THE LOWER RUSH RIVER

PRESENT HEALTH

AND A CALL TO ACTION

Prepared by Carl A. Nelson

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Carl is an engineer, landowner, and trout fisherman. From his first introduction to the Driftless Area more than 45 years ago, he has developed a deep connection to the land. He has owned and managed 200 acres of forested and agricultural land in Maiden Rock, Wisconsin since 1988. He is past chair of the Wisconsin Woodland Owners Association (WWOA) West Central Chapter, and an active member of The Prairie Enthusiasts, St. Croix Valley chapter. He holds a Ph.D. in Structural Engineering from the University of Minnesota. He was formerly vice president of ESI Engineering in Minneapolis, and currently is a registered Professional Engineer in Minnesota, Wisconsin, Iowa, and Nebraska.

As stated in the title, this report is “A Call to Action,” and those wishing to join an exploratory working group are encouraged to contact Carl at cnelso96@gmail.com.

Cover Photo: Sediment deposit during spring floods of 2019 with maple-basswood forest on slope in background. Section 16 Salem Township. Carl Nelson photo.

Introduction

The Rush River is a tributary of the Mississippi River lying almost entirely within Pierce County in west central Wisconsin, approximately 50 miles southeast of St. Paul, Minnesota. The river valley is a mosaic of different natural and man-made landscapes: from forested hillsides and dolomite bluffs to agricultural fields to flood plain forests and open wetlands. These landscapes include a variety of natural communities and pockets of relatively undisturbed land. The Rush and its tributary valleys contain a significant fraction of the forested land in Pierce County. The river itself is known as a popular trout stream.

From just above State Highway 10 to its mouth at Lake Pepin, the Rush River enters a broad valley that has been farmed since the late 19th century. This lower portion of the river, lying in El Paso, Salem, and Maiden Rock Townships is the subject of this report, and will be referred to as the "Lower Rush." While the upper reaches of the river have some of the same natural communities and face some of the same threats, the current document focuses on the lower Rush. The land use and ownership are noticeably different in this section, in particular the presence of row crops, paved roads, and large blocks of public land. Due to these differences, some unique opportunities exist for preserving the land and enhancing biodiversity.

The lower Rush currently faces a number of threats. These include:

- Excessive siltation and loss of water quality
- Soil erosion in the tributary valleys and ridge tops
- Lack of grassland habitat with an associated loss of biodiversity and grassland bird habitat
- Fragmentation and loss of forested lands with impact on forest-interior birds
- An overpopulation of whitetail deer, causing a host of environmental problems
- The rapid spread of invasive plants such as buckthorn, garlic mustard, and reed canary grass
- Disturbance and habitat destruction along the river banks due to frac sand mining.

Addressing these issues is a huge challenge. As a first step, this report examines the current state of the lower Rush River, with an emphasis on the river and floodplain environment, land use and public lands, fauna and flora, invasive species, and other threats to the fragile natural communities that form the landscape. Measures for mitigating some of the threats are touched upon. However, the details of planning and implementation are beyond the scope of this report, and will require the effort of a dedicated organization. Some ideas for building such an organization are presented in the final section, entitled "What Can Be Done?".

This report is intended for landowners, conservationists, and government land management professionals, and is meant to provide a basis for discussion and consensus-building. As such it is a working document, and any corrections, additions, and suggestions for improving the contents are welcome.

Topography and Geology

Figure 1 shows the Rush River from its source near Interstate 94 to the mouth at Lake Pepin (the wide section of the Mississippi between Red Wing and Wabasha, Minnesota). It can be seen that the Rush drains much of the central portion of Pierce County. Plum creek is another major watershed to the east, which drains into the Chippewa River. Isabelle Creek and the Trimbelle River are to the west, while Pine Creek is a smaller, pristine watershed draining into the Mississippi along the border with Pepin County.

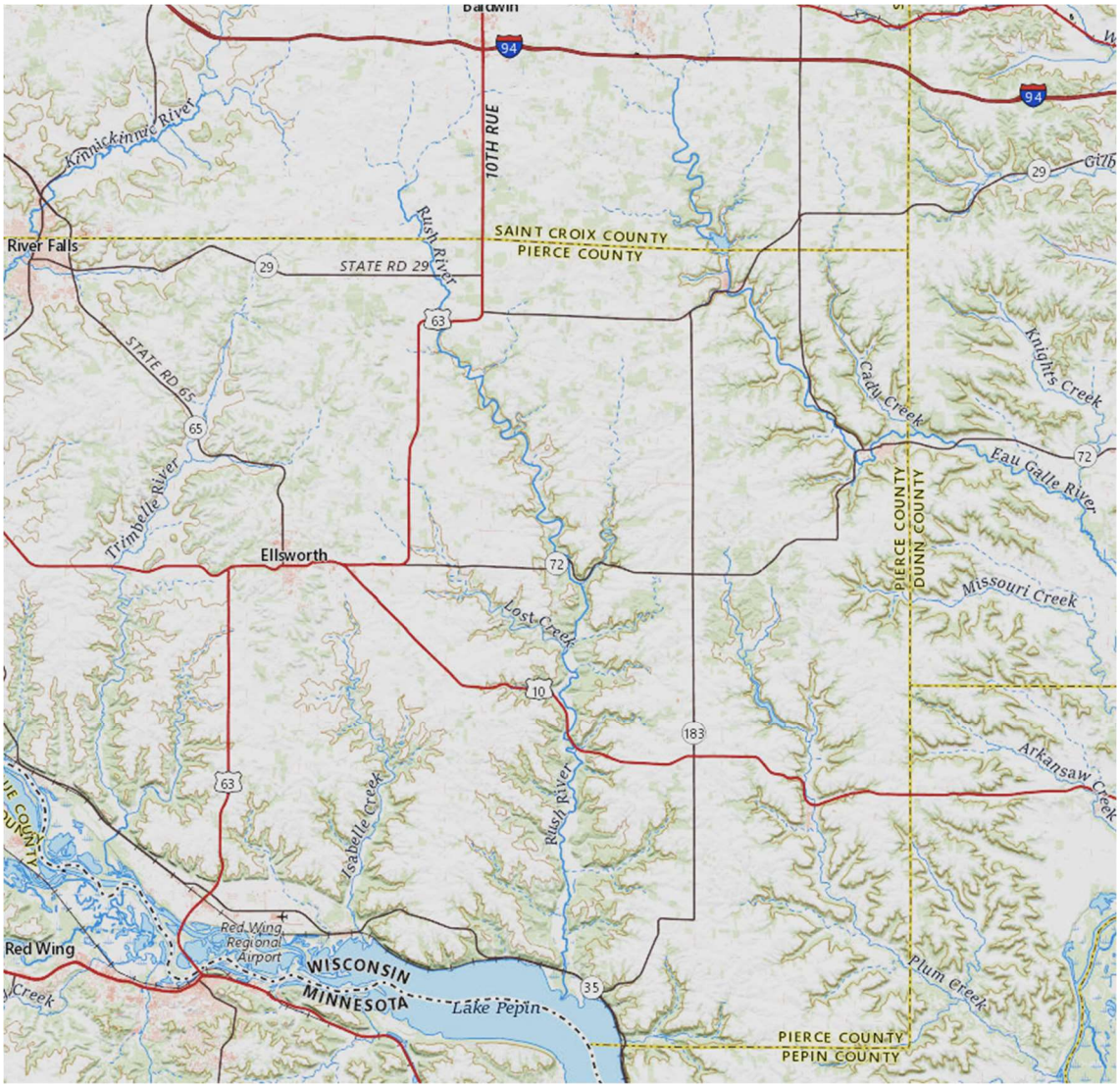

Figure 1: The Rush River and surrounding area.

Not far from its source, the Rush enters the Driftless Area, so called due to the absence of glacial drift from the latter part of the Wisconsin glaciation (Ref. 1) and flows south through the Driftless for the remainder of its 50-mile length. The Driftless is a picturesque region of ridges and valleys covering 24,000 square miles of southwest Wisconsin, southeast Minnesota, northeast Iowa, and northwest Illinois. It attracts visitors from around the world seeking to enjoy the unique scenery, recreational opportunities, and vibrant culture.

The Rush and surrounding area are characterized by a rugged, well-drained topography and numerous cold-water streams and rivers, typical of the Driftless Area. This area is known for its thousands of miles of trout streams, many of them spring fed. Virtually all of these streams ultimately feed the Mississippi River. Figure 2 shows the USGS topographic map of the lower Rush. This clearly shows the highly dissected terrain, with many valleys (coulees) branching off from the river valley, often with further upstream branches. Some of these coulees have small spring-fed streams running year-round, while others have dry stream beds except during heavy rains and snow melt.

Figure 2. USGS topographic map of the Rush River. Heavy red line at top is State Highway 10.

