City of Fayetteville, Arkansas
2019 Woolsey Wet Prairie
Adaptive Management Strategy & Monitoring Report No. 13






DECEMBER 2019

CITY OF FAYETTEVILLE ARKANSAS

ENVIRONMENTAL CONSULTING OPERATIONS
ECO, INC.
"Integrating ECOnomy and ECOlogy, since 1990"

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"Integrating ECOnomy and ECOlogy, since 1990"

"Special Thanks" to Jeff Hickle of Jacobs for his "hands on" adaptive management hard work to make things happen!

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1.0 – INTRODUCTION & PROJECT BACKGROUND

The City of Fayetteville, Arkansas' Wastewater System Improvement Project (WSIP) entailed improvements to the City's sewer collection system, upgrading the Paul Noland Wastewater Treatment Plant (WWTP), and construction of the new Westside WWTP. Construction activities for these improvements occurred during a period from 2005 through 2010. The WSIP primary purpose was to implement corrective actions to eliminate/reduce odor and overflow problems associated with the Noland Plant and collection system and to provide wastewater treatment to areas outside the treatment area while reducing the total hydraulic loading to the system. WSIP activities involved discharges of fill into "Waters of the U.S." within the Illinois River Watershed and the Beaver Reservoir Watershed (within the White River Basin); therefore, U.S. Army Corps of Engineers (COE) permitting under Section 404 of the Clean Water Act (CWA) was required.

1.1 – Individual Section 404 Permit No. 14207

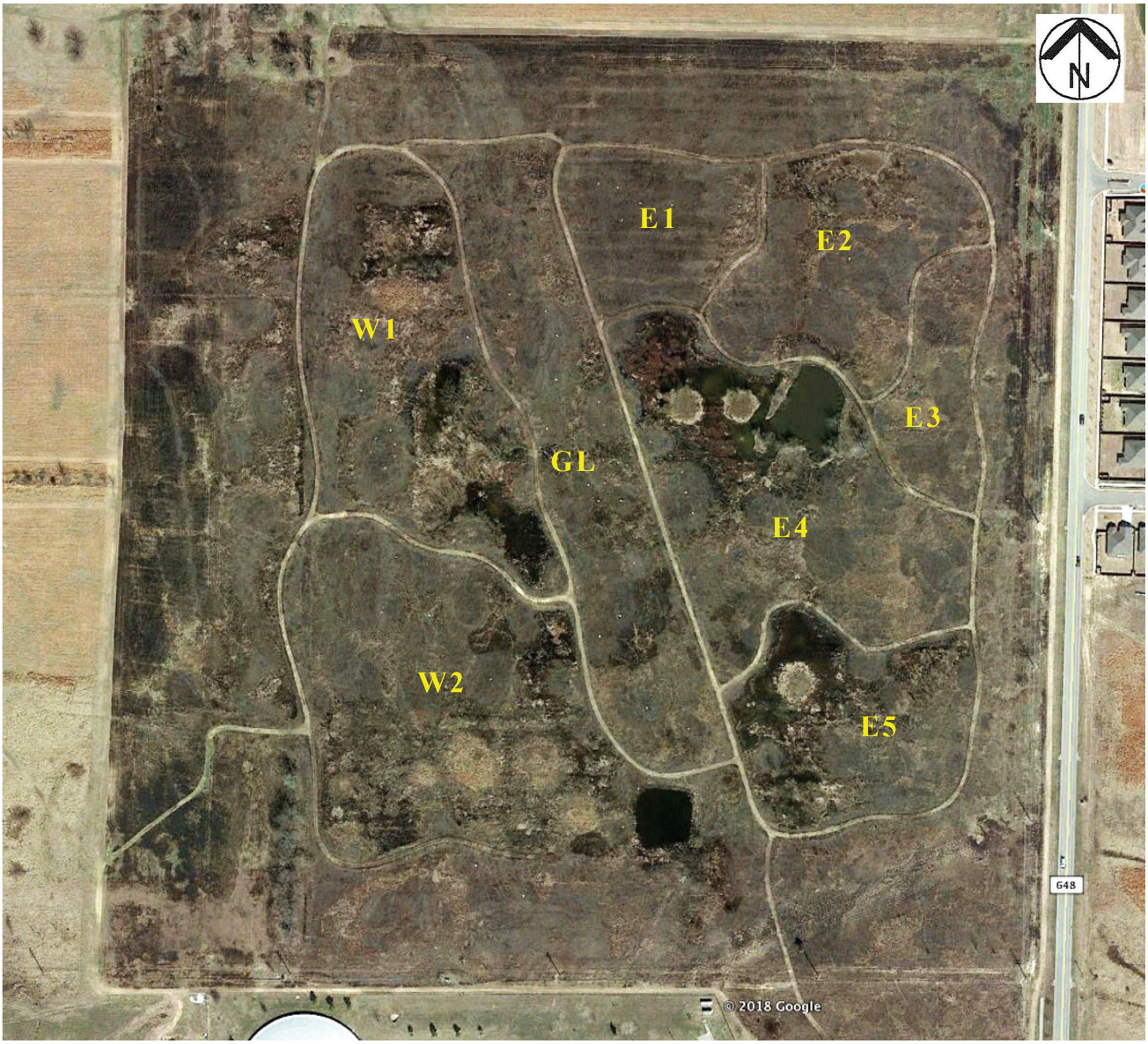
On March 10, 2005, the City of Fayetteville received Individual Section 404 Permit No. 14207 from the COE Little Rock District for the portion of the WSIP in the Illinois River Watershed (west side) that involved 36 stream crossings and 15 wetland crossings during construction of the new Westside WWTP, sewer lines, and improvements to Broyles Road. The 404 permit required wetland compensatory mitigation due to the permanent alteration of 8.87 acres of wetlands. As required by the COE, the wetland mitigation site was deed restricted in perpetuity to guarantee preservation of the wetlands and upland buffers. A certified copy of the Notice of Deed Restriction was recorded with the Washington County Registrar of Deeds on January 5, 2007. The City of Fayetteville is required to manage and maintain the property as a compensatory wetland mitigation site in perpetuity.

1.2 – Mitigation Site Concept and Team

The 43.65-acre wetland mitigation site (Figure 1) is located immediately to the north of the Westside WWTP. McGoodwin, Williams, and Yates Consulting Engineers, Inc. (MWY) provided civil engineering design of hydrological features and Environmental Consulting Operations, Inc. (ECO, Inc.) provided ecological feature design, site management, and monitoring. Brasfield and Gorrie General Contractors completed construction of earthen berms and water level control structures. Operation of hydrological controls, herbicide applications, fire line installations, and mowing are managed through Jacobs, who also maintains the City's wastewater utility system. Prescribed burns are contracted by the City through an informal bidding process. ECO, Inc. oversees Section 404 permit compliance, develops prescribed burn and herbicide application specifications, identifies problem areas where invasive plant species need to be controlled, and conducts annual monitoring and site adaptive management strategy development.

Modifications to the existing hydrology at the mitigation site were achieved via the construction of low elevation perimeter earthen berms designed to provide a mechanism for water retention within seven wetland cells. The micro-topography within the wetland cells was not disturbed or altered during the construction of the berms. The presence of depressions between prairie mounds provides a diversity of hydrology, which, in turn provides diversity in wetland and upland plant communities.

Figure 1 – Woolsey Wet Prairie Aerial Photograph



Water level control structures with stop logs were constructed within the berms in order to provide the ability to hold and to release water as needed in order to maintain inundation/saturation within the wetland cells for the purpose of optimizing wetland plant community diversity. Construction of the earthen berms resulted in two cells (W-1 and W-2) within the West Mitigation Site, and five cells (E-1 through E-5) within the East Mitigation Site. The west and east mitigation sites are separated by a gas pipeline easement that is 60 feet in width. The easement has undergone the same adaptive management as the remaining acreage on the deed restricted property. A perimeter buffer zone has been established around the perimeter of the deed-restricted mitigation site where herbicide applications and prescribed burns are performed to prevent migration of non-native invasive plant species into the mitigation area. Therefore, a total of approximately 65-acres are managed on the property.

In 2006, Bruce Shackleford, ECO, Inc. President, named the mitigation site "Woolsey Wet Prairie Sanctuary" in honor of Samuel Gilbert Woolsey, whose family settled the property in 1830 when prairies were abundant in Northwest Arkansas.

The Woolsey Wet Prairie Sanctuary is part of the original prairie of Prairie Township, Fayetteville, Arkansas that extended all the way to the Prairie Grove and Lincoln areas in Washington County. Conversion of an estimated 100,000 acres of both wetland and upland prairie habitat in Northwest Arkansas to production of wheat in the late 1800's and early 1900's was the beginning of the decimation of prairie habitat, America's most endangered ecosystem. Fire suppression and the introduction of non-native plant species have also contributed greatly to the near complete extirpation of prairie habitat.

1.3 – Historical Rare Plant Species Observed at Woolsey Wet Prairie Sanctuary

Ten plant species tracked as elements of conservation concern (rare species) by the Arkansas Natural Heritage Commission (ANHC), have been found to naturally occur at the wetland mitigation site. These rare plants include sedges (family *Cyperaceae*), milkwort (family *Polygalaceae*), and Hawthorn (genus *Crataegus*), and are characteristic of unplowed tall grass wet prairie remnants. An 11th ANHC tracking species, Mexican white sage, was successfully transplanted within the boundaries of the site during 2019.

Carex aggregata **(cluster sedge) – G5S1 –** This sedge is known in Arkansas only from a few sites in Benton, Carroll, Fulton, Newton, Sharp, and Washington counties. It typically grows in low open woodlands or seasonally wet grasslands. At Woolsey Wet Prairie, it is scattered in seasonally wet areas that are not inundated for long periods. It is has been historically and presently observed in all seven wetland cells and within the gas line easement at Woolsey Wet Prairie.

Polygala incarnata **(pink milkwort) – G5S1S2 –** This rare species of wildflower is known in Arkansas from remnant prairies and other historically open grassland habitats, such as glades and savannas. It is known from scattered counties in Arkansas, but most of the records of many of the sites where it was historically found have since been destroyed. A single plant was found on a prairie pimple mound in wetland cell E-4 in 2012 and was not observed in 2013. In 2014, this population increased to six plants, but none were observed from 2014 through 2017. It is thought that this plant's absence was due to shading out associated with the increase in woody plant densities observed during 2015 and 2016. Timber mulching activities were conducted during 2017 to reduce the over shading effect of woody vegetation. During 2018, a single plant was observed for the first time in the buffer zone south of wetland cell W-2. During 2019, no individuals of this species were observed at the site.

Carex scoparia **var.** ***scoparia*** **(pointed sedge) – G5S1S2 –** This species is very rare in Arkansas and is known only from prairie-associated wetlands in Washington and Benton counties. Historically, this plant was observed as a single clump that has persisted in wetland cell W-1. During 2018, it was observed for the first time in wetland cells E-4 and E-5. It was observed in 2019 as being present in wetland cells E-4, E-5, and W-1.

***Carex arkansana* (Arkansas sedge) – G4S2 –** This uncommon sedge is known in Arkansas from wet prairie remnants, open hydric oak flatwoods, and similar open wetland habitats (ANHC, 2014). While it has no wetland indicator status code in the United States Department of Agriculture (USDA) Plants Database, it is listed by Yatskievych (1999) as occurring primarily in bottomland prairies and moist depressions of upland prairies. At Woolsey Wet Prairie, it is scattered in seasonally wet areas that are only inundated for short periods. Historically, this plant species has been observed in all seven wetland cells and the gas line easement, but was absent during 2018 for the first time in monitoring history from wetland cell E-3. Monitoring activities during 2019 produced similar results, with the species being observed in all wetland cells and the gas line easement, with the exception of wetland cell E-3.

***Carex opaca* (opaque prairie sedge) – G4S2S3 –** This rare sedge is primarily associated with unplowed, wet tall grass prairie remnants in Arkansas (ANHC, 2014). While it has no wetland indicator status code in the USDA Plants Database, it is listed by Yatskievych (1999) as primarily occurring in bottomland prairies, moist depressions of upland prairies, and margins of fens. At Woolsey Wet Prairie, it is scattered in seasonally wet areas that are not inundated for long periods. Historically and presently, it has been found in all seven wetland cells and the gas line easement at Woolsey Wet Prairie.

***Carex fissa* var. *fissa* (hammock sedge) – G4S1 –** Prior to its discovery at Woolsey Wet Prairie, this rare sedge was known in Arkansas from only two sites in Franklin and Lonoke Counties, where it occurs in prairie-associated wetlands (ANHC, 2014). At Woolsey Wet Prairie, it has historically been found in three naturally occurring prairie swales in wetland cells E-2, W-1, and W-2. During 2015, it was absent from wetland cell E-2, but returned during 2016 and was observed again during 2018. During 2015 and 2016, it was absent from wetland cell W-1, but returned and was observed again in 2018. It is possible that this plant disappeared due to shading associated with the increase in woody plant densities observed during 2015 and 2016, and the timber mulching activities conducted during 2017 aided in this species return to the site. In 2018, it was observed for the first time within the gas line easement. This species was observed in 2019 in wetland cells W-1, W-2, and within the gas line easement, but was not observed in wetland cell E-2.

***Carex pellita* (woolly sedge) – G5S1S2 –** Prior to its collection at Woolsey Wet Prairie, this species was known to be extant at a single Arkansas locality, in a fen in Marion County. It has since been found at three other sites in Benton, Washington, and Marion counties. At Woolsey Wet Prairie, it has been historically observed at seasonally wet areas in wetland cells E-4, E-5, W-1, and W-2. It was absent from wetland cell W-1 in 2018. During 2019, this species was observed in wetland cells E-4, E-5, W-1, W-2, and within the gas line easement for the first time.

***Eleocharis wolfii* (Wolf's spikerush) – G3G4S3 –** This wetland sedge occurs in Arkansas primarily in wet areas in unplowed tall grass prairie remnants, but can persist in wet, open areas in landscapes that were formerly dominated by prairie vegetation (ANHC, 2014). At Woolsey Wet Prairie, this species has historically been found in several naturally occurring swales within wetland cells E-2, E-3, E-4, E-5, W-1, and W-2. It was not observed in wetland cell E-5 during 2015 and 2016, possibly due to shading associated with the increase in woody plant densities observed during 2015 and 2016, prior to the timber mulching activities conducted during 2017. During 2019, this species was observed in wetland cells E-2, E-3, E-4, E-5, W-1, W-2, and for the first time within the gas line easement.

Rhynchospora macrostachya **(tall horned beaksedge) – G4S2 –** Prior to its collection at Woolsey Wet Prairie, this species was known in Arkansas only from a few scattered historical collections from remnant prairies. It has since also been found in several prairie-associated wetlands in Franklin County. At Woolsey Wet Prairie, it was first known from two natural prairie swales prior to construction of the berms. In the fall of 2006, ECO, Inc. gathered seeds and successfully propagated over 50 specimens during the 2007 growing season that were transplanted into marsh areas at the site during 2008. A 90 percent survival rate was observed and transplanted specimens produced large seed heads by the end of the 2008 growing season. Historically, this species has been observed in wetland cells E-2, E-4, E-5, W-1, W-2, and within the gas line easement. In 2015 and 2018, it was absent from wetland cell E-2, and in 2018 it was absent from wetland cells E-4 and E-5. During 2019, this species was observed in wetland cells E-5, W-1, W-2, and within the gas line easement, but still absent from wetland cell E-2.

Crataegus reverchonii **(Reverchon's hawthorn) – G4S1 –** This small tree has been confirmed to occur in Arkansas only in Benton and Washington counties at low prairies or woodlands. It is primarily a western species. Specimens at Woolsey Wet Prairie appear to be *Crataegus reverchonii* subsp. *palmeri*, but both *palmeri* and the subspecies *reverchonii* have been reported for northwestern Arkansas. Additional study is needed to determine if both subspecies are present at the site. Historically, it has been observed within wetland cells W-1, E-4, E-5, and W-2. During 2019, this species was only observed within wetland cell W-1.

Artemisia ludoviciana **var. *mexicana* (Mexican white sage) – G5T5S1S2 –**This species is known to occur in Arkansas in dry grasslands and glades in a few counties in the northwestern part of the state. It was last documented from the Fayetteville area in 1954, when it was collected from "West Mountain" (a site believed to be about two miles east of Woolsey Wet Prairie). Historically, this species was observed as two distinct patches located in a fencerow and field margin along the south side of Persimmon Street, just west of Owl Creek. During 2018, Jeff Hickle of Jacobs collected and propagated seeds from these individuals and successfully transplanted them within the boundaries of the site during early 2019 in the buffer areas north of wetland cells E-1, E-2, west of W-1, and east of E-3.

Key to ANHC Species Category Rankings:

G3 – Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range
G4 – Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery
G5 – Demonstrably secure globally, although it may be quite rare in parts of its range, especially at the periphery
T – Subspecies or variety rank (ex. G5T4 applies to a subspecies with a global species rank of G5, but with a subspecies rank of G4)
S1 – Critically imperiled because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation
S2 – Imperiled because of rarity (6 to 20 known extant populations) or because of some factor(s) making it especially vulnerable to extirpation
S3 – Rare throughout the state or found locally in a restricted region of the state, or because of other factors making it vulnerable to extirpation

1.4 – Historical Monitoring Strategies at Woolsey Wet Prairie Sanctuary

As part of the terms and conditions included in the City of Fayetteville's Section 404 permit, seven annual reports on the status of the mitigation site were required to be submitted to the COE. The first annual wetland monitoring report was due December 31st after the first growing year, and each year thereafter, for a total of seven years. The first monitoring year was 2007 and the seventh annual monitoring report was completed in December 2013. Initially, the COE required intensive monitoring activities at 47 monitoring stations for the first seven years. Since that time, ECO, Inc. has transitioned to an abbreviated methodology strategy that focuses more on where adaptive management activities are needed on a cell-by-cell basis in lieu of the 47 monitoring stations. This serves to assure that the City of Fayetteville continues to meet COE Section 404 permit required

ecological performance standards and maintains eligibility to use surplus wetland credits for city infrastructure improvements that permanently alter wetlands.

ECO, Inc. conducted periodic site visits throughout the 2019-growing season to observe and evaluate the effectiveness of herbicide applications for control of invasive plant species, to evaluate plant succession, to evaluate performance standards status, and to observe the status of site hydrology. ECO, Inc. contracted Karen Willard from the University of Arkansas herbarium to conduct vegetation monitoring events during June and September to document the presence, densities, and locations of stands of non-native/invasive plant species and rare plant species tracked as elements of conservation concern by the ANHC. Karen marked Google Earth generated aerial photographs in the field to show locations of non-native/invasive and rare plant species. The non-native/invasive species aerial maps were used by Jacobs during the growing season as a guide for areas most heavily targeted for herbicide applications. The rare species aerial maps were used during the academic research project guidance, mitigation, and approval process.

The results of the 2019 field observations and monitoring data are compiled herein for the purpose of evaluating the degree of success in controlling non-native/invasive plant species that threaten the rare prairie ecosystem at Woolsey Wet Prairie and to develop and prioritize an action item list for adaptive management activities and goals for the upcoming 2020 growing season.

In prior years, monitoring activities focused largely on evaluating species richness within each wetland cell and for the overall site. During the 2018 and 2019 growing seasons, an increased focus was placed upon the evaluation of adverse impacts to the native prairie plants caused by persistent invasive plant species and the woody plant succession that was adversely affecting the prairie character of the site. Observations made during the 2017 and 2018 monitoring activities were used to develop a more aggressive plan of action for controlling invasive and woody plant species in 2018 and 2019. Positive results were achieved via this approach that will be continued throughout the 2020-growing season.

2.0 – 2019 GROWING SEASON OBSERVATIONS

The following sections describe observations for each wetland cell during the 2019 growing season. For purposes of adaptive management at Woolsey Wet Prairie, invasive plant species include both native and non-native plants that have the potential to outcompete native prairie and wetland plant species in a manner and degree that poses an ecological threat to sustaining the wetland prairie ecosystem.

2.1 – Wetland Cell E-1 Observations

E-1 Rare Species

Three rare plant species, cluster sedge, Arkansas sedge, and opaque prairie sedge were observed in wetland cell E-1. All three are uncommon in this cell and are scattered in low areas that are not inundated for long durations. The locations of these rare plant species are shown on the aerial photograph contained within Appendix III.

E-1 Invasive Species

Five invasive species were observed in this wetland cell in 2019 that need continued management; however, the densities of these invasives have been greatly reduced as compared to 2018. In particular, sericea lespedeza (*Lespedeza cuneata*), white sweet clover (*Melilotus albus*), Johnsongrass (*Sorghum halepense*), small carpetgrass (*Arthraxon hispidus*), and tall fescue (*Schedonorus arundinaceus*) are all persisting. The locations of the non-native/invasive plant species are marked on the E-1 Aerial Photograph (Appendix IV). The invasives are scattered within the cell, but persist in higher densities along the berms of the cell due to disturbances and imported soils when the earthen berms were constructed in 2006. Historically, 17 invasive plant species were previously observed in Wetland Cell E-1. The management team has experienced significant success in 2019 in terms of reducing density and species richness of invasive plant species.

2.2 – Wetland Cell E-2 Observations

E-2 Rare Species

Five rare plant species, cluster sedge, Arkansas sedge, opaque prairie sedge, pointed sedge, and Wolf's spikerush were observed in wetland cell E-2. The *Carex* species are uncommon in this cell and are scattered in low areas that are not inundated for long durations. In 2017, tall horned beaksedge was observed and in 2018 hammock sedge was observed; however, neither of these rare plant species were observed as being present during 2019. The locations of these rare plant species are shown on the aerial photograph contained within Appendix III.

E-2 Invasive Species

Eight invasive species were observed in this wetland cell in 2019 that need continued management; however, the densities of these invasives have been greatly reduced as compared to 2018. In particular, sericea lespedeza, white sweet clover, Johnsongrass, small carpetgrass, tall fescue, Japanese honeysuckle (*Lonicera* japonica), callery pear (*Pyrus* calleryana), and narrowleaf cattail (*Typha angustifolia*) are all persisting. The locations of the non-native/invasive plant species are marked on the E-2 Aerial Photograph shown in Appendix IV. Historically, nine invasive plant species have been observed in this cell. The management team has experienced significant success in 2019 in terms of reducing density and species richness of invasive plant species.

2.3 – Wetland Cell E-3 Observations

E-3 Rare Species

Three rare plant species, cluster sedge, opaque prairie sedge, and Wolf's spikerush were observed in wetland cell E-3. All are uncommon or rare in this cell and are scattered in low areas that are not inundated for long durations. Arkansas sedge, which has historically been observed within this cell, was not observed in 2018 or 2019. The locations of these rare plant species are shown on the aerial photograph contained within Appendix III.

E-3 Invasive Species

Four invasive species were observed in this wetland cell in 2019 that need continued management; however, the densities of these invasives have been greatly reduced as compared to 2018. In particular, sericea lespedeza, white sweet clover, tall fescue, and Johnsongrass are all persisting. The locations of the non-native/invasive plant species are marked on the E-3 Aerial Photograph shown in Appendix IV. The invasives are scattered within the cell, but persist in the greatest densities along the berms of the cell due to disturbances and imported soils when the earthen berms were constructed in 2006. The management team has experienced significant success in 2019 in terms of reducing density and species richness of invasive plant species.

2.4 – Wetland Cell E-4 Observations

E-4 Rare Species

Six rare plant species were observed in wetland cell E-4. Cluster sedge, Arkansas sedge, and opaque prairie sedge are uncommon in this cell and are scattered in low areas that are not inundated for long durations. A single colony of woolly sedge observed in this cell in 2013 has persisted and expanded. In 2018, pointed sedge was observed for the first time within this cell and was observed to have persisted in 2019. Wolf's spikerush occurs scattered at the edge of open marshes. Pink milkwort was observed on a pimple mound in 2012 and 2014, but was not observed in 2013, 2015, 2016, 2017, 2018, or 2019. However, this type of population fluctuation is not uncommon in annual species. A single plant of Reverchon's hawthorn (*Crataegus reverchonii*), which has historically been observed near the west side of the cell since 2014 was not observed during 2019. Tall horned beaksedge and hammock sedge, which have been historically observed within this cell, were found to not be present in 2018 or 2019. The locations of these rare plant species are shown on the aerial photograph contained within Appendix III.

