Programmatic environmental assessment for the use of antiparasitic animal drugs for the prevention and/or treatment of infestations caused by New World screwworm (*Cochliomyia hominivorax*) larvae (myiasis)

Food and Drug Administration
Center for Veterinary Medicine

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Acronyms

APHIS – Animal and Plant Health Inspection Service

CE – Categorical Exclusion

CFR – Code of Federal Regulations

CNADA – Conditional New Animal Drug Application

CVM – Center for Veterinary Medicine

DT_{50} – Degradation Half-Life

EA – Environmental Assessment

EUA – Emergency Use Authorization

EC_{50} – Median Effective Concentration

EIS – Environmental Impact Statement

FDA – Food and Drug Administration

FD&C Act – Federal Food, Drug, and Cosmetic Act

FONSI – Finding of No Significant Impact

GFI – Guidance for Industry

K_{oc} – Organic Carbon Soil-Water Partition Coefficient

LC_{50} – Median Lethal Concentration

NADA – New Animal Drug Application

NEPA – National Environmental Policy Act

NOEC – No Observed Effects Concentration

NWS – New World screwworm (*Cochlipmyia hominivorax*)

PEA – Programmatic Environmental Assessment

U.S. – United States

USDA – United States Department of Agriculture

EPA – Environmental Protection Agency

1. Summary

In order to fulfill the mandates set forth in the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321, *et seq.,* and the Food and Drug Administration's (FDA's) environmental impact considerations regulations (21 Code of Federal Regulations (CFR) part 25), FDA's Center for Veterinary Medicine (FDA-CVM) has prepared this programmatic environmental assessment (PEA)[1] to determine whether reasonably foreseeable significant environmental effects may result from the use of antiparasitic animal drugs approved under Conditional New Animal Drug Applications (CNADA) and authorized under emergency use authorizations (EUA) to prevent and/or treat infestations caused by New World screwworm (NWS) (*Cochliomyia hominivorax*) larvae (myiasis). Between September 2025 and July 2026, FDA-CVM has conditionally approved three new animal drugs for NWS indications under CNADAs and authorized over 10 new animal drugs for NWS indications under EUAs – all of which were antiparasitics – including some of those listed in Appendix A and B (e.g., ivermectin, doramectin).[2] Given the need for FDA-CVM to act quickly to conditionally approve and authorize these antiparasitic animal drugs to address the potential public health threat from NWS, there was not sufficient time for FDA-CVM to complete an adequate environmental assessment (EA) or environmental impact statement (EIS) prior to taking these actions. Therefore, FDA-CVM invoked 21 CFR 25.16[3] for these actions, which allowed FDA-CVM to prepare the EA or EIS documents as soon as practicable without delaying these actions. FDA-CVM determined that the most efficient NEPA process was to prepare a PEA and obtained agreement for these alternative arrangements from the Council on Environmental Quality (CEQ).

This PEA is intended to support the actions already taken on CNADAs and EUAs, as well as future actions on CNADAs and EUAs, for most antiparasitic animal drugs intended to address NWS infestations in animals in the United States (U.S.) When appropriate, FDA-CVM will prepare individual, tiered EAs or EISs for certain CNADAs and EUAs associated with NWS when this PEA does not adequately cover the environmental risks associated with a particular product. In addition to this PEA, a FONSI will be prepared for each individual action (conditional approval or EUA) where significant environmental impacts are not expected.

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[1] Under 42 United States Code 4336(e)(11), a "programmatic document" means an environmental impact statement or environmental assessment analyzing all or some of the environmental effects of a policy, program, plan, or group of related actions.

[2] All animal drugs approved or authorized under Conditional New Animal Drug Applications and Emergency Use Authorizations, respectively, are listed at: https://www.fda.gov/animal-veterinary/safety-health/new-world-screwworm-information-veterinarians (date accessed: July 24, 2026).

[3] Title 21 Code of Federal Regulations 25.16 states: Public health and safety emergencies. -- There are certain regulatory actions that, because of their immediate importance to the public health or safety, may make full adherence to the procedural provisions of NEPA [National Environmental Policy Act] and CEQ's [Council on Environmental Quality] regulations impossible. For such actions, the responsible agency official shall consult with CEQ about alternative arrangements before the action is taken, or after the action is taken, if time does not permit prior consultation with CEQ.

NWS is a parasitic fly that infests warm-blooded animals and poses an emerging threat to animal populations and the food supply chain in the U.S.[4,5] Female NWS flies lay their eggs either on open wounds or along mucous membranes of warm-blooded animals (such as livestock, pets, and wildlife), and after hatching, the NWS larvae will feed on the animal tissue, exacerbating existing wounds and/or causing secondary infections, often resulting in death (Novy, 1991).[6,7] This infestation of NWS larvae is referred to as myiasis.

NWS had been eradicated in the U.S. since 1966; however, beginning in 2022, the U.S. Department of Agriculture (USDA) has been monitoring the rapid northward expansion of NWS into Central American countries and Mexico (Valdez-Espinoza *et al.*, 2025).[6] The expansion reached the U.S. with the first detection of NWS in U.S. cattle reported by USDA on June 3, 2026.[8] NWS infestations in the U.S. could potentially result in serious adverse impacts on animal populations and the food supply chain in the U.S.[4] Therefore, FDA-CVM is working in collaboration with other Federal agencies, including USDA and the Environmental Protection Agency (EPA) to limit the expansion and eradicate NWS in the U.S.[9] As part of this effort, FDA-CVM is evaluating new animal drugs that have the potential to prevent and/or treat NWS infestations in animals under temporary regulatory pathways, including CNADAs and EUAs. Because NWS is a parasitic fly, FDA-CVM expects that the majority of submissions for potential CNADAs and EUAs for this purpose will be for animal drugs containing antiparasitics (i.e., animal drugs used to prevent and/or treat parasitic infestations). This PEA is intended to cover CNADAs and EUAs for a wide range of antiparasitic chemical classes, all routes of administration, and all warm-blooded target animal species susceptible to NWS. Because of the differences in the environmental exposure, fate and effects of the various potential antiparasitic animal drugs, the assessment was conducted using a qualitative approach.

Antiparasitic animal drugs are expected to enter the terrestrial and aquatic environment primarily through excretion in urine and feces, topical wash-off during rain events, and disposal of unused drug and containers. Cats, dogs, horses, and minor species are expected to contribute only limited, geographically dispersed environmental exposure due to small population sizes and individualized waste management practices.

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[4] Food and Drug Administration (FDA). FDA News Release. August 19, 2025. HHS Allows FDA Emergency Use of Animal Drugs to Combat New World Screwworm, Protect US Food Supply. https://www.fda.gov/news-events/press-announcements/hhs-allows-fda-emergency-use-animal-drugs-combat-new-world-screwworm-protect-us-food-supply (date accessed: August 26, 2025)

[5] American Veterinary Medical Association (AVMA). July 11, 2025. AVMA News. USDA unveils Texas screwworm facility, eradication strategy. Public input sought on New World screwworm sterile fly production technology, eradication tools, and innovative ideas. https://www.avma.org/news/usda-unveils-texas-screwworm-facility-eradication-strategy (date accessed: August 15, 2025)

[6] United States Department of Agriculture, Animal and Plant Health Inspection Service. April 2025. Eradicating New World Screwworm with Sterile Insect Technique. https://www.aphis.usda.gov/sites/default/files/factsheet-eradicating-nws-sit.pdf (date accessed: March 25, 2026)

[7] United States Department of Agriculture, Animal and Plant Health Inspection Service. July 2025. New World Screwworm. https://www.aphis.usda.gov/livestock-poultry-disease/cattle/ticks/screwworm (date accessed: August 27, 2025)

[8] United States Department of Agriculture. June 3, 2026. USDA Confirms Presence of New World Screwworm in the United States. https://www.aphis.usda.gov/news/agency-announcements/usda-confirms-presence-new-world-screwworm-united-states (date accessed: July 17, 2026)

[9] United States Department of Agriculture. July 2025. New World Screwworm Domestic Readiness and Response Policy Initiative. https://www.usda.gov/sites/default/files/documents/nws-visit-policy-brief.pdf (date accessed: May 27, 2026)

Livestock, defined herein as cattle, swine and poultry,[10] represent the greatest potential source of environmental exposure due to large herd sizes, outdoor rearing conditions, and high amounts of manure containing antiparasitic animal drug residues. Exposures are expected to occur in both the terrestrial and aquatic (both water and sediment) environments near where the animal drugs will be used (e.g., livestock feedlots and pasture) and exposures will be dependent on the antiparasitic animal drug's fate in the environment (e.g., water solubility, potential to sorb to soil and sediment, and potential to degrade in the environment). However, overall, the environmental exposure is expected to be limited both spatially and temporally. NWS is a warm-climate species expected to be most prevalent in the southern U.S., with only seasonal expansion northward. Use of the antiparasitic animal drugs is only expected in areas with active infestations or the potential for an infestation; however, as the need and use of these antiparasitic animal drugs is reduced due to the anticipated control, reduction and eventual eradication of NWS, the environmental introduction and exposure will be reduced, lowering the risk of effects. In addition, the use of the antiparasitic animal drugs will also be limited in duration because CNADAs terminate after five years, and EUAs will terminate when the HHS declaration is lifted following anticipated eradication of NWS.[11]

Due to the modes of action of antiparasitic animal drugs, non-target invertebrates are the organisms most at risk. More specifically, dung fauna and aquatic invertebrates, such as zooplankton and macro-invertebrates, are the most sensitive to antiparasitic animal drugs. Localized adverse effects on these groups are possible at certain locations with high environmental exposures. However, published literature supports that population recovery will likely occur following exposures to antiparasitic animal drugs and insecticides[12].

Based on the comprehensive qualitative analysis described herein, FDA-CVM concludes that no reasonably foreseeable significant environmental effects are expected from the approval of CNADAs or authorization of EUAs for most antiparasitic animal drugs used to prevent and/or treat NWS infestations. This conclusion is supported by the limited environmental introduction from cats, dogs, horses and minor species; the low environmental mobility of most antiparasitic drug classes; the expected use in limited geographic areas where there are active infestations or the potential for an infestation (mostly the southern U.S.); the temporal restrictions inherently imposed by CNADA and EUA statutory provisions; the expected reduction and eradication of NWS populations through the sterile fly program; and prior environmental evaluations for many of these same drugs under full NADA approvals, which found no significant impact from nationwide, indefinite use.

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[10] We acknowledge that this definition of "livestock" differs from that used by the United States Department of Agriculture. Title 29 Code of Federal Regulations 780.328.

[11] This programmatic environmental assessment evaluates a limited duration of use for the antiparasitic animal drugs to prevent and/or treat New World screwworm (NWS) infestations due to the limited durations of Conditional New Animal Drug Applications and Emergency Use Authorizations. The approval of a full new animal drug application (NADA) or abbreviated NADA for an antiparasitic animal drug to prevent and/or treat NWS infestations will require a separate evaluation under the National Environmental Policy Act and would evaluate a nationwide indefinite use.

[12] A "pesticide" is defined in part as, "any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest...." 7 United States Code (U.S.C.) 136. Insecticide is a category of pesticide that destroys, repels, or mitigates insects that are pests. Pesticides and insecticides are regulated by the Environmental Protection Agency under the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136 *et seq.)*

2. Background

2.1. New World Screwworm (NWS)

2.1.1. NWS Biology

NWS (*C. hominivorax*) is a parasitic fly that infests warm-blooded animals, such as livestock, wildlife, pets, and occasionally birds. Female NWS flies lay their eggs along the edges of and within open wounds and mucous membranes (e.g., nose, genitalia) of these animals. After hatching, larvae burrow in a screw-like manner into the tissue of the animal worsening existing wounds, causing secondary infections, and often resulting in death if left untreated (Novy, 1991).[6,7] As existing wounds worsen, increased serum and blood attract more female NWS flies who may lay eggs on animals with existing active infestations, causing tissue damage from larvae of varying feeding stages. Larvae continue to burrow into and feed on tissue of infested animals for approximately one week before dropping to the ground, where they burrow into the soil and develop into pupae before hatching as adult flies. Adult NWS flies emerge between 7 and 60 days later and the lifecycle repeats (Novy, 1991). The lifecycle of an individual NWS is relatively short and often complete within 21 days. During that time, adult NWS flies are capable of flying for up to 10-14 days, covering substantial distances, with some reports indicating flight distances up to 125 miles. However, if favorable environmental conditions and sufficient host animals are present, adult NWS flies are more likely to stay within a relatively small region, traveling only short distances.[13] These characteristics contribute to the potential rapid spread of NWS infestations, especially in animals housed in close proximity (e.g., intensively reared cattle).

NWS is native to tropical and subtropical areas, including South America, the Dominican Republic, Haiti, and Cuba (Valdez-Espinoza *et al.*, 2025).[7] Several environmental factors, including temperature and humidity, play a key role in the development and survival of NWS. Development of pupae is more favorable in warm, moist soils, whereas extreme temperature or flooding conditions often decrease development and survival (Valez-Espinoza *et al.*, 2025).[14]

2.1.2. History of NWS in the U.S. and Eradications Efforts

In the U.S., NWS was endemic until 1966, with occurrences mostly limited to the southern states (e.g., Texas, Louisiana, Florida). These areas were known to experience infestations year-round due to the consistently warmer climate. Expansion to northern states occurred mainly during warmer months (Krafsur *et al.*, 1987). The presence of NWS in the U.S. was not considered a significant threat until 1933, following the import of infested livestock through the southern border.[15] Due to impacts on wildlife and the

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[13] California Department of Food and Agriculture (CDFA). June 2025. New World Screwworm. https://www.cdfa.ca.gov/ahfss/animal_health/pdfs/screwworm_fact_sheet.pdf (date accessed: October 29, 2025)

[14] United States Department of Agriculture. 2025. Foreign Animal Disease Preparedness and Response Plan. Disease Response Strategy. New World Screwworm Myiasis. https://www.aphis.usda.gov/sites/default/files/nws-myiasis-disease-strategy.pdf (date accessed: September 15, 2025)

[15] United States Department of Agriculture, Animal and Plant Health Inspection Service. January 2025. New World Screwworm. Ready Reference Guide – Historical Economic Impact. https://www.aphis.usda.gov/sites/default/files/nws-historical-economic-impact.pdf (date accessed: August 29, 2025)

livestock industry, several strategies, including the use of chemicals such as pesticides and antiparasitic animal drugs, and changes in animal management practices, were utilized in order to control NWS during this time. However, these strategies were considered expensive, only provided short term pest control, and were generally ineffective on their own (Krafsur *et al.*, 1987). Therefore, additional efforts were undertaken in order to develop a more effective strategy for controlling and eventually eradicating NWS in the U.S.

In the 1950s, the sterile fly technique was developed to combat NWS, in which, NWS pupae are treated with gamma radiation to produce sterile male flies (Novy, 1991).[6,16] The sterile male flies are then released into the wild to mate with wild female flies, producing unfertilized eggs that do not hatch or produce larvae. Because NWS female flies typically only mate once in their lifetime, the sterile fly technique eventually leads to population collapse.[6]

NWS was eradicated from the Southeastern U.S. in 1959, after sterile flies were released for over a year in this region. Subsequently, an eradication program was initiated in the Southwest U.S. in 1962, and NWS was eradicated from this region in 1966. At that time, NWS was considered no longer endemic in the U.S.[15,16] NWS was also eradicated from Mexico and several countries in Central America as of 1984 due to the success of the sterile fly program, and a sterile fly barrier between Panama and Colombia (at the Darién Gap) was maintained by the U.S. and other Central and South American countries until 2022. This technique was and is still considered to be one of the most important and effective approaches for eradication of NWS.[17]

The effectiveness and importance of the sterile fly program in managing NWS populations is further highlighted by its use in eradicating an outbreak that occurred in the Florida Keys in October 2016. During this time, endangered Key deer were found to be infested. More than 150 million sterile male flies were released in the Florida Keys, and by March 23, 2017, USDA announced that NWS had been eradicated from the Florida Keys.[16]

NWS expanded beyond the sterile fly barrier at the Darién Gap in 2022. Since that time, USDA and other international regulatory agencies have been monitoring the expansion of NWS into Central American countries and Mexico (Valdez-Espinoza *et al*., 2025).[6] NWS was first detected in the U.S. by USDA on June 3, 2026.[8] In an effort to limit the northward expansion and the introduction of NWS into the U.S., USDA Animal and Plant Health Inspection Service (APHIS) temporarily suspended the import of cattle along the southern border in May 2025.[17] In addition, USDA has been working with Central American countries and Mexico to construct and operate sterile fly production and dispersal facilities in Panama, Mexico and the U.S.[20] A facility in Pacora, Panama is currently operational, producing and dispersing approximately 100 million sterile flies per week. An additional production facility in Metapa, Mexico, is operational and produces 60-100 million sterile flies per week. Two additional dispersal only facilities in Mexico

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[16] United States Department of Agriculture, Animal and Plant Health Inspection Service. February 2023. New World Screwworm. https://www.aphis.usda.gov/livestock-poultry-disease/cattle/ticks/screwworm/new-world-screwworm-story-map (date accessed: August 16, 2025)

[17] United States Department of Agriculture. June 18, 2025. Press Release No. 0137.25. Secretary Rolls Announces Bold Plan to Combat New World Screwworm's Northward Spread. https://www.usda.gov/about-usda/news/press-releases/2025/06/18/secretary-rollins-announces-bold-plan-combat-new-world-screwworms-northward-spread (date accessed: August 29, 2025)

(Tuxtla and Tampico) are currently operational. In the U.S., USDA has begun construction of a new sterile fly production and dispersal facility at Moore Air Base in Edinburg, Texas, which is expected to produce and release 100 million flies per week by November 2027 and will continue increasing production until it reaches the goal of 300 million flies per week.[18] New technologies are also being evaluated for use in combating NWS, such as a genetically a modified male NWS fly, known as Novofly, which is currently being evaluating by EPA as a new pesticide product to maintain broad suppression of and help prevent the NWS migration northward.[19]

Although the sterile NWS fly program is expected to be the main contributor to limiting the northward expansion and again eradicating NWS populations in the U.S., USDA is also collaborating with other Federal agencies[9], including FDA, EPA, state, local, and tribal governments, as well as universities to identify additional tools to respond to the infestation.[17] These efforts are outlined in the USDA APHIS "Response Playbook New World Screwworm" (April 2026, v2).[20] As part of this effort, FDA-CVM is working quickly to authorize, approve, or conditionally approve animal drugs to prevent and/or treat NWS infestations in warm-blooded animals; this is listed under item 2.1 of USDA APHIS NWS Playbook.[20]

2.2. Legal and Regulatory Authorities

2.2.1. Federal Food, Drug, and Cosmetic Act

FDA authority over new animal drugs comes from the Food, Drug, and Cosmetic (FD&C) Act (21 USC § 321 *et seq*.). Under the FD&C Act, a new animal drug may not be sold into interstate commerce unless it is the subject of an approved new animal drug application (NADA), abbreviated NADA (ANADA, also known as a generic animal drug), or there is a conditional approval (CNADA) in effect pursuant to 21 U.S.C. § 360ccc or there is an index listing in effect pursuant to 21 USC § 360ccc-1 (21 U.S.C. §§ 331(a) and 360b(a)).

