

# Neonicotinoid Pesticides in Colorado Water:

## Threats to the State's Aquatic Ecosystems

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# 1. EXECUTIVE SUMMARY AND CONCLUSIONS

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Colorado has seen a massive increase in the use of neonicotinoid pesticides, or “neonics,” in the last few decades, driven in large part by the widespread prophylactic use of neonic coatings on crop seeds—known as “seed treatments.” As a result, neonics are frequently found in Colorado water, including at elevated levels in agricultural watersheds. This contamination is likely causing significant and widespread damage to aquatic ecosystems and an increase in human exposure from groundwater.

Neonic seed treatments on corn seed, and to a lesser extent wheat seed treatments and neonic sprays in fruit and vegetable farming, appear to be the dominant agricultural neonic uses in Colorado. Clothianidin is likely the most used of all the neonics, as it is the most common insecticide coating on corn seed, with the highest recorded poundage at the time data were collected. The exact quantity of neonics in use today is difficult to ascertain because data on seed treatment use are no longer collected, but all agricultural uses combined likely exceed 60,000 pounds of active ingredient annually in the state. No information is collected on the use of neonics in other sectors, such as landscaping and structural applications, but it is clear from data elsewhere that these uses contribute to water contamination. In field crop-producing states like Colorado, non-agricultural uses typically account for a small fraction of total use, but they do expand the geographic areas where neonics are used, and, as a result, where neonic water contamination is typically found.

*It appears that maximum or worst-case estimates for groundwater contamination from neonics need to be revised upwards to accommodate the Colorado data.*



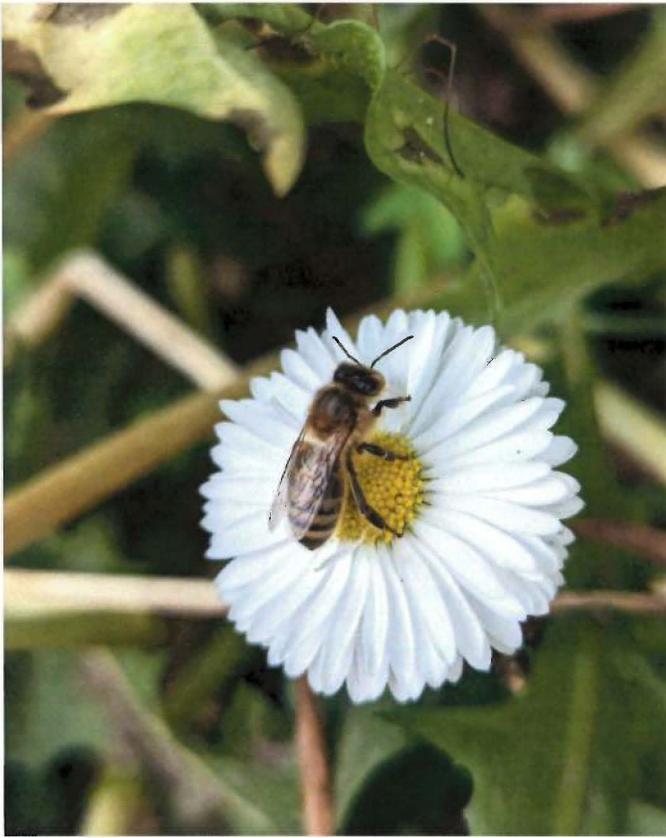
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The only data characterizing levels of all major neonicotinoids in Colorado’s water come from the state’s Agricultural Water Quality Program, which provides results from groundwater analyses conducted statewide. Despite high reporting thresholds that likely result in underreporting of neonic contamination levels in annual reports, multiple wells have shown contamination with combinations of neonics.

Neonics in well water were detected most frequently and at the highest levels in the South Platte Basin, where the aquifer is hydrologically connected to the South Platte River and its tributaries, meaning the results are also relevant to surface water considerations. Clothianidin was the most frequently detected neonic, followed by thiamethoxam, suggesting that seed treatments—most likely in corn—are the primary source of contamination. Imidacloprid detections may reflect the use of that compound in wheat seed treatments (based on older sales data) and/or landscape applications. Recorded contamination levels are alarmingly high, with frequently monitored wells showing peak concentrations of clothianidin or thiamethoxam 100 times above levels at which adverse effects on aquatic life from chronic exposure are expected.<sup>1</sup> It appears that maximum or worst-case estimates for groundwater contamination from neonics need to be revised upwards to accommodate the Colorado data.

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<sup>1</sup> Water contamination levels are often compared with acceptability benchmarks set by the U.S. Environmental Protection Agency (EPA). Appendix A includes an extensive review of neonic benchmarks and makes the case that the only reasonable U.S. benchmark, currently, is the chronic benchmark for imidacloprid: 10 ng/L. The European Union recently developed an acute (i.e., short-term) benchmark of 55 ng/L for harm to aquatic ecosystems from imidacloprid that is a more scientifically defensible benchmark than the EPA equivalent, so that benchmark is also referenced in this report. Benchmarks for clothianidin and thiamethoxam used in this report were derived through a comparative toxicity approach, which allows comparison of contamination levels as imidacloprid equivalents.



