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BUREAU OF LAND MANAGEMENT

DRAFT

Programmatic Environmental Impact Statement Addressing Vegetation Treatments Using Herbicides

March 2023

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Draft
Programmatic Environmental Impact Statement Addressing Vegetation Treatments Using Herbicides

March 2023

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ACRONYMS AND ABBREVIATIONS

Acronym	Full Phrase
ACCase	acetyl-CoA carboxylase
ALS	acetolactate synthase
BLM	United States Department of the Interior, Bureau of Land Management
CWA	Clean Water Act of 1972
DNA	Determination of NEPA Adequacy
DOI	United States Department of the Interior
EIS	environmental impact statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act of 1973
HHERA	human health and ecological risk assessment
HQ	hazard quotient
K_{oc}	organic carbon-water partitioning coefficient
NEPA	National Environmental Policy Act
NVCS	National Vegetation Classification Standard
PEIS	programmatic environmental impact statement
PPG	oxidase or Protox Protoporphyrinogen Oxidase
PPO	protoporphyrinogen oxidase
SME	subject matter expert
SOP	standard operating procedure
US	United States
USFWS	US Fish and Wildlife Service
WSSA	Weed Science Society of America

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Chapter 1. Introduction

1.1 SUMMARY

1.1.1 Background

Noxious weeds and invasive plants pose an ever-increasing threat to the integrity of our public lands and the many ecological services they provide by outcompeting native vegetation and by acting as hazardous fuels that contribute to the frequency and severity of wildfires. This problem of increasing weeds and wildfires has been exacerbated by climate change, which has resulted in higher temperatures and increased droughts (Jolly et al. 2015, Westerling et al. 2006). More wildfires facilitate the spread of invasive annuals, which results in positive feedback between wildfire and grasses (D'Antonio and Vitousek 1992). Further, potential climatic shifts may enhance the spread of invasive annuals such as cheatgrass into resistant ecosystems (Bradley et al. 2016). Protection of healthy, intact ecosystems provides the associated native plants and animals a better opportunity to persist and adapt compared with ecosystems that have already been converted to invasive annual grasses. Accordingly, effective management of noxious and invasive plants is essential in maintaining ecological health on the 247 million acres administered by the BLM. The application of herbicides and their active ingredients to control these threats is an essential tool in that effort.

This programmatic environmental impact statement (PEIS) analyzes the BLM's use of seven additional active ingredients on all BLM-administered lands. Partnerships with other federal, state, and local agencies, as well as organizations and private landowners, have been instrumental in making progress to manage invasive annuals. These partner agencies and groups have been using these additional active ingredients, such as indaziflam, on lands not administered by the BLM. The impact of these partnerships across jurisdictional boundaries may be limited if the BLM cannot use, on BLM-administered lands, the same active ingredients as its partners.

Note that within this PEIS, the term "active ingredient" is used to describe a specific chemical that could be used to control vegetation. The term "herbicide" is used more broadly when discussing the general use of chemicals for vegetation control and may be used to denote a specific trade name or commercial formulation.

1.1.2 Purpose and Need

Currently, the BLM uses 21 different active ingredients, as authorized by Records of Decisions for two different PEISs from 2007 and 2016. Several additional active ingredients have entered the market and have been assessed for human health and ecological risk. These active ingredients would benefit the BLM's weed control capability by increasing herbicide treatment options to better target problematic weeds, reduce impacts on nontarget species, and help prevent weed-developed herbicide resistance that can result from repeated use of the same active ingredients.

The BLM's purpose is to improve the effectiveness of its invasive plant treatment efforts by allowing the use of EPA-registered active ingredients not currently authorized for use on BLM-administered lands. This action would increase the BLM's treatment options for the public lands it administers. The overall goals are to control noxious weeds and invasive plants to restore degraded habitat and reduce the risk of further ecological damage across BLM-administered lands.

1.1.3 Scoping and Issues

The BLM began a 30-day public scoping comment period on April 4, 2022, with the publication of the notice of intent in the Federal Register. The BLM received a total of 19 submissions during the scoping period. Scoping comments can be found in the project record. The BLM developed and analyzed six issues related to this proposed effort.

1.1.4 Alternatives

No Action Alternative: This alternative describes an integrated vegetation management program for resource management and habitat enhancement using the 21 active ingredients approved in the 2007 and 2016 Records of Decisions to manage competing and unwanted vegetation. This alternative corresponds to Alternative B of the 2016 PEIS, which estimated that approximately 932,000 acres in the western US would be treated annually using active ingredients.

Preferred Alternative: Under the preferred alternative, the BLM would add the proposed active ingredients to its suite of tools for vegetation management. The new active ingredients would be integrated into the BLM's vegetation treatment activities. They could be used throughout BLM-administered lands, subject to applicable restrictions on their usage, such as those identified on the individual pesticide label and restrictions by each state's pesticide regulatory agency. Site-specific analyses and authorizations would be required prior to on-the-ground use of the new active ingredients.

1.1.5 Summary of Environmental Impacts

A more specific discussion of environmental impacts is provided in Chapter 3.

How would the application and use of proposed active ingredients affect nontarget plant species, including special status plants?

Short-term adverse effects to non-target vegetation and risks to sensitive species and populations include death, reduced productivity, and abnormal growth from unintended contact with chemicals via drift, runoff, wind transport, or accidental spills and direct spraying. The efficacy of some herbicide treatments could be improved through use of the proposed active ingredients, which may be more effective at managing target species than currently approved active ingredients and may improve control of populations that have developed or have the potential to develop a resistance to currently approved active ingredients.

How would the application and use of proposed active ingredients affect the potential for herbicide resistance?

Under the proposed action, the BLM would be able to respond appropriately with the use the proposed active ingredients and therefore more effectively manage weeds. The new active ingredients would provide additional treatment options and would reduce the potential for herbicide resistance.

How would the application and use of proposed active ingredients affect soil microbiology?

The proposed active ingredients are not known to cause substantial impacts to soil or soil organisms. With the addition of the proposed active ingredients, there may be a reduction in use of active ingredients that are relatively persistent in the soil.

How would the application and use of proposed active ingredients affect water quality?

The proposed action allows for a wider range of active ingredients options, allowing the BLM to make better decisions and potentially reducing localized impacts on water quality. The seven active ingredients have a wide range of mobility and potential to enter surface and groundwater. However, none of the seven active ingredients are listed on the EPA's National Primary Drinking Water Regulation's contaminant list and the implementation of prevention measures and Standard Operating Procedures reduces the opportunity for inadvertent herbicide application into water bodies.

How would the application and use of proposed active ingredients affect pollinator habitat?:

The potential effects on pollinators and pollinator habitat would potentially include death, reduced productivity, and abnormal growth from unintended contact with chemicals via drift, runoff, wind transport, or accidental spills and direct spraying. Using active ingredients with different modes of action would increase weed treatment effectiveness, helping maintain vegetation community structure and function, which would improve pollinator habitat and potentially reduce nontarget plant species impacts.

How would the application and use of proposed active ingredients affect fire risk across the landscape?

The use of the seven active ingredients would allow BLM managers more options in choosing active ingredients to best match treatment options with particular site conditions, thereby increasing the opportunities to reduce fire risk and facilitate the restoration of historic fire regimes. In addition, the ability to use these seven active ingredients would provide the BLM more options to best match treatment options with particular site conditions and reduce the likelihood for herbicide resistance, which would likely improve treatment effectiveness and reduce hazardous fuels.

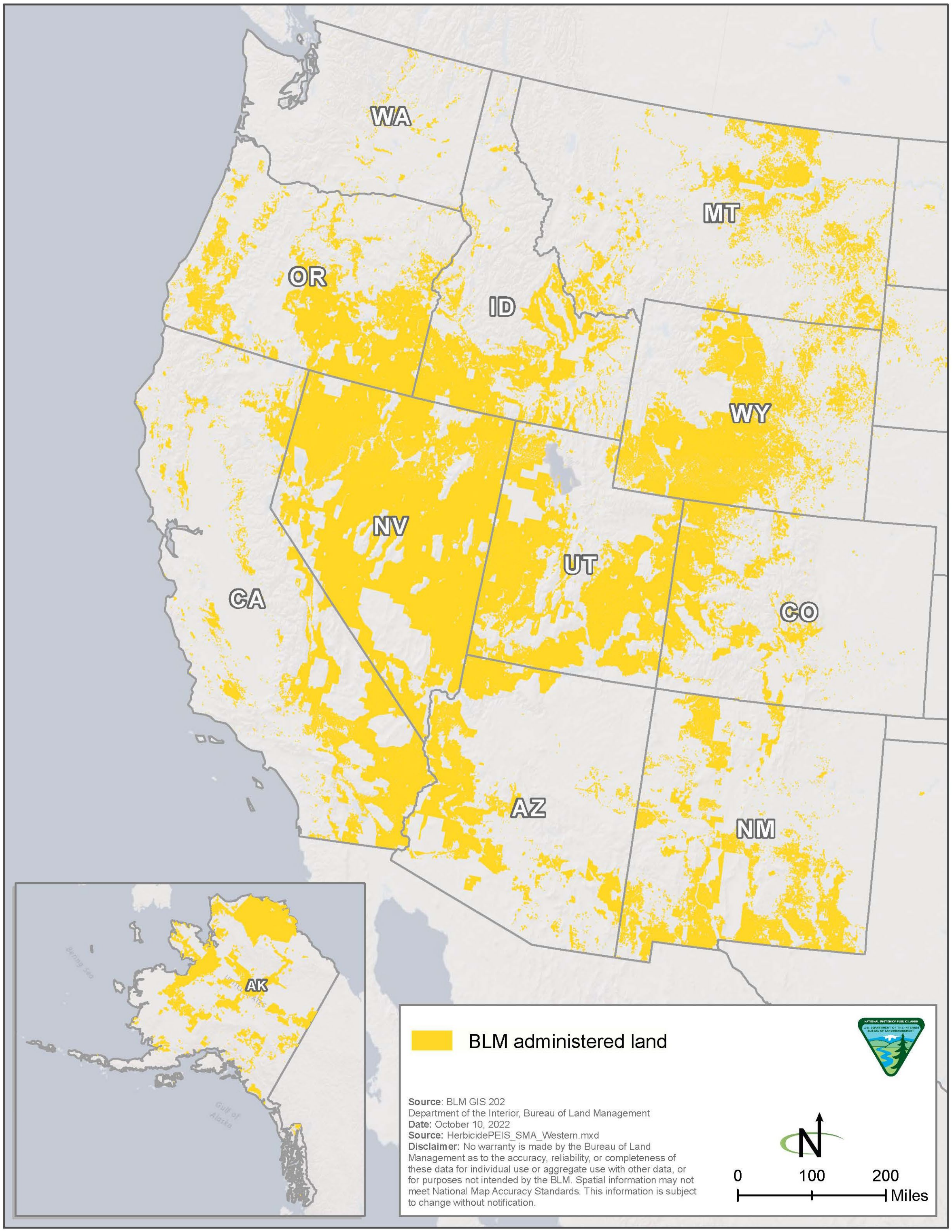
1.2 INTRODUCTION

The United States (US) Department of the Interior (DOI) Bureau of Land Management (BLM) administers approximately 247 million acres in 29 states in the continental US and Alaska. This programmatic environmental impact statement (PEIS) analyzes the BLM's use of seven additional active ingredients on all BLM-administered lands.

Map 1-1 shows the BLM-administered lands in the western US and Alaska. In addition to the 17 western states included in the 2016 PEIS, this PEIS includes the approximately 11,000 surface acres that the BLM administers in the eastern US (hereafter referred to as the "eastern states lands") (**Table 1-1**). Due to the dispersed and small nature of the BLM-administered surface land parcels in the eastern states, they are not shown on a map.

An environmental impact statement (EIS) is required to assess the impacts associated with the BLM's use of proposed active ingredients. Any proposed active ingredients considered for use by the BLM must be registered under the Federal Insecticide, Fungicide, and Rodenticide Act through the Environmental Protection Agency (EPA). Additionally, as a result of a 9th Circuit US Court decision, the BLM and United States Forest Service are required to complete a human health and ecologic risk assessment (HHERA) of individual active ingredients prior to being analyzed and approved for use by these agencies. The associated HHERA are available online at the BLM's ePlanning website for this project. Appendix E of the 2007 PEIS details the protocol for identifying, evaluating, and using new active ingredients.

Map 1-1. BLM-Administered Lands in the Western US and Alaska



Source: BLM GIS 2022

Table 1-1
BLM-Administered Lands in the Eastern US

State	Acres[1]
Alabama	180
Arkansas	1,030
Florida	370
Illinois	20
Louisiana	690
Michigan	530
Minnesota	4,990
Mississippi	260
Missouri	50
Virginia	710
Wisconsin	2,380
Total	11,210

Source: BLM GIS 2022
[1] Note: Acres founded to the nearest 10.

1.3 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

Noxious weeds and invasive weeds pose an ever-increasing threat to the integrity of our public lands and the many ecological services they provide by outcompeting native vegetation[1] and by acting as hazardous fuels that contribute to the frequency, extent, and severity of wildfires. Accordingly, effective weed management using the principles of integrated pest management is essential in maintaining ecological health on the 247 million acres administered by the BLM. Active ingredients are an essential tool in that effort.

Currently, the BLM is allowed to use 21 different herbicide active ingredients as authorized by Records of Decision from 2007 and 2016, herein referred to as the "2007 PEIS" and "2016 PEIS," respectively (BLM 2007a and BLM 2016a, see Table 2-2, p. 2-5 in BLM 2016b for active ingredients approved for use on public lands). Several additional active ingredients have entered the market and have been assessed for human health and ecological risk. These active ingredients would benefit the BLM's weed control capability by increasing herbicide treatment options to better target problematic weeds, reduce impacts on nontarget species, and help prevent weed-developed herbicide resistance that can result from repeated use of the same active ingredients.

The BLM's purpose is to improve the effectiveness of its invasive plant treatment efforts by allowing the use of EPA-registered active ingredients not currently authorized for use on BLM-administered lands. This action would increase the BLM's herbicide treatment options for the public lands it administers. The overall goals are to restore degraded habitat and reduce the risk of further damage by controlling noxious weeds and invasive plants across BLM-administered lands.

1.4 SCOPE OF ANALYSIS AND DECISIONS TO BE MADE

The scope of the analysis and the decisions to be made are the same as described in the 2016 PEIS (BLM 2016b pp. 1-2, 1-3) with the addition of approximately 11,000 acres of BLM-administered lands in the eastern states that would be included in this effort.

[1] For the purposes of this analysis, the term vegetation includes species in the plant kingdom as well as fungi and lichens.

1.5 PUBLIC INVOLVEMENT

1.5.1 Public Scoping

The BLM began a 30-day public scoping comment period on April 4, 2022, with the publication of the notice of intent in the *Federal Register*. The BLM received a total of 19 submissions during the scoping period. Scoping comments can be found in the project record.

1.6 ISSUES

The BLM conducted internal scoping by gathering an interdisciplinary team of specialists to review the 2007 and 2016 PEISs. This team then identified new issues for analysis associated with this effort and issues that may need updating from the previous PEISs. Then, after public scoping, the BLM reviewed all public comments and identified substantive ones—those that provide relevant and new information with sufficient detail. The substantive comments informed the development of issues for the analysis. Non-substantive comments were not discussed because the commenters did not provide information pertinent to the project or because they contained opinions or vague questions. As a result of the internal and public scoping efforts, the following issues were identified for analysis in this PEIS:

1. How would the application and use of proposed active ingredients affect nontarget plant species, including special status plants?
2. How would the application and use of proposed active ingredients affect the potential for herbicide resistance?
3. How would the application and use of proposed active ingredients affect soil microbiology?
4. How would the application and use of proposed active ingredients affect water quality?
5. How would the application and use of proposed active ingredients affect pollinator habitat?
6. How would the application and use of proposed active ingredients affect fire risk across the landscape?

1.7 RELATIONSHIP TO LAWS, REGULATIONS, AND BLM POLICIES, PLANS, AND PROGRAMS

The BLM is developing this PEIS in accordance with all applicable laws, rules, regulations, and guidelines; no federal permits, licenses, or other entitlements are needed to implement this PEIS.

The PEIS does not contradict or change any BLM policies, plans, or programs. Any subsequent site-specific NEPA compliance would also adhere to all BLM policies, plans, and programs, including applicable resource management plans and manuals, such as BLM Manual 9011, Chemical Pest Control Manual. During this effort, the BLM will also consider any applicable non-BLM policies, plans, and programs, as well as subsequent site-specific NEPA compliance requirements.

Chapter 2. Alternatives

2.1 INTRODUCTION

Introductory and background information pertinent to BLM herbicide treatment programs was provided in the 2007 PEIS (BLM 2007b, pp. 2-1 to 2-14). This information is still applicable, particularly in terms of BLM programs that implement herbicide treatments, planning and management of vegetation treatments, and the integration and selection of treatment methods within treatment projects.

2.2 HERBICIDE ACTIVE INGREDIENTS EVALUATED UNDER THE PROPOSED ALTERNATIVES

The BLM proposes to add seven active ingredients—aminocyclopyrachlor, clethodim, fluazifop-P-butyl, flumioxazin, imazamox, indaziflam, and oryzalin—to its list of approved active ingredients. The EPA has registered all these active ingredients. They also have been deemed effective in controlling vegetation, and they have minimal effects on the environment and human health, if used in accordance with label instructions. Characteristics of these active ingredients are presented in **Table 2-1**.

The proposed active ingredients were selected based on: 1) input from BLM field offices on the types of vegetation needing control; 2) studies indicating that these active ingredients would be more effective in managing noxious weeds and other unwanted vegetation than active ingredients currently used by the BLM; 3) EPA approval for use on rangelands, forestlands, and/or aquatic environments; 4) input from herbicide manufacturers regarding active ingredients not currently approved for use on public lands that may be appropriate to manage vegetation; 5) the effectiveness of the active ingredients on a variety of target species on BLM-administered lands; 6) the level of risk of the herbicidal formulations to human health and the environment; and 7) the availability of existing HHERAs for the proposed active ingredients, and the need to reduce herbicide resistance risk resulting from exclusive use of particular active ingredients.

The BLM would use these active ingredients to help reduce the spread of noxious weeds and other invasive plants to reduce the buildup of hazardous fuels, reduce the loss of wildlife habitat, help stabilize and rehabilitate sites impacted by fire, and restore native and desirable plant communities. BLM would require post-treatment monitoring and evaluation to record and identify treatment effectiveness and non-target effects.

2.2.1 Aminocyclopyrachlor

Aminocyclopyrachlor is used for post-emergence control of broadleaf weeds and woody species. It is registered for both ground and aerial application. Aminocyclopyrachlor is a systemic active ingredient that functions as a plant growth regulator which works by mimicking plant auxins[2] and interfering with plant growth. Leafy spurge (*Euphorbia esula*) is a rangeland weed that may be targeted with this active ingredient. As a result, use of picloram, which is a restricted-use pesticide, would be reduced.

[2] Growth hormone produced by plants.

Table 2-1
Herbicide Active Ingredient Characteristics

Active Ingredient	Representative Product Trade Name	Manufacturer/ Distributer	Concentration of Formulation	EPA Registration Number	Herbicide Resistance – WSSA Code	Mode and Mechanism of Action	Pre- or Post-emergence Application
Aminocyclopyrachlor	Method 240 SL	Bayer Environmental Science	2.0 pounds a.e./gallon*	432-1565	Group 4	Plant growth regulator – auxin receptor interference	Postemergence control of broadleaves and woody species
Clethodim	Envoy Plus	Valent U.S.A. Corporation LLC	0.97 pounds a.i./gallon**	59639-132	Group 1	Lipid biosynthesis inhibition –acetyl-CoA carboxylase (ACCase) inhibitor	Postemergence control of annual and perennial grasses
Fluazifop-P-butyl	Fusilade DX	Syngenta Professional Products	2.0 pounds a.i./gallon	100-1070	Group 1	Lipid biosynthesis inhibition – ACCase inhibitor	Postemergence control of annual and perennial grasses
Flumioxazin	Payload	Valent U.S.A. Corporation LLC	51% active ingredient	59639-120	Group 14	Cell membrane disruptor – protoporphyrinogen oxidase (PPO) inhibitor	Pre- and postemergence control
Imazamox	Clearcast	BASF Corporation	1.0 pound a.e./gallon	241-437	Group 2	Amino acid synthesis inhibitor –acetolactate synthase (ALS) inhibitor	Postemergence control
Indaziflam	Rejuvra	Bayer Environmental Science	1.67 pounds a.i./gallon	432-1609	Group 29	Cellulose biosynthesis inhibitor – inhibition of cellulose biosynthesis	Preemergence control

Active Ingredient	Representative Product Trade Name	Manufacturer/ Distributer	Concentration of Formulation	EPA Registration Number	Herbicide Resistance – WSSA Code	Mode and Mechanism of Action	Pre- or Post-emergence Application
Oryzalin	Surflan AS Specialty	United Phosphorus Inc.	4.0 pounds a.i./gallon	70506-44	Group 3	Seedling root growth inhibitor – microtubule inhibitor	Preemergence control

* a.e./gallon = acid equivalent per gallon
** a.i./gallon = active ingredient per gallon

2.2.2 Clethodim

Clethodim is used for selective post-emergence control of annual and perennial grasses. It is registered for both ground and aerial application. Clethodim works systemically as a fatty acid biosynthesis inhibitor ("post-grass herbicide"), which inhibits the enzyme ACCase. ACCase is responsible in the catalysis[3] of fatty acid synthesis, which contributes to energy storage, cell structure, and other vital physiological functions. Its use by the BLM is likely to be limited.

2.2.3 Fluazifop-P-butyl

Fluazifop-P-butyl works in a similar manner as clethodim. It also would be used for annual and perennial grasses, particularly those that have developed herbicide resistance. Applications would involve either spot or broadcast applications.

2.2.4 Flumioxazin

Flumioxazin is used for pre- and post-emergence control of both terrestrial and aquatic species. Preemergence applications need moisture to activate the active ingredient. It is registered for both ground and aerial application. Flumioxazin is a systemic active ingredient that functions as a cell membrane disruptor; the active ingredient works by inhibiting PPO, which is an enzyme in the chloroplast that is ultimately responsible for producing other molecules needed for important processes, such as photosynthesis and electron chain transfers. This active ingredient has the potential to provide a replacement for diuron as a bare-ground active ingredient and could assist in managing herbicide-resistant species.

2.2.5 Imazamox

Imazamox is used in a broadcast post-emergence application for both terrestrial and aquatic species. It is registered for both ground and aerial application. Imazamox is a systemic active ingredient that works as an amino acid synthesis inhibitor, which prevents the plant's ability to produce ALS, which is an enzyme that catalyzes the first step in the synthesis of branched-chain amino acids. Approval of this active ingredient would improve the BLM's invasive species management program by making available an aquatically approved active ingredient in addition to fluridone, diquat, and specific formulations of 2,4-D, imazapyr, glyphosate, and triclopyr.

2.2.6 Indaziflam

Indaziflam is a broadcast preemergence active ingredient that is registered for both ground and aerial applications to manage downy brome, other invasive annual grasses, and broadleaf species. It is a cellulose biosynthesis inhibitor, which weakens the structure of the cell wall. Because of its long residual activity and selectivity, this active ingredient is a potential tool for maintaining and promoting otherwise intact native plant communities threatened by invasive annual grasses and some broadleaf noxious weeds by being used as a spray and release treatment. There is some disagreement in the scientific literature regarding conditions under which indaziflam is most effective.

2.2.7 Oryzalin

Oryzalin is a preemergence active ingredient that, like flumioxazin, requires moisture to activate. It is registered for ground application. Oryzalin functions as a seedling root growth inhibitor; this mode of

[3] Increase in the rate of a chemical reaction

action targets cell division at the microtubule, reducing new plant growth and affecting the plant's ability to grow normally in the soil. This may be used in place of diuron and bromacil for the management of annual grasses and broadleaf species.

2.3 DESCRIPTION OF THE ALTERNATIVES

2.3.1 Alternative A—Continue Present Herbicide Use (No Action Alternative)

This alternative describes an integrated vegetation management program for resource management and habitat enhancement using the 21 active ingredients approved in the decision records for the 2007 and 2016 PEISs to manage competing and unwanted vegetation. This alternative corresponds to Alternative B of the 2016 PEIS, which estimated that approximately 932,000 acres in the western US would be treated annually using active ingredients. As shown in **Table 2-2**, total treatment acreages using all active ingredients have remained well below this number.

Table 2-2
Acreage[1] Treated in Select Years for each Active Ingredient

Active Ingredient	Acres Treated in 2015	Acres Treated in 2018	Acres Treated in 2021
2,4-D	27,500	26,800	24,100
Aminopyralid	80	70,000	74,000
Bromacil	1,900	3,100	4,400
Chlorsulfuron	10,700	8,800	6,100
Clopyralid	60,400	54,800	55,600
Dicamba	7,100	2,300	2,800
Diflufenzopyr	0	10	500
Diquat	0	200	0
Diuron	4,000	3,600	6,700
Fluridone	0	0	0
Fluroxypyr	0	200	2,100
Glyphosate	8,300	42,100	31,000
Hexazinone	30	0	0
Imazapic	108,500	185,900	182,700
Imazapyr	4,600	4,900	10,300
Metsulfuron methyl	4,700	12,400	13,600
Picloram	22,600	19,500	18,600
Rimsulfuron	0	0	20
Sulfometuron methyl	1,100	3,100	3,200
Tebuthiuron	43,400	50,900	25,600
Triclopyr	78,300	56,200	56,200
Total	383,100	566,200	517,700

Source: BLM GIS 2022

[1] Acres are rounded to the nearest 100. For numbers less than 100, acres are rounded to the nearest 10.

On lands within the BLM's eastern states jurisdiction, an environmental assessment was completed to adopt the 21 active ingredients approved for the western US.

Herbicide use data from BLM's Pesticide Use Reports from 2015, 2018, and 2021 are presented in **Table 2-2**. During this time period, the annual acreage has ranged from 383,000 acres to 566,000 acres, with the acres treated largely dependent on funding. Increases in funding are typically tied to incidence of wildfire. It is projected that the acreage of BLM-administered lands treated using active ingredients will increase from current levels, but it will not exceed the 932,000-acre estimate from the 2007 and 2016

PEISs. Therefore, the maximum annual treatment area of 932,000 acres is carried over to this PEIS for the purposes of analysis.

2.3.2 Alternative B—Allow for Use of Seven Proposed Active Ingredients on BLM-Administered Lands (Preferred Alternative)

Under the preferred alternative, the BLM would add the proposed active ingredients to its suite of tools for vegetation management. The proposed active ingredients would be integrated into the BLM's vegetation treatment activities. They could be used throughout BLM-administered lands, subject to applicable restrictions on their usage, such as those identified on the individual pesticide label and restrictions by each state's pesticide regulatory agency. Site-specific NEPA analyses would be required prior to on-the-ground use of the active ingredients.

2.4 Alternatives Considered but Not Analyzed Further

The BLM reviewed the alternatives analyzed in detail in the 2007 and 2016 PEISs, which included no use of herbicides, no aerial application of new herbicides, and no use of ALS-inhibiting active ingredients. This PEIS tiers to the analysis of the alternatives analyzed in the 2007 and 2016 PEISs but will not be carrying them forward for additional analysis in this PEIS for the reasons discussed below. None of the previously analyzed alternatives were suggested for re-analysis during public scoping for this PEIS. Further, because herbicide treatments on BLM-administered lands were already approved in the 2007 PEIS, Alternative C from that document (no use of herbicides), is not applicable and does not meet the current project's purpose and need. Alternatives related to no aerial application and no use of ALS-inhibiting active ingredients will not be analyzed in this PEIS since no new issues related to these alternatives have been identified associated with the use of the seven active ingredients, and the effects would be the same as described in the 2007 and 2016 PEISs. As such, none of the previously analyzed alternatives will be considered for the decision associated with this PEIS.

The BLM also reviewed the alternatives considered but not analyzed further in the 2007 PEIS. These included treating up to 25 million acres annually; treating fewer acres than are currently treated; not treating competing and unwanted vegetation; treating only acres needed to protect human health and safety; not conducting hazardous fuels treatments; revegetation with native vegetation; and excluding logging, grazing, off-highway vehicle use, and energy and mineral development on BLM-administered lands (BLM 2007b, p. 2-22). None of those alternatives were suggested for analysis during public scoping for this PEIS. Since no new issues related to these alternatives have been identified associated with the use of the seven active ingredients, and the effects would be the same as described in the 2007 and 2016 PEISs, those alternatives will again be dismissed from detailed analysis and they will not be considered for the decision associated with this PEIS. The 2016 PEIS did not have any additional alternatives that were considered, but not analyzed further.

During public scoping, the BLM received several proposals for the use of additional active ingredients or chemical formulations. The public has proposed inclusion of one additional active ingredient, florpyrauxifen-benzyl, known by the trade name Rinskor™. It is used in post-emergence applications against a broad spectrum of weeds at low use rates, and it rapidly degrades in the environment to nonherbicidal residues. However, neither the BLM nor the Forest Service have completed a HHERA for florpyrauxifen-benzyl; as such, it will not be analyzed in this PEIS.

NutraFix™ (Edaphix™ LLC) and various other proprietary soil amendments, have been promoted to purportedly control cheatgrass while promoting the growth of perennial plants. No peer-reviewed science exists regarding these products and as such they will not be analyzed in the PEIS.

2.5 Herbicide Treatment Standard Operating Procedures and Guidelines

Under either alternative, the BLM would follow prevention measures and standard operating procedures (SOPs) designed to minimize risks to human health and the environment from herbicide treatment actions. SOPs are management controls and performance standards that are required of all herbicide treatments. They are intended to protect and enhance natural resources that could be affected by herbicide treatments. The BLM reviewed and refined the prevention measures (BLM 2007b, pp. 2-24 to 2-25) and SOPs (BLM 2007b, pp. 2-30 to 2-35) from the 2007 PEIS for this effort, to reduce redundancy and improve clarity. The list of prevention measures and SOPs is presented in **Appendix A**.

2.6 Monitoring, Coordination, and Education

Monitoring of vegetation treatments is used to identify whether treatments are implemented appropriately and to determine their effectiveness. Under either alternative, the BLM would continue to use the BLM Assessment, Inventory, and Monitoring Strategy as a monitoring framework; this is described further in the 2016 PEIS (BLM 2016b, p. 2-9). The 2007 PEIS (BLM 2007b, pp. 2-35 to 2-39) provides an additional discussion of monitoring of vegetation treatments, including BLM guidance, procedures for implementation, monitoring methods, and dissemination of results.

The 2007 PEIS (BLM 2007b, p. 2-39) summarizes the ways in which the public can participate in this process, as well as other applicable coordination efforts between the BLM and the public.

2.7 Summary of Environmental Consequences

Table 2-3 summarizes the likely effects of vegetation treatments using the seven proposed active ingredients compared with the no action alternative. Information contained in this table is discussed in more detail in **Chapter 3**, Affected Environment and Environmental Consequences.

Table 2-3
Summary and Comparison of Effects on Issues Identified

Issue	No Action Alternative	Preferred Alternative
How would the application and use of proposed active ingredients affect nontarget plant species, including special status plants?	The effects on nontarget vegetation would generally be as described in Alternative B of the 2016 PEIS. Potential impacts on nontarget vegetation include death, reduced productivity, and abnormal growth from unintended contact with chemicals via drift, runoff, wind transport, or accidental spills and direct spraying. Following SOPs and mitigation measures from the 2007 and 2016 PEISs would prevent impacts or reduce the impact intensity. The degree of impact would depend on the chemical used and its properties, such as its persistence in the environment, the application rate, the application method, the physical site conditions, and the weather (such as wind or rain) during treatments (BLM 2007b, p. 4-47).	Broadly, the potential effects on nontarget vegetation would be similar to those described for the No Action Alternative. Herbicide treatments would be implemented in similar locations and with similar goals as under the No Action Alternative, but with more options for managing invasive plants in terms of active ingredients used. Short-term adverse effects to non-target vegetation and risks to sensitive species and populations would be similar to those under the No Action Alternative. The efficacy of some herbicide treatments could be improved through use of the active ingredients, which may be more effective at managing target species than currently approved active ingredients and may improve control of populations that have developed or have the potential to develop a resistance to currently approved active ingredients. Therefore, long-term benefits may be greater than under the No Action Alternative.
How would the application and use of proposed active ingredients affect the potential for herbicide resistance?	Under the No Action Alternative, the BLM would not be able to use the proposed active ingredients analyzed in this PEIS. Without the seven proposed active ingredients in this PEIS, there would be an increased likelihood for herbicide resistance in target species.	Under the proposed action, the BLM would be able to respond quickly to use the active ingredients and therefore more effectively manage weeds. The time line would be faster than under the No Action Alternative. The active ingredients would provide additional herbicide options to reduce the potential for herbicide resistance.

Issue	No Action Alternative	Preferred Alternative
How would the application and use of proposed active ingredients affect soil microbiology?	Impacts under the No Action Alternative would be the same as those described under Alternative B in the 2016 PEIS (BLM 2016b, p. 4-13). Minor effects to soil and soil organisms could occur, but treatments would potentially help reduce populations of invasive species and reduce wildfire risk. Beneficial effects to soil would include improved soil productivity and reduced soil erosion. The overall persistence of active ingredients in the soil has and would continue to be reduced. Overall, the potential adverse effects on the soil organisms' functionality and abundance would be minor.	Effects to soil microorganisms would be similar to those under the No Action Alternative. The active ingredients are not known to cause substantial impacts to soil or soil organisms. With the addition of the active ingredients, there may be a reduction in use of active ingredients that are relatively persistent in the soil. Of the seven proposed active ingredients, indaziflam and aminocyclopyrachlor are the most persistent in soils. Indaziflam can decrease soil organism diversity and impair the ability of soil organisms to complete the nitrification process. However, it likely does not decrease the organisms' abundance and does not drastically decrease soil microbial activity. Aminocyclopyrachlor can inhibit moss growth and reduce biological soil crust cover. The other proposed active ingredients would not severely affect the biological soil crust species abundance or diversity. Compared to other treatments, herbicides can simultaneously increase biological soil crust cover while reducing target plants such as perennial grasses. Beneficial effects to soil would be similar to those under the No Action Alternative and could be slightly greater if efficacy of treatments is increased.

Issue	No Action Alternative	Preferred Alternative
How would the application and use of proposed active ingredients affect water quality?	The impacts from the No Action Alternative on water quality would be the same as those described under Alternative B in the 2016 PEIS and are summarized in BLM 2007b (pp. 4-24 to 4-36) and BLM 2016b (pp. 4-14 to 4-21). The impacts on water quality that depend on the half-life and mobility of the active ingredient would remain the same as outlined in the 2007 and 2016 PEISs. Generally, direct effects include negatively impacting water chemistry, and aquatic organisms while indirect effects include impacts on riparian vegetation which could lead to changes in temperature, dissolved oxygen, turbidity, and further impact water quality. No currently approved active ingredient poses contaminant concern to groundwater or drinking waters; however, the potential for contamination does exist. SOPs and mitigation measures from the 2007 and 2016 PEISs help prevent impacts or reduce the likelihood of impacts on water quality.	The proposed action allows for a wider range of options for herbicides, allowing the BLM to make better decisions and potentially reducing localized impacts on water quality. Generally, the slower the half-life and the higher potential for runoff an active ingredient has, the greater likelihood of the herbicide reaching surface water. Additionally, the slower the half-life and the higher potential for leaching that the active ingredient has, the greater likelihood of the active ingredient reaching groundwater. The seven active ingredients have a wide range of mobility and potential to enter surface and groundwater. However, none of the seven active ingredients are listed on the EPA's National Primary Drinking Water Regulation's contaminant list.
How would the application and use of proposed active ingredients affect pollinator habitat?	Effects on pollinator habitat from using the 21 total active ingredients approved in the RODs for the 2007 and 2016 PEISs would generally be as described for non-target vegetation. Effects on pollinators would generally be as described in Alternative B of the 2016 PEIS (BLM 2007b, pp. 4-101 to 4-118; BLM 2016b, pp. 4-39 to 4-41). These effects could include death, reduced productivity, and abnormal growth from unintended contact with chemicals via drift, runoff, wind transport, or accidental spills and direct spraying. In general, modes of action that are primarily used for grass control which are short-lived or are inactive in soil, have low water solubility, or are used at relatively low rates would result in fewer effects on nontarget vegetation and, by extension, pollinator habitat. Modes of action that are used for grass and broadleaf weed control which have a greater potential for off-site movement via runoff or percolation, or have long soil residence times, would affect a wide variety of nontarget vegetation and increase the potential for nontarget vegetation effects, which would degrade pollinator habitat. SOPs and mitigation measures from the 2007 and 2016 PEISs help prevent impacts or reduce impact intensity on pollinators and pollinator habitat.	The potential effects on pollinators and pollinator habitat would be similar to those described for the No Action Alternative. Using active ingredients with different modes of action would increase weed treatment effectiveness, helping maintain vegetation community structure and function, which would improve pollinator habitat and potentially reduce nontarget plant species impacts. Following the SOPs in Appendix A would reduce the potential for effects on pollinators and pollinator habitat.

Issue	No Action Alternative	Preferred Alternative
How would the application and use of proposed active ingredients affect fire risk across the landscape?	The impacts on fire risk under the No Action Alternative would be similar to those described under Alternative B in the 2016 PEIS (BLM 2016b, p. 4-66). The beneficial effects of using herbicide treatments on fire regimes are described in the 2007 Programmatic Environmental Report (BLM 2007c, p. 4-53). In general, treatments that remove hazardous fuels from BLM-administered lands would be expected to reduce the incidence and severity of wildfires and move lands toward historic fire regimes. The time and cost involved in treating large annual grass-infested areas repeatedly may continue to prevent successful control of these species, with a continued risk of large wildfires across the landscape.	Under the preferred alternative, the use of the seven active ingredients registered by EPA would allow BLM managers more options in choosing herbicides to best match treatment options with particular site conditions, thereby increasing the probability that fire regimes move closer to historical levels. In addition, the ability to use the seven active ingredients would provide the BLM more options to best match treatment options with particular site conditions and reduce the likelihood for herbicide resistance, which would likely improve treatment effectiveness and reduce hazardous fuels.

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Chapter 3. Affected Environment and Environmental Consequences

3.1 INTRODUCTION

This chapter describes the natural environment of BLM-administered lands in the U.S., related to the issues that were identified in **Chapter 1**, which would be affected by the alternatives under consideration. This chapter also examines how herbicide treatment activities that utilize the seven active ingredients may affect these issues. These active ingredients would be part of a larger vegetation management program, and would potentially be used in conjunction with other treatment methods and other currently approved active ingredients. A summary of impacts associated with the use of the 21 currently approved active ingredients and with other treatment methods can be found in the *Final PEIS for Vegetation Treatments on Bureau of Land Management Lands in 17 Western States* (BLM 2007b), *Final Programmatic Environmental Report for Vegetation Treatments on Bureau of Land Management Lands in 17 Western States* (BLM 2007c), and the *Final PEIS for Vegetation Treatments Using Aminopyralid, Fluroxypyr, and Rimsulfuron on Bureau of Land Management Lands in 17 Western States* (BLM 2016b).

In many instances, the sections in this chapter incorporate by reference material provided in the affected environment and environmental consequences chapters of the 2007 and 2016 PEISs, rather than repeating the full discussions here. However, updated information is provided, where relevant.

3.1.1 Assumptions Common to All Issues

The following assumptions for analysis will apply to all issues discussed in this chapter:

- The analysis will not identify site-specific effects because its focus is on broadscale management direction. Site-specific effects would be addressed through environmental analyses prepared at the state, district, or field office level (BLM 2016b, p. 4-2).
- The BLM would continue to follow the applicable mitigation measures listed in the 2007 and 2016 PEISs (BLM 2007b, Table 2-8; BLM 2016b, Table 2-5) and SOPs included in **Appendix A** of this PEIS.
- While acres potentially available for herbicide treatment may be presented, not all of these acres would receive treatment under any alternative.

3.2 HOW WOULD THE APPLICATION AND USE OF PROPOSED ACTIVE INGREDIENTS AFFECT NONTARGET PLANT SPECIES, INCLUDING SPECIAL STATUS PLANTS?

3.2.1 Affected Environment

Vegetation Classification System

The vegetation classification system used in the previous vegetation treatment PEISs evolved in step with the national vegetation classification standards used at the time each PEIS was published. A detailed summary of this can be found in the 2016 PEIS (BLM 2016b, p. 3-12). Briefly, the 2007 PEIS classified vegetation consistent with the 1997 National Vegetation Classification Standard (NVCS; see BLM 2007b, p. 3-19, Table 3-4). The NVCS differentiated vegetation on the basis of growth form, life history strategy, and percentage of canopy closure or hydrologic influences (FGDC 1997). In 2008, a new—and the current—standard was adopted (FGDC 2008), which classifies vegetation based on floristic (species-based) and physiognomic (growth form-based) properties. The 2016 PEIS used this updated standard and identified the NVCS macrogroups within likely BLM vegetation treatment areas (BLM 2016b, p. 4-34, Table 4-9). This current PEIS follows the classification in the 2016 PEIS.

The 2016 PEIS identified and described the NVCS macrogroups that are the most likely locations of future herbicide treatments in the study area for that PEIS based on past vegetation treatment activities and future treatment goals (BLM 2016b, pp. 3-12 to 3-17). These macrogroups are summarized in **Table 3-1**. A complete list of macrogroups within the 2016 PEIS study area, along with brief descriptions of key macrogroups by ecoregion, is provided in Appendix D of that document (BLM 2016b, pp. D-1 to D-19).

Similarly, **Table 3-2** summarizes the NVCS macrogroups in the BLM eastern states study area that are the most likely locations for treatments. NVCS macrogroup descriptions can be found at the US National Vegetation Classification Hierarchy Explorer website (https://usnvc.org/explore-classification/; USNVC 2022).

Non-timber Special Forest Products

Non-timber special forest products include, but are not limited to, firewood, medicinal plants, wild foods, decorative and floral greens, and native seeds and transplants for restoration and nursery stock. The 2016 PEIS (BLM 2016b, p. 3-19) contained a more complete list of special forest products. Special forest products are harvested for a variety of reasons, including subsistence, cultural, spiritual, commercial, recreational, and educational purposes.

During fiscal year 2021, the BLM sold approximately $449,400 worth of non-timber forest products from the 17 western states (BLM 2022). Most wood product sales, including firewood, posts, poles, and other wood products, were from BLM-administered lands in California, western Oregon, Nevada, and Utah. Most non-wood forest product sales, including Christmas trees, cacti, seeds, pinyon nuts, mushrooms, and other products, were from BLM-administered lands in Nevada, western Oregon, and Utah (BLM 2022).

Corresponding special forest products statistics for the BLM eastern states study area (that is, the portions of the current study area not covered in the 2016 PEIS) are not available in the public land statistics maintained by the BLM (BLM 2022).

Special Status Plants

Special status species are 1) species listed or proposed for listing under the Endangered Species Act (ESA), and 2) species requiring special management consideration to promote their conservation and reduce the likelihood and need for future listing under the ESA. According to BLM policy (Manual 6840, Special Status Species Management), BLM actions must not adversely impact special status species.

Table 3-1
Most Likely Treatment Vegetation Classifications in the 2016 PEIS Study Area

Formation Class	Formation Subclass	Formation	Division	Macrogroup
Forest and Woodland	Temperate Forest	Warm Temperate Forest	Southwestern North American Warm Temperate Forest	California Forest and Woodland
				Californian-Vancouverian Foothill and Valley Forest and Woodland
				Madrean Warm Montane Forest and Woodland
			Southwestern North American Warm Temperate Scrub and Woodland	Southern Plains Scrub Woodland and Shrubland
		Cool Temperate Forest	Western North American Cool Temperate Forest	Southern Vancouverian Montane and Foothill Forest
				Vancouverian Lowland and Montane Rainforest
				Northern Rocky Mountain Lower Montane and Foothill Forest
				Southern Rocky Mountain Lower Montane Forest
			Western North American Cool Temperate Woodland and Scrub	Intermountain Singleleaf Pinyon-Western Juniper Woodland
				Rocky Mountain Two-Needle Pinyon-Juniper Woodland
Shrubland and Grassland	Mediterranean Scrub and Grassland	Mediterranean Scrub	California Scrub	California Chaparral
		Mediterranean Grassland and Forb Meadow	California Grassland and Meadow	California Annual and Perennial Grassland
				California Ruderal Grassland and Meadow
	Temperate and Boreal Shrubland and Grassland	Temperate Grassland, Meadow, and Shrubland	Western North American Grassland and Shrubland	Northern Rocky Mountain-Vancouverian Montane and Foothill Grassland and Shrubland
				Southern Rocky Mountain Montane Grassland and Shrubland
				Southern Vancouverian Lowland Grassland and Shrubland
			Great Plains Grassland and Shrubland	Great Plains Mixedgrass Prairie and Shrubland
				Great Plains Shortgrass Prairie and Shrubland
			Western North American Interior Sclerophyllous Chaparral Shrubland	Cool Interior Chaparral
				Warm Interior Chaparral

Formation Class	Formation Subclass	Formation	Division	Macrogroup
Semi-Desert	Warm Semi-Desert Scrub and Grassland	Warm Semi-Desert Scrub and Grassland	North American Warm Desert Scrub and Grassland	Apacherian-Chihuahuan Semi-Desert Grassland and Steppe
				Chihuahuan Desert Scrub
	Cool Semi-Desert Scrub and Grassland	Cool Semi-Desert Scrub and Grassland	Western North American Cool Semi-Desert Scrub and Grassland	Great Basin and Intermountain Dry Shrubland and Grassland
				Great Basin and Intermountain Tall Sagebrush Shrubland and Steppe

Source: BLM 2016, pp. 3-13 to 3-14, Table 3-4
Note: Vegetation treatments may occur in additional macrogroups not shown here; those macrogroups comprise a substantially smaller proportion of the proposed treatment acres.

