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**Southwestern
Region**

Environmental Assessment for Management of Noxious Weeds and Hazardous Vegetation on Public Roads on National Forest System Lands in Arizona

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Environmental Assessment for Management of Noxious Weeds and Hazardous Vegetation on Public Roads on National Forest System Lands in Arizona

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Abstract

The USDA Forest Service, Southwestern Region, proposes to authorize the Arizona Department of Transportation (ADOT) to use U.S. Environmental Protection Agency-registered herbicides as part of an annual vegetation management program along public roadways that pass through National Forest System lands throughout Arizona. The objectives of the proposal are to (1) contain, control, or eradicate noxious weeds that are spreading from highway and road easements onto adjacent forests and rangelands; and (2) control vegetation that presents safety hazards to drivers using public roadways. Public roadways include interstate highways, Federal highways, and State roads.

The Federal Highway Administration (FHWA) has the authority to approve herbicide use for all or portions of interstates, U.S. highways, and some State highways under U.S. Department of Transportation (USDOT) easements within the boundaries of the Apache-Sitgreaves, Coconino, Coronado, Kaibab, Prescott, and Tonto National Forests. Approval by a Forest Service official is required for the proposed use of herbicides on easements not authorized by the FHWA and in a 200-foot strip outside of USDOT easements on each side of and along other public roadways. Treatment of the 200-foot strip could be needed where noxious weed infestations extend outside the road easement. The objective of such a treatment would be to maintain the integrity of a site-specific noxious weed control operation.

Vegetation requiring control involves both native and introduced (exotic) species. Authorization to use herbicides would be provided to ADOT based on an annual work plan with each national forest prior to implementation of annual treatments. This proposal would provide the opportunity for the Forest Service, FHWA, and ADOT to coordinate treatment schedules to provide, to the extent possible, alternate routes of travel for individuals with multiple chemical sensitivity (MCS).

Throughout the State, ADOT has responsibility to manage vegetation along about 6,000 miles of highways, which includes about 378,000 acres of rights-of-way. About 2,700 miles (170,100 acres) pass through National Forest System lands. It is estimated that about 5,000 acres could be treated with herbicides on an annual basis. This is about 3 percent of the total area along and adjacent to these public roadways on National Forest System lands and about 1 percent of the rights-of way statewide. Aerial application of herbicides will not be considered.

This environmental assessment provides an analysis of the major vegetation management considerations and effects to the human environment for national forests throughout the State, including the (1) No Action and (2) Proposed Action alternatives. An adaptive management approach will be used, and decision-making will be focused on desired outcomes, using the best information available.

This environmental assessment is organized as follows:

- Chapter 1 is devoted to identifying the purpose and need for action, public involvement process, and issues identified by the interdisciplinary team;
- Chapter 2 describes the alternatives being considered and mitigations and Best Management Practices for the proposed action;
- Chapter 3 describes the environments comprising the highway system within National Forest System land in Arizona;

- o Chapter 4 identifies and assesses environmental effects that may occur for the five issues for the alternatives; and
- o Chapter 5 identifies team members, public contacts, reference, glossary of abbreviations, and definitions of terms used in the document.
- o Supplemental information and supporting documentation is provided in the Appendices.

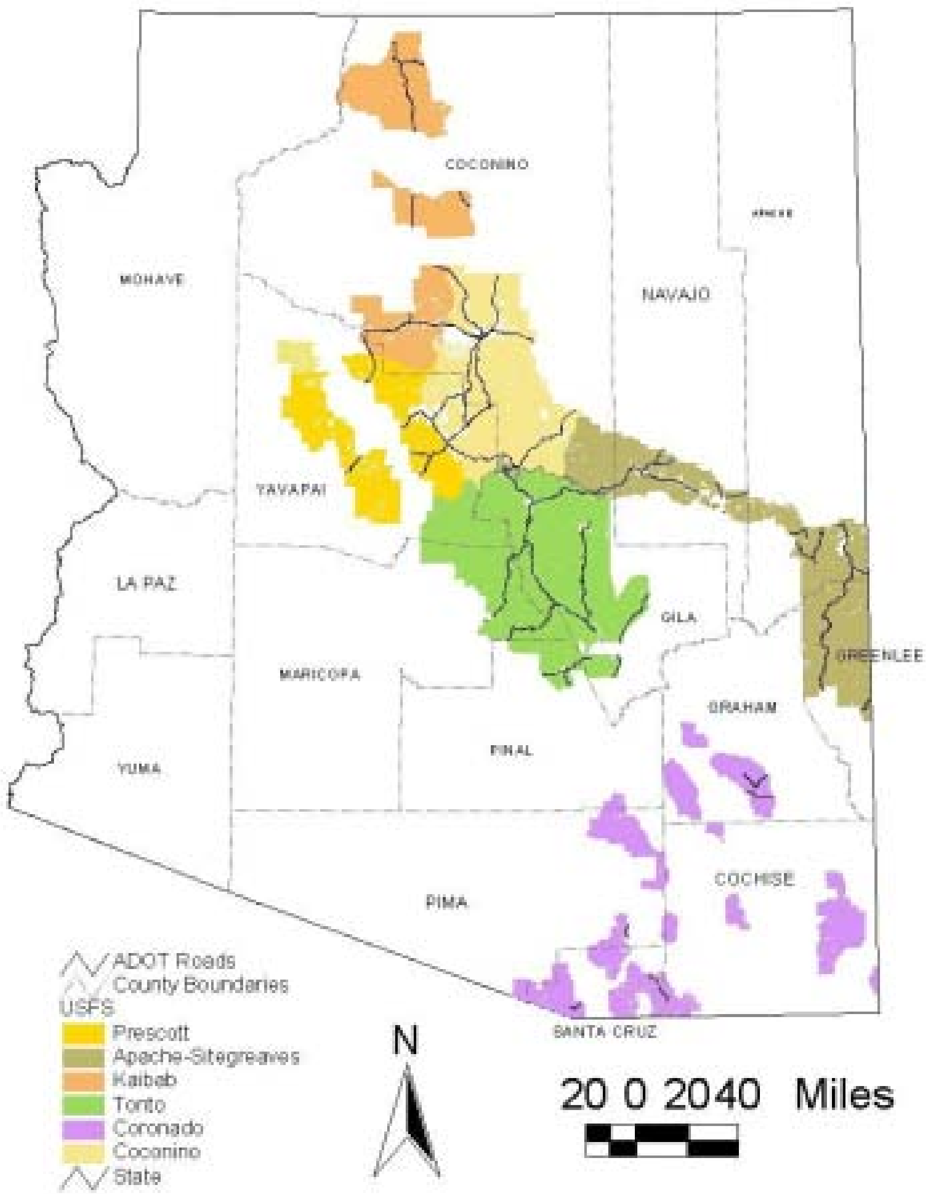

Figure 1. Map showing location of public roadways managed by Arizona Department of Transportation (ADOT) on the six national forests in Arizona.

Contents

List of Figures

List of Tables

Chapter 1 - Purpose of and Need for Action

Introduction

The Forest Service and cooperating agencies believe there is a need to be proactive in controlling hazardous vegetation and noxious weed and invasive plant infestations along public roadways in Arizona. User safety is a requirement of the Highway Safety Act, and management of vegetation that obscures roadway structures can reduce the risk of vehicle accidents. Noxious weeds and other invasive plant species pose a significant threat to native plant communities and early detection and control of infestations along the sides of roads could prevent them from spreading onto National Forest System lands, adversely affecting resource values and uses.

Public roads are under the jurisdiction of, and maintained by, a public authority and open to public travel (23 U.S.C. 101). Public Road Authorities (PRAs) are those Federal, State, county, town or township, Indian tribe, municipal or other local government or instrumentality thereof, with authority to finance, build, operate, or maintain toll or toll-free highway facilities (23 CFR 460.2(b)). In this proposal, these roads are interstates, U.S. and State highways that cross National Forest System lands. They are further identified by PRA and Forest Service Transportation Atlases as being under State jurisdiction and suitable for passenger car travel.

The presence of healthy plant communities along roadsides and on National Forest System (NFS) lands is considered to be desirable. Most plant communities, especially those composed of native species, stabilize roadside soils against erosion, provide a visible boundary at the pavement edge, and offer aesthetic appeal. However, when plants along roadsides present a hazard to motorists or endanger environmental quality to adjacent National Forest System lands, such as with noxious weeds, Integrated Vegetation Management (IVM) procedures may need to be initiated, including the use of herbicides.

Often, the terms “noxious weed” or “invasive plants” are used to apply to the same plants, but these terms are not considered to be synonymous in this document. Generally, a weed is an unwanted plant that grows or spreads aggressively. An invasive plant is one that grows and spreads rapidly, replacing desirable native plants. Executive Order 13112 defines an invasive weed as an alien species. The term “noxious” has legal ramifications for States that have noxious weed laws or regulations.

Noxious and other exotic weeds are becoming widespread in Arizona. Noxious weed species are abundant along roadways in northern portions of the State, especially on the Coconino and Kaibab National Forests. Elsewhere, non-native weed infestations, such as bufflegrass, are spreading rapidly and the associated adverse environmental effects are a major concern. Movement of plant parts and seeds on vehicles is a substantial means of introduction of new noxious and invasive weed species to Arizona from adjoining states.

Roadside environments are generally harsh sites for native plant life due to soil disturbances during construction, continued soil compaction by vehicles, and a host of other associated disturbances. In some areas, especially in low elevation deserts, frequent fires have modified vegetation along roadways and allowed invasive species, some of which are exotics, to gain dominance. These weeds are generally rapidly growing annual grasses and forbs that are tall and flammable and the hot, dry conditions, common in Arizona, can create an extreme fire hazard that can threaten manmade structures and properties as well as adjacent plant communities. The continued disturbances on the sides of roadways provides an ideal condition favoring the introduction of noxious weed species from seeds or plant parts carried by vehicles, and infestations can then spread into adjacent forest and rangeland ecosystems. In addition, some native trees, large shrubs, and tall herbaceous plants thrive on disturbed sites along roadways. These plants can decrease sight distance, obscure the view of roadside hazards, and compromise the effectiveness of the roadside recovery area for vehicles (also referred to as the clear zone; see definition section in Chapter 5).

It usually is difficult to visualize the threat from noxious weeds and describe the potential adverse environmental and social effects that can occur. Initially, only a few plants show up in an area and they often go unnoticed. When they are found, most people are unconcerned with the presence of a few plants. Unfortunately, people find the flowers of some noxious weeds to be attractive and some species are used as ornamentals, such as Dalmatian toadflax. People usually are not concerned until weeds become widespread, aggressive, and environmentally damaging. By then, it is often too late to implement effective prevention and eradication programs.

Awareness of noxious weeds and invasive plants has been slowly increasing over the past 30 years, and it has reached a level where more emphasis and funding will be made available to attempt to reduce the threat and impact from these plants. In the 1970s, Federal and State resource managers became concerned about the accelerating rate of spread of undesirable vegetation, especially exotic weeds, in the northern tier of states in the West. At about the same time, the Federal Noxious Weed Act became law in 1974 and was updated in 1990 with the passage of the Food, Agricultural Conservation and Trade Act, commonly called the Farm Bill. The Farm Bill directed Federal agencies to coordinate with State and local governments to contain and control undesirable plant species by directing Federal agencies to develop policy direction. Forest Service Manual 2080 was issued in November 1995 providing direction to agency personnel. In 1998, the Forest Service issued a National Strategy entitled “Stemming the Invasive Tide: Forest Service Strategy for Noxious and Nonnative Plant Management” (USDA FS, 1998). A Southwestern Regional strategy for the “Protection and Restoration of Native Plant Communities” was completed in January 1999. President Clinton signed Executive Order 13112 in February 1999 to mobilize the Federal government, in cooperation with States and others, to address the invasive species problem. The Plant Protection Act, Public Law 106-224, June 20, 2000, supersedes previously mentioned Federal laws concerning invasive plants.

The Forest Service is also directed by Section 302(b) of the Federal Land Policy and Management Act of 1976 to “take any action necessary to prevent unnecessary or undue degradation of the [public] lands” (43 U.S.C. 1732). Supplementing this mandate is Section 2(b)(2) of the Public Rangelands Improvement Act of 1978 in which Congress reaffirms a national policy and commitment to “manage, maintain, and improve the condition of public rangelands” (43 U.S.C. 1711). The regulations for implementing the National Forest Management Act of 1976 (36 CFR Part 219.27 a.3.) also provide direction for control of noxious weeds.

Control of hazardous vegetation along public roads is a requirement of the Highway Safety Act of 1966 and other Federal safety standards. The American Association of State Highway and Transportation Officials (AASHTO) consolidate these standards in “A Policy on Geometric Design of Highways and Streets”. AASHTO is an amalgamation of State and Federal transportation agencies that develop and adopt uniform standards for highway construction, operation, safety, and maintenance. These standards are based on traffic studies, research, and accident statistics and are the minimum criteria used by ADOT to provide for motorist and public safety. Control of noxious weeds and invasive plants is regulated by the Arizona State Noxious Weed Laws (Arizona Administrative Code. Title 3. Chapter 4. Article 2. Rule R3-4-244.

Regulated and Restricted Noxious Weeds, and Rule R3-4-245. Prohibited Noxious Weeds; and Arizona Administrative Code. Title 3. Chapter 4. Article 4. Rule R3-4-403. Noxious Weed Seeds), and Executive Order 13112.

It is easy to visualize how a tree on the side of a road can present a hazard to an errant motorist. To reduce roadside hazards, there is an area immediately adjacent to and parallel with the roadway that is kept free of hazards. This area is called the “clear zone” (reference definition on page 67). Transportation departments manage clear zones by removing vegetation considered to be an impact danger to errant motorists or which could block a driver’s view of things like guardrails, culvert outlets, driveways, road intersections, and wildlife approaching the road.

A requirement of a Public Road Authority vegetation management program is to provide safe highway travel to protect human lives and property. In addition, an important objective is to protect the natural resources along highway corridors. Thus, implementation of right-of-way vegetation management is necessary to:

- protect roadbed and pavement integrity;
- preserve visibility of highway facilities, and wildlife;
- promote road system drainage;
- inhibit ignition and spread of fire;
- maintain designed vehicle recovery areas;
- allow clearance for large vehicles and snowplows;
- promote melting of ice and snow on the road surface by removing trees which shade the road;
- minimize soil erosion and slope instability;
- suppress noxious weeds;
- eliminate damaged vegetation that may fall onto the road surface;
- maintain an attractive roadside appearance; and
- protect landscape plantings.

Need for Action

It has been estimated that noxious and exotic weeds now infest over 100 million acres in the continental United States, with an additional 3 million acres being infested annually. On Federal lands, these weeds are spreading at an average rate of over 5,000 acres per day (Westbrook 1998). The total cost to the U.S. economy is estimated at over $40 billion every year. Without intervention, noxious weed infestations will continue to expand exponentially and environmental and social impacts will intensify annually.

Compared to other Western States, such as Montana and Idaho, noxious weed infestations in Arizona are at a relatively low level, but the potential for spread and the disruption of native plant communities and associated environmental and social impacts are still a concern. Currently, it is estimated that more than 190,000 acres are infested with noxious weeds on the Coconino, Kaibab, and Prescott National Forests. The heaviest infestations are on the Coconino and Kaibab National Forests, especially along Interstate 40. Noxious weed infestations on the Prescott, Apache-Sitgreaves, Tonto, and Coronado National Forests are at a lower level; however, several species of exotic grasses infest thousands of acres. Excluding exotic grasses, over half of noxious weed infestations in the central and southern portions of Arizona occur along roadways. Importantly, new invasions are expected to occur along roadways through transport of plant parts and seeds attached to vehicles coming from adjoining states.

Vegetation along public highways and roads cause several substantial problems and the following aspects are of concern:

Roadbed Integrity: Vegetation growing in pavement, cracks and joints, and on the edge of roads can threaten roadbed integrity. Vegetation in pavement cracks and joints funnels water underneath roadbeds, causing softening and destabilization of the roadbed. Vehicle travel damages these weakened areas, causing potholes to form. Pavement cracks and joints can be enlarged by root growth and frozen water, and they cannot be sealed if vegetation is present. Plants like camelthorn (*Alhagi pseudoalhagi*), which is a noxious weed, have the capacity to grow through up to 6 inches of pavement.

Visibility: Unobstructed views of road features, designated passing zones, road edges, traffic, highway facilities, and wildlife movement are essential to highway safety.

Drainage: Ensuring the drainage of water from pavement areas is critical for suitable tire performance as well as roadbed integrity. Undesirable vegetation along pavement edges can cause ponding of sheet flow on the roadway. Vegetation in drainage ditches can impede water flow, particularly in ditches with gentle grades, and subsequently contribute to ponding in the ditch and on the travelway. Water ponding in the ditch can result in weakened subgrades and pavement failure. Water ponding on the pavement may cause vehicles to hydroplane and drivers may lose control.

Fire Hazard Reduction: Vehicle passengers throwing away burning objects, like cigarettes, can ignite dry vegetation along pavement edges. Catalytic converters on vehicles also can cause fires. Smoke obscures highway visibility, and fires can quickly move to bordering wildlands and threaten homes and other structures. Fuel loads and the potential for fire spread vary depending on climate and vegetation type. Exotic grasses in the Sonoran Desert are especially subject to burning and resulting fires can favor the formation of monotypic (pure) stands of such grasses, which could permanently modify desert plant communities.

Designed Vehicle Recovery Areas (Clear Zones): This is the immediate area along the side of a road, including the shoulder, available for recovery of an errant vehicle. The width of this area varies depending on the design speed for the road, road curvature, steepness of slopes, and environmental considerations. Recovery areas are intended to be clear of: (1) individual trees with a diameter greater than 6 inches measured 4 inches above the surrounding ground; (2) small trees or other woody vegetation with multiple trunks that have a combined cross section greater than 28 square inches when they are less than 8 feet apart; (3) large rocks that are loose and over 4 inches in height; and (4) solid tree stumps over 6 inches in diameter and over 4 inches in height, etc (Highway Safety Act and other safety standards, see page 2). Essentially, any object in a recovery area can be considered to be hazardous if it could cause a vehicle to abruptly stop, cause penetration of the passenger compartment, or cause a vehicle to become unstable resulting in a spin, vault, or rollover.

Clearance: Branches from trees and shrubs can encroach into the space above travelways thereby impeding the space required for safe passage of trucks and other large vehicles. Snowplows operating along road edges often require even greater clearance of vegetation to ensure adequate safety during snow removal operations.

Snow and Ice Melt: Trees and tall shrubs in forested areas can substantially reduce the amount of thermal energy reaching the road surface in winter. The resulting patches of ice and snow present a significant safety hazard to motorists.

Control of Erosion: Native vegetation plays an important role in protecting soils from erosion. Soil erosion along roadways can adversely affect aquatic ecosystems through sedimentation. Sediments can accumulate on roadways and clog drainage facilities. Extreme erosion can induce instability in cutbanks and fills, raising the risk of slope failure during wet periods. Several of the exotic plants have taproots, and solid stands of such plants can intensify soil erosion on the road shoulder causing small erosion channels that can pose a safety problem. Maintaining soils stability is especially important when overstory trees are removed for forestry and safety purposes.

Control of Noxious Weeds: Federal and State regulations require control of designated noxious weeds.

Hazard Tree Reduction: Dead or dying trees and large shrubs must be removed if they are an immediate threat of falling in the clear zone or onto the roadway or shoulders, either striking vehicles directly or placing an obstacle on the travelway. The hazard is worst during windstorms, heavy rain, and snow events.

Appearance and Protection of Landscape Plantings: The retention of vegetation along highway rights-of-way, especially native grasses, is beneficial, but some plants must be controlled in order to protect landscape plantings. In addition, some vegetation is considered to be unattractive, such as plants growing in pavement cracks or around highway structures, although most highway managers do not control plants based on their appearance. Insect and disease infested trees within rights-of-way can pose a threat of infestation to adjoining forested areas.

Forest Service officials realize there is a need to better respond to the increasing noxious weed and hazardous vegetation problems in Arizona. Since roadways are a primary factor influencing the introduction of noxious weeds, Agency officials are also concerned about the effectiveness of control options to protect native plant communities and resource values and uses. Further delays that prevent ADOT and other Public Road Authorities from being able to control weeds along roadways will contribute to the rapid expansion of noxious weed infestations and require increasingly larger funding for control. Within the past 15 years, ten species of noxious weeds in the northern part of Arizona have expanded from a few spot infestations along roadways to about 190,000 acres in 2002. These infestations are expected to increase from 8 to 12 percent per year without intervention (USDA Forest Service 1998). In addition, it is reasonable to expect that infestations of new species will be discovered and they could pose an additional threat to resource values and uses.

The opportunity exists to prevent the introduction of noxious weeds, prevent the spread of existing infestations, and eradicate some species that occur on a few acres of roadways. Effective vegetation management programs will reduce weed infestations and protect native plant communities. Any further delay will result in the continued spread of weed infestations and significantly increase the cost of future control work, including a substantial increase in the amount of herbicide that would be necessary to control infestations.

With regard to the safety of the public use roadways within national forests, it would be desirable for ADOT and other Public Road Authorities to have every method available at their disposal, including the use of herbicides, to give them a reasonable opportunity to effectively manage vegetation problems. The National Highway Traffic Safety Administration (NHTSA), U.S. Department of Transportation, released a report entitled "Traffic Safety Facts 2000, A Compilation of Motor Vehicle Crash Data from the Fatality Analysis Reporting system and the General Estimates System" with the following statistics and study facts for calendar year 2000: Deaths, 41,821; injuries 3,189,000; damaged vehicles, $28 million; lost productivity, $80 billion, property damage, $59 billion; travel delay, $26 billion; medical, $33 billion; and the total monetary loss was $198 billion. About 75 percent of these costs are paid by those not involved in the accidents through higher insurance rates, higher taxes, and travel delays. The cost to each citizen is about $750 per year. The NHTSA found that about 3,000 motorists a year are killed as a result of running off the road and striking a tree, shrub, or clump of brush. Also, safety studies by the Transportation Research Board indicate that about 30 percent of vehicle fatalities are the result of run-off-the-road type accidents involving striking trees, shrubs, or other roadside obstacles or overturning. Even one accident associated with hazardous vegetation can result in a lawsuit of several million dollars for loss of life, injury, and property damage.

The pervasiveness and complexity of the noxious weed and hazardous vegetation situation, combined with the complexity of management, necessitates using an integrated approach. Forest plans are consistent with the general principles of Integrated Pest Management (IPM), but they do not address specific vegetation management strategies, like the use of herbicides, to control vegetation. With regard to methods, IPM and IVM mean the same thing, but IVM is more specific in addressing vegetation. This analysis was necessary because forest plans do not cover herbicide use to manage unwanted vegetation, especially on road rights-of-way.

Roadway managers use a variety of methods to manage vegetation along roadways throughout Arizona. Most methods have been approved. The entire program would be considered as an IVM approach. A description of the various approved methods follows:

Manual Methods: Manual vegetation control involves the use of weed eaters, chain saws, small power mowers, as well as hand tools like hoes, shovels, and pruning shears. Hand pulling of weeds is also a manual control method. Manual control can be effective for shallow-rooted weeds, but this approach is ineffective for deep-rooted species. An advantage of manual control is that it can be performed selectively to remove target weeds, while preserving desirable plants. Disadvantages, relative to what can be accomplished, for manual methods are as follows: (1) they are labor-intensive, and (2) they are extremely expensive.

Cultural Methods: Cultural control refers to the use of organic mulches, such as wood chips, and material coatings, like plastic, to prevent vegetation emergence. Mulching can be effective for controlling herbaceous annual plants, but it is ineffective against aggressive woody perennials. Mulching is most effective in landscape areas, but it is not considered a practical or economical alternative for vegetation control along roadways in national forests.

The use of grazing animals, such as goats or sheep, is another cultural approach, although this technique is not an option on highway rights-of-way because of the danger of animals entering the travel lanes.