The bedrock of the Rush River consists of sedimentary rocks of the early Paleozoic Era, approximately 500 million years old (Ref. 1) The Oneota dolomite, with a typical thickness of 50 meters (160 feet) forms the prominent bluffs that can be seen in the area and are most visible along the Mississippi. It is

typically encountered at a shallow depth beneath the ridge tops and extends down nearly to the valley floor. The term “Paleozoic Plateau” is often used to refer to the relatively flat highlands (1000-1100 ft elevation) into which the many valleys are incised.

The Oneota dolomite is underlain by the Jordan sandstone, with a typical thickness of 25-35 meters (80-115 feet). It is generally found at the valley floor. Figure 3 shows an exposure of the Jordan sandstone at a roadcut near the Rush. As can be seen in the lower photo, this rock is friable and easily broken into grains by hand.

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Figure 3. Exposure of the Jordan sandstone at a roadcut along 400th St., Salem Township. Rush River is just beyond the road. (Below) Piece of sandstone from this location.

Jordan sandstone is the “frac sand” currently being mined at many locations in western Wisconsin and transported via rail to Texas and North Dakota for use in hydraulic fracturing (“fracking”) of natural gas wells. In 2015, frac sand mining was begun at the quarry adjacent to the Rush River just north of State Highway 10. It has since grown to around 50 acres in size and is a dominant feature of the landscape. More details on this subject are given later.

The highly permeable Jordan sandstone contains hundreds of springs that feed the Rush River. The groundwater level can be found close to the valley floor of the Rush and its tributary valleys, at an elevation of 700-750 feet above sea level. Residential wells located on the ridge tops are drilled to a depth of 350-400 feet.

The River

As it enters it lower portion, the Rush River is a high-quality cold-water river. Lost Creek, the Rush’s largest tributary, joins the river just above 450th Ave in El Paso Township. Gravel and sand bars have historically been common in this area, providing good habitat for a variety of plants and animals. The stretch of the river just above Highway 10 is a popular destination for trout fisherman, as there are two bridge crossings which provide access to good trout water. Willows are abundant and provide good streamside cover and bird habitat. Figure 4 shows a typical stretch in this section of the river.

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Figure 4. Typical stretch of the Rush above US 10 and below 450th Ave., El Paso Township Section 33 (July 2019).

Below Highway 10, the river valley widens to approximately a half mile in width, with the broad flood plain providing area for large agricultural fields. The course of the river alternates between the western and eastern sides of the valley. County Road A, which hugs the base of the steep slopes on the west side, provides access and a good view of the river at several points.

A wealth of information on the "primeval" state of the Rush at the beginning of European settlement can be found in the surveyor's field notes, recorded in 1849 as part of the Public Land Survey System used to divide the land into sections for sale to private citizens. It is fascinating to examine this documentation for a description of the natural communities present at this location. Where the surveyors crossed the Rush River, a description of the river itself is often included in their notes. An excerpt from these notes is shown in Figure 5. These notes were taken as the surveyors traversed the boundary between Sections 21 and 38, near the middle of Salem Township. The bridge at the intersection of County A and 385th St. is visible in the satellite image. Moving from east to west, the notes record that the valley bottom was entered at 15 chains (1 chain=66 ft, 80 chains=1 mile). The vegetation in the bottom was noted as prairie. At 39 chains, the halfway point and currently in the middle of the large field, the surveyors note: "*Enter timber*, "and at 48.4 chains "*Rush River, 81 links wide, runs south, rapid, rock bottom, pure cold water.*" Note that 81 links is equal to 53 feet, and that both the width of the river and its location within the valley are roughly the same at the present day as they were 170 years ago.

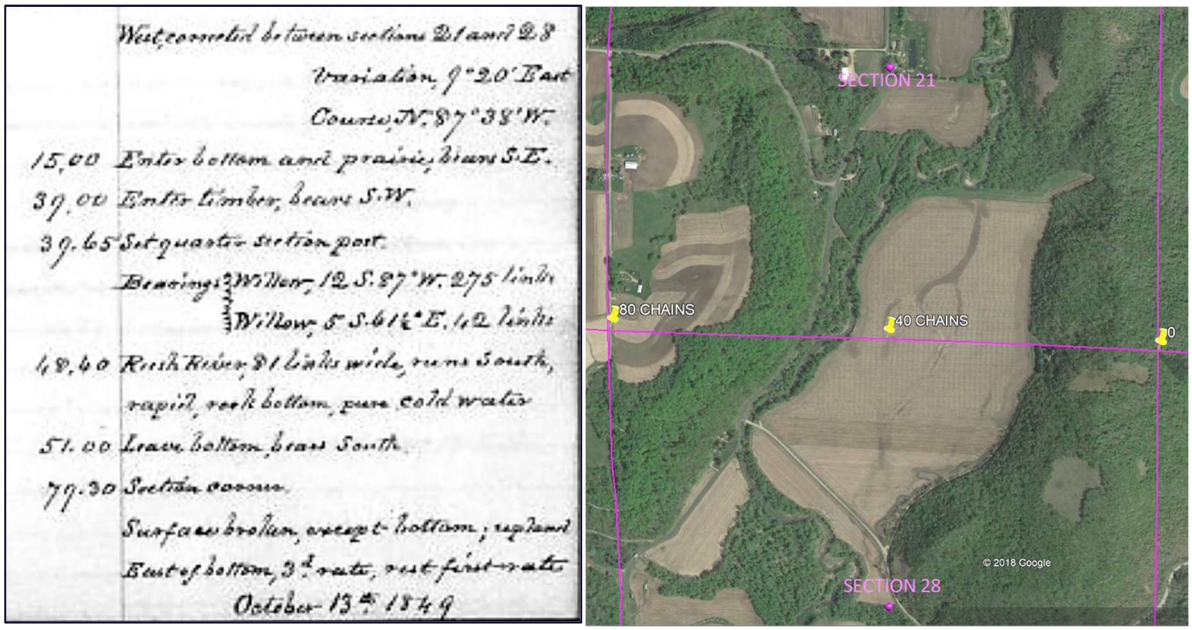

Figure 5. Surveyor's 1849 notes along the boundary between Sections 21 and 28 in Salem Township

However, it would be mistaken to conclude that the river has not changed. The historical record clearly shows that river valleys in this region experienced a massive deposition of soil, rock, and gravel that eroded from the adjacent ridge tops and slopes when much of the hardwood forest was cleared for agriculture in the late 19th and early 20th centuries (Ref. 2,3). In the Rush River valley, the sandy soil that probably dominated the surface layer for millennia would have been covered by a mixture of other soil types from the surrounding higher elevations. This led to the aggradation of the river bed and its floodplain, i.e. an increase in elevation, which has been found to be as much as 15 feet in other river valleys in the Driftless Area, sometimes burying farmsteads and even entire settlements. Trimble (Ref. 2) has made an exhaustive study of historical soil erosion in the Driftless Area, and the profound changes

that occurred in rivers as a result. These processes, minutely documented for similar rivers such as Coon Creek in Vernon County and the Whitewater River in Minnesota, undoubtedly also took place on the Rush, with massive aggradation and changes in the floodplain.

Beginning in the1930s, improved soil conservation practices on the valley slopes halted the wholesale erosion of the previous decades. However, the floodplain aggradation had major consequences. When the river cut through the new deposits, the stable, vegetated banks that the surveyors found in the 1840s, with a floodplain a few feet above the river level which allowed the river to easily spread out during heavy flooding, were gone forever, and an entirely different fluvial system came into being. The river became confined in a flume-like channel with high, steep banks, without easy access to a floodplain. As a result, a new floodplain was created through a dynamic process that still continues today. The chief characteristic of this process is the creation of meanders with high banks on the outside of the curves and a much lower bank of deposited soil – often in the form of sandbars – on the opposite side. These lower banks form the new floodplain. This process is described and many examples given by Trimble (Ref. 1).

This process is playing out on the lower Rush today. Figures 6 and 7 (both taken July 2019) show two examples of the high bank-sandbar system, one from near the mouth of the river and one from much farther upstream. These photos illustrate the more silty (muddy) composition of the sandbars as the river delta is approached. The high-bank meanders will continue to develop as part of the natural evolution of the river system and adaptation to the aggraded “old” floodplain. Due to human activity, this process has been accelerated in some places by the planting of row crops on the river banks. Conversely, in other places the presence of roads and the use of rip-rap to stabilize high banks has temporarily halted the growth of the meander. However, large-scale stabilization of the river banks remains an expensive and difficult task, given the increasing frequency of extreme rainfall events.

As a footnote, aggradation of the old floodplain—thought to have been virtually halted by measures taken in the 1930s—may be starting to re-occur. Figure 8 shows deposition of sandy silt on the high bank several feet above the normal river level. This photo was taken in April 2019 following heavy spring floods. The photo on the cover of this report was taken the same day at a location immediately downstream where the river “collides” with County Road A.

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Figure 6. Typical high bank with silty sandbar on opposite bank. Near boundary between Maiden Rock and Salem Townships, 3 miles from the mouth of the river.

