JULY 2018

Cardinal Valley Natural Habitat Restoration Project - Oronogo-Duenweg Mining Belt Superfund Site
Webb City, Missouri

FINAL RESTORATION PLAN AND ENVIRONMENTAL ASSESSMENT

Prepared by:

U.S. Fish and Wildlife Service

Missouri Department of Natural Resources

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Cardinal Valley Natural Habitat Restoration Project
Oronogo-Duenweg Mining Belt Superfund Site,

Webb City, Missouri

Final Restoration Plan and Environmental Assessment

July 2018

On the cover: Soil amendment pilot plot on mining waste within the Action Area (upper left); prairie plants from Diamond Grove Prairie Conservation Area (upper right); mining waste rock and pond within Action Area (lower left); Ben's Branch within Action Area (lower right)

Suggested Citation
U.S. Department of the Interior. 2018. Cardinal Valley Natural Habitat Restoration Project Final Restoration Plan/Environmental Assessment. Prepared by the U.S. Fish and Wildlife Service and Missouri Department of Natural Resources 89 pp

FACT SHEET

Final **Restoration Plan/Environmental Assessment for the Oronogo-Duenweg Mining Belt National Priorities List (NPL) Site**

Trustee Agencies: U.S. Fish and Wildlife Service, on behalf of U.S. Department of the Interior, and the Missouri Department of Natural Resources, on behalf of the State of Missouri.

Abstract:

To compensate the public for injuries to natural resources as a result of releases of hazardous substances from the Oronogo-Duenweg Mining Belt National Priorities List Site (Site) in Webb City, Missouri, the Natural Resource Trustee Agencies (Trustees) are proposing to enhance and restore prairie and wetland habitats that have been degraded by historical mining releases and subject to USEPA remedial actions. The Trustees would use a combination of biosolids, manure, and woody material to return soil fertility to areas where remedial work removed mine waste and contaminated soil, leaving behind degraded soils and residual metals. Following application of soil amendments, native seed would be applied to the landscape in an attempt to restore prairie habitat and associated natural resource services. Prescribed fire, mowing, and other weed management techniques would be used to maintain desirable habitat conditions. Conservation easements would be placed on restoration parcels and areas would be managed for wildlife habitat and limited recreation.

Contact Personnel:

Scott Hamilton
101 Park DeVille Drive
Columbia, MO 65203
Phone: 573.234-2132
Email: scott_hamilton@fws.gov

OR

John Nichols
POB 176
Jefferson City, MO
Phone: 573.751.8629
Email: john.nichols@dnr.mo.gov

Public Meeting Date and Location:

A public meeting was held at the Route 66 Events Center at 21 S. Webb St. , in Webb City, MO, on Feb 26th at 6:00pm..

Copies: Copies of the Final Restoration Plan/ Environmental Assessment are available online at https://www.fws.gov/midwest/es/ec/NRDA/MoTriState/index.html

EXECUTIVE SUMMARY

This Final Restoration Plan / Environmental Assessment (Final RP/EA) was prepared by the Missouri Trustee Council in accordance with the decisions and analysis contained in the Springfield Plateau Regional Restoration Plan and Environmental Assessment (SPRRP). This Final RP/EA evaluates the Cardinal Valley Natural Habitat Restoration Project, a primary restoration project involving the application of soil amendments to enhance and restore prairie and wetland habitats. This restoration action is designed to complement other restoration activities ongoing in the Oronogo-Duenweg Mining Belt Site, and other areas in the vicinity.

The Trustees provided a 30-day public notice and comment period on the Draft RP/EA. During that period, the Trustees held a public meeting to facilitate public input on the proposed restoration alternative. Public comments received during the comment period were considered before finalizing the Final RP/EA.

What actions were proposed and evaluated in the Draft RP/EA?

The Trustees considered several restoration alternatives, including a no action alternative, for restoration of remediated mine lands near Webb City, Missouri. Restoration Alternatives 2 through 5 contemplate habitat restoration activities, including invasive plant species management, prairie and wetland restoration, prescribed burning, land acquisition, and other activities, with the intent of enhancing and/or restoring wetland and prairie condition, with or without soil amendments. Soil amendments consist of a combination of animal manure, biosolids (composted municipal sewage sludge), and vegetation-based compost. A fifth restoration alternative would involve the Trustees purchasing clean topsoil from nearby areas to use as a clean cap over soils with residual metals. After evaluating the alternatives, and based on the anticipated ecological benefits to the mining-impacted habitats, including aquatic species and migratory bird habitat, project cost-effectiveness, and the overall need for restoration within Webb City, the Trustees identified Alternative 4 – Cow manure-based soil amendments and habitat restoration as the Preferred Alternative, also referred to as the Proposed Action.

What potential impacts have been identified?

Summary of the impacts anticipated from the restoration alternatives considered in Webb City, Jasper County, Missouri.

Resource Topics	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Physical Environment	Continued degraded conditions	No impacts, continued degraded conditions	Moderate short and long-term benefits		Moderate short and long-term benefits onsite, adverse impacts off-site
Habitat Resources	Continued degraded habitat	Minor beneficial impacts in short term. Likely continued degraded habitat in long term.	Moderate to major short and long-term benefits; short-term minor adverse impacts to water quality	Moderate to major short and long-term benefits	Moderate to major short and long-term benefits onsite, adverse impacts to off-site habitat
Fish and Wildlife	Adverse impacts	Long-term adverse impacts from wildlife exposure to metals	Moderate to major short and long-term benefits; short-term minor adverse impacts to aquatic biota	Moderate to major short and long-term benefits	Moderate to major short and long-term benefits onsite, adverse impacts to off-site habitat
Socioeconomics	Adverse impacts	Continued adverse impacts from the unproductive soils left after remediation	Minor beneficial impact from influx of restoration funds, and then from tourism after parks are established.		Minor benefits from influx of restoration funds, and then from tourism after parks are established.
Cultural Resources	No effect	No effect	No effect	No effect	No effect
Cumulative	Adverse impacts	Adverse impacts	Moderate benefits	Moderate benefits	Minor benefits if donor soil came from agricultural land

Alternative 1 - No Action
Alternative 2 - Habitat restoration without soil amendments
Alternative 3 - Poultry or cow manure-based soil amendments and habitat restoration
Alternative 4 - Cow manure-based soil amendments and habitat restoration
Alternative 5 - Capping remediated areas with natural topsoil and habitat restoration

What restoration projects will compensate the public for these injuries?

The Selected Action will create migratory bird and other wildlife-associated habitat in the areas in the vicinity of Webb City, where lead and zinc mining have occurred over the last century and where remedial actions under CERCLA have resulted in response injuries and failed to return natural resources to baseline conditions. The mine waste within Jasper County has negatively impacted uplands, wetlands, and riparian habitat. The Trustees intend to enhance the ecological and social values of these lands, creating habitat for wildlife that have been extirpated or had their numbers reduced because of the mining impacts, and providing opportunities for public use.

How are restoration projects being funded?

Under CERCLA, the responsible party is generally liable for the reasonable costs of assessing injuries to natural resources, which may include the costs to restore, rehabilitate, or replace the natural resources that have been injured as a result of the release of hazardous substances. In a bankruptcy settlement with ASARCO LLC in 2009, the Trustees received approximately $13,000,000 to use for restoration within Jasper County, MO.

Abbreviations and Acronyms

ASARCO	American Smelting and Refining Company
BMP	Best Management Practice
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
DOI	U.S. Department of the Interior
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
MBTA	Migratory Bird Treaty Act
MDNR	Missouri Department of Natural Resources
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NPL	National Priorities List
NRDAR	Natural Resource Damage Assessment and Restoration
PPCPs	Pharmaceuticals and Personal Care Products
PRPs	Potentially Responsible Parties
ROD	Record of Decision
RP	Restoration Plan
RP/EA	Restoration Plan and Environmental Assessment
Site	Oronogo-Duenweg Mining Belt Superfund Site
SPRRP	Springfield Plateau Regional Restoration Plan
USC	United States Code
USFWS	United States Fish and Wildlife Service

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1.0 INTRODUCTION

The Missouri Trustee Council (Trustees) is made up of the State of Missouri, represented by the Missouri Department of Natural Resources (MDNR), and the U.S. Department of the Interior, represented by the U.S. Fish and Wildlife Service (USFWS). In May 2012, the Trustees finalized the Springfield Plateau Regional Restoration Plan and Environmental Assessment (SPRRP), a comprehensive plan that describes the process by which the Trustees will use recovered funds to restore natural resources injured by the release of hazardous substances within the Springfield Plateau.

The Trustees have developed this Final Restoration Plan and Environmental Assessment (Final RP/EA) in accordance with the decisions and analysis contained in the SPRRP. Specifically, the Trustees have developed and analyzed an additional upland restoration project: the application of soil amendments to enhance and restore prairie and wetland habitats that have been degraded by historic mining releases and were subject to remedial actions at the Oronogo-Duenweg Mining Belt National Priority List Site (Site) in Webb City, Jasper County, Missouri.

This Final RP/EA identifies and evaluates a reasonable number of restoration alternatives considered for achieving the restoration objectives, and identifies the Selected Action that the Trustees will implement in order to compensate the public.

1.1 Background

Lead and zinc mining began in Jasper County in the mid-19th century and reached peak production around 1916. However, diminishing production led to the closure of the mining industry in Jasper County by 1957. After nearly 150 years of mining and smelting, the prominent features of the landscape were chat piles, tailings sites, waste rock piles, and subsidence ponds.

The Site covers about 20 square miles near Joplin, Missouri, where over 10 million tons of surface mining wastes historically contaminated approximately 7,000 acres. The Environmental Protection Agency (EPA) listed the Site on the National Priority List (NPL) in 1990. Un-vegetated and partially vegetated mine wastes covered over 3,600 acres, and contaminated soil covers an additional 4,000 acres at the Site. Cleanup was initiated in 2007, since which time approximately 7 million cubic yards of mine waste have been addressed. Remedial activities remain ongoing with a scheduled completion around 2020.

Since listing the Site on the NPL, EPA has undertaken numerous investigations to identify, characterize, and assess the risks posed by the levels of hazardous substances present at the Site for the purpose of determining appropriate removal and clean up actions. A number of such remedial actions have been undertaken to date. EPA continues to remove contaminated soil to repositories or cap contaminated soil in place. Such response actions, however, are not intended, nor are they sufficient, to either restore the local floral and faunal communities impacted by the releases to baseline conditions or to compensate the public for the ecological services lost in the interim.

1.2 Purpose and Need for Restoration

As described in §2 of the SPRRP, the Trustees developed the SPRRP to identify a preferred alternative to restore injured natural resources and to establish criteria for selecting projects to implement such restoration alternatives. The Trustees selected alternative included a combination of restoration activities and projects to accomplish restoration goals at or near the site of injury.

To date, ongoing restoration activities overseen by the Trustees have focused on the preservation and enhancement of higher quality upland habitat and riparian zones outside of the injured areas as compensation to the public for the interim loss of ecological services which occurred over time. The Trustees also initiated an effort to secure access, through the purchase of fee-simple title or easements, to remediated lands near Webb City, Jasper County, Missouri, in anticipation of the primary restoration activities described in this RP/EA.

The purpose and need of this RP/EA, in accordance with the analysis contained in the SPRRP, is to analyze an additional primary restoration project that the Trustees have developed during the on-going restoration process. This Final RP/EA presents a range of alternatives to meet the Trustees' goal of restoring and/or enhancing natural resources affected by historical mining activities and to compensate the public for ecological services lost in the interim.

1.3 Relationship to the SPRRP

This Final RP/EA complements the information and analysis contained within the Springfield Plateau Regional Restoration Plan (SPRRP). The SPRRP can be accessed at: https://www.fws.gov/midwest/es/ec/nrda/motristate/index.htmlThe Selected Action is an Upland Resource Restoration Project, as described in §3.3.1 and §3.5.1 of the SPRRP. The Trustees believe that the activities associated with this restoration plan are in alignment with the goals of the SPRRP, and compliant with the Preferred Alternative selected in the SPRRP.

Figure 1. Action Area in relation to the Springfield Plateau and Webb City.

1.4 Authorities and Legal Requirements

This Final RP/EA was prepared by the Trustees pursuant to their respective authority and responsibilities as natural resource trustees under CERCLA (42 U.S.C. § 9601, *et seq*.) and its implementing regulations.

In addition, federal trustees must comply with NEPA, 42 U.S.C. § 4321 et seq., and its regulations, 40 C.F.R. § 1500 *et seq*., when planning restoration projects. NEPA requires federal agencies to consider the potential environmental impacts of planned actions. NEPA provides a mandate and framework for federal agencies to determine if their proposed actions have significant environmental effects and related social and economic effects, consider these effects when choosing between alternative approaches, and inform and involve the public in the environmental analysis and decision-making process. In compliance with NEPA, this Final RP/EA summarizes the current environmental setting, describes the purpose and need for restoration actions, and identifies alternative actions and their potential environmental consequences and provides an environmental analysis of the restoration actions.

1.5 Public Participation and Response to Comments

In accordance with NEPA and the CERCLA regulations, this Draft RP/EA was made available for review and comment by the public for a period of 30 days.. A single comment was received:

"*WE NEED TO CHANGE THE MINING LAWS SO THAT THOSE WHO MINE CLEAN UP AFTER THEMSELVES. WE ARE SICK AND TIRED OF THE GENERAL AMERICAN POPULATION BEING RESPONSIBLE TO PAY TO CLEAN UP WHEN THESE PROFITEERS LEAVE THE MESS THAT THEY ALWAYS LEAVE IN ONE WAY OR ANOTHER. THEY PURPOSELY LEAVE THE MESS AND COSTS TO THE TAXPAYRS. WHY IS OUR CORRUPT CONGRESS ALLOWING THAT IMPOSITION. WHY DO NOT PROFITEERS HAVE TO PAY TO CLEAN UP AFTER THEMSELVES. THEY MAKE THE MONEY. THEY SHOULD BE BEARING THE COSTS OF CLEANUP.*

SECONDLY. I HAVE CONCERNS ABOUT USING HUMAN AND ANIMAL FECES TO PUT OVER THE CONTAMINATION.DISEASES COULKD BE TRANSMITTED IN THIS PROCESS OF SO FULLY UTILIZING HUMAN AND ANIMAL FECES. IT IS NOT A SOLUTION TI THIS ISSUE AT ALL. THIS COMMENT IS FOR THE PUBLIC RECORD. PLEASE RECEIPT."

Response:

Regarding the first portion of the comment, the funds for this restoration project are the result of a settlement with a mining company (ASARCO). . Regarding the use of "human and animal feces", only composted manures will be applied to the land for restoration. As noted in Section 4.2.4.4 of this document, there is minimal risk to the public from composted biosolids. The biosolids used in this process will be compliant with the U.S. Environmental Protection Agency's (EPA) regulations providing standards for the use or disposal of sewage sludge and which dictate pathogen reduction requirements such as thermal treatment and length of time before biosolids can be land applied in areas used by the public. (40 CFR Part 503Subpart B).

2.0 OVERVIEW OF RESTORATION PLAN – SELECTED ACTION AND ALTERNATIVES CONSIDERED

This section provides an overview of the restoration plan and a description of the restoration goals and criteria the Trustees used in developing this plan.

2.1 Restoration Goals

Based on the nature of the Site-related natural resource injuries and losses, the Trustees identified the following restoration goals:

Goal 1: to restore portions of the remediated mine waste areas in Jasper County to native prairie communities, and

Goal 2: to restore wetlands and riparian vegetation along streams and floodplains within remediated areas of Jasper County.

Figure 2. Left, a parcel where mine waste was removed by EPA, and purchased by Webb City for future restoration. Right, a remnant prairie within nearby Newton County with a diversity of vegetation, representing an ideal future condition for restoration.

2.2 Restoration Objectives

To meet the above restoration goals, the Trustees identified the following restoration objectives:

- Use soil amendments created from locally-sourced waste products such as manure, wood chips, and municipal wastewater treatment plant biosolids to rebuild topsoil within areas that have had their topsoil removed during the remedial process.
- Seed native species within prairie, wetland, and riparian habitats after soil amendments have been added (if needed) and actively manage the areas through mowing, spraying herbicide, and prescribed burning to achieve a native species cover of 80% or more within the five year restoration phase of the project.
- Maintain wildlife habitat with at least 80% native cover through active and passive management for at least 25 years after the initial restoration phase of the project. Lands that have been acquired for restoration are to be managed by Webb City as a park and will be protected by a conservation easement.

With these restoration goals in mind, the Trustees identified four types of restoration ("restoration alternatives"), in addition to a "No Action" alternative, that would potentially benefit terrestrial and aquatic habitat and associated species that were injured by releases of hazardous substances from and in the vicinity of the Site. The Trustees considered the following list of restoration alternatives in developing this plan:

- Alternative 1 – No Action
- Alternative 2 – Habitat restoration without soil amendments
- Alternative 3 – Poultry or cow manure-based soil amendments and habitat restoration
- Alternative 4 (Selected Action) – Cow manure-based soil amendments and habitat restoration
- Alternative 5 – Capping with natural topsoil and habitat restoration

2.3 Restoration Criteria

The Trustees used multiple factors to identify and evaluate the proposed restoration alternatives (see Table 4). The following subsection identifies the Restoration Criteria applied in developing this plan.

In selecting the restoration alternative to pursue, the Trustees evaluated each of the possible alternatives based on all relevant considerations, including the Acceptability Criteria identified in §6 of the SPRRP and other factors including, but not limited to:

Compliance with Laws and Policies (43 CFR 11.82(d)(9-10)):

The selected alternative must comply with all applicable federal, state, and local laws, policies, and regulations.

Technical Feasibility (43 CFR 11.82(d)(1)):
The selected restoration alternative must be technically sound. The Trustees considered the level of risk or uncertainty involved in implementing the project alternatives. A proven track record demonstrating the success of projects utilizing similar or identical restoration techniques can be used to satisfy this evaluation criterion.

Relationship to Injured Resources and Services:
A selected alternative that restores the resources and services injured by the release are preferred to projects that benefit other comparable resources or services. The Trustees considered the types of resources or services injured, the location of the resources, and the connection or nexus of project benefits to those injured resources.

Benefits Relative to Costs (43 CFR 11.82(d)(2)):
The Trustees considered the relationship of resource and service benefits to expected costs for each alternative.

Consistency with the Trustees Restoration Goals:
The selected alternative should meet the Trustee's intent to directly restore the injured resources or the services those resources provided at the Site. Included in this criterion is the potential for success (meeting restoration goals) and the level of expected return of resources and resource services. The Trustees also considered the ability to monitor and evaluate the performance of the project; the ability to correct any problems that arise during the course of the project; and the capability of individuals or organizations expected to implement the project.

Avoidance of Further Injury (43 CFR 11.82(d)(5)):
The selected alternative should avoid or minimize adverse impacts to the environment and the associated natural resources. The Trustees considered the future short- and long-term injuries, as well as mitigation of past injuries, when evaluating projects.

Public Health and Safety (43 CFR 11.82(d)(8)):
The selected alternative ideally should not pose a threat to the health and safety of the public.

Time to Provide Benefits:
The Trustees considered the time expected for the project to begin providing benefits to the target ecosystem and/or public. A more rapid time to delivery of benefits is favorable.

Duration of Benefits:
The Trustees considered the expected duration of benefits from the restoration alternatives. Projects expected to provide longer-term benefits were regarded more favorably.

3.0 SELECTED ACTION (& OTHER ALTERNATIVES CONSIDERED BUT ELIMINATED)

This Chapter describes the restoration alternatives identified by the Trustees for consideration, as briefly mentioned in Chapter 2, summarizes the Trustees' evaluation of those alternatives based on the Restoration Goals and Criteria for compensating for the Site-related natural resource losses, and identifies the restoration alternatives preferred for use to meet those restoration goals.[1] As described below, the Trustees identified Alternative 4 as the Selected Action. A comparative analysis of Alternatives 1 - 5 is presented in Table 1.

3.1 Common Elements of Restoration Alternatives

3.1.2 Land Application of Biosolids

Land application of biosolids as part of a soil amendment mixture is a restoration element common to Alternatives 3 and 4. A brief description of biosolids, their utility in restoration, and the regulations for their land application or disposal is provided in this section.