Table 3-2
Most Likely Treatment Vegetation Classifications in the BLM Eastern States Study Area

Formation Class	Formation Subclass	Formation	Division	Macrogroup
Forest and Woodland	Temperate and Boreal Forest and Woodland	Boreal Flooded and Swamp Forest	North American Boreal Flooded, Swamp and Bog Forest	North American Boreal Flooded, Swamp and Bog Forest
		Temperate Flooded and Swamp Forest	Eastern North American-Great Plains Flooded and Swamp Forest	Northern Flooded and Swamp Forest
				Central and Appalachian Floodplain Forest
			Southeastern North American Flooded and Swamp Forest	Southern Coastal Plain Floodplain Forest
				Southern Coastal Plain Evergreen Hardwood-conifer Swamp
		Cool Temperate Forest and Woodland	Eastern North American Forest and Woodland	Southern and South-Central Oak-Hickory-Pine Forest and Woodland
				Laurentian and Acadian Northern Hardwood-Conifer Mesic Forest
				Laurentian and Acadian Pine-Oak Forest and Woodland
				Appalachian and Northeastern Oak-Hardwood and Pine Forest
				Longleaf Pine Woodland

Formation Class	Formation Subclass	Formation	Division	Macrogroup
Forest and Woodland *(cont.)*		Warm Temperate Forest and Woodland	Southeastern North American Forest and Woodland	Southeastern North American Ruderal Forest
	Tropical Forest and Woodland	Tropical Dry Forest and Woodland	Caribbean-Mesoamerican Dry Forest and Woodland	Caribbean Coastal Lowland Dry Forest
		Mangrove	Atlantic-Caribbean and East Pacific Mangrove	Western Atlantic and Caribbean Mangrove
Shrub and Herb Vegetation	Shrub and Herb Wetland	Temperate to Polar Freshwater Marsh, Wet Meadow, and shrubland	Eastern North American Temperate Freshwater Marsh, Wet Meadow, and Shrubland	Eastern North American Wet Meadow and Marsh
		Temperate to Polar Bog and Fen	North American Bog and Fen	North American Boreal and Sub-Boreal Acidic Bog and Fen
		Salt Marsh	North American Atlantic and Gulf Coast Salt Marsh	North American Atlantic and Gulf Coast Salt Marsh
	Temperate and Boreal Grassland and Shrubland	Temperate Grassland and Shrubland	Southeastern North American Grassland and Shrubland	Southeastern Ruderal Grassland and Shrubland
Agriculture and Developed Vegetation	Herbaceous and Woody Developed Vegetation	Other Developed Vegetation	Other Developed Vegetation	Tree Developed Vegetation
				Shrub and Herb Developed Vegetation
	Herbaceous Agricultural Vegetation	Row and Close Grain Crop	Graminoid Row Crop	Corn Crop
		Fallow Field and Weed Vegetation	Cropland Fallow Field	Fallow Field

Sources: BLM GIS 2022; USNVC 2022

Note: Vegetation treatments may occur in additional macrogroups not shown here; those macrogroups comprise a substantially smaller proportion of the proposed treatment acres.

Federally Listed Threatened, Endangered, Proposed, and Candidate Plants

Plant species occurring on or near BLM-administered lands in the study area that are federally listed as threatened or endangered—or proposed for listing—are listed in **Appendix C**. The species' listing status may change over time depending on future evaluations of each species' status and threats.

For this PEIS, the BLM has consulted with the US Fish and Wildlife Service (USFWS) and National Marine Fisheries Service to determine how the preferred alternative may affect threatened or endangered species and species proposed for listing, and their critical habitat. As part of the ESA consultation process, the BLM is preparing a biological assessment, which will provide a description of the distribution, life history, and current threats for analyzed species.

Proposed and Designated Critical Habitat

There is proposed and designated critical habitat (hereafter "critical habitat" unless otherwise noted) for 47 plant species on BLM-administered lands in the study area. Where present, this is noted in the species list in **Appendix C**. More information on critical habitat, including narrative descriptions and an ArcGIS online web map of critical habitats, is available on the USFWS Environmental Conservation Online System[4] for species under USFWS jurisdiction.

BLM Sensitive Plants

BLM sensitive plants are those designated by a BLM state director that require special management consideration to promote their conservation and reduce the likelihood and need for future listing under the ESA. BLM sensitive plants also include all federal candidate species, proposed species, and delisted species in the 5 years following delisting. The BLM periodically reviews and updates the sensitive species list in coordination with state agencies.

BLM sensitive plants designated for the 17 western states are included in the species list in **Appendix C**. There are no BLM sensitive plants designated for the BLM eastern states lands, other than those that are federally listed as threatened or endangered, or proposed or candidates for listing in these areas.

3.2.2 Environmental Consequences

The study area for nontarget plant species, including special status plants, is BLM-administered lands. The study area also includes a buffer area around BLM-administered lands to account for potential indirect effects.

Assumptions

The following assumptions apply to the analysis of effects on nontarget plant species:

- Invasive species are expected to continue to spread into habitats occupied by special status species, including critical habitat for listed plant species, reducing or extirpating special status plant populations. Invasive species spread will continue to be facilitated by natural processes and anthropogenic disturbances.
- Post-treatment follow-up, such as seeding, monitoring, and retreatment, would occur, as needed, to achieve land management objectives.

[4] https://ecos.fws.gov/ecp/report/critical-habitat

- Risk characterization in the HHERAs is based on the hazard quotient (HQ).[5] This is defined as the estimated exposure divided by a toxicity value, such as a reference dose, that is likely not to be associated with adverse effects. If the quotient is equal to or less than one, then no adverse effects are anticipated as a result of exposure. When the quotient is greater than one, then the exposure exceeds the level of concern,[6] and adverse effects are possible. HQs greater than one and less than two, while above the level of concern, might not represent significant risks, given the conservative nature of exposure estimates (see Kestrel Tellevate 2020a).
- The modeled risk to nontarget vegetation from aerial drift of herbicides in the HHERAs uses values for fine to medium-coarse droplet sizes (as opposed to values for very fine to fine droplet size). Fine to medium-coarse droplet sizes are likely to reflect typical application conditions (see SERA 2012). The level of risk from aerial drift would be affected by environmental conditions, such as wind and precipitation, at the time of application.
- Active ingredients can be transported from the soil at the application site by runoff, sediment loss, or percolation. Only runoff and sediment loss are considered in in the HHERAs assessing the risk of off-site soil contamination. This is because off-site runoff and sediment transport would contaminate the off-site soil surface and could have an impact on nontarget vegetation. Percolation, on the other hand, represents active ingredients transported below the root zone, which may affect water quality but should not affect off-site vegetation (see SERA 2012).
- Modeled exposure scenarios for runoff and sediment losses in the HHERAs arbitrarily assume that an herbicide is lost from a treated field and spread uniformly over an adjacent untreated field of the same size. More severe exposures could occur if all runoff losses were distributed into a much smaller area. Conversely, lower exposures would occur if runoff losses were distributed into a much larger area (see SERA 2012).
- The level of risk to nontarget vegetation from runoff and sediment loss would vary substantially with different types of climates and soils conditions. Less runoff and sediment loss would be expected in predominantly sandy soils.
- Modeled exposure scenarios for soil loss and herbicide transport from wind erosion in the HHERAs are typically informed by studies of soil loss from wind erosion in agricultural field settings, and the HHERAs typically assume that risks would be moderated when applying herbicides in "forestry applications," or areas with soil vegetative cover. Such an assumption is likely also valid for the areas where the BLM would apply herbicides. Risk may increase in BLM-managed lands with increased aridity or soil types with increased potential for wind erosion losses.
- The analysis below relies on the modeled exposure scenarios and literature reviews for effects on nontarget vegetation, conducted as part of the HHERA process for the proposed active ingredients. The analysis also assumes that BLM would follow all applicable SOPs in **Appendix A** when conducting treatments. Following the SOPs would reduce to the extent possible, but not completely eliminate, the potential for nontarget vegetation to be exposed during treatments. There would still be the potential that nontarget vegetation could be unintentionally exposed and experience effects. This is because the modeled exposure scenarios and literature reviews cannot

[5] For most risk assessments, the EPA uses the quotient method to compare toxicity to environmental exposure. The hazard or risk quotient is calculated by dividing a point estimate of exposure by a point estimate of effects. This ratio is a simple, screening-level estimate that identifies high- or low-risk situations.
[6] A level of concern is a policy tool that the EPA uses to interpret the HQ and to analyze the potential risk to nontarget organisms and the need to consider regulatory action.

account for every species of nontarget vegetation in or near a treatment area, nor can the behavior of the proposed active ingredients be precisely predicted in all environmental settings and conditions, even those considered to be suitable for application per label requirements. However, the analysis below assumes that following SOPs would prevent accidental spills, misapplications using incorrect rates, and other similar exposure scenarios.

- Accidental spills, misapplications using incorrect rates, and other similar exposure scenarios would increase exposure and cause unintended impacts to nontarget vegetation. While analyzed in the HHERAs, such exposure scenarios are outside of the scope of the proposed action, and are not analyzed in detail.

Indicators

The effects on nontarget vegetation are assessed using the following indicators:

- Vegetation communities: changes in vegetation community composition, structure, or function
- Non-timber special forest products: changes in forest product productivity and availability
- Special status plants and critical habitat: plant injury or mortality, changes in the soil seed bank of special status plants, changes in the amount of suitable or occupied habitat, and changes resulting in destruction or adverse modification of critical habitat

Alternative A—No Action Alternative

The effects on nontarget vegetation in the western states area from using the 21 total active ingredients approved in the decision records for the 2007 and 2016 PEISs would generally be as described in Alternative B of the 2016 PEIS. This is because the No Action Alternative in this PEIS is the same as Alternative B, the Preferred Alternative, of the 2016 PEIS. This is also true for the potential for effects on BLM eastern states lands. The BLM completed an environmental assessment adopting use of the approved active ingredients on eastern states lands (see **Section 2.3.1**). In summary, chemical treatments would continue to be used to remove target plants or to decrease target plant growth, seed production, and competitiveness. This would release native or desirable species from competitive pressure and aid in their reestablishment, where vegetation modification is desired.

Following SOPs and mitigation measures from the 2007 and 2016 PEISs would prevent impacts or reduce the impact intensity on nontarget vegetation, including death, reduced productivity, and abnormal growth from unintended contact with chemicals via drift, runoff, wind transport, or accidental spills and direct spraying. The degree of impact would depend on the chemical used and its properties, such as its persistence in the environment, the application rate, the application method, the physical site conditions, and the weather (such as wind or rain) during treatments (BLM 2007b, p. 4-47).

Risks to nontarget vegetation (including vegetation communities, special forest products, and rare plants and critical habitat) from unintentional direct spray or spray drift would be greater when herbicides are applied in closer proximity to nontarget vegetation or from greater heights, such as during aerial application. Risks to off-site nontarget plants from surface runoff would be influenced by chemical properties, precipitation, soil type, and topography. Under most exposure scenarios, higher application rates would increase the risk to nontarget plants. The potential for effects would be reduced, but not completely eliminated, by following the SOPs and applicable mitigation measures from the 2007 and 2016 PEISs.

Nontarget vegetation exposure could result in localized alterations to the composition or structure of vegetation communities (synonymous with NVCS macrogroups) where herbicide treatments were implemented. This could occur if nontarget plants were killed or otherwise suppressed by contact with herbicides via direct spray, spray drift, runoff, or soil erosion, or if seedlings emerging from a soil seed bank encountered a pre-emergent herbicide in the soil. In this scenario, the species' composition could shift as unaffected plant species take advantage of available resources and the space that became available. Community structure also could be affected if a key functional group of nontarget plants (for example, perennial grasses or native shrubs) were killed or suppressed by a selective herbicide, allowing another functional group to become established instead. These effects would be local and limited to areas within or directly adjacent to (generally within several hundred feet) herbicide treatment areas; the potential for widespread vegetation community changes, or conversion from one vegetation type to another, would be unlikely.

Nontarget applications could also alter the productivity and availability of non-timber special forest products where forest products occur within or near herbicide treatment areas. For instance, unintentional direct spray, spray drift, runoff or soil erosion containing herbicide, or seedling exposure to pre-emergent herbicide in the soil, could increase plant mortality, reduce productivity, or cause abnormal growth of native perennial grasses and forbs in or near a treatment area. If the affected type of nontarget vegetation was harvested as a non-timber special forest product, these effects would likely reduce the amount of product available for harvest. These effects would also tend to be local and limited to areas in or directly adjacent to herbicide treatment areas.

As described in more detail in the 2007 PEIS (BLM 2007b, p. 4-72), invasive vegetation control is an important component of special status plant management; however, it requires care to ensure management actions do not harm or endanger special status plant populations. Nonetheless, all the active ingredients previously analyzed could pose some risk to special status plant species should plants be directly sprayed or otherwise come into contact with herbicides from spray drift, runoff, or contaminated soil erosion.

The potential for effects would vary based on the active ingredient used, the application rate, the affected nontarget species, soil and other site conditions, and environmental conditions at the time of application. Though unlikely, the potential for substantial adverse effects, such as a measurable population-level effect, an effect that adversely impacts a special status plant species' potential for recovery or contributes to its need for federal listing, or destruction or adverse modification of critical habitat, is not discountable.

As described in the 2007 PEIS (BLM 2007b, p. 4-73), additional indirect effects on certain special status plant species could occur if populations of pollinators were harmed by herbicide spraying. Following measures to reduce effects on pollinator populations, including using the lowest effective application rates, applying application buffers, and preventing spray drift (see **Appendix A**), would likewise reduce the effects on dependent special status plants and their critical habitat. See **Section 3.6** for an additional analysis of the effects on pollinator habitat.

Alternative B—Preferred Alternative

Adding the seven proposed active ingredients to the BLM's suite of tools for vegetation management would mean that these active ingredients could be used throughout BLM-administered lands, subject to applicable usage restrictions and a site-specific NEPA analysis. Broadly, the potential effects on nontarget vegetation would be similar to those described for the No Action Alternative. Overall, there would be no change to the goals or extent of herbicide treatment programs, relative to the No Action Alternative. However, it is possible there could be an improvement in the effectiveness of certain treatments with the availability of the additional active ingredients. Improved treatment effectiveness could allow the BLM to better meet its goals of managing undesirable vegetation, reducing fire risk, and restoring natural fire regimes. This would indirectly benefit vegetation communities, non-timber special forest product availability, and rare plants and their habitat, including critical habitat.

The paragraphs below provide an additional analysis of the potential effects on nontarget vegetation that could result from applying the proposed active ingredients. Exposure pathways and associated risks to nontarget vegetation were evaluated in the HHERAs for the proposed active ingredients referenced in the discussions below. The analysis of potential effects on nontarget vegetation by the active ingredient's mode of action[7] and by typical application methods is also presented below.

Aminocyclopyrachlor

Aminocyclopyrachlor is an auxin-mimicking active ingredient (Weed Science Society of America [WSSA] Group 4; see **Table 2-1** in **Chapter 2**) used for post-emergent control of broadleaf weeds and woody species. According to the HHERA (SERA 2012), aminocyclopyrachlor is hazardous to terrestrial and, to a lesser extent, aquatic plants. Broadleaf plants are substantially more sensitive than grasses, as is generally true for auxin-mimicking active ingredients. Incident reports for a specific formulation of aminocyclopyrachlor indicate that it may be atypically toxic to some species of conifers, particularly Norway spruce (*Picea abies*) and white pine (*Pinus strobus*).

Exposure assessments for terrestrial and aquatic organisms, including nontarget vegetation, are provided in the HHERA (SERA 2012, Attachment 1 worksheets) for applications made at the maximum labeled rate of 0.28 pounds of acid equivalent per acre. For terrestrial plants, the highest exposures for terrestrial plants are associated with direct spray and spray drift (Attachment 1, Worksheet G05). Runoff (Attachment 1, Worksheet G04) and soil erosion (Attachment 1, Worksheet G06b) are also significant sources of potential exposure for terrestrial plants in sites that may favor runoff, particularly sites with predominantly clay soils (SERA 2012).

Modeled direct spray and spray drift exposure assessments (SERA 2012, Attachment 1, Worksheet G05b) indicate that aminocyclopyrachlor poses a high risk to nontarget terrestrial vegetation up to 900 feet from the application site. The level of risk is highest using aerial application and generally decreases with ground broadcast applications using a high boom and low boom. Of the modeled applications, backpack applications pose the least risk to nontarget vegetation at all distances from application.

Modeled exposure scenarios for runoff and sediment loss (wind erosion) (SERA 2012, Attachment 1, Worksheet G04 and Worksheet G06b, respectively) indicate that aminocyclopyrachlor in runoff poses a high risk to nontarget vegetation. As stated in the HHERA (SERA 2012), in areas with predominantly sandy soils, the runoff of aminocyclopyrachlor following foliar applications should be negligible; risks to nontarget plants also should also be negligible. Conversely, risks are greatest in areas with predominantly clay soils

[7] The biochemical effects of an herbicide that lead to plant death. The primary mode of action is the biochemical effect that occurs at the lowest concentration or is the earliest among a number of biochemical effects that could lead to plant death. An herbicide can have multiple biochemical effects that occur later in time or at higher concentrations that may contribute to plant death; these are secondary modes of action.

and moderate to high rates of rainfall; this is because these areas favor runoff from the application site. Risks may also be relatively high in cool locations with predominantly loam soils.

Aminocyclopyrachlor would not pose a high risk to nontarget vegetation from sediment loss (wind erosion). However, as stated in the HHERA (SERA 2012, section 4.4.2.5.4, Wind Erosion, p. 105), there are uncertainties associated with this exposure scenario, and higher soil loss rates could occur if aminocyclopyrachlor were applied to bare soils because these soils would be more prone to wind erosion. Within this limitation, risk models indicate that wind erosion is a minor concern relative to other routes of exposure for nontarget vegetation.

The modeled exposure scenarios above indicate that aminocyclopyrachlor would pose a high risk to broadleaf nontarget vegetation under certain application and environmental scenarios. Following the SOPs in **Appendix A**, including establishing buffers between treatment areas and native vegetation communities, special status plant populations, and critical habitat; using appropriate application rates; and limiting applications to favorable weather conditions, would reduce to the extent possible, but not completely eliminate, the potential for nontarget vegetation to be exposed during treatments. There would still be the potential that nontarget vegetation could be unintentionally exposed, having the types of effects described in the No Action Alternative. These include minor and localized changes to the vegetation community structure and function, reduced special forest product availability for nearby product populations, and the potential for substantial adverse effects on special status plant species or critical habitat.

Clethodim

Clethodim is a fatty acid biosynthesis inhibitor that inhibits the enzyme ACCase (WSSA Group 1). It is used for selective post-emergent control of annual and perennial grasses, particularly those that have developed resistance to other herbicides at some oil and gas development sites. There is abundant open literature demonstrating the efficacy of clethodim for the control of grass weeds and the relative lack of toxicity to nontarget plants, particularly broadleaf species (SERA 2014a).

Exposure assessments for nontarget vegetation are provided in the HHERA (SERA 2014a, Section 4.4.2.5, p. 98, and Attachments 1 and 2). Attachment 1 details a single application at the maximum single application rate of 0.25 pounds of active ingredient per acre. Attachment 2 details the exposure assessments for the maximum seasonal application rate of two applications 14 days apart, at the same application rate. The highest expected exposures for terrestrial plants are associated with direct spray and spray drift (Attachments 1 and 2, Worksheet G05). However, runoff (Attachments 1 and 2, Worksheet G04) and soil erosion (Attachments 1 and 2, Worksheet G06b) are also significant sources of potential exposure for terrestrial plants in sites that may favor runoff, particularly sites with predominantly clay soils (SERA 2014a).

Modeled direct spray and spray drift exposure assessments (SERA 2014a, Attachments 1 and 2, Worksheet G05b) indicate that clethodim poses a high risk to nontarget terrestrial vegetation up to 100 feet from the application site for aerial applications. For high boom, low boom, and backpack applications, it would not pose a high risk at distances beyond 25 feet from the application site. Of the modeled applications, backpack applications pose the least risk to nontarget vegetation at all distances from application. Directed spray applications using coarse droplets, typical of a backpack spray scenario, are not likely to damage nontarget vegetation at distances of greater than 25 feet from the application site (SERA 2014a).

Modeled exposure scenarios for runoff and sediment loss (wind erosion) (SERA 2014a, Attachments 1 and 2, Worksheet G04 and Worksheet G06b, respectively) indicate that clethodim in runoff poses a high risk to nontarget vegetation. As stated in the HHERA (SERA 2014a), in areas with predominantly sandy soils, the runoff of clethodim following foliar applications should be negligible; risks to nontarget plants also should also be negligible. Conversely, risks would be greatest in areas with predominantly clay soils and moderate to high rates of rainfall.

Risks to nontarget vegetation from wind erosion of contaminated soils are insubstantial (SERA 2014a). However, higher soil loss rates and resulting risks could occur if clethodim were applied to bare soil.

The modeled exposure scenarios above indicate that clethodim would pose a high risk to nontarget grasses under certain application and environmental scenarios. Following the SOPs in **Appendix A** would reduce, but not eliminate, the potential for nontarget vegetation effects. There would still be the potential that nontarget vegetation could be exposed and have the types of effects described in Alternative A; however, the potential for nontarget vegetation effects would be higher for grasses than broadleaf weeds because clethodim selects for this type of vegetation.

Fluazifop-P-butyl

Fluazifop-P-butyl is a fatty acid biosynthesis inhibitor that inhibits the enzyme ACCase (WSSA Group 1) and would also be used for annual and perennial grasses, particularly those that have developed herbicide resistance. Fluazifop-P-butyl is toxic to true grasses at relatively low application rates, but much less toxic to other monocots[8] and dicots (SERA 2014b). Consistent with the labeled uses of fluazifop-P-butyl, this active ingredient is more toxic in post-emergent foliar applications than pre-emergent or direct soil applications (SERA 2014b).

Exposure assessments for terrestrial nontarget vegetation are provided in the HHERA (SERA 2014b, Section 4.4.2.5, p. 121, and Attachment 1 worksheets) for a single application at the maximum single application rate of 0.32 pounds of acid equivalent per acre. (Additional attachment worksheets detailing two applications and the maximum seasonal application rate of three applications 14 days apart at the rate above are also available in the HHERA.) For terrestrial plants, the highest expected exposures are associated with direct spray and spray drift (Attachment 1, Worksheet G05; SERA 2014b).

Modeled direct spray and spray drift exposure assessments (SERA 2014b, Attachment 1, Worksheet G05b) indicate that fluazifop-P-butyl poses a high risk to sensitive nontarget terrestrial vegetation, typically grasses up to 50 feet from the application site for aerial applications. For high boom, low boom, and backpack applications, it would not pose a high risk at distances beyond 25 feet from the application site. Of the modeled applications, backpack applications pose the least risk to nontarget vegetation at all distances from application. Directed spray ground applications using coarse droplets are not likely to damage nontarget vegetation at distances as close as 25 feet from the application site. Other types of nontarget vegetation are not likely to be damaged even if sprayed directly (SERA 2014b).

[8] Monocot: grass and grass-like flowering plants with one leaf in the embryo of the seed; dicot: flowering plants with a pair of leaves in the embryo of the seed.

Modeled exposure scenarios for runoff (SERA 2014b, Attachment 1, Worksheet G04) indicate that fluazifop-P-butyl in runoff does not pose a high risk to sensitive nontarget terrestrial vegetation even at upper application rates. This is the case even following three modeled applications at the maximum application rate and a minimum application interval of 14 days (SERA 2014b). As stated in the HHERA (SERA 2012), there is no basis for asserting that runoff of fluazifop-P-butyl is likely to adversely affect nontarget or even target vegetation.

Modeled exposure scenarios for sediment loss (wind erosion) (SERA 2014b, Attachment 1, Worksheet G06b) indicate that risks to nontarget vegetation from fluazifop-P-butyl in contaminated particles are insubstantial (SERA 2014b). Much higher soil loss rates and resulting risks could occur if fluazifop-P-butyl were applied to bare soil. Even with this uncertainty, wind erosion is not a substantial concern relative to other routes of exposure, particularly direct spray or drift.

The modeled exposure scenarios above indicate that fluazifop-P-butyl would pose a high risk to nontarget grasses under certain application and environmental scenarios. Following the SOPs in **Appendix A** would reduce, but not eliminate, the potential for nontarget vegetation effects. There would still be the potential that nontarget vegetation could be exposed and have the types of effects described under Alternative A; however, the potential for nontarget vegetation effects would be higher for grasses because fluazifop-P-butyl selects for this type of vegetation.

Flumioxazin

Flumioxazin is used for pre- and post-emergent control of both terrestrial and aquatic species. It is a systemic active ingredient that functions as a cell membrane disruptor (WSSA Group 14) and could assist in managing herbicide-resistant species. Flumioxazin has a phototoxic mechanism of action; exposed vegetation is not harmed until exposed to sunlight. Laboratory toxicity tests may not include the same light wavelength and intensity as natural sunlight; therefore, flumioxazin may be more toxic to terrestrial plants under field conditions compared with laboratory conditions (Kestrel Tellevate 2020a). Numerous field studies on flumioxazin's effects on nontarget plants indicate that adverse effects can occur at application rates below the approved maximum application rate of 0.38 pounds of active ingredient per acre (Kestrel Tellevate 2020a).

Exposure assessments for nontarget vegetation from several types of application methods (for example, broadcast granular, aquatic, aerial, boom, and bare ground) are provided in the HHERA (Kestrel Tellevate 2020a, section 6.4.2.5, p. 117 and section 6.4.3.4, p. 122). For terrestrial plants, the highest anticipated exposures are associated with direct spray and spray drift (Kestrel Tellevate 2020a, Worksheets G05). Runoff and sediment losses (Kestrel Tellevate 2020a, Worksheets G04) are also significant sources of potential exposure in sites that may favor runoff, particularly sites with predominantly clay soils.

Modeled direct spray and spray drift exposure assessments (Kestrel Tellevate 2020a, Attachments 4, 5, and 6, Worksheets G05) indicate that flumioxazin poses a high risk to nontarget terrestrial vegetation at distances of at least 900 feet from the application site for spray applications. This includes applications by backpack-directed foliar spray, boom ground spray, and aircraft aerial spray, for sensitive plant species (Kestrel Tellevate 2020a, Table 6.4-6, p. 117).

Modeled exposure assessments for soil runoff applies to spray applications as above, and granular applications to soil only. Assessments indicate a high risk to nontarget vegetation (Kestrel Tellevate

2020a). Soil type and rainfall would influence the extent of flumioxazin runoff and thus anticipated exposure and effects on nontarget vegetation. Risks to nontarget vegetation are not expected for wind erosion of soil following spray or granular applications (Kestrel Tellevate 2020a). For aquatic plants, significant toxicity is anticipated for all exposure scenarios. This outcome is not unexpected, as flumioxazin is approved for use to control aquatic plants (Kestrel Tellevate 2020a).

The modeled exposure scenarios above indicate that flumioxazin would pose a high risk to nontarget terrestrial and aquatic vegetation under certain application and environmental scenarios. Following the SOPs in **Appendix A** would reduce, but not eliminate, the potential for nontarget vegetation effects. There would still be the potential that nontarget vegetation could be exposed and have the types of effects described under Alternative A; however, the potential for nontarget riparian and wetland vegetation effects would be higher because flumioxazin also controls aquatic plants.

Imazamox

Imazamox is an amino acid synthesis inhibitor (WSSA Group 2) used in a broadcast post-emergent application for both terrestrial and aquatic species. Some plant species, or at least populations, may show resistance to imazamox, either through development of an insensitive form of ALS, or by developing the capability to rapidly metabolize the active ingredient (SERA 2010).

Exposure assessments for nontarget vegetation are provided in the HHERA (SERA 2010, Section 4.4.2.5, p. 67, and Attachments 1 and 2 worksheets). Attachment 1 includes exposure assessments for terrestrial applications made at the maximum rate of 0.5 pounds acid equivalent per acre. A subset of the standard exposure scenarios is provided for aquatic applications in Attachment 2 using the maximum target concentration of 0.5 milligrams acid equivalent per liter.

Modeled direct spray and spray drift exposure assessments (SERA 2010, Attachment 1, Worksheet G05) include drift estimates for aerial, low and high boom ground broadcast, and backpack applications. The risk of direct spray of terrestrial plants differs substantially depending on the application method (SERA 2010). Assessments indicate imazamox poses a high risk to sensitive nontarget terrestrial vegetation at least 900 feet from the application site for aerial, high boom, and low boom applications, and up to 300 feet for backpack applications. For plants that are more tolerant to the active ingredient, there is still a high risk to nontarget vegetation from aerial applications up to 25 feet from the application site.

Modeled exposure scenarios for runoff (SERA 2010, Attachment 1, Worksheet G04) indicate that imazamox in runoff poses a high risk to nontarget vegetation at central to upper application rates. Modeled exposure scenarios for wind erosion (SERA 2010, Attachment 1, Worksheet G06) indicate there is not a high risk to nontarget vegetation.

There is high risk to aquatic vegetation from both terrestrial and aquatic applications of imazamox (SERA 2010). Under conditions that favor the off-site transport of imazamox to surface water, there is likely to be adverse effects on aquatic plants. If aquatic applications of imazamox are made at effective application rates, damage to aquatic plants is a virtual certainty.

The modeled exposure scenarios above indicate that imazamox would pose a high risk to nontarget terrestrial and aquatic vegetation under certain intentional application and environmental scenarios. Following the SOPs in **Appendix A** would reduce, but not eliminate, the potential for nontarget vegetation effects. There would still be the potential that nontarget vegetation could be exposed with the types of effects described under Alternative A; however, the potential for nontarget riparian and wetland vegetation effects would be higher because imazamox also controls aquatic plants.

Indaziflam

Indaziflam is a cellulose biosynthesis inhibitor (WSSA Group 29) and a broadcast pre-emergent active ingredient that is applied by both ground and aerial application to manage cheatgrass and other invasive annual grasses and broadleaf species.

Exposure assessments for nontarget vegetation from direct spray, spray drift, runoff, and wind erosion are provided in the HHERA (Kestrel Tellevate 2020b, Section 6.4.2.5., p. 117). The highest anticipated exposures are associated with direct spray and spray drift (Kestrel Tellevate 2020b, Attachment 1, Worksheet G05). Runoff and sediment losses (Attachment 1, Worksheet G04 and Attachment 1, Worksheet G06b) are also significant sources of potential exposure for plants in sites that may favor runoff, particularly sites with predominantly clay soils.

Modeled direct spray and spray drift exposure assessments (Kestrel Tellevate 2020b, Attachment 1 Worksheet G05a and G05b) indicate high risks to sensitive vegetation at downwind distances of at least 900 feet for fine droplets and about 500 feet for course droplets following aerial application. For other spray application methods, there is high risk at distances of 300 feet downwind of the application site. Thus, the risks would be greatest with aerial applications and lower with other application methods such as spray boom and backpack applications.

Modeled exposure assessments for soil runoff (Kestrel Tellevate 2020b, Attachment 1 Worksheet G04) indicate a potentially high risk to nontarget terrestrial vegetation for both tolerant and sensitive species of plants. The extreme range of the model results reflects the nature of the non-site-specific modeling on which the exposure assessment is based; it should be viewed as an estimate. The EPA fact sheet for indaziflam notes that it is moderately mobile to mobile and moderately persistent to persistent in the soil (EPA 2010), indicating that movement in soil runoff and exposure to nontarget vegetation may be possible. Modeled exposure assessments for the wind erosion exposure scenario (Kestrel Tellevate 2020b, Attachment 1 Worksheet G06) are far below the level of concern for both tolerant species and sensitive species. Therefore, the current risk assessment does not raise substantial concerns for nontarget vegetation harm from wind erosion relative to other routes of exposure.

The modeled exposure scenarios above indicate that indaziflam would pose a high risk to nontarget terrestrial and aquatic vegetation under certain application and environmental scenarios. Following the SOPs in **Appendix A**, would reduce, but not eliminate, the potential for nontarget vegetation effects. There would still be the potential that nontarget vegetation could be exposed, resulting in the types of effects described under Alternative A.

In addition to the modeled exposure assessments in the HHERA, there is a body of experimental research on the effects of indaziflam, particularly on its effectiveness on providing longer-term control of annual grasses in invaded sagebrush communities, while leaving established native perennial grasses and forbs and shrubs relatively unharmed.

Indaziflam persists in the upper soil horizon with a half-life of 150 days (US EPA 2010; Guerra et al. 2016; Terry et al. 2021, see Section 3.4). Indaziflam remains near the surface of the soil, depleting shallow seedbanks, so it has been shown to be effective in controlling cheatgrass, with temporary effects on native perennial grasses and fobs but unlikely long-term impacts on the diversity of native plant communities. For example, Courkamp (2022) found that single applications of indaziflam reduced cheatgrass to low levels, and effectively depleted cheatgrass seed banks in treated areas in invaded sagebrush shrublands for up to several years, at least in higher-elevation, cooler sites. Courkamp and Meiman (2020) found that indaziflam provided long-term reductions in cheatgrass cover and density in invaded sagebrush-grasslands in western Wyoming without negative effects on native vegetation species richness. This was attributed to indaziflam's persistence in the upper soil, where risks to established plants with deeper roots, such as native perennial grasses and herbs and shrubs, are minimal. In contrast, cheatgrass seed banks are typically shallow and short-lived, while perennial forbs and grasses have deeper root systems that are not stunted by the application of indaziflam (Courkamp 2022).

The BLM often uses the active ingredient imazapic to control invasive annual grasses in situations like those described above as use of this active ingredient was approved in the 2007 PEIS ROD. However, imazapic tends to negatively affect native, nontarget vegetation in treated areas, including established native perennial grasses and forbs, and native species seeded concurrently with herbicide treatments (Applestein et al. 2018). While Indaziflam would likely have similar effects on concurrently seeded species, its effects on established nontarget vegetation may be reduced compared with those of imazapic in similar situations. This, combined with its soil persistence, would be expected to result in longer control of invasive annual grasses when applied in areas with an existing, established perennial component, allowing existing native vegetation to gain competitive advantage over the treated grasses.

Because Indaziflam is persistent in the upper soil, it may affect seedbanks for other functional groups of vegetation. For example, Meyer-Moyer et al. (2021) conducted a field study evaluating the impacts of indaziflam on nontarget native species in annual mustard-infested areas in big sagebrush communities. They found that because indaziflam effectively controls the emergence of plant species through the depletion of seedbanks in the soil, it also affects new recruitment of native perennials that rely on seedbanks in the soils (Meyer-Moyer et al. 2021). The researchers concluded that indaziflam would better be suited in areas where nonnative annual grasses are dominant, and diversity of native forbs and grasses are low.

Oryzalin

Oryzalin is a pre-emergent active ingredient that functions as a seedling root growth inhibitor (WSSA Group 3). It may be used for the management of annual grasses and broadleaf species. Exposure assessments for terrestrial nontarget vegetation are provided in the WorksheetMaker Workbook Documentation (SERA 2015, Attachment 1 worksheets). Attachment 1 includes exposure assessments for terrestrial applications made at the application rate of 2 pounds per acre.

Modeled ground broadcast spray drift exposure assessments (SERA 2015, Attachment 1, Worksheet G05) indicate oryzalin poses a high risk to susceptible nontarget terrestrial vegetation at least 25 feet from the application site. For tolerant species, there is not a high risk even from direct application. Modeled exposure scenarios for runoff (SERA 2015, Attachment 1, Worksheet G04) indicate that oryzalin in runoff poses a high risk to nontarget vegetation. Modeled exposure scenarios for wind erosion (SERA 2010, Attachment 1, Worksheet G06b) indicate that there is not a high risk to nontarget vegetation in contaminated soil particles. Modeled exposure scenarios for aquatic species (SERA 2015, Attachment 1, Worksheet G03) indicate that there is a high risk to nontarget aquatic vegetation (algae and macrophytes) for non-accidental exposures.

The modeled exposure scenarios above indicate that oryzalin would pose a high risk to nontarget terrestrial and aquatic vegetation under intentional application and certain environmental scenarios. Following the SOPs in **Appendix A** would reduce, but not eliminate, the potential for nontarget vegetation effects. There would still be the potential that nontarget vegetation could be exposed, resulting in the types of effects described under Alternative A.

Analysis by the Mode of Action

Table 2-1 in **Chapter 2** characterizes each of the seven proposed active ingredient's modes of action. The WSSA (2022) classifies 34 different groups based on the active ingredients' mode of action. **Table 3-3** below summarizes the proposed active ingredients' mode-of-action groups, their biochemical effects on vegetation, and the potential effects on nontarget vegetation that may be possible when applying active ingredients in each mode-of-action group. As described in the analyses above, following the SOPs in **Appendix A** would reduce, but not eliminate, the potential for nontarget vegetation effects.

Controlling and preventing development of herbicide-resistant weeds is best accomplished with management practices that integrate a diversity of chemical and non-chemical measures, including applying active ingredients with different modes of action together (HRAC 2022; also see **Section 3.3** for an analysis of herbicide resistance). Using active ingredients with different modes of action would increase weed treatment effectiveness, which would help to maintain the vegetation community structure and function, non-timber special forest product availability, and special status plant populations where treatments were implemented.

Analysis by Application Method

As described in the 2007 PEIS (BLM 2007b, p. 4-47), the effects on native plant communities (assumed to be synonymous with nontarget vegetation, including special forest products and special status plants) from chemical treatments would vary depending on the herbicide application method and on other site-specific and environmental variables, such as topography, chemical(s) applied, and the weather conditions during application. Application of SOPs in **Appendix A** would reduce the potential for effects.

As discussed in the analysis of individual proposed active ingredients in the sections above, nontarget vegetation could be exposed to herbicides during chemical applications via several pathways, including through direct spray or spray drift, water runoff from the application site, and wind erosion of contaminated soil particles. Holding constant the active ingredient used, the site-specific and environmental conditions at the time of application, and the SOPs to reduce the potential for exposure (**Appendix A**), different herbicide application methods would pose varying exposure risk levels to native plant communities. For instance, the risk of herbicide exposure to nontarget vegetation would be greater when herbicides are applied from a greater height, such as during aerial or high boom application (BLM 2007b, p. 4-47).

Monsen et al. (2004) describes common herbicide application methods used in western rangelands. Methods used by the BLM during chemical treatments are likely to continue to include most of the methods described therein, including foliar (post-emergent) spraying from aircraft; foliar spraying from vehicles using spray booms at varying heights above the ground; wipe-on methods using vehicle-mounted rope wicks or similar, individual plant applications, like spot applications using directional backpack sprayers, stem injections, or cut stump treatments; and soil (preemergent) applications, including broadcast spray, granule, or pellet applications.

Table 3-3
Mode of Action and Potential Effects on Nontarget Vegetation

Mode of Action (Site of Action) [Site of Action Group Numbers]	Proposed Active Ingredient	Biochemical Effects	Taxonomic Group Selected For	Potential Effects on Nontarget Vegetation
Lipid Synthesis Inhibitor (Acetyl-CoA carboxylase) [1]	Clethodim Fluazifop-P-butyl	Inhibition of the acetyl-CoA carboxylase (ACCase) enzyme impacts the synthesis of fatty acids and subsequent cell membranes. Grass species are the target species as broadleaves are naturally tolerant to applications of this group of herbicides.	Grasses	• Nontarget grass species are going to be more susceptible to these active ingredients than broadleaf species. • As with postemergence herbicides, only those emerged species that come in direct contact with the off-target herbicide will be impacted. • Characteristics associated with each active ingredient, such as adsorptivity, solubility, and chemical degradation reduce the potential impact to nontarget plant via the soil environment.
Amino Acid Synthesis Inhibitor (Acetolactate Synthase) [2]	Imazamox	Inhibition of the acetolactate synthase (ALS), also called acetohydroxyacid synthase (AHAS), impacts the biosynthesis of the branched-chain amino acids isoleucine, leucine, and valine.	Grasses Broadleaves	• With activity on both grass and broadleaf species, the potential for nontarget impact is greater. • Off-target particle spray drift is always a concern when applying postemergence applications. • Characteristics associated with the active ingredient, such as, solubility, adsorptivity, chemical degradation would indicate the potential for residual activity in the soil.

Mode of Action (Site of Action) [Site of Action Group Numbers]	Proposed Active Ingredient	Biochemical Effects	Taxonomic Group Selected For	Potential Effects on Nontarget Vegetation
Root and Shoot Inhibitor (Microtuble Assembly) [3]	Oryzalin	Inhibition of the polymerization of microtubules leads to the loss of microtubule structure and function, preventing the alignment and separation of chromosomes during mitosis.	Grasses Broadleaves	• As a preemergence herbicide those nontarget annual species that have germinated, along with perennial species that are actively growing will not be impacted by the nontarget contact with the herbicide. • Characteristics associated with the active ingredient, such as, solubility, adsorptivity, chemical degradation would indicate the potential for residual activity in the soil.
Plant Growth Regulator (Auxin Mimic) [4]	Aminocyclopyrachlor	The resulting impact of the elevated amount of indole-3-acetic acid (IAA) in the plant affects cell wall plasticity and nucleic acid metabolism, in addition to cell elongation and uncontrolled cell division and tissue destruction.	Broadleaves	• Nontarget broadleaf vegetation would have the most potential to be affected. • Characteristics associated with the active ingredient, such as, solubility, adsorptivity, chemical degradation would indicate the potential for off-site movement via percolation or runoff and residual activity in the soil under certain environmental situations.
Cell Membrane Disruptor (Protoporphyrinogen Oxidase) [14]	Flumioxazin	Inhibition of the protoporphyrinogen oxidase (PPO) enzyme impacts the biosynthesis of chlorophyll and heme resulting in lipid peroxidation, loss of chlorophyll and carotenoids, and leaky membranes.	Grasses Broadleaves	• A wide variety of nontarget vegetation may be affected from this active ingredient under preemergence and postemergence activity. • The active ingredient has limited translocation within the plant, resulting in limited potential injury to perennial species. • Characteristics associated with the active ingredient, such as solubility, adsorptivity, chemical degradation would result in limited impacts on nontarget vegetation.

Mode of Action (Site of Action) [Site of Action Group Numbers]	Proposed Active Ingredient	Biochemical Effects	Taxonomic Group Selected For	Potential Effects on Nontarget Vegetation
Cellulose Synthesis Inhibitor (Cellulose Biosynthesis) [29]	Indaziflam	Inhibition of root and shoot growth by way of influencing cell wall formation and cell division by inhibiting cellulose biosynthesis.	Grasses Broadleaves	• As a preemergence herbicide with extended residual activity, nontarget annual grasses and broadleaves may be impacted.

Sources: WSSA 2022; Lancaster et al. 2021; EPA 2022a

As described in Monson et al. (2004), broadcast spray applications require selective herbicides; this is because herbicides are applied to target and nontarget vegetation alike in the treatment area. Aerial spray applications can treat larger areas and difficult terrain more efficiently, but aerial spray applications increase the potential for direct spray and spray drift to affect nontarget vegetation in and outside the treatment area. As discussed in the analyses above, some of the proposed active ingredients could pose a high risk to sensitive nontarget vegetation hundreds of feet from treatment areas. Decreasing the spray application height, such as using a vehicle-mounted spray boom, would reduce, but not eliminate, this risk. Also, such ground-based application methods would increase the potential for mechanical injury to nontarget vegetation in the treatment area from crushing with vehicle tires or trampling by workers on foot during treatments.

Wipe-on applications using a rope wick or similar device would reduce the risk to nontarget vegetation. This is because herbicide application can be limited to a certain height, leaving taller target vegetation exposed and shorter, nontarget vegetation unexposed. Also, off-site drift is mostly eliminated compared with broadcast spray methods (Monson et al. 2004). Because such applications are typically conducted using vehicles, the potential for mechanical impacts on nontarget vegetation in the treatment area would remain.