FDA-CVM is considering all regulatory pathways for the legal marketing of animal drugs to prevent and/or treat NWS infestations. However, this PEA will focus on CNADAs and EUAs only, which are considered temporary regulatory pathways. If an NADA or ANADA for an animal drug for use to prevent and/or treat NWS infestations is pursued, the applicant will be required to submit a separate claim of categorical exclusion or an EA (21 CFR 25.15(a)). Additional information on the legal and regulatory authorities for CNADAs and EUAs are provided in Sections 2.2.1.1 and 2.2.1.2, respectively, below.

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[18] United States Department of Agriculture (USDA). March 9, 2026. Press Release No. 0040.26. USDA and United States Army Corps of Engineers Advance New World Screwworm Preparedness with New Texas Sterile Fly Facility Contract. https://www.usda.gov/about-usda/news/press-releases/2026/03/09/usda-and-us-army-corps-engineers-advance-new-world-screwworm-preparedness-new-texas-sterile-fly (date accessed: May 4, 2026)

[19] https://www.federalregister.gov/documents/2026/03/27/2026-05998/pesticide-product-registration-emergency-exemption-request-and-application-for-a-new-active (date accessed: July 24, 2026)

[20] United States Department of Agriculture, Animal and Plant Health Inspection Service. April 2026. Response Playbook New World Screwworm. Version 2. https://www.aphis.usda.gov/sites/default/files/nws-response-playbook.pdf (date accessed: June 5, 2026)

2.2.1.1. Conditional Approval

The Minor Use and Minor Species (MUMS) Animal Health Act of 2004 added new provisions to the FD&C Act including section 571, which established a conditional approval pathway that allows for marketing of an animal drug before establishing full effectiveness but with the full showing of safety.[21, 22] In 2018, Congress amended the FD&C Act to provide for "expanded conditional approval," which allows for conditional approval of non-MUMS drugs if they address a serious or life-threatening condition or an unmet animal or human health need, but demonstrating effectiveness would require complex or particularly difficult studies.[22] To receive conditional approval, an animal drug sponsor must complete all portions of an animal drug application, including the requirements of NEPA (see Section 2.2.2 below). The only difference between a CNADA and full NADA approval is the effectiveness requirement; the sponsor must show "reasonable expectation of effectiveness" for the CNADA approval and "substantial evidence of effectiveness" for the full NADA approval.

Animal drugs can be marketed under a conditional approval for a maximum of 5 years while the applicant collects additional data to demonstrate substantial evidence of effectiveness for the intended use. During this 5-year period, annual renewals are required. The intent of the CNADA pathway is to allow applicants additional time to collect substantial evidence of effectiveness data, which should lead to a full NADA approval by the end of the 5-year timeframe. The animal drug sponsor must submit the necessary data to support a full NADA, including the submission of either a categorical exclusion or EA (see Section 2.2.2 below), by four-and-a-half years after conditional approval, or the conditional approval will no longer be in effect, and the applicant must stop marketing the drug.[22] If the applicant submits the necessary information by four-and-a-half years, then they can continue to market the conditionally approved drug for an additional 6 months while FDA-CVM reviews their full NADA. The conditional approval automatically terminates after 5 years, and the conditionally approved drug must be removed from the market, unless the applicant receives full approval.[22]

2.2.1.2. Emergency Use Authorization

Another legal pathway to provide access to animal drugs needed to prevent and/or treat NWS infestations is through an EUA. Congress amended the FD&C Act in 2016 to allow FDA-CVM to authorize emergency uses of animal drugs under section 564 (including EUAs, revision to an EUA, and emergency use actions under Section 564A). Under the FD&C Act, when the Secretary of HHS makes the necessary emergency declaration,[23] FDA may authorize unapproved medical products or unapproved uses of approved medical products, including animal drugs, to be used during the emergency to diagnose, treat, or prevent serious or life-threatening diseases or conditions caused by chemical, biological, radiological, or nuclear threat agents when certain criteria are met, including

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[21] 21 United States Code 360ccc.
[22] More information on conditional approval can be found at: Food and Drug Administration. May 11, 2026. Conditional Approval Explained: A Resource for Veterinarians. https://www.fda.gov/animal-veterinary/resources-you/conditional-approval-explained-resource-veterinarians (date accessed: March 26, 2026)
[23] 21 United States Code 360BBB-3(b).

that there are no adequate, approved, and available alternatives.[24] EUAs remain effective while the declaration of emergency under section 564 remains in effect unless the declaration is terminated or the EUA is revised or revoked sooner. Once the Secretary of HHS terminates the emergency declaration then all EUAs issued under that declaration are terminated (with some limited exceptions under 564(f)(2) of the FD&C Act).[25]

The Secretary of HHS issued a declaration on August 19, 2025, that allows FDA to issue EUAs for animal drugs to treat or prevent infestations caused by NWS.[4,26] FDA through an EUA can authorize the flexible, faster use of certain animal drug products that may be approved for other purposes, or available in other countries, but not formally approved for NWS in the U.S. This ensures veterinarians, farmers, and animal health officials have timely access to the tools they need to protect pets, livestock, and the nation's food supply.4

2.2.2. National Environmental Policy Act

NEPA requires that all federal agencies, including FDA, consider the reasonably foreseeable environmental effects of their proposed major federal actions (40 U.S.C. § 4332(C)(i)). FDA's NEPA implementing regulations are codified under 21 CFR Part 25, Environmental Impact Considerations. Many of FDA's major federal actions that require a NEPA evaluation are identified under 21 CFR 25.20. Currently, CNADAs and EUAs are not listed under this provision; however, FDA was given these authorities by Congress under the FD&C Act after the most recent substantive revisions to Part 25 in 1997 (see Sections 2.1.1.1 and 2.2.1.2 above). Although CNADAs and EUAs are not specifically listed under 21 CFR 25.20, under NEPA (42 U.S.C. 4336e(10)) they are major federal actions requiring a NEPA evaluation.

NEPA requires that an agency prepare an EA for major federal actions that do not have a reasonably foreseeable significant effect on the quality of the human environment, or if the significance of such an effect is unknown, unless the agency finds that the proposed action is excluded pursuant to a categorical exclusion (42 U.S.C § 4336(b)(2)). If the EA concludes that reasonably foreseeable significant environmental effects are not expected, then a finding of no significant impact (FONSI) is prepared. An environmental impact statement (EIS) is prepared when a proposed major federal action has a reasonably foreseeable significant effect on the quality of the human environment (42 U.S.C. § 4336(b)(1)).

3. Purpose and Need

NWS poses an emerging threat to animal populations and the food supply chain in the U.S. FDA-CVM is currently working in collaboration with USDA and EPA in an effort to limit the northward expansion and eradicate NWS populations in the U.S.[17] As part of

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[24] More information on emergency use authorizations can be found at: Food and Drug Administration. July 1, 2026. Emergency Use Authorization. https://www.fda.gov/emergency-preparedness-and-response/mcm-legal-regulatory-and-policy-framework/emergency-use-authorization (date accessed: April 30, 2026)

[25] Food and Drug Administration. November 16, 2023. FAQs: What happens to EUAs when a public health emergency ends? https://www.fda.gov/emergency-preparedness-and-response/mcm-legal-regulatory-and-policy-framework/faqs-what-happens-euas-when-public-health-emergency-ends (date accessed: March 26, 2026).

[26] United States, Department of Health and Human Services. "Declaration of Emergency Pursuant to the Federal Food, Drug, and Cosmetic Act for New World Screwworm." 90 Fed. Reg. 40609 (Aug. 20, 2025).

this effort, FDA-CVM is evaluating new animal drugs to prevent and/or treat infestations caused by NWS larvae (myiasis) in mammals and birds. The use of animal drugs is considered to be only one part of the effort to combat NWS in addition to the sterile fly program (see Section 2.1 above) and other efforts (e.g., pesticides, animal management).[9,20]

Because NWS is a parasitic fly, FDA-CVM expects, based on its experience thus far, that the majority of CNADAs and EUAs submitted for this purpose will be for animal drugs containing antiparasitics, which are used to prevent and/or treat parasitic infestations.

Therefore, the purpose of this PEA is to evaluate the reasonably foreseeable environmental effects that may result from the use of antiparasitic animal drugs to prevent and/or treat infestations caused by NWS larvae (myiasis). This PEA will focus on antiparasitic animal drugs proposed under CNADAs and EUAs.

4. Approach and Scope

4.1. Approach to NEPA Requirements

At this time, FDA has not codified categorical exclusions for CNADAs and EUAs under 21 CFR 25.33. The categorical exclusions for animal drugs were promulgated in 1997 before Congress had given FDA authority to approve CNADAs or authorize EUAs (see Section 2.2 above). Therefore, an EA is required under NEPA to evaluate whether reasonably foreseeable significant environmental effects are likely to occur from the conditional approval or emergency authorization of antiparasitic animal drugs to prevent and/or treat NWS infestations. Given the need for CVM to act quickly to conditionally approve and authorize animal drugs to address the potential public health threat, there was not sufficient time for FDA-CVM to complete an EA or EIS prior to conditionally approving or authorizing new animal drugs for use to prevent and/or treat NWS infestations.[27] Therefore, FDA-CVM invoked 21 CFR 25.16, which allows FDA-CVM to prepare the EA or EIS documents as soon as practicable without delaying these actions. FDA-CVM determined that the most efficient NEPA process would be to prepare a PEA for this group of related actions, i.e., CNADAs or EUAs for antiparasitic animal drugs for prevention and/or treatment of infestations caused by NWS larvae (myiasis) in food and nonfood animals. As required under 21 CFR 25.16, FDA-CVM consulted with CEQ on these alternative arrangements (i.e., delaying the NEPA review and preparing a PEA).

NEPA allows for the preparation of a programmatic document (42 U.S.C. § 4336b). A “programmatic document” means an EIS or EA analyzing all or some of the environmental effects of a policy, program, plan, or group of related actions (42 U.S.C. 4336e(11)). The agency may rely on the programmatic document in a subsequent environmental document for related actions as follows: (1) within 5 years and without additional review of the analysis in the programmatic environmental document, unless there are substantial new circumstances or information about the significance of adverse

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[27] Between September 2025 and July 2026, Food and Drug Administration’s Center for Veterinary Medicine has conditionally approved three new animal drugs under Conditional New Animal Drug Applications and authorized over 10 new animal drugs under Emergency Use Authorizations – all of which were antiparasitic animal drugs – including some of those listed in Appendix A and B (e.g., ivermectin, doramectin). https://www.fda.gov/animal-veterinary/safety-health/new-world-screwworm-information-veterinarians (date accessed: July 24, 2026).

effects that bear on the analysis, (2) after 5 years so long as the agency reevaluates the analysis in the programmatic environmental document and any underlying assumption to ensure reliance on the analysis remains valid (42 U.S.C. § 4336b).

This PEA is intended to evaluate the majority of antiparasitic animal drugs authorized or conditionally approved to prevent and/or treat NWS infestations, though it is not inclusive of all animal drugs for this intended use. This PEA does not cover animal drugs that also contain an active pharmaceutical ingredient (API) that is not an antiparasitic (e.g., an antimicrobial), or particular animal drugs for which this PEA does not adequately address the potential environmental risks associated with its use. In these circumstances, additional analysis will be needed. In these cases, and others where necessary, FDA-CVM will prepare an individual tiered EA for that specific action. Tiering refers to an approach where federal agencies first consider the broad, general impacts of a proposed program, plan, policy, or large scope project—or at the early stage of a phased proposal—and then conduct subsequent, narrower, decision-focused reviews. PEAs or programmatic EISs (PEISs) are intended to evaluate the broad environmental consequences relevant at the programmatic level. A subsequent tiered EA or EIS can also be prepared for individual actions, which fully discusses certain issues not addressed in the PEA or PEIS. The tiered EA or EIS should incorporate a summary and reference to the programmatic document but focus on more specific considerations. It is noted in this assessment where additional analyses may be necessary under a tiered EA.

A FONSI will be prepared for each individual action where significant environmental impacts are not expected. For antiparasitic animal drugs where reasonably foreseeable environmental effects are expected to be significant, then an EIS may be needed.

4.2. Scope of PEA

As required under 21 CFR 25.40(a), this PEA will focus on relevant environmental issues relating to use and disposal from use of antiparasitic animal drugs[28] for the prevention and/or treatment of NWS infestations. This PEA was prepared following a qualitative approach and considers the potential environmental exposure and reasonably foreseeable environmental effects on non-target organisms from the conditional approval and authorization for emergency use of these antiparasitic animal drugs. This PEA also determines whether reasonably foreseeable environmental effects on non-target organisms would be significant. This assessment is based on available information from previous EAs and FONSIs published for NADA approvals of antiparasitic animal drugs[29], and decades of experience of FDA-CVM scientists who have assisted in the development and preparation of NEPA documents, including quantitative EAs, for antiparasitic animal drugs approved for similar indications (i.e., prevention and/or treatment of parasitic infestations). Although there are environmental fate and effects data available for many of the antiparasitic animal drugs that are expected to be authorized or conditionally approved to prevent and/or treat NWS infestations, a quantitative approach was not utilized in this PEA because these data can vary widely

[28] It is important to emphasize that this programmatic environmental assessment only evaluates antiparasitic animal drugs. It does not evaluate antiparasitic drugs for human use or pesticides.
[29] The Food and Drug Administration's Center for Veterinary Medicine Environmental Assessments are available at https://animaldrugsatfda.fda.gov/adafda/views/#/environmentalAssessments (date accessed: April 30, 2026)

for antiparasitic animal drugs. Therefore, when appropriate, additional discussion of the specific data for that particular antiparasitic animal drug will be included in the associated FONSI or in the tiered EA for that individual product.

5. Proposed Action and Alternatives

5.1. Description of Possible Major Federal Actions Evaluated in this PEA

The major federal actions evaluated in this PEA include the approval of a CNADA or authorization of an emergency use of an antiparasitic animal drug for prevention and/or treatment of infestations caused by NWS larvae (myiasis). Animal drugs are approved or authorized for a specific API(s), indication(s), and conditions of use (e.g., target animal, dose, duration, frequency, route of administration). This PEA was prepared and is intended to be inclusive of the majority of CNADAs and EUAs submitted to prevent and/or treat NWS infestations. Therefore, a broad set of APIs, indications, and conditions of use were considered as part of this evaluation, as described below.

Active Pharmaceutical Ingredients (API)

Antiparasitic animal drugs are commonly used to prevent and/or treat parasitic infestations. Because NWS is a parasitic fly, it is expected that the majority of CNADAs and EUAs for these proposed actions will be for animal drugs containing antiparasitics. Therefore, this PEA evaluates the use of antiparasitic animal drugs only. Other animal drugs approved or authorized to prevent and/or treat NWS infestations or other conditions associated with NWS infestations will be addressed in separate tiered EAs, individual EAs or EISs, as needed.

There are several antiparasitic chemical classes, such as macrocyclic lactones, isoxazolines, neonicotinoids, pyrethroids, insect growth regulators (IGR), organophosphates, carbamates, and phenylpyrazoles. These classes differ in chemical structure, mode of action, physical-chemical properties, etc. (see Appendices A and B); therefore, this assessment does not evaluate any one specific antiparasitic chemical class. However, when appropriate, chemical classes or specific antiparasitic animal drugs may be discussed as examples to support concepts in the assessment.

Indication

The antiparasitic animal drugs that will be conditionally approved or authorized to prevent and/or treat NWS infestations will be similar to those shown below. Some indications may have additional wording that limits when the drug can be used (e.g., “when administered within 24 hours of birth, at the time of castration, or at the appearance of a wound”). Some antiparasitic animal drugs may also have indications that include “prevention of reinfestation.”

> *For the prevention of infestations caused by New World screwworm (*Cochliomyia hominivorax*) larvae (myiasis)*
>
> *For the treatment of infestations caused by New World screwworm (*Cochliomyia hominivorax*) larvae (myiasis)*
>
> *For the prevention and treatment of infestations caused by New World screwworm* (Cochliomyia hominivorax) *larvae (myiasis)*

Target Animal

FDA-CVM defines the target animal as "the production class of animals in which a sponsored compound is proposed or intended for use" (21 CFR 500.82). The target animal can be either a major or minor species. There are seven major species: cattle, swine, chickens, turkeys, horses, cats, and dogs (21 U.S.C. 321(nn)). Minor species include all other animals that are not considered a major species (21 U.S.C. 321(oo)). Examples of minor species are zoo animals, captive and captured wildlife (e.g., deer), sheep, goats, gamebirds (e.g., pheasants), etc. In addition, target animals can also be food animals (i.e., species that produce products that may be consumed by humans or "food-producing animals") or nonfood animals (i.e., species for which there is a reasonable certainty that the animal or products derived from the animal will not be consumed).

NWS only infests warm-blooded mammals and birds. It is not known to infest reptiles and amphibians. As part of this PEA, it is assumed that any mammal or bird that is susceptible to NWS infestations, whether a major or minor species or a food or nonfood animal, may be proposed as the target animal in a CNADA or EUA submitted for prevention and/or treatment of NWS infestations.

Route of Administration

It is expected that antiparasitics used to prevent and/or treat NWS infestations may be administered through several routes, including injection, topical (pour-on, spray, ointment, etc.), or oral (feed, drinking water, chewable tablet, etc.). All routes of administration are considered in this assessment.

Dose, Duration and Frequency of Drug Administration

The dosage (dose and duration) and frequency of the antiparasitic animal drug use will depend on the specific drug and target animal needs.

5.2. Alternatives

The only other alternative to the proposed actions under FDA's authority is the "no action" alternative, which would be the decision to not authorize the emergency use of an antiparasitic animal drug or not conditionally approve an antiparasitic animal drug to prevent and/or treat NWS infestations. The potential environmental effects of the no action alternative are discussed in Section 7.2 below.

As previously discussed, other efforts are occurring in Federal, state, local and tribal governments, as well as universities, to combat NWS in the U.S. USDA is responsible for the overall coordination of this effort with domestic animal, wildlife and public health agencies at the Federal and State level, as outlined in the USDA APHIS "Response Playbook New World Screwworm" (April 2026, v2).[20] For example:

- USDA APHIS suspended the import of cattle and bison along the southern border to reduce the risk of NWS entering the U.S. from U.S.-Mexico trade; however,

USDA announced a phased reopening of trade ports as long as Mexico adheres to the Joint Action Plan.[30]

- When an infestation is reported, USDA will establish zones around the affected area, and the appropriate government (e.g., state, local, tribal) will implement quarantines and movement restrictions for domestic animals to prevent the spread of NWS. USDA will perform trace investigations for animal movement from these areas to determine other areas that could be at risk of infestation.
- USDA and the Department of Interior will work with other federal, state and tribal governments to conduct surveillance of domestic animals and wildlife.
- EPA is working to register pesticides and support emergency exemptions for products to control NWS.
- USDA will implement and coordinate the production and release of sterile flies in cooperation with other federal and state authorities, and international governments (see Section 2.1.2 above for more information on the sterile fly program).

