

## Firebreak Guideposts

28 May 2023 (T. Bragg and B.A. Hayes)

**Prelude:** Glacier Creek Preserve is a restored Tallgrass Prairie nature preserve used for research, teaching, and community engagement. It is among the largest of the early prairie restorations that were intended to restore tallgrass prairie, an ecosystem of which less than 1% remains. The 1856 survey of the area around Glacier Creek noted “*There is but little timber, which is in the north part of the Township on the Big Papillion...*” [this timber is well north of present Glacier Creek]. The Preserve has a diverse flora and fauna which has been maintained with prescribed burning since 1974. On average one third of the Preserve is burned each spring (a so-called 3-year fire return interval). This frequency is assumed to approximate the frequency with which the tallgrass prairie in this region was burned prior to European settlement. The Burn Unit Map shows the boundaries of the five burn units (Figure 2). More details about the Preserve are available either on the Preserve’s website <https://www.unomaha.edu/college-of-arts-and-sciences/nature-preserves/index.php> or in brochures available in the Barn.

**History in Brief:** The land presently making up Glacier Creek Preserve was part of the area first homesteaded in 1880 by Hans and Christiana Nielsen from Denmark. Most likely this was the approximate year that the area was converted from prairie to cropland. Fast forwarding, in 1959, the 65 ha (160 acre) Glen Haven Farm was donated to the University of Nebraska at Omaha (then the Omaha University). In 1950, 57 ha (140 acres) of the farm were reseeded to five species of native tallgrass prairie grasses establishing *Allwine Prairie Preserve*. Between 2009 and 2019, purchase of surrounding cropland resulted in today’s 212 ha (525 acre) Glacier Creek Preserve, a preserve that encompasses the entire Glacier Creek drainage. Glacier Creek is a small, spring-fed creek that is part of the larger Missouri River drainage. It was recorded in the 1856 land survey field notes as: “*Spring brook 4 links [0.8 m or 32 in] wide runs E.*” Allwine Prairie, now the Allwine Prairie Tract, is at the core of today’s Preserve. The purpose of this written tour is to allow you to walk the fire track at your own pace while you learn about some of the unique resources, features, and history of the preserve, a microcosm of Nebraska’s tallgrass prairie heritage.

**Guidepost Walk:** Fifteen guideposts are scattered along the 2.4 km (1.5 mi) fire track that takes you around the Allwine Prairie Tract with an additional 5 posts located along a 1 km (0.6 mi) sidetrack (Figure 1). The fire track is the boundary between the Preserve’s different burn units, so it is regularly mowed. The twenty numbered guideposts are the product of significant time and effort of Miles Divis in completion of his Eagle Scout project. Mile’s efforts were supported by other members of his Troop 99 as well as by members of their respective families.

**QR Code:** The QR Code at each of the 20 guideposts connects you to this document which provides information about the Preserve’s history as well as other biological, geological, and social features of this unique metropolitan resource. This information also is available electronically <https://www.unomaha.edu/college-of-arts-and-sciences/nature-preserves/education-use/self-guided-walk.php>.

**NOTES:** A few things before you start your walk.

1. Plants change throughout the season, so some descriptions need to be interpreted with that in mind.
2. Some of the Post descriptions below include separate paragraphs labeled **More** which is supplementary information intended to answer likely questions, but it is not essential to your viewing.
3. The order of the bullets at each Post is what we feel is most important.
4. Common names are used throughout but the scientific (binomial) name is given parenthetically as well, but only the first time to which the plant is referred.
5. Metric units are used throughout but imperial (English) units are included parenthetically.
6. List of maps available (Figure 1. Guidepost Map and Preserve Tracts/boundaries), (Figure 2. Glacier Creek Preserve Burn Units), and (Figure 3. Mitigation Bank Seeding and Grading Map).

**Post No. 1 (Metal Shed) (viewing from west (to your left) to east (to your right))**

- *Mowed Firebreak Track:* The mowed track to your right (east) is the *Firebreak Track* (i.e. the *fire track*) which, at Post 1, is the boundary (i.e. firebreak) between the *Northwest Tallgrass Prairie Burn Unit* (in front of you to the north) and the *Southwest Tallgrass Prairie Burn Unit* (behind you to the south) (Figure 2). The purpose of keeping the Track mowed is to make a defensible boundary when prescribed burning, however, it is most often used for walking the 2.4 km (1.5 mi) route around the Allwine Prairie Tract returning north of The Barn. A 0.3 km (0.2 mi) sidetrack starting from the northwest corner of the Allwine Prairie Tract will take you by the Kobs Pioneer Cemetery to the North Creek Restoration and along slope wetlands through the North Tract. Going off-track is permitted but please remain out of the research plots (described below) and avoid the area immediately around any colored flags or colored tape. These mark locations are used for research or monitoring and should be avoided. The 1.2 x 1.2 m (4 x 4 ft) sheets of metal or plywood within the prairie and adjacent habitat should not be disturbed as they are part of a long-term monitoring project.
- *Remnants of the Past:* When donated to UNO in 1959, the Glen Haven farmstead included several buildings of which only the old white garage and resident caretaker's house, both to the west, and the metal shed just behind you, remain today. Gone is the *Glen Haven Barn*, which collapsed sometime in the early 1980's. Gone too is the pig shed, the chicken house, and other structures once located west and north of *The Barn at Glacier Creek*, the current research and education center.
- *The Barn at Glacier Creek:* In 2012, a 1900 era, Sears kit barn and accompanying cement block silo were moved intact from their original location 4 miles to the southwest to the location where you see them before you today. From 2012-2013, the barn, officially *The Barn at Glacier Creek* (aka *The Barn*) was repurposed creating a fully wireless research and education facility with all the ADA specifications and other resources needed to meet on-campus classroom standards. Moving and repurposing the Barn were all possible because of generous donations by Barbi Hayes, the Roy Johnson Family Partnership, and Trilety Wade.
- *Triangle Prairie Restoration:* Just past the chain gate and on the north (left) side of the fire track is a triangular shaped area presently undergoing restoration. Prairie seeds collected from various locations within the Allwine Prairie Tract were scattered in this area in June 2020. The area is mowed occasionally to keep weedy species at bay. It was last burned in May 2023. Keep your eye on this location in future visits to the Preserve and see how prairie restorations can change over time.

**Post No. 2 (Turk's-Cap Lily) (viewing north)**

- *Turk's-Cap Lily:* The small, fenced enclosures to your left front were placed around two areas where bulbs of *Lilium superbum* (turk's-cap lily) were planted in October 2013. The bulbs were obtained from the Henry Doorly Zoo. The fencing is intended to protect the lilies from deer, at least until their populations are large enough to withstand some herbivory. Some lilies have already started to expand outside the fencing. Turk's-cap lilies generally flower in late May or early June.
- *Northwest Tallgrass Prairie Burn Unit.* From where you're standing to the hilltop in front of you is the *Northwest Tallgrass Prairie Burn Unit*. This is one of five burn units of the 57 ha (140 acres) that were restored to prairie in 1970. Prescribed fire has been used at the preserve to maintain prairie since 1974. See Figure 2 for the location of the different burn units.

