy margin. They are reddish to violet, maturing pale brown 5–7 months after pollination. The seeds are black, 3-4 mm long, with a slender, 10-13 mm long pale brown wing. [1][2]

Blue Spruce does not normally hybridize with other spruces, though hybrids with Engelmann Spruce have been f
ound very rarely.[2]

The Blue Spruce is the State Tree of Utah and Colorado.[5]

Cultivation

The Blue Spruce, despite its limited natural range, is able to grow under a wide variety of conditions, and is considered highly desireable as a landscape plant due to the unusual blue-gray color of its foliage. It is widely and commonly cultivated throughout both North America and

Europe.[6] One author listed it as appropriate for use in parks, gardens, and as a windbreak in the northeastern U.S., and as being tolerant to road salt.[7]

The American National Christmas Tree, located behind the White House at the center of the The Ellipse, is a Colorado Blue Spruce.[8]

References and External Links

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BRADFORD PEAR (*Pyrus calleryana*).

The Bradford or Callery Pear is a species of pear native to China. It is a deciduous tree growing to 15 to 20 m (49 to 66 ft) tall, with a conic to rounded crown. The leaves are oval, 4 to 7 cm (1.6 to 2.8 in) long, glossy dark green above, slightly paler below. The flowers are produced in early spring before the leaves expand fully, and are white, with five petals, and about 2 to 3 cm (0.79 to 1.2 in) in diameter. They have a sickly-sweet smell.

The fruit is less than one cm in diameter, hard, almost woody until softened by frost, after which it is readily taken by birds, which disperse the seeds in their droppings. In summer, the foliage is dark green and very smooth, and in autumn the leaves commonly turn brilliant colors, anything from yellow and orange to more common red, pink, purple, and bronze. Sometimes, several of these colors may be present on an individual leaf. However, the color often occurs very late in fall, and the leaves may be killed by a hard frost before full color can develop.

This tree is remarkably resistant to sicknesses or blight, and is killed more often by storms and high winds than by sickness.

Cultivation


Bradford pear in autumn color

It is so widely planted throughout North America as an ornamental tree that the tree (specifically the Bradford Pear) has become a ubiquity in many suburban communities. It is tolerant of a variety of soil types, drainage levels and soil acidity. Its shape varies from ovate to elliptical. The symmetry of several cultivars lends to their use in somewhat formal settings, such as office parks or industrial parks. It is commonly planted for its decorative value, but its hard little fruits are taken by birds. Its beautiful white blossoms can be seen in early spring along the boulevards of many eastern U.S. towns. At the latitude of Pittsburgh, PA the trees often remain green until mid-November, and in warm autumns, the colors are often a brilliant end to the fall color season, while in a cold year they may get frozen off before coloring. In the South, they tend to be among the more reliable coloring trees.

Invasive Species

The Callery Pear is proving to be an invasive species in some areas of North America, pushing out native American plants and trees. Seedling plants often differ from the selected cultivars in less regular shape, and also in frequently being densely thorny. In a paper in the botanical journal Castanea, Vincent (2005) reported the species as an escape in 152 counties in 25 states in the United States.


Callery pear fruit in winter

Cultivars

There are several cultivars in commerce, including 'Aristocrat', 'Autumn Blaze', 'Bradford' (Bradford Pear, the most commonly planted cultivar), 'Capital', 'Cleveland Select', 'New Bradford', 'Redspire', and 'Whitehouse'.

Bradford Pear in flower, Hemingway, South Carolina

The neat, dense upward growth of 'Bradford' — which makes it desirable in cramped urban spaces — also results in a multitude of narrow, weak forks, unless corrected by selective pruning at an early stage. These weak crotches make the Bradford Pear very susceptible to storm damage where snowfall is heavy or when ice storms occur, or during the high winds of severe thunderstorms. Because of this, and the relatively short lifespan that results (typically less than 25 years), many groups have discouraged their use in landscaping in favor of other stronger trees including other Callery Pear cultivars like 'Cleveland Select', but also encourage the use of more locally native tree species.

Uses by Humans

Callery pear can be used as rootstock for grafting pear cultivars such as Comice, Bosc, or Seckel and especially for nashi pear.

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External Links

- *Plant Invaders of Mid-Atlantic Natural Areas*
- *Pyrus calleryana images at bioimages.vanderbilt.edu*
- *"Scientists Look for Clues Into How Tree Populations Become Invasive" Jan 15, 2008 by Stacy Kish, CSREES Staff.*

Retrieved from "http://en.wikipedia.org/wiki/Callery_Pear"

CRABAPPLE (*Malus* spp.).

Malus (pronounced /ˈmeɪləs/),[1] the **apples**, is a genus of about 30–35 species of small deciduous trees or shrubs in the family Rosaceae. Other studies go as far as 55 species [2] including the domesticated Orchard Apple, or Table apple as it was formerly called (*M. domestica*, derived from *M. sieversii*, syn. *M. pumila*). The other species and subspecies are generally known as "wild apples", "crab apples", "crabapples" or "crabs".

Malus sikkimensis fruit

Winter Red Flesh, an edible crab variety producing intense red jelly

Crabapple fruit are mostly red, but some, such as this cultivar 'Golden Hornet', are yellow

The genus is native to the temperate zone of the Northern Hemisphere, in Europe, Asia and North America.

Apple trees are small, typically 4–12 m tall at maturity, with a dense, twiggy crown. The leaves are 3–10 cm long, alternate, simple, with a serrated margin. The flowers are borne in corymbs, and have five petals, which may be white, pink or red, and are perfect, with usually red stamens that produce copious pollen, and an inferior ovary; flowering occurs in the spring after 50–80 growing degree days (varying greatly according to subspecies and cultivar). Apples require cross-pollination between individuals by insects (typically bees, which freely visit the flowers for both nectar and pollen); all are self-sterile, and (with the exception of a few specially developed cultivars) self-pollination is impossible, making pollinating insects essential. The honeybee and mason bee are the most effective[citation needed] insect pollinators of apples. Malus species, including domestic apples, hybridize freely. *Malus* species are used as food plants by the larvae of a large number of Lepidoptera species; see list of Lepidoptera that feed on Malus.

The fruit is a globose pome, varying in size from 1–4 cm diameter in most of the wild species, to 6 cm in M. sylvestris sieversii, 8 cm in M. sylvestris domestica, and even larger in certain cultivated orchard apples; among the largest-fruited cultivars (all of which originate in North America) are 'Wolf River' and 'Stark Jumbo' . The centre of the fruit contains five carpels arranged star-like, each containing one to two (rarely three) seeds.

One species, Malus trilobata from southwest Asia, has three- to seven-lobed leaves (superficially resembling a maple leaf) and with several structural differences in the fruit; it is often treated in a genus of its own, as Eriolobus trilobatus.

Uses

Ripe crabapple fruit

For *Malus sylvestris domestica*, see Apple. The fruit of the other species is not an important crop in most areas, being extremely sour and (in some species) woody, and is rarely eaten raw for this reason. However, crabapples are an excellent source of pectin, and their juice can be made into a ruby-coloured jelly with a full, spicy flavour[3]. A small percentage of crab apples in cider makes a more interesting flavour.[*citation needed*] As Old English *Wergulu*, the crab apple is one of the nine plants invoked in the pagan Anglo-Saxon *Nine Herbs Charm*, recorded in the 10th century.

Crabapples are widely grown as ornamental trees, grown for their beautiful flowers or fruit, with numerous cultivars selected for these qualities and for resistance to disease.

Some crab apples are used as rootstocks for domestic apples to add beneficial characteristics.[4] For example, varieties of Baccata, also called Siberian crab, rootstock is used to give additional cold hardiness to the combined plant for orchards in cold northern areas[5]

They are also used as pollinizers in apple orchards. Varieties of crab apple are selected to bloom contemporaneously with the apple variety in an orchard planting, and the crabs are planted every sixth or seventh tree, or limbs of a crab tree are grafted onto some of the apple trees. In emergencies, a bucket or drum bouquet of crab apple flowering branches are placed near the beehives as orchard pollenizers. See also Fruit tree pollination.

Hybrid Crab apple grown for its flowering

Because of the plentiful blossoms and small sized fruit, crab apples are popular for use in bonsai culture. Because the trees are small due to the requirements of the hobby, but still show the abundant fruit bearing of full sized crab apples, it is important to thin out fruit so that trees do not exhaust themselves.

Apple wood "makes a wonderfully luxurious firewood with a lovely scent, and smoke from an apple wood fire gives a most excellent flavour to smoked foods," [6] including Applewood cheese.

Notes

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- Virginia Cooperative Extension - Disease resistant crabapples
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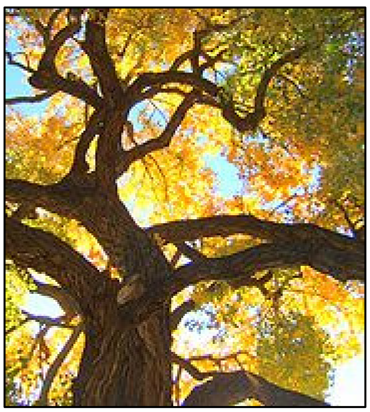
- Germplasm Resources Information Network: *Diab*

EASTERN COTTONWOOD (*POPULUS DELTOIDES*).

The **cottonwoods** are three species of poplars in the section *Aegiros* of the genus *Populus*, native to North America, Europe and western Asia.

Those in section *Populus* are large deciduous trees 20-45 m tall, distinguished by thick, deeply fissured bark, and triangular-based to diamond-shaped leaves, green on both sides (without the whitish wax on the undersides of balsam poplar leaves), and without any obvious balsam scent in spring. An important feature of the leaves is the petiole which is flattened sideways, so that the leaves have a particular type of movement in the wind.



A Cottonwood tree in the Fall

Male and female flowers are in separate catkins, appearing before the leaves in spring. The seeds are borne on cottony structures which allow them to be blown long distances in the air before settling to ground.

The cottonwoods are exceptionally tolerant of flooding, erosion and flood deposits filling around the trunk.

In the past up to five or six species were accepted, but recent trends have been to accept just three species, treating the others as subspecies of *P. deltoides*.

The **Eastern Cottonwood** *Populus deltoides* is one of the largest North American hardwood trees, although the wood is rather soft. It is a riparian zone tree. It occurs throughout the eastern United States and just into southern Canada. The leaves are alternate and simple, with coarsely-toothed (crenate/serrate) edges, and subcordate at the base. The leaf shape is roughly triangular, hence the species name, *deltoides*.

In the typical subspecies *deltoides* (Vermont south to northern Florida and west to about Michigan), the leaves are broad triangular, 7-15 cm across at the base. Further west (Minnesota south to eastern Texas), the subspecies *molinifera* (**Plains Cottonwood**; syn. *P. sargentii*) has somewhat narrower leaves 5-10 cm wide at the base. This is also the state tree of Nebraska, Wyoming and Kansas. In western Texas, New Mexico and Colorado the subspecies *wislizeni* (**Rio Grande Cottonwood**; syn. *P. wislizeni*) occurs.

The **Fremont cottonwood** *Populus fremontii* occurs in California east to Utah and Arizona and south into northwest Mexico; it is similar to Eastern Cottonwood, differing mainly in the leaves having fewer, larger serrations on the edge, and small differences in the flower and seed pod structure.

The third species, **Black Poplar** *Populus nigra*, native of Europe and western Asia, is distinct in its much smaller leaves, 5-11 cm across, with a more rhombic (diamond) shape; see the link for further details.

Cultivation and Uses

Cottonwoods are widely grown for timber production along wet river banks, where their exceptional growth rate provides a large crop of wood within just 10-30 years. The wood is coarse and of fairly low value, used for pallet boxes, shipping crates and similar, where a coarse but cheap and strong wood is suitable. They are also widely grown as screens and shelterbelts. Many of the cottonwoods grown commercially are the hybrid between Eastern Cottonwood and Black Poplar, *Populus* × *canadensis* (**Hybrid Black Poplar** or **Carolina Poplar**). In the West, a variant know as Hybrid Cottonwood are also grown[1].

Felling a cottonwood tree usually involves making an initial deep chainsaw cut to drain the water.Cottonwood bark is often a favorite medium for artisans. The bark, which is usually harvested in the fall after a tree's death, is generally very soft and easy to carve.

Cottonwood is one of the poorest woods to use as Wood fuel. It does not dry well, and rots quickly. It splits poorly, because it is very fibrous. It produces the lowest BTUs per cord of wood[2].

Cottonwoods serve as food for the caterpillars of several Lepidoptera. See List of Lepidoptera that feed on poplars.

External Links

- Swamp Cottonwood, *Populus heterophylla* Large-format diagnostic photographs, species information. Morton Arboretum acc. 144-91-6
- Minnesota DNR big tree list The largest tree by circumference in Minnesota is a *populus deltoides* at 394 inches (1,001 centimeters) measured at the trunk 4 and 1/2 feet (137 cm) above the ground. This tree is 106 feet (32.31 meters) tall.

- Large Ohio Cottonwood Tree [3]

Retrieved from "http://en.wikipedia.org/wiki/Cottonwood"

GREEN ASH (*Fraxinus pennsylvanica*).

Green Ash is a species of ash native to eastern and central North America, from Nova Scotia west to southeastern Alberta and eastern Colorado, south to northern Florida, and southwest to eastern Texas.[1]


Bark

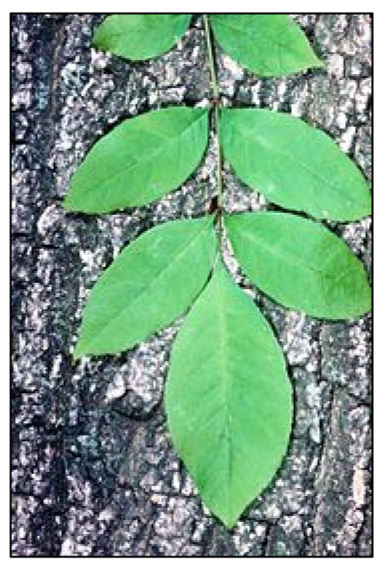
It is a medium-sized deciduous tree reaching 12-25 m (rarely to 45 m) tall with a trunk up to 60 cm in diameter. The bark is smooth and gray on young trees, becoming thick and fissured with age. The winter buds are reddish-brown, with a velvety texture. The leaves are 15-30 cm long, pinnately compound with seven to nine (occasionally five or eleven) leaflets, these 5–15 cm (rarely 18 cm) long and 1.2–9 cm broad, with serrated margins and short but distinct, downy petiolules a few millimeters long. They are green both above and below. The autumn color is golden-yellow, and the tree is usually the earliest to change color, sometimes being in autumn color as early as Labor Day. The flowers are produced in spring at the same time as the new leaves, in compact panicles; they are inconspicuous with no petals, and are wind-pollinated. The fruit is a samara 2.5-7.5 cm long comprising a single seed 1.5-3 cm long with an elongated apical wing 2-4 cm long and 3-7 mm broad.[2][3][4][5]

It is sometimes divided into two varieties, *Fraxinus pennsylvanica* var. *pennsylvanica* (Red Ash) and *Fraxinus pennsylvanica* var. *lanceolata* (Borkh.) Sarg. (syn. var. *subintegerrima* (Vahl) Fern.; Green Ash) on the basis of the hairless leaves with narrower leaflets of the latter, but the two intergrade completely, and the distinction is no longer upheld by most botanists.[1]

Ecology

It is the most widely distributed of all the American ashes. Naturally a moist bottom land or stream bank tree, it is hardy to climatic extremes. The large seed crops provide food to many kinds of wildlife.[6]

It is seriously threatened in some areas, particularly Michigan, by the emerald ash borer, a beetle introduced accidentally from Asia to which it has no natural resistance.[7]


Bark and leaf

Uses

Green Ash is one of the most widely planted ornamental trees throughout the United States and much of Canada, including in western areas where it is not native. Is also widely planted in Argentina. It is very popular due to its good form and resistance to disease. About 40% of boulevard trees in Edmonton, Alberta are Green Ash.[8] It has several drawbacks as an urban tree, notably a relatively short lifespan compared to many trees (rarely over 100 years, often only 30-50 years), and more recently, the threat from the emerald ash borer. Advantages include its tolerance of urban conditions, ease of propagation, and (in eastern North America) its value for wildlife as a native species.

