Appendix G

Integrated Pest Management Program for the Sonny Bono Salton Sea National Wildlife Refuge Complex (Sonny Bono Salton Sea NWR and Coachella Valley NWR)

Integrated Pest Management Program
for the
Sonny Bono Salton Sea
National Wildlife Refuge Complex
(Sonny Bono Salton Sea NWR and Coachella Valley NWR)

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1. Introduction

This document explains the concept of integrated pest management (IPM) and its application to the Sonny Bono Salton Sea National Wildlife Refuge (NWR) Complex. It provides guidance for controlling or managing pests in a manner that will provide the most benefit to Refuge trust species and their habitats. IPM is addressed in the objectives and strategies developed as part of the Comprehensive Conservation Plan (CCP) for the Refuges included within the Sonny Bono Salton Sea NWR Complex (USFWS 2013).

The Sonny Bono Salton Sea NWR Complex includes the Sonny Bono Salton Sea NWR and the Coachella Valley NWR (Figure 1). These refuges are located within the Salton Basin of the low-lying Colorado Desert where summer temperatures are high, annual precipitation is low, and high winds are prevalent.

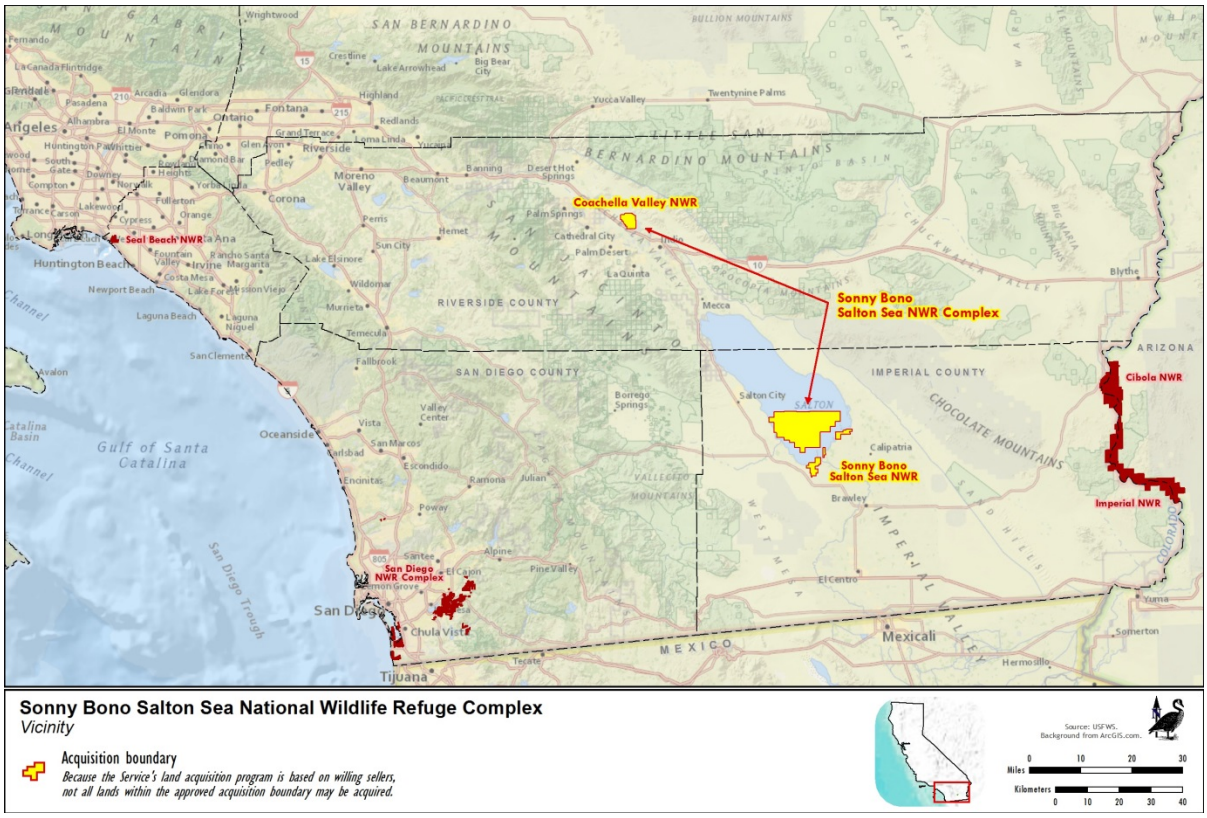

Figure 1. Location Map – Sonny Bono Salton Sea NWR Complex

<u>Sonny Bono Salton Sea NWR</u>

The lands and waters of the Sonny Bono Salton Sea NWR are located within and adjacent to the southern and southeastern portions of the Salton Sea in the northern portion of the Imperial Valley, Imperial County, California. Although its boundaries encompass approximately 37,660 acres, the majority of the Refuge is submerged beneath the Salton Sea. Approximately 4,690 acres to the south of the Sea are actively managed to support migratory and resident birds and other wildlife (Figure 2).

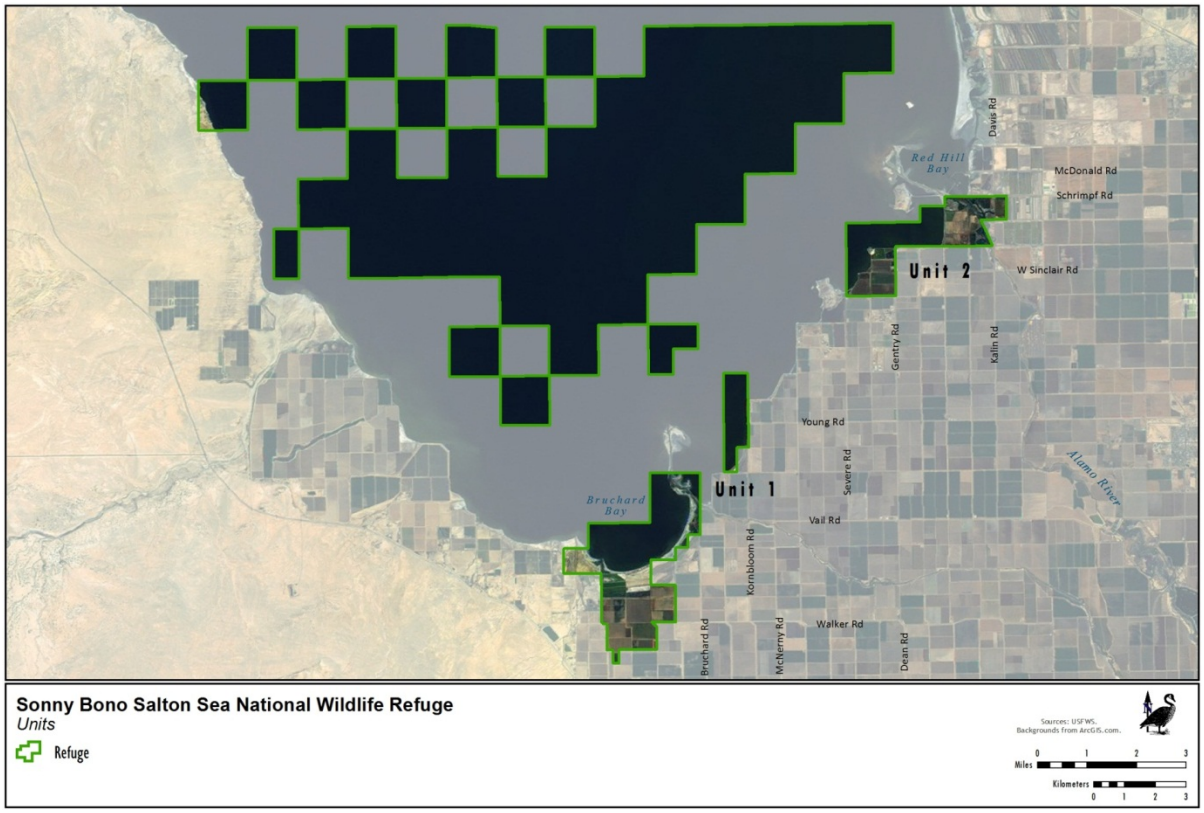

Figure 2. Location Map – Sonny Bono Salton Sea NWR

The lands owned and/or managed by the Refuge occur in three general locations.

- Approximately 32,410 acres of fee title (Service-owned) lands, consisting almost entirely of the open waters of the Salton Sea, are located in the southern portion of the Salton Sea; when the Refuge was established, this area consisted of both wetland and upland habitat that was subsequently flooded by the Salton Sea.

- Approximately 3,782 acres are located along the southern edge of the Salton Sea (Unit 1); with approximately 3,226 acres (a combination of open water, managed wetlands, and upland areas, some of which are actively farmed to create foraging areas for snow geese [*Chen caerulescens caerulescens*], Ross' geese [*Chen rossii*], and other waterfowl) located to the south of Bruchard Bay. An additional 556 acres (most of which were until recently submerged beneath the Salton Sea) are located just to the east. Of the approximately 3,780 acres of Refuge lands within Unit 1, approximately 560 acres are owned in fee title by the Service, about 2,980 acres are leased from the Imperial Irrigation District (IID), and approximately 240 acres, owned by the State of California (Caltrans), have been managed by the Service through an agreement with the State.

- Approximately 2,026 acres, which include the Refuge headquarters and a variety of managed uplands and wetlands, are located along the southeastern edge of the Salton Sea near the terminus of the Alamo River (Unit 2); of the 2,026 acres of Refuge lands within Unit 2, approximately 164 acres (including the 3.44-acre refuge headquarters site) are owned in fee title by the Service, about 1,247 acres are leased from IID, and 615 acres are leased from the California Department of Fish and Wildlife (CDFW).

Managed primarily for avian species, this Refuge provides significant habitat areas for a wide range of resident and migratory birds, including nesting and foraging areas for seabirds and shorebirds, highly managed foraging areas for wintering geese and other waterfowl, and managed cattail marshes to support the Federal endangered Yuma clapper rail (*Rallus longirostris yumanensis*), a year-round resident of the Refuge. The Federal endangered desert pupfish (*Cyprinodon macularius*) is also present on the Refuge, where it occurs within the waters of the New and Alamo Rivers and other drainages that empty into the Salton Sea. It may also occur in some of the managed water habitats within the Refuge.

The Sonny Bono Salton Sea NWR is highly managed to provide habitat for a diverse range of avian species throughout the year. Resident bird species including secretive marsh birds occupy the managed cattail marshes on the Refuge. Migratory nesting songbirds also utilize this habitat. The invasive plant species of concern in this habitat include salt cedar and common reed, which invade the perimeters of the marsh. These invasive plants also occur in moist soil areas adjacent to the Salton Sea, within drainage ditches, along portions of the New River and Alamo River banks. Typically, a combination of mechanical removal and appropriate herbicide application is used to eliminate salt cedar and common reed from wetland areas on the Refuge.

Productivity within the agricultural fields managed on the Sonny Bono Salton Sea NWR to provide winter forage for geese can be adversely affected by a variety of annual weeds including common mallow (*Malva neglecta*), cheeseweed (*Malva parviflora*), goosefoot (*Chenopodium album*), puncture vine (*Tribulus terrestris*), and wild radish (*Raphanus raphanistrum*). In the managed seasonal wetland areas of the Refuge, sesbania (*Sesbania exaltata*) inhibits the growth of forage grasses for waterfowl. Although mowing has been attempted to control this invasive weed, it has had limited success. As a result, chemical control has been employed involving the use of appropriate herbicides.

Coachella Valley NWR

The Coachella Valley NWR, located approximately ten miles east of Palm Springs in Riverside County, encompasses 3,709 acres of desert habitat (Figure 3). It is situated near the southern end of the Coachella Valley, to the north of Interstate 10 between Washington Street and Ramon Road in Thousand Palms. As part of the larger Coachella Valley Multiple Species Habitat Conservation Plan preserve area, this Refuge protects desert dune and associated creosote bush scrub habitat essential for the survival of the federally listed threatened Coachella Valley fringe-toed lizard (*Uma inornata*), the federally listed endangered Coachella Valley milk-vetch (*Astragalus lentiginosus* var. *coachellae*), and a number of other insects, reptiles, mammals, and birds of conservation concern.

In 2012, the Coachella Valley Conservation Commission (CVCC) issued the final Reserve Management Plan (RMP) for the Valley Floor Reserve Management Unit (RMU), which includes the Coachella Valley NWR. The RMP identifies invasive species as a significant management issue for the Valley Floor RMU, stating:

> Invasive species put pressure on the native species, communities, and ecosystems of the Valley Floor RMU, and can cause impacts through, competition, predation, physical alteration of the environment, or a combination of these and other factors. The threats from invasive species, especially at present Sahara mustard, fountain grass, and tamarisk, have the potential to impact covered species so severely that the Coachella Valley Multiple Species Habitat Conservation Plan's conservation goals and objectives for a species might not be met if the threat is not adequately addressed (CVCC 2012).

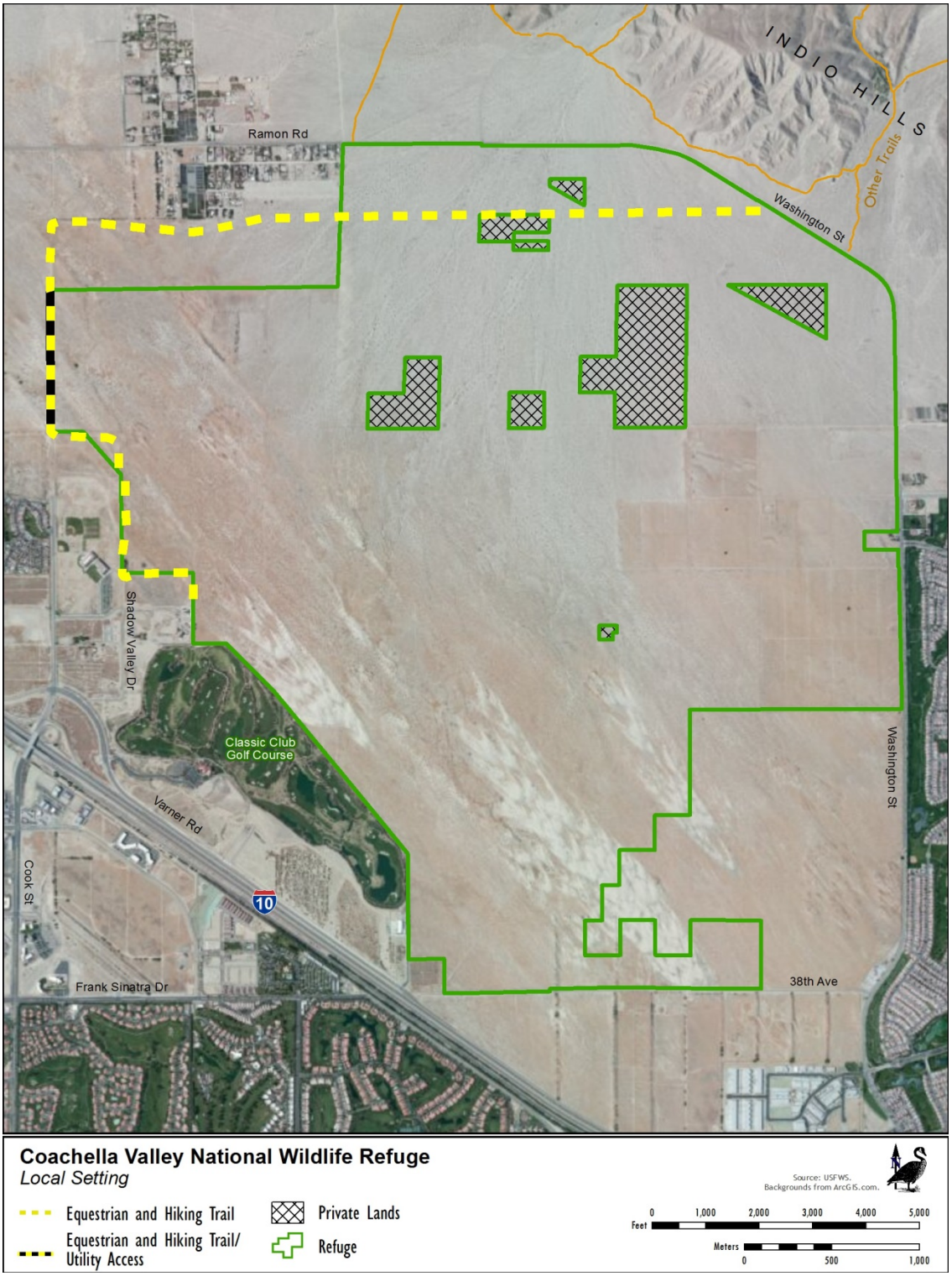

Figure 3. Location Map – Coachella Valley NWR

On the Refuge, endemic blowsand dependent species are threatened by the establishment of invasive annual weeds such as Sahara mustard (*Brassica tournefortii*), Russian thistle (*Salsola tragus*), and storksbill [*Erodium cicutarium*]), as well as invasive shrubs, primarily salt cedar (*Tamarix ramosissima*), within its dune and sandfield habitats. Sahara mustard, which occurs at various densities throughout the Refuge, currently represents the greatest threat to the Refuge's listed species, particularly the Coachella Valley fringe-toed lizard. Some attempts to control Sahara mustard through mechanical control (i.e., hand pulling of plants prior to seed set) were made in recent years, but as the density of the species continues to increase in sensitive habitat areas, additional actions will be necessary. Control of salt cedar through a combination of cutting and then applying an appropriate herbicide to the cut stump is also necessary. An integrated approach to managing the invasive plants on this Refuge, including surveillance and quick response when new invasive species are identified in the area, will be implemented in accordance with the recommendations and approval procedures described in this IPM plan.

2. Background

In August 2010, the U.S. Fish and Wildlife Service (Service) approved an IPM policy for pest management activities on and off Service lands. This IPM policy (Part 569, FW1 of the Service Manual), which is consistent with the Department of the Interior (Department) IPM policy (517 DM 1) and other applicable authorities, establishes procedures and responsibilities for pest management activities, adopts IPM as the Service's method for making pest management decisions; and provides guidance to employees on how to implement IPM for all pest management activities. Although the IPM policy does not require each refuge to prepare a separate IPM plan, it does encourage a refuge with employees engaging in pest management practices to include a separate pest management plan or incorporate IPM strategies into other resource planning documents, such as a CCP. Further, preparation of an IPM plan benefits refuge operations because it provides the opportunity for a refuge to receive multi-year approvals of certain proposed pesticide uses that would normally require regional or national level review of pesticide use proposals (PUPs).

IPM is an interdisciplinary approach utilizing methods to prevent, eliminate, contain, and/or control pest species in concert with other management activities on refuge lands and waters to achieve wildlife and habitat management goals and objectives. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. Examples of tools listed in the IPM definition include, but are not limited to:

- Biological tools (e.g., predators, parasites, and pathogens);
- Cultural tools (e.g., crop rotation, alterations in planting dates, and sanitation);
- Physical tools (e.g., barriers, traps, hand-pulling, hoeing, mowing, and tilling); and
- Chemical tools (e.g., pesticides, such as herbicides, insecticides, or fungicides).

IPM is also a scientifically based, adaptive management process where available scientific information and best professional judgment of the refuge staff, as well as other resource experts, is used to identify and implement appropriate management strategies that can be modified and/or changed over time to ensure effective, site-specific management of pest species to achieve desired outcomes. In accordance with 43 CFR 46.145, adaptive management is particularly relevant where long-term impacts may be uncertain and future monitoring will be needed to make adjustments in subsequent implementation decisions. After a tolerable pest population (threshold) is determined

considering achievement of refuge resource objectives and the ecology of pest species, one or more methods, or combinations thereof, will be selected that are feasible, efficacious, and most protective of non-target resources, including native species (e.g., fish, wildlife, and plants), and Service personnel, Service authorized agents, volunteers, and the public. Staff time and available funding will be considered when determining feasibility/practicality of various treatments.

IPM techniques to address pests are presented as CCP strategies in an adaptive management context to achieve refuge objectives (Chapter 6 of the Sonny Bono Salton Sea NWR Complex CCP). In order to satisfy requirements for IPM planning as identified in the Director's Memo (dated September 9, 2004) entitled *Integrated Pest Management Plans and Pesticide Use Proposals: Updates, Guidance, and an Online Database*, the following elements of an IPM program have been incorporated into the Sonny Bono Salton Sea NWR Complex CCP:

- Habitat and/or wildlife objectives that identify pest species and appropriate thresholds to indicate the need for and successful implementation of IPM techniques; and

- Monitoring before and/or after treatment to assess progress toward achieving objectives including pest thresholds.

Where pesticides would be necessary to address pests, the IPM Plan provides a structured procedure to evaluate potential effects of proposed uses involving ground-based applications to refuge biological resources and environmental quality in accordance with effects analyses presented in Chapter 5 of the draft CCP/Environmental Assessment (EA). The pesticides that will be allowed for use within the National Wildlife Refuge System (NWRS or Refuge System), including the Sonny Bono Salton Sea NWR and the Coachella Valley NWR, are those that are likely to only cause minor, temporary, or localized effects to Refuge biological resources and environmental quality. Pesticide use on these Refuges will also include the implementation of appropriate best management practices (BMPs) to further minimize or avoid adverse effects.

This IPM Plan also addresses the proposal for aerial application of specific pesticides on the Sonny Bono Salton Sea NWR. Aerial herbicide application has been identified as a necessary component of resource management on this Refuge, because of the extent of control that is required and the greater efficiency in terms of staff time required, accuracy of the application, and quantities of product used. Aerial application is proposed for use on the Refuge's managed agricultural fields and some managed seasonal wetlands to control broadleaf weeds, and on large areas of dense salt cedar stands in various locations on the Refuge. The potential effects of aerial application of select herbicides on the environment are analyzed in the Chapter 5 of the draft CCP/EA.

This IPM Plan does not address the effects of pesticide use (i.e., larvicide, pupacide, adulticide applications) to control mosquitoes, although the basic framework to assess potential effects to Refuge biological resources and environmental quality from the use of insecticides for mosquito management would be similar to the process described here for other pesticides. As of 2012, no mosquito control is conducted on either of the two Refuges within the Complex and there are currently no proposals to initiate mosquito control. If the need for mosquito control is identified in the future, additional review in accordance with National Environmental Policy Act of 1969 (NEPA) would be required and requests to apply specific pesticides to control mosquitoes would be subject to PUP review and approval.

3. Pest Management Laws and Policies

In accordance with Service policy 569 FW 1 (Integrated Pest Management), plant, invertebrate, and vertebrate pests on units of the National Wildlife Refuge System can be controlled to assure balanced wildlife and fish populations in support of refuge-specific wildlife and habitat management objectives. Pest control on Federal (refuge) lands and waters is also authorized under the following legal mandates:

- National Wildlife Refuge System Administration Act of 1966, as amended (16 USC 668dd-668ee);
- Plant Protection Act of 2000 (7 USC 7701 *et seq*.);
- Noxious Weed Control and Eradication Act of 2004 (7 USC 7781-7786, Subtitle E);
- Federal Insecticide, Fungicide, and Rodenticide Act of 1996 (7 USC 136-136y);
- National Invasive Species Act of 1996 (16 USC 4701);
- Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (16 USC 4701);
- Food Quality Protection Act of 1996 (7 USC 136);
- Executive Order 13148, Section 601(a);
- Executive Order 13112; and
- Animal Damage Control Act of 1931 (7 USC 426-426c, 46 Stat. 1468).

Pests are defined as "…living organisms that may interfere with the site-specific purposes, operations, or management objectives or that jeopardize human health or safety" from Department policy 517 DM 1 (Integrated Pest Management policy). Similarly, 569 FW 1 defines pests as "…invasive plants and introduced or native organisms that may interfere with achieving our management goals and objectives on or off our lands, or that jeopardize human health or safety." 517 DM 1 also defines an invasive species as "a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health." Throughout the remainder of this document, the terms pest and invasive species are used interchangeably because both can prevent/impede achievement of Refuge wildlife and habitat objectives and/or degrade environmental quality.

In general, control of pests on the Sonny Bono Salton Sea NWR and Coachella Valley NWR would conserve and protect the fish, wildlife, and plant resources on the Refuge, as well as maintain environmental quality. The IPM policy states that animal or plant species, which are considered pests, may be managed if the following criteria are met:

- The pest is causing a threat to human health and well-being or private property, the acceptable level of damage by the pest has been exceeded, or State or local government has designated the pest as noxious;
- The pest is detrimental to resource objectives as specified in a refuge resource management plan (e.g., CCP, habitat management plan); and
- The planned pest management actions will not interfere with attainment of resource objectives or the purposes for which a refuge was established.

The specific justifications for pest management activities on the Refuges of the Sonny Bono Salton Sea NWR Complex include:

- Protecting human health and safety;
- Preventing substantial damage to important Refuge resources;
- Protecting newly introduced or re-establishing native species;

- Controlling non-native (exotic) species in order to support existence for populations of native species; and
- Providing the public with quality, compatible wildlife-dependent recreational opportunities.

Service policy 620 FW 1 (Habitat Management Plans) provides additional management directives regarding invasive species found on Refuge lands and waters. Specifically, the Service is "prohibited by Executive order, law, and policy from authorizing, funding, or carrying out actions that are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere." The Habitat Management Plan policy requires that we: "Manage invasive species to improve or stabilize biotic communities to minimize unacceptable change to ecosystem structure and function and prevent new and expanded infestations of invasive species," and conduct "refuge habitat management activities to prevent, control, or eradicate invasive species..."

Animal species identified as damaging or destroying Federal property and/or considered detrimental to the management program of a refuge may be controlled as described in 50 CFR 31.14 (Official Animal Control Operations) and generally do not require a pesticide use proposal. For example, on the Sonny Bono Salton Sea NWR, the proposal to trap and/or shoot offending coyotes (*Canis latrans*) or raccoons (*Procyon lotor*) that prey on western gull-billed tern (*Gelochelidon nilotica vanrossemi*) chicks and eggs would be covered by the Predator Management Plan (Appendix C) prepared for the Refuge as part of the CCP rather than by this IPM Plan.

Trespass and feral animals also may be controlled on Refuge lands. Based upon 50 CFR 28.43 (Destruction of Dogs and Cats), dogs and cats running at large on a national wildlife refuge and observed in the act of killing, injuring, harassing or molesting humans or wildlife may be disposed of in the interest of public safety and protection of the wildlife. Feral animals should be disposed by the most humane method(s) available and in accordance with relevant Service directives (including Executive Order 11643). Disposed wildlife specimens may be donated or loaned to public institutions. Donation or loans of resident wildlife species will only be made after securing State approval (50 CFR 30.11 [Donation and Loan of Wildlife Specimens]).

4. Strategies

To fully embrace IPM as identified in 569 FW 1, the strategies described below, where applicable, would be carefully considered on the Sonny Bono Salton Sea NWR and Coachella Valley NWR for each pest species.

4.1 Prevention

Prevention is the most effective and least expensive long-term management option for pests. It encompasses methods to prevent new introductions or the spread of established pests to un-infested areas. It requires identifying potential routes of invasion to reduce the likelihood of infestation. Hazard Analysis and Critical Control Points planning can be used to determine if current management activities on a refuge may introduce and/or spread invasive species in order to identify appropriate BMPs for prevention. See http://www.haccp-nrm.org/ for more information.

Prevention may include source reduction such as using pathogen-free or weed-free seeds or fill; exclusion methods (e.g., barriers) and/or sanitation methods (e.g., wash stations) to prevent introductions by various mechanisms including Service vehicles, construction equipment, or boats. Because invasive species are frequently the first to establish newly disturbed sites,

prevention would require a reporting mechanism for early detection of new pest occurrences with quick response to eliminate any new satellite pest populations. Prevention would require consideration of the scale and scope of land management activities that may promote pest establishment within un-infested areas or promote reproduction and spread of existing populations. Along with preventing initial introduction, prevention would involve halting the spread of existing infestations to new sites (Mullin et al. 2000). The primary reason for prevention is to keep pest-free lands or waters from becoming infested. Executive Order 11312 emphasizes the priority for prevention with respect to managing pests.

The following methods will be implemented, as appropriate, to prevent the introduction and/or spread of pests within the Sonny Bono Salton Sea NWR Complex:

- Before beginning ground-disturbing activities (e.g., discing, grading), inventory and prioritize pest infestations in project operating areas and along access routes. Refuge staff will identify pest species on site and/or in areas adjacent to the work site. Where possible, project activities will begin in un-infested areas before working in pest-infested areas.
- Refuge staff will attempt to locate and, to the extent possible, use pest-free project staging areas. Travel through pest-infested areas will be avoided or minimized, and where this is not possible, travel will be restricted to those periods when spread of seed or propagules of invasive plants is least likely.
- Refuge staff will determine the need for, and when appropriate, identify sanitation sites where equipment can be cleaned of pests. Where possible, refuge staff will clean equipment before entering lands at on-refuge approved cleaning site(s). This practice does not pertain to vehicles traveling frequently in and out of the project area that will remain on roadways. Seeds and plant parts of pest plants will need to be collected, where practical. Refuge staff will remove mud, dirt, and plant parts from project equipment before moving it into a project area.
- Refuge staff will clean all equipment, before leaving the project site, if operating in areas infested with pests, and determine the need for, and when appropriate, identify sanitation sites where equipment can be cleaned.
- Refuge staff, authorized agents, and refuge volunteers will, where possible, inspect, remove, and properly dispose of seed and parts of invasive plants found on their clothing and equipment. Proper disposal means bagging the seeds and plant parts and then properly discarding of them.
- Refuge staff will revegetate disturbed soil (except travel ways on surfaced projects) to optimize plant establishment for each specific site. Revegetation may include weed free topsoil replacement, planting, seeding, and weed-free mulching as necessary.
- Refuge staff will use native species appropriate to the specific site. If needed, refuge staff will use certified weed-free or weed-seed-free hay or straw where certified materials are reasonably available.
- Refuge staff will provide information, training, and appropriate pest identification materials to refuge staff, permit holders, and recreational visitors. The refuge staff will educate them about pest identification, biology, impacts, and effective prevention measures.
- Refuge staff will inspect borrow material for invasive plants prior to use and transport onto and/or within refuge lands.
- Refuge staff will consider invasive plants in planning for road maintenance activities.
- Refuge staff will restrict off road travel to designated routes to the maximum extent practicable.

- Before allowing contact with Refuge waters, all construction and maintenance vehicles, and any boating equipment used by Refuge staff, volunteers, or researchers working in and around drainage ditches, managed wetlands, and moist areas adjacent to the Salton Sea will be inspected for the presence of pests and all visible plants or mud present on the equipment will be removed to reduce the potential spread of common reed (*Phragmites autralis*), salt cedar, and other invasive wetland plants.

These prevention methods to minimize/eliminate the introduction and/or spread of pests were developed in part from information provided in Appendix E of "Preventing and Managing Invasive Plants Final Environmental Impact Statement" (U.S. Forest Service 2005).

Another form of prevention is reduced soil disturbance. On the Sonny Bono Salton Sea NWR, the extent of weedy species present in the agricultural fields managed to provide forage for wintering geese has been reduced through the implementation of "no till" farming practices within some of the fields. The success of reducing the overall disturbance within these fields is evident by the reduction in the amount of herbicide required to control broadleaf weeds within these fields.

4.2 Mechanical and Physical Methods

Mechanical and physical methods will be used as appropriate to remove and destroy, disrupt the growth of, or interfere with the reproduction of pest species. For plants species, these treatments can be accomplished by hand, hand tool (manual), or power tools (mechanical) and can include pulling, grubbing, digging, tilling/discing, cutting, swathing, grinding, sheering, girdling, mowing, or mulching of the pest plants.

For animal species, Service employees or their authorized agents may use mechanical or physical methods (including trapping) to control pests as a refuge management activity. As described above, a predator management plan (Appendix C of the CCP) has been prepared for the Sonny Bono Salton Sea NWR to address the need for trapping and/or lethally controlling coyotes and raccoons that prey on nesting western gull-billed terns. Trapping is permitted on refuges in accordance with 50 CFR 31.2, which allows trapping to reduce surplus wildlife populations for a "balanced conservation program" in accordance with Federal or State laws and regulations. In some cases, non-lethally trapped animals may be relocated to off-refuge sites with prior approval from the California Department of Fish and Wildlife.

Depending upon the circumstances, mechanical and physical methods provide variable degrees of success and are generally applicable to a specific situation. If timed correctly, mechanical controls can effectively suppress most annual and biennial pest plants. For example, hand or mechanical removal of Sahara mustard on the Coachella Valley NWR prior to seed set will over time reduce the amount of seed stored in the soil. Unfortunately, this method of control often takes multiple growing seasons due to the extensive amount of seed deposited in the soil prior to initial control efforts and the potential for seed to be blown or otherwise deposited on the treatment site from nearby untreated areas.

To control perennial plants, the root system has to be destroyed or it will resprout and continue to grow and develop. Mechanical controls are typically not capable of destroying a perennial plant's root system. Although some mechanical tools (e.g., discing, plowing) may damage root systems, they may also stimulate regrowth, producing a denser plant population that may aid in the spread of the plant, depending upon the target species (e.g., giant cane [*Arundo donax*], perennial pepperweed [*Lepidium latifolium*]). In addition, as is the case

within the dune habitat on the Coachella Valley NWR, the presence of listed species and the existing sandy soil conditions are factors that can limit the use of mechanical control methods.

Combining mechanical control methods (e.g., mowing, stump cutting) with the use of herbicides can be a very effective technique for controlling perennial species. For example, cutting perennial plants followed sequentially by treating the cut stump with a systemic herbicide often improves the efficacy of the herbicide compared to herbicide treatment only. The combination of mechanical and herbicide control will be used from time to time on the Refuge Complex to control invasive plants such as salt cedar.

4.3 Cultural Methods

Cultural methods involve manipulating habitat to increase pest mortality by reducing its suitability to the pest. Cultural methods could include water-level manipulation, mulching, moisture management, changing planting dates to minimize pest impact, prescribed burning, flaming with propane torches, addition of beneficial insect habitat, reducing clutter, proper trash disposal, planting or seeding desirable species to out-compete invasive plants, and other habitat alterations. Within the Sonny Bono Salton Sea NWR, higher salinity water is released into seasonal wetland areas when needed to control unwanted cattail (*Typha* spp.) production.

4.4 Biological Control Agents

Classical biological control involves the deliberate introduction and management of natural enemies (e.g., parasites, predators, or pathogens) to reduce pest populations. The Service strongly supports the development and legal and responsible use of appropriate, safe, and effective biological control agents for nuisance and non-indigenous or pest species. To date, the intentional use of biological control agents has not been implemented on the refuges within the Sonny Bono Salton Sea NWR Complex.

Many of the most ecologically or economically damaging pest species in the United States originated in foreign countries. These newly introduced pests, which are free from natural enemies found in their country or region of origin, may have a competitive advantage over cultivated and native species. This competitive advantage often allows introduced species to flourish, potentially causing widespread economic damage to crops, or to out-compete and displace native vegetation. Once the introduced pest species population reaches a certain level, traditional methods of pest management may be cost prohibitive or impractical. It is typically when a pest populations has become so widespread that eradication or effective control would be difficult or no longer practical that biological controls are implemented.

Biological control has advantages as well as disadvantages. Benefits include reducing pesticide usage, host specificity for target pests, long-term self-perpetuating control, low cost per acre, capacity for searching and locating hosts, synchronizing biological control agents to hosts' life cycles, and the unlikelihood that hosts will develop resistance to agents. Disadvantages include limited availability of agents from their native lands, the dependence of control on target species density, slow rate at which control occurs, biotype matching, the difficulty and expense of conflicts over control of the target pest, and host specificity when host populations are low.

A reduction in target species populations from biological controls is typically a slow process, and efficacy can be highly variable. It may not work well in a particular area although it works well in other areas. Biological control agents would require specific environmental conditions to survive over time. Some of these conditions are understood; whereas, others are only partially or not at all understood.

The use of biological control agents would not eradicate a target pest, rather when using biological control agents, residual levels of the target pest typically are expected. The agent population level or survival would be dependent upon the density of its host. After the pest population decreases, the population of the biological control agent would decrease correspondingly. This is a natural cycle. Some pest populations (e.g., invasive plants) would tend to persist for several years after a biological control agent becomes established due to seed reserves in the soil, inefficiencies in the agents search behavior, and the natural lag in population buildup of the agent.

The full range of pest groups potentially found on Refuge lands and waters would include diseases, invertebrates (e.g., insects, mollusks), vertebrates, and invasive plants (the most common group). Often it is assumed that biological control would address many, if not most, of these pest problems. There are several well-documented success stories of biological control of invasive weed species in the Pacific Northwest including Mediterranean sage, St. Johnswort (Klamath weed) and tansy ragwort. Emerging success stories include Dalmatian toadflax, diffuse knapweed, leafy spurge, purple loosestrife, and yellow star thistle. However, historically, each new introduction of a biological control agent in the United States has only about a 30 percent success rate (Coombs et al. 2004).

Before a natural enemy of an invasive species can be released in the United States for biological control, the potential agent must undergo rigorous testing to ensure that it will not harm other organisms. If a biological control agent is proposed for release on the Refuge, Refuge staff will ensure that the particular agent has been approved by the applicable authorities.

Except for a small number of formulated biological control products registered by U.S. Environmental Protection Agency (USEPA) under the Federal Insecticide, Fungicide and Rodenticide Act of 1996 (FIFRA), most biological control agents are regulated by the U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service, Plant Protection and Quarantine unit (APHIS-PPQ). APHIS-PPQ review includes independent analysis by the Technical Advisory Group for Biological Control Agents of Weeds, an independent voluntary committee that is responsible for reviewing release petitions and providing an exchange of views, information, and advice to researchers. In addition, the State of California has additional approval authority. The statuary authority of the State program is provided in the State's Food and Agricultural Code. Section 403 of the Code states that the Department of Food and Agriculture "shall prevent the introduction and spread of injurious insect or animal pests, plant diseases, and noxious weeds;" and Section 405(a) states that "with the prior approval of the Department of Fish and Game and the Office of Environmental Health Hazard Assessment, the Department of Food and Agriculture and the Department of Pesticide Regulation may reproduce or distribute biological control organisms that are not detrimental to the public health and safety which are known to be useful in reducing or preventing plant or animal damage due to pests or diseases." The Imperial County Agricultural Commissioner may have additional approval authority; therefore, contact will be made with the Agricultural Commissioner prior to implementing any proposal to release a biological control agent on the Refuge.

Federal permits (USDA-APHIS-PPQ Form 526) are required to import biological control agents from another state. Form 526 may be obtained by writing: USDA-APHIS-PPQ, Biological Assessment and Taxonomic Support, 4700 River Road, Unit 113, Riverdale, Maryland 20737; or on the Internet at URL address: http://www.aphis.usda.gov/plant_health/permits/organism/plantpest_howtoapply.shtml.

The State of California Department of Food and Agriculture and the Imperial County Agricultural Commissioner may also be sources for biological control agents or they may have information about where biological control agents may be obtained. Commercial sources should have an Application and Permit to Move Live Plant Pests and Noxious Weeds (USDA-PPQ Form 226 USDA-APHIS-PPQ, Biological Assessment and Taxonomic Support, 4700 River Road, Unit 113, Riverdale, MD 20737) to release specific biological control agents in a state and/or county. Furthermore, certification regarding the biological control agent's identity (genus, specific epithet, sub-species and variety) and purity (e.g., parasite free, pathogen free, and biotic and abiotic contaminants) should be specified in purchase orders.

Biological control agents are subject to 7 RM 8 (Exotic Species Introduction and Management). In addition, Refuge staff must follow the International Code of Best Practice for Classical Biological Control of Weeds (http://invasives.wsu.edu/Code.htm), as ratified by delegates to the X International Symposium on Biological Control of Weeds, Bozeman, Montana (July 9, 1999). This code states the following:

- Release only approved biological control agents;
- Use the most effective agents;
- Document releases; and
- Monitor for impacts to the target pest, non-target species, and the environment.

Biological control agents formulated as pesticide products and registered by the USEPA (e.g., *Bti*) are also subject to review and approval through the pesticide use proposal process.

A record of any releases will be maintained by the Refuge staff with date(s), location(s), and environmental conditions of the release site(s); the identity, quantity, and condition of the biological control agents released; and other relevant data and comments such as weather conditions. Systematic monitoring to determine the establishment and effectiveness of the release is also recommended.

Prior to using any biological control agents, the Service would prepare a NEPA document (e.g., environmental assessment, environmental impact statement) that addresses the potential biological and other environmental effects of using the proposed biological control agent. The Service would also review and, where appropriate, incorporate by reference information included in NEPA documents prepared by another Federal agency, where the scope is relevant to evaluation of releases on Refuge lands. Possible source agencies for such NEPA documents include the Bureau of Land Management, U.S. Forest Service, National Park Service, U.S. Department of Agriculture Animal and Plant Health Inspection Service, and the military services. It might be appropriate to incorporate by reference parts or all of existing document(s) from the review. Incorporating by reference (43 CFR 46.135) is a technique used to avoid redundancies in analysis. It also can reduce the bulk of a Service NEPA document, which only must identify the documents that are incorporated by reference. In addition, relevant portions must be summarized in the Service NEPA document to the extent necessary to provide the decision maker and public with an understanding of relevance of the referenced material to the current analysis.

4.5 Pesticides

Selection and Approval of Pesticides

The selective use of pesticides on the Refuge will be based upon pest ecology (including mode of reproduction), the size and distribution of its populations, site-specific conditions (e.g., soils, topography), known efficacy under similar site conditions, and the capability to utilize BMPs to

reduce and/or eliminate potential effects to non-target species, sensitive habitats, and the potential to contaminate surface and groundwater. All pesticide usage, including the type of product used, target species, application rate, and method of application, will comply with the applicable Federal (FIFRA) and State regulations pertaining to pesticide use, safety, storage, disposal, and reporting.

Before pesticides can be used to eradicate, control, or contain pests on refuge lands and waters, the Refuge Manager must receive approval to use a specific product. Section 569 FW 1 of the Service Manual requires that pesticide use proposals (PUPs) be prepared and approved for each proposed pesticide use associated with annual pest management on refuge lands and waters. A PUP includes specific information about the proposed pesticide use, including the common and chemical names of the pesticide(s), target pest species, size and location of treatment site(s), application rate(s) and method(s), and federally listed species determinations, where applicable.

In accordance with Service guidelines (Director's memo [December 12, 2007]), Refuge staff may receive up to five-year approvals for Washington Office and field reviewed proposed pesticide uses based on meeting identified criteria, including an approved IPM plan, where necessary (http://www.fws.gov/contaminants/Issues/IPM.cfm). The IPM Plan for the Sonny Bono Salton Sea NWR Complex has been completed in association with a CCP, and the environmental effects of implementing the IPM Plan, as required by NEPA, are addressed in Chapter 5 of the draft CCP/EA (USFWS 2013).

Cost may not be the primary factor in selecting a pesticide for use on a refuge. If the least expensive pesticide could result in harm to natural resources or people, then a different product will be selected. The most efficacious pesticide available with the least potential to degrade environment quality (e.g., soils, surface water, and groundwater), as well as the least potential effect to native species and communities of fish, wildlife, plants, and their habitats would be acceptable for use on the Refuge Complex in the context of an IPM approach.

Current and Future Pesticide Use

As of 2012, the pesticides approved and/or considered for use within the Sonny Bono Salton Sea NWR Complex include the herbicides with the active ingredients glyphosate (e.g., Aquaneat, Razor Pro); imazapyr (e.g., Stalker, Habitat); aminopyralid (e.g., Milestone); 2,4-D DMA (e.g., WEEDAR 64); dicamba (e.g., Clarity); triclopyr (e.g., Garlon 3A, Garlon 4); halosulfuron methyl 75 percent (e.g., Sandea); and tribenuron methyl (e.g., Express). With the exception of glyphosate, which has been used to control salt cedar on the Coachella Valley NWR, the use of these products is currently directed at control of invasive plants on the Sonny Bono Salton Sea NWR. More information about these products can be found in the Chemical Profiles provided in Attachment B. Information about how these products are used on the Refuge can be found in Chapter 4 of the draft CCP/EA and the potential effects to the environment of using these products are addressed in Chapter 5 of the draft CCP/EA.

Application Methods

Pesticide application equipment is selected to provide site-specific delivery to target pests while minimizing or eliminating direct or indirect (e.g., drift) exposure to non-target areas and degradation of surface water and groundwater quality. Where possible, target-specific equipment (e.g., backpack sprayer, wiper) will be used to treat target pests. Other target-specific equipment to apply pesticides could include use of a hand wand attached to an ATV sprayer, soaked wicks or paint brushes for wiping vegetation and lances, hatchets, or syringes for direct injection into stems. If used, granular pesticides would be applied using seeders or

other specialized dispensers. For larger areas, such as the managed agricultural fields on the Refuge, herbicides are applied using a boom sprayer attached to a tractor or similar vehicle. To avoid impacts to non-target plants, appropriate buffer areas are maintained between treatment area and other adjacent habitats or commercially grown crops.

Aerial application (e.g., fixed wing or helicopter) of herbicides does not occur on the Coachella Valley NWR, but would be conducted within portions of the Sonny Bono Salton Sea NWR. The products most likely to be applied aerially include Milestone VM (active ingredient: aminopyralid), Clarity (active ingredient: dicamba), WEEDAR 64 (active ingredient: 2,4-D DMA), and Stalker or Habitat (active ingredient: imazapyr). Other products may be considered for aerial application in the future. Aerial application would be conducted via helicopter by a licensed aerial applicator. Helicopter applications are generally made using a boom sprayer. All aerial spraying is regulated by the USEPA, the State of California, and in Imperial County by the Imperial County Agricultural Commissioner. Applications must be conducted in accordance with the specifications provided on the herbicide product label, which generally address under what conditions (e.g., wind speed, temperature, air inversion, precipitation) applications are permitted to occur.