**Post No. 3 (Dead Deer Draw) (viewing south)**

- *Dead Deer Draw*: During 2016, what appeared to be a road-killed deer was “dropped off” at the Barn by unknown individuals. This unexpected “gift” was dealt with biologically by dragging the carcass a hundred or so meters up the ravine to your front and leaving it there, hence the name *Dead Deer Draw*. The location of the carcass was observed over many months as a succession of natural scavengers and decomposers proceeded to return the deer from whence it came. Today, no evidence of it remains.
- *Prairie Cordgrass*: Immediately to your front is a small colony of prairie cordgrass (*Spartina pectinata*), a tall, native, grass that once dominated prairie lowlands. It can be distinguished by its long curving narrow leaves and generally taller stature than the non-native reed canary grass (*Phalaris arundinacea*) that surrounds it. This particular colony was started with a single shovel full of prairie cordgrass sod from a local population and has expanded to what you see.
- *Early Research Plots*: Poles that you can see to your left front mark the location of the western extension of long-term research plots. These plots were established in 1978 along with the eastern series of plots but were dropped from annual to decadal evaluation in 2002. You will learn more about the active research plots at Post No. 5.

**Post No. 4 (Cottonwood Snags) (viewing north)**

- *Watershed Boundary*: On the slope to your front, you can make out the boundary between the prairie (Allwine Prairie Tract) and the cropland (Barbi Hayes Overlook). All the cropland around the Preserve, from the *Bouteloua Tract* to your northwest to the *Barbi Hayes Overlook* (and beyond) to your front and right front, was scheduled for a 1000 home housing development (*The Heritage*). Imagine what this view would be like now if that had happened. In 2004, though, the housing market crashed and the Preserve was able to acquire what has now become *Glacier Creek Preserve*, thanks to generous funding support from Barbi Hayes and the Nebraska Environmental Trust, with additional funding from the Pappio-Missouri River Natural Resources District, the University of Nebraska at Omaha, and the Audubon Society of Omaha. The Preserve now effectively incorporates the entire Glacier Creek watershed thus ensuring ecological sustainability into the future, irrespective of surrounding (and out of sight) development.
- *Floral Diversity*: To your front is a colony of stiff goldenrod (*Oligoneuron rigidum*). Behind it is Canada goldenrod (*Solidago canadensis*), the Nebraska state flower. The bright yellow clustered flowers of the stiff goldenrod are covered with insects in summers, with their stems rustling in the wind in the winter. The tall plants in the distance beyond the Canada goldenrod are sawtooth sunflowers (*Helianthus grosseserratus*). This suite of fall-flowering plants characterizes the patchy diversity of a functioning native prairie.
- *Recording Environmental*: The small post-like structure in the flat area to the left of the tall, dead cottonwood snags is one of seven stations that monitor soil temperature and soil moisture. These monitoring stations extend from the hilltop behind you, down the north-facing slope to the lowland in front of you then up the south-facing slopes to the hilltop in the distance. These stations are designed to record how aspect (i.e., the direction a slope faces) results in different soil temperature and moisture conditions

**Post No. 5 (Research Plots) (viewing southeast)**

- *Research Plots*: Before you is Plot 56, the western-most plot of a suite of 45 active research plots (15 treatments with 3 replicates of each) that extend around the slope to the east. All plots have mowed boundaries. Please DO NOT WALK OR COLLECT INSIDE ANY OF THESE PLOTS since that can affect ongoing research.
- *Research Plot Treatments*: This suite of research plots is believed to be among the longest running fire research plots in the region. They were established in 1978 to study the effect of fire frequency (burned every

- year or every four years) and fire season (burned in spring, summer, or fall) on prairie plant diversity. In 2002, the study was expanded to add separate mowed plots (mulch mowing) using the same frequency and season of treatment that was being used for burning. Each plot is marked on the western or northern edge with metal corner poles. The metal pole in the lower right corner of each plot (as viewed uphill) holds a metal tag with coding that indicates the treatment of that plot: B = Burn, M = Mow, 1 = Annual burn or mow, 4 = Quadrennial burn or mow, Sp = Spring treatment, Su = Summer treatment, and Fa = Fall treatment. For example, B4Su = burned every four years in the summer. In addition to the burned and mowed treatments, one set of plots is neither burned nor mowed (UBUM = unburned and unmowed). Two additional treatments are coded “var” representing plots where the season of treatment varies (i.e., B4var = burned every four years but the season of burning varies). Coding may also be seen handwritten on some of the metal poles and some metal poles may also have tags on the upper west corner plots.

**MORE:** Both grasses and forbs are herbaceous (i.e. non-woody) plants that produce flowers so both technically are flowering plants. Grasses are distinguished from forbs by long, slender leaves with parallel veins and fibrous root systems. Forbs have broader leaves with varied shapes and venation patterns, but may have either taproots or fibrous root systems.

**MORE:** The effect of treatment can be seen in the vegetation in some of the plots, although some of the differences are subtle and some are less visible at different times of the year. Some results to date include: (1) from 1978 to the present, the number of species (referred to as *Species Richness*) increased with all fire treatments, although the increase in species was greatest with 4-year interval spring burns and annual fall burns, intermediate with summer burns, and lowest with annual spring burns. When comparing both burning and mowing, though, the increase in species richness was greatest with both annual fall mowing and 4-year spring mowing. Unfortunately, both of these mow treatments resulted in an increase of smooth brome, an invasive Eurasian grass that was kept at bay with burning. Not surprisingly, prairie species responded differentially to frequency and season of fire treatment. Some examples of forb: (1) white prairie clover (*Dalea candida*) increased with both annual spring and fall burns but not summer burns, (2) white heath aster (*Symphyotrichum ericoides*) increased with any burns that occurred in the fall, and (3) leadplant (*Amorpha canescens*) increased mostly in 4-year interval spring and fall burns doing poorly with summer burns. The different responses of prairie plants to fire frequency and season of burn emphasizes the point that a diverse regime of fire is important to maintaining a biologically diverse and functioning prairie.

- *The Tree:* If you look near the top of the hill on your right (south), you will see a lone tree that seems out of place in a prairie environment. This is a white mulberry (*Morus alba*) that has survived since the Preserve was acquired in 1959 and has become the Preserve’s unlikely mascot. It is protected from fire by smooth brome (*Bromus inermis*), a cool season grass that is always green during our spring burn and consequently does not carry fire well.

**Post 5 Sidetrack: For those interested in a sidetrack, walk from here (Post No.5) up the mowed track to the hilltop to your right (south)**

- *Prairie Weather Station:* As you walk toward the hilltop you’ll pass the lone mulberry tree we just mentioned then, slightly to the right (west) you will see a small weather station. Data from this station is transmitted through radio waves and recorded on a receiver in the Barn. A bit further up, and on the east side of the fire track, you will see a larger weather station and associated equipment. This is the *Prairie Weather Station*. A similar weather station, the *Agricultural Weather Station*, is located in cropland and may be visible on the distant hilltop across the Glacier Creek Valley to the north. These larger weather stations are incorporated in a National Science Foundation research grant by Dr. Ashlee Dere (Geography/Geology Department) and others. Additional environmental data are collected from soil probes contained in and around the weather stations in small, box-like structures on the soil surface. Data from the Prairie and Agricultural weather stations are used

in the NSF research to expand our understanding of any differences in water movement through cropland and native prairie soil. A poster in The Barn explains this project further.

- *Prairie Transplant:* Just somewhat north and east of the Prairie Weather Station is a prairie sod transplant from 1980-1981. Look carefully and you may notice an area with greater plant diversity that defines the location of this transplant (metal poles also mark the four corners).

**More:** The sod from this transplant came from a native prairie (Millard Prairie) once located at 156<sup>th</sup> and Dodge that was scheduled for development. In the fall of 1980, and again in the fall of 1981, around 200 volunteers, dug up the sod, one shovel-full at a time, loaded it onto a truck that carried it to the Preserve and, one handful at a time, the volunteers carefully packed each piece of sod into a continuous area that, after the two years, was about 50 by 50 meters (165 by 165 ft) in size. The sod was placed on top of the existing grass sod that had been burned in preparation for the transplant. You can still feel (with your feet) the slightly elevated rise where the more elevated transplant was placed on top of what was the soil surface at the time. Three other smaller sod transplants from Millard Prairie were also placed around the Preserve.