E-4 Invasive Species

Nine invasive species were observed in this wetland cell in 2019 that need continued management; however, the densities of these invasives have been greatly reduced as compared to 2018. In particular, sericea lespedeza, white sweet clover, Johnsongrass, small carpetgrass, tall fescue, Japanese honeysuckle, callery pear, multiflora rose (*Rosa multiflora*), Himalayan blackberry (*Rubus serissimus*) are all persisting. In 2019, Japanese stiltgrass (*Microstegium vimineum*) was observed at the site for the first time in wetland cell E-4 in the northeast corner near the berm. The locations of the non-native/invasive plant species are marked on the E-4 Aerial Photograph shown in Appendix IV. The invasives are scattered within the cell, but persist in the greatest densities along the berms of the cell due to disturbances and imported soils when the earthen berms were constructed in 2006.

This wetland cell has approximately 0.54 acres of designated Tree Preservation Areas where woody vegetation is allowed to grow in order to meet COE compensatory requirements for permanent alterations to forested wetlands during construction of the WSIP. Otherwise, woody vegetation is controlled at other locations to prevent a prairie ecosystem from being converted into a forested ecosystem.

2.5 – Wetland Cell E-5 Observations

E-5 Rare Species

Seven rare plant species were observed in wetland cell E-5. Cluster sedge is rare and scattered on the east side of the cell. Arkansas sedge and opaque prairie sedge are uncommon and are scattered in low areas that are not inundated for long durations. A single colony of woolly sedge observed in 2013 has persisted and expanded in the northeast portion of the cell. Wolf's spikerush occurs scattered at the edge of open marshes on the south and east portions of the cell. Pointed sedge was observed for the first time within this cell in 2018 and was found to have persisted during 2019. Tall horned beaksedge, which has been historically observed within this cell, but was not observed during 2018, was once again observed during 2019. The locations of these rare plant species are shown on the aerial photograph contained within Appendix III.

E-5 Invasive Species

Eight invasive species were observed in this wetland cell in 2019 that need continued management; however, the densities of these invasives have been greatly reduced as compared to 2018. In particular, sericea lespedeza, small carpetgrass, tall fescue, Japanese honeysuckle, callery pear, multiflora rose, Himalayan blackberry, and narrow-leaf cattail are all persisting. The invasives are scattered within the cell, but persist in the greatest densities along the berms of the cell due to disturbances and imported soils when the earthen berms were constructed in 2006. The locations of the non-native/invasive plant species are marked on the E-5 Aerial Photograph shown in Appendix IV.

This wetland cell has approximately 0.75 acres of designated Tree Preservation Areas where woody vegetation is allowed to grow in order to meet COE compensatory requirements for permanent alterations to forested wetlands during construction of the WSIP. Otherwise, woody vegetation is controlled at other locations to prevent a prairie ecosystem from being converted into a forested ecosystem.

2.6 – Wetland Cell W-1 Observations

W-1 Rare Species

Eight rare plant species were observed in wetland cell W-1. The single clump of pointed sedge first observed in this cell in 2012 is still persisting and has expanded. Cluster sedge, Arkansas sedge, and opaque prairie sedge are uncommon in this cell and are scattered in low areas that are not flooded for long durations. Tall horned beaksedge and Wolf's spikerush occur scattered at the edge of open marshes. Reverchon's hawthorn was found to persist outside the berm on the west side of this cell. A few individuals of hammock sedge that in previous years had been shaded out by willows were observed to be present in 2018 following the 2017 timber mulching activities. These individuals were

observed during 2019. Woolly sedge, which has been historically observed within this cell, was found to not be present in 2018 or 2019. The locations of these rare plant species are shown on the aerial photograph contained within Appendix III.

W-1 Invasive Species

Seven invasive species were observed in this wetland cell in 2019 that need continued management; however, the densities of these invasives have been greatly reduced as compared to 2018. In particular, sericea lespedeza, Johnsongrass, small carpetgrass, tall fescue, callery pear, Himalayan blackberry, and narrow-leaf cattail are all persisting. The invasives are scattered within the cell, but persist in the greatest densities along the berms of the cell due to disturbances and imported soils when the earthen berms were constructed in 2006. The locations of the non-native/invasive plant species are marked on the W-1 Aerial Photograph shown in Appendix IV. The management team has experienced significant success in 2019 in terms of reducing density and species richness of invasive plant species.

This wetland cell has approximately 1.2 acres of designated Tree Preservation Areas where woody vegetation is allowed to grow in order to meet COE compensatory requirements for permanent alterations to forested wetlands during construction of the WSIP. Otherwise, woody vegetation is controlled at other locations to prevent a prairie ecosystem from being converted into a forested ecosystem.

2.7 – Wetland Cell W-2 Observations

W-2 Rare Species

Nine rare plant species occur in wetland cell W-2, with this cell being the most rich in rare plant species. Several clumps of cluster sedge were found in the central and northwest portions of the cell. Arkansas sedge, which historically has been common throughout the cell, was only observed as a few individuals. Opaque prairie sedge is fairly common and is scattered throughout the cell in low areas that are not inundated for long durations. Historically, a large population of hammock sedge existed in the southern half of this cell, but during 2018 and 2019, only a few individuals were observed. Several colonies of woolly sedge occur in the northeast and southeast portions of this cell. Wolf's spikerush occurs scattered at the edge of open marshes within the cell on the north and west edges. Pointed sedge was observed for the first time within this cell in 2018 as scattered individuals. During 2019 it was observed just outside the berm on the northwest corner and inside the berm in the northeast portion of the cell. In 2018, Pink milkwort was observed for the first time outside of the southern berm, but was not observed during 2019. A single large, fruiting tree of Reverchon's hawthorn that was historically observed on the west side of the wooded area outside the berm on the west edge of this cell was not observed during 2018 or 2019. Tall horned beaksedge was observed in the southwest portion of the cell. The locations of these rare plant species are shown on the aerial photograph contained within Appendix III.

W-2 Invasive Species

Ten invasive species were observed in this wetland cell in 2019 that need continued management; however, the densities of these invasives have been greatly reduced as compared to 2018. In particular, sericea lespedeza, Johnsongrass, small carpetgrass, tall fescue, callery pear, Himalayan blackberry, multiflora rose, white sweet clover, Japanese honeysuckle, and narrowleaf cattail are all persisting.

The wooded area outside the berm on the west edge of this cell is has historically been very thick with invasive plants including multiflora rose, Chinese privet (*Ligustrum sinense*), bush honeysuckle (*Lonicera maackii*), Himalayan blackberry, Japanese honeysuckle, and winter-creeper (*Euonymus fortunei*). These species are still persistent, but the density has been greatly reduced. In October 2017, the very invasive Chinese Silver Grass (*Miscanthus sinensis*) was found for the first time at the site in the southeast corner of Wetland Cell W-2 just west of the old farm pond. The tall clumps of Chinese Silver Grass were treated using the herbicide Outrider. Following the spring 2018 burn, individuals of this plant reemerged from dormancy and were again treated with very positive effects. During 2019, no individuals of this species were observed. The same process will need to be repeated following the 2020 spring burn to ensure that the species has been successfully removed from the site. The invasives are scattered within the cell, but persist in the greatest densities along the berms of the cell due to disturbances and imported soils when the earthen berms were constructed in 2006. The locations of the non-native/invasive plant species are marked on the W-2 Aerial Photograph shown in Appendix IV.

2.8 – Gas Line Easement Observations

Gas Line Easement Rare Species

A 60-foot wide high-pressure gas line easement separates the East Wetland Mitigation Cells from the West Wetland Mitigation cells. This easement is not included within the acreage designated for the deed-restricted wetland mitigation site. However, it is managed in the same manner as the wetland cells for the purpose of controlling invasive plant species and preserving the rare plant species.

Seven rare plants occur within the gas line easement. Arkansas sedge, opaque prairie sedge, and cluster sedge are fairly common and are scattered in low areas that are not inundated for long durations. A large colony of woolly sedge occurs in the southern half of this cell. Tall horned beaksedge and hammock sedge were observed as a few individuals in the central portion of the cell. Wolf's spikerush occurs scattered throughout the cell at the edges of open marshes. The locations of these rare plant species are shown on the aerial photograph contained within Appendix III.

Gas Line Easement Invasive Species

Nine invasive species were observed in this wetland cell in 2019 that need continued management; however, the densities of these invasives have been greatly reduced as compared to 2018. In particular, sericea lespedeza, Johnsongrass, small carpetgrass, tall fescue, callery pear, Himalayan blackberry, multiflora rose, white sweet clover, and Japanese honeysuckle are all persisting. The locations of the non-native/invasive plant species are marked on the Gas Line Aerial Photograph shown in Appendix IV.

2.9 - Overall Plant Species Richness Trends at Woolsey Wet Prairie

Management, inventory, and monitoring work findings in 2019 resulted in the addition of seven new plant species not previously observed at the Woolsey Wet Prairie. Among the 2019 additions were Mexican white sage (*Artemisia ludoviciana var. mexicana),* fox sedge (*Carex triangularis*), ditch stonecrop (*Penthorum sedoides*), hairy leafcup (*Smallanthus uvedalius*), Deptford pink (*Dianthus armeria*), blue mistflower (*Conoclinium coelestinum*), and pink thoroughwort (*Fleischmannia incarnata*).

To date, a total of 489 plant species have been observed at Woolsey Wet Prairie since 2001. Of these, 98 (20%) species are considered to be non-native and/or invasive species, and 390 (80%) are considered to be native plant species. Because different species emerge at different times of the year, and the fact that some plant species may not emerge every year, this does not mean that 489 plant species can be observed at any one moment in time. However, new plant species are appearing each year and a more than ten-fold increase in plant species has been observed since 2005 when only 47 plant species were observed at the site. The 2019 Woolsey Wet Prairie Master Plant Species List is contained within Appendix V.

3.0 – 2019 ADAPTIVE MANAGEMENT ACTIVITIES

ECO, Inc. develops annual adaptive management goals and objectives and works as a team with Jacobs who is the party that provides boots on the ground services at Woolsey Wet Prairie to implement adaptive management techniques such as mowing, herbicide application, and hand cutting/pulling. A comprehensive summary of the adaptive management activities completed at Woolsey Wet Prairie during 2019 is contained within Appendix VI.

3.1 – Mowing & Hand Cutting/Pulling

The mowing at the site is aimed toward invasive species such as tall fescue, Johnsongrass, Dallis grass (*Paspalum dilatatum*), Queen Anne's lace (*Daucus carota*), ragweed (*Ambrosia spp.),* and sericea lespedeza. When necessary, stands of these species are mowed to a height of 10-12 inches as they begin to mature, but before they form seed heads. This is intended to prevent the dispersal of additional seeds into the site seed bank from invasive species. As a precautionary measure, pastures to the north and west of the mitigation site are mowed to reduce the risk of seed dispersal of undesirable plant species from unrestored areas. The trails on top of the earthen berms are routinely mowed for the purpose of maintaining site access by the public and to control invasive plant species from forming seeds.

3.2 – Prescribed Burning

To date, twelve prescribed burns have been conducted at Woolsey Wet Prairie on February 29, 2008, February 19, 2009, December 16, 2009, March 18, 2011, March 13, 2012, March 3, 2013, March 13, 2014, March 23, 2015, March 5, 2016, February 24, 2017, March 8, 2018, and March 18, 2019. ECO, Inc. routinely develops prescribed burn specifications and a prescribed burn contractor is selected through an informal bid process.

For ecological restoration, fire has become recognized as a valuable vegetation management tool that can be used to enhance community diversity. Fire removes much of the surface layer of decaying vegetation "thatch" that covers the ground. Many native plant species require sunlight to germinate, while others actually require fire to germinate. Prescribed burns aide in preventing woody plant encroachment and maintains the wet prairie habitat, depending upon the time of year of the burn, and

the site hydrology at the time of the burn. The volunteer woody plant growth has primarily occurred in the wetter areas where inundation, and/or moist soils protect woody plants from fire.

With the objective of encouraging Native Warm Season Grasses (NWSG) and suppressing hardwood sprouts, the most effective burn period at Woolsey Wet Prairie has been found to be during the February to March time period. Ideally, this will occur during the transition from the Late Dormant to Dormancy Break periods. At that time, most of the warm season species will still be dormant and there will be adequate fuel from the vegetation killed by prior winter cold weather.
Prairies existed for thousands of years, primarily because Native Americans burned the local landscapes. Research has shown that they sometimes chose the most severe weather to ignite fires in order to maintain open grasslands that attracted the large herbivores they hunted. Some fires were done during drought conditions that greatly inhibited the plant succession, killing the majority of the trees in the fire's path. What remained were open grassland prairies with scattered post oak (*Quercus stellata*) savannas (very low density tree areas) that had an understory of native prairie grasses and forbs. The post oaks prevailed because they were the most fire-resistant tree species in the Ozarks. Unlike the use of fire by Native Americans during drought conditions, the prescribed burns at Woolsey Wet Prairie must be conducted under safe conditions due to the urban-interface setting, and when there are no burn bans issued by the Arkansas Forestry Commission.

Prescribed burns help maintain a fire dependent prairie ecosystem, but they are likely not as hot and as intense as historical fires of Native American origin and do not kill a large number of trees. Furthermore, because Woolsey has an abundance of wetland areas, thorough burning of stands of black willow (*Salix* nigra) and green ash (*Fraxinus pennsylvanica*) are often difficult to achieve due to moisture levels in the ground and vegetation. Therefore, the prescribed burning is supplemented with herbicide applications to control the woody vegetation.

3.3 – Hydrological Controls

All wetland cells (with the exception of wetland cell W-2) have water level control structures. The structures have stop logs consisting of two dimensions; five-inch and seven-inch heights. This allows for control of water levels within the wetland cells within two-inch increments, depending upon the configuration of the stop logs and the amount of rainfall. In general, the stop log configurations are set to: 1) maintain surface water within portions of each wetland cell; 2) maintain non-inundated areas that have saturated surface soils; and 3) preclude overflows over the berms that would result in berm erosion. Maximum water retention within the wetland cells is not desirable, as it may create conditions not suitable for maintaining rare wetland sedge and rush species that cannot survive in periods of prolonged inundation.

Management of hydrology is an important tool in vegetation community diversity optimization because plant zonation occurs along water depth and soil saturation gradients. Consequently, variations in water depth and degree of soil saturation lead to variations in species composition. In summary, for management of hydrology, the major emphasis will be to recreate natural hydrological regimes in a manner to limit productivity of any single species from becoming excessively high, while at the same time, enriching biodiversity. The strategy for management of hydrology has not only included considerations for the volume of water retained, but also the time of the year water is retained. It is vital to retain water during the growing season in order to maintain areas of soil saturation and/or inundation to support desirable wetland vegetation. Table 1 below shows the typical

seasonal stop log settings. Stop logs are typically set to lower water levels in December in preparation for the February to March prescribed burn, then returned to their original settings after the prescribed burn. The 2019 stop log data is contained in Appendix I.

Table 1 – Typical Seasonal Stop Log Settings

Wetland Cell	June – November	December – May
E-1	7:5	7
E-2	7:7	7:5
E-3	7:7	7:5
E-4	7:5	7
E-5	7:5	7
W-1	7:7	7
W-2	N/A	N/A

3.4 – Historical Herbicide Applications

ECO, Inc. routinely develops specifications for the types of herbicides and adjuvants that are applied for each targeted invasive plant species group. Use of broad-spectrum herbicides are avoided when practicable, but used on occasion. Herbicide applications are made following label recommendations and are not directly applied to standing surface water except when an EPA-approved Aquatic Site herbicide is used. Typically, graminicides are applied for control of invasive grass species and broadleaf-specific herbicides are applied for invasive broadleaf and woody plants. The majority of herbicide applications are made via backpack sprayers and/or UTV mounted spray equipment.

Historically, the predominate recurring and persistent non-native and invasive grasses to which herbicides have been applied, include:

- **tall fescue**
- **Johnsongrass**
- **small carpetgrass**
- **southern crabgrass *(Digitaria ciliaris)***
- **smooth crabgrass (*Digitaria ischaemum)***
- **Bermuda grass (*Cynodon dactylon)***

During pre-construction and early post-construction periods (pre-2006 through 2010) the very invasive tall fescue was the dominant plant species because the site was previously a hay pasture. Tall fescue has a wetland indicator status of FAC- and is capable of dominating wet meadow areas, significantly reducing native plant species richness. It is a cool season grass and actively begins photosynthesis very early in the growing season. It goes dormant during hot dry weather and actively grows in the fall even after several killing frosts. This provides an advantage in vegetation management since the fescue can have herbicide effectively applied at a time when native plant species are dormant. It has been observed that three to four weeks after the late winter/early spring burns are a critical time to apply herbicides on the fescue.

Since its original discovery in 2015 in the gas line easement west of wetland cell E-4, small carpetgrass has quickly become one of the most aggressive invasive species at the site and has now been observed as occurring in all of the wetland cells. Due to the nature of small carpet grass and its delayed growth cycle it is hard to observe new patches under the tall dense vegetation around it until it is already well established making it extremely hard to treat all of the individuals before going to seed in mid September. Historically, small carpetgrass has been treated with the herbicide Section 2EC (Clethodim 26.4%), which is a selective post-emergence herbicide used for the control of annual and perennial grasses that can be applied over standing water. While this herbicide has provided effective control for other species of grasses in the past, it is apparent that it is not being effective at controlling the spread of the populations of small carpet grass at the site.

Due to this fact and the fact that the majority of the small carpetgrass is located in upland areas away from standing water, it is ECO, Inc.'s opinion that for the 2020 growing season the herbicide Outrider (Sulfosulfuron 75%) should be used to treat small carpetgrass at the areas indicated on the invasive species maps and at any new additional patches that are discovered. Outrider is a systemic pre-emergent and post-emergent herbicide used to control a variety of broadleaf weeds and grasses that perhaps will aid in better control of the species.

Recurring and persistent non-native and invasive broadleaf forbs to which herbicides have been applied, include:

- **sericea lespedeza**
- **white sweet clover**
- **curly dock (*Rumex crispus)***
- **bitter dock *(Rumex obtusifolius)***
- **nodding thistle (*Carduus nutans*)**
- **Japanese honeysuckle**
- **wooly mullein (*Verbascum Thapsus)***
- **narrowleaf cattail**
- **Queen Anne's lace**
- **common thistle (*Cirsium vulgare)***
- **yellow rocket (*Barbarea vulgaris)***

Herbicide applications to woody plant species have primarily focused upon black willow, green ash, honey locust (*Gleditsia triacanthos*), and persimmon (*Diospyros virginiana*). Complete eradication of these woody plants has been part of an ongoing vegetation management objective, but is a difficult task to achieve. In the past, selected stands of black willows have routinely been cut, with cut stumps sprayed with herbicide for the intent of a complete kill of individual trees; while green ash and persimmon saplings have had foliar and basal bark applications of herbicides.

Historically, the predominate recurring and persistent non-native and/or invasive woody plants to which herbicides have been applied, include:

- **black willow**
- **green ash**
- **persimmon**
- **callery pear**
- **honey locust**
- **winged elm (*Ulmus alata)***
- **American elm (*Ulmus americana)***
- **multiflora rose**
- **Chinese privet**
- **bush honeysuckle**
- **Himalayan blackberry**

During 2016 monitoring activities, it became more apparent to ECO, Inc. that the rate of black willow, persimmon, honey locust, and green ash stand expansion exceeded the rate of black willow cutting/spraying/eradication. As a part of developing the 2016 Woolsey Wet Prairie Adaptive Management Strategy & Monitoring Report No. 10, ECO, Inc. reviewed tree density information and recommended a more aggressive tree removal strategy to control woody plant succession. The increase in woody plant density was problematic, because the woody growth outcompetes the native prairie forbs and grasses, resulting in a reduction in both species diversity and density of the desirable native plants in all seven wetland cells. Prairie Ecosystems are level or slightly undulating, mostly treeless tracts of land, dominated by coarse grasses, forbs, and shrubs, rather than trees, as the dominant vegetation type. The expanding stands of woody vegetation posed a threat to the prairie ecosystem character of the site to the point that if allowed to continue, the site would eventually become a forest. As observed during the 2016 monitoring season, the invasive black willows had increased from 2.1 acres to 8.76 acres of surface coverage, thereby displacing 6.66 acres of Wet Meadow/Marsh Habitat. Since Woolsey Wet Prairie is a wetland prairie designed to be a wetland mitigation site, it is difficult to control woody vegetation strictly through prescribed burning, alone. Therefore, additional adaptive management tools became necessary, such as mechanical clearing and/or more aggressive herbicide applications. As observed in 2016, much of the woody vegetation had grown too large to be controlled with herbicide applications. Consequently, the use of both mechanical treatments and herbicides became necessary.

3.5 – Benefits & Results of 2017 Timber Mulching and Adjustments to Herbicide Applications

During early 2016, ECO, Inc. developed a revised adaptive management strategy whereby a minimum of 2.26 acres of forested areas are to be maintained in order to comply with COE Section 404 permit requirements for compensatory mitigation of forested wetlands that were permanently altered during the construction of the City's WSIP.

In order to quickly mitigate this issue, Isaac Ogle of CBS based in Fayetteville, Arkansas was contracted by Jacobs to conduct timber mulching of the black willow, persimmon, and green ash stands at specific areas on the site. “Designated Tree Preservation Areas” were established within wetland cells E-4, E-5, and W-1 that totaled 2.5 acres, where no controls would be exercised on native trees and saplings. This provides a small buffer for the required 2.26-forested acres.

The timber mulching was conducted during January and February of 2017 prior to the prescribed burn, leaving dense piles of wood chips where the dense stands of trees once stood, greatly opening up and improving the view scape across the site, while restoring the mudflats used by many migratory shorebird species during the spring. Approximately 6.5 acres of trees were removed during the timber mulching activities. Following what was perhaps one of the hottest and most thorough prescribed burns in the history of Woolsey Wet Prairie on February 24, 2017, the dense piles of wood chips left behind by the timber mulching were completely burned leaving open mudflats as preferred shorebird habitat.

During the 2017 to 2018 growing seasons, changes to herbicide application rates were implemented to take a more aggressive approach in controlling woody vegetation. In 2018, the management team began the use of the herbicide Renovate 3, an EPA-approved herbicide for controlling woody plants in inundated areas. These activities have proven to be very successful in restoring the wet prairie habitat. Many of the rare ANHC tracking species that were either reducing in density, or were no longer present within the wetland cells are returning subsequent to tree canopy removal.

The 2019 growing season showed continued signs of success with the return of many of the rare ANHC tracking species that had previously been reduced by the woody vegetation. The densities of the woody species outside of the "Designated Tree Preservation Areas" were greatly reduced and at a much more manageable level of control.

4.0 – RECOMMENDED ADAPTIVE MANAGEMENT ACTIVITIES FOR 2020

Based upon observations made during the 2019, and previous growing seasons, the anticipated general adaptive management activities for 2020 are contained in Table 2 below.

Table 2 – 2020 Woolsey Wet Prairie Adaptive Management Tentative Schedule*

General Timeframe	Activity
January through March	Final adjustments to fire line if necessary after Burn Contractor inspection
	Adjust stop logs to reduce water retention in all wetland cells in preparation for the prescribed burn, as needed.
	Conduct prescribed burn
	Reset stop logs to retain more water in wetland cells after prescribed burn.
	Observe re-emergence of tall fescue in 3-4 weeks after burn and apply Section 2-EC when tall fescue is 4-6 inches tall. Spray tall fescue with after prescribed burn and before native plants come out of dormancy.
March through April	Observe site for the emergence of yellow rocket, bull thistle, burdock, bush honeysuckle, and Japanese honeysuckle. Treat with PastureGard HL.
	Select wetland depressions for herbicide applications to native and non-native plants in order to restore mudflat microhabitats for shorebirds.
Late-March through September	Observe site for emergence of woody vegetation, including Himalayan blackberry, black willow saplings, green ash saplings, callery pear saplings, and honey locust saplings, all of which are to be treated using basal bark spray with Remedy Ultra for terrestrial and dry areas, or Renovate 3 for areas of standing water.
	Spray sericea lespedeza with PastureGard HL.
	Spray small carpetgrass with Outrider
May through September	Evaluate site for presence of yellow rocket; control via top-cutting/hand pulling/spray with Remedy Ultra.
	Observe site for emergence of white sweet clover (previously observed in Wetland Cells E-1, E-2, and E-3 along the inner portions of the berms); treat with PastureGard HL.
June through September	Adjacent (west and north) fescue fields to be mowed before tall fescue goes to seed
	Spot spray Johnsongrass with Outrider.
	Hand pull curly dock & Queen Anne's lace.