Biosolids are a form of domestic wastewater sludge that meets standards for use as a fertilizer or soil conditioner. Applying biosolids to land, either in bulk form or as composted biosolids, its available nitrogen, phosphorus and potash as fertilizer for growing crops and other desired vegetation. Compost mixed with appropriate additives, including biosolids, creates a material useful in wetland and mine land restoration. Compost also plays a role in bioremediation of hazardous sites and pollution prevention. Compost has proven effective in degrading or altering many types of contaminants, such as heavy metals and petroleum products. Use of biosolids, either in bulk form or as a compost constituent, is an environmentally sound practice sanctioned by the EPA and the Missouri Department of Natural Resources (MDNR).

Land application is defined as the spreading, spraying, injection, or incorporation of biosolids, including a material derived from biosolids (e.g., compost and pelletized biosolids), onto or below the surface of the land to take advantage of the soil enhancing qualities of the biosolids. Biosolids are commonly applied to agricultural land (including pasture and range land), forests, reclamation sites, public contact sites (e.g., parks, turf farms, highway median strips, golf courses), lawns, and home gardens.

[1] The Trustees conducted a preliminary evaluation of the potential impacts of these potential restoration actions and concluded that none of the proposed activities would have an effect on cultural/historical resources, as the areas considered for restoration in this document have recently been excavated through EPA remedial actions. Therefore, these issues are not considered further in this assessment.

Table 1. Comparison matrix of restoration elements for Alternatives 1 – 5.

Restoration Element	Alternative 1: No Action	Alternative 2: Habitat restoration without soil amendments	Alternative 3: Poultry or cow manure-based soil amendments and habitat restoration	Alternative 4 (SELECTED ACTION): Cow manure-based soil amendments and habitat restoration	Alternative 5: Capping of areas with natural topsoil and habitat restoration
Type of soil amendment	None	None	Poultry or cow manure, biosolids, and vegetative material	Cow manure, biosolids, and vegetative material	Topsoil
Soil amendment application rate	None	None	Up to 160 dry tons/acre over 3 years	Up to 160 dry tons/acre over 3 years	18” cap
Includes mowing?	No	Yes	Yes	Yes	Yes
Includes herbicides?	No	Yes	Yes	Yes	Yes
Includes prescribed fire?	No	Yes	Yes	Yes	Yes
Includes seeding or planting?	No	Yes	Yes	Yes	Yes
Includes adding conservation easements to restoration sites?	No	Yes	Yes	Yes	Yes

Municipalities within the Southwest Missouri mining districts have elevated levels of metals, primarily zinc, within their biosolids due to the great amount of mine waste still distributed throughout the area. As precipitation falls on the mine waste, some of the metals are dissolved and carried off, and find their way into sewer pipes through cracks in a process known as inflow and infiltration. Because of the high levels of metals within the biosolids, often the biosolids must be dried and hauled to a landfill, at great expense to the municipality. The Trustees' plan to use biosolids as an amendment is contingent upon being able to dilute the biosolids' metals by mixing with manure and wood chips that are relatively free of metals, such that biosolids are only 5% of the total mix that is applied to the land. The biosolids will provide needed nutrients and organic matter. An analysis of Webb City's biosolids is shown below in Table 2.

Regulations for the use, including land application, or disposal of biosolids, also known as sewage sludge, are contained in *The Standards of the Use or Disposal of Sewage Sludge* (40 CFR Part 503), which became effective on March 22, 1993. The Part 503 rule establishes requirements for the final use or disposal of biosolids when they are:

- Applied to land to condition the soil or fertilize crops or other vegetation grown in the soil;
- Placed in a permitted sanitary landfill
- Placed on a surface disposal site for final disposal; or
- Fired in a biosolids incinerator.

Biosolids standards include limitations for metal and other trace substances, pathogen reduction, vector requirements and best management practices. Biosolids used as part of the soil amendment mixture intended to be used for habitat restoration have the potential to exceed certain constituent ceiling concentration limits set forth in the Part 503 standards (Table 2) and will therefore need a modification to the permit for land application. The Missouri DNR incorporated the Part 503 standards into the state requirements under the Missouri Clean Water Law and regulations. Complying with the state regulations automatically meets the EPA biosolids standards. The University of Missouri Extension developed best management practices (BMPs) for biosolids land application (Appendix B). The Trustees and their partners intend to adopt these BMPs where appropriate as part of process of applying compost to land in the Action Area.

Table 2. Analytical results (shaded in blue) from a biosolids sample collected from the Webb City Municipal Wastewater Treatment Plant in 2014. Part 503 constituent ceiling concentrations for comparison are shaded in gray.

Metals (parts per billion)								
As	***Cd***	**Cr**	**Cu**	**Pb**	**Ni**	**Se**	***Zn***	**Hg**
<8.0	*133*	76.3	415	194	34	<12	*13,200*	< 1.3
75	*85*	3,000	4,300	840	420	100	*7,500*	57

Other Analytes (parts per billion)						
Fecal Coliform (Colony Forming Units/g)	**Nitrate**	**Nitrite**	**Ammonia**	**Total Kjedahl Nitrogen**	**P**	**K**
<3,3341	< 35	< 35	2,270	38,800	16,800	1,510
No ceiling limits applicable						

3.1.3 Land Acquisition and Conservation Easements

As part of Alternatives 2, 3, 4, and 5, the Trustees, in coordination with Webb City, would continue the practice of placing conservation easements on restoration land, and those easements will be held by the Missouri Department of Natural Resources. The easement would ensure that the area would be maintained as wildlife habitat in perpetuity, and would not allow development or placement of structures other than park benches and signage associated with trails. Webb City has thus far acquired or committed approximately 630 acres of land to be restored under the purview of the SPRRP, 530 of which are the subject of this RP/EA. Approximately 450 additional acres of land may be targeted for acquisition and/or restoration by the Trustees. Note that land acquisition is a separate, ongoing action and much of the land purchased will not need soil amendments.

3.2 Alternative 1 – No Action

The No Action alternative is included in this Final RP/EA as a basis for comparison of the other alternatives to the status quo. Under the No Action alternative, no restoration or rehabilitation would occur on the project lands. If the No Action alternative is selected, there would be no restoration of the injured resources and their services, and the public would not be made whole for past injuries from releases from the Site. A pilot study conducted by the Trustees showed that plants grown on un-amended mining area soils accumulated more metals in their tissue. Likewise, worms raised in unamended soils accumulated more metals in their tissue. (MDNR and USFWS 2016). The No Action Alternative would not meet the Restoration Criteria.

The Trustees concluded that the No Action Alternative would not meet the purpose and need for restoration under this Final RP/EA, or the responsibilities of the Trustees under CERCLA and its associated regulations.

3.3 Alternative 2 – Habitat restoration without soil amendments

This alternative primarily involves planting and seeding native plants during the dormant season or early spring within uncapped areas of the Action Area via tractor-pulled surface

seeder. After sufficient vegetation growth is established, the seeded areas would be mowed several times during the first years to prevent weeds from shading out the native seedlings, which tend to grow slower. In areas in which invasive exotic weeds have taken hold, herbicides will be sprayed per label instructions using a certified pesticide applicator to reduce invasive plant abundance. Periodic prescribed burns would be conducted to control woody encroachment within the habitat areas. Figure 3 shows uncapped areas that are intended to be restored.

Based on restoration pilot studies conducted by the Trustees, seeding the barren remedial sites without any additional soil amendments is not likely to accomplish the restoration goal of restoring native prairie habitat or and will not meet the criterion of avoiding further injury to wildlife. The control plots (without amendments) in the Trustee's pilot studies performed poorly in growing a diversity of native plants both in upland and wetland scenarios. Wildlife exposure to metals is increased if no soil amendments are used. For example, worms accumulated more lead, zinc, and cadmium when no amendments were used compared to using a cow manure-based soil amendment. (MDNR and USFWS 2016). Plant uptake of metals within upland scenarios was notably high relative to test plots where soil amendments were used.

The Trustees concluded that the Habitat Restoration without Soil Amendments Alternative is not likely to result in significant improvement of wildlife habitat. In addition, the alternative is not cost-effective, has a low likelihood of success, and does not significantly improve wildlife habitat quality. For these reasons, Alternative 2 was not carried forward for additional evaluation in this Final RP/EA.

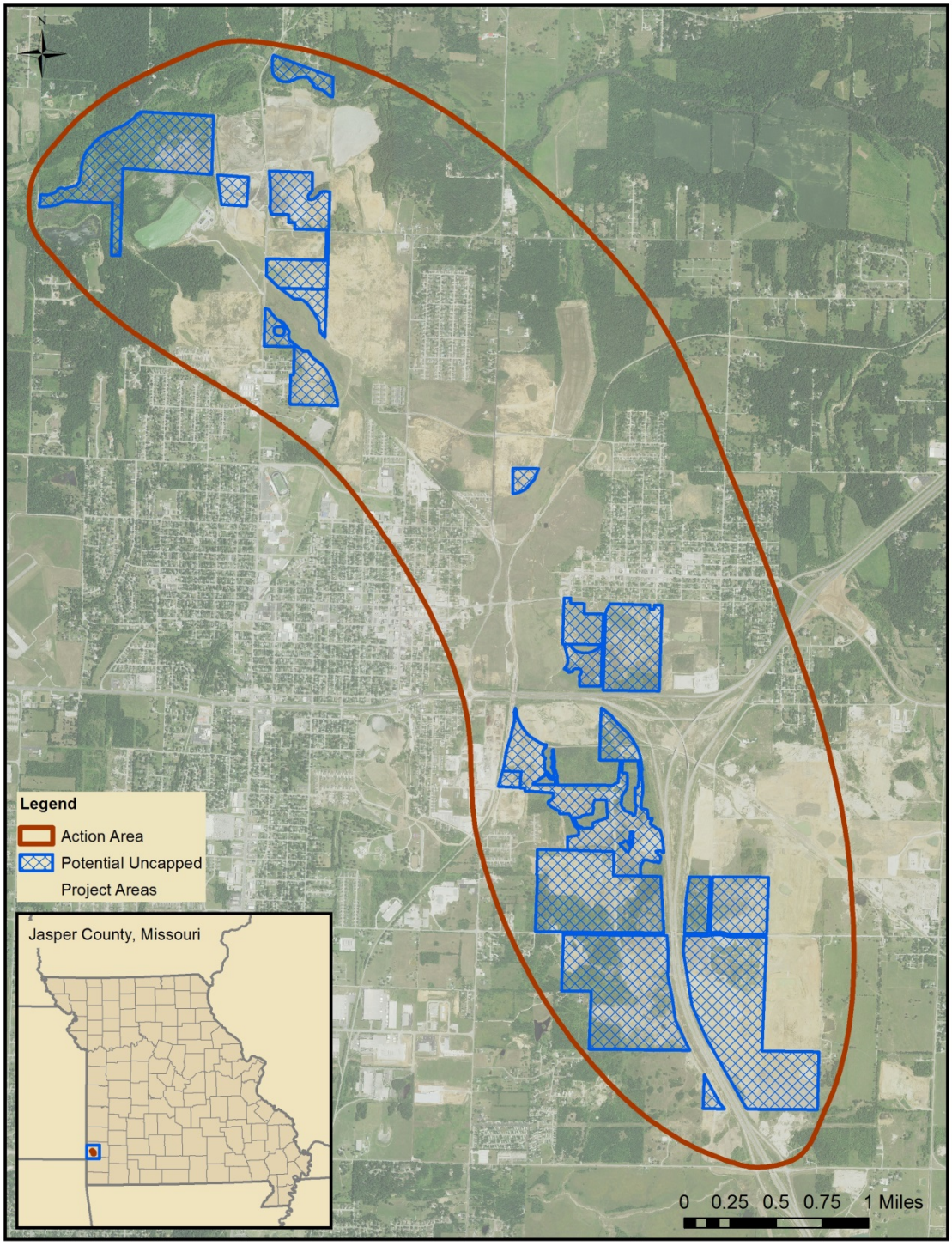

Figure 3. Uncapped areas of the Action Area located in Jasper County, Missouri.

3.4 Alternative 3 – Poultry or cow manure-based soil amendments and habitat restoration

Cow manure or poultry litter, would be mixed with biosolids from a local source, 10:1 by volume, and then would be composted with equal parts woody material long enough to comply with the EPA Part 503 standards (40 CFR Part 503). The compost would then be tilled into shallow soil, with lime added, in uncapped areas. Up to 160 dry tons/acre of compost (80 dry tons of composted manure) would be applied within a three year period, within upland or wetland remediated mine waste areas located in the Action Area. No soil amendments would be applied within a 50 foot buffer of streams. An equal volume of wood compost-fertilizer mixture might also be similarly used in upland or wetland areas if there were insufficient quantities of manure or odor issues.

Native plants would be seeded or planted during the dormant season or early spring after soil amendments have been applied. After sufficient vegetation growth is established, the seeded areas would be mowed several times during the first year to prevent weeds from shading out the native seedlings, which tend to grow slower. In areas in which invasive exotic weeds have taken hold, herbicides would be sprayed per label instructions to reduce invasive plant abundance. Periodic prescribed burns would be conducted to control woody encroachment within the habitat areas. If less than 160 tons/acre of amendments are initially applied to an area, and that area is not successfully growing native plants, follow-up amendments (not to exceed 80 dry tons of composted manure per acre) may be applied within the first three years of the project.

As part of this alternative, the Trustees would use a planned composting facility consisting of an approximately 30-acre footprint adjacent on the north side of the Webb City wastewater treatment facility lagoons. Biosolids, vegetative matter, and manure would be stockpiled within the 30-acre footprint and processed into soil amendments. Bulking agents, including manure and vegetative matter, would be hauled to the facility. Bulking agents of non-preferred size-class would be filtered prior to production of a final soil amendment product. The facility would generate soil amendment windrows running in a north-south direction that would be turned periodically to create cured soil amendment product. The composting facility would increase production capacity over many years, with only approximately 10 acres of the 30-acre site being needed for the first 10 – 15 years.

The Trustees concluded that the Poultry or Cow Manure-Based Soil Amendments and Habitat Restoration Alternative provides the most flexibility for the Trustees; however, there are potentially significant downsides associated with this restoration alternative. The poultry litter mixture performed poorly in growing native plants during the pilot study (described in Section 3.7), and the runoff from areas amended with poultry litter had high levels of nutrients (phosphorus and nitrogen) which showed the potential to adversely affect fish and other aquatic biota. In addition, the poultry litter mixture is also the least cost effective soil amendment because poultry litter is a commodity that must be purchased in addition to the hauling expense. The Trustees favor a reduced suite of options for soil amendments for economic and environmental reasons.

3.5 Alternative 4 (Selected Action) – Cow manure-based soil amendments and habitat restoration

Trustees' Proposed Action

The Natural Resource Trustees are proposing Alternative 4 - Cow manure-based soil amendments and habitat restoration, as the preferred alternative. Under this alternative, the Trustees would use a combination of biosolids, manure, and woody material to return soil fertility to areas impacted by mine waste. Following application of soil amendments, native seed would be applied to the landscape in an attempt to restore prairie habitat and associated natural resource services. Prescribed fire, mowing, and other weed management techniques would be used to maintain desirable habitat conditions. Conservation easements would be placed on restoration parcels and areas would be managed for wildlife habitat and limited recreation.

A cow manure-based soil amendment consisting of a manure and biosolids mixture, 10:1 by volume, would be composted with equal parts woody material for a period of time long enough (minimum of 15 days at 55 ° C with 5 turns for Class A biosolids compost) to comply with the Part 503 standards, then tilled into shallow soil, along with lime. Up to 160 dry tons/acre of compost (80 dry tons of composted manure) would be applied in three years, within upland or wetland remediated mine waste areas located in the Action Area. An equal volume of woody compost-fertilizer mixture may be similarly used in upland areas if there are insufficient quantities of manure or odor issues. No soil amendments would be applied within a 50 foot buffer of streams.

After soil amendments have been applied, native plants would be seeded or planted during the dormant season or early spring. After sufficient vegetation growth is established, the seeded areas would be mowed several times during the first year to prevent weeds from shading out the native seedlings, which tend to grow slower. In areas in which invasive exotic weeds have taken hold, herbicides would be sprayed per label instructions using a certified pesticide applicator to reduce invasive plant abundance. Periodic prescribed burns would be conducted to control woody encroachment within the habitat areas. If less than 160 tons/ac of amendments are initially applied to an area, and that area is not successfully growing native plants, follow-up amendments (not to exceed 80 dry tons of composted manure per acre) may be applied within the first three years of the project.

As part of this alternative, the Trustees would use a planned composting facility consisting of an approximately 30-acre footprint adjacent on the north side of the Webb City wastewater treatment facility lagoons. Biosolids, vegetative matter, and manure would be stockpiled within the 30-acre footprint and processed into soil amendments. Bulking agents, including manure and vegetative matter, would be hauled to the facility The facility would generate soil amendment windrows running in a north-south direction

that would be turned periodically to create a cured soil amendment product. The composting facility would increase production capacity over many years, with only approximately 10 acres of the 30-acre site being needed initially.

The Trustees concluded the Cow Manure-Based Compost Soil Amendments and Habitat Restoration Alternative meets all of the Restoration Criteria and identified the restoration of degraded lands in Webb City as being consistent with the goals to restore portions of the remediated mine waste areas in Jasper County to native communities. The Trustees have concluded that the cow manure-based compost soil amendments are more economical and environmentally benign. This soil amendment performed best in a direct measurement of run-off toxicity, and performed best in plant and animal (worm) tissue metal accumulation. Cow manure-based amendments had low ecological impact due to pharmaceuticals persisting within the compost. Unlike poultry-based compost, both the biosolids and cow manure are free and therefore are therefore the logical economical choice. For these reasons, Alternative 4 is the Selected Action.

3.6 Alternative 5 – Capping with natural topsoil and habitat restoration

Under this alternative, topsoil from local areas would be excavated and hauled to remediated areas containing elevated levels of metals within the soil. The soil would be applied in a similar manner to EPA's remedial cap, using 12 inches of clay as a base and 6 inches of topsoil over that base.

After the topsoil has been applied, native plants would be seeded or planted during the dormant season or early spring. After sufficient vegetation growth is established, the seeded areas would be mowed several times during the first year to prevent weeds from shading out the native seedlings, which tend to grow slower. In areas in which invasive exotic weeds have taken hold, herbicides would be sprayed per label instructions using a certified pesticide applicator to reduce invasive plant abundance. Periodic prescribed burns would be conducted to control woody encroachment within the habitat areas.

The Trustees concluded that the Capping Remediated Areas with Natural Topsoil and Habitat Restoration Alternative would have no net beneficial impact on wildlife habitat. This alternative essentially creates an equal area of infertile land by stripping soil from them to fix the problems of infertile soil in the remediated mining areas. EPA came to this same conclusion in their Explanation of Significant Differences document in May 2016, when they determined that they have "not been able to identify sources of topsoil within a reasonably close proximity to the site to meet the quantity needed for capping and erosion control without completely stripping hundreds of acres of valuable crop or pasture lands." They further state that "A feasible alternative would be the use of manufactured compost utilizing local wastewater treatment plant sludge composted with sufficient amounts of wood chips and animal manure to reduce the zinc concentrations to acceptable levels for use in land application."

3.7 Pre-Restoration Pilot Studies

To advise the development of alternatives for this Final RP/EA and assess the potential impacts of proposed restoration activities on Action Area natural resources, the Trustees completed several pilot-scale studies to examine strategies to effectively increase soil fertility and the potential for successful wetland and native prairie restoration. A summary of the studies is provided in this section, and details of study findings are provided in various parts of Sections 4.2.2.3 (Water Quality Impacts), 4.2.3.1 (Vegetation), and 4.2.3.2 (Fish and Wildlife Resources).

3.7.1 Rationale for Pilot Study

Despite the utility and benefits of biosolids-based soil amendments for remediation and restoration projects, such as improving physical, chemical ,and biological properties of soils, concerns have been raised about the potential for soils treated with these materials to leach excess nutrients (Stehouwer et al 2006), metals (Yang et al 2008), hormonally active agents, sometimes referred to as emerging contaminants, such as pharmaceuticals and personal care products (PPCPs, Wu et al. 2010) and perfluoronated alkyl substances (Venkatesan and Halden 2013), and classic persistent organic pollutants, such as polychlorinated biphenyls, brominated flame retardants (Venkatesan and Halden 2014), and furans. Studies have shown that PPCPs leaching from biosolids applied to land can persist for years following application (Walters et al. 2010) and can contaminate surface waters and groundwater (Gottschall et al. 2012), and be taken up by plants (Eggen et al. 2011) and earthworms (Kinney et al. 2008; Sherburne et al. 2016), with the potential to persist into higher trophic levels (Sherburne et al 2016). However, the majority of research has focused on land application in an agricultural setting with typical agronomic application rates of biosolids in the range of 8 Mg/ha (3.5 tons/acre) (Sabourin et al. 2009) to 22 Mg/ha (10 tons/acre) (Wu et al. 2010, Gottschall et al. 2012). The leaching potential of PPCPs from biosolids and manure at application rates used in mine land remediation (134 Mg/ha (60+ tons/acre) is unknown (Stehouwer et al 2006). The materials selected and the application rates used in restoration projects must balance the expected positive effects of metal immobilization and soil fertility increase with the potential unintended consequences of chemical leaching or contaminant exposure to fish, wildlife, or people.