The list presented above is not exhaustive. These efforts are occurring in parallel with the use of animal drugs; however, they do not replace the function performed by animal drugs - to prevent and/or treat NWS infestations in animals until NWS is once again eradicated from the U.S.

6. Exposure Assessment

6.1. Affected Environment

Antiparasitic animal drugs used to combat NWS are expected to be used in mammals (e.g., cats, dogs, livestock, wildlife) and birds. As a result, antiparasitic animal drug residues are expected to enter the environment through excretion (i.e., urine and feces) from the treated animals and may be introduced into the terrestrial and aquatic (both water and sediment) environments in areas where the drug is being used.

It is expected that the environmental exposures to antiparasitic animal drugs used in cats, dogs, horses and minor species (including wildlife, goats, sheep, etc.) to prevent and/or treat NWS infestations will be limited due to the limited number of animals treated[31] and discrete excretion patterns. The greatest potential environmental exposure from use of antiparasitic animal drugs is expected to come from livestock (cattle, swine and poultry). Use of antiparasitic animal drugs in cattle is expected to result in the highest introduction and exposure concentrations due to their high risk of infestation (outdoor intensive-rearing conditions) and greater amount of excreta containing drug

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[30] United State Department of Agriculture. July 24, 2026. USDA Announces Phased Reopening of Southern Ports for Livestock Trade. https://www.usda.gov/about-usda/news/press-releases/2026/07/24/usda-announces-phased-reopening-southern-ports-livestock-trade (date accessed: July 18, 2026)

[31] New World screwworm (NWS) infestations in dogs and cats are low, especially compared to livestock such as cattle. As of July 2026, United States Department of Agriculture has reported only three cases of NWS infestations in dogs in Texas and New Mexico and none in cats. Up to date information on NWS infestations in the United States can be obtained at: https://www.aphis.usda.gov/animals/animal-health/livestock-and-poultry-disease/current-status/us-confirmed-cases-new-world (date accessed: July 27, 2026). In addition, during the 2016 outbreak in the Florida Keys (see Section 2.1.2 above), only a total of 145 infestations were reported (128 presumptive and 17 confirmed). Of the positive cases, 135 were reported in Key deer. The remaining 10 cases were reported in 5 dogs, 2 cats, 1 raccoon, and 2 pet pigs. No livestock were infested which is likely due to large distance between the infested area and farms where livestock are reared (USDA, 2017).

residues. However, the environmental concentrations of the drug in each environmental compartment (manure, soil, water, sediment) will be dependent on the fate of the drug (e.g., adsorption, degradation) and other environmental processes (e.g., dispersion, dilution), which may reduce the environmental exposure.

The environmental exposure will be reduced further because the geographical use of antiparasitic animal drugs to prevent and/or treat NWS infestations is expected to be limited to areas of the U.S. infested with NWS, most likely in the southern U.S. (e.g., Florida, Texas) and in seasonally warm areas in the northern U.S. In addition, the use of antiparasitic animal drugs for this purpose will be limited in duration due to regulatory requirements for authorized and conditionally approved new animal drugs (see Section 2.2.1 above and Section 6.2.4 below). Moreover, efforts are currently underway to release sterile flies, which, based on its past successes (see Section 2.1.2 above), is expected to lead to the eradication of NWS from the U.S., and ultimately, limiting the duration of the current emergency declaration. Thus, it is expected that the use of the antiparasitic animal drugs used to prevent and/or treat NWS infestations will be spatially and temporally limited.

These concepts are described in detail in Section 6.2 below.

6.2. Expected Exposure

The environmental exposure to an antiparasitic animal drug is typically determined by several factors: (1) the proposed indication and conditions of use (dose, duration, frequency, route of administration, target animal), which are described in Section 5.1 above; (2) the potential exposure pathways; and (3) the environmental fate of the drug, which is determined by its physical-chemical and fate properties. In addition, for these temporary regulatory pathways (i.e., CNADAs and EUAs), the anticipated dispersal of NWS in the U.S. and the duration of the conditional approval or authorization of the antiparasitic animal drug are also relevant factors. These factors are discussed in detail below to characterize the potential environmental exposure of antiparasitic animal drugs to prevent and/or treat NWS infestations.

6.2.1. Exposure Pathways

An exposure pathway is characterized by the introduction and predicted movement of a chemical in the environment. Antiparasitic animal drugs used to prevent and/or treat NWS infestations will be introduced into the environment via three potential routes:

1) excretion of the antiparasitic animal drug and its metabolite(s) in the urine and feces of the target animal after use of the drug, and subsequent disposal (via landfill or spread on land) of the excreta containing the antiparasitic and its metabolites,
2) wash-off of topically applied antiparasitic animal drugs from the target animal during a rain event, bathing, or after entering waterways, and
3) disposal of unused drug and containers containing drug residues after use.

The routes of introduction and exposure pathways are greatly influenced by the drug conditions of use, specifically the target animal and route of administration (injection, topical, oral). The potential exposure pathways for antiparasitic animal drugs used to prevent and/or treat NWS infestations are described below based on whether the use is in a major or minor species.

Major Species

Cats and Dogs

For cats and dogs, antiparasitic animal drugs to prevent and/or treat NWS infestations may be administered via injection, topically or orally. Following administration, some of the antiparasitic animal drug, and its metabolites, can enter the environment in the animal's urine and/or feces. If the waste is not properly disposed of, some of the antiparasitic residues could potentially enter the terrestrial environment and run off to adjacent waterways during a rain event, thereby entering the aquatic environment. However, waste management practices employed by most pet owners are expected to substantially limit the environmental introduction of antiparasitic animal drugs excreted by cats and dogs. For example, urine and feces from domestic cats are typically collected in the home (e.g., litter boxes) and disposed of as municipal waste to landfills. Alternatively, dogs and cats that have access to the outdoors will directly urinate and defecate on the ground. Many cities and counties across the U.S. have local ordinances that require dog feces to be collected from public and private lands, which is most often also disposed of via landfill (see examples of ordinances for Baltimore, Maryland[32]; McCall, Idaho[33]; Atlanta, Georgia[34]; and Drain, Oregon[35]). Leaching of antiparsitic animal drugs from landfills is not expected, as landfills are generally constructed in such a way as to reduce leachate from entering the environment (40 CFR 258.40). Additionally, some pet owners may flush urine and feces down the drain; however, this pathway is considered to be very rare and is unlikely to substantially contribute to the overall environmental introduction and exposure of antiparasitic animal drugs. Even if the waste is not collected, the density of domestic cats and dogs in rural and urban areas across the U.S. is geographically disperse, and therefore, the introduction and environmental exposure of antiparasitic animal drugs is expected to be limited and spread out over large areas, substantially reducing the environmental concentrations. Therefore, it is expected that antiparasitic animal drugs excreted by cats and dogs generally results in limited environmental introductions and exposure.

Some antiparasitic animal drugs may be administered as a topical solution on cats and dogs, and residues may wash off as a result of bathing close to the time of application and washing of bedding material, leading to the potential for environmental introduction through wastewater treatment plant discharge. This potential pathway, typically referred to as "down the drain," has been explored as part of the scientific published literature (Little and Boxall, 2020; Perkins *et al.*, 2021; Teerlink *et al.*, 2017; Domingo-Echaburu *et al.*, 2021). Although it may be possible for some topically applied antiparasitic animal drugs to wash off, travel "down the drain," and ultimately end up in wastewater treatment plants, it is expected that the environmental introduction and exposure via this route in

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[32] Baltimore, Maryland. Health Code. § 10-313. Animal Waste. https://codes.baltimorecity.gov/us/md/cities/baltimore/code/health/10-313 (date accessed: December 18, 2025)
[33] McCall, Idaho. Code of Ordinances. § 5.7.180. Canine Waste. https://codelibrary.amlegal.com/codes/mccallid/latest/mccall_id/0-0-0-4427 (date accessed: December 18, 2025)
[34] Atlanta, Georgia. Code of Ordinances. § 18-9. Removal of Canine Fecal Matter. http://atlanta.elaws.us/code/coor_ptii_ch18_arti_sec18-9 (date accessed: December 18, 2025)
[35] Drain, Oregon. Code of Ordinances. § 90.23. Dog Waste Matter. https://codelibrary.amlegal.com/codes/drainor/latest/drain_or/0-0-0-2518 (date accessed: December 18, 2025)

the U.S. is minor. In addition, it is expected that the overall concentration of antiparasitic animal drugs will be reduced in the wastewater treatment plant prior to entering the environment due to physical, chemical and fate processes (e.g., dilution, dispersion, sorption to organic solids and degradation). Therefore, antiparasitic animal drugs discharged from wastewater treatment plants are expected to result in negligible concentrations of these drugs entering waterways.

Livestock (Cattle, Swine, Poultry) and Horses

The largest proportion of animal species expected to be administered an antiparasitic animal drug to prevent and/or treat NWS infestations is livestock, most notably cattle.[36] Cattle tend to be housed in open environments, including open feedlots and pasture, which increases their risk of exposure to NWS. Horses are reared similarly to cattle in open stables and pasture; however, substantially fewer horses are maintained in a single setting. It is also expected that other livestock species, such as swine and poultry, may be administered antiparasitic animal drugs to prevent and/or treat NWS infestations. However, these animals are frequently housed in environmentally controlled and enclosed areas with either limited or no time outdoors, reducing their overall risk of NWS infestations (Jeni *et al.*, 2021).[37] In addition, although some poultry animal management systems, such as free-range, allow for a certain duration of time outdoors, these operations make up a small proportion of total poultry operations in the U.S. Regardless of their risk for NWS infestations, all livestock species were considered as part of this PEA.

Livestock and horses may also be administered antiparasitic animal drugs via injection, topically or orally to prevent and/or treat NWS infestations. Following administration, livestock and horses may excrete the antiparasitic animal drug and its metabolites in manure (the combination of feces and urine). If animals are housed on a feedlot, then the manure with the antiparasitic animal drug and metabolite residues will be collected, held at the feedlot for a period (either in manure piles, tanks, lagoons or compost piles), and then applied to cropland. If the animals are housed on pasture, then the animals will deposit manure directly on the ground in the pasture. During rainfall events, the antiparasitic and its metabolites in the manure may leach or run off from the manure and enter the terrestrial and aquatic environments during rainfall events. In addition, if the animals have access to waterways, there is a possibility that the animals could defecate directly in the water.

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[36] United States Department of Agriculture defines livestock (Title 29 Code of Federal Regulations 780.328) as “cattle, sheep, horses, goats, and other domestic animals ordinarily raised or used on the farm... Turkeys or domesticated fowl are considered poultry and not livestock within the meaning of this exemption.” However, livestock is defined differently within this assessment. It is important to note that as of June 2026 more goats and sheep, then cattle, have been treated with antiparasitic animal drugs to prevent and/or treat New World screwworm infestations. Under the Federal Food, Drug, and Cosmetic Act, goats and sheep are considered minor species, so they are evaluated as such in this assessment. As discussed below, the exposure pathways for goats and sheep are the same as cattle, but the environmental exposure is expected to be less because there are less goats and sheep, and they will produce less manure with antiparasitic animal drug residues.

[37] United States Department of Agriculture, Economic Research Service. January 8, 2025. Hogs & Pork – Sector at a Glance. https://www.ers.usda.gov/topics/animal-products/hogs-pork/sector-at-a-glance#:~:text=Most%20hog%20producers%20use%20some,country%E2%80%94the%20pork%20is%20produced (date accessed: September 2, 2025)

If livestock and horses are administered a topical antiparasitic animal drug (e.g., an ointment or spray applied to a wound, or a pour-on over the back of the animal), then there is a potential that the antiparasitic animal drug could wash off the animal during a rain event, from the use of cooling sprinklers on a feedlot, or if the animal is allowed access to a waterway close to the time of application. Topical antiparasitic animal drugs could also be washed off horses the animal is hosed off for bathing or cooling. This could result in topically applied antiparasitic animal drugs entering the aquatic environment.

Based on the potential fate properties (see Section 6.2.2 below and Table B.1 in Appendix B), some antiparasitic animal drugs and their metabolites may bind to organic matter (as estimated by a high organic carbon soil-water partition coefficient (K_{oc}) and enter the sediment in in the aquatic environment (e.g., ivermectin, doramectin, eprinomectin, moxidectin), resulting in exposure to sediment organisms, while others may remain in the water (e.g., imidacloprid), exposing water column organisms. Antiparasitic animal drug use is expected to be spatially and temporally disperse and typically results in pulsed exposures to the environment. Between exposures, the concentration of the antiparasitic animal drug and its metabolites in the water or sediment is expected to be reduced over time due to dilution, dispersion, degradation (Appendix B), and burial.

It is expected that livestock species, especially cattle, will produce the most waste of all target animals that are expected to be susceptible NWS infestations in the U.S.; thus, this pathway will result in the greatest environmental exposure of the antiparasitic animal drug and its metabolites in the manure, terrestrial and aquatic (water and sediment) environments.

Minor Species

In addition to major species, it is also expected that minor species, such as goats, sheep, captive and captured wildlife (e.g., deer), animals raised on hunting ranches and farms (e.g., quail), and zoo animals, will also be treated with injectable, topical and oral antiparasitic animal drugs to prevent and/or treat NWS infestations. The potential exposure pathways for these animals are diverse given the different environments they may live in (e.g., a captive zoo animal will have its waste collected and disposed of versus a wild animal that will deposit feces and urine directly in the terrestrial environment). Regardless, the potential exposure pathways from minor species are the same as those described above for dogs, cats, livestock/horses (feedlot and pasture reared). In addition, the potential environmental exposure due to the use of antiparasitic animal drugs in minor species is expected to be even more limited compared to major species because (unlike cats, dogs, livestock and horses) wildlife are considerably more geographically dispersed, and the population of minor species is much smaller than major species (i.e., limited antiparasitic use and excretion over large areas), resulting in limited environmental introduction and exposure.

6.2.2. Physical-Chemical and Fate Properties of Antiparasitic Animal Drugs

The physical-chemical and environmental fate properties of antiparasitic animal drugs vary. These properties provide information on the potential transport, fate and bioavailability of the drugs in each environmental compartment (manure, soil, water-column, and sediment). Table B.1 in Appendix B reports various physical-chemical and

environmental fate properties, including water solubility, K_{oc} and degradation, from EAs published by FDA for approved antiparasitic animal drugs.

The majority of antiparasitic animal drugs have low water solubility and a high K_{oc}, indicating that they have a low affinity for remaining in the water column and have a tendency to sorb to organic carbon in soil or sediment. According to the mobility classification system created by the Food and Agriculture Organization of the United Nations (FAO)[38], which is used by EPA[39] in pesticide risk assessment, chemicals with a K_{oc} between 1,000-10,0000 L/kg are slightly mobile, 10,000-100,000 L/kg are hardly mobile, and >100,000 L/kg is considered immobile. Most antiparasitic animal drugs listed in Table B.1 range from 7,520 to 86,900 L/kg, which meet the criteria of slightly to hardly mobile (FDA, 1985; FDA, 1996a; FDA, 1996b; FDA, 2001; FDA, 2016; Jayasuriya ***et al.***, 2021; FDA, 2022). These characteristics suggest that many antiparasitic animal drugs will remain primarily in solid phases of manure and soil, with proportionally little in the liquid phase. If manure or soil containing the antiparasitic animal drug is transported via runoff from land it is expected that the drug will remain primarily bound to soil particles or dissolved organic carbon. If the drug bound to soil or organic carbon is then introduced into waterways via runoff, it would be expected to settle with the soil particles or partition primarily to the sediment environment (i.e., very little will be present in the water column).

However, some antiparasitic chemical classes, such as phenylpyrazoles (e.g., fipronil) and neonicotinoids (e.g., imidacloprid), have higher water solubilities and lower K_{oc} values indicating the potential for increased mobility in the environment, including the terrestrial environment, and have been reported to be present within the water-column (ECHA, 2025a; ECHA, 2025b; Gupta and Gajbhiye, 2007; FDA, 2022; EPA, 2012; ECHA, 2011). For example, imidacloprid has a K_{oc} of 266 L/kg, which would be classified as moderately mobile under the FAO's classification system. [38,39] Therefore, some types of antiparasitic animal drugs may have a higher propensity to be in the water column compared to those with high K_{oc} values.

Degradation of the antiparasitic animal drug and its metabolites in the soil, water, and sediment environments could also occur through photodegradation, and aerobic and anaerobic degradation, which will reduce the environmental concentration and exposure. Table B.1 in Appendix B lists soil and sediment dissipation half-life values (DT_{50}) reported in FDA EAs for various antiparasitic animal drugs. The soil DT_{50} values ranged from 13 to 260 days. Sediment DT_{50} values ranged from 27.4 to 187 days. Most of the antiparasitic animal drugs listed in Table B.1 had DT_{50} values of less than 100 days.

Animal drugs that are persistent (i.e., slow to degrade) in the environment have the potential to accumulate. According to FDA-CVM's Guidance for Industry (GFI) #166 (FDA-CVM, 2006), "for persistent compounds (e.g., DT_{90} > 1 year in soil based on the

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[38] Food & Agriculture Organization of the United Nations (FAO). 2000. Appendix 2. Parameters of pesticides that influence processes in the soil. In FAO Information Division Editorial Group (Ed.), *Pesticide Disposal Series 8. Assessing Soil Contamination. A Reference Manual.* https://www.fao.org/4/X2570E/X2570E06.htm (date accessed: June 12, 2026)

[39] Environmental Protection Agency. 2010. Guidance for Reporting on the Environmental Fate and Transport of the Stressors of Concern in Problem Formulations. https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/guidance-reporting-environmental-fate-and-transport#II_C (date accessed: June 12, 2026)

annual application)," accumulation in the environment should be considered.[40] When sufficient reliable information indicates that an antiparasitic animal drug for use to prevent and/or treat NWS infestations has DT_{90} > 1 year, additional evaluations will be conducted as part of the associated FONSI or a separate tiered EA or EIS, as needed.

6.2.3. Geographic Dispersal of NWS in the U.S.

The geographic dispersal of NWS in the U.S. is a factor to consider when determining the potential areas within the U.S. where antiparasitic animal drugs may be introduced into the environment.