Green Ash wood is similar in properties to White Ash wood, and is marketed together as "white ash". The commercial supply is mostly in the South. It is very popular, used in making guitars because it can be somewhat lighter than white ash without sacrificing too much in tone. It has a bright sound with long sustain, plus the wood grain is aesthetically desirable to many guitar players. Gibson, Fender, Ibanez, and many luthiers use ash in the construction of their guitars.

Other names more rarely used include downy ash, swamp ash and water ash.

References

^ A B GERMPLASM RESOURCES INFORMATION NETWORK: FRAXINUS PENNSYLVANICA

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3. ^ Virtual Herbarium of the Chicago Region: *Fraxinus pennsylvanica*
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5. ^ USDA Forest Service Silvics Manual: *Fraxinus pennsylvanica*
6. ^ Emerald ash borer: EAB website
7. ^ Edminton: trees

Retrieved from "http://en.wikipedia.org/wiki/Fraxinus_pennsylvanica"

HONEY LOCUST (*Gleditsia triacanthos*).

The **Honey locust** is a deciduous tree native to eastern North America. It is mostly found in the moist soil of river valleys ranging from southeastern South Dakota to New Orleans and central Texas, and as far east as central Pennsylvania.

Description

Honey locusts can reach a height of 20–30 m (66–100 ft), with fast growth, and are relatively short-lived; about 120 years, some living up to 150. They are also prone to losing large branches in windstorms. The leaves are pinnately compound on older trees but bipinnately compound on vigorous young trees. The leaflets are 1.5–2.5 cm (smaller on bipinnate leaves) and bright green. They turn yellow in the fall. Leafs out relatively late in spring, but generally slightly earlier than the black locust (*Robinia pseudoacacia*). The strongly scented cream-colored flowers appear in late spring, in clusters emerging from the base of the leaf axils.

The fruit of the Honey locust is a flat legume (pod) that matures between September and October. The pods are generally between 15–20 cm. The pulp on the insides of the pods is edible, unlike the Black locust, which is toxic. The seeds are dispersed by grazing herbivores such as cattle and horses, which eat the pod pulp and excrete the seeds in droppings; the animal's digestive system assists in breaking down the hard seed coat, making germination easier.

Honey locusts commonly have thorns 10–20 cm long growing out of the branches; these may be single, or branched into several points, and commonly form dense clusters. The thorns are fairly soft and green when young, harden and turn red as they age, then fade to ash grey and turn brittle when mature. These thorns are thought to have evolved to protect the trees from browsing Pleistocene megafauna which may also have been involved in seed dispersal.[1] Thornless forms (f. *inermis*) are occasionally found growing wild.

Uses

Despite its name, Honey locust is not a significant honey plant. The name derives from the sweet taste of the legume pulp, which was used for food by Native American people, and can also be fermented to make beer.

A Native American legend is that the Thunder Spirit recognized his son by his ability to sit comfortably on locust branches, despite the thorns.

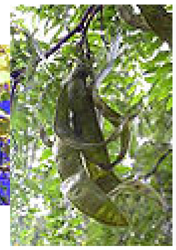
Its cultivars are popular ornamental plants, especially in the northern plains of North America where few other trees can survive and prosper. It tolerates urban conditions, compacted soil, road salt, alkaline soil, heat and drought. The popularity is in part due to the fact that it transplants so easily. The fast growth rate and tolerance of poor site conditions make it valued in areas where shade is wanted quickly, such as new parks or housing developments, and in disturbed and reclaimed environments, such as mine tailings. It is resistant to Gypsy moths but is defoliated by another pest, the mimosa webworm. Spider mites, cankers, and galls are a problem with some trees.

Honey locust produces a high quality, durable wood that polishes well, but the tree does not grow in sufficient numbers to support a bulk industry. Its also used for posts and rails since it works with soil so well and takes a long time to rot. However a niche market exists for honey locust furniture. In the past, the hard thorns of the younger trees have been used as nails.

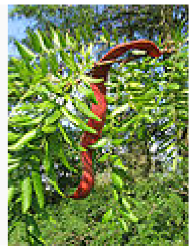
Images

Honey Locust thorns

Honey Locust foliage



Immature seed pods



Mature seed pod

Honey Locust thorns, Southwest Ohio

Notes

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External Links

- *Gleditsia triacanthos* images at bioimages.vanderbilt.edu
- *Gleditsia triacanthos* images at Forestry Images
- *Gleditsia triacanthos* at US Forest Service Silvics Manual
- *Gleditsia triacanthos* at USDA Plants Database

Retrieved from "http://en.wikipedia.org/wiki/Honey_locust"

NORWAY MAPLE (*Acer platanoides*).

Norway Maple is a species of maple native to eastern and central Europe and southwest Asia, from France east to Russia, north to southern Scandinavia and southeast to northern Iran.[1] [2]

It is a deciduous tree growing to 20–30 m tall with a trunk up to 1.5 m diameter, and a broad, rounded crown. The bark is grey-brown and shallowly grooved; unlike many other maples, mature trees do not tend to develop a shaggy bark. The shoots are green at first, soon becoming pale brown; the winter buds are shiny red-brown. The leaves are opposite, palmately lobed with five lobes, 7–14 cm long and 8–20 cm (rarely 25 cm) across; the lobes each bear one to three side teeth, and an otherwise smooth margin. The leaf petiole is 8–20 cm long, and secretes a milky juice when broken. The autumn colour is usually yellow, occasionally orange-red. The flowers are in corymbs of 15–30 together, yellow to yellow-green with five sepals and five petals 3–4 mm long; flowering occurs in early spring before the new leaves emerge. The fruit is a double samara with two winged seeds, the seeds are disc-shaped, strongly flattened, 10–15 mm across and 3 mm thick. The wings are 3–5 cm long, widely spread, approaching a 180° angle. It typically produces a large quantity of viable seeds. It is not particularly a long-lived tree, with a maximum age of around 250 years.

Classification and Identification


Norway Maple bark

Norway Maple is a member (and is the type species) of the section *Platanoidea* Pax, characterised by flattened, disc-shaped seeds and the shoots and leaves containing milky sap. Other related species in this section include *Acer campestre* (Field Maple), *Acer cappadocicum* (Cappadocian Maple), *Acer lobelii* (Lobel's Maple), and *Acer truncatum* (Shandong Maple). From Field Maple, Norway Maple is distinguished by its larger leaves with pointed, not blunt, lobes, and from the other species by the presence of one or more teeth on all of the lobes.[3][4]

It is also frequently confused with the more distantly related *Acer saccharum* (Sugar Maple). Sugar Maple is easy to identify by clear sap in the petiole (Norway Maple has white sap). The tips of the points on Norway Maple leaves reduce to a fine "hair", while the tips of the points on Sugar Maple leaves are on close inspection rounded. On mature trees, Sugar Maple bark is more shaggy, while Norway Maple bark has small, often criss-crossing grooves. While the shape and angle of leaf lobes vary somewhat within all Maple species, the leaf lobes of Norway Maple tend to have a more triangular shape, in contrast to the more squarish lobes often seen on Sugar Maples. The seeds of Sugar Maple are globose, while Norway Maple seeds are flattened. Sugar Maple usually has a brighter orange autumn color, where Norway Maple is usually yellow, although some of the red-leaved cultivars appear more orange. The tree tends to leaf out earlier than most maples and holds its leaves somewhat longer in autumn.[3][4]

Cultivation and Uses


Leaf of ‘Schwedleri’

The wood is hard, yellowish-white to pale reddish, with the heartwood not distinct; it is used for furniture and turnery.[7]

Many cultivars have been selected, with distinctive leaf shape or coloration such as the dark purple of 'Crimson King' and 'Schwedleri', the variegated leaves of 'Drummondii' and 'Emerald Queen', and the deeply divided, feathery leaves of 'Dissectum' and 'Lorbergii'. The purple-foliage cultivars have orange to red autumn colour. 'Columnare' is selected for its narrow upright growth.[4][8]

It has been widely introduced into cultivation in other areas, including western Europe northwest of its native range. It grows north of the Arctic Circle at Tromsø, Norway. In North America, it is grown as a street and shade tree. It is favoured due to its tolerance of poor, compacted soils and urban pollution. As a result of these characteristics it is considered invasive in some states[9] although it has not been proven to be and is still widely used for urban plantings in many areas.

Norway Maple itself is threatened in a few areas by the Asian long-horned beetle, which eats through the trunk of trees, often killing them.

A number of species of Lepidoptera feed on Norway Maple foliage; see Lepidoptera that feed on maples. Norway Maple is generally free of serious diseases, though can be attacked by the powdery mildew *Uncinula bicornis*, and verticillium wilt disease caused by *Verticillium* spp.[10]

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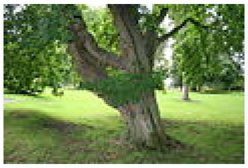
External Links

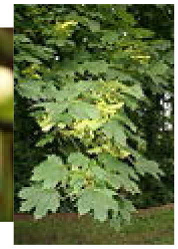
Winter ID pictures



A mature tree in Belgium

Tree in flower

Flower, close-up

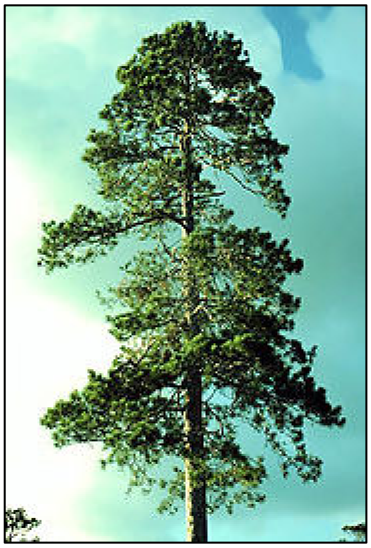


Foliage

An example of orange-red fall colour

Retrieved from "http://en.wikipedia.org/wiki/Acer_platanoides"

RED PINE (*Pinus resinosa*).



Old tree in Itasca State Park, Minnesota

The **Red Pine** is a pine native to northeastern North America, occurring from Newfoundland west to southeast Manitoba, and south to northern Illinois and Pennsylvania, with a small outlying population in the Appalachian Mountains in West Virginia. In the Upper Midwest of the United States it is sometimes known by the confusing name **Norway Pine** even though it is not native to Norway.

It is an evergreen tree characterized by tall, straight growth in a variety of habitats. It usually ranges from 20-35 m in height and 1 m in trunk diameter, but can exceed that in optimal conditions, exceptionally reaching 43 m tall (Gymnosperm Database). The crown is conical in young trees, becoming a narrow rounded dome with age. The bark is thick and gray-brown at the base of the tree, but thin, flaky and bright orange-red in the upper crown; the tree's name derives from this distinctive character. Some red color may be seen in the fissures of the bark. Red Pine is self pruning; there tend not to be dead branches on the trees, and older trees may have very long lengths of branchless trunk below the canopy.

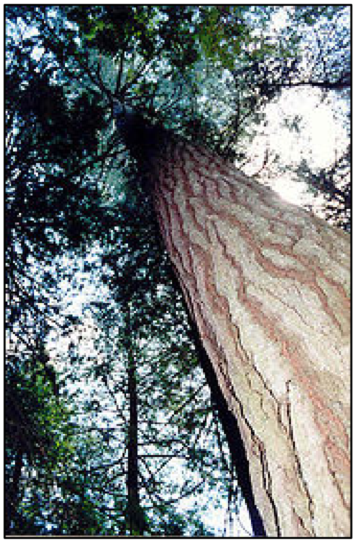
Pollen cones of *Pinus resinosa* in spring

Cone (scale in cm)

The leaves are needle-like, dark green, in fascicles of two, 12-18 cm long, and brittle. The leaves snap cleanly when bent; this character, stated as diagnostic for Red Pine in some texts, is however shared by several other pine species. The cones are symmetrical ovoid, 4-6 cm long, 2.5 cm broad and green before maturity, ripening nut-brown and opening to 4-5 cm broad, the scales without a prickle and almost stalkless.

The species is notable for its very constant morphology and low genetic variation throughout its range, suggesting it has been through a population bottleneck in its recent evolutionary history (Fowler & Morris 1977, Simon et al. 1986).

This species is intolerant of shade, but does well in windy sites; it grows best in well-drained soil. The wood is commercially valuable in forestry for timber and paper pulp, and the tree is also used for landscaping.


Old-growth red pine,
Algoma Highlands, Ontario

The Red Pine is the state tree of Minnesota.

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SILVER MAPLE (*Acer saccharinum*).

The **silver maple** — also called **creek maple**, **river maple**, **silverleaf maple**, **soft maple**, **water maple**, or **white maple** — is a species of maple native to eastern North America in the eastern United States and adjacent parts of southeast Canada. It is one of the most common trees in the United States.

Description


A Silver Maple leaf

The silver maple is a relatively fast-growing deciduous tree, commonly reaching a height of 15-25 m (50-80 ft), exceptionally 35 m (115 ft). Its spread will generally be 11-15 m (35-50 ft) wide. A 10-year-old sapling will stand about 8 m (25 ft) tall. It is often found along waterways and in wetlands, leading to the colloquial name "water maple". It is a highly adaptable tree, although it has higher sunlight requirements than other maples.

The leaves are palmate, 8-16 cm long and 6-12 cm broad, with deep angular notches between the five lobes. The 5-12 cm long, slender stalks of the leaves mean that even a light breeze can produce a striking effect as the silver undersides of the leaves are exposed. The autumn color is less pronounced than in many maples, generally ending up a pale yellow, although some specimens can produce a more brilliant yellow and even orange and red colorations. Some specimens can simply drop their leaves while still green as well.

The flowers are in small panicles, produced before the leaves in early spring, with the seeds maturing in early summer. The seeds are winged, in pairs, small (5-10 mm diameter), the wing about 3-5 cm long. Although the wings provide for some transport by air, the seeds are heavy and are also transported by water.


