Lake Red Rock Project

MASTER PLAN

CHAPTER 2

Project Setting and Factors Influencing Management and Development

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CHAPTER 2

PROJECT SETTING AND FACTORS INFLUENCING MANAGEMENT AND DEVELOPMENT

2.1. DESCRIPTION OF LAKE RED ROCK PROJECT

The Lake Red Rock Dam and reservoir is a very important component in water management on the Des Moines River. The project has the largest flood storage capacity in the Mississippi Valley Division. The 12,000 square mile watershed drains some of the most highly altered land in the nation with the majority of the area in intensive agriculture.

The lake created by the Red Rock Dam is the largest lake in Iowa and serves an important role in water based recreation for the regional area. The lake is 15,240 surface acres at normal level and increases to approximately 67,000 surface acres at full flood storage.

The Lake Red Rock Project is the largest contiguous piece of public land in Iowa. Approximately 50,000 acres was acquired for the reservoir and lands around the lake. This large piece of public land and its natural resources are especially significant in Iowa where public lands are scarce.

2.2. HYDROLOGY

The Saylorville and Lake Red Rock Dams are the primary flood control structures on the Des Moines River. Collectively, along with numerous levees and minor dam structures comprise a complex system of water management on a river draining approximately 25% of Iowa.

Because of this large watershed, the amount of flood water stored in Saylorville Lake and Lake Red Rock can fluctuate significantly. As opposed to some lakes across the nation that may only fluctuate five to ten feet, Lake Red Rock often fluctuates 10 to 20 feet. The high pool at Red Rock was over forty feet above normal lake level. Due to these fluctuations land based recreation facilities are constructed above flood pool wherever possible. Water based facilities are constructed to be useable at multiple lake elevations. Establishment and management of native ecosystems are focused on lands not subject to frequent inundation by flood water storage.

The major tributaries draining into Lake Red Rock below Saylorville Lake include: the Raccoon River (3,441 square miles), North River (590 square miles), Middle River (558 square miles) South River (590 square miles) and Whitebreast Creek (430 square miles).

2.3. TOPOGRAPHY, GEOLOGY, AND SOILS

2.3.1. Geology & Soils. The upper Des Moines River originated on the Des Moines Lobe of the Wisconsin Glacier during the Algona glacial advance about 12,000 years ago. It likely began as a channel in the ice and then quickly cut through relatively soft sedimentary 310 million year old Pennsylvanian age bedrock which is now exposed along both sides of the river valley both upstream and downstream of Red Rock Dam. The river meanders through a flood plain that is one to two miles wide and up to 150 feet deep. In inter-glacial times it was 20-40 feet deeper than present but filled with glacial outwash and alluvium during glacial and post glacial eras. The valley now consists of alluvial silts and clays up to 14 feet thick, underlain by sands and gravels.

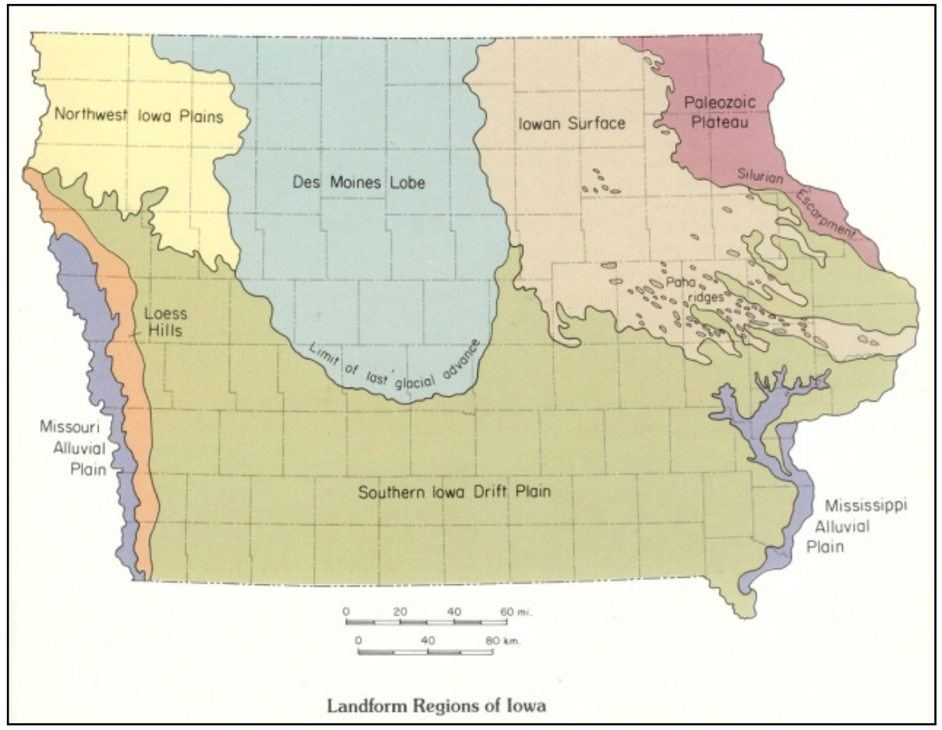
The area around Red Rock is underlain by Pennsylvanian (310 million years old) and Mississippian age deposits of approximately 320 million years old. Both the Pennsylvanian and Mississippian strata were formed when Iowa was part of a vast inland sea. The various layers of shale, sandstone, siltstone and coal beds represent the advance and retreat of this sea over a flat coastal plain, similar in some ways to the present day Louisiana delta and nearby Gulf of Mexico region (Anderson, 2007).

The oldest exposed strata in the project area are Meramec series St. Louis limestone of the Mississippian age where the Des Moines River has incised through Pennsylvanian formations. These strata, exposed along the valley floor for a few miles upstream from the dam site, are locally dense, cherty dolomites grading to sandstones. The St. Louis formation throughout the remainder of the project is overlain by the Cherokee group rock of the Pennsylvanian system. Between approximately a mile upstream of Highway 14 bridge and dam site, a bright red sandstone channel deposit found in the Cherokee group is exposed forming nearly perpendicular bluffs of 100 feet or more. These bluffs are the major scenic resource of the project and its namesake.

The Cherokee strata are quite diverse and also contain most of the coal bearing strata in the region. The Pennsylvania age rocks, including the Cherokee layer, are a repetition of deposits of sediment, mostly shales, interbedded with stratas of sandstone, siltstone, limestone and coal. Most sequences of Pennsylvanian rock represent cycles of sea level changes, often beginning with sandstone of beaches or stream channels that grades into gray sandy shale, and sometimes limestone, then into a light gray mudstone and eventually into coal beds formed when dense vegetation grew in a coastal plain. Rising sea levels eventually smother these coal forests and the cycle begins again with shallow marine shales and limestones. Pennsylvanian strata are overlain in much of the project area by Pleistocene alluvium, till and loess as described in the initial paragraph. (Anderson, 2007)

The Lake Red Rock area is known as an important site for tree fern fossils from the period when the large inland sea was alternately retreating and inundating large coastal river deltas (Pennsylvanian era). In many cases this resulted in coal seams but also created some remarkable fossils. Fossils from the Pella area are now on display at the Smithsonian Museum of Natural History in Washington, D.C. Special care should be taken to protect fossil beds on the project.

Example of Tree Fern Fossil



Landform Regions of Iowa

Prior, J.(Writer),& Lohmann, P.(Illus.).(1991). Landforms of Iowa. Iowa City: University of Iowa Press.

2.3.2. Soil Formation. Lake Red Rock is located in the Southern Iowa Driftplain landform. The topography of the area is steeply rolling hills interspersed with areas of uniformly level upland divides and level alluvial lowlands. This terrain was developed in Pre-Illinoisan glacial drift with a well developed Yarmouth-Sangamon paleosol and topped with moderately thick Peoria Loess.

2.3.3. Soil Associations. Primary soil associations in the county include Ladoga-Clinton-Otley [LCO (16%)], Ladoga-Sharpsburg-Clinton [LSC (29%)], and the Gosport-Pershing-Gara association [GPG (27%)]. Together these three associations comprise roughly 72% of all soil associations in the county. All were formed on convex ridge tops and moderate to steep side slopes and developed under native prairie or mixture of native prairie and trees. The surface layer is typically dark brown or grayish brown silty clay loams or silt loams of 6-20 inches in depth.

2.3.4. Soil Characteristics. Most of the terrain in the project area is gently sloping (0-2% slopes) to steep (9-14% slopes) with vertical bluffs in a few areas along the old river channel. The north side of the lake is predominantly the LCO association while the South side is predominantly the LSC association. These soil associations are generally silt loams or silty clay loams derived from loess.