NWS requires warmer climates that help ensure proper development. As reported by USDA[14], adult NWS flies prefer air temperatures between 77° and 86°F, with relative humidity ranging between 30 and 70%. Therefore, it can be reasonably assumed that NWS will mainly inhabit areas of the U.S. with warmer climates, including states along the southern border (e.g., Texas, New Mexico, Louisiana, Mississippi, Florida). Due to the warm climates in this region, it is expected that NWS may inhabit southern states year-round (Valdez-Espinoza *et al*., 2025), as they did before they were eradicated in 1966 (see Section 2.1.2 above). It is also likely that NWS may expand further north, especially during summer months when conditions are more favorable. However, any movement of NWS into northern states is expected to be limited to only warmer months, and therefore, intermittent.

Based on the expected dispersal of NWS, this PEA conservatively assumes that the use of antiparasitic animal drugs conditionally approved or authorized to prevent and/or treat NWS infestations will occur year-round in southern states (especially those along the southern border), while use in northern states will be more limited to warmer months.

6.2.4. Duration of CNADA and EUA

As discussed in Sections 2.2.1.1 and 2.2.1.2, CNADAs and EUAs are limited in the duration they can be marketed, thereby limiting the concentration of the animal drug introduced into the environment. Conditionally approved animal drugs can only be marketed for a maximum of 5 years (with limited exceptions where FDA-CVM issues a 180-day extension (21 U.S.C. 360ccc(h))), after which the CNADA automatically terminates and FDA-CVM either approves an NADA for the drug or the drug must come off the market. Likewise, EUAs authorized under the August 19, 2025, emergency declaration[26], will be terminated once the declaration is terminated by HHS unless the EUA is revised or revoked earlier (with limited exceptions under section 564(f)(2) of the FD&C Act). Based on the past success of the sterile fly program in the U.S. (see Section 2.1 above), it is expected that NWS will be eradicated from the U.S. in less than 5 years and the conditionally approved and authorized animal drugs to prevent and/or treat NWS infestations will no longer be marketed unless they are approved under an NADA. Even if they are fully approved to prevent and/or treat NWS infestations, once NWS is eradicated in the U.S., it is reasonable to expect that the drug will no longer be used for that intended use.

It is important to note that if an applicant pursues a full NADA or ANADA approval of an antiparasitic animal drug to prevent and/or treat NWS infestations, which would allow for

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[40] DT_{90} is defined in the Food and Drug Administration's Center for Veterinary Guidance for Industry #166 as the time to degradation of 90% of original concentration of the compound in the tested soils.

indefinite use, they will need to submit a separate claim of categorical exclusion or EA to support that specific proposed action (21 CFR 25.15(a)). Therefore, FDA would conduct a separate NEPA evaluation for that full (A)NADA approval.

6.2.5. Disposal of Unused Drug and the Container

Disposal of unused animal drug as well as the container that held the animal drug may lead to introduction of the animal drug into the U.S. environment if not disposed of properly. Introduction of an unused antiparasitic animal drug and its container into the environment from disposal is expected to be negligible compared to the use in animals. When the disposal of an antiparasitic animal drug and the drug container poses a potential risk, the product labeling under the CNADA and EUA, including Fact Sheets, will include storage and disposal directions for the users.

6.2.6. Concurrent Use and Overlapping Environmental Exposure

There is a potential for different antiparasitic animal drugs conditionally approved or authorized for prevention and/or treatment of NWS infestations to enter the same terrestrial and/or aquatic environments at or close to the same time, resulting in overlapping environmental exposure. There are three possible scenarios in which this could occur:

1) a single animal may be treated with one or more antiparasitic animal drugs simultaneously or at different times (e.g., days or weeks apart). For example, a topical antiparasitic animal drug may be applied directly to a wound to treat an active infestation while a different topical or injectable antiparasitic animal drug is administered systemically to prevent future infestations[41], or a subsequent treatment with the same or different antiparasitic animal drug is administered if the initial treatment was unsuccessful.
2) different animals on the same farm could be treated with different antiparasitic animal drugs at the same or different times (e.g., days or weeks apart). For example, a cow could be treated with one antiparasitic animal drug and a sheep reared on the same farm could be treated with the same or a different antiparasitic animal drug.
3) different animals on different farms in the same watershed could be treated at the same time with the same or different antiparasitic animal drugs.

7. Effects Assessment

7.1. Potential Effects of the Proposed Actions

Due to their mode of action (e.g., overexcitation of ion channels within the central nervous system of parasites leading to paralysis and death), invertebrates are expected to be more sensitive to antiparasitic animal drugs than plants, mammals, fish or birds. However, the type of effect and severity of effects is dependent on the chemical and the exposure (concentration, duration, and frequency). Effects data reported in previous EAs completed for the approval of various antiparasitic animal drugs (Tables B.2 and B.3 in Appendix B) indicate that acute exposures to high concentrations of antiparasitic animal

[41] For example, The Food and Drug Administration's Center for Veterinary Medicine has authorized Fact Sheets for Emergency Use Authorizations directing the user to administer the animal drug at the time of initial wound care, but to use another animal drug product if infestation develops.

drugs can result in mortality, while chronic exposures to lower concentrations can cause effects on growth, development, and reproduction in certain invertebrates.

It should also be noted that although metabolites of antiparasitic animal drugs have been detected in livestock manure, indicating that metabolites may also enter the environment, they are often reported to be less toxic than the parent compound. For example, the median lethal concentration (LC_{50}) in *Daphnia magna* for the parent compound, ivermectin, and a major metabolite, ivermectin-monosaccharide, have been reported as 20 ng/L and 400 ng/L, respectively (FDA, 1983). Similar results for other metabolites of ivermectin and other antiparasitic animal drugs have also reported reduced toxicity when compared with their parent compounds (Halley *et al.*, 1989; FDA, 1996b; FDA, 2001; Lumaret *et al.*, 2012). However, it is possible that some metabolites could be more toxic than the parent compound. When sufficient reliable information is identified to support that the metabolite(s) is more toxic than the parent compound, additional analysis may be included in the associated FONSI, tiered EA, or EIS, if necessary.

7.1.1. Effects on Dung Fauna

In the terrestrial environment, the most sensitive invertebrates have been found to be dung fauna. Other terrestrial invertebrate species, including earthworms, are less affected by exposure to antiparasitic animal drugs (see Table B.3 in Appendix B). Previous EAs published by FDA for approved antiparasitic animal drugs reported effects on survival, development, and reproduction of dung flies and dung beetles following chronic exposures to antiparasitic animal drugs (see Table B.3 in Appendix B). Dung fauna, and especially dung beetles, provide important services to maintain the health and functioning of ecosystems. The primary ecosystem service provided by dung fauna is decomposing livestock manure by feeding on and nesting inside, which improves soil health, enhances nutrient cycling, and reduces the need for chemical fertilizers (Skidmore, 1991; Mariod *et al.*, 2017; Floate, 2023). Dung fauna also provide additional ecological services such as dispersing seeds, acting as pollinators, and as food sources for predators (e.g., other insects, birds, and small mammals), serving as a biological control for livestock pests, reducing greenhouse gas emissions from livestock manure, and fertilizing soil (Floate, 2023; Nichols *et al.*, 2008; Slade *et al.*, 2016; deCastro-Arrazola *et al.*, 2023). Based on the importance of these ecosystem services, adverse effects to dung fauna as a result of the use of antiparasitic animal drugs to prevent and/or treat NWS infestations could lead to adverse effects on the ecosystem.

7.1.2. Effects on Aquatic Invertebrates

In the aquatic environment, the most sensitive invertebrates will depend on whether the antiparasitic animal drug will be present in the water column, sediment or both, as discussed in Section 6.2.2 above. Antiparasitic animal drugs could cause effects to both zooplankton and macro-invertebrates dwelling in these compartments depending on the concentration, duration and frequency of exposure. Acute and chronic effects in surrogate water column and sediment-dwelling invertebrates reported in EAs for various approved antiparasitic animal drugs are presented in Table B.1 and Table B.2, respectively, in Appendix B, and include mortality, immobilization, effects on development, and decreased growth. These effects, if great enough, could cause impacts on the overall ecosystem diversity and structure by affecting certain necessary ecosystem functions conducted by different types of invertebrates (e.g. decomposers,

grazers, shredders, filter feeders, predators) and limiting food availability or predatory services.

According to FDA-CVM's GFI #166 (FDA-CVM, 2006), bioaccumulation should be assessed if the log octanol-water partition coefficient (Kow) ≥ 4, which is the case for many antiparasitic animal drugs (see Table B.1 in Appendix B). In addition, FDA-CVM's threshold value of concern for potential secondary poisoning is a bioconcentration factor (BCF) in fish of ≥1,000 (FDA, 2006). Bioaccumulation of some antiparasitic animal drugs have been reported in plants, crustaceans, and fish in FDA-CVM EAs (FDA, 1996c; FDA, 2016). For example, ivermectin has a reported BCF of 19 to 69 (FDA, 1996c). In addition, ivermectin, lufenuron, and other antiparasitic animal drugs (e.g., imidacloprid) have been shown to depurate when the exposure is removed (FDA, 1996c; FDA 2016; FDA, 2022). Considering all this information collectively, bioaccumulation is not considered to be of great concern for most antiparasitics but should be considered in FONSIs or individual tiered EAs or EISs when sufficient reliable information identifies a concern.

7.1.3. Mixture Effects

There is a potential for aquatic organisms in the same affected environment to be exposed to multiple antiparasitic animal drugs at the same time or close in time due to concurrent use as described in Section 6.2.6. Predicting the effects of mixtures of antiparasitic animal drugs in aquatic organisms is extremely difficult, if not impossible, due to the many factors that affect mixture exposures and effects, such as (1) the modes of action of each antiparasitic will affect how the non-target organisms may be affected; (2) the life-stages of the non-target organisms will affect their susceptibility to different antiparasitics; (3) differences in the fate of each antiparasitic will affect where the chemical will be present and at what concentration; and (4) exposure concentration, bioavailability, duration and frequency of each individual chemical will be different and determines the effect in the non-target organism. All of these factors are unknown, and most cannot be predicted. The effects of mixtures of antiparasitic drugs have not been evaluated because of the unknown combinations of antiparasitic animal drugs that could occur in the environment, which cannot be predicted, and therefore, generating effects data of various mixtures of antiparasitic animal drugs would not provide any useful information to aid in determining risk, and would be cumbersome and costly.

7.2. Potential Effects of the No-Action Alternative

The no-action alternative would be the failure to authorize or conditionally approve antiparasitic animal drugs to prevent and/or treat NWS infestations in animals. As explained in Section 2.1 above, NWS is a parasitic fly that infests warm-blooded animals and, if left untreated, can result in tissue damage in wounds and mucous membranes (e.g., nose), secondary infections, and potentially death of the animal (Novy, 1991).[6,7] Failing to conditionally approve or authorize animal drugs to prevent and/or treat NWS infestations could result in (1) propagation and spread of NWS, (2) increased infestations and suffering and death of untreated animals, such as livestock, wildlife, and pets, (3) effects on the food supply chain, and (4) economic impacts.

Prior to eradication in the U.S. in 1966, NWS myiasis had been reported in Texas cottontail rabbits, Texas jack rabbits, Texas opossum, racoons, and white-tailed and Key deer (Wainwright *et al.*, 2024). During the NWS infestation of endangered Key deer in

2016-2017, it is estimated that 135 deer were euthanized due to the outbreak in the Florida Keys (Wainwright *et al.,* 2024). It has been estimated that for every deer euthanized during the infestation, another died in the field; thus, it is likely that as many as 270 Key deer died due to that single outbreak (Wainwright *et al.,* 2024).

Although NWS does not present a food safety issue[42], it could potentially disrupt the agricultural food supply chain in the U.S. by limiting beef supplies due to the suspension on imported cattle along the southern border, restricting movement of cattle from quarantined areas during outbreaks and livestock trade from infested zones, and the need to euthanize severely infected wildlife and livestock. Novy (1991) reported that the estimated cost to the livestock industry in the southeast in 1957 was $20 million annually and in the southwest, the cost was estimated at more than $100 million in 1960, due in part to losses from animals that would have entered the food supply, thus suggesting a significant effect on the U.S. food supply. Due to an increase in livestock held in the U.S. today, the impact on the food supply is expected to be substantially greater.

Similar impacts could be expected in the U.S. if animal drugs are not available to treat active NWS infestations and prevent new infestations from occurring.

8. Risk Characterization

The purpose of this risk characterization is to evaluate whether the potential environmental exposure due to the use of antiparasitic animal drugs to prevent and/or treat NWS infestations in various target animals is likely to result in reasonably foreseeable environmental effects, and if so, whether those effects are significant.

Risk is characterized by the likelihood of exposure and the likelihood of effects occurring based on that exposure. Therefore, exposure and effect are required components of risk; without exposure or effect there is no risk. It follows that the more limited the environmental exposure, the lower the risk of effects occurring.

For the current assessment, the magnitude of the environmental introduction of and exposure (concentration, duration, and frequency) to an antiparasitic animal drug will be different depending on the target animal that receives the animal drug. As summarized in Section 6.2, livestock species, especially cattle, will produce the most waste containing antiparasitic animal drug residues based on the intended use; thus, this pathway is expected to result in the highest environmental exposure in the manure, terrestrial and aquatic (water and sediment) environments. The highest exposure will also result in the highest risk. Therefore, the current evaluation was separated between livestock, mainly cattle, and all other species (i.e., cats, dogs, horses, and minor species).

8.1. Environmental Risk of Antiparasitic Drugs Used in Cats, Dogs, Horses and Minor Species

As described in Section 6.2, the introduction of antiparasitic animal drugs from cats, dogs, horses and minor species is expected to be limited and dispersed over large areas, substantially reducing the environmental exposure. Due to these generally

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[42] United States Department of Agriculture, Animal and Plant Health Inspection Service. July 2, 2026. Stop Screwworm: Unified Government Response to Protect the United States. https://www.aphis.usda.gov/animals/animal-health/livestock-and-poultry-disease/stop-screwworm (date accessed: July 2, 2026)

discrete exposure pathways, it is expected that antiparasitic animal drugs excreted by these species will generally result in limited environmental introduction and exposure, and therefore, are of limited risk. In fact, full NADA approvals, which allow for unlimited nationwide use of antiparasitic animal drugs for nonfood animals, such as cats, dogs, horses, and nonfood animal minor species, are eligible for a categorical exclusion from the requirement to prepare an EA or EIS under 21 CFR 25.33(d)(1), for an action on an NADA, abbreviated application, request for determination of eligibility for indexing, a supplement to such applications, or a modification of an index listing, for drugs intended for use in nonfood animals.[43] Similarly, full NADA approvals for antiparasitic animal drugs for minor species, including endangered species and wildlife, are eligible for a categorical exclusion under 21 CFR 25.33(d)(4) when the drug has been previously approved for use in another or the same species where similar animal management practices are used. Although these categorical exclusions cannot currently be used for actions on CNADAs and EUAs (see Section 4.1 above), the environmental introduction and exposure is expected to be similar to or less than that of a full NADA approval (see Section 6.2 above), supporting a low likelihood of significant effects from the conditional approval or authorization for emergency use of antiparasitic animal drugs for nonfood animals, such as cats, dogs and horses, and minor species (e.g., wildlife, goats and sheep).

In addition, the use of the antiparasitic animal drugs for the prevention and/or treatment of NWS infestations, and therefore, the introduction into the environment, will be limited both spatially and temporally due to the expected limited geographical distribution of NWS in the U.S. and limited durations of CNADAs and EUAs (see Sections 6.2.3 and 6.2.4 above). Furthermore, the past success of the sterile fly program in eradicating NWS from the U.S. in less than 5 years once the sterile flies were released further supports that use of animal drugs for NWS infestations will likely be limited spatially and temporally. Collectively, this information supports a very low risk of significant effects from the use of antiparasitic drugs in cats, dogs, horses and minor species.

8.2. Environmental Risk of Antiparasitic Drugs Used in Livestock

The majority of antiparasitic animal drugs that are expected to enter the environment, and pose the greatest environmental risk, are those administered in livestock species, especially cattle (see Section 6.2.1 above). As described in Section 6.2 above, antiparasitic animal drugs used to prevent and/or treat NWS infestations in livestock can enter the environment via two routes. First, antiparasitic animal drugs may be excreted in the manure of the target animal. For livestock held on a feedlot, manure containing antiparasitic animal drug residues is collected and held for a period of time before application to cropland. If the livestock are held on pasture, the manure containing antiparasitic animal drug residues is directly deposited on land or potentially in waterways. Following rain events, if the antiparasitic animal drug is mobile (see Section 6.2.2 above), then some portion of the residues in the manure may leach or runoff from the manure into the terrestrial environment, and then some portion of the residues in the terrestrial environment could also potentially enter nearby aquatic environments (e.g.,

[43] This categorical exclusion was established by the Food and Drug Administrations (FDA's) Center for Veterinary Medicine in 1997 (62 Federal Register 40592, July 29, 1997) after FDA demonstrated in many environmental assessment and findings of no significant impact that drugs used in nonfood animals do not normally result in significant environmental impacts. This categorical exclusion was established prior to Congress amending the Food, Drug and Cosmetic Act to provide for expanded conditional approval and emergency use authorizations for animal drugs (see Sections 2.2 and 4.1 above).

streams, rivers). Second, topical antiparasitic animal drugs (e.g., pour on, spray, ointment) used on livestock may also enter the aquatic environment via wash off during a rain event, use of sprinklers on feedlots, or the animal directly entering the waterway following administration of the drug. The hydrophobicity and K_{oc} value of each drug will influence the concentrations of the drug in the water column and sediment, influencing risk in these environmental compartments. In addition, the concentration of the antiparasitic in the water or sediment environment will likely be reduced over time due to dilution, dispersion, degradation, and burial. Additional discussion on influence of physical-chemical and fate properties on the environmental exposures of antiparasitic animal drugs is provided in Section 6.2.2 above.

Based on the expected environmental exposure of antiparasitic animal drugs described above, and the fact that invertebrate species are the most sensitive to antiparasitic animal drugs, the most at-risk organisms for the proposed actions are expected to be dung fauna in the terrestrial environment, and water column and sediment-dwelling invertebrates (zooplankton and macro-invertebrates) in the aquatic environment (see Section 7). Therefore, it is reasonably foreseeable that environmental effects in these species may occur in some locations depending on the antiparasitic animal drug and magnitude of exposure. However, any effects are expected to be limited due to the spatially and temporally limited environmental exposures, as well as recovery of invertebrate populations following exposure. These factors are discussed in detail below.

Because the exposure and effects of the antiparasitic animal drugs for prevention and/or treatment of NWS infestations are expected to be limited and short-term, the potential risk is expected to be low, and any effects in dung fauna or aquatic invertebrates are not expected to be significant. It is also important to note that many of these antiparasitic animal drugs have previously been approved for similar uses in the same or a similar target animal with the same conditions of use. As part of the approval process, an environmental evaluation determined that no significant environmental impacts were expected as a result of the nationwide, indefinite use, which further supports a low likelihood of significant effects from the conditional approval or authorization for emergency use of antiparasitic animal drugs for livestock species.