* The appropriate concentrations and application rates of herbicides summarized in the Appendix II Woolsey Wet Prairie Sanctuary Herbicide Mixing/Application Rates should be followed.

5.0 – 2020 EXISTING SURPLUS WETLAND MITIGATION CREDITS

5.1 – Background and Overview

Subsequent to construction and initial adaptive management of Woolsey Wet Prairie, ECO, Inc. determined that 94.47 mitigation credits had been generated, producing a surplus of 20.90 credits above the required 73.57 wetland mitigation credits required by the COE Section 404 permit. ECO, Inc. and the City of Fayetteville met with the COE in mid-2013 to discuss the use of surplus wetland credits for city infrastructure projects that required wetland compensatory mitigation. On September 30, 2013, the City of Fayetteville received approval from the COE to use the 20.90 surplus wetland credits for impacts to wetlands caused by municipal projects within the Illinois River Watershed 8-digit Hydrologic Unit Code (HUC) watershed (11110103), but the City would not be allowed to sell the surplus credits.

Consequently, the City of Fayetteville's surplus wetland credits in essence serve as a mitigation bank where improvements to wetland ecological function and value provide an ecological gain, and are available to be used to meet compensatory mitigation requirements for city projects that permanently alter wetlands. More specifically, these surplus credits serve as what is known as a Single-Client Mitigation Bank, or a bank for which the sponsor is also the principal credit user or client.

5.2 – Service Area

The Woolsey Wet Prairie Bank service area primarily includes impact projects within the watersheds of Clear Creek, Goose Creek, and headwaters of the Illinois River within HUC 11110103 that are under the authority and control of the City of Fayetteville. This service area may change as the city's area expands into other portions of HUC 11110103.

5.3 – Credit Release Process

ECO, Inc. provided wetland credit guidance to the City of Fayetteville for the purpose of clarifying the terms, uses, and measures of credits as they apply to wetland mitigation banking. This guide is intended for use by the City of Fayetteville as the bank sponsor of the surplus wetland credits to satisfy mitigation requirements for regulated impacts to aquatic resources. This process may change, as wetland mitigation regulations and policies are modified. The WSIP was funded by and through the City of Fayetteville Utilities Department. Therefore, the Utilities Department is considered to be the bank sponsor for releasing credits to other City of Fayetteville entities.

5.4 – Accounting Procedures For Tracking Credits

The number of available credits and all credit releases must be tracked throughout the life of a mitigation bank and credit use must be monitored to ensure that bank credits are not overdrawn. Tracking credits on a ledger ensures that the same credit is not used to meet compensatory mitigation requirements for multiple projects. The **ledger** documents the credit releases and withdrawals for a mitigation bank, similar to keeping track of money in a checking account.

The Sponsor shall be responsible for keeping an up-to-date ledger of all transactions within the Bank. The bank sponsor must compile an annual ledger report showing the beginning and ending balances of available credits and permitted impacts (i.e., debits) for each resource type, all credit additions and subtractions, and other changes in credit availability, such as the release of additional credits or the suspension of credit sales. The ledger report is to be submitted to the COE as part of the

administrative record for the mitigation bank and will be made available to the public by the COE upon request.

During 2014, the COE authorized the use of a portion of the Woolsey Wet Prairie surplus wetland credits to offset 0.31 acres of permanent alterations to wetlands from the construction of an extension to Van Ashe Drive (COE Project No. 2012-00525). Consequently, the City of Fayetteville Transportation Division Van Asche Drive project deducted 2.94 credits from the Woolsey Wet Prairie 20.90 surplus wetland credits, leaving a balance of 17.96 surplus credits.

In 2015, the COE authorized the use of a portion of the Woolsey Wet Prairie surplus wetland credits to offset 0.192 acres of permanent alterations to wetlands from the construction of the Clabber Creek Recreational Trail. Consequently, the City of Fayetteville Clabber Creek Recreational Trail project deducted 3.14 credits from the remaining 17.96 Woolsey Wet Prairie surplus wetland credits, leaving a balance of 14.82 surplus credits.

The City of Fayetteville did not use any surplus wetland credits in 2016, 2017, 2018, or 2019; therefore, a balance of 14.82 surplus credits remains. The current surplus wetland credit ledger report for Woolsey Wet Prairie is contained in Appendix VII.

6.0 – Academic Research and Guidance

In 2017 and 2018, there was an increased interest by the academic community in conducting scientific research at Woolsey Wet Prairie. ECO, Inc. has met with various professors and students to provide guidance to them concerning minimizing adverse impacts to the site during their fieldwork. To date, low impact studies have been conducted, including insect trapping, bird surveys, and herpetological surveys that have produced some amazing results. Most from academia are not fully aware of the 404 permit compensatory mitigation requirements and deed restrictions of Woolsey Wet Prairie. ECO, Inc. has educated academia that the site is preserved in perpetuity as a wetland compensatory mitigation site and that the 404 permit prohibits any activity such as ditching, draining, dumping, construction of any structure, or any other activity that would adversely impact the natural state of the area.

In order to further aid in educating academia interested in conducting research at the site, ECO, Inc. developed a document entitled "***Guidance For Conducting Scientific Research At Woolsey Wet Prairie Sanctuary***" that was been approved by the COE and City of Fayetteville. This document can be found on the ECO, Inc. Woolsey Wet Prairie Facebook page or the ECO, Inc. website. As a part of the guidance document, ECO, Inc. developed a research project application form for prospective academic projects to complete and subsequently be approved by the City of Fayetteville and ECO, Inc.

ECO, Inc. welcomes academic research projects at the site and has tried to make the approval process as streamlined as possible. It became necessary to develop this guidance to inform those who desire to conduct scientific research that Woolsey Wet Prairie Sanctuary is like no other City-owned property. It is a wetland compensatory mitigation site that is deed restricted in perpetuity with specific restrictions and is authorized under a Section 404 permit issued by the COE to the City of Fayetteville that will never expire. The City is required to comply with the terms and conditions of the COE permit and deed restrictions for protecting the site.

7.0 – Future Adjacent Land Use Activities

On November 20, 2018, the City Council passed resolutions to 1) support the permanent preservation of approximately 44-acres of environmentally sensitive wet prairie and oak savannah habitat on city-owned property adjacent to Woolsey Wet Prairie as a Conservation Area; and 2) support the construction and operation of a 22.34-acre solar array to be located immediately to the north of Woolsey Wet Prairie and a 15.46-acre solar array to be located immediately to the west of Woolsey Wet Prairie.

The planned construction and operation of the adjacent Solar Arrays will provide tremendous environmental and economical benefits for the City of Fayetteville. On December 5, 2018, ECO, Inc. met with city staff, Jacobs staff, and the Solar Developer, Today's Power, in an information exchange forum for the purpose of coordinating site activities in order to promote a harmonious co-existence of the Solar Arrays and Woolsey Wet Prairie. During 2019, the north and west solar arrays and all associated structures were constructed. Operation of the solar arrays commenced in September 2019 and vegetation management efforts have been initiated by the Solar Developer to maintain native vegetation.

The Fayetteville Natural Heritage Association will conduct management activities at the very rare wet prairie/oak savanna habitat Conservation Area. Both the adjacent Solar Array and the Conservation Area should provide positive ecological benefits for Woolsey Wet Prairie Sanctuary.

8.0 – Appendices

Appendix I
2019 Stop Log Data For
Hydrological Controls In Wetland Cells

Woolsey Wet-Prairie Annual Surface Water Monitoring Table

Year **2019**

Month			Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			ANN		
Precip.	ACT	NRM	DIFF	4.5	2.8	1.7	2.5	2.8	-0.4	3.4	4.0	-0.6	5.6	4.6	1.0	7.8	6.0	1.7	7.9	5.0	2.9	2.8	3.5	-0.6	5.9	3.2	2.6	7.0	4.8	2.2	13.6	4.3	9.3	5.2	4.2	0.9	3.2	3.2	0.0	69.2	48.5	20.7
Wetland Cells	E5	Surface H_2O		x			x			x			x			x			x			x			x			x			x			x			x			**12**	of	12
		WOF Ret.		X			X						-			-			X			X			-			-			X			X			X			**7**	of	12
	12" Max	Log Combo		5:			0:			7:5			7:5			7:5			7:5			7:5			7:5			7:5			7:5			5:			5:					
		Height (in.)		5			0			12			12			12			12			12			12			12			12			5			5					
	E4	Pond Ret.		x			x			x			x			x			x			x			x			x			x			x			x			**12**	of	12
		S. H2O		x			x			x			x			x			x			x			x			x			x			x			x			**12**	of	12
		WOF Ret.		X			X			-			-			X			X			X			-			-			X			X			X			**8**	of	12
	19" Max	L.C.		5:			0:			7:5			7:5			7:5			7:5			7:5			7:5			7:5			7:5			5:			0:					
		H. (in.)		5			0			12			12			12			12			12			12			12			12			5			-					
	E3	S. H_2O		x			x			x			x			x			x			x			-			-			x			x			x			**10**	of	12
		WOF Ret.		X			X			-			-			X			X			X			-			-			X			X			X			**8**	of	12
	21" Max	L.C.		5:			0:			7:7			7:7			7:7			7:7			7:7			7:7			7:7			7:7			5:			5:					
		H. (in.)		5			0			14			14			14			14			14			14			14			14			5			5					
	E1	S. H_2O		x			x			x			x			x			x			x			x			x			x			x			x			**12**	of	12
		WOF Ret.		X			X			-			-			X			X			X			-			X			X			X			X			**9**	of	12
	21" Max	L.C.		5:			0:			7:5			7:5			7:5			7:5			7:5			7:5			7:5			7:5			5:			5:					
		H. (in.)		5			0			12			12			12			12			12			12			12			12			5			5					
	E2	S. H2O		x			x			x			x			x			x			x			x			x			x			x			x			**12**	of	12
		WOF Ret.		X			X			-			-			X			X			X			-			X			X			X			X			**9**	of	12
	21" Max	L.C.		5:			0:			7:7			7:7			7:7			7:7			7:7			7:7			7:7			7:7			5:			5:					
		H. (in.)		5			0			14			14			14			14			14			14			14			14			5			5					
	W1	S. H_2O		x			x			x			x			x			x			x			x			x			x			x			x			**12**	of	12
		WOF Ret.		X			X			-			-			X			X			X			-			-			X			X			X			**8**	of	12
	17" Max	L.C.		5:			0:			7:7			7:7			7:7			7:7			7:7			7:7			7:7			7:7			5:			5:					
		H. (in.)		5			0			14			14			14			14			14			14			14			14			5			5					
	W2	Pond Ret.		x			x			x			x			x			x			x			x			x			x			x			x			**12**	of	12
		S. H2O		x			x			x			x			x			x			x			x			x			x			x			x			**12**	of	12
		Max Ret.		X			X			X			-			X			X			X			-			-			X			X			X			**9**	of	12
		L.C.		NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA					
		H. (in.)		NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA					

JACOBS

Appendix II
Woolsey Wet Prairie Sanctuary
Herbicide Mixing/Application Rates

WOOLSEY WET PRAIRIE SANCTUARY HERBICIDE MIXING/APPLICATION RATES

Herbicide	Target Species	Label Mixing Rate for Spot Spray Control of Target Plant Species
Remedy Ultra (60.45% triclopyr)	Broadleaf Weeds	3.2 fl. oz. Remedy Ultra + 0.68 fl. oz. surfactant + 124.12 fl. oz. water = 128 fl. oz. = 1 gal. of 2.5% mixture
Remedy Ultra	Woody Plants Cut stump/basal bark	32 fl. oz. Remedy Ultra + 96 fl. oz. Oil Carrier (in lieu of water + surfactant) = 1 gal. of 25% mixture Can be mixed with a penetrant such as Cide-kick in enough oil to make the desired volume of spray mixture to penetrate the cuticle of the woody plant, allowing more herbicide to translocate to the root system. Oil carrier should be a petroleum-based oil or a vegetable oil concentrate. DO NOT use diesel or kerosene at Woolsey Wet Prairie. For basil bark spraying stems < 6 inches in diameter, thoroughly wet the base and root collar of all stems to a height of 12 to 15 inches, but not to the point of runoff.
Remedy Ultra	Woody Plants Foliar	6.8 fl. oz. Remedy Ultra + 0.68 fl. oz. surfactant + 128 fl. oz. water = 1.06 gal. of 5.0% mixture Depending upon the size and density of the woody plants, apply sufficient spray volume to thoroughly wet all leaves, stems, and root collars. This concentration works best for regrowth less than 4 feet tall.
PastureGard HL (45% triclopyr + 15.56% fluroxypyr)	Broadleaf Weeds; Herbicide of choice for sericea lespedeza and white sweet clover	1.35 fl. oz. PastureGard HL + 0.68 fl. oz. surfactant + 125.97 fl. oz. water = 128 fl. oz. = 1 gal. = 1.0% mixture
PastureGard HL	Woody Plants Cut stump/basal bark	32 fl. oz. PastureGard HL + 96 fl. oz. Oil Carrier (in lieu of water + surfactant) = 1 gal. of 25% mixture Can be mixed with a penetrant such as Cide-kick in enough oil to make the desired volume of spray mixture to penetrate the cuticle of the woody plant, allowing more herbicide to translocate to the root system. Oil carrier should be a petroleum-based oil or a vegetable oil concentrate. DO NOT use diesel or kerosene at Woolsey Wet Prairie. For basil bark spraying stems < 6 inches in diameter, thoroughly wet the base and root collar of all stems to a height of 12 to 15 inches, but not to the point of runoff.
Renovate® 3 (44.4% trichlopry)	Woody Plants: Allowable to spray over water basal bark or cut surface treatment	Can be applied either undiluted or diluted in a 1 to 1 ratio with water and sprayed where the mixture will completely surround the tree trunk. Cide-Kick to be mixed with Renovate 3 as a penetrant to increase bark penetration.
Roundup Pro Concentrate (50.2% glyphosate)	Broad-spectrum non-selective chemical used to control both grasses and forbs.	Use a 1.6% solution for harder to control perennials such as Bermuda grass, dock, thistle, sericea, etc. This would be the equivalent of 2.1 fl. oz. Roundup Pro Concentrate in 125.9 fl. oz. of water to make one gallon of spray mix. Roundup Pro Concentrate already contains a 13% surfactant, so none should be added.
Section 2EC (26.4% clethodim)	Grasses; best herbicide for tall fescue, especially in moist soils because it will not harm rushes.	Mix 1.2 fl. oz. Section 2 EC + 1.66 fl. oz. Superb HC surfactant + 0.4 fl. oz. Mystic HC dye + 124.74 fl. oz. water = 1 gal. of 1% mixture
Outrider (75% Sulfosulfuron)	Grasses; best herbicide for Johnsongrass in upland habitat.	Mix 0.25 fl. oz. Outrider + 0.1 fl. oz. nonionic surfactant + 127.65 fl. oz. water = 1 gal. of 0.2% mixture

Appendix III
Tracking Species
Aerial Images

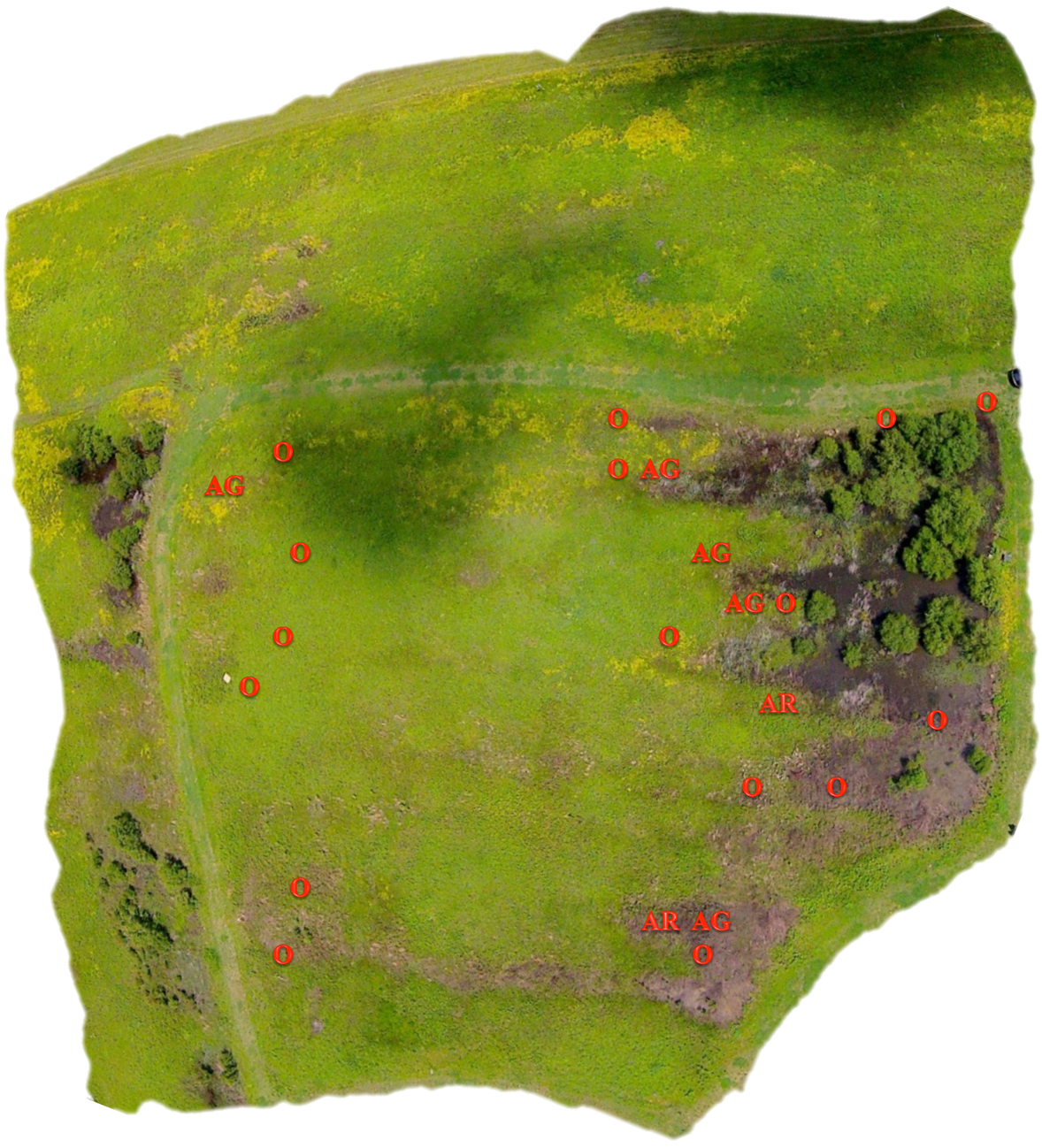
Wetland Cell E-1 2019 Tracking Species Aerial Image

LEGEND:

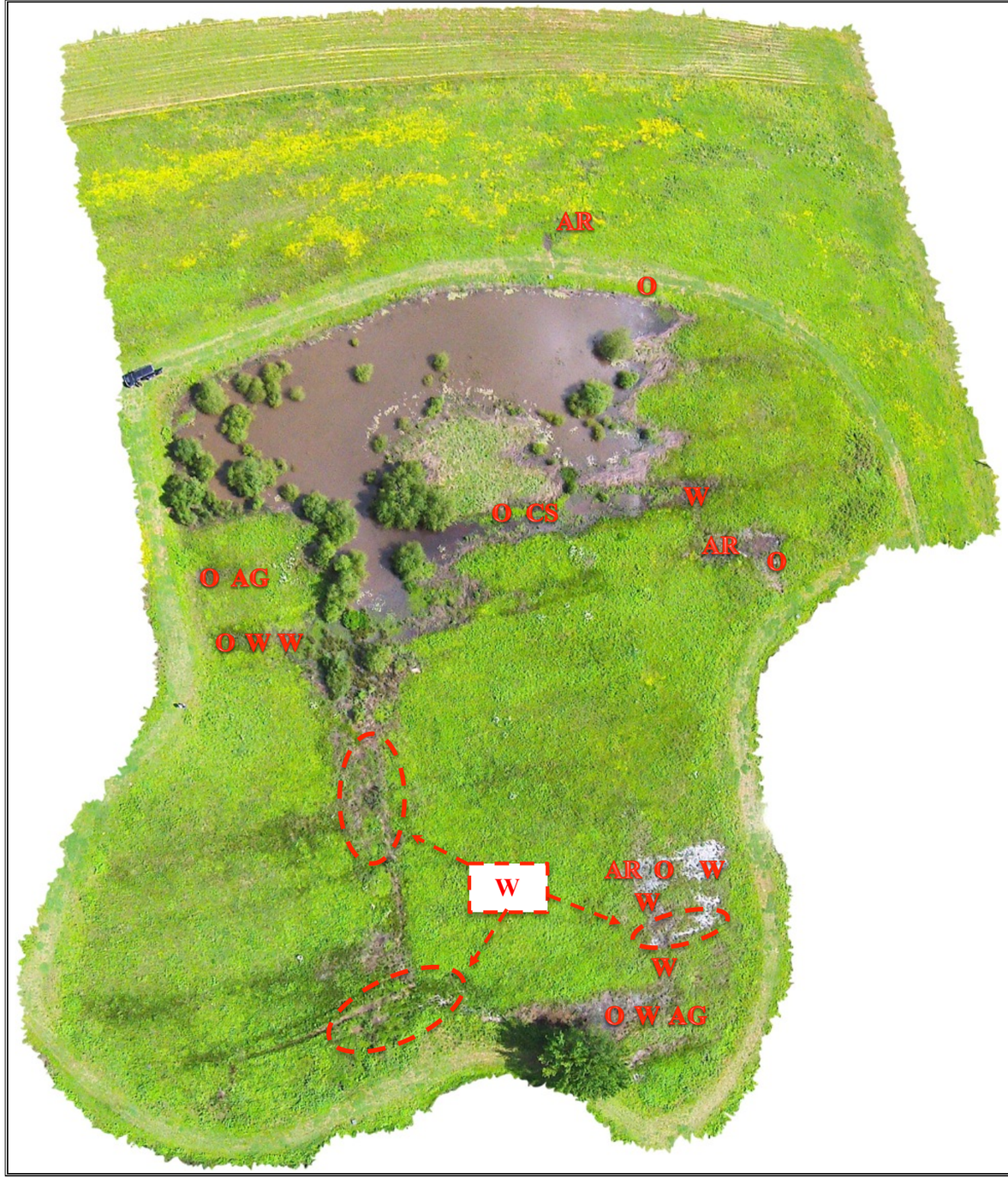
O – OPAQUE PRAIRIE SEDGE (*CAREX OPACA*)

AG – CLUSTER SEDGE (*CAREX AGGREGATA*)

AR – ARKANSAS SEDGE (*CAREX ARKANSANA*)



Wetland Cell E-2 2019 Tracking Species Aerial Image



LEGEND:

O – OPAQUE PRAIRIE SEDGE (*CAREX OPACA*)

AR – ARKANSAS SEDGE (*CAREX ARKANSANA*)

AG – CLUSTER SEDGE (*CAREX AGGREGATA*)

W – WOLF'S SPIKERUSH (*ELEOCHARIS WOLFII*)

CS – POINTED SEDGE (*CAREX SCOPARIA*)

A DASHED CIRCLE INDICATES A LARGE PATCH OF THE TRACKING SPECIES INDICATED IN THE ASSOCIATED TEXT BOX.