The collapsing high banks continue to send sediment downstream, and this sediment is deposited along the last few miles of the river. As explained by Trimble (Ref. 1), the lowest stretch of Driftless Area rivers is generally a "zone of perennial sedimentation," where continuous aggradation has taken place since shortly after settlement. This seems to hold true for the lower Rush. It is likely that the lowest stretch of the Rush will continue to aggrade in both the river bed and the floodplain, thus making this area significantly wetter as the river level rises.

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Figure 7. High bank (note cornfield) with gravelly sand bar opposite, Salem Township Section 4. near the intersection of Highway 10 and 400th St.

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Figure 8. Sediment deposit during spring floods of 2019. Looking upstream from same location as report cover photo. Section 16 Salem Township.

Deadfalls are common below the 385th Street bridge. In this section of the river, navigation by canoe or kayak becomes difficult. An interesting feature of the lowermost section of the river can be seen in Figure 9. A meander section of the river has been cut off, creating a small oxbow lake. This feature, more characteristic of much larger rivers such as the Chippewa, shows that as the Rush approaches its delta, it takes on a different character where different natural communities—such as those present in the lower Chippewa bottoms—can be used as models in developing conservation measures.

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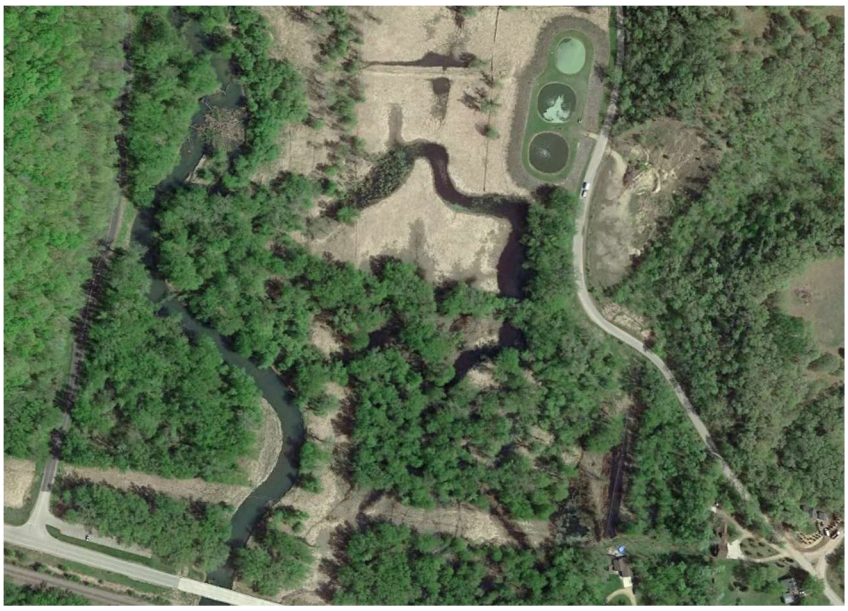

Figure 9. Oxbow lake (meander cutoff) just north of Highway 35.

Morgan Coulee Creek is a small tributary deserving of special mention. This spring creek is part of a rich complex of springs, creeks, and ponds located near the opening of Morgan Coulee into the Rush River valley. As seen in Figure 10, sections of this stream have been overgrown with boxelders—a common problem. Since this stream has a brook trout population and may provide spawning areas, water quality is a prime concern.

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Figure 10. Morgan Coulee Creek. Photo taken in early October 2019.

Land Ownership and Use

On the lower Rush, land ownership is less fragmented than on the upper river. Approximately 25 percent of the riverfront acreage belongs to three private landowners, with another 10 percent belonging to the US Army Corps of Engineers (COE) and Wisconsin DNR. This situation provides an opportunity for conservation.

The figure below shows a rough breakdown of the land use by acreage, for the 10 sections (6400 acres) shown in the Appendix. Recreational land constitutes almost three quarters of the land, while agricultural land accounts for another 17 percent.

For this analysis, the land use in 10 sections was analyzed based upon satellite imagery. The 10 sections were conveniently chosen since the river lies entirely within this block. It should be noted that more than half of the area analyzed lies in the uplands on either side of the main river valley bottom. This can be clearly seen in the topographic map in the Appendix. If the analysis was repeated for the valley bottom only, the percentage of agricultural land would be somewhat higher.

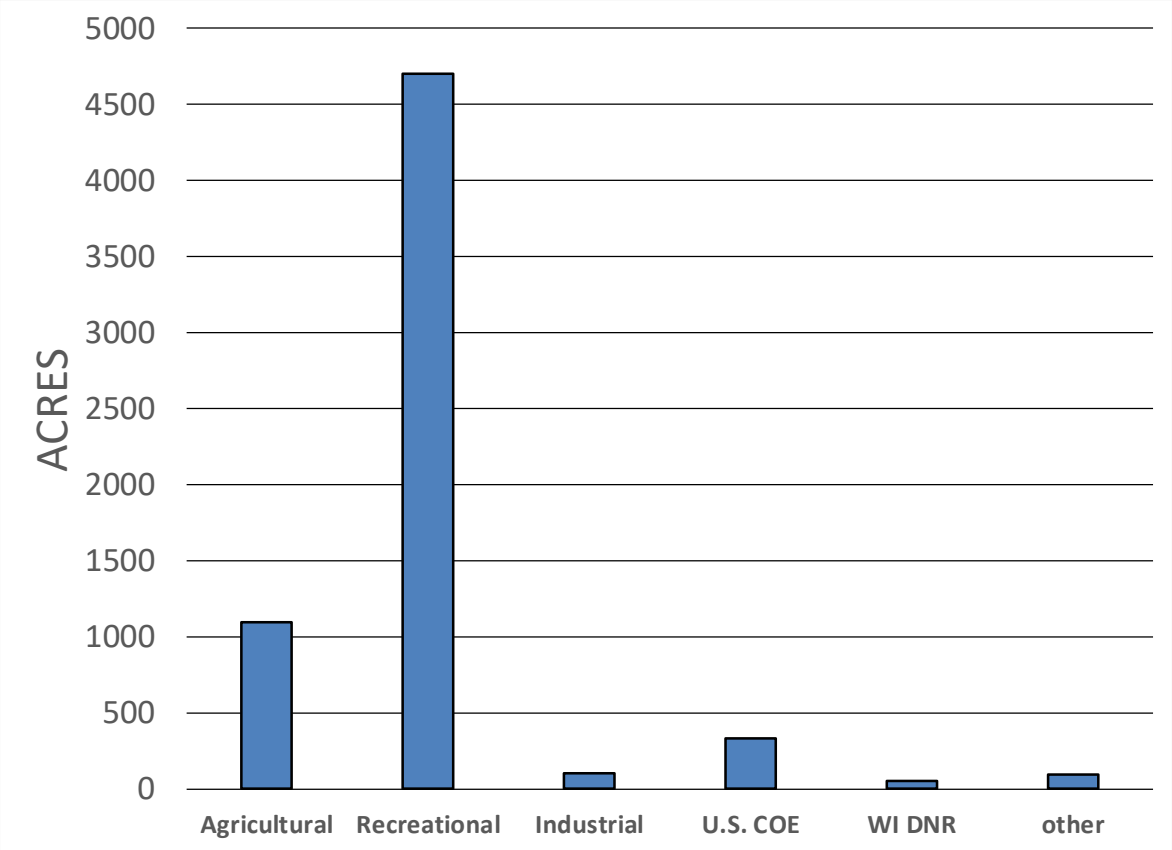

Figure 11. Lower Rush River land use by acreage (Includes sections shown in Appendix.)

A large block of agricultural land exists in Sections 21, 28, and 35 of Salem Township. A drive south from the bridge on 385th Avenue provides a good view of this land, and it also corresponds to the area described in the 1849 survey notes (See Figure 5.) A photo taken looking north from the road is shown in Figure 12. This area is also clearly visible in the satellite view of Figure 1. Together, the two contiguous fields on the two sides of the road contain approximately 400 acres.

Agriculture

Approximately 20 percent of the land area is devoted to agriculture along the lower Rush, and this situation has existed for at least 100 years. In spite of its tendency to flood, this land is very productive for the usual corn/soybean rotation. Figure 13 shows a field of soybeans to the south of 385th Avenue just east of the Rush River bridge. The large field to the north of the road is planted in corn. These fields often experience standing water in the spring. During the wet spring of 2019, water was flowing over the road in mid-April. However, the farmer was eventually able to plant and the crops are seen to be growing well by August.

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Figure 12. View looking north from 385th Avenue east of the Rush River bridge (April 2019).

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Figure 13. Soybean field (August 2019) looking west from 385th Avenue east of the Rush River bridge.

In general, the row crops are separated from the river by strips of trees, predominantly boxelder in the lower stretches of the river. However, a few fields are very close to the water's edge. An example of the consequences of corn on the river banks is seen in Figure 14. This field is located along the west bank of the river near the intersection of Highway 10 and 400th Avenue.