8.2.1. Spatially and Temporally Limited Exposures

The environmental introduction and exposure of antiparasitic animal drugs will be limited both spatially and temporally based on the expected distribution and occurrence of NWS in the U.S. It is expected that antiparasitic animal drugs will only be used in areas of the U.S. where there is an active NWS infestation or the potential for an infestation. These areas would be expected to have the highest risk due to the greatest use and exposure of antiparasitic animal drugs. However, as the need and use of these antiparasitic animal drugs is reduced due to the control, reduction and eventual eradication of NWS, the environmental introduction and exposure will be reduced, lowering the risk of effects.

Although this assessment assumed that NWS may occur nationwide, it is expected that due to climate preferences, NWS will be mostly present in the southern U.S. (e.g., Texas, New Mexico, Louisiana, Mississippi, Florida). This is further supported by Valdez-Espinoza *et al.* (2025) who conducted modeling to determine the potential for distribution and establishment of NWS in the U.S. Using Ecological Niche Models and Species Distribution Models to consider climate and host animal populations (e.g., cattle, swine), Valdez-Espinoza *et al.* (2025) concluded that Texas and Florida have the highest risk due to suitable climatic conditions; however, other southern states and California also

have favorable conditions for NWS to occur. In addition, Valez-Espinoza *et al.* (2025) noted that the estimated distribution within the U.S. was similar to that observed in the U.S. prior to eradication in 1966. Expansion into the northern U.S. may also occur but it would be limited to mid to late summer when temperatures are ideal for NWS (Krafsur *et al.*, 1987; Novy, 1991).

Federal, state, local and tribal governments are coordinating efforts to limit the dispersal of NWS and quickly eradicate NWS in the U.S., as outlined in the USDA APHIS "Response Playbook New World Screwworm" (April 2026, v2)[20]. The coordinated response is likely to slow and limit the movement and dispersal of NWS in the U.S.[20], which will reduce the need for antiparasitic animal drugs to prevent and/or treat NWS infestations. However, the sterile fly program is expected to be the most important factor in this plan. The past use of the sterile fly program in the U.S. demonstrates that it is successful at eradicating NWS within months for smaller outbreaks (October 2016 Key deer infestation) to less than 5 years for large outbreaks (~4-5 years for eradication of NWS in the Southwestern U.S. from 1962-1966; see Section 2.1). Therefore, although several efforts are currently being utilized as part of the current NWS outbreak[20], including the use of antiparasitic animal drugs, it is expected that after the sterile fly program is fully operational and sterile flies are repeatedly released in the U.S., that the NWS population will be reduced and eventually eradicated, which will ultimately reduce and eliminate the use for antiparasitic animal drugs to prevent and/or treat NWS infestations.

Following eradication of NWS from the U.S. and termination of the EUA declaration by HHS, all EUAs issued under that declaration are terminated, with limited exceptions under section 564(f)(2) of the FD&C Act, and can no longer be marketed for that specific use in the U.S. In addition, as stated previously, CNADAs are automatically terminated after five years, unless the Secretary grants a 180-day extension. After which, the antiparasitic animal drug must be fully approved under an NADA or removed from the market.[44] Thus, environmental exposure to antiparasitic animal drugs used under CNADAs and EUAs to prevent and/or treat NWS infestations will only occur during the limited time that they will be marketed (~5 years), thereby limiting environmental exposure and risk.

All of the factors described above are expected to limit the overall environmental introduction and exposure of antiparasitic animal drugs to non-target animals, thereby, lowering the environmental risk associated with these actions.

8.2.2. Recovery Following Exposure

The overall goal of risk assessment at FDA-CVM, including this PEA, is the protection of ecosystems, as discussed in FDA-CVM GFI #166 (FDA, 2006). Ecosystems are comprised of populations of organisms, whether plant or animal, with populations being comprised of individual organisms. Therefore, in order to have an impact on an ecosystem, an effect must first occur in an individual organism, which could result in an impact on the population if enough individuals are affected. For example, if reproduction is reduced in individual organisms, a reduction in the size of that specific population may occur over time. Decreased population size of a particular species could impact the

[44] The submission of a New Animal Drug Application is a new major federal action that would initiate the requirement for a new environmental review under the National Environmental Policy Act.

overall ecosystem structure by affecting certain necessary ecosystem functions and limiting food availability or predatory services.

Although it is expected that antiparasitic animal drugs used in livestock species to prevent and/or treat NWS infestations, will cause effects in individuals, including dung fauna and aquatic invertebrates (see Section 7.1 above), these effects are expected to be limited for the reasons summarized in Section 8.2.1 above. Furthermore, it is expected that when exposures are removed, populations will recover, and significant effects are unlikely. The ability of the ecosystem to recover following exposure further reduces the risk for significant long-term impacts of ecosystems due to the use of antiparasitic animal drugs for the prevention and/or treatment of NWS infestations.

8.2.2.1. Recovery of Dung Fauna

As described in Section 7.1.1 above, antiparasitic animal drugs can cause adverse effects in dung fauna, making them a susceptible non-target organism. It is likely that adverse effects, such as reduction in abundance and diversity of dung fauna species, will occur in some pastures where antiparasitic animal drugs are used to prevent and/or treat NWS infestations. Impacts on dung fauna individuals and populations following exposure to antiparasitics in livestock manure have been reported in the literature (Kruger and Scholtz, 1998a; Finch *et al.*, 2020; Floate *et al.*, 2008).

These impacts could disrupt the important ecosystem services dung fauna provide, thus resulting in adverse impacts on the ecosystem as a whole. However, due to the factors that are expected to limit the environmental exposure of antiparasitic animal drugs, including the spatial and temporal limitations, the overall severity of the impacts on dung fauna are also expected to be limited. Therefore, these ecosystems are expected to recover following the repopulation and recolonization of dung fauna, thus indicating that any adverse effects on dung fauna will not be significant.

This has been demonstrated in monitoring studies which have shown the ability of dung fauna to recover, recolonize, and repopulate after exposure to antiparasitics in livestock manure. For example, in a study conducted by Floate (1998), the average emergence of specific dung fauna species from manure containing ivermectin was significantly reduced after one week following administration in cattle. However, a gradual increase in average emergence was observed over the next 11 weeks. Additional studies have reported similar results (Floate *et al.*, 2002; Dadour *et al.*, 2000).

In addition, dung beetles are known to be strong fliers and will locate fresh manure from considerable distances by following the odors emitted by the manure (Halffter and Edmonds, 1983). They not only move among manure in a single pasture, but they will also frequently move between pastures. Movement between pastures, especially long-distances, is typically the result of several short-distance movements (Hanski, 1980). The reported travel distance per year of dung beetles range from several dozens of kilometers to 300 kilometers (Fincher *et al.*, 1983; Barbero and Lopez-Guerrero, 1992). Mature female dung beetles may leave manure considered unsuitable for reproduction and seek out more suitable manure for laying eggs. This behavior can result in new generations of dung beetles across pastures (Hanski, 1991). Similar behavior has also been reported for dung flies (Byford *et al.*, 1987; Kunz *et al.,* 1983; Fales, 1964; Killough *et al.*, 1965; Blanckenhorn *et al.,* 2000). Therefore, in addition to recovery of dung fauna populations on a single pasture, it is also likely that unaffected dung fauna populations from other pastures can repopulate and recolonize impacted populations.

Moreover, effects on dung fauna populations from exposure to antiparasitic animal drugs in livestock manure are also reportedly dependent on environmental factors such as weather conditions (e.g., rainfall, temperature) (Kryger *et al.*, 2005; Kruger and Scholtz, 1998b; Webb *et al.*, 2007; Verdu *et al.*, 2018). Differences in environmental factors have been implicated in the reporting of inconsistent results across certain studies. This highlights the complexity of ecosystems, which can further affect recovery (FDA, 2001).

8.2.2.2. Recovery of Aquatic Invertebrates

Potential impacts to aquatic invertebrate communities, including zooplankton and macro-invertebrates dwelling in the water column and sediment, from exposures to antiparasitic animal drugs have been discussed in the published literature (Sanderson *et al.*, 2007; Boonstra *et al.*, 2011; Brinke *et al.*, 2010). However, aquatic invertebrate communities have been shown to recover following pulse, episodic exposures to stressors, like antiparasitics and insecticides[45], due to internal (Sanderson *et al.*, 2007; Boonstra *et al.*, 2011; Brinke *et al.*, 2010; Mesa *et al.*, 2018) and external recolonization (Gergs, *et al.*; 2016; Mebane, 2022; Schweitzer *et al.*, 2010).

Two review articles, Gergs *et al.* (2016) and Mebane (2022), thoroughly summarized and synthesized results of studies that evaluated recovery of aquatic organisms (plants, invertebrates and fish) following acute and chronic exposures[46] to various stressors, including exposure to insecticides (pesticides). According to Gergs *et al.*, (2016) and Mebane (2022), several factors affected the recovery of the affected aquatic invertebrates. First, the species characteristics (e.g., life-history traits) of the affected organisms, and population dynamics and interactions affect how quickly the ecosystem will recover. For example, both reviews reported that aquatic invertebrate communities (zooplankton and macro-invertebrates) recover faster than fish communities due to shorter generation times (i.e., shorter life cycles and faster reproduction). Second, recovery time was dependent on the scale of the exposure, including magnitude of the exposure (concentration, duration, and frequency), extent of the affected area, as well as severity of the effect. For example, as expected, recovery from acute exposures occurs faster than chronic exposures, and populations that are driven close to extinction (>90% population reduction) take longer to recover than less affected populations. In addition, disturbances that occur on a wide scale take longer to recover than localized disturbances. Third, the distance and connection to unaffected areas with source populations reduced the time to recovery. Recovery in isolated ecosystems is typically driven by surviving organisms, known as internal recolonization. However, external recolonization can also occur by migration of organisms when an affected ecosystem is close or connected to an unaffected ecosystem(s). For example, lotic systems (moving or flowing water) recover faster than lentic systems (static or isolated water) due to

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[45] Insecticides are a class of pesticides that can be applied on farms and cropland to control populations of insects that can affect crops and animals. Pesticides can be applied to cropland to protect plants in a similar application pattern to manure containing an antiparasitic being spread on cropland as fertilizer resulting in similar runoff patterns. In addition, pesticides can also be applied externally to animals, similar to antiparasitic animal drugs, resulting in similar exposures due to wash-off.

[46] In Gergs *et al.* (2016) and Mebane (2022), acute exposures are referred to as pulse exposures and chronic exposures are referred to as press exposures. In addition, it is important to note that these review articles did not include data on recovery from antiparasitic animal drug exposure; however, the general information on recovery following chemical exposure, especially that for pesticides which have a similar exposure route as animal drugs, is useful to understand how an ecosystem may recover following exposure to an antiparasitic animal drug.

passive and active dispersal of organisms from unimpacted areas within the connected system. Many studies have found that recovery times for impacted ecosystems that have access or are connected to unaffected ecosystems are reduced (Gergs *et al.*, 2016; Mebane, 2022). Gergs *et al.* (2016) reported mean recovery times of 0.90 and 1.68 years for lotic and lentic systems, respectively, when recovery times were pooled from studies evaluating various environmental stressors.[47]

Similar recovery via internal and external recolonization has been observed with other stressors as reported by Gergs *et al.* (2016) and Mebane (2022). The recovery time ranges and means reported in Gergs *et al.* (2016) and Mebane (2022) were pooled for several different stressors, including metals, constructed systems, non-pesticide organic chemicals, pesticides, natural disasters (flood and drought) and physical disturbances. Neither Gergs *et al.* (2016) nor Mebane (2022) specifically focused on recovery of aquatic organisms following the use of antiparasitic animal drugs; however, their synthesis of data from studies evaluating recovery of aquatic ecosystems following disturbances provides insight into the potential recovery of aquatic invertebrate communities following exposures to antiparasitic animal drugs. Especially the recovery data for insecticide exposures, which are a similar chemical class to antiparasitic animal drugs, have similar exposure pathways[45], and also result in pulse exposures.

Gergs *et al.* (2016) found that zooplankton recovery was rapid (weeks to less than one year) following disturbances by different stressors[47], even when populations were reduced by >90%. Macro-invertebrate (Diptera, Ephemeroptera, Oligochaeta, Macro-crustacea (e.g., *Gammarus pulex*), Plecoptera, Trichoptera, Heteroptera, Odonata, Coleoptera, and Mollusca) recovery ranged from 1 day to 15 years with the mean recovery time ranging from 0.9 to 2.9 years. When considering only the recovery from pesticide exposure, Gergs *et al.* (2022, Figure 5) reported recovery of lotic macro-invertebrates (30 recovery endpoints from multiple studies) was <1 year. Mebane (2022) classified the ecosystem disturbances from different stressors as level 1 (most disturbing) to level 4 (least disturbing). The application of insecticides was classified as level 3 because pesticide exposure generally did not cause complete elimination of invertebrates, which resulted in shorter recovery times than more severe disturbances. Mebane (2022) determined that median recovery times were 1 year for level 3 disturbances, and within 3 years in 75% of the cases evaluated. Based on an evaluation of the literature, Mebane (2022) concluded that affected organisms can recover quickly (3 to 5 generations) following moderate disturbances with access to nearby unaffected populations. Both Gergs *et al.* (2016) and Mebane (2022) caution that repeated pulse exposures (over years), like that from pesticide use, could mimic chronic exposures, if the magnitude is great enough, by reducing sensitive invertebrate populations with each pulse to a point that it reduces yearly recruitment and shifts community structure and diversity. Thus, depending on the frequency of application and the chemical, pesticides, and similarly antiparasitic animal drugs, could result in both acute and chronic exposures depending on the frequency of exposure and the degradation of the compound in the environment. Both articles found that longer recovery times were usually due to large scale pesticide disturbance from multiple applications over several years, as well as low dispersal ability of affected populations.

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[47] Gergs *et al.* (2016) evaluated recovery from exposures to metals, constructed systems, non-pesticides organic chemicals, pesticides, natural disasters (flood and drought) and physical disturbances.

FDA-CVM could not identify any studies in the published literature that were specifically designed to study the recovery of aquatic systems following exposure to antiparasitic animal drugs. However, there are some microcosm and mesocosm studies that observed recovery via internal or external recolonization following exposure to ivermectin (a macrocyclic lactone) (Sanderson et al., 2007; Brink et al., 2010; Schweitzer *et al.*, 2010; Boonstra *et al.*, 2011; and Mesa *et al.*, 2018). For example, Schweitzer *et al.* (2010) found that effects of ivermectin to the aquatic invertebrate *D. magna* in aquatic systems may decrease over time and demonstrated the potential for external recolonization from unimpacted ecosystems to take place. Based on a review of the literature, Mebane (2022) concluded that affected aquatic invertebrates can recover quickly, within 3 to 5 generations, following moderate disturbances when external recolonization from unaffected ecosystems is possible. These studies demonstrate that although localized impacts can occur after a pulse exposure to an antiparasitic animal drug, the affected aquatic invertebrate communities can recover, even with only internal recolonization.

As stated above, exposure of aquatic systems to antiparasitic animal drugs is expected to be pulse, episodic and localized occurring in waterways next to cropland and pastures where manure is applied or deposited. The exposure is not expected to be widespread, leaving unaffected environments with source populations that can recolonize any affected environments. The potential for these affected ecosystems to recover quickly following pulse exposures of antiparasitic animal drugs reduces the overall risk of long-term significant effects.

8.3. Risk Characterization Conclusion

Although environmental effects may occur from the use of antiparasitic animal drugs for the prevention and/or treatment of NWS infestation, the following factors are expected to limit the overall environmental exposure; therefore, significant long-term effects are not expected. These factors include:

- The target animal to be treated results in limited environmental exposure due to their associated animal and waste management practices and disperse excretion patterns. This is particularly applicable to cats, dogs, horses and minor species.
- Several antiparasitic animal drugs from the classes considered in the current PEA have previously been approved for similar uses in the same or a similar target animal. As part of the approval process for each, an environmental evaluation determined that no significant environmental impacts were expected as a result of the nationwide indefinite use.
- It is unlikely that animal producers who were not previously administering antiparasitic animal drugs to their livestock for the treatment and/or prevention of parasites will start as a result of NWS, unless absolutely necessary.
- The majority of antiparasitic animal drugs have low mobility within the environment, likely staying primarily in the manure and soil; thus, reducing aquatic exposure and the potential for adverse effects in aquatic invertebrates.
- Due to preferences for warmer climates, it is expected that the occurrence of NWS will be limited to the southern U.S., thereby, limiting the area in which

animal drugs containing an antiparasitic will be used and potential environmental exposure will occur.

- The sterile fly program is expected to reduce NWS populations in the U.S., and once in full effect (approximately November 2027), the program is expected to eradicate NWS from the U.S. The previous eradications in the U.S. were on the scale of months for small outbreaks (Florida Key deer) to ~5 years for the entire Southwestern U.S. The use of sterile flies will greatly limit the duration that antiparasitic animal drugs for NWS myasis will be needed and used. The sterile fly program has been demonstrated to be the most effective strategy for eradicating NWS.
- Currently the only regulatory pathways (i.e., CNADAs and EUAs) being pursued for NWS are temporary in nature, thereby, limiting the duration the antiparasitic animal drugs can be used for the prevention and/or treatment of NWS infestation. CNADA approvals are only in effect for up to 5 years, and EUAs terminate when HHS terminates the EUA declaration. The intent of the CNADA pathway is to eventually lead to full NADA approval. If that occurs, a separate NEPA evaluation would be conducted that considers nationwide, indefinite use of the antiparasitic animal drug.[11] Nevertheless, even if insecticides are fully approved to prevent and/or treat NWS infestations, once NWS is eradicated in the U.S., it is reasonable to expect that the drug will no longer be used for that intended use.
- The use of antiparasitic animal drugs is only one of several efforts currently being implemented in an effort to limit the northward expansion and distribution of NWS in the U.S.[20]

9. Conclusions

Based on the information and analysis presented herein, no reasonably foreseeable significant environmental effects are expected from the use of most antiparasitic animal drugs used for the prevention and/or treatment of NWS infestations. As noted previously, this PEA is expected to be inclusive of many, but not all antiparasitic animal drugs either conditionally approved or authorized for emergency use for the prevention and/or treatment of NWS infestations. In the event that this PEA does not address specific concerns for an action on an antiparasitic animal drug product, FDA-CVM will prepare an individual tiered EA in order to sufficiently evaluate the potential for environmental effects of that specific action. If significant environmental effects are not expected, FDA-CVM will prepare an associated FONSI describing how the Agency came to that conclusion. Alternatively, if significant environmental impacts are expected, FDA-CVM will prepare an EIS.