Wetland Cell E-3 2019 Tracking Species Aerial Image

LEGEND:

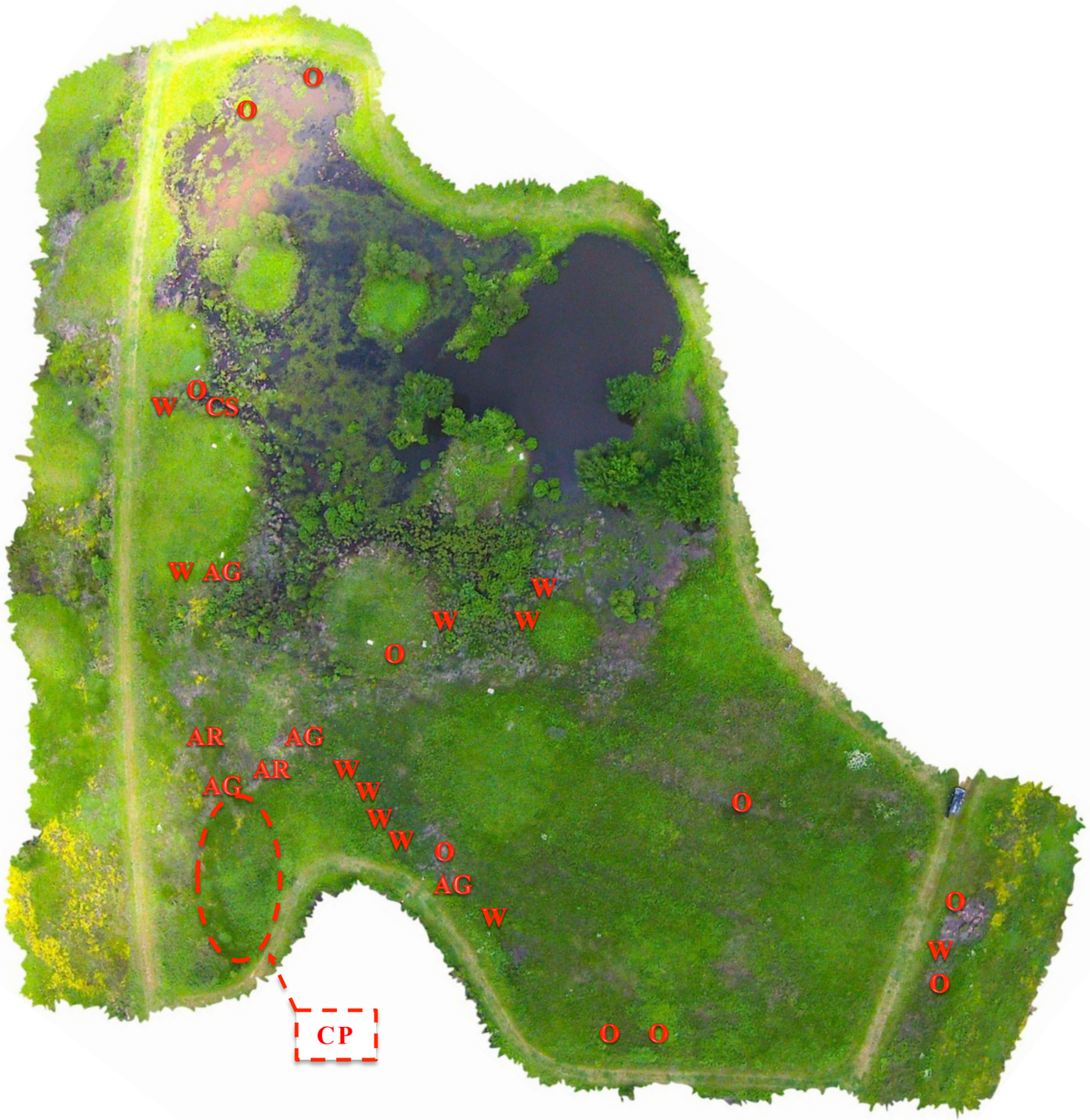
O – OPAQUE PRAIRIE SEDGE (*CAREX OPACA*)

AR – ARKANSAS SEDGE (*CAREX ARKANSANA*)

AG – CLUSTER SEDGE (*CAREX AGGREGATA*)

W – WOLF'S SPIKERUSH (*ELEOCHARIS WOLFII*)

Wetland Cell E-4 2019 Tracking Species Aerial Image



LEGEND:

O – OPAQUE PRAIRIE SEDGE (*CAREX OPACA*)

AR – ARKANSAS SEDGE (*CAREX ARKANSANA*)

AG – CLUSTER SEDGE (*CAREX AGGREGATA*)

W – WOLF'S SPIKERUSH (*ELEOCHARIS WOLFII*)

CS – POINTED SEDGE (*CAREX SCOPARIA*)

CP – WOOLLY SEDGE (*CAREX PELLITA*)

A DASHED CIRCLE INDICATES A LARGE PATCH OF THE TRACKING SPECIES INDICATED IN THE ASSOCIATED TEXT BOX.

Wetland Cell E-5 2019 Tracking Species Aerial Image

LEGEND:

O – OPAQUE PRAIRIE SEDGE (*CAREX OPACA*)

AR – ARKANSAS SEDGE (*CAREX ARKANSANA*)

AG – CLUSTER SEDGE (*CAREX AGGREGATA*)

W – WOLF'S SPIKERUSH (*ELEOCHARIS WOLFII*)

CS – POINTED SEDGE (*CAREX SCOPARIA*)

CP – WOOLLY SEDGE (*CAREX PELLITA*)

R – TALL-HORNED BEAKSEDGE (*RHYNCOSPORA MACROSTACHYA*)

A DASHED CIRCLE INDICATES A LARGE PATCH OF THE TRACKING SPECIES INDICATED IN THE ASSOCIATED TEXT BOX.

Gas Line Easement 2019 Tracking Species Aerial Image

LEGEND:

O – OPAQUE PRAIRIE SEDGE (*CAREX OPACA*)

AR – ARKANSAS SEDGE (*CAREX ARKANSANA*)

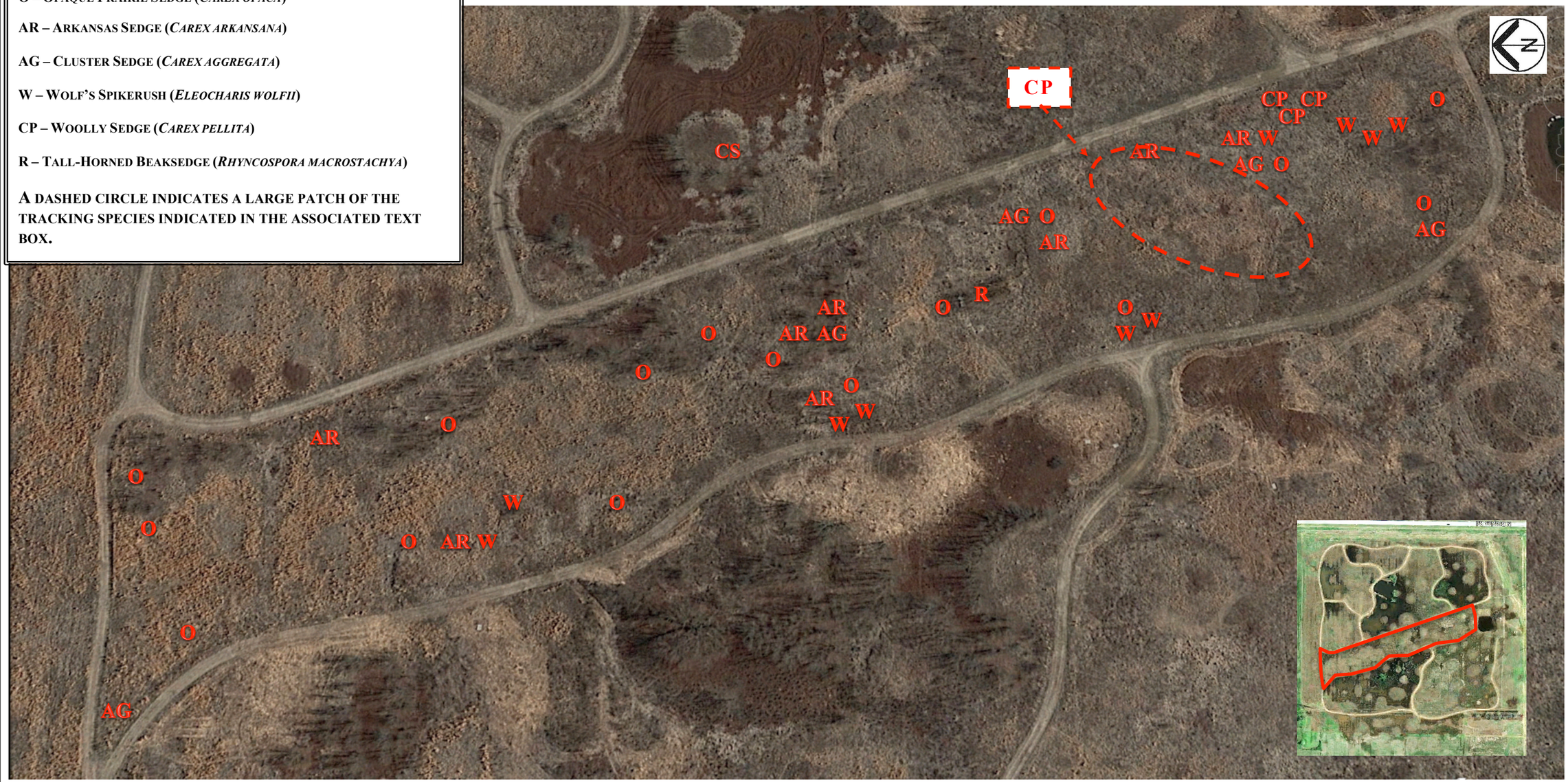
AG – CLUSTER SEDGE (*CAREX AGGREGATA*)

W – WOLF'S SPIKERUSH (*ELEOCHARIS WOLFII*)

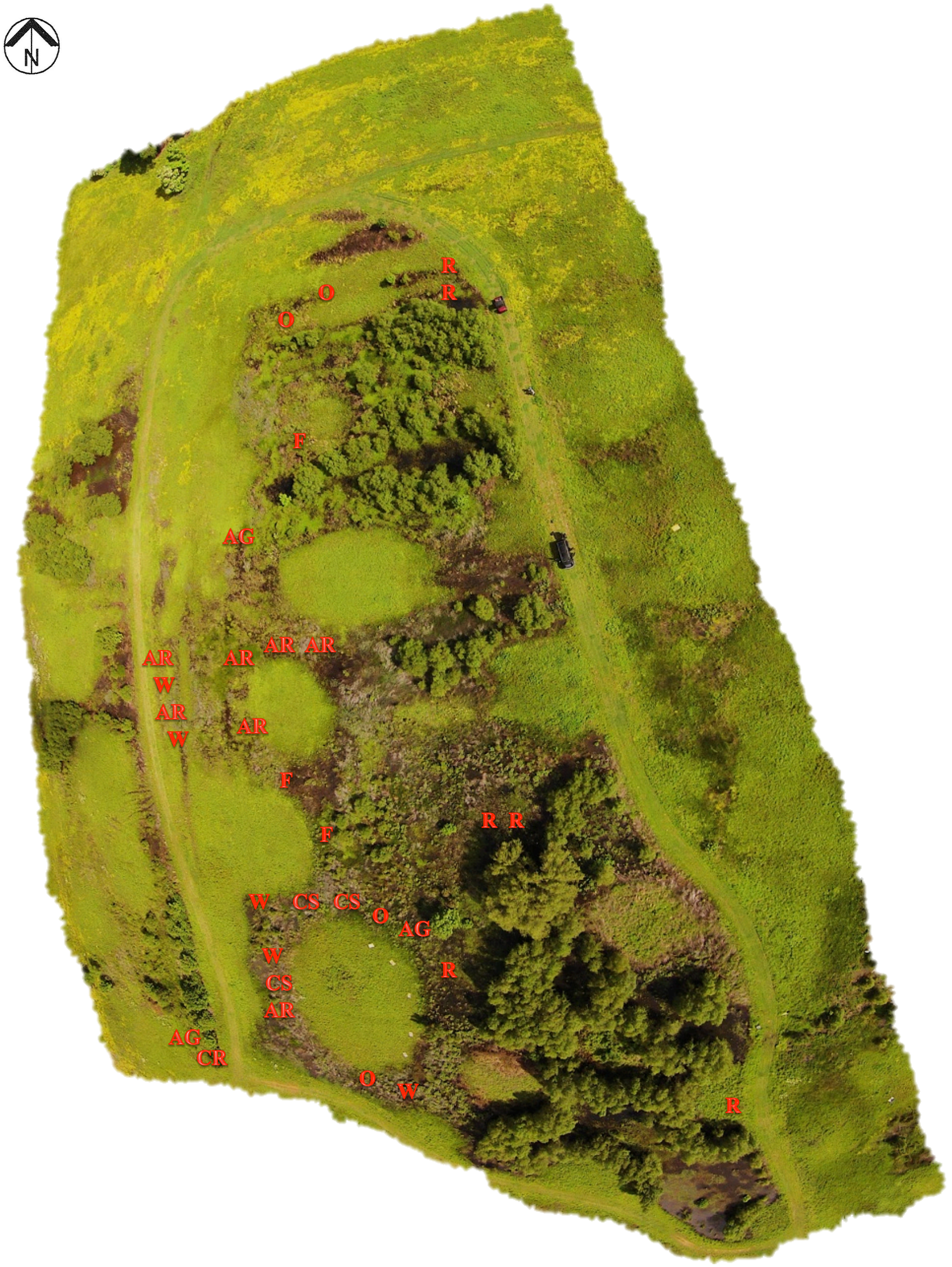
CP – WOOLLY SEDGE (*CAREX PELLITA*)

R – TALL-HORNED BEAKSEDGE (*RHYNCOSPORA MACROSTACHYA*)

A DASHED CIRCLE INDICATES A LARGE PATCH OF THE TRACKING SPECIES INDICATED IN THE ASSOCIATED TEXT BOX.



Wetland Cell W-1 2019 Tracking Species Aerial Image



LEGEND:

O – OPAQUE PRAIRIE SEDGE (*CAREX OPACA*)

AR – ARKANSAS SEDGE (*CAREX ARKANSANA*)

AG – CLUSTER SEDGE (*CAREX AGGREGATA*)

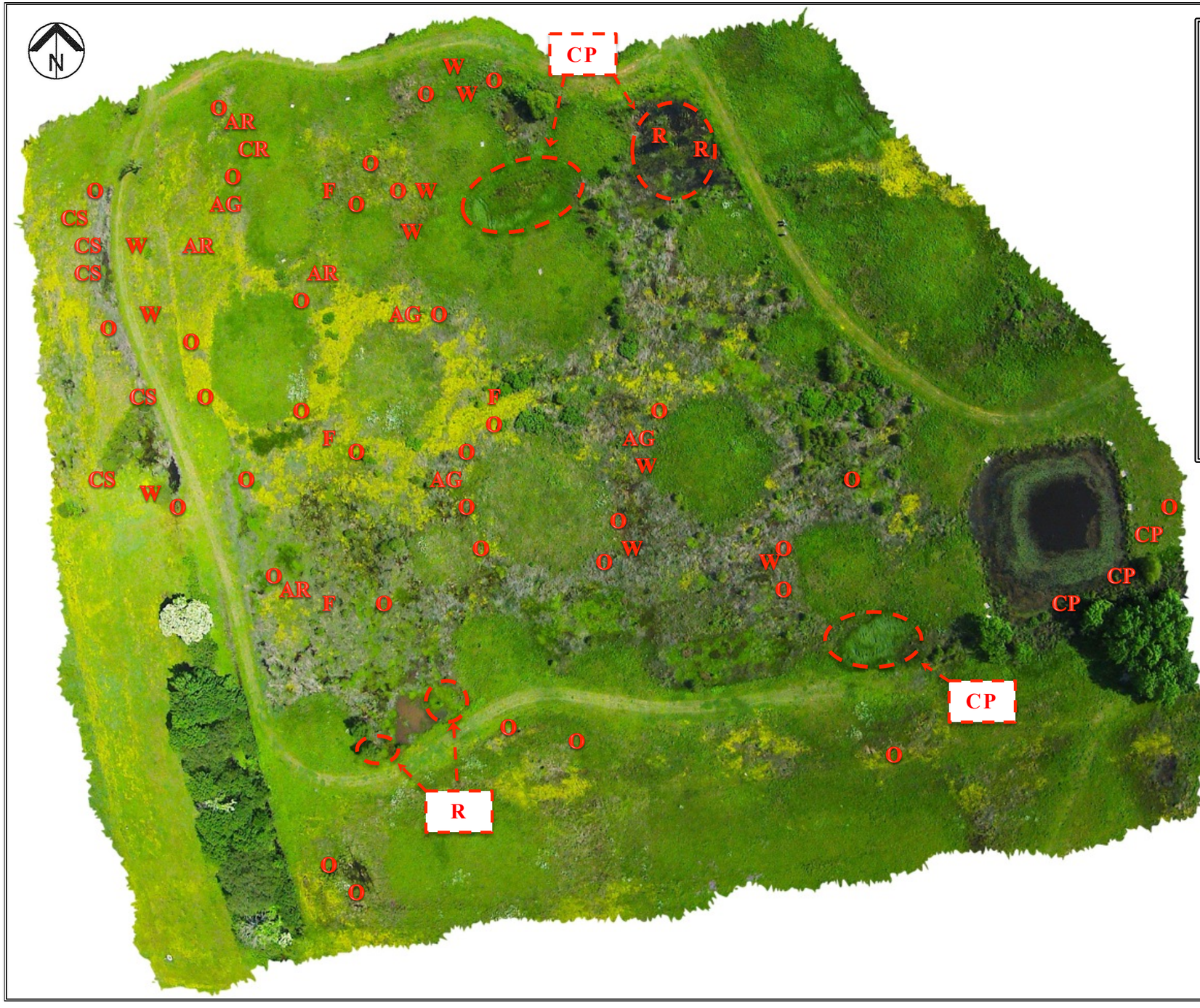
W – WOLF'S SPIKERUSH (*ELEOCHARIS WOLFII*)

CS – POINTED SEDGE (*CAREX SCOPARIA*)

CR – REVERCHON'S HAWTHORN (*CRATEGUS REVERCHONII*)

R – TALL-HORNED BEAKSEDGE (*RHYNCOSPORA MACROSTACHYA*)

F – HAMMOCK SEDGE (*CAREX FISSA*)



Wetland Cell W-2 2019 Tracking Species Aerial Image

Legend:

O – Opaque Prairie Sedge (*Carex opaca*)

AR – Arkansas Sedge (*Carex arkansana*)

AG – Cluster Sedge (*Carex aggregata*)

W – Wolf's Spikerush (*Eleocharis wolfii*)

CS – Pointed Sedge (*Carex scoparia*)

CP – Woolly Sedge (*Carex pellita*)

R – Tall-Horned Beaksedge (*Rhyncospora macrostachya*)

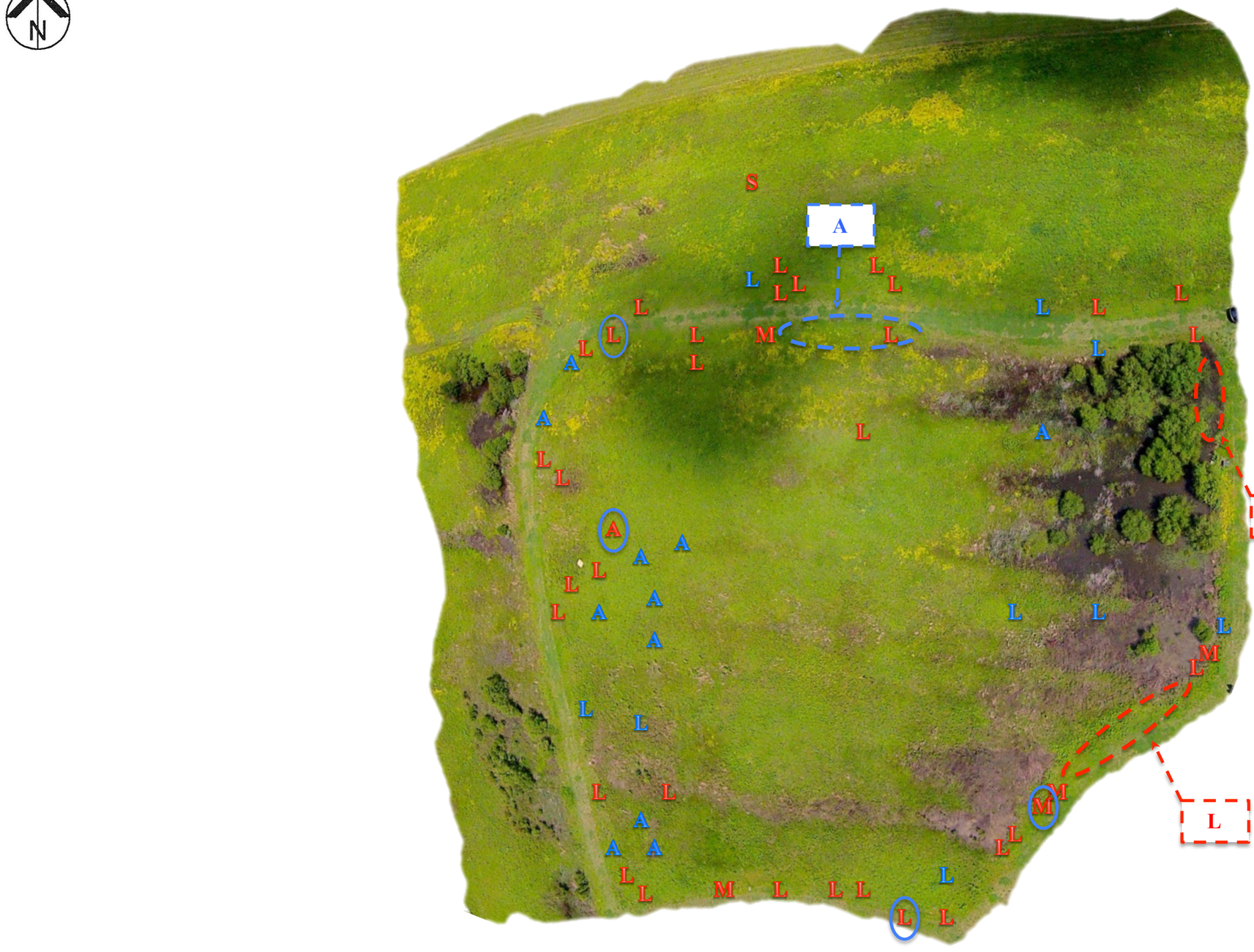
F – Hammock Sedge (*Carex fissa*)

CR – Reverchon's Hawthorn (*Crategus reverchonii*)

A dashed circle indicates a large patch of the tracking species indicated in the associated text box.