3.7.2 Pilot Study Objectives

It is the goal of the Trustees to restore portions of the remediated mine waste areas in Jasper County to native prairie communities, and restore wetlands and riparian vegetation along streams and floodplains. If restoration of these areas is to be successful, restoration actions, including land application of biosolids- and/or manure-based soil amendments, should not pose unacceptable risks to fish, wildlife, and humans. Unacceptable risks may exist when individuals or populations of fish, wildlife, or humans are exposed to potentially harmful concentrations of metals, PPCPs, or other contaminants in plants, soil, or other environmental media. The focus of the pilot study is to evaluate the suitability of soil amendment mixtures for prairie and wetland restoration of remediated mine waste areas in Jasper County and potential adverse effects of biosolids-associated

contaminants. The soil amendment mixtures are summarized in Table 3 and were evaluated in terms of their effects on 1) plant and earthworm metal bioavailability and PPCP bioavailability in worm tissue 2) nutrient, metal, and PPCP leaching and toxicity from runoff from amended soils, and 3) establishment and success of native prairie and wetland species on amended soils.

Table 3. Names, descriptions, abbreviations, and restoration alternative affiliations for soil amendments tested in pilot studies.

Soil Amendment Treatment Name	Soil Amendment Description	Pilot Study Abbreviation*	Restoration Alternative Affiliation
Biosolids	Biosolids from Springfield, MO mixed 10% (by weight) with biosolids from Webb City, mixed with wood chips/leaf waste.	BS	N/A
Cattle Manure	Cattle manure from local stockyard mixed with wood chips/leaf waste.	CM	Alternative 3
Yard Waste and Fertilizer	Mulched wood chips/leaf waste applied to plots with direct application of granular 10-20-10 NPK fertilizer.	AG	N/A
Cattle Manure plus Biosolids	10:1 mixture of cattle manure and municipal biosolids from Webb City, mixed with equal parts wood chips/leaf waste.	CM+	Alternative 4 (Selected Action)
Poultry Litter plus Biosolids	Dry poultry litter from local source mixed 10% (by weight) with biosolids from Webb City, and wood chips/ leaf waste.	PL+	Alternative 3
Composted Yard Waste and Fertilizer	Wood chips/leaf waste mixed with granular 10-20-10 NPK fertilizer and allowed to compost	YF	N/A

NPK = nitrogen, phosphorus, and potassium

* Abbreviation used in pilot study report (MDNR and USFWS 2016)

3.7.3 Pilot Study Conclusions

The results of the pilot studies indicate that the cow manure amendment, or the cow manure plus biosolids combination, will benefit the prairie and wetland restoration project the most and have the least environmental impact. Runoff water from the cow manure+biosolids compost treatment contained metals and nitrogen concentrations that may cause minor short-term adverse effects to the aquatic environment, but in the long-term should not cause adverse effects to receiving waters and associated aquatic organisms. In general, the cow manure+biosolids compost showed low risk associated

with exposure of wildlife to soil- and diet-associated metals. Results from a study investigating the potential effects of PPCPs to aquatic organisms suggest there is low risk of adverse aquatic ecological effects associated with exposure to PPCPs contained in the cow manure+biosolids compost soil amendment. Photodegradation and/or biodegradation of PPCPs during the composting process appear to reduce the concentrations of this class of contaminants. Given the good performance (high relative plant richness and native plant diversity) of the manure treatment in test plots and tubs containing wetland plants, data suggest that the cow manure+biosolids compost amendment or manure compost are the best amendments for restoring native vegetation.

The rate of soil amendment application, either low (80 dry tons/acre) or high (160 dry tons/acre), will be determined on a site by site basis based on soil needs and cost factors. Using biosolids mixed with manure and wood chips will 1) be the most economical amendment due to local sources of cow manure, biosolids, and woody material, and 2) reduce waste streams that may otherwise pollute the environment. Common-sense BMPs such as stream buffers and timing of land application will minimize potential impacts to the environment.

Table 4. Comparative analysis of Alternatives using required and additional restoration criteria.

Restoration Criteria	**Alternative 1: No Action**	**Alternative 2: Habitat restoration without soil amendments**	**Alternative 3: Poultry or cow manure-based soil amendments and habitat restoration**	**Alternative 4: Cow manure-based soil amendments and habitat restoration**	**Alternative 5: Capping Remediated Areas with Natural Topsoil and Habitat Restoration**
Compliance with Laws and Policies	The No Action alternative does not meet the requirements and goals of CERCLA and the NRDA process under CERCLA to provide for restoration that compensates the public for the injury and loss of the natural resources and services caused by releases of hazardous substances from the Site.	Alternative 2 does not meet the requirements and goals of CERCLA and the NRDA process under CERCLA to provide for restoration that compensates the public for the injury and loss of the natural resources and services caused by releases of hazardous substances from the Site.	Alternative 3 meets the requirements and goals of CERCLA and the NRDA process under CERCLA to provide for restoration that compensates the public for the injury and loss of the natural resources and services caused by releases of hazardous substances from the Site. Proposed activities under this restoration plan would be subject to requirements of other laws, regulations, and statutes mentioned in Section A.1.	Alternative 4 meets the requirements and goals of CERCLA and the NRDA process under CERCLA to provide for restoration that compensates the public for the injury and loss of the natural resources and services caused by releases of hazardous substances from the Site. Proposed activities under this restoration plan would be subject to requirements of other laws, regulations, and statutes mentioned in Section A.1.	Alternative 5 meets the requirements and goals of CERCLA and the NRDA process under CERCLA to provide for restoration that compensates the public for the injury and loss of the natural resources and services caused by releases of hazardous substances from the Site. Proposed activities under this restoration plan would be subject to requirements of other laws, regulations, and statutes mentioned in Section A.1.
Technical Feasibility	The No Action alternative is technically feasible.	Restoration activities included in Alternative 2 are technically feasible but are less likely to result in desired restoration condition, including re-establishment of native vegetation, in the Action Area.	Similar projects have been completed in the vicinity of the Action Area, and biosolids have been used to improve soil fertility in numerous other reclamation and restoration projects in other parts of the U.S. Such experience and successful completion of projects demonstrates proposed restoration activities are technically feasible.	Similar projects have been completed in the vicinity of the Action Area, and biosolids have been used to improve soil fertility in numerous other reclamation and restoration projects in other parts of the U.S. Such experience and successful completion of projects demonstrates proposed restoration activities are technically feasible.	Similar projects have been completed in the vicinity of the Action Area as EPA has used topsoil caps in their remedial actions. Such experience and successful completion of projects demonstrates this alternative is technically feasible.
Relationship to Injured Resources and Services	The No Action alternative would not provide for restoration, replacement, enhancement or acquisition of resources that were injured from releases of hazardous substances from the Site.	This Alternative would involve attempting to re-establish native vegetation in the Action Area. Based on pilot study findings, this alternative is not likely to restore prairie vegetation to a desired condition and does not significantly improve wildlife habitat.	This alternative would focus on improving habitat conditions and increasing the ecological productivity of prairies and the biological resources within the Action Area. Activities would be focused on restoring and compensating for impacts similar to the Site-related natural resource injuries and losses.	This alternative would focus on improving habitat conditions and increasing the ecological productivity of prairies and the biological resources within the Action Area. Activities would be focused on restoring and compensating for impacts similar to the Site-related natural resource injuries and losses.	This alternative would focus on improving habitat conditions and increasing the ecological productivity of prairies and the biological resources within remediated lands, but would have an equal and opposite impact on the lands from which topsoil was removed.
Project Will not Be Used for Response Actions	The No Action Alternative has not been proposed as part of EPA's selected remedy.	The remedial response has already been completed on the action areas. Native prairie habitat restoration activities have not been proposed as part of the selected remedy for the Site.	The remedial response has already been completed on the action areas. Native prairie habitat restoration activities have not been proposed as part of the selected remedy for the Site.	The remedial response has already been completed on the action areas. Native prairie habitat restoration activities have not been proposed as part of the selected remedy for the Site.	Remedial response has been completed on the action areas. Native prairie habitat restoration activities have not been proposed as part of the selected remedy for the Site.

Table 4 Continued.

Benefits Relative to Costs	The benefit to cost ratio of the No Action alternative is assumed to be lower than if the Trustees were to pursue restoration under the Selected Action; however, the Selected Action would address interim losses of natural resources and services, whereas the No Action alternative does not.	The Trustees anticipate significant costs with seeding and re-seeding of native plants as a result of poor soil fertility and poor plant germination. In addition, weed management activities would likely be expensive. This alternative is expected to provide low benefits compared to costs.	The Trustees anticipate favorable benefit to cost ratios given the success of similar types of projects in other part of the U.S. In addition, the Trustees have completed pilot studies in an effort to reduce uncertainty in restoration outcomes and optimize benefits relative to cost.	The Trustees anticipate favorable benefit to cost ratios given the success of similar types of projects in other part of the U.S. In addition, the Trustees have completed pilot studies in an effort to reduce uncertainty in restoration outcomes and optimize benefits relative to cost.	The Trustees do not anticipate favorable benefit to cost ratios given the experience of the EPA, which has written an Explanation of Significant Difference document that states they were unable to identify sources of topsoil within a reasonably close proximity to the site.
Consistency with the Trustees Restoration Goals and Objectives	The No Action alternative would not provide for restoration, replacement, enhancement or acquisition of injured natural resources, making this alternative inconsistent with Trustee restoration goals.	This is alternative is consistent with Trustee restoration goals listed in Section 2.1, but is not consistent with all objectives stated in Section 2.2. This alternative has a low certainty of restoration success.	This is alternative is consistent with Trustee restoration goals listed in Section 2.1, but is not consistent with all objectives stated in Section 2.2 . This alternative has a moderate certainty of restoration success.	This is alternative is consistent with Trustee restoration goals listed in Section 2.1 and objectives stated in Section 2.2. This alternative has a moderate to high certainty of restoration success.	This is alternative is consistent with Trustee restoration goals listed in Section 2.1 and objectives stated in Section 2.2. This alternative has a moderate to high certainty of restoration success.
Avoidance of Further Injury	The No Action alternative would not cause further injury, but will also provide no benefit to offset interim losses.	This alternative will not cause further injury in the Action, but it does not mitigate on-going injuries as effectively as other alternatives.	This alternative will not cause significant injury in the Action Area, but has the potential to result in elevated nitrogen concentrations in surface water if poultry manure is applied. This alternative reduces future injury to natural resources that have been and may continue to be exposed to on-Site contaminants.	This alternative will not cause significant injury in the Action Area and has low potential to result in elevated nitrogen concentrations in surface water. This alternative reduces future injury to natural resources that have been and may continue to be exposed to on-Site contaminants.	This alternative will cause significant injury in the vicinity of conservation areas by removing topsoil from areas equal in size to the areas to be restored. Experience has shown invasive weeds are often transferred with topsoil.
Public Health and Safety	Any potential public health and safety issues or concerns that exist under current and future natural resource management activities would likely remain the same.	This alternative involves restoration activities, including seed dispersal and weed management activities, on areas containing mine waste. Restoration activities and long-term management would not pose elevated exposure risk to workers and adjacent habitats.	Restoration activities and long-term management would not pose elevated risk to workers and any other people accessing restoration areas from exposure to contaminated soil.	Restoration activities and long-term management would not pose elevated risk to workers and any other people accessing restoration areas from exposure to contaminated soil.	Restoration activities and long-term management would not pose elevated risk to workers and any other people accessing restoration areas from exposure to contaminated soil.
Time to Provide Benefits	The time to provide natural resource benefits under the No Action alternative is greater than if the Trustees were to pursue restoration under the Selected Action. Under the No Action alternative, natural recovery would be relied upon to improve ecological services in the Action Area.	The time to provide natural resource benefits under this alternative is relatively long when taking into consideration poor soil fertility.	The time to provide natural resource benefits under this alternative is relatively short to moderate when taking into consideration the improved soil fertility following application of soil amendments.	The time to provide natural resource benefits under this alternative is relatively short to moderate when taking into consideration the improved soil fertility following application of soil amendments.	The time to provide natural resource benefits under this alternative is relatively short to moderate when taking into consideration the improved soil fertility following application of topsoil.
Duration of Benefits	The duration of benefits under the No Action alternative is unknown. Perpetual conservation easements and other mechanisms to conserve habitat would not occur under this alternative.	The duration of benefits associated with this alternative is uncertain. There is a low certainty of restoration success associated with this alternative, meaning that benefits may be short-lived.	Natural resource restoration of prairie habitat, monitoring, corrective actions, and adaptive management in the Action Area will ensure long-term benefits are being provided.	Natural resource restoration of prairie habitat, monitoring, corrective actions, and adaptive management in the Action Area will ensure long-term benefits are being provided.	Natural resource restoration of prairie habitat, monitoring, corrective actions, and adaptive management in the Action Area will ensure long-term benefits are being provided.

4.0 ENVIRONMENTAL ASSESSMENT

This Chapter presents the Trustees' analysis of the environmental consequences of the Selected Action.

4.1 Affected Environment

This section presents a brief description of the physical, biological, and cultural environment for the waterways and ecosystems adjacent to and in the vicinity of the Site. The information in this section, together with other information in this document, provides the basis for the evaluation of the potential environmental impacts of the Selected Action (Alternative 4). Natural resource injuries and losses occurred in Webb City and its vicinity, including floodplain habitats. Restoration activities under this Final RP/EA would occur within or in proximity to the same areas.

The Selected Action will be implemented in the area designated in Figure 1. The Action Area is located in Jasper County and nearest the city of Webb City, with the majority of restoration activities being performed on the east and north ends of the city.

4.1.1 Physical Environment

4.1.1.1 Surface Water

Summary information about surface waters of the Springfield Plateau, including typical characteristics, reasons for alterations, and nature of degradation are contained in the SPRRP (Appendix D, pages 1 and 2).

The Action Area contains two main waterbodies: Center Creek and Ben's Branch (Figure 4). Center Creek is approximately 54 miles long and encompasses a total watershed area 302 square miles. The large Oronogo/Duenweg designated area (19 square miles) and its numerous mines, spans Center Creek about 18 miles upstream from its confluence with Spring River. The Action Area is located approximately 10 miles from the confluence with the Spring River, in the midst of the EPA remedial clean-up. Center Creek is a perennial stream with the following designated beneficial uses: warm water habitat, cool water habitat, whole body contact recreation Category A, secondary contact recreation, human health protection, irrigation, livestock and wildlife protection, and industrial water supply.

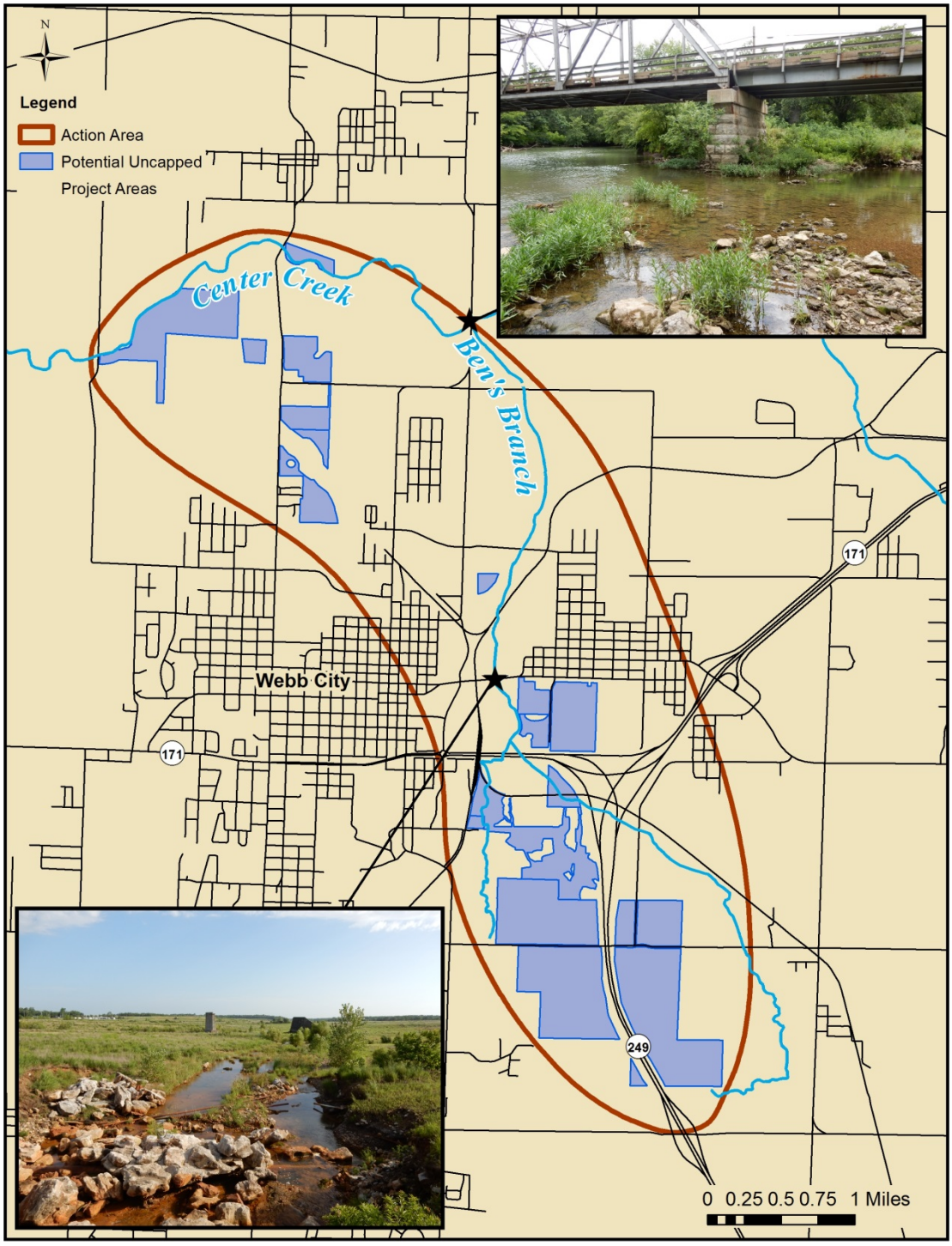

Figure 4. Photos of Ben's Branch and Center Creek (at the confluence with Ben's Branch) in relation to the Action Area.

Center Creek is impaired for cadmium, lead, and *E. coli* along a 27 mile segment (Figure 5). Center Creek beneficial uses that are impaired by metal contamination include warm water habitat and general criteria (Missouri DNR 2015a) Beneficial uses of Center Creek that are impaired by E. coli contamination include whole body contact recreation Category A (Missouri DNR 2015b).

Ben's Branch (or Mineral Branch) is described in various documents as a "miner's ditch" that enters Center Creek at Highway D, about 11 miles upstream of the confluence with the Spring River. Ben's Branch is approximately 5.4 miles long and drains the central portion of the Oronogo/Duenweg designated area, conveying runoff and seepage from numerous mill waste piles and overflow from mine shafts to Center Creek. Ben's Branch contributed an estimated 39 percent of Center Creek's total recoverable zinc load. Ben's Branch is an intermittent stream with the following designated beneficial uses: warm water habitat, whole body contact recreation Category B, secondary contact recreation, human health protection, irrigation, and livestock and wildlife protection.

Ben's Branch is impaired for cadmium, lead, and zinc in sediments along a 5.8 mile segment, with the source of contamination being the Oronogo Duenweg mining belt (Missouri DNR 2015). Ben's Branch beneficial uses that are impaired by metal contamination include warm water habitat and general criteria.