The Imperial County Agricultural Commissioner is responsible for implementing and enforcing the laws and regulations of the County's pesticide use enforcement program. The Agricultural Commissioner issues user permits, which define the manner, method, and approximate time of the proposed application, to all crop growers wishing to apply Restricted Use Materials on their fields. Operator Identification Numbers are issued to all agricultural pesticide applicators.

Approximately 870 acres of managed agricultural fields and areas supporting large infestations of salt cedar, such as adjacent to the New and Alamo rivers, along the Salton Sea shoreline, and within irrigation drains, would be aerially treated. Aminopyralid, 2,4-D DMA, and dicamba would be used to control broadleaf weeds such as cheeseweed (*Malva parviflora*), goosefoot (*Chenopodium album*), puncturevine (*Tribulus terrestris*), and London rocket (*Sisybrium irio*) in agricultural fields and imazapyr would be used to control salt cedar. A mixture of the approved herbicide, a surfactant, and a water conditioner (buffer) would be applied. In the case of Milestone VM, a surfactant (e.g., Agridex, Mor-Act) and a water conditioner (a combination of ammonium sulfate and Quest) would be included in the application mixture to enable the herbicide to stick to and penetrate the broadleaf weeds. Surfactants and water conditioners would also be used in aerial applications of imazapyr. Aerial applications of WEEDAR 64 on managed agricultural fields would consist of a tank mix of 32 ounces of WEEDAR 64 and four ounces of Clarity per acre.

For aerial applications, a minimum 100-foot buffer zone would be provided between all treatment areas and adjacent tree rows, flooded wetlands, and fields supporting commercial crops. The required buffer zone between treated areas and adjacent commercial cropland is generally a quarter mile, although larger buffers may be required by the Imperial County Agricultural Commissioner when sensitive non-target crops are located in proximity to treatment areas. Only one aerial application of each product, which would generally occur between November and February, would be permitted per treatment area per year.

Handling and Mixing

The location of pesticide handling and mixing operations prior to application varies according to the method of application. Mixing and handling operations for ground and aerial applications would occur on the Refuge. Helicopters and hydraulic sprayers would be

accompanied by nurse trucks which supply bulk water for mixing with the pesticides and adjuvants on site. The pesticides would either be mixed directly with water in a bulk tank, or poured into a small vessel connected to an injection system that automatically mixes the pesticide(s) with bulk water as the water flows through the application equipment to the spray nozzles. Cleaning aerial application equipment and disposal of any chemical residues would occur at the contract applicators primary mixing, handling and storage facilities which would be located off-refuge.

Resistance Issues

Because repeated use of one pesticide may allow resistant organisms to survive and reproduce, multiple pesticides with variable modes of action will be considered for treatments on refuge lands and waters. This is especially important if multiple applications within years and/or over a growing season are necessary for habitat maintenance and restoration activities to achieve resource objectives. Integrated chemical and non-chemical controls also are highly effective, where practical, because pesticide resistant organisms can be removed from the site.

4.6 Habitat Restoration and/or Maintenance

Restoration and/or proper maintenance of Refuge habitats associated with achieving wildlife and habitat objectives is the most important step that can be taken to ensure the long-term prevention, eradication, or control (at or below threshold levels) of pests. Promoting desirable plant communities through the manipulation of species composition, plant density, and growth rate is an essential component of invasive plant management (Masters et al. 1996, Masters and Shelly 2001, Brooks et al. 2004). Although herbicide treatment may eliminate or suppress pest species in the short term, the resulting gaps and bare soil create niches that are conducive to further invasion by the species and/or other invasive plants. On degraded sites where desirable species are absent or in low abundance, revegetation with site-appropriate native plant species is necessary to direct and accelerate plant community recovery and to achieve site-specific objectives in a reasonable time frame. The selection of appropriate species for revegetation would be dependent on a number of factors, including resource objectives and site-specific, abiotic factors (e.g., soil texture, precipitation/ temperature regimes, and shade conditions). Seed or plant availability and cost, ease of establishment, seed production, and competitive ability are also important considerations.

To achieve the purposes of the Sonny Bono Salton Sea NWR, active management of habitat areas to support a diversity of avian species will continue to occur and is likely to increase as a result of changing conditions in and around the Salton Sea. Therefore, restoration of historical habitats is not proposed for much of the Refuge located to the south of the Salton Sea, and the need to control invasive plants through an integrated approach to pest management will continue well into the future. The CCP includes IPM strategies for this Refuge that are intended to reduce invasive plant coverage including the continued use of no till practices in the managed agricultural fields. Where are opportunities for native habitat restoration, such as in riparian scrub habitat where salt cedar can be replaced with native willow (i.e., *Salix gooddingii*) and screwbean mesquite (*Prosopis pubescens*), they have been addressed in the CCP through objectives and strategies.

The CCP for the Sonny Bono Salton Sea NWR Complex also includes objectives and associated strategies for managing existing native habitats on the Coachella Valley NWR to maximize habitat quality, restoring native species in disturbed areas, and conducting periodic surveys to identify new invasive species and implement actions to control the new species before they become a significant problem.

5. Priorities for Treatments

For many refuges, the magnitude (number, distribution, and sizes of infestations) of pest problems is too extensive and beyond the available capital resources to effectively address during any single field season. To manage pests within the Sonny Bono Salton Sea NWR Complex, it is essential that treatment of infestations be prioritized. Highest priority treatments would be focused on early detection and rapid response to eliminate infestations of new pests, if possible. This is especially important for aggressive pests potentially affecting species, species groups, communities, and/or habitats of species associated with Refuge purpose(s); NWRS resources of concern (e.g., federally listed species, migratory birds, and selected marine mammals); and native species needed to maintain and/or restore a refuge's biological integrity, diversity, and environmental health.

The next priority would be treating established pests that appear in one or more previously uninfested areas. Moody and Mack (1988) demonstrated through modeling that small new outbreaks of invasive plants eventually would infest an area larger than the established source population. They also found that control efforts focusing on the large main infestation rather than the new small satellites reduced the chances of overall success. The lowest priority would be treating large infestations (sometimes monotypic stands) of well-established pests. In this case, initial efforts would focus on containment of the perimeter followed by work to control/eradicate the established infested area. If containment or control of a large infestation is not effective, then efforts would focus on halting pest reproduction or managing source populations. Maxwell et al. (*2009*) found treating fewer populations that are sources represents an effective long-term strategy for reducing the total number of invasive populations and decreasing metapopulation growth rates.

Although State listed noxious weeds are always of high priority for management, other pest species known to cause substantial ecological impact will also be considered. Pest control would likely require a multi-year commitment from Refuge staff. Essential to the long-term success of pest management would be pre- and post-treatment monitoring, assessment of the successes and failures of treatments, and the development of new approaches when proposed methods do not achieve desired outcomes.

6. Best Management Practices

Best management practices (BMPs) can minimize or eliminate possible effects associated with pesticide usage to non-target species and/or sensitive habitats, as well as degradation of water quality from drift, surface runoff, or leaching. Based upon the Department of Interior Pesticide Use Policy (517 DM 1) and the Service Pest Management Policy and Responsibilities (30 AM 12), the use of applicable BMPs (where feasible) during the application of pesticides will minimize the potential for adverse effects to federally listed species and/or their critical habitats.

Presented here are BMPs pertaining to the mixing, handling, and application of all ground-based treatments of pesticide. These BMPs will be implemented, as appropriate, based upon target- and site-specific factors and time-specific environmental conditions on the Refuges within the Sonny Bono Salton Sea NWR Complex. Although not listed here, the most important BMP to eliminate and/or reduce potential impacts to non-target resources would be an IPM approach to prevent, control, eradicate, and contain pests.

Pesticide Handling and Mixing

- As a precaution against spilling, spray tanks will not be left unattended during filling.
- All pesticide spray equipment will be properly cleaned. Where possible, rinsate will be used as part of the makeup water in the sprayer tank and applied to treatment areas.
- All pesticide containers will be triple rinsed and the rinsate will be used as water in the sprayer tank and applied to treatment areas.
- When a pesticide container is marked as recyclable, Refuge staff will deliver the triple rinsed pesticide containers to the appropriate herbicide container collection site.
- All unused pesticides will be properly discarded at a local "safe send" collection.
- Pesticides and pesticide containers will be lawfully stored, handled, and disposed of in accordance with the label and in a manner that will safeguard human, fish, and wildlife health and that will prevent soil and water contamination.
- Refuge staff will consider the water quality parameters (e.g., pH, hardness) that are important to ensure the greatest efficacy when specified on the pesticide label.
- All pesticide spills will be addressed immediately using procedures identified in the Refuge's spill response plan.

Applying Pesticides

- Pesticide treatments will only be conducted by or under the supervision of Service personnel and non-Service applicators with the appropriate, State or BLM certification to safely and effectively conduct these activities on Refuge lands and waters.
- Refuge staff will comply with all Federal, State, and local pesticide use laws and regulations, as well as Departmental, Service, and NWRS pesticide-related policies. For example, Refuge staff will use application equipment and apply rates for the specific pest(s) identified on the pesticide label as required under FIFRA.
- Before each treatment season and prior to mixing or applying any product for the first time each season, all applicators will review the product label, Material Safety Data Sheet (MSDS), and PUP for each pesticide, determining the target pest, appropriate mix rate(s), personal protective equipment (PPE), and other requirements listed on the pesticide label.
- Buffers will be maintained between sensitive resource areas and treatment areas; the width of the buffer will vary depending upon the type of wetland resources present and the product being applied (refer to the specific Chemical Profile and/or PUP),
- Refuge staff will use low impact herbicide application techniques (e.g., spot treatment, cut stump, oil basal, Thinvert system applications) rather than broadcast foliar applications (e.g., boom sprayer, other larger tank wand applications), where practical.
- Refuge staff will use low volume rather than high volume foliar applications when the low impact methods described above are not feasible or practical, to maximize herbicide effectiveness and ensure correct and uniform application rates.
- Applicators will use and adjust spray equipment to apply the coarsest droplet size spectrum with optimal coverage of the target species while reducing drift.
- Applicators will use the largest droplet size that results in uniform coverage.
- Applicators will use drift reduction technologies such as low-drift nozzles.
- Spraying will occur during low (average less than 7 mph and preferably 3-5 mph) and consistent direction wind conditions with moderate temperatures (typically less than 85°F).
- Applicators will avoid spraying during inversion conditions (often associated with very low to calm wind conditions) that can cause herbicide drift to non-target areas.
- Equipment will be calibrated regularly to ensure that the proper rate of pesticide is

applied to the target area or species.

- Spray applications will be made at the lowest height for uniform coverage of target pests to minimize or eliminate potential drift.
- If windy conditions frequently occur during afternoons, spraying (especially boom treatments) will typically be conducted during early morning hours.
- Spray applications will not be conducted on days with greater than 30 percent forecast for rain within six hours, except for pesticides that are rapidly rain fast (e.g., glyphosate in 1 hour) or pesticides that need rain to activate the product (e.g., oryzalin) so as to minimize or eliminate potential runoff.
- Applicators will use drift retardant adjuvants during spray applications, especially adjacent to sensitive areas.
- Applicators will use a non-toxic dye to aid in identifying treated target areas and any areas of over spray or drift. A dye can also aid in detecting equipment leaks. If a leak is discovered, the application will be stopped until repairs can be made to the sprayer.
- When drift cannot be sufficiently reduced through altering equipment set up and application techniques, buffer zones may be identified to protect sensitive areas downwind of applications. When an application is required adjacent to a sensitive habitat area, it will only occur when the wind is blowing away from the habitat area.
- For aerial applications, provide a 100-foot-wide buffer between treatment areas and row tree and wetland areas.
- Conduct half-boom aerial applications along all buffer edges.
- To eliminate unnecessary pesticide applications, Refuge staff will examine the target area for the presence of expected pests prior to applying a pesticide product.
- Refuge staff will consider the timing of a pesticide application to ensure that native plants are protected (e.g., senescence) while effectively treating invasive plants.
- Application equipment (e.g., backpack sprayer, transport vehicles) will be thoroughly cleaned and PPEs removed and properly disposed of on-site after treatments.

7. Safety

The transport, storage, handling, mixing, application, and disposal of pesticides are all regulated to protect applicators, other workers, the public, and the environment. It is important that all parties have the information necessary to avoid inappropriate exposure to humans and natural resources.

7.1 Personal Protective Equipment

All applicators will wear the specific personal protective equipment (PPE) identified on the pesticide label, and the appropriate PPE will be worn at all times during handling, mixing, and applying of the pesticide. PPEs can include disposable (e.g., Tyvek) or laundered coveralls, gloves (e.g., latex, rubber, or nitrile), rubber boots, eye protective wear, and/or a National Institute of Occupational Safety and Health (NIOSH) approved respirator. Because exposure to concentrated product is usually greatest during mixing, extra care will be taken while preparing pesticide solutions. Persons mixing these solutions can be best protected if they wear long gloves, an apron, appropriate footwear, and a face shield.

Coveralls and other protective clothing used during an application will be laundered separately from other laundry items. Transporting, storing, handling, mixing and disposing of pesticide containers will be consistent with label requirements, USEPA and OSHA requirements, and Service policy.

If a respirator is necessary for a pesticide use, the respirator will be used in accordance with the Service's Respiratory Protection policy (242 FW 14). Use of respirator in accordance with this policy requires that there be a written, site-specific respiratory protection plan for each work area where employees are required to wear respirators, a sufficiently trained Respiratory Protection Program Administrator to conduct and coordinate the respiratory protection plan at each facility requiring it, the availability of appropriate respirators and accessories for those who must wear them, and a clean storage area for respirators and their accessories at the work site. Respirators will only be issued to individuals who complete a Request for Respirator Clearance, pass a medical evaluation documenting that the individual is medically qualified for respirator use, complete the required respirator training, and successfully pass respirator fit testing. Respirators must be fit tested at least once a year. The policy also includes specific requirements for maintaining, cleaning, inspecting, and storing Service respirators.

7.2 Notification

The restricted entry interval is the time period required after the application at which point someone may safely enter a treated area without PPE. Refuge staff, authorized management agents of the Service, volunteers, and members of the public who could be in or near a pesticide treated area within the stated re-entry time period on the label will be notified about treatment areas. Posting will occur at any site where individuals might inadvertently become exposed to a pesticide during other activities on the Refuge. Where required by the label and/or State regulations, the perimeter of treated sites and other likely points of entry will be posted.

7.3 Medical Surveillance

Medical surveillance may be required for Service personnel and approved volunteers who mix, apply, and/or monitor the use of pesticides (see 242 FW 7 [Pesticide Users] and 242 FW 4 [Medical Surveillance]). In accordance with 242 FW 7.12A, Service personnel will be medically monitored if one or more of the following criteria is met: exposed or may be exposed to concentrations at or above the published permissible exposure limits or threshold limit values (see 242 FW 4); use pesticides in a manner considered "frequent pesticide use;" or use pesticides in a manner that requires a respirator (see 242 FW 14 for respirator use requirements). In 242 FW7.7A, "Frequent Pesticide Use means when a person applying pesticide handles, mixes, or applies pesticides, with a Health Hazard rating of 3 or higher, for 8 or more hours in any week or 16 or more hours in any 30-day period." Under some circumstances, individuals may be medically monitored who use pesticides infrequently (see section 7.7), experience an acute exposure (sudden, short term), or use pesticides with a health hazard ranking of 1 or 2. This decision will consider the individual's health and fitness level, the pesticide's specific health risks, and the potential risks from other pesticide-related activities. Other authorized agents (e.g., State and county employees) will be responsible for their own medical monitoring needs and costs. Standard examinations (at the Refuge's expense) of appropriate Refuge staff will be provided by the nearest certified occupational health and safety physician as determined by Federal Occupational Health.

7.4 Certification and Supervision of Pesticide Applicators

Appropriate Refuge staff or approved volunteers handling, mixing, and/or applying or directly supervising others engaged in pesticide use activities will be trained and State or federally (BLM) licensed to apply pesticides on the Sonny Bono Salton Sea NWR and the Coachella Valley NWR. In accordance with 242 FW7.18A and 569 FW 1.10B, certification is required to apply restricted use pesticides based upon USEPA regulations. For safety reasons, all individuals participating in pest management activities with general use pesticides also are encouraged to attend appropriate training or acquire pesticide applicator certification. A

Qualified Applicator Certificate, as required by the State of California, will be obtained by any person on the Refuge who applies or supervises the application of federally restricted use pesticides or State restricted materials. New staff unfamiliar with proper procedures for storing, mixing, handling, applying, and disposing of pesticides and containers will receive orientation and training before handling or using any products. Documentation of training will be kept in the files at the Refuge Complex headquarters.

7.5 Recordkeeping

Labels and Material Safety Data Sheets (MSDSs)

Approved PUPs stored in the PUPS database typically contain website links (URLs) to pesticide labels and MSDSs. Pesticide labels and MSDSs for all products approved for use on the Sonny Bono Salton Sea NWR Complex are maintained in the Complex's pesticide storage building, the Refuge Complex maintenance building, and at the Complex headquarters office. These documents are also carried by field applicators, where possible. A written reference (e.g., note pad, chalk board, dry erase board) for each tank to be mixed will also be kept in the mixing area for quick reference while mixing is in progress.

Pesticide Use Proposal System (PUPS)

PUP records provide a detailed, time-, site-, and target-specific description of the proposed use of pesticides on the Refuge. All PUPs will be created, approved or disapproved, and stored in the PUPS, which is a centralized database only accessible on the Service's intranet (https://systems.fws.gov/pups). Only Service employees would be authorized to access PUP records in this database.

Pesticide Usage

In accordance with 569 FW 1, the Refuge Project Leader is required to maintain records of all pesticides annually applied on lands or waters under Refuge jurisdiction. This would encompass pesticides applied by other Federal agencies, State and county governments, and non-government applicators, including cooperators and their pest management service providers with Service permission. For clarification, pesticide means all insecticides, insect and plant growth regulators, desiccants, herbicides, fungicides, rodenticides, acaricides, nematicides, fumigants, avicides, and piscicides.

The following usage information is reported for approved PUPs in the PUPS database:

- pesticide trade name(s);
- active ingredient(s);
- total acres treated;
- total amount of pesticides used (pounds or gallons);
- total amount of active ingredient(s) used (pounds), target pest(s); and
- efficacy (percent control).

To determine whether treatments are efficacious (i.e., eradicating, controlling, containing the target pest) and achieving resource objectives, habitat and/or wildlife response is monitored both pre- and post-treatment, where possible. Considering available annual funding and staffing, appropriate monitoring data regarding characteristics (attributes) of pest infestations (e.g., area, perimeter, degree of infestation-density, percent cover, density), as well as habitat and/or wildlife response to treatments, may be collected and stored in a relational database (e.g., Refuge Habitat Management Database), preferably a geo-referenced data management system (e.g., Refuge Lands GIS [RLGIS]) to facilitate data analyses and subsequent reporting. In accordance with adaptive management, data analysis and interpretation would allow treatments to be modified or changed over time, as necessary, to achieve resource objectives

considering site-specific conditions in conjunction with habitat and/or wildlife responses. Monitoring could also identify short- and long-term impacts to natural resources and environmental quality associated with IPM treatments in accordance with adaptive management principles identified in 43 CFR 46.145.

8. Evaluating Pesticide Use Proposals

Pesticides will only be used on the Sonny Bono Salton Sea NWR and the Coachella Valley NWR for habitat management and facilities maintenance after approval of a PUP. Approval of a PUP generally is issued where there would likely be only minor, temporary, or localized effects to fish, wildlife, and sensitive plant species; minimal potential to degrade environmental quality; and pesticide application is proposed to be implemented with appropriate BMPs as discussed previously. Potential effects to listed and non-listed species are evaluated with quantitative ecological risk assessments and other screening measures. Potential effects to environmental quality are determined based upon pesticide characteristics of environmental fate (e.g., water solubility, soil mobility, soil persistence, and volatilization) and other quantitative screening tools. Ecological risk assessments, characteristics of environmental fate, and potential to degrade environmental quality are all documented in Chemical Profiles as discussed previously. These profiles are to include threshold values for quantitative measures of ecological risk assessments and screening tools for environmental fate that represent minimal potential effects to species and environmental quality.

8.1 Overview of Ecological Risk Assessment

An ecological risk assessment process would be used to evaluate potential adverse effects to biological resources as a result of a pesticide(s) proposed for use on the Refuge. This process is an established quantitative and qualitative methodology for comparing and prioritizing risks of pesticides and conveying an estimate of the potential risk for an adverse effect. This quantitative methodology provides an efficient mechanism to integrate best available scientific information regarding hazard, patterns of use (exposure), and dose-response relationships in a manner that is useful for ecological risk decision making. It provides an effective way to evaluate potential effects where there is missing or unavailable scientific information (data gaps) to address reasonable, foreseeable adverse effects in the field as required under 40 CFR Part 1502.22. Protocols for ecological risk assessment of pesticide use on Refuge lands and waters were developed through research and established by the USEPA (2004). Assumptions for these risk assessments are presented in the section of titled Priorities for Treatment.

The toxicological data used in ecological risk assessments are typically results of standardized laboratory studies provided by pesticide registrants to the USEPA to meet regulatory requirements under FIFRA. These studies assess the acute (lethality) and chronic (reproductive) effects associated with short- and long-term exposure to pesticides on representative species of birds, mammals, freshwater fish, aquatic invertebrates, and terrestrial and aquatic plants. Other effects data publicly available would also be utilized for risk assessment protocols. Toxicity endpoint and environmental fate data are available from a variety of resources. Some of the more useful resources can be found in the section of this appendix titled Priorities for Treatment.

8.2 Determining Ecological Risk to Fish, Wildlife, and Terrestrial Plants

The potential for pesticides used on the Sonny Bono Salton Sea NWR Complex to cause direct adverse effects to sensitive plants, fish, and wildlife would be evaluated using USEPA's Ecological Risk Assessment Process (USEPA 2004). The risks posed to the trust resources protected on these refuges are particularly important because of the Federal endangered bird

and fish species supported on the Sonny Bono Salton Sea NWR and the Federal endangered and threatened reptile and plant species supported on the Coachella Valley NWR.

The Ecological Risk Assessment Process, which is based upon a two-phase process involving estimation of environmental concentrations and then characterization of risk, integrates exposure estimates (estimated environmental concentration [EEC] and toxicological endpoints [e.g., LC_{50} and oral LD_{50}]) to evaluate the potential for adverse effects to species groups (birds, mammals, and fish) representative of legal mandates for managing units of the NWRS. This integration is achieved through risk quotients (RQs) calculated by dividing the EEC by acute and chronic toxicity values selected from standardized toxicological endpoints or published effect (Table 1).

$$RQ = EEC/Toxicological\ Endpoint$$

Table 1
Ecotoxicity Tests Used to Evaluate Potential Effects to Birds, Fish, Mammals, and Terrestrial Plants to Establish Toxicity Endpoints for Risk Quotient Calculations

Species Group	Exposure	Measurement Endpoint
Bird	Acute	Median Lethal Concentration (LC_{50})
	Chronic	No Observed Effect Concentration (NOEC) or No Observed Adverse Effect Concentration (NOAEC)[1]
Fish	Acute	Median Lethal Concentration (LC_{50})
	Chronic	No Observed Effect Concentration (NOEC) or No Observed Adverse Effect Concentration (NOAEC)[2]
Mammal	Acute	Oral Lethal Dose (LD_{50})
	Chronic	No Observed Effect Concentration (NOEC) or No Observed Adverse Effect Concentration (NOAEC)[3]
Terrestrial Plants (Non-target)	Acute	Estimated Environmental Concentration/EC_{25}[4]
Terrestrial Plants (Listed Species)	Acute	No Observed Effect Concentration (NOEC) or Estimated Environmental Concentration/EC_{05}[4]

[1]Measurement endpoints typically include a variety of reproductive parameters (e.g., number of eggs, number of offspring, eggshell thickness, and number of cracked eggs).

[2]Measurement endpoints for early life stage/life cycle typically include embryo hatch rates, time to hatch, growth, and time to swim-up.

[3]Measurement endpoints include maternal toxicity, teratogenic effects or developmental anomalies, evidence of mutagenicity or genotoxicity, and interference with cellular mechanisms (e.g., DNA synthesis, DNA repair).

[4]Measurement endpoints evaluated from toxicity studies that quantify seedling emergence and vegetative vigor.

The level of risk associated with direct effects of pesticide use are characterized by comparing calculated RQs to the appropriate Level of Concern (LOC) established by USEPA (1998 [Table 2]). The LOC represents a quantitative threshold value for screening potential adverse effects to fish and wildlife resources associated with pesticide use. The following are four exposure-species group scenarios that would be used to characterize ecological risk to fish and wildlife on a NWR: acute listed species, acute non-listed species, chronic listed species, and chronic non-listed species.

Acute risk indicates the potential for mortality associated with short-term dietary exposure to pesticides immediately after an application. For characterization of acute risks, median values from LC_{50} and LD_{50} tests are used as toxicological endpoints for RQ calculations. In contrast, chronic risks indicate the potential for adverse effects associated with long-term dietary exposure to pesticides from a single application or multiple applications over time (within a season and over years). For characterization of chronic risks, the no observed concentration (NOAEC) or no observed effect concentration (NOEC) for reproduction are used as toxicological endpoints for RQ calculations. Where available, the NOAEC is preferred over a NOEC value.

Listed species are those federally designated as threatened, endangered, or proposed in accordance with the Endangered Species Act of 1973 (16 USC 1531-1544, 87 Stat. 884, as amended-Public Law 93-205). The Sonny Bono Salton Sea NWR supports the Federal endangered Yuma clapper rail and desert pupfish, while the Coachella Valley NWR supports the Federal threatened Coachella Valley fringe-toed lizard and the endangered plant, Coachella Valley milk-vetch. For listed species, potential adverse effects are assessed at the individual level because loss of individuals from a population could detrimentally affect a species. In contrast, risks to non-listed species are considered effects at the population level. A RQ<LOC indicates the proposed pesticide use "may affect, not likely to adversely affect" individuals (listed species), and it would not pose an unacceptable risk for adverse effects to populations (non-listed species) for each taxonomic group (Table 2). In contrast, a RQ>LOC indicates a "may affect, likely to adversely affect" for listed species, and it would also pose unacceptable ecological risk for adverse effects to non-listed species.

Table 2
Presumption of Unacceptable Risk for Birds, Fish, Mammals, and Terrestrial Plants

Risk Presumption		Level of Concern	
		Listed Species	Non-listed Species
Acute	Birds	0.1	0.5
	Fish	0.05	0.5
	Mammals	0.1	0.5
	Terrestrial Plants*	1.0	1.0
Chronic	Birds	1.0	1.0
	Fish	1.0	1.0
	Mammals	1.0	1.0

Source: (USEPA 1998) *Source: (USEPA 2004)

For terrestrial plants, the assessment endpoint concerns the status of non-target plant populations whose responses to pesticide exposure is evaluated from toxicity studies that quantify seedling emergence and vegetative vigor. Although it is recognized that the endpoints of seedling emergence and vegetative vigor may not address all terrestrial plant life cycle components, the USEPA in its assessment assumes that impacts at emergence and in the active growth stages have the potential to impact individual plant competitive ability and reproductive success (USEPA 2004). When determining the LOC for endangered plants, RQs are derived using lower toxicity endpoints than non-endangered plants.

8.3 Environmental Exposure

Following release into the environment through application, pesticides experience several different routes of environmental fate. Pesticides that are sprayed can move through the air (e.g., particle or vapor drift) and may eventually end up in other parts of the environment such as non-target vegetation, soil, or water. Pesticides applied directly to the soil may be washed off the soil into nearby bodies of surface water (e.g., surface runoff) or may percolate through the soil to lower soil layers and groundwater (e.g., leaching) (Baker and Miller 1999, Pope et. al. 1999, Butler et. al. 1998, Ramsay et. al. 1995, EXTOXNET 1993a). Pesticides that are injected into the soil may also be subject to the latter two fates. The aforementioned possibilities are by no means complete, but it does indicate that movement of pesticides in the environment is very complex with transfers occurring continually among different environmental compartments. In some cases, these exchanges occur not only between areas that are close together, but may also involve transportation of pesticides over long distances (Barry 2004, Woods 2004).

Terrestrial Exposure

The EEC for exposure to terrestrial wildlife is quantified using a USEPA screening-level approach (USEPA 2004). This screening-level approach is not affected by product formulation because it evaluates pesticide active ingredient(s). This approach would vary depending upon the proposed pesticide and method of application to be used.

Spray Application - For spray applications, exposure is determined by using the Kanaga nomogram method (Pfleeger et al. 1996, USEPA 2004, USEPA 2005a) through the USEPA's Terrestrial Residue Exposure model (T-REX) version 1.2.3 (USEPA 2005b). To estimate the maximum (initial) pesticide residue on short grass (less than 20 cm tall) as a general food item category for terrestrial vertebrate species, T-REX input variables include the following from the pesticide label: maximum pesticide application rate (pounds active ingredient [acid equivalent]/acre) and pesticide half-life (days) in soil. Although there are other food item categories (tall grasses; broadleaf plants and small insects; and fruits, pods, seeds and large insects), short grass was selected because it would yield maximum EECs (240 ppm per pound of active ingredient (ai) per acre) for worst-case risk assessments. Short grass is not representative of forage for carnivorous species (e.g., raptors), but it would characterize the maximum potential exposure through the diet of avian and mammalian prey items. Consequently, this approach provides a conservative screening tool for pesticides that do not biomagnify.

For RQ calculations in T-REX, the model requires the weight of surrogate species and Mineau scaling factors (Mineau et al. 1996). Body weights of bobwhite quail and mallard are included in T-REX by default, but body weights of other organisms (Table 3) can be entered manually. The Mineau scaling factor accounts for small-bodied bird species that may be more sensitive to pesticide exposure than would be predicted only by body weight. Mineau scaling factors are entered manually with values, which are unique to a particular pesticide or group of pesticides, ranging from 1 to 1.55. If specific information to select a scaling factor is not available, then a value of 1.15 is used as a default. Alternatively, zero is entered if it is known that body weight does not influence toxicity of the pesticide(s) being assessed. The upper bound estimate output from the T-REX Kanaga nomogram is used as an EEC for calculation of RQs. This approach yields a conservative estimate of ecological risk.

Granular Application - Granular pesticide formulations and pesticide-treated seed pose a unique route of exposure for avian and mammalian species. In these cases, the pesticide is applied in discrete units that birds or mammals might accidentally ingest with food items or intentionally ingest when actively seeking and picking up seed to eat or gravel or grit to aid digestion. Granules may also be consumed by wildlife foraging on earthworms, slugs, or other soft-bodied soil organisms to which the granules may adhere.

Terrestrial wildlife RQs for granular formulations or seed treatments are calculated by dividing the maximum milligrams of ai exposed (e.g., EEC) on the surface of an area equal to one square foot by the appropriate LD_{50} value multiplied by the surrogate's body weight (refer to Table 3). An adjustment to surface area calculations is made for broadcast, banded, and in-furrow applications. An adjustment is also made for applications with and without incorporation of the granules. Without incorporation, assumes that 100 percent of the granules remain on the soil surface available to foraging birds and mammals. Press wheels push granules flat with the soil surface, but they are not incorporated into the soil. If granules are incorporated in the soil during band or T-band applications or after broadcast applications, it is assumed that only 15 percent of the applied granules remain available to wildlife. Following in-furrow applications, it is assumed that only one percent of the granules are available on the soil surface.

Table 3
Average Body Weight of Selected Terrestrial Wildlife Species Frequently Used in Research to Establish Toxicological Endpoints

Species	Body Weight (kg)
Mammal (15 g)	0.015
House sparrow	0.0277
Mammal (35 g)	0.035
Starling	0.0823
Red-winged blackbird	0.0526
Common grackle	0.114
Japanese quail	0.178
Bobwhite quail	0.178
Rat	0.200
Rock dove (aka pigeon)	0.542
Mammal (1000 g)	1.000
Mallard	1.082
Ring-necked pheasant	1.135

Source: (Dunning 1984)

EECs for pesticides applied in granular form and as seed treatments are calculated based on potential ingestion rates of avian or mammalian species (e.g., 10-30 percent body weight per day). This provides an estimate of maximum exposure that may occur as a result of granule or seed treatment spills, which commonly occur at end rows during application and planting. The availability of granules and seed treatments to terrestrial vertebrates is also considered by calculating the loading per unit area (LD_{50}/ft^2) for comparison to USEPA LOCs (USEPA 1998). The T-REX version 1.2.3 (*USEPA 2005b*) contains a submodel that automates Kanaga exposure calculations for granular pesticides and treated seed.

The following formulas are used to calculate EECs depending upon the type of granular pesticide application:

For in-furrow applications, assume a typical value of one percent granules, bait, or seed remain unincorporated.

$$mg\ ai/ft.^2 = [(lbs.\ product/acre)(\%\ ai)(453{,}580\ mg/lbs.)(1\%\ exposed))] / \{[(43{,}560\ ft.^2/acre)/(row\ spacing\ (ft.))] / (row\ spacing\ (ft.)\}$$

or

$$mg\ ai/ft.^2 = [(lbs.\ product/1000\ ft.\ row)(\%\ ai)(1000\ ft.\ row)(453{,}580\ mg/lb.)(1\%\ exposed)$$

$$EEC = [(mg\ ai/ft.^2)(\%\ of\ pesticide\ biologically\ available)]$$

For incorporated banded treatments, assume that 15 percent of granules, bait, seeds are unincorporated.

$$mg\ ai/ft.^2 = [(lbs.\ product/1000\ row\ ft.)(\%\ ai)(453{,}580\ mg/lb.)(1\text{-}\%\ incorporated)] / (1{,}000\ ft.)(band\ width\ (ft.))$$

$$EEC = [(mg\ ai/ft.^2)(\%\ of\ pesticide\ biologically\ available)]$$

For broadcast treatment without incorporation, assume 100 percent of granules, bait, and seeds are unincorporated.

$$mg\ ai/ft.^2 = [(lbs.\ product/acre)(\%\ ai)(453{,}590\ mg/lb.)] / (43{,}560\ ft.^2/acre)$$

$$EEC = [(mg\ ai/ft.^2)(\%\ of\ pesticide\ biologically\ available)]$$

Where:

- *percent of pesticide biologically available = 100% without species specific ingestion rates*
- *Conversion for calculating mg ai/ft.^{2} using ounces: 453,580 mg/lb. /16 = 28,349 mg/oz.*

The following equation is used to calculate a RQ based on the EEC calculated by one of the previous equations. The EEC is divided by the surrogate LD_{50} toxicological endpoint multiplied by the body weight (Table 3) of the surrogate.

$$RQ = EEC / [LD_{50}\ (mg/kg) * body\ weight\ (kg)]$$

As with other risk assessments, a RQ>LOC is presumed an unacceptable ecological risk. A RQ<LOC is considered an acceptable risk with only minor, temporary, or localized effects to species.

For terrestrial plants, exposure calculations are based on a pesticide's water solubility and the amount of pesticide present on the soil surface within the first inch of depth (*USEPA 2004*), the natural variation in measurement endpoints for terrestrial plant toxicity tests has not been established (Kurnath 2008).

Aquatic Exposure. Exposures to aquatic habitats (e.g., wetlands, meadows, ephemeral pools, water delivery ditches) are evaluated separately for ground-based pesticide treatments. The primary exposure pathway for aquatic organisms from any ground-based treatments likely would be particle drift during the pesticide application. However, different exposure scenarios must be considered as a result of contrasting application equipment and techniques. In addition, the type of pesticides used to control pests as part of facilities maintenance (e.g., roadsides, parking lots, trails) may vary from those used to manage habitats on the refuge. Further, pesticide applications may be done less than 25 feet from the high water mark of aquatic habitats for habitat management treatments; whereas, no-spray buffers (greater than or equal to 25 feet) would be used for facilities maintenance treatments.

For the worst-case exposure scenario to non-target aquatic habitats, EECs (Table 4) are derived from Urban and Cook (1986) and assume an intentional overspray to an entire, non-target water body (one-foot depth) from a treatment <25 feet from the high water mark using the maximum application rate (acid basis). However, use of BMPs for applying pesticides (see the section of this appendix titled IPM Strategies for Invasive Plants) would likely minimize/eliminate potential drift to non-target aquatic habitats during actual treatments. An unacceptable (acute or chronic) risk to fish and wildlife with the simulated 100 percent overspray (RQ>LOC) would likely result in a proposed pesticide being disapproved or the pesticide proposal being approved at a lower application rate to minimize or eliminate unacceptable risk to aquatic organisms (RQ=LOC).

8.4 Cropland and Facilities Maintenance Treatments

Field drift studies conducted by the Spray Drift Task Force, which is a joint project of several agricultural chemical businesses, were used to develop a generic spray drift database. From this database, the AgDRIFT computer model was created to satisfy USEPA pesticide registration spray drift data requirements and as a scientific basis to evaluate off-target movement of pesticides from particle drift and to assess potential effects of exposure to wildlife. Several versions of the computer model have been developed (i.e., v2.01 through v2.10). The Spray Drift Task Force AgDRIFT model version 2.01 (AgDRIFT 2001, SDTF 2003) would be used to derive EECs resulting from drift of pesticides to Refuge aquatic resources from ground-based pesticide applications 25 feet or more from the high water mark. The Spray Drift Task Force AgDRIFT model is publicly available at http://www.agdrift.com. At this website, click AgDRIFT 2.0, click Download Now, and follow the instructions to obtain the computer model.

The AgDRIFT model is composed of submodels called tiers. Tier I Ground submodel is used to assess ground-based applications of pesticides. Tier outputs (EECs) are calculated with AgDRIFT using the following input variables: maximum application rate (acid basis), low boom (20 inches), fine to medium droplet size, USEPA-defined wetland, and a 25-foot or more distance (buffer) from treated area to water.

Table 4 Estimated Environmental Concentrations of Pesticides in Aquatic Habitats (1 foot depth) Immediately after Direct Application	
Lbs./acre	**EEC (ppb)**
0.10	36.7
0.20	73.5
0.25	91.9
0.30	110.2
0.40	147.0
0.50	183.7
0.75	275.6
1.00	367.5
1.25	459.7
1.50	551.6
1.75	643.5
2.00	735.7
2.25	827.6
2.50	919.4
3.00	1103.5
4.00	1471.4
5.00	1839
6.00	2207
7.00	2575
8.00	2943
9.00	3311
10.00	3678

Source: (Urban and Cook 1986)

There is also an AgDRIFT aerial model (Bird et al. 2001) which indicates that model predictions multiplied by a safety factor of two will generally be in excess of the observed (field) value over 80 percent of the time. For example, AgDRIFT calculates the estimated average environmental concentration is equal to the selected toxicological endpoint at 40 feet from a sensitive site such as a water body. Statistically the estimated environmental concentration would be expected to be equal to or less than the reference toxicological endpoint 80 percent of the time at 80 feet from the downwind edge of the application (USFWS 2006). This procedure will be used to establish aerial buffer zones for each pesticide that is proposed for aerial application on the Sonny Bono Salton Sea NWR. Using this procedure to establish buffer zones for aerial applications has two important attributes. First, it will provide a definable conservative estimate of pesticide deposition resulting from particle drift by aerial application, and second, it is supported by peer reviewed scientific research.

Required buffers for specific products will be determined as part of the PUP approval process. The products currently proposed for aerial application on the Sonny Bono Salton Sea NWR include Milestone VM (active ingredient: aminopyralid), WEEDAR 64 (active ingredient: 2,4-D DMA), and Clarity (active ingredient: dicamba), which would be used to control broad-leafed weeds in the managed agricultural fields, and Stalker or Habitat (active ingredient: imazapyr),

which would be used to control dense stands of salt cedar. Other products may be proposed for aerial application in the future and would be evaluated through PUPS.

8.5 Use of Information on Effects of Pesticides, Biological Controls, Degradates, and Adjuvants

Where the scope of a NEPA document prepared by another Federal agency is relevant to the evaluation of the effects of pesticide uses on refuge lands, that document may, in accordance with 43 CRF 46.120(d), be incorporated by reference into Service NEPA documents that address the impacts of pesticides on refuge resources. As such, it may be appropriate to incorporate through reference ecological risk assessments prepared by the U.S. Forest Service (http://www.fs.fed.us/r6/invasiveplant-eis/Risk-Assessments/Herbicides- Analyzed-InvPlant-EIS.htm) and Bureau of Land Management (http://www.blm.gov/wo/st/en/prog/ more/ veg_eis.html). These risk assessments and the associated documentation are available in total with the administrative record for the Final Environmental Impact Statement entitled *Pacific Northwest Region Invasive Plant Program – Preventing and Managing Invasive Plants* (U.S. Forest Service 2005) and *Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic EIS (PEIS)* (Bureau of Land Management 2007).

As a basis for completing "Chemical Profiles" for approving or disapproving refuge PUPs, ecological risk assessments for the following herbicide and adjuvant uses prepared by the U.S. Forest Service are incorporated by reference:

- 2,4-D
- Chlorosulfuron
- Clopyralid
- Dicamba
- Glyphosate
- Imazapic
- Imazapyr
- Metsulfuron methyl
- Picloram
- Sethoxydim
- Sulfometuron methyl
- Triclopyr
- Nonylphenol polyethylate (NPE) based surfactants

As a basis for completing "Chemical Profiles" for approving or disapproving refuge PUPs, ecological risk assessments for the following herbicides and pesticide degradates and adjuvants, prepared by the Bureau of Land Management, are incorporated by reference:

- Bromacil
- Chlorsulfuron
- Diflufenzopyr
- Diquat
- Diuron
- Fluridone
- Imazapic
- Overdrive (diflufenzopyr and dicamba)
- Sulfometuron methyl
- Tebuthiuron
- Pesticide degradates and adjuvants

8.6 Assumptions for Ecological Risk Assessments

There are a number of assumptions involved with the ecological risk assessment process for terrestrial and aquatic organisms associated with utilization of the USEPA (2004) process. These assumptions may be risk neutral or may lead to an overestimation or underestimation of risk from pesticide exposure depending upon site-specific conditions. The following describes these assumptions, their application to the conditions typically encountered, and whether or not they may lead to recommendations that are risk neutral or may underestimate or overestimate ecological risk from potential pesticide exposure.

1. Indirect effects would not be evaluated by ecological risk assessments. These effects include the mechanisms of indirect exposure to pesticides: consuming prey items (fish, birds, or small mammals), reductions in the availability of prey items, and disturbance associated with pesticide application activities.

2. Exposure to a pesticide product can be assessed based upon the active ingredient; however, exposure to a chemical mixture (pesticide formulation) may result in effects that are similar or substantially different compared to only the active ingredient. Non-target organisms may be exposed directly to the pesticide formulation or only various constituents of the formulation as they dissipate and partition in the environment. If toxicological information for both the active ingredient and formulated product are available, then data representing the greatest potential toxicity would be selected for use in the risk assessment process (USEPA 2004). This conservative approach may lead to an overestimation of risk characterization from pesticide exposure.

3. Because toxicity tests with listed or candidate species or closely related species are not available, data for surrogate species would most often be used for risk assessments. Specifically, bobwhite quail and mallard duck are the most frequently used surrogates for evaluating potential toxicity to federally listed avian species. Bluegill sunfish, rainbow trout, and fathead minnow are the most common surrogates for evaluating toxicity for freshwater fishes. Sheep's head minnow can be an appropriate surrogate marine species for coastal environments. Rats and mice are the most common surrogates for evaluating toxicity for mammals. Interspecies sensitivity is a major source of uncertainty in pesticide assessments. As a result of this uncertainty, data is selected for the most sensitive species tested within a taxonomic group (birds, fish, and mammals), assuming the quality of the data is acceptable. If additional toxicity data for more species of organisms in a particular group are available, the selected data will not be limited to the species previously listed as common surrogates.

4. The Kanaga nomogram outputs maximum EEC values that may be used to calculate an average daily concentration over a specified interval of time, which is referred to as a time-weighted-average (TWA). The maximum EEC would be selected as the exposure input for both acute and chronic risk assessments in the screening-level evaluations. The initial or maximum EEC derived from the Kanaga nomogram represents the maximum expected instantaneous or acute exposure to a pesticide. Acute toxicity endpoints are determined using a single exposure to a known pesticide concentration, typically for 48 to 96 hours. This value is assumed to represent ecological risk from acute exposure to a pesticide.

5. An organism's response to chronic pesticide exposure may result from either the concentration of the pesticide, length of exposure, or some combination of both factors. Standardized tests for chronic toxicity typically involve exposing an organism to several

different pesticide concentrations for a specified length of time (days, weeks, months, years, or generations). However, when a test is limited to a single length of time, the time response data is usually not available for inclusion into risk assessments, and without time response data, it is difficult to determine the concentration that elicited a toxicological response.

6. Using maximum EECs for chronic risk estimates may result in an overestimate of risk, particularly for compounds that dissipate rapidly. Conversely, using TWAs for chronic risk estimates may underestimate risk if it is the concentration rather than the duration of exposure that is primarily responsible for the observed adverse effect. The maximum EEC is used for chronic risk assessments although it may result in an overestimate of risk. TWAs may be used for chronic risk assessments, but they will be applied judiciously considering the potential for an underestimate or overestimate of risk. For example, the number of days exposure exceeds the LOC may influence the suitability of a pesticide use. The greater the number of days the EEC exceeds the LOC translates into greater the ecological risk. This is a qualitative assessment, and is subject to reviewer's expertise in ecological risk assessment and tolerance for risk.