- *Omaha From a Distance (sort of):* Once on the hilltop, you can see the top of downtown Omaha well off in the distance, but several surrounding housing developments are more clearly in sight. Despite developments at the Preserve's doorstep, once you enter the Preserve, where we own all the high ground, you can view prairie pretty much from horizon to horizon as it appeared before European settlement - with enough imagination, you can almost hear the grunting of the bison herds.
- To continue with the Post Walk, return to Post No. 5 from which you started this sidetrack and look for Post No. 6 which is nearby.

### Post No. 6 (Hover Transplant) (viewing north)

- *Hover Transplant:* The four poles in front of you mark the boundary of the Hover Prairie Transplant. Hover Prairie was located southeast of 36<sup>th</sup> on Cornhusker Road in Omaha. At one time, it had been owned by the grandmother of Edward Hover, one of UNO's graduate students. *Side note:* Ed's grandmother remembered having to plow around the house to keep prairie fires away. *Back to the transplant:* Knowing the prairie was to be sold for a home site, in 2000, sod containing selected plants of particularly desirable species was dug up from throughout Hover Prairie and carried to Allwine Prairie (now the Allwine Prairie Tract of Glacier Creek Preserve). At Allwine Prairie, the sod at the site in front of you was dug up and replaced with the sod from Hover Prairie leaving an even soil surface. This process differed from the approach of placing sod on top of the existing sod that was employed in the 1980 and 1981 Millard Prairie transplant.

**More:** Sod transplants are important for obtaining well established prairie species but, perhaps even more importantly, they are important because of the below-ground biota that come with them. Below-ground diversity is an oft forgotten component of a fully functioning prairie. You can see many plants that have expanded from the Hover Transplant outside the four poles and into the surrounding prairie. What we don't know, though, is whether the soil biota have done the same?

- *Cottonwood Wetland:* In the lowland before you, the distant cottonwood snags (dead cottonwoods) mark the general area where the first trickles of the spring-fed Glacier Creek flow more or less continuously year long. The areas to the right of the snags can be water covered at times with patches of cattails indicating locations where water is more likely to persist all year. In the 1970s, this entire lowland was hayed, something no longer possible because changes in the hydrology in recent years have increased surface water, although in 2023, much of the "wetland" was dry. A few willows (*Salix* spp.) can be seen in the wetter areas of the lowland where the flames of prescribed burns cannot easily reach.
- *Plot 55:* FYI - Behind you (south) is Plot 55, which is mowed annually in the spring (M1Sp)

**Post No. 7 (Glacial Till) (viewing east to southeast)**

- *Glacial Till:* Most surface soils across Glacier Creek Preserve are loess (windblown) soils however, in a few locations, including the one in front of you (Research Plot 54), glacial till is exposed at the soil surface. Glacial till is the sediment that was deposited by glaciers but left behind as they retreated from the area around 11,700 years ago. Here, the glacial till includes rocks of various sizes and colors. The two large glacial erratics (i.e., rock material not of local origin) seen here were found near the Barn but placed here to represent what is likely to have been present prior to cultivation. Most likely, these large erratics were among those removed from when the fields were first tilled.
- *Annual Fall Burn:* Research Plot 54, the plot before you, is burned annually in the fall (B1Fa). Areas burned in the fall initiate plant growth earlier in the spring than other seasonal treatments, in large part because litter (dead plant material) is burned off leaving bare soils in the spring that warms more quickly than soils with litter cover. Warmer soils initiate plant growth earlier in the year so fall burns tend to favor species of plants that initiate growth earlier in the season, such as sedges (*Carex* spp) and smooth brome (*Bromus inermis*), the latter being an undesirable and aggressive Eurasian grass. In this fall-burned plot, also notice also that clumps of grass, mostly little bluestem (*Schizachyrium scoparium*), seem to be somewhat raised above the soil surface, occasionally with small erosion channels between clumps, suggesting that fall burning may increase soil surface erosion.
- *Sedge Expansion:* Just upslope from you to the south are two metal stake pink flags that mark the end points of an 11-meter long transect extending from upslope to down slope. Plant species composition is evaluated along this transect each fall as part of the long-term research project. In 1978, when the research plots were being established, three porcupine grass (*Hesperostipa spartea*) plants were transplanted from a long-since destroyed prairie (Florida Prairie) and placed halfway between these two flags in order to add cool-season grasses to what was predominately a warm-season grass prairie. Inadvertently, along with the porcupine grass transplants, came sedges (*Carex* spp). By 2023, these sedges had expanded by underground roots reaching outwards about 5 m (15 ft) from the central location at which they were first introduced. The extent of the sedges can most clearly be seen in the early spring when the sedges are among the few plants that are green. Sedges are an often overlooked, short understory plant of native prairies and an important component of any seed mix attempting a prairie restoration.

**Post No. 8 (Cattails and The Peninsula) (viewing north)**

- *Cattails:* The patch of cattails in the creek bed in front of you indicates the location of the south fork of Glacier Creek which flows from left to right (west to east). The cattails also mark the western end of what once was a series of three farm ponds that were constructed in the 1950s by damming the creek at three locations. The long, thin stretch of Glacier Creek below you was the western-most farm pond with the two others located northeast and east of Post No. 8. From 2000-2001, with funding from the Nebraska Environmental Trust, these farm ponds were removed and the entire lowland to your front, from the dead cottonwoods at Post No. 4 to the eastern border of Allwine Prairie Preserve (Post No. 11), was graded to approximate the historic morphology of the prairie stream noted in the 1856 section-line survey. The area was then seeded with locally collected native prairie species.
- *The Peninsula:* Looking from the cattails in front of you across the flat area to the other side of the lowland you can see a group of trees, including a dead cottonwood tree. These trees mark the location of the north branch of Glacier Creek. The jut of prairie between the two branches of Glacier Creek, referred to as the *Peninsula*, was once separated from the lowland prairie further to the west (the Cottonwood Wetland), with an elevated soil berm. The berm was designed to divert runoff to the north and away from the farm ponds into a drainage ditch. The drainage ditch was filled during the 2001 lowland restoration. The western most end of this diversion ditch was located approximately at the location of the small group of trees along the north

branch of Glacier Creek. Both the berm and the diversion drainage are most easily seen in aerial photos, although plant species composition can give a clue on the ground.

- *Note:* Given the view from Post No. 8, it is useful to remind you that, as elaborated on at Post No. 4, all the cropland you can see across the valley would have been houses, instead of being part of the Preserve operation, but for significant donor and funding support.

### Post No. 9 (Springs Slope) (viewing north to northeast)

- *Plant Diversity:* Immediately in front of you is an area of high plant diversity that includes rattlesnake master (*Eryngium yuccifolium*) and prairie blazing star (*Liatris pycnostachya*), both of which are uncommon at the Preserve. This area has an abundance of other prairie plants including roundhead lespedeza (*Lespedeza capitata*), the plant with the clustered, dark-colored flower head. In the 1970's, this was one of the first areas seeded with native plants, although more species have been added to the area since then.
- *Springs:* Just down the slope from Post No. 9, and along the steeper south side of the creek bank, is the general location of a concentration of several small springs and seep areas that continuously feed Glacier Creek. They don't amount to much individually but together, along with other springs and seeps further up and downstream, they maintain a constant creek flow that has persisted at least since the 1856 section line survey. These springs emanate from a soil layer of glacial origin, which was the impetus for the creek's name. Glacier Creek has been assessed to be the highest quality stream in Douglas County and was identified as Douglas County's Reference Stream by the County Health Department. The springs, and slope wetlands (explained at Post No. 13), are a result of the geologic history of the area (see below for more).