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These silt loams are generally well drained, have high water holding capacity, and are quite fertile. Vegetation is easily established on these soils and thus they provide few limitations to the establishment of wildlife habitat, trees or lawns. Soil erosion can become a problem when slopes exceed 2%. Perennial cover on most of the project area greatly reduces this threat. However, proper precautions should be taken when soil on slopes exceeding 2% is exposed. Some of the soil types within the existing associations have limitations which do not make them ideal for construction or sanitary systems either due to slope, slow percolation, or excessive fines.

While most of the soils on the project are gentle to moderately sloping silt loams or silty clay loams there are scattered pockets of Gosport Rock Outcrop, Chelsea loamy fine sand, Strip Mine Spoils and Cut and Fill Land. Each of these areas provides some unique challenges for vegetation establishment, management, construction etc. The many strip mines are an artifact of the areas once thriving coal mining industry; mines are scattered throughout the project area. Cut and fill areas are the result of dam and road building projects resulting from construction of the dam and elevation of area roadways due to reservoir flooding and are found near the dam and roadways within the project area. Strip mine spoils are often acidic and cut and fill areas are usually comprised of thin soil over shale. Both types of areas can pose challenges to vegetation establishment, e.g. acidic soils, drought prone and shallow soils. The Gosport outcrops and Chelsea sands are natural artifacts of water and wind erosion respectively and are often associated with steeper bluffs overlooking the river valley. They create unique micro habitats which require special consideration when doing restoration or construction projects.

Mile Long Bridge Area during 2010 Lake Drawdown

2.4. SEDIMENTATION

The largest threat facing Lake Red Rock's water resource and water based recreation is sedimentation.

The 2011 resurvey shows that about 44% of the conservation pool is taken up by sediment deposition. The conservation pool is the water held in the main lake below the normal lake level of elevation 742. The future rate of sediment entrapment is expected to be about 3,500 acre feet per year. That is about the same as 3,000 football fields covered with one foot of mud per year. The 2011 resurvey estimated that the current conservation pool will substantially fill with sediment in 53.5 years (2065). This will significantly impact lake recreation, lake fisheries and potentially low flow river augmentation.

There will be a drastic reduction in boatable water surface of the lake and boat ramps and/or water access points will be impeded by sediment. As sediment builds, the bottom of the lake changes to a flat and even surface without any topography thus reducing habitat for fish and other aquatic life. The sediment will replace water stored within the normal pool level reducing conservation storage for low flow river augmentation.

Sedimentation is monitored by sedimentation resurveys, the original having been completed in 1969. There have been four resurveys completed since the original. Advances in the data collection equipment and techniques provide more accurate volumes of sediment in the Red Rock Reservoir.

At the request of the State of Iowa, the lake level was raised to 742 more quickly than originally planned due to the negative impact of sedimentation on recreation and to assure adequate conservation storage of water for low flow augmentation of the river during drought.

Sediment is generally thought to come from three sources in the watershed: surface soil erosion primarily from farmland; stream bank erosion; and down cutting of stream channels. Additionally shoreline erosion is an added sediment source within the reservoir and is addressed in Section 2.5. Surface soil erosion from farmland is well known. However, equally of concern is stream bank and stream channel erosion.

Straightened and channelized streams increase in velocity, enhancing their erosive effect and capacity to carry sediment. Many rivers and streams in the Red Rock watershed have been channelized. Extensive tiling to improve surface drainage in agricultural fields along with hard surfacing of urban sprawl rapidly moves rain and ground water into creeks and streams. In cases where vegetation has been removed from the stream bank, leaving it unprotected, bank erosion is excessive. Walnut Creek is a tributary within the reservoir at Lake Red Rock. Two studies concluded that eroding stream banks contributed 50 to 80% of the sediment load to the creek and eventually to Lake Red Rock.

2.5. SHORELINE EROSION

Shoreline erosion occurs along the perimeter of Lake Red Rock and is an added sediment source within the reservoir. In some places exposed glacial rock and gravel have offered some protection, but in others the bank erosion continues unabated. Areas with long wave fetch zones and highly erodible soils are particularly susceptible. The fetch zone across Lake Red Rock is up to two miles long. Waves, pushed by high winds of any duration, cause erosion and sloughing of the shoreline.

Sediment from shoreline erosion impacts recreation by making many areas difficult to access by boat and increasing the cost to maintain boat ramps and beaches. There are also negative environmental impacts associated with the shoreline mudflats.

Awareness of the shoreline erosion was heightened after the Flood of '93 (flood of record). There was a long duration of elevated pool, coupled with numerous storms and high winds, which caused an accelerated rate of erosion.

Example of Lake Red Rock Shoreline

As funding became available, critical operational features and recreation infrastructure have been protected by utilizing rip-rap to stabilize the banks, primarily: around the dam; along the Visitor Center/Administration Building; adjacent to the T Lam Cemetery; around the Marina Bay; along the Robert's Creek dam; along Volksweg bike trail embankments; along Highway 14 right of ways; and at boat ramps.

Erosion is also a problem on the river corridor below the Lake Red Rock Dam. This was especially evident following the Flood of '93 when outflows of approximately 104,000 cfs removed bank protection from the outlet works pilot channel, scoured huge excavations on both sides of the tailwaters and destroyed recreation facilities. The rip rap protection was reinforced for these areas. The Red Rock downstream shoreline protection extends to the Horn's Ferry Bridge.

Rip Rap Work at Visitor Center in 2010

The Lake Red Rock Project will place additional reservoir shoreline protection to protect critical habitat or infrastructure as funding allows. Past studies consistently choose riprap for the protection application due to extreme erosive action. An added benefit of riprap protection is the fish structure it provides.

Rip Rap Work in Tailwater

2.6. WATER QUALITY

The water quality of Lake Red Rock is highly dependent upon the water quality of the Des Moines River upstream from the lake. The water quality of the Des Moines River, the largest internal river in Iowa, and its tributaries, is a reflection of the pollution control, sewage treatment and land uses in the watershed. An initiative to understand the water quality of Lake Red Rock (and Saylorville Lake) and the water flowing into them was started in 1971. For the past 45 years the Corps of Engineers has maintained the Des Moines River Water Quality Network with assistance from the Environmental Engineering Section of the Department of Civil Engineering at Iowa State University (ISU). Samples are collected throughout the year from regular sampling stations, along the Des Moines River, Saylorville and Lake Red Rock, and tested for various physical, chemical and biological parameters.

The Des Moines River is a mineral laden, eutrophic river flowing through lands dominated by agricultural. In upper reaches of the Des Moines and Raccoon Rivers as much as 90% of the basin has been converted to agriculture, mostly corn and soybeans. Watersheds in the lower Des Moines Basin often have as much as 60% perennial cover. Water quality of the river is impacted by agriculture with high levels of sediment, phosphorus and nitrogen.

The U.S. Environmental Protection Agency (EPA) was directed in the Clean Water Act to establish water quality criteria to form the basis for enforceable standards to be developed by states. States are to assess the water quality data every two years to determine the degree to which the state's lakes, rivers and streams meet state water quality goals. The states are to submit to the EPA's list of the waters that are considered "impaired."

In 1986, the EPA recommended separate standards for swimming beaches, which the state of Iowa applies to class "A" waters. Class A waters are waters to be protected for primary contact water use. Lake Red Rock has two beaches that are monitored: North Overlook Beach and Whitebreast Beach. EPA fecal coliform standards of 235 organisms/100 ml (or the geometric mean of 126 organisms) for primary contact recreation is occasionally exceeded in late summer at both beaches. However during most of the spring and summer fecal coliform counts are well below the EPA standard for primary contact recreation at the beaches and in the main body of the lake. It is speculated that late season concentrations of migrating gulls cause many of the late season spikes in fecal coliform. Gulls prefer to loaf and rest on beaches.

A 2012 Water Quality Assessment by the Iowa DNR concluded that "the Class A1 (primary contact recreation) uses of Lake Red Rock were assessed as 'partially supported' due to the levels of turbidity that create aesthetically objectionable conditions." This factor is the stated reason for the listing of Lake Red Rock on the impaired list, as of 2015.

Fish consumption and tests for pesticides and heavy metals are within accepted standards.

Overall water quality of Lake Red Rock is good and is considered by Iowa DNR to support its designated uses. A select number of physical, chemical and biological parameters are used to calculate a Water Quality Index – a relative measure of overall water quality. In 2012 WQI values for the entire DMRWQN ranged from 30-94. An overall WQI rating for the stations upstream of Lake Red Rock was 71, with a five point improvement downstream from the dam. A rating of 26-50 is considered bad; ratings in range of 51-70 are considered fair; and 71-90 good. The highest water quality index values were below both Saylorville and Red Rock, indicating an overall positive effect on water quality.

ISU data show that a moderately large population of cyanobacteria, also known as blue-green algae, exists at Lake Red Rock, but it is not necessarily an impairment. Cyanobacteria are capable of producing toxins that can be hazardous to health, but they do not always produce toxins. Occasionally blooms of blue green algae form on the lake, and can give an eerie bluish cast to the water.