7. The length of time used to calculate the TWA can have a substantial effect on the exposure estimates, and there is no standard method for determining the appropriate duration for this estimate. The T-REX model assumes a 21-week exposure period, which is equivalent to avian reproductive studies designed to establish a steady-state concentration for bioaccumulative compounds. However, this does not necessarily define the true exposure duration needed to elicit a toxicological response. Pesticides, which do not bioaccumulate, may achieve a steady-state concentration earlier than 21 weeks. The duration of time for calculating TWAs will require justification, and it will not exceed the duration of exposure in the chronic toxicity test (approximately 70 days for the standard avian reproduction study). An alternative to using the duration of the chronic toxicity study is to base the TWA on the application interval. In this case, increasing the application interval would suppress both the estimated peak pesticide concentration and the TWA. Another alternative to using TWAs would be to consider the number of days that a chemical is predicted to exceed the LOC.

8. Pesticide dissipation is assumed to be first-order in the absence of data suggesting alternative dissipation patterns such as bi-phasic. Field dissipation data would generally be the most pertinent for assessing exposure in terrestrial species that forage on vegetation. However, this data is often not available and it can be misleading particularly if the compound is prone to "wash-off". Soil half-life is the most common degradation data available. Dissipation or degradation data that would reflect the environmental conditions typical of Refuge lands would be utilized, if available.

9. For species found in the water column, it is assumed that the greatest bioavailable fraction of the pesticide active ingredient in surface waters is freely dissolved in the water column.

10. Actual habitat requirements for any particular terrestrial species are not considered, and it is assumed that species exclusively and permanently occupy the treated area or adjacent areas receiving pesticide at rates commensurate with the treatment rate. This assumption produces a maximum estimate of exposure for risk characterization and will likely lead to an overestimation of exposure for species that do not permanently and exclusively occupy the treated area (USEPA 2004).

11. Exposure through incidental ingestion of pesticide contaminated soil is not considered in the USEPA risk assessment protocols. Research suggests less than 15 percent of the diet can consist of incidentally ingested soil, depending upon species and feeding strategy (Beyer et al. 1994). An assessment of pesticide concentrations in soil compared to food item categories in the Kanaga nomogram indicates incidental soil ingestion will not likely increase dietary exposure to pesticides. Inclusion of soil into the diet would effectively reduce the overall dietary concentration compared to the present assumption that the entire diet consists of a contaminated food source (Fletcher et al. 1994). An exception to this may be soil-applied pesticides in which exposure from incidental ingestion of soil may increase. Potential for pesticide exposure under this assumption may be underestimated for soil-applied pesticides and overestimated for foliar-applied pesticides. The concentration of a pesticide in soil would likely be less than predicted on food items.

12. Exposure through inhalation of pesticides is not considered in the USEPA risk assessment protocols. Such exposure may occur through three potential sources: spray material in droplet form at the time of application, vapor phase with the pesticide volatilizing from treated surfaces, and airborne particulates (soil, vegetative matter, and pesticide dusts). The USEPA (1990) reported exposure from inhaling spray droplets at the time of application is not an appreciable route of exposure for birds. According to research on mallards and bobwhite quail, respirable particle size (particles reaching the lung) in birds is limited to maximum diameter of two to five microns. The spray droplet spectra covering the majority of pesticide application scenarios indicate that less than one percent of the applied material is within the respirable particle size. This route of exposure is further limited because the permissible spray drop size distribution for ground pesticide applications is restricted to ASAE medium or coarser drop size distribution.

13. Inhalation of a pesticide in the vapor phase may be another source of exposure for some pesticides under certain conditions. This mechanism of exposure to pesticides occurs post-application and would pertain to those pesticides with a high vapor pressure. The USEPA is currently evaluating protocols for modeling inhalation exposure from pesticides including near-field and near-ground air concentrations based upon equilibrium and kinetics-based models. Risk characterization for exposure with this mechanism is unavailable.

14. The effect from exposure to dusts contaminated with a pesticide cannot be assessed generically, as partitioning issues related to application site, soils, and chemical properties of the applied pesticides render the exposure potential from this route highly situation specific.

15. Dermal exposure may occur through three potential sources: direct application of spray to terrestrial wildlife in the treated area or within the drift footprint; incidental contact with contaminated vegetation; or contact with contaminated water or soil. Interception of spray and incidental contact with treated substrates may pose risk to avian wildlife (Driver et al. 1991); however, research related to wildlife dermal contact with pesticides is extremely limited. Dermal toxicity values are common for some mammals used as human surrogates, particularly rats and mice. The USEPA is currently evaluating protocols for modeling dermal exposure. Risk characterization may be underestimated for this route of exposure, particularly with high risk pesticides such as some organophosphates or carbamate insecticides, which act by a similar mechanism to organophosphate pesticides. If protocols are established by the USEPA for assessing dermal exposure to pesticides, they will be considered for incorporation into pesticide assessment protocols.

16. Exposure to a pesticide may occur from consuming surface water, dew, or other water on treated surfaces. Water soluble pesticides have the potential to dissolve in surface runoff and puddles in a treated area may contain pesticide residues. Similarly, pesticides with lower organic carbon partitioning characteristics and higher solubility in water have a greater potential to dissolve in dew and other water associated with plant surfaces. Estimating the extent to which such pesticide loadings to drinking water occurs is complex and would depend upon the partitioning characteristics of the active ingredient, as well as the soils types and meteorology of the treatment area. In addition, the use of various water sources by wildlife is highly species-specific. Currently, risk characterization for this exposure mechanism is not available. The USEPA is actively developing protocols to quantify drinking water exposures from puddles and dew. If and when such protocols are formally established by the USEPA, these protocols will be incorporated into pesticide risk assessment protocols.

17. Risk assessments are based upon the assumption that the entire treatment area will be subject to pesticide application at the rates specified on the label. In most cases, however, there is potential for uneven application of pesticides through such plausible incidents as changes in calibration of application equipment, spillage, and localized releases at specific areas in or near the treated field that are associated with mixing and handling, application equipment, and applicator skill. Inappropriate use of pesticides and the occurrence of spills represent a potential underestimate of risk; however, this is generally a minor factor for risk characterization. All pesticide applicators are required to be certified by the state in which they apply pesticides. Certification training, which requires yearly updates, includes the safe storage, transport, handling, and mixing of pesticides; appropriate equipment calibration; and proper application.

18. The USEPA relies on Fletcher (1994) for setting the assumed pesticide residues in wildlife dietary items. The USEPA (2004) "believes that these residue assumptions reflect a realistic upper-bound residue estimate, although the degree to which this assumption reflects a specific percentile estimate is difficult to quantify." Fletcher's (1994) research suggests that the pesticide active ingredient residue assumptions used by the USEPA represent a 95th percentile estimate. However, research conducted by Pfleeger et al. (1996) indicates USEPA residue assumptions for short grass was not exceeded. Baehr and Habig (2000) compared USEPA residue assumptions with distributions of measured pesticide residues for the USEPA's Uptake, Translocation, Accumulation, and Biotransformation (UTAB) database. Overall residue selection level will tend to overestimate risk characterization. This is particularly evident when wildlife individuals are likely to have selected a variety of food items acquired from multiple locations. Some food items may be contaminated with pesticide residues whereas others are not contaminated. However, it is important to recognize differences in species feeding behavior. Some species may consume whole above-ground plant material, while others will preferentially select different plant structures. Species may also preferentially select a specific food item despite the presence of multiple food items. Without species-specific knowledge regarding foraging behavior, characterizing ecological risk other than in general terms is not possible.

19. Acute and chronic risk assessments rely on comparisons of wildlife dietary residues with LC_{50} or "no observed effect concentration" (NOEC) values expressed as concentrations of pesticides in laboratory feed. These comparisons assume that ingestion of food items in the field occurs at rates commensurate with those in the laboratory. Although the screening assessment process adjusts dry-weight estimates of food intake to reflect the

increased mass in fresh-weight wildlife food intake estimates, it does not allow for gross energy and assimilative efficiency differences between wildlife food items and laboratory feed. Differences in assimilative efficiency between laboratory and wild diets suggest that current screening assessment methods are not accounting for a potentially important aspect of food requirements.

20. It is assumed that aquatic species exclusively and permanently occupy the water body being assessed. Actual habitat requirements of aquatic species are not considered. With the possible exception of scenarios where pesticides are directly applied to water, it is assumed that no habitat use considerations specific for any species would place the organisms in closer proximity to pesticide use sites. This assumption produces a maximum estimate of exposure or risk characterization. It would likely be realistic for many aquatic species that may be found in aquatic habitats within or in close proximity to treated terrestrial habitats. However, the spatial distribution of wildlife is usually not random, because wildlife distributions are often related to habitat requirements of the species. Clumped distributions of wildlife may result in an underestimation or overestimation of risk, depending upon where the initial pesticide concentration occurs relative to the species or species habitat.

21. For species found in the water column, it is assumed that the greatest bioavailable fraction of the pesticide active ingredient in surface waters is freely dissolved in the water column. Additional chemical exposure from materials associated with suspended solids or food items is not considered because partitioning onto sediments is considered minimal. Adsorption and bioconcentration occurs at lower levels for many newer pesticides compared with older more persistent bioaccumulative compounds. For pesticides with RQs close to listed species' LOC, the potential for additional exposure from these routes may be a limitation of risk assessments because potential pesticide exposure or risk may be underestimated.

22. Mass transport losses of pesticide from a water body (except for losses by volatilization, degradation, and sediment partitioning) are not considered in ecological risk assessments. The water body would be assumed to capture all pesticide active ingredients entering as runoff, drift, and adsorbed to eroded soil particles. It would also be assumed that the pesticide active ingredient is not lost from the water body by overtopping or flow-through, nor is its concentration reduced by dilution. In total, these assumptions would lead to a near maximum possible water-borne concentration. However, this assumption would not account for the potential to concentrate pesticide through evaporative loss. This limitation may have the greatest impact on water bodies with high surface-to-volume ratios such as ephemeral wetlands, where evaporative losses are accentuated and applied pesticides have low rates of degradation and volatilization.

23. For acute risk assessments, there would be no averaging time for exposure. An instantaneous peak concentration would be assumed, where instantaneous exposure is sufficient in duration to elicit acute effects comparable to those observed over more protracted exposure periods (typically 48 to 96 hours) tested in the laboratory. In the absence of data regarding time-to-toxic event, analyses and latent responses to instantaneous exposure, risk would likely be overestimated.

24. For chronic exposure risk assessments, the averaging times considered for exposure are commensurate with the duration of invertebrate life-cycle or early fish life stage tests (e.g., 21-28 days and 56-60 days, respectively). Response profiles (time to effect and latency of

effect) to pesticides likely vary widely with mode of action and species and should be evaluated on a case-by-case basis as available data allow. Nevertheless, because the USEPA relies on chronic exposure toxicity endpoints based on a finding of no observed effect, the potential for any latent toxicity effects or averaging time assumptions to alter the results of an acceptable chronic risk assessment prediction is limited. The extent to which duration of exposure from water-borne concentrations overestimate or underestimate actual exposure depends on several factors including: localized meteorological conditions; runoff characteristics of the watershed (e.g., soils, topography); hydrological characteristics of receiving waters; environmental fate of the pesticide active ingredient; and the method of pesticide application. Also, chronic effects studies are performed using a method that holds water concentration in a steady state. This method is not likely to reflect conditions associated with pesticide runoff. Pesticide concentrations in the field increase and decrease in surface water on a cycle influenced by rainfall, pesticide use patterns, and degradation rates. As a result of the dependency of this assumption on several undefined variables, risk associated with chronic exposure may, in some situations, underestimate risk and overestimate risk in others.

There are several other assumptions that can affect non-target species that are not considered in the risk assessment process. These include possible additive or synergistic effects from applying two or more pesticides or additives in a single application, co-location of pesticides in the environment, cumulative effects from pesticides with the same mode of action, effects of multiple stressors (e.g., combination of pesticide exposure, adverse abiotic and biotic factors), and behavioral changes induced by exposure to a pesticide. These factors may exist at some level, contributing to adverse effects to non-target species, but they are usually characterized in the published literature in only a general manner, limiting their value in the risk assessment process. As this type of information becomes available, it would be included, either quantitatively or qualitatively, in this risk assessment process.

USEPA is required by the Food Quality Protection Act to assess the cumulative risks of pesticides that share common mechanisms of toxicity, or act the same within an organism. Currently, USEPA has identified four groups of pesticides that have a common mechanism of toxicity requiring cumulative risk assessments. These four groups are: the organophosphate insecticides, N-methyl carbamate insecticides, triazine herbicides, and chloroacetanilide herbicides.

8.7 Pesticide Mixtures and Degradates

Pesticide products are usually a formulation of several components generally categorized as active ingredients and inert or other ingredients. The term “active ingredient” is defined by FIFRA as preventing, destroying, repelling, or mitigating the effects of a pest, or it is a plant regulator, defoliant, desiccant, or nitrogen stabilizer. In accordance with FIFRA, the active ingredient(s) must be identified by name(s) on the pesticide label, along with its relative composition expressed in percentage(s) by weight. In contrast, inert ingredient(s) are not intended to affect a target pest. Their role in the pesticide formulation is to act as a solvent (keep the active ingredient is a liquid phase), an emulsifying or suspending agent (keep the active ingredient from separating out of solution), or a carrier such as clay in which the active ingredient is impregnated on the clay particle in dry formulations. For example, if isopropyl alcohol would be used as a solvent in a pesticide formulation, it would be considered an inert ingredient. FIFRA only requires that inert ingredients be identified if they pose a hazard to man or the environment. Inert ingredients that are not classified as hazardous are not required to be identified. The only other requirement is to state on the product label the percentage by weight of all inert ingredients.

The USEPA (September 1997) issued Pesticide Regulation Notice 97-6, which encouraged manufacturers, formulators, producers, and registrants of pesticide products to voluntarily substitute the term "other ingredients" for "inert ingredients" in the ingredient statement. This change recognized that all components in a pesticide formulation potentially could elicit or contribute to an adverse effect on non-target organisms and, therefore, are not necessarily inert. Whether referred to as "inerts" or "other ingredients," these constituents within a pesticide product have the potential to affect species or environmental quality. The USEPA categorizes regulated inert ingredients as follows (http://www.epa.gov/opprd001/inerts/index.html):

- List 1 – Inert Ingredients of Toxicological Concern;
- List 2 – Potentially Toxic Inert Ingredients;
- List 3 – Inerts of Unknown Toxicity; and
- List 4 – Inerts of Minimal Toxicity.

Several of the List 4 compounds are naturally-occurring earthen materials (e.g., clay materials, simple salts) that would not elicit toxicological response at applied concentrations. However, some of the inerts (particularly the List 3 compounds and unlisted compounds) may have moderate to high potential toxicity to aquatic species based on MSDSs or published data.

Comprehensively assessing potential effects to non-target fish, wildlife, plants, and/or their habitats from pesticide use is a complex task. It would be preferable to assess the cumulative effects from exposure to the active ingredient, its degradates, and inert ingredients, as well as other active ingredients in the spray mixture. However, it would only be feasible to conduct deterministic risk assessments for each component in the spray mixture individually. Limited scientific information is available regarding ecological effects (additive or synergistic) from chemical mixtures that typically rely upon broadly encompassing assumptions. For example, the U.S. Forest Service (2005) found that mixtures of pesticides used in land (forest) management were not likely to cause additive or synergistic effects to non-target species based upon a review of scientific literature regarding toxicological effects and interactions of agricultural chemicals (ATSDR 2004). Moreover, information on inert ingredients, adjuvants, and degradates is often limited by the availability of and access to reliable toxicological data for these constituents.

Toxicological information regarding "other ingredients" may be available from sources, including:

- TOMES (a proprietary toxicological database including USEPA's IRIS, the Hazardous Substance Data Bank, the Registry of Toxic Effects of Chemical Substances [RTECS]);
- USEPA's ECOTOX database, which includes AQUIRE (a database containing scientific papers published on the toxic effects of chemicals to aquatic organisms);
- TOXLINE (a literature searching tool);
- Material Safety Data Sheets (MSDSs) from pesticide suppliers; and
- Sources such as the Farm Chemicals Handbook.

Because there is a lack of specific inert toxicological data, inert(s) in a pesticide may cause adverse ecological effects. However, inert ingredients typically represent only a small percentage of the pesticide spray mixture, and it would be assumed that negligible effects would be expected to result from inert ingredient(s).

Although the potential effects of degradates should be considered when selecting a pesticide, it is beyond the scope of this assessment process to consider all possible breakdown chemicals of the various product formulations containing an active ingredient. Degradates may be more or less mobile and more or less hazardous in the environment than their parent pesticides (Battaglin et al.

2003). Differences in environmental behavior (e.g., mobility) and toxicity between parent pesticides and degradates would make assessing potential degradate effects extremely difficult. For example, a less toxic and more mobile, bioaccumulative, or persistent degradate may have potentially greater effects on species and/or degrade environmental quality. The lack of data on the toxicity of degradates for many pesticides would represent a source of uncertainty for assessing risk.

USEPA-approved labels specify whether a product can be mixed with one or more pesticides. Without product-specific toxicological data, it would not possible to quantify the potential effects of these mixtures. In addition, a quantitative analysis could only be conducted if reliable scientific information allowed a determination of whether the joint action of a mixture would be additive, synergistic, or antagonistic. Such information would not likely exist unless the mode of action would be common among the chemicals and receptors. Moreover, the composition of and exposure to mixtures would be highly site- and/or time-specific and, therefore, it would be nearly impossible to assess potential effects to species and environmental quality.

To minimize or eliminate potential negative effects associated with applying two or more pesticides as a mixture, the use would be conducted in accordance with the labeling requirements. Labels for two or more pesticides applied as a mixture should be completely reviewed, where products with the least potential for negative effects would be selected for use on the Refuge. This is especially relevant when a mixture would be applied in a manner that may already have the potential for an effect(s) associated with an individual pesticide (e.g., runoff to ponds in sandy watersheds). Use of a tank mix under these conditions would increase the level of uncertainty in terms of risk to species or potential to degrade environmental quality.

Adjuvants generally function to enhance or prolong the activity of pesticide. For terrestrial herbicides, adjuvants aid in the absorption into plant tissue. Adjuvant is a broad term that generally applies to surfactants, selected oils, anti-foaming agents, buffering compounds, drift control agents, compatibility agents, stickers, and spreaders. Adjuvants are not under the same registration requirements as pesticides, and the USEPA does not register or approve the labeling of spray adjuvants. Individual pesticide labels identify types of adjuvants approved for use with it. In general, adjuvants compose a relatively small portion of the volume of pesticides applied. Selection of adjuvants with limited toxicity and low volumes would be recommended to reduce the potential for the adjuvant to influence the toxicity of the pesticide.

8.8 Determining Effects to Soil and Water Quality

The approval process for pesticide use considers the potential to degrade water quality on and off Refuge lands. After application, pesticide mobilization can be characterized by one or more of the following (Kerle et al. 1996):

- Attach (sorb) to soil, vegetation, or other surfaces and remain at or near the treated area;
- Attach to soil and move off-site through erosion from run-off or wind; and/or
- Dissolve in water subjected to runoff or leaching.

As an initial screening tool, selected chemical characteristics and rating criteria for a pesticide can be evaluated to assess the potential for the product to enter ground and/or surface waters. These would include persistence, sorption coefficient (K_{oc}), groundwater ubiquity score (GUS), and solubility.

Persistence, which is expressed as half-life ($t_{½}$), represents the length of time required for 50 percent of the deposited pesticide to degrade (completely or partially). Persistence in the soil can

be categorized as the following: non-persistent (less than 30 days), moderately persistent (30-100 days), and persistent (greater than 100 days) (Kerle et al. 1996). Half-life data is usually available for aquatic and terrestrial environments.

Another measure of pesticide persistence is dissipation time (DT_{50}). This represents the time required for 50 percent of the deposited pesticide to degrade and move from a treated site; whereas, half-life describes the rate for degradation only. Similar to half-life, units of dissipation time are usually expressed in days. Field or foliar dissipation time is the preferred data for use to estimate pesticide concentrations in the environment; however, soil half-life is the most common persistence data cited in published literature. If field or foliar dissipation data is not available, soil half-life data may be used. The average or representative half-life value of the most important degradation mechanism will be selected for quantitative analysis for both terrestrial and aquatic environments.

Mobility of a pesticide is a function of how strongly it is adsorbed to soil particles and organic matter, its solubility in water, and its persistence in the environment. Pesticides strongly adsorbed to soil particles, relatively insoluble in water, and not environmentally persistent would be less likely to move across the soil surface into surface waters or to leach through the soil profile and contaminate groundwater. Conversely, pesticides that are not strongly adsorbed to soil particles, are highly water soluble, and are persistent in the environment would have greater potential to move from the application site (off-site movement). The degree of pesticide adsorption to soil particles and organic matter (Kerle et al. 1996) is expressed as the soil adsorption coefficient (K_{oc}). The soil adsorption coefficient is measured as micrograms of pesticide per gram of soil (μg/g) that can range from near zero to the thousands. Pesticides with higher K_{oc} values are strongly sorbed to soil and, therefore, would be less subject to movement.

The Groundwater Ubiquity Score (GUS) is a quantitative screening tool to estimate a pesticide's potential to move in the environment. It utilizes soil persistence and adsorption coefficients in the following formula: $GUS = \log_{10}(t_{½}) \times [4 - \log_{10}(K_{oc})]$. The potential pesticide movement rating would be based upon its GUS value. Pesticides with a GUS less than 0.1 would be considered to have an extremely low potential to move toward groundwater. Values of 1.0-2.0 would be low, 2.0-3.0 would be moderate, 3.0-4.0 would be high, and greater than 4.0 would have a very high potential to move toward groundwater.

Water solubility describes the amount of pesticide dissolving in a specific quantity of water, where it is usually measured as milligrams of pesticide dissolved per liter of water (mg/l) or parts per million (ppm). Solubility is useful as a comparative measure because pesticides with higher values are more likely to move by runoff or leaching. For example, pesticides with solubility less than 0.1 ppm are virtually insoluble in water, 100-1000 ppm are moderately soluble, and greater than 10,000 ppm highly soluble (U.S. Geological Survey 2000). As pesticide solubility increases, there is greater potential for off-site movement.

GUS, water solubility, $t_{½}$, and K_{oc} values are available for selected pesticides from the OSU Extension Pesticide Properties Database at http://npic.orst.edu/ppdmove.htm. Many of the values in this database were derived from the SCS/ARS/CES Pesticide Properties Database for Environmental Decision Making (Wauchope et al. 1992).

Soil properties influence the fate of pesticides in the environment. The following six properties are most likely to affect pesticide degradation and the potential for pesticides to move off-site by leaching (vertical movement through the soil) or runoff (lateral movement across the soil surface).

Permeability. This is the rate at which water moves vertically through the soil. It is affected by soil texture and structure. Coarse textured soils (e.g., high sand content) have a larger pore size and are generally more permeable than fine textured soils (i.e., high clay content). The potential for pesticides to move vertically down through the soil profile is greater the more permeable the soils are within the treatment area. Soil permeability rates (inches per hour) are usually available in county soil survey reports.

Soil Texture. Soil texture is defined by the relative percentage of sand, silt, and clay present in the soil. In general, greater clay content would lower the likelihood and rate at which water would move through the soil profile. Clay also serves to adsorb (bind) pesticides to soil particles. Soils with high clay content would adsorb more pesticide than soils with relatively low clay content. In contrast, sandy soils with coarser texture and lower water holding capacity would have a greater potential for water to leach through them.

Soil Structure. Soil structure describes soil aggregation. Soils with a well-developed soil structure have looser, more aggregated, structure that would be less likely to be compacted. Both characteristics would allow for less restricted flow of water through the soil profile, resulting in greater infiltration.

Organic Matter Content. This is the single most important factor affecting pesticide adsorption in soils. Many pesticides are adsorbed to organic matter, reducing their rate of downward movement through the soil profile. Also, soils high in organic matter tend to hold more water, which may make less water available for leaching.

Soil Moisture Content. Soil moisture content affects how the velocity at which water moves through the soil. If soils are already wet or saturated before rainfall or irrigation, excess moisture would runoff rather than infiltrate into the soil profile. Soil moisture also influences microbial and chemical activity in soil, which effects pesticide degradation.

Soil pH. Soil pH influences the chemical reactions that occur in the soil. This, in turn, determines whether or not a pesticide will degrade, as well as the rate of degradation, and, in some instances, the types of degradation products that are produced.

Based upon the aforementioned properties, soils most vulnerable to groundwater contamination are sandy soils with low organic matter. In contrast, the least vulnerable soils are well-drained, clayey soils with high organic matter. Consequently, pesticides with the lowest potential for movement in conjunction with appropriate BMPs will be used in an IPM framework to treat pests while minimizing effects to non-target biota and protecting environmental quality.

Along with soil properties, the potential for a pesticide to affect water quality through runoff and leaching would also be affected by site-specific environmental and abiotic conditions, including rainfall, water table conditions, and topography (Huddleston 1996). Water is necessary to separate pesticides from soil. This can occur in two basic ways: 1) pesticides that are soluble would move easily with runoff water, and 2) pesticide-laden soil particles could be dislodged and transported from the application site in runoff. The concentration of pesticides in the surface runoff would be greatest for the first runoff event following treatment. The rainfall intensity and route of water infiltration into the soil, to a large extent, determines pesticide concentrations in surface runoff.

The timing of the rainfall after application would also have an influence on the total pesticide concentrations in surface runoff. Rainfall interacts with pesticides at a shallow soil depth (¼ to ½

inch), which is called the mixing zone (Baker and Miller 1999). The pesticide/water mixture in the mixing zone would tend to leach down into the soil or runoff depending upon how quickly the soil surface becomes saturated and how rapidly water can infiltrate into the soil. Leaching would decrease the amount of pesticide available near the soil surface (mixing zone), reducing total runoff during the initial rainfall event following application, as well as during subsequent rainfall events.

Terrain slope would also affect the potential for surface runoff and the intensity of the runoff. Steeper slopes would have greater potential for runoff following a rainfall event. In contrast, soils that are relatively flat would have little potential for runoff, except during intense rainfall events. In addition, soils in lower areas would be more susceptible to leaching as a result of receiving excessive water from surrounding higher elevations.

Depth to groundwater is also an important factor affecting the potential for pesticides to leach into groundwater. If the distance from the soil surface to the top of the water table is shallow, pesticides would be more likely to influence groundwater quality. Soil survey reports, available for individual counties, provide data regarding the water table depths. In some situations, a hard pan may exist above the water table, preventing the pesticide from leaching into the groundwater.

8.9 Determining Effects to Air Quality

Pesticides may volatilize from soil and plant surfaces and move from the treated area into the atmosphere. The potential for a pesticide to volatilize is determined by the pesticide's vapor pressure. The extent to which a pesticide may volatilize is influenced by temperature, sorption, soil moisture, and the pesticide's solubility. Vapor pressure is often expressed in mm Hg. To make these numbers easier to compare, vapor pressure may be expressed in exponent form ($I \times 10^{-7}$), where "I" represents a vapor pressure index. In general, pesticides with I less than 10 would have a low potential to volatilize; whereas, pesticides with I greater than 1,000 would have a high potential to volatilize (Oregon State University 1996). Vapor pressure values for pesticides are usually available in the pesticide product MSDS or the USDA Agricultural Research Service (ARS) pesticide database.

9. Preparing a Chemical Profile

The following instructions will be used by Service personnel to complete Chemical Profiles for pesticides. Specifically, profiles will be prepared for pesticide active ingredients (e.g., glyphosate, triclopyr) that would be contained in one or more trade name products, registered and labeled with USEPA. A blank Chemical Profile form is provided as Attachment A. All fields under each category (e.g., Toxicological Endpoints, Environmental Fate) on the Chemical Profile must be completed. If no information is available for a specific field, then "No data is available in references" would be recorded in the profile. Available scientific information would be used to complete Chemical Profiles. Each entry of scientific information would be shown with applicable references.

Completed Chemical Profiles will provide a structured decision making process utilizing quantitative assessment and screening tools with threshold values, where appropriate, that would be used to evaluate potential biological and other environmental effects to Refuge resources. For ecological risk assessments presented in these profiles, the "worst-case scenario" would be evaluated to determine whether a pesticide could be approved for use considering the maximum single application rate specified on pesticide labels for Refuge habitat management and facilities maintenance. Where the "worst-case scenario" is likely to result in only minor, temporary, and localized effects to listed and non-listed species (when appropriate BMPs are implemented), the

proposed pesticide's use would have a scientific basis for approval under any application rate specified on the label that is at or below rates evaluated in a Chemical Profile. In some cases, the Chemical Profile will include a lower application rate than the maximum labeled rate in order to protect Refuge resources. As necessary, Chemical Profiles will be periodically updated to include new scientific information or include a new pesticide proposed for use on the Refuge through the PUPs process that possesses the same active ingredient described in the Chemical Profile.

Currently, eight Chemical Profiles have been prepared for the Sonny Bono Salton Sea NWR Complex: including one each for the active ingredients: glyphosate; triclopyr; tribenuron-methyl; imazapyr; halosulfuron-methyl; 2,4-D DMA; aminopyralid; and dicamba (Attachments B-1 - B-8). These and future Chemical Profile will clearly identify threshold values in order to prevent or minimize potential biological and environmental effects. Comparison of these threshold values provides an explicit scientific basis to approve or disapprove PUPs for habitat management and facilities maintenance on the Sonny Bono Salton Sea NWR Complex. In general, PUPs will be approved for pesticides with Chemical Profiles where there would be no exceedances of threshold values. However, BMPs are identified for some screening tools that would minimize and/or eliminate potential effects (exceedance of the threshold value) as a basis for approving PUPs.

The following information will be recorded for each Chemical Profile that is completed or updated.

9.1 General Information

Date. Service personnel will record the date when the Chemical Profile is completed or updated. Chemical Profiles (e.g., currently approved pesticide use patterns) will be periodically reviewed and updated, as necessary. The most recent review date will be recorded on a profile to document when it was last updated.

Trade Name(s). Service personnel will accurately and completely record the trade name(s) from the pesticide label, which includes a suffix that describes the formulation (e.g., WP, DG, EC, L, SP, I, II or 64). The suffix often distinguishes a specific product among several pesticides with the same active ingredient. Service personnel will record a trade name for each pesticide product with the same active ingredient.

Common Chemical Name(s). Service personnel will record the common name(s) listed on the pesticide label or MSDS for an active ingredient. The common name of a pesticide is listed as the active ingredient on the title page of the product label immediately following the trade name, and on the MSDS, Section 2: Composition/Information on Ingredients. A Chemical Profile is completed for each active ingredient.

Pesticide Type. Service personnel will record the type of pesticide for an active ingredient as one of the following: herbicide, desiccant, fungicide, fumigant, growth regulator, insecticide, pisicide, or rodenticide.

USEPA Registration Number(s). This number (USEPA Reg. No.) appears on the title page of the label and MSDS, Section 1: Chemical Product and Company Description. It is not the USEPA Establishment Number that is usually located near it. Service personnel will record the USEPA Reg. No. for each trade name product with an active ingredient based upon PUPs.

Pesticide Class. Service personnel will list the general chemical class for the pesticide (active ingredient). For example, malathion is an organophosphate and carbaryl is a carbamate.

CAS (Chemical Abstract Service) Number. Service personnel will record this number, which is often located in the second section (Composition/Information on Ingredients) of the MSDS, in the Chemical Profile. The MSDS table listing components usually contains this number immediately prior to or following the percent composition.

Other Ingredients. From the most recent MSDS for the proposed pesticide product(s), Service personnel will include any chemicals in the pesticide formulation not listed as an active ingredient that are described as toxic or hazardous, or that are regulated under the Superfund Amendments and Reauthorization Act (SARA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Toxic Substances Control Act (TSCA), Occupational Safety and Health Administration (OSHA), State Right-to-Know, or other listed authorities. These are usually found in MSDS sections titled Hazardous Identifications, Exposure Control/Personal Protection, and Regulatory Information. If concentrations of other ingredients are available for any compounds identified as toxic or hazardous, then Service personnel will record this information in the Chemical Profile by trade name. MSDS(s) may be obtained from the manufacturer, manufacturer's website or from an online database maintained by Crop Data Management Systems, Inc.

9.2 Toxicological Endpoints

Toxicological endpoint data is collected for acute and chronic tests with mammals, birds, and fish. This data will be recorded in the Chemical Profiles as available in the scientific literature. If no data are found for a particular taxonomic group, then "No data available is references" will be recorded as the data entry. Throughout the Chemical Profile, references (including toxicological endpoint data) will be cited using parentheses (#) following the recorded data.

Mammalian LD_{50}. For test species in the scientific literature, Service personnel will record available data for oral lethal dose (LD_{50}) in mg/kg-bw (body weight) or ppm-bw. The most common test species in scientific literature are the rat and mouse. The lowest LD_{50} value found for a rat will be used as a toxicological endpoint for dose-based RQ calculations to assess acute risk to mammals (see Table 1 in Section 7.1).

Mammalian LC_{50}. For test species in the scientific literature, Service personnel will record available data for dietary lethal concentration (LC_{50}) as reported (e.g., mg/kg-diet or ppm-diet). The most common test species in scientific literature are the rat and mouse. The lowest LC_{50} value found for a rat will be used as a toxicological endpoint for diet-based RQ calculations to assess acute risk (see Table 1 in Section 7.1).

Mammalian Reproduction. For test species listed in the scientific literature, Service personnel will record the test results (e.g., Lowest Observed Effect Concentration [LOEC], Lowest Observed Effect Level [LOEL], No Observed Adverse Effect Level [NOAEL], No Observed Adverse Effect Concentration [NOAEC]) in mg/kg-bw or mg/kg-diet for reproductive test procedure(s) (e.g., generational studies [preferred], fertility, new born weight). The most common test species available in scientific literature are rats and mice. The lowest NOEC, NOAEC, NOEL, or NOAEL test results found for a rat will be used as a toxicological endpoint for RQ calculations to assess chronic risk (see Table 1 in Section 7.1).

Avian LD_{50}. For test species available in the scientific literature, Service personnel will record values for oral lethal dose (LD_{50}) in mg/kg-bw or ppm-bw. The most common test species available in scientific literature are the bobwhite quail and mallard. The lowest

LD_{50} value found for an avian species will be used as a toxicological endpoint for dose-based RQ calculations to assess acute risk (see Table 1 in Section 7.1).

Avian LC_{50}. For test species available in the scientific literature, Service personnel will record values for dietary lethal concentration (LC_{50}) as reported (e.g., mg/kg-diet or ppm-diet). The most common test species available in scientific literature are the bobwhite quail and mallard. The lowest LC_{50} value found for an avian species will be used as a toxicological endpoint for dietary-based RQ calculations to assess acute risk (see Table 1 in Section 7.1).

Avian Reproduction. For test species available in the scientific literature, Service personnel will record test results (e.g., LOEC, LOEL, NOAEC, NOAEL) in mg/kg-bw or mg/kg-diet consumed for reproductive test procedure(s) (e.g., early life cycle, reproductive). The most common test species available in scientific literature are the bobwhite quail and mallard. The lowest NOEC, NOAEC, NOEL, or NOAEL test results found for an avian species will be used as a toxicological endpoint for RQ calculations to assess chronic risk (see Table 1 in Section 7.1).

Fish LC_{50}. For test freshwater or marine species listed in the scientific literature, Service personnel will record a LC_{50} in ppm or mg/L. The most common test species available in the scientific literature are the bluegill, rainbow trout, and fathead minnow (marine). Test results for many game species may also be available. The lowest LC_{50} value found for a freshwater fish species will be used as a toxicological endpoint for RQ calculations to assess acute risk (see Table 1 in Section 7.1).

Fish Early Life Stage (ELS)/Life Cycle. For test freshwater or marine species available in the scientific literature, Service personnel will record test results (e.g., LOEC, NOAEL, NOAEC, LOAEC) in ppm for test procedure(s) (e.g., early life cycle, life cycle). The most common test species available in the scientific literature are bluegill, rainbow trout, and fathead minnow. Test results for other game species may also be available. The lowest test value found for a fish species (preferably freshwater) will be used as a toxicological endpoint for RQ calculations to assess chronic risk (see Table 1 in Section 7.1).

Other. For test invertebrate, as well as non-vascular and vascular plant species, available in the scientific literature, Service personnel will record $LC_{50,}$ $LD_{50,}$ LOEC, LOEL, NOAEC, NOAEL, or EC_{50} (environmental concentration) values in ppm or mg/L. The most common test invertebrate species available in scientific literature are the honey bee and the water flea (*Daphnia magna*). Green algae (*Selenastrum capricornutum*) and pondweed (*Lemna minor*) are frequently available test species for aquatic non-vascular and vascular plants, respectively.

9.3 Ecological Incident Reports

After a site has been treated with pesticide(s), wildlife may be exposed to these chemical(s). When exposure is high relative to the toxicity of the pesticides, wildlife may be killed or visibly harmed (incapacitated). Such events are called ecological incidents. The USEPA maintains a database (Ecological Incident Information System) of ecological incidents. This database stores information extracted from incident reports submitted by various Federal and State agencies and non-government organizations. Information provided in an incident report includes date and location of the incident, type and magnitude of affects observed in various species, type(s) of pesticides known or suspected of contributing to the incident, and results of any chemical residue and cholinesterase activity analyses conducted during the investigation.

Incident reports can play an important role in evaluating the effects of pesticides by supplementing quantitative risk assessments. All incident reports pertaining to the active ingredient addressed in a Chemical Profile and the associated information related to the reported incident will be recorded. If no reports are available, this, too, will be noted.

9.4 Environmental Fate

Water Solubility. Service personnel will record values for water solubility (S_w), which describes the amount of pesticide that dissolves in a known quantity of water. S_w is expressed as mg/L (ppm). Pesticide S_w values would be categorized as one of the following: insoluble (less than 0.1ppm), moderately soluble (100-1000 ppm), highly soluble (greater than 10,000 ppm) (US Geological Survey 2000). As pesticide S_w increases, there is a greater potential for water quality to be degraded through runoff and leaching. S_w will be used to evaluate potential for bioaccumulation in aquatic species (see Octanol-Water Partition Coefficient (K_{ow}) section).

Soil Mobility. Service personnel will record available values for soil adsorption coefficient (K_{oc} [μg/g]), which provides a measure of a chemical's mobility and leaching potential in soil. K_{oc} values are directly proportional to organic content, clay content, and surface area of the soil. K_{oc} data for a pesticide may be available for a variety of soil types (e.g., clay, loam, sand). K_{oc} values will be used in evaluating the potential to degrade groundwater by leaching (see Potential to Move to Groundwater section).

Soil Persistence. Service personnel will record values for soil half-life ($t_{½}$), which represents the length of time (days) required for 50 percent of the deposited pesticide to degrade (completely or partially) in the soil. Based upon the $t_{½}$ value, soil persistence would be categorized as one of the following: non-persistent (less than 30 days), moderately persistent (30-100 days), and persistent (greater than 100 days) (Kerle et. al. 1996). Along with K_{oc}, soil $t_{½}$ values will be used in evaluating the potential to degrade groundwater by leaching (see Potential to Move to Groundwater below).

The following threshold has been established for approving PUPs:

> Where soil $t_{½}$ is less than or equal to 100 days, a PUP will be approved without additional BMPs to protect water quality.
>
> Where soil $t_{½}$ is greater than 100 days, a PUP will only be approved with additional BMPs implemented specifically to protect water quality.

When BMPs are required to protect water quality, one or more of the following measures will be included in the Specific Best Management Practices (BMPs) section of the Chemical Profile and will be implemented during the application of the specific pesticide to minimize potential surface runoff and leaching that can degrade water quality:

- Do not exceed one application per site per year;
- Do not use on coarse-textured soils where the groundwater table is less than 10 feet and average annual precipitation greater than 12 inches; and
- Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is already saturated.

Soil Dissipation. Dissipation time (DT_{50}) represents the time required for 50 percent of the deposited pesticide to degrade and move from a treated site; whereas, soil $t_{½}$ describes the rate for degradation only. As for $t_{½}$, units of dissipation time are usually expressed in days. Field dissipation time will be the preferred data for use to estimate pesticide concentrations in the environment because it is based upon field studies as compared to soil $t_{½}$, which is derived in a laboratory. However, soil $t_{½}$ is the most common persistence data available in the published literature. If field dissipation data is not available, soil $t_{½}$ data will be used in a Chemical Profile. The average or representative half-life value of the most important degradation mechanism will be selected for quantitative analysis for both terrestrial and aquatic environments. Along with K_{oc}, soil DT_{50} values (preferred over soil $t_{½}$) will be used in evaluating the potential to degrade groundwater by leaching (see Potential to Move to Groundwater below), if available.

Based upon the DT_{50} value, environmental persistence in the soil will also be categorized as one of the following: non-persistent (less than 30 days), moderately persistent (30-100 days), and persistent (greater than 100 days).

The following threshold has been established for approving PUPs:

> Where soil DT_{50} is less than or equal to 100 days, a PUP will be approved without additional BMPs to protect water quality.
>
> Where soil DT_{50} is greater than 100 days, a PUP will only be approved with additional BMPs implemented specifically to protect water quality.

When BMPs are required to protect water quality, one or more of the following measures will be included in the Specific Best Management Practices section of the Chemical Profile and will be implemented during the application of the specific pesticide to minimize potential surface runoff and leaching that can degrade water quality:

- Do not exceed one application per site per year;
- Do not use on coarse-textured soils where the ground water table is less than 10 feet and average annual precipitation greater than 12 inches; and
- Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is already saturated.

Aquatic Persistence. Service personnel will record values for aquatic $t_{½}$, which represents the length of time required for 50 percent of the deposited pesticide to degrade (completely or partially) in water. Based upon the $t_{½}$ value, aquatic persistence would be categorized as one of the following: non-persistent (less than 30 days), moderately persistent (30-100 days), and persistent (greater than 100 days) (Kerle et al. 1996).

The following threshold has been established for approving PUPs:

> Where aquatic $t_{½}$ is less than or equal to 100 days, a PUP will be approved without additional BMPs to protect water quality.
>
> Where aquatic $t_{½}$ is greater than 100 days, a PUP will only be approved with additional BMPs implemented specifically to protect water quality.

When BMPs are required to protect water quality, one or more of the following measures will be included in the Specific Best Management Practices section of the Chemical Profile and will be implemented during the application of the specific pesticide to minimize potential surface run-off and leaching that can degrade water quality:

- Do not exceed one application per site per year;
- Do not use on coarse-textured soils where the ground water table is less than 10 feet and average annual precipitation greater than 12 inches; and
- Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is already saturated.

Aquatic Dissipation. Dissipation time (DT_{50}) represents the time required for 50 percent of the deposited pesticide to degrade or move (dissipate); whereas, aquatic $t_{½}$ describes the rate for degradation only. As for $t_{½}$, units of dissipation time are usually expressed in days. Based upon the DT_{50} value, environmental persistence in aquatic habitats also would be categorized as one of the following: non-persistent (less than 30 days), moderately persistent (30-100 days), and persistent greater than 100 days.

The following threshold has been established for approving PUPs:

> Where aquatic DT_{50} is less than or equal to 100 days, a PUP will be approved without additional BMPs to protect water quality.
>
> Where aquatic DT_{50} is greater than 100 days, a PUP will only be approved with additional BMPs implemented specifically to protect water quality.

When BMPs are required to protect water quality, one or more of the following measures will be included in the Specific Best Management Practices section of the Chemical Profile and will be implemented during the application of the specific pesticide to minimize potential surface runoff and leaching that can degrade water quality:

- Do not exceed one application per site per year;
- Do not use on coarse-textured soils where the ground water table is less than 10 feet and average annual precipitation is greater than 12 inches; and
- Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is already saturated.

Potential to Move to Groundwater. The Groundwater Ubiquity Score (GUS) = $\log_{10}$(soil $t_{½}$) x [4 – $\log_{10}(K_{oc})$]. If a DT_{50} value is available, it will be used rather than a $t_{½}$ value to calculate a GUS score. Based upon the GUS value, the potential to move toward groundwater will be recorded as one of the following categories: extremely low potential (less than 1.0), low (1.0-2.0), moderate (2.0-3.0), high (3.0-4.0), or very high (greater than 4.0).

The following threshold has been established for approving PUPs:

> Where GUS is less than or equal to 4.0, a PUP will be approved without additional BMPs to protect water quality.
>
> Where GUS is greater than 4.0, a PUP will only be approved with additional BMPs implemented specifically to protect water quality.

When BMPs are required to protect water quality, one or more of the following measures will be included in the Specific Best Management Practices section of the Chemical Profile and will be implemented during the application of the specific pesticide to minimize potential surface runoff and leaching that can degrade water quality:

- Do not exceed one application per site per year;
- Do not use on coarse-textured soils where the ground water table is less than 10 feet and average annual precipitation greater than 12 inches; and
- Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is already saturated.

Volatilization. Pesticides may volatilize (evaporate) from soil and plant surfaces and move off-target into the atmosphere. In general, pesticides with I less than 10 would have low potential to volatilize; whereas, pesticides with I greater than 1,000 would have a high potential to volatilize (Oregon State University 1996). Vapor pressure values for pesticides are usually available in the pesticide product MSDS or the USDA Agricultural Research Service (ARS) pesticide database (see References).