Synthetic Herbicides: Outside of National Forest System lands, and within USDOT easements crossing National Forest System lands, Public Road Authorities, like ADOT, use a variety of herbicides to control noxious and invasive weeds using the following approaches:

> **Spot Applications**: Spot techniques consist of various means to apply herbicides manually to individual plants or small clumps of plants. These techniques afford a high degree of selectivity because only specific plants are killed. Surrounding vegetation can be retained to prevent establishment of unwanted plants. Spot treatments are most effective when target plants are low in density and access to the site is not hazardous or difficult. Spot applications along highways can be accomplished with: (1) a truck mounted spray systems; (2) a handgun attached to a truck-mounted or other vehicle-mounted sprayer with up to 200 feet of hose; (3) powered or hand-pump backpacks; (4) granular herbicides placed within the root zone of plants; (5) wick or roller applications; (6) treatment of stumps (recently cut surfaces), trees, or shrubs; and (7) stem injections or hack-and-squirt applications
>
> **Broadcast Applications**: Broadcast application techniques are used to treat weeds over relatively large areas, starting at about a tenth of an acre. These techniques are not selective in terms of the area treated, but they can be selective depending on the plants affected, the type of herbicide used, timing of the application, and the application rate. The primary advantage of broadcast applications is that large areas and many plants can be treated quickly and efficiently. Broadcast applications of herbicide solutions along roadways are made from trucks or trailers carrying a tank and pumping system. These spraying units use varying nozzle arrangements, including downward spraying booms, side-spraying nozzles, and cluster nozzles.

Controlled Burning: Fire can be used to remove flammable fuels, such as stands of annual grasses, to reduce the risk of a wildfire. A single, low intensity fire, however, is usually not effective in controlling most weeds because it does not get hot enough to prevent sprouting from crowns or re-establishment from seeds in the soil. In some situations, fire may create the type of disturbance that promotes the colonization of many weeds. In some instances, prescribed burns can be an effective means of increasing the vulnerability of some weeds, such as bufflegrass, to subsequent herbicide applications.

Grading: Grading is not commonly used as a maintenance approach to control weeds. However, this method can be used to remove vegetation in drainage ditches or other sites where other methods would be infeasible or inadequate. Grading is accomplished by scraping of the soil surface with ridged blades that remove vegetation or move soil. The most frequent use of grading is to remove debris from roadsides that slips from slopes or is moved by other means. On many sites, grading is considered to be undesirable because it creates erosion and waste disposal problems. It is also expensive in terms of labor and equipment, and the visual results are considered to be unattractive. Importantly, grading creates a disturbed area that increases the potential for noxious weed invasion and expansion.

Mowing: The use of rotary and flail mowers, within an IVM plan, can provide another tool to assist roadside managers in maintaining proper vegetation height for line of sight visibility, fire protection, and roadside appearance. A major disadvantage of mowing as an IVM tool, however, is the transportation and spread of seeds and plant parts to adjacent sites, holding areas, maintenance yards, and up and down highway corridors; thus, increasing the spread of weeds encountered during mowing operations.

Tillage: The practice of tilling is most commonly used in a cropland setting, not on highway rights-of-way. Tillage can be effective in controlling some deep-rooted plant species, such as Canada thistle, by conducting repeated tilling every 21 days during the growing season. However, some rhizomatous plants, like leafy spurge, are spread by such tillage applications. Another disadvantage of tillage is that it disturbs the soil, which can provide a favorable environment for noxious and invasive weeds. Also, the approach is not selective and desirable native plants will be removed as well.

Biological Control: Insect and plant pathogens can be used as biological control agents on exotic weed species. Classical biological control seeks to establish a self-sustaining population of control agents that come from the same place of origin as the exotic weed. The goal is not to eradicate the host but to reduce it to a level that is tolerable because elimination of the host would lead to the elimination of the biological control agent. Any release of a biological control agent on National Forest System lands will be based on another environmental assessment approved by the USDA Animal Plant and Health Inspection Service.

Restoration: Maintaining a healthy plant community of desirable plants along roadsides is necessary to offer competition to undesirable weeds and slow their invasion and spread. In some cases, natural seeding of desirable plants will occur, but mechanical or hand seeding is often necessary to establish desirable native plants in the harsh environment along roadsides. Selection of competitive seedling species is an important component of this approach.

A combination of IVM methods, techniques, and practices is needed to achieve vegetation management goals to maintain clear zones and protect native plant communities and natural resources. However, the use of herbicides to control noxious weeds and invasive vegetation has not been approved for roadways on National Forest System lands. Without synthetic herbicides, it may not be possible to achieve effective, economical, and environmentally acceptable management of weeds along roadways.

As with most vegetation management programs, it would be necessary to coordinate roadway treatments with programs being undertaken by other Federal agencies, State and local government agencies, and private landowners. Noxious and invasive weeds are a widespread problem and would require coordinated efforts.

Invasive Plant Infestations

Regulation by State and Federal law is the greatest difference between noxious weeds and invasive plants. Although noxious and invasive plants have similar effects on native plant communities, not all invasive plants have been listed on noxious weeds lists in Federal and State laws or State regulations. This occurs for a variety of reasons, including lack of information about the distribution of the species, differing public opinion about the effects of a species, and lack of proponents to list a species.

Officially listed noxious weeds are inherently invasive. Their ability to establish themselves in a variety of habitats and then quickly dominate an area is the prime reason that noxious vegetation is so problematic. However, invasive plants that are not classified as noxious, and not regulated by law, can and do exist along rights-of-way and other disturbed areas and pose just as serious a threat to natural ecosystems. These species, whether native like the common sunflower (*Helianthus annuus*), or naturalized exotics like Russian thistle (*Salsola kali*) and kochia (*Kochia scoparia*), have the ability to infest roadsides and adjacent lands at the expense of native plants. Other invasive plant species include camphorweed (*Heterotheca subaxillaris*), Russian olive (*Elaeagnus angustifolia*), Johnsongrass (*Sorghum halepense*), and mullein (*Verbascum thapsus).* Just like noxious weeds, most invasive plant species form monocultures that reduce soil stability, destroy the complex structure of native plant communities, and degrade the natural aesthetics of the area. They can infest riparian areas (e.g. saltcedar, *Tamarix ramosissima*), block culverts (e.g. Russian thistle), and obscure highway safety features such as signs, guardrails, and delineators, (e.g. desert broom, *Baccharis sarothroides*).

Because the threat of invasive plants to native ecosystems and public safety rivals that of noxious weeds, Public Road Authorities and their personnel control invasive vegetation in conjunction with noxious weed and hazardous vegetation. This is done with the intention of preventing many invasive plant species from reaching the point of needing government restrictions.

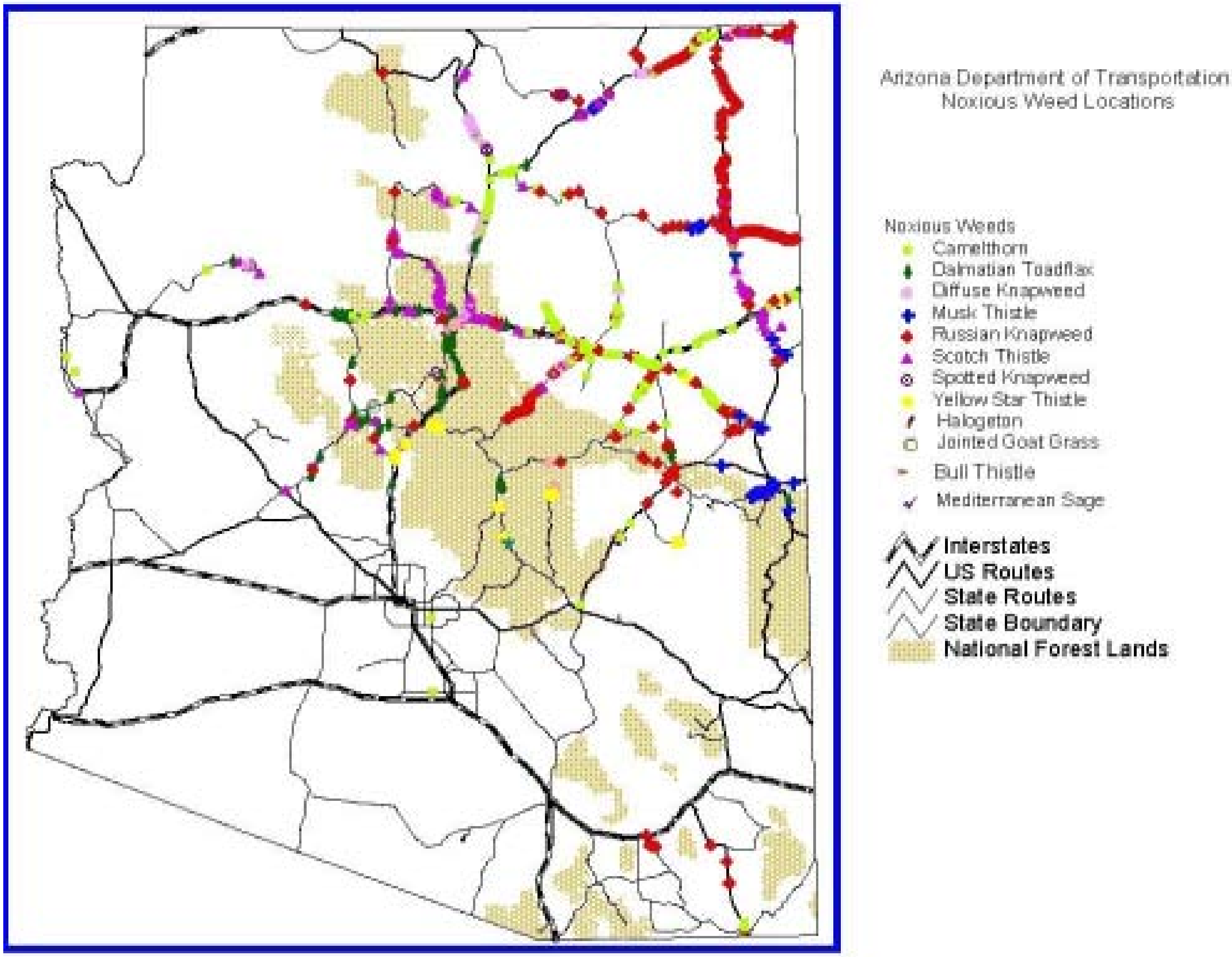

Figure 2. Map showing noxious weed infestations on public roadways in Arizona

Hazardous Vegetation

Hazardous vegetation is any plant that poses a threat to drivers, roads, biotic communities, or adjacent lands. The threat can be in the form of collision hazards, such as vehicles hitting trees that are too close to the road; sight distance impediments, such as drivers being unable to see wildlife approaching the roadway, around curves in passing zones, signs and safety features because of tall vegetation; vegetation encroachment into the travel lanes; fire hazards; and degradation of the roadbed.

Any plant species can be considered hazardous vegetation depending on its abundance and its location in the right-of-way. Those species, such as paloverdes (*Cercidium* spp.), mesquites (*Prosopis spp.*), pines (*Pinus spp.*) etc., that establish themselves immediately adjacent to the road with trunk diameters of 6 inches or greater at a height of 4 or more inches above the ground pose a collision hazard to motorists who lose control of their vehicles. Trees and brush species, like skunkbrush (*Rhus spp.*), that populate the area adjacent to the pavement edge have branches that extend into the roadway, causing drivers to swerve out of their lane to avoid them. Junipers (*Juniperus* spp.), acacia (*Acacia spp.*), Johnsongrass (*Sorghum halepense*), and other tree, brush, or grass species can be hazardous when they grow in front of and around road signs and guardrails preventing drivers from seeing them. Plants like sunflowers (*Helianthus* spp.) and kochia (*Kochia scoparia*) grow over 6 feet tall. They obscure culverts and safety features such as delineators, guardrails, and signs. Dense stands of any of these species and many others hide the presence of wildlife along the right-of-way. The growth of plants in pavement cracks is very destructive to the roadbed. The roots of plants enlarge these fissures and allow water to funnel under the pavement; thereby undermining the integrity of the roadbed.

Bufflegrass (*Pennisetum ciliare*), a common grass planted for cattle forage in Mexico and southern Arizona; Fountain grass (*Pennisetum setaceum*); and Bermuda grass (*Cynadon dactylon*); escaped landscape plantings and now present a fire hazard on road shoulders and surrounding natural areas. In addition, invasive annual grasses like wild oats (*Avena fatua*) and red brome (*Bromus rubens*), pose an extreme fire hazard in the Sonoran Desert when they infest roadsides. Highway travelers who toss cigarettes out of car windows and those who pull off the pavement along the highway can cause these grasses to ignite and create a wildfire in a habitat unaccustomed to the effects of fire. These fires cause severe damage to the native Sonoran Desert flora and fauna.

Regardless of the species, hazardous vegetation can exist in a variety of places within the right-of-way, from medians and shoulders to guardrails and the pavement itself. Each plant in each location presents a different threat to the safety of motorists, the integrity of the roadbed, and the preservation of native plant communities. Because of the multifaceted danger of hazardous vegetation, control for these plants, whether native, invasive, or noxious, remains a priority for public road authorities.

Proposed Action

The Forest Service proposes to authorize ADOT to conduct annual treatment programs, using EPA approved herbicides, to contain, control, or eradicate noxious, invasive, and native plant species that pose safety hazards or threaten native plant communities on road easements and National Forest System lands up to 200 feet beyond the road easement on the Apache-Sitgreaves, Coconino, Coronado, Kaibab, Prescott, and Tonto National Forests.

Herbicides currently being considered for possible use include: Chlorsulfuron, clopyralid, 2,4-D, dicamba, fluroxypyra, glyphosate, imazapyr, imazapic, isoxaben, metsulfuron methyl, pendimethalin, picloram, sethoxydim, sulfometuron methyl, tebuthiuron, and triclopyr.

Decision to be Made

The responsible official is the forest supervisor, Tonto National Forest, who has been delegated the authority to act on behalf of and issue the final decision for all Arizona forest supervisors. Regional foresters are responsible for reviewing and approving or disapproving all proposed pesticide uses on National Forest System lands (FSM 2151.04a). The Regional forester may delegate this authority to other line officers on a case-by-case basis or by supplement to FSM 2151.04a, except for (1) any pesticide use in wilderness, which includes Wilderness Study Areas, and (2) any pesticide use in candidate Research Natural Areas. The completed Environmental Assessment (EA) will provide the responsible official with the basis upon which to make an informed decision. The decision will outline the requirements necessary to authorize the proposed use of herbicides for noxious weed and hazardous plant management. Following a review of the completed EA, the responsible official will decide to do one of the following:

1. Determine if significant environmental impacts would result from implementing the proposed use of herbicides, which would require the preparation of an Environmental Impact Statement, or if there is a Finding of No Significant Impact.

2. Determine if the proposed program, using selected herbicides to manage noxious weeds and hazardous vegetation, has acceptable environmental consequences that, individually or cumulatively, are not considered to be significant (CEQ regulations 1508.27).

3. Do not allow the use of herbicides for management of noxious weeds, invasive plants, and hazardous vegetation.

Adaptive Management and Managerial Flexibility are tools that allow decision makers to take advantage of new information that becomes available after a decision has been made. It is possible that new or improved herbicide products could become available during implementation of this proposal. If implementation monitoring shows that herbicides being used are not effective in meeting the purpose and need for this project, and a new or improved product is available, the new herbicide product could be considered for use without further NEPA analysis. This would be the case only if the new or improved product fits within the same effects analysis disclosure as the herbicides proposed in this document. An analysis would be done to determine the similarities of effects and if the decision would be adapted to include that herbicide product.

Scoping

On May 8, 2002, a scoping letter was sent to 2,088 forest users, private individuals or groups, and county, State, and tribal governments, and other Federal agencies that expressed interest or may be affected by this decision. In addition, public notices were provided in several newspapers, including the Arizona Republic. Through the scoping process, a total of 145 responses were received. After reviewing the public responses, the Interdisciplinary (ID) Team developed five key issues to evaluate the proposed action and develop alternatives. The key issues will be tracked through the remainder of this document. The comments received are included in the project file for this proposal. The key issues, which are further discussed in Chapter 2, are:

Issue 1: The effectiveness of alternatives in controlling noxious weeds, invasive plants, and hazardous vegetation.

Issue 2: Effects of alternatives upon human health (public and workers), including multiple chemical sensitivity (MCS).

Issue 3: Effects of alternatives on non-target native vegetation, including threatened, endangered, and sensitive plants.

Issue 4: Effects of alternatives on non-target aquatic and terrestrial animals, including threatened, endangered, and sensitive animals.

Issue5: Effects of alternatives on water quality.

Issues Beyond the Scope of this Document

Other issues were raised through the scoping process. Each was evaluated by the ID Team and compared against the decision to be made, legal requirements, and Forest Service policy. The following issues were determined to be beyond the scope of this EA:

- Effectiveness and comparative cost of mechanical, manual, and other non-herbicidal techniques. Previous land management decisions allocated National Forest System lands for highway use purposes, including all maintenance activities, except the use of pesticides, for maintaining the roadways and adjacent areas for safe and efficient highway use (FSH 2709.11, Chapters 20 and 30).

- Providing a 5-mile buffer around residences and campgrounds and herbicide free access routes along roadways for those suffering from multiple chemical sensitivity to obtain commodities and services. The Forest Service only has authority within the boundaries of National Forest System lands and roadways outside the boundary could still be treated.

- Use biological control agents to control noxious weeds. Again, this method is authorized by other environmental analyses conducted by the USDA Animal and Plant Health Inspection Service.

Incorporation by Reference

Regulations to implement the National Environmental Policy Act (NEPA) provide for the reduction of bulk and redundancy (40 CFR 1502.21) through incorporation by reference when the effect will reduce the size of the document without impeding agency and public review of the action. The following documents are incorporated by reference to ensure that the most recent information is reflected in this environmental assessment. The conclusions related to human health and effects on non-target organisms are consistent with those identified in the 1992 Risk Assessment.

1. Risk Assessment for Herbicide Use in Forest Service Regions 1, 2, 3, 4, and 10 and on Bonneville Power Administration Sites (September 1992).

2. 2,4-D — WordPerfect Worksheets for Human Health and Ecological Risk Assessments. USDA Forest Service. November 24, 2001.

3. Clopyralid — WordPerfect Worksheet for Human Health and Ecological Risk Assessment. USDA Forest Service. November 28, 2001.

4. Selected Commercial Formulations of Glyphosate — Accord, Rodeo, Roundup, and Roundup Pro, Risk Assessment, Final Report. USDA Forest Service. April 25, 1999.

5. Effects of Surfactants on the Toxicity of Glyphosate, with specific Reference to Rodeo. USDA Forest Service. February 6, 1997.

6. Imazapyr — WordPerfect Worksheets for Human Health and Ecological Risk Assessments. USDA Forest Service. November 30, 2001.

7. Imazapic (Plateau and Plateau DG) — Human Health and Ecological Risk Assessment, Final Report. January 28, 2001.

8. Isoxaben — WordPerfect worksheets for Human Health and Ecological Risk Assessments. USDA Forest Service. December 2, 2001.

9. Metsulfuron methyl — WordPerfect Worksheets for Human Health and Ecological Risk Assessments. USDA Forest Service. December 4, 2001.

10. Picloram — WordPerfect Worksheets for Human Health and Ecological Risk Assessments. USDA Forest Service. December 1, 2001.

11. Sethoxydim (Poast) — Human Health and Ecological Risk Assessment, Peer Review Draft. USDA Forest Service. October 31, 2001.

12. Sulfometuron methyl (Oust) — WordPerfect Worksheets for Human Health and Ecological Risk Assessments. USDA Forest Service. November 23, 2001.

13. Triclopyr Acid (Garlon 3A) — WordPerfect Worksheets for Human Health and Ecological Risk Assessments. USDA Forest Service. November 23, 2001.

14. Triclopyr-Bee (Garlon 4) — WordPerfect Worksheets for Human Health and Ecological Risk Assessments. USDA Forest Service. November 23, 2001.

15. Neurotoxicity, Immunotoxicity, and Endocrine Disruption with Specific Commentary on Glyphosate, Triclopyr, and Hexazinone: Final Report. USDA Forest Service. February 14, 2002.

16. Vanquish (Dicamba) — WordPerfect Worksheets for Human Health and Ecological Risk Assessments. USDA Forest Service. November 27, 2001.

Chapter 2 - Alternatives

Introduction

The alternatives are the heart of this environmental assessment, and this chapter describes the activities of both the No Action and the proposed alternatives. These alternatives will be evaluated against the issues identified in Chapter 1 with respect to the affected environment described in Chapter 3 providing a clear basis for choice among the options for the decision maker and the public. This chapter displays the two alternatives developed in response to the public comments received and issues identified by the Interdisciplinary Team. Additional alternatives were identified through the analysis process, but they were later eliminated because they were outside the scope of the proposed action, irrelevant to the decision to be made, or conjectural and not supported by scientific or factual evidence. This chapter also contains mitigation measures and Best Management Practices developed for each of the alternatives to address significant issues.

Alternative 1 – No Action

Intent: No action would be taken to use any herbicide to control hazardous vegetation and noxious weeds and invasive plants along public roadways that are within the boundaries of National Forest System lands in Arizona and under the approval authority of Forest Service officials.

Under this alternative, ADOT and other Public Road Authorities would continue to implement annual herbicide treatment programs on about 6,000 miles of roadways outside National Forest System lands and U.S. Department of Transportation (USDOT) easements crossing National Forest System lands. The Federal Highway Administration has the authority to approve herbicide use within rights-of-way for USDOT easements crossing national forest lands. Prior to herbicide applications within USDOT easements, FHWA consults with the Forest Service. These applications are normally done on a project-by-project basis and do not involve annual maintenance treatments. Also, control of existing weed populations, using mechanical, manual, and site rehabilitation, is already authorized and would continue. ADOT's vegetation management projects would occur within the existing USDOT easement. The USDA Forest Service would continue to manage lands adjacent to the easement in accordance with established policies and procedures.

Principal Activities of the No Action Alternative

Roadway managers currently use a variety of methods to manage vegetation along roadways throughout Arizona. These techniques for control of hazardous and noxious vegetation are considered components of an Integrated Vegetation Management (IVM) approach. These activities would continue if the No Action Alternative were selected. Descriptions of the various methods follow.

Manual Methods

Manual vegetation control involves the use of weed eaters, chain saws, small power mowers, as well as hand tools like hoes, shovels, and pruning shears. Hand pulling of weeds is also a manual control method. Manual control can be effective for shallow-rooted weeds, but this approach may not be effective for controlling deep-rooted species. An advantage of manual control is that it can be performed selectively to remove target weeds, while preserving desirable plants. Disadvantages relative to what can be accomplished for manual methods are that they are labor-intensive and extremely expensive. ADOT would use mechanical vegetation control as appropriate to control hazardous and noxious vegetation.

Mechanical Methods

Mechanical vegetation control methods utilized by roadway managers follow:

Mowing: The use of rotary and flail mowers within an IVM plan can provide another tool to assist roadside managers in maintaining proper vegetation height for line of sight visibility, fire protection, and roadside appearance. One disadvantage of mowing is the scattering and transport of seeds and plant parts to surrounding sites, holding areas, maintenance yards, and up and down highway corridors, thus, potentially increasing the spread of these species.

Tillage: The practice of tilling is most commonly used in a cropland setting, not on highway rights-of-way. Tillage can be effective in controlling some deep-rooted plant species, such as Canada thistle, by conducting repeated tilling activities every 21 days during the growing season. However, some rhizomatous plants, like leafy spurge, are spread by these tillage applications. Another disadvantage of tillage is that it disturbs the soil, which can provide a favorable environment for noxious and invasive weeds. Also, the approach is not selective and desirable native plants may be removed as well.

Grading: Grading is not commonly used as a maintenance approach to control weeds; however, this method can be used to remove vegetation in drainage ditches or other sites where other methods would be infeasible or inadequate. Grading is accomplished by scraping of the soil surface with ridged blades that remove vegetation or move soil. The most frequent use of grading would be to remove debris from roadsides that slips from slopes or is moved by other means. On many sites, grading would be considered to be undesirable because it creates erosion and waste disposal problems. It would also be expensive in terms of labor and equipment, and the visual results are considered to be unattractive. Importantly, grading would create a disturbed area that increases the potential for hazardous and noxious weed invasion and expansion.