10. Agencies and Persons Consulted

No other agencies or persons were consulted in the preparation of this PEA.

11. List of Preparers

This PEA was prepared by environmental reviewers at FDA-CVM.

12. FDA Certification

FDA has considered the factors mandated by NEPA. This PEA represents FDA's good-faith effort to prioritize documentation of the most important considerations required by the statute within the congressionally mandated page limits. This prioritization reflects FDA's expert judgment. Any considerations addressed briefly or left unaddressed were, in FDA's judgment, comparatively not of a substantive nature that meaningfully informed the consideration of environmental effects and the resulting decision on how to proceed.

13. References

Barbero, E., López-Guerrero, Y. 1992. Some considerations on the dispersal power of *Digitonthophagus gazella* (Fabricius 1787) in the new world (Coleoptera Scarabaeidae Scarabaeinae). *Tropical Zoology* 5: 115-120.

Blanckenhorn, W.U., Cornelia, M., Reuter, M. 2000. Are dung flies ideal-free distributed at their oviposition and mating site? *Behaviour* 137: 233-248.

Byford, R.L., Broce, A.B., Lockwood, J.A., Smith, S.M., Morrison, D.G., Bagley, C.P. 1987. Horn fly (Diptera: Muscidae) dispersal among cattle herds. *Journal of Economic Entomology* 80: 421-426.

Dadour, I.R., Cook, D.F., Hennessy, D. 2000. Reproduction and survival of the dung beetle *Onthophagus binodis* (Coleoptera: Scarabaeidae) exposed to abamectin and doramectin residues in cattle dung. *Physiological and Chemical Ecology* 29: 1116-1122.

deCastro-Arrazola, I., Andrew, N.R., Berg, M.P., Curtsdotter, A., Lumaret, J.P., Menéndez, R., Moretti, M., Nervo, B., Nichols, S., Sánchez-Piñero, F., Santos, A.M.C., Sheldon, K.S., Slade, E.M., Hortal, J. 2023. A trait-based framework for dung beetle functional ecology. *Journal of Animal Ecology* 92: 44-65.

Domingo-Echaburu, S., Lertxundi, U., Boxall, A.B.A., Orive, G. 2021. Environmental contamination by pet pharmaceuticals: A hidden problem. *Science of the Total Environment* 788: 147827.

ECHA (European Chemical Agency). 2011. Inclusion of active substances in Annex I or IA to Directive 98/8/EC Assessment Report Fipronil Product-type 18 (Insecticides, Acaricides and Products to control other Arthropods). https://echa.europa.eu/documents/10162/30343c17-aea0-5fc0-228f-013b688bd866 (date accessed: January 7, 2026)

ECHA. 2025a. Dinotefuran. ECHA Chemicals Database. https://chem.echa.europa.eu/100.111.831/dossier-view/d9bfd827-78a2-4286-aeb5-90ac4c7d5b5c/0e89a0ed-b635-4e53-97f3-2b2e4370262b_0e89a0ed-b635-4e53-97f3-2b2e4370262b?searchText=Dinotefuran (date accessed: January 7, 2026)

ECHA. 2025b. Imidacloprid. ECHA Chemicals Database. https://chem.echa.europa.eu/100.102.643/dossier-view/55653e15-12ad-485a-a5f8-2510df6cd8c5/63399064-295f-4411-acdf-62c80f3e9739_63399064-295f-4411-acdf-62c80f3e9739 (date accessed: January 7, 2026)

EPA (Environmental Protection Agency). 2012. Problem Formulation for the Environmental Fate and Ecological Risk, Endangered Species, and Drinking Water Assessments in Support of the Registration Review of Acetamiprid. US EPA, Office of Pesticide Programs, Washington, DC. https://downloads.regulations.gov/EPA-HQ-OPP-2012-0329-0003/content.pdf (date accessed: January 6, 2026)

Fales, J.H., Bodenstein, O.F., Mills, G.D., Wessel, L.H. 1964. Preliminary studies on face fly dispersion. *Annals of the Entomological Society of America* 57: 135-137.

Finch, D., Schofield, H., Floate, K.D., Kubasiewicz, L.M., Mathews, F. 2020. Implications of endectocide residues on the survival of Aphodiine dung beetles. A meta-analysis. *Environmental Toxicology and Chemistry* 39: 863-872.

Fincher, G.T., Stewart, T.B., Hunter III, J.S. 1983. The 1981 distribution of *Onthophagus gazella* Fabricius from releases in Texas and *Onthophagus taurus* Schreber from an unknown release in Florida (Coleoptera: Scarabaeidae). *The Coleopterists Bulletin* 37: 159-163.

Floate, K.D. 1998. Off-target effects of ivermectin on insects and on dung degradation in southern Alberta, Canada. *Bulletin of Entomological Research* 88: 25-35.

Floate, K.D., Colwell, D.D., Fox, A.S. 2002. Reductions of non-pest insects in dung of cattle treated with endectocides: a comparison of four products. *Bulletin of Entomological Research* 92: 471-481.

Floate, K.D., Bouchard, P., Holroyd, G., Poulin, R., Wellicome, T. 2008. Does doramectin use on cattle indirectly affect the endangered burrowing owl. *Rangeland Ecology and Management* 61: 543-553.

FDA (Food and Drug Administration). 1983. Environmental Impact Analysis Report. Ivomec (Ivermectin) Injection for Cattle. New Animal Drug Application (NADA) 128-409. https://animaldrugsatfda.fda.gov/adafda/app/search/public/document/downloadEA/124 (date accessed: January 7, 2026)

FDA. 1996a. IVOMEC® EPRINEX™ (eprinomectin) Pour-On for Beef and Dairy Cattle. Environmental Assessment. NADA 141-079. https://animaldrugsatfda.fda.gov/adafda/app/search/public/document/downloadEA/93 (Date accessed: January 7, 2026)

FDA. 1996b. Environmental Assessment. Doramectin 1% Injectable solution for the treatment of parasitic infections in cattle. NADA 141-061. https://animaldrugsatfda.fda.gov/adafda/app/search/public/document/downloadEA/89 (Date accessed: January 7, 2026)

FDA. 1996c. Ivomec® SR Bolus for Cattle. Environmental Assessment. NADA 140-998. https://animaldrugsatfda.fda.gov/adafda/app/search/public/document/downloadEA/129 (date accessed: August 1, 2026)

FDA. 2001. Environmental Assessment. CYDECTIN® (moxidectin) Injectable Solution for Cattle. NADA 141-220.

https://animaldrugsatfda.fda.gov/adafda/app/search/public/document/downloadEA/147 (date accessed: January 7, 2026)

FDA. 2016. Lufenuron for Salmonids. Environmental Assessment in Support of an Import Tolerance Request. https://www.fda.gov/media/100121/download?attachment (date accessed: January 7, 2026)

FDA. 2022. Imidacloprid for Salmonids. Environmental Assessment in Support of an Import Tolerance Request. https://www.fda.gov/media/162718/download?attachment (date accessed: January 7, 2026)

FDA-CVM (Food and Drug Administration's Center for Veterinary Medicine). 2006. Guidance for Industry #166. Environmental Impact Assessments (EIAs) for Veterinary Medicinal Products (VMPs) – Phase II. https://www.fda.gov/regulatory-information/search-fda-guidance-documents/cvm-gfi-166-vich-gl38-environmental-impact-assessments-eias-veterinary-medicinal-products-vmps-phase (date accessed: December 19, 2025)

Gupta, S., and Gajbhiye, V.T. 2007. Persistence of acetamiprid in soil. *Bulletin of Environmental Contamination and Toxicology* 78: 349-352.

Hanski, I. 1980. Movement patterns in dung beetles and in the dung fly. *Animal Behavior* 28: 953-964.

Hanski, I. 1991. Chapter 5. North Temperate Dung Beetles. Hanski I, Cambefort Y (Eds.). In *Dung Beetle Ecology*. Princeton University Press: Princeton.

Halffter, G., and Edmonds, W.D. 1983. The nesting behavior of dung beetles (Scarabaeinae). An ecological and evolutive approach. *Journal of the New York Entomological Society* 91: 512-523.

Halley, B.A., Jacob, T.A., Lu, A.Y.H. 1989. The environmental impact of the use of ivermectin: environmental effects and fate. *Chemosphere* 18: 1543-1563.

Jeni, R.E., Dittoe, D.K., Olson, E.G., Lourenco, J., Seidel, D., Ricke, S.C., Callaway, T.D. 2021. An overview of health challenges in alternative poultry production systems. *Poultry Science* 100: 101173.

Killough, R.A., Hartsock, J.G., Wolf, W.W., Smith, J.W. 1965. Face fly dispersal, nocturnal resting places, and activity during sunset as observed in 1963. *Journal of Economic Entomology* 58: 711-715.

Krafsur, E.S., Whitten, C.J., Novy, J.E. 1987. Screwworm eradication in North and Central America. *Parasitology Today* 3: 131-137.

Kryger, U., Deschodt, C., Scholtz, C.H. 2005. Effects of fluazuron and ivermectin treatment of cattle on the structure of dung beetle communities. *Agriculture, Ecosystems and Environment* 105: 649-656.

Kunz, S.E., Kinzer, G.H., Miller, J.A. 1983. Areawide cattle treatments on populations of horn flies (Diperta: Muscidae). *Journal of Economic Entomology* 76: 525-528.

Little, C.J.L., and Boxall, A.B.A. 2020. Environmental pollution from pet parasiticides. *Veterinary Record* 186: 97.

Lumaret, J.P., Errouissi, F., Floate, K., Rombke, J., Wardhaugh, K. 2012. A review on the toxicity and non-target effects of macrocyclic lactones. *Current Pharmaceutical Biotechnology* 13: 1004-1060.

Mariod, A.A., Mirghani, M.E.S., Hussein, I. 2017. Chapter 43 – *Copris nevinsoni* Dung Beetle. AA Mariod, MES Mirghani, Hussein I (Eds.). In *Unconventional Oilseeds and Oil Sources* (2017). Academic Press, an imprint of Elsevier.

Mebane, C.A. 2022. The capacity of freshwater ecosystems to recover from exceedances of aquatic life criteria. *Environmental Toxicology and Chemistry* 41: 2887-2910.

Mesa LM, Hörler J, Lindt I, Gutiérrez MF, Negro L, Mayora G, Montalto L, Ballent M, Lifschitz A. 2018. Effects of the antiparasitic drug moxidectin in cattle dung on zooplankton and benthic invertebrates and its accumulation in a water-sediment system. *Archives of Environmental Contamination and Toxicology* 75: 316-326.

Nichols, E., Spector, S., Louzada, J., Larsen, T., Amezquita, S., Favila, M.E. 2008. Ecological functions and ecosystem services provided by Scarabaeinae dung beetles. *Biological Conservation* 141: 1461-1474.

Novy, J.E. 1991. Screwworm control and eradication in the southern United States of America. Special Issue of World Animal Review FAO. Pages 18-27.

Perkins, R., Whitehead, M., Civil, W., Goulson, D. 2021. Potential role of veterinary flea products in widespread pesticide contamination of English rivers. *Science of the Total Environment* 755: 143560.

Skidmore P. 1991. *Insects of the British cow-dung community*. Richmond Publishing.

Slade, E.M., Riutta, T., Roslin, T., Tuomisto, H.L. 2016. The role of dung beetles in reducing greenhouse gas emissions from cattle farming. *Scientific Reports* 6: 18140.

Teerlink, J., Hernandez, J., Budd, R. 2017. Fipronil washoff to municipal wastewater from dogs treated with spot-on products. *Science of the Total Environment* 599-600: 960-966.

USDA (United States Department of Agriculture) Animal and Plant Health Inspection Service (APHIS). 2017. Final Report for the APHIS Veterinary Services Response to the 2016–2017 Outbreak of New World Screwworm (NWS) in Florida. Located at: https://www.aphis.usda.gov/sites/default/files/public-nws-usdaaphis-final-report.pdf.

Department of Health and Human Services. August 20, 2025. “Declaration of Emergency Pursuant to the Federal Food, Drug, and Cosmetic Act for New World Screwworm.” 90 Federal Register (FR) 40609. https://www.federalregister.gov/documents/2025/08/20/2025-15918/declaration-of-emergency-pursuant-to-the-federal-food-drug-and-cosmetic-act-for-new-world-screwworm (date accessed: October 28, 2025)

Valdez-Espinoza, U.M., Fadda, L.A., Marques, R., Osorio-Olvera, L., Jiménez-García, D., Lira-Noriega, A. 2025. The reemergence of the New World screwworm and its potential distribution in North America. *Scientific Reports* 15: 23819.

Verdú, J.R., Lobo, J.M., Sánchez-Piñero, F., Gallego, B., Numa, C., Lumaret, J.P., Cortez, V., Ortiz, A.J., Tonelli, M., García-Teba, J.P., Rey, A., Rodríguez, A., Durán, J. 2018. Ivermectin residues disrupt dung beetle diversity, soil properties and ecosystem functioning: An interdisciplinary field study. *Science of the Total Environment* 618: 219-228.

Webb, L., Beaumont, D.J., Nager, R.G., McCracken, D.I. 2007. Effects of avermectin residues in cattle dung on yellow dung fly Scathophaga stercoraria (Diptera: Scathophagidae) populations in grazed pastures. *Bulletin of Entomological Research* 97: 129-138.

Appendix A. Information, including the mode of action and chemical structure, for various antiparasitic chemical classes.

Macrocyclic lactones

Macrocyclic lactones are a class of antiparasitics that demonstrate broad-spectrum activity against parasites, including endoparasites (e.g., intestinal worms) and ectoparasites (e.g., lice, ticks) (Lifschitz *et al.*, 2024). Macrocyclic lactones are typically divided into three separate groups – avermectins, milbemycins, and spinosyns (Lumaret *et al.*, 2012; Vardanyan and Hruby, 2016; Claerebout *et al.,* 2025).

This broad-spectrum activity is thought to result from their mode of action.

Avermectins and milbemycins share a similar structure, including a 16-membered lactone ring core (Lumaret *et al.*, 2012; Vardanyan and Hruby, 2016; Claerebout *et al.*, 2025). They reportedly exhibit a high affinity for binding to glutamate-gated chloride channels which are present in the central nervous system (CNS) and pharyngeal muscles[48] of invertebrate species, including parasites (Claerebout *et al.*, 2025; Mwacalimba *et al.*, 2024; Lumaret *et al.*, 2012). Glutamate-gated chloride channels are not present in vertebrate species, such as mammals (Mwacalimba *et al.*, 2024, Wolstenholme, 2011); therefore, macrocyclic lactones are generally considered safe for use in mammalian species. After binding, the glutamate-gated chloride channels open, increasing the concentration of chloride ions crossing the cell membrane and entering the nerve cells, leading to paralysis and death (Lifschitz *et al.*, 2024, Claerebout *et al.*, 2025; Mwacalimba *et al.*, 2024; Wolstenholme, 2011; de Souza and Guimaraes, 2022; Batiha *et al.*, 2020). Macrocyclic lactones have also been shown to bind to other ligand-gated chloride channels, including gamma-aminobutyric acid (GABA)-gated chloride channels present in muscle cells (Kovecses and Marcogliese, 2005; de Souza and Guimaraes, 2022). Although avermectins and milbemycins have similar modes of action against parasitic infections, milbemycins typically have a longer metabolic half-life (Vardanyan and Hruby, 2016). Both avermectins and milbemycins can be derived through the fermentation of the naturally occurring soil bacteria, *Streptomyces*, or through semi-synthetic or synthetic processes.

Spinosyns possess a different molecular structure from avermectins and milbemycins; they have a tetracyclic core with a 12-membered lactone ring (Lumaret *et al.*, 2012; Ramachanderan and Schaefer, 2020). In addition to their structure, spinosyns also possess a different main mode of action from avermectins and milbemycins. Spinosyns exhibit a high affinity for binding to the nicotinic acetylcholine receptors (nAChR) which are primarily present in neuromuscular junction of the CNS in insects. This binding leads to hyperexcitation of nerve and muscle cells, resulting in paralysis and death (Lu *et al.*, 2022; Lumaret *et al.*, 2012; Kirst, 2010; Smith *et al.*, 2024). There is also evidence to suggest that a secondary mode of action of spinosyns is interaction with GABA-gated chloride channels (Snyder *et al.*, 2007), which is similar to avermectins and milbemycins. Spinosyns can be derived either through aerobic fermentation of *Saccharopolyspora spinosa*, a naturally occurring soil bacteria, or through semi-synthetic or synthetic processes.

Avermectins

Avermectins are generally produced as a mixture of four homologue compounds, including avermectin A_1, avermectin A_2, avermectin B_1, and avermectin B_2. These

[48] Pharyngeal muscles are present along the pharynx of parasites, which are essential for eating (Song and Avery, 2013).

homologue compounds exist as one of two variants, a or b. These specific designations are used to differentiate each homologue compound based on chemical structure (Laing *et al*., 2017; Kovecses and Marcogliese, 2005; de Souza and Guimaraes, 2022; Batiha *et al*., 2020; Lumaret *et al.*, 2012). The A and B designations indicate which functional group is present at the C5 position (i.e., methoxy or hydroxy group), while the 1 or 2 subscript indicate whether a double carbon pond is present or absent at the C22 and C23 position of the compound (Laing *et al.*, 2017; de Souza and Guimares, 2022). Although all of the compounds demonstrate antiparasitic properties, each homologue has a different functionality. For example, avermectin B_1 is more active than B_2 when administered orally (Laing *et al.*, 2017; de Souza and Guimares, 2022).

The avermectins include specific compounds such as ivermectin, abamectin, doramectin, eprinomectin, emamectin, and selamectin.

Milbemycins

Although structurally similar, unlike avermectins, milbemycins collectively lack a sugar substituent at the C13 position on the macrocyclic ring (Lumaret *et al.*, 2012; Rugg *et al.,* 2005). Milbemycins are typically designated based on the functional group present at the C25 position (e.g., ethyl group, methyl group) (Jung *et al.*, 2002; Lumaret *et al.*, 2012; Rugg *et al.*, 2005; Prichard *et al.*, 2012) but may be modified further depending on the intended use (e.g., endo- vs. ecto-parasiticide) or to increase potency.

The milbemycins include specific compounds such as moxidectin, nemadectin, and milbemycin oxime.

Spinosyns

The production of spinosyns results in a mixture of several homologues, including two major forms, spinosyn A and spinosyn D. These two homologues only differ by the presence or absence of a methyl group at the C6 position of the compound (Kirst, 2010; Lumaret *et al.*, 2012; Ramachanderan and Schaefer, 2020).

The spinosyns include specific compounds such as spinosad (spinosyn A + spinosyn D) and spinetoram.