Silver maple leaves

On mature trunks, the bark is gray and shaggy. On branches and young trunks, the bark is smooth and silvery gray.

In many parts of the eastern U.S., the large rounded buds of the silver maple are one of the primary food sources for squirrels during the spring, after many acorns and nuts have sprouted and the squirrels' food is scarce. The seeds are the largest of any native maple and are also a food source for wildlife.

Cultivation

The silver maple has brittle wood, and is commonly damaged in storms. The roots are shallow and fibrous and easily invade septic fields and old drain pipes and can also crack sidewalks and foundations. It is a vigorous resprouter, and if not pruned, it will often grow with multiple trunks. It is, nonetheless, widely used as an ornamental tree because of its rapid growth and ease of propagation and transplanting. It is highly tolerant of urban conditions, which is why it is frequently planted next to streets. Although it naturally is found near water, it can grow on drier ground if planted there.


Silver maple bark

It is also commonly cultivated outside its native range, showing tolerance of a wide range of climates, growing successfully as far north as central Norway and south to Orlando, Florida. It can thrive in a Mediterranean climate, as at Jerusalem and Los Angeles, if summer water is provided. It is also grown in temperate parts of the Southern Hemisphere, as in Argentina and Uruguay.

The silver maple is closely related to the red maple, and can hybridise with it, the hybrid being known as the Freeman maple (*Acer x freemanii*). The Freeman maple is a popular ornamental tree in parks and large gardens, combining the fast growth of silver maple with the less brittle wood and less invasive roots of the red maple.

References

- USDA Plants Profile: *Acer saccharinum*
- UConn Plant Database: Silver Maple
- Trees of Western North Carolina: Silver Maple
- *Acer saccharinum* images at bioimages.vanderbilt.edu

External Links

- Winter ID pictures

Retrieved from "http://en.wikipedia.org/wiki/Acer_saccharinum"

WHITE PINE (*Pinus strobus*).

White pine is a large pine native to eastern North America, occurring from Newfoundland west to Minnesota and southeastern Manitoba, and south along the Appalachian Mountains to the extreme north of Georgia.

Description


Foliage

Like all members of the white pine group, *Pinus* subgenus *Strobus*, the leaves ('needles') are in fascicles (bundles) of five (rarely 3 or 4), with a deciduous sheath. They are flexible, bluish-green, finely serrated, and 5-13 centimeters (2-5 in) long, and persist for usually about 18 months. The cones are slender, 8-16 centimeters (3-6 in) long (rarely longer than that) and 4-5 centimeters (1.5-2 in) broad when open, and have scales with a rounded apex and slightly reflexed tip. The seeds are 4-5 millimeters (3/16 in) long, with a slender 15-20 mm (3/4 in) wing, and are wind-dispersed. Cone production peaks every 3 to 5 years. Mature trees can easily be 200 years old and 250 is not unusual. Some white pines live over 400 years. A tree growing near Syracuse, New York was dated to 458 years in the late 1980s and trees in Wisconsin and Michigan have approached 500 years in age. White pines prefer well-drained soil and cool, humid climates, but also grow in boggy areas and rocky highlands.


Cones

Range and Dimensions

The Eastern White Pine has the distinction of being the tallest tree in eastern North America. White pine forests originally covered much of northeastern North America, though only one percent of the original trees remain untouched by extensive logging operations in the 1700s and 1800s. In natural pre-colonial stands it is reported to have grown to as tall as 70 meters (230 ft) tall, at least on rare occasions. Even greater heights have been attributed to the species referenced in popular accounts such as Robert Pike's "Tall Trees, Tough Men", but the accounts are unverifiable. The current tallest pines as measured by the Eastern Native Tree Society (ENTS) reach to between 50 and 57.54 meters (160-188.8 ft). Within the Northeast, currently, 8 sites located in 4 states have been confirmed by ENTS to have trees over 48 m (160 ft) in height. The southern Appalachians have even more locations and the tallest pines growing today. Three locations in the Southeast and one site in the Northeast have been identified with white pines to 55 meters (180 ft) tall. One survivor is a specimen known as the "Boogerman Pine" in the Cataloochee Valley, Great Smoky Mountains National Park. At 57.54 m (188.54 ft)[*dubious – discuss*] tall, it is the tallest


A White pine pinecone frozen

accurately measured tree in North America east of the Rocky Mountains. It has been climbed and measured by tape drop by the Eastern Native Tree Society (ENTS). Before it lost its top in Hurricane Opal in October 1995, the Boogerman Pine was 63 m (207 ft) tall as determined by Will Blozan and Robert Leverett using ground-based measurement methods. The current height champion white pine of the Northeast is the Longfellow Pine in Cook Forest State Park, PA. It also has been climbed and measured by tape drop. Its current height is 55.96 m (183.6 ft). Within New England, a tree in the Mohawk Trail State Forest known as the Jake Swamp Tree is 51.54 m (169.1 ft) tall as of August 2008. The Jake Swamp Pine is the tallest accurately measured tree of any species in New England. It was climbed and tape drop-measured in November 1998 and again in October 2001. It is scheduled to be climbed and measured a third time in November 2008. Precise measurements are maintained on this tree by ENTS.

Diameters of the larger pines range from 1.0-1.6 m (3-5 ft). However, singled-trunk white pines in both the Northeast and Southeast with diameters over 1.45 m (4.75 ft) are exceedingly rare. Notable big pine sites of 40 ha (100 acres) or less will often have no more than 2 or 3 trees in the 1.2 to 1.4 m (4-4.5 ft) diameter class. A typical large white pine will be in the 3.0 to 3.7 m (10-12 ft) circumference range. Undocumented reports from colonial America reported diameters of virgin white pines of up to 8 feet in diameter (Ling, 2003).


Eastern White Pine in Arrowhead Provincial Park along Big East River

Total trunk volumes of the largest white pines are around 28 cubic meters (1,000 cubic feet) with some past giants reaching a possible 37 or 40 m³ (1,300 or 1,400 cu ft). Photographic analysis of giant pines suggests volumes closer to 34 m³ (1,200 cu ft). Outside the Great Smoky Mountains National Park, other areas with known remaining virgin stands as confirmed by the Eastern Native Tree Society include Algonquin Provincial Park, Quetico Provincial Park in Ontario; Algoma Highlands, Ontario; Huron Mountains, Michigan (Upper Peninsula); Estivant Pines in Michigan's Keweenaw Peninsula; Hartwick Pines State Park; Menomonie Indian Reservation, northeastern Wisconsin; Boundary Waters Canoe Area Wilderness, Minnesota; the Lost 40 Scientific and Natural Area (SNA) near Blackduck, Minnesota; and White Pines State Park, Illinois, Cook Forest State Park, Hearts Conent Natural Area, and Anders Run, all in Pennsylvania; Linville Gorge, North Carolina. Small groves of old-growth pines are found: (1) on numerous sites within New York's Adirondack Park. Old-growth pines are found in the Ordway Pines, Maine; Ice Glen, Massachusetts. Many sites with conspicuously large pines represent advanced old field succession. The tall white pine stands in Mohawk Trail State Forest and on the William Cullen Bryant homestead in Cummington, both in Massachusetts, are examples. Mohawk Trail State Forest includes 83 white pines reaching 45 m (150 ft) in height or more, of which six exceed 48.8 m (160 ft). This is the largest collection of 45 m (150 foot) class white pines in New England. The largest trees in Hartwick Pines State Parks are in the 45–48 m range (150-160ft). Cook Forest State Park has the largest collection of 45 m (150 foot) trees in the Northeast. At present one hundred ten trees have been measured to heights of 45 m (150 feet) or more. A private property in Claremont New Hampshire has about sixty white pines in the 45 m (150 ft) height class. Beyond the three mentioned properties, sites with 45 m (150 foot) trees typically have from one to fifteen, with most of the sites having less than ten.

Mortality and Disease

An illustration dated 1902 from the Seventh Report of the Forest, Fish and Game Commission of the State of New York, showing a variety of insect pests affecting white pine

Because the tree is somewhat resistant to fire, mature survivors are able to re-seed burned areas. In pure stands mature trees usually have no branches on the lower half of the trunk. In mixed forests, this dominant tree towers over all others, including the large hardwoods. It provides food and shelter for forest birds such as the Common Crossbill and small mammals such as squirrels. The white pine weevil (*Pissodes strobi*) and White Pine Blister Rust (*Cronartium ribicola*), an introduced fungus, can damage or kill these trees.

Mortality from Pine Blister in mature pine groves was often 50-80% during the early 20th century. The fungus must spend part of its life cycle on alternate hosts: gooseberry or wild currant. Foresters reasoned correctly that if all the alternate host plants were removed that White Pine Blister Rust might be eliminated. A very determined campaign was mounted and all land owners in commercial pine growing regions were encouraged to uproot and kill all wild gooseberry and wild currant plant (Ling, 2003). Today wild currants are relatively rare plants in New England and planting wild currants or wild gooseberries is strongly discouraged or may even be illegal. As an alternative new strains of commercial currants have been developed which are highly resistant to White Pine Blister Rust. Planting these new strains is a good compromise and will keep you in good standing with your neighbors and the local authorities. Possibly due to hard work of the foresters mortality in white pines from rust is only about 3% today. But alas wild currant and gooseberry pies are items found only in memories (Lombard and Bofinger, 1999).

Uses and Symbolism

During the age of sail, the tall trees with their high quality wood were valued for masts, and many trees were marked in colonial times with the broad arrow, reserving them for the British Royal Navy. An unusual large, lone, white pine was found in colonial times, in coastal South Carolina along the Black River (far south of its normal range), and the king's mark was put upon this particular tree, giving rise to the town of Kingstree. The wood was often squared immediately after felling to fit in the holds of ships better (Ling, 2003).

The British soon built special barge-like vessels which could carry up to 50 pine trunks destined to be ship masts. A 100' mast was about 3'X3' at the butt and 2'X2' at the top, while a 120' mast was a giant 4'X4' at the bottom and 30" at the top. The original masts on the US Constitution (Old Ironsides) were single trees but later they were laminated to better withstand cannon balls. During the American Revolution it became a great sport for the patriots to see how many of the King's trees one could cut down and haul off (Nizalowski, 1997; Sloane, 1965).

A large Eastern White Pine

Eastern White Pine is now widely grown in plantation forestry within its native area. Several cultivars have been developed for garden use, many of them dwarf with very slow growth. The species was imported into England by Captain George Weymouth in 1620, who planted it widely for a future timber crop, but the stand had little success because of White Pine Blister Rust disease.

Old growth pine in the Americas was a highly desired wood since huge, knot free, boards were the rule rather than the exception. Pine was common and easy to cut, thus many colonial homes used pine for paneling, floors and furniture. Pine was also a favorite tree of loggers since pine logs can still be processed in a lumber mill a year or more after being cut down. In contrast, most hardwood trees such as cherry, maple, oak, and ash must be cut into 1" thick boards immediately after felling or large cracks will develop in the trunk which can render the wood worthless (Ling, 2003).

Freshly cut white pine is creamy white or a pale straw color but pine wood which has aged many years tends to darken to a deep rich tan. Occasionally one can find light brown pine boards with unusual yellowish-golden or reddish brown hues. This is the famous pumpkin pine. It is generally thought that slow growing pines in virgin forests accumulate colored products in the heartwood but genetic factors and soil conditions may also play a role in rich color development (Nizalowski, 1997).

Although white pine was frequently used for flooring in buildings constructed before the Civil War, the wood is soft and consequently you will find cup shaped depressions from normal wear and tear on almost every old white pine floor. George Washington realized this would happen and wisely made his Mount Vernon floors out of yellow pine which is much harder (Ling, 2003).

Eastern White Pine is the provincial tree of Ontario and the state tree of Maine and Michigan and its "pine cone and tassel" is the "state flower" of Maine. Sprigs of Eastern White Pine were worn as badges as a symbol of Vermont identity during the Vermont Republic and appears in a stained glass window at the Vermont State House, on the Flag of Vermont and the naval ensign of the Commonwealth of Massachusetts. It is occasionally known as **White Pine**, **Northern White Pine**, or **Soft Pine**. It is also known as **Weymouth Pine**, especially in Britain. In addition, this tree is known to the Haudenosaunee Native Americans as the **Tree of Great Peace**.

It is now naturalizing in the mountains of southern Poland and the Czech Republic having spread from ornamental trees.

White Pine needles contain five times the amount of Vitamin C (by weight) of lemons and make an excellent tisane. The cambium is edible. It is also a source of resveratrol. Caterpillars of Lusk's Pinemoth (*Coloradia luski*) have been found to feed only on Eastern White Pines.

A board of *P. strobus*

The name "Adirondack" is an Iroquois word which means tree-eater and referred to their neighbors (more commonly known as the Algonquians) who collected the inner bark during times of winter starvation. The white soft inner bark (cambial layer) was carefully separated from the hard, dark brown bark and dried. When pounded this product can be used as flour or added to stretch other starchy products. Linnaeus noted in the 1700's that cattle and pigs fed pine bark bread grew well but he personally did not like the taste. The young staminate cones were stewed by the Ojibwe Indians with meat and were said to be sweet and not pitchy. In addition, the seeds are sweet and nutritious but not as good as those of some of the western nut pines (Fernald, 1943).

Pine resin has been used to waterproof baskets, pails and boats and the sap can be processed to make turpentine. In addition, the sap apparently has a number of quite efficient antimicrobials. The Chippewa even used it successfully to treat gangrenous wounds. Generally a wet pulp from the inner bark is applied to the wounds or pine tar can be mixed with beeswax or butter and used as a salve to prevent infection. Pine tar mixed with beer can be used to remove tapeworms (flat worms) or nematodes (round worms) and pine tar mixed with sulfur is useful to treat dandruff. Pine tar is produced by slowly burning pine roots, branches, or small trunks in a partially smothered flame (Erichsen-Brown, 1979).

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- Eastern Native Tree Society - Boogerman Pine photo gallery
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- Flora of N.Amer-RangeMap: *Pinus strobus*
- The Monday Garden: The Eastern White Pine
- *Pinus strobus* images at bioimages.vanderbilt.edu
- Netstate.com Maine State Flower

External Links

***EASTERN WHITE PINE* AT THE ENCYCLOPEDIA OF LIFE**

Retrieved from "http://en.wikipedia.org/wiki/Eastern_White_Pine"

WHITE SPRUCE (*Picea glauca*).

White Spruce is a species of spruce native to the north of North America, from central Alaska east to Newfoundland, and south to northern Montana, Michigan, Maine and Wisconsin; there is also an isolated population in the Black Hills of South Dakota and Wyoming.