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Data on surface water contamination were obtained from the United States Geological Survey (USGS), which tested only for imidacloprid and not the other major neonic insecticides. While the predominance of clothianidin in Colorado’s groundwater well samples underscores the shortcomings of USGS’s limited monitoring, the data nevertheless show that surface water contamination is common—**more than one-third of sampling sites reported imidacloprid residues**, even though most sites were sampled only once or infrequently. Where imidacloprid was detected (8 of 22 sites), peak detection levels were all above levels expected to harm aquatic life with chronic exposure, and 6 of 8 exceeded levels expected to cause immediate harm. Longer-term datasets show consistently high levels of contamination over the last decade. The results indicate that imidacloprid alone inflicts significant and widespread damage to aquatic life in Colorado, even before we consider the more widely used clothianidin and thiamethoxam. Given that many of the USGS sampling sites are urban or suburban in nature, it can be inferred that much of the recorded imidacloprid contamination is from non-agricultural sources such as landscape and structural uses. Given older neonic use patterns in agriculture, however, it is possible that at least one of the USGS sites is receiving imidacloprid contamination from nearby wheat fields.

The neonic contamination levels documented in Colorado samples indicate a significant and widespread threat to aquatic and terrestrial life. Although few species live in groundwater, groundwater mixes with surface water, both through natural recharge and through irrigation. As a result, numerous aquatic and terrestrial species are exposed to these contaminants. Irrigation, especially, has the potential to extend the period of time and locations where exposures may occur. In addition, the presence of high neonic concentrations in irrigation water may represent a previously ignored source of exposure for terrestrial wildlife, such as pollinators or other beneficial insects attracted to irrigated fields. Estimates of oral neonic toxicity, as well as estimates of water intake by bees, suggest that the higher neonic values seen in South Platte Basin wells are approaching the lethal range for the more sensitive terrestrial invertebrate species.

Further, the true extent of the neonic threat in Colorado is likely even greater than the numbers show. Current water sampling methods fail to capture peak pesticide loads in Colorado’s surface waters (see Appendix B), and the same limitations apply to pesticide plumes moving through aquifers. Furthermore, current benchmarks fail to consider the combined, potentially synergistic, and time-cumulative effects of neonics even though these insecticides typically occur in mixtures.

Scientific evidence confirms that ecological degradation due to neonic contamination is occurring in real time. Since their introduction, neonicotinoid pollution of aquatic environments has threatened ecosystems across the world (Morrissey et al. 2015), and Colorado is no exception.

For a comprehensive discussion of these issues and the historical context of neonic registration, refer to previous in-depth reports, particularly Mineau and Palmer 2013 and Mineau and Kern 2023.