**More:** A short description of Nebraska's recent geologic past will explain much about Glacier Creek Preserve's geologic and biologic diversity. Continental glaciers covered parts of eastern Nebraska during the Last Glacial Maximum, which peaked approximately 26,000 to 19,000 years ago. During this time, a massive ice sheet, known as the Laurentide Ice Sheet, extended over much of North America, including portions of eastern Nebraska, where the soil beneath glaciers was compacted by their tremendous weight. As the glaciers pushed southward they pushed before them rocks, boulders, gravel, and soil derived from the erosion and entrainment of material by the moving ice of the glaciers. As the climate began to warm at the end of the Pleistocene epoch, the glaciers gradually retreated northward so by approximately 11,700 years ago, the glaciers had largely disappeared from eastern Nebraska. The retreating glaciers, however, left behind evidence of their past presence in various forms including as *glacial till* (miscellaneous gravelly and rocky material deposited by glaciers). The glacial till-layered surface was subsequently covered by massive amounts of wind-blown material (*loess*) that had been picked up from the river channels flowing out of the retreating glaciers. This loess was deposited across large areas of eastern Nebraska and western Iowa (note, for example, the Iowa Loess Hills). Which brings us to today.... Precipitation falling on the soil surface percolates through the loess and into the glacial till. When it reaches the compacted soil beneath the glacial till, it can penetrate no deeper, so it travels horizontally through the soil until it exits as springs or seeps in valleys or along slopes. These springs feed Glacier Creek, hence its name, but also feed several slope wetlands (more on them later in the walk).

- *Branches of Glacier Creek:* In the valley to your right front is the junction of the north and south branches of Glacier Creek. The north branch drains mostly crop land but some prairie while the south branch drains only prairie. This difference in vegetation surrounding these branches has been the foundation of significant research.
- *Farm Pond Dams?* If you know where to look, or have a good imagination, you might be able to pick out a remnant of the largest old farm pond dam to your right front. Most of the dam was lost during the 2000-2001 lowland restoration (see Post No. 8 for more details).

- *Boocker Point*: Between groups of trees on the distant hilltop you can see the Agricultural Weather Station mentioned earlier at Post No. 5 (assuming you took the sidetrack). While not clearly visible, on the highest ground beyond the weather station is *Boocker Point*, named after a previous Dean of Arts & Sciences who supported the Glacier Creek Project when the project was focusing on purchasing the land that makes up today's Preserve (Figure 1).
- *Note*: Behind you (looking south) is Research Plot No. 28, which is burned every four years in the summer (B4Su)

### Post No. 10 (Prairie Cordgrass) (viewing northeast)

- *Remnant Prairie Cordgrass*: In the draw to before you is a stand of prairie cordgrass that is believed to be the only remnant of the historic prairie that once dominated this lowland. As described at Post No. 2, prairie cordgrass is a tall, native species of grass that is characterized by long, thin, curving leaves. It is generally found in wet, lowland areas. This particular stand survived the 2001 lowland restoration and since has expanded further into the restoration. In the winter, its color is more tan than brown but, in the summer, it is more difficult to distinguish from the surrounding vegetation.
- *The Seep*: About 10 m (33 ft) to the west (left) of the prairie cordgrass and in a small swale is *The Seep*, a small area where ground water continuously seeps to the surface, even remaining mostly unfrozen throughout the winter. Prior to the lowland restoration, this was the location of a large willow tree, typical of what we see now on slope wetlands (more on this subject later). If you try to investigate, be aware that the ground is uneven and difficult to navigate... but, for the curious, worth the effort.
- *The Sonde*: To your right front, in the center of the valley, you can see a bright spot that is the solar panel that supports the *Sonde*. The sonde, a water quality recorder, is permanently placed in Glacier Creek. Every 15 minutes, it records data on seven water characteristics: dissolved oxygen, turbidity, fluorescent dissolved organic matter, temperature, specific conductance, oxidation reduction potential, and pH. These data are downloaded and used both for research and to monitor water quality conditions over time. Located downstream from the sonde is a flow meter that records the amount of water flowing in Glacier Creek.

**More:** Based on 2017-2020 data, Glacier Creek averaged 10 Liters/second (L/sec) (20 cubic feet per minute (cfm)) annually, ranging from 2 - 72 L/sec (4-154 cfm), with the lowest flows most likely occurring during summer. An unusually high flow of 193 L/sec (408 cfm) that occurred in March 2019, the day after a bomb cyclone, was not included in the average.

- *Nutrient Network*: Behind you (south) on the distant slope is a series of fenced plots. This is the location of ongoing research that is part of the global Nutrient Network program. The purpose of this research is to collect data from a broad range of sites in a consistent manner to allow direct comparisons of environment-productivity-diversity relationships among systems around the world. The fencing is to prevent large herbivores, such as deer at Glacier Creek Preserve, from affecting the plants in the plots.
- *Note*: The research plots behind you are Plot 26 (B1Su) (burned annually in the summer) and Plot 25 (M4Fa) (mowed every four years in the fall).

### Post No. 11 (The Bridge and 2022 Mitigation Bank) (viewing north)

- *South Papio Tract and Glacier Creek Restoration*: The lowland and adjacent slopes in front of you make up the *South Papio Tract*. This is the location of the *Glacier Creek Restoration* where, from 2021-2023, both stream and wetland habitats were restored in a previously farmed lowland that was bisected by the deeply incised Glacier Creek. The project for the restoration, the *Glacier Creek Stream & Wetland Bank Project*, was funded by the Papio-Missouri River Natural Resources District (NRD) to recover funds used to help purchase the property in 2009. See "More" below for details. The walking bridge here is part of the mitigation bank

project. It was constructed in 2022 in order to provide dry and safe access across the creek, at least for those not inclined to get wet, muddy feet.

**MORE:** In 2009, the Papio-Missouri River Natural Resources District (NRD) provided a portion of the funding needed to purchase the approximately 34 ha (83 acres) of what is now the *Papio Tract* with the understanding that, while the Preserve would own the land, the NRD would be able to use the tract to create a stream and wetland mitigation bank. *Mitigation* is a term used when referring to the process of restoration, creation, or enhancement of (usually) wetlands or streams to compensate for federal or state permitted losses. A *mitigation bank* is a location at which wetlands, streams, or other aquatic resources have been restored, established, enhanced, or preserved and where credits (basically a defined amount of land or stream length) can be purchased by those whose permitted activities adversely affected wetland, stream, or aquatic resources elsewhere. Typically, mitigation banks include wetlands and streams.

- *Glacier Creek.* To your left (west) you can see Glacier Creek flowing out of the Allwine Prairie Tract, across the low-water crossing, and under the bridge heading east into lowland that makes up the Glacier Creek Restoration. The low-water road crossing you see here replaced two large, 1950's era, drop structures that diverted Glacier Creek under the road and into a deeply incised creek bed on the east (right) that was up to 6 m (20 ft) deep in places. During restoration, the incised creek bed was raised such that now Glacier Creek winds its way across a more level lowland much as we envision it might have in the past. The banks of the creek are stabilized variously with river rocks or erosion control wattles (straw rolled into long rolls) with willow sprigs or bundles added in 2022 to further stabilize the banks. Note that the appearance of the mitigation bank will change dramatically, especially over the first few years, so some of the sights you see now may appear to be very different in any future visits.