Appendix IV
Invasive Species
Aerial Images

2019 Invasive Species Monitoring Map Wetland Cell E-1



LEGEND:

RED – JUNE 2019
GROWING SEASON MONITORING EVENT

BLUE – SEPTEMBER 2019
POST GROWING SEASON MONITORING EVENT

L – SERICEA LESPEDEZA (*LESPEDEZA CUNEATA*)

M – WHITE SWEET CLOVER (*MELILOTUS ALBUS*)

A – SMALL CARPETGRASS (*ARTHRAXON HISPIDUS*)

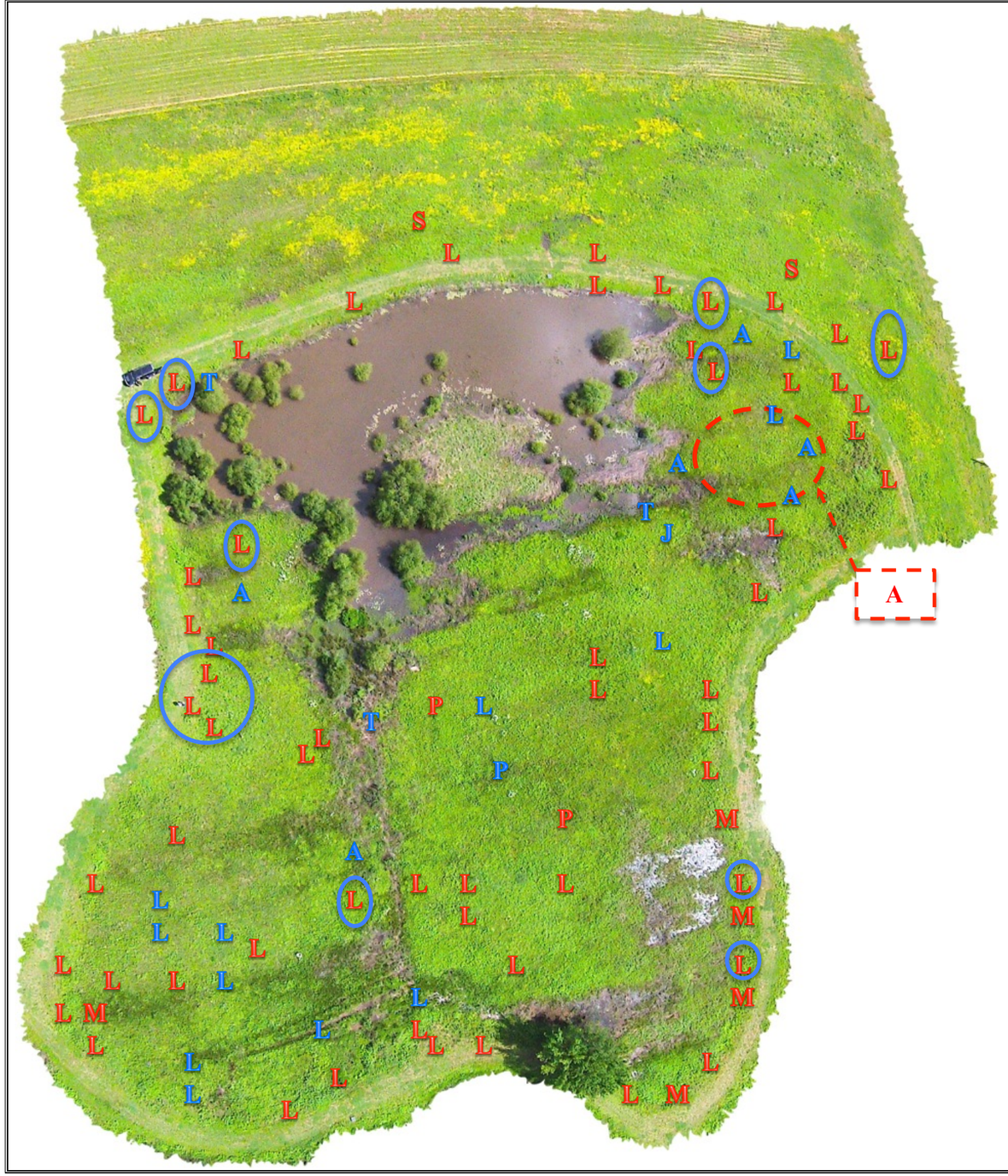
S – JOHNSONGRASS (*SORGHUM HALEPENSE*)

T – NARROW-LEAF CATTAIL (*TYPHA ANGUSTIFOLIA*)

A DASHED CIRCLE INDICATES A LARGE PATCH OF THE INVASIVE SPECIES INDICATED IN THE ASSOCIATED TEXT BOX.

A SOLID CIRCLE AROUND A LETTER REPRESENTS THAT THE INVASIVE SPECIES WAS OBSERVED AT THE SAME LOCATION AS THE PREVIOUS MONITORING EVENT.

2019 Invasive Species Monitoring Map Wetland Cell E-2



LEGEND:

RED – JUNE 2019
GROWING SEASON MONITORING EVENT

BLUE – SEPTEMBER 2019
POST GROWING SEASON MONITORING EVENT

L – SERICEA LESPEDEZA (*LESPEDEZA CUNEATA*)

M – WHITE SWEET CLOVER (*MELILOTUS ALBUS*)

A – SMALL CARPETGRASS (*ARTHRAXON HISPIDUS*)

S – JOHNSONGRASS (*SORGHUM HALEPENSE*)

P – CALLERY PEAR (*PYRUS CALLERYANA*)

T – NARROW-LEAF CATTAIL (*TYPHA ANGUSTIFOLIA*)

J – JAPANESE HONEYSUCKLE (*LONICERA JAPONICA*)

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2019 Invasive Species Monitoring Map Wetland Cell E-3

LEGEND:

RED – JUNE 2019
GROWING SEASON MONITORING EVENT

BLUE – SEPTEMBER 2019
POST GROWING SEASON MONITORING EVENT

L – SERICEA LESPEDEZA (*LESPEDEZA CUNEATA*)

M – WHITE SWEET CLOVER (*MELILOTUS ALBUS*)

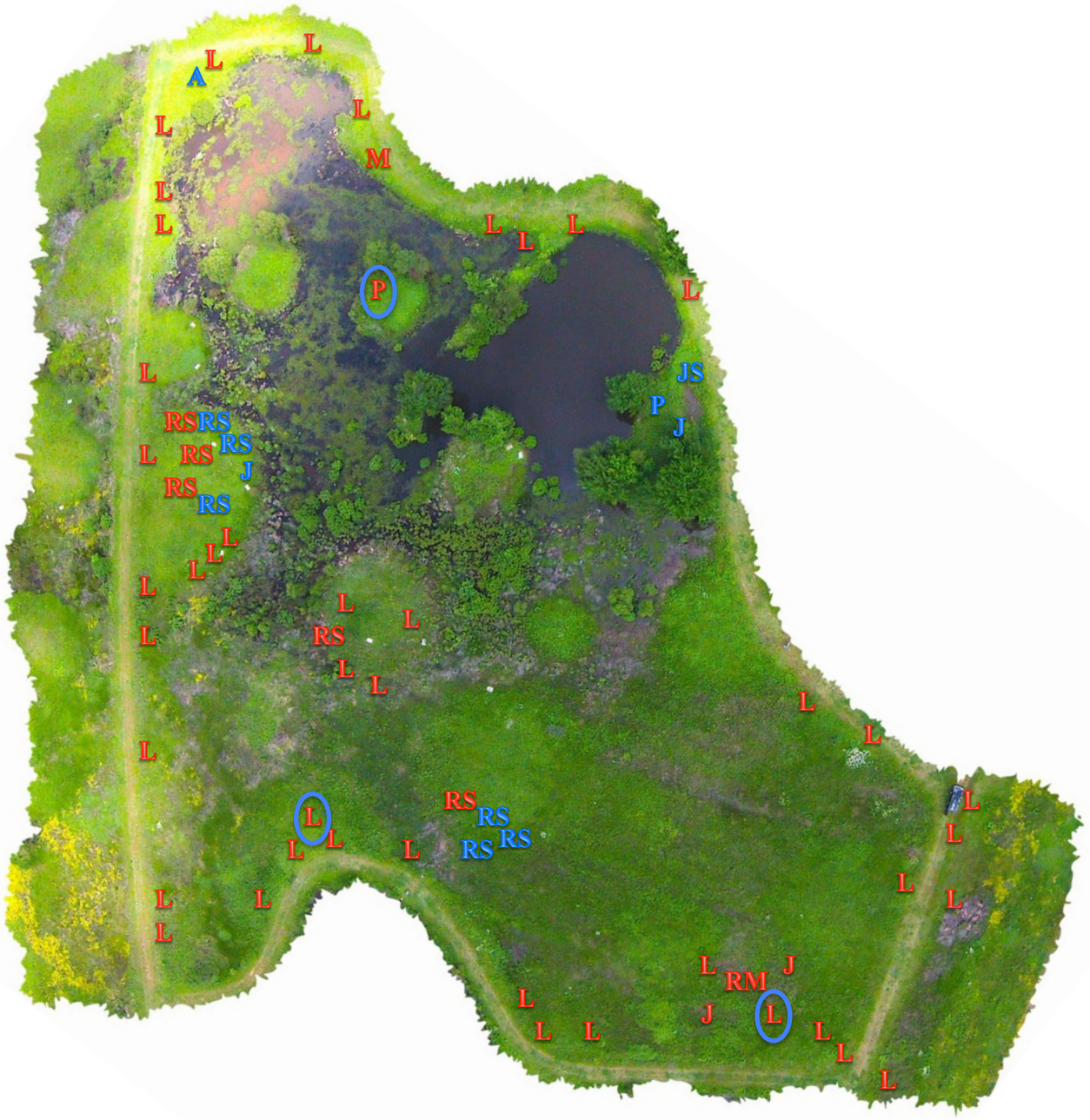
S – JOHNSONGRASS (*SORGHUM HALEPENSE*)

P – CALLERY PEAR (*PYRUS CALLERYANA*)

A DASHED CIRCLE INDICATES A LARGE PATCH OF THE INVASIVE SPECIES INDICATED IN THE ASSOCIATED TEXT BOX.

A SOLID CIRCLE AROUND A LETTER REPRESENTS THAT THE INVASIVE SPECIES WAS OBSERVED AT THE SAME LOCATION AS THE PREVIOUS MONITORING EVENT.

2019 Invasive Species Monitoring Map Wetland Cell E-4



LEGEND:

RED – JUNE 2019
GROWING SEASON MONITORING EVENT

BLUE – SEPTEMBER 2019
POST GROWING SEASON MONITORING EVENT

L – SERICEA LESPEDEZA (*LESPEDEZA CUNEATA*)

M – WHITE SWEET CLOVER (*MELILOTUS ALBUS*)

S – JOHNSONGRASS (*SORGHUM HALEPENSE*)

P – CALLERY PEAR (*PYRUS CALLERYANA*)

A – SMALL CARPETGRASS (*ARTHRAXON HISPIDUS*)

J – JAPANESE HONEYSUCKLE (*LONICERA JAPONICA*)

RS – HIMALAYAN BLACKBERRY (*RUBUS SERISSIMUS*)

RM – MULTIFLORA ROSE (*ROSA MULTIFLORA*)

JS – JAPANESE STILT GRASS (*MICROSTEGIUM VIMINEUM*)

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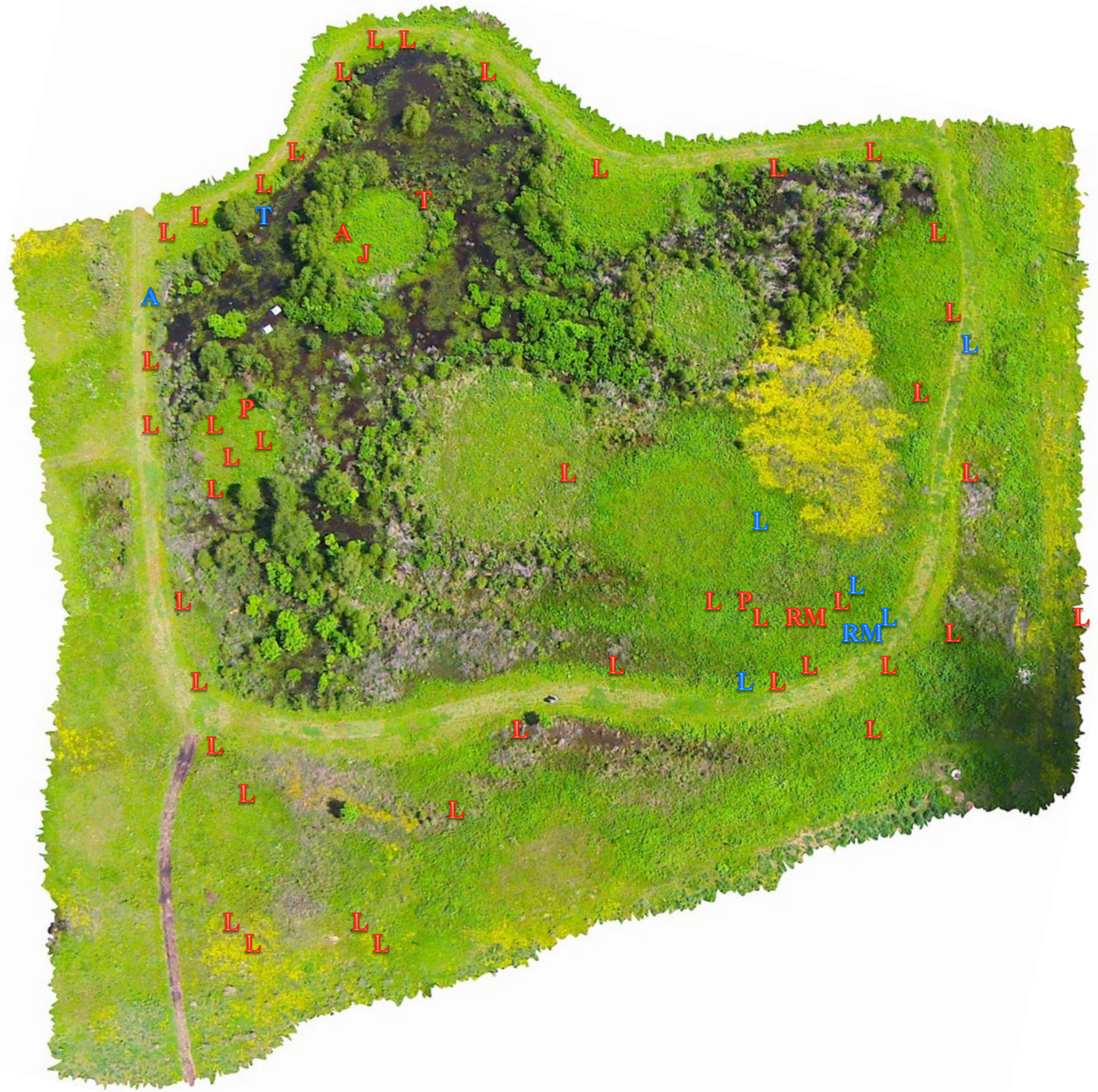
A SOLID CIRCLE AROUND A LETTER REPRESENTS THAT THE INVASIVE SPECIES WAS OBSERVED AT THE SAME LOCATION AS THE PREVIOUS MONITORING EVENT.



2019 Invasive Species Monitoring Map Wetland Cell E-5

LEGEND:

Red – June 2019
Growing Season Monitoring Event

Blue – September 2019
Post Growing Season Monitoring Event

L – Sericea Lespedeza (*Lespedeza cuneata*)

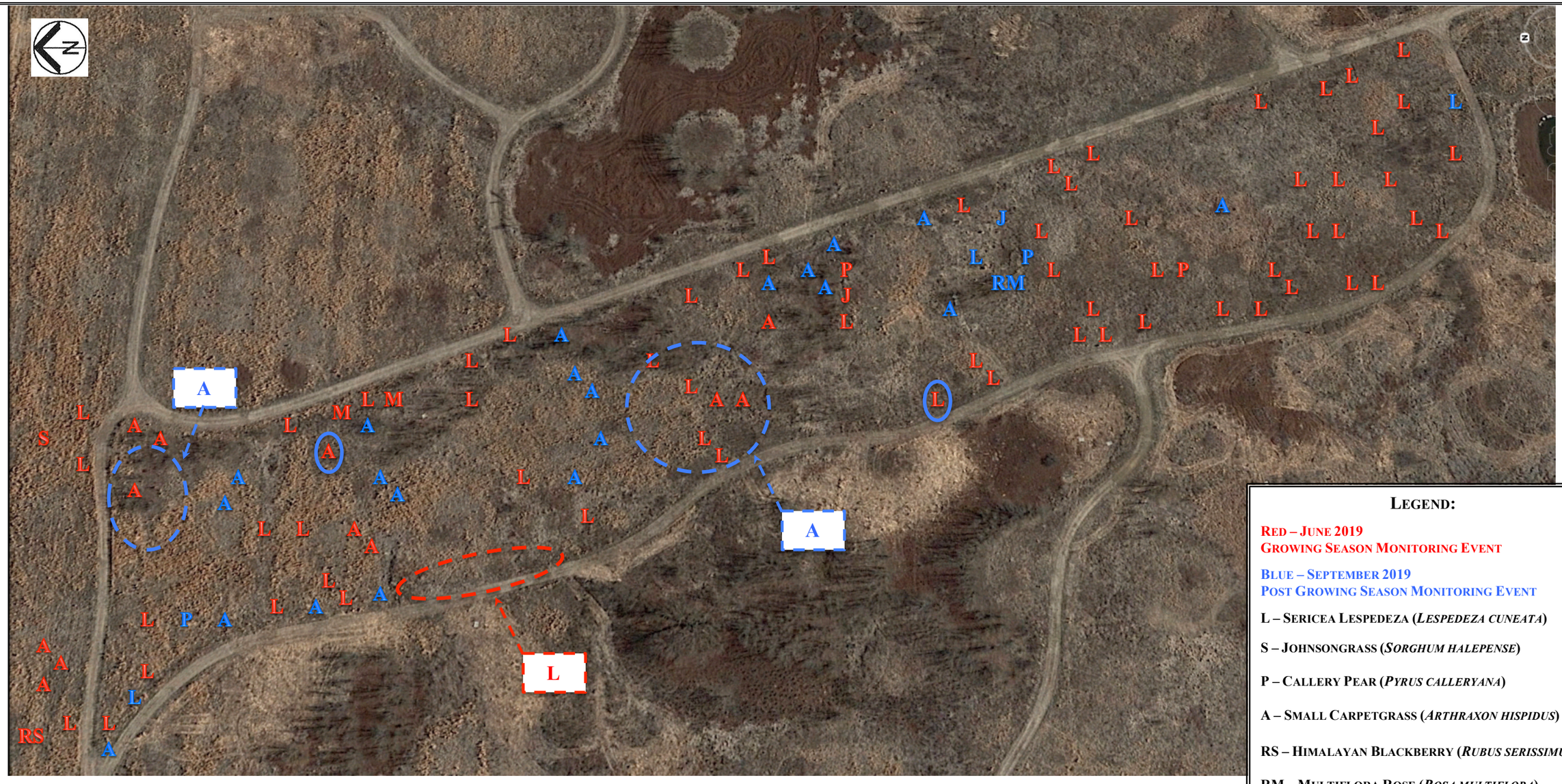
P – Callery Pear (*Pyrus calleryana*)

A – Small Carpetgrass (*Arthraxon hispidus*)

J – Japanese Honeysuckle (*Lonicera japonica*)

RM – Multiflora Rose (*Rosa multiflora*)

2019 Invasive Species Monitoring Map Gas Line Easement



LEGEND:

RED – JUNE 2019
GROWING SEASON MONITORING EVENT

BLUE – SEPTEMBER 2019
POST GROWING SEASON MONITORING EVENT

L – SERICEA LESPEDEZA (*LESPEDEZA CUNEATA*)

S – JOHNSONGRASS (*SORGHUM HALEPENSE*)

P – CALLERY PEAR (*PYRUS CALLERYANA*)

A – SMALL CARPETGRASS (*ARTHRAXON HISPIDUS*)

RS – HIMALAYAN BLACKBERRY (*RUBUS SERISSIMUS*)

RM – MULTIFLORA ROSE (*ROSA MULTIFLORA*)

J – JAPANESE HONEYSUCKLE (*LONICERA JAPONICA*)

A DASHED CIRCLE INDICATES A LARGE PATCH OF THE INVASIVE SPECIES INDICATED IN THE ASSOCIATED TEXT BOX.

A SOLID CIRCLE AROUND A LETTER REPRESENTS THAT THE INVASIVE SPECIES WAS OBSERVED AT THE SAME LOCATION AS THE PREVIOUS MONITORING EVENT.

2019 Invasive Species Monitoring Map Wetland Cell W-1

LEGEND:

RED – JUNE 2019
GROWING SEASON MONITORING EVENT

BLUE – SEPTEMBER 2019
POST GROWING SEASON MONITORING EVENT

L – SERICEA LESPEDEZA (*LESPEDEZA CUNEATA*)

S – JOHNSONGRASS (*SORGHUM HALEPENSE*)

P – CALLERY PEAR (*PYRUS CALLERYANA*)

A – SMALL CARPETGRASS (*ARTHRAXON HISPIDUS*)

RS – HIMALAYAN BLACKBERRY (*RUBUS SERISSIMUS*)

RM – MULTIFLORA ROSE (*ROSA MULTIFLORA*)

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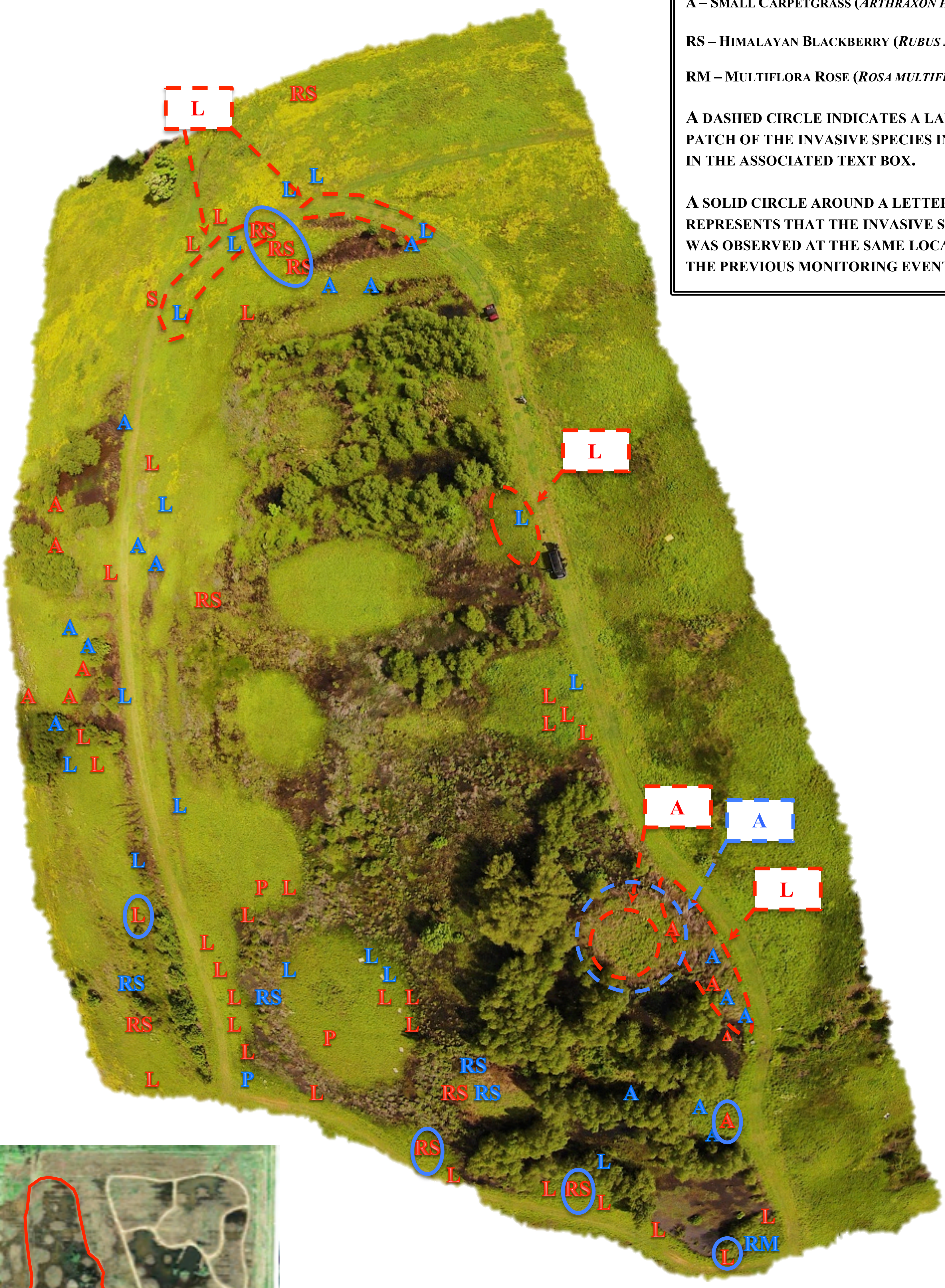
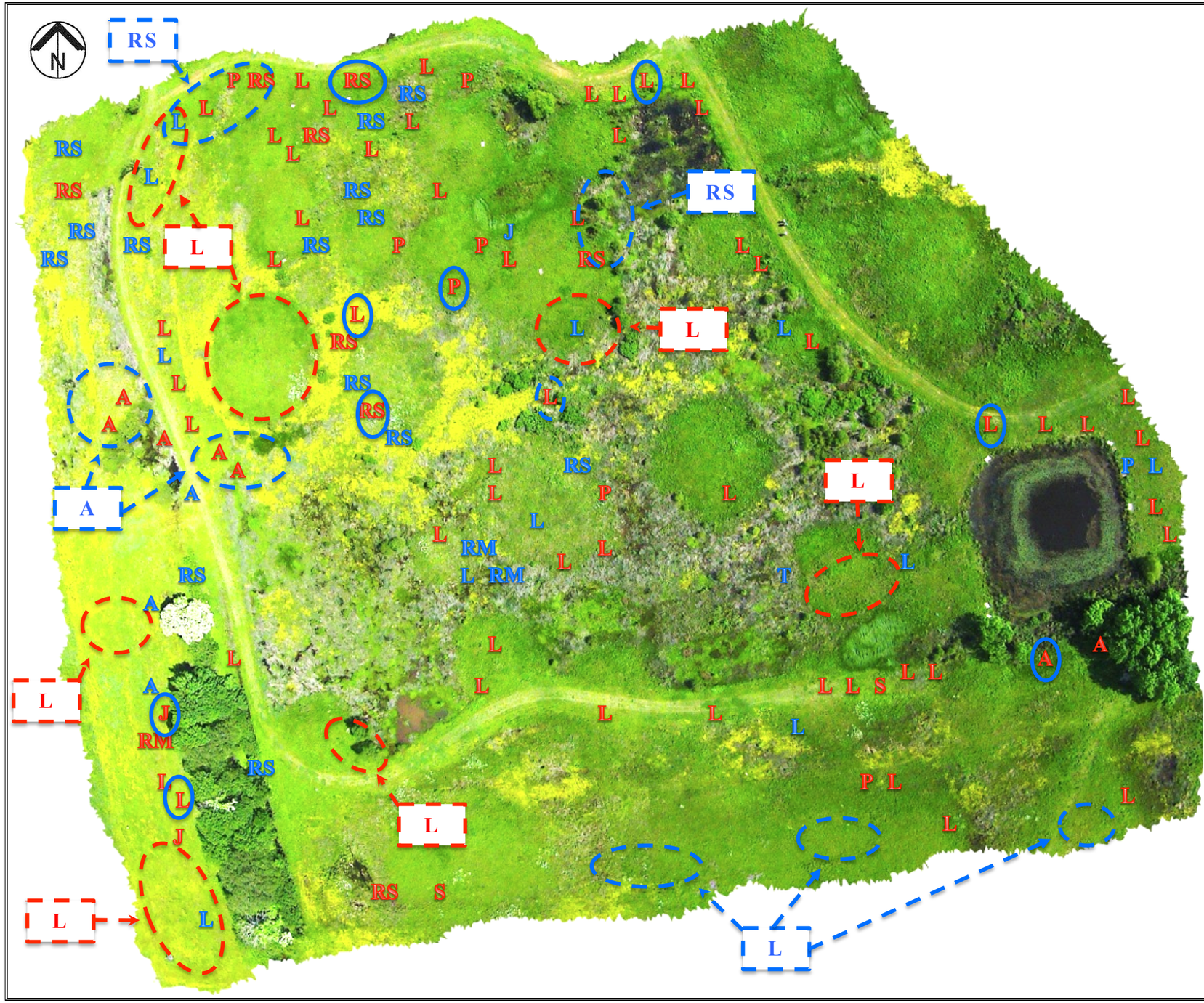