Cultural Methods

Cultural control refers to the use of organic mulches, such as wood chips, and material coatings, like plastic, to prevent vegetation emergence. Mulching can be effective for controlling herbaceous annual plants, but it is ineffective against aggressive woody perennials. Mulching is most effective in landscape areas, but it is not considered as a practical or economical method for roadside vegetation control along roadways on national forests. The use of grazing animals, such as goats or sheep, is another cultural approach, although this technique is not an option on highway rights-of-way because of the danger of animals entering the travel lanes. Controlled burning of hazardous and noxious plant species and revegetation projects would be considered cultural vegetation management techniques as well. ADOT and other Public Road Authorities would use cultural vegetation control as appropriate to manage hazardous and noxious vegetation.

Controlled Burning: Fire can be used to remove flammable fuels, such as stands of annual grasses, to reduce the risk of a wildfire. However, a single, low intensity fire will not effectively control most weeds because it does not get hot enough to prevent resprouting from crowns or re-establishment from seeds in the soil. Fire may create the type of disturbance that promotes the colonization of many weeds. However, when prescribed burns are coordinated in conjunction with other vegetation management techniques, it can be a very effective means of increasing the vulnerability and susceptibility of species such as buffelgrass to other methods of control. The NFS must approve a Public Road Authority Burn Plan prior to any burn activities taking place on NFS lands

Restoration/Rehabilitation: Maintaining a healthy plant community of desirable plants along roadsides is necessary to offer competition to undesirable weeds and slow their invasion and spread. In some cases, natural seeding of desirable plants will occur. However, mechanical or hand seeding is often necessary to establish desirable native plants in the harsh environment along roadsides. Selection of competitive seedling species is an important component of this approach.

Synthetic Herbicides

Public Road Authorities like ADOT use a variety of herbicides to control hazardous and noxious plant species. On USDOT easements through Forest Service lands, ADOT would apply chemicals as authorized by FHWA through coordination with the Forest Service on a project-by-project basis to control hazardous and noxious vegetation. Chemical herbicide applications would not occur outside the existing USDOT rights-of-way. ADOT would apply herbicides using the following approaches:

Spot Applications: Spot techniques consist of various means to apply herbicides manually to individual plants or small clumps of plants. These techniques afford a high degree of selectivity because only specific plants are killed. Surrounding vegetation can be retained to prevent establishment of unwanted plants. Spot treatments are most effective when target plants are low in density and access to the site is not hazardous or difficult. Spot applications along highways can be accomplished with: (1) a truck mounted spray systems; (2) a handgun attached to a truck-mounted or other vehicle-mounted sprayer with up to 200 feet of hose; (3) powered or hand-pump backpacks; (4) granular herbicides placed within the root zone of plants; (5) wick or roller applications; (6) treatment of stumps (recently cut surfaces), trees, or shrubs; and (7) stem injections or hack-and-squirt applications.

Broadcast Applications: Broadcast application techniques would be used to treat weeds over relatively large areas, starting at about a tenth of an acre. These techniques are not selective in terms of the area treated, but they can be selective depending on the plants affected, the type of herbicide used, timing of the application, and the application rate. The primary advantage of broadcast applications is that large areas and many plants can be treated quickly and efficiently. Broadcast applications of herbicide solutions along roadways are made from trucks or trailers carrying a tank and pumping system. These spraying units use varying nozzle arrangements, including downward spraying booms, side-spraying nozzles, and cluster nozzles.

Monitoring

ADOT natural resource planners currently review IVM projects on an individual basis. The planners develop site-specific mitigation for natural and cultural resources that may potentially be impacted by vegetation management activities. Natural resource managers and field personnel will then implement mitigative measures. Mitigation is developed to reduce potential impacts to threatened and endangered species, sensitive habitats, and other non-target plant and animal species. Cultural resources and public concerns may also be addressed. Mitigation for ADOT'S IVM may include reviewing the EPA's *Office of Pesticide Programs Endangered Species Bulletin* to identify listed species that may be susceptible to vegetation management activities utilizing chemicals. The EPA's recommended mitigative measures will be implemented to avoid known locations of threatened and endangered species. Furthermore, mitigation will require coordination with the Forest Service prior to spraying activities taking place on NFS lands. All chemical herbicides shall be applied according to label directions by certified applicators, and a toll free number will be maintained for members of the public to provide updated notification of herbicide application activities and locations.

ADOT Natural Resources Management Section personnel monitor the Level of Service (LOS) provided to rights-of way through an annual review of operational activities in conjunction with visual inspections of all ADOT rights-of-way. Natural resource personnel record the occurrence of hazardous and noxious vegetation observed within the transportation easement during the annual statewide LOS survey. ADOT natural resources managers then use the LOS data to develop a work plan for each region. This LOS monitoring would identify areas in need of vegetation management within rights-of-way crossing Forest Service lands in Arizona, and provide feedback to Natural Resources Managers as to the success of the previous years' vegetation management activities.

All national forests in Arizona are currently conducting environmental analyses for management of noxious weeds on rangelands, forested areas, riparian areas, wilderness areas, and forest roads and trails. Following completion of these analyses and a decision by responsible officials, treatments could be implemented, including the use of herbicides. As a result of the aforementioned analyses, the treatment of noxious weed infestations that extend from rangelands or forests into road right-of ways could begin in 2003.

Alternative 2 - Proposed Action

Intent: The Forest Service, in cooperation with the Federal Highway Administration (FHWA), Arizona Division, proposes to authorize the Arizona Department of Transportation to treat hazardous vegetation, noxious weeds and invasive plants with 16 herbicides along public roadways on National Forest System lands throughout Arizona.

This alternative would involve the ground application of 16 registered herbicides through the use of power sprayers and other ground equipment. There would be no aerial application of herbicides. It is estimated that no more than 5,000 acres would be treated annually along about 2,700 miles of interstate highways, U.S. highways, and State routes within the boundaries of 6 national forests: Apache-Sitgreaves, 500 acres; Coconino, 1,500 acres; Coronado, 500 acres; Kaibab, 500 acres; Prescott, 1,000 acres; and Tonto, 1,000 acres.

This alternative would provide the opportunity to effectively and economically control noxious weeds, invasive plants, and hazardous vegetation. Since undesirable plants are often spread by human activities, especially via vehicles and roads (Roche and Roche 1991), this alternative would provide for early identification and treatment of new noxious weed infestations. Noxious weeds pose a significant threat to native plant communities in Arizona, and this alternative would augment potential noxious weed control efforts on adjacent NFS lands. Also, one focus of this alternative involves the long-term management of noxious weeds. It is anticipated that most noxious weed infestations require many years of treatment until the seed bank in the soil is depleted.

User safety on public roadways is a maintenance priority of ADOT and a requirement of the Highway Safety Act. This alternative is considered the best approach to meet this priority. When roadside vegetation becomes hazardous, there is a substantial increase in the potential accident risk for drivers, and about 30 percent of accidents are run-off-the-road type accidents involving a tree strike or another object near the roadway. Vehicle accidents result in substantial loss of life, mental anguish, physical suffering, and property damage. In Arizona, accidents result in an estimated economic loss of almost three billion dollars each year.

Herbicides proposed for use in this alternative include chlorsulfuron, clopyralid, 2,4-D, dicamba, fluroxypyr, glyphosate, imazapic, imazapyr, isoxaben, metsulfuron methyl, pendimethalin, picloram, sethoxydim, sufometuron methyl, tebuthiuron, and triclopyr. These herbicides are marketed under a variety of trade names (Table 13, page 86). The U.S. Environmental Protection Agency (EPA) has registered all of the herbicides being considered for use and the various product labels include requirements and restrictions.

Herbicides are categorized as selective and non-selective. Selective herbicides can kill certain groups of plants and have little or no effect on other plants. For example, clopyralid is a selective herbicide that can kill certain broadleaf plants, but grass species are especially tolerant of this compound. In addition, certain herbicides can be selective depending on the amount and application technique used. For example, spotted knapweed can be controlled with less picloram than is needed to control leafy spurge. In this instance, the lower amount of picloram used to control spotted knapweed will have less impact on non-target broadleaf plants. Picloram, dicamba, and 2,4-D are all auxin-type compounds that affect the growth of plants and are selective for broadleaf plants, making them effective tools in some environments for controlling weeds while maintaining grasses and conifer trees. On the other hand, glyphosate and sethoxydim are non-selective herbicides and can kill a broad spectrum of plants, including monocotyledons and dicotyledons. Care must be taken when broad-spectrum herbicides are considered for use around desirable, non-target plant species, especially those that are considered to be sensitive or rare.

There is considerable variation in the persistence of herbicides in soil. Some materials can remain active for over a year while other compounds break down in a few days. Long-term persistence in soil can be a beneficial trait for control of plants, like Scotch thistle, after seed set. The residual herbicide in the soil can prevent development of the next generation of plants arising from the seed bank. Tebuthiuron can remain viable for more than a year, depending on weather and soil conditions, and this herbicide could be one choice for a hard-to-kill species like camelthorn, especially at locations where there are no concerns of this herbicide moving in soil or where non-target vegetation could be affected. Glyphosate, 2,4-D, dicamba, sethoxydim and fluroxypyr are short-lived herbicides that remain in the soil for less than a month.

Table 1. Persistence (average half-life) in soil for the herbicides proposed for use (Vencill 2002).

Herbicide	Persistence in Soil
2,4-D	10 Days
Chlorsulfuron	40 Days
Clopyralid	40 Days
Dicamba	Less than 14 Days*
Fluroxypyr	11-38 Days
Glyphosate	47 Days
Imazapic	120 Days
Imazapyr	25-142 Days*
Isoxaben	50-120 Days
Metsulfuron methyl	30 Days
Pendimethalin	44 Days
Picloram	90 Days*
Sethoxydim	5 Days
Sulfometuron methyl	20-28 Days
Tebuthiuron	Over 360 Days*
Tricolpyr	30 Days

*May persist significantly longer under conditions of low moisture and rainfall and soil types.

All of the herbicides proposed for use in this alternative, except for 2,4-D, are classified by the U.S. Environmental Protection Agency as slightly toxic (Category III) to almost non-toxic to humans (Category IV). However, 2,4-D is rated moderately toxic (Category II), but the use of protective equipment and following safety procedures will reduce the risk to applicators. It should be understood that humans and plants have different metabolic pathways, and a compound that is toxic to plants can be relatively non-toxic to humans. The same concept applies to animals and insects.

Table 2. Categories of acute pesticide toxicity and the associated signal word (Miller 1997)

Category	Signal word Required on Label	LD50		LC50 Inhalation Mg/l	Approximate Oral Dose That Can Kill an Average Person
		Oral Mg/kg	Dermal Mg/kg		
I Highly Toxic	DANGER-POISON!	0 to 50	0 to 200	0 to 0.2	A few drops to 1 teaspoon [or a few drops on the skin]
II Moderately Toxic	WARNING!	50-500	200-2,000	0.2 to2	Over 1 teaspoon to 1 ounce
III Slightly Toxic	CAUTION!	500 to 5000	2,000 to 20,000	2.0 to 20	Over 1 ounce to 1 pint or 1 pound
IV Relatively Nontoxic	CAUTION!	More than 5,000	More than 20,000	Greater than 20	Over 1 pint or 1 pound

Table 3. Relative acute toxicity and toxicity category of herbicides and common household compounds (Vencill 2002)

Common Name or Designation	Oral LD50 for Rats (mg/kg)	Toxicity Category
2,4-D	375	II
Chlorsulfuron	> 5,000	IV
Clopyralid	> 5,000	IV
Dicamba	> 5,000	IV
Fluroxypyr	> 2,000	III
Glyphosate	> 5,000	IV
Imazapic	> 5,000	IV
Imazapyr	> 5,000	IV
Isoxaben	> 10,000	IV

Common Name or Designation	Oral LD50 for Rats (mg/kg)	Toxicity Category
Metsulfuron methyl	> 5,000	IV
Pendimethalin	> 5,000	IV
Picloram	> 5,000	IV
Sethoxydim	> 2,600	III
Sulfometuron methyl	> 5,000	IV
Tebuthiuron	644	III
Triclopyr	> 1,500	III
Aspirin*	750	III
Caffeine*	200	II
Ethyl alcohol *	13,700	III
Sugar *	30,000	IV
Table salt*	3.320	IV

*Included for comparison

A more detailed description of each herbicide proposed for use follows (Reference Table 13, page 74, for a list of trade names):

2,4-D: This is one of the most commonly used home and garden herbicides in the United States, and it is one of the most extensively studied. It is a selective, foliar absorbed, translocated, phenoxy herbicide used mainly in post-emergence applications. The action that kills plants mimics natural plant hormones. 2,4-D is effective against many annual and perennial broadleaf weeds. Plants are most susceptible when they are young and growing rapidly. The average field half-life is 10 days. An important utility of 2,4-D is in riparian areas for products with an aquatic label. There are many different brands for sale on the market, such as Weed-Be-Gone, which can be purchased by the public in grocery stores, nurseries, etc.

Chlorsulfuron: This is a selective pre-emergence or early post-emergence herbicide used at very low rates, ½ to 3 ounces per acre. It is in a group of herbicides called sulfonylureas. Its action in plants is described as a rapid mitotic inhibitor. The product on the market is ***Telar***, and it is a dry flowable material that is mixed in water and applied as a spray to control many annual, biennial, and perennial weeds on non-crop sites. It is very soluble in water and mobile; thus, it will not be considered for use in buffer zones near water. It has a soil half-life of 40 days.

Clopyralid: This is a selective, post-emergence herbicide that is mainly used to control broadleaf species in three plant families: composites (Asteraceae), legumes (Fabaceae), and buckwheats (Polyganaceae). Its selectiveness makes this herbicide a useful material for control of invasive plants like knapweeds while preventing adverse effects to many native species. Grass species are especially tolerant to clopyralid. This herbicide is readily absorbed by roots and foliage and is readily transported in plant tissues. There is some information indicating that clopyralid may be more persistent in compost than soil, but there are no plans to use any compost along roadways as part of this hazardous vegetation management and noxious weed control. The material has moderate persistence, high mobility, and high leaching potential. Thus, it will not be used within designated buffer zones along streams or near water in compliance with label requirements. Available product is ***Transline*.**

Dicamba: Dicamba is a broad spectrum herbicide for broad-leaved plants. It is a growth-regulating herbicide readily absorbed and translocated from either roots or foliage. This herbicide produces effects similar to 2,4-D. It has moderate persistence (half-life in soil under 14 days), high mobility, and high leaching potential. This herbicide would not be used within buffer zones near water or areas identified as shallow and sensitive aquifers. Since it can move in surface runoff, it would not be used where impervious surfaces (compacted earth) exist proximal to water. However, the use of vegetated buffer zones would mitigate the risk of runoff-related contamination to surface water sources. ***Vanquish*** is a dicamba product that is labeled for non-crop situations. Dicamba can be mixed with 2,4-D to increase its effect on certain plants.

Fluroxypyr: The trade name for this product is ***Vista***. This is a broad spectrum, “auxin-type” herbicide. It offers a novel mode of action and is efficacious against many broadleaf and sulfonylurea-resistent weeds. It is a post-emergence herbicide with little soil activity. The compound is systemic and is readily absorbed by the foliage of growing plants and moves throughout the plant. It mimics plant hormones, causing an imbalance of plant growth hormones. The leaching potential is small and the soil half-life is 1-4 weeks.

Glyphosate: This is a non-selective herbicide that controls virtually all annual and perennial weeds, but it is generally most phytotoxic to annual grasses. It works by inhibiting amino acid pathways in plants. These amino acid pathways are not found in animals; thus, this herbicide has relatively low toxicity to humans. The compound is absorbed by foliage, but rainfall within 6 hours may reduce effectiveness. It has no soil activity. Persistence and mobility are low, and the compound tends to adhere to sediments when released into water. ***Roundup*** is the commercial name for the product, and ***Rodeo*** is an aquatically labeled formulation. Since this herbicide kills a broad spectrum of plants, care is needed when it is to be applied within buffer zones along streams to limit adverse effects on non-target plants.

Imazapic: This herbicide also is considered to be non-selective, although the rate and timing of application can provide some selectivity. It destroys weeds by blocking the pathways that produce branch chain amino acids in plants. As with glyphosate, humans and animals do not have such pathways, and the compound has low toxicity to humans. Many native grasses and wildflowers are tolerant of this herbicide at lower rates of application, while annual weedy species are susceptible. This herbicide is particularly effective for control of leafy spurge and perennial pepperweed. The product name is ***Plateau***.

Imazapyr: This herbicide is non-selective and it provides pre-emergence and post-emergence control, including residual control, of a variety of grasses, broadleaf weeds, and woody plants. Half-life in soil ranges from 25-142 days, depending on soil type and environmental conditions (Vencill 2002). Foliar absorption usually is rapid (within 24 hours). The product name is ***Arsenal***.

Isoxaben: This is a selective herbicide that is applied as a pre-emergent material that requires a light cultivation or at least 1.3 cm of rainfall within 3 weeks of application to be effective. It is readily absorbed into roots from soil by passive diffusion, but penetration into leaves is limited. Significant concentrations of the compound can accumulate in leaves within 3 days following root uptake. Many susceptible weeds fail to emerge following application. Broadleaf weeds generally show stunting, reduced root growth, root hair distortions and root clubbing (Vencill 2002). It works by inhibiting cell wall biosynthesis in susceptible weed species. The leaching potential is slight and the half-life in soil is 50-120 days. The trade name is ***Gallery***.

Metsulfuron Methyl: This is another sulfonylurea herbicide that is primarily absorbed through the foliage. It interrupts a biological process necessary for plant growth. It is a dry flowable that is mixed with water and applied at very low rates (1-3 ounces per acre) for control of a variety of weed species, including such difficult to control species as hoary cress (whitetop, *Cardaria draba*) and perennial pepperweed (*Lepidium latifolium*). It is moderately residual in soil with a typical half-life of 30 days (Vencill 2002). The product labeled for non-crop areas is called ***Escort***.

Pendimethalin: This herbicide provides pre-emergent control of most annual grasses and certain broadleaf weeds as they germinate in any non-cropland site. The formulation is mixed with water and applied to the soil. The active ingredient is absorbed by roots, and it works by inhibiting polymerization of microtubles at the growth end of the tubule; thus preventing the alignment and separation of chromosomes during mitosis. It has little leaching potential and the soil half-life is about 44 days. The trade name is ***Pendulum***.

Picloram:. Picloram is an active ingredient in ***Tordon***, which is the trade name. It is an organic chemical that is a plant growth regulator used for controlling unwanted broadleaf vegetation. Grasses are generally not susceptible to this herbicide. Picloram is considered to be rate-selective, meaning that the plants that can be controlled are dependent upon the rate of application. At one pint per acre, picloram kills knapweeds while leaving many native species unharmed. At one quart per acre for leafy spurge control, this herbicide kills many more plant species. This is the only “restricted use” herbicide proposed for use, and the purchase and application of this compound can only be done under the direction of a certified pesticide applicator with a valid license. The average field half-life is 90 days (Vencill 2002), although it can persist for a longer period of time. Its persistence makes it particularly useful for control of weeds, but it must be used in such a way that it does not contaminate water.

Sethoxydim: This is a selective, post-emergent herbicide used for control of annual and perennial grasses that are considered weeds. It does not control sedges or broadleaf weeds. The compound readily enters the target grass through its foliage and moves throughout the plant. Growth ceases within a few days of application with young and actively growing tissues being affected first. Leaf yellowing and eventual death develops within 1-3 weeks of application. The compound inhibits fatty acid synthesis in target grass species. The half-life in soil is 5 days. The trade name is ***Poast***.

Sulfometuron Methyl: This compound is another sulfonylurea herbicide that has broad spectrum properties. It is a dry flowable material that is mixed with water and is toxic to target plants at very low rates (1 to 3 ounces per acre). Roots and foliage readily absorb the active ingredient; thus, it is used as a pre-emergent and post-emergent herbicide. The product name is ***Oust.*** Great care is needed to prevent dispersal of this product by wind or water to off-target areas.

Tebuthiuron: This herbicide can be used in pastures, rangelands, and non-crop situations for control of certain broadleaf weeds and woody species. It is persistent in soil with a half-life of 115 months making this compound particularly useful for difficult to control species like camelthorn and woody species. The product name is ***Spike***.

Triclopyr: This herbicide is selective and especially useful for trees and woody shrubs. It acts by mimicking the activity of auxin, a natural growth hormone. The active ingredient is readily absorbed by foliage. Average half-life in soil is 30 days (Vencill 2002). Commercial formulations, ***Garlon 3A*** and ***Garlon 4*** are used for vegetation management programs, and **Renovate 3** is a new aquatic formulation.

Active ingredients in herbicide formulations are defined as the chemicals that actually control the weed. So, imazapic, clopyralid, and the other herbicides discussed earlier in this chapter are active ingredients. Because the water solubility of the some of these active ingredients is too low to feasibly dissolve large amounts in water, other ingredients are mixed with them to create a formulation. Other active ingredients like ester formulations of triclopyr are mixed with vegetable oils and products like limonene, which is a compound needed to move the active ingredient through bark for oil-basal bark applications for plants like saltcedar. These additional chemicals are called "inert ingredients" because they are not toxic to weeds at the designated rates of application (Felsot 2001).

Inert ingredients are identified on the herbicide label as a percentage of the entire formulation weight or volume. For example, the formulation containing imazapyr is called Arsenal. Arsenal is composed of 28.7 percent imazapyr and 71.3 percent inert ingredients. Thus, the majority of this formulation is actually inert ingredients.

Under pesticide law, the specific chemicals and amounts in the inert ingredients is considered proprietary information and they do not have to be identified. However, some manufacturers have released the list of inert ingredients and they have been posted on the Internet.

The Environmental Protection Agency (EPA) has identified about 1,200 inert ingredients that are used in registered pesticides. The EPA reviews existing human health data for inert ingredients including common carriers. The existing data include laboratory studies, epidemiological studies, and activity and structure relationships. EPA categorized inert ingredients into one of four categories:

Level 1 includes inert ingredients of toxicological concern.

Level 2 inert ingredients are potentially toxic and considered of high priority for further testing.

Level 3 inert ingredients are considered of "unknown toxicity." For these chemicals, the data is insufficient to classify them at a higher level or at a lower level of concern. It must be understood, however, that the chemicals on this list do have some toxicity information, but EPA has not made a decision as to their classification. A number of chemicals on this list are also used in commonly sold consumer products without incident (Felsot 2001). Level 3 inert ingredients that may be used in herbicide formulations include borax, carbon dioxide, castor oil, jojoba bean oil, orange oil, and coconut oil soap. Bear in mind that inclusion of a chemical on the Level 3 list does not mean the chemical is hazardous when it would be used in a prudent manner.

Level 4 inert ingredients are regarded by the EPA as being generally innocuous. Thus, the EPA indicates there should be no concern relative to adverse effects on public health or the environment when Level 4 compounds are used in herbicide formulations.

Inert ingredients likely to be in herbicide formulations to be used in Arizona include water, ethanol, isopropanol, triethylamine, EDTA (ethylenediaminetetracetic acid), polyglycol non-ionic surfactant, triisopropanolamine, and versene acid. None of these inert ingredients are listed as Level 1 or 2 compounds. The water and alcohols (ethanol and isopropanol) are Level 4 compounds, and all others are listed as Level 3.

The same method used to assess the risk of exposure and effects applied to herbicide active ingredients can be applied to the inert ingredients. The 1992 Risk Assessment for the Southwestern Region provided herbicide carrier profiles for diesel oil, limonene, kerosene, and mineral oil (III-C-90 to III-C-94), although diesel oil and other petroleum hydrocarbons will not be used as herbicide carriers added to tank mixes. However, some herbicide formulations may contain minor amounts of some petroleum hydrocarbons.

Herbicides are widely used for vegetation management because low hazard products are available, they can be safely applied in a variety of terrain, and they can effectively decrease the economic costs of management. Compared to other methods of control, herbicides can provide the highest level of control at the least cost. For example, a study of the cost and efficacy of spotted knapweed management with integrated methods in Montana provided the following results (Brown, et al. 1998): (1) Tordon 22 at one pint per acre, 95 percent control of plants at $30.75 per acre; (2) mowing, no plant control at $200 per acre; (3) hand-pulling, 25 percent control plants at $13,900 per acre. The average costs per acre for various vegetation control methods shown in Table 4 were provided by ADOT.