**MORE:** In the restoration before you, there are two large depressions that tend to retain water for longer periods of time than others. *The Pond*, which has retained at least some water since it was excavated in the spring of 2022, will be seen better as you approach Post No. 13. From here, it is just out of sight to the northeast. The second of the large, semi-wet depressions, the *Southeast Bottoms*, is out of sight in the southeastern-most corner of the mitigation bank. Various species of ducks, geese, and shorebirds have been seen at both these locations when they contain water. In addition to these two large depressions, scattered throughout this lowland are smaller, shallower swales that are designed to temporarily hold water in the spring in order to provide breeding habitat for the various amphibians (e.g. frogs, toads, and salamander) that require water at some point in their life cycle. These swales were designed to dry up during the summer to prevent fish from surviving, fish being major predators of amphibian eggs and larvae.

- *Glacier Creek Concrete Baffled Chute (aka Spillway):* Glacier Creek ultimately flows into the Big Papillion Creek over a large, stepped baffled chute, euphemistically referred to at the Preserve as a "spillway", located at the tree-line in the distance to the east. You will be able to see a similar structure at Post No. 16 at the North Creek Restoration in the North Papio Tract. A few years ago, a Great Blue Heron (*Ardea herodias*) rookery occupied the tall trees near the spillway but the birds have not returned since a substantial hail storm damaged the roost.
- *Trestle Bridge:* Looking northeast, across the lowland to the tree-line is an old trestle bridge stretching across the Big Papillion Creek. The bridge is barely visible even in the winter but glimpses of it can be seen from here and as you walk further north. According to the Kobs family, whose family has farmed in the area since the late 1800's, the bridge was moved from Superior, Nebraska (Nuckolls County) sometime in the 1950's with the purpose of enabling the farmer to cross over the creek to reach crop fields on both sides. It was disassembled for the move. This bridge, which may be the only bridge of its kind in Nebraska, is no longer functional and is unsafe to walk on or under.

**Post No. 12. (The Allwine Prairie Tract Overview) (viewing southeast to southwest)**

- *The View:* From this vantage point you get a particularly good overview of the Glacier Creek watershed, from the Bouteloua Tract to the right (west), which extends up to Military Road (where you can see the houses), to the Barn at Glacier Creek along the tree-line in the valley, to both the North Tallgrass Prairie (foreground) and the South Tallgrass Prairie (across the valley in the distance), to the South Papio Tract in the east (left). Note the patchiness of the vegetation across the Preserve. This patchiness (or *heterogeneity*) is typical of prairie ecosystems and suggests an underlying diversity at Glacier Creek Preserve that is central to a sustainable and functional ecosystem.
- *Research Plot Array:* Across the valley you can see the patchwork of research plots with the fire track on which you walked just this side of them. In the valley below, you can see both branches of Glacier Creek. The group of trees (with one large, dead cottonwood) in the valley to your right front is the effective head of the north branch of Glacier Creek. A small cattail marsh can be seen just left (east) of the trees.
- *Barbi Hayes Overlook:* Behind you (north) is the Barbi Hayes Overlook, which was acquired in 2013 largely with funds from Barbi Hayes. This, and other recently acquired property around the Preserve, is rented out for farming which provides much needed operating funds for the Preserve.
- *Allwine Prairie North Fence-Line:* Viewing both east and west from Post No. 12, you are looking along what once was the fence-line marking the north property boundary of the original, 57 ha (140 acre) Allwine Prairie Preserve.

**Decision Time:** From this post (Post No. 12), you can go back to the Barn the way you came or, if you want to continue, you can either continue west along the fire track and back the 1.2 km (0.75 mi) to the Barn or you can continue into the North and North Papio Tracts. If you choose to continue west from Post No 12 (back to the Barn), the track will take you by Posts 19 and 20, which would complete the 2.4 km (1.5 mi) around the Allwine Prairie Tract. Descriptions of Posts 19 and 20 can be found below - Post descriptions are listed in numerical order. If, instead, you're interested in exploring the North Tract and the North Papio Tract (see map), a 1 km (0.6 mi) (one way) sidetrack will take you by Posts 13-18, which include the Pioneer Cemetery and the North Creek Restoration. This route will involve walking up to Post 18 then back here, to Post No. 12, before continuing back to the Barn along the Allwine Prairie Tract. Taking this route would make the total distance of your walk (Barn to Barn) about 4.8 km (3 mi) or just 4.1 km (2.5 mi) if you skip the side, sidetrack to Post No. 18 and just go to the North Creek Restoration (see Figure 1).

**Post No. 13. (Slope Wetland) (viewing east and southeast)**

- *The Pond and Southeast Bottoms:* From Post No. 13, you get a broad overview of the South Papio Tract mitigation bank including the meandering, rock-lined Glacier Creek, the Pond in the center of the view and, in the distance, the Southeast Bottoms (See Figure 3). Blue-Winged Teal (*Spatula discors*) spent the summer of 2022 in the Pond with Mallards (*Anas platyrhynchos*) more common this year. Mallards have also been observed in the Southeast Bottoms when there is water but, usually, the only way to tell for certain if it has water is to take a cross-country hike. Also, from here, you may be able to make out some of the swales throughout the lowland. Ecological succession is likely to dramatically change the appearance of the mitigation bank, especially over the first few years, so some of the sights you see now may appear to be very different in any future visits.
- *Early Farmstead:* Due south (to your right) and across the crop field, is a grove of trees in the northeast corner of the Allwine Prairie Tract. In the lowland just below (east) of the trees, aerial photos from 1941 show what appears to be a farmstead with several structures, some extending east to the Big Papillion Creek. By 1962, the farmhouse appears to still be there but the outbuildings are gone and, sometime thereafter, no structures

can be seen with the entire lowland being uniformly farmed in 1994 aerial photos. An occasional red brick or piece of glass or porcelain may still be found in the field, last bits of evidence of past use?

- *Slope Wetlands*: The wooded area to your immediate left front is a slope wetland that is dominated by willow (*Salix* spp) trees. Willows are characteristic of wet areas so are normally found in lowlands or along creeks and rivers yet in the wooded area to your left, they are found on slopes in micro-ecosystems described as *slope wetlands*. In the middle of these trees is a small area with a spring that flows year long. This spring feeds into a loosely defined, small channel that extends about 5 m (15 ft) downslope before vanishing underground again resulting in saturated soil conditions that favor the wet-area species such as willow, sedges, and horsetail (*Equisetum* spp), that occur here. Some of the area around this slope wetland has been modified with various dams and berms, perhaps to keep water from seeping onto the crop field below.

**MORE:** At least at Glacier Creek Preserve, slope wetlands are a function of the geologic history of the area, as was explained at Post No. 7. Rather than groundwater occurring as springs that feed into a creek, as it does with Glacier Creek, groundwater that seeps to the surface on sloping ground, probably from buried glacial till, flows downslope over the surface for a relatively short distance then, where soil conditions are suitable, moves back underground. This process creates the saturated conditions for a short distance downslope that support slope wetland plant communities. While generally continuous across slopes, there are at least 5 principal slope wetland locations at Glacier Creek Preserve. At all of these locations, the area around them has been modified with various dams and berms by early farmers, perhaps to keep water from seeping onto crop fields further below.

- *East Slope Wetland Recovery Plot*: This is one of two slope wetland recovery plots in which, through use of prescribed burning and invasive tree and herbaceous plant control, we are attempting to reestablish what these slope wetlands may have been like when only prairie dominated the surrounding landscape.