The following threshold has been established for approving PUPs:

> Where I is less than or equal to 1000, a PUP will be approved without additional BMPs to minimize drift and protect air quality.
>
> Where I is greater than 1000, a PUP will only be approved with additional BMPs implemented specifically to minimize drift and protect air quality.

When BMPs are required to protect air quality, one or more of the following measures will be included in the Specific Best Management Practices section of the Chemical Profile and will be implemented during the application of the specific pesticide to reduce volatilization and drift:

- Do not treat when wind velocities are less than 2 or greater than 10 mph with existing or potential inversion conditions;
- Apply the largest diameter droplets possible for spray treatments;
- Avoid spraying when air temperatures are greater than 85°F;
- Use the lowest spray height possible above target canopy; and
- Where identified on the pesticide label, soil incorporates the pesticide as soon as possible during or after application.

Octanol-Water Partition Coefficient (K_{ow}). The octanol-water partition coefficient (K_{ow}) is the concentration of a pesticide in octanol and water at equilibrium at a specific temperature. Because octanol is an organic solvent, it is considered a surrogate for natural organic matter. Therefore, K_{ow} will be used to assess the potential for a pesticide to bioaccumulate in tissues of aquatic species (e.g., fish). If K_{ow} is greater than 1000 or S_w is less than 1 mg/L and soil $t_{½}$ is greater than 30 days, then there is a high potential for a pesticide to bioaccumulate in aquatic species such as fish (U.S. Geological Survey 2000).

The following threshold has been established for approving PUPs:

> If there is not a high potential for a pesticide to bioaccumulate in aquatic species, then the PUP would be approved.
> If there is a high potential to bioaccumulate in aquatic species (K_{ow} is more than 1000 or S_w is less than 1 mg/L and soil $t_{½}$ greater than 30 days), then the PUP would not approved, except under unusual circumstances where approval would only be granted by the Washington Office.

Bioaccumulation/Bioconcentration. This is the physiological process whereby pesticide concentrations in tissue would increase in biota because they are taken and stored at a faster rate than they are metabolized or excreted. The potential for bioaccumulation will be evaluated through bioaccumulation factors (BAFs) or bioconcentration factors (BCFs). Based upon BAF or BCF values, the potential to bioaccumulate will be recorded as one of the following: low (0-300), moderate (300-1000), or high (greater than 1000) (Calabrese and Baldwin 1993).

The following threshold has been established for approving PUPs:

> If BAF or BCF is less than or equal to 1000, then a PUP would be approved without additional BMPs.
>
> If BAF or BCF is greater than 1000, then a PUP would not approved, except under unusual circumstances where approval would only be granted by the Washington Office.

9.5 Worst-Case Ecological Risk Assessment

Max Application Rates (acid equivalent). Service personnel will record the highest application rate of an active ingredient (ae basis) for habitat management and facilities maintenance treatments in this data field of a Chemical Profile. These rates can be found in Table CP.1 of Attachment A under the column heading "Max Product Rate – Single Application (lbs. per acre – AI on acid equiv basis)." This table is to be filled out prior to completing the Chemical Profile to provide the basic information needed to complete the Chemical Profile. The information included on this table can be found on the product labels for trade name products identified in PUPs. If these data are not available in pesticide labels, then write "NS" for "not specified on label" in this table.

EECs. EECs represent potential exposure of fish and wildlife (birds and mammals) to a pesticide applied on the Refuge. EECs would be derived by Service personnel using a USEPA screening-level approach (USEPA 2004). For each max application rate (see description under Max Application Rates [acid equivalent]), Service personnel will record two EEC values in a Chemical Profile; these will represent the worst-case terrestrial and aquatic exposures for habitat management and facilities maintenance treatments. For terrestrial and aquatic EEC calculations, see description for data entry under Presumption of Unacceptable Risk/Risk Quotients, which is the next field for a Chemical Profile.

Presumption of Unacceptable Risk/Risk Quotients. Service personnel will calculate and record acute and chronic risk quotients (RQs) for birds, mammals, and fish using the provided tabular formats for habitat management and/or facilities maintenance treatments. RQs recorded in a Chemical Profile will represent the worst-case assessment for ecological risk. See Section 7.2 for discussion regarding the calculations of RQs.

For aquatic assessments associated with habitat management treatments, RQ calculations will be based upon selected acute and chronic toxicological endpoints for fish; and the EEC will be derived from Urban and Cook (*1986*) assuming 100 percent overspray to an entire one-foot-deep water body using the max application rate (ae basis).

For aquatic assessments associated with facilities maintenance treatments, RQ calculations will be calculated by Service personnel based upon selected acute and chronic toxicological endpoints for fish, and an EEC will be derived from the aquatic assessment in AgDRIFT model version 2.01 under Tier I ground-based application with the following input variables: max application rate (acid basis [see above]), low boom (20 inches), fine to medium/coarse droplet size, 20 swaths, USEPA-defined wetland, and 25-foot distance (buffer) from treated area to water. See the section of this appendix titled Aquatic Exposure for more details regarding the calculation of EECs for aquatic habitats for habitat management and facilities maintenance treatments.

For terrestrial avian and mammalian assessments, RQ calculations will be calculated by Service personnel based upon dietary exposure, where the "short grass" food item category will represent the worst-case scenario. For terrestrial spray applications associated with habitat management and facilities maintenance treatments, exposure (EECs and RQs) will be determined using the Kanaga nomogram method through the USEPA's Terrestrial Residue Exposure model (T-REX) version 1.2.3. T-REX input variables will include the following: max application rate (acid basis [see above]) and pesticide half-life (days) in soil to estimate the initial, maximum pesticide residue concentration on food items for terrestrial vertebrate species in short (<20 cm tall) grass.

For granular pesticide formulations and pesticide-treated seed with a unique route of exposure for terrestrial avian and mammalian wildlife, see the section of this appendix titled Terrestrial Exposure for the procedure that would be used to calculate RQs.

All calculated RQs in both tables would be compared with LOCs established by USEPA (see Table 2 in Section 7.2). If a calculated RQ exceeds an established LOC value (in brackets inside the table), then there would be a potential for an acute or chronic effect (unacceptable risk) to federally listed (T&E) species and non-listed species. See the section of this appendix titled Priorities for Treatment for detailed descriptions of acute and chronic RQ calculations and comparison to LOCs to assess risk.

The following threshold has been established for approving PUPs:

> If RQs is less than or equal to LOCs, then a PUP would be approved without additional BMPs.
>
> If RQs is greater than LOCs, then a PUP would only be approved with additional BMPs implemented specifically to minimize exposure (ecological risk) to bird, mammal, and/or fish species.

When BMPs are required to reduce the potential risk to listed or non-listed species, one or more of the following measures will be included in the Specific Best Management Practices section of the Chemical Profile:

- The application rate will be lowered and/or fewer number of applications will be conducted so RQs is less than or equal to LOCs; and

- For aquatic assessments (fish) associated with facilities maintenance, the buffer distance will be increased beyond 25 feet so RQs is less than or equal to LOCs.

9.6 Justification for Use

Service personnel will describe the reason(s) for using the pesticide to control specific pests or groups of pests. In most cases, the pesticide label provides the appropriate information regarding control of pests, which can be included in the section.

9.7 Specific Best Management Practices (BMPs)

Service personnel will record specific BMPs necessary to minimize or eliminate potential impacts to non-target species and/or to minimize or eliminate degradation of environmental quality related to drift, surface runoff, or leaching. These BMPs will be based upon scientific information documented in previous data fields of a Chemical Profile. Where necessary and feasible, these specific practices will be included in PUPs as a basis for approval.

If there are no specific BMPs that are appropriate, Service personnel will describe why the potential effects to Refuge resources and/or degradation of environmental quality is outweighed by the overall resource benefit(s) from the proposed pesticide use in the BMP section of the PUP. See the section of this appendix titled IPM Strategies for Invasive Plants for a complete list of BMPs associated with mixing and applying pesticides appropriate for all PUPs with ground-based treatments that would be additive to any necessary chemical-specific BMPs.

Specific BMPs have been identified for several of the products used or proposed for use on the Sonny Bono Salton Sea NWR and the Coachella Valley NWR. These specific BMPs, which are listed on the chemical profile for each product, are summarized here.

- **Glyphosate** (Product names - AquaNeat, Buccaneer, Extra Credit 5, Glyphosate Pro 4, Makaze, Prosecutor, Razor Pro): Apply aquatic labeled glyphosate formulations to aquatic habitats, and surfactant free glyphosate formulations to riparian habitats within 25 feet of surface water resources; note that tank-mixed with surfactants are classified as slight acute toxicity (less than 10 ppm) to aquatic organisms. Slight acute toxicity surfactants include LI-700, AgriDex, Activate Plus, Big Sur 90, Sil Energy, Dyne-Amic, Freeway, Cygnet Plus, Sun-Wet, Hasten Modified Vegetable Oil, Kinetic or Class Act Next Generation.

- **Imazapyr** (Product names - Habitat, Arsenal, Stalker, Ecomazapyr 2 SL): Habitat may be applied within 25 feet of surface water resources. Stalker may be applied to upland sites greater than 25 feet from surface water resources.

- **Aminopyralid** (Product names - Milestone, Milestone VM): Do not treat within 25 feet of surface water intended for irrigation of sensitive cultivated crops.

- **Halosulfuron-Methyl** (Product names - Halosulfuron Pro, Sandea, Sandea Herbicide)**:** Ground application only, with up to two applications per site per year. Do not exceed 0.125 lbs. ai per acre per year. Do not apply to coarse textured soils with soil organic matter less than 2 percent, and water table within 10 feet of soil surface. Do not apply to slopes less than 5 percent if significant rainfall is expected within 24 hours. Wind speed not to exceed seven mph or not less than one mph at time of application. Do not apply when inversion conditions exist. If applied within 25 feet of

surface water resources only use nonionic surfactants that are non-toxic or slight acute toxicity (LC_{50} less than 10 ppm) to aquatic organisms.

- **2,4-D DMA** (Product name – WEEDAR 64): Do not apply when wind velocity reaches five miles per hour. For ground application, do not spray within 100 feet of sensitive habitat or commercial crop areas, and for aerial applications, do not spray within 250 feet of sensitive habitat or commercial crop areas.

- **Triclopyr** (Product names - Garlon 3A, Garlon 4, Pathfinder II, Remedy): Must maintain a 25-foot treatment buffer zone from surface water resources, except for cut stump treatments of target woody pest species.

- **Tribenuron-Methyl** (Product name - Express)**:** Ground application only. Up to two applications per site per year; do not exceed 0.015 lbs. ai per acre per year. Maintain a 25-foot buffer zone from surface water resources. Do not apply to coarse textured soils with soil organic matter less than 2 percent, and water table within 10 feet of soil surface. Do not apply to slopes greater than 5 percent if significant rainfall is expected within 24 hours. Wind speed not to exceed seven mph or not less than one mph at time of application. Do not apply when inversion conditions exist. Only use nonionic surfactants that are non-toxic or slight acute toxicity (LC_{50} greater than 10 ppm) to aquatic organisms.

- **Dicamba** (Product names - Clarity, Vanquish, Vanquish Herbicide): No specific BMPs

10. Reference Sources

Service personnel will record scientific resources used to provide data/information for a Chemical Profile. Use the number sequence to uniquely reference data in a chemical profile.

The following online data resources are readily available for toxicological endpoint and environmental fate data for pesticides:

1. California Product/Label Database. Department of Pesticide Regulation, California Environmental Protection Agency. (http://www.cdpr.ca.gov/docs/label/labelque.htm#regprods)

2. ECOTOX database. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, DC. (http://cfpub.epa.gov/ecotox/)

3. Extension Toxicology Network (EXTOXNET) Pesticide Information Profiles. Cooperative effort of University of California-Davis, Oregon State University, Michigan State University, Cornell University and University of Idaho through Oregon State University, Corvallis, Oregon. (http://extoxnet.orst.edu/pips/ghindex.html)

4. Human health and ecological risk assessments. Pesticide Management and Coordination, Forest Health Protection, U.S. Department of Agriculture, U.S. Forest Service. (http://www.fs.fed.us/foresthealth/pesticide/risk.shtml

5. Pesticide Chemical Fact Sheets. Clemson University Pesticide Information Center. (http://www.clemson.edu/extension/pest_ed/safety_ed_prog/label_msds/factshee.html)

6. Pesticide Fact Sheets. National Pesticide Information Center. (http://npic.orst.edu/npicfact.htm)

7. Pesticide and Policy, Environmental Database. U.S. Environmental Protection Agency, Washington, DC. (http://www.epa.gov/opp00001/science/efed_databasesdescription.htm).

8. Pesticide product labels and material safety data sheets. Crop Data Management Systems, Inc. (CDMS) (http://www.cdms.net/pfa/LUpdateMsg.asp) or multiple websites maintained by agrichemical companies.

9. Registered Pesticide Products (Oregon database). Oregon Department of Agriculture. (http://oregon.gov/ODA/PEST/registration_index.shtml)

10. Regulatory notes. Pest Management Regulatory Agency, Health Canada, Ontario, Canada. (http://www.hc-sc.gc.ca/pmra-arla/)

11. Reptile and Amphibian Toxicology Literature. Canadian Wildlife Service, Environment Canada, Ontario, Canada. (http://publications.gc.ca/collections/Collection/CW69-5-357E.pdf)

12. Fact Sheet on New Active Ingredients. U.S. Environmental Protection Agency, Washington, DC. (http://www.epa.gov/opprd001/factsheets/)

13. Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas. The Invasive Species Initiative. The Nature Conservancy. (http://tnsweeds.ucdavis.edu/handbook.html)

14. Wildlife Contaminants Online. U.S. Geological Survey, Department of Interior, Washington, D.C. (http://www.pwrc.usgs.gov/contaminants-online/)

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Attachment A - Blank Chemical Profile Form

Date:			
Trade Name(s):		**Common Chemical Name(s):**	
Pesticide Type:		**EPA Registration Number:**	
Pesticide Class:		**CAS Number:**	
Other Ingredients:			

Toxicological Endpoints

Mammalian LD_{50}:	
Mammalian LC_{50}:	
Mammalian Reproduction:	
Avian LD_{50}:	
Avian LC_{50}:	
Avian Reproduction:	
Fish LC_{50}:	
Fish ELS/Life Cycle:	
Other:	

Ecological Incident Reports

Environmental Fate

Water solubility (S_w):	
Soil Mobility (K_{oc}):	
Soil Persistence ($t_{½}$):	
Soil Dissipation (DT_{50}):	
Aquatic Persistence ($t_{½}$):	
Aquatic Dissipation (DT_{50}):	
Potential to Move to Groundwater (GUS score):	
Volatilization (mm Hg):	
Octanol-Water Partition Coefficient (K_{ow}):	
Bioaccumulation/Biocentration:	**BAF:`** **BCF:**

Worst Case Ecological Risk Assessment

Max Application Rate (ai lbs/acre – ae basis)	**Habitat Management:** **Croplands/Facilities Maintenance:**
EECs	**Terrestrial (Habitat Management):** **Terrestrial (Croplands/Facilities Maintenance):** **Aquatic (Habitat Management):** **Aquatic (Croplands/Facilities Maintenance):**

Habitat Management Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	[0.1]	[0.5]
	Mammals	[0.1]	[0.5]
	Fish	[0.05]	[0.5]
Chronic	Birds	[1]	[1]
	Mammals	[1]	[1]
	Fish	[1]	[1]

Cropland/Facilities Maintenance Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	[0.1]	[0.5]
	Mammals	[0.1]	[0.5]
	Fish	[0.05]	[0.5]
Chronic	Birds	[1]	[1]
	Mammals	[1]	[1]
	Fish	[1]	[1]

Justification for Use:	
Specific Best Management Practices (BMPs):	
References:	

Attachment A (continued)

Table CP.1 (Accompanies the Chemical Profile) Pesticide Name						
Trade Name[a]	Treatment Type[b]	Max Product Rate – Single Application (lbs/acre or gal/acre)	Max Product Rate - Single Application (lbs/acre - AI on acid equiv basis)	Max Number of Applications Per Season	Max Product Rate Per Season (lbs/acre/season or gal/acre/season)	Minimum Time Between Applications (Days)

[a]From each label for a pesticide identified in pesticide use proposals (PUPs), Service personnel would record application information associated with possible/known uses on Service lands.

[b]Treatment type: H – habitat management or CF – cropland/facilities maintenance. If a pesticide is labeled for both types of treatments (uses), then record separate data for H and CF applications.

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Attachment B
Completed Chemical Profiles
for the Sonny Bono Salton Sea NWR Complex

B-1 Glyphosate Formulations Chemical Profile

(AquaNeat, Buccaneer, Extra Credit 5, Glyphosate Pro 4, Makaze, Prosecutor, Razor Pro)

B-2 Imazapyr Formulations Chemical Profile

(Habitat, Arsenal, Stalker, Ecomazapyr 2 SL)

B-3 Aminopyralid Formulations Chemical Profile

(Milestone, Milestone VM)

B-4 Halosulfuron-Methyl Formulations Chemical Profile

(Halosulfuron Pro, Sandea, Sandea Herbicide)

B-5 2,4-D Amine Chemical Profile

(WEEDAR 64 Broadleaf Herbicide)

B-6 Triclopyr Formulations Chemical Profile

(Garlon 3A, Garlon 4, Pathfinder II, Remedy)

B-7 Tribenuron-Methyl Formulations Chemical Profile
(Express)

B-8 Dicamba Formulations Chemical Profile
(Clarity, Vanquish, Vanquish Herbicide)

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B-1 Glyphosate Formulations Chemical Profile

Toxicological endpoint and environmental fate data listed in this chemical profile will be periodically reviewed and updated. New information, including, but not limited to, completion of national section 7consultation in accordance with the federal Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884), as amended, between the U.S. Fish and Wildlife Service and the U.S. Environmental Protection Agency on individual pesticide registrations and all federally listed and proposed species and proposed and designated critical habitat, may change ecological risk assessments, pesticide use patterns, best management practices, and/or justification for use. Consultations occur now at the local level for listed and proposed species and proposed and designated critical habitat on specific use of individual pesticides in specific project areas.

Date:	4/6/12				
Pesticide Class:	EPSP synthase inhibitor	**Common Chemical Name(s):**	Glyphosate	**Pesticide Type:**	Herbicide Group 9
Trade Name(s):	Accord Concentrate, Aqua Star, AquaMaster, AquaNeat, Buccaneer, Buccaneer Plus, Cornerstone, Cornerstone Plus, Gly Star Plus, Glyfos Aquatic, Glyfos XTRA, Glypro, Honcho, Honcho Plus, Makaze, Razor Pro, Rodeo, Roundup Original, Roundup Original MAX, Roundup Pro, Roundup PRO Concentrate, Roundup WeatherMAX	**EPA Registration Number:**	62719-324, 42750-59, 524-343, 228-365, 55467-10, 55467-9, 1381-191, 524-454-1381, 42750-61, 4787-34, 4787-23, 62719-324, 524-445, 524-454, 34704-890, 228-366, 62719-324, 524-445, 524-539, 524-475, 524-529, 524-537	**CAS Number:**	38641-94-0, 38641-94-0, 38641-94-0, 38641-94-0, 38641-94-0, 38641-94-0, 38641-94-0, 38641-94-0, 38641-94-0, 38641-94-0, 38641-94-0, 38641-94-0, 38641-94-0, 38641-94-0, 38641-94-0, 38641-94-0, 38641-94-0, 38641-94-0, 70901-12-1, 38641-94-0, 38641-94-0, 70901-12-1
Other Ingredients:	**Accord Concentrate (glyphosate N-(phosphonomethyl)glycine, isopropylamine salt (IPA)):** 53.8% IPA, 46.2% other ingredients (1a); **Aqua Star:** 53.8% IPA, 46.2% other (1b); **AquaMaster:** 53/8% IPA, 46.2% water (1c); **AquaNeat:** 53.8% IPA, 46.2% other (1d); **Buccaneer:** 41.0% IPA, 59.0% other (1e); **Buccaneer Plus:** 41.0% IPA, 59.0% other (1f); **Cornerstone:** 41.0% IPA, 59.0% other (1g); **Cornerstone Plus:** 41.0% IPA, 59.0% other (1h); **Gly Star Plus:** 41.0% IPA, 59.0% other (1i); **Glyfos Aquatic:** 40-70% IPA, 30-60% other (1j); **Glyfos XTRA:** 30-60% IPA, 5-15% surfactant (trade secret), 25-65% other (1k); **Glypro:** 53.8% IPA, 46.2% other (1l); **Honcho:** 41.0% IPA, 59.0% other (1m); **Honcho Plus:** 41.0% IPA, 59.0% other (1n); **Makaze:** 41.0% IPA, 59.0% other (1o); **Razor Pro:** 41.0% IPA, 59.0% other (including 14% POEA [polyethoxylated tallow amine] surfactant) (1p,3); **Rodeo:** 53.8% IPA, 46.2% other (1q); **Roundup Original:** 41.0% IPA, 59.0% other (1r); **Roundup Original MAX (glyphosate N-(phosphonomethyl) glycine, potassium salt (K)):** 48.7% K, 51.3% other (1s), including				

	unknown % of POEA surfactant (18); **Roundup Pro:** 41.0% IPA, 59.0% other (including unknown % of trade secret surfactant) (1t); **Roundup PRO Concentrate:** 50.2% IPA, 13.0% surfactant, 36.8% other (1u,3); **Roundup WeatherMAX:** 48.8% K, 51.2% other (1v).

Toxicological Endpoints	Endpoints highlighted yellow are selected for use in a screening-level ecological risk assessment. Endpoints selected are typically the most toxic endpoint for the most sensitive species listed in following summaries.
Mammalian LD_{50}:	**Glyphosate Tech 95.0-98.7%**: *Dog*: NOEL = 500 mg/kg/day (11). *Goat* (female): 96-h = 3,500 mg/kg bw (3). *Mice*: 96-h = 1,568 mg/kg bw (3); NOAEL = 3,125 mg/kg diet (10). *Rabbit*: 96-h = 3,800 mg/kg bw (3); 21-d NOAEL = 175 mg ae/kg/day (20). *Rat*: 96-h >4,320 mg/kg (2,7,11); 96-h = 4,873 mg/kg bw (3); 96-h > 2000 mg/kg (6); 96-h > 4,770 mg ae/kg bw (8), NOAEL < 3,125 mg/kg diet (10); Systemic Toxicity LOEL males = 940 mg/kg/day, females = 1,183 mg/kg/day (11); Systemic Toxicity NOELs: males = 362 mg/kg/day, females = 457 mg/kg/day (11); = 2,047 mg ae/kg/day (20). **Glyphosate Tech 88.0%:** *Rat*: 96-h >4,440 mg ae/kg bw (8). **Glyphosate Tech 76.0%:** 96-h >3,800 mg ae/kg bw (8). **AMPA 95.4-97.2%**: *Dog*: 90-d NOEL =263 mg/kg/day (20). *Rat*: >1,920 mg ae/kg bw (3); >4,750 mg ae/kg bw (3); >4,770 mg ae/kg bw (3); >4,800 mg ae/kg bw (3); >4,860 mg ae/kg bw (3); 90-d NOEL =400 mg/kg/day, LOEL =1,200 mg/kg/day (20). **AMPA 88.0%**: *Rat*: >4,400 mg ae/kg bw (3). **AMPA 76.0%**: *Rat*: >3,800 mg ae/kg bw (3). **IPA 62.0%:** *Rat*: >5,000 mg/kg (1c); Mouse: > 5,000 mg/kg (1c). **IPA 53.8%**: *Rat*: >5,000 mg/kg (1a). **IPA 41.0%**: *Rat*: >5,000 mg/kg (1i,m,o,r), = 5,108 mg/kg bw (1t). **K:** No information in references.
Mammalian LC_{50}:	**Glyphosate Tech (95.0-98.7%):** *Rat*: NOEL (diet) =150 ppm (6).
Mammalian Reproduction:	**Glyphosate Tech:** *Rabbit*: Maternal toxicity NOEL =175 mg/kg/day, LOEL =350 mg/kg/day (2,8,10); Developmental toxicity NOEL > 175 mg/kg/day (1c,e,f,h,m,n,r-v,2,8). *Rat*: Maternal & developmental toxicity NOEL = 1,000 mg/kg/day, LOEL = 3,500 mg/kg/day (2,3); 3-generation: Systemic & reproductive toxicity NOEL < 30 mg/kg/day (1c,e,f,2,8,10,20); Developmental toxicity NOEL=10 mg/kg/day,

	LOEL =30 mg/kg/day (2); 2-generation: Systemic & developmental toxicity NOEL =500 mg/kg/day, LOEL =1,500 mg/kg/day (2,3,8); Reproduction NOEL =1,500 mg/kg/day (1m,n,r-v,2,3); 21-d dietary NOEL =400 mg/kg/day (20). **AMPA 98.7%**: *Rat*: Systemic & Reproductive NOEL =740 mg/kg/day, LOEL =2,268 mg/kg/day (3). **IPA:** No information in references. **K:** No information in references.
Avian LD_{50}:	**Glyphosate Tech 95.6-99.0%:** *Bobwhite*: >3,851 mg ae/kg diet (1c,s,v,20); 96-h >1,912 mg/kg bw, NOAEL = 1,912 mg/kg bw (8); 8-d dietary =4,000 ppm (11); 8-d dietary > 4,640 mg ae/ kg diet (7,20). *Mallard*: 8-d dietary =4,000 ppm (11); 8-d dietary >4,640 mg ae/kg diet (7,20). **Glyphosate Tech 83.0%**: *Bobwhite*: 96-h >2,000 mg/kg (2,11); 96-h >3,196 mg ae/kg bw (8). **AMPA:** *Bobwhite*: >3,800 mg/kg (1b,i); >1,912 mg ae/kg bw (3); 8-d dietary >5,620 mg/kg diet, NOEC = 5,620 mg/kg diet (20); (Single Dose LC50) >2,250 mg ae/kg diet (20). *Mallard*: 8-d dietary >5,620 mg/kg diet, NOEC = 5,620 mg/kg diet (20). **AMPA 87.8%**: *Bobwhite*: 96-h >1,976 mg ae/kg, NOAEL = 1,185 mg ae/kg (8). **IPA 41.0%**: *Bobwhite*: >3,800 mg/kg (1g). *Japanese Quail*: 5-d dietary >5,000 ppm (1k,4). **K:** No information in references.
Avian LC_{50}:	**Glyphosate (95.6-98.5%)**: *Bobwhite*: 5-d >5,620 ppm diet (1t); 8-d >4,500 ppm (1d,p); 96-h >4,570 ppm ae, NOAEC = 4,570 ppm ae (3,8); 96-h >4,971.2 ppm ae, NOAEC = 4,971.2 ppm ae (3); 5-d LC50 (14-d old) >4,640 ppm (22). *Mallard*: 5-d >5,620 ppm diet (1t); 8-d >4,500 ppm (1d,p); 96-h > 4,570.4 ppm ae, NOAEC = 4,770.4 ppm ae (3,8); 96-h >4,971.2 ppm ae, NOAEC = 4,971.2 ppm ae (3); 5-d LC50 (14-d old) >4,640 ppm, NOEL =1,000 ppm (22). **AMPA (87.8%)**: *Bobwhite*: >4,934 ppm, NOAEC = 4,934 ppm (3,8). *Mallard*: > 4,934 ppm, NOAEC = 4,934 ppm (3,8). **IPA (Unk. %AI)**: *Mallard*: 8-d LC50 >4,640 ppm (4). *Bobwhite*: 8-d LC50 >4,640 ppm (4). **K:** No information in references.
Avian Reproduction:	**Glyphosate Tech (94.4-98.5%):** *Bobwhite*: 8-d >4,640 ppm diet (1c,s,v,2). *Mallard*: 5-d > 4,640 ppm diet (1c,s,v,2).

	Glyphosate Tech (90.4%): *Mallard*: No effects up to 30 ppm (2); NOAEC =27 ppm, LOAEC >27 ppm (3,8). **Glyphosate Tech (83.0%)**: *Mallard*: No effects up to 1,000 ppm (2,11); NOAEC =830 ppm (3,8), LOAEC >830 ppm (8). *Bobwhite*: No effects up to 1,000 ppm (2); NOAEC = 830 ppm (3,8), LOAEC > 830 ppm (8). **IPA:** No information in references. **K:** No information in references. **AMPA:** No information in references.
Fish LC_{50}:	**Glyphosate Tech. (95.4-99.7%)**: *Bluegill*: 96-h >24 ppm (2,20); 96-h =43 ppm ae (3,5,8), NOAEC = 30.6 ppm (3,8); 96-h LC50 (pH 6.5 @ 22°C) =140 ppm (3,4,5,14); 96-h LC50 (pH 9.5 @ 22°C) =220 ppm (4,5,14); 96-h =78 ppm (7); 96-h =100.2 ppm ae (8); 96-h, static water =34.0 ppm (10); 96-h flow-through water =5.8 ppm (10); 96-h = 150 ppm (11); 96-h =120 ppm (12,20). *Channel Catfish*: 48-h =140 ppm (2); 96-h LC50 @ 22°C =130 ppm (4,5,11,14); 96-h =93 ppm ae (8); 96-h = 39 ppm (10). *Chinook*: 96-h =20 ppm (10). *Coho*: 96-h =22 ppm (10). *Fathead Minnow*: 48-h =97 ppm (2,11); 96-h LC50 @ 22°C =97 ppm (4,5,14), NOAEC = 25.7 ppm ae (8); 96-h =69.4 ppm ae (8); 96-h = 23 ppm (10). *Pink*: 96-h =14 to 33 ppm (10). *Rainbow Trout*: 96-h >1,000 ppm (1b); 96-h =128.1 ppm, NOAEC = 30.6 ppm (dark coloration observed at 53.6 ppm) (3,8); 96-h LC50 (pH 6.5 @ 12°C) =140 ppm (3,4,5,11,14); 96-h LC50 (pH 9.5 @ 12°C) =240 ppm (4,5,14); 96-h LC50 =38 ppm (6,7); 21-d NOEC =25 ppm (6); 96-h =100.2 ppm ae (8); 96-h = 128.1 ppm ae (8); 96-h (static water) = 15 to 26 ppm (10); 96-h (flow-through water) =8.2 ppm (10). **Glyphosate Tech (83.0-87.3%)**: *Bluegill*: 96-h =99.6 ppm, NOAEC = 83 ppm (3,8); 96-h =120 ppm (1d,5); 48-h =120 ppm (2). *Fathead Minnow*: 48-h =84.9 ppm (2). *Rainbow Trout*: 96-h =86 ppm (1d,3,5,12,20); 96-h NOEC =42 ppm (20); 96-h =71.4 ppm ae (8). **AMPA (94.4-95.6% AI)**: *Species Unknown*: 96-h =499 ppm, NOAEC = 174 ppm (3,8); 96-h LC50 =520 ppm, NOEC =33 ppm (20). *Bluegill*: 96-h >1,000 ppm (1b). **IPA (%AI Unk):** *Rainbow Trout*: 21-d NOEC =52 ppm (20); **IPA (62.0%)**: *Bluegill*: 96-h >461.8 ppm ae (3). *Rainbow Trout*: 96-h >461.8 ppm ae (3).

	IPA (53.6-53.8%): *Channel Catfish*: 96-h =130 ppm (4,14,20). *Fathead Minnow*: 96-h NOEC =1,000 ppm (3,5); 96-h =97 ppm (4,14,20). *Rainbow Trout*: 96-h >2,500 ppm (1a,l,q), NOEC =1,000 ppm (3,20). **IPA (41% w/ 15% POEA surfactant)**: *Bluegill*: 96-h @ 22°C =5 ppm (5,14); 96-h @ 17°C =7.5 ppm (5,14); 96-h @ 22°C =5 ppm (14); 96-h @ pH 6.5 =4.2 ppm (14); 96-h 2 pH 7.5 =2.4 ppm (4,5,14); 96-h =6.4 ppm (11). *Channel Catfish*: 96-h @ 22°C =13 ppm (11,14). *Fathead Minnow*: 96-h @ 22°C = 2.3 ppm (5,14); 96-h =2.4 ppm (11). *Rainbow Trout*: 96-h @12°C =8.3 ppm (4,5,11,14); 96-h @ 7°C =14 ppm (4,5,14); 96-h @ 12°C =7.5 ppm (4,5,14); 96-h @ pH 6.5 =7.6 ppm (4,5,14); 96-h @ pH 7.5 =1.6 ppm (4,5,14); Behavioral LOEC =13.5 ppm (4,5); 21-d NOEC =2.4 ppm (20). **K:** No information in references.
Fish ELS/Life Cycle:	**Glyphosate Tech (%AI unk.)**: *Coho*: NOEC (15.5-16.9 g smolts, plasma Na concentrations) = 2.78 ppm ae (3). **Glyphosate Tech (95.4-99.7%)**: *Bluegill*: Av. wt. 0.4-0.9g @ 22°C, =44 ppm CaCO3; LC50s: @ pH 6.5: 24-h =240 ppm; 96-h =140 ppm (4,5); @ pH 7.4: 24-h =150 ppm; 96-h =135 ppm (4,5); @ pH 9.5: 24-h =230 ppm; 96-h =220 ppm (4,5). *Channel Catfish*: Av. wt. 2.2g @ 22°C: 24 & 96-h =130 ppm (4,5). *Chinook*: Av. wt. 0.3-0.7g: Creek (soft) water LC50s: 24-h =55 ppm; 96-h =30 ppm (4,5,15,20): Lake (hard) water LC50s: 24-h =220 ppm; 96-h =211 ppm (4,5,15,20). *Chum*: Av. wt. 0.3-0.7g: Creek (soft) water LC50s: 24-h =26 ppm; 96-h =22 ppm (4,5,15,20); Lake (hard) water LC50s: 24-h =202 ppm; 96-h =148 ppm (4,5,15,20). *Coho*: Av. wt. 0.3-0.7g: Creek (soft) water LC50s: 24-h =55 ppm; 96-h =36 ppm (4,5,15,20); Lake (hard) water LC50s: 24-h =210 ppm; 96-h =174 ppm (4,5,15,20). *Fathead Minnow*: Av. wt. 0.6g @ 20C, LC50s: 24 & 96-h =97 ppm (4,5). *Pink*: Av. wt. 0.3-0.7g: Creek (soft) water LC50s: 24-h =63 ppm; 96-h =23 ppm (4,5,15,20); Lake (hard) water LC50s: 24-h =380 ppm; 96-h =190 ppm (4,5,15,20). *Rainbow Trout*: Av. wt. 0.3-0.7g: Creek (soft) water LC50s: 24-h =32 ppm; 96-h =22 ppm (4,5,15,20); Lake (hard) water LC50s: 24-h =220 ppm; 96-h =197 ppm (4,5,15,20); Av. Wt. 0.7-0.8 g @12C, soft water, LC50s: @ pH 6.5: 24-h =240 ppm; 96-h =140 ppm (4,5); @ pH 7: 24 & 96-h =130 ppm (4,5); @ pH 9.5: 24 & 96-h =240 ppm (4,5). **Glyphosate Tech (41.%AI):** *Bluegill*: Av. wt. 0.7g @ 22°C @ pH 7.4 @ 44 ppm CaCO3, LC50s: 24-h =6.8 ppm; 96-h =5.6 ppm (4,5); Av. wt. 0.5g @ pH 7.4 @ 44 ppm CaCO3, LC50s: @17°C: 24-h =9.6 ppm; 96-h =7.5 ppm (4,5): @22°C: 24-h =6.4 ppm; 96-h =5 ppm (4,5); @27°C: 24-h =4.3 ppm; 96-h =4 ppm (4,5); Av. wt. 0.3g @ 22°C @ 44 ppm CaCO3, LC50s: @pH 6.5: 24-h =7.6 ppm; 96-h =4.2 ppm (4,5); @pH 7.5 24-h =4 ppm; 96-h =2.4 ppm (4,5); @pH 8.5: 24-h =3.9 ppm; 96-h =2.4 ppm (4,5); @pH 9.5: 24-h =2.4 ppm; 96-h =1.8 ppm (4,5); Degradation (degr.) study (av. wt. 0.5g, 12°C, pH 7.4, 44 ppm CaCO3): LC50s: 0-d degr.: 24-h =4.3

	ppm; 96-h =4 ppm (4,5); 1-d degr.: 24-h =6.6 ppm; 96-h =6 ppm (4,5); 3-d degr.: 24-h =8 ppm; 96-h =7 ppm, (4,5); 7-d degr.: 24-h =6.2 ppm; 96-h =5.6 ppm (4,5); Av. wt. 1.3g, 20°C, 272 ppm CaCO3: LC50: 96-h =5.5 ppm (4,5). *Channel Catfish*: Av. wt. 0.2g, 20°C: 24 & 96-h =4.4 ppm (4,5); Av. wt. 0.6 g, 22°C: 24 & 96-h =13 ppm (4,5); Eyed eggs (20°C): LC50 96-h =43 ppm (4,5); 225°C, LC50s: Swim-up Fry: 24-h =3.7 ppm 96-h =3.3 ppm (4,5); Yolk-sac Fry: 24 & 96-h =4.3 ppm (4,5). *Fathead Minnow*: Av. wt. 0.6-0.9 g, pH 7.4, 44 ppm CaCO3, LC50s: @15°C: 24-h =7 ppm; 96-h =4.8 ppm (4,5); @20°C: 24-h =4.1 ppm; 96-h =2.9 ppm (4,5); @22°C: 24-h =2.4 ppm; 96-h =2.3 ppm (4,5); @25°C: 24-h =6.4 ppm: 96-h = 4.3 ppm (4,5). *Rainbow Trout*: @12°C, pH 7.4, 44 ppm CaCO3, LC50s: Av. wt. 0.4 g: 24-h = 12 ppm; 96-h =7.6 ppm (4,5); Av. wt. 0.5 g: 24-h =5.2 ppm; 96-h =1.3 ppm (4,5); Av. wt. 1.0 g: 24 & 96-h =8.3 ppm (4,5); Av. wt. 0.7g @pH 7.4, 44 ppm CaCO3, LC50s: @7°C: 24 & 96-h =14 ppm (4,5); @12°C: 24-h =14 ppm; 96-h =7.5 ppm (4,5); @17°C: 24-h =7.5 ppm; 96-h =7.4 ppm (4,5); Av. wt. 0.4g, @12°C, 44 ppm CaCO3, LC50s: @pH 6.5: 24-h =14 ppm; 96-h =7.6 ppm (4,5); @pH 7.5: 24-h =2.4 ppm; 96-h =1.6 ppm (4,5); @pH 8.5 & 9.5: 24-h =2.4 ppm; 96-h =1.4 ppm (4,5); Degradation (degr.) study (av. wt. 0.5g, 12°C, pH 7.4, 44 ppm CaCO3, LC50s: 0-d degr.: 24-h =19 ppm; 96-h =9 ppm (4,5); 1-, 3- & 7-d degr.: 24-h =14 ppm; 96-h =7.6 ppm (4,5); Yolk-sac fry (10°C), LC50s: 24-h = 11 ppm; 96-h =3.4 ppm (4,5). **AMPA:** *Fathead Minnow*: NOEC (life-cycle) = 25.7 ppm (3). **IPA (96.7%):** *Bluegill*: 96-h LC50, av. wt. 1g =120 ppm, NOEL =100 ppm (22). *Channel Catfish*: 96-h LC50, av. wt. 2.2g =130 ppm (22). *Fathead Minnow*: 96-h LC50, av. wt. 0.6g =97 ppm (22). **IPA (83.0-87.3%):** *Fathead Minnow*: Life Cycle (LOEL) > 25.7 ppm, (NOEL) = 25.7 ppm (22). *Rainbow Trout*: 96-h LC50, av. wt. 0.8g =140 ppm (22). **IPA (62.4%):** *Rainbow Trout*: 96-h LC50, av. wt. 0.22) >1,000 ppm (22). **IPA (53.6-53.8%):** *Striped Bass*: Av. wt 1g: 1-h =131 ppm, 6-h =50 ppm, 96-h =23.5 ppm (4,5). **IPA (40.7-41.8%)**: *Bluegill*: 96-h LC50, av. wt. 0.45g =14 ppm, NOEL =8.7 ppm (22); 96-h LC50, av. wt. < 2.5g =2.4 ppm (22); 96-h LC50, av. wt. 0.25g =5.8 ppm, NOEL = 2.2 ppm (22); 96-h LC50, av. wt. 0.11g =134 ppm, NOEL <100 ppm (22); 96-h LC50, av. wt. 0.5g = 4.0 ppm (22). *Channel Catfish*: 96-h LC50, av. wt. 0.6g =13 ppm (22); 96-h LC50, av. wt. 3.0g =16 ppm, NOEL =9.4 ppm (22). *Fathead Minnow*: 96-h LC50, av. wt. 0.6g =9.4 ppm, NOEL =5.6 ppm (22). *Rainbow Trout*: 21-d NOEC =0.43-0.81 ppm (1k); 96-h LC50, av. wt. 0.5g =1.3 ppm (22); 96-h LC50, fingerling =8.3 ppm (22); 96-h LC50, av. wt. 0.4g =150 ppm, NOEL =100 ppm (22); 96-h LC50, av. wt. 2.4g =8.2 ppm, NOEL =5.8 ppm (22); 96-h LC50, av. wt. 0.5g =120 ppm (22).