Table 4. Average cost for various vegetation control methods (ADOT)

Activity Description	Cost Per Acre	Cost Per Tree
ROW Herbicide (Large Truck, Spot Application)	$24.01	
ROW Herbicide (Large Truck, Broadcast)	$24.28	
Herbicide (Pre-Emergent Application)	$37.39	
Herbicide (Off-Road Truck)	$37.83	
ROW Herbicide (Small Truck, Spot Application)	$45.31	
Herbicide (Hand Application of Dry Products)	$71.82	

Activity Description	Cost Per Acre	Cost Per Tree
Herbicide (Off-Road, Hand Wand)	$87.03	
Herbicide (Small Truck, Safety Features)	$97.94	
Herbicides (Hand Application, Liquids)	$151.93	
ROW Mowing (Native Vegetation)	$59.87	
Mowing (Standard Swath)	$60.95	
Prescribed Burning	$60.81	
Mechanical Tree and Brush Removal	$177.23	
Hand Tree and Brush Removal	$195.84	
Mechanical, Tumbleweed Disposal	$334.17	
Mechanical Removal of Large Trees		$46.25

Mitigations and Best Management Practices

The application of herbicides is tightly controlled by State and Federal agencies. The Forest Service is required to follow all State and Federal laws and regulations applicable to the application of herbicides. The following mitigation measures will be followed if herbicides are used:

- All herbicide label requirements would be followed.
- All applications would be under the direction of a Certified Pesticide Applicator.
- Herbicides would be applied only by ground-based equipment, including backpack sprayers, and spray units on ATVs, trucks, etc.
- All Best Management Practices (BMPs) would be followed
- Clopyralid, dicamba, picloram, and the sulfonylurea herbicides would not be used where the water table is within 6 feet of the surface or where soil permeability would be conducive to water contamination.
- Glyphosate, and amine formulations of 2,4-D and triclopyr are currently labeled for aquatic use and would be the materials used within designated buffer zones along streams and bodies of water (1992 Risk Assessment, pages III-F-32 and 39). Imazapic, imazapyr, and triclopyr could be used in buffer zones as long as they would not be directly applied to water.
- Applicators would be required to wear appropriate personal protective equipment as required on the label.
- All requirements in a Safety and Spill Plan (Appendix B) would be followed.

- The public would be able to access ADOT's timing and location of treatments along roadways by calling the following toll free number 1-800-546-6591.

When any herbicide is applied, best management practices (BMPs) should be used to ensure maximum safety (Felsot, 2001).

Pre-spray BMPs

- Determine the necessity for weed management by scouting the area for weed density.
- The Forest Service recognizes the significance of protecting Native American ethno-botany locations, and each forest will coordinate and consult with interested tribes to protect the integrity of sites where native plants may be collected.
- Use herbicides only when they will provide the most effective control relative to the cost and potential hazard of other management techniques.
- Choose the most effective herbicide that requires the least number of applications.
- Choose the lowest effective rate of application.
- Scout the area and identify sensitive situations like residential structures, campgrounds that will be used by the public, etc.
- Survey any suitable habitat for threatened, endangered, or sensitive species to find any previously unknown populations.
- Plan to leave an appropriate buffer zone (at least 30 feet on relatively level ground) around bodies of water, and adjacent sensitive areas, and populations of threatened, endangered, or sensitive species. Buffer zones will be marked as needed to guide herbicide applicators.

Herbicide Spraying BMPs

- Ensure meteorological conditions are favorable.
- Highway right-of-ways are closed areas to the pedestrian public, and it is illegal to stop on the highway except in emergency situations.
- Post informational signs at designated pullouts and rest areas and place signs on spray vehicles listing the herbicide being used.
- Use the lowest pressure, largest droplet size, and largest volume of water permitted by the label to obtain adequate treatment success.
- Use the lowest spray boom and release height possible consistent with operator safety.
- Spot applications of triclopyr, glyphosate, imazapic, and imazapyr could be done to the edge of some bodies of water in compliance with label requirements.
- Broadcast applications of glyphosate and other broad spectrum herbicides would not be considered where threatened, endangered, and sensitive plant species are known to occur.

- Buffer zones will be marked around any populations of threatened, endangered, and sensitive (TES) plant species, and undesirable plant control in buffer zones will include spraying with selective herbicides that will not affect the TES plants, or spot applications of individual weeds with backpack sprayers, daubing, or hand grubbing with no herbicide use.
- Require all herbicide applicators to use appropriate personal protective equipment (PPE).
- Only those herbicides labeled for use to the edge of bodies of water or with aquatic labeling shall be used within buffer zones and aquatic situations.

Herbicide Post-Spray BMPs

- Periodically scout treated areas to assess efficacy.
- Monitor populations of threatened, endangered, or sensitive species to ensure there were no adverse effects.

Alternatives Considered but Eliminated from Further Study

Eliminate the Use of 2,4-D: Consideration was given to eliminating the use of this herbicide along roadways within National Forest System lands to allow roadway access for individuals with MCS opposed to its use. This alternative was not considered in detail for several reasons: 2,4-D is one of the most commonly used agricultural and home and garden products in the United States, and anyone driving along a roadway through an agricultural area or a community could experience some level of exposure, albeit a very minimal amount. Second, this product, along with triclopyr and dicamba, is one of the most commonly used herbicides to selectively control weeds in road right-of-ways outside national forests in Arizona. Also, 2,4-D applications are already being done within the boundaries of national forests along roadways under the authority and approval of the Federal Highway Administration. As a result, restricting the use of this herbicide on roadways within national forests could not realistically provide 2,4-D-free access routes for public roadways in the State. However, it should be noted that the Forest Service would coordinate with Public Road Authorities on an annual basis, under the proposed action for this environmental assessment, to provide, to the extent possible, alternate access routes when herbicides would be proposed on and off National Forest System lands. Interested individuals can determine treatment schedules for roadways under ADOT jurisdiction by calling the toll-free number (1-800-546-6591). Finally, environmental analyses for noxious weed control are currently underway on all national forests in Arizona, and 2,4-D is being proposed in every instance. Currently, 2,4-D is one of the most commonly used herbicides for noxious weed control in the West due to its selectivity. In addition, 2,4-D products are registered for aquatic weed control, and this is another important reason for maintaining it as a viable option for control of noxious weeds along rights-of-way when they occur near streams, lakes, or in riparian areas.

Provide No Spray Buffers Around Homes (5-10 mile radius): Since this environmental analysis only addresses the use of herbicides on National Forest System lands, the Forest Service would have little, if any, influence over herbicide applications that could be done on private lands where homes are located. Herbicide spraying of roadways outside national forests, which is outside the scope of this analysis, would be proximal to communities and homes for people with MCS. Additionally, private homeowners often use herbicides. Therefore, the establishment of no spray buffers on National Forest System lands adjacent to private lands would have little effect in preventing potential herbicide exposure of people with MCS. In addition, it also is well known that sites most prone to the spread of noxious weeds are along travel routes for people. The effectiveness of proposed weed management programs on National Forest System lands would be seriously compromised through the use of no spray buffers around communities. For these reasons, this alternative was not considered in detail.

Use Vinegar, Salt, Boiling Water, or Steam to Control Weeds: It would be illegal to use salt, vinegar, or similar compounds to control weeds. Any chemical that is used to effect, retard, or kill a living organism must have a pesticide label, in compliance with the Federal Insecticide, Fungicide, and Rodenticide Act. The use of boiling water or steam was not considered in detail for the following reasons: (1) the possibility of injury to workers applying the boiling water or steam is considered to be too great; (2) there is no credible research to show that this approach would be effective for the various weed species that occur on roadways; and (3) the potential adverse effects on non-target plants is considered to be too great.

Place Used Carpet Along the Sides of Roads to Control Weeds: This alternative was not considered in detail because it would be contrary to Forest Service objectives for visual quality and aesthetics. Also, this approach is not supported by sufficient scientific evidence that it would be effective in controlling target weeds. Further, the use of carpet was considered to be impractical and uneconomical. Importantly, carpet would present a significant safety hazard for drivers using roadways because there would be no practical method to adequately anchor it to the ground and strong winds could blow the carpet onto the roadway creating a safety hazard. In addition, this approach would have unacceptable and adverse effects on native plants.

Use Burning to Control Weeds: The use of fire can be a viable option for control of some weeds, although prescribed burning can favor the development of other weed species. However, the use of fire, manual, mechanical, and other non-herbicidal weed control methods have been approved through another process and these techniques were considered to be beyond the scope of this analysis. It should be noted that ADOT and other Public Road authorities have the approval to use several non-herbicidal techniques, including the use of fire.

Use Goats and Other Livestock to Control Weeds: As previously stated, this analysis only addresses the option to use or not to use herbicides to control weeds and other options would be authorized through other processes. Thus, this alternative is beyond the scope of this analysis. In addition, although the use of goats or sheep can be a viable option in some areas, especially when used in combination with other techniques, the effectiveness of this approach for right-of-way weed control is questionable. It would not be practical to keep goats along the sides of roadways for a long enough period of time to achieve any significant level of control.

Comparison of Alternatives

This section displays the alternatives in tabular form so that they may be compared. Effects of each alternative to a variety of resources are discussed in Chapter 3.

Table 5. Comparison of Alternatives

Measurement Parameters	Alternative 1 – No Action (No Herbicide Use)	Alternative 2 – Proposed Action (Use of Herbicides)
Address the purpose and need?	No. Allows for slowing the spread of noxious weeds through the use of non-	Yes. Allows for the selection of a full range of management options,

Measurement Parameters	Alternative 1 – No Action (No Herbicide Use)	Alternative 2 – Proposed Action (Use of Herbicides)
	herbicidal methods, but infestations would still threaten native plant communities on National Forest System lands. Hazardous vegetation could be removed by manual and mechanical methods, but they would be too costly and jeopardize overall effectiveness of the program. Manual and mechanical treatments could be more hazardous to people doing the work.	including herbicides, to manage noxious weeds using an Integrated Vegetation Management approach. Offers the best protection of native plant communities on national forests and removal of hazardous vegetation to protect public safety.
Consistent with laws and policy for noxious weeds?	No. Not responsive to Farm Bill of 1990, Forest Service Manual 2080, the Forest Service National Strategy (Stemming the Invasive Tide), or Executive Order 13112.	Yes. Allows the Agency to cooperate with the Federal Highway Administration and Arizona Department of Transportation and other Public Road Authorities to effectively manage noxious weeds on public roadways and prevent their spread as required by Federal and State laws.
Consistent with American Association of State Highway and Transportation Officials (AASHTO) standards for highway operation, safety, and maintenance?	Yes. Minimal standards for motorist and public safety could be met, but it would be more costly.	Yes. Allows for meeting standards for motorist and public safety.

Chapter 3 - Affected Environment

Introduction

This chapter summarizes human activities and existing environmental conditions within and adjacent to public roadways that pass through the Apache-Sitgreaves, Coconino, Coronado, Kaibab, Prescott, and Tonto National Forests (NFs) in Arizona as they pertain to the key issues presented in Chapter 1. These issues were developed through the public scoping process and evaluated by the Interdisciplinary Team. Five key issues were identified. Each issue will be addressed later in this chapter. The affected environment for each of the issues is described in association with the actions outlined in this EA. This presentation to the issues will be used in the evaluation of each of the alternatives in Chapter 4.

Arizona's natural environment is characterized by an extreme diversity of climate, soils, vegetation, and wildlife. The northern half of the State is mainly a series of plateaus, and the southern half consists of deserts broken by numerous isolated mountain ranges. Like most arid and semiarid regions, Arizona is a land of great climatic contrasts. In the Sonoran Desert, freezing temperatures seldom, if ever, last longer than 24 hours, and summer temperatures are typically among the highest in the United States with daily highs often exceeding 100º F. Precipitation averages less than 2 to about 12 inches annually in the desert areas, depending on elevation, with well-defined winter and summer rainy seasons. Temperatures are much lower at higher elevations in the northern part of the State, and heavy snow events and below zero temperatures are common in winter. Annual precipitation can approach 60 inches at the higher elevations. The plant covering is extremely varied as would be expected from the great diversity of topography, altitude, soils, and climate. The life zones range from arctic-alpine at the top of the San Francisco Peaks near Flagstaff to lower Sonoran in the low deserts of the southwestern portion of the State. Likewise, there is a great diversity in plant life ranging from tall ponderosa pines and Douglas-fir trees of the high mountains to xerophytic (having various means of protections against loss of water by excessive transpiration) low shrubs and grasses in the desert areas. Human uses of the land are exceedingly diverse, and populations range from sparse over much of the State to highly concentrated in and around the Phoenix and Tucson areas.

A description of the environments through which roadways pass on each national forest in Arizona follows:

Apache-Sitgreaves NFs – Environments along public roadways in the Apache-Sitgreaves National Forests vary from alpine (example: SR 261 in the Big Lake area), ponderosa pine (example: SRs 260 and 60) on the Mogollon Plateau, open grasslands near Springerville (example: US 60), to piñon pine, juniper, and scrub oak (example: US 191).

Coconino NF – Environments along public roadways in the Coconino National Forest vary from ponderosa pine on the Mogollon Plateau (example: I-17, I-40, US 180, SR 87) to piñon pine, juniper and scrub oak (example: I-17, I-40).

Coronado NF – Environments along public roadways in the Coronado National Forest vary from alpine and ponderosa pine (example: SR 366 in the Mt. Graham area) to piñon pine, juniper, scrub oak and Sonoran Desert (example: SR 83, 266 & 289).

Kaibab NF – Environments along public roadways in the Kaibab National Forest vary from alpine and ponderosa pine on the north rim of the Grand Canyon (example: SR 67), ponderosa pine (example: I-40, SR 64), to piñon pine, juniper and scrub oak (example: I-40, US 180, SR 64).

Prescott NF – Environments along public roadways in the Prescott National Forest vary from ponderosa pine (example: SR 89) to piñon pine, juniper and scrub oak (example: SR 89, SR 89A).

Tonto NF – Environments along public roadways in the Tonto National Forest vary from ponderosa pine (example: SR 260), piñon pine, juniper, and scrub oak (example: US 188) to Sonoran Desert (example: SR 88).

The Arizona Department of Transportation, the largest of the Public Road Authorities in Arizona, is responsible for operating and maintaining over 6,000 miles of highways and roads throughout the State. Within the boundaries of national forests, there are about 2,700 miles of ADOT maintained roadways. Roadway widths vary from about 60 feet for lightly traveled 2-lane roads with narrow shoulders to about 1,000 feet for large freeways. Most of the roads are composed of asphalt, but some are composed of gravel or concrete. The system includes travel lanes, ramps, bridges, frontage roads, safety hardware, and other structures. Description of the roadway environment follows:

Roadside Soils: Highway construction is a soil-disturbing process involving excavation, movement, mixing, and compaction of large amounts of soil. Gravel, binder clays, and other materials are usually imported to provide a structural base for the roadbed. Compaction and topographic changes increase surface runoff and surface erosion and reduces infiltration. As a result, roadside soils differ considerably from soils on adjacent NFS lands. While the original soil may still be present, soil profiles may have been obliterated, and soils may have reduced porosity, increased bulk density, and changed texture. In addition, there may be little organic matter, and mychorrizal and other microbe activity in the surface horizon. These changes often reduce the water-holding capacity of the soil and decrease its inherent fertility, limiting the type and amount of vegetation it is able to support.

Roadside Drainage and Water Quality: Runoff rates from impervious highway surfaces and compacted soils along the sides of roadways tend to be high compared to adjacent sites outside of roadway easements with undisturbed natural vegetation. Where concentrated runoff is discharged into unlined ditches or natural drainages, surface flow is promoted and sediment loads tend to increase offsite unless channel protection is installed. Also, toxic substances can be present in highway runoff and, in some instances, can pose a threat to surface water and ground water quality. Besides some heavy metals, like lead and zinc, or organic compounds, like oil and grease, herbicide residues can be associated with highway runoff.

Roadside Vegetation: Roadside vegetation environments have the following conditions in common: (1) initial disturbance produced during construction, and (2) stressful and ongoing disturbance created by topographic reconfiguration and perpetuated by highway use and maintenance (mowing, snowplowing, grading, etc.). Some plant species spread readily to colonize exposed soils following highway construction. These species may exhibit a variety of life forms ranging from tall woody species, like ponderosa pine; shrubs, like desert broom; to annual grasses and herbs. Generally, these invading species have light, windblown seeds and exhibit rapid growth in bare soil and full sunlight. Species able to invade roadsides also include non-native colonizing species that are adapted to natural disturbances such as fire. Plants that tolerate repeated disturbance are annuals that reinvade after each disturbance cycle (e.g. wild oats) and perennials that sprout after cutting or mowing (e.g. mesquite, alligator juniper). Sprouting, tall-growing, perennial species often dominate along portions of roadways away from the stressful edge of the pavement. Some of the more common plants found along roadsides include:

- Common sunflower (*Helianthus annuus*)
- Russian thistle (*Salsola iberica*)
- Desertbroom (*Baccharis sarothroides*)
- Johnsongrass (*Sorghum halepense*)
- Bufflegrass (*Cenchrus ciliaris*)
- Cheesebush (*Hymonoclea salsola*)
- Burrobush (*Hymonoclea monogyra*)
- Paloverde trees (*Cercidium spp.* and *Parkinsonia aculeate*)
- Creosote bush (*Larea tridentata*)
- Juniper (*Juniperus spp.*)
- Ponderosa pine (*Pinus ponderosa*)

Special-Status Plant Species: Four Federally listed threatened or endangered plant species are known to occur or have suitable habitats within the project area. Also, several species of agave, principally *Agave palmeri*, are food plants for the endangered lesser longnose bat (*Leptonycteris curasae yerbabuenae*) and these agaves often occur in public road easements on national forests in Arizona. Twenty-seven Forest Service sensitive plant species are known to occur or have suitable habitats within the project area. None of the threatened or endangered plants and only a few of the sensitive plants are likely to occur within the clear zone maintained on highway shoulders. However, noxious weeds could invade the suitable or occupied habitats of some of these plants, and selective spot treatment with herbicides on individual noxious weeds or groups of weeds might be needed.

Roadside Wildlife: Roadsides provide several distinct environments that may encourage the presence or absence of certain species in relation to surrounding areas. Water collected in drainage facilities is attractive to a wide variety of species. Salt used for ice control is attractive to mammals. Roadside vegetation control favors low-growing forbs and grasses that are attractive to ground-feeding birds, such as horned larks and dark-eyed juncos, and small rodents. Thus, snakes and raptors can be attracted to roadways due to the presence of small rodents. On the other hand, vehicle travel may discourage the presence of certain species, like deer or elk, although ungulates may be attracted to roadside vegetation, which can, at times, offer the best forage available during periods of drought. Collisions of animals with vehicles increase when animals are attracted to the side of roads.

Special Status Animal Species: Twenty Federally listed threatened or endangered animal species have suitable habitat and could occur within the project area. These include 4 mammals, 6 birds, 8 fish, and 2 amphibians. The mammals and birds can be expected to occur in roadways only on an incidental basis while moving or foraging. None are known to exclusively occupy roadway habitats. The fish and amphibians are mostly not in roadways, but occur at distances of 2 miles or less downstream from roadways. There are 37 species of Forest Service sensitive animals that have suitable habitat and could occur within the project area. These include 6 mammals, 6 birds, 9 amphibians or reptiles, and 14 invertebrates. Some of these species, particularly the small mammals and some of the invertebrates, could be residents of roadside habitats.

Road and Right-of-Way Use: The human use of roadside areas on the six national forests in Arizona varies depending largely on the type of highway and the adjacent land uses. Two-lane conventional roadways, even though they may carry relatively light traffic volumes, present many opportunities for highway and roadside contact with herbicides used to control vegetation. Freeways may carry much more traffic, but they are designed to prevent pedestrian and non-motorized access, which would limit human contact. The potential for human contact on roadside areas can be categorized as high, medium, or low. High contact sites are those where road system features or environmental conditions encourage people to have ground or foliage contact, such as at rest areas, vista points, and segments that may contain plants that might be collected for food (berries), fiber (beargrass), or collected by American Indians or others for ceremonial or medicinal purposes. Medium contact areas are those where occasional ground or foliage contact is possible, such as roadway segments with frequent pedestrian bicycle use or attractions like a lake. Low contact areas are those where ground or foliage contact is infrequent, such as through conventional highway use or all controlled-access routes.

Adjacent Land Use: Noxious weeds are often spread by human activities associated with vehicles and roads (Roche and Roche 1991). Left untreated, infestations that start on roadway easements can increase and spread to adjacent Federal, State, and private lands threatening native plant communities. Under the various forest plans, these adjacent lands are designated for multiple uses. When noxious weeds dominate a site, resource values, like forest and rangeland health, and uses, such as recreation, can be adversely impacted. The Arizona Department of Transportation has conducted surveys for noxious weeds along the public roadways and on national forest System lands and the results are displayed in Figure 2, page 10.

Affected Environment

The following is the affected environment as it relates to the action alternative and the key issues identified through scoping.

Issue 1. Effectiveness of the action alternative in controlling noxious weeds, invasive plants, and hazardous vegetation.

The area affected by this EA encompasses approximately 170,100 acres along the 2,700 miles of public roadways that would be managed by ADOT on 6 national forests. Roadway easements vary in width from about 60 feet for 2-lane roads to over 1,000 feet for freeways, and the average width of all public roadways is estimated to be 120 feet. When 200 feet each side of a roadway is added to the average width, the total average width would be 520 feet. Thus, the average area per mile of roadway was computed to be about 63 acres (5,280 feet per mile times 520 feet equals 2,745,600 square feet and dividing this by 43,560 square feet per acre equals slightly over 63 acres per mile of roadway).

ADOT personnel estimate the maximum area that would be considered for treatment of noxious weeds and hazardous vegetation along the roadways on an annual basis would be 5,000 acres. A breakdown by national forest is shown in Table 6.

Table 6. Estimated acres of proposed treatment by herbicides on an annual basis

Forest	Acres Estimated To Be Treated Annually	Total NF Acres
Apache-Sitgreaves	500	2,017,725
Coconino	1,500	1,853,780
Coronado	500	1,717,857
Kaibab	500	1,559,203
Prescott	1,000	1,239,270
Tonto	1,000	2,873,164
Total	5,000	11,260,999

The estimated annual acreage that would be considered for treatment would be about 3 percent of the overall area covered by this EA and it would be 0.0004 percent of the total National Forest Systems lands. Refer to Figure 1 for a map showing Interstate, U.S., and State routes crossing national forest lands

Some of the noxious weeds known to occur along public roadways include: bull thistle, camelthorn, Dalmatian toadflax, diffuse knapweed, musk thistle, Russian knapweed, Scotch thistle, spotted knapweed, and yellow starthistle (refer to Figure 2, page 10). Additional information on noxious weed locations on interstate, U.S., and State routes is kept at ADOT district offices and regional ADOT Natural Resource Section offices.

Table 7. Approximate acreages of noxious weeds on National Forest System lands by ADOT Natural Resource Region.

Noxious Weed	Approximate Acreage by Natural Resource Region			
	Flagstaff	Prescott	Phoenix	Tucson
Bull Thistle	10	0	0	0
Camelthorn	340	5	11	0
Dalmation Toadflax	160	5	85	0
Diffuse Knapweed	120	0	75	0
Halogeton	40	0	0	0

Noxious Weed	Approximate Acreage by Natural Resource Region			
	Flagstaff	Prescott	Phoenix	Tucson
Jointed Goatgrass	10	7	3	0
Mediterranean Sage	0	0.5	0	0
Musk Thistle	30	0	0	0
Russian Knapweed	310	3	0.5	2
Scotch Thistle	150	1	0	0
Spotted Knapweed	4	0	0	0
Yellow Starthistle	10	0.25	10	0

Hazardous vegetation includes trees, shrubs, and grasses, regardless of size, that prevent drivers from maintaining control of their vehicles if they run off the road or from seeing oncoming or stopped vehicles, objects in or near the travelway, and fixed obstacles such as guardrails, signs, and bridge abutments. Hazardous vegetation also relates to the potential for roadside fire starts, physical damage to the roadway such as break-up of road edges, and fixed vegetation (either single or clumped plants) within the recovery zone. As a rule of thumb, woody plants near the roadway over 6 inches in diameter and greater than 4 inches in height are considered to be hazardous.