#### **Post No. 14. (Kobs Pioneer Cemetery) (viewing north)**

- *Kobs Pioneer Cemetery*: Established in 1879, the Kobs Pioneer Cemetery is a Nebraska State Historical Site. Up to 22 graves were once situated here but only three gravestones remain (see the historical marker for details). Based on discussions with Ernie and Marjorie Kobs, who farm the area along State Street adjacent to the Preserve, bad blood among past relatives resulted in cattle grazing in the cemetery which, along with theft of some headstones and poor care of the grounds, leaves only the three you can still see. The fencing around the headstones extends eastward, presumably incorporating the area in which the missing graves were once situated.
- *Cemetery Slope Wetland*: Directly downslope from the cemetery is another slope wetland. There are fewer willows in this site, but other wetland plants are present, including several species of sedges.
- *Cemetery Equisetum*: A short distance to the northeast of the cemetery is a draw in which rough horsetail (*Equisetum hyemale*) is abundant, although it is mostly visible in the fall since grasses overtop the plant early in the growing season.

#### **Post No. 15 (South Papio Overview) (viewing south and southeast).**

- *The Haul Road*: This post sits next to what was the “haul road,” the road that was used to move construction equipment and supplies from State Street to the North Papio wetland during the restoration.
- *South Papio Tract Overview*: Viewing south along the haul road, you get a broad overview of the South Papio Restoration including one of the larger, more northern swales. See Figure 3 for the location of some of the topographic features of the restoration.

- *The Old Dam*: Half-way down the hill to your front, and to the right, was a small earthen dam, most of which was removed during construction of the haul road. Four large cottonwoods (*Populus deltoides*) are located along what would have been the edge of the impoundment.
- *State Street*: The vehicle traffic that may be seen well to the south is traveling along State Street. State Street is the southern boundary of the Kobs farm that abuts the South Papio Tract on the south (Figure 1).

**Post No. 16. (Big Papillion Creek Overview) (viewing west to east)**

- *Big Papillion Creek*: The Big Papillion Creek, which flows from north to south at the base of this hill to the right, marks the eastern boundary of Glacier Creek Preserve.
- *North Creek Concrete Baffled Chute (aka Spillway)*: Looking north along the fire track (and old haul road) you can see the eastern portion of the North Creek Restoration including its spillway into the Big Papillion Creek. See Post No. 17 for more information.
- *North Slope Wetland Recovery Plot*: The wooded area immediately to the northwest of Post No. 16 is the second of the two slope wetland recovery plots. See Post No. 13 for information on slope wetlands.
- *Hill Prairie Restoration*: The small hill around this post (Post No. 16) is a general area in which we plan to establish a hill-prairie similar to those found along hilltops in both the Iowa Loess Hills and UNO's T.L. Davis Preserve. This project has not yet been initiated.
- *North Slope*: Looking west along the tree-line, in the distance you will see a north-facing grassy slope with scattered eastern red cedar trees (*Juniperus virginiana*) that part of what is referred to as the *North Slope* (See Figure 1). See Post No. 18 for more information on the slope.

**Another Decision Time:** From here (Post No. 16), both Posts 17 and 18 can be visited. The track down the hill to your north takes you to Post No. 17 where you can view North Creek and the North Papio Tract restoration. Northwest across the track and just this side of the southeast corner of the North Slope Wetland Recovery Plot, is the mowed track that goes for 0.4 km (0.25 mi) (one way) to Post No. 18. Both Posts are described below. Posts 17 and 18 also are out and back sidetracks that bring you back here, to Post No. 16, from which you can return via the Kobs cemetery to Post No. 12 and on west to the Barn. Ultimately, Post No. 18 will be connected to Post 19 along a track across the Preserve yet to be developed (See Figure 1).

**Post No. 17. (North Creek Restoration) (viewing northwest to northeast)**

- *North Creek Concrete Baffled Chute (aka Spillway)*: Before you is the spillway that joins North Creek with the Big Papillion Creek. This spillway is essentially the same as the one for Glacier Creek. Perhaps because the soil water is still adjusting to the effects of construction, or perhaps because of unusually dry weather, North Creek has yet to reach the spillway with enough water to test its effectiveness, at least as of summer 2023.
- *North Creek Water Source*: To the northwest you view across the North Creek Restoration where you can see the channel for the creek winding its way through this long bottomland, even with no water flow. North Creek originates both from springs on and off the Preserve and from runoff from *The Heritage* housing development, which is mostly out of sight to the northwest. Portions of the wooded area that can be seen in the distance to the northwest is are on the Preserve but other portions are owned by the *Heritage Homeowners Association*. The wooded area includes a wetland that, at least at one time, supported a beaver dam, crayfish, and other wetland species. Some water to the *North Creek Bottomland* seeps in, mostly below ground, from the Preserve's slope wetlands that are part of the long stretch of trees extending from southwest of Post No. 17 further west.

- *Willow Bank Stabilization:* Willow sprigs and bundles have been planted along the margins of the bottomland in order to stabilize the banks, but the creek channel has not been edged with river rocks as it was along Glacier Creek. Large concrete fragments make up the rip rap is used near the spillway.
- To get to Post No. 18, the next post in sequence, return to Post No. 16. From Post No 16, go northwest across the track to where there is a mowed track that goes west for 0.4 km (0.25 mi) (one way) to Post No. 18.

#### **Post No. 18. (North Slope Tract and Horsetail) (viewing 180 degrees)**

- *North Slope:* To the south of Post No. 18 is the North Slope Tract, early aerial photos suggest some form of agricultural use of the slope, although currently it's been described as "too rocky and too wet to farm." In the absence of any active management, eastern red cedar (*Juniperus virginiana*) has invaded but efforts are underway to remove the eastern red cedar and begin to restore this area to prairie.
- *Horsetail Slope:* Here the track goes through one of the denser stands of field horsetail (*Equisetum hyemale*), a plant that likes wet soil conditions. Note that the horsetail extends both downslope (north) into a slope wetland, where you can see willow trees, cattail, and other wetland species, and upslope (south) into the North Slope where its presence is indicative of wet soil condition, even without the other wetland species.
- *View of North Creek Restoration:* Depending on the time of year, you may be able to see the North Creek Restoration through the trees to the north.

What Next: To continue the Firebreak Post Walk, from Post No. 18, return to Post No. 16 then, via the cemetery, back to Post No. 12. From Post No. 12 walk west until reaching Post No 19. The walk back to the Barn from Post No. 12 is about 1.2 km (0.75 mi) from (Post No. 12). Again, you can also go back any way you want!

#### **Post No. 19. (Fence-Line Restoration) (viewing south)**

- *Bouteloua Tract:* Post No. 19 is located at the northwest corner of the Allwine Prairie Tract. The agricultural field extending from where you stand downslope and all the way to the south (State Street) and southwest (Military Road) is the *Bouteloua Tract*. Purchased in 2015, it was named by Barbi Hayes, the principal donor, for her favorite prairie grass, side oats grama (*Bouteloua curtipendula*). The purchase of the Bouteloua Tract incorporated the upper reaches of the Glacier Creek watershed thus preventing off-site pollution from flowing into the Preserve. Today, the Preserve extends from hilltop to hilltop so that, when in the valley, prairie can be viewed from horizon to horizon.
- *Fence-Line Restoration:* Paralleling the trail to the right and downslope (south) is the *North Fence-Line Restoration*, a 4-5 m (13-16 ft) wide strip between the prairie on the east and the farm field on the west that extends south to the wooded area in the valley. The *South Fence-Line Restoration* extends from south of the woodland further south to State Street. This restoration, which was designed to connect the Allwine Prairie Tract with the recently acquired Bouteloua Tract, started in 2018 with removal of the fence and the associated line of trees that extended along the western edge of the Allwine Prairie Tract. After selected herbicide application to control areas of smooth brome, the restoration was disced in preparation for seed scattering. In the years since, native prairie seeds have been scattered and individual plants have been transplanted into the restoration. Transplanted plants came from the area along State Street that was being affected by the 2023 widening of State Street. Seeds were either locally collected or purchased from the *Prairie Plains Resource Institute*. As you walk down the fire track, note the higher diversity in the fence-line restoration than in the Allwine Prairie Tract, a consequence of different restoration efforts.