2019 Invasive Species Monitoring Map Wetland Cell W-2



LEGEND:

RED – JUNE 2019
GROWING SEASON MONITORING EVENT

BLUE – SEPTEMBER 2019
POST GROWING SEASON MONITORING EVENT

L – SERICEA LESPEDEZA (*LESPEDEZA CUNEATA*)

S – JOHNSONGRASS (*SORGHUM HALEPENSE*)

P – CALLERY PEAR (*PYRUS CALLERYANA*)

A – SMALL CARPETGRASS (*ARTHRAXON HISPIDUS*)

RS – HIMALAYAN BLACKBERRY (*RUBUS SERISSIMUS*)

RM – MULTIFLORA ROSE (*ROSA MULTIFLORA*)

J – JAPANESE HONEYSUCKLE (*LONICERA JAPONICA*)

T – NARROW-LEAF CATTAIL (*TYPHA ANGUSTIFOLIA*)

A DASHED CIRCLE INDICATES A LARGE PATCH OF THE INVASIVE SPECIES INDICATED IN THE ASSOCIATED TEXT BOX.

A SOLID CIRCLE AROUND A LETTER REPRESENTS THAT THE INVASIVE SPECIES WAS OBSERVED AT THE SAME LOCATION AS THE PREVIOUS MONITORING EVENT.

Appendix V
Woolsey Wet Prairie
2019 Master Plant Species List

MASTER PLANT SPECIES LIST FOR WOOLSEY WET PRAIRIE - updated September 2019 - 489 taxa

SCIENTIFIC NAME	WETLAND INDICATOR STATUS	CODE	COMMON NAME	FAMILY	STRATA	SOURCE CODE
Abutilon theophrastii *	FACU-	ABUT THEO	pie-maker	MALVACEAE	herb	5
Acalypha gracilens	no data	ACAL GRAC	copperleaf	EUPHORBIACEAE	herb	5
Acalypha virginica	FACU-	ACAL VIRG	Virginia copperleaf	EUPHORBIACEAE	herb	3
Acer negundo	FACW	ACER NEGU	boxelder	ACERACEAE	tree/sapling	5
Acer saccharinum	FACW	ACER SACC	silver maple	ACERACEAE	tree/sapling	9
Achillea millefolium	FACU	ACHI MILL	yarrow	ASTERACEAE	herb	12
Agalinis fasciculata	FAC	AGAL FASC	gerardia	SCROPHULARIACEAE	herb	6
Agrimonia parviflora +	FACW	AGRI PARV	swamp agrimony	ROSACEAE	herb	21
Agrostis gigantea *	FACW	AGRO GIGA	redtop	POACEAE	herb	3
Agrostis hyemalis	FAC	AGRO HYEM	ticklegrass	POACEAE	herb	5
Ailanthus altissima **	NI	AILA ALTI	tree-of-heaven	SIMAROUBACEAE	tree/sapling	10
Allium canadense var. canadense	FACU	ALLI CANA CANA	wild onion	ALLIACEAE	herb	19
Allium vineale *	FACU-	ALLI VINE	field garlic	ALLIACEAE	herb	3
Amaranthus cf. viridis *	NO	AMAR VIRI	pigweed	AMARANTHACEAE	herb	4
Amaranthus spinosus	FACU	AMAR SPIN	spiny pigweed	AMARANTHACEAE	herb	3
Ambrosia artemisiifolia	FACU	AMBR ARTE	common ragweed	ASTERACEAE	herb	3
Ambrosia bidentata	no data	AMBR BIDE	lanceleaf ragweed	ASTERACEAE	herb	3
Ambrosia trifida	FAC	AMBR TRIF	giant ragweed	ASTERACEAE	herb	3
Ammannia X coccinea	FACW+	AMMA COCC	toothcup	LYTHRACEAE	herb	3
Amorpha fruticosa +	FACW	AMOR FRUT	false indigo bush	FABACEAE	shrub	21
Ampelopsis cordata	FAC+	AMPE CORD	heartleaf ampelopsis	VITACEAE	woody vine	10
Anagallis minima	FACW	ANAG MINI	chaffweed	PRIMULACEAE	herb	23
Andropogon gerardii	FAC	ANDR GERA	big bluestem	POACEAE	herb	3
Andropogon glomeratus	FACW+	ANDR GLOM	bushy bluestem	POACEAE	herb	11
Andropogon hirsutior	FACW	ANDR HIRS	hirsute bushy bluestem	POACEAE	herb	24
Andropogon virginicus	FAC-	ANDR VIRG	broomsedge bluestem	POACEAE	herb	3
Apios americana	FACW	APIO AMER	groundnut	FABACEAE	herb	3
Apocynum cannabinum	FAC-	APOC CANN	Indian hemp	APOCYNACEAE	herb	3
Arctium minus *	FACU	ARCT MINU	burdock	ASTERACEAE	herb	19
Arenaria serpyllifolia var. tenuior *	FAC	AREN SERP TENU	thyme-leaved sandwort	CARYOPHYLLACEAE	herb	19
Aristida dichotoma	FACU	ARIS DICH	churchmouse three-awn	POACEAE	herb	8
Aristida longespica var. longespica	UPL	ARIS LONG	slimspike three-awn	POACEAE	herb	22
Aristida oligantha	no data	ARIS OLIG	three-awn	POACEAE	herb	8
Arthraxon hispidus **	FAC	ARTH HISP	small carpetgrass	POACEAE	herb	23
Artemisia ludoviciana var. mexicana	***UPL***	**ARTE LUDO MEXI**	**Mexican white sage**	**ASTERACEAE**	**herb**	**31**
Asclepias amplexicaulis	no data	ASCL AMPL	curly milkweed	ASCLEPIADACEAE	herb	3
Asclepias longifolia ssp. hirtella	UPL	ASCL HIRT	longleaf milkweed	ASCLEPIADACEAE	herb	3
Asclepias incarnata	OBL	ASCL INCA	swamp milkweed	ASCLEPIADACEAE	herb	30
Asclepias viridis	no data	ASCL VIRI	spider milkweed	ASCLEPIADACEAE	herb	3
Baptisia alba var. macrophylla	no data	BAPT ALBA	white false indigo	FABACEAE	herb	3
Baptisia bracteata var. leucophaea	no data	BAPT BRAC	cream false indigo	FABACEAE	herb	1
Barbarea vulgaris **	FAC	BARB VULG	yellow rocket	BRASSICACEAE	herb	5
Bidens aristosa	FACW	BIDE ARIS	tickseed sunflower	ASTERACEAE	herb	8
Bidens frondosa	FACW	BIDE FRON	tickseed sunflower	ASTERACEAE	herb	13
Boehmeria cylindrica	FACW	BOEH CYLI	false nettle	URTICACEAE	herb	27

Boltonia asteroides	*FACW*	BOLT ASTE	false aster	ASTERACEAE	herb	3
Boltonia diffusa	*FAC*	BOLT DIFF	doll's daisy	ASTERACEAE	herb	8
Brassica rapa *	*no data*	BRAS RAPA	turnip	BRASSICACEAE	herb	5
Bromus catharticus *	*no data*	BROM CATH	rescue grass	POACEAE	herb	5
Bromus hordeaceus *	*no data*	BROM HORD	soft chess	POACEAE	herb	5
Bromus inermis *	*no data*	BROM INER	smooth broome	POACEAE	herb	5
Bromus racemosus **	*no data*	BROM RACE	bald brome	POACEAE	herb	5
Bromus sterilis **	*no data*	BROM STER	poverty brome	POACEAE	herb	19
Bromus tectorum *	*no data*	BROM TECT	cheatgrass	POACEAE	herb	5
Callitriche heterophylla	*OBL*	CALL HETE	water starwort	CALLITRICHACEAE	herb	5
Callitriche terrestris	*FACW*	CALL TERR	terrestrial water starwort	CALLITRICHACEAE	herb	19
Campsis radicans	*FAC*	CAMP RADI	trumpet creeper	BIGNONIACEAE	herb	10
Capsella bursa-pastoris *	*FACU+*	CAPS BURS	shepherd's purse	BRASSICACEAE	herb	5
Cardamine parviflora var. arenicola	*FACU*	CARD PARV AREN	small-flowered bittercress	BRASSICACEAE	herb	5
Carduus nutans **	*no data*	CARD NUTA	nodding thistle	ASTERACEAE	herb	4
Carex aggregata	***no data***	**CARX AGGR**	**cluster sedge**	**CYPERACEAE**	**herb**	**19**
Carex amphibola	*FAC*	CARX AMPH	a sedge	CYPERACEAE	herb	19
Carex annectens	*FACW*	CARX ANNE	a sedge	CYPERACEAE	herb	5
Carex arkansana	***no data***	**CARX ARKA**	**Arkansas sedge**	**CYPERACEAE**	**herb**	**5**
Carex aureolensis	*no data*	CARX AURE	a sedge	CYPERACEAE	herb	19
Carex austrina	*no data*	CARX AUST	a sedge	CYPERACEAE	herb	5
Carex blanda	*FAC*	CARX BLAN	a sedge	CYPERACEAE	herb	19
Carex brevior	*OBL*	CARX BREV	a sedge	CYPERACEAE	herb	5
Carex bushii	*FACW*	CARX BUSH	Bush's sedge	CYPERACEAE	herb	5
Carex complanata	*FAC+*	CARX COMP	a sedge	CYPERACEAE	herb	5
Carex festucacea	*FACW*	CARX FEST	a sedge	CYPERACEAE	herb	5
Carex fissa	***FACW+***	**CARX FISS**	**hammock sedge**	**CYPERACEAE**	**herb**	**5**
Carex flaccosperma	*FAC+*	CARX FLAC	a sedge	CYPERACEAE	herb	9
Carex frankii	*OBL*	CARX FRAN	Frank's sedge	CYPERACEAE	herb	5
Carex glaucodea	*no data*	CARX GLAU	blue sedge	CYPERACEAE	herb	15
Carex granularis	*FACW*	CARX GRAN	granular sedge	CYPERACEAE	herb	5
Carex grisea	*FACU*	CARX GRIS	inflated narrow-leaf sedge	CYPERACEAE	herb	26
Carex hirsutella	*no data*	CARX HIRS	a sedge	CYPERACEAE	herb	5
Carex leavenworthii	*no data*	CARX LEAV	Leavenworth's sedge	CYPERACEAE	herb	5
Carex meadii	*FAC*	CARX MEAD	Mead's sedge	CYPERACEAE	herb	7
Carex molestiformis	*no data*	CARX MOLE	frightful sedge	CYPERACEAE	herb	26
Carex oklahomensis	*OBL*	CARX OKLA	Oklahoma sedge	CYPERACEAE	herb	3
Carex opaca	***no data***	**CARX OPAC**	**opaque prairie sedge**	**CYPERACEAE**	**herb**	**5**
Carex pellita	***OBL***	**CARX PELL**	**woolly sedge**	**CYPERACEAE**	**herb**	**5**
Carex retroflexa	*no data*	CARX RETR	a sedge	CYPERACEAE	herb	5
Carex scoparia	***FACW***	**CARX SCOP**	**pointed sedge**	**CYPERACEAE**	**herb**	**16**
Carex shortiana	*FACW*	CARX SHOR	Short's sedge	CYPERACEAE	herb	14
Carex triangularis	*FACW*	CARX TRIA	eastern fox sedge	CYPERACEAE	herb	31
Carex vulpinoidea	*OBL*	CARX VULP	foxtail sedge	CYPERACEAE	herb	3
Carya illinoinensis	*FACU*	CARY ILLI	pecan	JUGLANDACEAE	tree/sapling	20
Catalpa bignonioides	*FAC-*	CATA BIGN	catalpa	BIGNONIACEAE	tree/sapling	3
Celtis laevigata	*FACW*	CELT LAEV	sugarberry	CELTIDACEAE	tree/sapling	20
Celtis occidentalis	*FACU*	CELT OCCI	hackberry	CELTIDACEAE	tree/sapling	8
Cephalanthus occidentalis	*OBL*	CEPH OCCI	buttonbush	RUBIACEAE	shrub	3
Cerastium fontanum ssp. vulgare *	*no data*	CERA FONT VULG	chickweed	CARYOPHYLLACEAE	herb	19
Cerastium pumilum *	*no data*	CERA PUMI	chickweed	CARYOPHYLLACEAE	herb	4
Ceratophyllum demersum	*OBL*	CERA DEME	coontail	CERATOPHYLLACEAE	herb	10

Chamaesyce humistrata	*FAC*	CHAM HUMI	spreading sandmat	EUPHORBIACEAE	herb	27
Chamaesyce maculata	*no data*	CHAM MACU	spotted spurge	EUPHORBIACEAE	herb	3
Chamaesyce nutans	*FACU*	CHAM NUTA	spurge	EUPHORBIACEAE	herb	8
Chasmanthium latifolium	*FACU*	CHAS LATI	river oats	POACEAE	herb	23
Chenopodium album	*FAC-*	CHEN ALBU	lamb's quarters	CHENOPODIACEAE	herb	3
Cicuta maculata	*OBL*	CICU MACU	water hemlock	APIACEAE	herb	5
Cirsium altissimum	*no data*	CIRS ALTI	tall thistle	ASTERACEAE	herb	19
Cirsium vulgare **	*FAC*	CIRS VULG	common thistle	ASTERACEAE	herb	8
Claytonia virginica	*FAC*	CLAY VIRG	spring beauty	PORTULACACEAE	herb	18
Cocculus carolinus	*FAC*	COCC CARO	Carolina snailseed	MENISPERMACEAE	herb	20
Conium maculatum *	*FACW*	CONI MACU	poison hemlock	APIACEAE	herb	7
Conoclinium coelestinum	*FAC*	CONO COEL	blue mistflower	ASTERACEAE	herb	31
Conyza canadensis	*FACU*	CONY CANA	horseweed	ASTERACEAE	herb	3
Coreopsis grandiflora	*no data*	CORE GRAN	tickseed	ASTERACEAE	herb	5
Cornus drummondii	*FAC*	CORN DRUM	rough-leaved dogwood	CORNACEAE	shrub	3
Corydalis crystallina	*no data*	CORY CRYS	mealy fumewort	FUMARIACEAE	herb	5
Crataegus mollis	*FAC*	CRAT MOLL	hairy hawthorn	ROSACEAE	herb	8
Crataegus reverchonii	***no data***	**CRAT CRUS**	**Reverchon's hawthorn**	**ROSACEAE**	**shrub**	**21**
Crotalaria sagittalis	*no data*	CROT SAGI	rattlebox	FABACEAE	herb	12
Croton capitatus	*no data*	CROT CAPI	goatweed	EUPHORBIACEAE	herb	3
Croton glandulosus var. septentrionalis	*no data*	CROT GLAN SEPT	tropic croton	EUPHORBIACEAE	herb	3
Croton monanthogynus	*no data*	CROT MONA	prairie tea	EUPHORBIACEAE	herb	8
Croton willdenowii	*no data*	CROT WILD	rushfoil	EUPHORBIACEAE	herb	3
Cruciata pedemontana *	*no data*	CRUC PEDE	yellow-flowered bedstraw	RUBIACEAE	herb	5
Cuscuta campestris	*no data*	CUSC CAMP	field dodder	CONVOLVULACEAE	herb	12
Cynodon dactylon **	*FACU*	CYNO DACT	Bermuda grass	POACEAE	herb	3
Cyperus acuminatus	*OBL*	CYPE ACUM	tapertip flatsedge	CYPERACEAE	herb	6
Cyperus echinatus	*FAC*	CYPE ECHI	globe flatsedge	CYPERACEAE	herb	3
Cyperus erythrorhizos	*OBL*	CYPE ERYT	redroot flatsedge	CYPERACEAE	herb	11
Cyperus esculentus	*FAC*	CYPE ESCU	yellow nutsedge	CYPERACEAE	herb	3
Cyperus flavescens	*OBL*	CYPE FLAV	yellow flatsedge	CYPERACEAE	herb	3
Cyperus lancastriensis	*FAC*	CYPE LANC	manyflower flatsedge	CYPERACEAE	herb	21
Cyperus lupulinus	*no data*	CYPE LUPU	flatsedge	CYPERACEAE	herb	4
Cyperus odoratus	*FACW*	CYPE ODOR	rusty flatsedge	CYPERACEAE	herb	6
Cyperus pseudovegetus	*FACW*	CYPE PSEU	marsh flatsedge	CYPERACEAE	herb	3
Cyperus strigosus	*FACW*	CYPE STRI	false nutsedge	CYPERACEAE	herb	1
Dactylis glomerata **	*FACU*	DACT GLOM	orchard grass	POACEAE	herb	3
Datura stramonium *	*no data*	DATU STRA	Jimson weed	SOLANACEAE	herb	5
Daucus carota **	*no data*	DAUC CARO	Queen Anne's lace	APIACEAE	herb	3
Desmanthus illinoensis	*FAC*	DESM ILLI	Illinois bundleflower	FABACEAE	herb	21
Desmodium canescens	*no data*	DESM CANE	tick-trefoil	FABACEAE	herb	19
Desmodium nuttallii	*no data*	DESM NUTT	tick-trefoil	FABACEAE	herb	8
Desmodium obtusum	*no data*	DESM OBTU	tick-trefoil	FABACEAE	herb	8
Desmodium paniculatum	*FACU*	DESM PANI	tick-trefoil	FABACEAE	herb	3
Desmodium sessilifolium	*no data*	DESM SESS	sessile-leaf tick-trefoil	FABACEAE	herb	16
*Dianthus armeria**	*UPL*	DIAN ARME	Deptford pink	CARYOPHYLLACEAE	herb	31
Dichanthelium aciculare	*FACU*	DICH ACIC	slimleaf rosettegrass	POACEAE	herb	3
Dichanthelium acuminatum	*FAC*	DICH ACUM	pointed rosettegrass	POACEAE	herb	3
Dichanthelium clandestinum	*FACW*	DICH CLAN	deer-tongue rosettegrass	POACEAE	herb	8
Dichanthelium commutatum	*FAC*	DICH COMM	variable rosettegrass	POACEAE	herb	11
Dichanthelium dichotomum	*FAC*	DICH DICH	rosettegrass	POACEAE	herb	3

Dichanthelium malacophyllum	*no data*	DICH MALA	soft-leaved rosettegrass	POACEAE	herb	19
Dichanthelium oligosanthes var. scribnerianum	*FACU*	DICH OLIG SCRI	Scribner's rosettegrass	POACEAE	herb	5
Dichanthelium scoparium	*FACW*	DICH SCOP	velvet rosettegrass	POACEAE	herb	3
Dichanthelium sphaerocarpon	*FACU*	DICH SPHA	rosettegrass	POACEAE	herb	5
Digitaria ciliaris **	*FAC*	DIGI CILI	southern crabgrass	POACEAE	herb	4
Digitaria ischaemum **	*UPL*	DIGI ISCH	smooth crabgrass	POACEAE	herb	3
Diodia teres	*FACU-*	DIOD TERE	poorjoe	RUBIACEAE	herb	3
Diodia virginiana	*FACW*	DIOD VIRG	Virginia buttonweed	RUBIACEAE	herb	3
Diospyros virginiana	*FAC*	DIOS VIRG	persimmon	EBENACEAE	tree/sapling	3
Dysphania ambrosioides *	*FACU*	DYSP AMBR	wormseed	CHENOPODIACEAE	herb	3
Echinochloa colona *	*FACW*	ECHI COLO	jungle rice	POACEAE	herb	3
Echinochloa crus-galli *	*FACW-*	ECHI CRUS	barnyard grass	POACEAE	herb	1
Echinochloa muricata	*FAC*	ECHI MURI	barnyard grass	POACEAE	herb	3
Eclipta prostrata	*FACW-*	ECLI PROS	yerba de tajo	ASTERACEAE	herb	1
Eleocharis acicularis	*OBL*	ELEO ACIC	least spikerush	CYPERACEAE	herb	5
Eleocharis lanceolata	*FACW*	ELEO LANC	spikerush	CYPERACEAE	herb	3
Eleocharis macrostachya	*OBL*	ELEO MACR	pale spikerush	CYPERACEAE	herb	16
Eleocharis obtusa	*OBL*	ELEO OBTU	blunt spikerush	CYPERACEAE	herb	3
Eleocharis palustris	*OBL*	ELEO PALU	common spikerush	CYPERACEAE	herb	3
Eleocharis quadrangulata	*OBL*	ELEO QUAD	squarestem spikerush	CYPERACEAE	herb	9
Eleocharis tenuis var. verrucosa	*FACW*	ELEO TENU VERR	slender spikerush	CYPERACEAE	herb	5
Eleocharis wolfii	***OBL***	**ELEO WOLF**	**Wolf's spikerush**	**CYPERACEAE**	**herb**	**5**
Eleusine indica *	*FACU*	ELEU INDI	India goosegrass	POACEAE	herb	3
Elymus glabrifloris	*no data*	ELYM GLAB	wild rye	POACEAE	herb	3
Eragrostis hirsuta	*UPL*	ERAG HIRS	bigtop lovegrass	POACEAE	herb	22
Eragrostis spectabilis	*FACU*	ERAG SPEC	purple lovegrass	POACEAE	herb	3
Eragrostis intermedia	*no data*	ERAG INTE	lovegrass	POACEAE	herb	8
Erechtites hieraciifolia	*FAC-*	EREC HIER	fireweed	ASTERACEAE	herb	8
Erigeron annuus	*FACU*	ERIG ANNU	fleabane	ASTERACEAE	herb	3
Erigeron strigosus	*FAC*	ERIG STRI	daisy fleabane	ASTERACEAE	herb	5
Erigeron tenuis	*no data*	ERIG TENU	fleabane	ASTERACEAE	herb	25
Eryngium yuccifolium +	*FAC*	ERYN YUCC	rattlensnake master	APIACEAE	herb	10
Euonymus fortunei **	*no data*	EUON FORT	winter-creeper	CELASTRACEAE	woody vine	19
Eupatorium perfoliatum	*FACW+*	EUPA PERF	clasping boneset	ASTERACEAE	herb	3
Eupatorium serotinum	*FAC*	EUPA SERO	late boneset	ASTERACEAE	herb	1
Euphorbia spathulata	*FACU*	EUPH SPAT	warty spurge	EUPHORBIACEAE	herb	21
Euthamia gymnospermoides	*FAC*	EUTH GYMN	Texas goldentop	ASTERACEAE	herb	21
Festuca rubra	*FACU+*	FEST RUBR	red fescue	POACEAE	herb	2
Fimbristylis annua	*FACW*	FIMB ANNU	annual fimbry	CYPERACEAE	herb	9
Fimbristylis puberula	*OBL*	FIMB PUBE	hairy fimbry	CYPERACEAE	herb	5
Fleischmannia incarnata	*FAC*	FLEI INCA	pink thoroughwort	ASTERACEAE	herb	31
Fraxinus pennsylvanica	*FACW*	FRAX PENN	green ash	OLEACEAE	tree/sapling	3
Galactia regularis	*no data*	GALA REGU	milk pea	FABACEAE	herb	3
Galium aparine	*FACU*	GALI APAR	cleavers	RUBIACEAE	herb	19
Galium obtusum	*FACW-*	GALI OBTU	bluntleaf bedstraw	RUBIACEAE	herb	7
Galium pilosum	*no data*	GALI PILO	hairy bedstraw	RUBIACEAE	herb	4
Gamochaeta antillana	*no data*	GAMO ANTI	cudweed	ASTERACEAE	herb	19
Gamochaeta purpurea	*UPL*	GAMO PURP	purple cudweed	ASTERACEAE	herb	5
Gaura longiflora	*no data*	GAUR LONG	gaura	ONAGRACEAE	herb	8
Geranium carolinianum	*no data*	GERA CARO	Carolina cranesbill	GERANIACEAE	herb	5
Geranium dissectum *	*no data*	GERA DISS	cutleaf cranesbill	GERANIACEAE	herb	5