Row crops are also planted on the ridge tops. Comparison of the satellite view and topographic maps in the Appendix shows how these fields occupy the flattest section of the ridge tops. Improvements in agricultural practices, begun after the disastrous erosion of the early 1900s, has kept these fields in generally good condition. However, with the increasing frequency of heavy rainfall events, fields planted in close proximity to the steep slopes of the valley sides have come under increased erosional stress.

While corn, soybeans, and alfalfa are the dominant crops, produce is also grown in at least one location. Rush River Produce is located on a ridge top just west of the river, and is known for its berry production (Figure 15). In the past apple orchards were present on the ridge tops in a few locations, but these have largely disappeared.

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Figure 14. Corn field along the west bank of the Rush near intersection of Highway 10 and 400th Avenue (July 2019). (Bottom) Location of the top photo. Note frac sand on the right edge of satellite photo.

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Figure 15. Blueberry bushes at Rush River Produce (August 2019).

Timber harvest is another form of agriculture that is often overlooked. Small-scale harvests take place frequently on the hillsides where the vast majority of woodland is found. Some of these are done to satisfy the requirements of the Managed Forest Land (MFL) program, in which many landowners are enrolled. Within the 10 section (6400 mi^2) area analyzed above, it is estimated that 1000-2000 acres of timber are still available for harvest, though much of it will not yield high quality timber.

Logging creates a major disturbance to the natural communities where it occurs. Harvests must be carefully managed to avoid premature loss of the most valuable trees, undesirable changes in the forest structure, and the spread of invasive plants. Regeneration of hardwoods, in particular oaks, following a harvest is difficult even under the best circumstances. This is discussed in more detail below.

Fauna and Flora

The Rush River is host to a rich variety of plant and animal life, and it is obviously not possible here to provide a compendium. Some of the fauna, for example whitetail deer, is problematic. Since deer are the most visible “megafauna” present in this area, as well as the key to the health of its natural communities, it is appropriate to begin with a discussion of this problematic species.

Whitetail deer are overabundant in the Driftless Area and throughout much of Wisconsin. Reference 4 contains a good overview of the relationship between deer population density, sustainable deer harvest, and biodiversity. In the Driftless Area, due to the mixture of woodland and abundant agricultural crops, the biological carrying capacity of the land is quite high. However, at a population density of much greater than 20 animals per square mile, the environment shows signs of negative impacts. Not only is the deer herd less healthy, but overall biodiversity suffers. Desirable herb and songbird species begin to decline. Browsing is evident and threatens both desirable tree seedlings and critical components of the understory. At densities around 45/mi^2, the harvest rate is maximized, but the quality of the deer is low. Browsing is severe, and begins to take a toll on agriculture.

The deer population in the area surrounding the lower Rush River is at least 30/mi^2, with some estimates as high as 50/mi^2. At these densities, the health of the herd is not sustainable. Direct threats to human health, such as deer/auto collisions and Lyme disease, also become a problem. Furthermore, the likelihood of Chronic Wasting Disease spreading to the area increases with population density. (CWD has been detected around 40 miles away in Eau Claire County.)

With the high number of deer present in the area, oak regeneration is practically impossible. Therefore, the red, white, and bur oaks—some of the most valuable components of the area's natural communities—are in decline. In order for oaks and other valuable hardwoods to regenerate and thus to remain in the forest canopy, deer browse must be controlled. Since white oaks can live for up to 500 years, it is worth investing in this species. In summary, maintaining a healthy deer herd that does not threaten the biodiversity and quality of life along the lower Rush River, and also provides good hunting, is one of the most pressing challenges facing land managers.

Birds, reptiles/amphibians, and fishes

Many birds are doing well on the lower Rush. Wild turkeys, bald eagles, and some songbirds are abundant. Other songbirds, in particular some neo-tropical migrants (birds that winter as far south as Argentina) are in decline. For some migrant species, the woodlands surrounding the Rush River provide a stopping point for birds en route to their nesting areas further north, while other species stay in the area to nest and raise their young. Some key species found on the Rush are mentioned in the later section on the Rush River Delta State Natural Area. Important Bird Areas (IBAs) are also discussed later.

A number of birds found along the Rush are forest-interior species and depend upon large blocks of mature woodland. See Reference 5 and other related publications from Cornell Lab of Ornithology's *Birds in Forested Landscapes* project. Reference 6 provides an excellent summary of bird species and the natural communities that support them on the Upper Mississippi.

Grassland birds such as bobolinks (Fig. 16) and eastern meadowlarks, as well as ringneck pheasants depend upon good nesting habitat that is undisturbed by agriculture when active nests are present. Both bobolinks and meadowlarks are in severe decline in the area.

Figure 16. Bobolink (*Dolichonyx oryzivoru*): breeding male and female (courtesy of Cornell Lab of Ornithology.)

Herptile fauna (reptiles and amphibians) are a less conspicuous but important part of the natural communities. Several species of turtles, including the state-threatened **w**ood turtle (*Glyptemys insculpta)* inhabit the riparian zone of the Rush. The author has encountered wood turtles on the Rush on two occasions, but not since approximately 2000. Hence an evaluation of the status of this species is a high priority.

Common turtles include the spiny softshell turtle (*Apalone spinifera*). Figure 17 shows a softshell turtle, probably a spiny softshell, that was spotted on the lower Rush in July of 2019. A related uncommon species, the smooth softshell (*Apalone mutica*), is a Species of Special Concern in Wisconsin, and has not been documented on the Rush.

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Figure 17. Spiny softshell turtle (*Apalone spinifera*), seen on the lower Rush in July of 2019.

Common snakes in the area include six species, with an additional two species—the bullsnake and the timber rattlesnake, having a status of Species of Special Concern. Small populations of both of these likely exist near the Rush. Rattlesnakes are found on rocky bluffs with plenty of sun, while bullsnakes prefer sandy sites where they frequently travel in rodent burrows. The sandy soil of the Rush River valley would thus provide good bullsnake habitat, and it is likely that they were once common. Unfortunately, a Wisconsin bounty on rattlesnakes—in place until 1975—led to the near extirpation of timber rattlers and probably also to indiscriminate killing of bullsnakes found in the same dens.

The Rush provides good habitat for a variety of amphibians, an important part of the ecosystem. In springtime, choruses of spring peepers (*hyla crucifer*) can be heard from the wetlands and flooded fields. Although they require standing, fishless water to reproduce, adult leopard frogs and woods frogs are found in a range of habitat from wetlands to higher elevation woodlands. The wood frog shown in Figure 18 was found on a wooded hillside bordering a tributary coulee of the Rush.

The waters of the Rush are home to many species of fish. With its reputation as a popular trout stream, non-game species are often overlooked. These are an important component of the aquatic community, as are thousands of other species of fauna from microscopic organisms to tiny invertebrates to insects.

From its upper reaches to its mouth at the Mississippi, the Rush provides excellent fishing. Early settlers found abundant native brook trout. As described in the surveyor's notes recorded just after statehood in 1848, the river was clear, cold, and rocky on its bottom, even its lower reaches. However, the brook trout declined over the next hundred years due to siltation. Brown trout were introduced in the late 1800s and are still present along the entire length of the river. Natural reproduction of trout is discussed in the final section.

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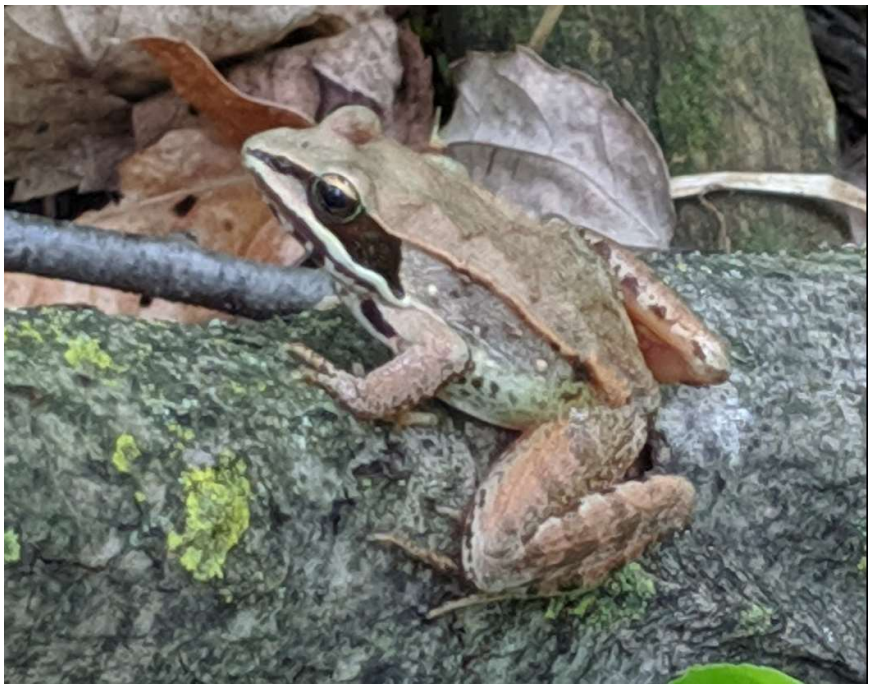

Figure 18. Wood frog (May 2019).