Example of Blue Green Algae at Lake Red Rock

In the summer of 2014, the alignment of nutrient rich waters, long retention time in the pool, high pool and calm wind conditions, combined with excellent water clarity and heat prompted the worst blue green algae bloom in Project history.

Water quality has significant environmental, economic, recreational and human health implications. Improved water quality would have significant positive impact on the Project's environmental and recreation missions.

2.7. CLIMATE AND WEATHER

Marion County's climate is typical for areas with a continental climate. There is considerable seasonable variation in temperatures and moderate precipitation which falls largely in spring and summer. Winters are often cold enough to support snow.

Climate data recorded at Knoxville, IA between 1971 and 2000 indicates that the mean annual temperature for the area is 49.5 ° (F) with a mean maximum daily temperature of 59.7° (F) and minimum daily mean of 39.2 ° (F). The highest daily temperature recorded for the period of record 1896-2001 was 114 ° (F) on Aug 8, 1934 and lowest daily temperature was -30° (F) on Jan 12, 1912 (National Climate Data Center, 2012). Statewide, the average annual temperature ranges from 45 degrees (F) in the north to 52 degrees (F) in the southeastern corner of the state. Extremes across Iowa include 118 degrees (F) at Keokuk on Jul 20, 1934, to -47 degrees (F) at Washta on Jan 12, 1912.

The mean annual precipitation recorded at Knoxville for the period 1971-2000 was 35.09 inches and ranged between 52.97 inches in 1973 and a low of 18.94 inches in 1956. Highest recorded daily rainfall was 6.08 inches on Nov 17, 1952. The months of April through August receive the highest levels of precipitation, averaging around 4 inches per month during this period. Rainfall has been increasing since the late 1950's, averaging 10% more per year than in previous 50 years (Harry Hillaker, IDALS, e-mail communication, 2011). Annual snowfall during the period 1971-2000 averaged 25.5 with most of the snow falling in the months of December-February (average of 6-7 inches per month). The highest daily maximum snowfall of 13 inches was recorded on February 2, 1983. Like temperature, snowfall is variable across the state. The highest average is 40 inches in northeast Iowa, to 20 inches in southeast Iowa, with a statewide average of 32 inches.

The prevailing wind in the area originates from the northwest from the late fall through early spring (November-April), but switches to the south from May through October. Annual average wind speed is 11 mph and the highest peak gust was 83mph in July.

Twenty-seven tornadoes were reported in Marion County, Iowa between 4/30/1950 and 11/30/2011. Most occurred in the months of May/June and all were F0-F2 strength storms. No tornadoes greater than F2 were reported. Because such storms occur during peak camping season they represent special challenges to campers at Lake Red Rock along with strong winds and thunderstorms.

Flooding is most common in June, which has the highest average rainfall of any month (4.64 inches), which is followed by spring months when snowmelt, combined with rain, and frozen soils can produce significant flooding on major rivers. However, severe localized events can produce phenomenal flash flooding. For example, in July of 1982 during a two week time period, Monroe County experienced nearly two feet of rain in a two week time period. Cedar Creek, which enters the Des Moines River about 15 miles below Red Rock Dam, responded with flow gauged at 100,000 cubic feet per second (cfs) and 80,000 cfs on July 3rd, and 16th.

Another reality of Iowa's climate is the occurrence of droughts. The most severe droughts in historical times occurred in the 1930s. However, other major droughts, characterized by deficient rainfall combined with high temperatures occurred in 1886, 1893-94, 1901, 1954-56, 1976-77, and 1988-89.

2.8. AIR QUALITY, AESTHETICS AND NOISE

Air quality in this region is generally good with particle pollution and nitrogen dioxide being the main offenders. Air quality in Marion County, IA is 89 on a scale to 100 (higher is better). This is based on ozone alert days and number of pollutants in the air, as reported by the EPA. The EPA calculates the Air Quality Index for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. For each of these pollutants, EPA has established national air quality standards to protect public health. Ground-level ozone and airborne particles are the two pollutants that pose the greatest threat to human health in this country. Particulates are the most common type of air pollutant in Iowa.

Lake Red Rock is located within rolling hills surrounded by forested hills, some development and farmland. The rolling hills and red rock outcroppings provide for excellent aesthetic views. Public comment placed a high value on the natural feel of Lake Red Rock with comments on the need to maintain undeveloped viewscapes. The combination of water features, natural vegetation, open fields and rolling topography around the lake provides high quality visual resources from numerous viewpoints.

There are no intrusive routine noise sources surrounding the lake. At the lake, noise sources include watercraft motors, vehicular traffic, and human voices at areas of concentrated use (for example, day use areas and campgrounds). Due to the presence of roads along the lake, most locations receive some noise from man-made sources.

2.9. ECOLOGICAL SETTING

Lake Red Rock is located in the Central Dissected Till Plain (CDTP) or Central Tallgrass Prairie Ecoregion (The Nature Conservancy, 2008). This ecoregion stretches across 110,000 square miles from eastern Nebraska to northeast Kansas east to northwestern Indiana The ecoregion is centrally located within the tallgrass prairie ecosystem that once covered the eastern plains of North America. The ecoregion also encompasses parts of the central Missouri and Mississippi rivers, including small headwater prairie streams to large floodplain rivers. These rivers were formerly bordered by prairie, wetland and savanna, but now are primarily agricultural watersheds.

The CDTP ecoregion is characterized by flat to rolling topography with steep bluffs on the major rivers. It was named for the tallgrass prairie mosaic that dominated the landscape prior to European settlement. Embedded in the prairie matrix were a complex array of woodlands and other smaller plant communities. Predominant grasses include big bluestem, little bluestem, prairie dropseed, Indian grass, switchgrass, sideots grama and various sedges. Included in the lush grass vegetation were a variety of forbs and in many cases total forb importance approaches that of grass.

Example of Prairie at Lake Red Rock

Associated with the prairies were extensive woodland communities, ranging from savannas to closed canopy woods, and in some limited area, true forest. Most woodlands are or were associated with large river systems in topographically dissected areas. These woodlands typically survived in areas where widespread and frequent dormant season fires were excluded, infrequent, or attenuated by infertile soils or high moisture. Woodlands in the Iowa portion of the ecoregion are dominated by burr oak, shagbark hickory, as well as red oak, black oak and white oak species. Hard maple, basswood and other fire intolerant species are found occasionally on steep north facing slopes. These communities and remnants of these communities are well represented at the Red Rock Project. Most of the woodlands within the reservoir flood pool have been lost, with woodlands in the upper reaches of the flood pool altered from original condition to species that tolerate occasional to frequent inundation. Downstream from Red Rock Dam the Des Moines River is now usually confined within its banks, making row crop production in river bottoms more reliable and profitable. Consequently, many large tracts and strips of timber have been cleared.

At the time of settlement, the primary ecological drivers within the ecoregion were climate, fire and grazing – with each driver interacting with the others at multiple scales. The landscape experienced frequent fires with fire return intervals ranging from one to seven years. Native Americans repeatedly set fire to the landscape to stimulate new growth to attract wildlife, clear vegetation to facilitate travel, as a tool for hunting and warfare, as a form of communication and to reduce the chance of wildfire (Krech, 1999, The Nature Conservancy, 2008). Since settlement, two of these drivers, fire and grazing by large herbivores, have been reduced or totally eliminated. This has caused a gradual change in all types of communities. Lake Red Rock Project uses prescribed fires to replicate these formerly common practices.

The Red Rock watershed encompasses approximately 12,000 square miles of the Des Moines River valley and its tributary rivers and streams. Red Rock Project lies principally in Marion and Warren Counties, but small tracts of fee title and flowage easement also are located in Jasper and Polk Counties. The Project lands and flowage easements are located entirely within the Southern Iowa Drift Plain. The Southern Iowa Drift Plain is the largest of Iowa landforms and was last glaciated 600,000 years ago. Its surface is a rolling network of well developed drainages with a mantel of loess over ancient glacial till.

The Des Moines River and Red Rock Project watershed extends into the Des Moines lobe of the Wisconsin Glacier and into a small part of Minnesota. The Des Moines lobe, by contrast, is Iowa's youngest landscape, having last seen glaciation about 12,000 years ago. Its drainages are less well developed. The northern part was the prairie pothole region, a large, flat landscape of wetlands, potholes, prairies and most of Iowa's natural, glacial formed lakes. It was the melting of the Wisconsin glacier in northern Iowa that helped form the Des Moines River valley.

It was the prairie biome that formed the rich black top soil that is so productive for agriculture today. Approximately 99% of the Iowa prairie has been converted to agriculture. Similarly, the wetlands and prairie potholes of northern Iowa were once quite extensive. The wetlands served as a giant sponge retaining water on the land; recharging groundwater and releasing the excess moisture gradually. However, with improved drainage, the productivity of these soils was discovered and put into agricultural production. Consequently, over 90% of Iowa wetlands are gone. This significant change in vegetation and drainage has a tremendous impact quantity of water entering the Des Moines River and water quality.