Geranium molle *	*no data*	GERA MOLL	dovesfoot cranesbill	GERANIACEAE	herb	4
Geum canadense	*FACU*	GEUM CANA	white avens	ROSACEAE	herb	19
Glandularia canadensis	*no data*	GLAN CANA	rose vervain	VERBENACEAE	herb	3
Gleditsia triacanthos	*FAC-*	GLED TRIA	honey locust	FABACEAE	tree/sapling	3
Glyceria septentrionalis	*OBL*	GLYC SEPT	mannagrass	POACEAE	herb	3
Gratiola neglecta	*OBL*	GRAT NEGL	hedge-hyssop	SCROPHULARIACEAE	herb	9
Gratiola virginiana	*OBL*	GRAT VIRG	hedge-hyssop	SCROPHULARIACEAE	herb	3
Helenium amarum	*FACU-*	HELE AMAR	bitterweed	ASTERACEAE	herb	3
Helenium flexuosum	*FACW*	HELE FLEX	purple-headed sneezeweed	ASTERACEAE	herb	1
Helenium autumnale	*FACW*	HELE AUTU	fall sneezeweed	ASTERACEAE	herb	8
Helianthus grosseserratus	*FAC+*	HELI GROS	sawtooth sunflower	ASTERACEAE	herb	3
Helianthus mollis	*no data*	HELI MOLL	ashy sunflower	ASTERACEAE	herb	3
Heliotropium indicum *	*FAC*	HELI INDI	Indian heliotrope	BORAGINACEAE	herb	21
Hibiscus moscheutos ssp. lasiocarpos	*OBL*	HIBI MOSC LASI	rose mallow	MALVACEAE	herb	3
Hieracium gronovii	*UPL*	HIER GRON	hawkweed	ASTERACEAE	herb	2
Hordeum pusillum *	*FACU*	HORD PUSI	little barley	POACEAE	herb	5
Hypericum drummondii	*FACU*	HYPE DRUM	nits-and-lice	CLUSIACEAE	herb	8
Hypericum gymnanthum	*FACW*	HYPE GYMN	clasping St. John's wort	CLUSIACEAE	herb	10
Hypericum hypericoides var. multicaule	*FAC*	HYPE HYPE MULT	creeping St. Andrew's cross	CLUSIACEAE	shrub	3
Hypericum mutilum	*FACW*	HYPE MUTI	dwarf St. John's wort	CLUSIACEAE	herb	9
Hypericum punctatum	*FAC*	HYPE PUNC	dotted St. John's wort	CLUSIACEAE	herb	8
Ilex decidua	*FACW*	ILEX DECI	deciduous holly	AQUIFOLIACEAE	shrub	22
Ipomoea lacunosa	*FAC+*	IPOM LACU	whitestar morning glory	CONVOLVULACEAE	herb	10
Ipomoea pandurata	*FACU*	IPOM PAND	wild potato vine	CONVOLVULACEAE	herb	5
Isoetes melanopoda	*OBL*	ISOE MELA	black-footed quillwort	ISOETACEAE	herb	19
Isolepis carinata	*FACW+*	ISOL CARI	bulrush	CYPERACEAE	herb	5
Juncus anthelatus	*no data*	JUNC ANTH	rush	JUNCACEAE	herb	3
Juncus biflorus	*FACW*	JUNC BIFL	rush	JUNCACEAE	herb	3
Juncus brachycarpus	*FACW*	JUNC BRAC	rush	JUNCACEAE	herb	9
Juncus diffusissimus	*FACW*	JUNC DIFF	spreading rush	JUNCACEAE	herb	10
Juncus effusus	*FACW+*	JUNC EFFU	soft rush	JUNCACEAE	herb	3
Juncus interior	*FACU*	JUNC INTE	inland rush	JUNCACEAE	herb	5
Juncus marginatus	*FACW*	JUNC MARG	rush	JUNCACEAE	herb	8
Juncus secundus	*FAC*	JUNC SECU	rush	JUNCACEAE	herb	4
Juncus tenuis	*FAC*	JUNC TENU	path rush	JUNCACEAE	herb	24
Juncus torreyi	*FACW*	JUNC TORR	Torrey's rush	JUNCACEAE	herb	23
Juncus validus	*FACW+*	JUNC VALI	rush	JUNCACEAE	herb	5
Juniperus virginiana	*FACU-*	JUNI VIRG	eastern redcedar	CUPRESSACEAE	tree/sapling	8
Krigia dandelion	*FACU*	KRIG DAND	potato dandelion	ASTERACEAE	herb	7
Kummerowia stipulacea **	*FACU-*	KUMM STIP	Korean bushclover	FABACEAE	herb	3
Kummerowia striata **	*FACU*	KUMM STRI	Japanese bushclover	FABACEAE	herb	3
Lactuca canadensis	*FACU-*	LACT CANA	Canada wild lettuce	ASTERACEAE	herb	16
Lactuca saligna *	*UPL*	LACT SALI	willowleaf lettuce	ASTERACEAE	herb	21
Lactuca serriola *	*FAC*	LACT SERR	prickly wild lettuce	ASTERACEAE	herb	3
Leersia oryzoides	*OBL*	LEER ORYZ	rice cutgrass	POACEAE	herb	2
Leersia virginica	*FACW*	LEER VIRG	Virginia cutgrass	POACEAE	herb	8
Lemna minuta	*OBL*	LEMN MINU	duckweed	LEMNACEAE	herb	5
Lepidium virginicum	*FACU*	LEPI VIRG	Virginia peppergrass	BRASSICACEAE	herb	3
Lespedeza cuneata **	*NI*	LESP CUNE	sericea lespedeza	FABACEAE	herb	3
Lespedeza repens	*no data*	LESP REPE	creeping lespedeza	FABACEAE	herb	21

Leucospora multifida	*OBL*	LEUC MULT	leucospora	SCROPHULARIACEAE	herb	5
Liatris pycnostachya +	*FACU*	LIAT PYCN	prairie gayfeather	ASTERACEAE	herb	27
Liatris squarrulosa	*FACU*	LIAT SQUA	Appalachian Blazing Star	ASTERACEAE	herb	29
*Ligustrum sinense ***	*FAC*	LIGU SINE	Chinese privet	OLEACEAE	shrub	17
Lindernia dubia var. anagallidea	*OBL*	LIND ANAG	false pimpernel	SCROPHULARIACEAE	herb	10
Lindernia dubia var. dubia	*OBL*	LIND DUBI	false pimpernel	SCROPHULARIACEAE	herb	23
Linum medium var. texanum	*FACU*	LINU MEDI TEXA	stiff yellow flax	LINACEAE	herb	23
Lobelia siphilitica	*OBL*	LOBE SIPH	big blue lobelia	CAMPANULACEAE	herb	8
Lobelia spicata	*FAC*	LOBE SPIC	spike lobelia	CAMPANULACEAE	herb	5
*Lolium perenne **	*FACU*	LOLI PERE	ryegrass	POACEAE	herb	5
*Lonicera japonica ***	*FAC-*	LONI JAPO	Japanese honeysuckle	CAPRIFOLIACEAE	woody vine	3
*Lonicera maackii ***	*no data*	LONI MAAC	bush honeysuckle	CAPRIFOLIACEAE	shrub	17
Lonicera sempervirens	*FAC*	LONI SEMP	trumpet honeysuckle	CAPRIFOLIACEAE	woody vine	5
Ludwigia alternifolia	*OBL*	LUDW ALTE	seedbox	ONAGRACEAE	herb	8
Ludwigia glandulosa	*OBL*	LUDW GLAN	primrose-willow	ONAGRACEAE	herb	23
Ludwigia palustris	*OBL*	LUDW PALU	creeping seedbox	ONAGRACEAE	herb	3
Ludwigia peploides ssp. glabrescens	*OBL*	LUDW PEPL GLAB	floating primrose-willow	ONAGRACEAE	herb	3
Luzula echinata	*FAC*	LUZU ECHI	wood rush	JUNCACEAE	herb	10
Lycopus americanus	*OBL*	LYCO AMER	American water horehound	LAMIACEAE	herb	8
Lythrum alatum	*FACW+*	LYTH ALAT	winged loosestrife	LYTHRACEAE	herb	5
*Maclura pomifera **	*FACU*	MACL POMI	bois d'arc	MORACEAE	tree/sapling	3
Mecardonia acuminata	*FACW*	MECA ACUM	purple axilflower	SCROPHULARIACEAE	herb	3
Medicago lupulina	*no data*	MEDI SP.	black medic	FABACEAE	herb	16
*Melilotus albus ***	*FACU-*	MELI ALBU	white sweetclover	FABACEAE	herb	3
*Melilotus officinalis **	*FACU-*	MELI OFFI	yellow sweetclover	FABACEAE	herb	16
Melothria pendula	*FACW-*	MELO PEND	dwarf cucumber vine	CUCURBITACEAE	herb	10
Mimosa quadrivalvis var. nuttallii	*no data*	MIMO QUAD NUTT	sensitive brier	FABACEAE	herb	3
*Miscanthus sinensis***	*FACU*	MISC SINE	Chinese Silvergrass	POACEAE	herb	29
Mollugo verticillata	*FAC*	MOLL VERT	green carpetweed	MOLLUGINACEAE	herb	10
*Morus alba **	*UPL*	MORU ALBA	white mulberry	MORACEAE	tree/sapling	20
Morus rubra	*FAC*	MORU RUBR	red mulberry	MORACEAE	tree/sapling	8
Muhlenbergia schreberi	*FAC*	MUHL SCHR	nimblewill	POACEAE	herb	8
Muhlenbergia sp.	*no data*	MUHL SP.	muhly grass	POACEAE	herb	19
Myosotis macrosperma	*FAC*	MYOS MACR	large-seeded forget-me-not	BORAGINACEAE	herb	19
Myriophyllum sp.	*OBL*	MYRI SP	water milfoil	HALORAGACEAE	herb	9
Nelumbo lutea	*OBL*	NELU LUTE	American yellow lotus	Nelumbonaceae	herb	30
Nothoscordum bivalve	*FAC*	NOTH BIVA	crow poison	ALLIACEAE	herb	7
Nuttallanthus texanus	*no data*	NUTT TEXA	blue toadflax	SCROPHULARIACEAE	herb	5
Oenothera biennis	*FACU*	OENO BIEN	evening-primrose	ONAGRACEAE	herb	7
Oenothera laciniata	*FACU*	OENO LACI	cutleaf evening-primrose	ONAGRACEAE	herb	5
Orbexilum pedunculatum var. pedunculatum	*FACU*	ORBE PEDU	Sampson's snakeroot	FABACEAE	herb	5
Oxalis dillenii	*no data*	OXAL DILL	yellow wood sorrel	OXALIDACEAE	herb	3
Oxalis stricta	*FACU*	OXAL STRI	yellow wood sorrel	OXALIDACEAE	herb	27
Oxalis violacea	*no data*	OXAL VIOL	violet woodsorrel	OXALIDACEAE	herb	5
Panicum anceps	*FAC-*	PANI ANCE	beaked panicgrass	POACEAE	herb	3
Panicum capillare	*FAC*	PANI CAPI	witchgrass	POACEAE	herb	8
Panicum dichotomiflorum	*FACW*	PANI DICH	fall panicgrass	POACEAE	herb	3
Panicum rigidulum	*FACW*	PANI RIGI	rigid panicgrass	POACEAE	herb	5
Panicum virgatum	*FAC+*	PANI VIRG	switchgrass	POACEAE	herb	3
Parthenocissus quinquefolia	*FACU*	PART QUIN	Virginia creeper	VITACEAE	woody vine	19

*Paspalum dilatatum **	*FAC+*	PASP DILA	Dallisgrass	POACEAE	herb	3
Paspalum floridanum	*FACW-*	PASP FLOR	Florida crowngrass	POACEAE	herb	3
Paspalum laeve	*FACW-*	PASP LAEV	field paspalum	POACEAE	herb	3
*Paspalum notatum **	*FACU+*	PASP NOTA	Bahia grass	POACEAE	herb	10
Paspalum pubiflorum	*FACW*	PASP PUBI	hairyseed crowngrass	POACEAE	herb	10
Paspalum setaceum	*FAC*	PASP SETA	thin crowngrass	POACEAE	herb	4
Passiflora incarnata	*no data*	PASS INCA	passion flower	PASSIFLORACEAE	herb	3
Passiflora lutea	*no data*	PASS LUTE	yellow passion flower	PASSIFLORACEAE	herb	19
Penstemon digitalis	*FAC*	PENS DIGI	foxglove beard-tongue	SCROPHULARIACEAE	herb	5
Penstemon tubaeflorus	*no data*	PENS TUBA	whitewand beard-tongue	SCROPHULARIACEAE	herb	3
Penthorum sedoides	*OBL*	PENT SEDO	ditch stonecrop	CRASSULACEAE	herb	31
*Persicaria hydropiper **	*OBL*	PERS HYDROPIPER	water pepper	POLYGONACEAE	herb	6
Persicaria hydropiperoides	*OBL*	PERS HYDROPIPEROIDES	wild water pepper	POLYGONACEAE	herb	3
Persicaria lapathifolia	*FACW*	PERS LAPA	pale smartweed	POLYGONACEAE	herb	3
*Persicaria longiseta **	*no data*	PERS LONG	pink smartweed	POLYGONACEAE	herb	8
*Persicaria maculosa **	*FACW*	PERS MACU	lady's-thumb	POLYGONACEAE	herb	6
Persicaria pensylvanica	*FACW*	PERS PENS	Pennsylvania smartweed	POLYGONACEAE	herb	3
Persicaria punctata	*FACW+*	PERS PUNC	dotted smartweed	POLYGONACEAE	herb	2
*Phleum pratense **	*FACU*	PHLE PRAT	timothy	POACEAE	herb	21
Phyla lanceolata	*OBL*	PHYL LANC	lanceleaf fogfruit	VERBENACEAE	herb	24
Physalis angulata	*FAC*	PHYS ANGU	smooth groundcherry	SOLANACEAE	herb	8
Physalis heterophylla	*no data*	PHYS HETE	clammy groundcherry	SOLANACEAE	herb	10
Physalis longifolia	*no data*	PHYS LONG	longleaf groundcherry	SOLANACEAE	herb	10
Physalis pubescens	*FACU*	PHYS PUBE	hairy groundcherry	SOLANACEAE	herb	3
Physostegia angustifolia	*FACW*	PHYS ANGU	false dragonhead	LAMIACEAE	herb	3
Phytolacca americana	*FACU+*	PHYT AMER	pokeweed	PHYTOLACACEAE	herb	3
Plantago aristata	*no data*	PLAN ARIS	bracted plantain	PLANTAGINACEAE	herb	3
*Plantago lanceolata **	*FAC*	PLAN LANC	English plantain	PLANTAGINACEAE	herb	3
Plantago rugelii	*FAC*	PLAN RUGE	blackseed plantain	PLANTAGINACEAE	herb	2
Plantago virginica	*FACU-*	PLAN VIRG	Virginia plantain	PLANTAGINACEAE	herb	5
Platanus occidentalis	*FACW-*	PLAT OCCI	American sycamore	PLATANACEAE	tree/sapling	12
Pluchea camphorata	*FACW*	PLUC CAMP	stinkweed	ASTERACEAE	herb	27
*Poa annua **	*FAC*	POA ANNU	annual bluegrass	POACEAE	herb	5
*Poa compressa **	*FACU-*	POA COMP	Canada bluegrass	POACEAE	herb	3
*Poa pratensis **	*FACU+*	POA PRAT	Kentucky bluegrass	POACEAE	herb	5
Polygala incarnata	***FAC-***	**POLY INCA**	**pink milkwort**	**POLYGALACEAE**	**herb**	**16**
Polygala sanguinea	*FAC-*	POLY SANG	purple milkwort	POLYGALACEAE	herb	10
Polygala verticillata	*UPL*	POLY VERT	whorled milkwort	POLYGALACEAE	herb	23
*Polygonum aviculare **	*FAC-*	POLY AVIC	knotweed	POLYGONACEAE	herb	3
Polygonum erectum	*FACU*	POLY EREC	erect knotweed	POLYGONACEAE	herb	10
Populus deltoides	*FAC+*	POPU DELT	eastern cottonwood	SALICACEAE	tree/sapling	10
Potamogeton diversifolius	*OBL*	POTA DIVE	pondweed	POTAMOGETONACEAE	herb	5
Potamogeton nodosus	*OBL*	POTA NODO	pondweed	POTAMOGETONACEAE	herb	1
Potamogeton pusillus	*OBL*	POTA PUSI	narrowleaf pondweed	POTAMOGETONACEAE	herb	11
*Potentilla recta **	*no data*	POTE RECT	rough-fruited cinquefoil	ROSACEAE	herb	5
Potentilla simplex	*FACU*	POTE SIMP	cinquefoil	ROSACEAE	herb	5
Proserpinaca palustris	*OBL*	PROS PALU	mermaid weed	HALORAGACEAE	herb	1
Prunella vulgaris ssp. lanceolata	*FAC-*	PRUN VULG	heal-all	LAMIACEAE	herb	4
Prunus munsoniana	*no data*	PRUN MUNS	wild goose plum	ROSACEAE	shrub	19
Prunus serotina	*FACU*	PRUN SERO	black cherry	ROSACEAE	tree/sapling	3
Pseudognaphalium obtusifolium	*no data*	PSEU OBTU	rabbit-tobacco	ASTERACEAE	herb	22
Pycnanthemum pilosum	*UPL*	PYCN PILO	hairy mountain mint	LAMIACEAE	herb	7

Pycnanthemum tenuifolium	*FAC-*	PYCN TENU	slender mountain mint	LAMIACEAE	herb	3
Pycnanthemum pilosum X P. tenuifolium	*no data*	PYCN PILO X TENU	hybrid mountain mint	LAMIACEAE	herb	13
Pyrrhopappus carolinianus	*no data*	PYRR CARO	false dandelion	ASTERACEAE	herb	12
Pyrus calleryana **	*no data*	PYRU CALL	callery pear	ROSACEAE	tree/sapling	3
Quercus +	-	QUER SP.	oak	FAGACEAE	tree/sapling	10
*Ranunculus bulbosus**	*FAC+*	RANU BULB	bulbous buttercup	RANUNCULACEAE	herb	1
Ranunculus laxicaulis	*OBL*	RANU LAXI	water plantain spearwort	RANUNCULACEAE	herb	5
Ranunculus micranthus	*FACU*	RANU MICR	rock buttercup	RANUNCULACEAE	herb	19
Ranunculus parviflorus *	*FAC*	RANU PARV	smallflower crowfoot	RANUNCULACEAE	herb	5
Ranunculus sardous *	*FAC+*	RANU SARD	hairy buttercup	RANUNCULACEAE	herb	3
Rhexia mariana	*FACW+*	RHEX MARI	meadow beauty	MELASTOMATACEAE	herb	10
Rhus copallinum	*NI*	RHUS COPA	winged sumac	ANACARDIACEAE	shrub	10
Rhus glabra	*no data*	RHUS GLAB	smooth sumac	ANACARDIACEAE	shrub	10
Rhynchospora harveyi	*OBL*	RHYN HARV	Harvey's beaksedge	CYPERACEAE	herb	5
Rhynchospora macrostachya	***OBL***	**RHYN MACR**	**tall horned beaksedge**	**CYPERACEAE**	**herb**	**1**
Rhynchospora recognita	*FACW*	RHYN RECO	beaksedge	CYPERACEAE	herb	14
Rorippa palustris ssp. fernaldiana	*OBL*	RORI PALU FERN	Fernald's yellowcress	BRASSICACEAE	herb	12
Rosa carolina	*FACU*	ROSA CARO	Carolina rose	ROSACEAE	shrub	3
Rosa multiflora **	*UPL*	ROSA MULT	multiflora rose	ROSACEAE	shrub	3
Rosa setigera	*FACU*	ROSA SETI	prairie rose	ROSACEAE	shrub	3
Rotala ramosior	*OBL*	ROTA RAMO	toothcup	LYTHRACEAE	herb	3
Rubus aboriginum	*no data*	RUBU ABOR	dewberry	ROSACEAE	shrub	21
Rubus laudatus	*no data*	RUBU LAUD	plains blackberry	ROSACEAE	shrub	21
Rubus satis	*no data*	RUBU SATI	dewberry	ROSACEAE	shrub	21
Rubus serissimus **	*UPL*	RUBU SERI	Himalayan blackberry	ROSACEAE	shrub	5
Rubus flagellaris	*UPL*	RUBU FLAG	northern dewberry	ROSACEAE	herb	3
Rudbeckia hirta	*FACU*	RUDB HIRT	black-eyed Susan	ASTERACEAE	herb	3
Rudbeckia subtomentosa	*FAC+*	RUDB SUBT	sweet coneflower	ASTERACEAE	herb	3
Ruellia humilis var. humilis	*FACU*	RUEL HUMI	hairy wild petunia	ACANTHACEAE	herb	3
Rumex acetosella *	*FACU+*	RUME ACET	red sorrel	POLYGONACEAE	herb	5
Rumex altissimus	*FACW*	RUME ALTI	pale dock	POLYGONACEAE	herb	4
Rumex crispus **	*FAC*	RUME CRIS	curly dock	POLYGONACEAE	herb	3
Rumex obtusifolius **	*FACU*	RUME OBTU	bitter dock	POLYGONACEAE	herb	23
Sabatia angularis	*FAC*	SABA ANGU	winged rosepink	GENTIANACEAE	herb	5
Sabatia campestris	*FACU*	SABA CAMP	prairie rosepink	GENTIANACEAE	herb	7
Sagittaria montevidensis	*OBL*	SAGI MONT	duck potato	ALISMATACEAE	herb	3
Sagittaria platyphylla	*OBL*	SAGI PLAT	delta arrowhead	ALISMATACEAE	herb	23
Salix nigra	*OBL*	SALI NIGR	black willow	SALICACEAE	tree/sapling	3
Salsola tragus *	*FACU*	SALS TRAG	Russian thistle	CHENOPODIACEAE	herb	11
Salvia lyrata	*FAC-*	SALV LYRA	cancerweed	LAMIACEAE	herb	3
Sambucus nigra ssp. canadensis	*FAC*	SAMB NIGR CANA	elderberry	CAPRIFOLIACEAE	shrub	24
Sanicula canadensis	*UPL*	SANI CANA	Canada black snakeroot	APIACEAE	herb	19
Sassafras albidum	*FACU*	SASS ALBI	sassafras	LAURACEAE	tree/sapling	3
Schedonorus arundinaceus **	*FAC-*	SCHE ARUN	tall fescue	POACEAE	herb	3
Schizachyrium scoparium	*FACU*	SCHI SCOP	little bluestem	POACEAE	herb	3
Schoenoplectus tabernaemontani	*OBL*	SCHO TABE	softstem bulrush	CYPERACEAE	herb	9
Scirpus cyperinus	*FACW*	SCIR CYPE	woolgrass bulbrush	CYPERACEAE	herb	20
Scirpus georgianus	*OBL*	SCIR GEOR	Georgia bulrush	CYPERACEAE	herb	3
Scirpus pendulus	*OBL*	SCIR PEND	drooping bulrush	CYPERACEAE	herb	5
Scleria ciliata	*FAC*	SCLE CILI	fringed nutrush	CYPERACEAE	herb	12
Scleria pauciflora var. caroliniana	*FAC+*	SCLE PAUC	fewflower nutrush	CYPERACEAE	herb	5