	IPA (7.03%): *Bluegill*: 96-h LC50, av. wt. 0.18g =830.8 ppm, NOEL =180 ppm (22). *Rainbow Trout*: 96-h LC50, av. wt. 1.0g =240 ppm, NOEL =180 ppm (22). **IPA (41% w/ 10% POEA surfactant)**: *Coho*: Av. wt. 0.3-0.7g: Creek (soft) water: 24-h =54 ppm, 96-h =51 ppm (4,5,15), Lake (hard) water: 24 & 96-h = 25 ppm (4,5,15). *Chum*: Av. wt. 0.3-0.7g: Creek (soft) water: 24-h =62 ppm, 96-h =58 ppm (4,5,15), Lake (hard) water: 24-h =25 ppm, 96-h =23 ppm (4,5,15); Av. wt. 0.3-0.7g: Creek (soft) water: 24-h =31 ppm, 96-h =19 ppm (4,5,15), Lake (hard) water: 24-h =17 ppm, 96-h =11 ppm (4,5,15). *Rainbow Trout*: Av. wt. 0.3-0.7g: Creek (soft) water: 24-h =33 ppm, 96-h =31 ppm (4,5,15), Lake (hard) water: 24-h =31 ppm, 96-h =17 ppm (4,5,15), 96-h (av. wt 0.37 g): (dechlorinated city water, pH 6.1) =26 ppm, (lake water, pH 7.7) =15 ppm (4,20). **IPA (41% w/ 15% POEA surfactant)**: *Channel Catfish*: 96-h, sac fry =4.3 ppm (4,14), swim-up fry =3.3 ppm (4,14), Av. wt 2.2g) =13 ppm (14). *Chinook*: Av. wt. 0.3-0.7g: Creek (soft) water: 24-h =41 ppm, 96-h =27 ppm (4,5,15,20), Lake (hard) water: 24 & 96-h =17 ppm (4,5,15,20), Av. wt. 4.6g, dechlorinated city water, pH 6.1: 96-h =20 ppm (4,20). *Chum*: Av. wt. 0.3-0.7g: Creek (soft) water: 24-h =31 ppm, 96-h =19 ppm (4,5,15,20), Lake (hard) water: 24-h =17 ppm, 96-h =11 ppm (4,5,15,20). *Coho*: Av. wt. 0.3-0.7g: Creek (soft) water: 24 & 96-h =27 ppm (4,5,15,20), Lake (hard) water: 24-h =14 ppm, 96-h =13 ppm (4,5,15,20), 96-h, av. wt. 0.3g @ 15°C =42 ppm (4,5,16,20); Av. wt. 11.8g, dechlorinated city water @ pH 6.2: 96-h =22 ppm (4,20). *Pink*: Av. wt. 0.3-0.7g: Creek (soft) water: 24-h =33 ppm, 96-h =31 ppm (4,5,15,20), Lake (hard) water: 24-h =17 ppm, 96-h =14 ppm (4,5,15,20). *Rainbow Trout*: 96-h, eyed eggs =16 ppm (4,5,14), sac fry =3.4 ppm, swim-up fry =2.4 ppm (4,5,14); 96-h, av. wt. 1g =1.3 ppm (4,5,14), 96-h, av. wt. 2g =8.3 ppm (4,5,14); Av. wt. 0.3-0.7g: Creek (soft) water: 24-h =21 ppm, 96-h =15 ppm (4,5,15,20), Lake (hard) water: 24-h =17 ppm, 96-h =14 ppm (4,5,15,20); 96-h, av. wt. 0.33g, 15°C =28 ppm, av. wt. 0.6g, 14.5°C =25.5 ppm (4,5,16). *Sockeye*: 96-h, av. wt. 3.8 g, 4.2°C) =26.7 ppm (4,5,16,20), Av. wt. 0.25 g, 4.5°C =28.8 ppm (4,5,16).
Amphibians/Reptiles:	**Glyphosate Tech (95.0% +):** *Gray Tree Frog*: 26-d NOEL, metamorphosis, growth & survival =0.0069 ppm (4,5). *Green Frog*: 24-h & 96-h LC50s, embryo >38.9 ppm (4,11); 7-d & 14-d NOEL, mortality =3.7 ppm (4,5); 15-d LOEL, immunological =3.7 ppm (4,5). *Leopard Frog*: 40 to 45-d NOEL, metamorphosis, growth & survival =0.0069 ppm (4,5); NOAEC =1.8 ppm ae (8). *Xenopus laevis*: 96-h LC50 @ pH 7.6 =7,297 ppm ae; 96-h LC05 @ pH 7.6 = 5,516 ppm ae (3). **AMPA:** No data in references. **IPA (53.8%)**: *African Clawed Frog*: 96-h LC50, embryo =7,296.8 ppm ae (4,5); 96-h LC10, embryo = 5,867.2 ppm ae (4); 96-h LC05, embryo =5,515.5 ppm ae (4); 96-h LOEL, growth =6,000 ppm ae (4,5), NOEL, growth 4,000 ppm ae (4,5); 96-h LC50, embryo @ pH 6.5 =4,341.6 ppm ae (4,5); 96-h LC10, embryo @ pH 6.5 =

	3,023.4 ppm ae (4); 96-h LC50, embryo @ pH 8.0 =645.2 ppm ae (4,5); 96-h LC10, embryo @ pH 8.0 = 395.2 ppm ae (4). **IPA (25.2%)**: *American Bullfrog*: 16-d NOEL, growth & survival =1 ppm (4,5), LOEL growth & survival =2 ppm (4,5); 16-d LC50 =2.07 ppm (5,17). *American Toad*: 16-d NOEL growth & survival =1 ppm (4,5), LOEL =2 ppm (4,5); 16-d LC50 =2.52 ppm (5,17). *Gray Tree Frog*: 16-d NOEL growth & survival =2 ppm (4,5); 16-d LC50 =1.35 ppm (5,17). *Green Frog*: 16-d NOEL growth & survival =1 ppm (4,5), LOEL =2 ppm (4,5); 16-d LC50 =2.17 ppm (5,17). *Leopard Frog*: 16-d NOEL growth & survival =2 ppm (4,5); 16-d LC50 =2.46 ppm (5,17). *Wood Frog*: 16-d NOEC =1 ppm (4,5); 16-d LC50 w/o predator =1.32 ppm (5,17), LC50 w/ predator [Red-spotted Newt] 0.55 ppm (5,17). **IPA (13.0%)**: *Leopard Frog*: 23-d LOEL, 29% reduction in survival w/out predation by Red-spotted Newts (RSN) = 1.3 ppm (4), (23-d LOEL, w/ predation by RSN, additional 21% reduction in survival =1.3 ppm (4,5). *Gray Tree Frog*: 23-d NOEL 0% reduction in survival = 1.3 ppm (4,5), LOEL 0% survival =1.3 ppm (4); Red-Spotted Newt: 23-d NOEL, survival =1.3 ppm (4,5). **IPA (41.0% w/ 15% POEA surfactant):** *African Clawed Frog*: 96-h LC50, embryo =9.3 ppm ae (4,5); 96-h LC10, embryo = 8.0 ppm ae (4); 96-h LC05, embryo =7.7 ppm ae (4); 96-h LC50, embryo @ pH 6 15.6 ppm ae (4,5,8); 96-h LC10, embryo @ pH 6 =6.2 ppm ae (4); 96-h LC50, embryo @ pH 7.5 =7.9 ppm ae (4,5,8); 96-h LC10 embryo @ pH 7.5 =4.0 ppm ae (4); 96-h LC50, larvae @ pH 6 =2.1 ppm ae (4,5,8); 96-h LC10 larvae @ pH 6 =1.99 ppm ae (4); 96-h LC50 larvae @ pH 7.5 =0.88 ppm ae (4,5,8); 96-h LC10 larvae @ pH 7.5 =0.85 ppm ae (4); 96-h LOEL growth =10 ppm ae (4), NOEL growth) = 8 ppm ae (4). *American Bullfrog*: 96-h LC50 larvae = 1.55 ppm ae (9). *American Toad*: 24-h LC50 embryo =13.5 ppm (4); 96-h LC50 embryo <12.9 ppm (3,4,5,8); 96-h LC50 embryo @ pH 6 =4.8 ppm ae (4,5,8,9); 96-h LC10 embryo @ pH 6 =2.2 ppm ae (4); 96-h LC50 embryo @ pH 7.5 =6.4 ppm ae (4,5,8,9); 96-h LC10 embryo @ pH 7.5 =4.3 ppm ae (4); 96-h LC50 larvae @ pH 6 =2.9 ppm ae (4,5,8,9); 96-h LC10 larvae @ pH 6 = 2.1 ppm ae (4); 96-h LC50 larvae @ pH 7.5 =1.7 ppm ae (4,5,8,9); 96-h LC10 larvae @ pH 7.5 =1.2 ppm ae (4); 96-h LC50 larvae <4 ppm ae (9); 16-d LC50 larvae =1.89 ppm ae (9). *Gray Tree Frog*: 96-h LC50 larvae =1.0 ppm ae (9). *Green Frog*: 96-h LC50 embryo =6.5 ppm (3,4,5,8); 96-h LC10 larvae =3.9 ppm (4); 96-h LC50 larvae =8.7 ppm (4); 96-h LC50 embryo @ pH 6 =5.3 ppm ae (4,5,8,9); 96-h LC10 embryo @ pH 6 =2.6 ppm ae (4); 96-h LC50 embryo @ pH 7.5 =4.1 ppm ae (4,5,8,9); 96-h LC10 embryo @ pH 7.5 =2.8 ppm ae (4); 96-h LC50 larvae @ pH 6 =3.5 ppm ae (4,5,8,9); 96-h LC10 larvae @ pH 6 =2.1 ppm ae (4); 96-h LC50 larvae @ pH 7.5 =1.4 ppm ae (4,5,8,9); 96-h LC10 larvae @ pH 7.5 =0.89 ppm ae (4); 96-h LC50 larvae =2.0 ppm ae (4,5,9); 16-d LC50 =1.63 ppm ae (4,5,9); Field enclosure studies (tadpoles) 96-h LC50s: Site A = 4.34 ppm ae (4,5,9), Site B =2.70 ppm ae (4,5,9). *Northern Leopard Frog*: 24-h LC50 embryo =11.9 ppm (4); 96-h LC50 embryo =9.2 ppm (3,4,5,8); 96-h LC10 larvae =10.5 ppm (4); 96-h LC50 larvae =13.7 ppm (4); 96-h LC50 embryo @ pH 6 =15.1 ppm ae (4,5,8,9); 96-h LC10 embryo @ pH 6 =13.1 ppm ae (4); 96-h LC50 embryo @ pH 7.5 =7.5 ppm ae (4,5,8,9);

	96-h LC10 embryo @ pH 7.5 =6.7 ppm ae (4); 96-h LC50 larvae @ pH 6 =1.8 ppm ae (4,5,8,9); 96-h LC10 larvae @ pH 6 =1.1 ppm ae (4); 96-h LC50 larvae @ pH 7.5 =1.1 ppm ae (4,5,8,9); 96-h LC10 larvae @ pH 7.5 =0.83 ppm ae (4); 96-h LC50 larvae =2.9 ppm ae (4,5,9); 16-d LC50 =1.85 ppm ae (9); Field enclosure studies (tadpoles) 96-h LC50s: Site A =11.47 ppm ae (4,5,9), Site B =4.25 ppm ae (4,5,9). *Wood Frog*: 24-h LC50 embryo =18.1 ppm (4); 96-h LC50 embryo =16.5 ppm (4,5,8); 96-h LC50 larvae =16.5 ppm (3,5); 96-h LC50 larvae =5.1 ppm ae (9); 16-d LC50, w/o predator =1.0 ppm ae (9); 16-d LC50 w/ predator =0.41 ppm ae (9). **K (48.8%):** Roundup WeatherMAX: New Mexico Spadefoot & Great Plains Toad: 48-h NOEC survival = 1.301 L/acre (21). **K (48.7% AI w/ unk % POEA surfactant – Roundup Original MAX:** *American Bullfrog*: 96-h LC50 larvae =0.8 ppm ae (3,18); 96-h LC10 & LC90 larvae =0.5 & 1.2 ppm ae (18). *American Toad*: 96-h LC50 larvae =1.6 ppm ae (3,18); 96-h LC10 & LC90 larvae =1.2 & 2.1 ppm ae (18). *Blue-spotted Salamander*: 96-h LC50 larvae =3.2 ppm ae (3,18); 96-h LC10 & LC90 larvae = 2.7 & 3.7 ppm ae (18). *Cascades Frog*: 96-h LC50 larvae =1.7 ppm ae (3,18); 96-h LC10 & LC90 larvae =1.2 & 2.1 ppm ae (18). *Gray Tree Frog*: 96-h LC50 larvae =1.7 ppm ae (3,18); 96-h LC10 & LC90 larvae =1.4 & 2.0 ppm ae (18). *Green Frog*: 96-h LC50 larvae =1.4 ppm ae (3,18); 96-h LC10 & LC90 larvae =1.0 & 1.8 ppm ae (18). *Leopard Frog*: 96-h LC50 larvae =1.5 ppm ae (3,18); 96-h LC10 & LC90 larvae =1.2 & 1.8 ppm ae (18). *Northwestern Salamander*: 96-h LC50 larvae =2.8 ppm ae (3,18); 96-h LC10 & LC90, larvae =2.4 & 3.3 ppm ae (18). *Spotted Salamander*: 96-h LC50 larvae =2.8 ppm ae (3,18); 96-h LC10 & LC90 larvae =2.4 & 3.3 ppm ae (18). *Spring Peeper*: 96-h LC50 larvae =0.8 ppm ae (3,18); 96-h LC10 & LC90 larvae =0.1 & 1.6 ppm ae (18). *Red-spotted Salamander*: 96-h LC50 larvae =2.7 ppm ae (3,18); 96-h LC10 & LC90, larvae =2.3 & 3.1 ppm ae (18). *Western Toad*: 96-h LC50 larvae =2.0 ppm ae (3,18); 96-h LC10 & LC90 larvae =1.7 & 2.4 ppm ae (18). *Wood Frog*: 96-h LC50 larvae =1.9 ppm ae (3,18); 96-h LC10 & LC90 larvae =1.3 & 2.8 ppm ae (18).
Invertebrates/Plants:	**Glyphosate Tech (95.0-99.7%)**: *Daphnia magna*: (48-h EC50) = 930 ppm (1c,7), (48-h EC50, immobilization) = 40 ppm (6), (21-d NOEC) = 30 ppm (6), NOAEC = 49.9 ppm ae (8), (48-h EC50, w/ aeration) = 37 ppm (10), (48-h EC50, w/out aeration) = 24 ppm (10), (48-h EC50) = 13 ppm (10); *Duckweed*: 7-d EC50 phytotoxicity =21.5 ppm (2); 7-d EC50 biomass =12 ppm (6); 7-d EC50 =10 ppm ae (20); 14-d EC50 growth =25.5 ppm ae, NOEC = 16.6 ppm ae (20). *Earthworm*: 14-d LC50 >5,000 mg kg dry soil (1c); 14-d LC50 >480 mg/kg (6), NOEC reproduction >28.8 mg/kg (6); 14-d LC50 >3,750 mg/kg soil, NOEC = 118.7 (20). *Eastern Oyster, eggs*: 48-h LC or EC50 >10 ppm ae (20).

	Fatmucket Clam: 48-h LC50, larvae >200 ppm ae (3,4,5); 96-h LC50 juvenile >200 ppm ae (3,4,5); 21-d LC50 >200 ppm ae (3,4,5). *Fiddler Crab*: 96-h LC50 =934 ppm (2,11,20). *Grass Shrimp*: 96-h LC50 =281 ppm (2,11,20). *Green Algae*: 96-h EC50 phytotoxicity =12.5 ppm (2); 72-h EC50 growth inhibition =166 ppm (1c); 72-h EC50 growth =4.4 ppm (6). *Honeybee*: 48-d contact LD50 >100 µg/bee (1c,2,4). 48-h LD50, oral & contact ≥100 µg/bee (6,7,8,10,11,20). *Midge*: 48-h LC50 =55 ppm (2,3,5); 48-h LC50 =53.2 ppm ae (8); 48-h LC50 =53.2 ppm ae (8). *Mysid Shrimp*: 96-h LC or EC50 >1,000 ppm ae (20). **Glyphosate Tech (83.0%)**: *Daphnia magna:* 48-h LC50 =780 ppm (1d,2); 21-d, life cycle NOEC = 49.9 ppm, LOEC = 95.7 ppm (3). **Glyphosate Tech (41.0% AI):** *Buzzer midge*: 3rd instar, 22°C, hard water, LC50s: (48-h) > 10 ppm @ pH 7.4); (48-h) = 55 ppm @ pH 7.4; 48-h >56 @ pH 6.6 (4,5). *Daphnia magna*: 1st instar, 22°C, hard water, LC50s: (24-h) = 5.3 ppm; 48-h = 2.95 ppm (4,5). **AMPA (94.4-98.5%):** *Daphnia magna*: 48-h EC50 =683 ppm, NOAEC = 320 ppm (3,8); 48-h LC or EC50 =690 ppm (20). *Duckweed*: 7-d EC50 growth =46.9 ppm ae (3); 7-d EC10 growth =3.78 ppm ae (3). *Honeybee*: 48-h LD50 contact >100 µg/bee (3). *Green Algae*: 48-h EC50 growth =270 ppm (3); 48-h EC10 growth =92.5 ppm (3); 96-h EC50 growth =55.9 ppm ae (3); 96-h IC50 growth = 24.7 ppm (3). **AMPA (83.0%)**: *Ceriodaphnia dubia*: 48-h LC50 =147 ppm ae (3). *Daphnia magna*: 48-h EC50 =647.4 ppm ae, NOAEC = 464.8 ppm ae (3,8); 48-h EC50 =128.1 ppm ae, NOAEC = 95.6 ppm ae (3). **IPA (Unk %AI):** *Daphnia pulex*: 48-h EC50 < 24 h old =7.9 ppm (22). *Duckweed*: 48-h EC50 growth =2.0 ppm (22); 48-h EC50 growth > 16.91 ppm, NOEL =16.91 ppm (22). *Honeybee*: 48-h LD50 contact >100 µg/bee (22). **IPA (95.0-99.7%)**: *Daphnia magna*: 21-d early life LOEC =96 ppm, NOEL =50 ppm (22). *Eastern Oyster*: 48-h LC50 embryo-larvae >10 ppm (22). *Fatmucket Clam*: 48-h LC50 larvae = 5.0 ppm ae (4,5); 96-h LC50 juvenile = 7.2 ppm ae (4,5). *Fiddler Crab*: 96-h LC50 =934 ppm, NOEL = 650 ppm (22). *Midge*: 48-h LC50 4th instar =55 ppm (22); 48-h LC50 juvenile =18 ppm (22). *Shore Shrimp*: 96-h LC50 =281 ppm, NOEL = 210 ppm (22). **IPA (83.0%):** *Daphnia magna*: 48-h EC50 =780 ppm, NOEL = 560 ppm (22). **IPA (62.4%):** *Daphnia magna*: 48-h EC50 =401.3 ppm ae, NOAEC = 147.8 ppm ae (3); 48-h

	LC50 1st instar = 869 ppm, NOEL = 320 ppm (22). **IPA (53.5-56.8%)**: *Ceriodaphnia dubia*: 48-h LC50 = 415 ppm ae (3,4,5); 24-h LC50 = 707 ppm ae (4). *Daphnia magna*: 48-h LC50 = 218 ppm (3,4,5); 48-h LC50 = 35.5 ppm, NOEC immobility = 13 ppm (3); 48-d LC50 =130 ppm (4). *Duckweed*: growth inhibition = 24.4 ppm (1a,l,q). *Earthworm*: LC50 > 1,000 ppm (1a,l,q). *Fatmucket Mussel*: 48-h EC50 larvae > 148 ppm ae (3,4,5); 96-h LC50 juvenile > 148 ppm ae (3,4,5); 28-d LC50 = 43 ppm ae (3,4,5). *Green Algae*: growth inhibition = 127 ppm (1a,1l,1q); 96-h IC50 growth = 41.0 ppm (3). *Honeybee* contact LD50: > 100 µg/bee (1a,l,q). *Midge*: 48-h EC50 immobilization = 5,600 ppm (3,4,5,20); 48-h LC50 =1,216 ppm (3,5); 24-h EC50 immobilization = 5,900 ppm (4,5). **IPA (40.7-41.4% AI):** *Crayfish*: Adult, 22°C, hard water, 96-h LC50 = 7 ppm (4,5,22). *Daphnia magna*: 48-h EC50 = 21.6 ppm (1k); 48-h LC50 = 11.0 ppm (1t); 21-d NOEC = 1.5 ppm (1k,5); 48-h EC50 immobility, first instar, w/o suspended sediments @ 22°C = 3 ppm (5,19); 48-h EC50, 1st instar =3 ppm (22); 48-h EC50, < 24 h old = 310 ppm, NOEL =56 ppm (22); 48-h EC50, < 24 h old = 72 ppm (22); 48-h EC50 < 24 h old = 5.3 ppm, NOEL = 1.9 ppm (22). *Daphnia pulex*: 48-h EC50 immobility, w/o suspended sediments @ 15°C = 7.9 ppm (4,5,19); 48-H EC50 immobility, w/ suspended sediments (50 mg clay/L) @ 15°C = 3.2 ppm (5,19**);** 48-h EC50 < 24 h old = 242 ppm, NOEL < 60 ppm (22). *Duckweed*: 7-d EC50 = 27.0 ppm (1k). *Earthworm*: 14-d EC50 > 1,000 ppm (dry soil) (1k); 14-d EC50 > 1,250 mg/kg soil (1t). *Green Algae*: 72-h IC50 = 17.4 ppm (1k); 96-h IC50 = 2.2 ppm (1k). *Honeybee*: 24-h LD50 contact) > 20 µg/bee (1k). **IPA (25.2%)**: *Pouch Snail*: 13-d NOEL = 3.8 ppm (4,5). *Marsh Pond Snail*: 13-d NOEL = 3.8 ppm (4,5). *Marsh Rams-Horn*: 13-d NOEL = 3.8 ppm (4,5). **IPA (7.03%):** *Daphnia magna*: 48-h EC50 1st instar > 1,000 ppm, NOEL = 560 ppm (22). **IPA (41% w/ 10-20% POEA surfactants)**: *Ceriodaphnia dubia*: (24-h LC50) = 6.0 ppm ae (4,5), (48-h LC50) = 5.7 ppm ae (4,5); **IPA (41% w/ 15% POEA surfactants)**: *Daphnia pulex*: 96-h EC50 = 25.5 ppm (4,5,12,16). *Duckweed*: 7-d EC50 growth = 15.1 ppm ae (20); 14-d EC50 growth = 4.9 ppm ae (20). *Earthworm*: 14-d LC50 >5,000 mg ae/kg soil (20), NOEC =500 mg ae/kg soil (20). *Midge*: 48-h LC50 = 16 ppm (11).

	K: No information in references.
Other:	**Glyphosate Tech:** Carcinogenic: Negative (2,6,11); Teratogenic: Negative (10,11); Mutagenic: Slightly, but not in mammals (3,11); Genotoxic: Potential; however, the research that raised the largest concerns involved the use of a formulation marketed in S. America (w/ EPA Registration No. 524-424) (3); Endocrine disruption: Unknown (5,6), Negative in mammals (11); **AMPA:** Unknown (5); Teratogenic: Negative (10,11); Mutagenic: Negative (10); Endocrine disruption: Unknown (5), Negative in mammals (11)

Glyphosate: 1st- order degradate of glyphosate salts (e.g. isopropylamine (IPA) and potassium (K)) (1d);
Aminomethylphosphonic Acid (AMPA): 2nd- order degradate of glyphosate salts (7,12).

Ecological Incident Reports

No incident reports in references.

Environmental Fate

Water solubility (S_w):	**Glyphosate:** Highly water soluble (2,12); = 11,600 ppm at 25°C (7); = 12,000 ppm at 25°C (8); = 10,500 ppm at 20°C (10); = 10,500 ppm at pH 1.9 (11); = 900,000 ppm (12); = 1.2 x 10^4 at 25°C (13); = 10,000 to 15,700 mg/L at 25°C (20). **IPA:** =786,000 ppm at pH 4.06 (11).
Soil Mobility (K_{oc}):	**Glyphosate:** =884-60,000 L/kg, absorbs strongly to soil (1c,e,f,h,m,n,r-v,2); = 1435 (slightly mobile) (6); sand = 58,000 mL/g (8); sandy loam = 3,100 – 13,000 mL/g (8), silty clay loam = 33,000 – 47,000 mL/g (8); = 2,640, 2,100, & 500 (12).
Soil Persistence ($t_{½}$):	**Glyphosate:** Primary degradation mechanism is biotic metabolism to AMPA (2,7,11,12). *Aerobic degradation*: Sandy loam =1.85 d (2), Silt loam =2.06 d (2); =96.4 d (7); Sandy loam =1.8 & 5.4 d, Silt loam =2.6 d (8), Remained in pond sediments at ≥ 1 ppm at 1 year post-treatment (8); = 2 to 197 d (11), Av. =47 d (11,12); Av. =0.9 d (0.6 to 1.1 d) (13). *Anaerobic degradation*: =22.1 d (7); *Photolysis*: Stable to photodegradation on soil (2); = stable (for at least 30 d) (8), **AMPA:** *Aerobic degradation*: = max. of 29% at 40 d (8).
Soil Dissipation (DT_{50}):	**Glyphosate:** =2-174 d (1c,1e,1f,1h,1m,1n,1r- v,13); Av. =13.9 days (2.6 in TX to 140.6 in IA) (2), Half lives are longer in colder climes (28.7 d in MN, 127.8 d in NY) (2), = av. 100 d (35 – 158 d) (2); field (aerobic) = 12 d (6), lab at 20°C = 49 d (6); =44 to 60 d (7); =7.3 d (OH), =1.7 d (TX), =17 d (AZ), =114 d (NY), =25 d (MN), =8.3 d (GA), =13 d (CA) (8); forest soil = 14.8 & 24.2 (13); = 27.3 to 55.5 d (20); = 1.7 to 141.9 d (20). **AMPA:** = 119 d (OH), =131 d (TX), =142 d (AZ), =240 d (NY), =302 d (MN), =958 d (GA), =896 d (CA) (2,8); = av. 118 d (71 to 165 d) (2).
Aquatic Persistence ($t_{½}$):	**Glyphosate:** < 7 d (1c,1e,1f,1h,1m,1n,1r- v). *Aerobic degradation*: Silty clay loam incubated in dark at ~25°C for 30 days =7 d (2); water-silty clay loam = 14.1 d (8); = 3 to 91 d (11). *Anaerobic degradation*: Silty clay loam sediment = 8.1 d (2); water-silty clay loam = 208 d (8). *Hydrolysis*: Stable to hydrolysis at pH 3,6, and 9 @ 5 & 35°C. *Photolysis*: Stable to photodegradation in pH 5,7, and 9 under natural sunlight (2,7,10,11); = stable (for at least 30 d) (8). **AMPA:** *Aerobic degradation*: = 19-25% at 7-30 d (8), =7 to 14 d (20), considered

	comparable to glyphosate (20). *Anaerobic degradation* = max. of 25% at 15 d (8).
Aquatic Dissipation (DT_{50}):	**Glyphosate:** = 7.5 d (irrigation water) (2,8); = 120 d (pond in MO) (2); > 35 d (av. across several temperatures and pH levels) (7); =stable at pH 5 to 8 at 25°C (6); Water-sediment DT50 = 87 d (6); = 7 & 14 d (20). *Hydrolysis*: DT50 = stable at pH 7, 20°C (6). *Photolysis*: DT50 = 33 d (pH 5), = 69 d (pH 7), 77 d (pH 9) (6).
Potential to Move to Groundwater (GUS score):	**Glyphosate:** Low potential (2,7,11,12). **AMPA:** Low potential (2)
Vapor Pressure (mm Hg):	**Glyphosate:** low (2,7), = 7.5 x 10^{-8} (6), = 1.84 x 10^{-7} at 45°C (11); **IPA:** = 1.58 x 10^{-8} at 25°C (11);
Octanol-Water Partition Coefficient (K_{ow}):	**Glyphosate:** low (2,7), = 6.31 x 10^{-4} at pH 7, 20°C, low, (6), = 0.00033, very low (7), < 6 x 10^{-4} at pH 5, 7 & 9 (10), = 0.02512 (12), = 2.57 x 10^{-5} to 0.01995 (20);
Bioaccumulation/ Biocentration:	**Glyphosate:** BCF (Bluegill) < 1 for whole fish (1c,e,f,h,m,n,r-v), = 0.52x (whole fish) (2), BCF = 0.5 (6). BAF: no significant bioaccumulation expected (1c,e,f,h,m,n,r-v).

Worst Case Ecological Risk Assessment

Max Application Rate (ai lbs/acre – ae basis)	**Habitat Management:** 1.0 lb. a.e./acre **Croplands/Facilities Maintenance:** 1.0 lbs. a.e./acre
EECs	**Terrestrial (Habitat Management):** 240 ppm **Terrestrial (Croplands/Facilities Maintenance):** 240 ppm **Aquatic (Habitat Management):** 0.368 ppm **Aquatic (Croplands/Facilities Maintenance):** 0.00335 ppm

Habitat Management Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	=0.05 [0.1]	=0.05 [0.5]
	Mammals	=0.13 [0.1]	=0.13 [0.5]
	Fish	=0.06 [0.05]	=0.06 [0.5]
Chronic	Birds	=0.29 [1]	=0.29 [1]
	Mammals	=0.40 [1]	=0.40 [1]
	Fish	=0.28 [1]	=0.28 [1]

Cropland/Facilities Maintenance Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	=0.05 [0.1]	=0.05 [0.5]
	Mammals	=0.13 [0.1]	=0.13 [0.5]
	Fish	<0.01 [0.05]	<0.01 [0.5]
Chronic	Birds	=0.29 [1]	=0.29 [1]
	Mammals	=0.40 [1]	=0.40 [1]
	Fish	<0.01 [1]	<0.01 [1]

Justification for Use:	Efficacious non-selective annual, biannual and perennial broadleaf and grass weed control.

Specific Best Management Practices (BMPs):	Apply aquatic labeled glyphosate formulations to aquatic habitats, and surfactant free glyphosate formulations to riparian habitats within 25 feet of surface water resources tank-mixed w/ surfactants classified as practically non-toxic or slight acute toxicity (>10 ppm) to aquatic organisms. Slight acute toxicity surfactants include LI-700, AgriDex, Activate Plus, Big Sur 90, Sil Energy, Dyne-Amic, Freeway, Cygnet Plus, Sun-Wet, Hasten Modified Vegetable Oil, Kinetic or Class Act Next Generation.
References:	[1a] _____. 2008 & 2004, respectively. Accord Concentrate specimen label and MSDS. Dow AgroSciences LLC, Indianapolis, IN. 17 & 3 pp. [1b] _____. 2002 & 2011, respectively. Aqua Star specimen label and MSDS. Albaugh, Inc. Ankeny, IA. 16 & 4 pp. [1c] _____. 2009 & 2005. AquaMaster label and MSDS. Monsanto Co., St. Louis, MO. 21 & 8 pp. [1d] _____. 2008 & 2007, respectively. AquaNeat specimen label and MSDS. Nufarm Americas, Inc., Burr Ridge, IL. 9 & 6 pp. [1e] _____. 2009 & 2005, respectively. Buccaneer specimen label and MSDS. Tenkoz, Inc., Alpharetta, GA. 54 & 9 pp. [1f] _____. 2009 & 2005, respectively. Buccaneer Plus specimen label and MSDS. Tenkoz, Inc., Alpharetta, GA. 51 & 8 pp. [1g] _____. 2010. Cornerstone specimen label and MSDS. Winfield Solutions LLC, St. Paul, MN. 70 & 3 pp. [1h] _____. 2010 & 2008, respectively. Cornerstone Plus specimen label and MSDS. Winfield Solutions LLC, St. Paul, MN. 79 & 9 pp. [1i] _____. 2010 & 2008, respectively. Gly Star Plus specimen label and MSDS. Albaugh, Inc., Ankeny, IA. 72 & 4 pp. [1j] _____. 2009 & 2006, respectively. Glyfos Aquatic specimen label and MSDS. Cheminova, Inc., Wayne, NJ. 20 & 6 pp. [1k] _____. 2008 & 2005, respectively. Glyfos X-TRA specimen label and MSDS. Cheminova, Inc., Wayne, NJ. 21 & 5 pp. [1l] _____. 2006 & 2004, respectively. Glypro specimen label and MSDS. Dow AgroSciences LLC, Indianopolis, IN. 17 & 3 pp. [1m] _____. 2007. Honcho specimen label and MSDS. Monsanto, Co., St. Louis, MO. 24 & 9 pp. [1n] _____. 2010. Honcho Plus specimen label and MSDS. Monsanto Co., St. Louis, MO. 26 & 9 pp. [1o] ____. 2009. Makaze specimen label and MSDS. Loveland Products, Inc., Greeley, CO. 26 & 3 pp. [1p] _____. 2011 & 2007, respectively. Razor Pro specimen label and MSDS. Nufarm Americas, Inc., 32 & 6 pp. [1q] _____. 2006 & 2004, respectively. Rodeo specimen label and MSDS. Dow AgroSciences LLC, Indianapolis, IN. 17 & 3 pp. [1r] _____. 2008 & 2006, respectively. Roundup Original specimen label and MSDS. Monsanto Co., St. Louis, MO. 23 & 9 pp. [1s] _____. 2007 & 2006, respectively. Roundup Original MAX specimen label and MSDS. Monsanto Co., St. Louis, MO. 27 & 9 pp. [1t] _____. 2010 & 2011, respectively. Roundup PRO specimen label and MSDS. Monsanto, Co., St. Louis, MO. 21 & 9 pp. [1u] _____. 2010 & 2011, respectively. Roundup PRO Concentrate specimen label and MSDS. Monsanto Co., St. Louis, MO. 22 & 9 pp. [1v] ____. 2009 & 2008, respectively. Roundup WeatherMAX specimen label and MSDS. Monsanto, Co., St. Louis, MO. 54 & 9 pp. [2] _____. 1993. Reregistration eligibility decision (RED) – glyphosate. USEPA, Prevention, Pesticides, and Toxic Substances, Washington, D.C. 291 pp. [3] Durkin, P.R. 2011. Glyphosate: Human Health and Ecological Risk Assessment – Final Report. Prepared for the USDA Forest Service by

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Table CP.1 - Pesticide Name
Active Ingredient = glyphosate

Trade Name[a]	Treatment Type[b, c]	Max Product Rate – Single Application (lbs/acre or gal/acre)	Max Product Rate - Single Application (lbs/acre - AI on acid equiv basis)	Max Number of Applications Per Season	Max Product Rate Per Season (lbs/acre/season or gal/acre/season)	Minimum Time Between Applications (Days)
Accord Concentrate	H, CF	0.25	1.0	1	1.0	0
Aqua Star	H, CF	0.25	1.0	1	1.0	0
AquaMaster	H, CF	0.25	1.0	1	1.0	0
AquaNeat	H, CF	0.25	1.0	1	1.0	0
Buccaneer	H, CF	0.33	1.0	1	1.0	0
Buccaneer Plus	H, CF	0.33	1.0	1	1.0	0
Cornerstone	H, CF	0.33	1.0	1	1.0	0
Cornerstone Plus	H, CF	0.33	1.0	1	1.0	0
Gly Star Plus	H, CF	0.33	1.0	1	1.0	0
Glyfos Aquatic	H, CF	0.25	1.0	1	1.0	0
Glyfos XTRA	H, CF	0.33	1.0	1	1.0	0
Glypro	H, CF	0.25	1.0	1	1.0	0
Honcho	H, CF	0.33	1.0	1	1.0	0
Honcho Plus	H, CF	0.33	1.0	1	1.0	0
Makaze	H, CF	0.33	1.0	1	1.0	0
Razor Pro	H, CF	0.33	1.0	1	1.0	0
Rodeo	H, CF	0.25	1.0	1	1.0	0
Roundup Original	H, CF	0.33	1.0	1	1.0	0
Roundup Original MAX	H, CF	0.22	1.0	1	1.0	0
Roundup Pro	H, CF	0.33	1.0	1	1.0	0
Roundup PRO Concentrate	H, CF	0.33	1.0	1	1.0	0
Roundup Weather MAX	H, CF	0.22	1.0	1	1.0	0

[a]From each label for a pesticide identified in pesticide use proposals (PUPs), Service personnel would record application information associated with possible/known uses on Service lands.

[b]Treatment type: H – habitat management or CF – cropland/facilities maintenance. If a pesticide is labeled for both types of treatments (uses), then record separate data for H and CF applications.

[c]Treatment type is for ecological risk assessment purposes only. The product label will determine whether or not the treatment type is permissible under Section 3 of the Federal Insecticide, Fungicide and Rodenticide Act.

B-2 Imazapyr Formulations Chemical Profile

Toxicological endpoint and environmental fate data listed in this chemical profile will be periodically reviewed and updated. New information, including, but not limited to, completion of national section 7consultation in accordance with the federal Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884), as amended, between the U.S. Fish and Wildlife Service and the U.S. Environmental Protection Agency on individual pesticide registrations and all federally listed and proposed species and proposed and designated critical habitat, may change ecological risk assessments, pesticide use patterns, best management practices, and/or justification for use. Consultations occur now at the local level for listed and proposed species and proposed and designated critical habitat on specific use of individual pesticides in specific project areas.

Date:	4/24/12				
Pesticide Class:	Imidazolinone	**Common Chemical Name(s):**	Imazapyr	**Pesticide Type:**	Herbicide Group 9
Trade Name(s):	Arsenal, Arsenal AC, Arsenal Powerline, Ecomazapyr 2 SL (Alligare), Ecomazapyr 2 SL (MANA), EZ-JECT Copperhead, Habitat, Polaris, Polaris AC, Stalker	**EPA Registration Number:**	241-346, 241-299, 241-431, 81927-22, 66222-168, 83220-2, 241-426, 228-534, 228-570, 241-398	**CAS Number:**	81510-83-0, 81510-83-0, 81510-83-0, 81510-83-0, 81510-83-0, 81510-83-0, 81510-83-0, 81510-83-0, 81510-83-0, 81510-83-0
Other Ingredients:	**Arsenal (isopropylamine [IPA]) salt of imazapyr):** 28.7% IPA, 71.3% proprietary ingredients (1a); **Arsenal AC:** 53.1% IPA, 46.9% proprietary ingredients (1b); **Arsenal Powerline:** 26.7% IPA, 73.3% proprietary ingredients (1c); **Ecomazapyr 2 SL (Alligare):** 27.8% IPA, 72.2% proprietary ingredients (1d); **Ecomazapyr 2 SL (MANA):** 27.8% IPA, 72.2% proprietary ingredients (1e); **EZ-JECT Copperhead Herbicide Shells:** 83.5% IPA, 16.5% other ingredients (1f); **Habitat:** 28.7% IPA, 71.3% proprietary ingredients (1g); **Polaris:** 27.7% IPA, 72.3% other ingredients (1h); **Polaris AC:** 53.1% IPA, 46.9% other ingredients (1i); **Stalker:** 27.6% IPA, 72.4% other ingredients (1j).				

Toxicological Endpoints	Endpoints highlighted yellow are selected for use in a screening-level ecological risk assessment. Endpoints selected are typically the most toxic endpoint for the most sensitive species listed in following summaries.
Mammalian LD_{50}:	**Acid:** No information in references. **IPA (<u>Arsenal</u>):** *Rat*: Single dose, 14-d observation period > 5,000 ppm (1a-b,d,f-j,3,8). **IPA (99.5% AI):** *Dog*: 1-year NOEL = 10,000 ppm (3). **IPA (26.7% AI):** *Rat*: > 2,000 mg/kg (1c).
Mammalian	**Acid:**

LC_{50}:	No information in references. **IPA:** No information in references.
Mammalian Reproduction:	**Acid (99.5% AI):** *Rat*: Reproductive: NOAEL, males = 738 mg/kg bw/day, NOAEL, females = 933.3 mg/kg bw/day (9). **Acid (93.0% AI):** *Rat*: Developmental: NOAEL = 300 mg/kg bw/day, LOAEL = 1,000 mg/kg bw/day (9). **IPA: (Arsenal):** *Rat*: Reproductive Study NOEL: = 300 mg/kg/day (10); 2 generation study NOEL = 738 mg/kg/day (10). *Rabbit*: Reproductive Study NOEL: = 400 mg/kg/day (10).
Avian LD_{50}:	**Acid (93.0+% AI):** *Bobwhite*: 21-d, 28-32 week old > 2,150 ppm (1h,i,3,4,6,8,9). *Mallard*: 21-d, 24-28 week old > 2,150 ppm (1h,i,3,4,6,7,8,9). **IPA:** No information in references.
Avian LC_{50}:	**Acid: (93.0% AI):** *Bobwhite*: 5-d, 16-d old > 5,000 ppm (3,4,6,10). *Mallard*: 5-d, 11-d old > 5,000 ppm (3,4,6,10). **Acid (49.7% AI):** *Bobwhite*: 5-d, 15-d old > 5,000 ppm (4,6), 5-d NOEL = 5,000 ppm (6). **IPA (22.6% AI):** *Mallard*: 5-d, 5 d old > 5,000 ppm, 5-d NOEL = 1,250 ppm (6). **IPA (49.7% AI, Arsenal AC):** *Bobwhite*: 5-d, 15 d old > 5,000 ppm (1b,4,6), 5-d NOEL = 5,000 ppm (6). **IPA (22.6% AI, Arsenal):** *Mallard*: 21-d, 27 week old > 2,150 ppm, 21-d NOEL = 2,150 ppm (6).
Avian Reproduction:	**Acid (99.0+% AI):** *Bobwhite*: 21-week reproductive study LOEL > 1,670 ppm, NOEL = 1,670 ppm (6,9); 18-week reproductive study NOEL < 2,000 ppm, NOEL = 2,000 ppm (3,6,9); 18-week reproductive study LD50 > 1,890 mg/kg, NOEL = 1,890 mg/kg (10). *Mallard*: 18-week reproductive study LD50 > 1,890 ppm, NOEL = 1,890 ppm (6,9,10). **IPA:** No information in references.
Fish LC_{50}:	**Acid:** See Fish ELS/Life Cycle data. **IPA:** See Fish ELS/Life Cycle data.
Fish ELS/ Life Cycle:	**Acid (93.0+% AI):** *Atlantic Silverside*: 96-h LC50, juvenile > 184 ppm (3,4,5,6,10), NOEL = 184 ppm (6). *Bluegill*: 96-h LC50, av. wt. 0.18 g > 100 ppm (1h,i,3,4,5,6,9,10), NOEL = 100 ppm (6).

	Channel Catfish: 96-h LC50, av. wt. 1.3 g > 100 ppm (3,4,5,6,9,10), NOEL = 100 ppm (6). *Fathead Minnow*: 8-month, life cycle LOEC > 120 ppm, NOEC = 120 ppm (3,6,9); 32-d LOEC, early life > 118 ppm, NOEC = 118 ppm (3,6,9). *Rainbow Trout*: 96-h LC50, av. wt. 0.48 g > 100 ppm (1a-c,f-i,4,5,6,7,9,10), 96-h NOEL = 100 ppm (6); 28-d early life stage LOEC= 92.4 ppm, NOEC = 43.1 ppm (3,6,9). **Acid (49.7% AI):** *Bluegill*: 96-h LC50, av. wt. 0.32 g > 100 ppm (4,6), NOEL = 100 ppm (6). **Acid (21.5% AI):** *Rainbow Trout*: 96-h LC50, av. wt. 3.8 g > 110 ppm (3,6), NOEL = 110 ppm (6). **IPA (49.7-53.1% AI, Arsenal AC):** *Bluegill*: 96-h LC50, av. wt. 0.32 g > 1,000 ppm (3,4,5,6), NOEL = 1,000 ppm (6). *Rainbow Trout*: 96-h LC50, av. wt. 0.36) = 43,947 ppm (11). **IPA (30.8% AI):** *Bluegill*: 96-h, av. wt. 1.1 g. = 24 ppm (4,6); 96-h, av. wt 0.76 g = 75 ppm (4,6). *Rainbow Trout*: 96-h, av. wt. 1.5 g = 6.7 ppm (4,5,6). **IPA (28.6% AI, Arsenal):** *Rainbow Trout*: 96-h LC50, av. wt. 0.21 g = 77,716 ppm (11). **IPA (22.6% AI):** *Rainbow Trout*: 96-h LC50, av. wt. 0.81 g = 112 ppm, NOEL = 56 ppm (6,9).
Amphibians/ Reptiles:	**Acid (Tech.):** *Bullfrog*: 96-h LC50, tadpoles = 799.6 ppm (12). **IPA (27.6% AI, Stalker):** *Bullfrog*: 96-h LC50, tadpoles = 14.7 ppm (12). **IPA (28.7% AI, Habitat):** *Bullfrog*: 96-h LC50, tadpoles = 1,739 ppm (12). Note: Previous research has demonstrated that bullfrog tadpoles and other ranid species are similar in sensitivity to pesticides (12)
Invertebrates/ Plants:	**Acid (Tech.):** *Honey Bee*: 96-h LD50 > 100 µg/bee (1a-c,f-i,3,6). **Acid (93.0+% AI):** *Daphnia magna*: 48-h EC50, immobility > 100 ppm (1a,c,f-i,3,4,5,6,7,9); 21-d LOEL => 97.1 ppm (3,6,9,10). *Duckweed*: 14-d, growth EC25 = 0.013 ppm (3); EC50 = 0.024 ppm (3,4,5,6,7,9); 14-d NOEL = 0.01 ppm (6,9). *Eastern Oyster*: 96-h EC50, spat > 132 ppm, NOEL = 132 ppm (6,10); 96-h EC50, 40 mm > 173 ppm (3,4,5,6), NOEL = 109 ppm (6). *Green Algae*: 7-d EC50, growth = 71 ppm (1c,f,h,4,5,6,7,9), NOEL = 50.9 ppm (6,9). *Pink Shrimp*: 96-h LC50, wt. 0.3 – 1 g > 189 ppm (4,5,6,10), NOEL = 189 ppm (6,10). **IPA (49.7% AI, Arsenal AC):** *Daphnia magna*: 48-h EC50, immobility, < 24 h old = 750 ppm (1b,4,5,6), NOEL = 560 ppm (6). **IPA (30.8% AI):**

	Daphnia magna: 48-h EC50, immobility, < 24 old = 6.6 ppm (4,5,6). **IPA (23.3-22.6% AI):** *Daphnia magna*: 48-h EC50, immobility, < 24 h old = 350 ppm (3,6), NOEL = 180 ppm (6). *Duckweed*: 14-d EC50, growth = 21.5 ppm, NOEL = 13.0 ppm (6). *Green Algae*: 120-h EC50, growth = 14.1 ppm, NOEL = 8.75 ppm (6).
Other:	**Acid:** Neurotoxic: Negative (2,7); Carcinogenic: Unlikely (2,5); Teratogenic: Negative (1b-c,f-j,2,7); Mutagenic: Negative (1b-c,f-j,8); Genotoxic: Negative (1b-c,f-j,8); Endocrine disruption: Negative (2). **IPA:** Neurotoxic: Negative (2); Carcinogenic: Unlikely (2,5); Teratogenic: Negative (2); Mutagenic: Negative (8); Genotoxic: Negative (8); Endocrine disruption: Negative (2).

Imazapyr Acid: 1st- order degradate of imazapyr salts (2)

Ecological Incident Reports

As of 2004, 12 incidents - Four incidents involved aquatic resources including fish kills. One report agricultural runoff to a pond resulting in a possible fish kill from imazapyr, but could not definitively determine mortalities were directly related to imazapyr exposure. Two other reports involved a mixture of herbicides, one of which was imzapyr. Because a mixture was involved it could not be definitively determined the mortalities were due to imazapyr exposure. A fourth report involved a goldfish kill from suspected runoff following aerial application of imazapyr, but could not be definitively determined (2,9).