2.10 VEGETATIVE RESOURCES

The Red Rock Project lands were acquired primarily for operation of the dam and reservoir for flood control. As such, all land lying within the conservation pool is permanently inundated. Land within the flood pool is frequently to occasionally flooded. This creates an artificial influence on the historic communities. For example, upland areas that were formerly xeric or dry, now can become wet during flood events, and upland vegetation dies, while more flood tolerant moisture loving flora replaces them.

From post-settlement time to the government acquisition of project lands the area was largely agrarian and small villages. Land in the upper reaches of the project was a patchwork of tilled fields, hayfields, pasture and relatively undisturbed grassland and woodlands. Less than 1% of this land could be considered native prairie, savanna or woodland in a pristine condition.

Most historical settler accounts indicate that open parklands of prairie and scattered trees were found in Missouri and Southern Iowa. These converted to brush, then forest as wildfires were suppressed and browsers were eliminated. This process took only 30-40 years to occur. Nearly all of the soils on the Red Rock Project had originated under prairie or savanna.

Red Rock prairie remnants tend to be grass dominated, especially big bluestem, little bluestem, or Indian grass, depending on slope position. Low forb diversity is probably caused by past history of tillage, herbicide use or overgrazing. An over-reliance on spring time controlled fires can also reduce forb diversity.

Native woodlands are now primarily closed canopy red/black oak woodlands located on ridge tops and slopes. There are scattered degraded burr oak and/or white oak savannas. Gradually, fire intolerant species became established in the woodlands and have shaded the understory to an extent that formerly dominant oak-hickory woodlands are being replaced by a different community of trees and herbaceous plants. New dominant trees include elms, boxelder, hackberry, honey locusts, etc. Closed canopy woodlands can no longer support an understory of grasses and forbs. Once the root systems of grasses and forbs are lost the landscape becomes prone to serious soil erosion. Consequently, they are now subjected to extensive sheet and gully erosion.

There are many thousands of acres of early successional trees and shrubs that have invaded former grassland and old fields. Due to a conservation bias toward reforestation at the time, a resource management goal of the first master plan was to plant trees in former crop fields and open areas. Hundreds of acres of tree plantations were planted in early 1970s and 1908s. Plantations are dominated by closely planted rows of walnut, green ash, red pine, white pine, silver maple, Norway maple, dogwood and ninebark, etc. Exotic invasives, such as autumn olive and honeysuckle, were included in the plantation species mix, or spread into these areas over time.

There are a few tracts of riparian forests in the higher elevations, especially in the upper end of the main body of the reservoir where trees are subject to less frequent inundation. The Eagles Lair Island is the only location downstream of the dam.

Some notable rare or uncommon state listed plant species found on the project area include Oval ladies'-tresses, broomsedge, ear leaf false foxglove. Prairie bushclover are federally listed plant species potentially located in the vicinity of the project, but there are no known locations for these at Red Rock. More extensive inventorying of less disturbed land is needed, as well as aggressive triage of overgrown landscapes where remnant plant recovery is possible.

2.11 WETLANDS

Red Rock Project has or had wetlands within the following classifications: Riverine, Lacustrine and Palustrine. However, following the creation of the reservoir many naturally occurring lowland areas became permanently inundated by open water or have been altered by the rising and falling of the flood pool. The construction of the dam and ponding of the reservoir also created wetlands by the changed hydrology which disrupted intermittent or reliable drainages. In recent years old strip mines, dam borrow sites and road relocation borrow sites on Project lands have been reclaimed from their post borrow/post mining condition. As part of the reclamation process, wetland impoundments are incorporated into the reclamation design.

The Iowa DNR has constructed three impoundments on the Red Rock Wildlife unit. Water is ponded in these impoundments in the fall to create marshes. A portion of these ponded areas are managed as waterfowl refuge while others are open to public hunting. The Corps has restrictions which apply when constructed within the flood pool or flowage easement lands.

Wetlands are regulated under Section(s) 401 and 404 of the Clean Water Act. Section 401 Water Quality Certification ensures compliance with water quality standards. Section 404 regulates activities within Waters of the U.S. which includes Lake Red Rock and its surrounding tributaries.

2.12. FISH AND WILDLIFE RESOURCES

Iowa ranks 49th in public land ownership and large tracts of wildlife habitat are uncommon. As Iowa's largest contiguous land base, Red Rock Project provides a significant fish and wildlife resource for the state and regionally.

Wildlife and Fisheries management is an important component of the resource management program. Close coordination and partnering occurs between Corps staff and the Iowa DNR to reach management objectives. In addition, Red Rock has partnered with non-governmental organizations to achieve fishery and wildlife management strategies.

Lake Red Rock is well known for its importance as a migratory corridor and was deemed a Globally Important Bird Area by the American Bird Conservancy in 1998. In the announcement letter it noted that Red Rock provides habitat for more than 1% of the biogeographic population of American white pelican, up to 8% of the world's Franklin's gulls, 2% of the biogeographic population of herring gulls, and nationally significant numbers of bald eagles. The Iowa Audubon Society has designated Lake Red Rock an Important Bird Area, citing its values of rare or unique habitats, and significant species concentrations. As of 2015, a whopping 287 species had been observed at Lake Red Rock.

Local woodlands are host to many breeding woodland birds, such as Acadian Flycatchers, Louisiana Waterthrush, Summer and Scarlet Tanagers, Red-headed woodpeckers, and Bell's Vireo. The same woodlands are also excellent places to observe migrating warblers. Of special interest to birders are the many species of waterbirds, shorebirds and waterfowl that visit the project annually. Over 150,000 waterfowl may use the area during migration peak. The mud flats of the upper reservoir are the best place in the state to spot shorebirds. The tailwaters are an excellent place to spot rare gulls. In the fall hundreds of migrating pelicans draw sightseers, and in winter, dozens of bald eagles perch in riverbank cottonwoods.

Little is known about Red Rock's non-game mammal and reptile fauna as no significant surveys of these taxa have been conducted. Several Iowa DNR frog and toad call surveys indicate that there are nine species of frogs and toads present on the Project area.

The Lake Red Rock Project has managed an artificial nesting box program since the mid 1980s. The leg work of this effort has been achieved by 1,000s of hours from volunteers. The species most directly benefiting from these efforts include bluebirds, wood ducks, kestrels, purple martins, and some non-targeted native species usurpers.
Large habitat complexes at Lake Red Rock have allowed for the successful reintroduction of river otter and osprey once extirpated species from Central Iowa. It has also aided recolonization of bobcat and bald eagle. All of these species now have reproducing and stable populations.

Most direct wildlife management activities are completed by the Iowa DNR staff located on the Red Rock Wildlife Unit. Wildlife management is targeted primarily at White-tailed Deer, Eastern Wild Turkey, waterfowl and mourning doves. Additionally, small game hunting and upland birds are managed species but limited by lack of suitable habitat. Red Rock has an abundance of huntable wildlife including very large herds of whitetail deer, turkeys, and migratory waterfowl. Furbearing wildlife such as raccoon, mink, skunk and opossum are also abundant in the woods surrounding the lake, however no local population estimates or local population trends are available for any of the economically important species except whitetail deer and waterfowl.

The Iowa State Wildlife Plan has wide ranging goals and objectives with a few key recommendations that relate directly to the Lake Red Rock project. The plan calls for a focus on species of greatest conservation need (SGCN) (Iowa DNR, 2007). Grassland and aquatic species comprise the largest block of SGCN. The plan also calls for the protection, restoration and enhancement of large core tracts and greenbelts to serve as reservoirs of biological diversity. The plan also calls for more reliable information on distribution, abundance and needs of all wildlife species.

Fisheries management is mostly a DNR led effort, and is primarily aimed at maintaining a sport fishery for anglers. Primary management species include walleye, largemouth bass and wiper, which require stocking due to limited or no reproduction in the lake. The Iowa DNR, the Corps, the Red Rock Lake Association and others have partnered to establish fish rearing ponds to increase survivability of stocked fish. Largemouth bass, channel and flathead catfish, white bass, crappie and other pan fish reproduce naturally and only require supplemental stocking when necessary. Commercial fishing for rough fish has occurred at Red Rock on a limited and irregular basis.

Hunting and fishing are popular at Lake Red Rock and efforts will continue to preserve and promote these activities.

2.13. THREATENED AND ENDANGERED SPECIES

2.13.1. Threatened and Endangered Species. Table 3-1 lists the federally-endangered, threatened, and proposed species possibly found in the four-county area (USFWS, 2014).