The effectiveness issue will be evaluated by identifying how well noxious weeds and hazardous vegetation are contained, controlled, or eradicated. The ultimate goal would be to eliminate recent and small infestations of noxious weeds and remove all vegetation that would present a hazard to the motoring public. During scoping, one individual expressed concern that some weed species may develop resistance to the proposed herbicides. The Committee on the Future Role of Pesticides in U.S. Agriculture (2002) indicated that herbicide resistance is still relatively rare. The relative rarity of herbicide resistance is likely due to low persistence of many herbicides relative to the generation time of the weeds, a large reserve of susceptible genotypes in the seed bank, and a few other factors. The most important practice to prevent herbicide resistance is to integrate management methods and rotate among different herbicide modes of action (Sheley and Petroff, 1999).

Issue 2. Effects of the action alternative upon human health (public and worker), including Multiple Chemical Sensitivity (MCS).

The Forest Service has supplemented the chemical registration process with a series of risk assessments. These assessments review available research and information on herbicides and then apply this information to conditions that will likely occur during application. These risk assessments, in concert with registration and pesticide label instructions, form the basis for the analysis of effects on human health. The Forest Service has analyzed the risk of weed control upon human health for 14 of the 16 herbicides being considered for use, and this 1992 risk assessment covers human health effects for the following herbicides: 2,4-D, chlorsulfuron, clopyralid, dicamba, glyphosate, imazapyr, metsulfuron methyl, picloram, sulfometuron methyl, tebuthiuron, and triclopyr. In addition, four carriers are analyzed in this risk assessment. Similarly, more recent risk assessments have been completed for several of the herbicides being considered (Chapter 1, page 13). These documents have been consulted to ensure that the most recent information is reflected in this EA. These risk assessments were completed under Forest Service contracts from 1996 to 2001 and they are included in the project file. The Forest Service has not analyzed the risk to human health for fluroxypyr and pendimethalin; however, risk assessments for these herbicides are available from the U.S. Environmental Protection Agency as part of the registration process (http://www.epa.gov/pesticides/cumulative). Although information is not as complete as for the other compounds, it has been assumed that the effects to human health are similar and within the range of effects identified for the other herbicides being considered. Under the adaptive management strategy, additional herbicides and differing rates of application can be considered as long as the affects are within the range of effects being analyzed. Fluroxypyr and pendimethalin would be applied according to label instructions.

The 1992 risk assessment is comprised of three parts: the exposure analysis, the hazard analysis, and the risk analysis. In the exposure analysis, a range of possible doses to the public and workers is estimated. A variety of scenarios and exposure pathways are examined that could result in dermal and oral doses. In general, the exposure analysis assumes that the more a person is exposed to a particular compound, the higher the dose will be. All herbicide application scenarios would be at or below the routine typical application rates. These estimated rates assume a minimal exposure to workers and an even lower exposure of the general public. In the hazard analysis, tests and data related to the toxicity of the various compounds are reviewed. Data indicate the doses at which toxic effects are seen and, conversely, dose levels at which no toxic effect are observed. To deal in part with incomplete information, a margin of safety, which is 100 times less than the no effect level, is used. The hazard analysis also reviews the data on the possible carcinogenicity of the herbicides. This analysis assumes that any dose of a carcinogen has some probability of causing cancer and that the higher the dose, the greater the probability of cancer. The third part of the risk assessment involves the analysis and characterization of risk. In this section, dose levels calculated in the exposure analysis are compared to determine the non-carcinogenic, systemic, and reproductive effects of herbicides. The risk analysis also indicates the probability of developing cancer based on a projection of the doses received over a lifetime (assumed to be 70 years for humans). Certain baseline criteria are set to evaluate the possible risk to humans. Cancer risk is set at a benchmark value of one in one million, which is commonly accepted by the scientific community as representing a negligible addition to the current U.S. cancer rate. Evaluation of systemic and reproductive health risk is based on the “no observed effect level” (NOEL). In evaluating the potential impact of herbicides to humans, it must be kept in mind the small amount that is typically used. This is normally less than two pounds per acre. Sulfonylurea herbicides are usually applied at 1-3 ounces per acre.

There is a possibility that a small percentage of the population in Arizona will be hypersensitive or allergic to any one or more of the herbicides proposed for use. Since allergenic and hypersensitive reactions can occur with even small amounts of a specific substance, information will be made available to those individuals who want to avoid potential treatment sites by calling a toll free number (1-800-546-6591).

Issue 3. Effects of the action alternative on non-target target vegetation, including threatened, endangered, and sensitive plants.

The plant covering of Arizona is extremely varied due to the great diversity in topography, altitude, soils, and climate. The life zones range from artic-alpine at the summits of two mountains to lower Sonoran desert. Public roadways on the national forests pass through many vegetation types, including evergreen forests, grasslands, chaparral, and deserts.

Four Federally threatened or endangered plant species are known to occur or have suitable habitats within the project area. These species are Arizona agave, Arizona cliffrose, Arizona hedgehog cactus, and Huachuca water umbel. Twenty-seven Forest Service sensitive plant species are known to occur or have suitable habitats within the project area. Various conservation measures will be taken to protect these plants. These measures include annual coordination meetings between Forest Service, Public Road Authority, and ADOT personnel, mitigation measures, and best management practices identified in Chapter 2, page 28. Descriptions of these plants and their habitats are discussed in the biological evaluation and assessment that will be completed at a later date and included as Appendix D.

Controlling hazardous vegetation, invasive plants, and noxious weeds will have associative effects to non-target vegetation. Herbicide drift could have the greatest impact. Non-target vegetation adjacent to weeds may be damaged during herbicide spraying. Where threatened, endangered, or sensitive species are absent, non-target plant mortality will be acceptable as long as damage does not reduce the vegetative condition, i.e. no loss of habitat health.

Failure to control noxious weeds in road right-of-ways provides the greatest risk to native plant communities on adjacent National Forest System lands. Displacement of native grasses and forbs by noxious weeds increase soil displacement and reduce native species diversity. Also, exotic grasses like buffelgrass and red brome greatly increase the risk of wildfire, and such fires can permanently modify native plant communities in desert areas.

Issue 4. Effects of the action alternative on non-target terrestrial and aquatic animals, including threatened, endangered, and sensitive animals

Highways may affect wildlife populations through their impact on habitats and animal movements. Depending on the type of road and characteristics of the surrounding habitat and wildlife community, roads could act as either corridors or barriers to animal movements, enhancing or isolating populations. For example, in forested landscapes, species that favor open habitats use roadways as travel and hunting routes. Other animals typically avoid well traveled roads. Some smaller vertebrates may choose to never cross roads. Highway mortality of animals can be a serious problem, especially during periods of drought.

Roadside vegetation management could influence wildlife populations through its effects on habitat and through direct impacts on wildlife. These effects may be either beneficial or harmful depending on the location, site characteristics, species affected, and the timing, intensity, and frequency of treatment. In some cases, the effect depends on the habitat changes caused by the treatment, rather than the particular method utilized. To the extent that vegetation management supports habitat use and normal movements of desirable native species of wildlife, it would be a beneficial management tool. Where vegetation management reduces the diversity of native vegetation, or promotes the dispersal of opportunistic, invasive plant species, it is undesirable.

The introduction and expansion of exotic weed infestations influences wildlife by displacing forage, modifying habitat structure, such as changing grasslands to a forb-dominated community, and changing species interactions within ecosystems. Native ungulate foraging can be reduced in noxious weed infested grassland habitats, which is often attributed to lower forage production. Bird species composition and small mammal populations have been reduced due to noxious weeds displacing native plant species. Affects to non-target animals are evaluated in Chapter 4 as direct physical and habitat modification impacts.

Herbicide treatments have the potential to impact wildlife either directly through toxicities to animals, or indirectly through manipulation of habitat. Ground-based herbicide applications were not specifically analyzed in the 1992 risk assessment because they have a very low potential to affect wildlife. The likelihood of wildlife receiving a direct spray of herbicide from ground applications or coming in contact with vegetation treated with ground application equipment is significantly lower than the exposure potential from aerial applications. Consequently, the potential risks from ground application will likely be much lower than the risks associated with aerial applications. In addition, for the herbicides proposed for use, there is little chance of bioaccumulation through the consumption of treated vegetation or prey species. The risk from herbicide use to threatened, endangered, sensitive, and management indicator species is no greater than that posed to other animal species. However, the EPA has set a standard twice as stringent as the "no observed effect level" for non-category animals. Habitat manipulations as a result of herbicide applications would benefit some animals and potentially harm others. For example, the elimination of shrubs could lead to a decline, albeit small, of species that depend on shrubs for nesting or cover, but it could cause a small increase in numbers of grass-adapted species. In general, wildlife impacts will depend on the herbicide used, its specific characteristics, and how and when it is applied.

Twenty Federally threatened or endangered animal species have suitable habitat and could occur within the project area. These include four mammals (black-footed ferret, jaguar, lesser long-nosed bat, Mexican gray wolf), six birds (bald eagle, brown pelican, California condor, Mexican spotted owl, southwestern willow flycatcher, Yuma clapper rail), eight fish (Apache trout, Colorado pikeminnow, Gila chub, Gila topminnow, Little Colorado spikedace, loach minnow, razorback sucker, spikedace), and two amphibians (Chiricahua leopard frog, Sonora tiger salamander). There are 37 species of Forest Service sensitive animals that have suitable habitat and could occur within the project area. These include 6 mammals, 6 birds, 9 amphibians or reptiles, and 14 invertebrates. Various conservation measures will be taken to protect these animals. These measures include annual coordination meetings between FS and ADOT personnel, mitigation measures, and best management practices identified in Chapter 2, page 28. Descriptions of these animals and their habitats are discussed in the biological evaluation and assessment to be included in Appendix D.

Although infrequent, aquatic habitats occur immediately next to some roadways that pass through NFS lands. It should be noted that there is usually a significant distance or buffer area with vegetation between most roads and aquatic systems that would intercept sediments and pollutants. The potential impacts of roadside vegetation management on aquatic habitats and organisms would be directly related to the water quality impacts described under Issue 5. Aquatic habitat degradation resulting from increased sediment and nutrients is the most likely adverse effect of a roadside vegetation management, but there is a possibility, albeit small, for overland movement of herbicides. Potential effects to aquatic organisms could include reduced survival and reproduction directly related to habitat degradation or exposure to toxic concentrations of herbicides or other pollutants. In general, however, roadside vegetation control treatments are not known to have caused significant losses of aquatic organisms in adjacent waters (Jones and Stokes 1991). Implementation of mitigations and BMPs (Chapter 2, page 28) would reduce the potential for adverse effects. The analysis of effects will be based on the concentration of herbicide that could be delivered to waters.

Issue 5. Effects of the Action Alternative on Water Quality.

Protecting water quality is one of the primary reasons for maintaining a healthy vegetative cover in the roadside environment. Potential impacts on water quality from roadside vegetation management are primarily related to mechanical, cultural, and herbicide methods, which may cause accelerated soil erosion, transport, and deposition of sediment (including sediments from road surfaces), and to the use of herbicides, which could introduce synthetic chemicals into non-target waters. Accelerated erosion may result from vegetation management where soil disturbance and compaction influence the natural infiltration and runoff process. Adverse effects on streams and lakes resulting from the transport and deposition of eroded sediments include nutrient enrichment, increased turbidity, decreased dissolved oxygen levels (if nutrient concentrations sufficiently stimulate algal blooms), and the accumulation of toxic pollutants. These effects, in turn, may adversely impact fish and aquatic resources.

Herbicide treatment impacts can be summarized as either direct or indirect. Direct impacts would result from the introduction of compounds directly into water from drift, runoff, or leaching. Indirect impacts would result if the vegetative cover were reduced to the degree that erosion increased.

This issue will be evaluated by how and where the herbicides will be applied and the mitigation measures that will be used to reduce potential contamination of water.

Chapter 4 - Environmental Consequences

Introduction

This chapter describes the potential consequences or effects of each of the alternatives presented in Chapter 2 evaluated against the issues described in Chapters 1 and 3. A summary of the effects by issue is provided in Table 12, page 61.

Issue 1. The effectiveness of the different alternatives in controlling noxious weeds and hazardous vegetation.

Alternative 1. No Action (No Herbicide Use)

Implementation of this alternative would be less effective and more expensive than the proposed action of controlling noxious weeds, invasive plants, and hazardous vegetation. Under this alternative, a limited amount of herbicide treatments would occur on sections of interstate and Federal highways within the boundaries of national forests because herbicide use on these highways has already been approved by the FHWA. The primary approach to management of vegetation on the public roadways through national forests, however, would rely on non-herbicidal methods. Thus, this alternative would involve a considerable amount of mechanical and manual labor, requiring a substantial investment in machinery and the development of a large labor force by Public Road Authorities or would require contracting the work.

Mechanical and manual treatment could be very effective for managing small trees, shrubs, and herbaceous vegetation on some sites. However, the operation of equipment on some soils may reduce vegetative cover, allowing a buildup of undesirable invasive plants. Repeated mowing of bunch grasses and forbs can weaken plants and mechanically degrade soil surfaces. Operation of even lightweight mowers can remove vegetative cover and allow invasion of undesirable species. Also, mowing can contribute to increased spread of weeds by spreading seeds and weed parts. Over time, vegetation would develop along normal successional pathways, if left undisturbed. On sites where some topsoil remains or has been replaced following construction, desirable native species could establish rapidly. However, due to the highly disturbed nature of rights-of-ways, cut and fill slopes and bare and compacted soils, most sites may revert to early successional plant communities composed of weedy annual and perennial grass and forb species. On sites where all upper soil horizons have been removed, communities of pioneer species may dominate the disturbed sites for long periods of time.

Some species of shrubs and trees controlled by mechanical methods often resprout from roots and root-crowns, creating higher plant/stem densities than before control. Many desert shrubs and resprouting trees, like mesquite and alligator juniper, respond vigorously after aerial-portions of plants have been removed, producing more and bigger stems, limbs, and suckers. Mechanical vegetation control measures should be applied in a manner that has the greatest adverse effect on the target species, and proper timing of treatment can be critical. Otherwise, removal of regrowth may be required two or more times year after year. Some areas may not be suitable for mechanical equipment due to steepness of the terrain and would require hand treatment.

Vegetation encroachment in pavement cracks cannot be treated mechanically and manual approaches are needed. Manual methods include the use of hand tools and hand operated power tools to cut, clear, or prune vegetation, generally above or at ground level. Hand treatment is tedious and slow and exposes the worker to safety hazards associated with nearby traffic. Pulling or digging out plant root systems for plants, like camelthorn, to prevent resprouting and regrowth, would be extremely difficult and impossible in most instances. Selection of this alternative is expected to result in the replacement of weed-infested pavement every 7-10 years, where the expected life could be 20 years without weeds. Manual methods are usually not a viable option due to the large scale of most projects, such as removing hazardous vegetation around structures along many miles of a highway. Also, manual treatment techniques generally require multiple visits to a site to control regrowth of a single species or to treat different selected species. Forbs and grasses are usually too numerous and extensive to be controlled effectively by manual techniques, except in small roadside areas, such as for a new infestation of a noxious weed.

A No Action (no herbicide) approach to roadside vegetation management would be undesirable. Under this alternative, native and exotic weedy vegetation would become established and dominate recently disturbed areas along roadways. Weed dominance within the clear zone or around roadway structures would require repetitive treatment. It would not be practical to control noxious weeds and invasive plants along the edges of all public roads on national forests using mechanical and manual methods due to limited funding available to Public Road Authorities for maintenance, and also because of the ineffectiveness of non-herbicidal approaches for many deep-rooted or sprouting species. As a result, infestations would become established and existing infestations would expand and move on to adjacent National Forest System lands threatening resource values and uses. Cooperative weed-fighting efforts would be hampered by the lack of effective treatment of noxious weeds along public roadways, and Federal laws and State regulations would be violated with selection of this alternative.

Overall, noxious weeds would not be effectively managed by this alternative, and the cost for treatment of hazardous vegetation would be many times higher than for the proposed action (Table 4, page 27). Current infestations of noxious weeds already present within public roadway easements on National Forest System lands would increase in size and density and spread to new locations through the transport of seed and plant parts through typical vectors of spread (vehicles, animals, wind, and/or water). These infestations would continue to spread on to the national forests in Arizona and adverse impacts to native plant communities would become increasingly apparent. In general, the cover and diversity of native species would be reduced, and the exotic species would form homogenous, monoculture-like conditions with reduced structural diversity (Belcher and Key 1989). Key forage species would be reduced in rangelands on national forests (Losensky 1987). Also, the vegetation changes produced by these invasive species would alter fire regimes at infested sites (Toney 1996). A greater quantity and continuity of fine fuels would be produced by stands of exotic plants, particularly grass species like red brome. This increase in fuels could lead to an increased frequency of damaging wildfires and adversely impact native perennials. It is impossible to accurately predict the rate of spread of the various noxious weeds on roadways and adjoining national forests, but it has been estimated that the total area infested in the West is expanding by 8-12 percent annually (USDA 1998).

The cumulative effects of this alternative would be adverse because infestations of invasive species would continue to spread and increase in density and native plant communities would be progressively replaced. Over time, resource values and uses on national forests in Arizona would be progressively degraded.

Alternative 2. Proposed Action (Use of Herbicides)

This alternative provides the most effective means of controlling hazardous vegetation, invasive plants, and noxious weeds in the most economical and environmentally compatible way. This alternative is a comprehensive, proactive approach to vegetation control and weed management, and the focus is on long-term management and control. All options are available for vegetation management, including the use of herbicides, used singly or in combination with other techniques, under an Integrated Vegetation Management concept. A fully integrated approach to invasive plant management represents the most efficient and cost effective control available (Bechinski, et al., 1991, and Everett, 1994). Consequently, this project would provide the greatest long-term protection to the integrity of native plant communities on national forests and nearby lands of mixed ownership. Rangeland condition and native plant communities would receive the most protection and the frequency and severity of wildfires would be reduced.

Followup treatments would be required at infested sites since the application of herbicides being considered for use or a combination of herbicides and manual/mechanical methods usually would not eliminate target species in one effort. Some spot treatments of hazardous vegetation and invasive plants can be close to 100 percent effective; but control effectiveness of most noxious weed species would be in the 70-90 percent range. Also, most noxious weeds have seeds that remain viable in the soil for many years, and repeated treatments would be needed to remove plants that germinate from seeds.

The effectiveness of vegetation management would be influenced by many factors: funding levels, success of annual treatments, success of finding and mapping new infestations, weather conditions, the degree of success of developing cooperative weed control across multiple ownerships, and other aspects. Cooperative working agreements with adjacent landowners are critical to the success of noxious weed management programs. Lands with unmanaged infestations become sources of seed dispersal. As infestations increase on unmanaged lands, the influx of weed seeds from neighboring areas can become overwhelming, including infestations on National Forest System lands. To address this problem along public roadways, this proposal includes a strip on National Forest System lands up to 200 feet on both sides of public roadways beyond the easement boundary. Public Roadway Authorities could be allowed to treat noxious weed and invasive plant infestations in this area when they extend from the right-of-way onto National Forest System lands. The Forest Service will authorize annual treatment programs based on a memorandum of understanding and an annual operating plan (Appendix C, page 97). Also, Forest Service crews or contractors could treat infestations within roadway easements to maintain the integrity of projects to manage noxious weeds. Such Forest Service programs would be authorized under another environmental analysis and decision.

The cumulative effects of this alternative would most likely be beneficial since noxious weed and invasive plant infestations would be reduced. Also, this would prevent the spread and expansion of noxious weed infestations. Thus, the condition of native plant communities would be improved in currently infested sites and the spread of new infestations would be prevented and roadway safety could be enhanced. Also, this alternative would provide the most effective, economical, and environmentally compatible approach for the management of hazardous vegetation. People who gather native plants for traditional purposes could benefit as well.

Issue 2. Effects of the alternative upon human health (public and workers), including multiple chemical sensitivity.

Alternative 1. No Action (No Herbicide Use)

Since there would be no herbicide use on roadways under the authority of the Forest Service, neither the public nor workers would be at risk from herbicides on these routes. However, herbicides would continue to be used within the boundaries of national forests on sections of interstate and major state highways under the approval authority of the FHWA and outside of

National Forest System lands on ADOT managed roads. Thus, the potential for exposure of individuals with MCS might be reduced but not eliminated. However, there would not be a coordinated approach between the three agencies for spray-free alternative routes.

There could be increased human health consequences to taking a no action approach. The potential for public injury would come from accidents related to the need to increase the number of road maintenance crews and equipment traveling to work sites to do manual or mechanical treatments. These problems could make this alternative a greater threat to human health than the use of herbicides.

The risks to workers would be somewhat higher for this alternative than for the preferred alternative. In addition to the risks from traveling and transportation of equipment to work sites, workers involved in hand pulling or grubbing of plants would be at an increased risk of physical injury while digging, although this risk can be mitigated through the use of safety procedures and safety equipment. Minor skin irritation may result from contact with thorny plants or those that contain toxic substances in their sap, such as leafy spurge.

Alternative 2. Proposed Action (Use of Herbicides)

Based on the summary of information in Appendix A (page 73), no toxic effects to public health are expected from the sixteen herbicides being considered for use. Routes and duration of exposure are important factors determining effect of toxins to human health. Exposure to the public would mainly come from skin contact with sprayed vegetation and, to a lesser extent, from consumption of sprayed vegetation and sprayed water. The chances of these exposures are low since individuals using roadways do not stop where spraying operations are being done. However, if an individual did enter a spray area, the skin is a protective barrier that slows movement of a material into the body, and studies show that about 10 percent or less of a chemical applied to skin is absorbed (Felsot 2001). Importantly, herbicide labeling requires low application rates for rights-of-way. In addition, the target for spraying is the hazardous vegetation, invasive plants, and noxious weeds and not native vegetation. Also, spraying will take place no more than twice in any one site in a season. Thus, potential exposure levels to the general public — those who might have dermal contact with a dilute concentration of a small quantity of herbicide — would be well below a threshold of concern. Exposure levels of workers could be of concern in extreme scenarios without protective clothing and equipment. Therefore, it is important for workers to mitigate this concern through the proper use of protective clothing and personal protective equipment and through careful handling of herbicide concentrates.

With respect to the herbicides identified for potential use, none pose a risk to public health for systemic or reproductive effects. None of the herbicides were found to pose greater than 1 in 1 million cancer risk. The various risk assessments indicate all of the herbicides analyzed show little tendency for bioaccumulation and the small amounts that could be absorbed through the skin are readily and completely eliminated from the body (Felsot 2001).

The risk to workers is low for all herbicides being considered, other than 2,4-D and dicamba, but this risk would be mitigated by limiting exposure as identified in Chapter 2, page 27 (1992 Risk Assessment, Table III-E-4, page E-III-8, 1992 Risk Assessment). In any 24-hour period, workers using backpacks will not be allowed to apply more than 0.9 pounds of 2,4-D or 2.3 pounds of dicamba (1992 Risk Assessment, Table III-E-21, page III-E-45).

As a general rule, the inert ingredients in the herbicide formulations proposed for use are less acutely toxic than the active ingredients (1992 Risk Assessment, Table III-F-1, page III-F-2-3). Diesel oil, kerosene, and mineral oil are considered to be in the EPA Toxicity Category of “very slightly toxic,” and limonene is considered “slightly toxic.” In addition, exposure to any one inert ingredient is significantly lowered due to the large amount of dilution for spray mixes. For example, one pint of Tordon 22K containing 75.6 percent inert ingredients is mixed with 35 gallons of water for every acre sprayed during ground applications. Thus, the concentration of the inert ingredients would be diluted with water approximately 370 fold prior to spraying, and the Tordon would constitute about 0.09 percent of the total volume of spray. After spraying, the inert ingredients will dry on plant surfaces or deposit in the soil, where they would be subject to plant and microbial metabolism just like the active ingredient.

People who have hypersensitive or allergic reactions to herbicides are generally aware of their sensitivities and will be provided a toll free number (1-800-546-6591) to find out the location and timing of herbicide applications taking place on roads under ADOT jurisdiction to allow them to seek alternative routes to obtain needed services. An advantage of the cooperative effort between the Forest Service and Public Road Authorities is that treatments will be coordinated and sections of roadways will be treated at one time instead of random treatments.