It is unlikely that the lower Rush will ever be restored to good brook trout habitat, and the brookies have retreated into the cold spring-fed tributaries. In any assessment of the Rush, these tributaries deserve special attention, and some recommendations are given at the end of this report.

Finally, the last few miles of the river are primarily a warm water environment. Smallmouth bass, northern pike, and other warm water fish are common here. In fact, there is no clear delineation between the warm- and cold-water sections of the river. Smallmouth bass have been caught as far upstream as Highway 10. The inflow of cold spring water creates localized cold water temperatures (60-70^{o} F) in lower sections of the river, and brown trout are found as far downstream as Lake Pepin. They are reported to move into the Mississippi and may migrate to other streams that flow into it.

Flora

Within the confines of this report, only a cursory description of the characteristic flora of many natural communities found along the Rush is possible. Since these are not unique to the locale, the reader is referred Hoffman's book *Wisconsin's Natural Communities: How to Recognize Them, Where to Find Them* (Ref. 7) for an excellent description.

From the satellite view, the Rush appears to be enveloped in a mass of greenery. Indeed, the thousands of acres classified as "recreational" in the earlier section are wooded. However, a closer look reveals that much of the tree canopy consists of low-quality trees such as boxelder, which are quick to colonize open areas. This is particularly the case along the river banks and of field edges. Due to the fragmented nature of the forest land, these edges comprise a large percentage of the area. Only a few areas of high quality, mature trees remain along the Rush, located primarily on the hillsides.

Generally, the history of disturbance experienced by the land depends upon the steepness of the slope. On the steepest slopes, small areas exist that have experienced very little disturbance. In these areas, mature forests can be found. A good example of a maple-basswood forest is found along the east-facing slope that runs along the west side of the Rush River valley. Hoffman (Ref. 7) has identified this slope as a valuable remnant of this type of forest. Large-flowered trilliums, as well as the more rare snow trillium blanket the slope in late spring. The base of this slope can be seen in the cover photo of this report. County Road A lies between the river and hill, but cannot be seen. Interestingly, the wildflower community still clings to existence in the harsh environment along the road. The bloodroot shown in Fig. 19 was found in late April only a few feet from the road, on the side *opposite* the hill, in a spot heavily trafficked by fishermen.

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Figure 19. Bloodroot flower in late April 2019, in a high traffic area along the Rush River.

On the slopes surrounding the Rush, the characteristic flora depend largely upon the aspect of the slope. On west and south-facing hillsides, the woodlands are often dominated by bur oak and other species that thrive in hot, dry conditions. As the hillside grades into a gentler slope near the ridge tops, white oak, red oak, black oak, green ash, black cherry, American elm, ironwood (*Ostrya virginiana)* become more prevalent. On north and east-facing slopes, maple and basswood typically dominate the forest canopy. Where oak has been harvested without leaving large openings for regeneration (clearcuts), red maple has become the dominant species in many areas. In the healthy forests, the ground layer includes a rich variety of wildflowers, with the spring ephemerals being the most spectacular. The understory includes a variety of shrubs such as pagoda dogwood.

On the floodplain and river banks, cottonwood, silver maple, and willow are common. These species are prodigious seed producers as well as very fast growers. Figure 20 shows the high density of silver maple seedlings that can be produced. These seedlings were found on an island just north of Highway 35 and west of the Maiden Rock sewage plant.

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Figure 20. Silver maple seedlings growing on a log-jam island, Maiden Rock Township Section 9, one mile from the mouth of the river (July 2019).

All evidence points to the past existence of prairie and oak savanna interspersed with the woodland along the Rush. These landscapes existed both in the river valley and on west and south-facing slopes. The Morgan Coulee Prairie—perhaps the only remaining prairie remnant in the area—is described later in this report and is an example of a “goat prairie.” Prairies and oak savannas represent the rarest of ecosystems and also the most biodiverse. They support grassland birds whose populations are declining. They support butterflies and other pollinators, as well as thousands of other invertebrates. They are stable, self-sustaining natural communities that are easily managed with fire. And they are beautiful reminders of the landscape that once existed.

It is difficult to construct a complete and accurate picture of the primeval landscape on the Rush. In fact, this landscape was already the product of millennia of habitation, including the use of fire, by native Americans. Trimble (Ref. 1) gives descriptions, gathered from many sources, of the vegetation along similar rivers in the Driftless Area. The sources include mostly the drawings and accounts of the earliest travelers and settlers. These can be combined with the description of the surveyors to get some idea of the landscape before it was drastically altered by European settlement. However, even if a complete picture could be constructed, it would be mainly of academic value. The best we can do now is to attempt to maintain the critical natural communities where they currently exist, without further degradation, and to restore other natural communities that have largely vanished, as feasible, such as oak savanna. This leads to a discussion of invasive plants.

Invasive Species

Invasive plants are a threat to the natural communities of the Rush and throughout the Driftless Area. The rapid spread of invasive species can fundamentally alter the floral composition of natural communities and ultimately destroy them. Unfortunately, the devastating impact of these invaders does not become evident until it is too late to effectively control them. Further, the control of these plants, when carried out on a large scale, diverts considerable resources that could otherwise be spent maintaining the ecosystems. For these reasons, control of invasive plants involves many important decisions regarding action (or inaction) that should be taken and the tradeoffs involved. It also requires specialized knowledge of control methods.

Many species and control methods could be considered; those that pose the greatest threat to the Rush will be briefly discussed here. Along the lower Rush, three species—buckthorn, garlic mustard, and reed canary grass—have established large populations and continue to spread aggressively.

Common and glossy buckthorn have been common in the woodland for many decades. In some areas, they are numerous enough to form a dense thicket. They are dioecious, with the female plants bearing a berry that is transported, sometimes over long distances, especially by birds. In shaded areas, they can remain small and grow quickly into large trees (20 ft or more) when exposed to full sun. When buckthorn form extensive thickets, they shade out the groundlayer and the tree seedlings growing there. This spells doom for many oak-dominated woodlands. Aggressive control measures are called for in this situation. Basal bark treatment has proven to an effective (but labor-intensive) control method for larger buckthorn stems. For thick carpets of smaller plants, a foliar treatment is more practical.

More recently, garlic mustard has spread throughout the region, often with overwhelming speed. It is a biennial, with seeds being produced quickly in the second year and dispersed from pods in June and early July. It also forms dense stands that will interfere with the native groundlayer flora. Its seeds are transported along roads, waterways, and deer trails. Along the Rush, the river banks are in places blanketed with this plant. The lower reaches of Lost Creek are also heavily infested. Garlic mustard also is found on the ridge tops, where it quickly migrates downhill, especially down gullies. Control methods include herbiciding (carefully timed to avoid killing native flora) and hand pulling. It is best treated during its first year, with any remaining second-year plants eradicated very early in the spring.

Figure 21 shows the seed pods of a garlic mustard plant that was found (on the author's land) to be setting seed in mid-October—much later than expected. This unusual occurrence shows that a close eye must be kept on the groundlayer throughout the growing season. The dried stalks and pods of plants that have dropped seed should also be looked for, and the locations carefully noted.

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Figure 21. Seed pods on a garlic mustard plant, October 15, 2018.

Reed canary grass is the third member of the "big three." It has invaded wet areas for many years, and has recently been appearing on upland areas, especially along roadsides and in fallow fields. In roadside observations during the summer of 2019, reed canary grass was seen along virtually every road in the area. In some areas, it forms a dense monoculture and destroys biodiversity. This has occurred along the lower Chippewa River and is in progress along the lower Rush. Herbicide spraying and mowing can be used for control, but once established this species is difficult to eradicate.

The control of invasive plants is a vast topic. The Invasive Plants Association of Wisconsin (IPAW) is active in this area and maintains an excellent website. https://ipaw.org/the-problem/ipaws-plant-list/. The three plants discussed above are rated by IPAW as having the highest impact on native landscapes.

State Natural Areas

Wisconsin owns and maintains State Natural Areas as examples of valuable natural communities that may harbor rare species. Two SNAs have been established on the Rush and its tributaries. The two descriptions below, as well as Figures 22 and 23, were taken from the Wisconsin DNR website.