Individual plant applications can be used when the treatment area's terrain is too rough for vehicles to access, and to treat widely spaced plants or spot infestations that are not conducive to aerial broadcast spraying (Monsen et al. 2004). Direct spray from a backpack sprayer would not eliminate the risk to nearby nontarget vegetation from spray drift; however, the risk would be reduced compared with other spray scenarios. Stem injection and cut stump treatment would nearly eliminate risks to nontarget vegetation, but treatments are limited to woody target vegetation. Mechanical damage to nontarget vegetation in the treatment area would be possible and limited to some trampling by workers.

Soil, or pre-emergent applications would vary in the risk to nontarget vegetation. Broadcast spray applications would have effects from spray drift as described above, while soil injections, direct application of granules, and direct pellet applications would eliminate this risk. These application methods tend to use active ingredients with longer soil half-lives (Monsen et al. 2004; also see **Section 3.4**, Soil Microbiology); this means the risks to nontarget vegetation from herbicide transport in runoff or soil erosion may be increased compared with application methods that do not use active ingredients with longer soil half-lives.

Cumulative Effects

The 2007 PEIS provided a thorough cumulative effects analysis for the BLM's herbicide treatment program (BLM 2007b, pp. 4-197 to 4-246), including a discussion of cumulative effects on vegetation (BLM 2007b, pp. 4-211 to 4-213). This analysis was updated in the 2016 PEIS (BLM 2016b, pp. 4-103 to 4-115), including for vegetation (BLM 2016b, p. 4-108).

Since the seven active ingredients would be added to an existing program of 21 approved active ingredients, with no changes in goals, acres, or areas treated, much of the 2007 analysis (updated in 2016) is inclusive of proposed herbicide use and does not warrant repetition here. The analysis presented here provides a general summary of the previous analyses, with updated information provided, where available. Additionally, the analysis includes a discussion of the cumulative effects associated with adding the seven proposed active ingredients to the BLM's list of approved active ingredients.

As described in the 2016 PEIS (BLM 2016b, p. 4-108), past effects on vegetation (including native plant communities, non-timber special forest products, and special status plant species) are predominantly associated with fire exclusion and other natural disturbance regime alterations, timber harvest, vegetation management programs, and livestock grazing. These have altered native plant communities and have led to the introduction and spread of invasive species.

Future effects on vegetation include many of the same human activities that have altered native plant communities in the past. Populations of invasive species will continue to spread, and altered disturbance regimes will continue to cause large wildfires that further alter the vegetation in the western US. Disturbance drivers in the eastern US will continue to become more severe in response to climate change (USGCRP 2018); flooding, drought, and intense storms will similarly alter vegetation and facilitate the establishment and spread of invasive species.

Treatments by the BLM and other federal, state, and local entities to remove hazardous fuels and control invasive species will help offset these adverse effects; however, multiple treatments followed by restoration would be necessary to recover native communities and restore disturbance regimes in targeted areas.

Because the acreage of BLM-administered lands treated with herbicides would be the same under the alternatives, the contribution to vegetation impacts in terms of departure from native conditions and disturbance regimes would also be similar under the alternatives. The countervailing effects associated with the long-term improvement in plant communities and the reduction in fire risk would also be similar under the alternatives.

Under the No Action Alternative, there would be 21 active ingredients used by the BLM with the potential to impact vegetation. Under the preferred alternative, seven additional active ingredients would be used. Under either alternative, herbicides would be available that would allow the BLM to meet its treatment goals to restore native communities. The preferred alternative would provide the BLM additional options for treating invasive species that could improve the effectiveness of treatment programs in certain circumstances. In all cases, herbicide treatments could be used in concert with other vegetation treatment methods.

3.3 How Would the Application and Use of Proposed Active Ingredients Affect the Potential for Herbicide Resistance?

3.3.1 Affected Environment

Herbicide resistance is mentioned in both the 2007 and 2016 PEISs, but it is not analyzed in detail (BLM 2007a, pp. 2-14, 4-66, 4-70; BLM 2016b, pp. 4-31 to 4-32, 4-36, 4-56). Those PEISs discuss what herbicide resistance is and general methods of avoiding the development of herbicide resistance. In the time since the 2016 PEIS was approved, new studies have shown that in some cases, herbicide resistance is aided by environmental stressors instead of solely by genetics. Since 2016, the known cases of unique herbicide resistance have increased from 476 to 513 (see **Table 3-4**).

Table 3-4
Unique Cases of Herbicide Resistance Worldwide

Mode of Action	Total Unique Cases
ALS inhibitor	170
ACCase inhibitor	50
Auxin receptors interference	41
PPO inhibitor	14
Microtubule inhibitor	12
Cellulose biosynthesis inhibitor	4
Other[1]	222
Total	**513**

Source: Heap 2022
[1] All other known modes of action that are not included in the seven herbicides analyzed in this PEIS

ALS inhibitors are the most common herbicides to which plants develop resistance. Currently, 170 of the 513 unique cases are weeds that are resistant ALS inhibitors. Table Resistance-1 shows the unique cases[9] for each of the six modes of action of the seven active ingredients in this PEIS. Using active ingredients and active ingredients that target a different mode of action can greatly increase the effectiveness of weed control. Studies have shown that overuse can cause up to 100 percent resistance in some species (Loubet et al. 2021).

A summary of herbicide resistance information that is known regarding the seven individual active ingredients under consideration is presented below. Much of the literature has been focused on agricultural uses; as such, knowledge of herbicide resistance in rangeland applications is not as well understood (Dhanda et al. 2022; Manalil et al. 2011; Mohammad et al. 2021; Powells 2022; Domínguez-Mendez et al. 2017).

Aminocyclopyrachlor

Aminocyclopyrachlor is a postemergence active ingredient that interferes with auxin receptors in plants and thus inhibits plant growth (see **Section 2.2.1**). This active ingredient can be used in areas where weed populations have grown resistance to other herbicide treatments (Kniss and Lyon 2011). The BLM does not have information on whether any species or types of plants have become resistant to aminocyclopyrachlor.

Clethodim

Clethodim is a postemergence active ingredient that inhibits ACCase through lipid biosynthesis (see **Section 2.2.2**). Resistance to clethodim in the weed Wimmera ryegrass (*Lolium rigidum*) is almost exclusively inherited from the female parent, although in one population studied, inheritance appeared to be more complex (Saini et al. 2016). Boutsalis et al. (2012) found that clethodim resistance in Wimmera ryegrass occurred at higher levels (up to 61 percent) in areas with higher rainfall that were more intensively cropped.

[9] Species * modes of action (Heap 2022).

Fluazifop-P-butyl

Fluazifop-P-butyl acts in a similar way to clethodim (see **Section 2.2.3**). Plants that have shown a resistance to fluazifop-P-butyl also have shown resistance to other active ingredients that are chemically similar, such as aryloxyphenoxypropionate herbicides and quizalofop-P-ethyl (Hidayat and Preston 1997).

Flumioxazin

Flumioxazin is a pre- and postemergence active ingredient that acts as a PPO inhibitor (see **Section 2.2.4**). Flumoxazin has been shown to work on target plants that have developed resistance to other types of herbicides, such as ACCase, ALS, and photosystem II site A inhibitors (Chhokar et al. 2019).

Imazamox

Imazamox is a postemergence ALS-inhibiting active ingredient (see **Section 2.2.5**). Several studies have shown that several species of crop wheat (*Triticum* spp.) are resistant to this active ingredient, causing more effective weed management in the agricultural setting (Domínguez-Mendez et al. 2017; Pozniak et al. 2004). Loubet et al. (2021) showed growing resistance in annual ragweed (*Ambrosia artemisiifolia*), a common weed both native and introduced across the US (USDA 2022).

Indaziflam

Indaziflam is a preemergence active ingredient that inhibits cellulose biosynthesis (see **Section 2.2.6**). In general, cellulose biosynthesis inhibitors have a lower history of causing herbicide resistance in weeds compared with other modes of action (Brabham et al. 2014).

Oryzalin

Oryzalin is a preemergence active ingredient that inhibits the growth of seedling roots (see **Section 2.2.7**). Oryzalin has proven effective on plants that have developed a resistance to many postemergence active ingredients; however, target-site resistance to this active ingredient has begun to develop in several weedy plants, such as Wimmera ryegrass, Indian goosegrass (*Eleusine indica*), and green bristlegrass (*Setaria viridis*) (Chen et al. 2021).

3.3.2 Environmental Consequences

Assumptions

The following assumptions apply to the analysis of effects on herbicide resistance:

- This analysis discusses herbicide applications only on BLM-administered lands; herbicide use on agricultural lands is not accounted for in this PEIS.
- It is anticipated that noxious and invasive weeds will continue to spread and will continue to need treatment in the future.

Indicators

The indicator for the analysis is the potential for increased herbicide resistance in target species.

Alternative A—No Action Alternative

Under Alternative A, the BLM would continue to use the 21 active ingredients that have been previously approved for use (see **Table 3-5**). Without the seven proposed active ingredients in this PEIS, there would be an increased likelihood for herbicide resistance in target species. The overuse of a single active ingredient or mode of action increases the likelihood that a plant population will develop resistance (Loubet et al. 2021). Herbicide resistance is occurring worldwide and across the entire US, negatively effecting native communities, removing nutrients and water from native and non-invasive plants. This process would lower biodiversity over time in these plant communities and make them more susceptible to disease and severe, off-season fires and other negative processes.

Table 3-5
Resistance to the 21 Active Ingredients from the 2007 and 2016 PEISs

Mode of Action	Active Ingredients from 2007 and 2016 PEISs	Unique Cases
Auxin Mimics	2,4-D, Aminopyralid, Clopyralid, Dicamba, Fluroxypyr, Picloram, Triclopyr	41
Photosystem II inhibitor	Bromacil, Diuron, Hexazinone, Tebuthiuron	87
ALS inhibitor	Chlorsulfuron, Hexazinone, Imazapic, Imazapyr, Metsulfuron methyl, Rimsulfuron, Sulfometuron methyl	170
Photosystem I electron diversion	Diquat	32
Phytoene Desaturase inhibitor	Fluridone	5
Enolpyruvyl Shikimate Phosphate Synthase inhibitor	Glyphosate	56

Source: Heap 2022

Alternative B—Preferred Alternative

The BLM could use the active ingredients based on local management needs. While plants that have developed resistance to a given active ingredient would not be the direct target, the use of active ingredients could potentially lower the populations of these plants. The active ingredients would target different areas, or application times, thus avoiding the resistant gene even if that is not the specific management goal.

Cumulative Effects

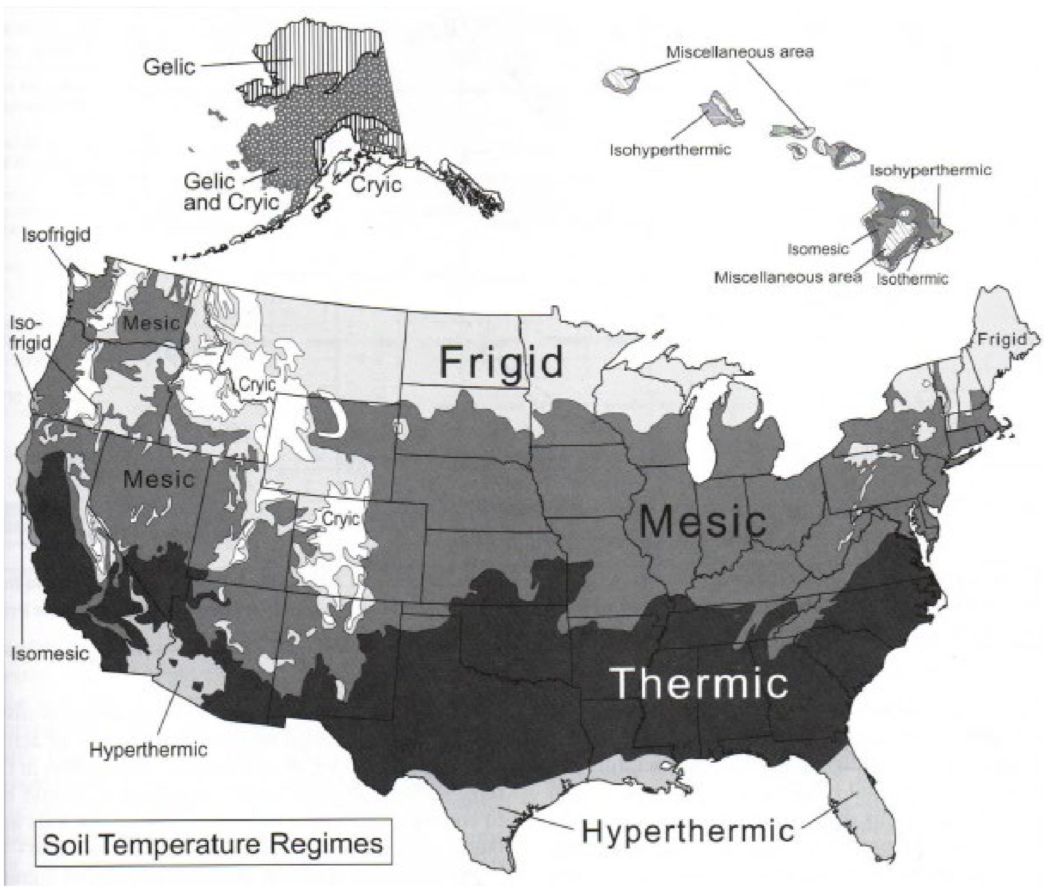
Development and improvements will continue on BLM-administered lands, creating more opportunity for weeds to grow in the disturbance. Alternative B would have less cumulative effects than Alternative A because the use of active ingredients would decrease weed growth. However, because the BLM is planning on using these active ingredients on a small area, the effects would be almost the same. More herbicides are applied on agricultural lands than on public lands; therefore, herbicide resistance will continue no matter the measures taken by the BLM.

3.4 HOW WOULD THE APPLICATION AND USE OF PROPOSED ACTIVE INGREDIENTS AFFECT SOIL MICROBIOLOGY?

3.4.1 Affected Environment

Soils in the treatment areas are diverse and range from the arid, saline soils of the Southwest, to the clayey glaciated soils of Montana, to the gelic permafrost and cryic wet soils of Alaska, to the thermic wet and acidic soils of the Southeast, to the mesic and frigid wet soils of the Northeast and Midwest. **Map 3-1** shows a graphic of soil temperature regimes across the US. Soils are the result of complex interactions between parent material (geology), climate, topography, organisms, and time. Soils are classified by the degree of development into distinct layers or horizons and their prevailing physical and chemical properties (Weil and Brady 2019). Detailed maps of soils and associated information for each state can be found in individual soil surveys online at http://www.nrcs.usda.gov/wps/portal/nrcs/soilsurvey/soils/survey/state.

Map 3-1. Major Soil Temperature Regimes in the US



Source: Schaetzl and Thompson 2015

Biological Soil Crusts

Biological soil crusts (also known as cryptogamic, microbiotic, cryptobiotic, or microphytic crusts) are most abundant in semiarid and arid environments, but they can also be found in mesic and frigid areas. They are a community of organisms at the surface of the soil comprised of varied amounts of cyanobacteria, blue-green algae, microfungi, mosses, liverworts, and lichens. *Cladonia perforate* is a federally endangered species of lichen found in the Jupiter Inlet Lighthouse Outstanding National Area in southeast

Florida (Rosentreter and DeBolt 2020). Biological soil crusts provide important functions, such as improving soil stability and reducing erosion, fixing atmospheric nitrogen and contributing nutrients to plants, and assisting with plant growth. They also enhance soil fertility and stability. Biological soil crusts occupy open spaces between the sparse vegetation of the Great Basin, Colorado Plateau, Sonoran Desert, and the inner Columbia Basin (BLM 2016b). They also occur in agricultural areas and native prairies, in tundra areas in Alaska, in pine barrens, and in shallow, compacted soils of eastern forests (Belnap et al. 2001).

Biological soil crusts can reach up to several inches in thickness and vary in terms of color, surface topography, and surficial coverage. Crusts generally cover all soil spaces not occupied by vascular plants, which may be 70 percent or more in arid regions. They are well-adapted to severe growing conditions, but they are influenced by disturbances such as compression from domestic livestock grazing, recreational activities (hiking, biking, and off-highway vehicles), mechanical treatment and agricultural practices (extensive tillage and planting), application of herbicides, and military activities (BLM 2016b).

Micro- and Macroorganisms

The soil microbial community plays a crucial role in maintaining ecosystem health and sustainability, with plant-microbe interactions contributing to the condition of the ecosystem. Microorganisms help to break down and convert organic remains into forms that can be used by plants. Microorganisms, such as mycorrhizal fungi, nitrogen-fixing organisms, and certain types of bacteria, assist plant growth, suppress plant pathogens, and build soil structure. There is evidence that certain bacteria in soil may suppress cheatgrass and other invasive species. One of the main benefits of mycorrhizal fungi is the improved uptake of nutrients (predominantly phosphorous) and water by plants. Soil microorganisms are also important in the breakdown of certain types of herbicides (BLM 2016b).

Macroorganisms, such as insects and earthworms mix the soil and allow organic matter on the surface to become incorporated into the soil. These organisms are part of a food web that is essential to the cycling of nutrients within the soil. Soil organisms interact and support plant health as they decompose organic matter, cycle nutrients, enhance soil structure, and control the populations of soil organisms, including pests (Weil and Brady 2019).

Weed establishment can decrease soil biodiversity and decrease the availability of soil organisms available to native plants. This decreases the growth of native plants and their capacity to outcompete weeds (Massenssini et al. 2014). In addition, weeds and invasive species increase the risk for cyclical and high-severity wildfires, which can burn soils and decrease organic matter (see **Section 3.7**).

Factors that Influence the Fate, Transport, and Persistence of Herbicides in Soil

The fate and transport of herbicides in soil is a function of their interaction with the soil environment. This is generally considered a complex process. Chemical, physical, and biological soil processes influence herbicide availability, phytotoxicity, and fate and transport. Herbicides dissipate from soils by transport with water or wind, by leaching out of soils, through chemical or biological degradation processes, or by immobilization through adsorption onto soil surfaces (BLM 2016b). These processes are discussed in more detail in the 2007 PEIS (BLM 2007b, pp. 4-14 and 4-15).

Herbicide persistence is often described in terms of the half-life, defined as the amount of time required for one half of the original amount of herbicide to dissipate (Colquhoun 2006). Microbial degradation and chemical absorption in soils are the most important processes that determine herbicide persistence; microbial degradation and chemical absorption depend on the existing soil nutrient composition and content, pH, moisture, and temperature (Banks et al. 2014; Zimdahl 2018; Rasool et al. 2022).

The estimated half-life and soil adsorption (organic carbon-water partitioning coefficient, given as K_{oc}) of the seven proposed active ingredients are presented in **Table 3-6**. Some of the approved active ingredients from the 2007 and 2016 PEISs are also provided for reference. Aerobic soils are those with available oxygen and high microbial activity. Anaerobic soils are common in saturated areas, such as wetlands, and they have little to no available oxygen for microorganisms. Limited oxygen availability decreases microbial activity and abundance.

Table 3-6
Herbicide Persistence in Soils as Measured by Half-life (days) and Adsorption Affinity for Active Ingredients

Active Ingredient	Soil Half-life, Aerobic Soils (Days)	Soil Half-life, Anaerobic Soils (Days) [2]	Soil Adsorption (K_{oc})
Proposed Active Ingredients			
Aminocyclopyrachlor	373	6,932	2–26 mL/g*
Clethodim	0.5–2.6	86.4–97.6[3]	5–270 mL/g
Fluazifop-P-butyl	21	1–3 years	2,010–5,700 mL/g
Flumioxazin	12–18	0.2	557 mL/g
Imazamox	12–30	Stable	5–144 mL/g
Indaziflam	30–176	>1 year	Less than 1000 mL/g
Oryzalin	63	10	602–1,109 mL/g
2016 PEIS Approved Active Ingredients			
Aminopyralid	32–533	Stable	1.05–24.3 mL/g
Fluroxypyr	7–23	8	50–136 mL/g
Rimsulfuron	5–40	22.2	19–74 mL/g
2007 PEIS Approved Active Ingredients[1]			
Glyphosate	47	199–208	24,000 mL/g
Imazapic	120–140	Stable	206 mL/g
Picloram	90	Stable	16 mL/g

Sources: BLM 2007, 2016; SERA 2010, 2012, 2014a, 2014b, 2015; Kestrel Tellevate 2020a, 2020b; González-Delgado et al. 2022
Notes: * mL/g = milliliters of the active ingredient in soil solution, per gram of soil
[1] This is not a complete list of approved active ingredients in the 2007 PEIS (BLM 2007, p. 4-15). Glyphosate, imazapic, and picloram are the only active ingredients relevant to this analysis.
[2] Half-life reported in days unless stated otherwise
[3] Half-life for toxic residues instead of parent

3.4.2 Environmental Consequences

Assumptions

The following assumptions apply to the analysis of effects on soil microbiology:

- Soil chemical reactions occur at a faster rate when soils are warm and moist than when soils are cold, dry, or saturated (Weil and Brady 2019). Herbicide degradation in soils follows the same parameters (Eason et al. 2022; Rasool et al. 2022).
- Soil organisms are generally found in greater numbers near plant roots, where organic compounds are most available (Massenssini et al. 2014; Darine et al. 2015).

- Active ingredients with short soil half-lives (approximately 1 month) are not likely to persist in soils long enough to adversely affect the soil organisms' functionality or abundance.
- Most herbicide applications would occur on aerobic soils; therefore, the following analysis uses the aerobic soil half-life values provided in Table 3-6.
- Where soil erosion occurs in herbicide-treated areas, herbicides adsorbed to soil particles would be transported off-site (BLM 2016b, p. 3-8). The BLM uses the following SOPs to minimize herbicide transport from a targeted treatment area (BLM 2007b, p. 4-13):
  - Minimize treatments in areas where herbicide runoff is likely, such as steep slopes when heavy rainfall is expected.
  - Minimize use of herbicides that have high soil mobility, particularly in areas where soil properties increase the potential for mobility.
  - Do not apply granular herbicides on slopes of more than 15 percent where there is the possibility of runoff carrying the granules into nontarget areas.

Indicators

The indicators of impacts on soil microbiology include:

- Active ingredient soil half-life and adsorption values
- Changes to soil microbial functions and biodiversity

Alternative A—No Action Alternative

Impacts under the No Action Alternative would be the same as those described under Alternative B in the 2016 PEIS (BLM 2016b, p. 4-13). The total area receiving herbicide treatments (932,000 acres) would remain the same as the total area in the 2007 PEIS. Fluroxypyr and rimsulfuron have relatively short half-lives and low soil adsorption values in soil (see **Table 3-6**). Aminopyralid also has a fairly short half-life and low soil adsorption values, but there is evidence that it may be quite persistent (with a half-life of more than a year; see **Table 3-6**) in clayey soils (OPPTS and EPA 2005). Additionally, plant materials and residues that have been treated with aminopyralid may continue to release aminopyralid to the soil until these materials have decomposed.

These three active ingredients have low toxicity to terrestrial organisms (AECOM 2014; EPA 2020a; Radivojevic et al. 2011), but there is a lack of information about their toxicity to soil microorganisms. Fluroxypyr and rimsulfuron (under most conditions) would likely not persist in the soil long enough to adversely affect the soil organisms' functionality or abundance (National Library of Medicine 2011; Martins and Mermoud 1999). Aminopyralid can persist longer, with an average soil half-life of about a month; however, it does not have residual concentration after one year (Lindenmyer 2012).

The use of glyphosate, imazapic, and picloram would continue to decrease. Imazapic and picloram have long half-lives, relative to aminopyralid, rimsulfuron, and fluroxypyr (see **Table 3-6**). This means the overall persistence of herbicides in the soil has and would continue to be reduced. Overall, the potential adverse effects on the soil organisms' functionality and abundance would be minor.

Future research may demonstrate that the active ingredients approved in the 2007 and 2016 PEISs are less beneficial than active ingredients not currently approved for use. Delayed approval of more beneficial active ingredients could result in unavoidable reduced soil organism functionality and abundance until the BLM can approve the use of more beneficial active ingredients.

Alternative B—Preferred Alternative

The BLM would apply preemergent herbicides directly to the soil to prevent weed germination. Post-emergent herbicides would be applied to the treated plant and incorporated into the soil as water infiltrates and from soil microbial interactions with that plant's roots. Either form of herbicide application would increase herbicide concentration in soils and expose soil organisms to these concentrations. Therefore, the impacts from preemergent and post-emergent herbicides would be the same.

The chemical breakdown of herbicides by soil organisms acts as a positive feedback loop to provide these organisms with energy to continue producing chemical reactions (Ayansina and Oso 2006; Sebiomo et al. 2011; Kizildağ et al. 2014; Rose et al. 2016; Torres et al. 2018; Zimdahl 2018; Rasool et al. 2022). This means herbicides, for the length of time they persist in different soils, can increase soil microbial activity. When herbicides are applied to target areas using the recommended label amount, they generally do not adversely affect the soil organisms' functionality or abundance (Rose et al. 2016; Zimdahl 2018; Koçak et al. 2021; Minnesota Department of Natural Resources 2022).

Herbicides that inhibit photosynthesis in plants are the most harmful to biological soil crusts; this is because most species (moss, lichen, cyanobacteria, and algae) in these crusts depend on photosynthesis to grow (Zaady et al. 2013; Rose et al. 2016). None of the proposed active ingredients have this mode of action. Herbicides used to control woody species and perennial grasses have been shown to increase lichen cover while simultaneously reducing either woody species or perennial grass cover (Condon and Gray 2019). Condon and Gray (2019) note that herbicides target vascular plant functions and do not affect lichens, which are non-vascular. In addition, herbicides do not induce bare soil conditions like other fuel treatment methods, such as mowing or prescribed fire. Except for aminocyclopyrachlor, which is described below, the proposed active ingredients would not severely affect the biological soil crust species abundance or diversity.

Aminocyclopyrachlor interferes with auxin receptors to reduce plant growth. Where mosses occur in the biological soil crust, their auxins would be inhibited by this active ingredient, which could reduce their abundance (Clarke Von Reis 2015). Aminocyclopyrachlor has a high soil half-life compared with the other proposed active ingredients, but it has low soil adsorption (see **Table 3-6**). This means it is persistent in soils, especially those with high organic matter and clay content (Guerra et al. 2016); however, it also has high potential for leaching. It has been shown to be lethal to earthworms at 0.03 ounces per pound of soil, based on decreased body weights (SERA 2012). However, annual maximum field applications would not reach this lethal amount (SERA 2012).

Fluazifop-P-butyl and clethodim are both ACCase inhibitors. Studies on the effects of clethodim on soil organisms are not well documented. However, its low soil half-life (see **Table 3-6**) indicates that it does not persist in soil long enough to adversely affect the soil organisms' functionality or abundance.

Fluazifop-P-butyl has high soil adsorption (K_{oc}) values compared with clethodim and the other proposed active ingredients. This means it persists longer in the soil, as demonstrated by its longer half-life (see **Table 3-6**) and has low potential to be leached out of the soil. Fluazifop-P-butyl has demonstrated structural changes to bacteria that increase pathogens in the soil and affect bacteria resilience (Darine et al. 2015). In addition, fluazifop-P-butyl can be lethal to earthworms in high concentrations (Lackmann et al. 2018). In their study, Lackmann et al. (2018) tested earthworm avoidance behavior using four different soils with increasing lethal concentrations of fluazifop-P-butyl and a control soil. The authors found that earthworms avoided the three highest lethal concentrations, in preference to the control soil. This suggests that, though they may still use habitat affected by fluazifop-P-butyl, earthworms prefer to leave these habitats, which could decrease earthworms' function and biodiversity (Lackmann et al. 2018). Fluazifop-P-butyl has also been shown to decrease fungi populations at concentrations above 0.32 pounds of acid equivalent per acre (SERA 2014b). Since this is below the annual maximum application rate, fungi populations would not be affected.

Flumioxazin has a mean K_{oc} of 557 mg/L, which gives it a moderate mobility potential in soils (Kestrel Tellevate 2020a). It degrades quickly in soil, as demonstrated by its low half-life range (see **Table 3-6**). Its half-life is inversely related to soil pH, meaning that the half-life decreases as the soil pH increases (Eason et al. 2022). Studies on flumioxazin's effects on soil organism functionality are not well documented. It can be assumed that it would not adversely affect microbial functions given its low persistence in soil.

Imazamox has a lower soil half-life, compared with the other active ingredients being proposed (see **Table 3-6**). It has a large range of soil adsorption values, which indicates its persistence in soil is very dependent on the soil type. Imazamox has been shown to significantly decrease the activities of nitrate-producing bacteria (Kizildağ et al. 2014). These bacteria are essential for nitrification, which includes the conversion of ammonium to nitrate. While ammonium and nitrate can both be absorbed by plants and support their growth, nitrate is the most available form. Unlike ammonium, it can be converted to atmospheric nitrogen. This conversion needs to occur for nitrogen cycling and microbial activity in soils to continue (Weil and Brady 2019). Imazamox could decrease the functionality of these bacteria to cycle nitrogen out of the soil and to provide enough nitrogen for plant uptake. It could also decrease their abundance relative to ammonium-producing bacteria.

Compared with the other proposed active ingredients, indaziflam has a high soil half-life; it also has moderate mobility in soil (Kestrel Tellevate 2020b; see **Table 3-6**). Indaziflam has been shown to decrease soil organism diversity and, like imazamox, it can impair the ability of soil organisms to complete the nitrification process (González-Delgado et al. 2022). However, in their respective studies comparing microbial activity and biomass in soils with no herbicides (control groups) and soils with indaziflam added, González-Delgado et al. (2022) and Torres et al. (2018) found that microbial activity and biomass were statistically similar to the control groups and were not affected by indaziflam.

Oryzalin has a high soil half-life and high soil adsorption rate (see **Table 3-6**), so it is persistent in soils. Its persistence in soils would be a concern if oryzalin were found to be toxic to soil organisms. The HHERA for oryzalin (SERA 2015) does not include an assessment for soil microorganisms and current research is lacking to demonstrate the effects, if any, of oryzalin on soil organisms' functionality and abundance.

Cumulative Effects

Herbicide adsorption in soil, and in some cases herbicide activation (by hydrolysis), both require a water input (Zimdahl 2018). Climate change could cause more drought conditions in the western US that would inhibit soil organism hydrolysis reactions and, therefore, the efficacy of herbicides in drier soils. Soil organism activity can also be inhibited, and herbicide movement and leaching out of the soil can increase, if there is too much water in the soil (Zimdahl 2018). Climate change could cause more high-intensity precipitation and runoff events that would worsen these effects. However, the BLM would use SOPs for moist or wet soils, as described above, to mitigate these impacts.

In areas adjacent to and within the proposed treatment areas, where mechanical thinning and prescribed fire projects occur in conjunction with herbicides, the potential for high-severity wildfires would be substantially decreased. This would reduce the potential for soil burning and loss of organic matter. It also would increase ecosystem resiliency, including for soil organisms, under both alternatives.

As described above, herbicides generally increase soil microbial activity and do not adversely affect soil organisms' abundance or functionality when they are applied according to the recommended label amount. This means the approved active ingredients under the No Action Alternative would have relatively the same effects as the proposed active ingredients. However, the effects of the 2016 PEIS's approved active ingredients on soil microorganisms are less known. Overall, Alternative B would provide more flexibility for the BLM to approve active ingredients that would be the most useful for specific site conditions. Therefore, it would be more effective than Alternative A in minimizing the effects of climate change and high-severity wildfires that would decrease herbicide effectiveness and soil organism abundance and functionality in soils.

3.5 How Would the Application and Use of Proposed Active Ingredients Affect Water Quality?

3.5.1 Affected Environment

Water Resources (Surface and Groundwater)

Water resources across the United States are important for fish and wildlife habitat and a variety of human needs, such as domestic consumption, industrial activities, crop irrigation, livestock watering, and recreation. Numerous legal and policy requirements have been established to manage water resources for these multiple needs, including the Clean Water Act (CWA), the Colorado River Basin Salinity Control Act, and Executive Order 11988 (Floodplain Management).

Water resources are classified as surface water or groundwater. Surface water resources include rivers, streams, lakes, ponds, reservoirs, and wetlands. Major river systems (for example, the Colorado, Columbia, Missouri, Mississippi, Susquehanna, Rio Grande, and Yukon Rivers) and their tributaries are important sources of water.

The quantity and quality of surface water resources are affected by precipitation, topography, soil type, vegetation, agricultural practices, urbanization, and general land use practices, especially for large tracts of public land. The alteration of vegetative cover from land use practices can have significant impacts on water infiltration, soil erosion, and stream sedimentation.

Groundwaters are different than surface waters as they are located in underground aquifers that cannot be seen. Aquifers recharge and discharge at different rates and locations and can be difficult to assess. Groundwater and the aquifers that contain them can become contaminated and can transport contaminants over great distances very rapidly or over thousands of years. Once contaminated, aquifers can be very difficult to clean, either naturally or by remediation. Very shallow aquifers can release contaminants over a matter of days, while very deep aquifers with long flow paths can take thousands of years to flush, possibly longer if contaminants become bound in the strata.

The continental United States and the State of Alaska are separated into 19 hydrologic regions. As shown on **Map 3-2**, nine hydrologic regions have been identified in the eastern states' portion of the study area: New England, Mid-Atlantic, South Atlantic-Gulf, Great Lakes, Ohio, Tennessee, Upper Mississippi, Lower Mississippi, and Souris-Red-Rainy (USGS 1987). A map of the hydrologic regions in the western states and Alaska is included in the 2016 PEIS (BLM 2016b, Map 3-5).

Alaska and the Western States

A discussion of the western states and Alaska hydrologic regions and their main hydrologic resources is included in the 2007 and 2016 PEISs (BLM 2007b, pp. 3-11 to 3-15; BLM 2016b, pp. 3-8 to 3-9), and is incorporated here by reference.

As global climate change trends continue, the western US is expected to continue seeing hotter and drier conditions. Average yearly precipitation is expected to decrease, snow water equivalent, or the amount of water stored in snow, is anticipated to decrease, and overall water availability will decrease in both surface and groundwater. However, regional variability of drought severity is expected. Groundwater trends and analysis are more difficult to predict; however, it is still expected that groundwater recharge decreases and therefore groundwater levels will decrease and be significantly lower than historical data in certain areas in this region. However, some areas in this region will see increased groundwater recharge and therefore increased groundwater levels (BOR 2021).

Souris-Red-Rainy Region

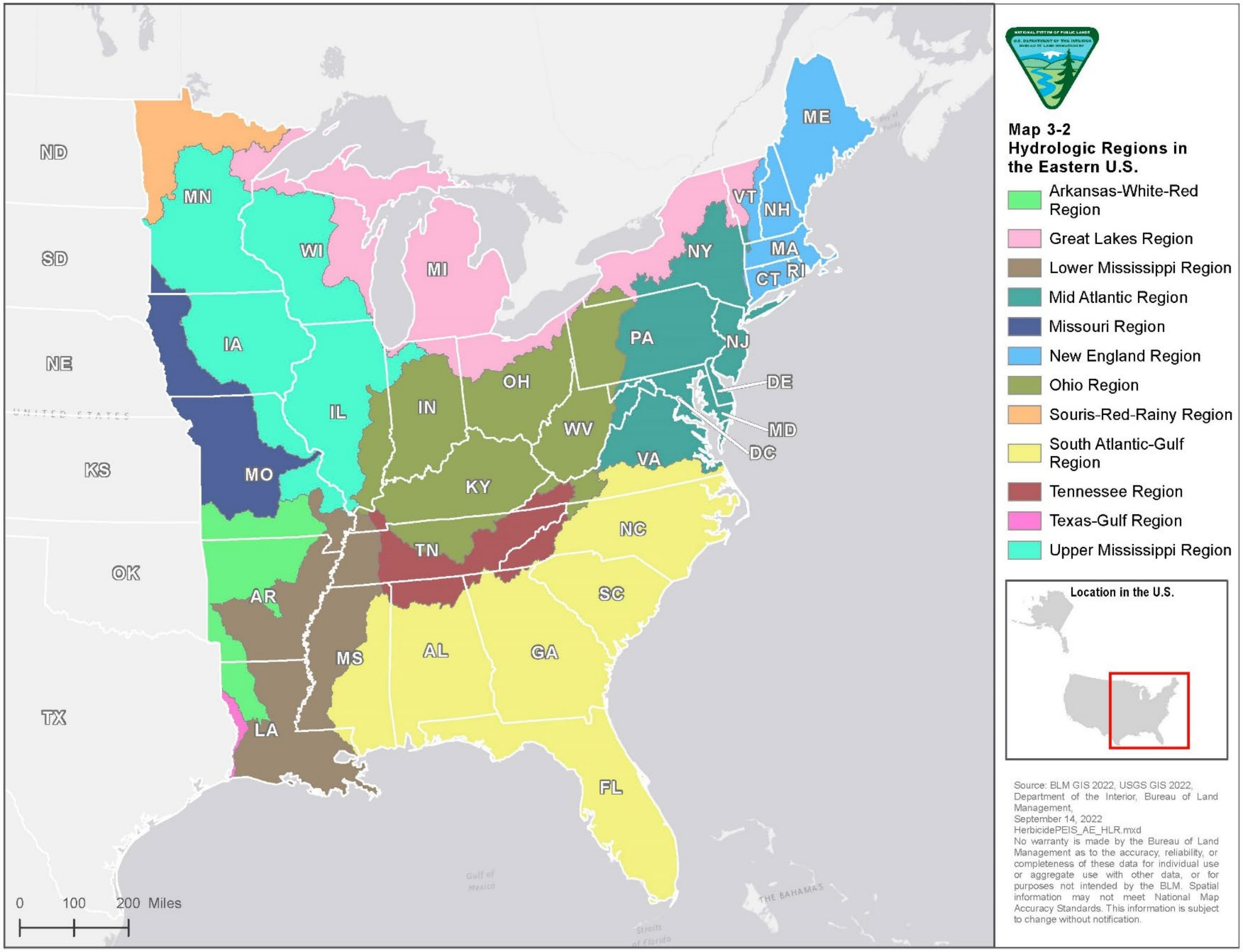
The Souris-Red-Rainy Region encompasses approximately 59,600 square miles of Minnesota, North Dakota, and South Dakota, see **Map 3-2** for the outline of the region (USGS 1987). The region is generally flat with a wide range of hydrologic conditions. This northern region is dominated by cold winter conditions, melting events in the spring, and moderate summer climates. The major river systems consist of the Souris River, Red River of the North (hereafter referred to as the Red River), and the Rainy River. All three rivers drain into Canada (USGS 1987).

The Souris River runs through North Dakota and drains the driest portion of the region. It is highly regulated and a major water supply for agriculture, municipal use, and recreation. An international agreement exists between Canada and the United States to determine water availability for downstream communities in Manitoba, Canada. This region relies on precipitation for stream flow and glacial aquifer groundwater recharge (USGS 2022b).

The Red River runs along the border of Minnesota and North Dakota before draining into Manitoba, Canada. The river is an important water source for major urban areas, but mostly for agricultural communities. Due to the extremely flat topography, the area is very prone to flooding. Semi-arid conditions have led to limited surface and groundwater supply (USACE 2017).

The Rainy River is the easternmost major river in the region, flowing through Minnesota before draining into Canada. The Rainy receives the most average annual precipitation, lending to the best supply of water. Recreation and tourism are the main uses for water in this part of the region (MPCA 2022).

Map 3-2. Hydrologic Regions in the Eastern US



Hydrologic processes vary widely across this region, but typically rely on precipitation for surface water and groundwater recharge. Most of the precipitation falls as rain during the spring and summer and as snow in the winter. Water supply decreases to the west in this region due to changes in climate and increases in population (USGS 1978b).

Lower Mississippi Region

The Lower Mississippi Region stretches from Missouri to the Gulf of Mexico, encompassing approximately 107,000 square miles and including parts of Arkansas, Tennessee, Mississippi, and Louisiana, see **Map 3-2** for the outline of the region (USGS 1987). Most of the region consists of low hills and alluvial valleys along the Mississippi River floodplain. The region's climate varies with latitude, but mainly consists of humid subtropical conditions with high annual precipitation and warm temperatures (USGS 2017).

This region is dominated by the lower stem of the Mississippi River, one of the most important waterways in the United States. Frequent historical flooding has created wide floodplains with rich soils and large amounts of water storage throughout the region. The large supply of surface water paired with the presence of an extremely large aquifer has created ample opportunity for agriculture. Transportation provided by the river and lush farmland led to several urban population centers that have grown in the region (USDA 2012).

Flood control such as levees shortly followed the population growth, which depleted floodplain connectivity along the Mississippi River. As agriculture grew, the demand for water grew with it. Today, particularly in Arkansas and Mississippi, over-extraction from the aquifer has caused rapidly declining groundwater levels, leading to increasingly strict management of water resources in the area (USDA 2012).

Upper Mississippi Region

The Upper Mississippi Region stretches from the headwaters of the Mississippi River in Minnesota to the confluence with the Ohio River, see **Map 3-2** for the outline of the region. The region falls within parts of Minnesota, Wisconsin, Michigan, Iowa, Illinois, Indiana, and Missouri, and encompasses approximately 189,100 square miles (USGS 1987). Like the Lower Mississippi region, this upper region contains a significant amount of agricultural land and large population centers, and is dominated by the Mississippi River and its tributaries (USGS 2022a).

Climate and watershed conditions vary greatly over the region. Generally, the entire area gets adequate average annual precipitation. Recent trends driven by climate change have increased precipitation and flood frequency (NOAA 2022).

The Mississippi River water levels are highly regulated and maintained to allow continuous navigation through the channel. The system has been heavily altered, including channelization, construction of locks, draining wetlands, and installation of diversion structures. Water use in the region is split relatively evenly between groundwater and surface water extraction. Water use has not had a significant impact on water availability; however, recent trends have shown an increase in discharge in the Mississippi River throughout the region (USGS 2022a).

Groundwater in the northern part of the region varies greatly and can be found in sedimentary rock, or glacial sand and gravel. The most accessible aquifers can be found in the glacial sand and gravel areas. Recharge rates vary widely, depending on the aquifer, but, on average, are generally high (MPCA 2017).

Tennessee Region

The Tennessee Region consists of approximately 40,670 square miles across Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee, and Virginia, see **Map 3-2** for the outline of the region (USGS 1987). The region begins in the Appalachian Mountains to the east and drains west along the main stem of the Tennessee River, which flows into the Ohio River just above the confluence with the Mississippi River.

The climate varies with elevation across the region, but is generally temperate and cooler in the higher elevations to the east. Precipitation ranges greatly, from approximately 40 inches per year in the western lowlands to more than 90 inches in the eastern mountains (USGS 1998, USGS 2001). These high levels of precipitation have led to a consistent surface water supply for the region.

Due to the excess surface water supply, most water use and extraction come from surface waters. The Tennessee River and its tributaries are dominated by dams that allow for heavy regulation of flows. Dams in the area allow for water use, agriculture, hydropower, and flood control (ALCC 2018).

The excess surface water supply has also led to less groundwater use compared with other regions. The upper Tennessee River watershed consists of the Appalachian Mountains, where bedrock dominates the local geology, so aquifers are generally confined and small in size (USGS 2001). However, a significant percentage of the rural population in both the upper and lower watershed rely on groundwater for drinking water. The lower watershed has more available groundwater due to the presence of unconsolidated sands and gravel aquifers (USGS 1998).

Ohio Region

The Ohio Region encompasses the Ohio River Basin, excluding the Tennessee River Basin. The region covers approximately 161,250 square miles and includes parts of Illinois, Indiana, Kentucky, Maryland, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia, see **Map 3-2** for the outline of the region (USGS 1987). The Ohio River's major tributaries are the Allegheny, Cumberland, and Monongahela Rivers.

This region consists of a mix of rural agricultural land and urban population centers. Water use is a mix of agricultural, industrial, municipal, and recreational. Most rivers in the region, including the Ohio River, are heavily impacted by a series of dams and locks to regulate flows and transportation (USGS 2016).

Historically, the region receives adequate annual precipitation to maintain surface water supply. The State of Ohio averages more than 3 feet of precipitation annually, with most falling as rain during the spring (ODNR 2011b). Recent trends associated with global change have created extreme climatic swings, including floods and droughts (Cherkauer et al. 2021).

Groundwater is readily available in the region and with average precipitation will typically recharge at adequate rates. However, increasing populations and agricultural withdrawals have led to rapidly decreasing groundwater levels (ODNR 2011a).