Environmental Fate

Water solubility (S_w):	**Acid:** =11,000 mg/L (3), = 13,100 mg/L (at 25ºC) (3), = 110,000 to 150,000 mg/L (3), = 9,740 mg/L (20ºC) (7), = 11,272 ppm (8). **IPA:** = 6,500,000 mg/L (3).
Soil Mobility (K_{oc}):	**Acid:** (sand sediment, Florida) = 31 mL/g (9), (silt loam, Missouri) = 100 mL/g (9), (loamy sand) = 15 mL/g (9), (silt loam) = 82 mL/g (9), (sandy loam) = 8.2 mL/g (9), (loam) = 17 mL/g (9), (pond sediment) = 150 mL/g (9), (sandy loam, Princeton) = 110 mL/g (9), (loamy sand, Delaware) = 100 mL/g (9), (clay loam, North Dakota) = 18 mL/g (9), (silt loam, Wisconsin) = 52 mL/g (9). **IPA:** = 100 mL/g (3), = 46 mL/g (3), = 30.6 mL/g (sand) (3,9), = 99.8 mL/g (silt loam) (3,9), (sand sediment, Florida) = 31 mL/g (9), (silt loam, Missouri) = 100 mL/g (9), (loamy sand) = 15 mL/g (9), (silt loam) = 82 mL/g (9), (sandy loam) = 8.2 mL/g (9), (loam) = 17 mL/g (9), (pond sediment) = 150 mL/g (9), (sandy loam, Princeton) = 110 mL/g (9), (loamy sand, Delaware) = 100 mL/g (9), (clay loam, North Dakota) = 18 mL/g (9), (silt loam, Wisconsin) = 52 mL/g (9).
Soil Persistence ($t_{½}$):	**Acid:** = 25 to 141 d (8). *Aerobic degradation*: Loamy sand = stable (9), Loamy sand = approx. 5.9 years, > 296 d (9). *Anaerobic degradation*: Loamy sand = stable, > 60 d (9). **IPA:** *Aerobic degradation*: = 210 d (3), = 5.9 yrs (3), = 313 d (3), Loamy sand = stable (9), Loamy sand = approx. 5.9 years, > 296 d (9). *Anaerobic degradation*: Loamy sand = stable, > 60 d (9). *Photolysis*: At soil surface= 149 d (3,9); Degraded primarily by microbial metabolism, little to no photodegradation in soil and not readily by other chemical

	processes (8), = 1 to 7 months (dependent on soil type, temperature, and moisture) (8), half-life shorter at cooler temperatures and in sandier (versus clay loam) soils (8), up to 50 months in loam and clay loam soils with pH 7-8 (8), At above pH 5, does not bind strongly with soil particles and can remain available in the environment (8).
Soil Dissipation (DT_{50}):	**Acid:** Aerobic degradation: Typical = 11 d (7), (lab) = 11 d (20ºC) (7); Bare ground, silt loam, Hillsboro, OR = 143 d (9), bare ground/sandy loam soil, North Carolina) = 64 d (9). **IPA:** = 90 d (3), = 138 d (3), = 30 d (3), = 34 to 65 d (3), = 70 to 155 d (3), = 150 d (Oregon) (3), = 180 d (North Carolina) (3), = 94 d (3), = 25 to 58 d (3); = 143 d (9), bare ground/sandy loam soil, North Carolina = 64 d (9).
Aquatic Persistence ($t_{½}$):	**Acid:** *Anaerobic degradation*: > 120 d (9). **IPA:** *Aerobic degradation*: Surface water = 3 to 5 d (2); Water/sediment = 17 months (3). *Anaerobic degradation*: = > 120 d (9); = 14.1 & 14.5 d (MO ponds) (10), = 3.9 & 8.4 d (FL ponds) (10). *Hydrolysis*: = 325 d at pH 7 (3). *Photolysis*: = 3.7 d at pH 7 (3); = 2.5 to 5.3 d (9); Quickly undergos photodegradation in aqueous solutions (photohydrolysis) (8), photodegradation = 2 d (8).
Aquatic Dissipation (DT_{50}):	**Acid:** = 300 to 700 d (under more typical aquatic field conditions) (9). *Hydrolysis*: = 30 d (pH 7, 20ºC) (7), *Photolysis*: = 2.1 d (pH 7) (7). **IPA:** = 300 to 700 d (under more typical aquatic field conditions) (9).
Potential to Move to Groundwater (GUS score):	**Acid:** Potential (5), = 1.98 (7), Increased potential for transport to ground and surface waters due to low sorption and long residence times in soil (9). **IPA:** Increased potential for transport to ground and surface waters due to low sorption and long residence times in soil (9).
Volatilization (mm Hg):	**Acid:** < 10^{-7} at 60ºC (9). **IPA:** < 10^{-7} at 60ºC (9).
Octanol-Water Partition Coefficient (K_{ow}):	**Acid:** = 1.3 (22ºC) (3), = 1.29 (7). **IPA:** No information in references
Bioaccumulation/ Bioconcentration:	**BAF:** Does not appreciably bioaccumulate (9). **BCF:** Does not bioconcentrate (9).

Worst Case Ecological Risk Assessment

Max Application Rate (ai lbs/acre – ae basis)	**Habitat Management:** 1.5 lbs. a.e./acre – terrestrial 1.0 lb. a.e./acre – aquatic[1] **Croplands/Facilities Maintenance:** 1.5 lbs. a.e./acre
EECs	**Terrestrial (Habitat Management):** 360 ppm **Terrestrial (Croplands/Facilities Maintenance):** 360 ppm **Aquatic (Habitat Management):** 0.368 ppm **Aquatic (Croplands/Facilities Maintenance):** 0.00503 ppm

[1]Aquatic overspray and riparian areas within 25 feet of surface water resources.

Habitat Management Treatments:

Presumption of Unacceptable Risk		Risk Quotient (RQ)	
		Listed (T&E) Species	Nonlisted Species
Acute	Birds	=0.07 [0.1]	=0.07 [0.5]
	Mammals	=0.08 [0.1]	=0.08 [0.5]
	Fish	=0.05 [0.05][1]	=0.05 [0.5][1]
Chronic	Birds	=0.22 [1]	=0.22 [1]
	Mammals	=0.06 [1]	=0.06 [1]
	Fish	=0.05 [1][1]	=0.05 [1][1]

[1]Screening-level ecological risk assessment assumes an application rate = 1.0 a.e./acre.

Cropland/Facilities Maintenance Treatments:

Presumption of Unacceptable Risk		Risk Quotient (RQ)	
		Listed (T&E) Species	Nonlisted Species
Acute	Birds	=0.07 [0.1]	=0.07 [0.5]
	Mammals	=0.08 [0.1]	0.08 [0.5]
	Fish	<0.01 [0.05]	<0.01 [0.5]
Chronic	Birds	=0.07 [1]	=0.07 [1]
	Mammals	=0.08 [1]	=0.08 [1]
	Fish	<0.01 [1]	<0.01 [1]

Justification for Use:	Reduced risk herbicide active ingredient that may be used in upland, riparian and aquatic habitats.
Specific Best Management Practices (BMPs):	Apply aquatic labeled imazapyr formulations to aquatic and riparian habitats within 25 feet of surface water resources tank-mixed w/ surfactants classified as practically non-toxic or slight acute toxicity to aquatic organisms (>10 ppm). These surfactants include, but not necessarily limited to, LI-700, AgriDex, Activate Plus, Big Sur 90, Sil Energy, Dyne-Amic, Freeway, Cygnet Plus, Sun-Wet, Hasten Modified Vegetable Oil, Kinetic or Class Act Next Generation. Maximum application rate = 1.0 lb. a.e./acre for aquatic and riparian treatment sites within 25 feet of surface water resources.
References:	[1a] _____. 2010. Arsenal specimen label & MSDS. BASF Corp., Florham, NJ. 19 & 8 pp., respectively. [1b] _____. 2011 & 2009, respectively. Arsenal AC specimen label & MSDS. BASF Corp., Florham, NJ. 23 & 7 pp., respectively. [1c] _____. 2011 & 2009, respectively. Arsenal Powerline specimen label & MSDS. BASF Corp., Florham, NJ. 18 & 8 pp., respectively. [1d] _____. 2008. Ecomazapyr 2 SL specimen label & MSDS. Alligare, LLC, Opelika, AL. 7 & 4 pp., respectively. [1e] _____. 2006. Ecomazapyr 2 SL specimen label & MSDS. Makhteshim-Agan of North America (MANA), Inc., Raleigh, NC. 7 & 3 pp., respectively. [1f] _____. 2006. EZ-JECT Copperhead Herbicide Shells specimen label & MSDS. EZ-Ject, Inc., Omaha, NE. 2 & 3 pp., respectively. [1g] _____. 2008 & 2011, respectively. Habitat specimen label & MSDS. BASF Corp., Florham, NJ. 13 & 8 pp., respectively. [1h] _____. 2011 & 2008, respectively. Polaris specimen label & MSDS. Nufarm Americas Inc., Burr Ridge, IL. 19 & 6 pp., respectively.

[1i] _____. 2008. Polaris AC specimen label & MSDS. Nufarm Americas Inc., Burr Ridge, IL. 22 & 6 pp., respectively.
[1j] _____. 2008 & 2010. Stalker specimen label & MSDS. BASF Corp., Florham, NJ. 9 & 8 pp., respectively.
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[12] Trumbo, J. and D. Waligora. 2009. The Impact of the Herbicides Imazapyr and Triclopyr Triethylamine on Bullfrog Tadpoles. California Fish and Game 95(3):122-127.

Table CP.1 Pesticide Name
Active Ingredient = Imazapyr

Trade Name[a]	Treatment Type[b,c]	Max Product Rate – Single Application (lbs/acre or gal/acre)	Max Product Rate - Single Application (lbs/acre - AI on acid equiv basis)	Max Number of Applications Per Season	Max Product Rate Per Season (lbs/acre/season or gal/acre/season)	Minimum Time Between Applications (Days)
Arsenal, Arsenal AC, Arsenal Powerline,	H	0.75 gal/acre	1.5 lbs a.e./acre	1	1.5 lbs a.e./acre/season	0
Ecomazapyr 2 SL (Alligare), Ecomazapyr 2 SL (MANA), EZ-JECT	H	0.75 gal/acre	1.5 lbs a.e./acre	1	1.5 lbs a.e./acre/season	0
Copperhead, Habitat, Polaris,	H	0.75 gal/acre	1.5 lbs a.e./acre	1	1.5 lbs a.e./acre/season	0
Polaris AC, Stalker,	H	0.75 gal/acre	1.5 lbs a.e./acre	1	1.5 lbs a.e./acre/season	0

[a]From each label for a pesticide identified in pesticide use proposals (PUPs), Service personnel would record application information associated with possible/known uses on Service lands.
[b]Treatment type: H – habitat management or CF – cropland/facilities maintenance. If a pesticide is labeled for both types of treatments (uses), then record separate data for H and CF applications.
[c]Treatment type is for ecological risk assessment purposes only. The product label will determine whether or not the treatment type is permissible under Section 3 of the Federal Insecticide, Fungicide and Rodenticide Act.

B-3 Aminopyralid Formulations Chemical Profile

Toxicological endpoint and environmental fate data listed in this chemical profile will be periodically reviewed and updated. New information, including, but not limited to, completion of national section 7consultation in accordance with the federal Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884), as amended, between the U.S. Fish and Wildlife Service and the U.S. Environmental Protection Agency on individual pesticide registrations and all federally listed and proposed species and proposed and designated critical habitat, may change ecological risk assessments, pesticide use patterns, best management practices, and/or justification for use. Consultations occur now at the local level for listed and proposed species and proposed and designated critical habitat on specific use of individual pesticides in specific project areas.

Date:	9/20/11				
Pesticide Class:	Pyridine carboxylic acid	**Common Chemical Name(s):**	Aminopyralid	**Pesticide Type:**	Herbicide, Group 4
Trade Name(s):	Milestone, Milestone VM	**EPA Registration Number:**	62719-519, 62719-537	**CAS Number:**	566191-89-7 566191-89-7
Other Ingredients:	59.4% inert ingredients (TIPA and water). No ingredients requiring regulatory advisories (1).				

Toxicological Endpoints

Endpoints highlighted yellow are selected for use in a screening-level ecological risk assessment. Endpoints selected are typically the most toxic endpoint for the most sensitive species listed in following summaries.

Mammalian LD_{50}:	**Aminopyralid Tech.** *Rat*: > 5,000 mg/kg (oral in males and females) (1,2,3,4,6,7,8), NOAEL (90-day feeding) = 520 mg/kg/day (8); **Milestone:** *Rat* = 5,000 mg/kg bw (7).
Mammalian LC_{50}:	**Aminopyralid Tech**: *Rat*: NOEL = > 1,000 ppm (6)
Mammalian Reproduction:	**Aminopyralid Tech.**: *Rabbit*: NOAEL = (dam) 250 mg/kg/day, = (fetus) 500 mg/kg/day (2,8), LOAEL = (dam) = 500 mg/kg/day; NOAEL = 1,000 mg/kg/day (2); *Rat*: 2-generation NOEL (dam & fetus) = 1,000 mg/kg/day (2,5,8); **Milestone**: *Rabbit*: NOAEL = (dam) 104 mg/kg/day, = (fetus) 260 mg/kg/day (2,4,8), LOAEL = (dam) 260 mg/kg/day, = (fetus) 520 mg a.e./kg/day (2,8); *Rat*: NOAEL (dam & fetus) = 520 mg a.e./kg/day (4,8);
Avian LD_{50}:	**Aminopyralid Tech**: *Bobwhite*: > 2,250 mg a.e./kg bw (2,3,6)
Avian LC_{50}:	**Aminopyralid Tech**: *Bobwhite*: NOEC = 5,556 ppm a.e. (2,5,7). *Mallard*: NOEC = 5,496 ppm a.e. (2,5,7).
Avian Reproduction:	**Aminopyralid Tech**: *Bobwhite*: LOEC = 640 mg a.e./kg diet (2). *Mallard*: NOEC = 2,623 mg a.e./ kg diet (2,7).

Fish LC_{50}:	**Aminopyralid Tech.**: *Bluegill*: 96-hour > 100 ppm a.e. (2,3,5). *Rainbow Trout*: 96-hour > 100 ppm a.e. (2,3,5,6). *Sheepshead Minnow*: 96-hour > 120 ppm a.e. (2,3,5).
Fish ELS/Life Cycle:	**Aminopyralid Tech.**: *Fathead Minnow*: NOEC = 1.36 ppm a.e., LOEC = 2.44 ppm a.e. (2,5);
Amphibians/Reptiles:	**Aminopyralid Tech.**: *Northern Leopard Frog*: 96-hour LC50 > 95.2 mg a.e./L (2,5)
Invertebrates/Plants:	**Aminopyrlaid Tech.**: *Blue-green Algae*: 120-hour EC50 = 27 ppm a.e. (3). *Daphnia magna*: 48-hour EC50 > 98.6 ppm a.e. (2,5); 21-day NOEC = 100 ppm a.e. (6), LOEC = >102 ppm a.e. (3,5). *Duckweed*: 14-day EC50 > 88 ppm a.e. (2,3,5), NOEC = 44 ppm a.e. (2,5). *Earthworm*: 14-day LC50 > 1,000 mg a.e./kg soil (3,6). *Eastern Oyster*: 48-hour EC50 > 89 ppm a.e. (2,5). *Green Algae*: 72-hour ErC50 = 30 ppm a.e., NOEC = 23 ppm a.e. (3,5). *Honey Bee*: 48-hour LD50 (contact) > 100 µg a.e./bee (2,3,5). *Midge*: NOEC = 130 ppm a.e. (3). *Mysid Shrimp*: 96-hour LC50 > 100 ppm a.e. (2,3,5).
Other Endpoints:	Carcinogenic: Negative (1), Teratogenic: Negative (1); Mutagenic: Negative (1); Endocrine disruption: Negative (8)

Ecological Incident Reports

No incident reports in references.

Environmental Fate

Water solubility (S_w):	= 203 g/L (pH 5 @ 20°C), 205 g/L (pH 7 @ 20°C, and 212 g/L @ 20°C (2,4,8); = 2.48 g/L @ 18°C (3,5,8).
Soil Mobility (K_{oc}):	= 1.05 to 24.3 mL/g (2,5); =10.8 mL/kg (3).
Soil Persistence ($t_{½}$):	*Aerobic degradation*: Aerobic microbial degradation is the primary route of breakdown in soils. Aerobic soil half-life (across range of 5 soil types) = 31.5 - 533.2 days , USEPA assumes half-life = 103.5 days (2,3,5) for risk assessments, however, persistence may be up to 5x longer (5). *Photolysis*: Soil photodegradation half-life = 61 days (3); = 72.2 days (2,5).
Soil Dissipation (DT_{50}):	*Terrestrial field dissipation*: surface soil = 20 days, total soil =26 days (CA); surface soil = 32.1 days, total soil =34 days (MS) (5); DT_{50} =21.1 days (6).
Aquatic Persistence ($t_{½}$):	*Aerobic degradation*: Aerobic sediment-water degradation (aquatic metabolism) half-life = 462 to 990 days (2). Water-sediment DT_{50} =712 days (6). *Anaerobic degradation*: Anaerobic aquatic metabolism ½ life = stable (4). Anaerobic sediment-water degradation half-life = stable (2,5).

	Hydrolysis: =Stable (3). *Photolysis*: Primary route of degradation is photolysis (2); Half-life = 0.6 days (2,3,5,6) in clear/shallow water, considerably longer in turbid/deep water (5).
Aquatic Dissipation (DT_{50}):	Water = 250 days (6).
Potential to Move to Groundwater (GUS score):	=4.8 (high probability of leaching) (6).
Vapor Pressure (mm Hg):	7.14×10^{-11} mm Hg @ 20°C (2,3,5); 1.92×10^{-10} mm Hg @ 25°C (2).
Octanol-Water Partition Coefficient (K_{ow}):	Log Kow = 0.201 (unbuffered water), -1.75 (pH 5), -2.87 (pH 7), -2.96 (pH 9) @ 20°C (2,4,5,6); Kow = 1.58 @ 20°C (5).
Bioaccumulation/Biocentration:	**BAF:** No information in references. **BCF:** = 100 (7).

Worst Case Ecological Risk Assessment

Max Application Rate (ai lbs/acre – ae basis)	**Habitat Management:** 0.11 lbs. a.e./acre **Croplands/Facilities Maintenance:** 0.11 lbs. a.e./acre
EECs	**Terrestrial (Habitat Management):** 26.4 ppm **Terrestrial (Croplands/Facilities Maintenance):** 26.4 ppm **Aquatic (Habitat Management):** 0.04 ppm **Aquatic (Croplands/Facilities Maintenance):** 0.00037 ppm

Habitat Management Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	=0.01 [0.1]	=0.01 [0.5]
	Mammals	<0.01 [0.1]	<0.01 [0.5]
	Fish	<0.01 [0.05]	<0.01 [0.5]
Chronic	Birds	=0.04 [1]	=0.04 [1]
	Mammals	=0.01 [1]	=0.01 [1]
	Fish	=0.03 [1]	=0.03 [1]

Cropland/Facilities Maintenance Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	<0.01 [0.1]	<0.01 [0.5]
	Mammals	<0.01 [0.1]	<0.01 [0.5]
	Fish	<0.01 [0.05]	<0.01 [0.5]
Chronic	Birds	=0.04 [1]	=0.04 [1]
	Mammals	=0.01 [1]	=0.01 [1]
	Fish	<0.01 [1]	<0.01 [1]

Justification for Use:	Control of many noxious and invasive weed species in the Aster family notably thistles and knapweeds.
Specific Best Management Practices (BMPs):	Do not treat within 25 feet of surface water intended for irrigation of sensitive cultivated crops.
References:	[1] _____. 2006. Milestone and Milestone VM MSDS. Dow AgroSciences LLC, Indianapolis, IN. 4 pp. [2] _____. 2005. Pesticide fact sheet – aminopyralid. USEPA, Office of Prevention, Pesticides and Toxic Substances, Washington, D.C. 56 pp.

[3] _____. 2005. Aminopyralid – technical bulletin. Dow AgroSciences, LLC. Indianapolis, IN. 19 pp.
[4] _____. 2007. Regulatory note – aminopyralid. Pest Management Regulatory Agency, Health Canada, Ottawa, Canada. 87 pp.
[5] _____. 2005. Environmental fate and ecological risk assessment for the registration of aminopyralid. Office of Pesticide Programs, Environmental Fate and Effects Division, USEPA, Washington, D.C. 151 pp.
[6] _____. 2009. The Pesticide Properties Database (PPDB) developed by the Agricultural & Environment Research Unit (AERU), University of Hertfordshire, funded by UK national sources and the EU-funded FOOTPRINT project (Hatfield, UK); Last accessed: 6 September 2011.
[7] _____. 2007. Aminopyralid: Human Health and Ecological Risk Assessment – Final Report. Prepared by USDA Forest Service and National Park Service by Syracuse Environmental Research Associates, Inc (USDA Contract#: AG-3187-C-06-0010).
[8] _____. 2005. Aminopyralid: Aggregate Human Health Risk Assessment for the Proposed Uses on Wheat, Grasses, Non-cropland Areas, and Natural Areas. USEPA Health Effects Division, Scientific Data Reviews, Series 361, File R112051, 61 pp

Table CP.1 Pesticide Name
Active Ingredient = aminopyralid

Trade Name[a]	Treatment Type[b]	Max Product Rate – Single Application (lbs/acre or gal/acre)	Max Product Rate - Single Application (lbs/acre - AI or acid equiv basis)	Max Number of Applications Per Season	Max Product Rate Per Season (lbs/acre/season or gal/acre/season)	Minimum Time Between Applications (Days)
Milestone	H	0.055 gal/acre	0.11 lbs a.e./acre	1	0.055 gal/acre/season	0
Milestone VM	H	0.055 gal/acre	0.11 lbs a.e./acre	1	0.055 gal/acre/season	0

[a]From each label for a pesticide identified in pesticide use proposals (PUPs), Service personnel would record application information associated with possible/known uses on Service lands.
[b]Treatment type: H – habitat management or CF – cropland/facilities maintenance. If a pesticide is labeled for both types of treatments (uses), then record separate data for H and CF applications.
[c]Treatment type is for ecological risk assessment purposes only. The product label will determine whether or not the treatment type is permissible under Section 3 of the Federal Insecticide, Fungicide and Rodenticide Act.

B-4 Halosulfuron-Methyl Formulations Pesticide Profile

Date:	2/17/12				
Pesticide Class:	sulfonylurea	**Common Chemical Name(s):**	Halosulfuron-methyl	**Pesticide Type:**	Herbicide Group 2
Trade Name(s):	Halosulfuron Pro Sandea Sandea Herbicide	**EPA Registration Number:**	2749-528-228 81880-18-10163 10163-254	**CAS Number:**	100784-20-1 100784-20-1 100784-20-1
Other Ingredients:	**Halosulfuron Pro:** None listed (1). **Sandea:** <3.0% silica, 8-13% kaolin clay (2). **Sandea Herbicide:** <3.0% silica, 8-13% kaolin clay (3).				

Toxicological Endpoints

Mammalian LD_{50}:	Rat: =8866 mg/kg (8); >1287 mg/kg (10). Estimated chronic acute toxicity NOEC=128.7 mg/kg using 10:1 acute to chronic ratio (11).
Mammalian LC_{50}:	No information in references.
Mammalian Reproduction:	No information in references.
Avian LD_{50}:	Bobwhite: >2250 mg/kg (4,7).
Avian LC_{50}:	Bobwhite: >5620 ppm (4,7). Mallard: >5620 ppm (4,7). Estimated chronic acute toxicity NOEC=562 ppm using 10:1 acute to chronic ratio (11).
Avian Reproduction:	No information in references.
Fish LC_{50}:	Bluegill: >118 ppm (4,5,6,10); >21 ppm (4,5,6). Rainbow: >26.7 ppm (4,5,6); >131 ppm (4,5,6,10).
Fish ELS/Life Cycle:	Rainbow: LOEC <106 ppm (4). Estimated ELS/Life Cycle NOEC =2.1 ppm using 10:1 acute to chronic ratio (11).
Other:	*Daphnia*: 48 hr EC_{50}>107 ppm (4,5,6,10); 96 hr EC_{50}>24 ppm (4,5,6); LifCycl LOEC<6.8 ppm (4); LOEC <1.8 ppm (4). Bluegreen algae: EC_{50}=0.11 ppm (4,5,6). Green algae: EC_{50}=0.0041 ppm (4,5,6). Inflated duckweed: 0.000042 ppm (5,6). Honeybee: LD_{50}>100 ug/bee (4,9,10).

Ecological Incident Reports

No incident reports in references.

Environmental Fate

Water solubility (S_w):	=1650 ppm (8,9); =1630 ppm @ pH 7 (10).
Soil Mobility (K_{oc}):	=124 (9); =75 (10).
Soil Persistence ($t_{½}$):	Aerobic ½ life =51 days (9). Anaerobic ½ life =23 days (9). Soil ½ life =55 days (10).
Soil Dissipation (DT_{50}):	DT_{50} =247 days (8).
Aquatic Persistence ($t_{½}$):	Hydrolysis ½ life =14 days (9). Water-sediment DT_{50} =25.1 days (8), Water DT_{50}=20.1 days (8).
Aquatic Dissipation DT_{50}):	No information in references.
Potential to Move to Groundwater (GUS score):	No information in references.
Vapor Pressure (mm Hg):	=$1x10^{-7}$ mm Hg (9).
Octanol-Water Partition Coefficient (K_{ow}):	Log Kow =0.0186 (8,9).

Bioaccumulation/ Biocentration:	**BCF:** Slight potential (10). **BAF:** No information in references.

Worst Case Ecological Risk Assessment

Max Application Rate (ai lbs/acre – ae basis)	**Habitat Management:** 0.125 lb. a.i./acre **Croplands/Facilities Maintenance:** 0.125 a.i./acre Up to 2 applications per year not to exceed 0.125 lb. a.i./acre per year (total use) .
EECs	**Terrestrial (Habitat Management):** 30 ppm **Terrestrial (Croplands/Facilities Maintenance):** 30 ppm **Aquatic (Habitat Management):** 0.0919 ppm **Aquatic (Croplands/Facilities Maintenance):** 0.000419 ppm

Habitat Management Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	=0.02 [0.1]	=0.02 [0.5]
	Mammals	=0.01 [0.1]	=0.01 [0.5]
	Fish	<0.01 [0.05]	<0.01 [0.5]
Chronic	Birds	=0.05 [1]	=0.05 [1]
	Mammals	=0.01 [1]	=0.01 [1]
	Fish	=0.04 [1]	=0.04 [1]

Cropland/Facilities Maintenance Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	=0.02 [0.1]	=0.02 [0.5]
	Mammals	=0.01 [0.1]	=0.01 [0.5]
	Fish	<0.01 [0.05]	<0.01 [0.5]
Chronic	Birds	=0.05 [1]	=0.05 [1]
	Mammals	=0.01 [1]	=0.01 [1]
	Fish	<0.01 [1]	<0.01 [1]

Justification for Use:	Reduced risk herbicide used for broadleaf weed control in diverse habitat types.
Specific Best Management Practices (BMPs):	Ground application only. Up to 2 applications per site per year. Do not exceed 0.125 lbs a.i./acre/year. Do not apply to coarse textured soils with soil organic matter <2%, and water table within 10 feet of soil surface. Do not apply to slopes >5% if significant rainfall is expected within 24 hours. Wind speed not to exceed 7 mph or not less than 1 mph at time of application. Do not apply when inversion conditions exist. If applied within 25 feet of surface water resources only use nonionic surfactants that are non-toxic or slight acute toxicity (LC_{50} >10 ppm) to aquatic organisms.
References:	[1] _____. 2009. Halosulfuron Pro specimen label and MSDS. Nufarm Americas, Inc., Burr Ridge, IL. 5 & 6 pp., respectively. [2] _____. 2007 & 2009. Sandea specimen label and MSDS, respectively. Produced for Canyon Group LLC by Gowan Co., Yuma, AZ. 23 & 4 pp., respectively. [3] _____. 2007. Sandea Herbicide specimen label and MSDS. Gowan Co.,

Yuma, AZ. 20 & 4 pp., respectively.
[4]_____. 2000. USEPA one-liner database.
[5]Kegley, et. al. 2000. PAN pesticide database. Pesticide Action Network, San Francisco, CA.
[6]Office of Pesticide Programs. 2000. ECOTOX: aquatic report. Pesticide Ecotoxicity Database, Environmental Fate and Effects Division, U.S. Environmental Protection Agency, Washington, D.C.
[7]Office of Pesticide Programs. 2000. ECOTOX: terrestrial report. Pesticide Ecotoxicity Database, Environmental Fate and Effects Division, U.S. Environmental Protection Agency, Washington, D.C.
[8]_____. 2010. Pesticide properties database. Agricultural & Environmental Research Unit, Science and Technology Research Institute, University of Hertfordshire, Hatfield, UK.
[9]_____. 2009. Halosulfuron methyl. Thruston Co. Health Depart., Olympia, WA.
[10]_____. 2000. Halosulfuron-methyl herbicide fact sheet. Bonneville Power Admin., US Dept. of Energy, Washington, D.C.
[11]Scofield, R. 2010. Introduction to Aquatic Toxicology. Course ID: ETOX-410, April 26-27, 2010 (Sacramento, CA) Northwest Environmental Training Center, Seattle, WA.

Table CP.1 - Pesticide Name
Active Ingredient = halosulfuron-methyl

Trade Name[a]	Treatment Type[b, c]	Max Product Rate – Single Application (lbs/acre or gal/acre)	Max Product Rate - Single Application (lbs/acre - AI on acid equiv basis)	Max Number of Applications Per Season	Max Product Rate Per Season (lbs/acre/season or gal/acre/season)	Minimum Time Between Applications (Days)
Halosulfuron Pro	CF, H	0.167 lbs/acre	0.125 lbs. a.i./acre	2	0.125 lbs. a.i./acre	15
Sandea	CF, H	0.167 lbs/acre	0.125 lbs. a.i./acre	2	0.125 lbs. a.i./acre	15
Sandea Herbicide	CF, H	0.167 lbs/acre	0.125 lbs. a.i./acre	2	0.125 lbs. a.i./acre	15

[a]From each label for a pesticide identified in pesticide use proposals (PUPs), Service personnel would record application information associated with possible/known uses on Service lands.

[b]Treatment type: H – habitat management or CF – cropland/facilities maintenance. If a pesticide is labeled for both types of treatments (uses), then record separate data for H and CF applications.

[c]Treatment type is for ecological risk assessment purposes only. The product label will determine whether or not the treatment type is permissible under Section 3 of the Federal Insecticide, Fungicide and Rodenticide Act.

B-5 2,4-D Amine Chemical Profile

Toxicological endpoint and environmental fate data listed in this chemical profile will be periodically reviewed and updated. New information, including, but not limited to, completion of national section 7consultation in accordance with the federal Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884), as amended, between the U.S. Fish and Wildlife Service and the U.S. Environmental Protection Agency on individual pesticide registrations and all federally listed and proposed species and proposed and designated critical habitat, may change ecological risk assessments, pesticide use patterns, best management practices, and/or justification for use. Consultations occur now at the local level for listed and proposed species and proposed and designated critical habitat on specific use of individual pesticides in specific project areas.

Date:	4/5/12				
Pesticide Class:	Phenoxy	**Common Chemical Name(s):**	2,4-D, 2,4-D dimethylamine salt, 2,4-D diethanolamine salt	**Pesticide Type:**	Herbicide, Grp 4
Trade Name(s):	2,4-D Amine, 2,4-D Amine 4 (AgriStar), 2,4-D Amine 4 (Winfield), 2,4-D Amine Weed Killer, Amine 4 2,4-D Herbicide Amine 4 2,4-D Weed Killer, DMA 4 IVM, HI-DEP, UAP Timberland Platoon, Savage, Unison, Weedar 64, Weedestroy AM-40	**EPA Registration Number:**	5905-72, 42750-19, 1381-103, 1386-43-72693, 71368-1-5546, 34704-120, 62719-3, 2217-703, 228-145, 34704-606, 5905-542, 71368-1, 228-145	**CAS Number:**	2008-39-1, 2008-39-1, 2008-39-1, 2008-39-1, 2008-39-1, 2008-39-1, 2008-39-1 & 124-40-3, 2008-39-1 & 5742-19-8, 2008-39-1, 2008-39-1 & , 124-40-3, 94-75-7, 2008-39-1, 2008-39-1
Other Ingredients:	**2,4-D Amine (dimethylamine [DMA] salt of 2,4-dichlorophenoxyacetic acid [2,4-D]):** 46.6% DMA,53.2% other (including water and sequestering agents) (1a); **AgriStar 2,4-D Amine 4 (2,4-D DMA):** 46.8% DMA, 53.2% other (1b); **Winfield 2,4-D Amine 4 (2,4-D DMA):** 47.3% DMA, 52.7% other (1c); **2,4-D Amine Weed Killer (2,4-D DMA):** 47.2% DMA, 52.8% other (1d); **Amine 4 2,4-D Herbicide (2,4-D DMA):** 46.8% DMA, 53.2% other (1e); **Amine 4 2,4-D Weed Killer (2,4-D DMA):** 46.5% DMA, 53.5% other (1f); **DMA 4 IVM (2,4-D DMA):** 46.3% DMA, 53.7% other (including 1% dimethylamine [**dimethyl**]) (1g); **HI-DEP (2,4-D DMA and diethanolamine [DEA] salt of 2,4-D):** 33.2% DMA, 16.3% DEA, 50.5% other (including 10.1% ethylene glycol) (1h); **Platoon (2,4-D DMA):** 47.3% DMA, 52.7% other (1i); **Savage (2,4-D DMA):** 95% DMA, 5% other (including unknown % of dimethyl) (1j); **Unison (2,4-D):** 19.6% 2,4-D, 80.4% other				

	(including surfactants and solvents) (1k); **Weedar 64 (2,4-D DMA):** 46.8% DMA, 53.2% other (1l); **WEEDestroy AM-40 (2,4-D DMA):** 46.8% DMA, 53.2% other (1m)
1st Order Degradates	Highly variable, dependent upon substrate, water content, pH, oxygen content, etc (7), some degradates include: 1,2,4-benzenetriol, 2,4-dichlorophenol (2,4-DCP), 2,4-dichloroanisol (2,4-DCA), chlorohydroquinone (CHQ), 4-chlorophenol (2,7)

Toxicological Endpoints Endpoints highlighted yellow are selected for use in a screening-level ecological risk assessment. Endpoints selected are typically the most toxic endpoint for the most sensitive species listed in following summaries.

Mammalian LD_{50}:	**2,4-D: (%AI Unk):** *Gray-tailed Vole*: Single dose, 3-6 mo old, 14-d observation period: male = 1,205 mg/kg, female = 1,314 mg/kg (19). *Prairie Vole*: Single dose, 3-6 mo old, 14-d observation period: male = 2,106 mg/kg, female = 2,104 mg/kg (19). *Rat*: Acute neurotoxicity NOAEL = 67 mg/kg bw, LOAEL = 227 mg/kg bw (3). **2,4-D (95.0+% AI):** *Mule Deer*: 14-d, 11 mo. old, both sexes = 400 to 800 mg/kg (4,18). **2,4-D (95.0% AI):** *Rat*: Single dose, young adults, 14-d observation period: male = 639 mg/kg, female = 764 mg/kg (2,3,4). **DMA (%AI Unk):** *Rat*: Unk. Time = 949 mg/kg (2,3); Unk. Time = 716 mg/kg bw (3). **DMA (67.9% AI):** *Rat*: Single dose, young adults, 14-d observation period: male = 1,090 mg/kg, female = 863 mg/kg (4). **DMA 4:** *Canids*: acute NOAEL = 1.1 mg ae/kg (3). **DEA (%AI Unk):** *Rat*: Unk. Time = 735 mg/kg (2,3). **Dimethyl:** *Rat*: Unk. Time = 698 mg/kg (3); Mouse: Unk. Time = 316 mg/kg (3).
Mammalian LC_{50}:	**2,4-D:** No information in references. **DMA:** No information in references. **DEA:** No information in references. **Dimethyl:** No information in references.
Mammalian Reproduction:	**2,4-D (97.5% AI):** *Rat*: 2-generation study, Parental & Offspring NOAEL = 5 mg/kg/day, LOAEL = 20 mg/kg/day; Reproductive NOAEL = 20 mg/kg/day, LOAEL = 80 mg/kg/day (3). **2,4-D (%AI Unk):** *Mouse*: Parental NOAEL = 370 mg ae/kg/day (3); Offspring NOAEL = 8.5 mg ae/kg/day, LOAEL = 37 mg ae/kg/day (3); *Rabbits*: Maternal & Developmental NOAEL = 30 mg/kg/day, LOAEL = 90 mg/kg/day (2,3). *Rat*: Chronic Toxicity NOAEL = 5 mg/kg/day, LOAEL = 75 mg/kg/day (2,3); Developmental Toxicity (Maternal & Developmental) NOAEL = 25 mg/kg/day, LOAEL = 75 mg/kg/day.

	DMA: No information in references. **DEA:** No information in references. **Dimethyl:** No information in references.
Avian LD_{50}:	**2,4-D (%AI Unk):** *Bobwhite*: Unk. Time NOAEL = 76 mg ae/kg bw/day (3). *Quail*: Unk. Time = 500 mg/kg (1a). **2,4-D (99.0% AI):** *Chukar*: 14-d, 4 mo. old, both sexes = 200 to 400 mg/kg (4,18). *Japanese Quail*: 14-d, 2 mo. old males = 668 mg/kg (4,18). *Mallard*: 14-d, 4 mo. old males > 2,000 mg/kg bw (4,18), (14-d, 3-5 mo. old males) >2,025 mg/kg (4,18), (14-d, 7 mo. old males) < 2,000 mg/kg (4,18), (14-d, 3-5 mo. old females) > 1,000 mg/kg (4,18). *Ring-necked Pheasant*: 14-d, 3-4 mo. old females = 472 mg/kg (4,18). *Rock Dove*: 14-d, both sexes = 668 mg/kg (4,18). **DMA (66.8% AI):** *Bobwhite*: Single dose, 14-d obs. period, 21 weeks old = 500 mg/kg bw (4,18), NOEL < 125 mg/kg bw (18). **DEA (73.1% AI):** *Bobwhite:* Single dose, 14-d obs. period, > 16 weeks old = 595 mg/kg bw, (NOEL) < 292 mg/kg bw (4,18). **Dimethyl:** No information in references;
Avian LC_{50}:	**2,4-D:** *Mallard*: Unk. Time > 5,550 ppm (1a). **2,4-D (95.0+% AI):** *Bobwhite*: 5-d, 10 d old > 5,620 ppm (4,6,18), NOEL = 1,000 ppm (4,18). *Mallard*: 5-d, 10 day old > 5,620 ppm , NOEL = 1,000 ppm (4,18). **2,4-D (75.0% AI):** *Japanese Quail*: 5-d, 14 d old > 5,000 ppm (4,18). **DMA (%AI Unk):** *Bobwhite*: 5-d, 14 days old > 5,000 ppm in feed (18). *Japanese Quail*: 5-d, 14 days old > 5,000 ppm in feed (18). *Mallard*: 5-d, 14 days old > 5,000 ppm in feed (18). *Ring-necked Pheasant*: 5-d, 14 days old > 5,000 ppm in feed (18). **DMA (66.8% AI):** *Bobwhite*: 5-d, 10 days old > 5,620 ppm (4,18), NOEL = 3,160 ppm (18). *Mallard*: 5-d, 10 days old > 5,620 ppm (4,18), NOEL = 5,620 ppm (18). **DMA (49.4-49.6% AI):** *Bobwhite*: 5-d, 23 days old > 5,000 ppm (18). *Japanese Quail*: 5-d, 16 d old > 5,000 ppm (4), 5-d, 20 d old > 5,000 ppm (18). *Mallard*: 5-d, 17 d old > 5,000 ppm (18). *Ring-necked Pheasant*: 5-d, 10 d old > 5,000 ppm (18).

	DEA (73.1% AI): *Bobwhite*: 5-d, 10 days old > 5,620 ppm (4,18), NOEL = 1,780 ppm (18). *Mallard*: 5-d, 10 days old > 5,620 ppm (4,18), NOEL = 1,780 ppm (18). **(57.9% AI):** *Bobwhite*: 5-d, 10-14 days old > 4,640 ppm (4,18), NOEL = 1,000 ppm (18). *Mallard*: 5-d, 14 days old > 4,640 ppm (4,18), NOEL = 4,640 ppm (18). **Dimethyl:** No information in references.
Avian Reproduction:	**2,4-D:** *Bobwhite*: 21-week LOEL > 962 mg/kg diet, NOEL = 962 mg/kg diet (3,18). **DMA:** No information in references. **DEA:** No information in references. **Dimethyl:** No information in references.
Fish LC_{50}:	**2,4-D (%AI Unk):** *Bluegill*: 96-h = 524 ppm (1a); 96-h = 830 mg ae/L (3). *Fathead Minnow*: 96-h = 263 mg/L (3), NOAEC = 63.4 mg ae/L (3,6), LOAEC > 102 mg/L (3). *Largemouth Bass*: 3.5 d = 160.7 mg/L (3). *Rainbow Trout*: 96-h = 250 ppm (1a); 96-h = 830 mg ae/L (3). *Zebrafish*: 48 & 96-h = 160 ppm (3,5); 24-h = 180 ppm (5). **2,4-D (98.0+% AI):** *Inland Silverside*: 96-h = 175 ppm (4,5). **DMA (%AI Unk):** *Fathead Minnow*: NOAEC = 14.2 mg ae/L, LOAEC = 23.6 mg ae/L (3,9). **DMA (49.0% AI):** *Western Mosquitofish*: LC50s, Age unk., 24-h = 500 ppm, 48-h = 445 ppm, 96-h = 405 ppm (4,5). **DEA:** No information in references; **Dimethyl (%AI Unk):** *Guppy*: age unk., 96-h = 210 ppm (4,5). **Dimethyl (41% AI):** *Rainbow Trout*: 96-h age unk: hard water)= 118 ppm, soft water = 17 ppm (4,5); 96-h (hard water, age unk) = 120 ppm (4,5), (96-h, soft water, age unk) = 20 ppm (4,5).
Fish ELS/Life Cycle:	**2,4-D: (%AI Unk):** *American Eel*: Young-of-year LC50s: 24-h = 427.2 ppm (4,5), 48-h = 390.2 ppm (4,5), 96-h = 300.6 ppm (3,4,5). *Bluegill & Green Sunfish & Lake Chub-sucker & Smallmouth Bass*: Exposed to 25 ppm from fertilization to hatching (~72 h), no effects on hatching or development, survived up to 8 d [experiment terminated at 8 d] at this concentration (4,5). *Banded Killifish*: Young-of-year LC50s : 24-h = 306.2 ppm (4,5), 48-h = 261.1 ppm (4,5), 96-h = 26.7 ppm (3,4,5). *Brown Bullhead*: 7-d LC50 (Length 12.7-15.2 cm) = ~2,000 ppm (4,5). *Killifish* (Cyprinodontidae family): 7-d LC50 (av. wt. 1.5g) = 2,000 ppm (4,5). *Largemouth Bass*: LC50, # days exposed post fertilization [dpf]: 3.5 dpf (at hatching): (soft) = 165.4 mg/L, (hard water) = 160.7 ppm (4,5), 7.5 dpf (at hatching): (soft water) = 108.6 ppm, (hard) = 81.6 ppm (4,5); (LC01, # days exposed post fertilization [dpf]): 7.5 dpf (4 days post hatching): (soft water) = 13.1 ppm, (hard water) = 3.2 ppm (4,5). *Pumpkinseed*: Young-of-year LC50s: 24-h = 120.0 ppm (4,5), 48-h = 118.3 ppm (4,5),

	96-h = 94.6 ppm (3,4,5); 7-d LC50 (av. wt. 5.0g) = 1,000 ppm (4,5), 7-d LOEC (av. wt. 5.0g) = 10 ppm (4,5). *Rainbow Trout*: LC50, # days exposed post fertilization [dpf]: 23 dpf (at hatching) & 27 dpf (4 days post hatching): (soft water) = 11 ppm, (hard water) = 4.2 ppm (4,5); LC01, # days exposed post fertilization [dpf]: 27 dpf (4 days post hatching): (soft water) = 0.0325 ppm, (hard water) = 0.0219 ppm (4,5). *Sockeye*: 7-d NOEC fingerlings = 200 ppm (4). *Spot Croaker*: 48-h NOEC (juvenile) = 50 ppm (4). *Striped Bass*: Young-of-year LC50s: 24-h = 85.6 ppm (4,5), 48-h = 70.2 ppm (4,5), 96-h = 70.1 ppm (3,4,5). *White Mullet*: 24 & 48-h NOEC Juvenile > 50 ppm (4). *White Perch*: Young-of-year LC50s: 24-h = 55.5 ppm (4,5), 48-h = 48.2 ppm (4,5), 96-h = 40 ppm (3,4,5). **2,4-D (98.0+% AI):** *Bluegill*: Av. Wt. 0.15 g at ~ 16.5°C LC50s: 24-h = 305 ppm (4,5), 48-h = 290 mg/L (4,5), 72 & 96-h = 263 ppm (4,5,9,18); 96-h NOEL < 204 ppm (18); Fingerling (Av. Length 6.2 cm: NOEC = 1 ppm, LOEC = 100 ppm (4); Av. Wt. 0.5 g: 96-h LC50 = 180 ppm (5,18). *Chum*: fry, 96-h NOEC = 10 ppm ae, LOEC = 50 ppm ae (4,5). *Coho*: Parr, LOEL, olfaction) = 100 ppm (4); Fry: 96-h NOEC = 10 ppm ae, 96-h LOEC = 50 ppm ae (4,5); Fingerlings: Alaska: 96-h NOEC = 50 ppm ae (4,5); Oregon: 96-h NOEC = 10 ppm ae, 96-h LOEC = 50 ppm ae (4,5). *Cutthroat trout*: 96-h LC50 (av. Wt. 0.5 g) = 24.5 ppm (18), Av. Wt. 0.4-0.6 g, pH 7.4, Hardness = 44 ppm, LC50s: (24 & 96-h at 5°C and 15°C) = 41.5 ppm (5); 24 & 96-h at 10°C)= 64 ppm (3,5,14); Av. Wt. 0.5-0.6 g, 10°C, Hardness 44 ppm, LC50s 24 & 96-h @ pH 6.5 = 67 ppm (5), (24 & 96-h, pH 7.5) = 130 ppm (5), (24 & 96-h, pH 8.5) = 40 ppm (5); Av. Wt. 0.8 g, 10°C, Hardness 44 ppm, LC50s 24 & 96-h @ pH 6.5 = 43.5 ppm (5); (24 & 96-h @ pH 7.5) = 169 ppm (5), 24-h @ pH 8.5 = 185 ppm (5), 96-h @ pH 8.5 = 172 ppm (5); Av. Wt. 0.5-0.8 g, 10°C @ pH 7.4, LC50s: Hardness 44 ppm: 24-h = 49 ppm, 96-h = 44 ppm (5), Hardness 160 ppm: 24-h = 41 ppm, 96-h = 37 ppm (5), Hardness 300 ppm: 24-h = 32 ppm, 96-h = 24.5 ppm (5). *Dolly Varden*: Fingerling, 96-h NOEC = 50 ppm ae (4,5). *Fathead Minnow*: Av. Wt. 0.14 g at ~ 16.5°C LC50s: 24-h = 344 ppm (4,5), 48 & 72-h = 325 ppm (4,5); 96-h = 320 ppm (4,5,9,18); 96-h NOEL = 256 ppm (18); 32-d LOEC = 102 ppm, NOEC = 63.4 ppm (18); 96-h LC50, av. wt. 0.9 g = 133 ppm (5,18). *Green Sunfish*: 41-h NOEC = 110 ppm ae (4,5). *Lake Trout*: 24 & 96-h LC50 (av. wt. 0.3g at 10°C) = 44.5 ppm (3,5,14,18), Av. Wt. 0.3-0.7 g, pH 7.4, Hardness 44 ppm, LC50s: (24 & 96-h at 5°C) = 65.7 ppm (5), 24 & 96-h at 10°C = 44.5 ppm (5), 24 & 96-h at 15°C = 64 ppm (5), Av. Wt. 0.7-0.9 g, 10°C, Hardness 44 ppm, LC50s: 24-h, pH 6.5 = 63 ppm, 96-h, pH 6.5 = 62 ppm (5), 24 & 96-h, pH 7.5 = 105 ppm (5), 24-h, pH 8.5 = 127.5 ppm, 96-h, pH 8.5 = 120 ppm (5). *Largemouth Bass*: LOEC Fingerling (Av. Length 7.8 cm) = 1 ppm (4). *Pink Salmon*: 96-h LOEC, fry < 1 ppm (4,5). *Rainbow Trout*: Av. Wt. 0.34 g at ~ 12°C: (24, 48, 72 & 96-h LC50s) = 358 mg/L (3,4,5,9,18); 96-h NOEL = 320 ppm (18); 24-h LOEL,(gill damage) = 5 mg/L (4); 96-h NOEC (Fingerlings) = 50 ppm ae (4,5); 96-h LC50 (av. wt. 0.3 g) = 110 ppm (5,18). *Sockeye*: Smolt, 96-h NOEC = 10 ppm ae, LOEC = 50 ppm ae (4,5). **DMA (%AI Unk):** *Bluegill*: Length 7.6 -12.7 cm: Av. dissolved O2 (4.6 mg/L), Av. Hardness (77.1 ppm):