**MORE:** The 1970s restoration of the original Allwine Prairie Preserve involved seeding only five native warm-season (big bluestem, little bluestem, Indiangrass *Sorghastrum nutans*), switchgrass

(*Panicum virgatum*), and sideoats grama) but not forbs. Over the years, locally collected prairie plant seeds have been scattered throughout the already-established stand of grass on the Allwine Prairie Tract. While we continue to scatter seeds throughout the Allwine Prairie Tract, the diversity remains lower than in the Fence-Line restoration pointing out the importance of including both grasses and forbs when initially restoring prairie.

- *Audubon Wetland*: In the lowland of the Bouteloua Tract is a small grove of green ash (*Fraxinus pennsylvanica*) surrounded by smaller willows. On the south side of this grove of trees is the *Audubon Wetland*, named after the Audubon Society of Omaha who provided funds towards purchase of the Bouteloua Tract.

### **Post No. 20 (Spartina Plots) (viewing south and north)**

- *Spartina Research*: The lowland before you is dominated by reed canary grass (*Phalaris arundinacea.*), a tall, aggressive Eurasian grass that does well in wetter lowlands where it can withstand conditions that native species cannot (e.g. siltation) and where it depletes soil resources. Together, these characteristics result in the loss of native prairie species. To try to control reed canary grass so as to allow native species to flourish, research plots were established in 2018 by Erin Wolfe, a Graduate Student at UNO. The Spartina Plots, the corners of which are marked by tall poles, are on both sides of the firebreak track and contain a sub-plots of prairie cordgrass and sawtooth sunflower (*Helianthus grosseserratus*) embedded within a stand of reed canary grass (see Figure 2). Both East and West Plots are burned annually in the spring but the plot to the east is also mowed annually around 1 July. It's too early to see clear results.
- To your right front (southwest) are a series of tall poles extending from north to south. These are the siltation poles where the rate of silt being deposited from upstream is regularly recorded.
- Behind you (north) is one of the more diverse plant communities of the Allwine Prairie Tract. The diversity is most visible during late summer and fall.
- As you walk from Post 20 back to The Barn, you are walking across an area that, in the 1940s was a closely grazed, fenced-in barnyard for farm animals, probably horses, cows, or pigs. In the 1980's this same area, then part of Allwine Prairie Preserve, was an area dominated by giant ragweed (*Ambrosia trifida*), and, as you can see, today it is an area dominated by the non-native reed canary grass. Someday, it will be prairie!
- In 2017, the wooden boardwalk you see extending before you was installed across the lowland to assist hikers during wet times when this lowland area can be saturated or have constant flow of water. As mentioned in Post No 6, the hydrology of the lowland has changed over the years so the boardwalk is maintained for the future as much as for the present.

### **END: Back at the Barn, which ends your Glacier Creek Guidepost Walk.**

While updates on the Guidepost Walk text will change as we make corrections and updates over time, the most recent version will be available on our website <https://www.unomaha.edu/college-of-arts-and-sciences/nature-preserves/education-use/self-guided-walk.php>. If you have questions, comments, or suggestions, please pass them on to us, and thanks for taking time to visit.

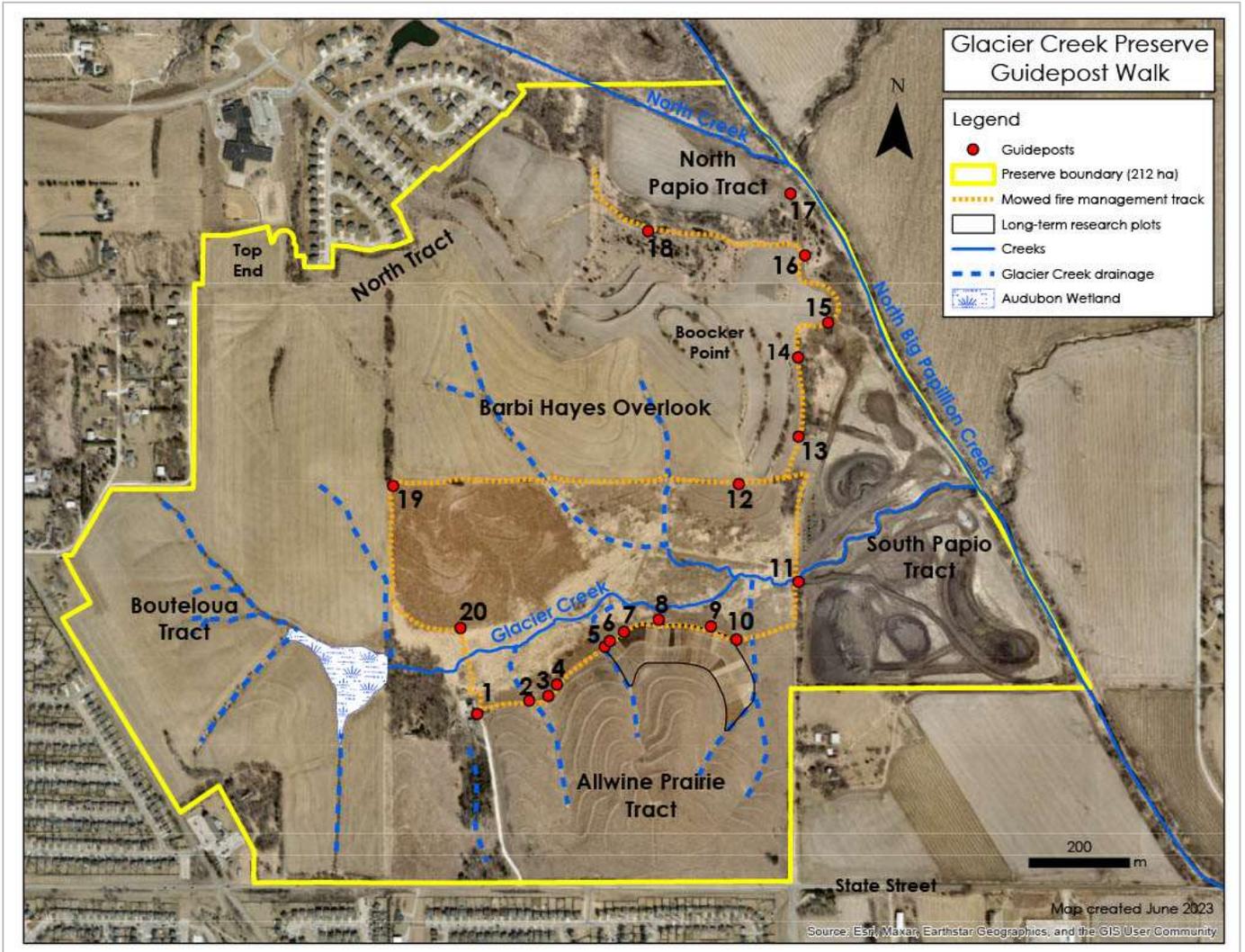


Figure 1: Guidepost locations and principal features for self-guided walk.