Great Lakes Region

The Great Lakes Region consists of the drainage area that ultimately discharges into the Great Lakes system, including parts of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and

Wisconsin, see **Map 3-2** for the outline of the region. The area covers approximately 178,300 square miles and five of the largest lakes in North America: Lake Superior, Lake Huron, Lake Michigan, Lake Erie, and Lake Ontario (USGS 1987).

The climate in this region varies, but typically consists of cold, snowy winters and moderate summers. Precipitation varies drastically across the region due to the "Lake Effect" that can bring extreme snowstorms to areas east of the lakes. With recent global climate change trends, the Great Lakes are experiencing increases in extreme climatic events. Frequent and severe flooding is becoming common, which increases water supply but damages crop yield and negatively impacts developments, especially in urban areas (ELPC 2019).

The Great Lakes region contains the greatest freshwater surface supply in the United States and one of the largest supplies in the entire world. The five Great Lakes hold approximately 5,500 cubic miles of freshwater. Water use in the region consists of agricultural, industrial, transportation, recreation, and municipal. A series of canals and locks allow ocean-going shipping vessels to transport goods from across the world into the Great Lakes (ELPC 2019).

Due to the excess surface water supply and the associated goods and services, groundwater is often overlooked in the region. However, groundwater is a major source of input for the Great Lakes, and it provides drinking water for a significant population within the region. As the suburban and rural population grows in the region, the dependence on groundwater will increase, reducing the amount of groundwater feeding the Great Lakes (USGS 2000a).

South Atlantic-Gulf Region

The South Atlantic-Gulf Region encompasses an approximately 277,000-square-mile area that drains to the Atlantic Ocean and the Gulf of Mexico, see **Map 3-2** for the outline of the region (USGS 1987). This region includes parts of Florida, Louisiana, Alabama, Georgia, Mississippi, Tennessee, South Carolina, North Carolina, and Virginia. Some of the region's major waterways and features include the Everglades wetlands and the Chattahoochee, Savannah, and Alabama Rivers.

This region has a wide range of ecosystems and land uses, including forestlands, wetlands, major urban areas, and agricultural lands. The region has been heavily impacted by hydrologic alteration from wetland draining for agriculture and development. In addition, rising sea levels from climate change are reducing the amount of coastal wetlands and increasing saltwater intrusion to local surface and groundwater supply (EPA 2008).

Ample amounts of surface water in the region are from higher annual precipitation, which averages between 44 to 80 inches and falls almost exclusively as rain (USGS 1979). Precipitation with minimal supplemental irrigation can typically sustain local agricultural practices throughout the growing season. In addition to large amounts of surface water, the groundwater supply in the region is also extensive (USGS 1979). Local withdrawals in heavily populated or agricultural areas are typically negligible due to the high groundwater recharge rate and the high average annual precipitation. However, wetland draining, particularly in coastal areas such as Florida, has had a major impact on groundwater availability (EPA 2008).

Mid-Atlantic Region

The Mid-Atlantic Region drains to the Atlantic Ocean, encompassing an area of approximately 108,000 square miles, see **Map 3-2** for the outline of the region (USGS 1987). The region includes parts of Maryland, Delaware, New Jersey, the District of Columbia, Connecticut, Massachusetts, New York, Pennsylvania, Vermont, Virginia, and West Virginia. Major rivers in the region into the Hudson, Delaware, Susquehanna, and Potomac Rivers.

The region generally has a temperate climate and ample precipitation. Land use in the region mainly consists of large urban and suburban areas, with some rural communities. The region contains the majority of the US population, which has a high demand for water (USGS 1978a). This demand is generally met through the high average annual precipitation of approximately 40 inches (USGS 1978a).

High precipitation rates and a significant amount of impervious rock in the region have led to a substantial amount of surface runoff. Most water use in the region is withdrawn from surface waters. Climate change is not anticipated to have drastic effects on water availability in the region, but streamflow timing may be altered as seasonal temperatures shift (Neff et al. 2000).

The region consists of three general groundwater types that range depending on the distance from coastal areas and the age of the rock in the interior of the region. Some of the region's groundwater can be difficult to access due to old, impervious rock layers. Groundwater is typically used in rural areas and recharged via precipitation (USGS 1978a).

Water Quality

Water quality is defined in relation to its specified and/or beneficial uses, such as human consumption, irrigation, fisheries, livestock, industry, or recreation. The quality of surface water is determined by interactions with soil, transported solids (organics and sediments), rocks, groundwater, and the atmosphere.

In accordance with mandates of the Federal Land Policy and Management Act and the CWA, as well as other laws and regulations that pertain to water quality, the BLM has responsibilities to protect water quality, and it cooperates with the EPA, states, and tribes to meet water quality standards. The BLM must maintain waters for designated beneficial uses, restore impaired water resources in support of their designated beneficial uses, and provide water for public consumption and use (EPA 2013).

Section 303(d) of the CWA requires that water bodies violating state water quality standards and failing to protect beneficial uses be identified and placed on a 303(d) list for impaired waterways. It is a BLM priority to implement mitigation strategies to try to improve water quality which may lead the EPA and State governments to delist 303(d)-listed streams (EPA 2013).

Alaska and the Western States

Alaska and the western United States are continuing to see hot and drier conditions due to global climate change. Additional human development, increases to forest fire size and frequency, and increases to water withdrawals has generally decreased water quantity and quality across these regions (BOR 2021, USGS 2021).

Additional discussion of water quality pollutants and a summary of baseline water quality information for surface and groundwater resources in the western United States hydrologic regions are provided in the 2007 and 2016 PEISs and incorporated by reference (BLM 2007b, pp. 3-15 to 3-18; BLM 2016b, pp. 3-9 to 3-10).

Souris-Red-Rainy Region

Surface water quality varies greatly across the region, depending on land use. The Red River Basin is significantly impaired due to eutrophication, high sulfates, turbidity, pesticides, and fecal coliform (USACE 2017). The Rainy River Basin has significantly higher water quality, particularly with reductions in sediment and phosphorus (MPCA 2022). The Souris River can typically exceed phosphorus levels and can also experience flash increases of nutrients during heavy spring rainstorms (ISRB 2020).

Groundwater in the region varies greatly across the area and within individual aquifers, depending on local conditions. Overall, groundwater typically has a high mineral and saline content. Higher dissolved solids are typically found in the western half of the region around the Souris and Red Rivers (USGS 1978b).

Lower Mississippi Region

Surface water resources along the Lower Mississippi River have generally poor water quality. Contaminant-laden water from the Mississippi River has led to a large hypoxic zone in the Gulf of Mexico. The poor water quality is mostly due to nonpoint sources such as agricultural runoff (Secchi and Mcdonald 2019). The Lower Mississippi also suffers from a drastic reduction in sediment load due to upstream dams. In turn, this has led to a decrease in coastal wetlands (NAS 2007).

Groundwater in the region has good water quality and rarely exceeds human-health benchmarks; however, throughout the region, it had significantly higher phosphorus levels compared to the rest of the country. Despite the large amounts of agriculture in the region, nitrogen levels remain relatively low. Deeper groundwater is vulnerable to decreases in water quality due to high amounts of well pumping for agriculture (USGS 2014).

Upper Mississippi Region

Surface water quality is mainly dictated by land use in this region, with the highest quality water generally found within forested areas, especially the St. Croix River Basin. Agricultural areas, such as the Minnesota River Basin, typically have degraded water quality due to the input of sediment, nutrients, and pesticides. The Mississippi and Minnesota Rivers in the urban area adjacent to Minneapolis can experience the worst water quality in the region due to urban runoff (USGS 2000b).

Groundwater quality tends to mirror surface water quality, with forested areas maintaining higher quality water compared to urban and agricultural lands. Shallow groundwater adjacent to urban areas tends to have the worst quality due to higher surface water exchange. Deeper groundwater, which is used for public supply in these areas, tends to have much better water quality. Some of the greatest pollutants in the region include nitrates and pesticides in agricultural areas and road salts in urban areas (USGS 2000b).

Tennessee Region

Surface water quality is mostly impacted by agricultural lands throughout the region. The eastern portion of the region has significantly better surface water quality due to the undeveloped forested lands. Farther west, the region becomes more heavily impacted by agricultural and human development. Surface water is typically impaired by nutrient loading and pesticides from agricultural lands and by sedimentation and bacteria in urban areas (USGS 2000c).

Groundwater resources throughout the region are typically high in carbonates due to the geology of the area. The groundwater is particularly susceptible to surface water quality, mirroring the quality trend across the region. However, compared to national levels, the groundwater quality throughout this region is typically high quality (USGS 2000c).

Ohio Region

Historically, the surface water in the region has been some of the worst in the nation. While water quality has drastically improved, phosphorus and chloride levels have been trending higher in the Ohio River and its tributaries. The major urban areas along the Ohio River have elevated bacteria levels, and algal blooms from excessive nutrient loading are occurring more frequently in agricultural areas (USGS 2016).

Groundwater resources in the region typically have higher levels of arsenic than national levels. This arsenic is naturally occurring in the geology of the region. Due to oil and gas development, methane can also be found in groundwater adjacent to well development (USGS 2016).

Great Lakes Region

Surface water quality has been heavily impacted recently by urban development and agricultural runoff. Urban areas like Chicago have contributed to significantly higher levels of E. coli. Nutrient loading from agricultural lands has created toxic algal blooms that have left areas like Toledo without access to local drinking water. Climate change is anticipated to have severe impacts on surface water quality as higher runoff from agricultural areas and higher temperatures lead to larger algal blooms (ELPC 2019).

Groundwater quality is generally good throughout the region, with increased degradation in urban areas. Excessive withdrawal of groundwater near urban areas has created poor water quality, as oxygen has been allowed into aquifer layers and resulted in unique chemical reactions not typically seen in groundwater resources. As development continues in the region, groundwater quality is anticipated to continue to degrade (USGS 2000a).

South Atlantic-Gulf Region

Surface water quality is highly variable in the region; some coastal waterways experience high salinity content while interior surface water is impacted by development and agriculture. In recent years, nitrogen levels have decreased, particularly near developed areas where municipal wastewater treatment has improved (USGS 2010). Degradation of wetlands, which are known to have positive impacts on water quality, has had negative impacts on surface water quality throughout the region, particularly in Florida (EPA 2008).

Groundwater quality generally follows patterns seen in surface water: high salinity levels near coastal areas and better-quality groundwater in inland aquifers. Agriculture, septic tanks, landfills, and feed lots have all historically impacted groundwater negatively. In addition, heavy metals have been found around larger urban areas (USGS 1979).

Mid-Atlantic Region

Surface water quality in the region has historically been very poor. Mining, urban development, and agricultural practices were severely degrading surface water quality until the Federal Water Pollution Control Act and CWA were adopted in the 1970s. Since then, phosphorus levels and acidity have decreased significantly due in part to wastewater treatment facilities and the reduction of acid rain (Neff et al. 2000). Mining, agriculture, and urban areas are still creating major problems for surface water quality, including increases in dissolved solids, metals, chloride, and total nitrogen (EPA 2017).

Groundwater quality varies greatly over the region, with coastal areas showing high levels of salinity and interior areas showing high levels of nitrogen and phosphorus. Mountainous regions such as the Appalachians have high levels of alkalinity due to the weathering of the rock. Even with the high alkalinity, the region's mountainous areas tend to have significantly better groundwater quality due to the lack of development and agriculture (EPA 2017).

3.5.2 Environmental Consequences

Assumptions

There are no assumptions specific to the analysis of effects on water quality.

Indicators

The indicators of impacts on water quality include:

- Half-life in water
- Likelihood for runoff and leaching

Alternative A—No Action Alternative

Under the No Action Alternative, the BLM would continue its vegetation treatment program following Alternative B in the 2016 PEIS (BLM 2016b). This program would continue to consist of 21 active ingredients that have been approved for use across the western United States. The estimated total land area treated with herbicides would be no more than 932,000 acres annually. The impacts from the approved active ingredients on water quality under this alternative were summarized in the 2007 and 2016 PEISs and are incorporated by reference (BLM 2007b, pp. 4-24 to 4-36; BLM 2016b, pp. 4-14 to 4-21). The impacts on water quality that depend on the half-life and mobility of the active ingredient would remain the same as outlined in the 2007 and 2016 PEISs.

No approved active ingredient poses contaminant concern to groundwater or drinking waters; however, the potential for contamination does exist. Alternative B in the 2016 PEIS (USGS 2016) was implemented to reduce the use of active ingredients that have a higher chance for contamination, including glyphosate, imazapic, and picloram. This alternative added the use of fluroxypyr, aminopyralid, and rimsulfuron to the approved list of active ingredients from the 2016 PEIS (BLM 2016b). These three active ingredients were added to the approved list because they lowered the risk of adverse effects on water resources, and they will continue to be used on approximately 27 percent of all acres treated (BLM 2016b).

Alternative B—Preferred Alternative

Herbicides can be applied pre- or post-emergent directly to soil, vegetation, or water bodies. Pre-emergent herbicides are typically adsorbed by soil and have a higher chance to reach groundwater resources. Post-emergent herbicides are applied to plants and have a higher chance of reaching surface water bodies via overland runoff. All types of herbicides have the potential to enter groundwater or surface water, with varying degrees of likelihood depending on application methods and site-specific conditions. Herbicides can have direct impacts when added to water resources or indirect impacts such as alterations to riparian vegetation that provides habitat or food to local species. Generally, an herbicide that has a slower half-life and a higher potential for runoff will lead to a greater likelihood of the herbicide reaching surface water. Additionally, the slower the half-life and the higher potential for leaching that an herbicide has, a greater likelihood of the herbicide reaching groundwater. When the herbicide reaches a surface or ground water resource, it has the potential to negatively impact water chemistry, and aquatic organisms. In addition, the herbicide can impact riparian vegetation which could lead to changes in temperature and further impact water quality.

The seven active ingredients analyzed below have been approved by the EPA, and have had extensive assessments for risks to human health and ecological risk. These assessments include any potentially adverse impacts on water resources their half-life in water and likelihood for runoff and leaching. The EPA has created application and use guidelines for each active ingredient to minimize adverse impacts, and the BLM will continue to use SOPs identified in **Appendix A** to reduce impacts on water resources. None of the seven active ingredients are listed on the EPA's National Primary Drinking Water Regulation's contaminant list (EPA 2009). **Table 3-7** includes a list of the half-lives for each active ingredient and the conditions at which these half-lives were calculated.

Table 3-7
Estimated Water Half-life and Associated Conditions for Active Ingredients

Active Ingredient	Water Half-life (days)	Half-life Rating	Conditions	Leaching Potential	Runoff Potential
Aminocyclopyrachlor	1.2–7.8	Low-Medium	pH 6.2–pH 4	Possible	Unlikely in sandy soils
Clethodim	2.1–27	Low-High	pH 5–pH 9	Possible	High in clay soils
Fluazifop-P-butyl	6	High	pH 5	Low	Low
Flumioxazin	1	Low	pH 5	Low	High in clay soils
Imazamox	6.8 hours	Low	pH 5-9	Medium-High	Medium-High
Indaziflam	3.7	Low	pH 7	Medium	High
Oryzalin	2 months	High	N/A	Medium-High	Medium-High

References: EPA 1994, SERA 2010, SERA 2012, SERA 2014a, SERA 2014b, SERA 2015, SERA 2020a, SERA 2020b

Aminocyclopyrachlor

Aminocyclopyrachlor is relatively persistent with high mobility. Under ideal conditions, little mobility is anticipated via wind; however, it is dependent on site-specific characteristics. It has the potential to leach anywhere from 6 to 35 inches and may reach groundwater resources, particularly in areas with shallow groundwater levels and permeable soils (SERA 2012). It also has a high potential to reach surface waters for several months after application. Aminocyclopyrachlor is soluble in water and has a relatively fast half-life range of 1.2 to 7.8 days in water (**Table 3-7**, SERA 2012). When exposed to water and sunlight, it can degrade to cyclopropane carboxylic acid. Cyclopropane carboxylic acid is an environmental degradate, which can be toxic to mammals; however, no risks or concerns were identified for humans (EPA 2020b).

Clethodim

Clethodim is poorly adsorbed in soil, and has a high potential for mobility to surface waters and a lower chance of leaching to groundwater. It is water soluble and can create photoproducts when introduced to water and sunlight (Villaverde et al. 2018). Clethodim has a low persistence, with a half-life ranging from 2.1 to 27 days, depending on water quality (**Table 3-7**, SERA 2014a). However, the photoproducts[10] can remain in the environment for much longer and were found to be much more toxic compared to clethodim (Villaverde et al. 2018). These photoproducts were also significantly better at leaching when compared to clethodim. Standard operating procedures would be followed to mitigate any impacts from these photoproducts.

Fluazifop-P-butyl

Fluazifop-P-butyl strongly binds to soil, and has very low mobility rates. It is unlikely that it will contaminate surface or groundwater via runoff or leaching. If fluazifop-P-butyl does enter a water body, it quickly hydrolyzes to fluazifop acid, becoming very toxic to fish and other aquatic species (TNC 2001). It does not degrade by sunlight and has a half-life of approximately 6 days in water (**Table 3-7**, SERA 2014b). This half-life increases with the rising pH of the water body.

Flumioxazin

Flumioxazin can be applied pre- or post-emergent to land or directly onto surface water bodies. It should only be applied to water resources that are stagnant or have slow velocities, such as ponds or lakes (USDA 2020). The active ingredient should not be applied to bodies of water with higher velocities to avoid migration from targeted area. When applied directly to water bodies, it can decompose aquatic plant tissue and reduce the oxygen to levels that may result in fish kill (Ecology 2012). Flumioxazin degrades rapidly in water with a half-life of 1 day at pH 7 (**Table 3-7**, USDA 2020). It can also degrade in sunlight or with the presence of certain bacteria. The products from degradation can have significantly higher mobility than the parent flumioxazin. However, the mobility of flumioxazin and its products is still low, and contamination of groundwater is unlikely (USDA 2020).

Imazamox

Imazamox is another active ingredient that has been approved by the EPA to be applied to land or directly to surface water bodies. When applied to land, it can be moderately persistent in soils with high mobility (MASS 2014). This combination of persistence and mobility could result in the contamination of groundwater resources. When applied directly to surface water, imazamox degrades significantly faster, with a half-life of 6.7 hours (**Table 3-7**, MASS 2014). It degrades mainly from sunlight and oxygen, resulting in faster degradation in shallow water bodies. It is not considered toxic to mammals, birds, or fish.

Indaziflam

Indaziflam is a pre-emergent active ingredient that is applied directly to the soil and requires precipitation to leach into the soil. It is classified as moderately mobile to mobile, depending on soil type, and it ranges

[10] The product of a photochemical reaction, in this case when an herbicide is introduce to sunlight.

from moderately mobile in aerobic soils to mobile in anaerobic soils (USDA 2020). Due to these traits, indaziflam has the potential to leach into groundwater resources. It is typically found 0 to 6 inches from the surface, but it has been found as deep as 30 inches (USDA 2020). The mobility and persistence also mean it can runoff into surface waters, where it can adversely affect aquatic plants and algae. Microphytes are particularly sensitive to indaziflam and have shown negative effects to even low doses of the active ingredient (USDA 2020). Once it reaches surface water, it remains persistent unless the water body is clear and shallow; in these conditions, indaziflam will degrade much quicker.

Oryzalin

Oryzalin is an active ingredient applied directly to soils, where it has low mobility but high persistence. The high persistence and half-life of approximately 2 months mean the active ingredient can leach into the soils and reach groundwater resources, particularly in areas with permeable soils (**Table 3-7**, EPA 1994, EPA 2019). The low mobility means surface runoff is unlikely; however, if oryzalin does reach surface waters, it can be highly toxic to aquatic plants. It is moderately toxic to fish and moderately to highly toxic to aquatic invertebrates (Erickson and Turner 2003). It has also been found to have adverse effects on endangered aquatic species (Erickson and Turner 2003).

Cumulative Effects

Herbicide efficiency is changing due to the impacts of climate change, including increasing temperatures, changes in precipitation, and elevated carbon dioxide. Studies are finding that some weed species are less sensitive to certain herbicides (Matzrafi et al. 2019). For this reason, it is imperative to have multiple options for herbicides so that treatment can be as efficient as possible.

Climate change is also expected to produce drier conditions causing droughts and erratic precipitation events, leading to an increase in the frequency and severity of floods. With less water availability, weeds are anticipated to outperform native plants and agricultural crops (Jugulam et al. 2018). Extreme precipitation events could lead to significantly more runoff and the potential for high mobility of herbicides within a system.

For herbicidal use within or adjacent to surface water resources, climate change could have compounding impacts on water quality. Reduction of vegetation can increase solar radiation and increase surface water temperature, leading to algae blooms and changes in water body oxygen levels. These will impact habitat and food availability for aquatic species.

The no action alternative and the preferred alternative include the use of herbicides that could impact water quality. The preferred alternative allows for a wider range of options for herbicides, allowing the BLM to make better decisions and potentially reducing localized impacts on water quality.

3.6 How Would the Application and Use of Proposed Active Ingredients Affect Pollinator Habitat?

3.6.1 Affected Environment

A pollinator is an animal that helps move pollen from the male part of the flower to the female part of the same or another flower. Birds, bats, small mammals, and insects are all pollinators that contribute substantially to the US food production systems; however, insects are responsible for most of the pollination and economic value of agricultural crops (USDA and USDOI 2015, Xerces Society 2022). Therefore, the focus of this discussion will be on insect pollinators and their habitats. Additionally, effects on birds and mammals and their habitats have been previously described in the 2007 and 2016 PEISs (BLM 2007b, pp. 4-96 to 4-124; BLM 2016b, pp. 4-51 to 4-63).

Bees

Solitary Bees

Solitary bees are a diverse group of Hymenopterans that do not live in large family groups like honey bees do (Peterson and Artz 2013). Over 90 percent of all bee species are solitary bees, and include species such as mason bees (*Osmia* sp.), plasterer bees (Colletidae family), digger bees (Anthophorini tribe), sweat bees (Halictidae family), and carpenter bees (*Xylocopa* sp.). Approximately 65 percent of female solitary bees build their nests underground; the rest build their nests above ground in existing cavities or excavate nests in dead wood or in soft-pith stems (Sgolastra et al. 2019). Solitary wild bees have spatially separated nest sites and foraging sites with an average foraging range of 328 feet (100 meters) and a maximum foraging range between 492 and 1,969 feet (150 and 600 meters) (Sgolastra et al. 2019; Gathmann and Tscharntke 2002). Native solitary bees are important pollinators of wild plants and crops such as sweet cherry orchards, tomatoes, and sunflowers. Natural habitats for solitary bees include woodlands, prairies, and grasslands (Kline and Joshi 2020).

Social Bees

Social bees live in colonies with one reproductive female and a varying number of nonreproductive workers. Social bees include stingless bees (Meliponini tribe); bumblebees (*Bombus* sp.); and honey bees (*Apis* sp.), including the most well-known: the European honey bee (*A. mellifera*). Social bee species nest in underground cavities such as old rodent burrows and in aboveground cavities such as in trees or in human-made hives (NCSU 2022). The foraging range for social bees is generally larger than solitary bees with a range of 1,024 to 3,281 feet (312 to 1,000 meters) reported for *B. pascuorum* and an average foraging range of 4,921 feet (1,500 meters) for honey bees (Herrmann et al. 2007; Sgolastra et al. 2019). Social bees, particularly honey bees, are important pollinators of crops such as cranberries, almonds, blueberries, squash, pumpkins, and alfalfa, among others (Mader et al. 2010).

Non-bee Insect Pollinators

Non-bee pollinators include butterflies and moths, wasps, beetles, and flies. These pollinators often have broader temporal activity ranges and pollinate at different times of the day compared with bees and in weather conditions when bees are unable to forage. In addition, non-bee pollinators may be more efficient in transferring pollen for some crops under certain conditions and may be able to carry pollen further distances than some bees. This long-distance pollen transfer could have important genetic consequences for wild plants. Non-bee pollinators also tend to be more tolerant to changes in land use compared with bees (Rader et al. 2016).

Butterflies and Moths

Butterflies and moths are both members of the Lepidoptera order, and are valuable pollinators of crops and wild plants. The host plants for butterflies and moths provide a place for their eggs and developing caterpillars, and they provide nectar for the adults (Xerces 2022). Unlike bees, moths and butterflies are incidental pollinators. They seek out nectar and transfer pollen from flower to flower unintentionally (EPRI 2022). Moths and butterflies are important pollinators of plants like yucca, morning glory, milkweed, and purple coneflowers and crops such as carrots, sunflowers, legumes, mint, and mustards (Mader et al. 2010).

Wasps

Wasps are another member of the Hymenoptera that are important pollinators. Most wasps visit flowers for their nectar source or to hunt small insects and, like Lepidoptera, are accidental pollinators. Nevertheless, they are still effective pollinators of plants such as the California bee plant (*Scrophularia californica*) and Brazilian peppertree (*Schinus terebinthifolius*) and are specialized pollinators of many species, including figs, penstemon species, and at least 100 orchid species (Hooks and Espindola 2020a).

Beetles

Beetles belong to the largest insect order, Coleoptera, and make up the largest and most diverse group of pollinators in the United States. They are generalist pollinators of plants such as carrot, buttercup, sunflower, and cabbage and are specialist pollinators of some of the earliest evolved flowering plants such as magnolia, spicebush, water lilies, and custard apples. Beetles visit flowers to feed on pollen, nectar, and sometimes floral structures. Wildflowers, native shrubs and trees, and soil or loose-leaf litter are important habitats for pollinating beetle species (Hooks and Espindola 2020b).

Flies

Flies (Diptera) are another insect group that are important pollinators of crops and wild plants. They have been estimated to contribute to the pollination of at least 70 percent of food crops, and are dominant pollinators in high altitude and latitude environments where the conditions are unfavorable for bees (Hooks and Espindola 2020c). Flies are currently used commercially to pollinate onion, chive, carrot, strawberry, and blackberry crops and are known to pollinate other plants such as dill, parsnip, yarrow, skunk cabbage, and red trillium (Hooks and Espindola 2020c; Mader et al. 2010). Flies belonging to the Syrphidae and Bombyliidae families are major contributors to plant pollination due to their fuzzy bodies and because the adults feed exclusively on nectar or pollen. Many flies lack central nest locations (Rader et al. 2016) and are less impacted by land use changes than bees; however, land management practices that include hedgerows, diverse flower plantings, and no-till practices provide beneficial habitat for fly larval and adult stages (Hooks and Espindola 2020c).

3.6.2 Environmental Consequences

Assumptions

The following assumptions apply to the analysis of effects on pollinator habitat:

- Herbicide treatments of noxious and invasive weeds would temporarily reduce food sources and habitat for pollinators that obtain pollen and nectar from exotic plants and could adversely affect these pollinators, particularly if alternative habitat plants were not available nearby.
- Herbicide treatments that result in decreased plant species homogeneity and the increase in native plant diversity would increase pollinator diversity and potentially increase pollination opportunities.
- The honey bee is the standard test organism for assessing the potential effects of pesticides on terrestrial invertebrates; therefore, risk assessments for other pollinators are often not available. The honey bee serves as a surrogate species for other terrestrial insects and risk characterization is limited by the nature of toxicity data limited to honey bees.

Indicators

Effects on pollinators and pollinator habitat are assessed using the following indicators:

- HQs from HHERAs of the additional seven proposed active ingredients
- Changes in vegetation communities due to nontarget vegetation exposure

Alternative A—No Action Alternative

Since the No Action Alternative in this PEIS corresponds to Alternative B, the Preferred Alternative, of the 2016 PEIS, effects on pollinators and pollinator habitat from using the 21 total active ingredients approved in the RODs for the 2007 and 2016 PEISs would generally be as described in Alternative B of the 2016 PEIS. This is also true of the potential for effects on BLM eastern states lands. In summary, treatments would be expected to improve habitat for pollinators by removing plant species that offer limited habitat value and displace higher-value native forbs and grasses. Temporary loss of herbaceous vegetation that provide sources of pollen and nectar and serve as larval host plants could have a short-term effect on pollinator habitat. These short-term impacts should be offset by long-term improvements to habitat if treatment programs effectively reduce cover of target plant species and promote the establishment of native plant species. Over time, treatments would eventually increase the longevity of the community by providing sustenance to pollinators through increased native plant diversity, vigor, and nutrient and hydrologic cycling, all of which balance a plant community's ability to retain a higher resistance and resilience.

The effects of chemical treatments on plant pollinators would depend on the chemical used, treatment timing, and plant and pollinator species affected. As described in BLM 2007b (pp. 4-101 to 4-118) and BLM 2016b (pp. 4-39 to 4-41), some chemical formulations can be toxic to pollinators; acute or chronic exposure to these formulations could result in mortality and reduced population sizes, indirectly reducing ecosystem function. Following SOPs and mitigation measures described in the PEISs, such as using lowest effective rates, applying application buffers, and preventing drift, would minimize or prevent these impacts. This would prevent or reduce pollinator mortality and population decline, indirectly maintaining pollination rates and ecosystem function. These measures are consistent with best practices for pollinators on western rangelands such as using formulations that are least toxic to pollinators (for example, using such as granular formulations instead of wettable powders or microencapsulated formulations), using the lowest effective rates, timing application to avoid pollinator exposure, incorporating application buffers, and preventing drift, among others (Xerces 2018).

Following SOPs and mitigation measures from the 2007 and 2016 PEISs would also prevent impacts or reduce impact intensity on pollinator habitat, including death, reduced productivity, and abnormal growth from unintended contact with chemicals via drift, runoff, wind transport, or accidental spills and direct spraying. The degree of impact would depend on the chemical used and its properties, such as its persistence, the application rate, the treatment method, the physical site conditions, and the weather (such as wind or rain) during treatments (BLM 2007b, pp. 4-47). These effects would generally occur during and immediately following treatments.

Alternative B—Preferred Alternative

Adding the seven proposed active ingredients to the suite of tools for vegetation management would mean that they could be used anywhere on BLM-administered lands, subject to applicable usage restrictions and site-specific NEPA analysis. Broadly, the potential effects on pollinators and pollinator habitat would be similar to those described for the No Action Alternative. The paragraphs below provide additional analysis of potential effects on pollinators and pollinator habitat by the individual active ingredients, and by select herbicide characteristics. Exposure pathways and associated risks to pollinators and pollinator habitat were evaluated in HHERAs for the proposed active ingredients referenced in the discussions below.

Aminocyclopyrachlor

At the maximum application rate of 0.28 pound acid equivalent/acre, the HQ for the direct spray of honey bees with no foliar interception is 0.02, below the level of concern by a factor of 50. Given these very low HQs, there is no basis for asserting that insect pollinators would be at risk due from the deposition of aminocyclopyrachlor. Given the generally low direct toxicity of herbicides to insects, this risk characterization for aminocyclopyrachlor is common to many herbicides (SERA 2012).

The current risk assessment is concerned with reports of damage to conifers following applications of aminocyclopyrachlor (SERA 2012). Since conifers are wind-pollinated species, this would not have an effect on pollinator habitat. Aminocyclopyrachlor is an auxin-mimicking active ingredient. Given that broadleaf plants are more sensitive to auxin-mimicking active ingredients than grasses, effects on pollinator habitat from treatments of aminocyclopyrachlor would be greater than treatments that target grasses since grasses are wind pollinated and are not as common pollinator habitat. However, some native grasses do provide host plants for the larvae of butterflies and moths, structure and cover for nesting bumblebees, and a source of pollen for bees, which could have negative effects on habitat for those pollinators if nontarget grasses are impacted. General effects on pollinator habitat from aminocyclopyrachlor would be the same as effects on nontarget vegetation discussed in **Section 3.2.2**.

Clethodim

According to the HHERA, exposure studies on the toxicity of clethodim on honey bees do not report mortality rates or information and observations on sublethal effects and an oral toxicity study of honey bees has not been identified (SERA 2014a).

Clethodim is a fatty acid biosynthesis inhibitor that obstructs the enzyme ACCase (WSSA Group 1), which is used for selective post-emergent control of annual and perennial grasses and has low to no efficacy on broadleaf plants. As described for aminocyclopyrachlor, treatments that target grasses would result in less effects on pollinator habitat than treatments that target broadleaf plants. General effects on pollinator habitat from clethodim would be the same as effects on nontarget vegetation discussed in **Section 3.2.2**.

Fluazifop-P-butyl

The HQ associated with direct spray of honey bees is 0.03, which is below the level of concern by a factor of over 30. HQs based on drift, with or without foliar interception, are much lower, indicating that there is no basis for asserting that insect pollinators would be at risk from the deposition of fluazifop-P-butyl (SERA 2014b). The HHERA also indicates that there is no basis for asserting that herbivorous insects would be at risk following the consumption of contaminated vegetation (SERA 2014b). Summaries of toxicity studies on insects other than the honey bee indicate levels of concern may be viewed as variable, ranging from 0.5 for direct toxicity to 0.1 for threatened or endangered species. However, these studies were conducted with Fusilade Max (13.7 percent active ingredient) and their relevance in assessing risks associated with Fusilade DX that might be used on BLM-administered lands is not clear (SERA 2014b).

Published field studies indicate that applications of fluazifop-P-butyl, used to enhance the growth of wildflowers, can be beneficial to both bees and butterflies. They also suggest that the beneficial effect on habitat may outweigh, or at least outlast, any possible direct toxic effects for species of insects that rely on wildflowers (SERA 2014b). Fluazifop-P-butyl is used to control grasses, and is less toxic to dicots, which would result in less effects on pollinator habitat. General effects on pollinator habitat from fluazifop-P-butyl would be the same as effects on nontarget vegetation discussed in **Section 3.2.2**.

Flumioxazin

HQs for direct spray and spray drift exposure to honey bees were all below 0.03, with no lethality or sublethal effects observed. No data for ingestion of flumioxazin were identified, which is considered a data gap (Kestrel Tellevate 2020a).

Both monocots and dicots are sensitive to flumioxazin, which would result in a greater effect from unintentional applications to pollinator habitat than herbicides that target grasses. General effects on pollinator habitat from flumioxazin would be the same as effects on nontarget vegetation discussed in **Section 3.2.2**.

Imazamox

HQs for honey bees range from 0.07 to 1.1, where the upper bound HQ of 1.1 is associated with the consumption of contaminated short grasses and would not be regarded as a substantial concern for pollinators (SERA 2010).

Both monocots and dicots are sensitive to imazamox, which would result in a greater effect from unintentional applications to pollinator habitat than herbicides that target grasses. General effects on pollinator habitat from imazamox would be the same as effects on nontarget vegetation discussed in **Section 3.2.2**.

Indaziflam

HQs for honey bees are well below one for direct spray, spray drift, and the consumption of contaminated vegetation or prey, which means there is no basis for asserting that application of indaziflam would lead to significant, or even detectable, signs of toxicity to honey bees or herbivorous insects (Kestrel Tellevate 2020b).

Indaziflam is a broadcast pre-emergent active ingredient used to target cheatgrass and other grasses and broadleaf species. This would result in a greater effect from unintentional applications to pollinator habitat than active ingredients that only target grasses. However, since it is a pre-emergent active ingredient, treatments would likely occur during periods when pollinator habitat is not in flower, which would have less effects on pollinator habitat. This is particularly useful in areas where the seedbank is composed mostly of nonnative species. However, treatments of indaziflam in diverse, native shrub communities that have a native, diverse seedbank could decrease species diversity and richness, which would degrade pollinator habitat (Meyer-Morey et al. 2021). General effects on pollinator habitat from indaziflam would be the same as effects on nontarget vegetation discussed in **Section 3.2.2**.

Oryzalin

Risks to honey bees are not quantified in the HHERA for oryzalin, which is a data gap (SERA 2015).

Oryzalin is a pre-emergent active ingredient that can be used for the management of annual grasses and broadleaf species. Effects on pollinator habitat from oryzalin would be the same as described for indaziflam and nontarget vegetation (**Section 3.2.2**).

Analysis by Modes of Action

Table 3-3 in **Section 3.2.2** describes the modes of action and general effects on vegetation for 29 different herbicide mode of action groups. Effects on pollinator habitat would be the same as effects on nontarget vegetation described in **Table 3-3**. In general, modes of action that are primarily used for grass control, are short-lived in the soil or are inactive in soil, have low water solubility, or are used at relatively low rates would result in less effects on nontarget vegetation and, by proxy, pollinator habitat. Examples of these are ACCase inhibitors and glutamine synthetase inhibitors. Modes of action that are used for grass and broadleaf weed control, have a greater potential for off-site movement via runoff or percolation, or have long soil residence times would affect a wide variety of nontarget vegetation and increase the potential for nontarget vegetation effects, which would degrade pollinator habitat. Examples of these include photosystem II inhibitors, carotenoid biosynthesis inhibitors, and synthetic auxins.

Pollinators that inhabit subsurface areas may also be at higher risk if soils are nonporous and herbicides have high soil-residence times. Soil is not likely to be an important route of exposure for honey bees, but it is very relevant for species that nest underground like the alkali bee (*Nomia melanderi*) (Sgolastra et al. 2019).

As described in **Section 3.2.2**, using active ingredients with different modes of action would increase weed treatment effectiveness, helping maintain vegetation community structure and function, which would improve pollinator habitat. Following the SOPs in **Appendix A** would reduce, but not eliminate, the potential for effects on pollinators and pollinator habitat.

Cumulative Effects

Cumulative effects on pollinators and pollinator habitat have been previously described in the 2007 and 2016 PEISs (BLM 2007b, pp. 4-216 to 4-222; BLM 2016b, pp. 4-109 to 4-110). Cumulative effects on pollinator habitat would be the same as for nontarget vegetation as described in **Section 3.2.2**. Past effects include discussion of habitat loss, modification, and fragmentation as well as wildlife (including pollinator) health. Future effects on pollinators include continued loss, modification, and fragmentation of habitat, increasing the likelihood of the loss of species diversity and local extirpations. Actions to protect pollinators and their habitats, restore native plant communities and disturbance regimes, control the spread of invasive species, and reduce the risk of catastrophic wildfire are all expected to help offset some of the adverse impacts to pollinators and pollinator habitats.

In summary, the use of herbicides and other pesticides will continue and likely increase, and pollinators will continue to be at risk for exposure to these chemicals. Identifying and restricting use of active ingredients with the greatest toxicological risks to pollinators in favor of active ingredients with lower risks would help reduce cumulative effects associated with exposure to pesticides.

Because the acreage of public lands treated with herbicides would be similar under both alternatives, the impacts to pollinator habitat would also be similar under both alternatives. Countervailing long-term effects associated with restoration of native plant communities and disturbance regimes would also be similar under both alternatives.

Under the No Action Alternative, the number of active ingredients used by the BLM would be 21. Under the preferred alternative, seven additional active ingredients would be used. The potential toxicological effects on pollinators associated with the active ingredients vary. By allowing the BLM the flexibility to use additional active ingredients, the action alternatives would result in the release of a larger number of active ingredients. A cumulative effect of adding additional active ingredients could be a reduction in overall risk to pollinators associated with herbicide use, as use of active ingredients with a greater risk to pollinators would potentially be less. The ways in which the additional seven active ingredients might interact with other active ingredients, and the potential for synergistic effects, are largely unknown. Additionally, the toxicity of breakdown products to pollinators is largely unknown.

3.7 HOW WOULD THE APPLICATION AND USE OF PROPOSED ACTIVE INGREDIENTS AFFECT FIRE RISK ACROSS THE LANDSCAPE?

3.7.1 Affected Environment

Fire Regime Groups

Fire regime groups on BLM-administered lands in the western US are described in the 2016 PEIS (BLM 2016b, p. 3-19). Five natural fire regimes developed using a combination of fire severity (reflecting relative vegetation replacement) and fire frequency were used to classify fire patterns and its interactions with the landscape. Throughout the western US, 44 percent of BLM-administered lands were categorized under groups I through III, where more frequent fire is generally desired (and historically present). The majority (66 percent) were categorized under groups IV and V, which represent higher severity regimes with lower fire frequency. Historically, these lands were adapted to an occasional fire and native shrub species prevented the expansion of invasive grasses and other plants less tolerant to fire. Since native plant species in such communities have a longer recovery time after disturbance, they are easily outcompeted by invasive annual grasses. Cheatgrass, in particular, spreads easily after disturbance because of its fast growth rate, high seed productions, and rapacious root development (Courkamp 2022). Fire regime groups in the eastern states portion of the study area are primarily in fire regime groups I through III and are broadly not experiencing the same issues related to invasive annual weed spread as in the western US.

Vegetation Condition Class

Vegetation condition class describes how much current vegetation conditions have departed from the natural fire regimes. This measurement was not included in the 2007 or 2016 PEISs; as such, information for the entire study area is presented below. Acres of each vegetation condition class in the study area are shown in **Table 3-8**. Of the areas classified under one of the vegetation condition classes (excludes "Other"), the largest portion (38 percent) experienced low to moderate vegetation departure (class I.B, 17-33 percent departure), followed by 30 percent that experienced moderate to low vegetation departure (class II.A, 34-50 percent departure). Only about 18 percent of the classified areas experienced very low departure (class I.A, 0-16 percent departure). The remaining areas experienced moderate to high and very high vegetation departures, with 1 percent of all areas experiencing 84 to 100 percent vegetation departure (class III.B). The largest portion of lands with very high vegetation departure (class III.B, 84-100 percent departure) were found in New Mexico (88 percent). New Mexico also contained the largest proportion of areas (20 percent) with high vegetation departure (class III.A, 67-83 percent departure) and Wyoming had the largest proportion of areas (51 percent) that had moderate to high vegetation departures (class II.B, 51-66 percent departure). Overall, the greatest level of vegetation departure has been observed for the western US.

Table 3-8
Vegetation Condition Class

Vegetation Condition Class	Acres	Description
I.A	41,022,000	Very low vegetation departure, 0-16%
I.B	84,752,000	Low to moderate vegetation departure, 17-33%
II.A	67,457,000	Moderate to low vegetation departure, 34-50%
II.B	23,824,000	Moderate to high vegetation departure, 51-66%
III.A	4,821,000	High vegetation departure, 67-83%
III.B	2,802,000	Very high vegetation departure, 84-100%
Other	17,869,000	Water, snow and ice, non-burnable urban, burnable urban, barren, sparsely vegetated, burnable agriculture

Source: BLM GIS 2022

Much of the departures from historic condition observed in the western US has been attributed to fire suppression following European settlement across the west. This practice led to the expansion of less fire-tolerant plant species and accumulation of hazardous fuel. A combination of increased fuel load and continuity has led to increased fire frequency and decreased interval between fire returns, which accelerates the spread of invasive annual grasses.

There is a strong relationship between precipitation and fire in the western US, particularly the Great Basin ecoregion. The precipitation pattern of consecutive wet years followed by consecutive dry years allow for fuel accumulation and increase the probability of wildfire events in dry years (Pilloid et al. 2017). Cheatgrass is highly flammable and in arid shrub-dominated portions of the Great Basin ecoregion, cheatgrass has been observed to burn 2 times more frequently than all other vegetation types and is more likely to result in larger fires (Blach et al. 2013). Driven by higher fine fuel biomass, increased flammability and/or faster postfire recovery (Haubensak et al. 2009), a grass-fire feedback has steadily converted portions of sagebrush steppe to grasslands.

Recent Fire History

Between 2013 and 2021, the number of wildfires and land area burned have increased, with drastically larger increases during the 2020-2021 time period. **Table 3-9** shows number of fires and acres burned on BLM-administered and non-BLM-administered lands for the time period between 2013 and 2021. The peak of the US wildfire season has been occurring in July for the time period between 2002 and 2020, a month earlier than its occurrence during the time period between 1984 and 2001. The proportion of burned land suffering severe damage has increased from 5 to 23 percent between 1984 and 2020 (EPA 2022b).

3.7.2 Environmental Consequences

Assumptions

The following assumption applies to the analysis of effects on fire risk:

- The number and cause of fire starts would remain unchanged.

Indicators

The indicator for impacts on fire is the length of time active ingredients would persist in the soil.

Table 3-9
Fires on or Threatening BLM-administered Lands

Year	Number of Fires	BLM acres	Non-BLM acres	Total
2013	3,923	1,005,946	1,085,373	2,091,319
2014	2,950	505,775	523,365	1,029,140
2015	3,221	2,171,985	3,903,179	6,075,164
2016	3,247	473,456	1,172,459	1,645,915
2017	4,007	1,587,593	1,691,290	3,278,883
2018	2,216	833,320	1,413,829	2,247,149
2019	1,731	570,399	323,348	893,747
2020	25,731	1,130,034	8,453,485	9,583,519
2021	24,154	330,165	5,824,959	6,155,124

Sources: BLM 2014, BLM 2015, BLM 2016, BLM 2017, BLM 2018, BLM 2019, BLM 2020, BLM 2021, BLM 2022

Alternative A—No Action Alternative

Under the No Action Alternative, BLM would continue the current vegetation management program, using 21 total active ingredients across the US to treat no more than an estimated 932,000 acres annually. The impacts under this alternative on fire risk would be similar to those described under Alternative B in the 2016 PEIS (BLM 2016b, p. 4-66). The beneficial effects of using herbicide treatments on fire regimes are described in the 2007 Programmatic Environmental Report (BLM 2007c, p. 4-53). In general, treatments that remove hazardous fuels from BLM-administered lands would be expected to reduce the incidence and severity of wildfires and move lands toward historic fire regimes.