Rush River Delta (400 acres)

Rush River Delta protects a floodplain forest on the alluvial plain at the mouth of the Rush River where it empties into the Mississippi River's Lake Pepin. The area supports stands of lowland hardwoods including silver maple, cottonwood, willow, American elm, and green ash. Large patches of wood nettle dominate the groundlayer. Several open, wet depressions are vegetated with river bulrush and smartweed and provide excellent spawning habitat for northern pike and rearing areas for mallards and wood ducks. A sand spit extends into Lake Pepin at the Rush River mouth and provides feeding and nesting areas for shorebirds. Woodland birds include yellow-throated vireo, warbling vireo, blue-gray gnatcatcher, American redstart, and northern oriole. Rush River Delta is owned by the DNR and was designated a State Natural Area in 1986.

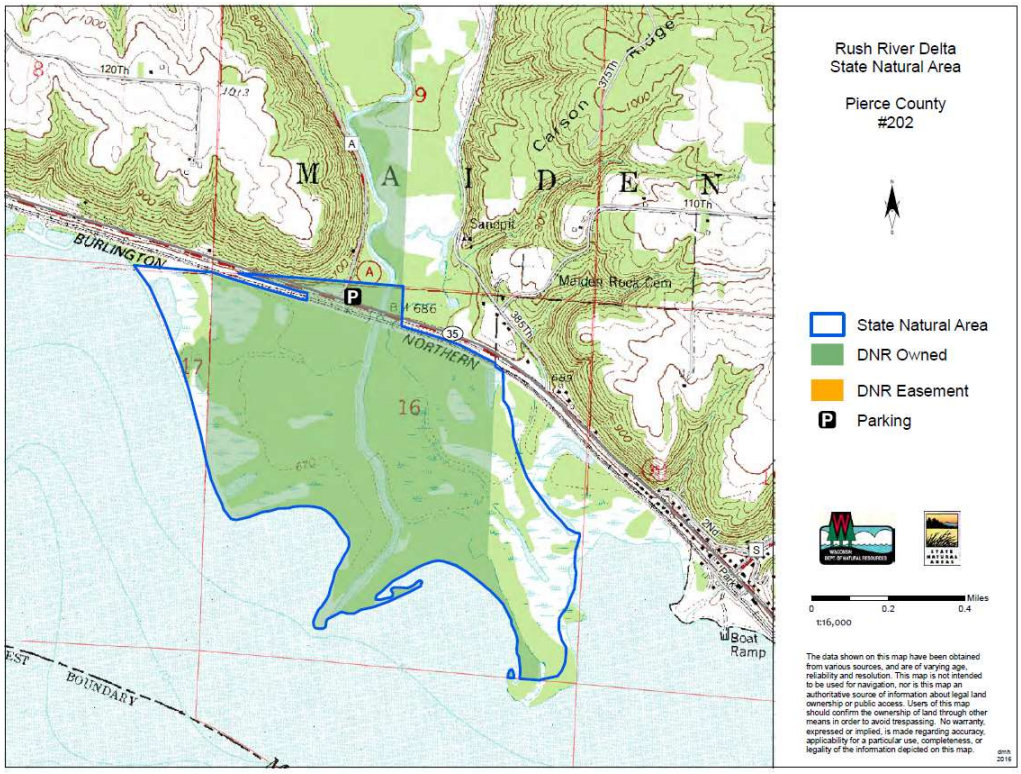

Figure 22. The Rush River Delta State Natural Area and surrounding area (Source WDNR).

Morgan Coulee Prairie (58 acres)

The second largest dry prairie in the west central region, Morgan Coulee Prairie extends for over a half-mile along a steep, south-facing bluff in a coulee opening onto the Rush River valley. The large expanse of relatively undisturbed dry prairie is broken up with scattered islands of bur oak savanna dominated by open grown, gnarly oaks and shallow wooded draws. Limestone outcrops are scattered about the area and support a community of lichens and ferns. Dominant grasses include big and little blue-stem, side-oats and hairy grama, Indian grass, needle grass, prairie drop-seed, and several muhly grasses. The forbs are equally diverse, highlighted by showy species such as asters, milkweeds, white and purple prairie-clover, blazing-star, Great Plains lady's-tresses, and prairie larkspur. Wild bergamot, bastard-toadflax, and western sunflower are found under the oaks. Much of the prairie is remarkably free of shrubs; those present include hazelnut, bittersweet, smooth sumac, and dogwoods. At the bluff is a southern dry oak forest. Morgan Coulee Prairie is owned by the DNR and was designated a State Natural Area in 1986.

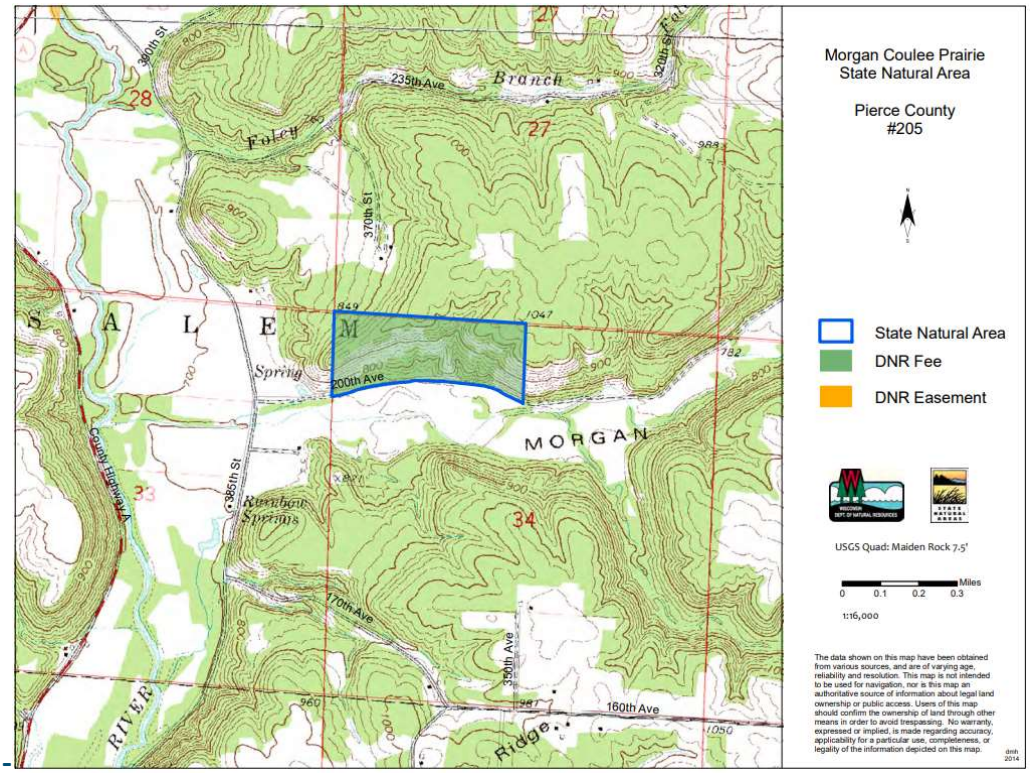

Figure 23. The Morgan Coulee Prairie State Natural Area and surrounding area (Source WDNR). Morgan Coulee Creek runs along the foot of the hill.

Army Corps of Engineers (COE) Lands

North of Highway 35 and extending up to Section 33 in Salem Township, large parcels of land are owned by the State and US government. Figure 24 shows the extent of these areas. Approximately 330 acres belong to the U.S. Army Corps of Engineers, and another 53 acres belong to the State of Wisconsin.

Figure 24. US government (Army COE) and State of Wisconsin-owned lands along the lower Rush.

These extensive public lands north of Highway 35 encompass much of the floodplain downstream of Morgan Coulee, and comprise wet and seasonally wet grasslands, with scattered trees. Much of the area is covered with small cottonwood trees, with a thick groundlayer of reed canary grass. The area is well marked (Figure 25) as a reforestation area. On the positive side, there is great potential for enhancing the valuable wetland habitat with a variety of conservation measures. This topic is touched upon in the final section.

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Figure 25. Wetland habitat on the US Army Corps of Engineers land (September 2019).

Frac Sand Mining

Until recently, the only major frac sand mine in the area was the underground mine in the Village of Maiden Rock. However, beginning in 2015, excavation to expand operations at the quarry belonging to Weiser Concrete Products was begun. This expansion was undertaken for the purpose of mining the Jordan Sandstone that is used for hydraulic fracturing.

Figure 26 below shows the expansion of the mine beginning in 2012 through the most recent satellite image in May 2018. It can be seen that the area of the mine has approximately doubled over that time, with more than 20 acres added to the east. More importantly, the volume of material removed has been enormous, due to fact that the added area has been from a hillside with an elevation at least 200 feet over the adjacent river valley. It is estimated that at least 4 million cubic yards of earth have been removed, and the once heavily wooded hillside, which included remnant white pines as well as hardwoods, is now gone forever. Figure 27 shows a topographic map with contours superimposed on the mine footprint.

September 2012

May 2016

Figure 26. Progression of the excavation into the wooded hillside for the frac sand mine just north of Highway 10.