Surface water in Ben's Branch receives metal contamination via two pathways, runoff from the mining mill waste deposits and associated soils and sediments, and groundwater discharge from mined/mineralized portions of the shallow aquifer. The Trustees have sampled water and sediment from Ben's Branch as recently as spring 2016 to ascertain the baseline quality of water prior to restoration efforts. Dissolved zinc was generally found (11 out of 15 samples) to exceed the chronic levels for a warm-water fishery. Ben's Branch sediment contains elevated concentrations of cadmium, lead, and zinc above "Probable Effects Concentrations" (MacDonald et al. 2000). Water quality is expected to improve as EPA continues to remove mine waste from the watershed.

Several locations within the Action Area contain freshwater emergent or forested/shrub wetlands (Figure 6). Approximately 83 acres of wetlands are located in the Action Area according to available data sources. The riparian corridor of Center Creek contains the most concentrated areas of both freshwater wetland types within the Action Area.

Portions of the Action Area are within the 100-year flood zone (Figure 7). The majority of habitats in the flood zone lie within the riparian corridors of Ben's Branch and Center Creek.

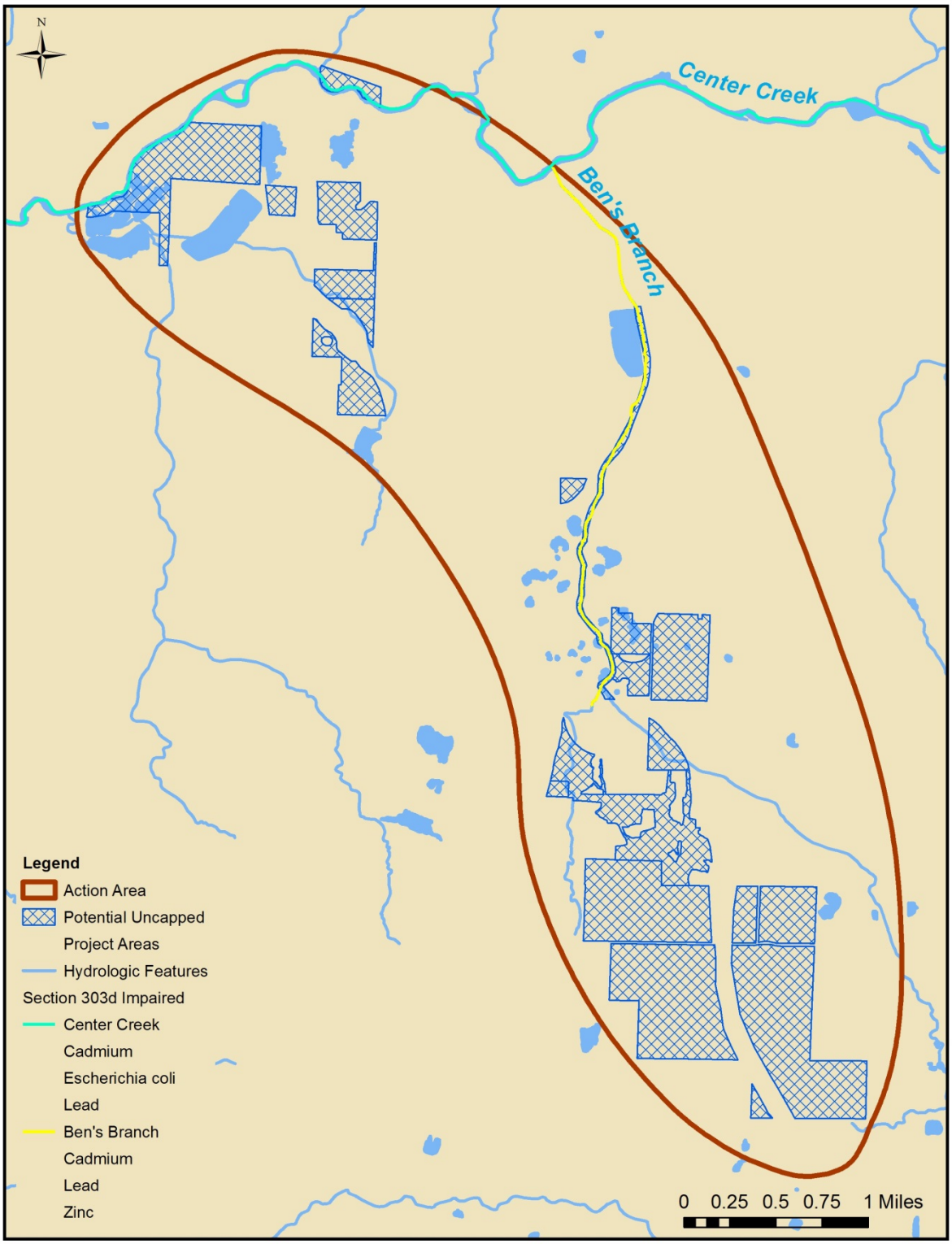

Figure 5. Map showing the streams that are impaired for water or sediment quality under Section 303 D of the Clean Water Act. Impaired waters are those that are too polluted or otherwise degraded to meet the water quality standards set by states, territories, or authorized tribes.

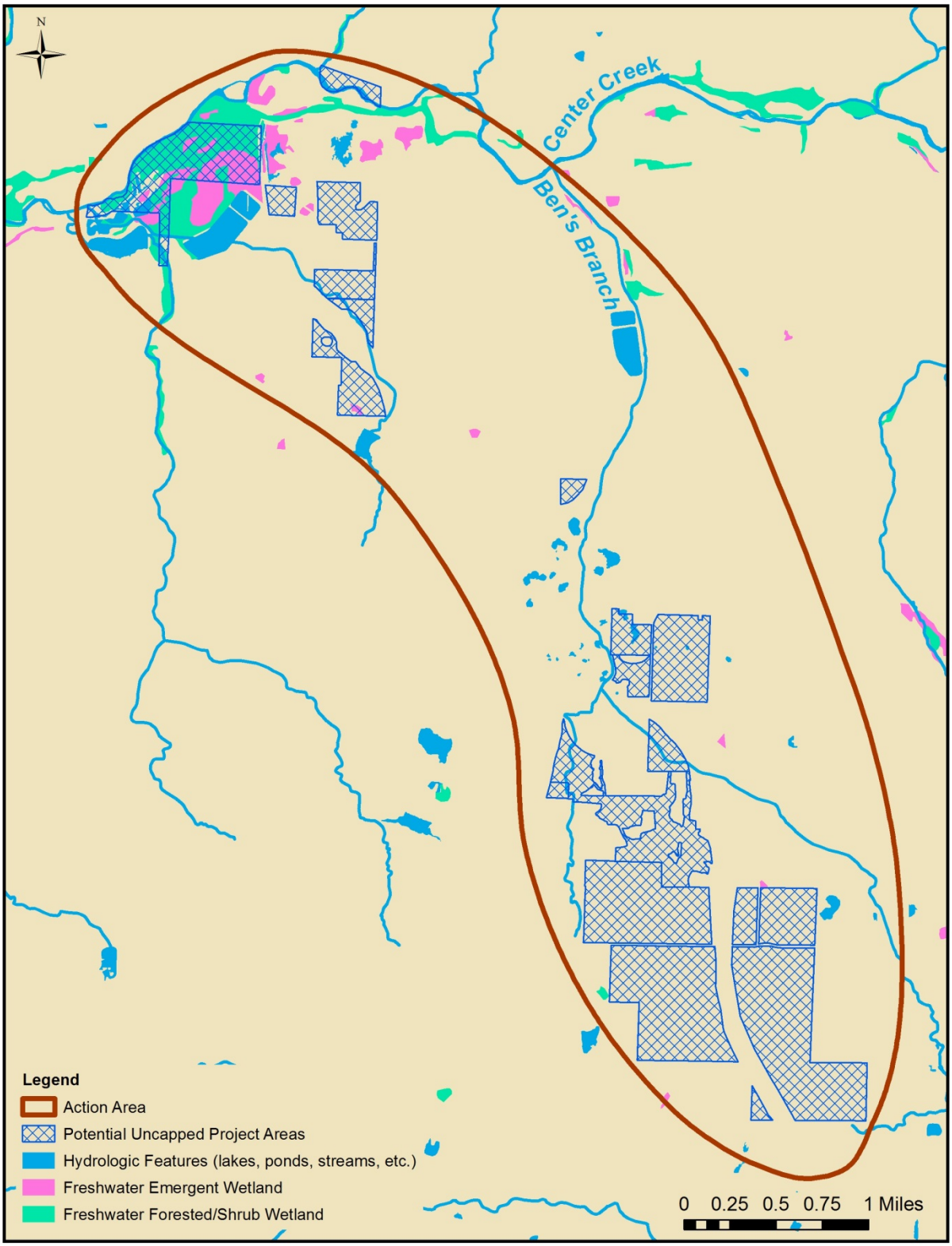

Figure 6. Freshwater emergent wetlands, freshwater forested/shrub wetlands, and other hydrologic features in the Action Area.

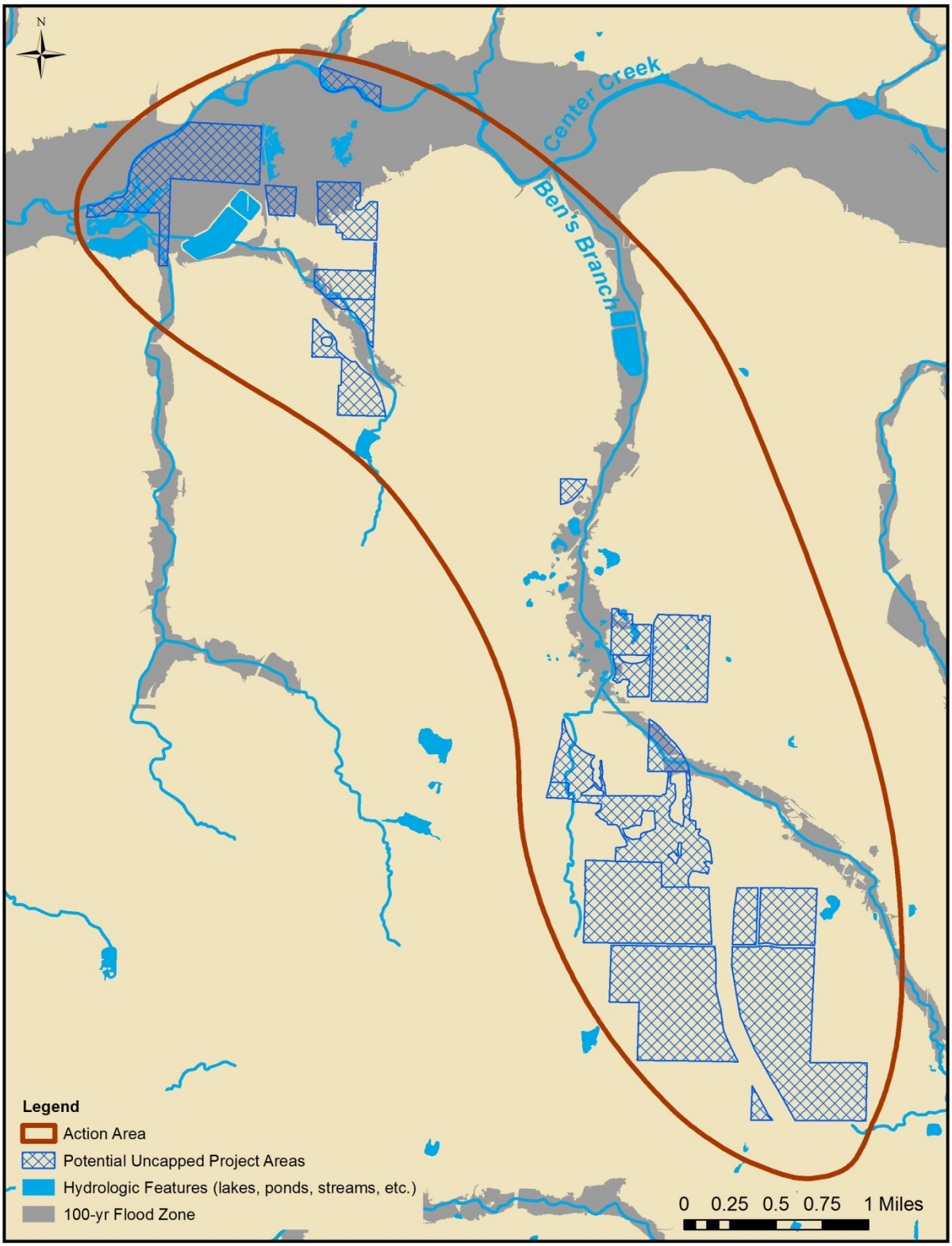

Figure 7. 100 - year flood zone in relation to Action Area.

4.1.1.2 Groundwater

Summary information about groundwater of the Springfield Plateau, including aquifer composition of aquifers and other characteristics, are contained in the SPRRP (Appendix D, pages 2 and 3).

Two major aquifers underlie the Action Area, a shallow aquifer and a deep aquifer. The two aquifers are separated by a 400-foot-thick sequence of shale and limestone that yields little or no water to wells. This sequence of shale and limestone acts as a relatively impermeable layer between the two aquifers, thus the deep aquifer is typically referred to as a "confined aquifer". Limestone of Mississippian age constitutes the shallow aquifer, generally exhibiting unconfined or water-table conditions except where Pennsylvanian shale is present above the limestone, where the shale can act to confine the shallow aquifer. The shallow aquifer in the Mississippian limestone formations hosts lead-zinc ores. Many private wells tap the shallow aquifer for drinking water. Most public water supplies are drawn from the deep aquifer. Water obtained from the shallow aquifer water is contaminated with cadmium, lead, and zinc in some areas.

4.1.1.3 Regional Geology and Soils

Summary information about the regional topography, bedrock, and soils of the Springfield Plateau, including bedrock composition and soil characteristics, are contained in the SPRRP (Appendix D, page 1).

The project area is located within the Osage Plains section of the Central Lowlands Physiographic Province and the Ozark Plateau subdivision of the Interior Highlands Physiographic Province. The Central Lowlands Province encompasses the area where Pennsylvanian shale occurs as the uppermost bedrock unit, generally in the area west of the Spring River. Soils in this province are formed primarily from weathered Pennsylvanian shale. The Ozark Plateau (Springfield subdivision) includes the area developed on Mississippian limestone, or that area generally east of the Spring River. Here the Pennsylvanian shale occurs as scattered erosional remnants. These soils are weathered from underlying cherty limestone. The darker colored soils of the nearly level and gently rolling stream divide areas support agriculture; these soils may be derived from loess (wind-deposited silt and fine sand) or bedrock, or both.

4.1.1.4 Climate

According to the Missouri Climate Center, the annual mean temperature from 1981 – 2010 for Joplin (Joplin regional airport station) is 59° F. The annual average maximum temperature is 69 ° F and annual average minimum temperature is 48° F. The average annual total precipitation is approximately 47 inches per year, with nearly 13 inches of that coming in the form of snow.

4.1.2 Biological Environment

4.1.2.1 Terrestrial and Aquatic Habitat

Summary information about the regional terrestrial and aquatic habitat resources of the Springfield Plateau, including natural community types, rare community types, and streams, are contained in the SPRRP (Appendix D, page 3 and 4). Ecological sites located in the Action Area include chert upland prairie, loamy upland prairie, chert upland woodland, low-base chert protected backslope woodland, sandstone/hale upland prairie, wet terrace prairie, and sandy/gravelly floodplain forest.

In Jasper County, croplands, grasslands, and woodlands are interspersed with mine-impacted spaces (Dames & Moore 1995). Open areas such as cropland, pasture, meadows, and overgrown areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The remaining areas of native prairie including native prairie hay meadows are highly valued because less than four percent of the original habitat remains, making it among the most endangered ecosystems in the world. Native tallgrass prairies support native plants and support exceptionally high numbers of plant species. In particular, they can support hundreds of forb species and their seed banks are exceptionally rich, even in areas used as hay meadows. Native prairie areas may also support important native rangeland grass species, such as the big bluestem (*Andropogon gerardii*), switchgrass (*Panicum virgatum*) and little bluestem (*Schizachyrium scoparius*).

About 18 percent of the Spring River basin is forested (Dames & Moore 1995). These woodlands tend to occur as irregular areas or strips, and as riparian corridors (Dames & Moore 1995). Woodlands also occur as strips on upland drainageways and on steep upland slopes (CDM 1995). Native forests are characterized by a variety of oak species (*Quercus* spp.), black walnut (*Juglans nigra*), pecan and other hickory species (*Carya* spp.), and associated shrubs, grasses, legumes, and wild herbaceous plants.

Center Creek is an Ozarkian stream that joins the Spring River near the Kansas/Missouriborder. The creek's base flow is sustained from springs originating in the upper aquifer (Davis and Schumacher 1992).). Center Creek is a significant contributor of metals to the Spring River (Davis and Schumacher 1992; Dames & Moore 1995, Wildhaber et al. 2000); indeed, Center Creek receives loadings from its tributaries as well as miner's ditches, such as Ben's Branch. Drainage canals were dug to divert rain and mine waters away from heavy-use mine shafts, and heavy precipitation still flows through these man-made Center Creek tributaries (McFarland 1989). The Oronogo/Duenweg designated area contributes contamination via "[a]rtesian flow from shafts and subsurface seepage…during low-flow. Seepage and runoff from tailing piles [in the Oronogo/Duenweg designated area] are the principle sources of contamination in the stream during high flow" (Kiner et al. 1997).

4.1.2.2 Fish and Wildlife

Summary information about the commonly hunted game mammals, game birds, and popular sport fish of the Springfield Plateau is contained in the SPRRP (Appendix D, page 12).

Local fish species include a number of larger or recreationally important fish species such as smallmouth bass (*Micropterus dolomieui*), rock bass (*Amploplites rupestris*), longear sunfish (*Lepomis megalotis*), and several sucker species (Dames & Moore 1995). Smaller fish species include minnows and darters. Other common fish species within the vicinity of the Action Area include bluegill (*Lepomis macrochirus*) and common carp (*Cyprinus carpio*), with fewer numbers of largemouth bass (*Micropterus salmoides*), and green sunfish (*Lepomis cyanell*us) (Dames & Moore 1995).

Mammals observed within seven of the Jasper County designated areas include raccoon (*Procyon lotor*), coyote (*Canis latrans*), striped skunk (*Mephitis mephitis*), bobcat (*Lynx rufu*s), whitetail deer (*Odocoileus virginianus*), red fox (*Vulpes vulpes*), mice, shrews, voles and various other small rodents (Dames & Moore 1995; Cedar Creek Associates 1999).

4.1.2.3 Rare, Threatened, Endangered, and Special Concern Species

The Endangered Species Act (ESA) of 1973 (16 U.S.C. §§1531, et seq.) requires federal agencies to conserve endangered and threatened species and to conserve the ecosystems upon which these species depend. The habitat of endangered, threatened, and rare species takes on special importance because of state and federal laws, and the protection and conservation of these species requires diligent management.

Summary information about rare, federally threatened or endangered, and special concern species (also referred to collectively as special status species) of the Springfield Plateau, including birds, mammals, fish, mollusks, insects, and plants, are contained in the SPRRP (Appendix D, pages 5 through 10).

Several federally-listed threatened and endangered species (Table 5) and Missouri species of conservation concern (Table 6) have the potential to occur in the vicinity of the Site or in areas affected by past re leases of mine-associated wastes. The Spring River, for which Center Creek is a tributary, provides critical habitat for the endangered Neosho mucket (*Lampsilis rafinesqueana*) and threatened rabbitsfoot mussel (*Quadrula cylindrica cylindrical*) (Figure 8). Critical Habitat Unit 4 for the Neosho mucket includes 63.6 river miles of the Spring River from Missouri Highway 97 north of Stotts City, Lawrence County, Missouri, downstream to the confluence of Turkey Creek north of Empire, Cherokee County, Kansas (50 CFR Part 17, Vol 80, No. 83) . Critical Habitat Unit 1 for the rabbitsfoot includes 35.1 river miles of the Spring River from Missouri Highway 96 at Carthage, Jasper County, Missouri, downstream to the confluence of Turkey Creek north of Empire, Cherokee County, Kansas (50 CFR Part 17, Vol 80, No. 83). However, it is highly unlikely that any federally-listed species occur in the areas in which the

Trustees will conduct primary restoration activities because the habitat is currently unsuitable for such special status species.