The Indiana bat is a federally-endangered species found in central and southern portions of Iowa. This species occupies forested areas, usually near permanent sources of water. It typically roosts under the peeling bark of shagbark hickories (*Carya ovata*) or dead trees and occasionally in tree cavities. Since trees with cavities and dead trees are more abundant in mature forests, the Indiana bat tends to be most common in moderate-aged to older forests containing large trees as well as standing dead trees. Indiana bat has been recorded on project lands multiple times since the 1980s.

The Northern long-eared bat (*Myotis septentrionalis*) is proposed as endangered. Its range includes much of the eastern and north-central United States. It hibernates in caves and mines and swarms in surrounding wooded areas in autumn. It roosts and forages in upland forests and woods.

Prairie bush clover (*Lespedeza leptostachya*) is a federally-threatened prairie plant found only in the tallgrass prairie region of four Midwestern states. At the beginning of the 19th century, native prairie covered almost all of Illinois and Iowa, a third of Minnesota and 6% of Wisconsin. Prairie with moderately damp-to-dry soils favored by prairie bush clover was also prime cropland; today only scattered remnants of prairie can be found in the four states. Many of today's prairie bush clover populations occur in sites that were too steep or rocky for the plow.

The western prairie fringed orchid *(Platanthera praeclara)* is restricted to west of the Mississippi River and currently occurs in Iowa, Kansas, Minnesota, Nebraska, North Dakota, and in Manitoba, Canada. This orchid occurs most often in mesic-to-wet unplowed tallgrass prairies and meadows, but has been found in old fields and roadside ditches.

The least tern (*Sterna antillarum*) is listed as endangered in Polk County, Iowa. Historically, terns nested on sparsely-vegetated sandbars along major rivers in the Central United States. Much of their natural habitat has been lost because of broad-scale changes to our natural river systems that include invasive plants, dams and reservoirs, river channelization, bank stabilization, hydropower generation, and water diversion.

Table 3-1. Federally-Endangered, Threatened and Proposed Species Possibly Found in: Marion (M), Warren (W). Jasper (J) or Polk (P) Counties IA

Species	Scientific Name	Status	Habitat
Indiana Bat [M,W,J,P]	*Myotis sodalis*	Endangered	Caves, mines (hibernacula); small stream corridors with well-developed riparian woods: upland forests (foraging)
Northern long-eared bat [M,W,J.P]	*Myotis septentrionalis*	Proposed as Endangered	Hibernates in caves and mines – swarming in surrounding wooded areas in autumn. Roosts and forages in upland forests during late spring and summer
Prairie bush clover [M,W,J,P]	*Lespedeza leptostachya*	Threatened	Dry to mesic prairies with gravelly soil.
Western prairie fringed orchid [M,W,J,P]	*Platanthera praeclara*	Threatened	Wet prairies and sedge meadows.
Least tern [P]	*Sterna antillarum*	Endangered	Bare alluvial and dredged spoil islands

2.13.2. State of Iowa Listed Species. There are 71 state listed species for Marion, Warren, Jasper and Polk Counties. This list includes 42 plant, 9 bird, 3 fish, 5 mammals, 6 insects, 2 mussels and 4 reptile species. Specific species are listed in Appendix G. Iowa's endangered and threatened species law was enacted in 1975. The current law, entitled Endangered Plants and Wildlife is Chapter 481B of the Code of Iowa. The Natural Resource Commission and the Director of the Department of Natural Resources are responsible for administration of Chapter 481B.

2.13.3 Multi-Species Inventory and Monitoring (MSIM) Program Saylorville Lake. An extensive multi-species inventory was not done at Lake Red Rock due to limited funding. However as part of Saylorville Lake's master plan process, an extensive MSIM Program inventory was conducted on 18 different habitat types identified throughout the project. The inventory data that was collected at Saylorville Lake may present similar species, especially common species, as the habitat types at Saylorville and Red Rock are similar and in close proximity to one another.

The MSIM final report by Iowa State University and the Iowa DNR tallied 19 species of mammals, 177 species of birds, 20 species of herptiles, 34 species of butterflies, 43 species of dragonfly, and 17 species of mussels during the survey period. This report can be found in its entirety in Appendix G, of the Saylorville Lake Master Plan. Many Species of Greatest Conservation Need (Iowa Action Plan 2006) were identified during the MSIM study, including 3 mammals, 43 birds, 3 herptiles, and 1 dragonfly. Presence and absence of species are noted in the final MSIM report. Some species not recorded (absent) have suffered significant decline at Saylorville Lake in the last two decades. Three mammals including Franklins Ground Squirrel, Grey Fox, and Southern Flying Squirrels have scant records of late but were common occurring mammals in the 1970s.

2.14. INVASIVE SPECIES

Invasive species are one of the worst ecological problems that resource agencies face across the country. In this context, these are species that are either flora or fauna that originated from another country, or outside of another distinct and isolated biome. They can also be described as "alien," as in from another place, or non-native. Another adjective to describe them can be "exotic," because they are strange or unusual to the historical environment to which they are now firmly established. Invasive can also be used to describe certain native species. These species may have aggressive or colonizing early successional traits can displace other less aggressive native species. While Red Rock Project resource management will be conscious of native invasive plants and animals, it is the alien or exotic type that presents a more vexing challenge. Their aggressive nature combined with their exotic origin threatens native plant communities with partial or total ecological disruption of balance.

The early conservation practice of introducing exotic species through wildlife food plantings or habitat had significant consequences in establishment of invasive species harmful to native ecosystems. A prime example of that occurred at the Lake Red Rock Project in the 1970s and 1980s. Tree plantations were established for reforestation at 79 sites covering 792 acres. Of these sites, roughly 50 included autumn olive in the plantations and many others included bush honeysuckle (amur, tartarian, Bell's). These two species were promoted at the time as a bountiful producer of wildlife food.

Now they are two of the most troublesome invasive species on the project. Staff estimates that up to 8,000 acres of the project are significantly impacted by autumn olive and another 8,000 acres by honeysuckle. Autumn olive tends to invade former old fields, especially open sites, while honeysuckle prefers early successional, partially open woodlands. Both species tend to form very dense thickets that are difficult to walk through and shade over all other forms of native vegetation.

A third invasive of primary concern threatening Lake Red Rock Project prairies is Sericea lespedeza also commonly called just "sericea," or Chinese bush clover. It prefers grasslands and re-constructed or native prairie where it quickly establishes and crowds out native plants. Its most troublesome trait is its reproductive capacity. One stem can produce up to 1,500 seeds that may be capable of germination for 20 years. It is particularly difficult to control because it may be located in native prairies where great care must be exercised when using herbicides. Sericea is a close relative of many native lespedeza, which may limit the kinds of herbicides that can be used.

Black locust is an invasive species that may impact up to 5,000 acres of the project. It originated south and east of Iowa and tends to form dense stands that crowd out other vegetation. It has been common long enough that it could be considered naturalized in Iowa. Black locust prefers to invade old fields and grasslands.

Other invasive plant species found on the project include multiflora rose, Siberian elm, Japanese Knotweed, purple loosestrife, buckthorn, reed canary grass and several species of non-native thistles (bull, musk and Canadian thistle). While less serious and less widespread than the other invasives, these have the potential to harm habitats if not kept in check. Thistles on public lands are often cited by adjacent farmers as a significant nuisance because they are difficult to control and spread quickly into both cropland and pasture.

The only aquatic invasive plant is a population of Eurasian water milfoil. It is currently confined to a pond on the south side of Lake Red Rock. It is uncertain if this invasive is able to establish within the main reservoir, but presents a nucleus from which this very troublesome aquatic invasive could spread to other water bodies. Extensive proliferation or blooms of many aquatic plants is common in Iowa due to rich, organic bottoms and benthic layers, plus high nutrient inputs from the watershed. Eurasian water milfoil colonizes ponds making boating, fishing, and other forms of aquatic recreation very difficult. The dense mats can interfere with fish reproduction, or when they die off can lead to fish kills.

House, or English sparrows, along with their fellow English invader, the starling, is found throughout the project. They are aggressive species that can displace bluebirds and other cavity nesters. House sparrows are particularly troublesome residents of the project's network of bluebird nest boxes. Popular species such as tree swallows, bluebirds and purple martins are all negatively impacted by usurpation of nesting cavities.

Three species of exotic carp—bighead, silver and common—are found on the project. Bighead and Silver carp are currently confined to the tailwaters and have not been detected above the dam. Common carp comprise a significant proportion of the lakes biomass and cause problems by muddying the water by rooting for food in bottom sediments and dislodging aquatic plants. Bighead and silver are plankton feeders that compete with native fish for this vital foundation of the food chain. In areas where they are present they constitute a significant proportion of the aquatic biomass.