Description

Foliage and cones

It is a medium-sized evergreen tree growing to 15-30 m tall, rarely to 40 m tall, and with a trunk diameter of up to 1 m. The bark is thin and scaly, flaking off in small circular plates 5-10 cm across. The crown is narrow conic in young trees, becoming cylindric in older trees. The shoots are pale buff-brown, glabrous (hairless) in the east of the range, but often pubescent in the west, and with prominent pulvini. The leaves are needle-like, 12-20 mm long, rhombic in cross-section, glaucous blue-green above with several thin lines of stomata, and blue-white below with two broad bands of stomata.[1][2]

The cones are pendulous, slender cylindrical, 3-7 cm long and 1.5 cm broad when closed, opening to 2.5 cm broad. They have thin, flexible scales 15 mm long, with a smoothly rounded margin. They are green or reddish, maturing pale brown 4-6 months after pollination. The seeds are black, 2-3 mm long, with a slender, 5-8 mm long pale brown wing.[1][2]

Varieties

Several geographical varieties have been described, but are not accepted as distinct by all authors. These comprise, from east to west:[1][2]

- *Picea glauca* var. *glauca* (Typical or Eastern White Spruce). From Newfoundland east to eastern Alberta, on lowland plains.
- *Picea glauca* var. *densata* (Black Hills White Spruce). The Black Hills.
- *Picea glauca* var. *albertiana* (Alberta White Spruce). The Rocky Mountains in Alberta, British Columbia and northwest Montana.
- *Picea glauca* var. *porsildii* (Alaska White Spruce). Alaska and Yukon.

The two western varieties are distinguished by pubescent (downy) shoots, and may be related to extensive hybridisation and/or intergradation with the closely related Engelmann Spruce found further south in the Rocky Mountains. White Spruce also hybridises readily with the closely related Sitka Spruce where they meet in southern Alaska; this hybrid is known as *Picea* × *lutzii*.[1][2]

White Spruce is the northernmost tree species in North America, reaching just north of 69°N latitude in the Mackenzie River delta.[6]

Uses

A Dwarf Alberta Spruce,
with reversion in one branch

A dwarf cultivar of the Alberta White Spruce, *Picea glauca* var. *albertiana* 'Conica', is a very popular garden plant. It has very slender leaves, like those normally found only on one-year-old White Spruce seedlings, and very slow growth, typically only 2-10 cm per year. Older specimens commonly 'revert', developing normal adult foliage and starting to grow much faster; this 'reverted' growth must be pruned if the plant is to be kept dwarf.

White Spruce is of major economic importance in Canada for its wood, harvested for paper-making. It is also used to a small extent as a Christmas tree.

The wood is also exported to Japan where, known as "shin-kaya", it is used to make go boards as a substitute for the rare kaya wood.

White Spruce is the Provincial tree of Manitoba and the State tree of South Dakota.

References and External Links

1. ^ *a b c d e* Farjon, A. (1990). *Pinaceae. Drawings and Descriptions of the Genera*. Koeltz Scientific Books ISBN 3-87429-298-3.
2. ^ *a b c d e* Rushforth, K. (1987). *Conifers*. Helm ISBN 0-7470-2801-X.
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5. **^** Flora of North America*Picea glauca*
6. **^** Arno, S. F. & Hammerly, R. P. (1984). *Timberline. Mountain and Arctic Forest Frontiers*. The Mountaineers, Seattle. ISBN 0-89886-085-7.

Dec. 1, 1992

Trees, Shrubs and Ground Covers

Description

This BMP addresses the selection and maintenance of woody plant materials, including trees, shrubs, and ground covers. Seed selection is discussed in the Seeding BMP, and sod selection in the Sodding BMP.

Trees, shrubs and ground covers can be used on steep or rocky slopes where mowing is not feasible. Once trees, shrubs and ground covers are well established they:

-help stabilize the soil, reducing both wind and water erosion
-reduce stormwater runoff by intercepting rainfall and promoting infiltration
-filter pollutants from the air and produce oxygen
-moderate temperature changes and provide shade
-provide some privacy
-improve aesthetic values and increase property values

In addition, ground covers can provide stabilization in areas which are heavily shaded.

Other Terms Used to Describe

Landscape Planting
Landscaping

Pollutants Controlled and Impacts

Tree, shrub and ground cover plantings: protect the soil from wind and water erosion, thereby reducing sedimentation in surface waters; utilize nutrients, thereby minimizing nutrient loading to surface water and nitrate leaching to groundwater; and filter soil that has eroded.

Application

Land Use
The BMP is applicable to all land uses.

Soil/Topography/Climate
Soils, topography and climate will all be considerations in selecting the appropriate trees, shrubs and ground covers for the site.

When to Apply
Plantings are usually done in the spring or fall, based on the following dates and depending on the type of vegetation.

Spring: April 15 - May 30
Fall: September 1 - October 30

Winter and summer plantings are generally not as successful.

Where to Apply
Apply at all sites where landscape planting will minimize soil erosion and/or enhance aesthetic values.

Relationships With Other BMPs

This BMP should also be used when trees, shrubs or ground covers are accidently damaged during Land Clearing operations. Trees, shrubs and ground covers are often incorporated into sites which need Critical Area Stabilization.

Specifications

Planning Considerations:
Wherever possible, **preserve existing woody vegetation.** Existing vegetation is more aesthetically pleasing, costs less than purchasing new species, and provides immediate shade, canopy and habitat. The identification of trees which should be preserved is discussed in the Tree Protection BMP.

For New Plantings:
1. Selection of appropriate species should be based on the following:

    Soil texture. Some species will grow best in certain soil textures. Information on soils for many counties is available from the local Soil Conservation District office. The Appendices include an update of the soils information that has been entered in the Department's land resources database.

    Soil tests may be needed to determine if nutrients or fertilizers need to be added to the site. All additions to the soil should be based on the results of soil tests. Follow the specifications in the Soil Management BMP.

    Exhibit 1 can be used as a starting point for selecting trees and shrubs based on soil conditions.

    Exhibit 2 can be used as a starting point for selecting ground covers based on soil conditions.

    Drainage classification. Drainage classification is reflective of the soil moisture condition of the soil. For example, species such as white birch will grow best if soil moisture is high. Other species such as Jack pines will "drown" and die in soils of high water content. Be sure to take the drainage classification of soils into consideration when selecting tress and shrubs.

    Native species. The type of vegetation which exists in the area is a good indicator of plants which will likely have good survival rates. These indicator species provide information on soil texture, drainage class, and fertility. Native vegetation or plant materials with similar requirements can then be used.

Purpose (Use). The purpose for which the plant is being used should also be considered. If the plant is being added for shade, trees with fuller canopies should be selected. If the plant is being added to control soil erosion, then its rate of growth, type of root system, ground covering characteristics, and spacing between plants are important factors.

2. Because of the spacing required between many shrubs and trees, and because it takes time for most woody species to "take hold," soil erosion between plants may occur. To prevent erosion, mulch all sites which will be planted with woody species. See the Mulching BMP.

3. On steep slopes, stagger plantings and consider using erosion control mats or netting prior to placing to keep soil from eroding. Mats and netting should be slit to accommodate the shrubs. See the Filters BMP for information on the proper selection of nets and mats.

4. For areas in which trees or shrubs will be planted, any seeding that is done to help stabilize the area should consist of the least competitive plant species. Species such as tall fescue, which produces vigorous early growth, is highly competitive with tree seedlings and therefore should not be used. Species such as annual lespedezas, which starts growing relatively late in the spring, is much less competitive.

5. Any pruning that needs to be done should be completed before planting occurs and should be done by persons experienced in pruning.

   For deciduous trees: Prune to balance the loss of roots so as to retain the natural form of the plant type. The height ratio of the crown to the trunk after pruning should be approximately one-third crown to two-thirds trunk. The primary leader should not normally be cut back. Branches to be removed should be cut off flush with the trunk or main branch.

   For deciduous shrubs: Prune by removing all dead wood and broken branches, thinning out entire canes where they are too thick, cutting back or removing unsymmetrical branches and sufficient other growth to ensure healthy and symmetrical growth of new wood. Shrubs should be pruned so that they form a loose outline conforming to the general shape of the shrub type.

   Evergreen trees and shrubs: Evergreens should be pruned only to remove broken or damaged limbs.

6. In windy areas or where plantings will be done in stages, always begin planting on the windward side and progress across the area as it is being stabilized. Stagger trees in rows.

Trees:

Selecting Individual Trees:
Large nursery trees usually come with the roots and attached soil wrapped in burlap. As a rule of thumb, the soil ball of containerized and burlapped trees should be 12 inches in diameter for each inch of trunk diameter. Keep the soil around the roots moist until the tree is planted. Bind branches with soft rope to

prevent damage during transport.

Smaller nursery trees are usually sold in plastic containers as balled and burlapped stock, or as bare-root stock (seedlings):

Container-grown plants should have grown in the container for at least one growing season. If plants have been in the container too long they will show "pot-bound" root ends.

Balled and burlapped plants should be planted prior to "bud break." If planted in the fall, balling operations should not begin until after the plants have begun to "harden off." All plants should be dug and transported so that the ball is moist, and protected from rain or sudden changes in the weather.

Bare-root plants should only be handled in early spring, late fall or late winter. These plants should meet the following criteria to prevent a high rate of mortality:

Seedlings should be fresh smelling. Sour odor indicates that the seedlings have been stored too long and have begun to rot. Trees stored at correct temperatures will be free of mold.

The roots must be moist and glistening white when stripped of bark. Using a knife or fingernail, strip the bark off the root, working from base to tip. If the roots appear yellow, brown or have brown spots, the stock is badly damaged and has little chance of survival. Check the roots of several seedlings.

Buds must be firm, with no evidence of new growth.

Seedlings should be packed and shipped in wet moss or other medium, and kept cool (less than 34 degrees F) and moist prior to and throughout the planting process. Moss-packed seedlings should be kept in their container and kept moist. Clay-packed seedlings should not be watered, but should be covered with burlap if they are not to be planted soon after they are purchased.

Store packages of seedlings in a shaded location out of the wind.

Seedlings should be planted as soon as possible after they are received. If planting is delayed longer than four days after seedlings are received, "heel" the seedlings in a shaded area and keep moist. To heel in seedlings, dig a trench in soil that is shaded or in a well-ventilated enclosure. Place seedlings in the trench and cover the roots with soil. Replant when planting conditions allow.

<u>Site Preparation:</u>
Dig a hole at least deep enough and wide enough to hold the entire root ball. The final level of the root ball's top should be level with the ground surface. Keep topsoil separate from the subsoil. If the soils are clay, dig a deeper hole and backfill with some of the topsoil.

<u>Planting:</u>
Although the planting seasons for deciduous plants is between March 1 and October 1 or until the prepared soil becomes frozen, spring and fall are the best times to plant. Planting of evergreens should occur between March 1 and June 1, before new growth occurs.

Trees in containers and burlap will need to be planted individually. See Exhibit 3 and follow the steps below:

Trees in containers should be removed carefully so that all roots and soil remain attached. It may be easiest to cut the container. On balled and burlapped trees, loosen the twine and burlap at the top and check to make sure no other wrapping is present before planting.

Depending on the type of subsoil, it may be beneficial to mix a little peat moss into the soil.

The dug hole should be such that the plant is planted at the same depth as the original container.

Add water to settle the soil and eliminate air pockets. Once the water is drained off, lower the tree into the hole, backfill half way, and pat firm. Water again. Once the water is drained again, remove the burlap from ball and burlapped trees from around the trunk and the upper half of the ball. Fill the hole so that it is filled even with the ground line.

Backfill the hole and pat the soil firm. Leave a small depression around the tree so that water can run into the depression.

Add mulch around the tree to reduce competition from unwanted vegetation and to help prevent roots from drying out.

Bare-root seedlings should not be pruned prior to planting, except for broken or damaged roots. Plants can be planted either by hand or by machine. On large sites where slopes do not prohibit machinery, bare-root seedlings can be planted in furrows using a tree-planting machine.

A method of hand planting bare-root seedlings is shown in Exhibit 4. Plants should be set at a depth equal to the depth in their original location. The exposed roots should be held firmly in the proper position, with the roots spread out. The prepared soil should be watered around the roots and thoroughly firmed at intervals during the process of backfilling. Sufficient water should be used to ensure the soil is thoroughly saturated.

Spacing and Rates of Planting:
The proper spacing and rates of planting various tree species are shown in Exhibit 5.

Tree seedlings should *not* be fertilized during the first 12 months following planting because fertilizer tends to dehydrate newly planted trees.

Mulch between plants to prevent soil from eroding. Follow specifications in the Mulching BMP.

Plants Located on Slopes:
For plants located on slopes, a berm of prepared soil should be constructed halfway around each plant on the down-slope side. The berm of prepared soil should have an inside diameter equal to that of the planting hole, and a maximum height of 6 inches. Soil should not spill down-slope more than 18 inches.

Wrapping trees:
Trees should be wrapped within one week following planting. Trunks should be carefully wrapped beginning at the base of the trunk just above the roots and below the normal ground line, and should extend upward in a spiral with an overlap of one-half the width of the strip. The portion of the wrapping below the finished grade should be covered with soil. The paper should be held securely in place with masking tape.

Staking trees:
Newly planted trees often need to be staked for support. Trees which need to be staked should be secured with stakes and guy wires. Cushion the tree against the wire by placing old garden hose or equivalent between the tree and wire. See Exhibit 3.

Shrubs:

Selecting Shrubs:
For erosion control purposes, and when more than one species can be used, make the final species selection using the following characteristics:

-fast growing
-easy to establish
-have large lateral spread or prostrate growth (i.e. will grow outwardly to provide more cover)
-disease and insect resistant
-ability of the roots to fix nitrogen
-adaptation to a broad range of soil conditions

Like small trees, nursery shrubs usually come in plastic containers or as bare-root stock.

Site Preparation and Planting:
Follow the tree planting procedures for "Trees in containers and burlap," above. See Exhibit 3. Space shrubs approximately three feet apart.

It is important to mulch the entire area to keep other plants from competing with the desired plant and to cover exposed soil. See the Mulching BMP for mulching specifications.

Ground Covers:

Selecting Ground Covers:
When ground covers are to be used to help stabilize soils, select fast-growing, evergreens that require little maintenance.

Site Preparation:
The dense growth of ground covers requires that they have good soil. Well-drained soils high in organic matter work best. Make soil additions based on the results of soil tests. See the Soil Management BMP.

On steep slopes, till the soil in contour rows, or dig individual holes for each plant. Blend soil additions into the soil.

Planting:
Most ground covers are planted from container-grown nursery stock. Transplanting to the seedbed can be done using a small trowel or spade. Dig a hole large enough to accommodate the roots and soil. Backfill and firm the soil around the plant. Water immediately.

Space between plants based on how quickly full cover is achieved, usually between 1 and 3 feet apart.

Like with trees and shrubs, ground covers will be better protected from competitive species if the area is mulched. See the Mulching BMP for mulching specifications.

Maintenance

For New Plantings:
1. Check survival the first and second year and replant where survival is poor.

2. Where needed, control competing vegetation the first 2 or 3 years, preferably by mulching or cultivating.

3. Exclude livestock from all plantings.

For All Trees, Shrubs and Ground Covers:
Trees:
Seedlings are subject to competition with invading grasses and other vegetation. For hardwoods, vegetation must be controlled for at least three growing seasons. For conifers, vegetation must be controlled for at least two growing seasons. Mulch to prevent competition, or mow or clip competitive vegetation, where possible. Use herbicides only where mulching has failed and mowing and clipping are not possible. Follow guidelines in the Pesticide Management BMP.