Special status bat species use trees for roosting and raising young, and the areas to be restored by this project lack trees of sufficient size to be of any use to these species. Evidence (dead shells) of the Neosho mucket has been found downstream of the project areas within Center Creek. Similarly, the Arkansas darter has been found in the general area within the last 30 years. Among the many migratory bird species occurring in the vicinity of the Action Area are 23 species which are Birds of Conservation Concern (Table 7).

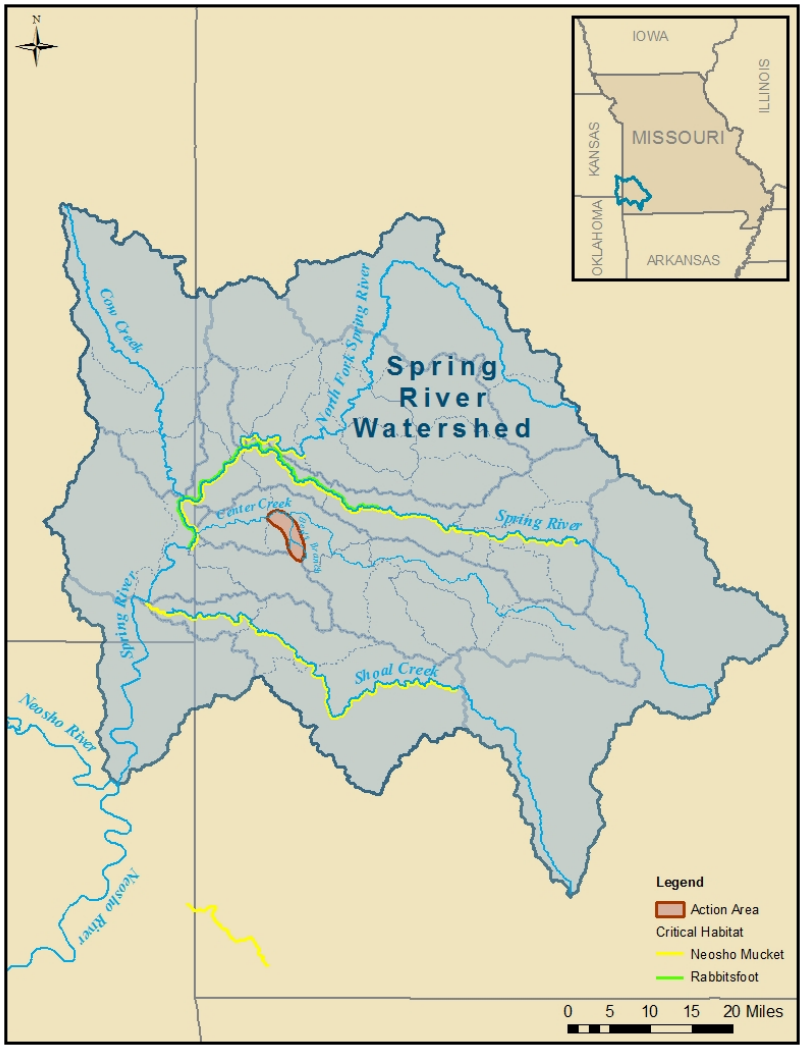

Figure 8. Critical habitat for Neosho mucket and rabbitsfoot mussel in relation to Action Area.

Table 5. List of federally protected species potentially occurring at or in the vicinity of the Action Area in Jasper County. Data from U.S. Fish and Wildlife Service Information, Planning, and Conservation System (http://ecos.fws.gov/ipac) generated on June 20, 2016. Key: E – Federally Endangered, T –Federally Threatened, C - Federal Candidate, CH – Federal Critical Habitat (final or proposed)

Common Name	**Scientific Name**	**Status**
Arkansas darter	*Etheostoma cragini*	C
Geocarpon minimum	*Geocarpon minimum*	T
Gray bat	*Myotis grisescens*	E
Indiana bat	*Myotis sodalist*	E
Neosho Madtom	*Noturus placidus*	T
Neosho mucket	*Lampsilis rafinesqueana*	E, CH
Northern long-eared bat	*Myotis septentrionalis*	T
Ozark cavefish	*Amblyopsis rosae*	T
Rabbitsfoot	*Quadrula cylindrica cylindrical*	T, CH
Running buffalo clover	*Trifoliam stoloniferum*	E
Western prairie fringed orchid	*Platanthera praeclara*	T

Table 6. List of Missouri species of conservation concern that may occur in the vicinity of the Action Area. Some species listed below may also be protected under federal law (Table 5).

Common Name	Scientific Name	State Status or Rank
American bittern	*Botaurus lentiginosus*	Endangered/S1
Arkansas darter	*Etheostoma cragini*	S3S4
Black-tailed jackrabbit	*Lepus californicus*	Endangered/S1
Cerulean warbler	*Setophaga cerulean*	S2S3
Channel darter	*Percina copelandi*	S3
Eastern eulophus	*Perideridia americana*	S2
Geocarpon	*Geocarpon minimum*	S2
Gray bat	*Myotis grisescens*	Endangered
Greater Prairie-chicken	*Tympanuchus cupido*	Endangered/S1
Indiana bat	*Myotis sodalis*	Endangered
Least bittern	*Ixobrychus exilis*	S3
Neosho madtom	*Noturus placidus*	Endangered/S1
Neosho mucket	*Lampsilis rafinesqueana*	S2
Northern long-eared bat	*Myotis septentrionalis*	S3
Ozark Cavefish	*Amblyopsis rosae*	Endangered/S2
Plains Spotted Skunk	*Spilogale putorius interrupta*	Endangered/S1
Prairie Mole Cricket	*Gryllotalpa major*	S3
Rabbitsfoot	*Quadrula cylindrical cylidrica*	S1
Regal fritillary	*Speyeria idalia*	S3
Running Buffalo clover	*Trifolium stoloniferum*	Endangered/S1
Schweinitz's flatsedge	*Cyperus schweinitzii*	S3
Southern cattail	*Typha domingensis*	S1
Starvation cactus	*Opuntia polyacantha var. polyacantha*	SX
Stemless evening primrose	*Oenothera triloba*	S2
Tansy mustard	*Descurainia pinnata ssp. pinnata*	S2S3
Western prairie fringed orchid	*Platanthera praeclara*	S1
Western slim minnow	*Pimephales tenellus tenellus*	S3

Endangered: Any species which is in danger of extinction throughout all or a significant portion of its range.

S1: Critically Imperiled: Critically imperiled in the state because of extreme rarity or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state.

S2: Imperiled: Imperiled in the state because of rarity due to very restricted range, very few populations or occurrences, steep declines, or other factors making it very vulnerable to extirpation from the state.

S3: Vulnerable: Vulnerable in the state due to a restricted range, relatively few populations or occurrences, recent and widespread declines, or other factors making it vulnerable to extirpation.

S4: Apparently Secure: Uncommon but not rare; some cause for long-term concern due to declines or other factors.

SX: Presumed Extirpated: Species is believed to be extirpated from the state. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.

Table 7. List of migratory Birds of Conservation Concern[2] potentially occurring at or in the vicinity of the Action Area. Data generated from Information for Planning and Conservation (https://ecos.fws.gov/ipac/) on June 20, 2016

Common Name	Scientific Name	Seasonal Occurrence
Bald eagle	*Haliaeetus leucocephalus*	Year-round
Bell's vireo	*Vireo bellii*	Breeding
Bewick's wren	*Thryomanes bewickii ssp. Bewickii*	Breeding
Blue-winged warbler	*Vermivora pinus*	Breeding
Dicksissel	*Spiza Americana*	Breeding
Fox sparrow	*Passerella iliaca*	Wintering
Harris's sparrow	*Zonotrichia querula*	Wintering
Henslow's sparrow	*Ammodramus henslowii*	Breeding
Hudsonian godwit	*Limosa haemastica*	Migrating
Kentucky warbler	*Geothlypis Formosa*	Breeding
Least bittern	*Ixobrychus exilis*	Breeding
Loggerhead shrike	*Lanius ludovicianus*	Year-round
Painted bunting	*Passerina ciris*	Breeding
Pied-billed grebe	*Podilymbus podiceps*	Year-round
Prairie warbler	*Dendroica discolor*	Breeding
Prothonotary warbler	*Protonotaria citrea*	Breeding
Red-headed woodpecker	*Melanerpes erythrocephalus*	Year-round
Rusty blackbird	*Euphagus carolinus*	Wintering
Sedge Wren	*Cistothorus platensis*	Migrating
Short-eared owl	*Asio flammeus*	Wintering
Willow flycatcher	*Empidonax traillii*	Breeding
Wood thrush	*Hylocichla mustelina*	Breeding
Worm eating warbler	*Helmitheros vermivorum*	Breeding

[2] The 1988 amendment to the Fish and Wildlife Conservation Act mandates the U.S. Fish and Wildlife Service to "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act (ESA) of 1973." The overall goal of the Birds of Conservation Concern (USFWS 2008) is to accurately identify the migratory and non-migratory bird species (beyond those already designated as federally threatened or endangered) that represent FWS' highest conservation priorities.

4.1.3 Socioeconomic and Cultural Environment

4.1.3.1 Demographics

The estimated human population for Webb City was 11,165 as of July 1, 2015. In April, 2010, at the time the last census data were published, the population in Jasper County was 117,404. The median household income for Jasper County from 2010 – 2014 was $40,914, and the median household income for Webb City during the same time period was $37,854.

The Jasper County unemployment rate in 2010 was 8.0 percent. In 2010, the types of workers were:

- Private wage or salary: 83.4 percent
- Government: 8.9 percent
- Self-employed, not incorporated: 7.7 percent
- Unpaid family work: 0.1 percent

Table 8. Action Area demographics*.

Demographic Category	
Population	12,124
Minority Population	1,292
Percent Minority	11%
Percent Persons in Poverty (estimate) **	16.1%
Households	4,669
Males	5,892
Females	6,232

* Statistics generated using 2010 U.S. Census Bureau data and EPA's Environmental Justice Screening and Mapping Tool (Version 2016) https://ejscreen.epa.gov/mapper/; demographics are for an approximately 10 square mile area encompassing the Action Area.
** Estimate for Webb City using U.S. Census Bureau statistics.

Industries providing employment in Joplin County based on 2010 statistics include:

- Management, professional, and related occupations (26.1 percent).
- Sales and office occupations (25.7 percent)
- Production, transportation, and material moving occupations (19.3 percent)

Agriculture is important to the economy of Jasper County. Jasper County ranked 30th out of 114 state counties for total value of agricultural products sold in 2012, with livestock, poultry and eggs, soybeans, wheat for grain, and winter wheat for grain being important agricultural commodities to the county (Table 9). Within the state, Jasper County is in the top ten percent of producers of horses, ponies, mules, burros, and donkeys; wheat; and turkeys.

Table 9. Jasper County agricultural statistics. All data are 2015 statistics except where noted. Data from USDA National Agricultural Statistics Service.

Agricultural Category	
Beef cows*	26,000
Milk cows*	1,400
All cattle and calves*	50,000
Acres planted for corn	29,900
Acres planted for soybeans	45,200
Acres planted for winter wheat	40,700
Acres harvested for other hay (non-alfalfa)	33,900

* January 1, 2016 statistics

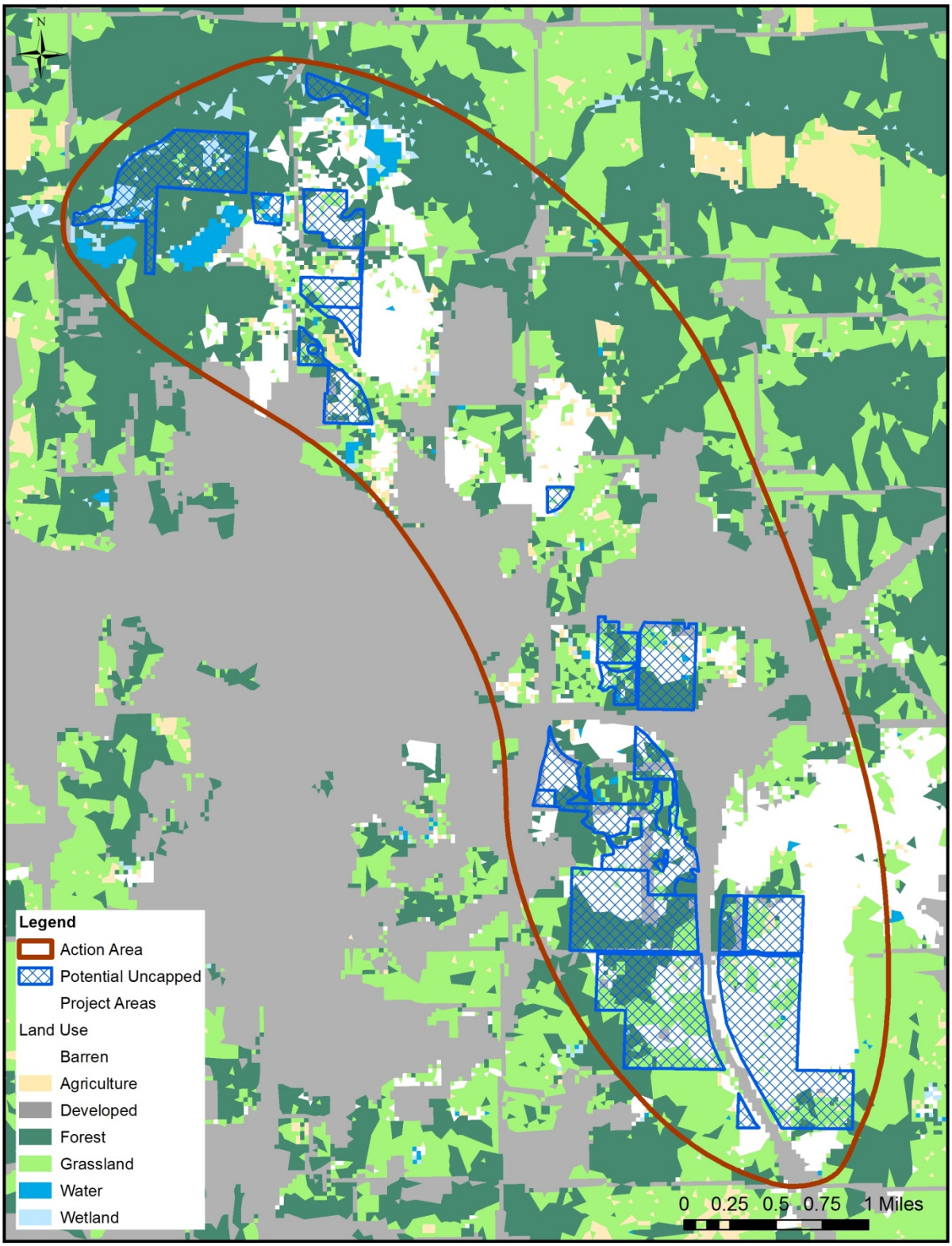

Figure 9. Land use in the vicinity of the Action Area.

4.1.3.2 EO 12898 Analysis

Executive Order 12898 (Feb 11, 1994) requires each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. For this Restoration Plan, the relevant demographic data were obtained from the U.S. Census Bureau and the State of Missouri. Data are presented at the county level to accommodate the geographic size of each portion of the Action Area.

In this analysis, a county is considered to have a minority population if its non-white population is greater than 50 percent or is meaningfully larger than the general (statewide) non-white population. Low-income areas are defined as counties in which the percentage of the population below poverty status exceeds 50 percent, or is meaningfully greater than the general population (average statewide poverty level).

To make a finding that disproportionately high and adverse effects would likely fall on minority or low-income populations, three conditions must be met simultaneously:

- There must be a minority or low-income population in the impact zone.
- A high and adverse impact must exist.
- The impact must be disproportionately high and adverse on the minority or low-income population

Based on the census data for Jasper County, the minority population in the Action Area does not meet the condition of being classified having a minority population since the minority population comprises only 11% of the action area's population. The Action Area is not considered a low-income area because the percentage of persons in poverty is below 50 percent and is similar to the statewide poverty level (estimate of 15.5%).

4.1.3.3 Recreation

Recreation areas in Jasper County primarily consist of designated recreational facilities, such as parks or sports facilities. There are no federal or state parks in Jasper County. City parks and private facilities are the only designated recreational areas available to residents. The Parks and Recreation Department of Webb City manages several city parks, including King Jack and Memorial park, and three park facilities. Wah-Sha-She Prairie State Wildlife Area is a 160 acre designated natural claypan prairie area owned by The Nature Conservancy and provides opportunities for viewing native prairie and wetland plants, birds, and other wildlife. Undesignated recreational areas include waterways, such as Center Creek, used for fishing, swimming, wading, or rafting/tubing.

4.1.3.4 Cultural and Historic Resources

Prior to the implementation of a Selected Action, potential impacts to historic and archaeological resources must be reviewed. Section 106 of the National Historic Preservation Act requires federal agencies to consider the effects of Selected Actions on historic properties. Historic properties must also be given consideration under NEPA. The National Register of Historic Places is a federally-maintained list of districts, sites,

buildings, structures, objects, and landscapes significant in American history, prehistory, architecture, archaeology, engineering, and culture. Archaeological sites are places where past peoples left physical evidence of their occupation. Sites may include ruins and foundations of historic-era buildings and structures. Native American cultural resources may include human skeletal remains, funerary items, sacred items, and objects of cultural patrimony. Historic properties can also include traditional cultural properties. The Selected Action is located in Jasper County, near the city of Webb City. Coordination with the Missouri State Historic Preservation Office will be completed prior to implementing the Selected Action, but according to a preliminary analysis and based on the previous mining use and impacts within the Action area, there are no historic or cultural resource sites within restoration areas. The nearest state historic site is approximately eight miles east of the Action Area Battle of Carthage State Historic Site is located in Jasper County in the city of Carthage. Therefore, the Selected Action will have no have impacts on this historic site.

4.2 Environmental Consequences of No Action Alternative and Selected Action

NEPA requires that the Trustees evaluate the potential impacts of their actions. This includes evaluation of what would happen if the Trustees did nothing further, referred to as the "No Action Alternative". This section of the Final RP/EA sets out the potential impacts of both the No Action Alternative and the Selected Action alternative evaluated in Chapter 3 as meeting the Trustees' Restoration Goals and Evaluation Criteria. The analysis presented here considers the range of potential environmental consequences that may be anticipated to occur as a result of implementation of activities within the scope of the Selected Action. A summary of the impacts anticipated from the restoration alternatives considered in the Webb City area are listed in Table 10.

The following definitions will be used to characterize the nature of the various impacts evaluated in this Final RP/EA:

- *Short-term or long-term impacts.* These characteristics are determined on a case-by-case basis and do not refer to any rigid time period. In general, short-term impacts are those that would occur only with respect to a particular activity or for a finite period. Long-term impacts are those that are more likely to be persistent and chronic.

- *Direct or indirect impacts.* A direct impact is caused by a proposed action and occurs contemporaneously at or near the location of the action. An indirect impact is caused by a proposed action and might occur later in time or be farther removed in distance but still be a reasonably foreseeable outcome of the action. For example, a direct impact of erosion on a stream might include sediment-laden waters in the vicinity of the action, whereas an indirect impact of the same erosion might lead to lack of spawning and result in lowered reproduction rates of indigenous fish downstream.

- *Minor, moderate, or major impacts.* These relative terms are used to characterize the magnitude of an impact. Minor impacts are generally those that might be perceptible but, in their context, are not amenable to measurement because of their relatively minor

character. Moderate impacts are those that are more perceptible and, typically, more amenable to quantification or measurement. Major impacts are those that, in their context and due to their intensity (severity), have the potential to meet the thresholds for significance set forth in CEQ regulations (40 CFR 1508.27) and, thus, warrant heightened attention and examination for potential means for mitigation to fulfill the requirements of NEPA.

- *Adverse or beneficial impacts.* An adverse impact is one having adverse, unfavorable, or undesirable outcomes on the man-made or natural environment. A beneficial impact is one having positive outcomes on the man-made or natural environment. A single act might result in adverse impacts on one environmental resource and beneficial impacts on another resource.

- *Cumulative impacts.* CEQ regulations implementing NEPA define cumulative impacts as the "impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." (40 CFR 1508.7) Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time within a geographic area.

4.2.1 Environmental Consequences of the No Action Alternative

This section provides a brief summary of the potential environmental consequences of the No Action Alternative. Potential environmental impacts include:

Air Quality: The No Action Alternative would not result in any air quality impacts since no restoration actions would be undertaken.

Hydrology: The No Action Alternative would not result in any hydrology impacts since no restoration actions would be undertaken.