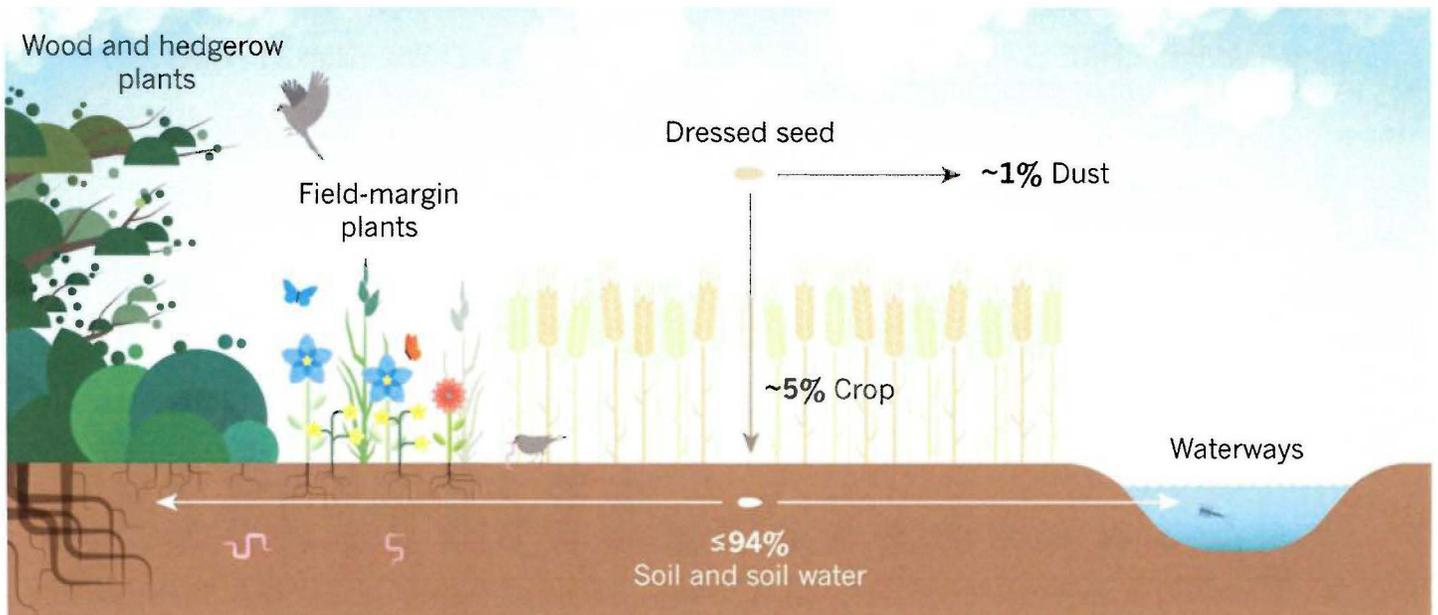
FACT SHEET

# NEONICS: THE TOXIC TRUTH PESTICIDES KILL BEES, POLLUTE WATER, AND THREATEN OUR HEALTH

The world’s most widely used insecticides, neonicotinoids or “neonics,” are neurotoxic chemicals linked to massive bee losses, vast water and soil contamination, ecosystem-wide harms, and human health concerns.<sup>1</sup> A growing body of research shows that the neonic uses in the United States that pose the greatest threats—from coating corn and soybean seeds to spraying gardens and golf courses—provide little to no benefits to users or are easily replaceable with safer alternatives.<sup>2</sup>

**Neonics Are Toxic:** Neonics kill insects by permanently binding to, overstimulating, and ultimately destroying their nerve cells.<sup>3</sup> Insects poisoned with neonics often begin twitching, become paralyzed, and die.<sup>4</sup> Even at minute doses, neonics weaken critical functions.<sup>5</sup> In fact, the thin neonic coating on just one small corn seed can contain enough active ingredient to kill a quarter million bees or more.<sup>6</sup>

**Neonics Threaten Human Health:** Research links neonics to neurological, developmental, and reproductive harms, including birth defects of the heart and brain.<sup>7</sup> This is deeply concerning because at least half of the U.S. population is regularly exposed to neonics, with children facing higher exposure rates.<sup>8</sup> In fact, a study of 171 pregnant women in the United States found that over 95 percent had neonics



Neonics spread, persist, and concentrate in soil and water, where they threaten insects and organisms and are taken up by wild plants, turning them toxic (reprinted by permission from Springer Nature: Dave Goulson, “Pesticides Linked to Bird Declines,” *Nature* 511, no. 7509 (July 2014): 295-296, <https://go.nature.com/2rNOZcK>).



in their bodies, with the highest levels in Hispanic women, and detection levels were on the rise.<sup>9</sup> Standard drinking water treatment does not remove neonics from water, so households that cannot afford or do not have access to extra filtration devices face a greater risk of finding neonics in their tap.<sup>10</sup>

**Neonics Are Persistent and Everywhere:** Neonics are “systemic,” so when applied around a plant’s roots or as a coating on a seed, they are absorbed and permeate the entire plant as it grows—poisoning its nectar, pollen, and fruit. Neonics also persist, travel, and concentrate in soil and water, spreading the threats well beyond the original application site.<sup>11</sup> Over half of streams tested across the United States contain neonics, including in both urban and agricultural areas.<sup>12</sup>

**Neonics Kill Bees and Other Pollinators Essential for Food Production:** Since their introduction in the mid-1990s, neonics have made U.S. agriculture 48 times more harmful to insects.<sup>13</sup> For over a decade, beekeepers have lost 30 to 50 percent of their bee colonies every year, and two decades of research have identified neonics as a leading cause of pollinator decline.<sup>14</sup> Many popular foods like nuts and berries rely on pollination by bees. A lack of pollinators is already linked to decreased food production, and further losses threaten the estimated \$50 billion in pollinator-dependent crops grown in the United States each year.<sup>15</sup>

**Neonics Kill Birds:** Neonics are one of the critical factors driving mass loss of birds.<sup>16</sup> Eating just one neonic-coated seed is enough to kill some songbirds, and low doses of neonics can harm birds’ immune systems, fertility, and navigation, and cause rapid weight loss—reducing birds’ chances of surviving in the wild.<sup>17</sup> As neonics kill insect