Two recent arrivals of alien invasive and destructive pests to Iowa include the gypsy moth and emerald ash borer. The gypsy moth was intentionally introduced into Massachusetts in 1869 to develop the silkworm industry. The plan failed, but the gypsy moth soon became accustomed to its new surroundings and gradually spread westward. It has a voracious appetite and can totally defoliate trees, leaving them weakened or dead. Emerald ash borer is a more recent arrival, believed to be accidentally introduced in Michigan in 2002. It has had a rapid expansion of its range and is deadly to all species of ash trees. Neither of these pests have invaded the Red Rock Project to date.

2.15. RESOURCE ANALYSIS (Level 1 Inventory Data)

The Corps requires that two types of natural resource inventories, Level One and Level Two, be conducted at Corps civil works projects to provide quantitative and qualitative data for use in determining resource management needs. Level One inventories are of a general nature and have been completed for the Red Rock Project to provide baseline information for planning purposes.

Level One inventory determines general plant and animal composition, acreage of dominant vegetation type, soils, land use capabilities and the presence of "special status species," and/or their critical habitats.

Level Two inventories provide a thorough flora and fauna inventory to aide in development of detailed stewardship plans and to monitor progress in meeting goals. A complete Level Two inventory has not been completed for the Red Rock Project. However, during the master plan process, high value natural landscapes were evaluated as part of the analysis for Environmentally Sensitive Area (ESA) designations. The analysis further defined the ESAs and the communities surrounding them according to the National Vegetation Classification System, a methodology of inventory adopted by the Department of Defense and other federal agencies. A key element of the analysis is the identification of threatened, endangered or special status species.

Due to the lack of a complete Level Two inventory a variety of inventory data was utilized. There are extensive records maintained in the Natural Resource Inventory System which was a project wide inventory completed in the 1980's and updated as work was performed. The Iowa DNR maintains a list of threatened, endangered and special concern species in their Natural Areas Inventory database. Red Rock Project accessed this database for any records pertinent to the project. Most of Project land had been occupied by farms and small villages prior to federal acquisition. The extent and degree of disturbance on the landscape was determined by examination of aerial photography going back to the 1930's. This allowed biologists to focus field investigations to those sites most likely to have species of concern and critical habitat. If it was discovered in the ESA analysis that records were deficient or absent, an onsite field visit was performed to visually assess the qualitative attributes of a site.

More complete and thorough inventory is needed throughout the Project. Additional Level Two Inventory needs will be determined in Environmental Stewardship plans for each unit. The inventories should be performed at varied times of the seasons in order to capture those ephemeral, transitory or migratory species that comprise the unit's comprehensive ecosystem.

2.16. CULTURAL AND HISTORIC RESOURCES

Lake Red Rock is the result of impounding water in a portion of the Des Moines River Valley 40 miles south of the city of Des Moines, Iowa. The cultural history of the Lake Red Rock area covers approximately 14,000 years. The prehistoric record spans the Paleoindian through the Oneota periods, and the historic record starts with the pre-settlement exploration period and continues today in the modern era. Several recent cultural resource management reports for Lake Red Rock (e.g., Rogers and Koldehoff 1987; Roper et al. 1986; Roper and Bastian 1986; Stanley et al. 1988) have included detailed cultural histories of the central Des Moines River valley that follow the framework used in the Iowa Resource Protection Planning Process Plan (RP3) (Henning 1985). Although there are some differences between the Red Rock and Saylorville regions, Benn and Rogers' (1985) recent synthesis of the prehistory of the Saylorville Lake region is also relevant.

Evidence for the Paleoindian period (12,000-8,500 B.P.) of the central Des Moines River valley is meager. Paleoindian populations are thought to have been organized into small, mobile bands with economies based on big game hunting. Paleoindian remains have rarely been found in the Lake Red Rock area and have consisted only of occasional surface finds in questionable contexts (Rogers and Koldehoff 1987 :28; Roper et al 1986:361).

The Archaic period (8,500-700 B.P.) includes the archaeological remains left by hunter/ gatherer populations that occupied the Midwest after the end of the Pleistocene and before the introduction of ceramics at the beginning of the Woodland period. Archaic sites are characterized by a variety of notched and stemmed projectile point/knife forms and a number of groundstone tools that are often associated with plant food processing or woodworking (Alex 1980; Roper et al. 1986:362). The Archaic is a long period of time and is often split into Early, Middle and Late sub periods. It represents a time of transition from the highly-mobile Paleo-Indian Period to settled villages. Populations gradually grew as people began focusing on exploiting plant and animal resources in one area, rather than following the migrations of herd animals. Trade began to develop as people in settled villages interacted with one another, exchanging food and raw materials.

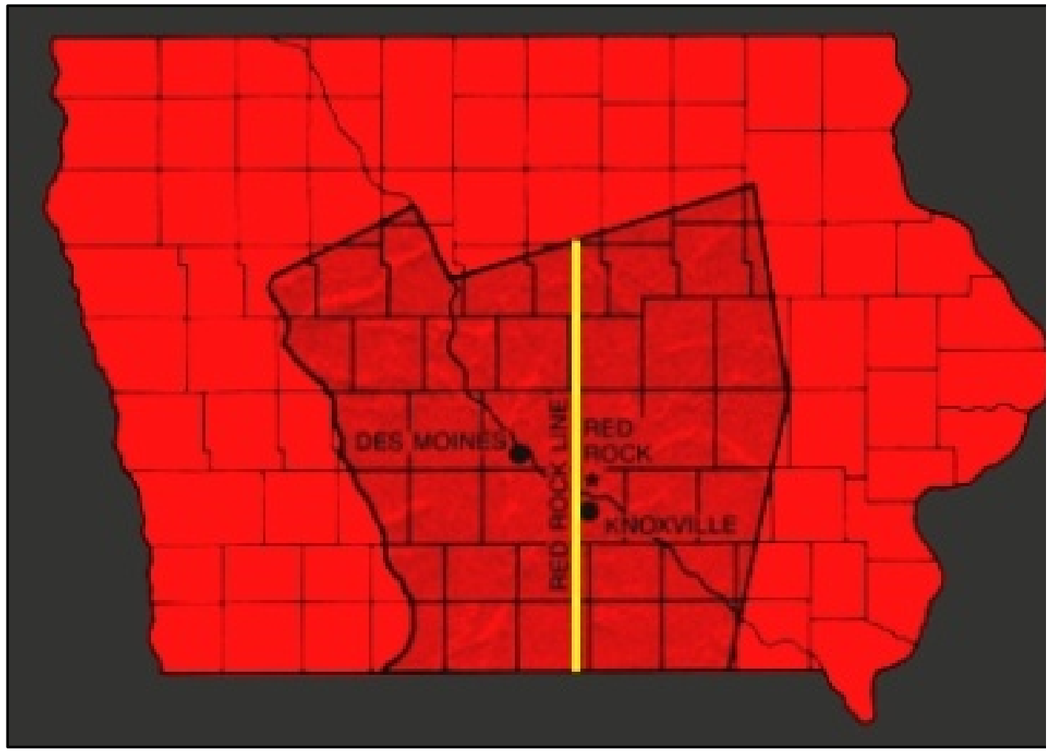
Woodland period (2,500-500 B.P.) is marked by the introduction of grit-tempered pottery. Burial mound construction also becomes common during the Woodland period. Once again this long period is generally split into Early, Middle and Late sub periods. Population increased as food production continued to shift from a focus on hunting and gathering to crop production. By the Middle Woodland period (2,050–1,550 B.P.), society had become quite complex with trade bringing in raw materials and finished goods from as far away as the Gulf Coast and the Rocky Mountains to the Central Iowa region. Also beginning in the Middle Woodland, corn was found in small amounts for the first time. By the Late Woodland (1,550–850 B.P.), corn became a staple food in the diet. Populations increased substantially and societies became even more complex leading to warfare between villages and groups.

The Oneota period (1,000-300 B.P.), the most recent prehistoric period in central Iowa, is characterized by shell-tempered pottery with angled rims and punctuated or trailed shoulder designs. Oneota people lived in large villages and engaged in hunting and gathering and maize agriculture. Late Oneota sites have been associated with several Siouan tribes, including the Ioway, Omaha, and Oto (Alex 1980:145-148). In some areas of the Midwest the populations were so high that people were living in what we would today call "city states" at places like Cahokia near St. Louis, Missouri, and the Aztalan site in Wisconsin. In the Des Moines River valley the time period is generally referred to as the Oneota period and the villages did not reach such a high level of complexity. It appears that during the later portion of the Mississippian or Oneota period, the region may have been slowly abandoned. None of the sites from the later portion of the period have "trade goods" that would show evidence of contact with Europeans.

The period from A.D. 1600-1820 was characterized by occupation of the Des Moines River valley by the Ioway and the Sauk and Fox (Mesquakie). The Ioway in particular are known to be descendent from the Oneota, and in the late 18th century they occupied a village near Selma, Iowa, in Van Buren County southeast of Lake Red Rock. The Fox and Sauk established villages on the Des Moines River near Eldon and Ottumwa in Van Buren County in the early nineteenth century. It is likely that these and other groups made forays into the Lake Red Rock area, which was claimed at one time by the Ioway as part of their territory.