With respect to cumulative effects, the probability of Forest Service applicators or the general public being exposed simultaneously to herbicide applications done along roadways within National Forest System lands or other projects on adjacent State and private lands, in addition to that done on national forest, appears to be very remote. Once the spray mixture dries on plants or moves into plant tissues, the risk of exposure is very small. Likewise, the risk of exposure to herbicides applied in the previous year is even less likely. Most of the herbicides being considered for use do not persist for very long in the environment, since they are degraded by sunlight and soil microbes. Some compounds only remain in the soil for a few days while others may be present for a few months. Exposure from the various programs done in the past, and the possible exposure from proposed operations, would not likely approach the acceptable daily intake (ADI) for any of the proposed herbicides.

Table 8. Acceptable daily intake (ADI) mg/kg/day; reference dose RfD

Herbicide	ADI/RfD
2,4-D	0.1
Chlorsulfuron	0.05
Clopyralid	0.5
Dicamba	3.0
Fluroxypyr	0.5
Glyphosate	0.1
Imazapic	0.5
Imazapyr	2.5

Herbicide	ADI/RfD
Isoxaben	0.05
Metsulfuron methyl	0.3
Pendimethalin	0.1
Picloram	0.07
Sethoxydim	0.2
Sulfometuron methyl	0.02
Tebuthiuron	0.07
Triclopyr	0.05

Issue 3. Effects of the alternative on non-target vegetation, including threatened, endangered, and sensitive plants.

Alternative 1. No Action (No Herbicide Use)

Manual methods are highly selective and would have little unintended effects on non-target vegetation, especially if the locations are known for threatened, endangered, and sensitive plants.

Mechanical methods such as mowing, grading, and disking are much less selective and effects to non-target plants would occur, although adverse effects could be mitigated by restricting the use of mechanical methods at known locations of the sensitive plants. Nevertheless, the expanded use of mechanical methods for this alternative would have a greater potential effect to non-target vegetation than through the use of selective herbicides under the preferred alternative. Grading and disking would involve repeated disturbance of the soil surface, providing a favorable substrate for seed of undesirable species, including noxious weeds. The equipment can transport seeds and other plant parts capable of establishment on the disturbed soil surfaces. Undesirable vegetation is expected to continue to flourish in the right-of-way and be available for spread to adjacent areas when soils are disturbed. Mowing can be an effective means of controlling hazardous vegetation where accessible. Mower height can be adjusted to minimize disruption of plant roots and the soil surface to encourage successful competition by preferred ground cover species. However, some noxious weed species, like yellow starthistle, are adaptive to mowing regimes and will overcome the adverse pressure of mowing by altering their growth form to flower and set seed below the level of a mower deck (Callihan, et al. 1995 and Lass, et al. 1999). This adaptive nature effectively minimizes the positive results achieved by mowing. If noxious weeds are present in an area treated mechanically, equipment would need to be cleaned of plant materials before moving to uninfested areas. Adverse effects to threatened, endangered, and sensitive plants would be eliminated by using the same coordination, mitigations, and best management practices that are planned for the preferred alternative.

Cumulative effects would be the same as those described under the No Action alternative for Issue 1, page 43. Over the long term, noxious weeds would not be controlled through the exclusive use of manual and mechanical methods, and this would pose a greater threat to native plant populations, including threatened, endangered, and sensitive species.

Alternative 2. Proposed Action (Use of Herbicides)

The use of herbicides can greatly impact non-target plant populations if the herbicide being used would kill the species of concern in occupied habitat. Although several of the herbicides being considered for use are selective, which means that they can kill the species of concern while causing little or no effect to non-target plants, many of the target plants and threatened, endangered, and sensitive plants are dicotyledons. Therefore, a selective method of application that would keep the herbicide off species of concern would be required. Broadcast applications of glyphosate, a broad-spectrum herbicide, would not be used where sensitive plants are known to occur. The impacts of treatment with selective herbicides would vary depending on how closely the target and non-target plant species are related and the rate of application.

Annual plants are generally more sensitive to herbicides, and they would be affected to a greater degree than perennial plants, especially if they are treated before seed production. Annual and perennial weed species growing at a site for more than a few years often have large seed reserves in the upper soil horizons. Infested sites could require repeated treatment until the majority of the seeds have germinated and the plants killed. Repeated applications of broad-leaf selective herbicides could lead to grass-dominated roadsides

Whether herbicidal or mechanical means are being considered, the locations of threatened, endangered, and sensitive plant populations will be identified prior to planned treatments of hazardous vegetation, invasive plants, and noxious weeds. To protect populations of sensitive plant populations that are known to occur within easements and the 200-foot buffer areas outside of easements, broadcast applications of herbicides will only be authorized by the Forest Service if a selective herbicide is applied that will not harm the plants of concern. In the event that harm could occur from broadcast applications of the herbicides being considered, spraying will be limited to individual target plant applications, such as with backpack sprayers, or by truck-mounted hand wands.

There are four species of endangered plants and 27 species of sensitive plants that either occur or have suitable habitats within the project area (Table 9). Most roadways have had no thorough plant surveys. The coordination, mitigation, and best management practices described elsewhere in this document would ensure the conservation of TES plant populations. Annual coordination meetings between USDA-FS and ADOT personnel will be held before the growing season to identify areas to be treated with herbicides. Most treatments will be for maintenance of the highway clear zone rather than noxious weed control. Treatment of clear zone will be in highly modified areas directly adjacent to the road surface. These areas are not suitable habitat for most TES plants. When known populations or suitable habitats of TES plants are identified as being in a proposed treatment area, surveys will be done prior to herbicide applications. Buffer zones will be marked around any populations that are found. Treatments to eliminate hazardous vegetation, invasive plants, and noxious weeds within buffer zones could include spraying with selective herbicides that would kill target plants, but not harm the TES plants. Spot treatments with backpack sprayers or with daubing, or hand grubbing with no herbicide use would be the method of treatment.

Post spray monitoring will be done to ensure that the protective measures were effective and to determine the effectiveness of the treatments on the target species. With these protective measures in place, the proposed action will not adversely affect any of the four threatened or endangered plants in the project area. These same measures will ensure that none of the Forest Service sensitive plants will be reduced in population viability or harmed in a way that would increase their likelihood of trending toward Federal listing. These determinations are discussed in more detail in the biological assessment and evaluation, Appendix D.

Table 9. Threatened, endangered, or sensitive plants along Federal and State highways passing through National Forest System lands in Arizona.

Common Name	Scientific Name	Status	National Forest
Arizona agave	***Agave arizonica***	Endangered	Tonto
Arizona cliffrose	***Purshia subintegra***	Endangered	Coconino
Arizona hedgehog cactus	***Echinocereus triglochidiatus var. arizonicus***	Endangered	Tonto
Huachuca water umbel	***Lilaeopsis schaffneriana* ssp. *recurva***	Endangered	Coronado
Arizona alumroot	***Heuchera glomerulata***	Sensitive	Apache-Sitgreaves
Arizona sneezeweed	***Helenium arizonicum***	Sensitive	Coconino, Apache-Sitgreaves
Arizona willow	***Saliz arizonica***	Sensitive	Apache-Sitgreaves
Beardless cinchweed	*Pectis imberbis*	Sensitive	Coronado
Blumer's dock	***Rumex orthoneurus***	Sensitive	Apache-Sitgreaves, Tonto
Chiricahua mountain brookweed	***Samolus vagans***	Sensitive	Coronado
Fish Creek rock daisy	***Perityle saxicola***	Sensitive	Tonto
Flagstaff beardtongue	***Penstemon nudiflorus***	Sensitive	Tonto
Gila groundsel	***Senecio quaerens***	Sensitive	Apache Sitgreaves
Goodding's onion	***Allium gooddingii***	Sensitive	Apache-Sitgreaves
Haulapai milkwort	***Polygala rusbyi***	Sensitive	Coconino, Prescott
Heartleaf wild buckwheat	***Eriogonum ericifolium* var. *ericifolium***	Sensitive	Coconino, Prescott

Common Name	Scientific Name	Status	National Forest
Hohokam agave	***Agave murpheyi***	Sensitive	Tonto
Kaibab bladderpod	***Lesquerella kaibabensis***	Sensitive	Kaibab
Kaibab paintbrush	***Castilleja kaibabensis***	Sensitive	Kaibab
Kaibab pincushion cactus	***Pediocactus paradinei***	Sensitive	Kaibab
Mearns sage	*Salvia dorrii* ssp. *mearnsii*	Sensitive	Coconino, Prescott
Mogollon paintbrush	***Castilleja mogollonica***	Sensitive	Apache-Sitgreaves
Mt. Dellenbaugh sandwort	***Arenaria aberrans***	Sensitive	Kaibab
Ripley wild buckwheat	***Eriogonum ripleyi***	Sensitive	Coconino, Prescott
Rock fleabane	***Erigeron saxatilis***	Sensitive	Coconino
Rusbyi's milkvetch	***Astragalus rusbyi***	Sensitive	Coconino
Sunset Crater beardtongue	***Penstemon clutei***	Sensitive	Coconino
Supine bean	***Macroptilum supinum***	Sensitive	Coronado
Tonto Basin agave	***Agave delamateri***	Sensitive	Coconino, Tonto
Tusayan rabbitbrush	***Chrysothamnus molestus***	Sensitive	Kaibab
White Mountain clover	***Trifolium longipes* ssp. *neurophyllum***	Sensitive	Apache-Sitgreaves

In general, the proposed alternative would provide the best long-term management of target plants utilizing herbicidal and other methods, under an Integrated Vegetation Management approach, and the combined use of all methods would provide the best protection for populations of sensitive plant species. The uncontrolled spread of noxious and invasive plant species poses the greatest threat to threatened, endangered, sensitive and native plant communities.

Issue 4. Effects of the alternative on non-target terrestrial and aquatic animals, including threatened, endangered, and sensitive animals.

Alternative 1. No Action (No Herbicide Use)

Under this alternative, intensive vegetation management in the roadside environment by maximizing the use of mechanical and manual methods would have some adverse impacts on wildlife, wildlife habitat, and adjacent aquatic sites. More frequent disturbance to soils and vegetation would prevent native plant communities from remaining or becoming established. Mowing of roadside vegetation would reduce cover for nesting and hiding and food availability for many small birds and mammals. Mowing during the breeding season could damage habitat, destroy nestlings, and reduce productivity of ground-nesting birds. Conversely, mowing may stimulate the production of palatable grasses and forbs, thus providing food for various wildlife species and attracting large ungulates. This attraction could cause an increase in vehicle/animal collisions. The use of mechanical equipment could result in increased soil compaction and accelerated erosion which, in turn, could inhibit the growth of new vegetation, damage the habitat for burrowing animals, open sites to invasive plants, and damage adjacent aquatic environments due to increased sedimentation. Over time, selection of this alternative would increase sediment delivery to aquatic habitats, alter aquatic ecosystems, and negatively affect aquatic organisms. On the other hand, there would be little or no herbicide residues that could move into aquatic habitats by selection of this alternative. Any direct adverse effects to threatened, endangered, and sensitive animals would be eliminated by using the same coordination, mitigations, and best management practices that are planned for the preferred alternative.

The direct, indirect, and cumulative effects for this alternative would be greater than for the proposed action. The greatest threat to terrestrial wildlife and aquatic species over the long term would come from habitat loss and erosion related to the continued expansion of noxious weed and invasive plant infestations. Monocultures of these species would develop along roadways and move onto National Forest System lands. Palatable forage for game and non-game wildlife species would progressively decrease. Ground cover, grass production, seed producing food sources, and the prey base would continue to decline. The continued expansion of noxious weed infestation would lead to a reduction in populations of deer and non-game animals. For example, in Colorado, the invasion of Russian knapweed resulted in a large reduction in the availability of winter range for wildlife (Goold 1994). It was estimated that there would be a loss of 220 elk annually in Montana due to noxious weed invasions of big game winter ranges (Westbrooks 1998). In Arizona, extensive stands of Lehmann lovegrass (Eragrostis lehmanniana) had fewer quail, small mammals, and seed-harvester ants (Westbrooks 1998).

Alternative 2. Proposed Action (Use of Herbicides)

Impacts of herbicidal vegetation control to terrestrial and aquatic organisms include direct toxicological effects and indirect effects from habitat alternation. The toxicological impacts to terrestrial and aquatic organisms are discussed in Appendix A, pages 75 to 81.

Risk assessments prepared by the Forest Service reviewed the toxicity levels of 14 of the 16 herbicides being considered for use. Comparisons of the expected environmental concentrations with the toxic levels of these 14 herbicides indicate that adverse effects on birds, rodents, and grazing animals are not expected. Levels to which the organisms would be exposed would be hundreds to thousands of times lower than the levels that would cause toxic effects. Forest Service risk assessments are not available for fluroxypyr and pendimethalin, but the toxicological properties and application rates for fluroxypyr, imazapic, isoxaben, and pendimethalin are similar and the range of effects are expected to be similar. All of the herbicides being considered are quickly excreted by exposed animals and do not accumulate in body tissues or organs. Thus, secondary effects on predators, such as coyotes or raptors, are not reasonably expected.

The direct and indirect impacts to animals, including insects, from herbicide applications are expected to be negligible. Since these herbicides do not bioaccumulate and they are degraded in the environment, the cumulative effects of the proposed use of herbicides would be insignificant. In addition, the proposed herbicides kill weeds by a mode of action that is unique to plants, and the toxic effects to animals, especially for dilute solutions, is relatively low or negligible.

There are 17 species of threatened or endangered animals and one proposed endangered animal that occur, have designated or proposed critical habitat, or have suitable habitats within the project area (Table 10). For aquatic animals, this includes habitats that are within 2 miles downstream from roadways. Threatened or endangered mammals and birds occur adjacent to roadways only on an incidental basis while moving or foraging. None are known to exclusively occupy roadway habitats. Threatened or endangered fish and amphibians are mostly not in roadways, but occur at distances of 2 miles or less downstream from roadways. Herbicides are unlikely to be applied directly to any of these species and because of the timing and frequency of applications any contact with herbicides, such as from rubbing against vegetation, would occur very infrequently. Because the herbicides proposed for use have low toxicity to animals and any contact with herbicides will be very infrequent, if at all, the application of herbicides is not likely to adversely affect any threatened, endangered, or proposed animals.

Table 10. . Threatened, endangered, proposed, candidate, or sensitive animals along Federal and State highways passing through National Forest System lands in Arizona.

Common Name	Scientific Name	Status	National Forest
Mammals			
Black-footed ferret	*Mustela nigripes*	Endangered	Coconino
Jaguar	*Panthera onca*	Endangered	Apache-Sitgreaves
Lesser long-nosed bat	*Leptonycteris curasae yerbabuenae*	Endangered	Coronado
Mexican gray wolf	*Canis lupus baileyi*	Experimental Nonessential Population	Apache-Sitgreaves
Navajo Mexican vole	*Microtus mexicanus Navaho*	Sensitive	Coconino
New Mexican meadow jumping mouse	*Zapus hudsonius luteus*	Sensitive	Apache-Sitgreaves
Silky pocket mouse	*Perognathus flavus goodpasteri*	Sensitive	Apache-Sitgreaves
Southwestern river otter	*Lutra Canadensis Sonora*	Sensitive	Coconino
White Mountains ground squirrel	*Spermophilus tridecemlineatus*	Sensitive	Apache-Sitgreaves
Wupatki Arizona pocket mouse	*Perognathus amplus cineris*	Sensitive	Coconino

Common Name	Scientific Name	Status	National Forest
pocket mouse	*cineris*		
Birds			
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Apache-Sitgreaves, Coconino, Kaibab, Tonto
Brown pelican	*Pelecanus occidentalis*	Endangered	Apache-Sitgreaves
California condor	*Gymnogyps californianus*	Experimental Nonessential population	Kaibab
Mexican spotted owl	*Strix occidentalis lucida*	Threatened	Apache-Sitgreaves, Coconino Kaibab, Tonto
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Apache-Sitgreaves, Coconino
Yuma clapper rail	*Rallus longirostris yumanensis*	Endangered	Coconino
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	Candidate	Coconino
Bell's vireo	*Vireo bellii*	Sensitive	Coconino
Common blackhawk	*Buteogallus anthracinus*	Sensitive	Coconino, Tonto
Eared trogan	*Euptilotis neoxenus*	Sensitive	Tonto
Northern goshawk	*Accipiter gentilis*	Sensitive	Apache-Sitgreaves, Coconino, Kaibab
Northern peregrine falcon	*Falco perefrinus anatum*	Sensitive	Tonto
Fish			
Apache trout	*Oncorhynchus apache*	Threatened	Apache-Sitgreaves
Colorado pikeminnow	*Ptychocheilus lucius*	Endangered	Coconino
Gila topminnow	*Poeciliposis occidentalis occidentalis*	Endangered	Coronado, Tonto
Little Colorado spinedace	*Lepidomeda vittata*	Threatened, Critical	Apache-Sitgreaves, Coconino

Common Name	Scientific Name	Status	National Forest
spinedace		Habitat	Coconino
Loach minnow	*Tiaroga cobitis*	Threatened	Coconino, Tonto
Razorback sucker	*Xyrauchen texanus*	Endangered	Coconino, Tonto
Spikedace	*Meda fulgida*	Threatened	Coconino, Tonto
Gila chub	*Gila intermedia*	Proposed Endangered, Proposed Critical Habitat	Coronado
Little Colorado sucker	*Catostomus sp3*	Sensitive	Coconino
Roundtail chub	*Gila robusta*	Sensitive	Coconino, Tonto
Reptiles/Amphibians			
Chiricahua leopard frog	*Rana chiricahuensis*	Threatened	Apache-Sitgreaves, Coconino, Coronado
Sonora tiger salamander	*Ambystoma tigrinum stebbinsi*	Endangered	Coronado
Arizona night lizard	*Xantusia vigilis arizonae*	Sensitive	Coconino
Arizona ridgenose rattlesnake	*Crotalus willardi willardi*	Sensitive	Coronado
Arizona southwestern toad	*Bufo microscaphus microscaphus*	Sensitive	Apache-Sitgreaves, Coconino
Lowland leopard frog	*Rana yavapaiensis*	Sensitive	Coconino, Tonto
Mexican garter snake	*Thamnophis eques megalops*	Sensitive	Coconino, Coronado
Narrowheaded garter snake	*Thamnophis rufipunctatus*	Sensitive	Apache-Sitgreaves, Coconino
Northern leopard frog	*Rana pipiens*	Sensitive	Apache-Sitgreaves, Coconino
Ramsey Canyon leopard frog	*Rana subaquavocalis*	Sensitive	Coronado
Sonoran desert tortoise	Gopherus agassizii	Sensitive	Tonto

Common Name	Scientific Name	Status	National Forest
Invertebrates			
A tiger beetle	*Cicindela hirticollis corpuscular*	Sensitive	Coconino
Blue-black silverspot butterfly	*Speyeria nokomis nokomis*	Sensitive	Coconino
California floater	Anodonta californiensis	Sensitive	Coconino
Constock's hairstreak	*Callophrys comstocki*	Sensitive	Coconino
Early elfin	*Incisalia fotis*	Sensitive	Coconino
Freeman's agave borer	*Agathymus baueri freemani*	Sensitive	Coconino
Giant aryxna skipper	*Agathymus aryxna*	Sensitive	Coconino
Huachuca springsnail	*Pyrgulopsis thompsii*	Sensitive	Coronado
Maricopa tiger beetle	*Cicindela oregona Maricopa*	Sensitive	Coconino
Mountain silverspot butterfly	*Speyeria nokomis nitocris*	Sensitive	Coconino
Neumogen's giant skipper	*Agathymus neumoegeni*	Sensitive	Coconino
Obsolete viceroy butterfly	*Limenitis archippus obsolete*	Sensitive	Coconino
Spotted skipperling	*Piruna polingii*	Sensitive	Coconino
White Mountains water penny beetle	*Psephenus montanus*	Sensitive	Apache-Sitgreaves

The use of herbicides may affect the habitat of some threatened, endangered, or proposed animals, but any changes would be minor and for the most part beneficial. Most herbicide treatments will be for hazardous vegetation management in highly modified areas directly adjacent to the road surface. These areas are not suitable habitat for threatened or endangered animals and pose a threat to them from vehicle collisions when the animals approach roadsides to scavenge or move across the roadway. The removal of hazardous vegetation will make mammals or birds along roadsides more visible to motorists and, therefore, less likely to be struck by vehicles. The removal of noxious weeds and invasive plants will benefit the habitat and the areas of designated or proposed critical habitat for threatened, endangered, or proposed animals. As discussed elsewhere, the invasion of noxious weeds into native habitats has the potential to seriously degrade them and make them unsuitable for native wildlife, including threatened, endangered, and proposed animals.

The coordination, mitigation, and best management practices described elsewhere in this document would further ensure the conservation of threatened, endangered, and proposed animals. Annual coordination meetings between Forest Service and ADOT personnel will be held before the growing season to identify areas to be treated with herbicides. When known populations, suitable habitats, or designated or proposed critical habitats of threatened, endangered, or proposed animals occur in a proposed treatment area, surveys will be done, as needed, prior to herbicide applications. Buffer zones will be marked. Treatments to eliminate noxious weeds and invasive plants within buffer zones could include spraying with selective herbicides that would kill the target plants but not harm important native plants, spot treatment of the target plants with backpack sprayers or truck mounted hand wands, or hand grubbing with no herbicide use. Post spray monitoring will be done to ensure that the protective measures were effective and to determine the effectiveness of the treatments in eliminating target plants. With these protective measures in place, the proposed action will not adversely affect any of the 17 species of threatened or endangered animals or areas of designated critical habitat and the one proposed endangered animal and its proposed critical habitat. These determinations are discussed in more detail in the biological assessment and evaluation, Appendix D.

There are 36 species of Forest Service sensitive animals that occur or have suitable habitats within the project area (Table 10). For aquatic species, this includes habitats that are within 2 miles downstream from roadways. As with the threatened and endangered animals, most of the sensitive animals are not permanent residents of roadway habitats and the affects on them will be the same as for the threatened and endangered animals. There are, however, several sensitive species (small mammals and some invertebrates) that may be permanent residents of roadway habitats. The conservation of these species will be through the coordination, mitigation, and best management practices already described. Overall impacts to these and other sensitive species will be minimal because only a small part of their suitable habitat is along roadways. Treatments in these habitats will be limited to areas with noxious weed infestations. With these protective measures in place, no Forest Service sensitive animals will be reduced in population viability or harmed in a way that would increase the likelihood of trending toward Federal listing. These determinations will be discussed in more detail and included in the biological assessment and evaluation, Appendix D.

To prevent certain herbicides from entering water, several mitigations and Best Management Practices (Chapter 2, page 27) would be implemented under this alternative to limit potential adverse effects. These measures include establishing a buffer area next to bodies of water for broadcast applications of herbicide products that do not have aquatic labels. Glyphosate, 2,4-D, triclopyr formulations are labeled for aquatic use and would be the herbicides used next to bodies of water. Spot applications of material like triclopyr, glyphosate, imazapic, and imazapyr could occur to the edge of some bodies of water in compliance with label requirements. Through the use of these resource protection measures and following herbicide label restrictions, the potential for adverse effects to aquatic organisms and habitats would be negligible. For all of the herbicides being considered, it does not appear that an observed level of effect would occur, including threatened, endangered, and sensitive animals.

Directly, indirectly, and cumulatively, this alternative provides the greatest protection for terrestrial and aquatic animals, including threatened, endangered, and sensitive animals, through the most aggressive approach for control of noxious and invasive weeds and protection of native plant communities.

Issue 5. Effects of the alternative on water quality

Alternative 1. No Action (No Herbicide Use)

The potential impact to water quality for this alternative would be related to the increased use of mechanical and manual methods to treat vegetation. Impacts would include increased runoff, soil erosion, and sedimentation. Frequent use of heavy equipment for mechanical management of vegetation could result in significant soil disturbance or compaction. Mechanical vegetation management activities that remove extensive areas of vegetation would reduce the capacity for filtration and the removal of pollutants. Mowing, cutting, and trimming of vegetation may temporarily reduce the ability of vegetation to protect soil surfaces from erosion and to filter pollutants from water produced during storms. Adverse effects on water quality would result from the transport and deposition of eroded sediments that would include nutrient enrichment, increased turbidity, decreased oxygen levels (if nutrient concentration sufficiently stimulate algal blooms), and the accumulation of toxic pollutants (oil products, heavy metals, etc.) from vehicle use on roadways. On the other hand, careful mechanical treatments like mowing, in some areas, could improve the vegetative cover along roadways and these areas would help to intercept sediments and contaminants. However, in other areas of the State, particularly Prescott and Kingman, repeated mowing pressure on native grasses reduces their vigor and leads to an increase in brush and annual weed species, which do not bind the soil and cause an increase in soil erosion. It is important to remember that cultural practices, such as seeding, would be used where practicable to reclaim areas that have an erosion problem. However, the potential adverse effects related to reliance on mechanical and manual methods would be expected to be greater than for the proposed action.