Some treatments would be very successful at removing weeds over the short term, but seeding of native plant species would be necessary to reestablish desired conditions. Species such as cheatgrass would remain dominant over large areas due to the difficulty in eradicating this species, in part attributable to its ability to rapidly grow and reproduce before most native grasses and the need for multiple treatments over many years. The time and cost involved in treating large cheatgrass-infested areas repeatedly may continue to prevent successful control of this species, with a continued risk of large wildfires across the landscape.

Alternative B—Preferred Alternative

Under the preferred alternative, 7 active ingredients would be used to help reduce the spread of invasive plants and reduce hazardous fuel availability. The use of the 7 active ingredients would allow BLM managers more options in choosing herbicides to best match treatment options with particular site conditions, thereby increasing the probability that fire regimes move closer to historical levels. Use of active ingredients would reduce the likelihood for herbicide resistance (see **Section 3.3**), which would likely improve treatment effectiveness and reduce hazardous fuels.

Some active ingredients, such as indaziflam, are more persistent in the soil and thus provide a longer-term mechanism to remove and prevent the re-introduction of some weeds (Terry et al. 2021, see **Section 3.4**). One study has evaluated long-term control of invasive annual grass and rangeland restoration with indaziflam. Courkamp (2022) analyzed the effectiveness of imazapic and indaziflam in reducing cheatgrass density and cover over a 5-year period at two invaded sagebrush habitat sites near Pinedale, Wyoming. Single applications of indaziflam greatly reduced cheatgrass to low levels, and effectively depleted cheatgrass seed banks within the soils. This suggests that it may be possible to eliminate cheatgrass seed banks with one application. However, cheatgrass can re-establish through seed dispersal once the herbicide becomes inactive in the soil, making reapplication after several years necessary. Also, higher elevations with colder climates are typically less susceptible to a monoculture of cheatgrass; cheatgrass at these elevations may go through natural cycles of growth and depletion that vary based on climatic factors, such as spring precipitation, and drought. In Courkamp's study, field sites were located at high elevations and may have experienced these natural cycles of growth and recession of cheatgrass during the study period, therefore suggesting site-specific approaches to the control of nonnative annual grasses with indaziflam are needed (Courkamp 2022).

In addition, effects on nontarget species are a consideration in the use of indaziflam. Meyer-Moyer et al. (2021) conducted a field study evaluating the impacts of indaziflam on nontarget native species in areas that had infestations of annual mustards in big mountain sagebrush communities in Yellowstone National Park. Their findings showed that indaziflam controlled the emergence of annual mustard for approximately 2 years, however had a negative impact on native perennial forbs. Because indaziflam effectively controls the emergence of plant species through the depletion of seedbanks in the soils, it also affects new recruitment of native perennials that rely on seedbanks in the soils (Meyer-Moyer et al. 2021). The researchers concluded that indaziflam would better be suited in areas where the invasion of nonnative annual grasses is the dominating plant species, and diversity of native forbs and grasses are low. Other studies highlight the effectiveness of indaziflam in the control of cheatgrass with temporary effects on native perennial grasses and fobs but unlikely long-term impacts on the diversity of native plant communities. This is because indaziflam remains near the surface of the soil, depleting shallow seedbanks. While new growth of perennials is temporarily impacted, the established perennial plants were shown to remain unaffected. Cheatgrass seed banks are typically shallow and short-lived, while perennial forbs and grasses have deeper root systems that are not stunted by the application of indaziflam (Courkamp 2022). This finding is further supported by Seedorf et al. (2022), who found that native perennial plant communities were not negatively impacted by prescribed burns with applications of indaziflam. This is because native perennials with established roots showed some resistance to the low intensity prescribed burns and were not stunted by indaziflam treatment.

The study by Seedrof et al. (2002) evaluated the combination of indaziflam treatments with prescribed burning. They compared the effectiveness of prescribed burning followed by indaziflam treatments with treatments without prescribed burning. The effectiveness of prescribed burning followed by indaziflam application greatly enhanced the control of cheatgrass. Prescribed burns allowed for lower levels of indaziflam to be used with the same efficiency as multiple treatments without prescribed burns. After prescribed burns, there is less residual ground cover and litter, therefore more of the herbicide can reach the soil surface, having a stronger impact on seed banks of annual grasses across multiple seasons. Prescribed burning may not be feasible in some areas, however. In these areas, applying a selective postemergence active ingredient (such as imazapic or rimsulfuron) with higher levels of indaziflam may be effective in the control of annual grasses where ground cover and litter remains (Seedorf at al. 2022).

Cumulative Effects

Anthropogenic climate change can further increase the spread of invasive annual grasses and contribute to the grass-fire feedback loop. Climate factors that affect cheatgrass cover include changes in precipitation timing and volume, increases in freeze-thaw cycles, and earlier and/or longer fire seasons (Abatzoglou and Kolden 2011; Boyte et al. 2016). Parts of the west and southwest show the largest increase in burned acreages. Burned acreage in the west has increased noticeably in nearly every month of the year (EPA

2022b). With a warming climate, this trend is projected to further increase in those regions (Wehner et al. 2017). Climate change threatens to increase the frequency, extent, and severity of fires through increased temperatures and drought (Wuebbles et al. 2017). Other factors such as land use, large-scale insect infestation, fuel availability (including invasive species such as highly flammable cheatgrass), and management practices, including fire suppression—play an important role in wildfire frequency and intensity. All of these factors influencing wildfires vary greatly by region and over time, as do precipitation, wind, temperature, vegetation types, and landscape conditions (USDA 2013).

The no action alternative would not contribute substantially to cumulative effects, as it would maintain the current trends in fire risk. The preferred alternative would likely reduce cumulative effects due to the use of indaziflam which, if used over a large scale, would reduce the extent and spread of nonnative invasive grasses such as cheatgrass and disrupt the grass-fire feedback loop.

3.8 ENVIRONMENTAL JUSTICE

Under all alternatives, herbicide treatments could occur on BLM-administered lands near minority or low-income populations. As discussed in the 2007 PEIS (BLM 2007b, p. 4-167), it is not possible to determine whether these populations would be disproportionately affected at the broad scale of analysis in this PEIS. Specific evaluation of environmental justice impacts would be conducted in concert with environmental analyses for site-specific treatment project proposals. Additionally, ongoing consultation and close communication with Indian tribes about the locations and timing of future herbicide treatments would continue to address potential impacts to Native American populations.

3.9 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The 2007 and 2016 PEISs summarized the short-term effects of herbicide treatment activities, versus the maintenance and enhancement of potential long-term productivity for the BLM's ongoing vegetation management programs (BLM 2007b, pp. 4-246 to 4-251; BLM 2016b, pp. 4-117 to 4-121). E Effects described in those two documents would be largely applicable to treatments involving the seven active ingredients proposed for use for nontarget vegetation, water quality, and fire risk. Additional discussion is provided below related to herbicide resistance, soil microbiology, and pollinator habitat.

The use of active ingredients could replace active ingredients to which weeds have developed resistance and could increase the effectiveness of weed control over the short-term. If weeds do not develop additional herbicide resistance, this would increase long-term productivity by removing weeds and improving cover of native plants. It is not known, however, whether active ingredients would remain effective over the long term or whether weeds would continue to develop resistance to these active ingredients.

Although treatments would have short-term effects on soil microbes, it is predicted that the reduction in weeds and restoration activities that increase native species would support a healthier environment for these organisms. This effect may cause a positive feedback whereby an increase in soil microbe diversity would further support the health and functioning of native plant species over the long term.

All treatments could have short-term adverse impacts to pollinators and pollinator habitat, as discussed under **Section 3.6** above. Several of the active ingredients are of lower risk to pollinators than many of the currently approved active ingredients. Treatments that improve habitat would provide long-term benefits to pollinators by restoring pollinator habitat and reducing the risk of catastrophic wildfire.

3.10 Unavoidable Adverse Effects

The 2007 and 2016 PEISs summarize the unavoidable adverse effects that would occur as a result of the BLM's vegetation management programs, including herbicide and other forms of vegetation treatment analyzed in the 2007 PER (BLM 2007b, pp. 4-243 to 4-246; BLM 2016b, pp. 4-115 to 4-117).

As the seven active ingredients would be incorporated into the BLM's treatment programs, but the extent and goals of those programs would remain unchanged, the analysis provided in the 2007 and 2016 PEISs is largely applicable to treatments involving active ingredients. Many adverse impacts could be lessened by SOPs but would not be completely eliminated or reduced to negligible levels. No unavoidable adverse effects on fire risk are expected.

Depending on the location, extent, type of herbicide, and method of application, unavoidable adverse impacts could potentially include:

- Herbicide treatments would continue to cause unavoidable short-term disturbances to plant communities by killing both target and non-target plants and removing pollinator habitat. The extent of these impacts is not expected to change substantially as a result of adding the active ingredients, as they act by modes of action similar to those of some of the currently approved active ingredients.
- While many of the proposed active ingredients were chosen to address herbicide resistance that has developed to current active ingredients, it is likely not possible to prevent additional herbicide resistance from developing with the continued use of active ingredients.
- Herbicide treatments would continue to result in changes or damage to soil microbes as described in **Section 3.4** above. No addition impacts to soil microbes would occur as a result of adding the active ingredients, although these organisms would be exposed to active ingredients and their degradation products.
- Water quality would continue to experience impacts as a result of continued use of herbicides. The geographic extent of water resources potentially exposed to herbicide treatments would show little change as a result of adding the active ingredients, but active ingredients, degradates, and other ingredients would be released to the environment, increasing the number of potential water contaminants.

3.11 Irreversible and Irretrievable Commitment of Resources

The 2007 and 2016 PEISs summarized the irreversible and irretrievable commitments of resources that would occur from herbicide treatments (BLM 2007b, pp. 4-251 to 4-253; BLM 2016b, pp. 4-121 to 4-123). Effects described in those two documents would be largely applicable to treatments involving the seven active ingredients proposed for use for nontarget vegetation, soil microbiology, and water quality. Additional discussion is provided below related to herbicide resistance and pollinator habitat. Herbicide treatments would have irreversible or irretrievable commitments of resources related to fire risk.

Use of herbicides could cause herbicide resistance to develop, which would constitute an irreversible effect. It is expected that with use according to the label and with application of SOPs, these effects would not occur.

While none of the active ingredients pose a known toxicological risk to pollinators, some individual pollinators could be affected irreversibly by equipment used during treatments or habitat modification.

However, overall effects to populations would be reversible. Native pollinator habitat that is lost as a result of treatments would be irretrievable until native plant communities are reestablished, usually within several growing seasons. Treatments that improve rangeland and forestland ecosystem health, including plant productivity, would translate into benefits for pollinators, except for those species that have adapted to use nonnative species.

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Chapter 4. Consultation and Coordination

This section summarizes the public involvement and scoping and public comment process conducted for the preparation of the Draft PEIS. Summaries of agency and government-to-government consultation are provided. The individual preparers, with their areas of expertise and/or responsibility, are also listed.

4.1 PUBLIC INVOLVEMENT

4.1.1 Public Scoping

The BLM published a Federal Register Notice of Intent (Notice) on April 4, 2022 (Federal Register, Volume 87, Number 64, Pages 19525-19526). The Notice asked the public to provide comments on the proposal to use eight active ingredients in its vegetation treatment activities, and to identify issues that should be considered in the PEIS. The BLM later dropped the active ingredient trifluralin from consideration for analysis. The Notice indicated that the public comment period for the scoping process was 30 days.

The BLM received 19 individual submissions during the public scoping period, with a total of 6 substantive comments. Substantive comments have been addressed through the analysis of issues in this PEIS. A scoping report is available for review upon request.

4.1.2 Public Review and Comment on the Draft PEIS

[To be developed before the Final PEIS]

4.2 AGENCY COORDINATION AND CONSULTATION

4.2.1 Endangered Species Act Section 7 Consultation

The BLM initiated informal consultation with the USFWS and NMFS (the Services) in August 2022. A BA evaluating the likely impacts to listed species (and species proposed for listing) and critical habitat from the preferred alternative, and presenting programmatic level conservation measures to minimize impacts to these species, will be submitted to the Services for their review and comment. The BA will also include an Essential Fish Habitat Assessment, as required under the Magnuson-Stevens Fishery Management Act. Consultations with are ongoing and will be completed by the time of the signing of the ROD.

4.2.2 Cultural and Historic Resource Consultation

The BLM is consulting with State Historic Preservation Officers as part of Section 106 consultation under the National Historic Preservation Act to determine how treatments with active ingredients could impact cultural resources listed on or eligible for inclusion in the National Register of Historic Places. Formal consultations with State Historic Preservation Officers and Indian Tribes also may be required during implementation of individual projects. Consultations with State Historic Preservation Officers are ongoing and will be completed by the time of the signing of the ROD.

4.3 GOVERNMENT-TO-GOVERNMENT CONSULTATION

Formal government-to-government consultation with federally recognized traditional governments and Alaska Native Corporations is being initiated by written correspondence. The letter sent to all of the tribal governments and Alaska Native Corporations describes the preferred alternative. The tribes and native corporations will be provided with information on the project and asked to provide the BLM with their concerns about vegetation treatments with the seven active ingredients and their impacts on subsistence, religious, and ceremonial purposes and traditional cultural properties. The BLM also invites the tribes and native corporations to call if they have questions or concerns, or want additional information.

The BLM will complete an ANILCA Section 810 analysis of subsistence impacts to evaluate the potential impacts to subsistence pursuits in Alaska.

4.4 List of Preparers of the PEIS

An interdisciplinary team of staff from the BLM prepared and reviewed this PEIS, in collaboration with Environmental Management and Planning Solutions, Inc. (EMPSi) (see **Table 4-1**, below).

Table 4-1
List of Preparers and Reviewers

Bureau of Land Management	
Name	**Role/Responsibility**
Core Team	
Seth Flanigan	BLM Project Manager
Kimberly Allison	BLM Nevada Invasives Program Subject Matter Expert (SME)
Nathan Combs	BLM New Mexico Invasives Program SME
Jack Hamby	BLM California Invasives Program SME
Lonnie Huter	BLM Idaho Invasives Program SME
Steven Jirik	BLM Idaho Invasives Program SME
Dr. Richard Lee	Integrated Pest Management Specialist
Kimberly Wahl	BLM Wyoming Invasives Program SME
Interdisciplinary Team	
Chadwick Mickschl	Physical resources
Ryan McCammon	Physical resources
Georges Damone	Cultural resources and tribal coordination
Grace Glaszcz	Environmental specialist
Aaron Roe	Botany, pollinators, and threatened and endangered species
Deena Lentz	NEPA/Planning Specialist
Anne Halford	Botany, ecology
Rebecca Theodorakos	Macroinvertebrates, soils, toxicology
Jeremiah Zurenda	Wildlife
EMPSi	
Name	**Role/Responsibility**
Meredith Linhoff	Project Manager
Kirsten Davis	Soil Microbiology
Chelsea Ontiveros	GIS
Shannon Regan	Pollinator Habitat
Shine Roshan	Fire Risk
Liza Schill	Herbicide Resistance
David Scott	Water Quality
Andy Spellmeyer	Project Assistant
Morgan Trieger	Nontarget Vegetation

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Appendix A

Prevention Measures and Standard Operating Procedures

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Appendix A. Prevention Measures and Standard Operating Procedures

The following appendix describes measures to prevent the introduction and spread of noxious and invasive weeds (**Table A-1**) and standard operating procedures (SOPs) for applying herbicides (**Table A-2**). The 2007 PEIS describes further the importance, priorities, and processes associated with prevention, early detection, and rapid response (BLM 2007b, p. 2-23 to 2-25).

As described in the 2007 PEIS (BLM 2007b, p. 2-22 to 2-23), SOPs would be followed by the BLM under all alternatives to ensure that risks to human health and the environment from herbicide treatment actions would be kept to a minimum. Standard operating procedures are the management controls and performance standards required for vegetation management treatments. These practices are intended to protect and enhance natural resources that could be affected by future vegetation treatments. For instance, following specifications on an herbicide's label may require spray at a certain droplet size which is intended to prevent offsite spread. Drift prevention may also be accomplished by the use of adjuvants or tank mixes.

Table A-1
Prevention Measures

BLM Activity	Prevention Measure
Project Planning	• Incorporate prevention measures into project layout and design, alternative evaluation, and project decisions to prevent the introduction or spread of weeds. • Determine prevention and maintenance needs, including the use of herbicides, at the onset of project planning. • Before ground-disturbing activities begin, inventory weed infestations and prioritize areas for treatment in project operating areas and along access routes. • Remove sources of weed seed and propagules to prevent the spread of existing weeds and new weed infestations. • Pre-treat high-risk sites for weed establishment and spread before implementing projects. • Post weed awareness messages and prevention practices at strategic locations such as trailheads, roads, boat launches, and public land kiosks. • Inform the public about weed free hay, straw, and gravel requirements in applicable states. • Coordinate project activities with nearby herbicide applications to maximize the cost-effectiveness of weed treatments. • Consider adjustments in the existing grazing permit, needed to maintain desirable vegetation on the treatment site. • Identify and implement any temporary domestic livestock grazing and/or supplemental feeding restrictions needed to enhance desirable vegetation recovery following treatment. • Provide educational materials at trailheads and other wilderness entry points to educate the public on the need to prevent the spread of weeds. • Encourage backcountry pack and saddle stock users to feed their livestock only certified weed-free feed for several days before entering a wilderness area.

BLM Activity	Prevention Measure

Project Development	• Minimize soil disturbance to the extent practical, consistent with project objectives.
	• To prevent weed germination and establishment, retain native vegetation in and around projectactivity areas and keep soil disturbance to a minimum, consistent with project objectives.
	• Locate and use weed-free project staging areas. Avoid or minimize all types of travel through weed-infested areas, or restrict travel to periods when the spread of seeds or propagules is least likely.
	• Prevent the introduction and spread of weeds caused by moving weed-infested sand, gravel, borrow, and fill material.
	• Inspect material sources on site, and ensure that they are weed-free before use and transport. Treat weed-infested sources to eradicate weed seed and plant parts, and strip and stockpile contaminated material before any use of pit material.
	• Survey the area where material from treated weed-infested sources is used for at least 3 years after project completion to ensure that any weeds transported to the site are promptly detectedand controlled.
	• Prevent weed establishment by not driving through weed-infested areas.
	• Inspect and document weed establishment at access roads, cleaning sites, and all disturbed areas; control infestations to prevent spread within the project area.
	• For operations in waterbodies, when moving equipment or personnel through waterbodies on the way to the project site or before transporting watercraft and aquatic gear (i.e., hip boots, waders, and bait containers) to the authorized use area, permittee shall:
	    ◦ Remove any aquatic plants, animals, and mud attached to watercraft and equipment,
	    ◦ Drain water from boat, motor, bilge, live wells, and bait containers, and
	    ◦ Spray all watercraft and equipment with high pressure water or dry for at least 5 days

Project Development *(cont.)*	• Avoid acquiring water for dust abatement where access to the water is through weed-infested sites. • Identify sites where equipment can be cleaned. Clean equipment before entering public lands. • Clean all equipment before leaving the project site if operating in areas infested with weeds. • Inspect and treat weeds that establish at equipment cleaning sites. • Ensure that rental equipment is free of weed seed. • Inspect, remove, and properly dispose of weed seed and plant parts found on workers' clothing and equipment. Proper disposal entails bagging the seeds and plant parts and incinerating them. • Use certified weed-free feed for horses and pack animals. • Develop monitoring and evaluation plans to record and identify treatment effectiveness and non-target effects

BLM Activity	Prevention Measure
Revegetation	• Include weed prevention measures, including project inspection and documentation, in operation and reclamation plans. • Retain bonds until reclamation requirements, including weed treatments, are completed, based on inspection and documentation. • To prevent conditions favoring weed establishment, re-establish vegetation on bare ground caused by project disturbance as soon as possible using either natural recovery or artificial techniques. Revegetate disturbed sites with native species if there is no reasonable expectation of natural regeneration. • Maintain stockpiled, uninfested material in a weed-free condition. • Revegetate disturbed soil (except travel ways on surfaced projects) in a manner that optimizes plant establishment for each specific project site. For each project, define what constitutes disturbed soil and objectives for plant cover revegetation. Revegetation may include topsoil replacement, planting, seeding, fertilization, liming, and weed-free mulching, as necessary. • Where practical, stockpile weed-seed-free topsoil and replace it on disturbed areas (e.g., road embankments or landings). • Inspect seed and straw mulch to be used for site rehabilitation (for wattles, straw bales, dams, etc.) and certify that they are free of weed seed and propagules. • Inspect and document all limited term ground-disturbing operations in noxious weed infested areas for at least 3 growing seasons following completion of the project. • Use native material where appropriate and feasible. Use certified weed-free or weed-seed-free hay or straw where certified materials are required and/or are reasonably available. • Provide briefings that identify operational practices to reduce weed spread (for example, avoiding known weed infestation areas when locating fire lines). • Evaluate options, including closure, to regulate the flow of traffic on sites where desired vegetation needs to be established. Sites could include road and trail ROW, and other areas of disturbed soils.

Table A-2
Standard Operating Procedures for Applying Herbicides

Resource Element	Standard Operating Procedure
Guidance Documents	BLM Handbook H-9011-1 (*Chemical Pest Control*); and manuals 1112 (*Safety*), 9011 (*Chemical* *Pest Control*), 9012 (*Expenditure of Rangeland Insect Pest Control Funds*), 9015 (*Integrated Weed Management*), 9220 (*Integrated Pest Management*), and 1740-2 (*Integrated Vegetation Management*)
General	**General standard operating procedures would be used for all projects; standard operating procedures for other resource elements would be used as appropriate.**
	Follow product label for use and storage. **Storage, Contingency, and Record Keeping** • Prepare spill contingency plan in advance of treatment. • Keep copy of Safety Data Sheets (SDSs) at work sites. SDSs are available for review at http://www.cdms.net/. • Keep records of each application, including the active ingredient, formulation, application rate, date, time, and location. • Conduct mixing and loading operations in an area where an accidental spill would not contaminate an aquatic body. **Herbicide Treatment Planning** • Use only BLM-approved herbicides. Some state or local restrictions may apply. • Use only licensed herbicide applicators. • Pesticide use proposals are required for all herbicide treatments on BLM public lands. • Review, understand, and conform to all aspects of the herbicide label for each specific herbicide used. • Consult the herbicide label when planning revegetation to ensure that subsequent vegetation would not be injured following application of the herbicide. • Select herbicides and adjuvants that are least damaging to environment while providing the desired results. • Where habitat is present, conduct pre-treatment surveys for sensitive habitat and special status species within or adjacent to proposed treatment areas. • Consider site characteristics, environmental conditions, application equipment, and herbicide characteristics in order to minimize damage to resources, such as non-target vegetation or water resources. • Minimize the size of application areas, when feasible. • Consider surrounding land use (including visual resources and socioeconomic conditions) before assigning aerial spraying as a treatment method and avoid aerial spraying near agricultural or densely populated areas. • Notify adjacent landowners prior to treatment. • Post treated areas and specify reentry or rest times, if appropriate. • Observe restricted entry intervals specified by the herbicide label. • Apply the least amount of herbicide needed to achieve the desired result. • Avoid accidental direct spray and spill conditions to minimize risks to resources. • Avoid aerial spraying during periods of adverse weather conditions (snow or rain imminent, fog, or air turbulence). • Consider the effects of wind, humidity, temperature inversions, and heavy rainfall on herbicide effectiveness and risks.

Resource Element	Standard Operating Procedure
General *(cont.)*	**Minimizing Herbicide Drift** • Only apply herbicides when winds are <10 mph (<6 mph for aerial applications) or if no serious rainfall event is imminent. Some state/local or label restrictions may apply. • Use drift control agents, drift reduction agents, and low volatile formulations to reduce drift hazards. • Use appropriate application equipment/method near water bodies if the potential for off-site drift exists. • Establish herbicide-free buffer zones to ensure that drift will not affect crops or nearby residents/landowners. • Keep records of each application, including the active ingredient, formulation, application rate, date, time, and location. • Avoid accidental direct spray and spill conditions to minimize risks to resources. • Consider surrounding land uses before aerial spraying. • Avoid aerial spraying during periods of adverse weather conditions (snow or rain imminent, fog, or air turbulence). • Make helicopter applications at a target airspeed of 40 to 50 miles per hour (mph), and at about 30 to 45 feet above ground. • Turn off applied treatments at the completion of spray runs and during turns to start another spray run.
Air Quality See Manual 7000 (*Soil, Water, and Air Management*)	• Select proper application equipment (e.g., spray equipment that produces 200- to 800-micron diameter droplets [spray droplets of 100 microns and less are most prone to drift]). • Select proper application methods (e.g., set maximum spray heights, use appropriate buffer distances between spray sites and non-target resources).
Soil See Manual 7000 (*Soil, Water, and Air Management*)	• Minimize treatments in areas where herbicide runoff is likely, such as steep slopes when heavy rainfall is expected. • Minimize use of herbicides that have high soil mobility, particularly in areas where soil properties increase the potential for mobility. • Do not apply granular herbicides on slopes of more than 15%, or as specified in the label, where there is the possibility of runoff carrying the granules into non-target areas.
Water Resources See Manual 7000 (*Soil, Water, and Air Management*)	• Select herbicide products to minimize impacts to water. This is especially important for application scenarios that involve risk from active ingredients in a particular herbicide, as predicted by risk assessments. • Use local historical weather data to choose the month of treatment. Considering the phenology of the target species, schedule treatments based on the condition of the water body and existing water quality conditions. • Plan to treat between weather fronts (calms) and at appropriate time of day to avoid high winds that increase water movements, and to avoid potential stormwater runoff and water turbidity. • Review hydrogeologic maps of proposed treatment areas .Note depths to groundwater and areas of shallow groundwater and areas of surface water and groundwater interaction. Minimize treating areas with high risk for groundwater contamination.. • Do not rinse spray tanks in or near water bodies. Do not broadcast pellets where there is danger of contaminating water supplies. • Maintain buffers between treatment areas and water bodies. Buffer widths should be developed based on herbicide- and site-specific criteria to minimize impacts to water bodies. • Apply measures to prevent sedimentation into surface water from treatment areas.

Resource Element	Standard Operating Procedure
Wetlands and Riparian Areas	• Use a selective herbicide and a wick or backpack sprayer. • Use appropriate herbicide-free buffer zones for herbicides not labeled for aquatic use based on risk assessment guidance, with minimum widths of 100 feet for aerial, 25 feet for vehicle, and 10 feet for hand spray applications.
Vegetation See Handbook H-4410-1 (*National Range Handbook*), and manuals 5000 (*Forest Management*) and 9015 (*Integrated Weed Management*)	• Identify if the vegetation has acquired resistance to any active ingredient and select herbicides to reduce potential for resistance.

Pollinators	• Time vegetation treatments to take place when foraging pollinators are least active both seasonally and daily.
	• Design vegetation treatment projects so that nectar and pollen sources for important pollinators and resources are treated in patches rather than in one single treatment.
	• Maintain herbicide free buffer zones around patches of important pollinator nectar and pollen sources.
	• Maintain herbicide free buffer zones around patches of important pollinator nesting habitat and hibernacula.
	• Make special note of pollinators that have single host plant species, and minimize herbicide spraying on those plants (if invasive species) and in their habitats.
	• Use the least hazardous formulation to pollinators available
	    • Dust, wettable powders, and microencapsulated formulations are most hazardous to bees because they are similar in size to pollen and can stick to hairs on a bee's body.
	    • Granulated formulations are generally the least hazardous to bees.

Fish and Other Aquatic Organisms See manuals 6500 (*Wildlife and Fisheries Management*) and 6780 (*Habitat Management Plans*)	• Use appropriate buffer zones based on label and risk assessment guidance. • Minimize treatments near fish-bearing water bodies during periods when fish are in life stages most sensitive to the herbicide(s) used, and use spot rather than broadcast or aerial treatments. • For treatment of aquatic vegetation, 1) treat only that portion of the aquatic system necessary to achieve acceptable vegetation management; 2) use the appropriate application method to minimize the potential for injury to desirable vegetation and aquatic organisms; and 3) follow water use restrictions presented on the herbicide label.
Wildlife See manuals 6500 (*Wildlife and Fisheries Management*) and 6780 (*Habitat Management Plans*)	• Use herbicides of low toxicity to wildlife, where feasible. • Use spot applications or low-boom broadcast operations where possible to limit the probabilityof contaminating non-target food and water sources, especially non-target vegetation over areas larger than the treatment area. • Use timing restrictions (e.g., do not treat during critical wildlife breeding or staging periods) to minimize impacts to wildlife.
Threatened, Endangered, andSensitive Species See Manual 6840 (*Special Status Species*)	• Use a selective herbicide and a wick or backpack sprayer to minimize risks to special status plants. • Avoid treating vegetation during time-sensitive periods (e.g., nesting and migration, sensitive life stages) for special status species in area to be treated.

Resource Element	Standard Operating Procedure
Livestock See Handbook H-4120-1 (*Grazing Management*)	• Whenever possible and whenever needed, schedule treatments when livestock are not presentin the treatment area. Design treatments to take advantage of normal livestock grazing rest periods, when possible. • As directed by the herbicide label, remove livestock from treatment sites prior to herbicide application, where applicable. • Use herbicides of low toxicity to livestock, where feasible. • Notify permittees of the project to improve coordination and avoid potential conflicts andsafety concerns during implementation of the treatment. • Notify permittees of livestock grazing, feeding, or slaughter restrictions, if necessary. • Provide alternative forage sites for livestock, if possible.
Wild Horses and Burros	• Apply SOPs as listed above for wildlife.
Cultural Resources and Paleontological Resources See handbooks H-8120-1 (*Guidelines for Conducting Tribal Consultation*) and H-8270-1 (*General Procedural Guidance for Paleontological Resource Management*), and manuals 8100 (*The Foundations for Managing Cultural Resources*), 8120 (*Tribal Consultation Under Cultural Resource Authorities*), and 8270 (*Paleontological Resource Management*), See also: *Programmatic Agreement among the Bureau of Land Management, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers Regarding the Manner in Which BLM Will Meet Its Responsibilities Under the National Historic Preservation Act.*	• Follow standard procedures for compliance with Section 106 of the National Historic Preservation Act as implemented through the *Programmatic Agreement among the Bureau ofLand Management, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers Regarding the Manner in Which BLM Will Meet Its Responsibilities Under the National Historic Preservation Act* and state protocols or36 CFR Part 800, including necessary consultations with State Historic Preservation Officers and interested tribes. • Follow BLM Handbook H-8270-1 (*General Procedural Guidance for Paleontological Resource Management*) to determine known Condition I and Condition 2 paleontological areas, or collect information through inventory to establish Condition 1 and Condition 2 areas, determine resource types at risk from the proposed treatment, and develop appropriate measures to minimize or mitigate adverse impacts. • Consult with tribes to locate any areas of vegetation that are of significance to the tribe and that might be affected by herbicide treatments. • Work with tribes to minimize impacts to these resources. • Follow guidance under Human Health and Safety in areas that may be visited by Native peoples after treatments. • Consult with Native American tribes and Alaska Native groups to locate any areas of vegetation that are of significance to the tribe and that might be affected by herbicide treatments.
Visual Resources See handbooks H-8410-1 (*Visual Resource Inventory*) and H-8431-1 (*Visual Resource Contrast Rating*), and manual 8400 (*Visual Resource Management*)	• If the area is a Class I or II visual resource, ensure that the change to the characteristic landscape is low and does not attract attention (Class I), or if seen, does not attract the attention of the casual viewer (Class II). • Lessen visual impacts by: 1) designing projects to blend in with topographic forms; 2) leaving some low-growing trees or planting some low-growing tree seedlings adjacent to the treatment area to screen short-term effects; and 3) revegetating the site following treatment. • When restoring treated areas, design activities to repeat the form, line, color, and texture of the natural landscape character conditions to meet established Visual Resource Management (VRM) objectives.

Resource Element	Standard Operating Procedure
Wilderness and Other Special Areas See handbooks H-8550-1 (*Management of Wilderness Study Areas (WSAs)*), and H-8560-1 (*Management of Designated Wilderness Study Areas*), and Manual 8351 (*Wild and Scenic Rivers*)	• Use the "minimum tool" to treat noxious and invasive vegetation, relying primarily on use of ground-based tools, including backpack pumps, hand sprayers, and pumps mounted on packand saddle stock. • Use chemicals only when they are the minimum method necessary to control weeds that arespreading within the wilderness or threaten lands outside the wilderness. • Give preference to herbicides that have the least impact on non-target species and the wilderness environment. • Implement herbicide treatments during periods of low human use, where feasible.
Recreation See Handbook H-1601-1 (*Land Use Planning Handbook, Appendix C*)	• Schedule treatments to avoid peak recreational use times, while taking into account the optimum management period for the targeted species. • Use herbicides during periods of low human use, where feasible.
Rights-of-way	• Coordinate vegetation management activities where joint or multiple use of a ROW exists. • Notify other public land users within or adjacent to the ROW proposed for treatment.
Human Health and Safety	• Establish a buffer between treatment areas and human residences based on guidance given in the HHRA, with a minimum buffer of ¼ mile for aerial applications and 100 feet for ground applications, unless a written waiver is granted. • Use protective equipment as directed by the herbicide label. • Provide public notification in newspapers or other media where the potential exists for public exposure. • Notify local emergency personnel of proposed treatments. • Notify local emergency response agencies of herbicides stored on-site. • Contain and clean up spills and request help as needed. • Secure containers during transport. • Dispose of unwanted herbicides, contaminated materials, and pesticide containers promptly and correctly. • Clean vehicles and equipment to prevent further contamination by chemicals. • Consult with Native American tribes and Alaska Native groups to locate any areas of vegetation that are of significance to the tribe and that might be affected by herbicide treatments.

Appendix B
Glossary

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Appendix B. Glossary

Adsorption—1) The adhesion of substances to the surface of solids or liquids, or 2) The attraction of ions of compounds to the surface of solids or liquids.

Aquatic—Growing, living in, frequenting, or taking place in water; used to indicate habitat, vegetation, or wildlife in freshwater.

Aquifer—Rock or rock formations (often sand, gravel, sandstone, or limestone) that contain or carry groundwater and act as water reservoirs.

Adsorb—To hold (molecules of a gas or liquid or solute) as a thin film on the outside surface or on internal surfaces of a material.

Clayey—Soils with a large proportion of clay particles relative to silt and sand particles.

Cryic—A soil temperature regime representing soils with a mean annual soil temperature between 32 and 46 degrees Fahrenheit (0 and 8 degrees Celsius).

Degradation—Physical or biological breakdown of a complex compound into simpler compounds.

Endangered species—Plant or animal species that are in danger of extinction throughout all or a significant part of their range.

Frigid—A soil temperature regime representing soils with a mean annual soil temperature between 32 and 46 degrees Fahrenheit (0 and 8 degrees Celsius), but warmer in the summer than cryic soils.

Groundwater—Subsurface water that is in the zone of saturation; the top surface of the groundwater is the water table; source of water for wells, seeps, and springs.

Gelic—A soil temperature regime representing soils with a mean annual soil temperature less than 32 degrees Fahrenheit (0 degrees Celsius). Gelic is usually associated with permafrost soils.

Habitat—The natural environment of a plant or animal, including all biotic, climatic, and soil conditions, or other environmental influences affecting living conditions; the place where an organism lives.

Half-life—The amount of time required for half of a compound to degrade.

Hazard quotient—For most risk assessments, the EPA uses the quotient method to compare toxicity to environmental exposure. The hazard or risk quotient is calculated by dividing a point estimate of exposure by a point estimate of effects. This ratio is a simple, screening-level estimate that identifies high- or low-risk situations.

Herbicide resistance—The acquired ability of a weed population to survive an herbicide application that previously was known to control the population.

Hydrolysis—The chemical breakdown of a compound due to a reaction with water.

Impermeable—Cannot be penetrated.

Invertebrate—Small animals that lack a backbone or spinal column, including spiders, insects, and worms.

Leaching—Usually refers to the movement of chemicals through the soil by water; may also refer to the movement of herbicides out of leaves, stems, or roots into the air or soil.

Level of concern—A policy tool that the EPA uses to interpret the hazard quotient and to analyze the potential risk to nontarget organisms and the need to consider regulatory action.

Macrogroup—In the NVCS hierarchy, a vegetation classification unit of intermediate rank (fifth level) defined by combinations of moderate sets of diagnostic plant species and diagnostic growth forms that reflect biogeographic differences in composition and sub-continental to regional differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.

Macrophytes—Terrestrial or aquatic plants that are large enough to be seen without the aid of a microscope.

Mesic—A soil temperature regime representing soils with a mean annual soil temperature between 46 and 59 degrees Fahrenheit (8 and 15 degrees Celsius).

Microbial—Relating to or characteristic of a microorganism.

Mode of action—The biochemical effects of an herbicide that lead to plant death. The primary mode of action is the biochemical effect that occurs at the lowest concentration or is the earliest among a number of biochemical effects that could lead to plant death. An herbicide can have multiple biochemical effects that occur later in time or at higher concentrations that may contribute to plant death; these are secondary modes of action.

Persistence—Refers to the length of time a compound, once introduced into the environment, stays there.

pH—A measure of how acidic or alkaline (basic) a solution is on a scale of 0 to 14, with 0 being very acidic, 14 being very alkaline, and 7 being neutral; the abbreviation stands for the potential of hydrogen.

Photodegradation—The photochemical transformation of a molecule into lower molecular weight fragments, usually in an oxidation process; widely used in the destruction (oxidation) of pollutants by ultraviolet-based processes.

Photolysis—Chemical decomposition induced by light or other radiant energy.

Phytotoxicity—Delay of seed germination, inhibition of plant growth, or any adverse effect on plants caused by specific substances (phytotoxins).

Riparian—Occurring adjacent to streams and rivers and directly influenced by water; a riparian community is characterized by certain types of vegetation, soils, hydrology, and fauna and requires free or unbound water or conditions more moist than that normally found in the area.

Runoff—That part of precipitation, as well as any other flow contributions, that appears in surface streams, either perennial or intermittent.

Sediments—Unweathered geologic materials generally laid down by or within waterbodies; the rocks, sand, mud, silt, and clay at the bottom and along the edge of lakes, streams, and oceans.

Sedimentation—The process of forming or depositing sediment; letting solids settle out of wastewater by gravity during treatment.

Sensitive species—1) Plant or animal species susceptible or vulnerable to activity impacts or habitat alterations, or 2) Species that have appeared in the *Federal Register* as proposed for classification or are under consideration for official listing as endangered or threatened species.

Soil adsorption coefficient—A measure for the mobility of a substance in soil. A very high value means the substance is adsorbed onto the soil and organic matter, and it does not move through the soil. A very low value means it is highly mobile in the soil.

Soil half-life—The time required for a quantity of a substance to reduce to half its initial concentration in the soil.

Soil solution—Water with dissolved gases, minerals, and organic matter.

Standard Operating Procedures (SOPs)—Procedures followed by the BLM to ensure risks to human health and the environment from treatment actions were kept to a minimum.

Thermic—A soil temperature regime representing soils with a mean annual soil temperature between 59 and 72 degrees Fahrenheit (15 and 22 degrees Celsius).

Water quality—The interaction between various parameters that determines the usability or non-usability of water for onsite and downstream uses; major parameters that affect water quality include temperature, turbidity, suspended sediment, conductivity, dissolved oxygen, pH, specific ions, discharge, and fecal coliform.

Watershed—The region draining into a river, river system, or body of water.

Wetlands—Areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstance do support, a prevalence of vegetation typically adapted for life in saturated soil conditions; include habitats such as swamps, marshes, and bogs.