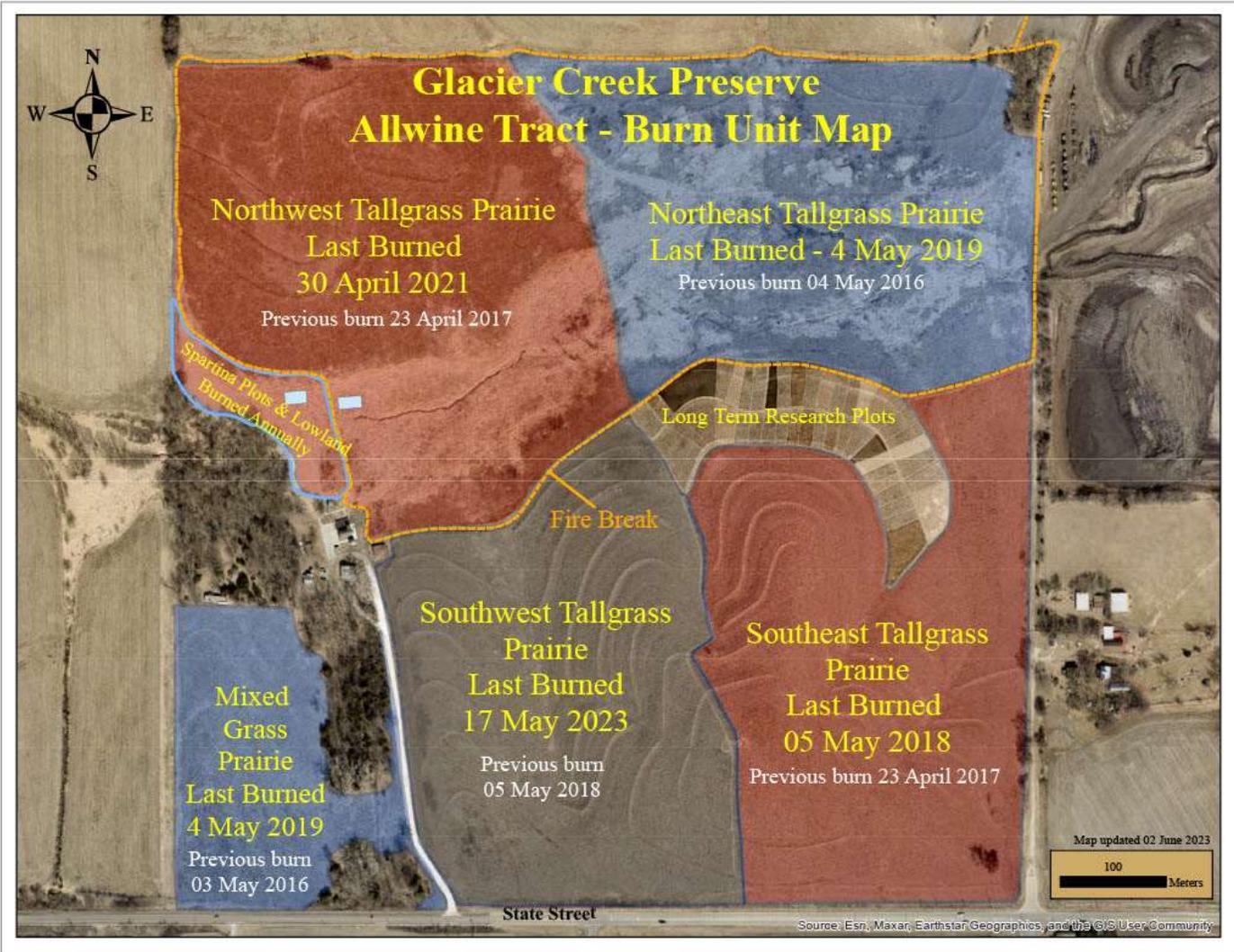


Figure 2: Burn units of the Allwine Prairie Tract of Glacier Creek Preserve.

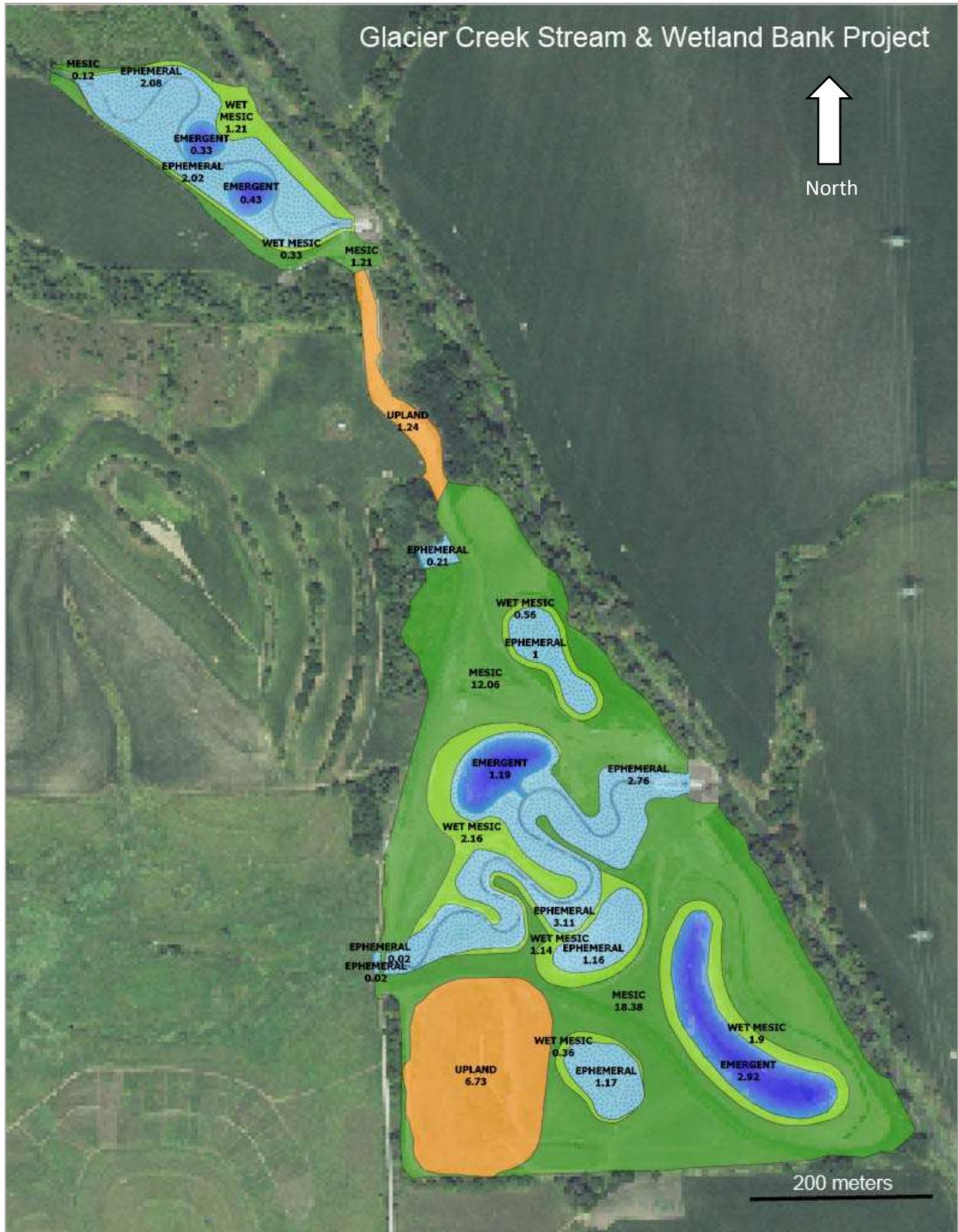


Figure 3: Glacier Creek Stream and Wetland Bank Project map showing general location of major features.