	(24-h LC50) = 350 ppm (4,5), Av. dissolved O2 (7.3 mg/L), Av. Hardness (19.0 ppm), LC50s: 24-h = 390 ppm, 48-h = 375 ppm (4,5); Length (2.5-7.6cm): 24 & 48-h LC50 = 188 ppm ae (4,5), Av. Wt. 0.7g LC50s: 96-h @ 17°C = 177 ppm (4,5), 96-h, 25°C = 160 ppm (4); Av. wt 2.3g: 96-h LC50 = 106 ppm (5,18), NOEL < 87 ppm (18). *Channel Catfish*: 96-h @ 17°C (Av. Wt. 1.4 g) = 193 ppm (4), 96-h, 25°C = 125 ppm (4,5). *Fathead Minnow*: Av. Wt. 0.8g @ 17°C: 96-h LC50 = 335 ppm (4,5). *Largemouth Bass*: Length 7.6 -12.7 cm, LC50s: Av. dissolved O2 (4.6 mg/L), Av. Hardness (77.1 ppm): (24-h LC50) = 350 ppm (4,5), Av. dissolved O2 (7.3 mg/L), Av. Hardness (19.0 ppm): (24-h LC50) = 375 ppm, (48-h) = 350 ppm (4,5). *Longnose Killifish*: 48-h NOEC (juvenile) = 15 ppm (4). **DMA (99.3% AI):** *Fathead Minnow*: Full life cycle: LOEC = 28.4 ppm, NOEC = 17.1 ppm (18). **DMA (66.8-67.3% AI):** *Bluegill*: Av. Wt. 0.23 g at ~ 16.5°C LC50s: 24-h)> 600 ppm (4,5), 48-h = 570 ppm (4,5), 72-h = 547 ppm (4,5), 96-h = 524 ppm (4,5,18), Av. Wt. 0.28g: (96-h LC50) = 524 ppm (4,5,18), 96-h NOEL = 197 ppm (18). *Fathead Minnow*: Av. Wt. 0.11 g at ~ 16.5°C LC50s: 24-h > 600 ppm (4,5), 48-h = 382 ppm (4,5), 72-h = 365 ppm (4,5), 96-h = 344 ppm (4,5); Av. wt. 0.104g: 96-h LC50 = 318 ppm (4,5), 96-h NOEL < 246 ppm (18). *Inland Silverside*: Av. wt. 0.17g: 96-h LC50 = 469 ppm (4,5,18), NOEL < 224 ppm (18). *Rainbow Trout*: Av. Wt. 0.28 g at ~ 12°C LC50s: 24-h = 303 ppm (4,5), 48-h = 258 ppm (4,5), 72-h = 250 ppm (4,5), 96-h = 250 ppm (4,5); Av. wt. 0.23g: 96-h LC50 = 250 ppm (4,5,18), NOEL = 120 ppm (18). **DMA (56.7% AI):** *Bull Trout*: 96-h, fry: LC05 = 265 ppm, LC10 = 280 ppm, LC20 = 309 ppm, LC50 = 398 ppm, NOEL = 20 ppm (4). *Rainbow Trout*: 96-h, fry: LC05 = 334 ppm, LC10 = 417 ppm, LC20 = 530 ppm, LC50 = 707 ppm, NOEL = 35 ppm (4,5). **DMA (49.3-49.6% AI):** *Bluegill*: LC50 (Av. wt. 0.75 g, 210 ppm of CaCO3): 6-h = 282 ppm (4,17), 24-h = 176 ppm, 48 & 96-h = 140 ppm (4,17); LC50 (Av. Wt. 1.0 g): 24 & 96-h @ 15°C > 100 ppm, 24 & 96-h @ 20°C > 100 ppm, 24 & 96-h @ 25°C > 100 ppm (4,5); LC50 (Av. wt. 1.1g) soft & hard water: 24 & 96-h > 120 ppm (4,5); LC50 (Av. wt. 0.7g @ 18°C): 24-h = 262 ppm, 96-h = 177 ppm (4,5); LC50 (Av. wt. 1.1g @ 18°C): 24-h = 379 ppm, 96-h = 168 ppm (4,5,18); LC50 (Av. wt. 0.2g @ 20°C): 24-h = 420 ppm, 96-h = 335 ppm (4,5). *Channel Catfish*: LC50: (Av. Wt. 0.8 g @ 20°C): 24 & 96-h > 100 ppm (4,5); LC50 (Av. Wt. 1.8 g @ 18°C): 24 & 96-h > 160 ppm (4,5); LC50 (Av. Wt. 1.1g @ 18°C): 24 & 96-h > 160 ppm (4,5), LC50 (Av. Wt. 1.9g @ 18°C): 24-h = 210 ppm (4,5), 96-h = 155 ppm (4,5), LC50 (Av. Wt. 0.2g @ 20°C): 24-h = 560 ppm, 96-h = 395 ppm (4,5); LC50 (Av. Wt. 0.4g @ 22°C): 96-h = 119 ppm (4,5,18). *Chinook*: LC50 (Av. wts. 0.3, 0.4 & 1.0g @ 10°C): 24 & 96-h > 100 ppm (4,5,18). *Fathead Minnow*: LC50 (Av. Wt. 0.6g at 20°C): 24-h = 780 ppm, 96-h = 760 ppm (4,5); LC50 (Av. Wt. 0.8g @ 7.4 pH @ 17°C: 24-h = 389 ppm, 96-h = 335 ppm (4,5), @ 20°C: 24 & 96-h @ 6.5 pH = 440 ppm (4,5), 24-h @ 7.5 pH = 800 ppm, 96-h @ 7.5 pH = 760 ppm (4,5), 24-h @ 8.5 pH = 760 ppm, 96-h @ 8.5 pH = 740 ppm (4,5); LC 50 (Av. Wt. 1.3g @20°C): 24-h @ 6.5 pH = 300 ppm, 96-h @ 6.5 pH = 266 ppm (4,5), 24-h @ 7.5 pH = 690 ppm, 96-h @ 7.5 pH = 630 ppm (4,5), 24-h @ 8.5 pH =

	1,000 ppm, 96-h @ 8.5 pH = 630 ppm (4,5); LC50 (Av. Wt. 0.9g @ 7.4 pH @ 20°C) @ 12 ppm CaCO3: 24-h = 450 ppm, 96-h = 285 ppm (4,5); @ 44 ppm CaCO3: 24-h = 1,000 ppm, 96-h= 760 ppm (4,5); @ 138 ppm CaCO3: 24-h = 1,320 ppm, 96-h = 800 ppm (4,5); @ 258 ppm CaCO3: 24-h = 1,120 ppm, 96-h = 800 ppm (4,5); @ 7.4 pH @ 44 ppm CaCO3; LC50 Egg: 24-h = 6,700 ppm, 96-h = 1,530 ppm (4,5); LC50 Eyed-egg: 24-h = 2,350 ppm, 96-h = 1,450 ppm (4,5), @ 7.4 pH @ 44 ppm CaCO; LC50 Fingerling: @ 10°C, 24-h = 495 ppm, 96-h = 320 ppm (4,5), @ 15°C: 24-h = 760 ppm, 96-h = 700 ppm (4,5), @ 20°C: 24 & 96-h = 740ppm (4,5), @ 25°C: 24-h = 740 ppm, 96-h = 630 ppm (4,5); LC50 Yolk-sac Fry: 24-h = 1,330 ppm, 96-h = 630 ppm (4,5); LC50 Swim-up Fry: 24-h = 590 ppm, 96-h = 425 ppm (4,5); LC50 (av. wt. 0.8g) 96-h = 266 ppm (5,18). *Rainbow Trout*: LC50 (Av. wt. 0.2g @ 10°C, hard water): 24 & 96-h > 100 ppm (4,5); LC50 (Av. wt. 1.4g @ 10°C & 15°C, soft): 24 & 96-h > 100 ppm (4,5,18); LC50 (Av. wt. 0.1g @ 10°C, soft): 24-h = 560 ppm, 96-h = 420 ppm (4,5); LC50 (Av. wt. 0.4g): 24-h 1,420 ppm, 96-h = 1,170 ppm (4,5). *Smallmouth Bass*: LC50 (Av. wt. 0.4g @ 10°C): 24-h = 242 ppm (4,5), 96-h = 236 ppm (4,5,18). **DMA (46.8% AI, <u>Weedar 64</u>):** *Bluegill*: 96-h LC50 (av. wt. 1.4g at 20°C) = 7.4 ppm (14). *Channel Catfish*: 96-h LC50 (av. wt. 0.8g at 20°C) = 7.0 ppm (14). *Chinook*: 96-h LC50 (av. wt. 1.0g at 10°C) = 4.8 ppm (14). *Fathead Minnow*: 96-h LC50 (av. wt. 0.9g at 20°C) = 2.7 ppm (14). *Rainbow Trout*: 96-h LC50 (av. wt. 1.4g at 10°C) = 3.1 ppm (14). *Smallmouth Bass*: 96-h LC50 (av. wt. 0.4g at 20°C) = 3.1 ppm (14). **DMA (39.3% AI, <u>Weedestroy AM-40</u>):** *Channel Catfish*: LC50, Juvenile (5.1-7.6 cm long): 48-h = 224.2 ppm, 96-h = 181.2 ppm (4). *Bluegill*: LC50: 48-h = 313 ppm, 96-h = 266.3 ppm (4). **DEA (73.1-73.8% AI):** *Atlantic Silverside*: 96-h LC50 (Av. Wt. 0.14g) > 118 ppm (4,5,18), NOEL = 188 ppm (18). *Bluegill*: 96-h LC50 (Av. Wt. 1.03g) > 121 ppm (4,5,18), NOEL = 121 ppm (18). *Rainbow Trout*: 96-h LC50 (Av. Wt. 2.0g) > 120 ppm (4,5,18), NOEL = 120 ppm (18). **DEA (31.0% AI):** *Pink Salmon*: 96-h LC50, lake (hard water) = 438 ppm (3). **Dimethyl:** *Creek Chub*: No mortality at 30 ppm for 24 h (5), 100% mortality at 50 ppm for 3 h (5). *Zebrafish*: 8-cell stage to hatch: 96-h LC50 = 396.9 ppm , LOEL = 1 ppm (5).
Amphibians/ Reptiles:	**2,4-D (%AI Unk.):** *American Alligator*: NOEC (reproductive, applied to egg shell, tested 10 d post hatch) = 14 ppm (4). **2,4-D (98.0%+ AI):** *Leopard Frog*: 96-h LC50 (tadpoles) = 359 ppm ae (3). *Xenopus*: 96-h EC50 (embryo abnormalities) = 245 ppm (4,5); 96-h LC50 = 254 ppm (4,5), LOEC = 226 ppm (4,5).

	2,4-D (44.5% AI): *American Toad*: 13-d NOEL (abundance) = 0.12 ppm (4,5). *Gray Tree Frog*: 13-d NOEL (abundance) = 0.12 ppm (4,5). *Leopard Frog*: 13-d NOEL (abundance) = 0.12 ppm (4,5). *Spotted Salamander*: 13-d NOEL abundance) = 0.12 ppm (4,5). *Spring Peeper*: 13-d NOEL (abundance) = 0.12 ppm (4). *Wood Frog*: 13-d NOEL (abundance) = 0.12 ppm (4,5). **2,4-D (97.5% AI):** *Leopard Frog*: 96-h LC50 (tadpole) = 349 ppm, NOEL = 186 ppm (18). **DMA (%AI Unk):** *Leopard Frog*: 96-h LC50 (tadpoles) = 278 ppm ae(3). **DMA (~46.8% AI):** *Western Chorus Frog*: 24 & 96-h LC50 (tadpole) = 100 ppm (4,5). **DEA:** No information in references; **Dimethyl:** No information in references
Invertebrates/ Plants:	**2,4-D: (%AI Unk):** *Brown Shrimp*: 48-h LC10 = 2 ppm (4). *Ceriodaphnia dubia*: 48-h LC50 = 236 ppm (3); 24 & 48-h LC50 > 422 ppm (4,5); 24-h LC50 = 272.5 ppm (4), NOEC = 166.2 ppm (4). *Daphnia magna*: 21-d survival/reproduction study: NOAEC = 79 ppm, LOAEC = 151 ppm (3); 24-h LC50 = 415.7 ppm (4), NOEC = 263.9 ppm (4); 48-h EC50 @ 21ºC (immobility) > 100 ppm (5,6,16). *Duckweed*: 96-h EC50 (growth inhibition) > 100 ppm (4). *Eastern Oyster*: 96-h EC50 (shell growth inhibition at 19 & 23% salinity) > 2 ppm (4), NOEC (shell growth) = 2 ppm (4,5). *Fatmucket Clam* (Glochidia): 24-h LC50 = 362.2 ppm (4,5), NOEC = 191.7 ppm (4,5). *Fiddler Crab*: 48-h LC50 = 400 ppm (3). *Fragile Papershell* (Glochidia) : 24-h NOEC < 153.4 ppm (4). *Green Algae*: 96-h EC50 (growth inhibition) = 41.8 ppm (4), NOEC = 25 ppm (4,5). *Honeybee*: 48-h LD50 > 18.13 µg/bee (4,18), NOEL < 18.13 µg/bee (18). *Paper Pondshell* (Glochidia): 24-h LC50 = 436.5 ppm (4,5), NOEC = 226.5 ppm (4,5). *Plain Pocketbook* (Glochidia): 24-h LC50 = 402.3 ppm (4), NOEC< 191.7 ppm (4). *Pond Mussel* (Glochidia): 24-h LC50 = 352.9 ppm (4), NOEC = 181.2 ppm (4). *Mosquito*: 24-h LC50 = 91.8 mg/L (3,5). *Stonefly*: 48-h LC50 = 44 ppm (3). *Washboard Mussel* (Glochidia): 24-h LC50 = 247.9 ppm (4,5), NOEC < 191.7 ppm (4,5). **2,4-D (95.0%+ AI):** *Daphnia magna*: 24-h EC50 (1st instar, immobility) > 100 ppm (4,5); 48-h LC50 = 25 ppm (3,4); 48-h EC50 (immobility, 1st instar) = 25 ppm, NOEL = 12 ppm (4,5,18). *Duckweed*: 14-d EC50 (growth) = 0.695 ppm ae, NOAEC = 0.058 ppm ae (3,18); 14-d EC50 (growth) > 2.02 ppm, NOEL < 2.02 ppm (5,18); 7-d EC50 (biomass) = 0.58 ppm (6). *Dungeness Crab* (Zoeae): 64% survival at day 10 of exposure to 10 ppm (5). *Earthworm*: 14-d LC50 = 350 ppm (6). *Eastern Oyster*: 96-h EC50 (immobility, spat) = 58.7 ppm (4,5,18); 96-h EC50 (immobility, juvenile) = 146 ppm (4,5,18). *Green Algae*: 24-h EC50 (reproductive) = 88.9 ppm (4,5); 5-d EC50 (growth) = 33.2 ppm (5,18), NOEL = 26.4 ppm (18); 10-d EC50 (growth) = 50 ppm (18). *Pink Shrimp*: 96-h LC50 = 467 ppm, NOEL = 187 ppm (3,4,5,18).

	Stonefly: 24-h LC50 = 56 ppm (4), 48-h LC50 = 44 ppm (4), 96-h LC50 = 15 ppm (4). **2,4-D (91.3% AI):** *Daphnia magna*: 21-d life cycle: LOEC = 151 ppm, NOEC = 79 ppm (18). **2,4-D (44.5-49.6% AI):** *Crayfish*: 48-h LC50 @ 15.5°C > 100 ppm (16). *Daggerblade Grass Shrimp*: 96-h LC50 > 0.14 ppm (4). *Damselfly*: 13-d NOEC = 0.12 ppm (4,5). *Daphnia magna*: 48-h EC50 @ 21°C (immobility) = 4 ppm (16). *Glass Shrimp*: 48-h LC50 @ 21°C > 100 ppm (4,16,18). *Seed Shrimp*: 48-h EC50 @ 21°C (immobility) = 8 ppm (16). *Stonefly*: 13-d NOEC = 0.12 ppm (4). **DMA (%AI Unk):** *Brown Shrimp*: 48-h LC10 = 2 ppm (4,5). *Crayfish*: 96-h LC50 = 1,389 ppm (3). *Daphnia magna*: 21-d LC50 = 75.7 ppm ae (3), NOAEC = 79 ppm ae, LOAEC (# young) = 151 ppm ae (3); 48-h LC50 = 184 ppm (3). *Eastern Oyster*: 14-d LC50 = 64.2 ppm (3); 96-h EC50 (shell growth inhibition at 19 & 23% salinity) > 2 ppm (4); 96-h NOEC (shell growth inhibition) = 2 ppm (4,5). *Fiddler Crab*: 96-h LC50 = 830 ppm ae(3). *Honeybee*: LD50 > 100 µg/bee (3). **DMA (66.7-67.3% AI):** *Daphnia magna*: 24-h LC50 = 406 ppm (4,5); 48-h LC50 = 184 ppm (4,5). *Duckweed*: Single dose, 14-d obs. period [EC50], growth) = 0.58 ppm (4,5,18), (14-d NOEL) = 0.27 ppm (18). *Eastern Oyster*: 96-h EC50 (spat) = 102.25 ppm (5,18), NOEL = 40.6 ppm (18). *Green Algae*: 5-d EC50 (growth) = 51.2 ppm (4,18), NOEL= 19.2 ppm (18). **DMA (46.8-49.6% AI, <u>Weedar 64</u>)**: *Daphnia magna*: Hard Water, early instar: 24-h EC50 (immobility) = 13 ppm; 48-h EC50 (immobility, early instar) = 4 ppm (4,5,18); 48-h EC50 (immobility, soft water, early instar) > 100 ppm (4,5). *Glass Shrimp*: 48-h LC50 = 0.15 ppm (18); 48-h LC50 > 100 ppm (18). *Midge*: 48-h EC50 (immobility @ 22°C) > 100 ppm (4,5,18). *Sago Pondweed*: 24-h NOEC (biomass) < 2 ppm (3). *Seed Shrimp*: 48-h LC50 (early instar) = 8 ppm (5,18). **DMA (39.3% AI, <u>Weedestroy AM-40</u>):** *Crayfish*: 48-h LC50 (adult) = 1,436 ppm, 96-h LC50 = 750 ppm (4). **DMA (38.8% AI):** *Red Swamp Crayfish*: 96-h LC50 (adult) = 185 ppm (4). **DEA (%AI Unk):** *Daphnia magna*: Chronic NOAEC = 16.05 ppm ae, LOAEC = 25.64 ppm ae(3). **DEA (73.1-73.8% AI):** *Daphnia magna*: 48-h EC5 (immobility, 1st instar) > 100 ppm (4,5,18), NOEL = 100 ppm (18).

	Duckweed: 5-d EC50 (growth) = 0.44 ppm, NOEL = 0.07 ppm (18). *Eastern Oyster*: 96-h EC50 (immobility, spat) > 112 ppm (4,5,18), NOEL < 6.9 ppm (18). *Pink Shrimp*: 96-h LC50 (av. wt. 4.5 g) > 99.6 ppm (4,5,18), NOEL = 99.6 ppm (18). *Green Algae*: 5-d EC50 (growth) = 11 ppm, NOEL = 0.50 ppm (18). **Dimethyl (%AI Unk):** *Daphnia* magna: 48-h LC50 = 50 ppm (4); 30-d life cycle NOEC = 10 ppm (4). *Green Algae*: 96-h EC50 (growth) = 30 ppm (4). **Dimethyl (41% AI):** *Daphnia magna*: 24-h EC50 (immobility) = 48 ppm (4); 24-h EC50 (growth) = 46 ppm (4). *Green Algae*: 96-h EC50 (growth) = 9 ppm (4), EC50 (growth) = 6.2 ppm (4).
Other:	**2,4-D: :** Neurotoxic: Positive in mammals and amphibians (3,6); Carcinogenic: Possible (1e,5,6); Teratogenic: Positive (1e,o,6); Mutagenic: Some positive and negative results (1e); Genotoxic: Some positive and negative results (1e); Endocrine disruption: Suspected (5,6,11,20); **DMA: :** Carcinogenic: Majority of studies negative (1g), Possible (5); Teratogenic: Negative (1d,f); Mutagenic: Primarily negative (1f); Genotoxic: No information in references; Endocrine disruption: Suspected (5); Reproductive: Positive (reduced fetal viability and birth weights) (1d); **DEA: :** Carcinogenic: Possible (5); Teratogenic: Negative (2); Mutagenic: Negative (2); Genotoxic: No information in references; Endocrine disruption: Suspected (5); **Dimethyl: :** Carcinogenic: Unk (5); Teratogenic: No data available (1n); Mutagenic: No data available (1n); Genotoxic: No data available (1n); Endocrine disruption: Unk (5);

Note: Numerous degradates of 2,4-D: none considered for further aquatic or terrestrial ecological analyses (2)

Incident Reports:

Plants: Acid: 269 incident reports for a wide variety of terrestrial plants, particularly for uses on home/lawn, residential turf, agricultural areas, and right-of-ways (8), **DMA:** 73 reports for a wide variety of terrestrial plants, especially for uses on home/lawn (8), **DEA:** one incident for an agricultural area (8); **Aquatic: Acid:** 26 incidents resulting in mortality of aquatic organisms, including fish and invertebrates (8), **DMA:** 3 incidents also resulting in mortality of aquatic organisms (8)

Environmental Fate

Water solubility (S_w):	**2,4-D:** = 569 mg/L at 20°C (2,3,15), = 311 mg/L (pH 1, 25°C), =20,031 mg/L (pH 5, 25°C), 23, =180 mg/L (pH 7, 25°C), =34,196 mg/L (pH 9, 25°C) (3,13); Av. = 27,600 mg/L (5); = 23,180 mg/L (20°C) (6); = Av. 3.39 x 10^4 ppm at 25°C, pH 7 (7); = 569 mg/L at 20°C (8,9,15); = 29,934 ± 2,957 (pH 5) (11), = 44,558 ± 674 (pH 7) (11), = 43,134 ± 336 (pH 9) (11); = 900 ppm (12). **DMA:** = 72.9 g/L at 20°C w/ pH 7 (2,8); = 3 x 10^6 mg/L (at 20°C) (3); 6.57 x 10^6 mg/L (5); = 320,632 ± 3,645 mg/L (pH 5, 25°C) (10,11), = 729,397 ± 86,400 mg/L (pH 7, 25°C) (10,11), = 663,755 ± 94,647 mg/L (pH 9, 25°C) (10,11). **DEA:** = 806 mg/g at 25°C (2,8,10,11); 6.57 x 10^6 mg/L (5). **Dimethyl:** No data available (1n).
Soil Mobility (K_{oc}):	**2,4-D:** Absorption increases with increasing pH (6), high tendency to remain in water and not adsorb onto soil (7); = 70 mL/g (sandy loam) (2,8,11), = 76 mL/g (sand) (2,8,11), = 59 mL/g (silty clay loam) (2,8,11), = 117 mL/g (loam) (2,8,11); Av. =88.4 mL/g (range 31 – 275 mL/g), Av. = 61.7 mL/g (8), = 20 to 136 (11). **DMA:** = 72 to 136 (11).

	DEA: No information in references. **Dimethyl:** No information in references.
Soil Persistence ($t_{½}$):	**2,4-D:** Microbial degradation primary cause of breakdown in soil (7,12) and is largely dependent on pH (> pH 7, 2,4-D rapidly converted to anion, while < 4 pH, degradation inhibited (12). Av. = 10 d (12); = Av. 5.5 d (1.5 – 8.5) (13); = 4 d @ pH 6.9 (13), = 7 d @ pH 5.8 (13). *Aerobic soil metabolism*: = 6.2 days (mineral soils) (2); = 5.5 d, =5 d, =10 to 30 d, =10 d (3); = 6.2 d (3,8,15); = Av. 34.0 days (5); = 66 d (7). *Anaerobic soil metabolism*: = Av. 333 days (5). *Hydrolysis*: = 39 d (7); silty clay loam = 1.7 d (8). *Photodegradation*: = 68 days (2). **DEA:** *Aerobic soil metabolism*: = Av. 34.0 days (5); = 1.7 d (8,15), sandy loam = 1.4 d (8), silt loam = 5.8 d (8,15). *Anaerobic soil metabolism*: = Av. 333 days (5); = 1,050 d (8); = 990 d (8,15). **Dimethyl:** No information in references. **DMA:** = 4 to 6 d (agriculture soil) (3), = 7 to 23 d (forest soil) (3), =10 d (3). *Aerobic soil metabolism*: = Av. 34.0 days (5); = 4 to 14 d (8). *Anaerobic soil metabolism*: = Av. 333 days (5).
Soil Dissipation (DT_{50}):	**2,4-D:** =14 d (3); Median = 6.1 d, range 1.1 - 42.5 d (8); granular median 11.9 d, range = 5.1 – 24.6 (8); concentrate = median 5.5 d, range 1.1 – 42.5 d, (8); exposed soil = 59 d (OR), protected soil = 68 d (OR) (15), on foliage = 42 d (OR), =32.5 d (GA) (15), on leaf litter = 72 d (OR), =51.7 d (GA) (15). *Aerobic degradation*: = 10 d (6), = 14 d (lab at 20°C) (6). *Field dissipation*: = 10 d (6); = 59.3 d (7). **DEA:** No information in references. **Dimethyl:** No information in references. **DMA:** Half -lives of 2,4-D salts ≤ those of 2,4-D acid (8), median =5.6 d, range 1.1 to 30.5 d (8).
Aquatic Persistence ($t_{½}$):	**2,4-D:** Microbial degradation primary cause of breakdown in water (7). *Aerobic degradation*: = 15 days (2,8,10); = 45 d (3,15); = 15.0 d (7,8); in water column = 45 d (8). *Anaerobic degradation*: Moderately persistent to persistent (41 to 333 days) in anaerobic laboratory studies (2,8); = 10 to > 50 d (3); = 231 d (3,15); Av. = 39 days (5,7), = 312 d (7); benthic = 231 d (8). *Hydrolysis*: =Stable. *Photolysis*: = 12.9 days or 7.6 days of constant light in pH 5 buffer solution (2); @ 25°C = 13 d (7,8). **DMA:** = 0.5 to 6.6 d (in various natural waters) (3), = 10 to 11 d (in plastic-lined pools) (3), = 3.9 to 11 d (3); = Av. 39 d (5).

	Aerobic degradation: = 2.8 d (8,15). *Anaerobic degradation*: = 1,732 d (8,15). **DEA:** = Av. 39 d (5). *Aerobic degradation*: = 5.8 d (8). *Anaerobic degradation*: = 10.9 d (8). **Dimethyl:** No information in references.
Aquatic Dissipation (DT_{50}):	**2,4-D:** = 20.4 d (North Caroline pond) (8), = 14.0 d (North Dakota pond) (8), = 28.5 d (8), stable for 30 d in Lake Mendota, Madison, WI (8). **DMA:** No information in references. **Weedar 64**: reservoirs at Banks Lake, WA and Fort Cobb, OK < 3 d (8). **DEA:** No information in references. **Dimethyl:** No information in references.
Potential to Move to Groundwater (GUS score):	**2,4-D:** Potential (5), 1.62 (6). **DMA:** No Potential (5). **DEA:** Potential (5). **Dimethyl:** No information in references.
Vapor Pressure (mm Hg):	**2,4-D:** < 0.75 at 20°C (1o), = 1.4 x 10^{-7} at 25°C (2,3,7,8,9,11,15), = 9.7 x 10^{-8} at 25°C (3), = 2.79 x $^{-5}$ at 25°C (3). **DMA:** = 16.5 at 20°C (1b), = 0.00141 at 20°C (1f), < 1 x 10^{-7} at 26°C (2,11), 3.98 x $^{-8}$ at 25°C (3), dissociates rapidly to acid (8). **DEA: =** 1.33 x 10^{-5} at 25°C (8), = 9.98 x 10^{-8} (11). **Dimethyl (40% Solution):** 877.6 at 55°C (1n).
Octanol-Water Partition Coefficient (K_{ow}):	**2,4-D:** 0.148 (pH 7, 20°C), = 0.148 (pH 7, 20°C) (6), = 9.15 x 1010^{-2} to 6.74 x 10^{2} (7), = 501.19 (pH 1), 1.51 (pH 5), 0.148 (pH 7), 0.098 (pH 9) (10), = 138.04 (pH 5), 1.50 (pH 7), 1.27 (pH 9) (11), = 645.65 (13,15). **DMA:** = 501.18 (pH 1), 1.51 (pH 5), 0.148 (pH 7), 0.098 (pH 9) (10), = 138.04 (pH 5), 1.50 (pH 7), 1.27 (pH 9) (11). **DEA:** = 0.022 (25°C) (10), = 1.053 to 44.67 (11). **Dimethyl:** No data available (1n).
Bioaccumulation/ Biocentration:	**BAF:** **2,4-D:** No data available (1o). **DMA:** No information in references. **DEA:** No information in references. **Dimethyl:** No information in references. **BCF:** **2,4-D:** 10 (6). **DMA:** No information in references. **DEA:** No information in references. **Dimethyl:** No information in references.

Worst Case Ecological Risk Assessment

Max Application Rate (ai lbs/acre – ae basis)	**Habitat Management:** 0.75 lb. a.e./acre **Croplands/Facilities Maintenance:** 0.75 lb. a.e./acre
EECs	**Terrestrial (Habitat Management):** 180 ppm **Terrestrial (Croplands/Facilities Maintenance):** 180 ppm

	Aquatic (Habitat Management): 0.2756 ppm **Aquatic (Croplands/Facilities Maintenance):** 0.00124 ppm

Habitat Management Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	=0.06 [0.1]	=0.06 [0.5]
	Mammals	=0.11 [0.1]	=0.11 [0.5]
	Fish	<0.01 [0.05]	<0.01 [0.5]
Chronic	Birds	=0.19 [1]	=0.19 [1]
	Mammals	=0.45 [1]	=0.45 [1]
	Fish	=0.10 [1]	=0.10 [1]

Cropland/Facilities Maintenance Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	=0.06 [0.1]	=0.06 [0.5]
	Mammals	=0.11 [0.1]	=0.11 [0.5]
	Fish	<0.01 [0.05]	<0.01 [0.5]
Chronic	Birds	=0.19 [1]	=0.19 [1]
	Mammals	=0.45 [1]	=0.45 [1]
	Fish	<0.01 [1]	<0.01 [1]

Justification for Use:	Efficacious broad spectrum broadleaf weed control in crop and non-crop habitats. Often tank-mixed w/ other broadleaf and grass herbicides (e.g., dicamba, glyphosate) to broaden weed control spectrum and increase efficacy.
Specific Best Management Practices (BMPs):	• 1 application per year. • Ground application only. • Maintain a 3-foot treatment buffer zone from all surface water resources.
References:	[1a] _____. 2005 & 2000, respectively. 2,4-D Amine label and MSDS. Helena Chemical Company, Memphis, TN. 4 & 4 pp. [1b] _____. 2008 & 2008, respectively. 2,4-D Amine 4 label and MSDS. Albaugh, Inc. Ankeny, IA. 20 & 4 pp. [1c] _____. 2010 & 2008. 2,4-D Amine 4 label and MSDS. Winfield Solutions, LLC, St. Paul, MN. 19 & 6 pp. [1d] _____. 2001 & 2011, respectively. 2,4-D Amine Weed Killer label and MSDS. Universal Crop Protection Alliance LLC, Eagan, MN. 8 & 4 pp. [1e] _____. 2002 & 2006, respectively. Amine 4 label and MSDS. Tenkoz, Inc., Alpharetta, GA. 17 & 6 pp. [1f] _____. 2010 & 2009, respectively. Amine 4 2,4-D Weed Killer label and MSDS. Loveland Products, Inc, Greeley, CO. 22 & 3 pp. [1g] _____. 2010 & 2009, respectively. DMA 4 IVM label and MSDS. Dow AgroSciences, Indianopolis, IN. 9 & 4 pp.

[1h] _____. 2010 & 2002, respectively. HI-DEP label and MSDS. PBI/Gordon Corporation, Kansas City, MO. 14 & 93 pp.
[1i] _____. 2010 & 2008, respectively. UAP Timberland Platoon label and MSDS. Nufarm Americas, Inc, Burr Ridge, IL. 17 & 6 pp.
[1j] _____. 2008 & 2008, respectively. Savage label and MSDS. Loveland Products, Inc., Greeley, CO. 21 & 3 pp.
[1k] _____. 2011 & 2005, respectively. Unison label and MSDS. Helena Chemical Company, Memphis, TN. 26 & 5 pp.
[1l] _____. 2010 & 2009, respectively. Weedar 64 label and MSDS. Nufarm Americas, Inc., Burr Ridge, IL. 16 & 7 pp.
[1m] _____. 2010. WEEDestroy AM-40 label and MSDS. Nufarm Americas, Inc., Burr Ridge, IL. 21 & 7 pp.
[1n] _____. 2012. Dimethylamine solution MSDS. Sigma-Aldrich, St. Louis, MO. 7 pp.
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Table CP.1 - Pesticide Name
Active Ingredient = 2,4-D Salt

Trade Name[a]	Treatment Type[b, c]	Max Product Rate – Single Application (lbs/acre or gal/acre)	Max Product Rate - Single Application (lbs/acre - AI on acid equiv basis)	Max Number of Applications Per Season	Max Product Rate Per Season (lbs/acre/season or gal/acre/season)	Minimum Time Between Applications (Days)
2,4-D Amine	CF, H	0.2 gal/acre	0.75 lb. ae/acre	1	0.2 gal/acre	0
2,4-D Amine 4 (AgriStar)	CF, H	0.2 gal/acre	0.75 lb. ae/acre	1	0.2 gal/acre	0
2,4-D Amine 4 (Winfield)	CF, H	0.2 gal/acre	0.75 lb. ae/acre	1	0.2 gal/acre	0
2,4-D Amine Weed Killer	CF, H	0.2 gal/acre	0.75 lb. ae/acre	1	0.2 gal/acre	0
Amine 4 2,4-D Herbicide	CF, H	0.2 gal/acre	0.75 lb. ae/acre	1	0.2 gal/acre	0
Amine 4 2,4-D Weed Killer	CF, H	0.2 gal/acre	0.75 lb. ae/acre	1	0.2 gal/acre	0
DMA 4 IVM	CF, H	0.2 gal/acre	0.75 lb. ae/acre	1	0.2 gal/acre	0
HI-DEP	CF, H	0.2 gal/acre	0.75 lb. ae/acre	1	0.2 gal/acre	0
UAP Timberland Platoon	CF, H	0.2 gal/acre	0.75 lb. ae/acre	1	0.2 gal/acre	0
Savage	CF, H	1 gal/acre	0.75 lb. ae/acre	1	1 gal/acre	0
Unison	CF, H	0.42 gal/acre	0.75 lb. ae/acre	1	0.42 gal/acre	0
Weedar 64	CF, H	0.2 gal/acre	0.75 lb. ae/acre	1	0.2 gal/acre	0
Weedestroy AM-40	CF, H	0.2 gal/acre	0.75 lb. ae/acre	1	0.2 gal/acre	0

[a]From each label for a pesticide identified in pesticide use proposals (PUPs), Service personnel would record application information associated with possible/known uses on Service lands.

[b]Treatment type: H – habitat management or CF – cropland/facilities maintenance. If a pesticide is labeled for both types of treatments (uses), then record separate data for H and CF applications.

[c]Treatment type is for ecological risk assessment purposes only. The product label will determine whether or not the treatment type is permissible under Section 3 of the Federal Insecticide, Fungicide and Rodenticide Act.

B-6 Triclopyr Formulations Chemical Profile

Date:	6/14/11		
Trade Name(s):	Garlon 3A, Garlon 4, Pathfinder II, Remedy	**Common Chemical Name(s):**	Triclopyr TEA, Triclopyr BEE, Triclopyr BEE, Triclopyr BEE
Pesticide Type:	herbicide	**EPA Registration Number:**	62719-37, 62719-40, 62719-176, 62719-70
Pesticide Class:	Pyridine carboxylic acid	**CAS Number:**	057213-69-1, 64700-56-7, 64700-56-7, 64700-56-7
Other Ingredients:	**Garlon 3A (triclopyr triethylamine (TEA)):** 3.0% w/w triethylamine (1a), 2.1% w/w ethanol (1a), 50.5% w/w unidentified compounds (1a). **Garlon 4 (triclopyr butoxyethyl ester (BEE)):** 18.6-31.0% kerosene (1b), 0.5% ethylene glycol monobutyl ether (1b), 0.2% naphtha (1b), 6.7-19.1% unidentified compounds (1b). **Pathfinder II (triclopyr BEE):** 86.2% w/w unidentified compounds (1c). **Remedy (triclopyr BEE):** 31% kerosene, 7.4% unspecified (1d). **TCP:** 1st-order degradate (7,8).		

Toxicological Endpoints

Mammalian LD_{50}:	**Acid:** =Rat, oral: =630-729 mg/kg (4,6,7,8,11); >2000 mg/kg (female) (7), =1915 mg/kg (male) (7); =1847 mg/kg (8). Rabbit: =550 mg/kg (4). Guinea pig: =310 mg/kg (4). **TEA:** Rat, oral: >2,000 mg/kg (4); =1847 mg/kg (female) (7), =2574 mg/kg (male) (7). **TCP:** Toxicity similar to parent acid (7).
Mammalian LC_{50}:	Rat, dietary: NOEL=3 mg/kg (11).
Mammalian Reproduction:	**Acid:** 3-generation dietary study, >30 mg/kg/day (4,7). Exposure during gestation (maternal body weight, litter size, fetal body weight), >100 mg/kg/day (4). 2-generation study, LOEL >250 mg/kg (6,8), NOEL =25 mg/kg (6,8). 2-generation dietary study, fertility and neonatal toxicity NOEL =25 mg/kg/day and parental systemic toxicity NOEL =5 mg/kg/day (7). **TEA:** Gestation gavage study, LOEL =300 mg/kg (7), NOEL =100 mg/kg (7). Gestation gavage study, developmental NOEL=100 mg/kg/day (7), embryo-toxicity (dose) NOEL =100 mg/kg/day (7).
Avian LD_{50}:	**Acid:** Mallard: =1698 mg/kg (2,6,7,9,11), NOEL=464 mg/kg (2). **TEA:** Mallard: =3176 mg/kg (2,9), NOEL<215 mg/kg (2); =1698 mg/kg (2,9); =2055 mg/kg (6,7). **BEE:** Bobwhite: =849 mg/kg (9); =735 mg/kg (9).
Avian LC_{50}:	**Acid:** Bobwhite: =2934 ppm (2,6,7,9); =2935 ppm (4,8,9). Mallard: =5620 ppm (2,6,7,9,11); =5000 ppm (8). Coturnix quail: =3272 ppm (2,6,7); Jap quail: =3278 ppm (4,8). **TEA:** Bobwhite: =11,622 ppm (2,6,7,8,9), NOEC=1000 ppm (2). Mallard: >10,000 ppm (2,6,7,8,9), NOEC<4640 ppm (2). **BEE:** Bobwhite: >5620 ppm (9); >5401 ppm (9); =9026 ppm (9). Mallard: >5401 ppm (9). Zebra finch: =1923 ppm (9).
Avian Reproduction:	**Acid:** Bobwhite: LOEL=200 ppm (2,6,7), NOEL=100 ppm (2,6,7); LOEC >500 ppm (6,8), NOEC =500 ppm (6,8). Mallard: LOEL=200

	ppm (2,8), NOEL=100 ppm (2,8); LOEL =500 ppm (7), NOEL =200 ppm (7). **TEA:** Bobwhite: LOEL>500 ppm (2), NOEL=500 ppm (2). Mallard: LOEL=200 ppm (2), NOEL=100 ppm (2).
Fish LC_{50}:	**Acid:** Bluegill: =148 ppm (2,4,6,7,8,10); =124 ppm (5). Fathead minnow: =120.0-947 ppm (10). Rainbow: =117 ppm (2,4,6,7,8,11); =5.26 ppm (5); =7.6 ppm (10); =420 ppm (10). Chum: =7.5 ppm (10); =275.0 ppm (10). Chinook: =9.7 ppm (10). Coho: =3.94 ppm (5); =9.6 ppm (10). Pink salmon: =6.1 ppm (10). Sockeye: =3.46 ppm (5); =311.0 ppm (10). Chinook: =5.02 ppm (5). **TEA:** Bluegill: =891 ppm (2), NOEC =560 ppm (2); =471 ppm (2,6,7,8); =681 ppm (5); =893 ppm (6,7,8); =344 ppm (7); =286 ppm (7). Rainbow: =400 ppm (1); =552 ppm (2), NOEC =240 ppm (2); =240 ppm (2,8); =447.3 ppm (5); =613 ppm (6,7,8); =240 ppm (6,7). Coho: =478.2 ppm (5); =400 ppm (7). Sockeye: =321.5 ppm (5). Chinook: =335.5 ppm (5). Channel catfish: =446 ppm (1); =344 ppm (7); =141 ppm (7). Fathead minnow: =546 ppm (2), NOEC=370 ppm (2); =947 ppm (2,6,7,8); =373 ppm (5); =544 (6,7,8); =279 ppm (2,6,7,8), NOEC=98 ppm (2); =891 ppm (7); =400 ppm (7); =245 ppm (7); =120 ppm (7). **BEE:** Rainbow: =2.7 ppm (10); =1.1 ppm (10). Pink salmon: =1.2 ppm (10); =0.5 ppm (10). Chum salmon: =1.7 ppm (10); =0.3 ppm (10). Coho: =2.1 ppm (10); =1.0 ppm (10). Chinook: =2.7 ppm (10); =1.1 ppm (10). Sockeye: =1.4 ppm (10); =0.4 ppm (10). **TCP:** Bluegill: =12.5 ppm (7,8). Rainbow: =12.6 ppm (7,8); =1.5 ppm (7,8). Coho: =1.8 ppm (7,8). Sockeye: =2.5 ppm (7,8).
Fish ELS/Life Cycle:	**Acid:** Fathead minnow: LOEC=162 ppm (2,6,8), NOEC=104 ppm (2,6,8). Species unknown: =46.3 ppm (11). **TCP:** Rainbow: Overall survival LOEC=0.273 ppm (7), NOEC=0.134 ppm (7). Weight and length LOEC=0.134 ppm (7), NOEC=0.0808 ppm (7).
Other:	**Acid:** EC_{50}, *Daphnia*: =132.9 ppm (2,6,7,8); >131 ppm (1,11). 21-day chronic NOEC =48.5 ppm (11). Green algae: =32.5 ppm (2), NOEC=7.0 ppm (2). Duckweed: =2.56 ppm (5); =0.8 ppm (11). Midge: 28 d NOEC=23.0 ppm (11). Honeybee: >100 ppm (11). Earthworm: >521 ppm (11). **TEA:** EC_{50}, *Daphnia*: =132.9 ppm (2), NOEC=32 ppm (2); =775 ppm (2), NOEC<100 ppm (2); =1496 ppm (2,6,7); =1170 ppm (4,7); =1,155 ppm (5); =1110 ppm (7); =1496 ppm (8). ErlyLf: LOEC<149 ppm (2,6,7,8), NOEC>80.7 ppm (2,6,7,8). Green algae: =45 ppm (1); =39.1 ppm (2), NOEC=25 ppm (2). Bluegreen algae: =5.9 ppm (2,8), NOEC=2.0 ppm (2). Duckweed: =6.7 ppm (6), NOEC=0.4 ppm (7); =11 ppm (6,8), NOEC =3.5 ppm (6); =24 ppm (8); =8.8 ppm (8). Amphibian (frog): Species not identified: =162.5 ppm (8).