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Appendix C
Special Status Plant Species List

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Appendix C. Special Status Plant Species List

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Abronia bigelovii	Sand Verbena, Galisteo	NM	BS	
Abronia mellifera	Sand-Verbena, White	ID	BS	
Abronia turbinata	Abronia, Trans Montane	OR	BS	
Abronia umbellata var. breviflora	Sand-Verbena, Pink	CA, OR	BS	
Abronia villosa var. aurita	Sand-Verbena, Chaparral	CA	BS	
Abutilon parishii	Mallow, Pima Indian	AZ	BS	
Acanthomintha ilicifolia	Thornmint, San Diego	CA	FT	
Acanthoscyphus parishii var. goodmaniana	Oxytheca, Cushenberry	CA	FE	
Acarospora clauzadeana	Lichen, Acarospora Clauzadeana	NM	BS	
Achnatherum hendersonii	Ricegrass, Henderson's	OR	BS	
Achnatherum nevadense	Needlegrass, Nevada	OR	BS	
Achnatherum robustum	Grass, Sleepy	MT	BS	
Achnatherum wallowaense	Ricegrass, Wallowa	OR	BS	
Acmispon argyraeus var. multicaulis	Lotus, Scrub	CA, NV	BS	
Acmispon haydonii	None	CA	BS	
Acmispon rubriflorus	Lotus, Red-Flowered	CA	BS	
Acorus americanus	Sweetflag	ID	BS	
Adiantum jordanii	Maiden-Hair, California	OR	BS	
Agastache cusickii	Giant-Hyssop, Cusick's	OR, MT	BS	
Agastache pringlei var. verticillata	Giant Hyssop, Organ Mountains	NM	BS	
Agave murpheyi	Agave, Murphey	AZ	BS	
Agave utahensis var. eborispina	Agave, Ivory-Spined	CA	BS	
Agoseris elata	Agoseris, Tall	OR	BS	
Agoseris lackschewitzii	Agoseris, Pink Or Mill Creek	ID	BS	
Agrimonia striata	Agrimonia, Roadside	ID	BS	
Agrostis blasdalei	Grass, Blasdale's Bent	CA	BS	
Agrostis hooveri	Grass, Hoover's Bent	CA	BS	
Agrostis howellii	Bentgrass, Howell's	OR	BS	
Agrostis lacuna-vernalis	Grass, Vernal Pool Bent	CA	BS	
Agrostis mertensii	Bentgrass, Northern	OR	BS	
Aliciella caespitosa	Gilia, Rabbit Valley	UT	BS	
Aliciella formosa	Gilia, Aztec	NM	BS	
Aliciella stenothyrsa	Gilia, Narrow-Stem	CO	BS	
Aliciella tenuis	Gilia, Mussentuchit	UT	BS	
Allenrolfea occidentalis	Iodinebush	OR, ID	BS	
Allium aaseae	Onion, Aase's	ID	BS	
Allium anceps	Onion, Two-Headed	ID	BS	
Allium campanulatum	Onion, Sierra	OR	BS	
Allium columbianum	Onion, Columbia	ID	BS	
Allium constrictum	Onion, Constricted Douglas'	OR	BS	
Allium geyeri var. geyeri	Onion, Geyer's	OR	BS	
Allium hickmanii	Onion, Hickman's	CA	BS	
Allium howellii var. sanbenitense	Onion, San Benito	CA	BS	
Allium jepsonii	Onion, Jepson's	CA	BS	
Allium marvinii	None	CA	BS	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Allium munzii	Onion, Munz's	CA	FE	
Allium parishii	Onion, Parish Wild	AZ	BS	
Allium peninsulare	Onion, Peninsular	OR	BS	
Allium sharsmithiae	Onion, Sharsmith's	CA	BS	
Allium shevockii	Onion, Spanish Needle	CA	BS	
Allium tolmiei var. persimile	Onion, Tolmiei's	ID	BS	
Allium tuolumnense	Onion, Rawhide Hill	CA	BS	
Allotropa virgata	Candystick	ID	BS	
Ambrosia pumila	Ambrosia, San Diego	CA	FE	
Ammannia robusta	Grand Redstem	ID, OR	BS	
Amsinckia carinata	Fiddleneck, Malheur Valley	OR	BS	
Amsinckia lunaris	Fiddleneck, Bent-Flowered	CA	BS	
Amsonia fugatei	Amsonia, Fugate's	NM	BS	
Amsonia jonesii	Bluestar, Jones'	CO	BS	
Amsonia kearneyana	Blue-Star, Kearney's	AZ	FE	
Amsonia tharpii	Bluestar, Tharp's	NM	BS	
Ancistrocarphus keilii	Groundstar, Santa Ynez	CA	BS	
Anemone patens var. multifida	Pasqueflower	OR	BS	
Angelica kingii	Angelica, Great Basin	ID	BS	
Angelica scabrida	Angelica, Rough	NV	BS	
Anisocarpus scabridus	Tarplant, Scabrid Alpine	CA	BS	
Antennaria arcuata	Pussytoes, Meadow	ID, NV, WY	BS	
Antennaria corymbosa	Pussy-Toes, Meadow	OR	BS	
Antennaria densifolia	Pussytoes, Denseleaf	AK	BS	
Antirrhinum kingii	Snapdragon, King	OR	BS	
Anulocaulis leiosolenus var. howardii	Ringstem, Howard's Gyp	NM	BS	
Anulocaulis leiosolenus var. leiosolenus	Ringstem, Sticky	NV	BS	
Aquilegia atwoodii	Columbine, Atwood's	UT	BS	
Aquilegia chrysantha var.chaplinei	Columbine, Chapline's	NM	BS	
Aquilegia chrysantha var.rydbergii	Columbine, Rydberg's Golden	CO	BS	
Aquilegia desolaticola	Columbine, Desolation Canyon	UT	BS	
Aquilegia laramiensis	Columbine, Laramie	WY	BS	
Aquilegia scopulorum var. goodrichii	Columbine, Goodrich's	UT	BS	
Arabis crandallii	Rockcress, Crandall's	CO	BS	
Arabis crucisetosa	Rockcress, Cross-Haired	OR	BS	
Arabis goodrichii	Rockcress, Goodrich Eared	UT	BS	
Arabis koehleri var. koehleri	Rockcress, Koehler's	OR	BS	
Arabis macdonaldiana	Rockcress, Macdonald's	OR, CA	FE	
Arabis modesta	Rockcress, Rogue Canyon	OR	BS	
Arabis pusilla	Rockcress, Fremont County	WY	C	
Arabis vivariensis	Rockcress, Park	UT	BS	
Arctomecon californica	Bearpoppy, Las Vegas	NV	BS	
Arctomecon humilis	Bear-Poppy, Dwarf	UT	FE	
Arctomecon merriamii	Bearpoppy, White	NV	BS	
Arctostaphylos bakeri ssp. sublaevis	Manzanita, The Cedars	CA	BS	
Arctostaphylos cruzensis	Manzanita, Arroya De La Cruz	CA	BS	
Arctostaphylos glandulosa ssp. gabrielensis	Manzanita, Gabilan Mountains	CA	BS	
Arctostaphylos hispidula	Manzanita, Gasquet	OR	BS	
Arctostaphylos hookeri ssp. hookeri	Manzanita, Hooker's	CA	BS	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Arctostaphylos klamathensis	Manzanita, Klamath	CA	BS	
Arctostaphylos manzanita ssp. elegans	Manzanita, Konocti	CA	BS	
Arctostaphylos montereyensis	Manzanita, Monterey	CA	BS	
Arctostaphylos morroensis	Manzanita, Morro	CA	FT	
Arctostaphylos myrtifolia	Manzanita, Ione	CA	FT	
Arctostaphylos nissenana	Manzanita, Nissenan	CA	BS	
Arctostaphylos otayensis	Manzanita, Otay	CA	BS	
Arctostaphylos pajaroensis	Manzanita, Pajaro	CA	BS	
Arctostaphylos pilosula	Manzanita, Santa Margarita	CA	BS	
Arctostaphylos pumila	Manzanita, Sandmat	CA	BS	
Arctostaphylos rainbowensis	Manzanita, Rainbow	CA	BS	
Arctostaphylos rudis	Manzanita, Sand Mesa	CA	BS	
Arctostaphylos standfordiana ssp. raichei	Manzanita, Raiche's	CA	BS	
Arenaria paludicola	Sandwort, Marsh	OR	FE	
Argemone munita	Prickly-Poppy	OR, ID	BS	
Argemone pinnatisecta	Prickly-Poppy, Sacramento	NM	FE	
Aristocapsa insignis	Spineflower, Indian Valley	CA	BS	
Arnica lonchophylla ssp. lonchophylla	Arnica, Longleaf	AK	BS	
Arnica viscosa	Arnica, Shasta	OR	BS	
Artemisia campestris ssp. borealis var. wormskioldii	Wormwood, Northern	OR	BS	
Artemisia globularia var. lutea	Wormwood, Purple	AK	BS	
Artemisia papposa	Sagebrush, Owyhee	OR	BS	
Artemisia porteri	Sagebrush, Porter's	WY	BS	
Artemisia pycnocephala	Sagewort, Coastal	OR	BS	
Artemisia senjavinensis	Wormwood, Arctic	AK	BS	
Asclepias asperula	Spider Milkweed	ID	BS	
Asclepias eastwoodiana	Milkweed, Eastwood	NV	BS	
Asclepias lanuginosa	Milkweed, Sidecluster	MT	BS	
Asclepias sanjuanensis	Milkweed, San Juan	NM	BS	
Asclepias uncialis	Milkweed, Dwarf	CO	BS	
Asclepias welshii	Milkweed, Welsh's	AZ, UT	FT	X
Asimina tetramera	Four-petal Pawpaw	—	FE	
Asplenium dalhousiae	Spleenwort, Dalhouse	AZ	BS	
Asplenium septentrionale	Grass-Fern	OR	BS	
Asplenium viride	Spleenwort, Green	OR	BS	
Astragalus agnicidus	Milkvetch, Humboldt	CA	BS	
Astragalus agrestis	Milkvetch, Field	CA	BS	
Astragalus albens	Milkvetch, Cushenberry	CA	FE	X
Astragalus amblytropis	Milkvetch, Challis	ID	BS	
Astragalus americanus	Rattlepod	MT	BS	
Astragalus amnis-amissi	Milkvetch, Lost River	ID	BS	
Astragalus ampullarioides	Milkvetch, Shivwits	UT	FE	X
Astragalus ampullarius	Milkvetch, Gumbo	UT	BS	
Astragalus anisus	Milkvetch, Gunnison	CO	BS	
Astragalus anserinus	Milkvetch, Goose Creek	ID, NV, UT	BS	
Astragalus anxius	Milkvetch, Ash Valley	CA	BS	
Astragalus applegatei	Milkvetch, Applegate's	OR	FE	
Astragalus aquilonius	Milkvetch, Lemhi	ID	BS	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Astragalus argophyllus var. argophyllus	Milkvetch, Silverleaf	CA	BS	
Astragalus arrectus	Milkvetch, Palouse	OR	BS	
Astragalus arthurii	Milkvetch, Arthur's	OR	BS	
Astragalus asotinensis	Milkvetch, Asotin	ID, OR	BS	
Astragalus atratus var. inseptus	Milkvetch, Mourning	ID	BS	
Astragalus atratus var. mensanus	Milkvetch, Darwin Mesa	CA	BS	
Astragalus australis var. cottonii	Milkvetch, Cotton's	OR	BS	
Astragalus barrii	Milkvetch, Barr's	MT	BS	
Astragalus bernardinus	Milkvetch, San Bernardino	CA	BS	
Astragalus bisulcatus var. bisulcatus	Milkvetch, Two-Grooved	ID	BS	
Astragalus brauntonii	Milkvetch, Braunton's	CA	FE	
Astragalus californicus	Milkvetch, California	OR	BS	
Astragalus callithrix	Milkvetch, Callaway	NV	BS	
Astragalus calycosus	Rattleweed, King's	OR	BS	
Astragalus calycosus var. monophyllidius	Milkvetch, Torrey	NV	BS	
Astragalus ceramicus var. apus	Milkvetch, Painted	MT	BS	
Astragalus cimae var. cimae	Milkvetch, Cima	NV	BS	
Astragalus cimae var. sufflatus	Milkvetch, Inflated Cima	CA	BS	
Astragalus cobrensis var.maguirei	Milkvetch, Coppermine	NM	BS	
Astragalus columbianus	Milkvetch, Columbia	OR	BS	
Astragalus conjunctus var. conjunctus	Milkvetch, Stiff	ID	BS	
Astragalus convallarius var. margaretiae	Milkvetch, Margaret Rushy	NV	BS	
Astragalus cremnophylax var. hevronii	Milkvetch, Marble Canyon	AZ	BS	
Astragalus cronquistii	Milkvetch, Cronquist's	UT	BS	
Astragalus cusickii var. cusickii	Milkvetch, Cusick's	OR	BS	
Astragalus cusickii var. packardiae	Milkvetch, Packard's	ID	BS	
Astragalus cusickii var. sterilis	Milkvetch, Barren	ID, OR	BS	
Astragalus deanei	Milkvetch, Deane's	CA	BS	
Astragalus debequaeus	Milkvetch, Debeque	CO	BS	
Astragalus detritalis	Milkvetch, Debris	CO	BS	
Astragalus diaphanus var. diurnus	Milkvetch, South Fork John Day	OR	BS	
Astragalus diversifolius	Milkvetch, Meadow	ID, WY	BS	
Astragalus douglasii var. perstrictus	Milkvetch, Jacumba	CA	BS	
Astragalus duchesnensis	Milkvetch, Duchesne	CO	BS	
Astragalus ensiformis var. gracilior	Milkvetch, Veyo	NV	BS	
Astragalus equisolensis	Milkvetch, Horseshoe	CO, UT	BS	
Astragalus ertterae	Milkvetch, Walker Pass	CA	BS	
Astragalus eurylobus	Milkvetch, Needle Mountains	NV	BS	
Astragalus funereus	Milkvetch, Black	CA, NV	BS	
Astragalus gambelianus	Milkvetch, Gambel	OR	BS	
Astragalus geyeri var. geyeri	Milkvetch, Geyer's	OR	BS	
Astragalus geyeri var. triquetrus	Milkvetch, Three-Cornered	AZ, NV	BS	
Astragalus gilmanii	Milkvetch, Gilman's	NV	BS	
Astragalus gilviflorus	Milkvetch, Threeleaf Or Plains	ID	BS	
Astragalus gilviflorus var. purpureus	Milkvetch, Threeleaf	WY	BS	
Astragalus gypsodes	Milkvetch, Gypsum	NM	BS	
Astragalus hamiltonii	Milkvetch, Hamilton's	UT	BS	
Astragalus holmgreniorum	Milkvetch, Holmgren	AZ, UT	FE	X
Astragalus hornii var. hornii	Milkvetch, Horn's	CA	BS	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Astragalus humillimus	Milkvetch, Mancos	CO, NM	FE	
Astragalus hypoxylus	Milkvetch, Huachuca	AZ	BS	
Astragalus iselyi	Milkvetch, Isely's	UT	BS	
Astragalus jaegerianus	Milkvetch, Lane Mtn.	CA	FE	X
Astragalus jejunus var. articulatus	Milkvetch, Hyattville	WY	BS	
Astragalus jejunus var. jejunus	Milkvetch, Starveling	ID	BS	
Astragalus johannis-howellii	Milkvetch, Long Valley	CA, NV	BS	
Astragalus knightii	Milkvetch, Knight's	NM	BS	
Astragalus lemmonii	Milkvetch, Lemmon's	CA, OR	BS	
Astragalus lentiformis	Milkvetch, Lens-Pod	CA	BS	
Astragalus lentiginosus var. coachellae	Milkvetch, Coachella Valley	CA	FE	X
Astragalus lentiginosus var. piscinensis	Milkvetch, Fish Slough	CA	FT	
Astragalus lentiginosus var. pohlii	Milkvetch, Pohl's	UT	BS	
Astragalus lentiginosus var. sesquimetralis	Milkvetch, Sodaville	NV	BS	
Astragalus lentiginosus var. stramineus	Milkvetch, Straw	NV	BS	
Astragalus leptaleus	Milkvetch, Park	ID	BS	
Astragalus leucolobus	Woolypod, Big Bear Valley	CA	BS	
Astragalus linifolius	Milkvetch, Grand Junction	CO	BS	
Astragalus loanus	Milkvetch, Loa	UT	BS	
Astragalus magdalenae var. peirsonii	Milkvetch, Peirson's	CA	FT	X
Astragalus microcymbus	Milkvetch, Skiff	CO	C	
Astragalus microcystis	Milkvetch, Least Bladdery	OR	BS	
Astragalus misellus var. misellus	Milkvetch, Pauper	OR	BS	
Astragalus misellus var. pauper	Milkvetch, Pauper	OR	BS	
Astragalus mohavensis var. hemigyrus	Milkvetch, Half-Ring	NV	BS	
Astragalus mojavensis var. hemigyrus	Milkvetch, Curved-Pod	CA	BS	
Astragalus mokiacensis	Milkvetch, Mokiak	NV	BS	
Astragalus monoensis	Milkvetch, Mono	CA	BS	
Astragalus montii	Milkvetch, Heliotrope	UT	FT	
Astragalus mulfordiae	Milkvetch, Mulford's	ID, OR	BS	
Astragalus musiniensis	Milkvetch, Ferron's	CO	BS	
Astragalus naturitensis	Milkvetch, Naturita	CO	BS	
Astragalus newberryi var. aquarii	Milkvetch, Aquarius	AZ	BS	
Astragalus newberryi var. castoreus	Milkvetch, Newberry's	ID	BS	
Astragalus nyensis	Milkvetch, Nye	CA	BS	
Astragalus oniciformis	Milkvetch, Picabo	ID	BS	
Astragalus oocarpus	Rattleweed, San Diego	CA	BS	
Astragalus oophorus var. lavinii	Milkvetch, Lavin's	CA, NV	BS	
Astragalus oophorus var. lonchocalyx	Milkvetch, Pink Egg	NV, UT	BS	
Astragalus osterhoutii	Milkvetch, Osterhout	CO	FE	
Astragalus pachypus var. jaegeri	Milkvetch, Jaeger's Bush	CA	BS	
Astragalus paysonii	Milkvetch, Payson's	ID	BS	
Astragalus peckii	Milkvetch, Peck's	OR	BS	
Astragalus phoenix	Milkvetch, Ash Meadows	NV	FT	X
Astragalus piscator	Milkvetch, Fisher	CO	BS	
Astragalus platytropis	Milkvetch, Broad-Keeled	OR	BS	
Astragalus porrectus	Milkvetch, Lahontan	NV	BS	
Astragalus proimanthus	Milkvetch, Precocious	WY	BS	
Astragalus pseudiodanthus	Milkvetch, Tonopah	CA, NV	BS	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Astragalus pubentissimus var. peabodianus	Milkvetch, Peabody's	UT	BS	
Astragalus pulsiferae var. pulsiferae	Milkvetch, Ames	CA, NV	BS	
Astragalus pulsiferae var. suksdorfii	Milkvetch, Suksdorf's	CA	BS	
Astragalus purshii var. lagopinus	Milkvetch, Hare's-Foot	ID	BS	
Astragalus purshii var. ophiogenes	Milkvetch, Snake River	ID	BS	
Astragalus pycnostachyus var. pycnostachyus	Milkvetch, Coastal Marsh	CA	BS	
Astragalus racemosus var. treleasei	Milkvetch, Racemose	WY	BS	
Astragalus rafaelensis	Milkvetch, San Rafael	CO	BS	
Astragalus rattanii var. jepsonianus	Milkvetch, Jepson's	CA	BS	
Astragalus remotus	Milkvetch, Spring Mountains	NV	BS	
Astragalus riparius	Milkvetch, Piper's	ID, OR	BS	
Astragalus ripleyi	Milkvetch, Ripley's	CO, NM	BS	
Astragalus sabulosus var. sabulosus	Milkvetch, Cisco	UT	BS	
Astragalus sabulosus var. vehiculus	Milkvetch, Stage	UT	BS	
Astragalus scaphoides	Milkvetch, Bitterroot	MT	BS	
Astragalus sesquiflorus	Milkvetch, Sandstone	CO	BS	
Astragalus shevockii	Milkvetch, Shevock's	CA	BS	
Astragalus sinuatus	Milkvetch, Whited's	OR	BS	
Astragalus solitarius	Milkvetch, Weak	NV	BS	
Astragalus striatiflorus	Milkvetch, Escarpement	UT	BS	
Astragalus tegetarioides	Kentrophyta, Bastard	OR	BS	
Astragalus tener var. ferrisiae	Milkvetch, Ferris's	CA	BS	
Astragalus terminalis	Milkvetch, Railhead	MT	BS	
Astragalus tetrapterus	Milkvetch, Four-Wing	ID	BS	
Astragalus tiehmii	Milkvetch, Tiehm's	CA, NV	BS	
Astragalus toanus var. scidulus	Milkvetch, Diamond Butte	AZ	BS	
Astragalus toquimanus	Milkvetch, Toquima	NV	BS	
Astragalus tricarinatus	Milkvetch, Triple-Ribbed	CA	FE	
Astragalus tyghensis	Milkvetch, Tygh Valley	OR	BS	
Astragalus uncialis	Milkvetch, Currant	NV	BS	
Astragalus vexilliflexus	Milkvetch, Bentflower	MT	BS	
Astragalus webberi	Milkvetch, Webber's	CA	BS	
Astragalus welshii	Milkvetch, Welsh's	UT	BS	
Astragalus yoder-williamsii	Milkvetch, Mudflat	ID, NV	BS	
Atriplex argentea var. longitrichoma	Silverscale, Pahrump	CA	BS	
Atriplex canescens var. gigantea	Saltbush, Dunes Four-Wing	UT	BS	
Atriplex cordulata var. cordulata	Saltbush, Heart-Leaved	CA	BS	
Atriplex cordulata var. erecticaulis	Orache, Earlimart	CA	BS	
Atriplex coronata var. notatior	Crownscale, San Jacinto Valley	CA	FE	
Atriplex coronata var. vallicola	Crownscale, Lost Hills	CA	BS	
Atriplex subtilis	Orache, Subtle	CA	BS	
Baccharis vanessae	Coyotebrush, Encinitas	CA	FT	
Balsamorhiza lanata	Balsamroot, Woolly	CA	BS	
Balsamorhiza macrolepis	Balsamroot, Big-Scale	CA	BS	
Balsamorhiza sericea	Balsamroot, Silky	CA	BS	
Bensoniella oregana	Bensonia	OR	BS	
Berberis harrisoniana	Barberry, Kofa Mountain	AZ, CA	BS	
Berberis nevinii	Barberry, Nevin's	CA	FE	X
Blepharidachne kingii	Grass, King's Desert	ID	BS	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Bloomeria clevelandii	Goldenstar, San Diego	CA	BS	
Boechera atrorubens	Rockcress, Sickle-Pod	OR	BS	
Boechera bodiensi	Rockcress, Bodie Hills	NV	BS	
Boechera bodiensis	Cress, Bodie Hills Rock	CA	BS	
Boechera davidsonii	Rockcress, Davidson's	OR	BS	
Boechera falcifructa	Rockcress, Elko	NV	BS	
Boechera fecunda	Rockcress, Sapphire	MT	BS	
Boechera lincolnensis	Cress, Lincoln Rock	CA	BS	
Boechera serpenticola	Rockcress, Serpentine	CA	BS	
Boechera zephyra	Wind Mountain Rockcress	NM	BS	
Bolandra oregana	Bolandra, Oregon	OR	BS	
Brodiaea filifolia	Brodiaea, Thread-Leaved	CA	FT	X
Brodiaea insignis	Brodiaea, Kaweah	CA	BS	
Brodiaea matsonii	Brodiaea, Sulphu Creek	CA	BS	
Brodiaea orcuttii	Brodiaea, Orcutt's	CA	BS	
Brodiaea rosea ssp. rosea	Brodiaea, Indian Valley	CA	BS	
Brodiaea terrestris	Brodiaea, Dwarf	OR	BS	
Bupleurum americanum	Bupleurum	OR, MT	BS	
Calamagrostis breweri	Reedgrass, Brewer's	OR	BS	
Calamagrostis tweedyi	Reedgrass, Cascade	ID	BS	
Callitriche marginata	Water-Starwort, Winged	ID, OR	BS	
Calochortus clavatus var. avius	Mariposa Lily, Pleasant Valley	CA	BS	
Calochortus clavatus var. gracilis	Mariposa Lily, Slender	CA	BS	
Calochortus coxii	Mariposa-Lily, Crinite	OR	BS	
Calochortus dunnii	Mariposa Lily, Dunn's	CA	BS	
Calochortus excavatus	Mariposa Lily, Inyo	CA	BS	
Calochortus fimbriatus	Mariposa Lily, Late-Flowered	CA	BS	
Calochortus greenei	Mariposa-Lily, Greene's	OR, NV, CA	BS	
Calochortus howellii	Mariposa-Lily, Howell's	OR	BS	
Calochortus longebarbatus var. longebarbatus	Star-Tulip, Long-Haired	CA	BS	
Calochortus longebarbatus var. peckii	Mariposa-Lily, Peck's	OR	BS	
Calochortus macrocarpus var. maculosus	Mariposa-Lily, Green-Band	OR	BS	
Calochortus monanthus	Mariposa Lily, Shasta River	CA	BS	
Calochortus monophyllus	Mariposa-Lily, One-Leaved	OR	BS	
Calochortus nitidus	Lily, Broad-Fruit Mariposa	ID	BS	
Calochortus obispoensis	Mariposa Lily, San Luis	CA	BS	
Calochortus palmeri var. munzii	None	CA	BS	
Calochortus palmeri var. palmeri	Mariposa Lily, Palmer's	CA	BS	
Calochortus persistens	Mariposa-Lily, Siskiyou	CA, OR	BS	
Calochortus raichei	Fairy-Lantern, The Cedars	CA	BS	
Calochortus simulans	Mariposa Lily, San Luis Obispo	CA	BS	
Calochortus striatus	Mariposa Lily, Alkali	CA, NV	BS	
Calochortus umpquaensis	Mariposa-Lily, Umpqua	OR	BS	
Calochortus westonii	Star-Tulip, Shirley Meadows	CA	BS	
Calycadenia hooveri	Calycadenia, Hoover's	CA	BS	
Calycadenia micrantha	Calycadenia, Small-Flowered	CA	BS	
Calycadenia villosa	Calycadenia, Dwarf	CA	BS	
Calyptridium parryi var. hesseae	Pussypaws, Santa Cruz Mountains	CA	BS	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Calyptridium pulchellum	Pussypaws, Mariposa	CA	FT	
Calyptridium roseum	Pussypaws, Rosy	OR	BS	
Calystegia collina ssp. tridactylosa	Morning-Glory, Three-Fingered	CA	BS	
Calystegia purpurata ssp. saxicola	Morning-Glory, Coastal Bluff	CA	BS	
Calystegia sepium ssp. angulata	Morning-Glory, Wild	ID	BS	
Calystegia stebbinsii	Morning-Glory, Stebbins'	CA	FE	
Calystegia vanzuukiae	Morning-Glory, Van Zuuk's	CA	BS	
Camassia cusickii	Camas, Cusick's	ID	BS	
Camassia howellii	Camas, Howell's	OR	BS	
Camissonia bairdii	Camissonia, Baird's	UT	BS	
Camissonia benitensis	Evening-Primrose, San Benito	CA	FT	
Camissonia bolanderi	Camissonia, Bolander's	UT	BS	
Camissonia eastwoodiae	Suncup, Grand Junction	CO	BS	
Camissonia gouldii	Camissonia, Gould's	UT	BS	
Camissonia integrifolia	Evening-Primrose, Kern River	CA	BS	
Camissonia nevadensis	Suncup, Nevada	NV	BS	
Camissonia parvula	Suncup, Lewis' River	OR	BS	
Camissonia pterosperma	Suncup, Pygmy	ID	BS	
Camissonia pusilla	Suncup, Washoe	OR	BS	
Camissoniopsis hardhamiae	Evening-Primrose, Hardham's	CA	BS	
Campanula californica	Harebell, Swamp	CA	BS	
Campanula exigua	Harebell, Chaparral	CA	BS	
Campanula lasiocarpa	Harebell, Alaska	OR	BS	
Campanula sharsmithiae	Harebell, Sharsmith's	CA	BS	
Campanula shetleri	Harebell, Castle Crags	CA	BS	
Cardamine constancei	Bittercress, Constance's	ID	BS	
Cardamine pattersonii	Bittercress, Saddle Mountain	OR	BS	
Carex aboriginum	Sedge, Indian Valley	ID	BS	
Carex alopecoidea	Sedge, Tawny	MT	BS	
Carex anthoxanthea	Sedge, Yellow-Flowered	OR	BS	
Carex athrostachya	Sedge, Jointed-Spike	MT	BS	
Carex atrosquama	Sedge, Blackened	OR	BS	
Carex bella	Sedge, Elegant	MT	BS	
Carex brevicaulis	Sedge, Short Stemmed	OR	BS	
Carex capillaris	Sedge, Hairlike	OR	BS	
Carex capitata	Sedge, Capitate	OR	BS	
Carex chordorrhiza	Sedge, Cordroot	OR	BS	
Carex circinata	Sedge, Coiled	OR	BS	
Carex comosa	Sedge, Bristly	OR, ID	BS	
Carex concinna	Sedge, Low Northern	OR	BS	
Carex cordillerana	Sedge, Cordilleran	OR	BS	
Carex densa	Sedge, Dense	OR	BS	
Carex diandra	Sedge, Lesser Panicled	OR	BS	
Carex eburnea	Sedge, Bristleleaf	OR	BS	
Carex gynocrates	Sedge, Yellow Bog	OR	BS	
Carex idahoa	Sedge, Idaho	ID, OR, MT	BS	
Carex intumescens	Sedge, Swollen	MT	BS	
Carex klamathensis	Sedge, Klamath	CA, OR	BS	
Carex lasiocarpa	Sedge, Slender	OR	BS	
Carex laxa	Sedge, Weak	AK	BS	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Carex livida	Sedge, Pale	OR	BS	
Carex macrocephala	Sedge, Bighead	OR	BS	
Carex macrochaeta	Sedge, Large-Awn	OR	BS	
Carex media	Sedge, Intermediate	OR	BS	
Carex micropoda	Sedge, Pyrenaean	OR	BS	
Carex nardina	Sedge, Spikenard	OR	BS	
Carex nervina	Sedge, Sierra Nerved	OR	BS	
Carex obispoensis	Sedge, San Luis Obispo	CA	BS	
Carex obtusata	Sedge, Blunt	OR	BS	
Carex occidentalis	Sedge, Western	ID	BS	
Carex parryana	Sedge, Parry	AK	BS	
Carex pauciflora	Sedge, Few-Flowered	OR	BS	
Carex pelocarpa	Sedge, New	OR	BS	
Carex proposita	Sedge, Smokey Mtn.	OR	BS	
Carex retrorsa	Sedge, Retrorse	OR	BS	
Carex rostrata	Sedge, Beaked	OR	BS	
Carex rupestris	Sedge, Curly	MT	BS	
Carex saliniformis	Sedge, Deceiving	CA	BS	
Carex scirpoidea ssp. scirpoidea	Sedge, Canadian Single-Spike	OR	BS	
Carex scirpoidea ssp. stenochlaena	Sedge, Alaskan Single-Spiked	OR	BS	
Carex specuicola	Sedge, Navajo	UT	FT	
Carex spissa	Sedge, Giant	AZ	BS	
Carex stylosa	Sedge, Long-Styled	OR	BS	
Carex subnigricans	Sedge, Dark Alpine	OR	BS	
Carex sychnocephala	Sedge, Many-Headed	OR	BS	
Carex tahoensis	Sedge, Tahoe	OR	BS	
Carex tenera var. tenera	Sedge, Quill	OR	BS	
Carex tenuiflora	Sedge, Sparseflower	OR	BS	
Carex tiogana	Sedge, Tioga Pass	OR	BS	
Carex tumulicola	Sedge, Foothill Or Splitawn	ID	BS	
Carex vaginata	Sedge, Sheathed	MT	BS	
Carex vallicola	Sedge, Valley	OR	BS	
Carex vernacula	Sedge, Native	OR	BS	
Carex xerophila	Sedge, Chaparral	CA	BS	
Carlquistia muirii	Raillardella, Muir's	CA	BS	
Carpenteria californica	Tree-Anemone	CA	BS	
Cassiope mertensiana ssp. mertensiana	Bell-Heather, Western	ID	BS	
Castilleja ambigua ssp. insalutata	Johnny-Nip, Pink	CA	BS	
Castilleja ambigua var. humboldtiensis	Owl's-Clover, Humboldt Bay	CA	BS	
Castilleja campestris ssp. succulenta	Clover, Succulent Owl's	CA	FT	X
Castilleja chlorotica	Paintbrush, Green-Tinged	OR	BS	
Castilleja cryptantha	Indian-Paintbrush, Obscure	OR	BS	
Castilleja densiflora ssp. obispoensis	Paintbrush, Obispo Indian	CA	BS	
Castilleja flava var. rustica	Paintbrush, Rural	OR	BS	
Castilleja fraterna	Paintbrush, Fraternal	OR	BS	
Castilleja gleasoni	Paintbrush, Mt. Gleason Indian	CA	BS	
Castilleja levisecta	Paintbrush, Golden	OR	FT	
Castilleja mendocinensis	Paintbrush, Mendocino Coast	CA	BS	
Castilleja organorum	Paintbrush, Organ Mountains	NM	BS	
Castilleja rubicundula ssp. rubicundula	Creamsacs, Pink	CA	BS	

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Castilleja rubida	Paintbrush, Purple Alpine	OR	BS	
Castilleja salsuginosa	Paintbrush, Monte Neva	NV	BS	
Castilleja thompsonii	Paintbrush, Thompson's	OR	BS	
Caulanthus californicus	Jewelflower, California	CA	FE	
Caulanthus crassicaulis var. glaber	Cabbage, Smooth Wild	OR	BS	
Caulanthus lemmonii	Jewelflower, Lemmon's	CA	BS	
Caulanthus major var. nevadensis	Cabbage, Alender Wild	OR	BS	
Caulanthus pilosus	Cabbage, Hairy Wild	OR	BS	
Ceanothus confusus	Ceanothus, Rincon Ridge	CA	BS	
Ceanothus cyaneus	Ceanothus, Lakeside	CA	BS	
Ceanothus divergens	Ceanothus, Calistoga	CA	BS	
Ceanothus fendleri	Whitethorn, Fendler's	MT	BS	
Ceanothus ferrisiae	Ceanothus, Coyote	CA	FE	
Ceanothus hearstiorum	Ceanothus, Hearst's	CA	BS	
Ceanothus otayensis	Ceanothus, Otay Mountain	CA	BS	
Ceanothus prostratus	Ceanothus, Prostrate	ID	BS	
Ceanothus roderickii	Ceanothus, Pine Hill	CA	FE	
Centromadia parryi ssp. congdonii	Tarplant, Congdon's	CA	BS	
Centromadia parryi ssp. parryi	Tarplant, Pappose	CA	BS	
Cercocarpus montanus	Mahogany, Birchleaf Mountain	ID	BS	
Chaenactis carphoclinia var. peirsonii	None	CA	BS	
Chaenactis cusickii	Pincushion, Cusick's	ID	BS	
Chaenactis glabriuscula var. orcuttiana	Pincushion, Orcutt's	CA	BS	
Chaenactis parishii	None	CA	BS	
Chaenactis stevioides	Pincushion, Desert Or Broadflower	ID	BS	
Chaenactis suffrutescens	Chaenactis, Shasta	CA	BS	
Chaenactis thompsonii	Chaenactis, Thompson's	OR	BS	
Chaenactis xantiana	Chaenactis, Desert	OR	BS	
Chaetadelpha wheeleri	Skeleton-Weed, Wheeler's	OR	BS	
Chamaesyce hooveri	Spurge, Hoover's	CA	FT	X
Cheilanthes covillei	Lip-Fern, Coville's	OR	BS	
Cheilanthes feei	Lip-Fern, Fee's	OR	BS	
Cheilanthes intertexta	Lipfern, Coastal	OR	BS	
Chlorocrambe hastata	Spearhead	OR	BS	
Chlorogalum angustifolium	Amole, Narrow-Leaved	OR	BS	
Chlorogalum grandiflorum	Soaproot, Red Hills	CA	BS	
Chlorogalum pomeridianum var. minus	Soaproot, Dwarf	CA	BS	
Chlorogalum purpureum var. purpureum	Amole, Purple	CA	FT	
Chloropyron maritimum ssp. palustre	Bird's-Beak, Pt. Reyes	CA, OR	BS	
Chloropyron molle ssp. hispidum	Bird's-Beak, Hispid	CA	BS	
Chloropyron tecopense	Bird's-Beak, Tecopa	CA	BS	
Chorizanthe biloba var. immemora	Spineflower, Hernandez	CA	BS	
Chorizanthe blakleyi	None	CA	BS	
Chorizanthe breweri	Spineflower, Brewer's	CA	BS	
Chorizanthe parryi var. parryi	Spineflower, Parry's	CA	BS	
Chorizanthe polygonoides var. longispina	Spineflower, Long-Spined	CA	BS	
Chorizanthe pungens var. pungens	Spineflower, Monterey	CA	FT	X
Chorizanthe rectispina	Spineflower, Straight-Awned	CA	BS	
Chorizanthe robusta var. robusta	Spineflower, Robust	CA	FE	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Chorizanthe xanti var. leucotheca	Spineflower, White-Bracted	CA	BS	
Chrysolepis chrysophylla var. chrysophylla	Chinquapin, Golden	OR	BS	
Chrysosplenium tetrandrum	Golden-Carpet, Northern	OR	BS	
Chylismia scapoidea ssp. scapoidea	Evening-Primrose, Naked-Stemmed	OR	BS	
Cicendia quadrangularis	Timwort	OR	BS	
Cicuta bulbifera	Hemlock, Bulbous Water	ID, OR	BS	
Cirsium aridum	Thistle, Cedar Rim	WY	BS	
Cirsium brevifolium	Thistle, Palouse	ID	BS	
Cirsium ciliolatum	Thistle, Ashland	CA	BS	
Cirsium crassicaule	Thistle, Slough	CA	BS	
Cirsium fontinale var. campylon	Thistle, Mt. Hamilton	CA	BS	
Cirsium fontinale var. obispoense	Thistle, Chorro Creek Bog	CA	FE	
Cirsium mohavense	Thistle, Mojave	NV, UT	BS	
Cirsium occidentale var. lucianum	Thistle, Cuesta Ridge	CA	BS	
Cirsium ownbeyi	Thistle, Ownbey's	WY	BS	
Cirsium rhothophilum	Thistle, Surf	CA	BS	
Cirsium scariosum var. loncholepis	Thistle, La Graciosa	CA	FE	
Cirsium vinaceum	Sacramento Mountains Thistle	NM	FT	
Cirsium wrightii	Thistle, Wright's Marsh	NM	C	
Cladonia perforata	Perforate lichen	—	FE	
Clarkia amoena ssp. whitneyi	Clarkia, Whitney's Farewell-To-Spring	CA	BS	
Clarkia australis	Clarkia, Small Southern	CA	BS	
Clarkia borealis ssp. arida	Clarkia, Shasta	CA	BS	
Clarkia borealis ssp. borealis	Clarkia, Northern	CA	BS	
Clarkia delicata	Clarkia, Delicate	CA	BS	
Clarkia gracilis ssp. albicaulis	Clarkia, White-Stemmed	CA	BS	
Clarkia mildrediae ssp. mildrediae	Clarkia, Mildred's	CA	BS	
Clarkia mosquinii	Clarkia, Mosquin's	CA	BS	
Clarkia rostrata	Clarkia, Beaked	CA	BS	
Clarkia springvillensis	Clarkia, Springville	CA	FT	
Clarkia tembloriensis ssp. calientensis	Clarkia, Vasek's	CA	BS	
Claytonia multiscapa var. flava	Springbeauty, Lanceleaf	ID	BS	
Claytonia ogilviensis	Springbeauty, Ogilvie Mountain	AK	BS	
Clematis columbiana var. tenuiloba	Clematis, Slender-Lobed	MT	BS	
Cleome multicaulis	Spiderflower, Slender	CO, WY	BS	
Cleomella hillmanii var. goodrichii	Stickweed, Goodrich's	UT	BS	
Cleomella plocasperma	Cleomella, Twisted Or Alkali	ID	BS	
Clinopodium chandleri	Savory, San Miguel	CA	BS	
Cochlearia sessilifolia	Scurvygrass, Sessileleaf	AK	BS	
Coeloglossum viride	Orchid, Long-Bract Frog	OR	BS	
Collinsia antonina	Collinsia, San Antonio	CA	BS	
Collinsia sparsiflora var. bruceae	Collinsia, Few-Flowered	OR	BS	
Collomia mazama	Collomia, Mt. Mazama	OR	BS	
Collomia renacta	Collomia, Barren Valley	NV, OR	BS	
Comarostaphylis diversifolia ssp. diversifolia	Holly, Summer	CA	BS	
Comastoma tenellum	Gentian, Slender	OR	BS	
Coptis aspleniifolia	Goldthread, Spleenwort-Leaved	OR	BS	
Coptis trifolia	Goldthread, Three-Leaf	OR	BS	

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Cordylanthus eremicus ssp. kernensis	None	CA	BS	
Cordylanthus nidularius	Bird's-Beak, Mt. Diablo	CA	BS	
Cordylanthus rigidus ssp. littoralis	Bird's-Beak, Seaside	CA	BS	
Cordylanthus tecopensis	Birdbeak, Tecopa	NV	BS	
Cordylanthus tenuis ssp. pallescens	Bird's-Beak, Pallid	CA	BS	
Corispermum navicula	Bugseed, Crescent	CO	BS	
Corydalis aquae-gelidae	Corydalis, Cold-Water	OR	BS	
Corydalis caseana ssp. hastata	Corydalis, Case's	ID	BS	
Coryphantha robustispina ssp.scheeri	Cactus, Scheer's Beehive	NM	BS	
Coryphantha scheeri var. robustispina	Cactus, Pima Pineapple	AZ	FE	
Crepis bakeri ssp. idahoensis	Hawksbeard, Idaho	ID	BS	
Croton wigginsii	Croton, Wiggins'	CA	BS	
Cryptantha barnebyi	Cryptanth, Barneby's	UT	BS	
Cryptantha caespitosa	Cryptantha, Tufted	ID	BS	
Cryptantha cana	Candleflower, Silver-Mounded	MT	BS	
Cryptantha clokeyi	Cryptantha, Clokey's	CA	BS	
Cryptantha compacta	Cryptanth, Mound	UT	BS	
Cryptantha creutzfeldtii	Creutzfeldt-Flower	UT	BS	
Cryptantha crinita	Cryptantha, Silky	CA	BS	
Cryptantha dissita	Cryptantha, Serpentine	CA	BS	
Cryptantha excavata	Cryptantha, Deep-Scarred	CA	BS	
Cryptantha fendleri	Cat's-Eye, Fendlers	MT	BS	
Cryptantha ganderi	Cryptantha, Gander's	CA	BS	
Cryptantha gracilis	Cryptantha, Narrow-Stem	OR	BS	
Cryptantha leiocarpa	Cryptantha, Seaside	OR	BS	
Cryptantha leucophaea	Cryptantha, Gray	OR	BS	
Cryptantha mariposae	Cryptantha, Mariposa	CA	BS	
Cryptantha milo-bakeri	Cryptantha, Milo Baker's	OR	BS	
Cryptantha propria	Cryptantha, Malheur	ID	BS	
Cryptantha rostellata	Cryptantha, Beaked	OR	BS	
Cryptantha schoolcraftii	Catseye, Schoolcraft	CA, NV	BS	
Cryptantha semiglabra	Catseye, Smooth	AZ	BS	
Cryptantha sericea	Cryptantha, Silky	ID	BS	
Cryptantha shackletteana	Cryptantha, Shacklette's	AK	BS	
Cryptantha simulans	Cryptantha, Pine Woods	OR	BS	
Cryptantha spiculifera	Cryptantha, Snake River	OR	BS	
Cryptantha spithamaea	Cryptantha, Red Hills	CA	BS	
Cryptantha subcapitata	Miner's Candle, Owl Creek	WY	BS	
Cryptantha torreyana	Cryptantha, Torrey's	MT	BS	
Cuscuta denticulata	Dodder, Sepal-Tooth	ID	BS	
Cusickiella douglasii	Draba, Douglas'	OR	BS	
Cusickiella quadricostata	Cusickiella, Bodie Hills	CA, NV	BS	
Cycladenia humilis var. jonesii	Cycladenia, Jones	AZ, UT	FT	
Cylindr fosbergii	Cholla, Pink Teddy-Bear	CA	BS	
Cylindropuntia multigeniculata	Cholla, Blue Diamond	NV	BS	
Cylindropuntia munzii	Cholla, Munz	CA	BS	
Cymopterus acaulis var. greeleyorum	Cymopterus, Greeley's	ID, OR	BS	
Cymopterus basalticus	Wavewing, Intermountain	NV	BS	
Cymopterus beckii	Spring-Parsley, Pinnate	UT	BS	
Cymopterus deserticola	Cymopterus, Desert	CA	BS	
Cymopterus duchesnensis	Springparsley, Uintah Basin	CO	BS	

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Cymopterus evertii	Wafer-Parsnip, Evert's	WY	BS	
Cymopterus goodrichii	Biscuitroot, Goodrich	NV	BS	
Cymopterus ibapensis	Springparsley, Ibapah	ID, OR	BS	
Cymopterus nivalis	Spring-Parsley, Snowline	OR	BS	
Cymopterus purpurascens	Cymopterus, Purple	OR	BS	
Cymopterus ripleyi var. saniculoides	Cymopterus, Ripley's	CA	BS	
Cymopterus spellenbergii	Taos Springparsley	NM	BS	
Cymopterus williamsii	Spring-Parsley, Williams'	WY	BS	
Cyperus acuminatus	Cyperus, Short-Pointed	OR	BS	
Cyperus lupulinus ssp. lupulinus	Cyperus	OR	BS	
Cyperus odoratus	Flatsedge, Rusty	ID	BS	
Cypripedium fasciculatum	Lady's-Slipper, Clustered	CA, ID, OR	BS	
Cypripedium montanum	Slipper, Mountain Lady's	CA	BS	
Cypripedium parviflorum	Lady's-Slipper, Yellow	OR, MT	BS	
Dalea flavescens var. epica	Clover, Hole-In-The-Rock Prairie	UT	BS	
Dalea ornata	Dalea, Ornate	CA	BS	
Dalea tentaculoides	Bush, Gentry Indigo	AZ	BS	
Damasonium californicum	Waterplantain, Fringed	ID	BS	
Dedeckera eurekensis	Gold, July	CA	BS	
Deinandra arida	Tarplant, Red Rock	CA	BS	
Deinandra conjugens	Tarplant, Otay	CA	FT	
Deinandra floribunda	Tarplant, Tecate	CA	BS	
Deinandra halliana	Tarplant, Hall's	CA	BS	
Deinandra increscens ssp. villosa	Tarplant, Gaviota	CA	FE	
Deinandra minthornii	Tarplant, Santa Suzana	CA	BS	
Deinandra mohavensis	Tarplant, Mojave	CA	BS	
Delphinium califonicum ssp. interius	None	CA	BS	
Delphinium hesperium ssp. cuyamaceae	Larkspur, Cuyamaca	CA	BS	
Delphinium nudicaule	Larkspur, Red	OR	BS	
Delphinium nuttallii	Larkspur, Nutall's	OR	BS	
Delphinium parryi ssp. blochmaniae	Larkspur, Dune	CA	BS	
Delphinium purpusii	Larkspur, Kern County	CA	BS	
Delphinium recurvatum	Larkspur, Recurved	CA	BS	
Delphinium umbraculorum	Larkspur, Umbrella	CA	BS	
Delphinium viridescens	Larkspur, Wenatchee	OR	BS	
Dermatophyllum guadalupense	Mescalbean, Guadalupe	NM	BS	
Descurainia torulosa	Tansy-Mustard, Wyoming	WY	BS	
Dicentra pauciflora	Bleedingheart, Few-Flowered	OR	BS	
Dieteria asteroides var. lagunensis	Aster, Mount Laguna	CA	BS	
Dimeresia howellii	Doublet, Dimeresia Or	ID	BS	
Diphasiastrum complanatum	Cedar, Ground	OR, MT	BS	
Diplacus bolanderi	Monkeyflower, Bolander's	OR	BS	
Diplacus congdonii	Monkeyflower, Congdon's	OR	BS	
Diplacus cusickii	Monkeyflower, Cusick's	OR	BS	
Diplacus mohavensis	Monkeyflower, Mojave	CA	BS	
Diplacus ovatus	Monkeyflower, Steamboat	NV	BS	
Diplacus pulchellus	Monkeyflower, Pansy	CA	BS	
Diplacus tricolor	Monkeyflower, Three-Colored	OR	BS	
Dithyrea maritima	Spectaclepod, Beach	CA	BS	