Where soil tests indicate fertilizers are needed, fertilize in late fall or early spring before leaves emerge. For evergreens, use only 1/2 the recommended amount of fertilizer. Use a punchbar, crowbar or auger. Make holes about 18 inches deep and about 2 feet apart around the drip line of each tree. Distribute fertilizer evenly among the holes to bring it in contact with trees roots. Store and mix fertilizers following specifications in the Fertilizer Management BMP.

Ideally, newly planted trees should receive an inch of water each week for the first two years after planting. When rain does not supply this need, and where possible, the tree should be watered deeply but not more often than once per week.

Trees should be protected and unhealthy limbs cut following procedures in the Tree Protection BMP. Train and prune black walnut and other hardwoods to produce straight, single stemmed trees.

Christmas tree shearing should begin after the third year. Refer to the Soil Conservation Service Technical Guide, #660, Woodland Pruning.

Shrubs:
Maintenance of shrubs, including watering and fertilizing, depends upon the species. Maintain mulch around the base of each plant to reduce weed competition and retain moisture. See the Mulching BMP. Fertilizers are usually needed only once every 3 years or so, depending on the results of soil tests.

Pruning should be done as needed to remove dead limbs.

Ground Covers:
Most ground covers need yearly trimming to promote growth. Trim back from trees, flower beds, fences, and buildings. Add additional mulch as needed until the area is completely stabilized. Like shrubs, fertilizers may only be needed once every 3-4 years, depending on the results of soil tests.

Organic Debris Disposal:
Any organic debris which results from pruning, trimming or any other vegetative maintenance should be disposed of following specifications in the Organic Debris Disposal BMP.

Exhibits

Exhibit 1: Selecting Trees and Shrubs. USDA Soil Conservation Service Technical Guide, #342.

Exhibit 2: Selecting Ground Covers. USDA Soil Conservation Service Technical Guide, #342.

Exhibit 3: Planting Balled-and-Burlapped and Container-Grown Shrubs and Trees. North Carolina "Soil Erosion and Sediment Control Planning and Design Manual," as modified from the Virginia Division of Forestry.

Exhibit 4: A Method for Planting Bare-Root Seedlings and Sprigs of Grasses. Modified from the North Carolina "Erosion and Sediment Control Planning and Design Manual."

Exhibit 5: The Proper Spacing and Rates of Planting. USDA Soil Conservation Service Technical Guide, #612.

Exhibit 1
Selecting Trees and Shrubs

Soil Condition	Trees[1]	Shrubs[2]
1. Well and moderately well drained sand and loamy sand (coarse textured soils)	Austrian pine Jack pine* Red pine White pine* Black locust Cottonwood	Autumn olive Hawthorn Crabapple Tatarian honeysuckle Staghorn sumac Serviceberry
2. Well and moderately well drained, moderately coarse to moderately fine textured soils (sandy loam, loam, silt loam and clay loam)	Red pine White pine* Cottonwood Norway spruce* Jack pine* White spruce* Black locust Sugar maple*	Gray dogwood Autumn olive Crabapple
3. Well and moderately well drained clay and silty clay (fine textured soils)	White pine* Norway spruce* Black locust White spruce* Sugar maple* Red pine Cottonwood	Silky dogwood Tatarian honeysuckle Autumn olive Crabapple
4. Excessively wet (poorly drained) organic soils	Northern white cedar* White spruce* Red maple Silver maple Green ash Swamp white oak* Pin oak**	American cranberry bush Redosier dogwood Gray dogwood "Indigo" silty dogwood Nannyberry Viburnum
5. Excessively wet (poorly drained) mineral soils	Northern white cedar* Silver maple Green ash**	Nannyberry Viburnum "Indigo" silky dogwood Redosier dogwood American cranberry bush
6. Excessively wet (poorly drained) pH>7.4	Northern white cedar* White spruce* Green ash**	Nannyberry Viburnum

[1]For other species, refer to section II-H of the SCS Technical Guide, or the appropriate county soil survey, as available from the USDA Soil Conservation Service.
[2]Indicates species best suited for wildlife food or cover.
*Indicates species best suited for wildlife food or cover.
**Tamarack and willow may also be used, where available.

Source: USDA, Soil Conservation Service Technical Guide #342

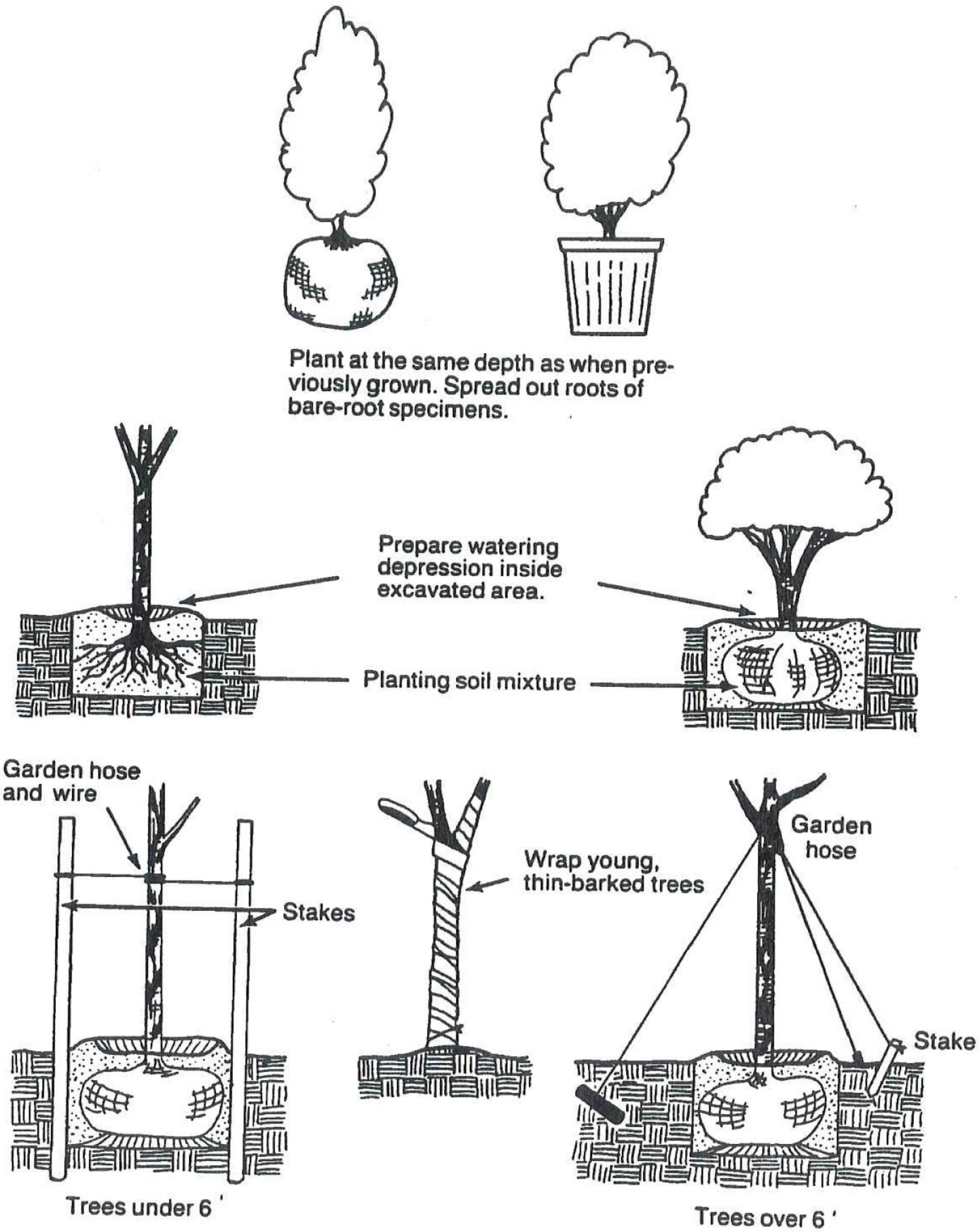
EXHIBIT 2
SELECTING GROUND COVERS

Plant	Height (inches)	Sun	Partial Shade	Shade	Soil	
Buglewood (carpet bugle) (Ajuga reptans)	4 to 8	X	X	X	most soils	One of the best perrenials; spreads rapidly. Parent plant has deep deep green foliage, blue flowers. Gaiety and Metallica Crispa varieties have bronze-purple leaves. Silver Beauty's foliage is cream and light green. Alba is white-flowered.
English Ivy (Hedera helix)	6 to 8	X	X	X	rich, well-drained	Semievergreen to evergreen; covers large or small areas. Look for improved varieties: Baltic, Thornapple, Wilson and others.
Japanese Spurge (Pachysandra terminalis)	up to 6		X	X	fertile, moist	Universally popular evergreen herb. Some plants have small, spiked white flowers sometimes followed by white berries in the fall. Improved forms Green Carpet, Silver Edge.
Juniper* (Juniperus hortizontalis)	12 to 18	X	X		dry areas	Creeping, soft-textured plant; light green to steel blue needles frequently turn purple in winter. Waukegan variety is good. Japanese garden variety is very compact.
Juniper* (J. sabina tamariscifolia)	up to 24	X	X		dry areas	Sometimes called Tamarix Savin juniper. Needle-like silver-green leaves. A good spreader for slopes; use as foreground for deciduous trees or complete ground cover.
Lily-of-the-Valley (Convallaria majalis)	6 to 10		X	X	rich, moist	Fragrant white bell-like flowers; Rosea variety has purplish-pink flowers.
Periwinkle (myrtle) (Vinca minor)	up to 6		X	X	moist, well-drained	Almost universally used. Dislikes humid conditions. Good on slopes, level land or as a backdrop for bulbs. Bowles, a superior variety, has glossier leaves, larger blue flowers. Golden Bowles has gold and yellow foliage with white flowers.
Stonecrop, Goldmoss (Sedum acre)	up to 4	X	X		stony, sandy, dry	Mats of tiny foliage, good between stepping stones and in crevices. Spreads rapidly and can become a weed in grass. The sedum variety, Dragon's Blood, is known for its reddish-brown inch-high foliage and carmine flowers.
Sedum album	up to 4	X	X		sandy, well-drained	Forms mats of attractive dark-green to red foliage on creeping stems. Not as likely to invade grass areas as stonecrop.

* Indicates species best suited for wildlife cover.
Source: USDA, Soil Conservation Service Technical Guide #342.

Exhibit 3

Planting Balled-and Burlapped and Container-Grown Shrubs and Trees

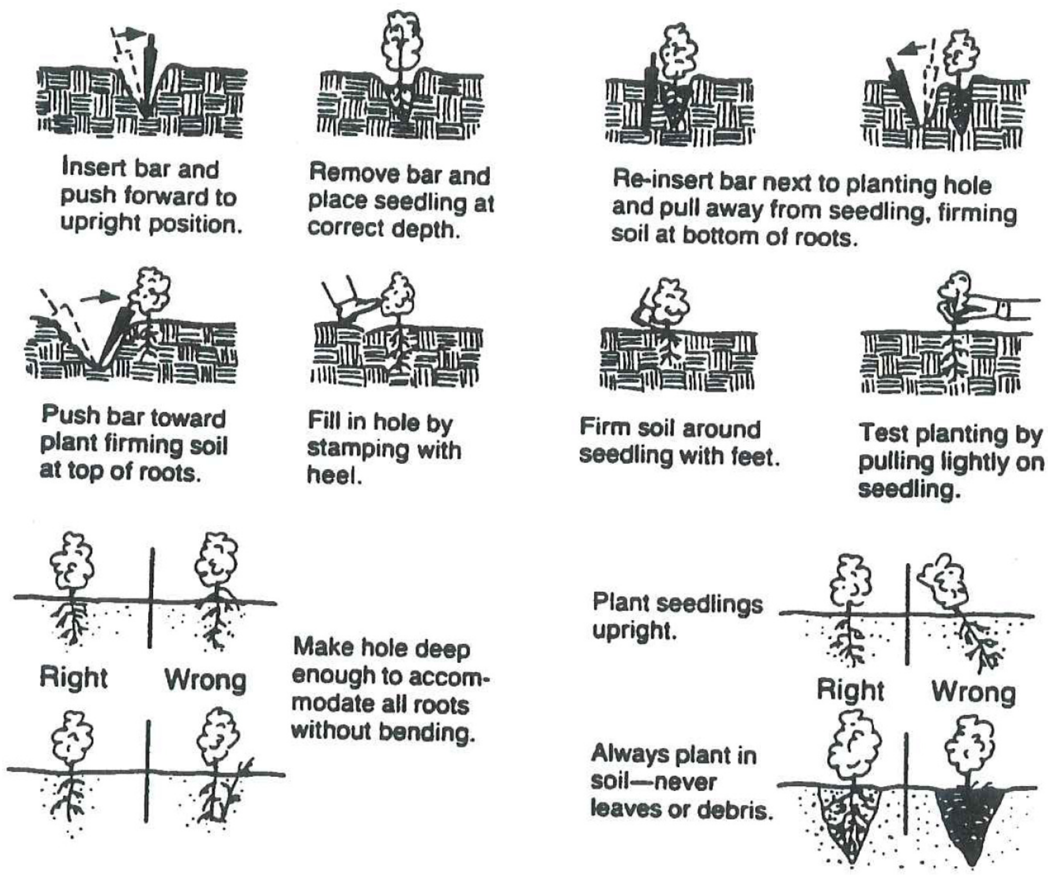


Source: North Carolina Erosion & Sediment Control Planning & Design Manual, as modified from the Virginia Division of Forestry.

Exhibit 4

A Method for Planting Bare-Root Seedlings and Sprigs of Grasses

A method of hand planting bare-root seedlings and sprigged grasses is shown below. With a planting bar/iron or shovel/spade, make a notch in the soil no less than 8 inches deep. Place the roots in the notch to the same depth as the plant was in its original growing container. Firm soil around the roots by pressing the notch closed. Water immediately, and mulch, where necessary, within 2 feet of the plant. Since fertilizers tend to dry out young seedlings, do not fertilize bare-root seedlings until the end of the first year.



Source: North Carolina Erosion and Sediment Control Planning and Design Manual, as modified from the Va. Div. of Forestry.

Exhibit 5

Spacing and Rates of Planting Several Tree Species

Species	Recommended Spacing (Open Planting) Between Rows	In Rows	Approx. No. Trees Needed Per Acre	Acceptable Range In Rate Per Acre
Jack Pine	8 feet	5 feet	1,050	900-1,200
Spruce & N. White-Cedar	8 feet	6 feet	900	800-1,000
Red Pine	8 feet	7 feet	800	700-950
White Pine	8 feet	7 feet	800	700-950[1]
Hardwood Trees (including black walnut)	10 feet	10 feet	430	400-500[2]
Hardwood Shrubs	6 feet	5 feet	1,450	1200-1800

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[1]Planting white pine is recommended primarily for understocked wooded areas from Jackson County north because of the white pine weevil. The number of seedlings required for interplanting on a per acre basis will usually be less in a wooded area. Most seedlings should be planted in the small openings where they will have significant amounts of sunlight. From Jackson County south, planting white pine in open fields is an acceptable practice, as well as interplanting.