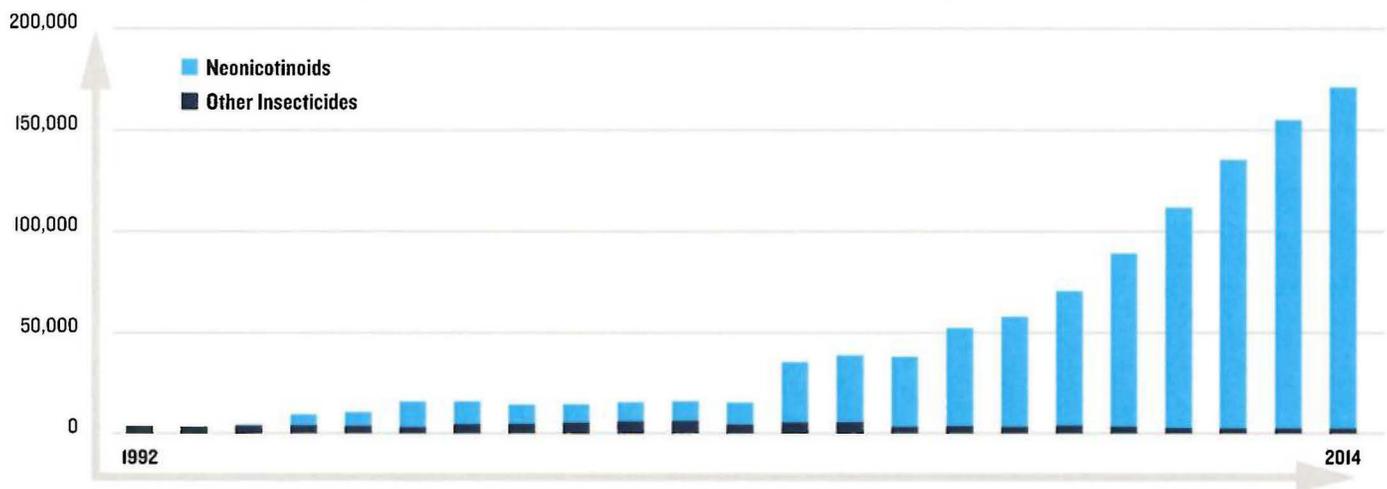
populations, birds also starve. In Europe, for example, researchers have linked declining populations of insect-eating birds to the introduction of neonics, even in areas with exceptionally low neonic levels in water.<sup>18</sup>

**Neonics Debilitate Ecosystems:** The U.S. Environmental Protection Agency predicted that continued, unchecked neonic use will likely push more than 200 threatened and endangered species toward extinction.<sup>19</sup> Neonics hollow out ecosystems by eradicating insect populations that birds, fish, amphibians, and other animals depend on for food. For example, a Japanese fishery collapsed within one year of the introduction of neonics in nearby agricultural fields. Neonic levels later measured at the site matched those commonly seen in U.S. waterways.<sup>20</sup>

**Most Harmful Neonic Uses Are Unnecessary:** Neonic corn and soybean seed coatings provide “no overall net income benefits” to most U.S. farmers, but they remain widespread, in part because of the influence of a few large corporations that produce both the seeds and the pesticides that coat them.<sup>21</sup> Further, research shows that neonics can actually decrease crop yields by killing pollinators or pest predators (i.e., “good bugs”).<sup>22</sup> Similarly, lawn and garden uses pose some of the highest risks to pollinators but are likewise unneeded. In Quebec, where formal justification has been required for certain neonic uses since 2019, use of neonic seed coatings in corn and soybeans has been nearly eliminated, without negative impacts on crop yields or switching to more harmful alternatives.<sup>23</sup> Significant reductions in neonic use could also be achieved in the United States, and forward-looking policies to limit and improve transparency and oversight of neonic use can help us get there.

Total ACUTE Oral Insect-Toxicity LOAD of Insecticides in U.S. Agriculture by Year (in LD<sub>50</sub>-days)

## U.S. AGRICULTURE IS 48 TIMES MORE HARMFUL TO INSECT LIFE NOW THAN 25 YEARS AGO—WHEN NEONIC PESTICIDE USE BEGAN



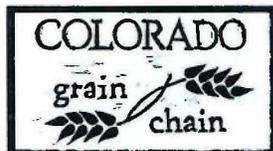
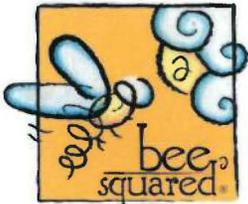
Data from Michael DiBartolomeis et al., “An Assessment of Acute Insecticide Toxicity Loading (AITL) of Chemical Pesticides Used on Agricultural Land in the United States,” *PLoS One* (August 6, 2019).

## Endnotes

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# SUPPORT THE seed ACT

We are a coalition of farmers, scientists, beekeepers, businesses, and advocates. Together, we're building a movement to bring transparency and safer choices to Colorado agriculture. We support eliminating unnecessary uses of neonicotinoids in Colorado through need-based use programs.



View the latest coalition members at: [www.seedweneedcolorado.org](http://www.seedweneedcolorado.org)