By the early 1830s a military presence was established on the Des Moines River with Fort Des Moines located near the confluence of the Des Moines and Mississippi Rivers. In 1843, to facilitate the removal of the Sauk and Fox from the central Des Moines River valley, a new Fort Des Moines was established at the confluence of the Raccoon and Des Moines Rivers near the present-day Des Moines. The Indians had sold the last of their lands in this area in the Treaty of 1842 and were to initially move west of the Red Rock Line (just west of the future location of the town of Red Rock) before leaving Iowa entirely by 1845. The government land surveys of the Lake Red Rock area were not completed until 1847-1848; however, there was a small amount of settlement, authorized and unauthorized, prior to that time. Of note was the establishment of a trading post at Red Rock in 1843 (Campbell n.d.). Following the opening of this area to legal settlement, the Des Moines River valley attracted much of the initial settlement, in part because of the abundance of timber along its banks and tributaries.

An important historical site on the project is the former Red Rock Line. The site consists of heavily wooded vertical 100-150-foot red sandstone bluffs which once formed the north-south line dividing Sauk and Fox Indian cessions from the Territory of Iowa in 1842. The original treaty document of 1842 clearly references Red Rock's most notable landmark:



Example of 1842 Treaty Map

> *"the confederated tribes of Sacs [Sauk] and Foxes [Mesquakies] cede to the United States, forever, all the lands west of the Mississippi River to which they have any title or claim or in which they have any interest whatever; reserving the right to occupy for the term of three years, from the time of signing this treaty, all that part of the land hereby ceded which lies west of a line running due north and south from the painted or red rocks on the White Breast fork of the Des Moines River, which rocks will be found about eight miles, when reduced to a straight line, from the junction of the White Breast and Des Moines (Stiles 1911:4)." (Rogers, 1992)*

Local legend also claims that a very large Sycamore nicknamed the "Peace Tree" or Red Rock Line Tree was located on this line and was a landmark known to native tribes. The Peace Tree name comes from oral history which stated that the tree was the site of many treaty negotiations etc. While there is no direct historical evidence that the tree was the site of such peace treaties or that it had special significance to Native Americans tree ring cores indicate that the "Peace Tree" was between 400 and 500 years old and stood near a known Indian trail (Rogers 1992). The tree was located in the flood pool of the reservoir but remnants of the tree can still be seen from the Highway 14 bridge.

The "Peace Tree" Before and Present

Settlers entered Marion County and the Red Rock project area prior to vacation by Meskwakie in 1843 but most, about 70 families, from Virginia, Kentucky, Illinois, Indiana, Ohio etc, staked claims in 1843. Just prior to and during early settlement several trading houses were set up in the Des Moines River valley, the Phelps Trading House, which was located in Lake Prairie Township just below the site of Red Rock Dam was probably one of the first but many more sprung up along the Red Rock line near the town of Red Rock. Red Rock itself was one platted in 1845 making it one of the first settlements in the county. Knoxville, named for Revolutionary War Hero General Knox, was selected as the county seat shortly thereafter and platted in 1845-46. The other major town, Pella, was settled in 1847 by a large group of immigrants from the Netherlands. The leader, Pastor Hendrik Scholte led the group to Iowa to find economic opportunity and greater religious freedom (Donnel, 1872).

The period from A.D. 1850-1890 is characterized by the intensification of settlement and the initial development of towns and industries. Two of the early industries in the Lake Red Rock area were coal mining and pottery manufacture. A pottery was established near Coalport in 1847-1848 and remained in operation until 1869, when another pottery was established in the town. This pottery operated into the early 1880s. Early agriculture in the area was geared primarily toward diversification and subsistence. This pattern persisted into the late nineteenth century, when improvements in drainage, farm machinery, and improved seed and livestock provided the impetus for increased production and specialization. Emphasis shifted to corn and livestock production, marking a trend which would continue into the twentieth century (Henning 1985:74; Roper et al. 1986:374-376). For a short time between 1842 and 1869 steamships traveled up the Des Moines River to supply goods to Fort Des Moines located at the confluence of the Raccoon and Des Moines River (now near downtown Des Moines). The first railroad traversed the county in 1870 on the ridge between the Des Moines and Skunk River, putting an end to the need for river transportation.

Coal mining was a leading industry in Marion County from the 1880s to the 1990s and had a significant impact on the landscape, including the Red Rock Project area. From the 1930s through the 1960s, Marion County was the leading coal producer in Iowa. The town of Coal Port had some of the earliest coal mines established in the county; the town is now under the waters of the lake below the Coal Ridge church. Coal Port was located on a bend on the river and was the primary fuel stop for coal burning paddlewheel steamboats between Eddyville and Des Moines. Later the towns of Dunreath, Flagler and Pershing sprung up around mines in the southern portion of the county and within the project area. Strip mines; reclaimed strip mines and small underground mines can be found on the Red Rock Project or adjacent (Heusinkveld, 1995).

2.17. REAL ESTATE AND ACQUISITION POLICY

The real estate acquisition program was initiated in 1960 and completed in 1973. The 1953 real estate acquisition policy (a.k.a. the Eisenhower Policy) governed with respect to acquisition of fee simple title and flowage easement lands. The acquisition policy was to purchase all lands below elevation 760 and lands needed for flood control features; administration and operational areas; and public use areas. Flowage easements were purchased above elevation 760 to 783 elevations.

The 1962 real estate acquisition policy that guided purchasing for the Saylorville Lake Project did not apply to the Red Rock Project because significant acquisition had already been accomplished under the 1953 policy.

Project acquisition resulted in purchase of approximately 50,000 acres in fee title and 29,000 acres with flowage easement. See Chapter 6 for discussion of later fee title acquisitions.

2.18. SHORELINE MANAGEMENT (Private Boat Docks)

Lake Red Rock was constructed prior to December 13, 1974. In accordance with Title 36 Code of Federal Regulations 327.30 and Engineer Regulations (ER) 1130-2-406, Shoreline Management at Civil Works Projects, 31 October 1990, private shoreline uses are not allowed on projects where project construction was initiated after December 13, 1974, or on projects where no private exclusive shoreline uses existed as of that date, except to honor written commitments made prior to that date. No private exclusive shoreline use existed as of that date nor were any written commitments in existence. Therefore no private exclusive use of Lake Red Rock shoreline is allowed. Current and future management of Lake Red Rock lands and shoreline will be to protect and preserve the existing shoreline by not allowing private and exclusive use.

2.19. RECREATION ANALYSIS

2.19.1. Zone of Influence. The primary zone of influence is an approximate 50 mile radius of Lake Red Rock. 2010 Census figures indicate that there are 943,227 people living in counties within this radius of the Lake (30.9% of the state's population). Of this, 586,265 individuals live in Marion County and the counties immediately adjacent to Marion County (19.2% of state population).

The current population of Iowa is 3,046,355. The Census estimates the population will reach 2,955,172 by 2030 (2.3% decline). However, the Greater Des Moines Metropolitan Area to which Lake Red Rock is adjacent saw a 17% growth in population since the 2000 census. Recent studies from The Tomorrow Plan have projected that the current population of 558,700 in Des Moines metro will increase to approximately 745,000 within the next 25 years. (*State of the Region Greater Des Moines; The Tomorrow Plan.*).

2.19.2. Demographics. The median age for Iowan's is expected to increase slightly from 40 in 2010 to 43 in 2030. In 2000 Iowa ranked 4th in terms of percent of the population over 65 (14.9%). By 2030 the percentage of Iowan's over 65 is expected to increase to 22.4%. Racial diversity is quite low in Iowa. Just over 91% of Iowans are white with the remaining being of Hispanic (5%), African American (2.9%) or Asian descent (1.7%). 90% of Iowan's have a minimum of a high school degree or better and 24.5% have a Bachelors or graduate degree. Household income varies widely, but most households in the state can claim to be middle class with a median household income of $48,872. (U.S. Census Bureau 2012)

Iowa's current demographic data suggest that demand for outdoor recreational services will remain fairly constant over the next 25 years. However, the projected growth of the Des Moines Area will likely result in increased demand for outdoor recreation opportunities at Lake Red Rock. This will be driven by the more natural experience offered at Lake Red Rock and less crowded facilities than are available closer to Des Moines. Education and income distributions all indicate a public that will have good interest in outdoor activities and at least some discretionary income to spend on outdoor equipment. However overall income levels suggest demand for moderate to low cost alternatives will be strong as roughly 85% of all Iowa households currently make less than $100,000. The increasing proportion of people of retirement age may increase demand for leisure activities, particularly those enjoyed by individuals over 65 years of age. With projections of declining population, industries and communities will be seeking outdoor activities to attract more young people and families to fill local manufacturing, service and professional jobs and to sustain Iowa's small towns and communities.