[2]The spacing for hardwood trees depends upon several factors. Hardwood trees will not grow and develop well when spaced as closely together as conifers; however, competing vegetation is much more detrimental to hardwood plantations particularly in the establishment period. The closer spacing is recommended where the vegetation will only be controlled for approximately 3 years. The close spacing will enable the hardwood crowns to close more quickly and shade out the competing vegetation. Closer spacing will, however, require thinning at an earlier date. Wider spacing requires controlling the vegetation more than 3 years or until the crowns close, which may take up to 6 years. The closer spacing is an alternative to controlling the vegetation for longer periods of time.

Source: USDA Soil Conservation Service Technical Guide #612

URBAN TREE CARE
HOW TO GROW HEALTHY, BEAUTIFUL TREES

Planting

Whenever possible, schedule your planting during the dormant season, when trees are not actively growing. Dormancy is from the time trees shed their leaves in fall until new growth appears in spring. Fall planting is best since the roots have more time to become established before leaves emerge. Planting may be extended through spring if trees are watered regularly.

Current techniques for tree planting require preparation of a large planting bed with favorable conditions for root growth. Using a shovel or tiller, loosen the soil to a depth of 12 inches in an area three times the diameter of the root ball. Organic matter such as compost or peat moss may be mixed throughout the planting bed at this time, if needed.

Dig a shallow hole in the middle of the bed so that the top of the root ball will sit level with or slightly higher than the surrounding ground. Remove wires and ropes from balled and burlapped trees, and also the "fabric" if it is made from a material that will not decay. Lift containerized plants from the pot, then cut any circling roots by making four or five vertical slits along the sides of the rootball. Be careful to keep roots from drying out.

Place the tree in the shallow hole. Backfill with soil from the planting area, watering and firming to settle air pockets. Mulch with bark, leaves, wood chips or pine straw 3 to 4 inches deep to conserve moisture and reduce weed growth. Be sure that the mulch does not touch the tree trunk.

Organic fertilizers, such as cow manure, or fertilizers with little or no nitrogen may be used at planting, but those with a significant nitrogen content should not be used until one year after planting. Chicken manure is also quite high in nitrogen and may damage the tree.

Do not prune except to remove dead or broken branches. Staking is only necessary if the tree starts to lean or is subject to high winds. Stake with soft, flexible ties but not so tightly that the tree cannot bend with the wind. Be sure to remove the ties at the end of one growing season.

Watering

The limiting factor for tree growth is often lack of adequate water. Water newly planted trees every week to ten days, unless there is sufficient rainfall, during the first two growing seasons. Established trees should be watered at the first sign of wilting or when the top 12" of soil is dry.

A good slow soaking over several hours is best, and may be done with an oscillating sprinkler or a soaker hose, starting at the trunk and extending beyond the furthest branch spread. Don't overwater - too much water can kill a tree by eliminating the air from the soil. The soil should not stay saturated, but have time to dry out between waterings.

Fertilization

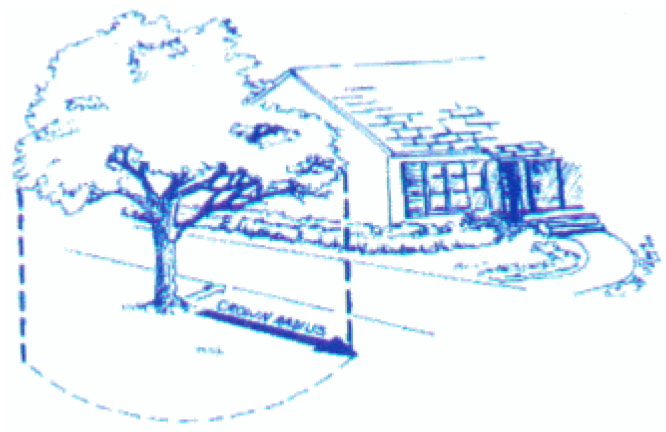
Fertilization aids in maintaining tree vigor, promoting new growth, and overcoming insect, disease, or wound problems. Small, yellow-green leaves, sparse foliage, or leaves dropping early may be indicators of the need for fertilization. Fertilization is not a "cure-all" for declining trees, but may be used to complement other tree maintenance activities.

The ideal time to fertilize is late winter or early spring just before the leaves begin expanding. Fertilization may continue until mid-July. Avoid fertilization late in the growing season which may stimulate a flush of new growth that would be susceptible to damage by an early frost.

Fertilizer should always be applied to moist soil to improve uptake and to reduce the chance of root injury. If soil is dry, irrigate prior to fertilization.

Application Rate:

A soil test is best for determining the amount of fertilizer to apply, especially in coastal areas where soils may be high in phosphorus. For most areas, the following guidelines based on the distance to the edge of the branches may be used for fertilizing established trees:



Step 1 - Measure the distance from the trunk to the edge of the branch spread; this is the crown radius.

Crown Radius = distance from edge of branch spread to trunk.

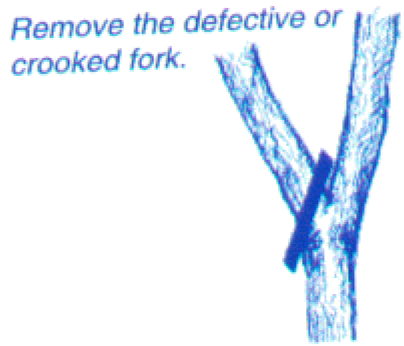
STEP 2 - Use the table below to determine the amount of fertilizer to apply. Find the crown radius in the left column, then look in the appropriate column for the type of fertilizer that you are using to determine how many pounds of the fertilizer to apply. An 18-5-11 type fertilizer would have the best ratio of Nitrogen-Phosphorus-Potassium, 16-4-8 is considered good, and 12-6-6 is acceptable.

If the area under the branches is restricted by sidewalks or driveways, or the root system has been damaged by construction, the rate should be reduced by an equal percentage to avoid damage to the tree.

FERTILIZER APPLICATION RATE :

Crown Radius (feet)	**BEST Pounds 18-5-11 to apply**	**GOOD Pounds 16-4-8 to apply**	**ACCEPTABLE Pounds 12-6-6 to apply**
0-5	1	1.5	2
10	5	6	8
15	12	13	18
20	21	24	31
25	33	27	49
30	47	53	71
35	64	72	96
40	84	94	126
45	106	119	156
50	131	147	196
55	158	178	237
60	188	212	283

NOTE: If using a slow release fertilizer, use twice the indicated amount and apply it every *two years.*
One pound of fertilizer is approximately two cups.



METHOD:

Apply fertilizer to the soil surface, starting 2 to 3 feet from the trunk and extending several feet beyond the furthest branch tip. If the soil is compacted or grass is present, drill holes in the soil to apply the fertilizer.

The drill hole method requires that holes be dug in a 2 foot by 2 foot grid pattern starting 2 to 3 feet from the trunk and extending slightly beyond the edge of the branches. Holes should be 8-12" deep and 1 -2" in diameter, and may be made with a fertilizing auger, pipe, broom handle or tire tool. To avoid damaging the roots, mix fertilizer with an equal amount of peat or other organic material and stay at least 6" from small plants. The total amount of fertilizer should be divided evenly among the holes. The increased amount of air available to the roots is often as beneficial as the fertilizer.

WARNING

Use of lawn fertilizers which contain herbicides for broadleaf weed control will cause tree damage or mortality. Do not use herbicide type fertilizers or soil sterilants in the area beneath the branches of trees.

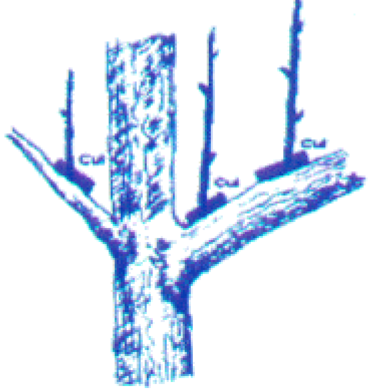
Arborists frequently apply liquid fertilizer through a probe into the soil which results in faster uptake by the trees, and a more visible response. Injecting or implanting fertilizer into the trunk is useful for specific nutrient deficiencies or where root area is limited. Since injection and implants require holes to be drilled into the tree, their use should be limited to special applications.

Pruning

Pruning is probably the most neglected tree maintenance practice, yet it's vital to tree health. Pruning adds strength, beauty and value to trees.

Avoid the need for excessive pruning by planting the right species. Begin to prune while the tree is young, removing problems while they are small. Pruning of large trees which requires climbing or the removal of heavy limbs should be left to skilled arborists.

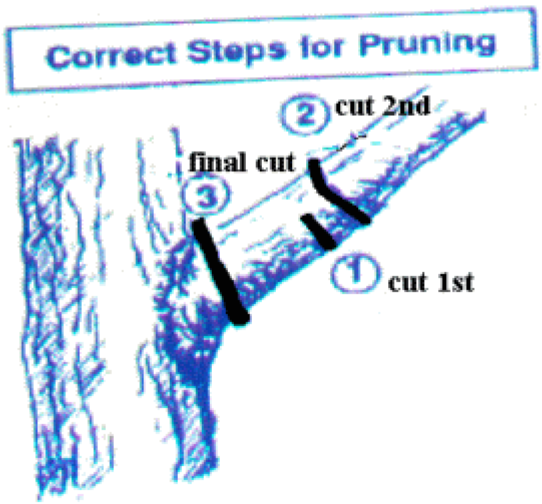
1. **What to prune:**
    - Dead, diseased, or broken branches are hosts for decay organisms and should be removed promptly. When pruning diseased branches, dip the pruners in household bleach or rubbing alcohol before storing or making the next cut.
    - Double leaders or branches that fork at a narrow angle are more likely to split. Ideally, the branch angle should be at 10 or 2 o'clock. When pruning, leave branches with wide angles.



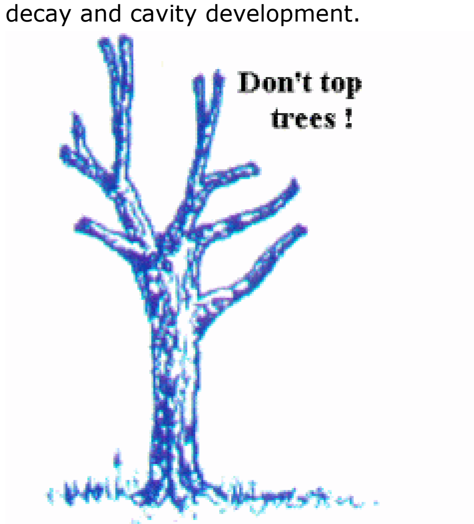
Cut sprouts next to limb

- Reduce the weight of long, heavy horizontal branches which are more likely to break, especially those over your home or where property damage or personal injury is likely to occur.
- Remove nuisance growth. Prune to remove low limbs over sidewalks and roads which limit their use or present a safety hazard. Remove branches that may interfere with utility lines in the future.
- Remove sprouts and suckers at the base of the tree or inside the crown that are upright and grow rapidly.

2. **When to prune:**



The best time to prune live limbs is during late winter or early spring before leaves emerge. Avoid pruning when leaves are expanding since this is more likely to cause heavy bleeding. Prune dead and dying limbs as soon as you notice them; prompt pruning prevents the spread of decay and cavity development.



Flowering and fruiting can be encouraged through pruning. Trees that bloom in spring (dogwood and flowering fruit trees) should be pruned when flowers fade. Trees that bloom in summer (crape myrtle) should be pruned during the winter.

3. **How to prune:**

- *Step 1* Cut the branch from underneath about a foot from the trunk to prevent stripping or peeling the bark off.

- *Step 2* A couple inches further from the main trunk, make the cut from the top down to remove the branch.

- *Step 3* Locate the branch collar, a layer of wrinkled bark where the branch attaches to the trunk. Make the final cut just outside of the branch collar, at a slight downward and outward angle. Do not cut into the collar or leave a stub.

When shortening a small branch, prune just outside of a bud or another branch that faces the direction of desired growth, usually towards the outside of the crown. One-handed pruning shears with curved blades work best on small limbs; use a saw for larger ones.

Avoid making a cut that leaves a wound over 4" in diameter since these take longer to callus over. <u>*Do not paint the pruning cut.*</u> Research shows that wound dressings are not effective in preventing decay or rot.

Never remove over one-third of the crown at one time. This ensures that the tree always has enough leaves to manufacture its food.

WARNING
<u>Don't top trees.</u> **"Topping" is the reduction in size of a tree by severely cutting back the crown. Topping results in weakly attached branches and large wounds. Instead of topping, begin to prune while the tree is young, and make all pruning cuts where branches fork.**

WOUNDS, CAVITIES, CABLES & BRACING

Wounds are openings in the bark that expose trees to insect and disease attack. Be careful not to wound trees with lawn mowers, string-type weed trimmers, vehicles or heavy equipment, improper pruning, or any other cause.

If trees are wounded, remove all loose bark and cut off any wood protruding from the wound. As when pruning, there is no need to paint the wound, since this has not been proven to prevent decay. Stimulate tree growth by fertilizing, watering, and pruning - this will help the wound to callus rapidly.

Prevent cavities from developing by pruning out dead, diseased or broken limbs. Filling cavities will not stop decay from spreading, or strengthen a tree. Filling a cavity may provide support for callus tissue so it will not "roll" inward. Generally, it's best to leave cavity work to trained arborists. If a cavity has structurally weakened a tree, support from cables or mechanical rods may be needed. Branches with cavities should be removed if the natural shape of the tree can be maintained.

Cable bracing is the use of flexible steel support cables in or between trees to prevent breakage of branches weakened by decay, narrow forks, large, heavy limbs or breakage during high winds. Avoid the need for cable bracing by pruning as the tree grows. Rod bracing should be used where decay has developed, where a fork has split, or to hold rubbing branches together or apart. Cable and rod bracing are recommended for high value trees where personal injury or property damage is likely, and should be left to professionals.

Insect and Disease Pests

Insect and disease pests often attack trees which are already under stress or weakened. Drought, improper planting, and disturbance of the root system through digging or addition of soil to the root area can make trees more susceptible to attack. Find out why the tree is weak and treat the primary cause of stress.

Examine your trees regularly, looking for anything out of the ordinary: sap coming out of the bark, bark falling off, decaying wood, holes in the bark or leaves, leaves changing color early, and swellings or sunken areas on branches or the trunk. Mushrooms at the base of a tree can indicate root rot. Try to identify the cause of the symptom. Not all pests require control measures, and some have no practical control.

Always identify the pest before applying "sprays" to control it. A good fungicide will never control an insect population. If you cannot diagnose a problem, get professional assistance from a local nurseryman, professional arborist, the **SC Forestry Commission**, or Clemson University Cooperative Extension Service.

Trees and People Need Each Other!

For trees to thrive, they need people. People can choose the right species of tree to plant on a site and give their tree a good start by providing a favorable environment for the root growth. They can water trees in times of drought, provide nutrients for growth, prune to remove potential problems, and be alert to environmental changes.