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Dodecahema leptoceras	Spineflower, Slender-Horned	CA	FE	
Dodecatheon austrofrigidum	Shootingstar, Frigid	OR	BS	
Dodecatheon pulchellum var. shoshonense	Shootingstar, Darkthroat	OR	BS	
Douglasia arctica	Douglasia, Mackenzie's River	AK	BS	
Douglasia beringensis	Primrose, Arctic Dwarf	AK	BS	
Downingia bacigalupii	Downingia, Bacigalupi's	ID	BS	
Downingia insignis	Calicoflower, Harlequin	ID	BS	
Draba aurea	Draba, Golden	OR	BS	
Draba cana	Draba, Lance-Leaved	OR	BS	
Draba carnosula	Draba, Mt Eddy	CA	BS	
Draba globosa	Draba, Pointed	ID, MT	BS	
Draba howellii	Whitlow-Grass, Howell's	OR	BS	
Draba micropetala	Draba, Small-Flowered	AK	BS	
Draba murrayi	Draba, Kathul Mountain	AK	BS	
Draba ogilviensis	Draba, Ogilvie Range	AK	BS	
Draba pauciflora	Draba, Fewflower	AK	BS	
Draba ventosa	Draba, Wind River	MT	BS	
Dracocephalum parviflorum	Dragonhead, American	OR	BS	
Dryas drummondii var. drummondii	Mountain-Avens, Drummond's	OR	BS	
Dryopteris cristata	Shield-Fern, Crested	OR	BS	
Dudleya abramsii ssp. murina	Dudleya, Mouse-Gray	CA	BS	
Dudleya multicaulis	Dudleya, Many-Stemmed	CA	BS	
Dudleya saxosa ssp. saxosa	Dudleya, Panamint	CA	BS	
Dudleya variegata	Dudleya, Variegated	CA	BS	
Dudleya viscida	None	CA	BS	
Eatonella nivea	Eatonella, White Or False Tickhead	ID	BS	
Echinocactus horizonthalonius var. nicholii	Cactus, Nichol's Turk's Head	AZ	FE	
Echinocereus engelmannii var. howei	Cactus, Howe's Hedgehog	CA	BS	
Echinocereus fendleri var. kuenzleri	Hedgehog Cactus, Kuenzler's	NM	FT	
Echinocereus triglochidiatus var. arizonicus	Cactus, Arizona Hedgehog	AZ	FE	
Echinomastus erectocentrus var. acunensis	Cactus, Acuna	AZ	FE	X
Elatine brachysperma	Waterwort, Short Seeded	OR	BS	
Eleocharis bolanderi	Spikerush, Bolander's	OR	BS	
Enceliopsis argophylla	Sunray, Silverleaf	AZ, NV	BS	
Enceliopsis covillei	Daisy, Panamint	CA	BS	
Enceliopsis nudicaulis var. corrugata	Sunray, Ash Meadows	NV	FT	X
Enemion occidentale	Rue-Anemone, Western False	OR	BS	
Epilobium canum ssp. garrettii	Fuchsia, Garrett's California	NV	BS	
Epilobium nevadense	Willowherb, Nevada	NV, UT	BS	
Epilobium nivium	Willowherb, Snow Mountain	CA	BS	
Epilobium oreganum	Willow-Herb, Oregon	CA, OR	BS	
Epilobium palustre	Willow-Herb, Swamp	ID	BS	
Epilobium siskiyouense	Fireweed, Siskiyou	CA	BS	
Epipactis gigantea	Orchid, Chatterbox Or Stream	ID	BS	
Equisetum variegatum	Rush, Variegated Scouring	MT	BS	
Eremalche kernensis	Mallow, Kern	CA	FE	
Eremothera pygmaea	Evening-Primrose, Dwarf	OR	BS	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Eriastrum brandegeeae	Eriastrum, Brandegee's	CA	BS	
Eriastrum densifolium ssp. sanctorum	Woolystar, Santa Ana River	CA	FE	
Eriastrum harwoodii	Eriastrum, Harwood's	CA	BS	
Eriastrum luteum	Eriastrum, Yellow-Flowered	CA	BS	
Ericameria arborescens	Fleece, Golden	OR	BS	
Ericameria bloomeri	Goldenweed, Rabbitbrush Or Bloomer's	ID	BS	
Ericameria cervina	Goldenbush, Antelope Canyon	NV	BS	
Ericameria crispa	Goldenbush, Pine Valley	UT	BS	
Ericameria discoidea var. winwardii	Goldenbush, Winward's	ID, WY	BS	
Ericameria fasciculata	Goldenbush, Eastwood's	CA	BS	
Ericameria gilmanii	Goldenbush, Gilman's	CA	BS	
Ericameria lignumviridis	Goldenbush, Greenwood's	UT	BS	
Ericameria palmeri var. palmeri	Goldernbush, Palmer's	CA	BS	
Erigeron acomanus	Fleabane, Acoma	NM	BS	
Erigeron aequifolius	Daisy, Hall's	CA	BS	
Erigeron allocotus	Fleabane, Big Horn	MT	BS	
Erigeron basalticus	Daisy, Basalt	OR	BS	
Erigeron blochmaniae	Daisy, Blochman's Leafy	CA	BS	
Erigeron calvus	Daisy, Bald	CA	BS	
Erigeron cervinus	Daisy, Siskiyou	OR	BS	
Erigeron davisii	Daisy, Engelmann's	OR	BS	
Erigeron decumbens	Daisy, Willamette	OR	FE	X
Erigeron disparipilus	Erigeron, White Cushion	OR	BS	
Erigeron flabellifolius	Fleabane, Fan-Leaved	MT	BS	
Erigeron howellii	Daisy, Howell's	OR	BS	
Erigeron kachinensis	Fleabane, Kachina	CO, UT	BS	
Erigeron lackschewitzii	Fleabane, Lackschewitz'	MT	BS	
Erigeron latus	Fleabane, Broad	NV, OR	BS	
Erigeron maguirei	Daisy, Maguire's	UT	BS	
Erigeron maniopotamicus	Daisy, Mad River Fleabane	CA	BS	
Erigeron muirii	Fleabane, Muir's	AK	BS	
Erigeron multiceps	Daisy, Kern River	CA	BS	
Erigeron oreganus	Daisy, Oregon	OR	BS	
Erigeron ovinus	Fleabane, Sheep	NV	BS	
Erigeron parishii	Daisy, Parish's	CA	FT	X
Erigeron parryi	Fleabane, Parry's	MT	BS	
Erigeron peregrinus var. thompsonii	Daisy, Thompson's Wandering	OR	BS	
Erigeron piscaticus	Fleabane, Fish Creek	AZ	BS	
Erigeron radicatus	Fleabane, Taproot	MT	BS	
Erigeron rhizomatus	Fleabane, Zuni	NM	FT	
Erigeron salishii	Fleabane, Salish	OR	BS	
Erigeron serpentinus	Daisy, Serpentine	CA	BS	
Erigeron stanselliae	Daisy, Stansell's	OR	BS	
Erigeron supplex	Daisy, Supple	CA	BS	
Erigeron uncialis var. uncialis	Daisy, Limestone	CA	BS	
Erigeron untermannii	Daisy, Untermann's	UT	BS	
Eriodictyon altissimum	Mountainbalm, Indian Knob	CA	FE	
Eriogonum acaule	Buckwheat, Singlestem	CO	BS	
Eriogonum alexanderae	Buckwheat, Alexander's	CA, NV	BS	
Eriogonum ammophilum	Buckwheat, Ibex	UT	BS	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Eriogonum anemophilum	Buckwheat, Windloving	NV	BS	
Eriogonum apricum var. apricum	Buckwheat, Ione	CA	FE	
Eriogonum artificis	Buckwheat, Kaye H. Thorne's	UT	BS	
Eriogonum beatleyae	Buckwheat, Beatley	NV	BS	
Eriogonum bifurcatum	Buckwheat, Pahrump Valley	CA, NV	BS	
Eriogonum brachyanthum	Eriogonum, Short-Flowered	OR	BS	
Eriogonum brandegeei	Buckwheat, Brandegee's	CO	BS	
Eriogonum brevicaule var. mitophyllum	Buckwheat, Lost Creek Wild	UT	BS	
Eriogonum capistratum var. welshii	Buckwheat, Welsh's	ID	BS	
Eriogonum cedrorum	Buckwheat, The Cedars	CA	BS	
Eriogonum chrysops	Buckwheat, Golden	OR	BS	
Eriogonum clavellatum	Buckwheat, Comb Wash	CO	BS	
Eriogonum codium	Buckwheat, Umtanum Desert	OR	FT	
Eriogonum coloradoense	Buckwheat, Colorado	CO	BS	
Eriogonum concinnum	Buckwheat, Darin	NV	BS	
Eriogonum contiguum	Buckwheat, Reveal's	CA	BS	
Eriogonum contortum	Buckwheat, Grand	CO	BS	
Eriogonum corymbosum var. nilesii	Buckwheat, Las Vegas	NV	BS	
Eriogonum corymbosum var. smithii	Buckwheat, Flat Top	UT	BS	
Eriogonum cronquistii	Buckwheat, Cronquist's	UT	BS	
Eriogonum crosbyae var. crosbyae	Buckwheat, Crosby's	CA, NV, OR	BS	
Eriogonum crosbyae var. mystrium	Buckwheat, Pueblo Mountains	ID	BS	
Eriogonum cusickii	Buckwheat, Cusick's	OR	BS	
Eriogonum diatomaceum	Buckwheat, Churchill Narrows	NV	BS	
Eriogonum ephedroides	Buckwheat, Ephedra	CO	BS	
Eriogonum eremicola	Buckwheat, Wildrose Canyon	CA	BS	
Eriogonum eremicum	Buckwheat, Limestone	NV	BS	
Eriogonum gypsophilum	Buckwheat, Gypsum Wild	NM	FT	X
Eriogonum heermannii var. clokeyi	Buckwheat, Clokey	NV	BS	
Eriogonum heermannii var. occidentale	None	CA	BS	
Eriogonum hoffmannii var. hoffmannii	Buckwheat, Hoffmann's	CA	BS	
Eriogonum hoffmannii var. robustius	Buckwheat, Robust Hoffmann's	CA	BS	
Eriogonum hookeri	Buckwheat, Hooker's	ID, OR	BS	
Eriogonum kelloggii	Buckwheat, Red Mountain	CA	BS	
Eriogonum kennedyi var. pinicola	Buckwheat, Kern	CA	BS	
Eriogonum lachnogynum var.colobum	Wildbuckwheat, Clipped	NM	BS	
Eriogonum lemmonii	Buckwheat, Lemmon	NV	BS	
Eriogonum lewisii	Buckwheat, Lewis	NV	BS	
Eriogonum lobbii	Buckwheat, Lobb's	OR	BS	
Eriogonum mensicola	Buckwheat, Pinyon Mesa	CA	BS	
Eriogonum microthecum var. panamintense	Buckwheat, Panamint Mountains	CA	BS	
Eriogonum microthecum var. schoolcraftii	Buckwheat, Schoolcraft	CA, NV	BS	
Eriogonum nervulosum	Buckwheat, Snow Mountain	CA	BS	
Eriogonum nortonii	None	CA	BS	
Eriogonum novonudum	Buckwheat, False Naked	ID	BS	
Eriogonum nudum var. murinum	Buckwheat, Mouse	CA	BS	
Eriogonum nutans var. glabratum	Buckwheat, Deeth	NV	BS	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Eriogonum ochrocephalum var. calcareum	Buckwheat, Calcereous	ID	BS	
Eriogonum ovalifolium var. focarium	Buckwheat, Craters-Of-The-Moon Wild	ID	BS	
Eriogonum ovalifolium var. vineum	Buckwheat, Cushenberry	CA	FE	X
Eriogonum ovalifolium var. williamsiae	Buckwheat, Steamboat	NV	FE	
Eriogonum pelinophilum	Buckwheat, Clay-Loving Wild	CO	FE	
Eriogonum pharnaceoides var. cervinum	Buckwheat, Deer Lodge	NV, UT	BS	
Eriogonum phoeniceum	Buckwheat, Scarlet	NV, UT	BS	
Eriogonum prociduum	Buckwheat, Prostrate	CA, OR	BS	
Eriogonum racemosum var. nobilis	Buckwheat, Bluff	UT	BS	
Eriogonum robustum	Buckwheat, Altered Andesite	NV	BS	
Eriogonum rubricaule	Buckwheat, Lahontan Basin	NV	BS	
Eriogonum salicornioides	Buckwheat, Playa	OR	BS	
Eriogonum shockleyi var. packardiae	Buckwheat, Packard's	ID	BS	
Eriogonum shockleyi var. shockleyi	Buckwheat, Shockey's Or Matted Cowpie	ID	BS	
Eriogonum soliceps	Buckwheat, Railroad Canyon	ID, MT	BS	
Eriogonum soredium	Buckwheat, Frisco	UT	C	
Eriogonum temblorense	Buckwheat, Temblor	CA	BS	
Eriogonum terrenatum	Buckwheat, San Pedro River Wild	AZ	BS	
Eriogonum tiehmii	Buckwheat, Tiehm	NV	BS	X
Eriogonum tumulosum	Buckwheat, Woodside	CO	BS	
Eriogonum umbellatum var. ahartii	Buckwheat, Ahart's	CA	BS	
Eriogonum umbellatum var. glaberrimum	Buckwheat, Green	CA, OR	BS	
Eriogonum ursinum var. erubescens	Buckwheat, Blushing Wild	CA	BS	
Eriogonum viridulum	Buckwheat, Clay Hill	CO	BS	
Eriogonum viscidulum	Buckwheat, Sticky Wild	AZ, NV	BS	
Eriogonum visheri	Buckwheat, Visher's	MT	BS	
Eriophorum angustifolium	Cottongrass, Tall	MT	BS	
Eriophorum chamissonis	Cotton-Grass, Russet	OR	BS	
Eriophorum viridicarinatum	Cotton-Grass, Green Keeled	OR	BS	
Eriophyllum mohavense	Woolly-Sunflower, Barstow	CA	BS	
Eritrichium nanum var. elongatum	Forget-Me-Not, Pale Alpine	OR	BS	
Erodium macrophyllum	Filaree, Large-Leaved	OR	BS	
Errazurizia rotundata	Broom, Round-Leaf	AZ	BS	
Eryngium articulatum	Coyotethistle, Jointed Or Beethistle	ID	BS	
Eryngium petiolatum	Coyote-Thistle, Oregon	OR	BS	
Eryngium sparganophyllum	Eryngo, Arizona	AZ	FE	X
Eryngium spinosepalum	None	CA	BS	
Erysimum ammophilum	Wallflower, Coast	CA	BS	
Erysimum concinnum	Wallflower, Bluff	CA	BS	
Erysimum menziesii	Wallflower, Menzies'	CA	FE	
Erythranthe calcicola	Monkeyflower, Limestone	CA	BS	
Erythranthe carsonensis	Monkeyflower, Carson Valley	NV	BS	
Erythranthe hymenophylla	Monkeyflower, Membrane-Leaved	OR	BS	
Erythranthe latidens	Monkeyflower, Broad-Toothed	OR	BS	
Erythranthe marmorata	Monkeyflower, Stanislaus	CA	BS	
Erythranthe patula	Monkeyflower, Stalk-Leaved	OR	BS	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Erythranthe pulsiferae	Monkey-Flower, Pulsifer's	OR	BS	
Erythranthe rhodopetra	Monkeyflower, Red Rock Canyon	CA	BS	
Erythranthe suksdorfii	Monkeyflower, Suksdorf's	OR	BS	
Erythronium citrinum var. roderickii	Lily, Scott Mtn. Fawn	CA	BS	
Erythronium elegans	Fawn-Lily, Coast Range	OR	BS	
Erythronium howellii	Adder's-Tongue, Howell's	OR	BS	
Erythronium tuolumnense	Fawn-Lily, Tuolumne	CA	BS	
Eschscholzia caespitosa	Poppy, Gold	OR	BS	
Eschscholzia lemmonii ssp. kernensis	None	CA	BS	
Eschscholzia minutiflora ssp. twisselmannii	Poppy, Red Rock	CA	BS	
Eschscholzia rhombipetala	Poppy, Diamond-Petaled California	CA	BS	
Escobaria duncanii	Cactus, Duncan's Pincushion	NM	BS	
Escobaria robbinsiorum	Cactus, Cochise Pincushion	AZ	FT	
Escobaria sneedii var. leei	Cactus, Lee's Pincushion	NM	FT	
Escobaria sneedii var. sneedii	Cactus, Sneed's Pincushion	NM	FE	
Escobaria villardii	Cactus, Villard's Pincushion	NM	BS	
Etriplex joaquinana	Spearscale, San Joaquin	CA	BS	
Eucephalus gormanii	Aster, Gorman's	OR	BS	
Eucephalus vialis	Aster, Wayside	OR	BS	
Euphorbia fendleri	Spurge, Fendler's	MT	BS	
Euphorbia jaegeri	Spurge, Orocopia Mountains	CA	BS	
Euphorbia nephradenia	Spurge, Utah	UT	BS	
Euphorbia ocellata ssp. rattanii	Spurge, Stony Creek	CA	BS	
Euphorbia platysperma	Spurge, Flat-Seeded	CA	BS	
Eustoma exaltatum	Gentain, Tulip	MT	BS	
Eutrema penlandii	Mustard, Penland Alpine Fen	CO	FT	
Frasera ackermaniae	Gentian, Ackerman's Green	UT	BS	
Frasera gypsicola	Gentian, Sunnyside Green	NV, UT	BS	
Frasera paniculata	Frasera, Tufted	CO	BS	
Frasera umpquaensis	Swertia, Umpqua	OR	BS	
Fremontodendron californicum	Flannelbush, California	AZ	BS	
Fremontodendron decumbens	Flannelbush, Pine Hill	CA	FE	
Fremontodendron mexicanum	Flannelbush, Mexican	CA	FE	X
Fritillaria camschatcensis	Lily, Black	OR	BS	
Fritillaria falcata	Fritillary, Talus	CA	BS	
Fritillaria gentneri	Fritillary, Gentner's	CA, OR	FE	
Fritillaria ojaiensis	Fritillary, Ojai	CA	BS	
Fritillaria pluriflora	Adobe-Lily	CA	BS	
Fritillaria striata	Adobe-Lily, Striped	CA	BS	
Fritillaria viridea	Fritillary, San Benito	CA	BS	
Galium angustifolium ssp. Borregoense	None	CA	BS	
Galium angustifolium ssp. jacinticum	None	CA	BS	
Galium angustifolium ssp. onycense	Bedstraw, Onyx Peak	CA	BS	
Galium californicum ssp. primum	Bedstraw, Alvin Meadow	CA	BS	
Galium californicum ssp. sierrae	Bedstraw, El Dorado	CA	FE	
Galium glabrescens ssp. modocense	Bedstraw, Modoc	CA	BS	
Galium grande	Bedstraw, San Gabriel	CA	BS	
Galium hardhamiae	Bedstraw, Hardham's	CA	BS	
Galium hilendiae ssp. kingstonense	Bedstraw, Kingston	CA	BS	
Galium serpenticum ssp. scotticum	Bedstraw, Scott Mtn.	CA	BS	

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Galium serpenticum ssp. warnerense	Bedstraw, Warner Mtns.	CA, OR	BS	
Gaultheria hispidula	Snowberry, Creeping	OR	BS	
Gentiana affinis	Gentian, Northern	MT	BS	
Gentiana douglasiana	Gentian, Swamp	OR	BS	
Gentiana glauca	Gentian, Glaucous	OR	BS	
Gentiana newberryi var. newberryi	Gentian, Newberry's	OR	BS	
Gentiana plurisetosa	Gentian, Elegant	OR	BS	
Gentiana prostrata	Gentian, Moss	OR	BS	
Gentiana setigera	Gentian, Waldo	CA, OR	BS	
Gentianella tortuosa	Gentian, Cathedral Bluff Dwarf	CO	BS	
Gentianopsis richardsonii	Gentian, Windmill Fringed	AK	BS	
Geum rivale	Avens, Water	OR	BS	
Geum rossii var. turbinatum	Avens, Slender-Stemmed	OR	BS	
Gilia capitata ssp. pacifica	Gilia, Pacific	CA	BS	
Gilia millefoliata	Gilia, Seaside	CA, OR	BS	
Gilia tenuiflora ssp. arenaria	Gilia, Sand	CA	FE	
Githopsis specularioides	Blue-Cup, Common	OR	BS	
Githopsis tenella	Bluecup, Delicate	CA	BS	
Glossopetalon pungens	Glossopetalon, Pungent	CA	BS	
Glossopetalon pungens var. glabrum	Greasebush, Smooth Dwarf	NV	BS	
Glossopetalon pungens var. pungens	Greasebush, Rough Dwarf	NV	BS	
Glyptopleura marginata	Waxplant, White-Margined	ID	BS	
Graptopetalum bartramii	Stonecrop, Bartram	AZ	BS	
Gratiola heterosepala	Hedge-Hyssop, Boggs Lake	CA, OR	BS	
Grindelia fraxinipratensis	Gum-Plant, Ash Meadows	CA	FT	X
Grindelia fraxinopratensis	Gumplant, Ash Meadows	NV	FT	
Grindelia hallii	Gumplant, San Diego	CA	BS	
Grindelia howellii	Gumweed, Howell's	MT	BS	
Gutierrezia elegans	Snakeweed, Lone Mesa	CO	BS	
Hackelia bella	Stickseed, Beautiful	OR	BS	
Hackelia cinerea	Stickseed, Gray	OR	BS	
Hackelia cronquistii	Forget-Me-Not, Cronquist's	ID, OR	BS	
Hackelia diffusa var. diffusa	Stickseed, Diffuse	OR	BS	
Hackelia hispida var. disjuncta	Stickseed, Sagebrush	OR	BS	
Hackelia hispida var. hispida	Stickseed, Rough	OR	BS	
Hackelia ophiobia	Forget-Me-Not, Owyhee	ID, OR	BS	
Hackelia venusta	Stickseed, Showy	OR	FE	
Harmonia doris-nilesiae	Harmonia, Niles's	CA	BS	
Harmonia hallii	Harmonia, Hall's	CA	BS	
Harmonia stebbinsii	Harmonia, Stebbins's	CA	BS	
Harrisia aboriginum	Prickly-Apple, Aboriginal	FL	FE	X
Hastingsia bracteosa var. atropurpurea	Rush-Lily, Purple-Flowered	OR	BS	
Hastingsia bracteosa var. bracteosa	Rush-Lily, Large-Flowered	OR	BS	
Hedeoma todsenii	Pennyroyal, Todson's	NM	FE	
Helianthella castanea	Rock-Rose, Diablo	CA	BS	
Helianthus bolanderi	Sunflower, Bolander's	OR	BS	
Helianthus niveus ssp. tephrodes	Sunflower, Algodones Dunes	CA	BS	
Helianthus paradoxus	Sunflower, Pecos	NM	FT	
Helianthus winteri	Sunflower, Winter's	CA	BS	
Heliotropium curassavicum	Heliotrope, Salt	OR	BS	

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Hesperevax sparsiflora ssp. brevifolia	Evax, Short-Leaved	CA	BS	
Hesperidanthus jaegeri	Hesperidanthus, Jaeger's	CA	BS	
Hesperocyparis bakeri	Cypress, Baker's	OR	BS	
Hesperolinon adenophyllum	Flax, Glandular Western	CA	BS	
Hesperolinon bicarpellatum	Flax, Two-Carpellate Western	CA	BS	
Hesperolinon breweri	Flax, Brewer's Dwarf	CA	BS	
Hesperolinon didymocarpum	Flax, Lake County Dwarf	CA	BS	
Hesperolinon drymarioides	Flax, Drymaria-Like Western	CA	BS	
Hesperolinon sharsmithiae	Flax, Sharsmith's Western	CA	BS	
Hesperolinon tehamense	Flax, Tehama County Western	CA	BS	
Heterotheca oregona	Goldenaster, Oregon	OR	BS	
Heterotheca rutteri	Aster, Huachuca Golden	AZ	BS	
Heterotheca shevockii	Golden-Aster, Shevock's	CA	BS	
Heuchera brevistaminea	Alumroot, Laguna Mountains	CA	BS	
Hexalectris warnockii	Coralroot, Purple-Spike	AZ	BS	
Hieracium horridum	Hawkweed, Shaggy	OR	BS	
Hierochloe odorata	Grass, Vanilla	ID	BS	
Horkelia bolanderi	Horkelia, Bolander's	CA	BS	
Horkelia congesta ssp. congesta	Horkelia, Shaggy	OR	BS	
Horkelia hendersonii	Horkelia, Henderson's	CA	BS	
Horkelia marinensis	Clarkia, Mariposa	CA	BS	
Horkelia parryi	Horkelia, Parry's	CA	BS	
Horkelia tenuiloba	Horkelia, Thin-Lobed	CA	BS	
Horkelia tridentata ssp. tridentata	Horkelia, Three-Toothed	OR	BS	
Horkelia truncata	None	CA	BS	
Hosackia crassifolia var. otayensis	Lotus, Otay Mountain	CA	BS	
Howellia aquatilis	Howellia, Water	ID, OR	FT	
Hulsea californica	Sunflower, San Diego	CA	BS	
Hydrocotyle verticillata	Marsh-Pennywort, Whorled	OR	BS	
Hymenoxys ambigens var. neomexicana	Bitterweed, New Mexico	NM	BS	
Hymenoxys cooperi var. canescens	Rubber-Plant, Cooper's	ID	BS	
Hymenoxys lapidicola	Hymenoxys, Rock	UT	BS	
Hypericum majus	St. John's Wort, Large Canadian	ID	BS	
Iliamna latibracteata	Globe-Mallow, California	OR	BS	
Impatiens noli-tangere	Jewel-Weed, Western	OR	BS	
Ionactis caelestis	Aster, Red Rock Canyon	NV	BS	
Ipomopsis polyantha	Skyrocket, Pagosa	CO	FE	X
Ipomopsis polycladon	Gilia, Spreading	ID	BS	
Ipomopsis tenuituba	Gilia, Rydberg's	OR	BS	
Iris hartwegii ssp. columbiana	Iris, Tuolumne	CA	BS	
Iris munzii	Iris, Munz's	CA	BS	
Iris tenax var. gormanii	Iris, Gorman's	OR	BS	
Isocoma menziesii var. decumbens	None	CA	BS	
Isoetes minima	Quillwort, Midget	OR	BS	
Isoetes nuttallii	Quillwort, Nuttall's	OR	BS	
Ivesia aperta var. aperta	Mousetails, Sierra Valley	CA	BS	
Ivesia arizonica var. saxosa	Purpusia, Rock	NV	BS	
Ivesia jaegeri	Ivesia, Jaeger's	CA, NV	BS	
Ivesia kingii var. eremica	Mousetails, Ash Meadows	NV	FT	
Ivesia kingii var. kingii	Ivesia, Alkali	CA, NV	BS	

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Ivesia longibracteata	Ivesia, Castle Crags	CA	BS	
Ivesia paniculata	Ivesia, Ash Creek	CA	BS	
Ivesia patellifera	Ivesia, Kingston Mountains	CA	BS	
Ivesia pickeringii	Ivesia, Pickering's	CA	BS	
Ivesia pityocharis	Mousetails, Pine Nut Mountains	NV	BS	
Ivesia rhypara var. rhypara	Ivesia, Grimy	CA, NV, OR	BS	
Ivesia rhypara var. shellyi	Ivesia, Shelly's	OR	BS	
Ivesia sericoleuca	Ivesia, Plumas	CA	BS	
Ivesia shockleyi	Ivesia, Shockley's	OR	BS	
Ivesia shockleyi var. ostleri	Ivesia, Ostler's	UT	BS	
Ivesia webberi	Ivesia, Webber's	CA, NV	FT	X
Jamesia tetrapetala	Waxflower	NV, UT	BS	
Johanneshowellia crateriorum	Buckwheat, Lunar Crater	NV	BS	
Juncus articulatus	Rush, Jointed	AK, MT	BS	
Juncus hemiendytus var. abjectus	Rush, Least	OR	BS	
Juncus howellii	Rush, Howell's	OR	BS	
Juncus kelloggii	Rush, Kellogg's	OR	BS	
Juncus leiospermus var. leiospermus	Rush, Red Bluff Dwarf	CA	BS	
Juncus luciensis	Rush, Santa Lucia Dwarf	CA	BS	
Juncus tiehmii	Rush, Tiehm's	OR	BS	
Juncus triglumis var. albescens	Rush, Three-Flowered	OR	BS	
Juncus uncialis	Rush, Inch-High	OR	BS	
Justicia wrightii	Water- Willow, Wright's	NM	BS	
Kalmia procumbens	Azalea, Alpine	OR	BS	
Kalmiopsis fragrans	Kalmiopsis, Fragrant	OR	BS	
Keckiella lemmonii	Beardtongue, Bush	OR	BS	
Kobresia myosuroides	Kobresia, Pacific	OR	BS	
Kobresia simpliciuscula	Kobresia, Simple	ID, OR	BS	
Lagophylla diabolensis	Hare-Leaf, Diablo Range	CA	BS	
Lappula cenchrusoides	Stickseed, Great Plains	MT	BS	
Lasthenia californica ssp. macrantha	Goldfields, Perennial	CA	BS	
Lasthenia conjugens	Goldfields, Contra Costa	CA	FE	
Lasthenia glaberrima	Goldfields, Smooth	OR	BS	
Lasthenia glabrata ssp. coulteri	Goldfields, Coulter's	CA	BS	
Lathrocasis tenerrima	Gilia, Delecate	OR	BS	
Lathyrus grimesii	Vetchling, Grimes	NV	BS	
Lathyrus hitchcockianus	Sweetpea, Bullfrog Hills	NV	BS	
Lathyrus holochlorus	Peavine, Thin-Leaved	OR	BS	
Layia carnosa	Layia, Beach	CA	FE	
Layia discoidea	Tidytips, Rayless	CA	BS	
Layia heterotricha	Layia, Pale-Yellow	CA	BS	
Layia jonesii	Layia, Jones'	CA	BS	
Layia leucopappa	Layia, Comanche Point	CA	BS	
Layia munzii	Tidy-Tips, Munz's	CA	BS	
Layia septentrionalis	Layia, Colusa	CA	BS	
Lechea stricta	Pinweed, Prairie	MT	BS	
Legenere limosa	Legenere	CA	BS	
Lepechinia ganderi	Pitcher-Sage, Gander's	CA	BS	
Lepidium barnebyanum	Ridge-Cress, Barneby	UT	FE	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Lepidium davisii	Peppergrass, Davis'	ID, OR, NV	BS	
Lepidium flavum var. felipense	Pepper-Grass, Borrego Valley	CA	BS	
Lepidium huberi	Pepperplant, Huber's	UT	BS	
Lepidium integrifolium var. integrifolium	Pepperwort, Entire Thickleaf	WY, NV	BS	
Lepidium jaredii ssp. album	Pepper-Grass, Panoche	CA	BS	
Lepidium jaredii ssp. jaredii	Pepper-Grass, Jared's	CA	BS	
Lepidium montanum var. nevadense	Peppercress, Pueblo Valley	NV	BS	
Lepidium ostleri	Pepperplant, Ostler	UT	C	
Lepidium papilliferum	Peppergrass, Slickspot	ID	FT	X
Lepidospartum burgessii	Scalebroom, Gypsum	NM	BS	
Leptodactylon glabrum	Phlox, Bruneau River Prickly	ID, NV	BS	
Leptosiphon bolanderi	Linanthus, Baker's	OR	BS	
Leptosiphon floribundus ssp. hallii	None	CA	BS	
Leptosiphon nuttallii ssp. howellii	Linanthus, Mt. Tedoc	CA	BS	
Leptosyne hamiltonii	Coreopsis, Mt. Hamilton	CA	BS	
Lesquerella arenosa var. argillosa	Bladderpod, Secund	WY	BS	
Lesquerella fremontii	Bladderpod, Fremont's	WY	BS	
Lesquerella macrocarpa	Bladderpod, Large-Fruit	WY	BS	
Lesquerella montana	Bladderpod, Mountain	MT	BS	
Lesquerella multiceps	Bladderpod, Western	WY	BS	
Lesquerella prostrata	Bladderpod, Prostrate	ID, WY	BS	
Lesquerella tumulosa	Bladderpod, Kodachrome	UT	FE	
Lessingia glandulifera var. tomentosa	None	CA	BS	
Leucocrinum montanum	Starlily, Common	MT	BS	
Lewisia cantelovii	Lewisia, Cantelow's	CA	BS	
Lewisia columbiana var. columbiana	Lewisia, Columbia	OR	BS	
Lewisia cotyledon var. heckneri	Lewisia, Heckner's	CA	BS	
Lewisia disepala	None	CA	BS	
Lewisia leeana	Lewisia, Lee's	OR	BS	
Lewisia maguirei	Bitterroot, Maquire	NV	BS	
Lewisia pygmaea	Bitterroot, Alpine	MT	BS	
Lewisia sacajaweana	Bitterroot, Sacajawea's	ID	BS	
Leymus flavescens	Wildrye, Yellow	OR	BS	
Leymus simplex	Wildrye, Alkali	WY	BS	
Lilaea scilloides	Quillwort, Flowering	ID	BS	
Lilaeopsis schaffneriana var. recurva	Water-Umbel, Huachuca	AZ	FE	X
Lilium maritimum	Lily, Coast	CA	BS	
Lilium occidentale	Lily, Western	CA, OR	FE	
Limnanthes alba ssp. gracilis	Meadow-Foam, Slender	OR	BS	
Limnanthes alba ssp. parishii	Meadowfoam, Cuyamaca	CA	BS	
Limnanthes bakeri	Meadowfoam, Baker's	CA	BS	
Limnanthes floccosa ssp. bellingeriana	Meadow-Foam, Bellinger's	CA, OR	BS	
Limnanthes floccosa ssp. californica	Meadowfoam, Butte County	CA	FE	
Limnanthes pumila ssp. grandiflora	Meadow-Foam, Big-Flowered Wooly	OR	FE	
Limnanthes pumila ssp. pumila	Meadow-Foam, Dwarf Wooly	OR	BS	
Limonium californicum	Marsh-Rosemary, Western	OR	BS	
Linanthus bernardinus	Linanthus, Pioneertown	CA	BS	
Linanthus maculatus ssp. emaculatus	Linanthus, Jacumba Mountains	CA	BS	

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Linanthus maculatus ssp. maculatus	Linanthus, Little San Bernardino Mtns.	CA	BS	
Linanthus orcuttii	Linanthus, Orcutt's	CA	BS	
Linanthus pungens ssp. *hazeliae*	Phlox, Granite Prickly	ID	BS	
Linum allredii	Flax, Allred's	NM	BS	
Lipocarpha aristulata	Lipocarpha, Aristulate	OR	BS	
Listera borealis	Twayblade, Northern	OR	BS	
Listera convallarioides	Twayblade, Broad-Lipped	MT	BS	
Loeflingia squarrosa ssp. artemisiarum	Pygmyleaf, Sagebrush	NV	BS	
Loeflingia squarrosa var. artemisiarum	Loeflingia, Sagebrush	CA	BS	
Lomatium andrusianum	Andrus' Lomatium	ID	BS	
Lomatium attenuatum	Desert-Parsley, Taper-Tip	MT	BS	
Lomatium bentonitum	Biscuitroot, Bentonite	OR	BS	
Lomatium bradshawii	Desertparsley, Bradshaw's	OR	FE	
Lomatium concinnum	Parsley, Adobe Desert	CO	BS	
Lomatium congdonii	Lomatium, Congdon's	CA	BS	
Lomatium cookii	Lomatium, Cook's	OR	FE	X
Lomatium engelmannii	Desert-Parsley, Englemann's	OR	BS	
Lomatium erythrocarpum	Lomatium, Red-Fruited	OR	BS	
Lomatium foeniculaceum ssp. fimbriatum	Desert-Parsley, Fringed	OR	BS	
Lomatium knokei	Desert-Parsley	OR	BS	
Lomatium laevigatum	Desertparsley, Smooth	OR	BS	
Lomatium latilobum	Biscuitroot, Canyonlands	CO, UT	BS	
Lomatium nuttallii	Desert-Parsely, Nuttall	MT	BS	
Lomatium ochocense	Lomatium, Ochoco	OR	BS	
Lomatium packardiae	Parsley, Packard's Desert	ID, NV	BS	
Lomatium ravenii var. ravenii	Lomatium, Raven's	CA	BS	
Lomatium rollinsii	Lomatium, Rollins'	OR	BS	
Lomatium roseanum	Lomatium, Adobe	CA	BS	
Lomatium salmoniflorum	Biscuitroot, Salmon River	ID	BS	
Lomatium serpentinum	Parsley, Snake Canyon Desert	OR	BS	
Lomatium shevockii	Lomatium, Owens Peak	CA	BS	
Lomatium suksdorfii	Parsley, Suksdorf's Desert	OR	BS	
Lomatium tuberosum	Parsley, Hoover's Desert	OR	BS	
Lomatogonium rotatum	Felwort, Marsh	ID	BS	
Lotus stipularis	Trefoil, Stipuled	OR	BS	
Luina serpentina	Luina, Colonial	OR	BS	
Lupinus caudatus var. cutleri	Lupine, Cutler's Spurred	UT	BS	
Lupinus citrinus var. citrinus	Lupine, Orange	CA	BS	
Lupinus citrinus var. deflexus	Lupine, Mariposa	CA	BS	
Lupinus crassus	Lupine, Paradox	CO	BS	
Lupinus duranii	Lupine, Mono Lake	CA	BS	
Lupinus excubitus var. medius	Lupine, Mountain Springs Bush	CA	BS	
Lupinus holmgrenianus	Lupine, Holmgren	NV	BS	
Lupinus lepidus var. cusickii	Lupine, Cusick's	OR	BS	
Lupinus ludovicianus	Lupine, San Luis Obispo County	CA	BS	
Lupinus magnificus var. hesperius	Lupine, Mcgee Meadows	CA	BS	
Lupinus magnificus var. magnificus	Lupine, Panamint Mtns.	CA	BS	
Lupinus nevadensis	Lupine, Nevada	OR	BS	
Lupinus oreganus	Lupine, Kincaid's	OR	FT	X

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Lupinus sericatus	Lupine, Cobb Mountain	CA	BS	
Lupinus spectabilis	Lupine, Shaggyhair	CA	BS	
Lupinus tracyi	Lupine, Tracy's	OR	BS	
Lupinus uncialis	Lupine, Inchhigh	CA, ID	BS	
Luzula acuminata	Woodrush, Hairy	MT	BS	
Luzula parviflora	Woodrush, Small-Flowered	MT	BS	
Lycopodiella inundata	Club-Moss, Bog	OR	BS	
Lycopodium annotinum	Clubmoss, Bristly	MT	BS	
Lycopodium dendroideum	Clubmoss, Treelike	OR	BS	
Lygodesmia grandiflora var. entrada	Rushpink, Entrada	UT	BS	
Lyodesmia grandiflora var. doloresensis	Skeletonplant, Dolores River	CO	BS	
Madia radiata	Madia, Showy Golden	CA	BS	
Malacothamnus aboriginum	Mallow, Indian Valley Bush	CA	BS	
Malacothamnus hallii	Bush-Mallow, Hall's	CA	BS	
Malacothamnus palmeri var. involucratus	Bush-Mallow, Carmel Valley	CA	BS	
Malacothamnus palmeri var. lucianus	Bush-Mallow, Arroyo Seco	CA	BS	
Malacothrix saxatilis var. arachnoidea	Malacothrix, Carmel Valley	CA	BS	
Malacothrix sonchoides	Malacothrix, Lyrate	OR	BS	
Meconella oregana	Fairypoppy, White	OR	BS	
Melica bulbosa	Oniongrass	MT	BS	
Melica stricta	Melic, Rock	ID	BS	
Menodora spinescens var. mohavensis	Menodora, Mojave	CA	BS	
Mentzelia argillicola	Blazingstar, Pioche	NV	BS	
Mentzelia argillosa	Stickleaf, Arapien	UT	BS	
Mentzelia candelariae	Blazingstar, Candelaria	NV	BS	
Mentzelia chrysantha	Blazingstar, Gold	CO	BS	
Mentzelia conspicua	Blazingstar, Rio Chama	NM	BS	
Mentzelia decapetala	Ten-Petal Blazingstar	ID	BS	
Mentzelia densa	Blazingstar, Royal Gorge	CO	BS	
Mentzelia goodrichii	Blazingstar, Goodrich's	UT	BS	
Mentzelia humilus var. guadalupensis	Stickleaf, Guadalupe	NM	BS	
Mentzelia inyoensis	Blazingstar, Inyo	CA, NV	BS	
Mentzelia leucophylla	Blazingstar, Ash Meadows	NV	FT	
Mentzelia memorabilis	Stickleaf, September 11	AZ	BS	
Mentzelia mollis	Stickleaf, Smooth	ID, NV, OR	BS	
Mentzelia multicaulis var. librina	Stickleaf, Horse Canyon	UT	BS	
Mentzelia packardiae	Mentzelia, Packard's	OR	BS	
Mentzelia polita	Blazingstar, Polished	CA, NV	BS	
Mentzelia rhizomata	Blazingstar, Roan Cliffs	CO	BS	
Mentzelia shultziorum	Stickleaf, Shultz'	UT	BS	
Mentzelia sivinskii	Sivinski's Blazingstar	NM	BS	
Mentzelia tiehmii	Blazingstar, Tiehm	NV	BS	
Mentzelia todiltoensis	Stickleaf,Todilito	NM	BS	
Mentzelia tridentata	Star, Creamy Blazing	CA	BS	
Menyanthes trifoliata	Buckbean, Bog	MT	BS	
Mertensia ciliata	Bluebells, Streamside	MT	BS	
Mertensia drummondii	Bluebells, Drummond's	AK	BS	
Micranthes nelsoniana ssp. insularis	Saxifrage, Heartleaf	AK	BS	
Micranthes occidentalis	Saxifragee, Western	MT	BS	

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Micranthes porsildiana	Saxifrage, Porsild's	AK	BS	
Micromonolepis pusilla	Weed, Red Poverty	OR	BS	
Microseris borealis	Microseris, Northern	OR	BS	
Microseris nutans	Silver-Puffs, Nodding	MT	BS	
Microseris paludosa	Microseris, Marsh	CA	BS	
Mimulus clivicola	Monkeyflower, Hill	ID	BS	
Mimulus evanescens	Monkeyflower, Disappearing	CA, ID, OR	BS	
Mimulus filicaulis	Monkeyflower, Slender-Stemmed	CA	BS	
Mimulus gracilipes	Monkerflower, Slender-Stalked	CA	BS	
Mimulus hymenophyllus	Monkeyflower, Thinsepal	ID, MT	BS	
Mimulus norrisii	Monkeyflower, Kaweah	CA	BS	
Mimulus pictus	Monkeyflower, Calico	CA	BS	
Mimulus shevockii	Monkeyflower, Kelso Creek	CA	BS	
Minuartia nuttallii ssp. fragilis	Sandwort, Nuttall's	OR	BS	
Mirabilis macfarlanei	Four-O'Clock, Macfarlane's	ID, OR	FT	
Monardella angustifolia	Monardella, Narrow-Leaved	ID, OR	BS	
Monardella beneolens	Monardella, Sweet-Smelling	CA	BS	
Monardella boydii	Monardella, Boyd's	CA	BS	
Monardella eremicola	Monardella, Clark Mountain	CA	BS	
Monardella hypoleuca ssp. lanata	Monardella, Felt-Leaved	CA	BS	
Monardella linoides ssp. oblonga	Monardella, Tehachapi	CA	BS	
Monardella nana ssp. leptosiphon	Monardella, San Felipe	CA	BS	
Monardella purpurea	Monardella, Siskiyou	OR	BS	
Monardella robisonii	Monardella, Robison	CA	BS	
Monardella sinuata ssp. nigrescens	Monardella, Northern Curly-Leaved	CA	BS	
Monardella stoneana	Monardella, Jennifer's	CA	BS	
Monardella undulata ssp. crispa	Monardella, Crisp	CA	BS	
Monardella undulata ssp. undulata	Monardella, San Luis Obispo	CA	BS	
Monardella venosa	Monardella, Veiny	CA	BS	
Moneses uniflora	Wintergreen, One-Flower	MT	BS	
Monolepis spathulata	Weed, Prostrate Poverty	OR	BS	
Monolopia congdonii	Threads, San Joaquin Woolly	CA	FE	
Montia diffusa	Montia, Branching	OR	BS	
Montia vassilievii ssp. vassilievii	Minerslettuce, Bostock's	AK	BS	
Muhlenbergia glomerata	Muhly, Marsh	OR	BS	
Muhlenbergia minutissima	Dropseed, Annual	OR	BS	
Myosurus clavicaulis	Mousetail	OR	BS	
Nama demissa var. covillei	Purple Mat, Coville's	CA	BS	
Nassella viridula	Needlegrass, Green	ID	BS	
Navarretia leucocephala ssp. bakeri	Navarretia, Baker's	CA	BS	
Navarretia leucocephala ssp. pauciflora	Navarretia, Few-Flowered	CA	BS	
Navarretia nigelliformis ssp. radians	Navarretia, Shining	CA	BS	
Navarretia paradoxiclara	Navarretia, Patterson's	CA	BS	
Navarretia paradoxinota	Navarretia, Porter's	CA	BS	
Navarretia prostrata	None	CA	BS	
Navarretia rosulata	Navarretia, Marin County	CA	BS	
Navarretia setiloba	Navarretia, Piute Mountains	CA	BS	
Navarretia tagetina	Navarretia, Marigold	OR	BS	
Navarretia willamettensis	Navarretia, Willamette	OR	BS	