2.19.3. Economics. Lake Red Rock visitors have a significant economic impact on Marion County and the surrounding area. In addition to direct spending from tourists, the area also benefits from indirect spending on recreational equipment, supplies and services. Tourism is a major industry for Marion County and Lake Red Rock is a prime asset in bringing $48 million annual traveler spending to Marion County. The county has been a five time winner of Iowa's Tourism County of the Year award.

2.19.4. Visitation Profile. Lake Red Rock is one of the most popular recreation destinations in Iowa with over 600,000 people visiting the project each year. Peak visitation at Lake Red Rock occurs May through September. Approximately 40,000 nights of camping occur in lake campgrounds each year. Over 15,000 visitors participate in family reunions, weddings and other group events held in recreation areas each year.

2.19.5 Existing Recreation Facilities and Opportunities

Campgrounds. Approximately 640 individual campsites are maintained within modern campgrounds operated by the Corps, Iowa DNR and Marion County Conservation Board. Roughly ninety-five percent of the campsites have electrical hookups and most have mature trees and gravel camp pads. Two campgrounds, Hickory Ridge and Elk Rock State Park, are specialized campgrounds catering to wilderness/canoe camping and horseback riders, respectively.

Rental Cabins. Seven modern cabins are available for rent at Cordova Park.

Picnic Shelters. Approximately 22 group picnic shelters are located within campgrounds or day use areas. Group shelters range in size from small group to a large pavilion shelter. Individual picnic sites are scattered within day use areas.

Playgrounds. Thirteen playgrounds exist in campgrounds and day use areas.

Boat Ramps, Marina and Other Boating Facilities. There are currently 11 boat ramps on the project maintained by the Corps and leaseholders. Most are subject to closing during high water events between elevations 760-765 feet above sea level. Two ramps, the Red Rock Marina and the Elk Rock West ramp remain open until water levels reach 780. The Whitebreast Ramp is also open until water levels reach 777. All ramps are paved and some have courtesy docks. There is one marina on the project with approximately 120 slips.

Trail Systems - Biking, Hiking, Water and Equestrian. The Red Rock project has 32 miles of multi-use trails. Roughly 11.5 miles are the paved trails of the Volksweg system. The Volksweg is a 8-10 foot wide asphalt trail linking Howell Station, Ivan's, North Overlook and Wallashuck Campgrounds, ending at the west end of the Robert's Creek Dam. A 3-mile spur of the Volksweg links Howell Station to the City of Pella. The remaining miles of trail are unpaved 0.5-1.5 mile earthen trails maintained by the Corp and County Conservation Board in several recreation areas. At Elk Rock State Park the State of Iowa maintains 13 miles of equestrian trails. In 2011 the Corps established an approximately 40 mile long water trail extending from the Boxcars access near 68th Avenue to the Dam, Cordova Park and back to Boxcars. This loop has eight designated and signed access points for canoes and kayaks, including a dedicated wilderness campsite for water trails users

Swimming Beaches. Two beaches are located on the lake. The North Overlook Beach is usable at all lake elevations and has ample parking and good boat in access.

Other Recreation Facilities. The Marion County Conservation Board maintains a 106 foot tall observation tower which affords a commanding view of the entire lake and on clear days provides views of landmarks 35 miles away. Visitors ascend the tower via a circular stairwell of 169 steps which provides access to a spacious enclosed observation deck. Other unique recreation facilities offered at the lake include a nine hole disk golf course and archery range.

Hunting and Fishing Opportunities. Red Rock area is popular destination for waterfowl hunting each fall. Overall Red Rock provides approximately 44,000 acres of public hunting land and water. The Iowa DNR estimated that between 44,000 and 50,000 fish were caught in the tailwaters alone in 2000 and 2001 by an estimated 14,000 and 17,000 anglers respectively.

Wildlife Observation Opportunities. Each year, people flock to Red Rock to observe annual migrations of White Pelicans and wintering aggregations of Bald Eagles. Red Rock is known as an area to catch glimpses of very rare waterbirds during migration or winter.

2.19.6. Recreation Survey Results

Iowa State Comprehensive Outdoor Recreation Plan (SCORP). Iowans were surveyed during development of the Iowa SCORP and their responses provide some insight into future recreation development needs at Lake Red Rock.

The survey delved into reasons for participating in outdoor recreation. Not surprisingly, for fun/relaxation (41%) tops the list. This is followed by being close to nature/enjoying the scenery (38%), being with family (29%), and staying in shape/exercising (25%).

A series of questions asked about the importance of various potential benefits of parks and recreation areas. The top benefits, when looking at the percentages saying *very* important are cleaner air and water (83% say this is a *very* important benefit of parks and recreation areas), positive family activities (82%), protecting natural resources (82%), and healthy childhood development (81%).

One question asked about the most important reasons that respondents visit State Parks. The top motivations are to be close to nature/enjoy scenery (36% of State Park visitors), for fun/relaxation (30%), and to be with family (28%).

The survey asked about interest in activities in which the respondent had *not* participated. Top activities listed were canoeing/kayaking, horseback riding, and hiking.

Outdoor Research Foundation Annual Outdoor Participation Report. The Outdoor Research Foundation issues an annual Outdoor Participation Report based on nationwide surveys.

In 2008 their report showed that activities such mountain biking (10%), trail running (15%) and backpacking (19%) experienced double digit increases while interest in jogging and road biking remained steady or declined slightly. Interest in snow shoeing (22%), cross country skiing (9%), hiking (9%) car camping (7%), and wildlife viewing (5%) also increased in 2008.

In 2014, the Foundation included the following chart, which shows exercise and the opportunity to spend time with friends and family topping the list of reasons Americans give for outdoor recreation.

What Motivates Americans to Get Outside

Get exercise	72%
Be with family/friends	54%
Keep physically fit	53%
Be close to nature	48%
Get away from usual demands of life	46%
Observe scenic beauty	46%
Enjoy the sounds/smells of nature	44%
Experience excitement/adventure	43%
Develop my skills/abilities	35%
Be with people who enjoy the same things I do	31%
Gain a sense of accomplishment	29%
Experience solitude	26%
Gain self-confidence	24%
Be with people who share my values	18%
It is cool	18%
Talk to new/varied people	12%
Other reason(s)	6%

2.19.7. Recreation Needs/Desires at Lake Red Rock. Lake visitors and stakeholder groups were most interested in seeing the expansion of trails at the lake and generally wanted more opportunities to get out and be active. Expansion of hard surface hiking and biking trails was mentioned most often, but many individuals wanted to see more trail opportunities for mountain biking; kayaking and horseback riding.

Better fishing opportunities ranked second to expansion of trails in terms of number of mentions by respondents. Fishing enthusiasts wanted to see better aquatic habitat, more stocking and better shore access. Hunting enthusiasts wanted to see more upland habitat acres and improved habitat conditions.

Having "destinations" to visit when at the lake was also important to many. Visitors wanted to see an improved marina concession along with a lakeside restaurant. There were numerous requests for more equipment rental opportunities, e.g. bikes, kayaks, boats.

Stakeholders frequently mentioned the desire for more activities and events. Educational workshops, especially "how-to" sessions had several mentions along with requests for more live concerts, festivals and other family friendly events. Others wanted to see more competitive events, e.g. triathlons, bike races, archery shoots, etc., along with the necessary facilities needed to host such events.

Better signage and wayfinding was often mentioned as a need. This request applied to trails as well as roadway signage.

Keeping the natural look and feel of Red Rock was very important to stakeholders while meeting new or expanded needs.

Visitors also frequently requested that current facilities be updated or expanded. Maintenance and updating of picnic shelters, trails and the visitor center was a frequent request.

2.19.8. Recreation Carrying Capacity. Lake Red Rock campsite occupancy rates and other facility use is much higher on weekends as compared to weekdays. Campsite occupancy is near 100% for holiday periods and during area community special events

During warm temperatures beach use is significant. However, there is high capacity for sand beach users at the North Overlook Beach. If high lake levels close the Whitebreast Beach, sand beach usage at the North Overlook beach is limited only by available parking. Boat access to the North Overlook Beach is limited by available shoreline for boat parking.

Lake Red Rock has several boat ramps that remain usable during high lake level events and have large parking capacity. When Saylorville Lake experiences high lake levels that inundate and limit the availability of boat ramps and parking lots some of that boating use transfers to Lake Red Rock. During these periods, open boat ramps can become overcrowded. Once on the water the lake seldom feels overcrowded due to the large surface area of Lake Red Rock. Boating conflicts do arise within protected coves when fishermen, skiers, and kayakers all need to seek relief from high wind and waves.

Despite these periods of heavy use in the parks, overcrowding is not an issue at this time. We will continue to evaluate the carrying capacity of the recreation areas as visitation increases.

Cordova Observation Tower

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