Planting and caring for trees gives people a chance to do something of global importance that will continue to improve their environment long after they're gone. People surround their homes with trees - trees make people feel they are a part of nature; trees add stateliness and stature to homes and provide feelings of inner peace.

APPENDIX B

ADDITIONAL INVASIVE SPECIES INFORMATION

(Provided on CD)

APPENDIX C

ADDITIONAL WILDLIFE ENHANCEMENT INFORMATION

(Provided on CD)

APPENDIX D

URBAN TREE SURVEY FIELD DATA SHEETS

(Provided on CD)

APPENDIX E

SELFRIDGE ANGB URBAN TREE MAPS

APPENDIX F

SELFRIDGE ANGB WOODY VEGETATION

CLUSTERS MAPPING

Appendix I

Information Regarding Species Presence and Associations at Selfridge ANGB

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APPENDIX I1

Birds Potentially Occurring Within or Near Selfridge ANGB

Table I1. Birds Potentially Occurring Within or Near Selfridge ANGB

Common Name	Scientific Name	Primarily Winter	Primarily Spring	Primarily Summer	Primarily Fall	Spring/Fall Migrant	Year Round
Common Loon *	*Gavia immer*					■	
Red-throated Loon	*Gavia stellata*					■	
Pied–billed Grebe	*Podilymbus podiceps*			■			
Horned Grebe	*Podiceps auritus*					■	
Red-necked Grebe	*Podiceps grisegena*					■	
Double-crested Cormorant *	*Phalacrocorax auritis*			■			
American Bittern *	*Botaurus lentiginosus*			■			
Least Bittern	*Ixobrychus exilis*			■			
Great Blue Heron *	*Ardea herodias*			■			
Great Egret *	*Ardea alba*			■			
Snowy Egret	*Egretta thula*			■			
Cattle Egret	*Bubulcus ibis*			■			
Green Heron *	*Butorides virescens*			■			
Black-crowned Night Heron	*Nycticorax nycticorax*			■			
Mute Swan *	*Cygnus olar*						■
Tundra Swan *	*Cygnus columbianus*					■	
Snow Goose *	*Chen caerulescens*					■	
Canada Goose*	*Branta Canadensis*						■
Mallard*	*Anas platyrynchos*			■			
Blue-winged Teal	*Anas discors*			■			
Green-winged Teal	*Anas crecca*					■	
Northern Pintail	*Anas actua*			■			
Wood duck *	*Aix sponsa*			■			
Black duck	*Anas rubripes*						■
Northern Shoveler	*Anas clypeata*					■	
Gadwall	*Anas strepera*			■			
American Widgeon	*Anas americana*					■	
Canvasback *	*Aythya valisineria*	■					
Redhead *	*Aythya americana*						■
Ring-necked Duck	*Aythya collaris*					■	
Greater Scaup *	*Aythya marila*					■	
Lesser Scaup *	*Aythya affinis*					■	
Long-tailed Duck	*Clangula hyemalis*					■	
White-winged Scoter	*Melanitta fusca*					■	

Common Name	Scientific Name	Primarily Winter	Primarily Spring	Primarily Summer	Primarily Fall	Spring/Fall Migrant	Year Round
Surf Scoter	*Melanitta perspicillata*					■	
Black Scoter	*Melanitta nigra*					■	
Common Goldeneye	*Bucephala clangula*	■					
Bufflehead *	*Bucephala albeola*					■	
Hooded Merganser *	*Lophodytes cucullatus*						■
Common Merganser *	*Mergus merganser*	■					
Red-breasted Merganser	*Mergus serrator*					■	
Ruddy Duck	*Oxyura jamaicensis*					■	
Turkey Vulture *	*Cathartes aura*			■			
Osprey *	*Pandion haliaetus*			■			
Bald Eagle *	*Haliaeetus leucocephalus*						■
Northern Harrier *	*Circus cyaneus*						■
Cooper's Hawk*	*Accipiter cooperii*						■
Northern Goshawk	*Accipiter gentilis*	■					
Sharp-shinned Hawk *	*Accipiter striatus*						■
Red-shouldered Hawk	*Buteo lineatus*			■			
Red-tailed Hawk*	*Buteo jamaicensis*						■
Rough-legged Hawk *	*Buteo lagopus*	■					
Broad-winged Hawk *	*Buteo platypterus*			■			
Golden Eagle	*Aquila chrysaetos*					■	
Merlin	*Falco columbarius*					■	
Peregrine Falcon *	*Falco peregrinus*						■
American Kestrel *	*Falco sparverius*						■
Ring-necked Pheasant *	*Phaianus colchicus*						■
Ruffed Grouse	*Bonasa umbellus*						■
Wild Turkey *	*Meleagris gallopavo*						■
Northern Bobwhite	*Colinus virginianus*						■
Sora Rail	*Porzana carolina*			■			
King Rail	*Rallus elegans*			■			
Virginia Rail	*Rallus limicola*			■			
American Coot	*Fulica americana*						■
Common Moorhen	*Gallinula chloropus*			■			
Sandhill Crane *	*Grus canadensis*			■			
Killdeer *	*Charadrius vociferus*			■			
Black-bellied Plover	*Pluvialis squatarola*					■	
American Golden-plover	*Pluvialis dominica*					■	

Common Name	Scientific Name	Primarily Winter	Primarily Spring	Primarily Summer	Primarily Fall	Spring/Fall Migrant	Year Round
Semipalmated Plover	*Charadrius semipalmatus*					■	
Lesser Yellowlegs	*Tringa flavipes*					■	
Greater Yellowlegs	*Tringa melanoleuca*					■	
Solitary Sandpiper	*Tringa solitaria*					■	
Spotted Sandpiper	*Actitis macularia*			■			
Willet	*Catoptrophorus semipalmatus*					■	
Hudsonian Godwit	*Limosa haemastica*					■	
Whimbrel	*Numenius phaeopus*					■	
Upland Sandpiper *	*Bartramia longicauda*			■			
Ruddy Turnstone	*Arenaria interpres*					■	
Sanderling	*Calidris alba*					■	
Red Knot	*Calidris canutus*					■	
Dunlin	*Calidris alpina*					■	
Pectoral Sandpiper	*Calidris melanotos*					■	
White-rumped Sandpiper	*Calidris fuscicollis*					■	
Baird's Sandpiper	*Calidris bairdii*					■	
Semipalmated Sandpiper	*Calidris pusilla*					■	
Western Sandpiper	*Calidris mauri*					■	
Least Sandpiper	*Calidris minutilla*					■	
Stilt Sandpiper	*Calidris himantopus*					■	
Short-billed Dowitcher	*Limnodromus griseus*					■	
Long-billed Dowitcher	*Limnodromus scolopaceus*					■	
Wilson's Snipe	*Gallinago delicata*			■			
American Woodcock	*Scolopax minor*			■			
Red-necked Phalarope	*Phalaropus lobatus*					■	
Little Gull	*Larus minutus*					■	
Bonaparte's Gull	*Larus philadelphia*					■	
Iceland Gull	*Larus glauciodes*	■					
Glaucous Gull	*Larus hyperboreus*	■					
Thayer's Gull	*Larus thayeri*	■					
Great Black-backed Gull *	*Larus marinus*	■					
Ring-billed Gull *	*Larus delawarensis*						■
Herring Gull *	*Larus argentatus*						■
Caspian Tern *	*Hydroprogne caspia*					■	
Common Tern	*Sterna hirundo*			■			
Forster's Tern *	*Sterna forsteri*			■			

Common Name	Scientific Name	Primarily Winter	Primarily Spring	Primarily Summer	Primarily Fall	Spring/Fall Migrant	Year Round
Black Tern	*Chlidonias niger*			■			
Rock Dove	*Columba livia*						■
Mourning Dove *	*Zenaida macroura*						■
Yellow-billed Cuckoo	*Coccyzus americanus*			■			
Black-billed Cuckoo	*Coccyzus erythropthalmus*			■			
Long-eared Owl	*Asio otus*						■
Short-eared Owl *	*Asio flammeus*	■					
Eastern Screech Owl *	*Otus asio*						■
Great Horned Owl *	*Bubo virginianus*						■
Snowy Owl *	*Nyctea scandiaca*	■					
Barred Owl	*Strix varia*						■
Northern Saw-whet owl	*Aegolius acadicus*	■					
Common Nighthawk	*Chordeiles minor*			■			
Whip-poor-will	*Caprimulgus vociferous*			■			
Ruby-throated Hummingbird	*Archilochus colubris*			■			
Chimney Swift	*Chaetura pelagica*			■			
Belted Kingfisher	*Ceryle alcyon*						■
Yellow-bellied sapsucker	*Sphyrapicus varius*					■	
Red-headed Woodpecker *	*Melanerpes erythrocephalus*						■
Red-bellied Woodpecker	*Melanerpes carolinus*						■
Downy Woodpecker	*Picoides pubescens*						■
Hairy Woodpecker	*Picoides villosus*						■
Yellow-shafted Flicker	*Colaptes auratus*						■
Pileated Woodpecker	*Drycopus pileatus*						■
Olive-sided Flycatcher	*Contopus cooperi*					■	
Eastern Wood Pewee	*Contopus virens*			■			
Acadian Flycatcher	*Empidonax virescens*			■			
Alder Flycatcher	*Empidonax alnorum*			■			
Willow Flycatcher	*Empidonax spp.*			■			
Least Flycatcher	*Empidonax minimus*			■			
Yellow-bellied Flycatcher	*Empidonax flaviventris*					■	
Eastern Phoebe	*Sayornis phoebe*			■			
Great Crested Flycatcher	*Myiarchus crinitus*			■			
Eastern Kingbird	*Tyrannus tyrannus*			■			
Northern Shrike	*Lanius excubitor*	■					
Philadelphia Vireo	*Vireo philadelphicus*					■	

Common Name	Scientific Name	Primarily Winter	Primarily Spring	Primarily Summer	Primarily Fall	Spring/Fall Migrant	Year Round
White-eyed Vireo	*Vireo griseus*			■			
Warbling Vireo	*Vireo gilvus*			■			
Red-eyed Vireo	*Vireo olivaceus*			■			
Yellow-throated Vireo	*Vireo flavifrons*			■			
Blue-headed Vireo	*Vireo solitarius*					■	
Blue Jay *	*Cyanocitta cristata*						■
American Crow *	*Corvus brachyrhynchos*						■
Horned Lark *	*Eremophila alpestris*						■
Purple Martin *	*Progne subis*			■			
Tree Swallow *	*Tachycineta bicolor*			■			
N. Rough-winged Swallow	*Stelgidopteryx serripennis*			■			
Bank Swallow	*Riparia riparia*			■			
Cliff Swallow *	*Petrochelidon pyrrhonota*			■			
Barn Swallow *	*Hirundo rustica*			■			
Black-capped Chickadee	*Poecile atricapillus*						■
Brown Creeper	*Certhia americana*						■
Tufted Titmouse	*Baeolophus bicolor*						■
White-breasted Nuthatch	*Sitta carolinensis*						■
Red-breasted Nuthatch	*Sitta canadensis*	■					
Marsh Wren	*Cistothorus palustris*			■			
Sedge Wren	*Cistothorus platensis*			■			
Carolina Wren	*Thryothorus ludovicianus*						■
Winter Wren	*Troglodytes troglodytes*					■	
House Wren	*Troglodytes aedon*			■			
Golden-crowned Kinglet	*Regulus satrapa*	■					
Ruby-crowned Kinglet	*Regulus calendula*					■	
Blue-gray Gnatcatcher	*Polioptila caerulea*			■			
Eastern Bluebird	*Sialia sialis*			■			
Swainson's Thrush	*Catharus ustulatus*					■	
Veery	*Catharus fuscescens*			■			
Gray-cheeked Thrush	*Catharus minimus*					■	
Hermit Thrush	*Catharus guttatus*	■					
Wood Thrush	*Hylocichla mustelina*			■			
American Robin *	*Turdus migratorius*						■
Gray Catbird	*Dumetella carolinensis*			■			
Brown Thrasher	*Toxostoma rufum*			■			

Common Name	Scientific Name	Primarily Winter	Primarily Spring	Primarily Summer	Primarily Fall	Spring/Fall Migrant	Year Round
American Pipit	*Anthus rubescens*			■			
European Starling *	*Sturnus vulgaris*						■
Cedar Waxwing	*Bombycilla cedrorum*						■
Tennessee Warbler	*Vermivora peregrina*					■	
Nashville Warbler	*Vermivora ruficapilla*					■	
Orange-crowned Warbler	*Vermivora celata*					■	
Golden-winged Warbler	*Vermivora chrysoptera*			■			
Blue-winged Warbler	*Vermivora pinus*			■			
Yellow Warbler *	*Dendroica petechia*			■			
Northern Parula	*Parula americana*					■	
Magnolia Warbler	*Dendroica magnolia*					■	
Chestnut-sided Warbler	*Dendroica pensylvanica*					■	
Cape May Warbler	*Dendroica tigrina*					■	
Blackburnian Warbler	*Dendroica fusca*					■	
Black-throated Blue Warbler	*Dendroica caerulescens*					■	
Cerulean Warbler	*Dendroica cerulea*					■	
Black-throated Green Warbler	*Dendroica virens*			■			
Yellow-rumped Warbler	*Dendroica coronata*					■	
Palm Warbler	*Dendroica palmarum*					■	
Pine Warbler	*Dendroica pinus*			■			
Blackpoll Warbler	*Dendroica striata*					■	
Bay-breasted Warbler	*Dendroica castanea*					■	
Black-and-White Warbler	*Mniotilta varia*			■			
American Redstart	*Setophaga ruticilla*			■			
Mourning Warbler	*Oporornis philadelphia*			■			
Connecticut Warbler	*Oporornis agilis*					■	
Northern Waterthrush	*Seiurus noveboracensis*			■			
Louisiana Waterthrush	*Seiurus motacilla*			■			
Ovenbird	*Seiurus aurocapillus*			■			
Canada Warbler	*Wilsonia canadensis*					■	
Hooded Warbler	*Wilsonia citrina*			■			
Wilson's Warbler	*Wilsonia pusilla*					■	
Common Yellowthroat	*Geothypis trichas*			■			
Yellow-breasted Chat	*Icteria virens*			■			
Scarlet Tanager	*Piranga olivacea*			■			

Common Name	Scientific Name	Primarily Winter	Primarily Spring	Primarily Summer	Primarily Fall	Spring/Fall Migrant	Year Round
Eastern Towhee	*Pipilo erythrophthalmus*			■			
Grasshopper Sparrow*	*Ammodramus savannarum*			■			
Chipping Sparrow	*Spizella pallida*			■			
Clay- colored Sparrow	*Spizella pusilla*			■			
Field Sparrow	*Passerculus sandwichensis*			■			
American Tree Sparrow	*Spizella arborea*	■					
Vesper Sparrow	*Pooecetes gramineus*			■			
Henslow's Sparrow	*Ammodramus henslowii*			■			
Nelson's Sharp-tailed Sparrow	*Ammodramus nelsoni*					■	
Savannah Sparrow *	*Passerculus sandwichensis*			■			
Song Sparrow *	*Melospiza georgiana*						■
Lincoln's Sparrow	*Melospiza lincolnii*					■	
Swamp Sparrow	*Melospiza georgiana*						■
Fox Sparrow	*Passerella iliaca*					■	
White-throated Sparrow	*Zonotrichia albicollis*					■	
White-crowned Sparrow	*Zonotrichia leucophrys*					■	
Dark-eyed Junco (Slate-colored)	*Junco hyemalis*	■					
Lapland Longspur	*Calcarius lapponicus*	■					
Snow Bunting	*Plectrophenax nivalis*	■					
Northern Cardinal *	*Cardinalis cardinalis*						■
Rose-breasted Grosbeak	*Pheucticus ludovicianus*			■			
Indigo Bunting	*Passerina cyanea*			■			
Dickcissel	*Spiza americana*			■			
Bobolink	*Dolichonyx oryzivorus*			■			
Red-winged Blackbird	*Agelaius phoeniceus*						■
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*			■			
Rusty Blackbird	*Euphagus carolinus*	■					
Brewer's Blackbird	*Euphagus cyanocephalus*					■	
Eastern Meadowlark *	*Sturnella magna*			■			
Western Meadowlark	*Sturnella neglecta*			■			
Common Grackle *	*Quiscalus quiscula*			■			
Brown-headed Cowbird *	*Molothrus ater*						■
Orchard Oriole	*Icterus spurious*			■			
Baltimore Oriole *	*Icterus galbula*			■			
House Finch *	*Carpodacus mexicanus*						■

Common Name	Scientific Name	Primarily Winter	Primarily Spring	Primarily Summer	Primarily Fall	Spring/Fall Migrant	Year Round
Purple Finch	*Carpodacus purpureus*						■
White-winged Crossbill	*Loxia leucoptera*	■					
Red Crossbill	*Loxia curvirostra*	■					
American Goldfinch *	*Carduelis tristis*						■
House Sparrow *	*Passer domesticus*						■
Evening Grosbeak	*Coccothraustes vespertinus*	■					
Pine Siskin	*Carduelis pinus*	■					
Common Redpoll	*Carduelis flammea*	■					

Source: Sauer *et al.* 2000, Sibley 2003, Griggs 1997.