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Nemacladus calcaratus	None	CA	BS	
Nemacladus capillaris	Nemacladus, Slender	OR	BS	
Nemacladus rigidus	Threadbush, Rigid	ID	BS	
Nemacladus twisselmannii	Nemacladus, Twisselmann's	CA	BS	
Neoparrya lithophila	Neoparrya, Rock-Loving	CO	BS	
Neostapfia colusana	Grass, Colusa	CA	FT	X
Nerisyrenia hypercorax	Greggia, Crow Flat	NM	BS	
Nevada holmgrenii	Smelowskia, Holmgren	NV	BS	
Neviusia cliftonii	Snow-Wreath, Shasta	CA	BS	
Nicotiana attenuata	Tobacco, Coyote	OR	BS	
Nicotiana quadrivalvis	Tobacco, Indian	OR	BS	
Nitrophila mohavensis	Niterwort, Amargosa	CA, NV	FE	X
Noccaea parviflora	Pennycress, Small-Flowered	MT	BS	
Nolina interrata	Grass, Dehesa Nolina, Bear	CA	BS	
Oenothera acutissima	Primrose, Flaming Gorge Evening	CO, UT	BS	
Oenothera caespitosa ssp caespitosa	Primrose, Cespitose Evening	OR	BS	
Oenothera caespitosa ssp. marginata	Primrose, Tufted Evening	OR	BS	
Oenothera coloradensis ssp. coloradensis	Butterfly Plant, Colorado	CO, WY	FT	
Oenothera flava	Primrose, Yellow Evening	MT	BS	
Oenothera murdockii	Primrose, Murdock's Evening	UT	BS	
Oenothera psammophila	Primrose, Anthony's Evening	ID	BS	
Oenothera wolfii	Evening-Primrose, Wolf's	CA	BS	
Ophioglossum pusillum	Adder's-Tongue	OR	BS	
Opuntia arenaria	Pricklypear, Sand	NM	BS	
Opuntia basilaris var. brachyclada	Beavertail, Short-Joint	CA	BS	
Opuntia basilaris var. treleasei	Cactus, Bakersfield	CA	FE	
Opuntia pulchella	Cholla, Sand	NV	BS	
Opuntia x viridiflora	Cholla, Santa Fe	NM	BS	
Orcuttia californica	Grass, California Orcutt	CA	FE	
Orcuttia inaequalis	Grass, San Joaquin Valley Orcutt	CA	FT	X
Orcuttia pilosa	Grass, Hairy Orcutt	CA	FE	X
Orcuttia tenuis	Grass, Slender Orcutt	CA	FT	X
Oreocarya caespitosa	Cryptanth, Tufted	CO	BS	
Oreocarya osterhoutii	Cryptantha, Osterhout's	CO	BS	
Oreocarya revealii	Cateye, Gypsum Valley	CO	BS	
Oreocarya rollinsii	Cryptantha, Rollins'	CO	BS	
Oreocarya roosiorum	Cryptantha, Bristlecone	CA	BS	
Oreonana vestita	None	CA	BS	
Oreostemma elatum	Aster, Tall Alpine	CA	BS	
Oreoxis trotteri	Oreoxis, Trotter's	UT	BS	
Orobanche pinorum	Broomrape, Pine	ID	BS	
Orobanche uniflora	Broom-Rape, Naked	AK, MT	BS	
Orthocarpus bracteosus	Owl-Clover, Rosy	OR	BS	
Orthocarpus holmgreniorum	Holmgren's Owl Clover	ID	BS	
Orthocarpus pachystachyus	Orthocarpus, Shasta	CA	BS	
Orthotrichum shevockii	Bristlemoss, Shevock	NV	BS	
Oryctes nevadensis	Oryctes	NV	BS	
Oxyria digyna	Sorrel, Mountain	MT	BS	
Oxytheca watsonii	Spinecup, Watson	NV	BS	
Oxytropis besseyi var. obnapiformis	Locoweed, Bessey	CO	BS	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Oxytropis besseyi var. salmonensis	Crazyweed, Challis	ID	BS	
Oxytropis campestris var. wanapum	Crazyweed, Wanapum	OR	BS	
Oxytropis kokrinensis	Locoweed, Kokrines	AK	BS	
Oxytropis monticola	Locoweed, Yellowflower	OR	BS	
Oxytropis sericea var. sericea	Locoweed, White	OR	BS	
Packera eurycephala var. lewisrosei	Ragwort, Cut-Leaved	CA	BS	
Packera ganderi	Butterweed, Gander's	CA	BS	
Packera layneae	Butterweed, Layne's	CA	FT	
Packera pauciflora	Ragwort, Few-Flower	CO	BS	
Palafoxia arida var. gigantea	Needle, Giant Spanish	CA	BS	
Panicum acuminatum var. thermale	Panicum, Geyser's	CA	BS	
Papaver gorodkovii	Poppy, Arctic	AK	BS	
Pappostipa speciosa	Needlegrass, Desert	OR	BS	
Parnassia kotzebuei	Grass-Of-Parnassus, Kotzebue's	OR	BS	
Parnassia palustris var. tenuis	Grass-Of-Parnassus, Northern	OR	BS	
Paronychia ahartii	Paronychia, Ahart's	CA	BS	
Paronychia sessiliflora	Nailwort, Creeping	ID	BS	
Paronychia wilkinsonii	Nailwort, Wilkinson's	NM	BS	
Parrya nauruaq	Wallflower, Naked-Stemmed	AK	BS	
Parthenium ligulatum	Feverfew, Colorado	CO, NV	BS	
Pectis imberbis	Chinchweed, Beardless	AZ	FE	X
Pedicularis centranthera	Lousewort, Dwarf	CA	BS	
Pedicularis crenulata	Lousewort, Meadow	MT	BS	
Pedicularis hirsuta	Lousewort, Hairy	AK	BS	
Pediocactus bradyi	Cactus, Brady Pincushion	AZ	FE	
Pediocactus despainii	Cactus, San Rafael	UT	FE	
Pediocactus knowltonii	Cactus, Knowlton's	CO, NM	BS	
Pediocactus nigrispinus	Cactus, Snowball	ID, OR	BS	
Pediocactus paradinei	Cactus, Kaibab Plains	AZ	BS	
Pediocactus peeblesianus fickeiseniae	Cactus, Fickeisen Plains	AZ	FE	X
Pediocactus peeblesianus var. peeblesianus	Cactus, Peebles Navajo	AZ	FE	
Pediocactus sileri	Cactus, Siler Pincushion	AZ, UT	FT	
Pediocactus simpsonii	Cactus, Simpson's Hedgehog	ID	BS	
Pediocactus winkleri	Cactus, Winkler	UT	FT	
Pediomelum aromaticum	Breadroot, Aromatic Indian	CO	BS	
Pediomelum aromaticum var. barnebyi	Breadroot, Barneby's	UT	BS	
Pediomelum aromaticum var. tuhyi	Breadroot, Tuhy's	UT	BS	
Pediomelum castoreum	Breadroot, Beaver Dam	CA, NV	BS	
Pediomelum epipsilum	Breadroot, Kane	UT	BS	
Pediomelum pentaphyllum	Scurfpea, Chihuahua	AZ, NM	BS	
Pellaea andromedifolia	Fern, Coffee	OR	BS	
Pellaea brachyptera	Cliffbrake, Sierra	OR	BS	
Pellaea bridgesii	Cliff-Brake, Bridges'	OR	BS	
Pellaea mucronata ssp. californica	Cliff-Brake, California Birds-Foot	OR	BS	
Peniocereus greggii var. greggii	Cereus, Night-Blooming	NM	BS	
Penstemon absarokensis	Beardtongue, Absaroka	WY	BS	
Penstemon acaulis	Beardtongue, Stemless	WY	BS	
Penstemon acaulis var. acaulis	Penstemon, Stemless	UT	BS	
Penstemon acaulis var. yampaensis	Beardtongue, Yampa	CO	BS	
Penstemon alamosensis	Beardtongue, Alamo	NM	BS	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Penstemon albomarginatus	Beardtongue, White-Margined	AZ, CA, NV	BS	
Penstemon angustifolius var. dulcis	Penstemon, Neese Narrowleaf	UT	BS	
Penstemon arenarius	Beardtongue, Nevada Dune	NV	BS	
Penstemon barrettiae	Penstemon, Barrett's	OR	BS	
Penstemon bicolor	Beardtongue, Pinto	AZ	BS	
Penstemon bicolor ssp. bicolor	Beardtongue, Yellow Twotone	NV	BS	
Penstemon bicolor ssp. roseus	Beardtongue, Rosy Two-Toned	CA, NV	BS	
Penstemon cardinalis ssp. regalis	Penstemon, Guadalupe	NM	BS	
Penstemon concinnus	Beardtongue, Tunnel Springs	NV	BS	
Penstemon debilis	Beardtongue, Parachute	CO	FT	X
Penstemon degeneri	Beardtongue, Degener's	CO	BS	
Penstemon deustus var. variabilis	Penstemon, Variable Hot-Rock	OR	BS	
Penstemon distans	Beardtongue, Mt. Trumbull	AZ	BS	
Penstemon eriantherus var. whitedii	Penstemon, Whited's	OR	BS	
Penstemon filiformis	Beardtongue, Thread-Leaved	CA	BS	
Penstemon floribundus	Beardtongue, Cordelia	NV	BS	
Penstemon franklinii	Penstemon, Franklin's	UT	BS	
Penstemon fruticiformis var. amargosae	Beardtongue, Death Valley	CA, NV	BS	
Penstemon gibbensii	Beardtongue, Gibben's	CO, UT, WY	BS	
Penstemon glaucinus	Penstemon, Blue-Leaved	OR	BS	
Penstemon goodrichii	Penstemon, Goodrich's	UT	BS	
Penstemon grahamii	Beardtongue, Graham's	CO, UT	BS	
Penstemon harringtonii	Beardtongue, Harrington's	CO	BS	
Penstemon haydenii	Penstemon, Blowout	WY	FE	
Penstemon idahoensis	Penstemon, Idaho	ID, NV, UT	BS	
Penstemon janishiae	Beardtongue, Janish's	CA, ID	BS	
Penstemon leiophyllus var. francisci-pennellii	Beardtongue, Pennell	NV	BS	
Penstemon lemhiensis	Penstemon, Lemhi	ID, MT	BS	
Penstemon moriahensis	Paintbrush, Mount Moriah	NV	BS	
Penstemon newberryi var. sonomensis	Beardtongue, Sonoma	CA	BS	
Penstemon nitidus	Penstemon, Shining	MT	BS	
Penstemon pahutensis	Beardtongue, Pahute Mesa	NV	BS	
Penstemon palmeri var. macranthus	Beardtongue, Lahontan	NV	BS	
Penstemon peckii	Penstemon, Peck's	OR	BS	
Penstemon penlandii	Beardtongue, Penland	CO	FE	
Penstemon perpulcher	Penstemon, Beautiful	OR	BS	
Penstemon personatus	Beardtongue, Closed-Throated	CA	BS	
Penstemon pinorum	Penstemon, Pinyon	UT	BS	
Penstemon pudicus	Beardtongue, Bashful	NV	BS	
Penstemon rubicundus	Beardtongue, Wassuk	NV	BS	
Penstemon seorsus	Penstemon, Short-Lobed	ID	BS	
Penstemon stephensii	Beardtongue, Stephens'	CA	BS	
Penstemon sudans	Beardtongue, Susanville	CA, NV	BS	
Penstemon thompsoniae ssp. jaegeri	Beardtongue, Jaeger	NV	BS	
Penstemon tiehmii	Beardtongue, Tiehm	NV	BS	
Penstemon wardii	Penstemon, Ward's	UT	BS	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Penstemon wilcoxii	Penstemon, Wilcox's	OR	BS	
Penstemon scariosus var. albifluvis	Beardtongue, White River	CO, UT	BS	
Pentachaeta exilis ssp. aeolica	Pentachaeta, Slender	CA	BS	
Peraphyllum ramosissimum	Crabapple, Wild	ID	BS	
Perideridia erythrorhiza	Yampah, Red-Rooted	OR	BS	
Perityle ambrosiifolia	Daisy, Clifton Rock	AZ	BS	
Perityle cernua	Cliff Daisy, Nodding	NM	BS	
Perityle inyoensis	Daisy, Inyo Rock	CA	BS	
Perityle specuicola	Rock-Daisy, Alcove	UT	BS	
Perityle villosa	Daisy, Hanaupah Rock	CA	BS	
Petalonyx parryii	Petalonyx, Parry's	UT	BS	
Petalonyx thurberi ssp. gilmanii	Sandpaper-Plant, Death Valley	CA	BS	
Petasites sagittatus	Sweet-Coltsfoot	MT	BS	
Peteria thompsoniae	Milkvetch, Spine-Noded	ID	BS	
Petrophytum caespitosum var. caespitosum	Rockmat, Rocky Mountain	OR	BS	
Petrophytum cinerascens	Rockmat, Chelan	OR	BS	
Phacelia argentea	Phacelia, Silvery	OR	BS	X
Phacelia argillacea	Phacelia, Clay	UT	FE	
Phacelia argylensis	Phacelia, Argyle Canyon	UT	BS	
Phacelia beatleyae	Scorpionflower, Beatley	NV	BS	
Phacelia cookei	Phacelia, Cooke's	CA	BS	
Phacelia cronquistiana	Phacelia, Cronquist's	UT	BS	
Phacelia filiae	Phacelia, Clarke	NV	BS	
Phacelia formosula	Phacelia, North Park	CO	FE	
Phacelia glaberrima	Phacelia, Reese River	NV	BS	
Phacelia greenei	Phacelia, Scott Valley	CA	BS	
Phacelia idahoensis	Phacelia, Idaho	ID	BS	
Phacelia inconspicua	Phacelia, Obscure	ID, NV	BS	
Phacelia indecora	Phacelia, Bluff	UT	BS	
Phacelia insularis var. continentis	Phacelia, North Coast	CA	BS	
Phacelia inundata	Phacelia, Playa	CA, NV, OR	BS	
Phacelia inyoensis	Phacelia, Inyo	CA	BS	
Phacelia lenta	Phacelia, Sticky	OR	BS	
Phacelia leonis	Phacelia, Siskiyou	CA, OR	BS	
Phacelia lutea var. calva	Scorpionweed, Yellow	ID	BS	
Phacelia lutea var. mackenzieorum	Phacelia, Mackenzie's	OR	BS	
Phacelia minutissima	Phacelia, Least	OR, ID, NV	BS	
Phacelia mollis	Phacelia, Soft	AK	BS	
Phacelia monoensis	Phacelia, Mono County	CA, NV	BS	
Phacelia mustelina	Phacelia, Death Valley Round-Leaved	CA	BS	
Phacelia nashiana	Phacelia, Charlotte's	CA	BS	
Phacelia novenmillensis	Phacelia, Nine Mile Canyon	CA	BS	
Phacelia parishii	Phacelia, Parish	AZ, CA, NV	BS	
Phacelia perityloides var. jaegeri	None	CA	BS	
Phacelia phacelioides	Phacelia, Mount Diablo	CA	BS	
Phacelia pulchella var. atwoodii	Phacelia, Atwood's Pretty	UT	BS	
Phacelia scopulina var. scopulina	Prostrate Scorpionweed	ID	BS	

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Phacelia submutica	Phacelia, Debeque	CO	FT	X
Phacelia tetramera	Phacelia, Dwarf	OR	BS	
Phacelia utahensis	Phacelia, Utah	UT	BS	
Phemeranthus parviflorus	Sunbright	MT	BS	
Phemeranthus spinescens	Fameflower, Spinescent	OR	BS	
Phemeranthus thompsonii	Talinum, Thompson's	UT	BS	
Phlox hendersonii	Phlox, Henderson's	OR	BS	
Phlox hirsuta	Phlox, Yreka	CA	FE	
Phlox multiflora	Phlox, Many-Flowered	OR	BS	
Phlox pungens	Phlox, Beaver Rim	WY	BS	
Pholisma arenarium	Food, Scaly Sand	AZ	BS	
Pholisma sonorae	Food, Sand	AZ, CA	BS	
Physaria brassicoides	Twinpod, Rydberg's	MT	BS	
Physaria calderi	Bladderpod, Calder's	AK	BS	
Physaria carinata	Bladderpod, Payson's	MT	BS	
Physaria chambersii	Twinpod, Chambers'	OR	BS	
Physaria condensata	Twinpod, Dense	WY	BS	
Physaria congesta	Bladderpod, Dudley Bluffs	CO	FT	
Physaria didymocarpa var. lyrata	Twinpod, Idaho	ID	BS	
Physaria dornii	Twinpod, Dorn's	WY	BS	
Physaria douglasii ssp. tuplashensis	Bladderpod, Whitebluffs	OR	FT	
Physaria kingii ssp. cobrensis	Bladderpod, Cobre	OR	BS	
Physaria lesicii	Bladderpod, Pryor Mt.	MT	BS	
Physaria newberryi var. yesicola	Twinpod, Yeso	NM	BS	
Physaria obcordata	Twinpod, Dudley Bluffs	CO	FT	
Physaria obdeltata	Bladderpod, Middle Butte	ID	BS	
Physaria pachyphylla	Bladderpod, Thick-Leaf	MT	BS	
Physaria parviflora	Bladderpod, Piceance	CO	BS	
Physaria pruinosa	Bladderpod, Pagosa Springs	CO	BS	
Physaria pulchella	Bladderpod, Beautiful	MT	BS	
Physaria pulvinata	Bladderpod, Cushion	CO	BS	
Physaria saximontana var. saximontana	Twinpod, Rocky Mountain	WY	BS	
Physaria vicina	Bladderpod, Uncompaghre	CO	BS	
Pilularia americana	Pillwort, American	OR	BS	
Pinus monophylla	Single-Leaf Pinyon Pine	ID	BS	
Piperia candida	Orchid, White-Flowered Rein	CA	BS	
Piperia yadonii	Orchid, Yadon's Rein	CA	FE	
Piptatherum micranthum	Ricegrass, Small-Flowered	ID	BS	
Plagiobothrys austiniae	Plagiobothrys, Austin's	OR	BS	
Plagiobothrys chorisianus var. chorisianus	None	CA	BS	
Plagiobothrys figuratus ssp. corallicarpus	Allocarya, Coral Seeded	OR	BS	
Plagiobothrys glomeratus	Popcorn-Flower, Clustered	NV	BS	
Plagiobothrys greenei	Flower, Greene's Popcorn	OR	BS	
Plagiobothrys hirtus	Flower, Rough Popcorn	OR	FE	
Plagiobothrys parishii	Popcorn-Flower, Parish's	CA	BS	
Plagiobothrys salsus	Allocarya, Desert	OR	BS	
Plagiobothrys uncinatus	Popcorn-Flower, Hooked	CA	BS	
Plantago eriopoda	Plantain, Saline	ID	BS	

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Platanthera chorisiana	Bog-Orchid, Choris'	OR	BS	
Platanthera dilatata	Orchid, Northern White	MT	BS	
Platanthera obtusata	Bog-Orchid, Small Northern	OR	BS	
Platanthera orbiculata	Orchid, Round-Leaved	MT	BS	
Pleiacanthus spinosu	Skeletonweed, Spiny	MT	BS	
Pleuropogon hooverianus	Grass, Hoover's Semaphore	CA	BS	
Pleuropogon oregonus	Semaphoregrass, Oregon	OR	BS	
Pleuropogon sabinei	Semaphoregrass, False	AK	BS	
Poa diaboli	Grass, Diablo Canyon Blue	CA	BS	
Poa hartzii ssp. alaskana	Bluegrass, Alaskan	AK	BS	
Poa macrantha	Bluegrass, Seashore	AK	BS	
Poa porsildii	Bluegrass, Porsild's	AK	BS	
Poa rhizomata	Bluegrass, Timber	OR	BS	
Poa sierrae	Grass, Sierra Blue	CA	BS	
Poa sublanata	None	AK	BS	
Podistera yukonensis	Podistera, Yukon	AK	BS	
Pogogyne floribunda	Mint, Profuse-Flowereed Mesa	OR	BS	
Pogogyne serpylloides	Thymeleaf Mesamint	ID	BS	
Polemonium carneum	Polemonium, Great	OR	BS	
Polemonium elusum	Jacob's-Ladder, Elusive	ID	BS	
Polemonium pectinatum	Polemonium, Washington	OR	BS	
Polemonium viscosum	Polemonium, Skunk	OR	BS	
Polyctenium fremontii	Combleaf, Fremont's	OR	BS	
Polyctenium williamsiae	Combleaf, Williams	CA, NV	BS	
Polygonum leptocarpum	Knotweed, Narrowpoint	MT	BS	
Polygonum polygaloides ssp. esotericum	Knotweed, Modoc County	CA	BS	
Polystichum californicum	Sword-Fern, California	OR	BS	
Polystichum lonchitis	Holly-Fern, Northern	MT	BS	
Potamogeton diversifolius	Pondweed, Waterthread	ID, OR	BS	
Potentilla basaltica	Cinquefoil, Soldier Meadow	CA, NV	BS	
Potentilla breweri	Cinquefoil, Brewer's	OR	BS	
Potentilla cottamii	Cinquefoil, Cottam	NV, UT	BS	
Potentilla fragiformis	Cinquefoil, Strawberry	AK	BS	
Potentilla glaucophylla var. perdissecta	Cinquefoil, Diverse-Leaved	OR	BS	
Potentilla nivea	Cinquefoil, Snow	OR	BS	
Prenanthella exigua	Prenanthella, Desert	OR	BS	
Primula alcalina	Primrose, Alkali	ID, MT	BS	
Primula cusickiana ssp domensis	Primrose, House Range	UT	BS	
Primula maguirei	Primrose, Maguire	UT	FT	
Primula tschuktschorum	Primrose, Chukchi	AK	BS	
Proatriple x pleiantha	Saltbush, Mancos	NM	BS	
Prosartes parvifolia	Bells, Siskiyou Fairy	OR	BS	
Psathyrotes annua	Brittlebrush, Turtleback, Annual	ID	BS	
Pseudobahia peirsonii	Pseudobahia, Tulare	CA	FT	
Psorothamnus arborescens var. pubescens	Bush, Marble Canyon Indigo	AZ	BS	
Psorothamnus polydenius var. jonesii	Indigo Bush, Jones	UT	BS	
Puccinellia banksiensis	None	AK	BS	
Puccinellia howellii	Alkaligrass, Howell's	CA	BS	
Puccinellia parishii	Alkaligrass, Parish's	CA, NM	BS	

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Puccinellia simplex	Alkali-Grass, California	CA	BS	
Puccinellia vaginata	Alkaligrass, Sheathed	AK	BS	
Purshia subintegra	Cliff-Rose, Arizona	AZ	FE	
Pyrrocoma carthamoides var. subsquarrosa	Goldenweed, Beartooth Large-Flowered	MT	BS	
Pyrrocoma hirta var. sonchifolia	Goldenweed, Sticky	OR	BS	
Pyrrocoma insecticruris	Goldenweed, Bugleg	ID	BS	
Pyrrocoma liatriformis	Goldenweed, Palouse	ID	BS	
Pyrrocoma linearis	Goldenhead, Thinleaf	ID	BS	
Pyrrocoma lucida	Pyrrocoma, Sticky	CA	BS	
Pyrrocoma racemosa var. paniculata	Goldenweed, Panicled or Clustered	ID, OR	BS	
Pyrrocoma racemosa var. racemosa	Pyrrocoma, Racemose	OR	BS	
Pyrrocoma radiata	Goldenweed, Snake River	ID, OR	BS	
Pyrrocoma scaberula	Pyrrocoma, Rough	OR	BS	
Quercus dumosa	None	CA	BS	
Rafinesquia californica	Chicory, California	OR	BS	
Raillardella pringlei	Raillardella, Showy	CA	BS	
Ranunculus aestivalis	Buttercup, Autumn	UT	FE	
Ranunculus austrooreganus	Buttercup, Southern Oregon	OR	BS	
Ranunculus californicus var. californicus	Buttercup, California	OR	BS	
Ranunculus cardiophyllus	Buttercup, Heartleaf	MT	BS	
Ranunculus cooleyae	Buttercup, Cooley's	OR	BS	
Ranunculus pacificus	Buttercup, Pacific	AK	BS	
Ranunculus ponojensis	None	AK	BS	
Ranunculus populago	Buttercup, Mountain	OR	BS	
Ranunculus triternatus	Buttercup, Dalles Mt.	NV, OR	BS	
Ranunculus turneri ssp. turneri	Buttercup, Turner's	AK	BS	
Rhamnus ilicifolia	Redberry	OR	BS	
Rhus kearneyi ssp. kearneyi	Sumac, Kearney	AZ	BS	
Rhynchospora alba	Beakrush, White	OR	BS	
Rhynchospora californica	Beaked-Rush, California	CA	BS	
Ribes canthariforme	Currant, Moreno Currant, San Diego	CA	BS	
Ribes cereum var. colubrinum	Currant, Wax	OR	BS	
Ribes oxyacanthoides ssp. irriguum	Gooseberry, Idaho	OR	BS	
Ribes sanguineum var. sanguineum	Winter Currant	ID	BS	
Ribes tularense	Gooseberry, Sequoia	CA	BS	
Romanzoffia thompsonii	Mistmaiden, Thompson's	OR	BS	
Romanzoffia unalaschcensis	Mistmaiden, Alaska	AK	BS	
Rorippa calycina	Yellowcress, Persistent-Sepal	WY	BS	
Rorippa columbiae	Cress, Columbia	CA, OR	BS	
Rorippa subumbellata	Yellowcress, Tahoe	NV	BS	
Rosa stellata var. abyssa	Rose, Grand Canyon	AZ	BS	
Rotala ramosior	Toothcup, Lowland	OR	BS	
Rubus arcticus ssp. acaulis	Nagoonberry	OR	BS	
Rubus bartonianus	Bartonberry	OR	BS	
Rumex aureostigmaticus	None	AK	BS	
Rumex beringensis	Dock, Bering Sea	AK	BS	
Rumex krausei	Sorrel, Krause's	AK	BS	
Rupertia hallii	Rupertia, Hall's	CA	BS	

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Sabulina howellii	Sandwort, Howell's	CA	BS	
Sabulina stolonifera	Sandwort, Scott Mtn.	CA	BS	
Sagittaria sanfordii	Arrowhead, Sanford's	CA	BS	
Sairocarpus kingii	Snapdragon, King's	ID	BS	
Salicornia rubra	Glasswort, Red	ID	BS	
Salix candida	Willow, Hoary	ID, OR, MT	BS	
Salix farriae	Willow, Farr's	OR	BS	
Salix glauca ssp. glauca var. villosa	Willow, Glaucus	OR	BS	
Salix lucida	Willow, Shinning	MT	BS	
Salix maccalliana	Willow, Maccall's	OR	BS	
Salix pseudomonticola	Willow, False Mountain	ID, OR	BS	
Salix sessilifolia	Willow, Soft-Leafed	OR	BS	
Salix wolfii	Willow, Wolf's	OR	BS	
Saltugilia latimeri	Woodland-Gilia, Latimer's	CA	BS	
Salvia amissa	Sage, Aravaipa	AZ	BS	
Salvia columbariae var. argillacea	Chia, Chinle	UT	BS	
Salvia funerea	Sage, Death Valley	NV	BS	
Salvia greatae	Sage, Orocopia	CA	BS	
Sanicula arctopoides	Sanicle, Bear's-Foot	OR	BS	
Sanicula saxatilis	Sanicle, Rock	CA	BS	
Saxifraga adscendens ssp. oregonensis	Saxifrage, Wedge-Leaf	OR	BS	
Saxifraga cernua	Saxifrage, Nodding	OR	BS	
Saxifragopsis fragarioides	Saxifrage, Joint-Leaved	OR	BS	
Scheuchzeria palustris ssp. americana	Scheuchzeria	OR	BS	
Schizachyrium scoparium var. scoparium	Bluestem, Little	OR	BS	
Schoenocrambe argillacea	Reed-Mustard, Clay	UT	FT	
Schoenocrambe barnebyi	Reed-Mustard, Barneby	UT	FE	
Schoenocrambe suffrutescens	Reed-Mustard, Shrubby	UT	FE	
Schoenoplectus subterminalis	Bulrush, Swaying	ID, OR	BS	
Scirpus pendulus	Bulrush, Drooping	OR	BS	
Sclerocactus blainei	Pincushion, Blaine	NV	BS	
Sclerocactus brevispinus	Cactus, Pariette	UT	FT	
Sclerocactus cloverae	Cactus, Clover's	NM	BS	
Sclerocactus cloverae ssp. brackii	Cactus, Brack's Hardwall	NM	BS	
Sclerocactus glaucus	Cactus, Colorado Hookless	CO	FT	
Sclerocactus mesae-verdae	Cactus, Mesa Verde	CO, NM	FT	
Sclerocactus nyensis	Pincushion, Nye	NV	BS	
Sclerocactus pubispinus	Cactus, Great Basin Fishhook	NV	BS	
Sclerocactus schlesseri	Pincushion, Schlesser	NV	BS	
Sclerocactus sileri	Cactus, Paria Plateau Fishhook	AZ	BS	
Sclerocactus wetlandicus	Cactus, Uinta Basin Hookless	UT	FT	
Sclerocactus wrightiae	Cactus, Wright Fishhook	UT	FE	
Scribneria bolanderi	Grass, Scribner's	OR	BS	
Scrophularia laevis	Figwort, Organ Mountain	NM	BS	
Scrophularia macrantha	Figwort, Mimbres	NM	BS	
Sedum albomarginatum	Stonecrop, Feather River	CA	BS	
Sedum laxum ssp. eastwoodiae	Stonecrop, Red Mountain	CA	BS	
Sedum moranii	Stonecrop, Rogue River	OR	BS	
Sedum obtusatum ssp. paradisum	Stonecrop, Canyon Creek	CA	BS	

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Sedum valens	Sedum, Salmon River or Canyon	ID	BS	
Senecio clevelandii var. heterophyllus	Ragwort, Red Hills	CA	BS	
Senecio ertterae	Senecio, Ertter's	OR	BS	
Sericocarpus oregonensis var. oregonensis	Aster, Oregon White-Top	OR	BS	
Sericocarpus rigidus	Aster, White-Topped	OR	BS	
Sesuvium verrucosum	Sea-Purslane, Verrucose	OR	BS	
Shoshonea pulvinata	Shoshonea	WY, MT	BS	
Sibara grisea	Sibara, Gray; Thelypody, Texas	NM	BS	
Sidalcea covillei	Checkerbloom, Owens Valley	CA	BS	
Sidalcea hendersonii	Sidalcea, Henderson's	OR	BS	
Sidalcea hickmanii ssp. anomala	Checkerbloom, Cuesta Pass	CA	BS	
Sidalcea hickmanii ssp. parishii	Checkerbloom, Parish's	CA	BS	
Sidalcea hickmanii ssp. petraea	Sidalcea, Neil Rock	OR	BS	
Sidalcea hirtipes	Sidalcea, Bristly-Stemmed	OR	BS	
Sidalcea keckii	Checkerbloom, Keck's	CA	FE	X
Sidalcea malviflora ssp. patula	Checkerbloom, Siskiyou	CA, OR	BS	
Sidalcea malviflora ssp. purpurea	Checkerbloom, Purple-Stemmed	CA	BS	
Sidalcea nelsoniana	Checkermallow, Nelson's	OR	FT	
Sidalcea oregana ssp. eximia	Checkerbloom, Coast	CA	BS	
Sidalcea oregana var. calva	Checker-Mallow, Wenatchee Mountains	OR	FE	
Sidalcea robusta	Checkerbloom, Butte County	CA	BS	
Silene campanulata ssp. campanulata	Catchfly, Red Mountain	CA	BS	
Silene hookeri ssp. bolanderi	Catchfly, Bolander's	OR	BS	
Silene nachlingerae	Catchfly, Nachlinger	NV	BS	
Silene occidentalis ssp. longistipitata	Campion, Long-Stiped	CA	BS	
Silene scaposa var. lobata	Silene, Lost River	ID	BS	
Silene scouleri ssp. scouleri	Catchfly, Scouler's	OR	BS	
Silene seelyi	Silene, Seely's	OR	BS	
Silene spaldingii	Catchfly, Spalding's	ID, OR	FT	
Sisyrinchium hitchcockii	Grass, Hitchcock's Blue-Eyed	OR	BS	
Sisyrinchium montanum var. montanum	Eyed-Grass, Strict Blue	OR	BS	
Sisyrinchium pallidum	Grass, Pale-Eyed	CO	BS	
Sisyrinchium radicatum	Grass, St. George Blue-Eyed	NV	BS	
Sisyrinchium sarmentosum	Grass, Pale Blue-Eyed	OR	BS	
Smelowskia johnsonii	Candytuft, Johnson's False	AK	BS	
Smelowskia pyriformis	Smelowskias, Pearshaped	AK	BS	
Smilax jamesii	Greenbriar, English Peak	CA	BS	
Solanum parishii	Horse-Nettle, Parish's	OR	BS	
Solidago spectabilis	Goldenrod, Basin	ID	BS	
Sophora leachiana	Sophora, Western	OR	BS	
Spartina pectinata	Cordgrass, Prairie	OR	BS	
Spermolepis organensis	Scaleseed, Organ Mountains	NM	BS	
Sphaeralcea caespitosa var. caespitosa	Globemallow, Jones	UT	BS	
Sphaeralcea caespitosa var. williamsiae	Globemallow, Railroad Valley	NV	BS	
Sphaeralcea gierischii	Mallow, Gierisch	AZ, UT	FE	X
Sphaeralcea grossulariifolia var. fumariensis	Globemallow, Smoky Mt.	UT	BS	

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Sphaeralcea janeae	Globemallow, Jane's	UT	BS	
Sphaeralcea psoraloides	Globemallow, Psorlea	UT	BS	
Sphaeralcea rusbyi var. eremicola	Desert-Mallow, Rusby's	CA	BS	
Sphaeromeria argentea	Sage, Chicken	MT	BS	
Sphaeromeria capitata	Tansy, Rock	CO	BS	
Sphaeromeria simplex	Sagebrush, Laramie False	WY	BS	
Spiraea alba	Meadowsweet	MT	BS	
Spiranthes delitescens	Ladies'-Tresses, Canelo Hills	AZ	FE	
Spiranthes diluvialis	Ladies'-Tresses, Ute	CO, ID, OR, NV, UT, WY	FT	
Spiranthes porrifolia	Ladies-Tresses, Western	OR	BS	
Sporobolus compositus var. compositus	Dropseed, Tall	OR	BS	
Stanleya confertiflora	Princesplume, Malheur	ID, OR	BS	
Stanleya tomentosa var. runcinata	Prince's-Plume, Hairy	ID	BS	
Stenotus lanuginosus var. lanuginosus	Stenotus, Woolly	CA	BS	
Stephanomeria malheurensis	Wire-Lettuce, Malheur	OR	FE	X
Stephanomeria occultata	Wirelettuce, Hidden	UT	BS	
Stephanomeria schottii	Wire-Lettuce, Schott	AZ	BS	
Stipa exigua	Ricegrass, Little	CA	BS	
Streptanthus albidus ssp. peramoenus	None	CA	BS	
Streptanthus brachiatus ssp. brachiatus	Jewelflower, Socrates Mine	CA	BS	
Streptanthus brachiatus ssp. hoffmanii	Jewelflower, Freed's	CA	BS	
Streptanthus callistus	Jewelflower, Mount Hamilton	CA	BS	
Streptanthus campestris	Jewelflower, Southern	CA	BS	
Streptanthus cordatus var. piutensis	Jewelflower, Piute Mountains	CA	BS	
Streptanthus glandulosus ssp. hoffmannii	Jewelflower, Hoffmann's	CA	BS	
Streptanthus glandulosus ssp. josephinensis	Flower, Common Jewel	OR	BS	
Streptanthus hesperidis	Jewel-Flower, Green	CA	BS	
Streptanthus howellii	Streptanthus, Howell's	OR	BS	
Streptanthus insignis ssp. lyonii	None	CA	BS	
Streptanthus morrisonii ssp. elatus	Jewelflower, Three Peaks	CA	BS	
Streptanthus morrisonii ssp. hirtiflorus	Jewelflower, Dorr's Cabin	CA	BS	
Streptanthus morrisonii ssp. kruckebergii	Jewelflower, Kruckeberg's	CA	BS	
Streptanthus morrisonii ssp. morrisonii	Jewelflower, Morrison's	CA	BS	
Streptanthus oliganthus	Jewelflower, Masonic Mountain	CA, NV	BS	
Streptanthus sparsiflorus	Jewelflower, Sparseflower	NM	BS	
Streptanthus vernalis	Jewelflower, Early	CA	BS	
Streptopus streptopoides	Kruhsea	OR	BS	
Stroganowia tiehmii	Peppercress, Tiehm	NV	BS	
Stylocline citroleum	Neststraw, Oil	CA	BS	
Stylocline masonii	Neststraw, Mason	CA	BS	
Suksdorfia violacea	Suksdorfia, Violet	OR	BS	
Sullivantia oregana	Sullivantia, Oregon	OR	BS	
Swertia perennis	Swertia	OR	BS	
Symphoricarpos longiflorus	Snowberry, Long-Flowered	OR	BS	
Symphotrichum greatae	Aster, Greata's	CA	BS	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Symphyotrichum boreale	Aster, Rush Or Boreal	ID	BS	
Symphyotrichum defoliatum	Aster, San Bernardino	CA	BS	
Symphyotrichum jessicae	Aster, Jessica's	ID	BS	
Symphyotrichum pygmaeum	Aster, Pygmy	AK	BS	
Symphyotrichum yukonense	Aster, Yukon	AK	BS	
Synthyris pinnatifida var. lanuginosa	Kittenstails, Featherleaf	OR	BS	
Tauschia hooveri	Tauschia, Hoover's	OR	BS	
Terraria haydenii	Mustard, Hayden's	UT	BS	
Tetracoccus dioicus	Tetracoccus, Parry's	CA	BS	
Tetrapteron graciliflorum	Evening-Primrose, Slender-Flowered	OR	BS	
Teucrium canadense var. occidentale	Woodsage, American Or Western Germander	ID	BS	
Thalictrum alpinum	Meadowrue, Alpine	OR	BS	
Thalictrum dasycarpum	Meadowrue, Purple	ID	BS	
Thalictrum heliophilum	Meadowrue, Cathedral Bluffs	CO	BS	
Thelesperma caespitosum	Greenthread, Green River	UT, WY	BS	
Thelesperma megapotamicum	Hopi-Tea	MT	BS	
Thelesperma pubescens	Greenthread, Uinta	WY	BS	
Thelesperma subnudum var. alpinum	Greenthread, Alpine	UT	BS	
Thelypodiopsis ambigua var. erecta	Thelypody, Kanab	UT	BS	
Thelypodium eucosmum	Thelypody, Arrow-Leaf	OR	BS	
Thelypodium howellii ssp. spectabilis	Thelypody, Howell's Spectacular	OR	FT	
Thelypodium howellii var. howellii	Thelypodium, Howell's	CA	BS	
Thelypodium laciniatum var. streptanthoides	Thelypody, Purple Thick-Leaved	ID	BS	
Thelypodium repandum	Thelypody, Wavy-Leaf	ID	BS	
Thelypodium sagittatum ssp. sagittatum	Thelypody, Arrow	OR	BS	
Thermopsis californica var. semota	Lupine, Velvety False	CA	BS	
Thysanocarpus rigidus	Fringepod, Ridge	CA	BS	
Tonestus graniticus	Goldenheads, Lone Mountain	NV	BS	
Townsendia aprica	Townsendia, Last Chance	UT	FT	
Townsendia beamanii	Townsendia, Beaman's	UT	BS	
Townsendia gypsophila	Daisy, Gypsum Townsend	NM	BS	
Townsendia hookeri	Townsend-Daisy, Hooker's	MT	BS	
Townsendia jonesii var. lutea	Townsendia, Sevier	UT	BS	
Townsendia microcephala	Easter-Daisy, Cedar Mountain	WY	BS	
Townsendia montana	Townsendia, Mountain	OR	BS	
Townsendia parryi	Townsendia, Parry's	OR	BS	
Townsendia scapigera	Daisy, Scapose	OR	BS	
Townsendia strigosa	Daisy, Hairy Townsend	CO	BS	
Townsendia strigosa var. prolixa	Townsendia, Strigose	UT	BS	
Toxicoscordion exaltatum	Camas, Giant Death	OR	BS	
Trichophorum pumilum	Bulrush, Rolland's	CO, ID	BS	
Trifolium andinum var. podocephalum	Clover, Currant Summit	NV	BS	
Trifolium barnebyi	Clover, Barneby's	WY	BS	
Trifolium buckwestiorum	Clover, Santa Cruz	CA	BS	
Trifolium douglasii	Clover, Douglas	ID, OR	BS	
Trifolium friscanum	Clover, Frisco	UT	BS	
Trifolium jokerstii	Clover, Butte County Golden	CA	BS	
Trifolium kingii ssp. dedeckerae	Clover, Dedecker's	CA	BS	

Scientific Name	Common Name	State[1,2]	Status[3]	Critical Habitat[4]
Trifolium leibergii	Clover, Leiberg's	OR	BS	
Trifolium owyheense	Clover, Owyhee	ID, OR	BS	
Trifolium plumosum var. amplifolium	Clover, Plumed	ID	BS	
Trifolium polyodon	Clover, Pacific Grove	CA	BS	
Trifolium siskiyouense	Clover, Siskiyou	CA	BS	
Trifolium thompsonii	Clover, Thompson's	OR	BS	
Trifolium variegatum var. parunuweapensis	Clover, Sand Seep	UT	BS	
Trillium kurabayashii	Trillium, Siskiyou	OR	BS	
Trillium parviflorum	Trillium, Small-Flowered	OR	BS	
Tripterocalyx micranthus	Puffs, Sand	MT	BS	
Triteleia ixioides ssp. cookii	None	CA	BS	
Triteleia piutensis	Triteleia, Piute Mountains	CA	BS	
Triteleiopsis palmeri	Lily, Blue Sand	AZ	BS	
Trollius albiflorus	Globeflower, American	OR	BS	
Tropidocarpum californicum	None	CA	BS	
Tuctoria greenei	Tuctoria, Green's	CA	FE	X
Tumamoca macdougalii	Globeberry, Tumamoc	AZ	BS	
Utricularia gibba	Bladderwort, Humped	OR	BS	
Utricularia intermedia	Bladderwort, Flat-Leaved	OR	BS	
Utricularia minor	Bladderwort, Lesser	OR	BS	
Utricularia ochroleuca	Bladderwort, Northern	OR	BS	
Vaccinium membranaceum	Huckleberry, Mountain	MT	BS	
Vaccinium myrtilloides	Blueberry, Velvet-Leaf	OR	BS	
Vaccinium shastense ssp. shastense	Huckleberry, Shasta	CA	BS	
Vauquelinia californica ssp. sonorensis	Rosewood, Arizona Sonoran	AZ	BS	
Verbena californica	Vervain, Red Hills	CA	FT	
Viburnum edule	Squashberry	MT	BS	
Viola lithion	Violet, Rock	NV	BS	
Viola pinetorum ssp. grisea	None	CA	BS	
Viola primulifolia ssp. occidentalis	Violet, Western Bog	OR	BS	
Waldsteinia idahoensis	Strawberry, Idaho Barren	ID	BS	
Wolffia borealis	Water-Meal, Dotted	OR	BS	
Wolffia columbiana	Water-Meal, Columbia	OR	BS	
Wyethia reticulata	Ears, El Dorado Mule	CA	BS	
Xylorhiza cognata	Mecca-Aster	CA	BS	
Xylorhiza orcuttii	Aster, Orcutt's Woody	CA	BS	
Yermo xanthocephalus	Yellowhead, Desert	WY	FT	X
Yucca brevifolia	Tree, Joshua	AZ, NV	BS	
Yucca sterilis	Yucca, Sterile	UT	BS	
Zeltnera namophila	Centaury, Spring-Loving	CA, NV	FT	X

Source: BLM National Special Status Species List, November 2019

Notes:

[1] Alaska (AK), Arizona (AZ), California (CA), Colorado (CO), Idaho (ID), Montana (MT), Nevada (NV), New Mexico (NM), Oregon (OR), Utah (UT), Washington (WA), Wyoming (WY)

[2] There are no BLM sensitive plants designated for the BLM eastern states lands, other than those that are federally listed as threatened or endangered, or proposed or candidates for listing in these areas.

[3] BA = Bureau of Land Management Sensitive; FE = Federal Endangered; FT = Federal Threatened; C = Federal Candidate

[4] Indicates critical habitat is present on BLM-administered surface lands

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