Scutellaria parvula var. missouriensis	*no data*	SCUT PARV MISS	glade skullcap	LAMIACEAE	herb	27
Senna marilandica	*FACW*	SENN MARI	wild senna	FABACEAE	herb	30
Setaria faberi *	*UPL*	SETA FABE	Chinese foxtail	POACEAE	herb	3
Setaria italica *	*FACU*	SETA ITAL	Italian foxtail	POACEAE	herb	14
Setaria parviflora	*FAC*	SETA PARV	knotroot bristlegrass	POACEAE	herb	3
Setaria pumila ssp. pumila *	*FAC*	SETA PUMI	yellow foxtail	POACEAE	herb	3
Setaria viridis *	*no data*	SETA VIRI	green bristlegrass	POACEAE	herb	23
Sherardia arvensis *	*no data*	SHER ARVE	field madder	RUBIACEAE	herb	5
Sida spinosa *	*FACU*	SIDA SPIN	prickly sida	MALVACEAE	herb	3
Sideroxylon lanuginosum	*FACU*	SIDE LANU	chittum wood	SAPOTACEAE	tree/sapling	3
Silene antirrhina	*no data*	SILE ANTI	sleepy catchfly	CARYOPHYLLACEAE	herb	19
Silphium laciniatum	*no data*	SILP LACI	compass plant	ASTERACEAE	herb	7
Sisymbrium officinale *	*no data*	SISY OFFI	hedge mustard	BRASSICACEAE	herb	5
Sisyrinchium angustifolium	*FAC*	SISY ANGU	blue-eyed grass	IRIDACEAE	herb	7
Sisyrinchium atlanticum	*FACW-*	SISY ATLA	blue-eyed grass	IRIDACEAE	herb	5
Smallanthus uvedalia	*UPL*	SMAL UVED	hairy leafcup	ASTERACEAE	herb	31
Smilax bona-nox	*FAC*	SMIL BONA	bull greenbrier	SMILACACEAE	woody vine	3
Smilax rotundifolia	*FAC*	SMIL ROTU	common greenbrier	SMILACACEAE	woody vine	19
Solanum carolinense	*FACU*	SOLA CARO	Carolina horsenettle	SOLANACEAE	herb	3
Solanum sarrachoides *	*no data*	SOLA PHYS	hairy nightshade	SOLANACEAE	herb	6
Solidago altissima	*FACU*	SOLI ALTI	tall goldenrod	ASTERACEAE	herb	3
Solidago gigantea	*FACW*	SOLI GIGA	giant goldenrod	ASTERACEAE	herb	16
Solidago rugosa	*FAC*	SOLI RUGO	wrinkleleaf goldenrod	ASTERACEAE	herb	13
Sonchus asper **	*FAC+*	SONC ASPE	spiny sowthistle	ASTERACEAE	herb	10
Sorghastrum nutans	*FACU*	SORG NUTA	Indiangrass	POACEAE	herb	3
Sorghum bicolor *	*FACU*	SORG BICO	sorghum	POACEAE	herb	15
Sorghum halepense **	*FACU*	SORG HALE	Johnsongrass	POACEAE	herb	3
Sphenopholis obtusata	*FAC+*	SPHE OBTU	prairie wedgescale	POACEAE	herb	3
Spiranthes cernua	*FACW*	SPIR CERN	nodding ladies'-tresses	ORCHIDACEAE	herb	4
Spiranthes vernalis	*FACW-*	SPIR VERN	spring ladies'-tresses	ORCHIDACEAE	herb	10
Spirodella polyrhiza	*OBL*	SPIR POLY	giant duckweed	LEMNACEAE	herb	5
Sporobolus compositus var. compositus	*UPL*	SPOR COMP COMP	rough dropseed	POACEAE	herb	4
Sporobolus compositus var. macer	*no data*	SPOR COMP MACE	creeping dropseed	POACEAE	herb	22
Sporobolus vaginiflorus var. vaginiflorus	*UPL*	SPOR VAGI	dropseed	POACEAE	herb	8
Steinchisma hians	*OBL*	STEI HIAN	gaping panicgrass	POACEAE	herb	1
Stellaria media *	*FACU*	STEL MEDI	common chickweed	CARYOPHYLLACEAE	herb	5
Strophostyles leiosperma	*no data*	STRO LEIO	wild bean	FABACEAE	herb	8
Strophostyles helvola	*FAC*	STRO HELV	amberique-bean	FABACEAE	herb	3
Stylosanthes biflora	*no data*	STYL BIFL	pencil flower	FABACEAE	herb	7
Symphoricarpos orbiculatus	*FAC-*	SYMP ORBI	coralberry	CAPRIFOLIACEAE	shrub	3
Symphyotrichum divaricatum	*OBL*	SYMP DIVA	annual aster	ASTERACEAE	herb	24
Symphyotrichum dumosum	*FAC*	SYMP DUMO	aster	ASTERACEAE	herb	1
Symphyotrichum ericoides	*UPL*	SYMP ERIC	heath aster	ASTERACEAE	herb	3
Symphyotrichum lanceolatum	*NI*	SYMP LANC	tall white ater	ASTERACEAE	herb	5
Symphyotrichum patens	*no data*	SYMP PATE	spreading aster	ASTERACEAE	herb	4
Symphyotrichum pilosum	*FAC-*	SYMP PILO	white heath aster	ASTERACEAE	herb	3
Taraxacum officinale	*FACU*	TARA OFFI	common dandelion	ASTERACEAE	herb	3
Teucrium canadense	*FACW-*	TEUC CANA	germander	LAMIACEAE	herb	10
Torilis arvensis *	*no data*	TORI ARVE	hedge parsley	APIACEAE	herb	3

Toxicodendron radicans	*FAC*	TOXI RADI	poison ivy	ANACARDIACEAE	woody vine	3
Trachelospermum difforme	*FACW*	TRAC DIFF	climbing dogbane	APOCYNACEAE	woody vine	5
Tragia ramosa	*no data*	TRAG RAMO	noseburn	EUPHORBIACEAE	herb	5
Tridens flavus var. flavus	*FACU*	TRID FLAV	purpletop tridens	POACEAE	herb	1
Tridens strictus	*FACW*	TRID STRI	longspike tridens	POACEAE	herb	1
Tridens X oklahomensis	*no data*	TRID OKLA	Oklahoma purpletop	POACEAE	herb	11
Trifolium campestre *	*no data*	TRIF CAMP	hop clover	FABACEAE	herb	5
Trifolium dubium *	*FACU-*	TRIF DUBI	low hop clover	FABACEAE	herb	5
Trifolium pratense *	*FACU-*	TRIF PRAT	red clover	FABACEAE	herb	3
Trifolium repens *	*FACU*	TRIF REPE	white clover	FABACEAE	herb	2
Triodanis perfoliata var. biflora	*no data*	TRIO PERF BIFL	round-leaved Venus' looking glass	CAMPANULACEAE	herb	19
Triodanis perfoliata var. perfoliata	*FAC*	TRIO PERF PERF	twinflower Venus' looking glass	CAMPANULACEAE	herb	5
Tripsacum dactyloides +	*FACW*	TRIP DACT	eastern gamagrass	POACEAE	herb	19
Typha angustifolia **	*OBL*	TYPH ANGU	narrowleaf cattail	TYPHACEAE	herb	7
Typha domingiensis	*OBL*	TYPH DOMI	southern cattail	TYPHACEAE	herb	3
Typha latifolia	*OBL*	TYPH LATI	broadleaf cattail	TYPHACEAE	herb	14
Ulmus alata	*FACU+*	ULMU ALAT	winged elm	ULMACEAE	tree/sapling	3
Ulmus americana	*FACW*	ULMU AMER	American elm	ULMACEAE	tree/sapling	3
Valerianella radiata	*FAC*	VALE RADI	cornsalad	VALERIANACEAE	herb	5
Verbascum thapsus *	*no data*	VERB THAP	woolly mullein	SCROPHULARIACEAE	herb	11
Verbena bracteata	*FACU-*	VERB BRAC	bigbract vervain	VERBENACEAE	herb	16
Verbena hastata	*FAC*	VERB HAST	blue vervain	VERBENACEAE	herb	3
Verbena simplex	*OBL*	VERB SIMP	vervain	VERBENACEAE	herb	5
Verbena stricta	*no data*	VERB STRI	hoary vervain	VERBENACEAE	herb	21
Verbena urticifolia	*FAC+*	VERB URTI	white vervain	VERBENACEAE	herb	5
Vernonia arkansana	*FAC*	VERN ARKA	Arkansas ironweed	ASTERACEAE	herb	10
Vernonia baldwinii	*UPL*	VERN BALD	Baldwin's ironweed	ASTERACEAE	herb	8
Vernonia missurica	*FAC+*	VERN MISS	Missouri ironweed	ASTERACEAE	herb	3
Veronica arvensis *	*NI*	VERO ARVE	corn speedwell	SCROPHULARIACEAE	herb	5
Veronica peregrina	*FAC+*	VERO PERS	necklace weed	SCROPHULARIACEAE	herb	5
Vicia sativa *	*FACU*	VICI SATI	common vetch	FABACEAE	herb	5
Vicia villosa *	*no data*	VICI VILL	vetch	FABACEAE	herb	19
Viola sagittata	*FAC*	VIOL SAGI	arrowleaf violet	VIOLACEAE	herb	24
Vitis cinerea	*FACW*	VITI CINE	grayback grape	VITACEAE	herb	23
Vitis vulpina	*FAC+*	VITI VULP	fox grape	VITACEAE	woody vine	3
Vulpia octoflora	*FACU*	VULP OCTO	sixweeks fescue	POACEAE	herb	21
Wolffia brasiliensis	*OBL*	WOLF BRAS	wolffia	LEMNACEAE	herb	11
Xanthium strumarium	*FAC*	XANT STRU	cocklebur	ASTERACEAE	herb	6

Species in bold type are tracked by the ANHC. (n = 11)

Species in red font are new additions to the master list for 2019. (n=7)

***/** = non-native/invasive species (98/489 = 20% of total)**

+ = native species intentionally introduced to site (n = 7)

STRATA:

tree = ≥ 5 in dbh and ≥ 20 ft tall

sapling = 0.4 to < 5 in dbh and ≥ 20 ft. tall

shrub = usually 3 to 20 ft tall; multi-stemmed brushy shrubs, small trees, and saplings

woody vine = vines that are woody

herb = graminoids, forbs, ferns, fern allies, herbaceous vines, tree seedlings

SOURCE CODES:

1 = Chris Reid, site inventory, 17 August 2001 (west side)
2 = Bruce Shackleford, plot data
3 = Theo Witsell, site inventory, 1 August 2006
4 = Theo Witsell, Fall 2006 monitoring & inventory
5 = Theo Witsell, June 2007 monitoring & inventory
6 = Theo Witsell, October 2007 monitoring & inventory
7 = Theo Witsell, May/June 2008 monitoring & inventory
8 = Theo Witsell, September 2008 inventory
9 = Theo Witsell, November 2008 monitoring & inventory
10 = Theo Witsell, July 2009 monitoring & inventory
11 = Theo Witsell, October/November 2009 monitoring & inventory
12 = Theo Witsell, July 2010 monitoring & inventory
13 = Theo Witsell, October/November 2010 monitoring & inventory
14 = Theo Witsell, July 2011 monitoring & inventory
15 = Theo Witsell, November 2011 monitoring & inventory
16 = Theo Witsell, June 2012 monitoring & inventory
17 = Theo Witsell, November 2012 monitoring & inventory
18 = Bruce Shackleford & Seth Pickens, Spring 2013 inventory
19 = Theo Witsell, June 10 & 11 2013 monitoring & inventory
20 = Theo Witsell, November 2013 monitoring & inventory
21 = Theo Witsell, July 2014 monitoring & inventory (with Rubus identified by Dr. Johnnie Gentry, U of A)
22 = Theo Witsell, November 2014 monitoring & inventory
23 = Theo Witsell, June 2015 monitoring & inventory
24 = Theo Witsell, November 2015 monitoring & inventory
25 = Theo Witsell, 13 May 2016 site visit
26 = Theo Witsell, 19 May 2016 site visit
27 = Theo Witsell, 3 & 4 July 2016 monitoring & inventory
28 = Theo Witsell, 5 & 6 November 2016 monitoring & inventory
29 = Jeff Hickle, 2017 Growing Season
30 = Jeff Hickle, 2018 Growing Season
31 = Karen Willard & Jeff Hickle, 2019 Growing Season

Scientific Nomenclature according to Checklist of the Vascular Plants of Arkansas
Arkansas Vascular Flora Committee. 2006.

Appendix VI
Woolsey Wet Prairie
2019 Adaptive Management Activities

Woolsey Wet Prairie 2019 Adaptive Management Activities:

Date	Activity
March 18, 2019	Prescribed Burn – Wildland, LLC.
April 8, 12, 17, & 22, 2019	Spot spray tall fescue, winter bromes, and winter annuals w/ Section 2EC – Jacobs
April 8, 12, 17, & 22, 2019	Spot spray yellow rocket, burdock, curly doc, & Queen Anne's Lace w/ Remedy Ultra – Jacobs
May 1, 10, & 17, 2019	Spot spray tall fescue, bromes, and winter annuals w/ Section 2EC – Jacobs
May 1, 10, & 17, 2019	Spot spray yellow rocket, burdock, curly doc, Queen Anne's lace, white sweet clover, & sericea lespedeza w/ Remedy Ultra – Jacobs
May 28 & 30, 2019 June 1, 5, 9, & 11, 2019	Karen Willard growing season invasive species and tracking species monitoring event
June 5, 13, 20, 26, 27, & 28, 2019	Spot Spray for thistle, white sweet clover, sericea lespedeza, & knapweed w/ PastureGard HL – Jacobs
June 20 & 26, 2019	Spot spray small carpetgrass w/ Section 2EC – Jacobs
June 5, 13, 20, & 27 2019	Spot spray Johnsongrass w/ Outrider – Jacobs
July 10, 12, 19, 20, & 25, 2019	Spot spray Johnsongrass w/ Outrider – Jacobs
July 20, 25, & 26, 2019	Spot spray small carpetgrass w/ Section 2EC – Jacobs
July 3, 5, 10, 11, 18, 19, 20, 25, & 26, 2019	Spot Spray for thistle, white sweet clover, & sericea lespedeza w/ PastureGard HL – Jacobs
August 1, 14, 15, & 16, 2019	Spot Spray for white sweet clover & sericea lespedeza w/ PastureGard HL – Jacobs
August 21 & 28, 2019	Spot spray sericea lespedeza w/ Remedy Ultra – Jacobs
August 14 & 15, 2019	Spot spray small carpetgrass w/ Section 2EC – Jacobs
August 15 & 16, 2019	Spot spray Johnsongrass w/ Outrider – Jacobs
September 3, 4, 5, 6, 9, 10, 12, 16, 19, 23, & 30, 2019	Spot spray sericea lespedeza, honey locust, persimmon, black willow, green ash, blackberry, callery pear, & white sweet clover w/ Remedy Ultra – Jacobs
September 6, 11, 12, 19, & 23, 2019	Spot spray small carpetgrass w/ Section 2EC – Jacobs (inflorescences 1st noted 9/19/19)
September 16, 17, 19, 22, & 23, 2019	Karen Willard post growing season invasive species and tracking species monitoring event
October 1 & 4, 2019	Spot spray sericea lespedeza, honey locust, persimmon, black willow, blackberry, & callery pear w/ Remedy Ultra – Jacobs
October 1 & 2, 2019	Spot spray small carpetgrass w/ Section 2EC – Jacobs (inflorescences prevalent)
October 14, 2019	Non-Selective boom spray of perimeter firelines w/ Cornerstone Pro – Jacobs

Appendix VII
2019 Woolsey Wet Prairie
Surplus Wetland Credit Ledger Report

CITY OF FAYETTEVILLE WOOLSEY WET PRAIRIE SURPLUS WETLAND CREDITS LEDGER
SERVICE AREA: City Jurisdictional Property Within Illinois River Watershed 8-digit Hydrologic Unit Code (HUC) watershed (11110103)

Contact: Don Marr, Chief of Staff City of Fayetteville
113 West Mountain Street
Fayetteville, Arkansas 72701
479-575-8330

Entry #	Entry Date	Available Credits	Withdrawn Credits for Impact Site	Debit (Impact) Site	Date of Credit Withdrawal	Debit Site Impacts	Debit Site COE Project/Permit No.	New Credit Balance
1	06/30/13	20.90[1]	3.09[2]	Van Asche Drive Extension Terry Gulley, City of Fayetteville Transportation Services Director 479-444-3491	June 30, 2013	0.31 acres Palustrine Emergent Wetland	2012-00525	17.81
2	01/05/15	20.90	2.94[3]	Van Asche Drive Extension Terry Gulley, City of Fayetteville Transportation Services Director 479-444-3491	October 10, 2013	0.31 acres Palustrine Emergent Wetland	2012-00525-1	17.96
3	04/16/15	NA	NA	Correcting entry to change Van Asche Drive Extension contact to be Chris Brown City of Fayetteville City Engineer 479-575-8207	NA	NA	NA	NA
4	04/16/15	17.96	3.14	Clabber Creek Recreational Trail Chris Brown City of Fayetteville City Engineer 479-575-8207	April 10, 2015	0.192 acres Emergent Wetlands	2013-00322-1	14.82

[1] As per September 30, 2013 Corps Correspondence approving use of Woolsey Wet Prairie 20.90 surplus wetland credits for impacts to wetlands caused by municipal projects within the Illinois River Watershed 8-digit Hydrologic Unit Code (HUC) watershed 11110103 (Standard Permit Modification No. 1997-14207-3) contained as Attachment #1 in January 5, 2015 City of Fayetteville, AR Woolsey Wet Prairie Surplus Wetland Credit Guidance.

[2] As per February 14, 2013 initial mitigation credit work sheets submitted to Corps contained as Attachment #2 in January 5, 2015 City of Fayetteville, AR Woolsey Wet Prairie Surplus Wetland Credit Guidance.

[3] Correcting entry for final required credits for mitigation as per October 10, 2013 Van Asche Drive Project Corps of Engineers Section 404 Permit No. 2012-00525-1 contained as Attachment #3 in January 5, 2015 City of Fayetteville, AR Woolsey Wet Prairie Surplus Wetland Credit Guidance.

Entry #	Date Updated Ledger Submitted to Little Rock District Corps of Engineers	Submitted By
1	December 31, 2014	Bruce Shackleford, ECO, Inc. 501-765-9009
2	January 5, 2015	Bruce Shackleford, ECO, Inc. 501-765-9009
3		
4		

DEPARTMENT OF THE ARMY
LITTLE ROCK DISTRICT, CORPS OF ENGINEERS
POST OFFICE BOX 867
LITTLE ROCK, ARKANSAS 72203-0867
www.swl.usace.army.mil/

REPLY TO
ATTENTION OF

Regulatory Division

STANDARD PERMIT MODIFICATION NO. **1997-14207-3**

The Honorable Lioneld Jordan
Mayor of Fayetteville
113 West Mountain Street
Fayetteville, Arkansas 72701

Dear Mayor Jordan:

This letter is in response to the request by Environmental Consulting Operations, Inc. (ECO) to recalculate impacts incurred and mitigation required for Department of the Army (DA) Permit No. **1997-14207**. The project site is located in the E ½ of section 14, T. 16 N., R. 31 W., in Fayetteville, Washington County, Arkansas.

Regulatory personnel have evaluated the original authorizations, existing site conditions, and current proposal. The impacts and mitigation credits were reviewed and recalculated based off of the original 2005 mitigation proposal, with these changes/additions:

1. On the Adverse Impacts calculation, corrected Duration value for Wastewater Treatment Plant and North Broyles Road from 0.2 to 2.0.
2. On the Adverse Impacts calculation, adjusted impact acreages based on information from ECO in June 2013.
3. On the Adverse Impacts calculation, adjusted Cumulative Impact value to account for lesser impact acreage.
4. On the Restoration and Enhancement calculation, removed Eastside Line Work as there were no impacts to restore.
5. On the Restoration and Enhancement calculation, changed the Net Improvement value for the buffer areas to 0.1, per ECO.
6. On the Restoration, Enhancement, and Creation calculations, separated herbaceous and forested as well as inside berm and outside berm to maintain consistency with original proposal.
7. On the Restoration, Enhancement, and Creation calculations, adjusted the Control value to "Covenant POA," except for Westside Line Work, which cannot be deed restricted.
8. On the Creation calculation, adjusted wetland created acreage to account for additional wetlands created.
9. On the Creation calculation, adjusted Vegetation values within the berms to 0.25, and used a value of 0.1 for areas outside the berms, per ECO.

As identified on the attached 2002 Charleston Method calculation sheets, 73.57 credits are

required to mitigate for impacts to aquatic resources for the City of Fayetteville's Wastewater Treatment Plant. We have calculated that the mitigation areas have generated 94.47 wetland credits. Therefore, the city will be able to use the excess 20.90 wetland credits to mitigate for wetland impacts generated by the City of Fayetteville within the Illinois River watershed, HUC 11110103.

The additional areas (referred to as South, West, and North Buffer) cannot generate buffer credit for this project. If you are interested in expanding the mitigation area into these areas, please submit a mitigation bank prospectus and we will evaluate these areas at that time.

This project and the Woolsey mitigation area present a unique situation in which we are considering new assessments of wetland impacts for a finalized project and recalculation of credits generated from a completed mitigation area. Please note that the Corps Regulatory Division does not intend to use this approach with other permit actions. It would not be feasible to make this a standard practice with the numerous issued permits, mitigation sites, and wetland banks finalized within the Little Rock District. The mitigation assessment credits for this 43-acre site will not be reconsidered in the future.

This letter becomes a part of and should be attached to your original permit.

If you have any questions, please contact Lisa Boyle, Project Manager, at (501) 324-5295 and refer to DA Permit No. **1997-14207-3**.

Sincerely,

M. Elaine Edwards

M. Elaine Edwards
Chief, Regulatory Division

Enclosures

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Copy Furnished:
Environmental Consulting Operations, Inc.
Mr. Bruce Shackleford, w/cy permit
Arkansas Department of Environmental Quality, w/cy dwgs
Proj Mgr, Beaver Lake PO, w/cy permit
Ch, Regulatory Enf, w/cy permit
Mr. Rocky Presley, w/cy permit