May 2018

Figure 26 (cont.) Progression of the excavation into the wooded hillside for the frac sand mine just north of Highway 10.

Figure 27. Elevation contours superimposed on the current mine footprint. An estimated 4 million cubic yards of earth have been removed.

This mining operation poses a number of threats to the environment. Crystalline silica dust is introduced into the environment through air- and waterborne pathways. Noise and heavy truck traffic are also by-products of the operations.

However, the most profound and lasting effect of this operation is the massive destruction of the forested landscape, with all of the associated ecological, hydrological, and micro-climatic consequences. Notwithstanding the reclamation plan that is required for permitting, it will be impossible to "reclaim" the forested hillside that has been removed from the banks of the Rush. The landscape has been changed forever.

To make matter worse, a wash plant at this site has been approved. A wash plant entails the construction of large silos and other structures, and draws a large volume of wash water from the aquifer. This facility would probably be similar to the wash plant that currently exists approximately five miles to the east on Highway 10. (See Figure 28.) The fact that this existing nearby plant is no longer in operation attests to the unsustainability of most frac sand operations. Unfortunately, the permitting process is relatively easy, fast-tracked, and imposes little financial burden on the permittee.

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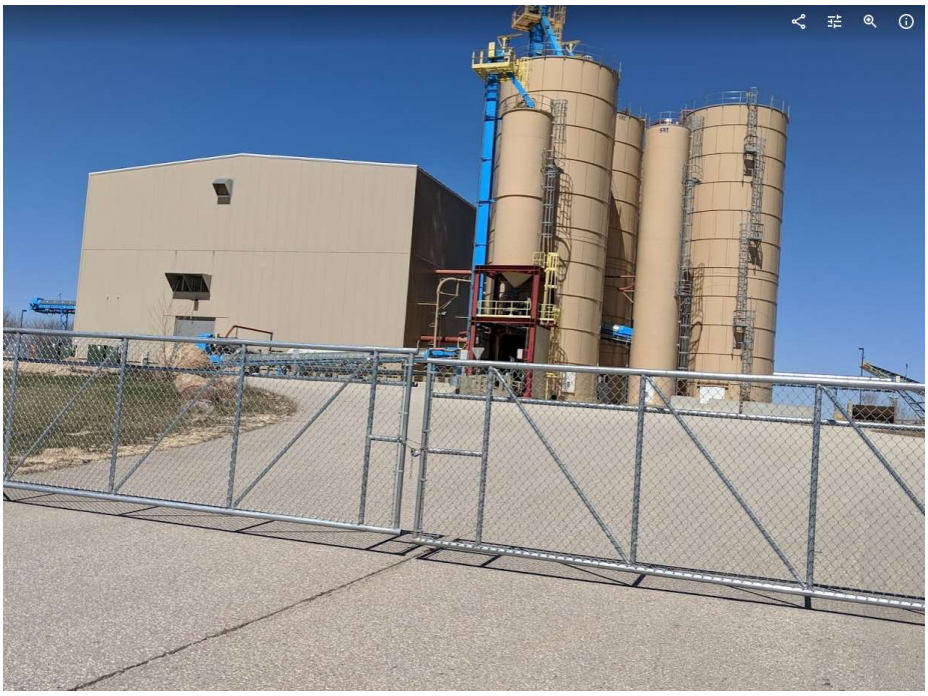

Figure 28. Idled wash plant five miles east of the Rush River on Highway 10. Photo taken April 2019.

What Can Be Done?

There is much that can be done to help save the lower Rush River. However, given the approximately 2000 acres that comprise the floodplain, together with several thousand acres of adjacent uplands, it is difficult to know where to begin. Many of the threats facing the river has been discussed above. Specialized expertise will be required to prioritize greatest conservation needs and prescribe appropriate, cost-effective conservation measures. Progress will necessarily be incremental and will require decades of work and follow-up.

To provide focus for initial planning and coordination efforts, the following areas are proposed as focal points:

1. Capture a "snapshot" of the erosion/sedimentation environment of the main river; consult with experts to identify any practical measures that can be taken to improve it.
2. Survey the riparian habitat, fauna, and flora and develop recommendations for conservation.
3. Survey the health of the tributary spring-fed creeks and direct springflow into the river.
4. Explore the potential for creating new grassland habitat. Engage private landowners.
5. Engage private woodland owners to protect high-quality woodland, with an emphasis on oak regeneration. Explore potential for reducing edge effects to benefit forest-interior birds.
6. Develop practical recommendations to slow the spread of invasive plants.
7. Work with the Wisconsin DNR to formulate a plan for reducing the deer population.
8. Draft recommendations to minimize the impact of frac sand mining.

Making progress in some of these areas will be difficult. Perhaps the best starting point is to identify the principal players and the available resources. A partial list is given below:

1. Private Landowners
2. Conservation organizations:
    - Trout Unlimited
    - Pheasants Forever
    - Ducks Unlimited
    - Audubon Society (with other bird advocacy groups such as Partners in Flight)
    - Wisconsin Woodland Owners Association (WWOA)
    - The Prairie Enthusiasts (TPE)
    - Lake Pepin Legacy Alliance
    - The Nature Conservancy
    - Many others
3. Governmental agencies:
    - Wisconsin DNR
    - USDA-Natural Resources Conservation Service (NRCS)
    - US Army Corps of Engineers
    - US Fish and Wildlife Service (USFWS)
    - Pierce County
    - Towns of Maiden Rock, Salem, and El Paso

The role of private landowners

Private landowners control the vast majority of the land along the lower Rush, and their participation is vital for implementing conservation measures. In particular the control of invasive species depends upon private landowners' awareness. Generally, however, once invasives are established, control requires ongoing expenditures that most large landowners simply cannot afford without cost-sharing from government. In this regard, landowners need to be connected with both funding sources and reliable contractors.

One area where private landowners can have a huge impact is in the decision to plant row crops, versus other options such as enrollment in CRP. In the current economic environment of low and generally volatile corn and soybean prices, the financial case for conversion to CRP is strong. When planted in warm-season grasses and forbs (flowers), these acres provide critical habitat for grassland birds, butterflies, and other pollinators. Conversion of a significant fraction of the approximately 1000 acres of row crops to grassland would have an almost immediate impact on biodiversity. As an added bonus, it would provide pheasant habitat. Many of the fields now in row crops also have wet areas where "potholes" should be established and would certainly attract waterfowl. In some cases, existing potholes were filled to attempt to increase tillable acres, but remain prone to flooding and largely unproductive.

The floodplain of the lower Rush offers an exciting opportunity to help declining songbird species, as well as waterfowl, and pheasants—all with relatively simple changes in land use. The conversion away from row crops, however, runs counter to a century or more of farming practice. For this reason, landowners and farmers must be engaged in a conversation to understand the obstacles to conversion and to present the potential benefits of a different model of land use.

The same considerations apply to row crops on the adjacent uplands. For these more erosion-prone fields that are on or close to steep slopes, the case for planting to grasslands is even stronger: not only do they provide critical faunal and floral diversity and nesting habitat for at-risk birds, but they also increase the infiltration capacity of the soil manyfold over fields planted in row crops. With greater infiltration, runoff can be prevented from flowing into the gullies that border the fields and often threaten serious erosion. In addition, groundwater flow can be increased, thus increasing the springflow that is vital for the health of the Rush and its tributaries.

If large-scale conversion is not possible, smaller areas planted to grasses and forbs within large fields of row crops can be beneficial. The enormous ecological benefits of even small areas of native prairie, when planted along field edges and along slopes to arrest runoff and create habitat have been documented in a recent study in Iowa (Ref. 8).

Landowners who control blocks of high-quality woodland also have an important role to play. These natural communities—not only the trees but the native groundlayer and understory flora—have developed over centuries and, once disturbed, cannot be restored without decades of careful management, if at all. Woodlands are also critical to the health of the Rush, and are increasingly threatened by invasive species, deer, fragmentation, and poor harvest practices. Some prescriptions for good forest management—as well as available resources—are discussed below.

The role of conservation organizations

Conservation organizations are the "muscle"' of conservation efforts. They are able to reach and leverage sizeable memberships, disseminate information, and access world-class expertise in many areas. They generally fall into two categories: organizations based upon hunting and fishing, and organizations based upon "non-game" conservation, which concentrate upon native natural communities, fauna and flora, and migratory non-game species. The National Audubon Society is a good example of the latter type of organization—one that has global reach and expertise. The Audubon Society administers many Important Bird and Biodiversity Areas (IBAs) along the upper Mississippi and its tributaries. IBAs have been identified by BirdLife International as providing important habitat for migrating and nesting birds, and are given priority for conservation funding on the state and federal level. Figure 29 shows the extensive areas of IBAs along the upper Mississippi. Note that extensive areas exist along the Minnesota side. Although the Rush River valley has been considered in the past, there is a conspicuous absence on the Wisconsin side. Designation of the lower Rush as an IBA would be a significant milestone toward implementing critical conservation measures.