Water Quality: Water quality in Ben's Branch and Center Creek would continue to be degraded in both the short- and long-term as a result of metals being transported from mining-impacted areas.

Sediment Quality: Contaminated soil from upland and floodplain mining-impacts areas would continue to migrate into streams until natural vegetation growth impedes such movement. Adverse impacts to aquatic biota would likely continue until sediment quality improves over the long-term.

Vegetation: The No Action Alternative would not result in any impacts to vegetation since no restoration actions would be undertaken. Vegetation communities in the Action Area will likely remain in a degraded condition into the foreseeable future.

Fish and Wildlife: The No Action Alternative would not result in any impacts to fish and wildlife resources since no restoration actions would be undertaken. Any historical,

current, and future impacts to fish and wildlife would not be addressed through restoration activities.

Rare, Threatened, Endangered, and Special Concern Species: The No Action Alternative would not result in any impacts to rare, threatened, endangered and special concern species since no restoration actions would be undertaken.

Aesthetics: The No Action Alternative would not result in any impacts to aesthetic or scenic qualities and values in the Action Area as no restoration actions would be undertaken.

Noise: The No Action Alternative would not result in any change in current or ambient noise levels in the Action Area since no restoration actions would be undertaken.

Recreation: The No Action Alternative would not result in recreational impacts since no restoration actions would be undertaken.

Public Health and Safety: The No Action Alternative would not result in any impacts to public health and safety since no restoration activities would be undertaken.

Transportation: The No Action Alternative would not result in any transportation impacts since no restoration actions would be taken.

Economy: The No Action Alternative would not result in any economic impacts within the Action Area since no restoration actions would be undertaken.

Table 10. Summary of the impacts anticipated from the No Action and Selected Action restoration alternatives considered in Webb City, Jasper County, Missouri.

Resource Topics	Alternative 1 (No Action)	Alternative 4 (Selected)
Physical Environment	Unknown, but likely continued degraded conditions	Moderate short and long-term benefits
Habitat Resources	Continued degraded habitat	Moderate to major short and long-term benefits
Fish and Wildlife	Adverse impacts	Moderate to major short and long-term benefits
Socioeconomics	Adverse impacts	Minor beneficial impact from influx of restoration funds, and then from tourism after parks are established.
Cultural Resources	No effect	No effect
Cumulative	Adverse impacts	Minor to moderate benefits

4.2.2 Physical Environment Consequences of the Selected Action

4.2.2.1 Air Quality Impacts

Restoration activities that may have short-term, adverse effects to air quality include mechanical clearing, application of herbicides, spreading of soil amendments, seeding native species, and other similar activities. Construction equipment anticipated to be used for the types of restoration activities proposed (e.g., soil amendment application and seeding prairie habitat) and equipment-associated emissions are presented in Tables 11 and 12. Construction equipment (e.g., tractor, ATV) would likely be used periodically within restoration areas throughout the year. Temporary and minor increases in emissions, such as smoke, fuel vapors, or herbicide aerosols from construction equipment or habitat management activities would occur during restoration activities. However, no air quality permits are required for these types of projects and no violations of state air quality standards would be expected from a project of this type and scope. All equipment used for restoration activities would be compliant with EPA emission standards.

Emissions generated from restoration activities would not generate a noticeable increase in levels of emissions outside of normal environmental conditions or have direct or indirect adverse impacts to humans in the areas within or beyond the Action Area. Impacts to air quality would be short-term, direct, adverse and negligible to minor. Long-term, indirect, and minor beneficial impacts from the proposed restoration include carbon sequestration in the prairie and wetland areas via grass, forbs, and wetland plants that will be allowed to grow and not be removed from restoration areas.

Control of invasive species is not expected to include use of heavy construction equipment. Emissions from lightweight power tools such as weed-whackers would be negligible and occur only during the periods of active vegetation control. Prescribed burns would be limited in size and duration, timed to avoid conditions that would result in unacceptable localized air quality conditions, and subject to fire management techniques. Prescribed burns will be conducted in accordance with the Webb City burning regulations. Prescribed fire operations already occur on capped areas within the Action Area targets for restoration, and the Webb City and Oronogo Fire Departments have being directing those operation and will operate prescribed burns associated with the Selected Action. In general, impacts to air quality from invasive species control activities are expected to be short-term, direct, adverse and minor. Estimates of carbon dioxide, methane, nitrogen oxides, sulfur dioxide, and particulate matter (2.5 and 10 micrometers) resulting from prescribed burns are listed in Table 12.

During prescribed fire operations, best management practices (BMPs) would be utilized to ensure that any temporary negative impacts are minimized. This would include, as appropriate, such BMPs as:

1. Firebreaks and fuel reduction lines will be used appropriately to minimize fire escape potential.

2. Weather conditions as follows: humidity range between 30% and 55%; wind speed 5 to 15 mph with no shifts in direction anticipated; dominant wind direction away from residences, businesses, and roads
3. Jasper County Dispatch will be contacted prior to and at the conclusion of each prescribed burn; a summary of the prescribed burn operation will be provided.
4. Installing erosion control measures, where necessary, to protect water quality and minimize soil erosion.
5. A maximum of 40 contiguous acres will be burned during a single operation.

The land application of manure will have some short-term odors for several days after application. Nuisance odors can have detrimental impacts on aesthetics, property values, and the quality of life in communities subjected to them. Many of the odor-causing bacteria in biosolids have been destroyed in the stabilization process, but additional actions will be taken to control odors. The soil amendments will have been composted for at least one month before being applied on the landscape, which should reduce odors considerably. To mitigate for the odors in areas near residential (or commercial/retail) areas, the Trustees intend to spread the soil amendments in the colder months, when nearby citizens are likely to spend more time indoors than during the warmer months. If there are complaints by nearby citizens, the Trustees may use only wood compost or use a manure-biosolids mixture that has been composted long enough to not have an objectionable smell. Given that land application of biosolids is already used by the adjacent City of Joplin wastewater treatment plant, and manure is commonly applied in the rural areas, the negative impacts to the community should be minor. In general, impacts to air quality from soil amendment application are expected to be short-term, direct, adverse and minor, particularly in close proximity to the application areas.

Table 11. Estimates of emissions from heavy-duty trucks and a tractor that may be used for hauling compost material. Estimates for dump truck and tractor trailor are based on the assumption that 160 tons per acre of compost would be applied to up to 700 acres. Estimates do not take into consideration re-fueling trips.

Vehicle type	**Pounds of:**					**Tons of:**
	VOCs	Total Hydrocarbons	CO	NO_x	Total PM^3	CO_2
Dump truck (gasoline)[1]	1,007.77	1,029.99	8158.82	1,481.15	35.98	256.25
Long-haul semi-tractor trailer rig (diesel)[2]	112.35	113.83	591.36	2,269.40	110.62	179.38
120-hp tractor (4-cyl, John Deere 4045H engine; diesel)[4]	**Pounds per day of:**					**Pounds/gal of diesel**
	N/A	1.33	1.92	16.71	0.52	4.64

[1] Emissions based on in-use emissions data from EPA for weight class 7 heavy-duty trucks; assumes 20 miles per trip, maximum of 15 trips/day, and 14 ton capacity

[2] Emissions based on in-use emissions data from EPA for weight class 8a heavy-duty trucks; assumes 20 miles per trip , maximum of 15 trips/day, and 20 ton capacity

[3] Combination of $PM_{2.5}$ and PM_{10}

[4] Fuel efficiency for the tractor depends on various factors and therefore is unknown. Assumes 8 hours of operation time.

Table 12. Estimates of prescribed fire emissions based on several burn acreage scenarios. Estimates based on fuel loading of 1.9 tons/acre (pasture/grass) and 85% combustion completion[3].

Acres	Tons of:					
	CO_2	Methane	NO_x	SO_2	$PM_{2.5}$	PM_{10}
40	100.21	0.37	0.14	0.03	0.75	1.02
250	626.30	2.31	0.87	0.16	4.69	6.39
500	1,252.61	4.62	1.74	0.32	9.38	12.77
700	1,753.65	6.46	2.44	0.45	14.07	17.88
1000	2,505.22	9.23	3.48	0.65	18.76	25.55

4.2.2.2 Hydrology

Upland and riparian vegetation influences hydrological processes through effects on runoff and control of uptake, storage, and return of water to the atmosphere. Native plant restoration has the potential, in combination with other restoration activities, to return the vegetation-hydrology interactions to an ecological condition of higher integrity. Invasive species management and revegetation under this alternative includes limited involvement of heavy construction equipment and the methods proposed for use are not anticipated to have any adverse impacts on the Action Area hydrology. Native prairie species restoration and management activities are expected to result in both short- and long-term, indirect, and minor to moderate beneficial impacts to local hydrology.

During restoration activities, BMPs would be utilized to ensure that any temporary negative impacts are minimized. This would include, as appropriate, such BMPs as:

1. Restricting heavy equipment use to the minimum time needed to achieve restoration objectives;
2. Requiring the use of low-ground pressure tracked and/or wheeled vehicles to avoid rutting soils;
3. Flagging authorized restoration areas to prevent impacts outside of designated areas;
4. Restricting equipment access to designated corridors.

Therefore, impacts of restoration activities are expected to include both short-term, direct, minor hydrological adverse impacts and long-term, direct, moderate, beneficial impacts.

[3] Source: https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-information (accessed August 29, 2016)

4.2.2.3 Water Quality Impacts

Land practices, including mine reclamation or restoration, involving the use of biosolids can increase revegetation success and provide other environmental benefits; however, nutrient addition in the form of biosolids in excess of vegetation requirements, or when appropriate practices to reduce runoff are not used, has the potential to increase leaching of various contaminants, including nitrogen, nitrates, and metals (Stehouwer et al. 2006). Biosolids-associated contaminants, such as pharmaceuticals, also have the potential to leach into soil following land application and subsequently be introduced into local surface waterways or groundwater through runoff, overland flow, or additional leaching (Wu et al. 2010). Other contaminants, such as perfluorinated compounds, sometimes referred to as perfluoroalkyl substances, which may have developmental or reproductive effects, can be introduced into ground and surface waters under scenarios of long-term application of biosolids at agronomic rates (Venkatesan and Halden 2013).
As mentioned in Section 3.7, the Trustees undertook a set of pilot-scale studies to investigate the potential for biosolids-based soil amendments to contaminate the environment with metals, nutrients, and certain pharmaceutical and personal care products that have been documented as entering the environment following biosolids land applications. The Trustees measured the run-off from a series of experimental plots in terrestrial areas with various manure amendments incorporated into the shallow soil (Figure 10A). The results of the run-off analysis for metal and nutrient concentrations were compared to the Missouri Aquatic Life Criteria levels as well as average levels recorded in Center Creek and Bens Branch.

Runoff from the plots treated with cattle manure/biosolids compost initially showed somewhat elevated levels of nutrients and metals one month after application, although the levels generally decreased by an order of magnitude within the first year. Concentrations of lead in the runoff samples generally exceeded levels measured in Center Creek and Ben's Branch, but were below the aquatic life criteria throughout the study duration. Concentrations of zinc and cadmium in runoff from the high application rate cattle manure plots exceeded the aquatic life criteria during initial sampling but in samples collected one year after application, concentrations of all constituents of concern were below the criteria. Concentrations of zinc in the cattle manure runoff were well below ambient levels measured in Center Creek and Bens Branch while levels of cadmium in the runoff occasionally exceeded the average levels in the creeks but were within the range of recorded values. There are no established criteria for total nitrogen or phosphorus levels, however one year after the amendments were applied, concentrations of nitrogen in the runoff were similar to those measured in Center creek and concentrations of phosphorus in the runoff were only slightly elevated above the range of ambient concentrations. Although certain PPCPs were detected in cattle manure/biosolids runoff samples including triclocarban, fluoxetine (Prozac), and various antibiotics, none of the concentrations detected exceeded any known biological effects thresholds published in the scientific literature.

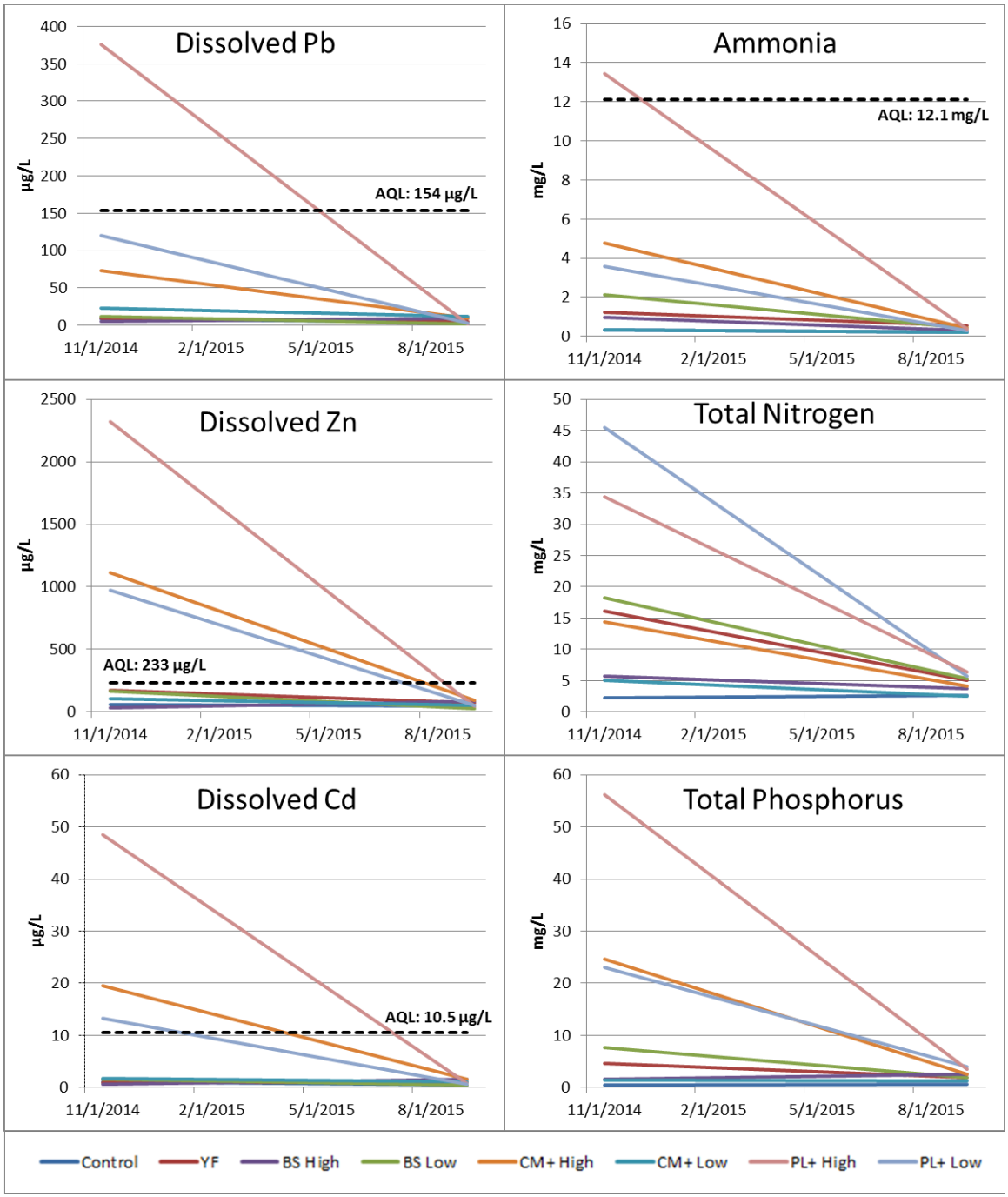

Figure 10. Temporal trends in dissolved metal and nutrient concentrations in runoff collected from compost treated plots. Missouri Chronic Aquatic Life Criteria (AQL), based on average parameters in Ben's Branch and Center Creek, are shown for comparison

The Trustees anticipate two applications of the cow manure+biosolids compost amendment, at most, will occur in the restoration areas within the Action Area. This would result in a total application rate of 8 tons/acre of biosolids over a three year period.

Following application of soil amendments, establishment of prairie and wetland vegetation is anticipated to stabilize soils and sediments and result in reduced mobilization of contaminants into nearby surface waters.

Figure 11. Example terrestrial upland (A) treatment plot and wetland tubs (B) used for pilot studies.

Similar to the above-mentioned upland pilot study test plots, the Trustees measured the runoff from several experimental tubs containing Action Area floodplain wetland sediments treated with various soil amendments (Figure 10B). Metals, nitrogen, and phosphorus concentrations in wetland tub treatment varied substantially. Phosphorus and total nitrogen concentrations from all treatment tubs exceeded values reported for Center Creek. Dissolved zinc concentrations from the cow manure+biosolids compost treatment exceeded water quality standards, but were below zinc concentrations measured in Center Creek. Lead concentrations from the cow manure-based compost treatment did not exceed water quality standards or surface water lead concentrations measured in Center Creek. Cadmium concentrations from the cow manure+biosolids compost treatment were below those measured from the control tub, and those measured in Ben's Branch but exceeded water quality standards as well as levels measured in Center Creek. Detectable concentrations of PPCPs in surface runoff samples from the cow manure+biosolids compost treatment did not exceed literature values associated with adverse effects in aquatic organisms.

Restoration activities (e.g. land application of compost or burning prairie) included in the Selected action could involve some localized soil/sediment disturbance that could temporarily affect ambient water quality adjacent to the restoration areas. BMPs would be implemented, as appropriate, to minimize the disturbance and/or local effect. These may include:

1. Halting use of heavy construction equipment during heavy rains;

2. Flagging authorized restoration areas to prevent impacts outside of designated areas;

3. Monitoring of vegetation regrowth to prevent excessive erosion in restored areas and implementation of corrective actions in areas identified as experiencing excessive erosion by overseeding or installation of straw bale barriers, straw wattles, or silt fence.

4. Buffer strips

Excess nitrogen is detrimental to soil, plants, and water, so care must be taken when choosing soil amendment application sites, selecting plant/crop types, and calculating the agronomic rate for biosolids land application. For this reason the Trustees have decided to not apply soil amendments closer than 50 feet to streams. It has been observed that the riparian corridors around Ben's Branch (where most restoration work will occur) are already well vegetated, and would therefore act as a buffer for the land application activities. Grassland buffer strips used alone or in conjunction with woody vegetation are effective at removing nitrogen. A 24-ft buffer was shown to reduce 80 percent of the total nitrogen and 62 percent of nitrate (Mayer et al. 2005) and there is a positive correlation between buffer width and the percentage of nitrogen removed. It should be noted that the most plant-available form of nitrogen in biosolids (ammonium ion (NH_4+)) is converted to nitrate (NO_3 -) by the composting process. Improper use of biosolids can result in the contamination of water resources with leached nitrogen, because nitrate is more mobile than ammonium, and is taken up less easily by plants. However, applying compost in accordance with the Part 503 Regulations poses little risk to the environment or public health (Fermante and Janes, 1997). In fact, the use of compost can have a positive impact on the environment in addition to the soil improving characteristics previously discussed. Reduced dependence on inorganic fertilizers can significantly decrease nitrate contamination of ground and surface waters often associated with use of inorganic fertilizers.

The impacts of this alternative on water quality are expected to be short-term, direct, minor and adverse.

4.2.2.4 Sediment Quality Impacts

As described in Section 4.2.1.2 Hydrology, BMPs would be implemented where appropriate to minimize erosion and sediment transport from restoration areas, including monitoring of erosion in restored areas and implementation of corrective actions in areas identified as experiencing excessive erosion by installation of straw bale barriers, straw wattles, or silt fence. There would be long-term direct beneficial impacts to sediment at restoration sites because the improved hydrology at these sites would mitigate surface scour during storm or flooding events and reduce instream transport of sediment into nearby waterways.

Management of invasive species and prescribed burns and fire management activities may result in minor temporary changes in sediment quality. Soil and sediment will be disturbed during physical removal of undesired vegetation in upland and aquatic areas, and vegetation burning may result in changes to soil and sediment composition. Disturbed areas at restoration areas would likely not need re-contouring since surface conditions are not anticipated to be altered substantially following invasive species

management activities or prescribed burns. Therefore, short-term impacts of these actions to sediment quality would be expected to be direct, minor and adverse, whereas long-term impacts would be anticipated to be direct and indirect, minor and beneficial.

4.2.2.5 Prime Agricultural Lands

There are no known prime agricultural lands in the Action Area.