Notes: * Indicates that species was observed during INRMP site visits ,2015 Federal and State Listed Species Surveys, and by installation pest management personnel during ongoing wildlife management.

APPENDIX I2

Reptiles and Amphibians with the Potential to Occur at Selfridge ANGB

Table I2. Reptiles and Amphibians with the Potential to Occur at Selfridge ANGB

Common Name	***Scientific Name***
Eastern American Toad *	*Bufo a. americanus*
Fowler's Toad	*Bufo fowleri*
Blanchard's Cricket Frog	*Acris blanchardi*
Western Chorus Frog *	*Pseudacris triseriata*
Spring Peeper	*Pseudacris cruifer*
Eastern Gray Treefrog	*Hyla versicolor*
Cope's Gray Treefrog	*Hyla chrysoscelis*
American Bullfrog	*Lithobates catesbeianus*
Green Frog *	*Lithobates clamitans*
Northern Leopard Frog*	*Lithobates pipiens*
Pickerel Frog	*Lithobates palustris*
Wood Frog	*Lithobates sylvaticus*
Blue-spotted Salamander	*Ambystoma laterale*
Jefferson Salamander	*Ambystoma jeffersonianum*
Spotted Salamander	*Ambystoma maculatum*
Eastern Tiger Salamander	*Ambystoma tigrinum*
Red-backed Salamander	*Plethodon cinereus*
Mudpuppy	*Necturus maculosus*
Red-spotted Newt	*Notophthalmus v. viridescens*
Snapping Turtle *	*Chelydra serpentina*
Common Musk Turtle	*Sternotherus odoratus*
Blanding's Turtle	*Emydoidea blandingii*
Spotted Turtle	*Clemmys guttata*
Eastern Spiny Softshell	*Apalone s. spinifera*
Northern Map Turtle *	*Graptemys geographica*
Midland Painted Turtle	*Chrysemys picta marginata*
Five-lined Skink	*Plestiodon fasciatus*
Midland Brown Snake	*Storeria dekayi wrightorum*
Northern Brown Snake	*Storeria d. dekayi*
Queen Snake	*Regina septemvittata*
Eastern Fox Snake	*Pantherophis vulpinus*
Black Rat Snake	*Pantherophis obsoletus*

Common Name	***Scientific Name***
Eastern Milk Snake	*Lampropeltis t. triangulum*
Northern Water Snake	*Nerodia s. sipedon*
Northern Red-bellied Snake	*Storeria o. occipitomaculata*
Eastern Hognose Snake	*Heterodon platirhinus*
Northern Ringneck Snake	*Diadophis punctatus edwardsii*
Blue Racer	*Coluber constrictor foxii*
Smooth Green Snake	*Opheodrys vernalis*
Butler's Garter Snake	*Thamnophis butleri*
Eastern Garter Snake*	*Thamnophis s. sirtalis*
Eastern Ribbon Snake	*Thamnophis s. sauritus*
Eastern Massasauga Rattlesnake	*Sistrurus catenatus*

Source: Conant and Collins 1998.

Notes: * Indicates that species was observed INRMP site visits, Biological Survey site visits, and the 2015 Federal and State Listed Species Survey.

APPENDIX I3

Mammals with the Potential to Occur at Selfridge ANGB

Table I3. Mammals with the Potential to Occur at Selfridge ANGB

Common Name	*Scientific Name*
Virginia Opossum	*Didelphis marsupialis*
Eastern Cottontail *	*Sylvilagus floridanus*
Eastern Chipmunk	*Tamias striatus*
Woodchuck *	*Marmota monax*
Thirteen-lined Ground Squirrel	*Spermophilus tridecemlineatus*
Southern Flying Squirrel	*Glaucomys volans*
Eastern Gray Squirrel *	*Sciurus carolinensis*
Fox Squirrel *	*Sciurus niger*
Red Squirrel	*Tamiasciurus hudsonicus*
Beaver *	*Castor canadensis*
White-footed Mouse	*Peromyscus leucopus*
Prairie Deer Mouse *	*Peromyscus maniculatus bairdii*
Meadow Vole *	*Microtus pennsylvanicus*
Woodland Vole	*Microtus pinetorum*
Muskrat *	*Ondatra zibethica*
Southern Bog Lemming	*Synaptomys cooperi*
House Mouse *	*Mus musculus*
Norway Rat	*Rattus norvegicus*
Meadow Jumping Mouse	*Zapus hudsonicus*
Little Brown Bat *	*Myotis lucifugus*
Northern long-eared Bat	*Myotis septentronalis*
Indiana Bat	*Myotis sodalis*
Silver-haired Bat *	*Lasionycteris noctivagans*
Big Brown Bat *	*Eptisicus fuscus*
Eastern Red Bat *	*Lasiurus borealis*
Hoary Bat *	*Lasiurus cinereus*
Evening Bat *	*Nycticeius humeralis*
Tri-colored Bat *	*Perimyotis subflavus*
Coyote *	*Canis latrans*
Red Fox *	*Vulpes vulpes*
Gray Fox	*Urocyon cinereoargentus*
Raccoon *	*Procyon lotor*
Ermine	*Mustela erminea*
Long-tailed Weasel	*Mustela frenata*
Least Weasel	*Mustela nivalis*
Mink *	*Mustela vison*
Badger	*Taxidea taxus*
Striped Skunk *	*Mephitis mephitis*
Feral Cat *	*Felis catus*

Common Name	*Scientific Name*
Masked Shrew	*Sorex cinereus*
Northern Short-tailed Shrew	*Blarina brevicauda*
Least Shrew	*Cryptotis parva*
Eastern Mole	*Scalopus aquaticus*
Star-nosed Mole	*Condylura cristata*
White-tailed Deer *	*Odocoileus virginianus*

Source: Selfridge ANGB 2001, Kurta 1998
Notes: * Indicates that species was observed during INRMP sites visits, 2015 Federal and State Listed Species Survey, 2015 Bat Surveys , and by installation pest management personnel during ongoing wildlife management.

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APPENDIX I4

Plant Species Observed at Selfridge ANGB

Table I4. Plant Species Observed at Selfridge ANGB

Species	Common Name
Abies balsamea	Balsam Fir
Acer negundo	Box Elder
Acer platanoides	Norway Maple
Acer rubrum	Red Maple
Acer saccharinum	Silver Maple
Acer saccharum	Sugar Maple
Agrostis alba	Redtop
Ailanthus altissima	Tree of Heaven
Alisma triviale	Northern Water Plantain
Alliaria petiolata	Garlic Mustard
Alnus rugosa	Speckled or Tag Alder
Amelanchier arborea	Common Serviceberry
Ampelopsis arborea	Peppervine
Amphicarpa bracteata	Hog Peanut
Apocynum androsaemifolium	Spreading Dogbane
Apocynum sp.	Dogbane
Argentina sp.	Silverweed
Asclepias syriaca	Common Milkweed
Asclepias viridiflora	Green Milkweed
Asparagus officinalis	Asparagus
Aster umbellatus	Flat-topped Aster
Barbarea vulgaris	Garden Yellowrocket
Berberis thunbergii	Japanese Barberry
Betula alleghaniensis	Yellow Birch
Betula nigra	River Birch
Betula payrifera	Paper Birch
Betula populifolia	Gray Birch
Butomus umbelattus	Flowering Rush
Carex lurida	Shallow Sedge
Carex stricta	Tussock Sedge
Carya glabra	Pignut Hickory
Carya ovata	Shagbark Hickory
Celtis occidentalis	Hackberry
Centaurea stoebe	Spotted knapweed
Cichorium intybus	Chicory
Cirsium arvense	Canadian Thistle
Cirsium vulgare	Bull Thistle
Convolvulus arvensis	Field Bindweed
Cornus alternifolia	Alternate-leaved Dogwood

Species	Common Name
Cornus amomum	Silky Dogwood
Cornus florida	Flowering Dogwood
Cornus racemosa	Grey-stemmed Dogwood
Cornus sericea	Red Osier Dogwood
Crataegus sp.	Hawthorn
Cyperus involucratus	Umbrella Plant
Daucus carota	Queen Anne's Lace
Dipsacus fullonum sylvestris	Wild Teasel
Dryopteris X neowherryi	Wood Fern
Echinochloa crus-galli	Barnyardgrass
Echinochloa muricata	Rough Barnyardgrass
Elaeagnus angustifolia	Russian Olive
Elaeagnus umbellata	Autumn Olive
Eleocharis palustris	Common Spikerush
Equisetum sp.	Horsetail
Erigerson sp.	Fleabane
Fagus grandifolia	American Beech
Festuca arundinacea	Tall Fescue
Festuca sp.	Grass sp.
Fragaria sp.	Strawberry
Frangula alnus	Glossy Buckthorn
Fraxinus americana	White Ash
Fraxinus pennsylvanica	Green Ash
Galium boreale	Northern Bedstraw
Galium sp.	Bedstraw sp.
Gaylussacia baccata	Black Huckleberry
Gleditsia triacanthos	Honeylocust
Gramineae sp.	Grass sp.
Gymnocladus dioicus	Kentucky Coffeetree
Hypericum perforatum	Common St. Johnswort
Ilex verticullata	American Holly
Impatiens capensis	Jewelweed
Ipomoea sp.	Morning-glory
Juglans nigra	Black Walnut
Juncus effusus	Common Rush
Juniperus virginiana	Eastern Redcedar
Lepidium virginicum	Peppergrass
Ligustrum sp.	Privet
Linaria vulgaris	Butter and Eggs
Liriodendron tulipfera	Tulip Poplar

Species	Common Name
Lonicera maackii	Amur Honeysuckle
Lycopus uniflorus	Northern Bugleweed
Lythrum salicaria	Purple Loosestrife
Malus sp.	Crab Apple sp.
Malus sp.	Apple sp.
Melilotus officinalis	Sweetclover
Morus rubra	Red Mulberry
Onoclea sensibilis	Sensitive Fern
Panicum virgatum	Panic Grass
Parthenocissus quinquefolia	Virginia Creeper
Phalaris arundinacea	Reed Canarygrass
Phleum pratense	Timothy Grass
Phragmites australis	Common Reed
Picea abies	Norway Spruce
Picea glauca	White Spruce
Picea mariana	Black Spruce
Picea pungens	Blue Spruce
Pinus banksiana	Jack Pine
Pinus nigra	Black Pine
Pinus resinosa	Red Pine
Pinus strobus	White Pine
Pinus taeda	Loblolly Pine
Plantago lanceolata	Narrowleaf Plantain
Platanus occidentalis	American Sycamore
Platanus hybrida	London Planetree
Poa sp.	Grass
Polygonum sp.	Knotweed sp.
Populus Alba	White Poplar
Populus deltoides	Eastern Cottonwood
Populus tremuloides	Quaking Aspen
Prunus avium	Sweet Cherry
Prunus X cistena	Sandcherry
Prunus serotina	Black Cherry
Prunus sp.	Cherry sp.
Prunus subhirtella	Weeping Cherry
Prunus virginiana	Chokeberry
Pyrus calleryana	Bradford Pear
Quercus alba	White Oak
Quercus bicolor	Swamp White Oak
Quercus montana	Chestnut Oak

Species	Common Name
Quercus palustris	Pin Oak
Quercus rubra/velutina	Red/Black Oak
Rhamnus cathartica	Common Buckthorn
Rhus glabra	Smooth Sumac
Robinia pseudoacacia	Black Locust
Rosa multiflora	Multiflora Rose
Rosa palustris	Swamp Rose
Rubus illecebrosus	Strawberry Raspberry
Rubus sp.	Blackberry
Rumex crispus	Curley Dock
Salix alba	White Willow
Salix babylonica	Weeping Willow
Salix exigua	Sand-Bar Willow
Salix fragilis	Crack Willow
Salix nigra	Black Willow
Schedonorus arundinaceus	Tall Fescue
Scirpus americanus	Chairmaker's Bulrush
Scirpus sp.	Bulrush sp.
Securigera varia	Crownvetch
Setaria viridis	Green Bristlegrass
Smilax sp.	Greenbriar sp.
Solanum sp.	Nightshade
Solidago gigantean	Late Goldenrod
Spirea tomentosa	Steeplebush
Symphyotrichum ericoides	White Heath Aster
Symphyotrichum novae-angliae	New England Aster
Symphytum officinale	Common Comfrey
Taraxacum officinale	Common Dandelion
Thuja sp.	Arborvitae sp.
Tilia americana	Basswood
Tilia cordata	Littleleaf Linden
Toxicodendron radicans	Eastern Poison Ivy
Tragopogon sp.	Goatsbeard
Trifolium sp.	Clovers
Typha angustifolia	Narrow-leaved Cattail
Typha latifolia	Broad-leaved Cattail
Ulmus americana	American Elm
Ulmus rubra	Slippery Elm
Ulmus thomasii	Rock Elm
Verbascum thapsus	Mullein

Species	Common Name
Viburnum acerifolium	Maple-leaf Viburnum
Viburnum opulus	Highbush Cranberry
Vitis riparia	Riverbank Grape
Vitus aestivalis	Summer Grape