Isoxazolines

Isoxazolines are a newer class of antiparasitics that demonstrates broad-spectrum antiparasitic activity that are commonly used to treat flea and tick infestations in cats and dogs, and mites in poultry species (Zhou *et al*., 2021; Gonçalves *et al.,* 2021; Gupta and Doss, 2024a). Isoxazolines act as noncompetitive antagonists, strongly binding to GABA-gated chloride channels in the CNS and muscle cells, including pharyngeal muscles,[48] of insects, including parasites (Sager *et al.*, 2025; Gupta and Doss, 2024a; Kono *et al*., 2022). After binding, isoxazolines prevent the flow of chloride ions across the nerve or muscle cell membrane, resulting in uncontrolled nerve firing and hyperexcitation of the nerve and/or muscle cells. This leads to paralysis and death (Zhou *et al.*, 2021; Gupta and Doss, 2024a). Similar to macrocyclic lactones, isoxazolines have a reduced selectivity for GABA-gated chloride channels in mammals (Gonçalves *et al.*, 2021; Zhou *et al*., 2021; Gupta and Doss, 2024a); and therefore,are considered a safe option for use in mammalian species. There is also evidence to suggest that isoxazolines inhibit glutamate-gated chloride channels, but with a much lesser potency (Zhou *et al.*, 2021).

All isoxazolines consist of a five-membered core ring containing both an oxygen and a nitrogen. Differences in functional groups present on the core ring result in isoxazoline derivatives that have varying degrees of potency and activity.

Isoxazolines include specific compounds such as afoxolaner, fluralaner, sarolaner, and lotilaner.

Neonicotinoids

Neonicotinoids are a class of synthetically derived compounds with antiparasitic properties and commonly used as a pesticide for crop protection (Ensley, 2012; Manavi *et al.*, 2024). Neonicotinoids were originally derived in the 1970s and were purposely designed to be chemically similar to nicotine (Ensley, 2012). As such, neonicotinoids have a similar mode of action as nicotine in that they selectively bind to the nicotinic acetylcholine receptors (nAhRs) which are primarily present in neuromuscular junction of the CNS in insects (Jeschke and Nauen, 2005), resulting in hyperexcitation of the nervous system, paralysis, and death (Niessen, 2021). They exhibit a much lower affinity for interacting with vertebrate nAChRs, including mammals. Due to this selectivity, it has been historically assumed that neonicotinoids are less toxic to vertebrate species (Manavi *et al.*, 2024; Rose, 2012).

Neonicotinoids include specific compounds such as imidacloprid, acetamiprid, dinotefuran, thiamethoxam, and clothianidin.

Pyrethrins and pyrethroids

Pyrethrins are insecticides that are naturally derived from the chrysanthemum plant (*Tanacetum cinerariifolium*). Conversely, pyrethroids are the synthetically derived version of pyrethrins, which were developed to have enhanced stability in the environment and potency as an insecticide (Holynska-Iwan and Szewczyk-Golec, 2020; Abubakar *et al.*, 2020). Pyrethrins and pyrethroids have a similar mode of action in that both bind to voltage-gated sodium channels in the CNS of insects. This binding prevents the channels from closing, resulting in hyperexcitation, paralysis, and death (Hołyńska-Iwan and Szewczyk-Golec, 2020).

Pyrethrins and pyrethroids include specific compounds such as pyrethrin I and II, cinerin I and II, and jasmolin I and II, and permethrin, cypermethrin, deltamethrin, and bifenthrin, respectively.

Insect growth regulators (IGR)

Insect growth regulators (IGR) are synthetically derived juvenile hormone analogues that unlike other pesticides, do not directly lead to death, but instead, affect juvenile development (e.g., metamorphosis) and prevent maturity (Gupta and Doss, 2024b; Jindra and Bittova, 2019). Different IGRs have been developed to disrupt different stages of an insect's lifecycle. For example, one type of IGR called juvenoids mimic the juvenile hormone and bind to the juvenile hormone receptor found in insects. This prevents the insect from properly molting and developing into the next phase of the lifecycle, such as pupae or adults (Tumova *et al.*, 2022). A second type of IGR are known as chitin synthesis inhibitors. These compounds prevent the formation of chitin, a major component of insect exoskeletons, which restricts proper formation of the exoskeleton, leading to molting failure and the development of deformed larvae and pupae. (Tanani *et al.*, 2022). Because these compounds act by inhibiting lifecycle stages specific to insects, IGRs are considered safe for use in mammals (Gupta and Doss, 2024b).

IGRs include specific compounds like methoprene, pyriproxyfen, diflubenzuron, and lufenuron.

Organophosphates

Organophosphates are a class of compounds that have several applications, including use as a pesticide and herbicide. These compounds all share a similar molecular structure, in that a central phosphorous atom shares a double bond with either a sulfur or oxygen atom. Three additional functional groups are present on the central phosphorous atom (Richardson and Makhaeva, 2014; Mahajan *et al.*, 2022; Gupta *et al.*, 2018).

The primary mode of action for organophosphates is the irreversible inhibition of the acetylcholinesterase enzyme (AChE) (Aroniadou-Anderjaska *et al.,* 2023; Gupta *et al.*, 2018) found at the neuromuscular junction in nerve and muscle cells. The AChE is responsible for the breakdown of the acetylcholine, an excitatory neurotransmitter that when present activates muscle and nerve cells which is important for many physiological functions (e.g., muscle contraction, cognition, digestion, salivation, heart rate). The AChE is important in terminating muscle and nerve cell activation. When the AChE is inhibited, acetylcholine is no longer broken down and can build up within the neuromuscular junction. A buildup of acetylcholine results in continuous activation of muscle and nerve cells, which ultimately leads to paralysis and to death (Trang and Khandhar, 2023; Gasmi *et al.*, 2023).[49]

Organophosphate pesticides include specific compounds such as chlorpyrifos, coumaphos, fenthion, dichlorvos, malathion, parathion, and crotoxyphos.

Carbamates

Carbamates all share a similar structure in that they possess a centralized carbon atom that consists of a double bond with an oxygen atom. Three additional functional groups, which differ between carbamates, are present on the central carbon atom (Matoševic and Bosak, 2020; Jepson, 2001; Gupta *et al.*, 2018). These differences typically alter the potency as an insecticide.

Similar to organophosphates, carbamates have a high affinity for binding to and inhibiting the AChE (Fukuto, 1990; Gupta *et al.*, 2018). Unlike organophosphates, which irreversibly bind to AChE leading to long term toxicity, carbamates bind reversibly which greatly reduces the duration of their toxic effect (Silberman and Taylor, 2023).

Carbamates include specific compounds such as propoxur, carbofuran, and aldicarb.

Phenylpyrazoles

Phenylpyrazoles are a class of synthetically derived antiparasitics that demonstrate broad-spectrum activity against parasites. As a result of this broad-spectrum activity, phenylpyrazoles are commonly used as an antiparasitic in companion animals, such as cats and dogs, as well as in agricultural applications for crop protection (Dryden, 2024; Salgado, 1999). Phenylpyrazoles bind to GABA-gated chloride channels and glutamate-gated chloride channels in the CNS of parasitic species. This binding leads to an inhibition of chloride ions into nerve cells, resulting in hyperexcitation, paralysis, and death (Dryden, 2024; Gupta and Milatovic, 2014; Cole *et al.*, 1993).

[49] Cleveland Clinic. December 30, 2022. Acetylcholine. https://my.clevelandclinic.org/health/articles/24568-acetylcholine-ach (date accessed: November 6, 2025)

Phenylpyrazoles all share a common chemical structure that consists of a phenyl group attached to a central pyrazole ring (Gong *et al.*, 2024). Differences in stability and functionality are provided based on the specific functional groups that are attached to either the phenyl group or the pyrazole ring (Caboni *et al.*, 2003).

Phenylpyrazoles include specific compounds such as fipronil, ethiprole, and pyriprole.

References

Abubakar, Y., Tijjani, H., Egbuna, C., Adetunji, C.O., Kala, S., Kryeziu, T.L., Ifemeje, J.C., Patrick-Iwuanyanwu, K.C. 2020. Chapter 3 – Pesticides, History, and Classification. C. Egbuna and B. Sawicka (Eds.), In *Natural Remedies for Pest, Disease and Weed Control*. Academic Press, an imprint of Elsevier.

Aroniadou-Anderjaska, V., Figueiredo, T.H., Furtado, M.A., Pidophlichko, V.I., Braga, M.F.M. 2023. Mechanisms of organophosphate toxicity and the role of acetylcholinesterase inhibition. *Toxics* 11: 866.

Batiha, G.E.S., Alqahtani, A., Ilesanmi, O.B., Saati, A.A., El-Mleeh, A., Hetta, H.F., Beshbishy, A.M. 2020. Avermectin derivatives, pharmacokinetics, therapeutic and toxic dosages, mechanism of action, and their biological effects. *Pharmaceuticals* 13: 196.

Caboni, P., Sammelson, R.E., Casida, J.E. 2003. Phenylpyrazole insecticide photochemistry, metabolism, and GABAergic action: Ethiprole compared with fipronil. *Journal of Agricultural and Food Chemistry* 51: 7055-7061.

Claerebout, E., Lanusse, C.E., Abuelo, A. 2025. Pharmacodynamics: Mechanisms of Anthelmintic Action in Animals – Pharmacology. Merck Veterinary Manual. https://www.merckvetmanual.com/pharmacology/anthelmintics/pharmacodynamics-mechanisms-of-anthelmintic-action-in-animals (date accessed: October 9, 2025)

Cole, L.M., Nicholson, R.A., Casida, J.E. 1993. Action of phenylpyrazole insecticides at the GABA-gated chloride channel. *Pesticide Biochemistry and Physiology* 46: 47-54.

de Souza, R.B., Guimarães, J.R. 2022. Effects of avermectins on the environment based on its toxicity to plants and soil invertebrates – a Review. *Water, Air, and Soil Pollution* 233: 259.

Dryden MW. 2024. Ectoparasiticides used in small animals. Merck Veterinary Manual. https://www.msdvetmanual.com/pharmacology/ectoparasiticides/ectoparasiticides-used-in-small-animals?query=Phenylpyrazole (date accessed: January 7, 2026)

Ensley, S.M. 2012. Chapter 48 – Neonicotinoids. R. Gupta (Ed.), In *Veterinary Toxicology (Second Edition)*. Academic Press, an imprint of Elsevier.

Fukuto, T.R. 1990. Mechanism of action of organophosphorous and carbamate insecticides. *Environmental Health Perspectives* 87: 245-254.

Gasmi, A., Nasreen, A., Menzel, A., Benahmed, A.G., Pivina, L., Noor, S., Peana, M., Chirumbolo, S., Bjørklund, G. 2023. Neurotransmitters regulation and food intake: The role of dietary sources in neurotransmission. *Molecules* 28: 210.

Gong, Q., Li, C., Wang, H., Cao, J., Li, Z., Zhou, M., Li, Y., Chu, Y., Liu, H., Wang, R. 2024. Discovery of phenylpyrazole derivatives as a new class of selective inhibitors of MCL-1 with antitumor activity. *ACS Omega* 9: 27369-27396.

Gonçalves, I.L., das Neves, G.M., Kagami, L.P., Eifler-Lima, V.L., Merlo, A.A. 2021. Discovery, development, chemical diversity and design of isoxazoline-based insecticides. *Bioorganic and Medicinal Chemistry* 30: 115934.

Gupta, R.C., and Milatovic, D. 2014. Chapter 23 - Insecticides. RC Gupta (Ed.) *In* Biomarkers in Toxicology. Academic Press, an imprint of Elsevier.

Gupta, R.C., and Doss, R.B. 2024a. Isoxazoline toxicosis in Animals. Merck Veterinary Manual. https://www.merckvetmanual.com/toxicology/insecticide-and-acaricide-organic-toxicity/isoxazoline-toxicosis-in-animals (date accessed: November 4, 2025)

Gupta, R.C., and Doss, R.B. 2024b. Insect Growth and Development Regulator Toxicosis in Animals. https://www.merckvetmanual.com/toxicology/insecticide-and-acaricide-organic-toxicity/insect-growth-and-development-regulator-toxicosis-in-animals (date accessed: November 5, 2025)

Gupta, R.C., Sachana, M., Mukherjee, I.M., Doss, R.B., Malik, J.K., Milatovic, D. 2018. Chapter 37 – Organophosphates and Carbamates. RC Gupta (Ed.), In Veterinary Toxicology, Basic and Clinical Principles (Third Edition). Academic Press, an imprint of Elsevier.

Hołyńska-Iwan I., and Szewczyk-Golec K. 2020. Pyrethroids: How they affect human and animal health? *Medicina* 56: 582.

Jepson, P.C. 2001. Pesticides, uses and effects of. SA Levin (Ed.). In Encyclopedia of Biodiversity (Second Edition). Academic Press, an imprint of Elsevier.

Jeschke, P., and Nauen, R. 2005. 5.3 – Neonicotinoid Insecticides. *Comprehensive Molecular Insect Science* 5: 53-105.

Jindra, M., and Bittova L. 2019. The juvenile hormone receptor as a target of juvenoid “insect growth regulators.” *Archives of Insect Biochemistry and Physiology* 103: e21615.

Jung, M., Saito, A., Buescher, G., Maurer, M., Graf, J.F. 2002. Chapter 1.3 – Chemistry, Pharmacology and Safety: Milbemycin Oxime. J. Vercruysse and R.S. Rew (Eds). In *Macrocyclic Lactones in Antiparasitic Therapy* (2002). CABI Publishing, a division of CAB International.

Kirst, H.A. 2010. The spinosyn family of insecticides: realizing the potential of natural products research. *The Journal of Antibiotics* 63: 101-111.

Kono, M., Ozoe, F., Asahi, M., Ozoe, Y. 2022. State-dependent inhibition of GABA receptor channels by the ectoparasite fluralaner. *Pesticide Biochemistry and Physiology* 181: 105008.

Kovecses, J., and Marcogliese, D.J. 2005. Avermectins: potential environmental risks and impcts on freshwater ecosystems in Quebec. Scientific and Technical Report ST-233E. Environment Canada – Quebec Region, Environmental Conservation, St. Lawrence Centre.

Laing, R., Gillan, V., Devaney, E. 2017. Ivermectin – Old drug, new tricks? *Trends in Parasitology* 33: 463-472.

Lifschitz, A., Nava, S., Miro, V., Canton, C., Alvarez, L., Lanusse, C. 2024. Macrocyclic lactones and ectoparasites control in livestock: Efficacy, drug resistance and therapeutic challenges. *International Journal of Parasitology Drugs and Drug Resistance* 26: 100559.

Lu, W., Liu, Z., Fan, X., Zhang, X., Qiao, X., Huang, J. 2022. Nicotinic acetylcholine receptor modulator insecticides act on diverse receptor subtypes with distinct subunit compositions. *PLoS Genetics* 18: e1009920.

Lumaret, J.P., Errouissi, F., Floate, K., Rombke, J., Wardhaugh, K. 2012. A review on the toxicity and non-target effects of macrocyclic lactones. *Current Pharmaceutical Biotechnology* 13: 1004-1060.

Mahajan R, Verma S, Chandel S, Chatterjee S. 2022. Chapter 24 – Organophosphate pesticide: usage, environmental exposure, health effects, and microbial bioremediation. S Das and HR Dash (Eds.). In Microbial Biodegradation and Bioremediation (Second Edition). Academic Press, an imprint of Elsevier.

Manavi, M.A., Nasab, M.H.F., Daghighi, S.M., Baeeri, M. 2024. Neonicotinoids. P. Wexler (Ed.). In *Encyclopedia of Toxicology (Fourth Edition)*. Academic Press, an imprint of Elsevier.

Matoševic, A., and Bosak, A. 2020. Carbamate group as structural motif in drugs: A review of carbamate derivatives used as therapeutic agents. *Archives of Industrial Hygiene and Toxicology* 71: 285-299.

Mwacalimba, K., Sheehy, J., Adolph, C., Savadelis, M., Kryda, K., Nautrup, B.P. 2024. A review of moxidectin vs. other macrocyclic lactones for prevention of heartworm disease in dogs with an appraisal of two commercial formulations. *Frontiers of Veterinary Science* 11: 1377718.

Niessen, W.M.A. 2021. Tandem mass spectrometry of organic nitro and halogen compounds: Competition between losses of molecules and of radicals. *International Journal of Mass Spectrometry* 460: 116496.

Prichard, R., Ménez, C., Lespine, A. 2012. Moxidectin and the avermectins: Consanguinity but not identity. *International Journal for Parasitology: Drugs and Drug Resistance* 2: 134-153.

Ramachanderan, R., and Schaefer, B. 2020. Spinosyn insecticides. *ChemTexts* 6:20.

Richardson RJ, Makhaeva GF. 2014. Organophosphorous Compounds. Wexler P (Ed.). In *Encyclopedia of Toxicology Third Edition*. Academic Press, an imprint of Elsevier Inc.

Rose, P.H. 2012. Chapter 6 – Nicotine and the Neonicotinoids. T. Marrs (Ed.). In *Issues in Toxicology, Mammalian Toxicology of Insecticides*. The Royal Society of Chemistry.

Rugg, D., Buckingham, S.D., Sattelle, D.B., Jansson, R.K. 2005. 5.2 – The insecticidal macrocyclic lactones. *Comprehensive Molecular Insect Science* 5: 25-52.

Sager, H., Sarr, A., Kuntz, E., Rufener, L. 2025. Comparative analysis of isoxazoline activity on human and canine GABA receptors expressed in *Xenopus* oocytes. *Parasites and Vectors* 18: 213.

Silberman, J., and Taylor, A. 2023. Carbamate Toxicity. Treasure Island, Florida, StatPearls Publishing LLC.

https://www.ncbi.nlm.nih.gov/books/NBK482183/#:~:text=Introduction,than%2024%20hours%5B1%5D (date accessed: November 6, 2025).

Smith, R.J., Chen, Y., Lafleur, C.I., Kaur, D., Bede, J.C. 2024. Effect of sublethal concentrations of the bioinsecticide spinosyn treatment of Trichoplusia ni eggs on the caterpillar and its parasitoid, Trichogramma brassicae. *Pest Management Science* 80: 2965-2975.

Snyder, D.E., Meyer, J., Zimmermann, A.G., Qiao, M., Gissendanner, S.J., Cruthers, L.R., Slone, R.L., Young, D.R. 2007. Preliminary studies on the effectiveness of the novel pulicide, spinosad, for the treatment and control of fleas on dogs. *Veterinary Parasitology* 150: 345-351.

Song, B., and Avery, L. 2013. The pharynx of the nematode *C. elegans*. *Worm* 2: e21833.

Tanani, M.A., Hasaballah, A.I., Hussein, R.M. 2022. Assessment of the perturbation induced by chitin synthesis inhibitors lufenuron, flufenoxuron and hexaflumuron in the house fly, *Musca domestica* vicina (Diptera: Muscidae). *The Journal of Basic and Applied Zoology* 83: 29.