4.2.3 Biological Impacts

4.2.3.1 Vegetation

Executive Order 13112 - Invasive Species calls for federal agencies to prevent the introduction of invasive species and provide for their control, and to minimize the economic, ecological, and human health impacts that invasive species cause.

Environmental Consequences
The Proposed action includes activities for management of invasive species. Surveys for invasive species and actions to control them, should they be present on restoration areas, would be performed.

Proposed activities on existing uncapped parcels would restore significant area(s) of prairie habitat, and to a lesser extent wetland habitat, that has been impacted by past mining activities and practices. Soil amendment applications, seeding/planting, invasive species management, and prescribed burns would directly impact plant communities in those areas. Following soil amendment application(s), vegetation would be restored by seeding or planting with species native to the Webb City area, followed by management activities to reduce potential occurrence of invasive plant species and optimize growth of native prairie species. Removal of invasive species would impact interrelated native vegetation in the treated areas. Application of herbicides and prescribed burns could impact native vegetation as well as invasive vegetation. Proper herbicide application and control of burns, however, would result in long-term benefits to native vegetation because these activities reduce competition by invasive vegetation. Habitat enhancement, through management of invasive plant species and revegetation with native vegetation, is anticipated to have a positive effect on biodiversity at restoration sites within the Action Area. Areas would be monitored after construction to identify and correct erosion that threatens revegetation. Activities to restore or improve habitat conditions could also potentially result in localized management of existing trees and shrubs as well as loss of vegetation due to flooding or desiccation.

As part of the set of pilot studies completed by the Trustees, diversity of prairie and wetland plants in response to application of several soil amendments was investigated. Wetland plant diversity data for the cow manure+biosolids compost treatment are not

available; therefore, results for both the biosolid-only compost and manure-only compost treatment groups are discussed briefly due to their similarity with the soil amendment that is associated with the Selected Action. The cow manure+biosolids compost treatment performed the best among soil amendment treatments as a substrate for prairie plant germination and survival based on the endpoint of overall diversity (accounting for # of species and evenness of represented species) and second best based on the endpoints of native species richness (# of species) and native species diversity. Results from a single growing season demonstrated that the cow manure-only and biosolids-only treatment groups (both low and high application rates) were among the best mediums for growing wetland plants as determined by wetland plant cover and relative abundance of seeded native wetland plants.

Metal uptake into upland prairie and wetland plants was also investigated as part of the pilot studies. Zinc and lead concentrations in upland prairie plants from the cow manure + biosolids compost treatment did not exceed background plant zinc and lead for the Action Area. Prairie plant cadmium concentrations from the cow manure+biosolids compost treatment exceed background cadmium concentrations, but should not pose risk to upland wildlife based on peer-reviewed literature-based toxicological thresholds. Wetland plants grown in mine-waste contaminated sediment mixed with soil amendments, including cow manure+biosolids compost as one of the treatments, did not accumulate metals in concentrations above average plant tissue metal concentrations measured for reference areas of Missouri. Lead, cadmium, and zinc concentrations measured in wetland and upland plants suggest negligible to low risk of potential toxicological effects in wildlife foraging on edible portions of plants.

Impacts to vegetation as a result of restoration activities would be short-term, direct, and minor. Benefits are anticipated to be long-term, both direct and indirect, and moderate to major.

4.2.3.2 Fish and Wildlife Resources

Fish and Other Aquatic Biota

As part of the pilot studies to investigate potential environmental impacts of soil amendment application within the Action Area, the Trustees completed Whole Effluent Toxicity tests to assess the aggregate toxicity to aquatic organisms from all pollutants contained in the run-off from upland treatment plots. In these tests, water fleas (*Ceriodaphnia dubia*) and fathead minnows (*Pimephales promelas*), standard test organisms for this types of test (40 CFR 136.3), were placed in an environmentally relevant dilution (12.5%) of the runoff for seven days. Growth and survival of larval minnows were unaffected by runoff from any of the soil amendments or bare-ground control, nor was the survival and reproduction of the water fleas. A stronger dilution (50% run-off) revealed significant reduction of growth in the minnows, and significant reduction of reproduction in the water fleas, in the bare-ground control and the poultry litter soil amendment. High survival and the highest growth of the minnows was observed

for the cow manure+biosolids treatment. In summary, data from the Whole Effluent Toxicity tests suggest that effects to fish and aquatic macroinvertebrates in receiving waters in the Action Area are unlikely to be observed following application of soil amendment, especially if BMPs are appropriately applied.

Proposed restoration activities completed as part of the Selected Action are anticipated to have negligible to minor adverse impacts to fish and other aquatic biota because aquatic biota populations are depressed in the vicinity of the restoration areas as a result of historical mining activities. Increased turbidity and sedimentation from construction activities could potentially cause gill-smothering that may suffocate individual fish and other aquatic biota at or in the vicinity of restoration sites in the Action Area, as well as cause temporary changes in animal behavior. Increased turbidity and sedimentation from construction activities may affect the ability of nearby filter-feeders to feed. Herbicide and soil amendment application has the potential to temporarily affect ambient water quality in the Action Area as a result of elevated water concentrations of herbicides and nutrients. However, these adverse impacts to fish and other aquatic biota would be short-term in nature and would be minimized by use of BMPs such as erosion control, the use of a certified pesticide applicator or the use of herbicides approved for use within wetlands. Use of seasonal restrictions during restoration activities would also occur where applicable to avoid impacts to species during sensitive life stages. Deployment of sediment barriers and sheet piling to minimize effects to sensitive aquatic species would also occur where applicable. Turbidity and sedimentation caused by construction activities should be minimal, localized and of short duration as particulates would settle out of the water column.

Reptiles and Amphibians

As part of the pilot studies to investigate potential environmental impacts of soil amendment application within the Action Area, the Trustees completed a soil exposure study with earthworms. Earthworms are typical test organisms (e.g., *Eisenia*) in standardized toxicity tests and ingest large amounts of soil, thereby being continuously exposed to contaminants through their alimentary canal (ie. gut). These contaminants can be accumulated by predators that feed on earthworms. Earthworms were exposed to upland remediated clay soils treated with the various soil amendments to analyze metals and PPCP uptake and estimate potential risk to predators that may consume contaminated earthworms. The treatments assessed included non-amended contaminated soil, poultry litter+biosolids amendment (low and high application rate), cow manure+biosolids compost (low and high application rate), composted yard waste and fertilizer, and biosolids (low and high application rates). All treatments showed a reduction in earthworm lead and zinc bioaccumulation when compared to the non-amended contaminated soil group. The two cow manure+biosolids compost treatments had a three-fold reduction in earthworm cadmium accumulation when compared to earthworms in the non-amended contaminated soil. In total, 10 PPCP constituents were detected in earthworm samples collected from all treatment groups. For the cow manure+biosolids compost treatment group, earthworms contained detectable concentrations of the antibiotic erythromycin and the antimicrobial triclocarban. Both of these compounds

have been observed to accumulate in earthworms inhabiting soils amended with biosolids, and the overuse of oral antibiotics and other antimicrobial products has been associated with the presence of antibiotic-resistant bacteria. Triclocarban contained in biosolids and released into the environment has also been shown to negatively affect organisms, however, the only treatment in the pilot study approaching these levels was the biosolids-only soil amendment (Sherburne et al. 2016).. Based on the data from the pilot study and available literature-based toxicological thresholds, it is unlikely that application of the cow manure+biosolids compost soil amendment would result in accumulation of PPCPs and metals in earthworms, or invertebrates with similar contaminant uptake potential, at concentrations potentially harmful to terrestrial and semi-aquatic predators, such as reptiles and amphibians.

Habitat for several species of reptiles (e.g., western painted turtle) and amphibians (e.g., Blanchard's cricket frog) occurs within the Action Area. Enhancement of upland, riparian, and wetland habitat through proposed restoration activities has the potential to benefit reptile and amphibian nesting and foraging within the Action Area. All species in the Action Area are mobile and can relocate during construction activities. BMPs would be followed to ensure a minimal number of individuals are impacted during construction, spraying, and prescribed burning. A shift in habitat conditions is anticipated to occur as result of the restoration actions and improve landscape scale habitat mosaics enhancing habitat suitability for many reptiles and amphibians. As a result, short-term, direct and indirect, minor, adverse impacts would be expected as a result of construction activities. Additionally, long-term, direct and indirect, moderate, beneficial impacts would be expected from the enhanced prairie, wetland, and riparian habitat, and improved water quality.

Birds

As previously mentioned in the subsection on *Reptiles and Amphibians*, the Trustees completed a soil exposure study with earthworms to investigate potential toxicity to wildlife that prey on contaminated earthworms. Earthworms and other soil invertebrates can be an important part of the diet of soil-probing birds, such as American robins. However, because composted cow manure+biosolids soil amendments tested in the pilot studies were shown to result in low accumulation of metals and PPCPs in earthworms, it unlikely that birds will be exposed to adverse levels of these contaminant types. In the case of triclocarban, which was shown to accumulate to low part per billion concentrations in earthworms, adverse impacts to avian reproductive success are not anticipated based on recent findings comparing concentrations of triclocarban with egg size, egg shell thickness, or nesting success in a soil-probing species (Sherburne et al 2016). Adverse effects are not anticipated in birds feeding on edible plant parts since neither upland prairie nor wetland plants accumulated potentially toxic concentrations of lead, cadmium, or zinc (see Section 4.2.3.1)

Restoration activities have the potential to provide enhanced habitat to terrestrial, aquatic, and semi-aquatic avian species over the long-term. Short-term and minor impacts, such as disturbance due to construction noise, to migratory birds during construction activities are

possible. Direct mortality to birds is not anticipated since birds are mobile and generally avoid human activities. All work areas would be inspected to ensure that migratory birds are not nesting in active work areas. The following guidelines would be used to ensure ground-disturbing activities do not result in the "take" of an active nest or migratory bird protected under the Migratory Bird Treaty Act:

a. Any ground-disturbing activities or vegetation treatments would be performed before migratory birds begin nesting or after all young have fledged to avoid incidental take;

b. If activities must be scheduled to start during the migratory bird breeding season, appropriate steps would be taken to prevent migratory birds from establishing nests in the potential impact area. These steps could include covering equipment and structures and use of various excluders (e.g., noise).

c. A site-specific survey for nesting birds would be performed starting at least two weeks prior to groundbreaking activities or vegetation treatments if activities need to be scheduled during the migratory bird breeding season.

d. If nesting birds are found during the survey, appropriate spatial buffers would be established around nests. Vegetation treatments or ground-disturbing activities within the buffer areas would be postponed until the birds have left the nest. Confirmation that all young have fledged would be made by a qualified biologist.

The **Migratory Bird Treaty Act (16 U.S.C. § 715, et seq.)** provides for the protection of migratory birds. The Act does not specifically protect the habitat of these birds but may be used to consider time of year restrictions for activities on restoration sites where it is likely migratory birds may be nesting and/or to stipulate maintenance schedules that would avoid the nesting seasons of migratory birds.

Environmental Consequences
Appropriate measures will be implemented to avoid impacts to migratory birds if future restoration activities under this plan are deemed to adversely impact them.

Therefore, short-term, direct and indirect, minor, adverse impacts would be expected during construction activities. Long-term, direct and indirect, and moderate to major beneficial impacts would be expected from the improved terrestrial habitat interconnections, enhanced terrestrial, wetland and riparian habitat, and improved water quality.

Mammals

As previously mentioned in the subsections on *Reptiles and Amphibians* and *Birds*, the Trustees completed a soil exposure study with earthworms to investigate potential toxicity to wildlife that prey on contaminated earthworms. Earthworms and other soil invertebrates can be an important part of the diet of some mammal species, such as deer

mouse. However, because composted cow manure+biosolids soil amendments tested in the pilot studies were shown to result in low accumulation of metals and PPCPs in earthworms, it unlikely that mammals will be exposed to adverse levels of these contaminant types. In the case of triclocarban, which was shown to accumulate to low part per billion concentrations in earthworms, adverse effects to mammals are not anticipated; however, there is limited information available for triclocarban concentrations measured in the tissues of free-ranging small mammals, including mammals exposed to biosolids. Assuming toxicity thresholds would be similar between free-ranging mammals and laboratory rodents, and there is similar mammalian toxicity for triclocarban and triclosan (there are no literature-based thresholds for triclocarban in mammals), adverse effects in mammals occupying the Action Area are not expected (Crofton et al. 2007; Zorrilla et al. 2009; Sherburne et al. 2016). Adverse effects are not anticipated in mammals feeding on edible plant parts since neither upland prairie nor wetland plants accumulated potentially toxic concentrations of lead, cadmium, or zinc (see Section 4.2.3.1)

Mammals such as raccoons, deer, and bats occupying restoration areas may be temporarily affected by construction or other habitat management activities. Heavy machinery, vegetation management, and other human disturbance may displace individuals or potentially even cause mortality. Direct impacts to mammal populations in restoration areas would likely be negligible or minor since mammals are mobile. Beneficial indirect impacts to mammals, such as through improving food chain dynamics, reducing contaminant uptake, and increasing vegetation cover would result from habitat restoration enhancement. The habitat restoration activities would improve habitat quality and potentially increase the habitat suitable for mammals that forage and rest in nearby areas. The Selected Action would result in short-term, direct and indirect, minor, adverse impacts to mammals within restoration areas. The Selected Action would also be expected to result in long-term, direct and indirect, moderate, beneficial impacts from the improved habitat interconnections, enhanced prairie, wetland, and riparian habitat condition, and improved water quality.

4.2.3.3 Rare, Threatened, Endangered, and Special Concern Species

As noted in Sections 4.1.2.3, many federal and state special status species have the potential to be present within or in the vicinity of the Action Area; however, currently there are no known federally threatened or endangered species and no critical habitat in the Action. Similar potential impacts as described previously in Section 4.2.3.2 would be anticipated for other special status species occurring in the Action Area.

Minor, temporary adverse impacts for special status species within the Action Area may result from actions involved in soil amendment applications, native species revegetation, management of invasives, and prescribed fire. Potential impacts include those generally described for Fish and Wildlife Resources above (See Section 4.2.3.2). Areas identified for restoration activities would be surveyed by trained biologist for special status species and methods or practices identified that can be used to avoid inadvertently impacting special status species. Short-term, direct and indirect, minor, adverse impacts would be expected to special status species as a result of restoration activities. Long-term, direct and indirect, moderate, beneficial impacts would also be expected from the improved habitat interconnections, enhanced prairie, wetland and riparian habitat, and improved water quality.

Additional reviews and documentation will be completed to address impacts, if any, to federally protected species from implementation of the Selected Alternative pursuant to Section 7 of the ESA. The Trustees will ensure that, to the extent possible, implementation of the Selected Alternative will have no effect on listed or special status species, and/or that any effects are mitigated consistent with federal and state laws.

Endangered Species Act directs all federal agencies to conserve endangered and threatened species and their habitats and encourages such agencies to utilize their authority to further these purposes. Section 7 of the Act requires that federal agencies consult with USFWS to minimize the effects of federal actions on endangered and threatened species.

Environmental Consequences
Currently there are no known federally threatened or endangered species and no critical habitat in the Action Area. However, the Trustees will still conduct necessary Section 7 consultations with USFWS prior to implementation of any restoration activity proposed under this plan that may have potential impacts to federally listed species occurring within or in the vicinity of the Action Area.

4.2.4 Socio-Economic Impacts

4.2.4.1 Aesthetics Impacts

Adverse effects to aesthetic and scenic qualities and values within the Action Area as a result of proposed restoration activities are anticipated to be minor. Aesthetic and scenic qualities and values that are important to recreationists would be reduced during active construction due to the presence of construction equipment. Aesthetic and scenic qualities and values associated with active restoration areas would be reduced due to the presence of equipment, for the duration of activities such as management of invasive species, and during and following prescribed burns. Changes in vegetation and other topographical features at these sites may also temporarily reduce aesthetic and scenic values. The Selected Action may also result in expanding or reopening areas with high aesthetic and scenic qualities to recreational users. Activities associated with soil amendment

application would be temporary and similar in type but to a lesser scale than remediation activities conducted by response agencies that have been ongoing in the vicinity of the Action Area. In the long-term, aesthetic and scenic qualities and values in the Action Area would likely be enhanced as a result of the Selected Action.

4.2.4.2 Noise Impacts

There would be a minor increase in noise levels at and in the vicinity of areas where restoration actions are proposed, for the duration of construction activities (e.g., hauling of soil amendments) from equipment, machinery, vehicles and laborers used. Some locations proposed for restoration activities are in relatively close proximity to residential areas. Wildlife in the vicinity of construction activities may be temporarily impacted by increased construction noise, but these impacts would be short in duration. Noise impacts would be short-term, adverse, and limited to active periods of construction between sunrise and sunset.

4.2.4.3 Recreational Impacts

The noise and aesthetics of construction equipment and vehicles associated with restoration activities, particularly movement and placement of soil amendments would be expected to decrease the quality of recreation experiences in the immediate vicinity of restoration areas. Any such effect would be limited to the period of application and should be minor. Once lands are restored, they would be available for public access and recreational use, in accordance with Webb City park regulations and guidelines. Over the long-term, restoration activities would be expected to increase the quality, productivity and quantity of prairie, wetland, and riparian habitat in the Action Area and to generally enhance recreational use and enjoyment of resources associated with the restored areas. There are limited opportunities for recreation in the Action Area due to historical contamination and on-going remediation and rehabilitation activities; however it is assumed that habitat conservation and improvement in the Action Area and management by Webb City has the potential to encourage recreational uses. Depending on the long-term plans for management by Webb City of the restored areas and other factors, new or improved access to resource-based recreational activities, such as bird watching or hiking on trails, and other similar activities, may result from the Selected Action.

4.2.4.4 Public Health and Safety

The Trustees do not anticipate an increased risk to the public of adverse health and safety effects from implementation of potential restoration activities under the selected alternative. The available literature suggests that the risk of human exposure to contaminants in biosolids is very low and may involve only those who work with biosolids such as land appliers and sludge workers (Clarke et al 2015). Very low risks associated with public exposure to other soil amendment contaminants, such as metals, are also anticipated since BMPs will be used to minimize airborne and water contaminants.

Projects involving construction and associated construction activities carry short-term risks to workers from the operation of heavy equipment and from the transport and handling of project equipment and materials. All restoration activities would be

conducted in accordance with applicable occupational safety regulations and laws, including state and local health and safety protocols and procedures, so as to ensure the safety of all workers and monitors.

Invasive species management, including herbicide application and prescribed burning, and revegetation activities are anticipated to have minor, short-term impacts to public health and safety. However, all herbicide application and prescribed burning will be conducted by, or under the supervision of, staff with appropriate certification, which would limit potential safety issues associated with these activities.

4.2.4.5 Transportation Impacts

Depending on the land management plans applicable to these city-owned restoration areas and other factors, the interest and ability of the public to access these areas for bird watching, hiking, and other similar activities may be enhanced and increased, and result in increased traffic in the vicinity of the future restoration site(s). It is currently unknown at this time, but new or improved public access to restoration areas may result in new or improved roads in the Action Area in the future. Because of the rural nature of potential restoration areas in proximity to populated areas, however, any increase in site-specific recreational use is expected to be minor.

Additional minor impacts to land-based transportation in the vicinity of Action Area are expected during period of soil amendment application. Trucks would be used to transport soil amendments and workers to restoration areas. Other materials necessary to perform prairie, wetland, and riparian restoration activities would need to be transported over roads. Existing transportation networks would be utilized as much as possible. Accordingly, transportation impacts would be short-term, episodic, indirect, adverse and minor.

4.2.4.6 Economic Impacts

Permanent public open space areas, if viewed as an improvement in quality of life, may have the effect of increasing nearby residential land values, and increases in recreational activity in the Action Area may result in increased local sales in food service, hospitality, and recreation-related industries. There are sufficient labor resources in the immediate area to support the level of habitat restoration activities proposed in the Action Area. Thus, the economic impacts of proposed land acquisitions and restoration activities under this alternative are expected to be long-term, direct and indirect, minor and beneficial.