Figure 29. Important Bird Areas (IBAs) within 50 miles of the lower Rush. Red areas have been identified as having global priority.

Organization such as Trout Unlimited (TU) and Pheasants Forever bring a large membership base of passionate fishermen, hunters, and conservationists. In the Driftless Area, TU has been active in restoring and protecting trout habitat. In 2018, Minnesota Trout Unlimited was instrumental in the drafting of a state law (Minnesota 2018 Statutes, 103G.217 DRIFTLESS AREA; WATER RESOURCES) to require special permitting for silica sand mines located within one mile of Driftless Area trout streams.

Given the popularity of trout fishing on the Rush, TU has an important role to play in protecting the cold-water fishery and natural reproduction that exists on the lower Rush. Natural reproduction of both brook and brown trout depends upon the existence of gravelly areas (known as "redds") where the eggs are laid and fertilized. It is unlikely that the lower Rush will ever be restored to good brook trout habitat, and the brookies have retreated into the cold tributaries. One of these—Morgan Coulee Creek—is a small stream with over two miles of designated trout water. This irreplaceable jewel deserves special attention.

Pheasants Forever works closely with the USDA NRCS to promote pheasant habitat. In fact, Pheasants Forever employs Farm Bill Biologists to assist private landowners in designing, developing, and funding habitat improvements. This partnership offers a unique opportunity for landowners to leverage biologists' expertise to create valuable grassland habit that produces rental income. As noted above, grassland habitat for pheasants has many other benefits. CRP acreage has been closely tied to the pheasant population for many decades, and this relationship is likely to become even more important as grassland habitat for non-game species disappears.

Many other conservation organizations are active in the region. Two that deserve special mention are the Wisconsin Woodland Owners Association and The Prairie Enthusiasts. These organizations provide landowners access to valuable resources, in particular to like-minded individuals facing the same challenges in managing their land. Both mobilize a large and enthusiast local membership with hands-on experience in invasives control, timber harvest and forest products, restoration of prairie remnants, and many other practical aspects of land management.

The role of government agencies

Government agencies create the framework in which those seeking to implement conservation measures must operate. US agricultural policy, as administered by the USDA and its sub-agencies, is one of the primary determinants of land use in rural areas. This holds true for the Driftless Area, although this area is actually a patchwork of agricultural and woodland created largely by topography. The existence of crop fields as a part of many landowners' holdings—a system perpetuated by USDA and tax policy—has a disproportionate influence on land use as a whole, since the crop fields impact adjacent lands. In this regard, the CRP program, which has been discussed above, is one of the most important tools that can be used to influence land use on the Rush River in the short term. CRP policy alone, however, is problematic due to the constant re-conversion of grassland habitat back into row crops with volatile corn and soybean prices (Ref. 9).

Forest land is also heavily impacted by government programs. Many woodland owners are enrolled in the Managed Forest Land (MFL) program, administered by the Wisconsin DNR. This program gives reduced tax rates on eligible forest land in return for the fulfilling specific management practices, including mandatory timber harvests. Although MFL-mandated timber harvests include prescriptions for regeneration, hardwood regeneration is at best a difficult proposition. Even with proper woodland management (clearcutting, seedling planting, etc.) aggressive measures must be taken to control deer browse.

The DNR—through its deer hunting regulations and harvest limits—holds the key to the ecological health and biodiversity of forest communities. As discussed above, the overpopulation of deer has reached crisis proportions along the lower Rush. Lacking action in this area, all other woodland management practices—with the exception of large scale exclosures to keep deer out of hardwood regeneration areas—risk being a waste of time and money. Given all the tangible and immediate benefits that would result from a reduction in the deer population, this should be given the highest priority.

Finally, the US Army Corps of Engineers, with their holdings of hundreds of acres on the lower stretch of the Rush, is a key player in the health of the river and its natural communities in this section. This section appears to be in transition to a floodplain forest, and may grow wetter in the coming decades due to floodplain aggradation. This could create various conservation opportunities such as habitat for the state-threatened red-shouldered hawk.

Beginning the discussion

Much of what has been discussed above is difficult to achieve, and depends upon the cooperation of many individuals and organizations. Consensus-building is one of the keys to achieving success in large-scale conservation measures, in particular among private landowners, where the buy-in of several of the largest landowners bordering the river is an important step. Before any specific measures can be discussed, it is important to build trust and a sense of mission in protecting the resource for future generations. The interconnectedness of areas like the lower Rush with larger natural areas—such as the Driftless—is a unifying principle. Landowners must be convinced that everyone is working together for a common purpose—to preserve the Rush and by extension—the planet.

The following paragraphs are an attempt to outline a preliminary plan and timeline. First, an exploratory group of three to five individuals should be formed. The first task of the group will be to discuss the various topics covered in this report and reach a consensus regarding priorities and a plan of action. A key activity of the exploratory group will be consult with conservation experts (both within government and others) to answer any questions that arise during initial discussions.

Following this initial exploratory discussion phase, outreach and education will be needed to begin to build a “grassroots” organization of landowners, conservation groups, and government agencies. An educational conference will be organized. This event would bring together a number of speakers who are qualified to communicate the guiding principles and goals of conservation action, as well as the specific issues facing the lower Rush. The event would be held and publicized locally to reach the widest possible audience, and landowners will be encouraged to attend. Given the vast subject matter that could be presented, it will be critical to focus primarily on local issues, with an emphasis on the critical role of private landowners, and to engender the spirit of cooperation. Audience participation will be a key to gaging interest and—more important—resistance to conservation measures such as CRP conversion. The target date for this conference is February 2021. Based on feedback from attendees, follow-up conferences focusing in specific areas of interest may be a good idea.

Creating a roadmap for the future

Ideally, the conference and any follow-up will generate ideas for concrete action. At a minimum, the goal should be to provide focus for the interested parties (landowners, conservationists, and government) to identify areas where progress can be made in the near term, and to pinpoint other areas where progress may be more difficult.

It is hoped that, by 2021, a larger group can be formed to begin the real work of mapping out specific conservation measures for local landowners, providing expertise, and identifying sources of funding. This group could be loosely organized or, with sufficient interest, a formal non-profit organization. To ensure continued communication and consensus, this organization will hold conferences, field days, and other educational events to engage the local community. As properties change ownership and a new generation of owners becomes active, education will be the key to conservation.

Finally, the river and its natural communities are in a constant state of flux. Therefore, continued monitoring "on the ground" is essential to understand the evolving challenges, threats, and opportunities. This will be part of the mission of the Lower Rush River working group.

Conclusion

In the 170 years since government surveyors first crossed the lower Rush River in 1849, the landscape has undergone tremendous change. Agriculture altered the land in the first half century after settlement, ultimately bringing about catastrophic erosion in the early 1900s. With improved farming practices, the land recovered, but new threats emerged: loss of water quality, invasive species and deer overpopulation, fragmentation and decline of hardwood forests, the disappearance of prairies, and a loss of biodiversity. Now, in 2019, the fate of the Rush and other rivers hangs in the balance.

We must try to preserve what is left. Current landowners, as stewards of the land must understand the threats and what can be done to combat them. Their decisions today may determine whether future generations will inherit a biodiverse landscape or a wasteland. If we map out a clear path now, landowners will be able to make informed choices that preserve the value of their land, enhance recreational opportunities, and promote biodiversity. Working with committed landowners, conservationists and enlightened government will always be willing to contribute their resources. It is the author's sincere hope that this will happen.

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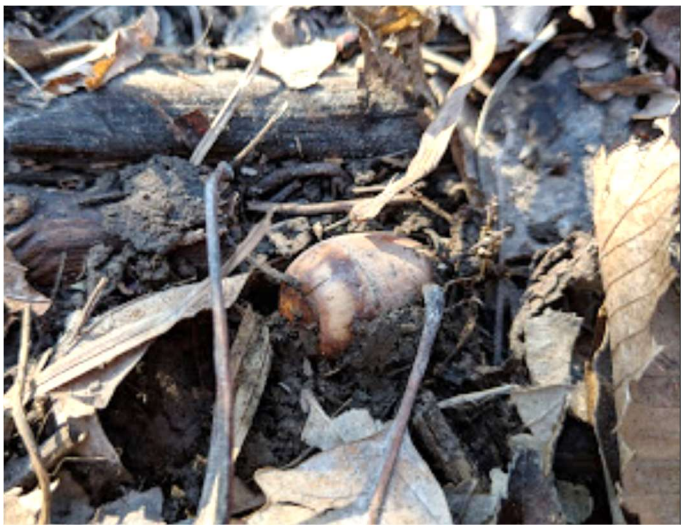

APPENDIX

Sections Used for Land Use Analysis (Figure 11)

From Top to Bottom: El Paso Sect. 33, Salem Sects. 4,9,16,21,28,33, Maiden Rock Sects. 9,16

Satellite

Topographic Map