The greater the precipitation, the greater the likelihood for experiencing runoff for a given area of roadway. Runoff is defined as the movement of water across the soil surface until it reaches a defined natural stream channel. If the soil surface on a highway right-of-way is disturbed during construction or maintenance, the infiltration capacity may be significantly reduced and runoff may occur. During heavy rain events, such as thunderstorms, even undisturbed sites could experience some runoff. Moreover, the impervious road surface creates additional volumes of water and increases runoff.

For roadways at high elevations with temperate climates, it is expected that a mixture of grasses, forbs, and wildflowers would quickly occupy the sides of roadways that have received mechanical or manual treatments. Grasses are particularly effective in intercepting sediments and filtering pollutants. However, where woody vegetation moves onto the right-of-way and out-competes grasses, a decrease in filtration could occur. Likewise, noxious weed infestations would reduce grasses and increase the potential for runoff. In general, the absence of any vegetation management could increase the risk of erosion of roadside soils and decrease soil stability, thereby reducing the ability of the right-of-way vegetation to filter pollutants from storm water before it reaches nearby streams.

In arid and desert sites, surface water is generally ephemeral and present only after rainstorms. Vegetation along roadsides is usually sparse, except during particularly wet periods. The potential for surface runoff during heavy storms is usually high with or without mechanical and manual treatments. Overall, it is not likely that water quality would be substantially impacted on these sites through selection of this alternative.

Roadways are considered linear features on national forests, and they generally comprise only a small portion of the total drainage basin for streams or lakes. For this reason, the impact of mechanical treatments along a highway corridor on overall water quality should be minimal in most cases. However, roadside vegetation management practices, which lead to a decrease in grass and other plant species that have good soil binding root systems, could have significant effects on small streams flowing parallel to a roadway.

Cumulatively, this alternative would not be as effective in controlling noxious weeds and invasive plants, and erosion from adjacent lands of mixed ownership would increase as these plant infestations expand over the long run.

Alternative 2. Proposed Action (Use of Herbicides)

Both direct and indirect water quality impacts can result from the use of herbicides to control roadside vegetation. Direct adverse effects could result from improper applications for the following situations: (1) waters receiving herbicide from spray, drift, or spills; or (2) the possibility of large-scale applications to impervious roadway surfaces and compacted soils, combined with runoff, transporting herbicides to water resources. However, the herbicides proposed for use are expected to have little to no negative impact on water quality if they are applied in accordance with registered label directions. Utilization of mitigation measures and Best Management Practices will further reduce the potential adverse effects (refer to Chapter 2, page 28). To ensure proper application and to avoid problems related to runoff, all herbicide applications would be conducted by or under the supervision of a certified pesticide applicator.

Several mechanisms prevent or retard the migration of herbicides through the soil profiles. These mechanisms include chemical precipitation, chemical degradation, volatilization, physical and biological degradation, biological uptake, and adsorption (Table 2, page 21). Clays and organic matter in the soil adsorb certain organic compounds like herbicides (e.g. glyphosate). As a result, the ability of herbicides to leach through the soil column for entry to ground water would be reduced significantly (Table 11). However, some herbicides have some soil activity, that is, they can dissolve in water and move down the soil column. An example would be picloram. An extensive study of the environmental fate of picloram determined that, at normal application rates, picloram was not detectable in surface or groundwater over a 445-day study (Watson et al. 1989). Nevertheless, where soil permeability could be conducive to water contamination, picloram and other water-mobile compounds will not be used where the water table is within 6 feet of the surface. Also, a buffer of 10 feet for flat terrain and up to 100 feet for steep slopes will be imposed for herbicides that could move over the surface and contaminate water sources. Aquatically labeled formulations of 2,4-D, glyphosate, and triclopyr can be safely applied up to the edge of water sources. These herbicides have a short half-life, do not move readily through soil, have low toxicity to aquatic organisms, and have other properties that allow for their safe use near water. Imazapic, imazapyr, and triclopyr can be applied up to the edge of non-irrigation water sources, but they cannot be applied to water. The other materials considered in this analysis should not pose any significant threat to water quality as long as they are not applied within the buffer zone established for surface water sources.

Table 11. Potential for surface runoff and leaching for proposed herbicides (Vencill 2002)

Common Name of Herbicide	Solubility in Water (mg/L)	Half Life in Soil	Potential for Surface Runoff	Potential for Leaching
2,4-D	796 (salt)	10 Days	Low	Moderate
Chlorsulfuron	587 (pH 5) – 31,800 (pH 7)	40 Days	Low	Moderate at pH 7, but less at pH 6
Clopyralid	1,000 (acid) – 300,000 (salt)	40 Days	Low	Moderate
Dicamba	4,500 (acid) – 4000,000 (salt)	Less than 14 Days*	Low	Low to Moderate
Fluroxpyr	4,000 (acid, pH 6.95)	11-38 Days	Low	Low
Glyphosate	15,700 (pH 7) – 900,000 (salt, pH 7)	47 Days	Low	Low
Imazapic	2,200	120 Days	Low	Low
Imazapyr	11,272 (pH 7)	25-142Days*	Low	Low
Isoxaben	1	50-120 Days	Low	Low
Metsulfuron methyl	548 (pH 5) – 2,790 (pH 7)	30 Days	Low	Moderate at pH 7, but less at pH 6
Pendimethalin	0.275	44 Days	Low	Low
Picloram	430	90 Days*	Moderate	High
Sethoxydim	257 (pH 5) – 4,390 (pH 7)	5 Days	Not Available	Not Available
Sulfometuron methyl	10 (pH 5) – 300 (pH 7)	20-28 Days	Low	Moderate at pH 7, but less at pH 6
Tebuthiuron	2.57	Over 360 Days*	Small	High
Triclopyr	23 (ester) – 2,100,000 (salt)	30 Days	Not Available	Not Available

*May persist significantly longer under conditions of low soil moisture and rainfall and soil types.

Changes to roadside vegetative cover through the use of selective herbicides can have a substantial affect on protecting water quality. Removal of target noxious weeds and invasive plants, which are currently minor components of roadside vegetation, will favor establishment of healthy vegetation that will serve to intercept herbicide residues, other contaminants, and sediments. Also, herbicides will be applied in narrow bands or as spot treatments for treatment of hazardous vegetation, minimizing the impacts on water quality. These conservative treatments would target only a tiny fraction of the land in any watershed. Further, as covered in Chapter 2, most of the herbicides being considered rapidly degrade by contact with sunlight, water, or soil (Table 2, page 21).

Since the herbicides considered for use are short-lived and degrade in the environment and mitigations and BMP's will reduce the chances of herbicides moving into water, it is concluded that the typical application rates will not contribute to any significant cumulative impacts to water quality.

Alternatives Compared

Table 12. Summary of the comparison of the alternatives against the five issues

Key Issues	Alternative 1. No Action (No Herbicide Use)	Alternative 2. Proposed Action (Use of Herbicides)
Issue 1. Effectiveness of the alternatives in controlling noxious weeds and hazardous vegetation	Marginally effective for hazardous vegetation and ineffective for most noxious weeds and invasive plants.	Best and most economical method for controlling hazardous vegetation, invasive plants, and noxious weeds.
Issue 2. Effects of the alternative upon human health (public and workers)	For the public, no risk from herbicides, but moderate risk to drivers related to increased equipment used to remove hazardous vegetation and noxious weeds and invasive plants. The risk to workers would be higher than for the proposed action due to potential for vehicle accidents.	For the public, negligible risk from herbicide use, and lowest risk related to accidents from removal of hazardous vegetation and reduced use of mechanical equipment. For workers, lower risk associated with equipment/vehicle accidents, and negligible risk from herbicides.
Issue 3. Effects of the alternative on non-target vegetation, including threatened, endangered, and sensitive species	No risk to non-target plants from herbicide use, but the long-term risk to native plant communities on national forests would be much higher than the proposed action due to the continued expansion of noxious weeds and invasive plant infestations.	Highest risk to non-target plants where herbicide use would occur, but the long-term risk to native plant communities on adjacent National Forest System lands would be lower than for the No Action alternative.

Key Issues	Alternative 1. No Action (No Herbicide Use)	Alternative 2. Proposed Action (Use of Herbicides)
Issue 4. Effects of the alternative on non-target terrestrial and aquatic species, including threatened, endangered, and sensitive species	No risk to non-target species from use of herbicides, but the long-term risk would be higher due to habitat modification caused by expansion of noxious weeds and invasive plant infestations.	Negligible risk associated with herbicide use, but the long-term risk would be lower than the No Action alternative due to preventing the spread of noxious weed and invasive plant infestations.
Issue 5. Effects of the alternative on water quality	No risk from herbicide use, but increased use of mechanical methods would result in higher risk to water quality.	Possible high risk associated with herbicide use, but maintaining healthy vegetation would prevent adverse effects to water quality.

Chapter 5 – Team Members, Public Contacts, References, Acronyms, and Glossary

Team Members

The following individuals participated in the environmental analysis and preparation of the assessment:

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Public Contacts

Over 2,000 forest users; private individuals or groups; county, State, and tribal governments; and other Federal Agencies expressed interest or may be affected by this decision. Through the scoping process, a total of 145 comments were received. A complete list of the responses received is contained in the project file in the Regional Office, Engineering staff.

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Acronyms

AASHTO: American Association of State Highway and Transportation Officials

ADI: Allowable daily intake

ADOT: Arizona Department of Transportation

BMP: Best management practices

Chemtrec: Chemical Transportation Center, Manufacturing Chemicals Association

EPA: U.S. Environmental Protection Agency

FHWA: Federal Highway Administration

FIFRA: Federal Insecticide, Fungicide, and Rodenticide Act

IPM: Integrated Pest Management

IVM: Integrated Vegetation Management

MSDS: Materials Safety Data Sheet

MCS: Multiple Chemical Sensitivity

NHTSA: National Highway Traffic Safety Administration

NEPA: National Environmental Policy Act

NFS: National Forest System

NOEL: No observable effect level

PPE: Personal Protective Equipment

PRA: Public Road Authority

RfD: Reference Dose

SERA: Syracuse Environmental Associates, Inc.

Glossary

Absorb: To take up by attraction to a surface. Soil particles, dust, activated charcoal, or other substances often absorb chemicals.

Absorbed dose: The amount of a substance (e.g., a chemical) that enters the body of an exposed organism.

Absorption: The movement of a substance (e.g., a chemical) through a membrane into the body after exposure has occurred.

Active ingredient (a.i.): The effective part of a pesticide formulation that actually destroys the target pest or performs the desired functions, or the actual amount of a technical material present in the formulation.

Acute effects: The adverse effects caused by a toxic agent that shows up within a short period of time after exposure.:

Adsorption: The attachment of one substance to the surface of another.

Adjuvant: Material added to the pesticide mixture to help the active ingredient do a better job of control. Examples of an adjuvant include: wetting agent, spreader, adhesive, emulsifying agent, and bark penetrant.

Adaptive Management: A concept of allowing decisions, which are focused on desired outcomes, to be made with the best information available and to adjust operations to achieve desired conditions.

ADI (Acceptable Daily Intake): The amount of a chemical (dose), presumed by the EPA, that a person could receive every day for a lifetime of 70 years without any adverse health effects.

Allergen: A foreign substance that induces a response from the immune system of some people that subsequent exposures to the substance cause allergic reaction (wheezing, sneezing, runny nose, red eyes, hives, other dermatitis, shock, etc.). Also, called an antigen.

Allergic reaction: A reaction to an antigen or allergen, such as pollen or a chemical, that is acquired from previous contact with the material and that is far stronger than would be expected in most people.

Amino acid: Any of numerous nitrogen-containing acids, which include some that are the building blocks of proteins.

Annual (plant): A plant species living for only one year or season.

Benchmark value: An established quantitative limit at which no more than one individual in one million would have the potential to contract cancer from exposure to a chemical under a set of conditions.

Bioaccumulation: The retention and concentration of a substance by an organism.

Biodegradation: The series of processes by which living systems, particularly microorganisms, degrade chemical compounds, and the breakdown products may be either more or less toxic than the parent compound.

Biological diversity: The variety of life and its processes, including all life forms from one-celled organisms to complex organisms such as insects, plants, birds, reptiles, fish, other animals and the processes, pathways and cycles that link such organisms into natural communities.

Buffer strip: A strip of vegetation that is left unmanaged or is managed to reduce the impact that a treatment or action on one area would have on an adjacent area, especially for streams or other water sources.

Carcinogen: A substance that causes or induces cancer.

Chronic exposure: Adverse effects occurring after exposure to a toxic agent for a long period (with animal testing, this is considered to be the majority of the animal's life). These effects are considered to be permanent or irreversible.

Clear zone: An unobstructed area needed along highways to allow motorists to recover control of their vehicles if they run off the road. Width varies depending on design speed, alignment, and environmental factors. Minimum width is generally 10 feet. Maximum width can exceed 40 feet.

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

Dermal exposure: Contact between a chemical and the skin.

Dicotyledons: A group of flowering plants characterized by two cotyledons in a seed. A cotyledon is a food-digesting and food-storing part of an embryo, also known as a seed leaf.

Diffusion: The movement of suspended or dissolved particles from a more concentrated to a less concentrated region as a result of the random movement of individual particles. The process tends to distribute the particles uniformly throughout the available volume.

Dose: The quantification of exposure. For oral and dermal exposures, it is typically expressed as the amount of chemical in grams or milligrams per kilogram of body weight, and for inhalation, as the concentration of the chemical in the air.

Dose-response: A quantitative relationship between the dose of a chemical and the effect caused by the substance.

Endangered species: Any species that is seriously threatened with extinction throughout all or a sign.

Exotic plant: A non-native plant.

Exposure analysis or assessment: The determination or estimation (qualitative or quantitative) of the magnitude, frequency, duration, route, and extent (number of people) of exposure to a substance.

Exposure pathways: Routes that a substance (e.g., a chemical) could enter the body: dermal, ingestion, inhalation.

Exposure scenario: A set of conditions or assumptions about sources, exposure pathways, concentrations of toxic chemicals, and populations (numbers, characteristics, and habits) that aid the investigator in evaluating and quantifying exposure in a given situation.

Extrapolation: An inference (unknown data) from known data.

Forbs: A group of herbaceous (non-woody) plants, other than grasses, generally including wildflowers and many other plants, including those commonly referred to as weeds.

Formulation: The form in which a pesticide is packaged or prepared for use. A chemical mixture that includes a certain percentage of active ingredient (technical chemical) with an inert carrier.

Grasses: A group of herbaceous (non-woody) plants with fibrous roots, jointed stems, sheathed, and alternating leaves originating from nodes, and flowers occurring from spikelets.

Half-life: The length of time required for the mass, concentration, or activity of a chemical or physical agent to be reduced by one-half.

Hazard analysis: Involves gathering and evaluating data on the types of injury or disease that may be produced by a substance and on the conditions of exposure under which injury or disease occurred.

Hazardous vegetation: Any plant that poses a threat to drivers, roads, biotic communities, or adjacent lands. The threat can be in the form of collision hazards, such as vehicles hitting trees that are too close to the road; sight distance impediments, drivers being unable to see wildlife approaching the roadway, around curves in passing zones, signs and safety features because of tall vegetation; vegetation encroachment into the travelway; fire hazard; and degradation of the roadbed.

Herbicide: A chemical that regulates the growth of or kills specific weeds or undesirable plants.

Hypersensitivity: A state of extreme sensitivity to an action of a chemical; a state of altered reactivity in which the body reacts with an exaggerated immune response to a foreign substance.

Immune system: The body' system that protects against infectious agents, controls white blood cell maturation and immuno/globulin production, and guards against the proliferation of cancerous cells.

Individual lifetime risk: The estimated incremental lifetime risk of an adverse effect incurred by an individual owing to exposure to a specific concentration of risk for a given period of time.

Inert ingredients: All ingredients in a formulated pesticide product that are not classified as active ingredients.

Inhalation: The movement of a chemical from the breathing zone, through lung tissues, and into the blood system.

Intake: Amount of material inhaled, absorbed through the skin, or ingested during a specified period of time.

Integrated Pest Management (IPM): A multi-disciplinary, ecological approach to managing a pest, which involves the use of several control techniques in a planned, coordinated program, to limit the impacts of the pest.

Integrated Vegetation Management (IVM): This is the same concept as IPM, but it is specific to plants.

Invasive plant: An invasive plant is a weed that grows and spreads rapidly, replacing desirable native plants.

Kilogram: A Kilogram is 2.205 pounds.

LC50 (Median Lethal Concentration): A measure of acute toxicity. The dose level that kills 50 percent of the test animals exposed. Used in aquatic toxicity and inhalation studies.

LD50 (Median Lethal Dose): A measure of acute toxicity. The dose level that kills 50 percent of the test animals exposed.

Likelihood: Statistical probability that an event, such as harm or injury, may occur as a result of exposure to a risk agent.

Margin of safety (MOS): A separation between the highest no-effect level of a chemical found by animal experimentation and the level of exposure estimated to be safe for humans. It is derived by reducing the NOEL by 100 times, which is considered to be a low risk.

Mitigation measures: The identification of specific practices and methods that will reduce or eliminate adverse effects related to implementation of an alternative.

Monocotyledons: A group of flowering plants that produces seeds having only one cotyledon. Grasses are included in this group of plants.

Mutagen: A substance that can produce change in the genetic material (DNA) of cells that can be transformed during cell division.

Mutagencity: The capacity of a chemical or physical agent to cause permanent alteration of the genetic material within living cells.

Natural community: An assemblage of organisms indigenous to an area that is characterized by distinct combinations of species occupying common ecological zones and interacting with one another.

Nesting cover: An assemblage of vegetation exhibiting a specific growth form to allow nesting activities associated with wildlife reproduction.

Neurotoxicity: Exerting a destructive or poisonous effect on nerve tissue.

NOEL (No Observed Effect Level): In dose-response experiments, it is the exposure level which causes no statistically significant increase in frequency or severity of any effect between the exposed population and its appropriate controls.

Non-target: Any plant, animal, or organism that a method of application is not aimed at, but may accidentally be injured by the application.

Noxious Weed: A noxious weed is a plant species listed in State laws or regulations or specifically listed by a Federal agency.

Perennial: A plant species that has a lifespan of more than 2 years.

Persistence: Resistance to degradation due to low volatility and chemical stability. A persistent substance is expected to remain in the environment for a long time.

Pesticide: Any substance used to control, prevent, destroy, repel, or mitigate insects, rodents, fungi, weeds, or other forms of plant or animal life that are considered to be pests.

Plant community: An association of plants or various species found growing together in different areas with similar site characteristics.

Poison: A substance that may be dangerous to life or health. Often considered to be a substance with relatively high acute toxicity; legally defined as having an acute oral toxicity of less than 50 milligrams per kilogram of body weight.

Public Roadways: Interstates, U.S. highways, and State and county roads are considered public roadways.

Reference Dose (RfD): The term preferred by the U.S. Environmental Protection Agency to express acceptable daily intake (ADI).

Registered herbicide: All pesticides sold or distributed in the United States must be registered by the U.S. Environmental Protection Agency, based on scientific studies, showing that they can be used without posing unreasonable risks to people or the environment.

Right-of-way (ROW): The land provided for a highway, usually including the roadway itself, shoulders, and areas between the roadway and adjacent properties.

Risk: In risk assessment, the probability that an adverse effect (injury, disease, or death) will occur under specific conditions of exposure to a risk agent.

Risk agent: Chemical substance, biological organism, radioactive material, or other potentially hazardous substance or activity.

Risk characterization: Integration of the data and analysis involved in hazard identification, exposure assessment, and dose-response assessment to estimate the nature and likelihood of adverse effects.

Risk estimate: A description of the probability that organisms exposed to a specific dose of a chemical will develop an adverse response, such as cancer.

Roadside recovery area: Synonymous with clear zone and denotes a strip of at least 10 feet on roadsides to allow motorists an unobstructed area in which to recover control of their vehicles if they run off the road.

Route of exposure: An avenue by which a chemical comes in contact with an organism, including inhalation, ingestion, and dermal contact.

Runoff: The movement of water across the soil surface until it reaches a defined natural stream channel.

Safety: Practical certainty that a substance will not cause injury under carefully defined circumstances of use.

Safety factor: A factor conventionally used to extrapolate human tolerance for chemical agents below no-observable-effect levels in animal test data. For Forest Service risk assessments, a safety factor of 100 is used.

Slope failure: Gradual or rapid downslope movement of soil or rock under gravitational stress, often as a result of human-caused factors, e.g., removal of material from the base of a slope.

Solvent: A liquid capable of dissolving another substance. Many solvents are organic, or carbon-based; many of these are volatile, flammable, and toxic. Examples of organic solvents include acetone, trichloroethylene (TCE), ethanol, isopropanol, and benzene. Water is a nonorganic solvent.

Succession: The progressive development of trees or other plants towards their highest role in their ecology; their climax. An example would be the replacement of shrubs and grasses by a forest.

Synthetic: Made by humans.

Systemic effects: Effects observed at sites distant from the entry of a chemical owing to its absorption and distribution into body.

Teratogenic: Capable of producing birth defects.

Threatened species: Any species that is not presently endangered but could become so in the foreseeable future.

Threshold level: A dose or exposure below which there is no apparent or measurable adverse effect.

Toxicity: The quantity or degree of being poisonous or harmful to plant, animal, or human life.

Toxicology: The study of toxic chemicals and their effects on organisms.

Volatilization: To evaporate or cause to evaporate.

Water-soluble: Dissolves in water.

Xerophytic: Plants having various means of protection against the loss of water by excessive transpiration.

Appendix A - Risk Assessment for Humans and Non-Target Species

Introduction

The potential effects on humans and non-target species are somewhat complicated to analyze when synthetic herbicides are considered for use to control noxious weeds and invasive plants on rangelands and in forests and riparian areas. A method commonly used to analyze such effects is known as a risk assessment, which is an analytical tool that attempts to quantify the long-term risks from an action utilizing standards of safety generally accepted by the scientific and health communities. The Southwestern Region has analyzed the risk of the use of 21 herbicides and 4 carriers (USDA 1992). In addition, specific risk assessments are available for 14 of the herbicides being considered (http://www.fs.fed.us/foresthealth/pesticide/risk_assessments). A comparison of the 1992 risk assessment and the updated risk assessments indicate that the conclusions are essentially the same. All of these risk assessments are incorporated by reference and included in the project file.

"The Assessment for the Southwestern Region (1992)" displays estimated risks to the public and applicators when selected herbicides are used. In addition, estimated risks to non-target species of mammals, fish, birds, reptiles, amphibians, and invertebrates are displayed. These estimates are based on a comparison of laboratory toxicity studies with estimated exposures of representative species. The assessments display risks from "routine typical" and "routine extreme" cases. Routine typical cases represent risks to workers, the public, and other organisms that may occur as a result of routine operations. The routine extreme approach is used to estimate doses that would occur under conditions of maximum use and maximum exposure.

The risk assessment has three parts:

Exposure Analysis: This analysis estimates the range of possible doses to workers, the general public, aquatic organisms, etc. A variety of scenarios and exposure pathways are examined that could result in dermal and oral exposures.

Hazard Analysis: Tests and data related to the toxicity of herbicides are reviewed under this analysis. Data are reviewed to indicate the doses at which toxic effects occur and, conversely, levels at which no toxic effects are seen. Of particular interest is a value known as the "No Observed Effect Level" or NOEL. NOEL is the highest dose at which no adverse effects were noted in test animals. The NOEL, in combination with the various safety factors, is a partial basis for determining the safety of human doses and is useful for determining the possible noncarcinogenic effects of herbicides, such as effects on liver or kidney functions. The hazard analysis also reviews data on the possible carcinogenicity of the chemical.