4.2.4.7 Historic and Cultural Impacts

There are no known historical and cultural resources in restoration areas owned by Webb City within the Action Area. For parcels that are currently within the Action Area that are not owned by Webb City but may be purchased by the Trustees and transferred to Webb City, all restoration actions proposed in this plan will be subject to review under Section 106 of the National Historic Preservation Act of 1966 and NEPA, coordinated with the Missouri State Historic Preservation Office, and implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic

resources. The restoration activities described and included in the Selected Action are feasible to implement in this area without, or with only minimal, effects to any historic or cultural resources. The potential for impacts to historic and cultural resources is very location-dependent. Accordingly, under the Selected Action, a Phase I archaeological investigation and evaluation will be completed, if necessary, for any parcels prior to acquisition, as well as in the development and design of any future habitat enhancement activities that would be proposed under this plan. Under the Selected Action, future restoration activities will be planned to avoid impacts to identified historical and cultural resources.

4.2.4.8 EO 12898 Analysis

As noted above in section 4.1.3.2, Executive Order 12898 (Feb 11, 1994) requires each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations.

The Selected action includes prairie and aquatic restoration, encompassing a range of activities that are proposed for use to conserve and restore habitats within the Action Area that are key to enhancing the productivity of natural resources in order to meet the objectives of restoration under this plan. The preferred restoration alternative proposed in this plan, in general, does not create a disproportionately high and adverse effect on any minority or low-income populations. Further, the use of restoration funds to implement restoration would include spending and workforce support to design, engineer, manage, and carry out the projects and the purchase or lease of equipment and materials locally, and extend to downstream economic activity in the area. Such spending in the Action Area would generally be beneficial to local economies.

4.3 Cumulative Impacts

The CEQ regulations to implement NEPA require the assessment of cumulative impacts in the decision-making process for federal projects, plans, and programs. Cumulative impacts are defined as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions” (40 C.F.R. §1508.7). As stated in the CEQ handbook, “Considering Cumulative Effects” (CEQ 1997), cumulative impacts need to be analyzed in terms of the specific resource, ecosystem, and human community being affected and should focus on effects that are truly meaningful.

The cumulative effects analysis of the Selected Action in this Final RP/EA is commensurate with nature and the degree of direct and indirect effects anticipated from implementation of the proposed restoration activities. For the purpose of this analysis, the cumulative impact spatial boundary includes the Action Area (Figure 1) since that is where restoration actions described as part of the Selected Action could likely occur. The Selected Action includes one restoration alternative, encompassing primary activities of soil amendment application, native vegetation seeding and planting, invasive plant

management, and prescribed burning, all of which are intended to conserve and restore habitats within the Action Area in order to compensate the public for past Site-related injuries and losses to trust resources and services. The Selected Action is anticipated to result in predominantly beneficial impacts to those same resources and services, to help return injured natural resources to baseline conditions, and to compensate for interim losses.

4.3.1 Past, Current, and Foreseeable Future Projects

Remediation activities that have been pursued by the EPA within the Action Area include sub-aqueous disposal of mine wastes, removal of contaminated soil in residential yards, capping with topsoil, and the application of biosolids. Cleanup of mine waste was initiated in 2007, with a completion date of around 2020, and includes removal of approximately 7 million cubic yards of waste as of August 9, 2016.

In the past and currently, the wastewater treatment plant in Webb City has been drying wastewater sludge, then hauling it to a hazardous waste landfill in Lamar (Lamb 2014). The hauling of the sludge has contributed to large truck emissions and local traffic, including potential noise impacts.

A current and future project by Webb City to acquire lands around the wastewater treatment plant, and along Center Creek, will allow them to maintain the sludge onsite and filter water through the manmade wetlands to eliminate zinc. It will also create wildlife habitat and allow for recreational activities such as a trail system and picnic areas (Lamb 2014, Pound 2015 & 2016). Cumulatively, the wastewater treatment activities and wetland creation and enhancement have the potential to decrease carbon emissions from the local area, provide wetland habitat for wetland-dependent organisms, and improve water quality entering into Center Creek

4.3.2 Summary of Cumulative Impacts

4.3.2.1 No Action Alternative

The No Action Alternative would have a cumulative impact that is long-term and adverse. Several hundred acres would remain disturbed, further contributing to the contamination of surface water and wetlands. No habitat will be restored, and in some cases may continue to degrade. Recreation opportunities in contaminated soils and water will remain limited.

4.3.2.2 Alternative 4 (Preferred)

Alternative 4 would have a cumulative impact that is long-term, and beneficial. Terrestrial and aquatic habitat will be restored or enhanced after potential minor short-term impacts to water quality. Wetlands will be created or enhanced, thereby providing additional habitat for fish and wildlife. Terrestrial habitat conditions will improve as a result of improved soil fertility and prairie restoration and water quality in Ben's Branch and Center Creek should improve over the long-term. Recreational opportunities will be created or enhanced as a result of the improved environment within the Action Area.

5.0 MONITORING FRAMEWORK AND ADAPTIVE MANAGEMENT

5.1 Monitoring Framework

The Trustees have outlined a monitoring framework for proposed restoration activities. In general, comprehensive evaluation of restoration is uncommon, and thus, future restoration within the Cardinal Valley Natural Habitat Restoration Project presents an opportunity to utilize a standard monitoring framework to collect data that will inform the ongoing project success (Roni 2005). Ultimately, the outcomes of restoration projects, as determined through monitoring data, will assist the Trustees in determining the best ecological techniques and the most appropriate geological and/or climatological conditions in which to focus projects.

Monitoring plans will be guided by performance criteria, or measures that assess the progress of restoration sites toward restoration goals. In this way, the Trustees will be able to determine which project attributes are not on target, and what actions and course corrections are needed to achieve project success. Monitoring information may also be used by the Trustees as an outreach tool to illustrate to the public continued success over time (quantitatively and qualitatively). Support for future restoration-based programs may increase due to increased public outreach (Roni 2005).

Various types of monitoring exist to answer different questions (Roni 2005; Williams et al. 1997). The most appropriate type of monitoring is decided on a project-specific basis,

and is influenced by the question to be answered, the expertise of the partner, and the overall need in order to reach restoration goals.

- **Baseline monitoring** is designed to characterize the specific condition of the habitat prior to restoration implementation. It should be adequate enough to document habitat degradation specific to the goals and objectives of the restoration program, and will likely include photographing the restoration site. In many cases, this information is collected as part of normal project operations.
- **Implementation monitoring** helps determine if the restoration effort was implemented properly. Implementation monitoring may focus on the field techniques used, and can inform contract specifications and management plans. Implementation monitoring may be undertaken during the course of project maintenance and management.
- **Effectiveness monitoring** focuses on whether the restoration action was effective in attaining the desired future conditions and in meeting restoration objectives. Effectiveness monitoring answers, for example, whether target organisms are responding to restoration as expected, or if the habitat was restored to its proper function. This type of monitoring is more complex than implementation monitoring and requires an understanding of physical and biological factors. Sometimes effectiveness monitoring can be accomplished with qualitative methods (e.g., through site descriptions) rather than more quantitative methods. This information is often some of the most useful in illustrating how a particular restoration program is working.
- **Validation monitoring** is rigorous and specialized, and verifies assumptions made in the course of effectiveness monitoring. It is usually accomplished through ecological research. Effectiveness and validation monitoring together are specifically needed to evaluate adaptive management designs.

Table 13 is an example of a generic monitoring framework that the Trustees will utilize for the Cardinal Valley Natural Habitat Restoration Project. The following are components of a project-specific monitoring plan: the details of the monitoring action outlined in a step-wise manner, the performance standards, the organization or person responsible for monitoring, and the associated schedule and timing of monitoring actions.

5.2 Adaptive Management

The concept of adaptive management is broadly considered here to be the systematic improvement of resource management through iterative learning from project outcomes (for more information, see Murray and Marmorek (2003) and Williams and Brown (2012)). Adaptive management is a tool that synthesizes monitoring data and analyzes it against performance standards in order to maximize the benefits of the current project, as well as increase the design effectiveness of future watershed and habitat restoration efforts (O'Donnell and Galat 2008; Williams 2011).

Table 13. General Monitoring Framework

Monitoring Components	MONITORING STEP			
	Pre-Project Monitoring	**Implementation Monitoring**	**Short-term Effectiveness Monitoring**	**Validation Monitoring**
OBJECTIVE: What is the objective of the monitoring step?	Document pre-construction conditions.	Document if the project implementation occurred according to design plans.	Document if the main ecological or human-use outcome was achieved.	Document if the main ecological or human use outcome persists into the future.
MONITORING PLAN: Describe the monitoring plan.	For each monitoring step, describe the approach, methods, and amount of data that will be collected and assessed. This will be specific to each selected project.			
PERFORMANCE STANDARDS: What are the performance standards?	For each monitoring step, include a specific performance criterion to evaluate progress as monitoring progresses.			
ORGANIZATIONS: Who is responsible for the monitoring step?	For each monitoring step, record the person or organization that is responsible for conducting the monitoring as well as any related assessment or analysis of monitoring data.			
SCHEDULE: How does monitoring fit into the project schedule?	For each monitoring step, outline a schedule for completion of monitoring tasks. In general, pre-project monitoring will occur before restoration begins; implementation monitoring will occur immediately following the completion of restoration actions; and short-term effectiveness and validation monitoring will use time frames specific to each selected project.			

The Trustees have both restoration planning experience and an available body of literature documenting best practices for soil amendment application, prairie restoration, and wetland restoration. Moving forward with restoration projects, the Trustees will ensure long-term success by implementing standard procedures to assess whether intermediate milestones are met or whether the technical parameters need to be altered to ensure project success. The Trustees plan to efficiently allocate monitoring funds on a project-specific basis to ensure that a relevant and cost effective type of monitoring is chosen for each project.

Table 14. Appropriate floodplain forb and grass species for restoration work in Webb City.

Floodplain Forbs		**Floodplain Grasses**	
New England Aster	*Symphyotrichum novae-angliae*	River Oats	*Chasmanthium latifolium*
Sweet Black Eyed Susan	*Rudbeckia submentosa*	Beaked Rush	*Rhynchospora globularis*
Brown Eyed Susan	*Rudbeckia triloba*	Short's Sedge	*Carex shortiana*
Cardinal Flower		Yellow Fox Sedge	*Carex vulpinoidea*
Plains Coreopsis	*Coreopsis tinctoria*	Virginia Wild Rye	*Elymus virginicus*
Culvers Root	*Veronicastrum virginicum*		
Southern Blue Flag	*Iris virginica*		
Blue Lobelia	*Lobelia siphilitica*		
Seed Box	*Ludwigia alternifolia*		
Ohio Spiderwort	*Tradescantia ohiensis*		
Swamp Milkweed	*Asclepias syriaca*		
Shining Blue Star	*Amsonia illustris*		
Cup Plant	*Silphium perfoliatum*		

Table 15. Appropriate upland forb and grass species for restoration work in Webb City.

Upland Forbs		Upland Grasses	
Common Spiderwort	*Tradescantia ohiensis*	Big Bluestem	*Andropogon gerardii*
Blue Vervain	*Verbena hastata*	Eastern Woodland Sedge	*Carex blanda*
Brown-eyed Susan	*Rudbeckia triloba*	Virginia Wildrye	*Elymus virginicus*
Gray-headed Coneflower	*Ratibida pinnata*	Little Bluestem	*Schizachyrium scoparium*
Golden Alexander's	*Zizia aurea*	Prairie Cordgrass	*Spartina pectinata*
New England Aster	*Symphyotrichum novae-angliae*	Common Threesquare	*Schoenoplectus pungens*
Partridge Pea	*Chamaecrista fasciculata*	Indiangrass	*Sorghastrum nutans*
Tall Thoroughwort	*Eupatorium altissimum*	Purpletop Tridens	*Tridens flavus*
Wild Bergamot	*Monarda fistulosa*	Switchgrass	*Panicum virgatum*
White Wild Indigo	*Baptisia alba*	Canada Wildrye	*Elymus canadensis*
Pale Beardtongue	*Penstemon pallidus*	Side Oats Grama	*Bouteloua cirtipendula*
Slenderleaf False Foxglove	*Agalinis tenuifolia*		
Tall Blazing Star	*Liatris aspera*		
Sneezeweed	*Helenium autumnale*		
Rattlesnake Master	*Eryngium yuccifolium*		
Saw-tooth Sunflower	*Helianthus grosseserratus*		
Swamp Milkweed	*Asclepias syriaca*		
Illinois Ticktrefoil	*Desmodium illinoense*		
Common Milkweed	*Asclepias syriaca*		
Purple Prairie Clover	*Dalea purpurea*		
Purple Coneflower	*Echinacea purpurea*		
Butterfly Milkweed	*Asclepias tuberosa*		

6.0 BUDGET AND TIMELINE

A tentative timeline for additional restoration planning, implementation, and monitoring is provided below (Figure 13). The Trustees anticipate using approximately 25% of the total available Jasper County restoration funds on acquisition of land, and approximately 15% on the restoration of uncapped lands. The remainder of funds will be spent on restoration design, permitting, project operation and maintenance, and monitoring, as well as capped land restoration and aquatic restoration.

Figure 12. Tentative restoration planning, implementation, and monitoring timeline for the Cardinal Valley Natural Habitat Restoration Plan.

7.0 AGENCIES, ORGANIZATIONS, AND PARTIES CONSULTED FOR INFORMATION

City of Webb City

200 S Main St

Webb City, MO 64870

Missouri Department of Conservation

2901 W. Truman Blvd.

Jefferson City , MO 65109

USEPA (Mark Sprenger)

Raritan Depot

2890 Woodbridge Avenue

Edison, NJ 08837-3679

8.0 REFERENCES

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APPENDIX A: UNIVERSITY OF MISSOURI EXTENSION BEST MANAGEMENT PRACTICES FOR BIOSOLIDS LAND APPLICATION

The following document will guide the Trustees and their partners in planning the land application of soil amendments on restoration sites:

Arnold K, Dunn J, and Carpenter J. Best Management Practices for Biosolids Land Application. Revised August, 1994. Available online http://extension.missouri.edu/p/WQ426

Best management practices, or "good farming practices," include agronomic load rates, buffer zones, depth to groundwater, wetlands protection, harvest and grazing deferments, threatened and endangered species protection, field slope limitations, restrictions for frozen or saturated soils, requirements for public-use sites, soil conservation practices and other site restrictions.

The following list of practices is based on the regulations and standard permit conditions:

1. **No discharge**

Biosolids must not discharge from the application site, except during catastrophic or chronic precipitation exceeding the 1-in-10 year rainfall level.

2. **Public contact sites and public-use or distribution of biosolids**

- Class A biosolids applied to public-use sites, distributed for general public use or used on vegetable crops, root crops or home gardens must comply with 40 CFR 503 Subpart B.
- A biosolids management plan or engineering report for Class A biosolids used on public sites must be approved by the DNR before use or distribution.
- Do not apply Class B biosolids to public contact areas, residential lawns or turf farms unless the biosolids are incorporated. Restrict public access for 12 months. You must gain approval from the permitting authority.

3. Crop restrictions

Do not apply Class B biosolids to root crops, home gardens or vegetable crops whose edible parts will come in contact with applied biosolids, unless the crops are not used for direct human consumption.

4. Harvest and grazing restrictions

Do not apply biosolids to land within 30 days of harvest or grazing by cattle. Applicators are also subject to requirements of the Missouri Department of Agriculture State Milk Board concerning grazing restrictions of lactating dairy cattle.

5. Threatened or endangered species

Applying biosolids must not adversely affect a threatened or endangered species or its designated critical habitat. This is in accordance with section 4 of the Endangered Species Act.

6. Nitrogen limitations

Do not apply more than the agronomic rate of nitrogen needed.

- The applicator must document the Plant Available Nitrogen (PAN) loadings, available nitrogen in the soil and crop removals, unless the following conditions are met:
    - Nitrogen content of the biosolids does not exceed 50,000 milligrams per kilogram of total nitrogen on a dry weight basis; and
    - Biosolids application rate is less than two dry tons per acre per year.
- Report nitrogen compounds as nitrogen in the PAN calculations. Calculate PAN as follows:

(Nitrate + nitrite nitrogen) + (organic nitrogen x 0.2) + (ammonia nitrogen x volatilization factor)

The volatilization factors are 0.7 for surface application and 1 for subsurface injection.

- You may use alternate PAN calculations if documented by site-specific data and prior approval is obtained from the DNR.
- If you use the University soil test laboratory, the soil test report will provide the net nitrogen to apply for a specific crop and yield goal. If you use a private soil test laboratory, the available nitrogen in the soil must be determined and subtracted from the nitrogen application requirements.

7. Buffer zones

Do not apply biosolids within:

- 300 feet of a water supply well, sinkhole, lake, pond, water supply reservoir or water supply intake in a stream;
- 300 feet of a losing stream, no-discharge stream, stream stretches designated for whole body contact recreation, wild and scenic rivers, Ozark National

Scenic Riverways or outstanding state resource waters as listed in the Water Quality Standards, 10 CSR 20-7.031;

- 150 feet of dwellings;
- 100 feet of wetlands or permanent flowing streams;
- 50 feet of a property line or other waters of the state, including intermittent flowing streams.

8. Slope limitations for application sites

- On slopes of 0 to 6 percent, there is no rate limitation
- On 7 to 12 percent slopes, you may apply biosolids when soil conservation practices are used to meet minimum erosion (T) levels in accordance with U.S. Soil Conservation service recommendations.
- For slopes of 12 percent or more, apply biosolids only when the site is maintained in grass vegetation with at least 80 percent ground cover. Do not apply more than two dry tons per acre per year.

9. Storm water runoff

- Do not place biosolids in a location where it is reasonably certain that pollutants will be transported into waters of the state during stormwater runoff.
- Subsurface inject the biosolids, incorporate after application, use soil conservation practices, adhere to slope restrictions, create buffer areas and follow other approved methods, as necessary.
- Soil conservation practices for application must be approved by the U.S. Soil Conservation Service or MU Extension.

10. Frozen, snow-covered or saturated soil conditions

Do not apply biosolids when the ground is frozen, snow covered or when the soil is saturated, unless site restrictions or other controls are provided to prevent pollutants from being discharged during snowmelt or storm water runoff. If land application is necessary during inclement weather, use sites which meet the following:

- A maximum field slope of 6 percent and a minimum 300 feet grass buffer between the application site and waters of the state.
- A maximum field slope of 2 percent and 100 feet grass buffer between the application site and waters of the state.
- Other best management practices approved by the DNR.

11. Biosolids storage

- Provide adequate sludge and biosolids storage as needed to match the application windows for cropplanting, harvesting and inclement weather conditions. Operate storage basins so there is no discharge to waters of the state.
- Recommended biosolids storage for grassland sites ranges from 60 to 120 days as follows: 60 days south of Highway 60; 75 days between Highway 60 and Highway 50; 90 days between Highway 50 and Highway 36; and 120 days north of Highway 36.
- Storage should be increased for tilled cropland application sites depending on the crop rotations and ratio of tilled land to grassland. Recommended storage is 180 to 365 days if all sites are tilled cropland.
- Any storage area located off-site of the sludge or biosolids generating facility must have a separate individual permit for the storage site, except for temporary stockpiles.
- Use temporary stockpiles for solid or semi-solid materials (no free liquids) only. Limit the stockpile to two weeks per year at any one application field. Locate stockpiles at least 300 feet from drainage ways or they must have runoff collection berms at least 6 inches high around the pile.

12. Application rates

Evenly spread the biosolids over the entire application site. Do not dump the material in batches or spread a pile using a blade, disc or similar equipment.

13. Application equipment

Properly operate and maintain application equipment. Visually check the equipment each day during operation. Apply biosolids during daylight hours only, unless approval is obtained from the permitting authority.

14. Soil pH limitations

Do not apply biosolids to sites with a soil pH less than 6.0 or greater than 7.5 (based on the salt solution test, which is preferred) or less than 6.5 or greater than 8.0 (based on the water solution test).

Application of biosolids to higher pH soils may be considered on a case-by-case basis. Submit a site-specific permit application and supporting document, addressing crop and groundwater protection, to DNR. Tracking of aluminum loading rates will be required. See Table 4 in MU publication WQ425, Biosolids Standards for Metals and Other Trace Substances.

15. Soil phosphorus limitations

Do not apply biosolids to soils that contain more than 800 pounds of available phosphorus, based on the Bray P-1 test, unless approval is obtained from the permitting authority DNR.

16. Soil depth

Do not apply biosolids to sites that have less than 5 feet of soil above bedrock or a groundwater aquifer, unless authorized in a site-specific permit for the application site.

17. Record keeping

Sludge applicators must keep detailed records for at least five years on each location and amounts ofbiosolids applied.

Landowners are not required to keep records. However, it is highly recommended that biosolids application records be incorporated into your total nutrient management plan.