Trang, A., and Khandhar, P.B. 2023. Physiology, Acetylcholinesterase. Treasure Island, Florida, StatPearls Publishing LLC. https://www.ncbi.nlm.nih.gov/books/NBK539735/ (date accessed: November 6, 2025)

Tumova, S., Milacek, M., Snajdr, I., Muthu, M., Tuma, R., Reha, D., Jedlicka, P., Bittova, L., Novotna, A., Majer, P., Sedlak, D., Jindra, M. 2022. Unique peptidic agonists of a juvenile hormone receptor with species-specific effects on insect development and reproduction. *PNAS* 119: e2215541119.

Vardanyan, R., and Hruby, V. (Eds.). 2016. Chapter 36 – Anthelmintics. In *Synthesis of Best-Seller Drugs* (2016). Academic Press, an imprint of Elsevier.

Wolstenholme, A.J. 2011. Ion channels and receptor as targets for the control of parasitic nematodes. *International Journal for Parasitology: Drugs and Drug Resistance* 1: 2-13.

Zhou, X., Hohman, A.E., Hsu, W.H. 2021. Current review of isoxazoline ecotoparasiticides used in veterinary medicine. *Journal of Veterinary Pharmacology and Therapeutics* 45: 1-15.

Appendix B. Physical-chemical characteristics, environmental fate properties, and acute and chronic effects data contained in environmental assessments for approved antiparasitic animal drugs.

Table B.1. Physical-chemical and fate properties of various approved antiparasitic animal drugs.

Antiparasitic	Water Solubility	pKa	Vapor Pressure	Log K_{ow}	Adsorption (K_{oc})	Soil Degradation or Dissipation (DT_{50})	Sediment Degradation or Dissipation (DT50)
Doramectin	0.025 mg/L at 25°C (FDA, 1996a)	Neutral between pH 5 and 9 (FDA, 1996a)	<7 x 10^{-7} torr (FDA, 1996a)	4.4 (FDA, 1996a)	7,520-86,900 L/kg (FDA, 1996a)	61-79 days (FDA, 1996a)	
Eprinomectin	3.5 mg/L at 25°C (FDA, 1996b)	Neutral between pH 3 and 10 (FDA, 1996b)		5.4 (FDA, 1996b)	3231-9208 (FDA, 1996b)	64 days (FDA, 1996b)	
Moxidectin	0.51 mg/L at 20°C (FDA, 2001)		<3.2 x 10^{-8} Torr (FDA, 2001)	4.77 (FDA, 2001)	18,000-41,000 (FDA, 2001)	~60 days (FDA, 2001)	
Ivermectin	4.0 mg/L at 20°C (FDA, 1990)			3.2 (FDA, 1990)	12,600-15,700 L/kg (FDA, 1990)	111-260 days (FDA, 1983)	
Imidacloprid	580-610 mg/L at 20°C (FDA, 2022)		4.0 x 10^{-10} Pa (FDA, 2022)	0.57 (FDA, 2022)	266 L/kg (FDA, 2022)		118 days (marine) (FDA, 2022)
Lufenuron			< 4.0 x 10^{-6} Pa (FDA, 2016)	5.12 (FDA, 2016)	41,209 L/kg (FDA, 2016)	13-23.7 days (FDA, 2016)	27.4-187 days (FDA, 2016)

Table B.2. Acute effects data for various antiparasitic approved animal drugs.

Antiparasitic	Common Name	Scientific Name	Duration (hours)	Effect	Endpoint	Value (µg/L)	Reference
Algae Data							
Moxidectin	Green algae	*Selenastrum capricornutum*	72	Growth inhibition	EC_{50}	> 87	FDA, 2001
Ivermectin		*Chlorella pyrenoidsa*	Not reported	Growth inhibition	NOEC	10,000	FDA, 1990
Cladocera Data							
Doramectin	Water flea	*Daphnia magna*	48	Immobilization	EC_{50}	0.10	FDA, 1996a
Eprinomectin	Water flea	*Daphnia magna*	48	Immobilization	EC_{50}	0.45	FDA, 1996b
Moxidectin	Water flea	*Daphnia magna*	48	Mortality	LC_{50}	0.0302	FDA, 2001
Ivermectin	Water flea	*Daphnia magna*	48	Mortality	LC_{50}	0.036	FDA, 1983
Ivermectin	Water flea	*Daphnia magna*	48	Mortality	LC_{50}	0.025	FDA, 1990
Fish Data							
Doramectin	Bluegill Sunfish	*Lepomis macrochirus*	96	Mortality	LC_{50}	11	FDA, 1996a
Eprinomectin	Bluegill sunfish	*Lepomis macrochirus*	96	Mortality	LC_{50}	370	FDA, 1996b
Moxidectin	Bluegill sunfish	*Lepomis macrochirus*	96	Mortality	LC_{50}	0.62	FDA, 2001
Ivermectin	Bluegill sunfish	*Lepomis macrochirus*	96	Mortality	LC_{50}	5.3	FDA, 1990
Doramectin	Rainbow trout	*Oncorhynchus mykiss*	96	Mortality	LC_{50}	5.1	FDA, 1996a
Eprinomectin	Rainbow trout	*Oncorhynchus mykiss*	96	Mortality	LC_{50}	1200	FDA, 1996b
Moxidectin	Rainbow trout	*Oncorhynchus mykiss*	96	Mortality	LC_{50}	0.16	FDA, 2001
Ivermectin	Rainbow trout	*Oncorhynchus mykiss*	96	Mortality	LC_{50}	3.3	FDA, 1990

EC_{50} = median effective concentration
LC_{50} = median lethal concentration

Table B.3. Chronic effects data for various approved antiparasitic animal drugs.

Antiparasitic	Common Name	Scientific Name	Duration (days)	Effect	Endpoint	Value	Reference
Plant Data							
Doramectin	Corn		5-6	Germination	NOEC	840 mg/kg	FDA, 1996a
Doramectin	Corn		5-6	Root Elongation	NOEC	840 mg/kg	FDA, 1996a
Doramectin	Cucumber		5-6	Germination	NOEC	840 mg/kg	FDA, 1996a
Doramectin	Cucumber		5-6	Root Elongation	NOEC	840 mg/kg	FDA, 1996a
Doramectin	Perennial Ryegrass		5-6	Germination	NOEC	6.6 mg/kg	FDA, 1996a
Doramectin	Perennial Ryegrass		5-6	Root Elongation	NOEC	1.6 mg/kg	FDA, 1996a
Doramectin	Soybean		5-6	Germination	NOEC	990 mg/kg	FDA, 1996a
Doramectin	Soybean		5-6	Root Elongation	NOEC	990 mg/kg	FDA, 1996a
Doramectin	Tomato		5-6	Germination	NOEC	840 mg/kg	FDA, 1996a
Doramectin	Tomato		5-6	Root Elongation	NOEC	840 mg/kg	FDA, 1996a
Doramectin	Wheat		5-6	Germination	NOEC	57 mg/kg	FDA, 1996a
Doramectin	Wheat		5-6	Root Growth	NOEC	57 mg/kg	FDA, 1996a
Eprinomectin	Cucumber		Not reported	Germination	NOEC	1300 mg/kg	FDA, 1996b
Eprinomectin	Cucumber		Not reported	Root Elongation	NOEC	95 mg/kg	FDA, 1996b
Eprinomectin	Cucumber		21	Shoot Length	NOEC	0.47 mg/kg	FDA, 1996b
Eprinomectin	Cucumber		21	Shoot Weight	NOEC	0.47 mg/kg	FDA, 1996b
Eprinomectin	Cucumber		21	Root Weight	NOEC	0.47 mg/kg	FDA, 1996b
Eprinomectin	Lettuce		Not reported	Germination	NOEC	1300 mg/kg	FDA, 1996b
Eprinomectin	Lettuce		Not reported	Root Elongation	NOEC	8.5 mg/kg	FDA, 1996b
Eprinomectin	Lettuce		21	Shoot Length	NOEC	6.5 mg/kg	FDA, 1996b
Eprinomectin	Lettuce		21	Shoot Weight	NOEC	6.5 mg/kg	FDA, 1996b

Antiparasitic	Common Name	Scientific Name	Duration (days)	Effect	Endpoint	Value	Reference
Eprinomectin	Lettuce		21	Root Weight	NOEC	6.5 mg/kg	FDA, 1996b
Eprinomectin	Soybean		Not reported	Germination	NOEC	1300 mg/kg	FDA, 1996b
Eprinomectin	Soybean		Not reported	Root Elongation	NOEC	95 mg/kg	FDA, 1996b
Eprinomectin	Soybean		21	Shoot Length	NOEC	6.5 mg/kg	FDA, 1996b
Eprinomectin	Soybean		21	Shoot Weight	NOEC	6.5 mg/kg	FDA, 1996b
Eprinomectin	Soybean		21	Root Weight	NOEC	6.5 mg/kg	FDA, 1996b
Eprinomectin	Perennial Ryegrass		Not reported	Germination	NOEC	1300 mg/kg	FDA, 1996b
Eprinomectin	Perennial Ryegrass		Not reported	Root Elongation	NOEC	8.5 mg/kg	FDA, 1996b
Eprinomectin	Perennial Ryegrass		21	Shoot Length	NOEC	0.47 mg/kg	FDA, 1996b
Eprinomectin	Perennial Ryegrass		21	Shoot Weight	NOEC	0.47 mg/kg	FDA, 1996b
Eprinomectin	Perennial Ryegrass		21	Root Weight	NOEC	0.47 mg/kg	FDA, 1996b
Eprinomectin	Tomato		Not reported	Germination	NOEC	1300 mg/kg	FDA, 1996b
Eprinomectin	Tomato		Not reported	Root Elongation	NOEC	8.5 mg/kg	FDA, 1996b
Eprinomectin	Tomato		21	Shoot Length	NOEC	0.47 mg/kg	FDA, 1996b
Eprinomectin	Tomato		21	Shoot Weight	NOEC	0.47 mg/kg	FDA, 1996b
Eprinomectin	Tomato		21	Root Weight	NOEC	0.47 mg/kg	FDA, 1996b
Eprinomectin	Wheat		Not reported	Germination	NOEC	1300 mg/kg	FDA, 1996b
Eprinomectin	Wheat		Not reported	Root Elongation	NOEC	8.5 mg/kg	FDA, 1996b
Eprinomectin	Wheat		21	Shoot Length	NOEC	0.47 mg/kg	FDA, 1996b
Eprinomectin	Wheat		21	Shoot Weight	NOEC	0.47 mg/kg	FDA, 1996b
Eprinomectin	Wheat		21	Root Weight	NOEC	0.47 mg/kg	FDA, 1996b

Antiparasitic	Common Name	Scientific Name	Duration (days)	Effect	Endpoint	Value	Reference
Ivermectin	Cucumber		Not reported	Germination	NOEC	≥980 mg/kg	FDA, 1996c
Ivermectin	Cucumber		Not reported	Root Elongation	NOEC	98 mg/kg	FDA, 1996c
Ivermectin	Cucumber		Not reported	Shoot Length	NOEC	0.68 mg/kg	FDA, 1996c
Ivermectin	Cucumber		Not reported	Shoot Weight	NOEC	0.68 mg/kg	FDA, 1996c
Ivermectin	Cucumber		Not reported	Root Weight	NOEC	≥790 mg/kg	FDA, 1996c
Ivermectin	Lettuce		Not reported	Germination	NOEC	≥980 mg/kg	FDA, 1996c
Ivermectin	Lettuce		Not reported	Root Elongation	NOEC	≥980 mg/kg	FDA, 1996c
Ivermectin	Lettuce		Not reported	Shoot Length	NOEC	6.9 mg/kg	FDA, 1996c
Ivermectin	Lettuce		Not reported	Shoot Weight	NOEC	0.68 mg/kg	FDA, 1996c
Ivermectin	Lettuce		Not reported	Root Weight	NOEC	≥790 mg/kg	FDA, 1996c
Ivermectin	Soybean		Not reported	Germination	NOEC	≥930 mg/kg	FDA, 1996c
Ivermectin	Soybean		Not reported	Root Elongation	NOEC	≥930 mg/kg	FDA, 1996c
Ivermectin	Soybean		Not reported	Shoot Length	NOEC	≥790 mg/kg	FDA, 1996c
Ivermectin	Soybean		Not reported	Shoot Weight	NOEC	6.9 mg/kg	FDA, 1996c
Ivermectin	Soybean		Not reported	Root Weight	NOEC	≥790 mg/kg	FDA, 1996c
Ivermectin	Perennial Ryegrass		Not reported	Germination	NOEC	≥980 mg/kg	FDA, 1996c
Ivermectin	Perennial Ryegrass		Not reported	Root Elongation	NOEC	98 mg/kg	FDA, 1996c

Antiparasitic	Common Name	Scientific Name	Duration (days)	Effect	Endpoint	Value	Reference
Ivermectin	Tomato		Not reported	Germination	NOEC	≥980 mg/kg	FDA, 1996c
Ivermectin	Tomato		Not reported	Root Elongation	NOEC	≥980 mg/kg	FDA, 1996c
Ivermectin	Tomato		Not reported	Shoot Length	NOEC	0.68 mg/kg	FDA, 1996c
Ivermectin	Tomato		Not reported	Shoot Weight	NOEC	0.68 mg/kg	FDA, 1996c
Ivermectin	Tomato		Not reported	Root Weight	NOEC	0.68 mg/kg	FDA, 1996c
Ivermectin	Wheat		Not reported	Germination	NOEC	≥930 mg/kg	FDA, 1996c
Ivermectin	Wheat		Not reported	Root Elongation	NOEC	≥930 mg/kg	FDA, 1996c
Ivermectin	Wheat		Not reported	Shoot Length	NOEC	6.9 mg/kg	FDA, 1996c
Ivermectin	Wheat		Not reported	Shoot Weight	NOEC	0.68 mg/kg	FDA, 1996c
Ivermectin	Wheat		Not reported	Root Weight	NOEC	0.56 mg/kg	FDA, 1996c
Soil Invertebrate Data							
Doramectin	Earthworm	*Eisenia fetida*	28	Mortality	LC_{50}	>1,000,000 µg/kg	FDA, 1996a
Doramectin	Earthworm	*Eisenia fetida*	28	Growth	NOEC	2000 µg/kg	FDA, 1996a
Eprinomectin	Earthworm	*Lumbricus terrestris*	28	Mortality	LC_{50}	951,000 µg/kg	FDA, 1996b
Moxidectin	Earthworm	*Eisenia fetida*	28	Mortality	NOEC	1000 µg/kg	FDA, 2001
Ivermectin	Earthworm	*Eisenia fetida*	14	Growth	NOEC	4000 µg/kg	FDA, 1996c
Ivermectin	Earthworm	*Eisenia fetida*	28	Mortality	LC_{50}	315 mg/kg	FDA, 1983
Dung Fauna Data							
Doramectin	Hornfly	*Haematobia irritans*	Not reported	Emergence	NOEC	2.4 µg/kg	FDA, 1996a

Antiparasitic	Common Name	Scientific Name	Duration (days)	Effect	Endpoint	Value	Reference
Doramectin	Dung beetle	*Onthophagus gazella*	Not reported	Mortality	LC_{50}	12.5 µg/kg	FDA, 1996a
Eprinomectin	Dung beetles	*Onthophagus gazella*	9	Mortality	NOEC	590 µg/kg	FDA, 1996b
Eprinomectin	Dung beetles	*Onthophagus gazella*	27	Emergence	NOEC	64.7 µg/kg	FDA, 1996b
Eprinomectin	Dung beetles	*Euoniticellus intermedius*	9	Mortality	NOEC	590 µg/kg	FDA, 1996b
Eprinomectin	Dung beetles	*Euoniticellus intermedius*	24	Emergence	NOEC	64.7 µg/kg	FDA, 1996b
Moxidectin	Dung beetles	*Onthophagus gazella*	7-10	Reproduction	NOEC	>500 µg/kg	FDA, 2001
Moxidectin	Dung beetles	*Onthophagus gazella*	23-35	Emergence	NOEC	>500 µg/kg	FDA, 2001
Moxidectin	Dung beetles	*Onthophagus gazella*	7-10	Survival	NOEC	>500 µg/kg	FDA, 2001
Moxidectin	Dung beetles	*Euoniticellus intermedius*	7	Reproduction	NOEC	>269 µg/kg	FDA, 2001
Moxidectin	Dung beetles	*Euoniticellus intermedius*	7	Emergence	NOEC	>269 µg/kg	FDA, 2001
Moxidectin	Dung beetles	*Euoniticellus intermedius*	7	Survival	NOEC	>500 µg/kg	FDA, 2001
Moxidectin	Buffalo fly	*Haematobia irritans exigua*	7	Mortality	NOEC	64 µg/kg	FDA, 2001
Algae Data							
Eprinomectin	Green algae	*Raphidocelis subcapitata*	14	Growth Rate	NOEC	7000 µg/L	FDA, 1996

EC_{50} = median effective concentration
LC_{50} = median lethal concentration
LOEC = lowest observed effects concentration
NOEC = no observed effects concentration

References

FDA (Food and Drug Administration). 1983. Environmental Impact Analysis Report. Ivomec® (Ivermectin) Injection for Cattle. New Animal Drug Application (NADA) 128-409. https://animaldrugsatfda.fda.gov/adafda/app/search/public/document/downloadEA/124 (date accessed: January 7, 2026)

FDA. 1990. IVOMEC® (ivermectin) Pour-On for Cattle. Environmental Assessment. NADA 140-841. https://animaldrugsatfda.fda.gov/adafda/app/search/public/document/downloadEA/126 (date accessed: August 1, 2026)

FDA. 1996a. Environmental Assessment. Doramectin 1% Injectable solution for the treatment of parasitic infections in cattle. NADA 141-061. https://animaldrugsatfda.fda.gov/adafda/app/search/public/document/downloadEA/89 (Date accessed: January 7, 2026)

FDA. 1996b. IVOMEC® EPRINEX™ (eprinomectin) Pour-On for Beef and Dairy Cattle. Environmental Assessment. NADA 141-079. https://animaldrugsatfda.fda.gov/adafda/app/search/public/document/downloadEA/93 (Date accessed: January 7, 2026)

FDA. 1996c. Ivomec® SR Bolus for Cattle. Environmental Assessment. NADA 140-998. https://animaldrugsatfda.fda.gov/adafda/app/search/public/document/downloadEA/129 (date accessed: August 1, 2026)

FDA. 2001. Environmental Assessment. CYDECTIN® (moxidectin) Injectable Solution for Cattle. NADA 141-220. https://animaldrugsatfda.fda.gov/adafda/app/search/public/document/downloadEA/147 (Date accessed: January 7, 2026)

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Signing Authority (Role)	Letter Date
Matthew Lucia (Office Director)	08/11/2026

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