Risk Analysis: Under this analysis, the dose levels calculated in the exposure analysis are compared to the NOEL levels to determine the noncarcinogenic effects of herbicides. Because NOEL levels are based on animal tests, it is assumed that the NOEL should be at least 100 times greater than the doses to establish a margin of safety (MOS). This risk analysis also indicates the probability of developing cancer based on a projection of the lifetime doses received from Forest Service spraying.

Proposed Action

The Forest Service proposes to authorize the Arizona Department of Transportation and other Public Road Authorities to treat about 5,000 acres of noxious weeds, invasive plants, and hazardous vegetation annually along public roadways that pass through the Apache-Sitgreaves, Coconino, Coronado, Kaibab, Prescott, and Tonto National Forests. The acreage of treatment each year may vary depending on infestation levels, new introductions, funding, and weather conditions. Even at the maximum level of annual treatments, only a small percentage of the rights-of-way acreage on the forests, less than 3 percent, would be treated with herbicides. All applications would be done by ground-based equipment, including low-pressure systems on pickup trucks or other vehicles, backpacks, and other hand-held devices.

Table 13 is a list of herbicides being considered for use through this document, including trade and common names. This is not an exclusive list and additional products may be registered.

Table 13. Herbicide trade name list

Common Name	Trade Name
2,4-D	Clean Crop Amine 4CA other products
Chlorsulfuron	Telar
Clopyralid	Transline
Dicamba	Dicamba & 2,4-D
Fluroxypyr	Vista
Glyphosate	Roundup & Rodeo
Imazapic	Plateau
Imazapyr	Arsenal
Isoxaben	Gallery
Metsulfuron Methyl	Escort
Pendimethalin	Pendulum
Picloram	Tordon 22K
Sethoxydim	Poast
Sulfometuron Methyl	Oust
Tebuthiuron	Spike
Triclopyr	Garlon 3A & Garlon 4

Human Health Risk

A considerable body of information from tests on laboratory animals is available for the herbicides considered for possible use in controlling noxious and invasive weeds and hazardous species. Most of these tests were conducted as a requirement of the U.S. Environmental Protection Agency (EPA) for the registration process. Only those herbicides approved by the EPA will be considered for use. In addition, all of the herbicides proposed for use have been subjected to long-term feeding studies that test for general systemic effects, such as kidney and liver damage. Also, tests of the effects on reproductive and developmental toxicity (birth defects), mutagenicity (permanent transmissible change in genetic material), neurotoxicity (destructive or poisonous effect upon nerve tissue), carcinogenicity (ability or tendency to produce cancer), and immunotoxicity (poisonous to components of the entire immune system) have been conducted. NOELs are available for most types of these tests.

Extrapolating a NOEL from an animal study to humans is an uncertain process. No one can predict a safe exposure to any substance, natural or synthetic, unless the specific situation or context of exposure and dose are known. In other words, the risk or probability of harm from any substance or activity is never zero, but it can be so low as to be negligible. The EPA compensates for the uncertainty by dividing NOELs from test animals by a safety factor, typically 100, to derive a Reference Dose (RfD). Thus, the RfD is defined as the dose to humans at which there is a reasonable certainty of no harm. The factor of 100 is a risk management device that allows extrapolation of the data from animals to humans under the assumption that animals are less sensitive than humans. The factor also allows the data to be applicable to the most vulnerable members of the population — children and senior citizens. Because the NOEL is mostly based on animal lifetime exposure tests, the RfD actually represents the tolerable daily exposure over a lifetime (assumed to be 70 years for humans).

To evaluate the possible risk to humans, certain baseline criteria were set. Cancer risk is set at a benchmark value of 1 in 1 million. This benchmark is commonly accepted by the scientific community as a negligible addition to the current U.S. cancer rate. Evaluation of systemic and reproductive health risk will be based on a “no observed effect level” (NOEL), which is a long-term dose that does not result in apparent adverse effects.

In evaluating the potential impact of herbicides, it must be kept in mind the small amount that is typically used on National Forest System lands. This is normally less than 2 pounds per acre. Some products are applied at an ounce per acre.

Direct effects for workers are those that may occur from direct contact (dermal exposure) with an herbicide. Potential applications will be by backpack and ground based mechanical methods, and the area treated per day will be dependent on the specific site and type of application. It is determined that the proposed noxious weed, invasive plant, and hazardous species treatments fall within the typical scenario for herbicide use considering the proposed application rates (Table III-B-1, page III-B-3) and acres treated per day per worker (Table III-D-8, page III-D-23) in the 1992 risk assessment. It is determined that it is very unlikely that a project would include all of the conditions that exist in the routine extreme scenario (Table III-D-6, page III-D-20; Table III-B-2, page III-B-4; Table III-D-8, page III-D-23, 1992 risk assessment). The conditions of herbicide application will affect the exposure; thus, implementation of the mitigation measures and Best Management Practices, covered in Chapter 2 (page 28), will reduce possible exposures. Also, using personal protective equipment, as covered in the Safety and Spill Plan (Appendix B, page 83) will lower exposure of workers by as much as 68 percent, since most application exposure is through the skin and not through the lungs by breathing vapors (Monnig 1988). Proper training and certification of applicators on mixing, loading, and application is essential to reduce the risks to workers.

For the herbicides being considered for use, 2,4-D and triclopyr pose a moderate risk of systemic effects for backpack applicators and ground mechanical applicator/mixer loader (Table III-E-13, page III-E-17, 1992 risk assessment). In addition, 2,4-D, dicamba, and tebuthiuron have a moderate risk for reproductive effects. These risks would be mitigated by measures covered in the preceding paragraph and by limiting maximum exposure to these herbicides. Worker doses for the remaining herbicides proposed for use are likely to be well below the RfD if reasonable safety precautions are followed.

There is the possibility that workers could receive dermal exposures from the spill of a herbicide concentrate and/or the spill of a herbicide mixture, including carriers. Table III-E-14 (page III-E-18), 1992 risk assessment, for right-of-way sites, displays the risks associated with accidents (assuming a 2,000-gallon tank spill). The risk to workers associated with accidental spills is expected to be negligible if they are trained, use required protective clothing and equipment, and follow steps outlined in the Safety and Spill Plan (Appendix B).

Concern has been raised about the collection and consumption of native herbs, medicinal plants, berries, etc., that could be inadvertently sprayed. The main concern appears to center on the increased risk of cancer that could result from exposure to low levels of an herbicide. All of the herbicides being considered for use have undergone testing for cancer. Clopyralid and dicamba tests have shown no evidence of cancer initiation or promotion. The evidence for 2,4-D and picloram have been debated. Nevertheless, the 1992 risk assessment assumes that the various herbicides are carcinogens. The analyses also assume that any dose of a carcinogen could cause cancer and the probability of cancer increases with increased doses. Estimates of the probability of developing cancer from exposure to these compounds are based on a conservative extrapolation from cancer rates in animals subjected to the chemical for a lifetime. The projected cancer rates are highest for workers since their dose could be higher. Even for the workers, the risks seem relatively low compared to other commonly encountered risks. For example, one round-trip transcontinental aircraft trip carries with it an increased risk of cancer from cosmic rays in the order of one in a million. Smoking two cigarettes increases the risk of cancer by one in a million as does eating six pounds of peanut butter due to aflaxtoxin. Cancer probabilities would increase by one in a million after spraying 2,4-D for 137 days or spraying picloram for about 11,000 days. Since the average American has about a one in four chance of developing cancer in his or her lifetime, the cumulative impact from spraying herbicides at the proposed rates is considered to be insignificant. Nevertheless, studies by the California Environmental Protection Agency, Department of Pesticide Regulation, for tribal people who gather plant materials for food, medicinal, ceremonial, or basketry purposes show that herbicides were no longer detectable or plant materials were no longer available after 80 weeks (California Environmental Protection Agency, May 2001). As a result, if and when treatments are done, information on the timing and location of spraying will be provided upon request to individuals who want to avoid these areas (1-800-546-6591).

There is the possibility that a small percentage of the population in Arizona will be hypersensitive or allergic to any one or more of the herbicides proposed for use. Well-known allergenic substances include common foods, pollen, bacterial and fungal toxins, insect bites and stings, etc. Less frequent are hypersensitivities to certain fragrances and solvents. Allergies and hypersensitivities are atypical reactions exhibited by very few individuals in any population (Felsot 2001). Typical allergic symptoms include runny nose, watery eyes, swelling, and hives. Symptoms exhibited by allergic individuals are caused by specific immunological reactions of the body that are triggered by exposure to very low doses of allergens. Allergic reactions result when the body's normal immune system defenses overproduce antibodies to specific foreign substances. Allergenic and hypersensitive reactions occur by different mechanisms than toxicity. Toxic reactions result when chemical doses become high enough to interfere with normal physiological functions of cells and tissues. Individuals who have allergic reactions or hypersensitivity are generally aware of their sensitivities and such people would not be permitted to work on spray crews. In addition, a toll free number (1-800-546-6591) is available to allow concerned members of the public to avoid the possibility of exposure from proposed herbicide applications conducted by the Arizona Department of Transportation. Other Public Road Authorities would need to be contacted directly regarding herbicide operations.

In summary, the risk or probability of harm to humans is not zero, but it is reasonable to expect that the human health impacts from the proposed herbicide applications would be insignificantly small.

Effects on Aquatic Resources

The potential impact of herbicides proposed for use on fish and other aquatic organisms is a function of three factors: 1) toxic characteristics of the active ingredient; 2) amount of the active ingredient in the water where aquatic organisms live, and 3) length of time an organism is exposed to the active ingredient.

Whether an organism is affected by an herbicide is generally measured in a laboratory using a "LC50" test. The LC50 is the herbicide concentration that is lethal to 50 percent of the organisms exposed to the active ingredient for a given time. Although the LC50 is frequently used as a toxicity standard, 50 percent mortality of fish or other aquatic organisms would not be acceptable under any circumstance on a national forest. For this reason, biologists calculate a "No Observed Effect Level" (NOEL). This is the amount of active ingredient that would have no measurable effects on test organisms after several days of exposure.

The herbicides proposed for use are all characterized by relatively low aquatic toxicity under typical case water concentrations (Table III-H-6. page III-H-13. 1992 risk assessment). The only exceptions are for triclopyr and limonene, which may present a high risk for trout in streams and a moderate risk for trout in lakes. Picloram, dicamba, and 2,4-D may present a moderate risk under extreme water concentration, but this case seems highly unlikely under the conditions of proposed application. Clopyralid, dicamba, and glyphosate are roughly 1/5 to 1/50 as toxic to various aquatic organisms.

In regard to the risk to endangered and threatened (T&E) or sensitive aquatic organisms, triclopyr products not labeled for aquatic use may present an unacceptable risk to T&E cold water fish under the typical case scenario. Likewise, 2,4-D not labeled for aquatic use may present an unacceptable risk to T&E aquatic invertebrates. It must be noted that the assessment was made using aerial application as the treatment approach. A ground-based application would reduce the risk. Also, it does not appear that any proposed applications will occur where these organisms are present; however, to mitigate the concern, triclopyr products not labeled for aquatic use will not be sprayed within the high water zone of any stream or water course were cold water T&E or sensitive fish are present. In addition, 2,4-D products not labeled for aquatic use will not be sprayed in any location where there are T&E or sensitive aquatic invertebrate species.

The majority of herbicide applications near water will be by hand backpack or truck mounted hand wand applications, and this will result in minimal risk to contamination of surface water. Leaching of herbicides through soil is not a significant process. Herbicides do have the potential for overland flow during heavy rainstorms, but the likelihood of such movement on infiltration-dominated sites makes water contamination unlikely. Mitigation measures and Best Management Practices will serve to reduce the potential for possible adverse effects to aquatic organisms.

Non-Target Animal Species

A short list of management indicator species (MIS) for the Southwestern Region (Region 3) were identified in the 1992 risk assessment (Table III-H-10, page III-H-2) and these species can serve as general indicators for the proposed program's effect on non-target animal species. To analyze the program's potential risk to MIS, the various species were paired with the most closely related representative species used in the non-target species analysis. The results of the non-target species risk analysis were then extrapolated to the indicator species by assuming that the doses received by the representative species also apply to the indicator species.

There currently are 66 species listed as Management Indicator Species (MIS) that occur on National Forest System lands in Arizona. Population and habitat trends for each species can be found in MIS reports for the Apache-Sitgreaves, Coconino, Coronado, Kaibab, Prescott, and Tonto National Forests. Copies of the MIS reports are maintained at the forest supervisor's office for each national forest in Arizona. A list of the MIS species follows:

Birds

Goshawk

Pygmy nuthatch

Merriam's turkey

Yellow-bellied sapsucker (red-naped sapsucker)

Mexican owl

Plain titmouse (juniper titmouse)

Hairy woodpecker

Lincoln's sparrow

Lucy's warbler

Yellow-breasted chat

cinnamon teal

coppery-tailed trogon

sulpher-bellied flycatcher

gray hawk

blue-throated hymmingbird

rose-throated becard

thick-billed kingbird

northern beardless tyrannulet

Bell’s vireo
buff-breasted flycatcher
Mearn’s quail
Baird’s sparrow
five-spotted sparrow
peregrine falcon
Gould’s turkey
rufous-sided towhee
violet green swallow western bluebird
ash-throated flycatcher
fray vireo
Townsend’s solitaire
common flicker
black-chinned sparrow
savannah sparrow
horned lark
black-throated sparrow
brown towhee
Birds (continued)
bald eagle
summer tanager
hooded oriole
warbling vireo
western wood pewee
black hawk

Mammals

Abert’s squirrel
elk
mule deer
antelope
red squirrel
black bear
white-tailed deer
Mt Graham spruce squirrel
Arizona gray squirrel

Macro-invertebrates

Macro-invertebrates

Herptiles

desert massassauga
twin-spotted rattlesnake
Arizona ridge-nosed rattlesnake
Huachuca tiger salamander
Tarahumara frog
western barking frog
Arizona tree frog

Fish

Mexican stoneroller
Arizona trout
Gila topminnow
Gila chub
Sonora chub
Spikedace

Pages III-H-1 through III-H-9 and Table III-H-2 (page III-H-7), 1992 risk assessment, address possible effects on representative species. Under the typical case, all species are in the low risk category given the materials proposed for use. Although the 66 MIS listed above are not specifically addressed in either the 1992 risk assessment or the risk assessments for specific herbicides that are incorporated by reference (page 13), no additional information is available to assess the potential risks from the proposed use of the herbicides. Because the proposed herbicides have low toxicity to animals and any contact with herbicides would be very infrequent, it was concluded that the proposed application of the herbicides is not likely to have a greater affect on MIS than for threatened, endangered, sensitive, or other species.

An analysis of the potential effects of the proposed use of herbicides on MIS population trends and habitats was completed and included in the process record, and it was determined that the potential affects would not be significant. Linear roadways that pass through National Forest System lands in Arizona are disturbed sites that would not provide suitable habitat for MIS. Significantly, it is estimated that the majority (70 percent or more) of the proposed herbicide applications would occur within 5 feet of roadway edges. In addition, the proposed applications of herbicides would involve spot treatments and no more than 3 percent of the total area within easements could be treated. Thus, modification of habitats for individual species would be very small and the potential affect on MIS populations is expected to be negligible.

Appendix B - Herbicide Safety and Spill Plan

Information and Equipment

All individuals applying herbicides will receive training on safety and application procedures prior to any spraying.

Only Arizona Department of Transportation and Public Road authority employees, who have been certified by the Arizona Structural Pest Control Commission, will conduct spray operations.

A copy of the Labels and Material Safety Data Sheets (MSDS) for all herbicides will be available at all times during project operations. Employees will be completely familiar with the information in these documents in case it is needed in the event of a spill or incident.

Required Personal Protective Equipment (PPE) will be worn at all times when herbicides are being mixed and applied. Label requirements for specific herbicides will be followed. Applicators and handlers must wear the maximum PPE required by the labels for each herbicide being applied.

An emergency spill kit, with directions for use, will be present when herbicides are being mixed, transported, and applied. Employees will be trained in the use of the spill kit prior to initiation of operations.

The spill kit will contain the following equipment:

- Shovel
- Broom
- Ten pounds of absorbent material
- Box of large plastic bags
- Nitrile gloves

Procedures for Herbicide Spill Containment

Information in this section is derived from the EPA document "Applying Pesticides correctly: A Guide for Private and Commercial Applicators," and the rules and regulation of the State of Arizona Structural Pest Control Commission.

The following information will be reviewed by all workers who handle herbicides:

> Immediately notify the direct supervisor of an incident or spill. Identify the nature of the incident and extent of the spill, including the product and chemical names and the EPA registration number(s).
>
> Remove any injured or contaminated person to a safe area. Remove contaminated clothing and follow MSDS guidelines for emergency first aid procedures regarding exposure. Do not leave an injured person alone. Obtain medical help for any injured employee.
>
> Contain the spilled herbicide as much as possible on the site. Prevent the herbicide from entering ditches, gullies, wells, or water systems.

Small Spills (Less than 1 gallon of herbicide formulation or less than 10 gallons of herbicide mixture)

- Qualified employees will be present to confine a spill.
- Follow MSDS guidelines for emergency first aid procedures in the event of an accidental exposure.
- Restrict entry to the spill area.
- Contain the spread of the spill with earthen dikes.
- Cover the spill with absorbent material.
- Place contaminated materials into leak-proof container(s) and label.
- Dispose of contaminated material according to label instructions and State requirements.

Large Spills (More than 1 gallon of herbicide formulations or more than10 gallons of herbicide mixture)

- Keep people away from the spill.
- Follow MSDS guidelines for emergency first aid procedures in the event of an accidental exposure.
- Contain the spread of the spill with earthen dikes.
- Cover the spill with absorbent material.
- Spread the absorbent material around the perimeter of the spill and sweep toward the center.
- Call the direct supervisor and the local fire department; follow their instructions for further actions.

Procedures for Herbicide Mixing, Loading, and Disposal

1. Mixing of herbicides and adjuvants will be done at least 100 feet from well heads or surface waters.
2. Dilution water will be added to the spray container prior to addition of the herbicide concentrate.
3. Hoses used to add dilution water to spray containers shall be equipped with a device to prevent back-siphoning, or a minimum 2-inch air gap.
4. Workers mixing herbicides will wear the maximum personal protective equipment required by the label.

Empty containers will be triple rinsed. Rinsate will be added to the spray mix or disposed of on the application site at a rate that does not exceed amounts addressed on the label.

Unused herbicide will be stored in a locked facility in accordance with herbicide storage instructions provided by the manufacturer, and in accordance with Arizona Structural Pest Control Commission Regulations.

Empty and rinsed herbicide containers will be punctured and disposed of according to label directions.

Appendix C - Memorandum of Understanding

FS Agreement No. 03-MU-11031600-048________
Cooperator's No. __________________________

Memorandum of Understanding Between the Arizona Department of Transportation, Federal Highway Administration, and USDA Forest Service, Southwestern Region

Purpose

In recognition of the severe impact from invasive species, President Clinton issued Executive Order 13112 on February 3, 1999, which mobilized the Federal government, in cooperation with States and others, to address the invasive species problem. The USDA Forest Service (USFS), the Federal Highway Administration (FHWA), and the Arizona Department of Transportation (ADOT), collectively called the "parties," have entered into this agreement to carry out their separate activities in a coordinated and mutually beneficial manner for management of invasive plants and hazardous vegetation through the proposed use of herbicides. The purpose of this agreement is to support preservation of Arizona's native ecosystems and reduce the hazard to the motoring public through cooperative management of invasive species and hazardous vegetation along public roadways managed by ADOT that pass through National Forest System lands. It provides for coordination between ADOT, FHWA, and the USFS to facilitate prompt identification of weed problems, provide a public information source related to proposed herbicide spraying, and facilitate the control of invasive weeds and hazardous vegetation.

Scope

A. ADOT, FHWA, and USFS shall:

1. Meet at least once annually, preferably in February, to identify issues and opportunities, plan vegetation control actions, and resolve potential difficulties or conflicts. It is agreed that ADOT, Natural Resources, will coordinate all such meetings.

2. Conduct surveys and share information on location and potential for spread of invasive plants and identify hazardous vegetation concerns related to public safety.

3. Jointly develop a long-term plan to control invasive weeds and hazardous vegetation and update the plan, as needed, to include:

    a. Assess previous year's program and, if necessary, modify established treatments and methods to achieve desired results;

    b. Identify locations of planned treatments;

    c. Establish schedule for treatments;

    d. Identify treatment methods;

    e. Establish mitigations and other constraints;

    f. Determine equipment and supplies to be shared, and execute any necessary agreements or paperwork; and

    g. Identify other operational aspects.

4. Check treatment sites for compliance with jointly established mitigations and constraints.

B. The USDA-FS shall:

1. Complete required environmental documents in compliance with the National Environmental Policy Act and associated regulations for implementation of this agreement.

2. On an annual basis, at the annual meeting, identify all sites along and near public roadways that have threatened, endangered, or sensitive plant species and discuss necessary mitigation measures and other constraints.

C. The ADOT Shall:

1. Provide direction to all Natural Resource crews and Agents of the Natural Resource Section to ensure compliance with established procedures, mitigations, and other constraints.

2. Maintain a toll free number (1-800-546-6591) to allow the public to assess the timing and location of proposed herbicide applications.

3. If herbicides are used, provide an annual report to the Forest Service Regional Pesticide Coordinator by November 15 for the previous Federal fiscal year (October 1 through September 30) including:

   a. National Forest: Apache-Sitgreaves, Coconino, Coronado, Kaibab, Prescott, and Tonto;

   b. Active ingredient: Common name (trade name) of individual herbicides. When mixtures of herbicides are used, list herbicides separately;

   c. EPA Number;

   d. Management objective (Noxious weeds or hazardous vegetation);

   e. Unit treated (acres);

   f. Total pounds of active ingredient;

   g. Primary target plant; and

   h. Comment (record active ingredient mixes, tank (T) or formulated mix (M).

   i. Maintain required records for restricted use herbicides.

D. It Is Mutually Agreed and Understood by the Parties that:

1. The USDA-FS, FHWA, and ADOT will handle their own activities and utilize their own resources, including the expenditure of their own funds, in pursuing these objectives. Each party will carry out its separate activities in a coordinated and mutually beneficial manner.

2. Nothing in this MOU shall obligate the USDA-FS, FHWA, or ADOT to obligate or transfer any funds. Specific work projects or activities that involve the transfer of funds,

services, or property among the various agencies and offices of the USFS and ADOT will require execution of separate agreements and be contingent upon the availability of appropriated funds. Such activities must be independently authorized by appropriate statutory authority. This MOU does not provide such authority. Negotiation, execution, and administration of each such agreement must comply with all applicable statutes and regulations.

3. This MOU takes effect upon the signature of the USFS, FHWA, and ADOT, and shall remain in effect for 5 years from the date of execution. This MOU may be extended or amended upon written request of the USFS, FHWA, or ADOT and the subsequent written concurrence of the other(s). The USFS, FHWA, or ADOT may terminate this MOU with a 60-day written notice to the other(s).

4. This MOU is not intended to, and does not create, any right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity, by a party against the United States, its agencies, its officers, or any person.

E. PRINCIPAL CONTACTS. The principal contacts for this instrument are:

Forest Service Project Contact

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FHWA Project and Administrative Contact

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Phone: (602) 379-3645 ext. 117
FAX: (602) 379-3608
E-Mail: steve.Thomas@fhwa.dot.gov

IN WITNESS WHEREOF, the Parties hereto have executed this agreement as of the dates shown below.

ARIZONA DEPARTMENT of TRANSPORTATION

BY: /s/ Bill Higgins___________________ **DATE:**___4/10/03_______

FEDERAL HIGHWAY ADMINISTRATION

BY: /s/ Stephen D. Thomas___________________ **DATE:**____4/16/03______

USDA FOREST SERVICE

BY: /s/ Lucia M. Turner______________________ **DATE:**______5/27/03_____

The authority and format of this instrument has been reviewed and approved for signature.

__/s/ _Susan McDonnell___________________________ Date:___5/27/03_________

SUSAN McDONNELL
Grants & Agreements Specialist

Appendix D - Biological Assessment and Evaluation

This document will be prepared and reviewed by the U.S. Fish and Wildlife Service concurrently with the review of this environmental assessment. The biological assessment and evaluation will be included with the final environmental assessment.