Ecological Incident Reports

No incident reports in references.

Environmental Fate

Water solubility (S_w):	**Acid:** =435 ppm (3); =440 mg/L (4); =430 mg/L (6,8); =8100 mg/L (11). **TCP:** =49,100 ppm (8).
Soil Mobility (K_{oc}):	=68 mg/L (range =12-160) (3); =62 mg/L(5); =27 mg/L (8); =48 ml/g (11). **TCP:** Koc =151 m/L (8).
Soil Persistence ($t_{½}$):	**Acid:** The predominant degradation pathway in soil is microbial degradation (6). Aerobic soil ½ life =13 days (5); =8-18 days (6); =32 days (3). Anaerobic soil ½ life =1,600 days (5); =1300 days (6). Average soil ½ life = 46 days (30-90 days) (4). **TCP:** (3,5,6-trichloro-2-

	pyridinol): is a major metabolite of triclopyr acid and is found in both soil and water (7).
Terrestrial Field Dissipation (DT_{50}):	**Acid:** Terrestrial field dissipation: =35 days (range=15-84); =46 days (range=18-84 days) GA, ND, OR, TX, WV, WY) (3). =30 days (11).
Aquatic Persistence ($t_{½}$):	**Acid:** The primary degradation pathway in water is photodegradation (6). Aqueous photolysis: =0.5 day in sterile water and =1.3 day in natural water (6,8); =0.1 days @ pH 7 (11). =8.7 days @ pH 7 (11). Hydrolysis: =Stable (8). Anaerobic aquatic metabolism ½ half = 142 days (6,8). **Salt:** Aquatic ½ life = 0.12-0.5 days (4). **TCP:** (3,5,6-trichloro-2-pyridinol): is a major metabolite of triclopyr acid and is found in both soil and water (7). Aqueous photolysis ½ life = 0.08 days (8). Hydrolysis = Stable (8). Exposure to UV light ½ life = 0.017 days (8).
Aquatic Dissipation (DT_{50}):	Aquatic field dissipation ½ life: =0.5-4.7 days (6,8); <1 to 7.9 days (8). Water-sediment =29.2 days (11); water phase only =24.8 days (11).
Potential to Move to Groundwater (GUS score):	=3.69 (11).
Volatilization (mm Hg):	=0.75 (11).
Octanol-Water Partition Coefficient (K_{ow}):	
Bioaccumulation/Bioconcentration:	**BAF:** Low potential (11). **BCF:** =0.77 (11).

Worst Case Ecological Risk Assessment

Max Application Rate (ai lbs/acre – ae basis)	**Habitat Management:** 2 lbs. a.e./acre **Croplands/Facilities Maintenance:** 2 lbs. a.e./acre
EECs	**Terrestrial (Habitat Management):** 480 ppm **Terrestrial (Croplands/Facilities Maintenance):** 480 ppm **Aquatic (Habitat Management):** 0.736 ppm **Aquatic (Croplands/Facilities Maintenance):** 0.0067 ppm

Habitat Management Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	=0.25 [0.1]	=0.25 [0.5]
	Mammals	=0.33 [0.1]	=0.33 [0.5]
	Fish	=1.84[1] [0.05] =0.21[2] [0.05]	=1.84[1] [0.5] =0.21[2] [0.5]
Chronic	Birds	=0.96 [1]	=0.96 [1]
	Mammals	=0.96 [1]	=0.96 [1]
	Fish	=0.02 [1]	=0.02 [1]

[1]Triclopyr butoxyethyl ester (BEE)
[2]Triclopyr acid

Cropland/Facilities Maintenance Treatments:

Presumption of Unacceptable Risk		Risk Quotient (RQ)	
		Listed (T&E) Species	Nonlisted Species
Acute	Birds	=0.25 [0.1]	=0.25 [0.5]
	Mammals	=0.33 [0.1]	=0.33 [0.5]
	Fish	=0.02 [0.05]	=0.02 [0.5]
Chronic	Birds	=0.96 [1]	=0.96 [1]
	Mammals	=0.96 [1]	=0.96 [1]
	Fish	<0.01 [1]	<0.01 [1]

Justification for Use:	Control of woody plants including salt cedar.
Specific Best Management Practices (BMPs):	Must maintain 25-foot treatment buffer zone from surface water resources, except for cut stump treatments of target woody pest species.
References:	[1a] _____. 2006. Garlon 3A specimen label and MSDS. Dow AgroSciences LLC, Indianapolis, IN. 9 & 5 pp., respectively. [1b] _____. 2007 & 2009, respectively. Garlon 4 specimen label and MSDS. Dow AgroSciences LLC, Indianapolis, IN. 13 & 10 pp., respectively. [1c] _____. 2006 & 2007, respectively. Pathfinder II specimen label and MSDS. Dow AgroSciences, Indianapolis, IN. 4 pp. [1d] _____. 2010 & 2007, respectively. Pathfinder II specimen label and MSDS. Dow AgroSciences, Indianapolis, IN. 8 & 4 pp., respectively. [2] _____. 2000. USEPA one-liner database. [3] _____. 1995. ARS pesticide properties database. USDA-ARS, Washington, D.C. [4] _____. 1996. Triclopyr. EXTOXNET, Extension Toxicology Network, Pesticide Information Profiles, Oregon State Univ., OR. 4 pp. [5] _____. 2000. Pesticide database. Pesticide Action Network, San Francisco, CA. [6] _____. 1988. Reregistration eligibility decision (RED) – triclopyr. USEPA, Prevention, Pesticides, and Toxic Substances, Washington, D.C. 92 pp. [7] _____. 2003. Triclopyr – revised human health and ecological risk assessments final report. Prepared for: USDA, Forest Service, Forest Health Protection (GSA Contract No. GS-10F-0082F), Arlington, VA by Syracuse Environmental Research Associates, Inc., Fayetteville, NY. 230 pp. [8] Antunes-Kenyon, S. E. and G. Kennedy. 2004. A review of the toxicity and environmental fate of triclopyr. Massachusetts Dept. of Agric. Res., Boston, MA. 47 pp. [9] Office of Pesticide Programs. 2000. ECOTOX database – terrestrial report. Environmental Fate and Effects Division, USEPA, Washington, D.C. [10] Office of Pesticide Programs. 2000. ECOTOX database – aquatic report. Environmental Fate and Effects Division, USEPA, Washington, D.C. [11] _____. 2009. Pesticide properties database. Agricultural & Environmental Research Unit, Science and Technology Research Institute, University of Hertfordshire, Hatfield, UK.

Table CP.1 Pesticide Name
Active Ingredient = triclopyr

Trade Name[a]	Treatment Type[b,c]	Max Product Rate – Single Application (lbs/acre or gal/acre)	Max Product Rate - Single Application (lbs/acre - AI on acid equiv basis)	Max Number of Applications Per Season	Max Product Rate Per Season (lbs/acre/season or gal/acre/season)	Minimum Time Between Applications (Days)
Garlon 3A,	H	0.67 gal/acre	2.0 lbs. a.e./acre	1	0.67 gal/acre/season	0
Garlon 4,	H	0.5 gal/acre	2.0 lbs. a.e./acre	1	0.5 gal/acre/season	0
Pathfinder II,	H	2.67 gal/acre	2.0 lbs. a.e./acre	1	2.67 gal/acre/season	0
Remedy	H	0.5 gal/acre	2.0 lbs. a.e./acre	1	0.5 gal/acre/season	0

[a]From each label for a pesticide identified in pesticide use proposals (PUPs), Service personnel would record application information associated with possible/known uses on Service lands.

[b]Treatment type: H – habitat management or CF – cropland/facilities maintenance. If a pesticide is labeled for both types of treatments (uses), then record separate data for H and CF applications.

[c]Treatment type is for ecological risk assessment purposes only. The product label will determine whether or not the treatment type is permissible under Section 3 of the Federal Insecticide, Fungicide and Rodenticide Act.

B-7 Tribenuron-Methyl Formulations Chemical Profile

Date:	02/14/2012				
Pesticide Class:	Sulfonylurea	**Common Chemical Name(s):**	Tribenuron-methyl	**Pesticide Type:**	Herbicide Group 2
Trade Name(s):	Express	**EPA Registration Number:**	352-509	**CAS Number:**	101200-48-0
Other Ingredients:	None listed (1). No regulatory advisories (1).				

Toxicological Endpoints

Mammalian LD_{50}:	Rats, oral: >5000 mg/kg (1,2,3).
Mammalian LC_{50}:	No data in references.
Mammalian Reproduction:	Rat, 2-generation reproduction study: NOAEL=25 ppm (3); developmental toxicity study: NOAEL=20 mg/kg (3); 2 year oral chronic toxicity and carcinogenicity study: NOAEL=25 ppm (3).
Avian LD_{50}:	Bobwhite: >2250 mg/kg (1,2,3,5,6), NOEL <292 mg ai/kg bw (3).
Avian LC_{50}:	Bobwhite: >5620 ppm (1,3,5,6), NOEL=1780 ppm (3,5). Mallard: >5620 ppm (1,3,5,6), NOEL=1780 ppm (3,5).
Avian Reproduction:	Bobwhite (23-week reproduction study): NOEC=180 mg a.s./kg diet (3). Mallard (21-week reproduction study): NOEC=180 mg a.s./kg diet (3).
Fish LC_{50}:	Rainbow: >1000 ppm (1,5,6); =738 ppm (2,3). Bluegill: >1000 ppm (3,5,6).
Fish ELS/Life Cycle:	Rainbow: LC_{50} >560 ppm (3); =560 ppm (2).
Other:	*Daphnia*: EC_{50} >894 ppm (3), =720 ppm (5); =894 ppm (2); 21-day chronic toxicity: Survival LOEC=940 ppm (3), NOEC=480 ppm (3), Reproduction EC_{50} = 900 ppm (3), LOEC=480 ppm (3), NOEC=250 ppm (3); LC_{50}=120 ppm (2). Green algae: EC_{50} = 4.9 ppm (5,6), NOEL=0.25 ppm (5). Duckweed: EC_{50}=0.0099 ppm (2). Honeybee: >9.1 ug/bee (2). Earthworm: >1000 mg/kg (2).

Ecological Incident Reports

No incident reports in references.

Environmental Fate

Water solubility (S_w):	H_2O solubility = 18,300 ppm @ pH 9 (3); =2040 ppm (2).
Soil Mobility (K_{oc}):	Koc = 52 (30-80) (4). Kd = 1.3, Range = 0.1 – 2.5 (7).
Soil Persistence ($t_{½}$):	Aerobic soil metabolism = 1-16 days (warmer to cooler climates) (4); =3-12 days (8); DT_{50} =14 days (2). Anaerobic metabolism = 2.5-11 days (cooler to warmer climate) (4); 2-14 days (8). Soil photolysis =2.5 days (8).
Soil Dissipation (DT_{50}):	Field dissipation half-life = 9 days @ pH 8.3 and %OM = 1.7 (4); = 11 days @ pH = 7.9 and %OM = 6.6 (4), range = 2-23 days (4); DT_{50}=10 days (2).
Aquatic Persistence ($t_{½}$):	Hydrolysis = stable @ pH 9 (3,4); =32 days (8); =16 days @ pH 7 (2). Aqueous photolysis = stable (2,3,4); =3280-5210 days (8). Water-sediment DT_{50} =26 days (2). Water phase only DT_{50}=23.5 days (2).
Aquatic Dissipation (DT_{50}):	No data in references.
Potential to Move to Groundwater (GUS score):	=2.88 (high leachability) (2).
Vapor Pressure (mm	3.98×10^{-10} mm Hg (2).

Hg):	
Octanol-Water Partition Coefficient (K_{ow}):	Log Kow = -2.52 (4).
Bioaccumulation/ Biocentration:	Log Pow = 0.3 @ pH 9 (3). BCF =0.08 (2).

Worst Case Ecological Risk Assessment

Max Application Rate* (ai lbs/acre – ae basis)	**Habitat Management:** Not Applicable (NA) **Croplands/Facilities Maintenance:** 0.015 lb. a.i./acre
EECs	**Terrestrial (Habitat Management):** NA **Terrestrial (Croplands/Facilities Maintenance):** 3.6 ppm **Aquatic (Habitat Management):** NA **Aquatic (Croplands/Facilities Maintenance):** 0.00005 ppm

*Up to 2 applications per year not to exceed 0.015 lbs. a.i./acre/year (total annual usage).

Habitat Management Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	NA	NA
	Mammals	NA	NA
	Fish	NA	NA
Chronic	Birds	NA	NA
	Mammals	NA	NA
	Fish	NA	NA

Cropland/Facilities Maintenance Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	<0.01 [0.1]	<0.01 [0.5]
	Mammals	<0.01 [0.1]	<0.01 [0.5]
	Fish	<0.01 [0.05]	<0.01 [0.5]
Chronic	Birds	=0.02 [1]	=0.02 [1]
	Mammals	=0.14 [1]	=0.14 [1]
	Fish	<0.01 [1]	<0.01 [1]

Justification for Use:	Low-risk alternative herbicide for broadleaf weed control in agricultural small grain production.
Specific Best Management Practices (BMPs):	Ground application only. Up to 2 applications per site per year. Do not exceed 0.015 lbs a.i./acre/year. 25-foot buffer zone from surface water resources. Do not apply to coarse textured soils with soil organic matter <2%, and water table within 10 feet of soil surface. Do not apply to slopes >5% if significant rainfall is expected within 24 hours. Wind speed not to exceed 7 mph or not less than 1 mph at time of application. Do not apply when inversion conditions exist. Only use nonionic surfactants that are non-toxic or slight acute toxicity (LC_{50} >10 ppm) to aquatic organisms.

References:

[1] _____. 2000 and 1998. Express specimen label and MSDS, respectively. E.I. du Pont de Nemours and Company, Wilmington, DE. 8 & & pp., respectively.

[2] _____. 2009. The Pesticide Properties Database (PPDB) developed by the Agricultural & Environment Research Unit (AERU), University of Hertfordshire, funded by UK national sources and the EU-funded FOOTPRINT project (Hatfield, UK); Last accessed: 12 February 2012.

[3] _____. 2002. FAO specifications and evaluations for plant protection products – tribenuron-methyl. Food and Agriculture Organization, United Nations, New York, NY. 23 pp.

[4] _____. 1995. Tribenuron-methyl properties. ARS Pesticide Properties database.

[5] _____. 2000. Tribenuron-methyl toxicity. USEPA one-liner database.

[6] _____. XXXX. Tribenuron-methyl aquatic report. ECOTOX database, USEPA, Washington, D.C.

[7] Hass, J. 2008. K_d value for tribenuron. USFWS, R8 Environmental Contaminants, Personal Communication.

[8] _____. 2000. Tribenuron methyl. Active Ingredient Fate Studies, Pesticide Fate Database. Environmental Fate and Effects Division, USEPA, Washington, D.C.

Table CP.1 - Pesticide Name
Active Ingredient = Tribenuron-methyl

Trade Name[a]	Treatment Type[b, c]	Max Product Rate – Single Application (lbs/acre or gal/acre)	Max Product Rate - Single Application (lbs/acre - AI on acid equiv basis)	Max Number of Applications Per Season	Max Product Rate Per Season (lbs/acre/season or gal/acre/season)	Minimum Time Between Applications (Days)
Express	CF	0.021 lbs./acre	0.015 lbs a.i./acre	2	0.021 lbs/acre/season	15

[a]From each label for a pesticide identified in pesticide use proposals (PUPs), Service personnel would record application information associated with possible/known uses on Service lands.

[b]Treatment type: H – habitat management or CF – cropland/facilities maintenance. If a pesticide is labeled for both types of treatments (uses), then record separate data for H and CF applications.

[c]Treatment type is for ecological risk assessment purposes only. The product label will determine whether or not the treatment type is permissible under Section 3 of the Federal Insecticide, Fungicide and Rodenticide Act.

B-8 Dicamba Formulations Chemical Profile

Toxicological endpoint and environmental fate data listed in this chemical profile will be periodically reviewed and updated. New information, including, but not limited to, completion of national section 7consultation in accordance with the federal Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884), as amended, between the U.S. Fish and Wildlife Service and the U.S. Environmental Protection Agency on individual pesticide registrations and all federally listed and proposed species and proposed and designated critical habitat, may change ecological risk assessments, pesticide use patterns, best management practices, and/or justification for use. Consultations occur now at the local level for listed and proposed species and proposed and designated critical habitat on specific use of individual pesticides in specific project areas.

Date:	5/29/12				
Pesticide Class:	Substituted benzoic acid	**Common Chemical Name(s):**	Dicamba	**Pesticide Type:**	Herbicide
Trade Name(s):	Banvel, Clarity, Cruise Control, Diablo, Dicamba DMA, Dicamba HD, Rifle, Riverdale Vanquish, Sterling Blue, Vanquish, Vision	**EPA Registration Number:**	66330-276, 7969-137, 42750-40-81927, 228-379, 42750-40, 42750-209, 34704-861, 228-397, 7969-137-1381, 100-884, 5905-57	**CAS Number:**	2300-66-5, 104040-79-1, 2300-66-5, 2300-66-5, 2300-66-5, 104040-79-1, 2300-66-5, 104040-79-1, 104040-79-1, 1918-00-9, 1918-00-9
Other Ingredients:	**Banvel (dimethylamine salt (DMA) of dicamba):** 48.2% DMA, 12.0% DMA of related acids, 39.8% proprietary ingredients (1a), **Clarity (diglycoamine salt (DGA) of dicamba):** 56.8% DGA, 43.2% proprietary ingredients (1b), **Cruise Control:** 48.2% DMA, (1c), **Diablo:** 48.2% DMA, 51.8% proprietary ingredients (1d), **Dicamba DMA:** 48.2% DMA, 51.8% proprietary ingredients (1e), **Dicamba HD:** 56.8% DGA, 43.2% proprietary ingredients (1f), **Rifle:** 48.2% DMA, 51.8% proprietary ingredients (1g), **Riverdale Vanquish:** 56.8% DGA, 43.2% proprietary ingredients (1h), **Sterling Blue:** 58.1% DGA, 41.9% proprietary ingredients (1i), **Vanquish:** 56.8% DGA, 43.2% proprietary ingredients (1j), **Vision (Dicamba Acid [Acid]):** 40% Acid, 60% proprietary blend of methylated fatty acids (1k)				

Dicamba (acid): 1st- order degradate of dicamba salts (e.g. dimethylamine [DMA] and diglycoamine [DGA]) (2)

Toxicological Endpoints	Endpoints highlighted yellow are selected for use in a screening-level ecological risk assessment. Endpoints selected are typically the most toxic endpoint for the most sensitive species listed in following summaries.
Mammalian LD_{50}:	**NOTE:** Pattern of interspecies scaling, smaller animals are less sensitive than larger animals (3). **Acid (%AI Unk):** *Rabbit*: 1-d exposure = 2,000 mg/kg/day (3,14). *Rat*: acute oral, time unk = 1,581 mg/kg bw (7,9), Short term [time not specified] dietary NOEL > 110 mg/kg bw (7). **Acid Tech.:** *Mouse*: (Single dose, ≥ 7-d observation period, females) = 1,189 mg/kg/day (3,14).

	Rat: Single dose, 14-d observation period: (males) = 1,404 mg/kg/day, (females) = 1,039 mg/kg/day (3,14). **DGA:** No information in references. **DMA (99.8% AI):** *Rat*: Single dose, 15-d observation period = 5,000 mg/kg/day (3). **DMA (40.0% AI):** *Rat*: Single dose, 14-d observation period: (males) = 1,918 mg/kg/day, (females) = 2,087 mg/kg/day (3).
Mammalian LC_{50}:	**NOTE:** Apparent pattern of interspecies scaling, smaller animals are less sensitive than larger animals (3). **Acid Tech.:** Rat: 13-week systemic study: NOAELs (males) = 5,015 ppm, (females) = 5,220 ppm, LOAELs (males & females) = 10,000 ppm (3). **DGA:** No information in references. **DMA:** No information in references.
Mammalian Reproduction:	**NOTE:** Apparent pattern of interspecies scaling, smaller animals are less sensitive than larger animals (3). **Acid: Tech.:** *Rabbit*: Reproductive/Developmental study: Maternal toxicity NOAEL = 30 mg/kg/day, LOAEL = 150 mg/kg/day; Developmental toxicity NOAEL = 30 mg/kg/day, LOAEL = 150 mg/kg/day (3,9,12). *Rat*: Reproductive/Developmental study: Maternal toxicity NOAEL = 160 mg/kg/day, LOAEL = 400 mg/kg/day; Developmental toxicity NOAEL = 400 mg/kg/day, LOAEL = not identified (3,9,12). **DGA:** No information in references. **DMA: 87.2-87.7% AI:** *Rabbit*: Reproductive/ Developmental study: Maternal toxicity NOAEL = 3 mg/kg/day, LOAEL = 10 mg/kg/day; Developmental toxicity NOAEL = 3 mg/kg/day, LOAEL = 10 mg/kg/day (3). *Rat*: Reproductive study NOAEL = 25 mg/kg/day, LOAEL = not identified (3).
Avian LD_{50}:	**Acid (86.6-86.9% AI):** *Bobwhite*: Single dose, 14-d observation period: = 216 mg/kg bw (1j,3,4,6,9,12), 14-d NOEL = 15.6 mg/kg bw (3,6), 14-d LOEL, signs of neurotoxicity = 31.2 mg/kg/bw (3), No mortality level = 62.5 mg/kg bw (3). *Mallard*: 5-d, 14 d old = 1,951 mg/kg bw (4,6), 14-d NOEL < 215 mg/kg bw (6), Single dose, 14-d observation period; 27 weeks old: = 1,373 mg/kg bw (3,4,6,7,9,12), 14-d NOEL < 175 mg/kg bw (6) 14-d LOEL = 175 mg/kg bw (3), No mortality level = 810 mg/kg bw (3); 5-d, 14 d old = 2,009 mg/kg bw (3,4,6). **DGA (56.8% AI):** *Bobwhite*: Single dose, 14-d observation period: = 968 mg/kg bw, 14-d LOEL = 292 mg/kg bw (3). **DGA (40.0% AI):** *Bobwhite*: Single dose, 14-d observation period, 22 weeks old: = 387.2 mg/kg bw

	(4,6), 14-d NOEL < 116 mg/kg bw (6). **DMA (48.2% AI):** *Mallard*: Single dose, 14-d observation period, 20 weeks old: > 2,510 mg/kg bw (4,6). **DMA (11.5% AI):** *Mallard*: Single dose, 14-d observation period, 6 mo old: > 2,510 mg/kg bw (4,6), 14-d NOEL < 2,510 mg/kg bw (6).
Avian LC_{50}:	**Acid 86.6-86.9% AI:** *Bobwhite*: 5-d, 14 d old > 10,000 ppm (3,4,6,12,13,14), 5-d NOEL = 1,000 ppm (6); 1-generation (21 wks) NOEL = 1,600 ppm (highest level tested) (3). *Mallard*: 5-d, 14 d old > 10,000 ppm (3,4,6,7,13,14), 5-d NOEL = 2,150 ppm (6); 1-generation (21 wks) NOEL = 1,600 ppm (highest level tested) (3). **Acid (10.0-11.5% AI):** *Bobwhite*: 5-d, 14 d old > 10,000 ppm (4,6). *Mallard*: 5-d, 14 d old > 10,000 ppm (4,6). **DGA (56.8% AI):** *Bobwhite*: 5-d, dietary > 5,620 ppm, 5-d NOEL = 5,620 ppm (3). **DGA (40.0% AI):** *Bobwhite*: 5-d, 11 d old > 2,248 ppm (4,6), 5-d NOEL = 2,248 ppm (6). *Mallard*: 5-d, 10 d old > 2,248 ppm (4,6), 5-d NOE) = 2,248 ppm (6). **DMA (86.8% AI):** *Bobwhite*: 5-d dietary, 14-d old NOEL = 1,000 ppm, LOEL = 2,150 ppm (3); 5-d > 10,000 ppm (3). *Mallard*: 5-d dietary, 14-d old NOEL = 2,150 ppm, 5-d LOEL = 4,640 ppm (3). **DMA (48.2% AI):** *Bobwhite*: 5-d, 14 d old > 4,620 ppm (4,6,14), 5-d NOEL = 4,620 ppm (6). *Mallard*: 5-d, 14 d old > 4,640 ppm (4,6,14), 5-d NOEL = 4,640 ppm (6). **DMA (11.5% AI):** *Bobwhite*: 5-d, 14 d old > 5,620 ppm (1b,i,4,6). *Mallard*: 5-d, 14 d old > 5,620 ppm (1b,i,4,6).
Avian Reproduction:	**Acid: (86.9% AI):** *Bobwhite*: 21 week reproductive study LOEL > 1,600 ppm, NOEL = 1,600 ppm (6). Mallard: 21 week reproductive study LOEL = 1,600 ppm, NOEL = 800 ppm (6). **DGA:** No information in references. **DMA:** No information in references.
Fish LC_{50}:	**Acid (%AI Unk):** *Bluegill*: 48-h, age unk = 130 ppm (3,5). *Rainbow Trout*: 96-h, age unk > 100 ppm (7,11,13); 21-d NOEC = 180 ppm (7,9). **Acid (88.0% AI):** *Bluegill*: 96-h, age unk > 50 ppm (3). *Cutthroat Trout*: 96-h, age unk > 50 ppm (3,12,14). *Rainbow Trout*: 96-h, age unk = 28 ppm (3,11,14). **Acid (11.5% AI):** *Bluegill*: 96-h, age unk > 1,000 ppm (5,6).

	DGA: No information in references. **DMA (%AI Unk):** *Bluegill*: Age Unk., 24-h = 600 ppm ae (3,4,5), 48-h = 410 ppm ae (3,4,5). *Mosquito Fish*: Age Unk, LC50 24-h = 516 ppm (3,4,5,14), 48-h = 510 ppm (3,4,5,14), 96-h = 465 ppm (3,4,5,14). **DMA (86.2% AI):** *Bluegill*: Age unk 24-h = 227.3 ppm, 48-h = 135.3 ppm (3,5,11), NOEC, no abnormal behavior/dark discoloration = 56.0 ppm (3). *Sheepshead Minnow*: 24, 48 & 96-h, no mortality or abnormal behavior > 180 ppm (3).
Fish ELS/ Life Cycle:	**Acid (86.8-88.0% AI):** *Bluegill*: Av. wt. 0.9 g, 12°C, LC50s: 24-h > 50 ppm (4,5), 96-h > 50 ppm (4,5,6,8,11,14); 96-h LC50, av. wt. 0.44 g = 135.3 ppm (1c,d,e,h,4,5,6), 96-h NOEL = 100 ppm (6). *Cutthroat Trout*: 96-h, fingerling > 50 ppm (3,4). *Rainbow Trout*: Av. wt. 0.8 g, 12°C, LC50s: 24-h = 35 ppm (4,5), 96-h = 28 ppm (4,5,6,8); 96-h LC50, av. wt. 0.36 g = 135.4 ppm (1c,e,f,h,j,4,5,6), 96-h NOEL = 100 ppm (6). *Sheepshead Minnow*: 96-h LC50, av. wt. 0.48 g > 180 ppm (4,5,6,11), 96-h NOEL = 100 ppm (6). *Spot Croaker*: 48-h LC50, juvenile > 1.0 ppm (6). **Acid (10.0% AI):** *Rainbow Trout*: 96-h LC50, av. wt. 1.3 g = 153 ppm (4,5,6,11), 96-h NOEL = 49 ppm (6). **DGA (40.15% AI):** *Bluegill*: 96-h LC50, av. wt. 0.22 g > 400 ppm (4,5,6,11). *Rainbow Trout*: 96-h LC50, av. wt. 0.43 g > 400 ppm (4,5,6), 96-h NOEL = 224 ppm (6). **DMA (%AI Unk):** *Coho*: Juvenile (40-50 mm) LC50s: 24-h = 151 ppm (3,4,12,14), 48-h = 120 ppm (3,4,12,14). *Rainbow Trout*: 24 & 48-h LC50, juvenile [62-105 mm] > 320 ppm (3,4,14). **DMA (48.2-48.3% AI):** *Rainbow Trout*: 96-h LC50, av. wt. 0.7 g > 1,000 ppm (1a,4,5,6,11). *Bluegill*: 96-h LC50, av. wt. 2.3 g > 1,000 ppm (1a,b,4,5,6,11). **DMA (11.5% AI):** *Rainbow Trout*: (96-h LC50, av. wt. 1.2 g) > 1,000 ppm (4,5,6,11).
Amphibians/ Reptiles:	**Acid:** No information in references. **DGA:** No information in references. **DMA:** No data on species in U.S. States/Territories in references. **DMA (%AI Unk) Australian Sp.**: *Tusked Frog*: Tadpole LC50s 24-h = 220 ppm, 48-h = 202 ppm, 96-h = 185 ppm (3,4,12,14). *Striped Marsh Frog*: Tadpole LC50 24-h = 205 ppm, 48-h = 166 ppm, 96-h = 106

	ppm (3,4,12,14).
Invertebrates/ Plants:	**Acid (%AI Unk):** *Daphnia magna*: 48-h EC50 > 41 ppm (7,9); 21-d NOEC = 97 ppm (7,9). *Daphnia pulex*: 48-h EC50 = 11 ppm (3,14). *Duckweed*: 7-d EC50, biomass = 0.45 ppm (7). *Earthworm*: 14-d LC50 > 500 mg/kg soil (7). *Freshwater Shrimp*: LC50 24-h = 10 ppm, 48-h = 5.8 ppm, 96-h = 3.9 ppm (3), 96-h LC50 = 3.8 ppm (3). *Green Algae*: 72-h EC50, biomass = 1.8 ppm (7,9). *Honey Bee*: 48-h LD50 > 100 µg/bee (1d,h,7,9,12,13). *Mysid Shrimp*: 96-h LC50 = 6.8 ppm (7). **Tech:** *Daphnia magna*: 48-h EC50, 1st instar, immobility > 100 ppm (3,4,5,8,11,14). *Honey Bee*: 48-h LD50, adult > 90.65 µg/bee (4,6), 48-h NOEL < 90.65 µg/bee (6). **Tech (86.2-89.5% AI):** *Brown Shrimp*: 48-h LC50, juvenile > 1.0 ppm (6,11). *Daphnia magna*: 48-h EC50, immobility, 1st instar > 100 ppm (3,4,6,8,12, 14); 48-h EC50, 1st instar = 110.7 ppm (4,5,6,11), 48-h NOEL < 18 ppm (6). *Duckweed*: 14-d EC50, growth > 3.25 ppm (4,5,6,9), 14-d NOEL = 0.20 ppm (6). *Eastern Oyster*: 96-h LC50, juvenile > 1.0 ppm (6). *Fiddler Crab*: 96-h LC50, av. wt. 2 g > 180 ppm (3,4,5,6,13). *Freshwater Shrimp*: 15°C, soft & hard water, mature. LC50 24-h > 100 ppm (4), 96-h > 100 ppm (3,4,8,14). *Glass Shrimp*: 24-h LC50, adult > 56 ppm (4,5), 96-h LC50, adult > 56 ppm (5,6,8,11). *Grass Shrimp*: 24 & 96-h LC50 > 56 ppm (4,14); 48 & 96-h LC50, juvenile > 100 ppm (3,4,5,6,11, 13,14), 96-h NOEL = 56 ppm (3,6). *Green algae*: 5-d EC50, growth > 3.7 ppm (1b,i,j,3,4,5,6), 5-d NOEL = 3.7 ppm (3,6). **DGA (40.15% AI):** *Daphnia magna*: 48-h EC50, < 24 h old > 400 ppm (4,5,6,11). **DMA (Tech.):** *Crayfish*: 48-h LC50 > 100 ppm (4,5). *Daphnia magna*: 48-h LC50 > 100 ppm (4,5). *Glass Shrimp*: 48-h LC50 > 100 ppm (4,5). **DMA (48.2% AI):** *Daphnia magna*: 48-h EC50, 1st instar = 1,600 ppm (1a,4,5,6,11), 48-h NOEL = 560 ppm (6).
Other:	**Acid:** Neurotoxic: No direct potential (9); Carcinogenic: Potential for weak promoting activity (3); Teratogenic: Unknown (7); Mutagenic: Negative (7,13); Genotoxic: Negative (9); Endocrine disruption: Unknown (7); **DMA:** Neurotoxic: No direct potential (9); Carcinogenic: Potential for weak promoting activity (3); Teratogenic: Unknown (7); Mutagenic: Negative (1d,7,13); Genotoxic: Negative (1b,d,9); Endocrine disruption: Unknown (3); **DGA:** Neurotoxic: No direct potential (9); Carcinogenic: Potential for weak promoting activity (3); Teratogenic: Unknown (7); Mutagenic: Negative (7,13); Genotoxic: Negative (9); Endocrine disruption: Unknown (3)

Ecological Incident Reports

101 incidents have been attributed to dicamba (acid and formulations) of which 4 involved fish mortality

(2). Thirty-five incident reports involved dicamba acid of which 2 involved fish mortality. One incident was agricultural and the other incident was residential in origin. Forty-six incident reports involving dimethylamine salt formulation of which one originated from residential use involving fish mortality (2). No information was provided regarding the mechanism (i.e., direct toxicity or altering the environment such as oxygen depletion) for the incident. All other incidents involved crop damage from misapplication or off-target movement.

Environmental Fate

Water solubility (S_w):	**Acid:** Very soluble (2), = 0.5 g/100 mL at 25°C (2); = 6,500 mg/L (3); = 250,000 mg/L at 20°C (7); pH 1.8, 25°C = 6,600 mg/L (1j,9,10); pH 4.1, 6.8 & 8.2, 25°C > 250,000 mg/L (9,10); 25°C = 4,500 mg/L (12); pH 7, 25°C = 400,000 mg/L (13). **DGA:** = 107 g/100 mL at 25°C (2). **DMA:** = 94.5 g/100 mL at 25°C (2); = 720,000 mg/L (12).
Soil Mobility (K_{oc}):	**Acid:** Very mobile (2); High mobility (1j,9,12,14); Greater mobility at higher pHs (14); = 0.078 to 511 mL/g (3), clay loam = 2.41 mL/g (3), silt loam = 13.6 mL/g (3), sandy loam = 32.5 mL/g (3), sediment = 15.83 mL/g (3), , = 2 mL/g (12,13,14); Primary route of degradation is microbial activity (13), Essentially no photolytic degradation occurred over 16 d (10,14). **DGA:** No information in references. **DMA:** No information in references.
Soil Persistence ($t_{½}$):	**Acid:** *Aerobic metabolism*: Is the main degradative process (2); = 6 d (2), *Anaerobic metabolism*: = 141 d (2); = 58 d (3,12,14), loam = 31 d (3,12,14), forest soils = 26 d (12), grassland soil = 17 d (12), = 90 d (13), Texas sandy loam & clay < 10 d (14), clay loam & sandy loam = 16 d (14), heavy clay soil = 50 d (14), = 4 to 555 d (10,14). *Photolysis*: = 0.0035 d (3), **DGA:** No information in references. **DMA:** No information in references.
Soil Dissipation (DT_{50}):	**Acid:** *Aerobic*: Av. = 25 d, range = 3.24 to 35.2 d (3); typical = 8 d (7), lab, aerobic, 20°C Av. = 4 d, range = 2.1 - 10.5 d (7), field Av. = 3.9 d, range = 3.2 - 4.9 d (7); @ 20°C = 3.2 to 4.9 d (9), loamy sand, pH 5.5, 20°C = 3.2 d (9), loam, pH 7.3, 20°C = 3.3 d (9), sandy loam, pH 7.4, 20°C = 4.2 d (9), silt loam, pH 5.1, 23°C = 3.9 d (9), silt loam, pH 5.1, 20°C = 4.9 d (9); silt loam @ 35°C (@ 25, 50 & 100 g H_2O/100g dry soil) = 14, 4 & 37 d (10), @ 28°C (at 25, 50 & 100 g H_2O/100g dry soil) = 7, 2 & 42 d (10), @ 16°C (at 25, 50 & 100 g H_2O/100g dry soil) = 19, 10 & 166 d (10), @ 3°C (at 25, 50 & 100 g H_2O/100g dry soil) = 199, 164 & 333 d (10), loamy sand, 20°C, pH 5.5) Av. = 2.1 d (10), Kenyon loam: (25°C, pH 6.2) Av. = 26 d, (20°C, pH 6.2) Av. = 39 d (10), Elliot silt loam: (23°C, pH 5.1) Av. = 6.3 d, (20°C, pH 5.1) Av. = 8 d (10), loam (20°C, pH 7.3) Av. = 3.6 d (10), sandy loam (20°C, pH 7.4) Av. = 4.5 d (10), loamy sand (20°C, pH 5.8) Av. = 6 d (10). **DGA:** No information in references. **DMA:** No information in references.
Aquatic Persistence	**Acid:**

($t_{½}$):	*Photolysis* : = 0.018 d (3). **DGA:** No information in references. **DMA:** No information in references.
Aquatic Dissipation (DT_{50}):	**Acid:** *Aerobic*: Water/sediment < 50 d (9), water/sediment @ 20°C, Rhine River = 38 d (9), water/sediment @ 20°C, pond = 45 d (9). *Hydrolysis*: @ pH 7, 20°C = Stable (7), water-sediment = 41 d (7), water only = 40 d (7); negligible hydrolysis (3). *Photolysis*: @ pH 7 = 50.3 d (7); surface water dissipation < 7 d (3); photostability @ 25°C = 38.1 d (9). **DGA:** No information in references. **DMA:** No information in references.
Potential to Move to Groundwater (GUS score):	**Acid:** = 2.637 (7, 14). **DGA:** No information in references. **DMA:** No information in references.
Vapor Pressure (mm Hg):	**Acid:** = 1 x 10^{-6} (25°C) (1h,j), = 3.41 x 10^{-5} (25°C) (2,3). **DGA:** = 3.41 x 10^{-5} (25°C) (2). **DMA:** = 3.41 x 10^{-5} (25°C) (2).
Octanol-Water Partition Coefficient (K_{ow}):	**Acid:** = 0.1 (2); @ pH 5 = 3.981 (3), @ pH 7 = 0.158 (3), 2 pH 9 = 0.575 (3), @ pH 5 = 0.589 (3), @ pH 7 = 0.275 (3), @ pH 9 = 0.076 (3); pH 7@ 20°C = 0.0132 (7); @ pH 5, 25°C = 0.2818 (9,10,12), @ pH 6.8, 25°C = 0.0158 (9,10,12), @ pH 8.9, 25°C = 0.0126 (9,10,12). **DGA:** = 0.061 (2). **DMA:** = 0.078 (2).
Bioaccumulation/ Biocentration:	**BAF:** Low potential (1j). **BCF:** **Acid:** = 15 (7). **DGA:** No information in references. **DMA:** No information in references.

Worst Case Ecological Risk Assessment

Max Application Rate (ai lbs/acre – ae basis)	**Habitat Management:** 1.0 lb. a.e./acre **Croplands/Facilities Maintenance:** 1.0 lb. a.e./acre
EECs	**Terrestrial (Habitat Management):** 240 ppm **Terrestrial (Croplands/Facilities Maintenance):** 240 ppm **Aquatic (Habitat Management):** 0.368 ppm **Aquatic (Croplands/Facilities Maintenance):** 0.00165 ppm

Habitat Management Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	=0.11 [0.1]	=0.11 [0.5]

	Mammals	=0.02 [0.1]	=0.02 [0.5]
	Fish	=0.01 [0.05]	=0.01 [0.5]
Chronic	Birds	=0.30 [1]	=0.30 [1]
	Mammals	=0.48 [1]	=0.48 [1]
	Fish	=0.01 [1]	=0.01 [1]

Cropland/Facilities Maintenance Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	=0.11 [0.1]	=0.11 [0.5]
	Mammals	=0.02 [0.1]	=0.02 [0.5]
	Fish	<0.01 [0.05]	<0.01 [0.5]
Chronic	Birds	=0.30 [1]	=0.30 [1]
	Mammals	=0.48 [1]	=0.48 [1]
	Fish	<0.01 [1]	<0.01 [1]

Justification for Use:	Broad spectrum annual, biennial and perennial broadleaf weed control.
Specific Best Management Practices (BMPs):	• Do not apply if air temperature several days post application is expected to exceed 85° F. • 1 application per year. • Ground application.
References:	[1a] _____. 2009 & 2008, respectively. Banvel specimen label & MSDS. Arysta LifeScience North America, LLC., 29 & 4 pp., respectively. [1b] _____. 2010 & 2009, respectively. Clarity specimen label & MSDS. BASF Corp., Florham Park, NJ. 23 & 8 pp., respectively. [1c] _____. 2003 & 2012, respectively. Cruise Control specimen label & MSDS. Alligare, LLC., Opelika, AL. 11 & 4 pp., respectively. [1d] _____. 2009 & 2011, respectively. Diablo specimen label & MSDS. Nufarm Americas, Inc., Burr Ridge, IL, 34 & 6 pp., respectively. [1e] _____. 2007 & 2009, respectively. Dicamba DMA specimen label & MSDS. Albaugh, Inc., Ankeny, IA, 24 & 4 pp., respectively. [1f] _____. 2009 & 2010, respectively. Dicamba HD specimen label & MSDS. Albaugh, Inc., Ankeny, IA, 28 & 4 pp., respectively. [1g] _____. 2009 & 2010, respectively. Rifle specimen label & MSDS. Loveland Products, Inc., Greeley, CO, 38 & 3 pp., respectively. [1h] _____. 2004 & 2011, respectively. Riverdale Vanquish specimen label & MSDS. Nufarm America, Inc., Burr Ridge, IL, 13 & 6 pp., respectively. [1i] _____. 2011 & 2009, respectively. Sterling Blue specimen label & MSDS. Winfield Solutions, LLC, St. Paul, MN., 35 & 6 pp., respectively. [1j] _____. 2011 & 2010, respectively. Vanquish specimen label & MSDS. Syngenta Crop Protection, LLC., Greensboro, NC, 8 & 5 pp., respectively. [1k] _____. 2008. Vision specimen label & MSDS. Helena Chemical Company, Collierville, TN. 26 & 4 pp., respectively. [2] _____. 2006. Reregistration eligibility decision (RED) for Dicamba and Associated Salts. USEPA, Prevention, Pesticides, and Toxic Substances, Washington, D.C. 37 pp. [3] Durkin, P. and S. Bosch. 2004. Dicamba: Human Health and Ecological Risk Assessment – Final Report. Prepared for the USDA Forest Service by Syracuse Environmental Research Associates, Inc (GSA Contract#: GS-10F-0082F). 179 pp. [4] US Environmental Protection Agency. 2007. ECOTOX User Guide: ECOTOXicology Database System. Version 4.0: http:/www.epa.gov/ecotox; Last accessed 15 April 2012.

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[13] Herbicide Fact Sheet – Dicamba, 2006, U.S. Department of Energy, Bonneville Power Administration. 8 pp.

[14] Caux, P-Y *et al*. 1993. Environmental fate and effects of dicamba: A Canadian perspective. Reviews of Environmental Contamination and Toxicology 133:1-58.

Table CP.1 Pesticide Name
Active Ingredient = Dicamba

Trade Name[a]	Treatment Type[b,c]	Max Product Rate – Single Application (lbs/acre or gal/acre)	Max Product Rate - Single Application (lbs/acre - AI on acid equiv basis)	Max Number of Applications Per Season	Max Product Rate Per Season (lbs/acre/season or gal/acre/season)	Minimum Time Between Applications (Days)
Banvel	H, CF	0.25gal/acre	1.0 lbs a.e./acre	1	0.25 gal/acre/season	0
Clarity	H, CF	0.25 gal/acre	1.0 lbs a.e./acre	1	0.25 gal/acre/season	0
Cruise Control	H, CF	0.25 gal/acre	1.0 lbs a.e./acre	1	0.25 gal/acre/season	0
Diablo	H, CF	0.25 gal/acre	1.0 lbs a.e./acre	1	0.25 gal/acre/season	0
Dicamba DMA	H, CF	0.25 gal/acre	1.0 lbs a.e./acre	1	0.25 gal/acre/season	0
Dicamba HD	H, CF	0.25 gal/acre	1.0 lbs a.e./acre	1	0.25 gal/acre/season	0
Rifle	H, CF	1 gal/acre	1.0 lbs a.e./acre	1	1 gal/acre/season	0
Riverdale Vanquish	H, CF	0.25 gal/acre	1.0 lbs a.e./acre	1	0.25 gal/acre/season	0
Sterling Blue	H, CF	0.25 gal/acre	1.0 lbs a.e./acre	1	0.25 gal/acre/season	0
Vanquish	H, CF	0.25 gal/acre	1.0 lbs a.e./acre	1	0.25 gal/acre/season	0
Vision	H, CF	0.26 gal/acre	1.0 lbs a.e./acre	1	0.26 gal/acre/season	0

[a]From each label for a pesticide identified in pesticide use proposals (PUPs), Service personnel would record application information associated with possible/known uses on Service lands.
[b]Treatment type: H – habitat management or CF – cropland/facilities maintenance. If a pesticide is labeled for both types of treatments (uses), then record separate data for H and CF applications.
[c]Treatment type is for ecological risk assessment purposes only. The product label will determine whether or not the treatment type is permissible under Section 3 of the Federal Insecticide, Fungicide and Rodenticide Act.